江淮瑞风维修手册

Emissions Control System

排放控制系统

Engine Electrical System

引擎电子系统

Engine Mechanical System [2.4 I4]

引擎机械系统[2.4 I4]

Engine Mechanical System [2.5 TCI]

引擎机械系统[2.5 TCI]

Fuel System [Gasoline]

燃料系统[汽油]

Fuel System [Diesel]

燃料系统[柴油机]

Emissions Control System

GENERAL .... EC - 2

CRANKCASE EMISSION CONTROL SYSTEM .... EC - 8

EVAPORATIVE EMISSION CONTROL SYSTEM .... EC -11

EXHAUST EMISSION CONTROL SYSTEM .... EC -15

GENERAL

SPECIFICATIONS EEHA0010

Components	Function	Remarks
Crankcase Emission System Positive crankcase ventilation (PCV) valve	HC reduction	Variable flow rate type
Evaporative Emission System EVAP Canister EVAP Canister Purge Solenoid Valve	HC reduction	Duty control solenoid valve
Exhaust Emission System MFI system (air-fuel mixture control device) Three-way catalytic converter	CO, HC, NOx reduction CO, HC, NOx reduction	Heated oxygen sensor feedback type Monolithic type

EVAP : Evaporative Emission

SERVICE STANDARD

EVAP Canister Purge Solenoid Valve Coil current	0.45A or below (at 12V)

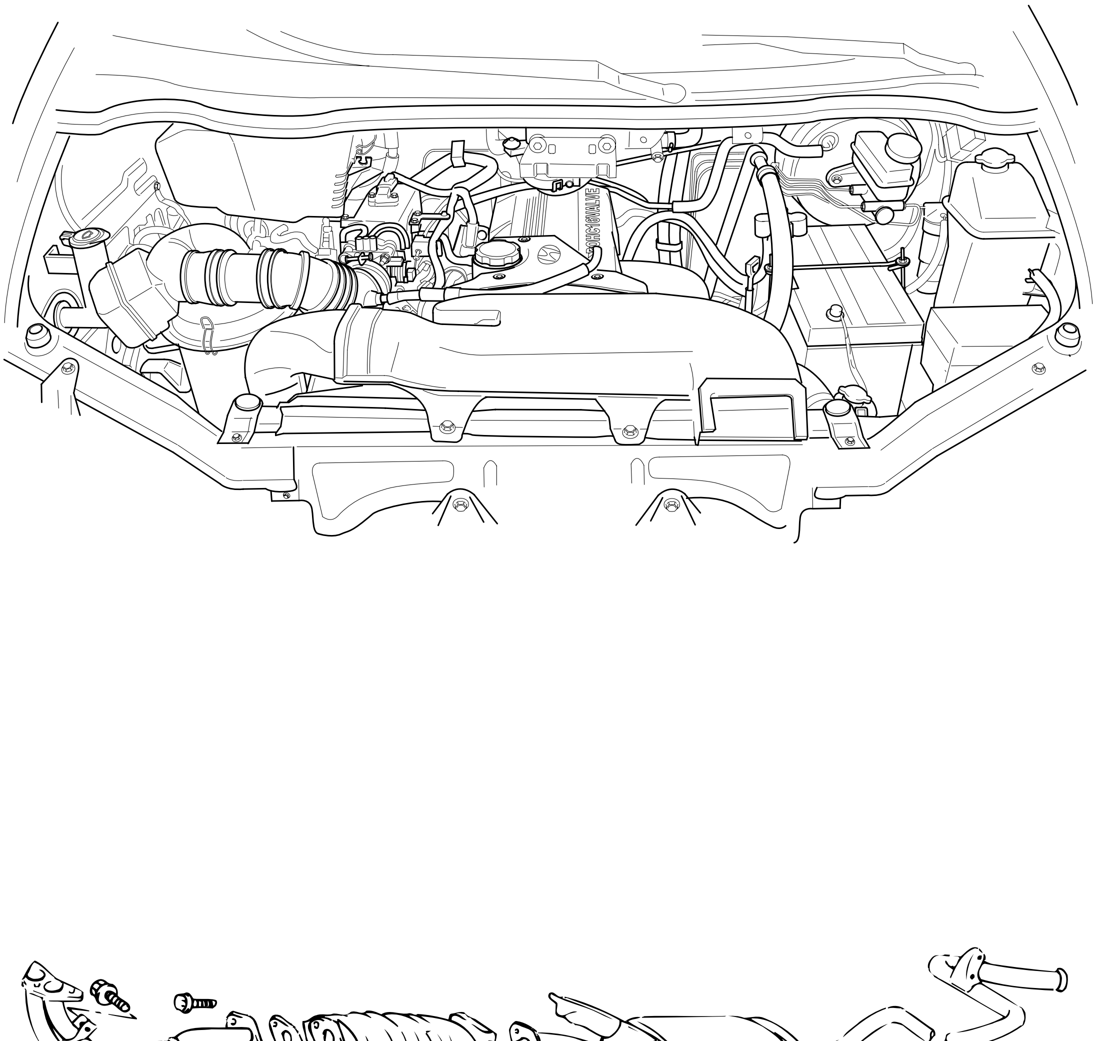
TIGHTENING TORQUE

Item	Nm	kg·cm	lb·ft
Positive crankcase ventilation valve	8-12	80-120	6-9

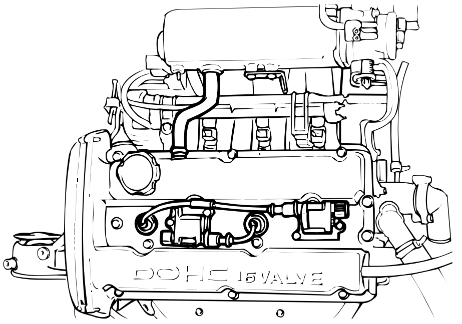
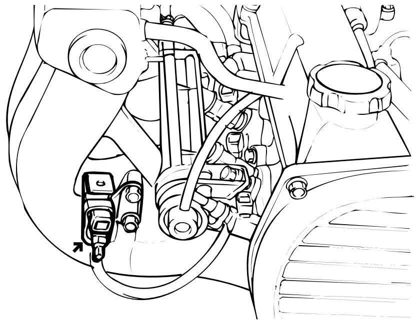
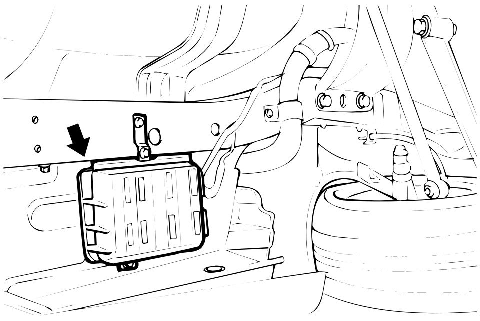
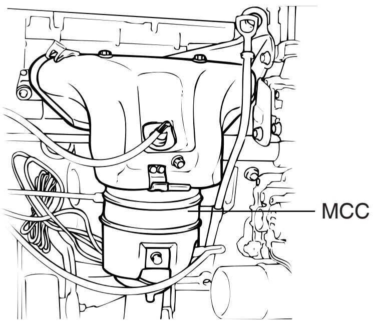
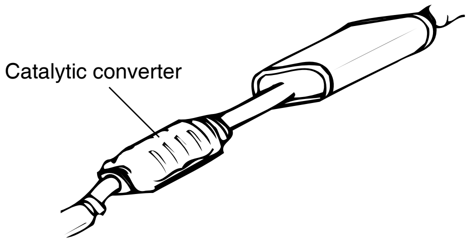
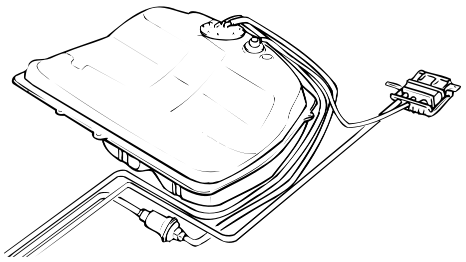
TROUBLESHOOTING

Symptom	Probable cause	Remedy
Engine will not start or hard to start	Vacuum hose disconnected or damaged EGR valve is not closed Malfunction of the EVAP Canister Purge Solenoid Valve	Repair or replace Repair or replace Repair or replace
Rough idle or engine stalls	Vacuum hose disconnected or damaged EGR valve is not closed Malfunction of the PCV valve Malfunction of the EVAP Canister Purge System	Repair or replace Repair or replace Replace Check the system; if there is a problem, check its component parts
Excessive oil consumption	Positive crankcase ventilation line clogged	Check positive crankcase ventilation system
Poor fuel mileage	Malfunction of the exhaust gas recirculation	Check the system; if there is a problem, check its component parts

EMISSION CONTROLS LOCATION EEUC0050



EEUC005A

A. PCV valve	B. EVAP Canister Purge Solenoid Valve
 EEA9005C	 EEA9005D
C. EVAP. Canister	D. Catalytic Converter (MCC)
 EEA9005E	 EEA9005G
E. Catalytic Converter (UCC)	F. Two-way Valve
 EEA9005F	 EEA9005H

SCHEMATIC DRAWING (2.4 I4-EOBD)

EEAC5070

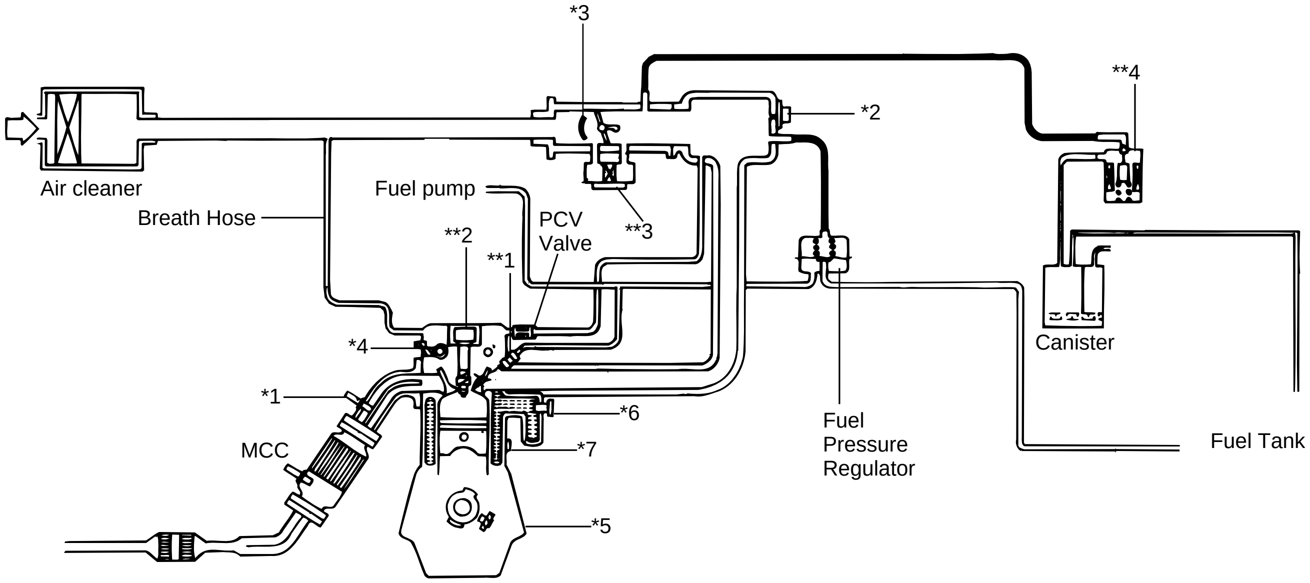
[UNLEADED]

- *1. HEATER OXYGEN SENSOR (HO2S)
- *2. MAP SENSOR
- *3. THROTTLE POSITION SENSOR (With Idle Switch)
- *4. CAMSHAFT POSITION SENSOR (CMP SENSOR)
- *5. CRANKSHAFT POSITION SENSOR (CKP SENSOR)
- *6. ENGINE COOLANT TEMP. SENSOR (ECT Sensor)
- *7. KNOCK SENSOR

- o IGNITION SWITCH
- o VEHICLE SPEED SENSOR
- o COOLER LOAD SIGNAL
- o "PNP" SWITCH (A/T ONLY)
- o POWER STEERING SWITCH
- o IGNITION DETECT SIGNAL
- o BATTERY VOLTAGE

INPUT → ECM → OUTPUT

- **1. FUEL INJECTOR
- **2. IGNITION COIL
- **3. ISC MOTOR (Linear Solenoid Type)
- **4. EVAP Canister Purge Solenoid Valve
  - o FUEL PUMP CONTROL
  - o MFI CONTROL RELAY
  - o COOLER RELAY
  - o IGNITION TIMING CONTROL
  - o DIAGNOSIS



ECM : Engine Control Module
EVAP : Evaporative Emission
MCC : Manifold Catalytic Converter
UCC : Under floor Catalytic Converter

EEAC007A

SCHEMATIC DRAWING (2.4 I4) EEAC5071

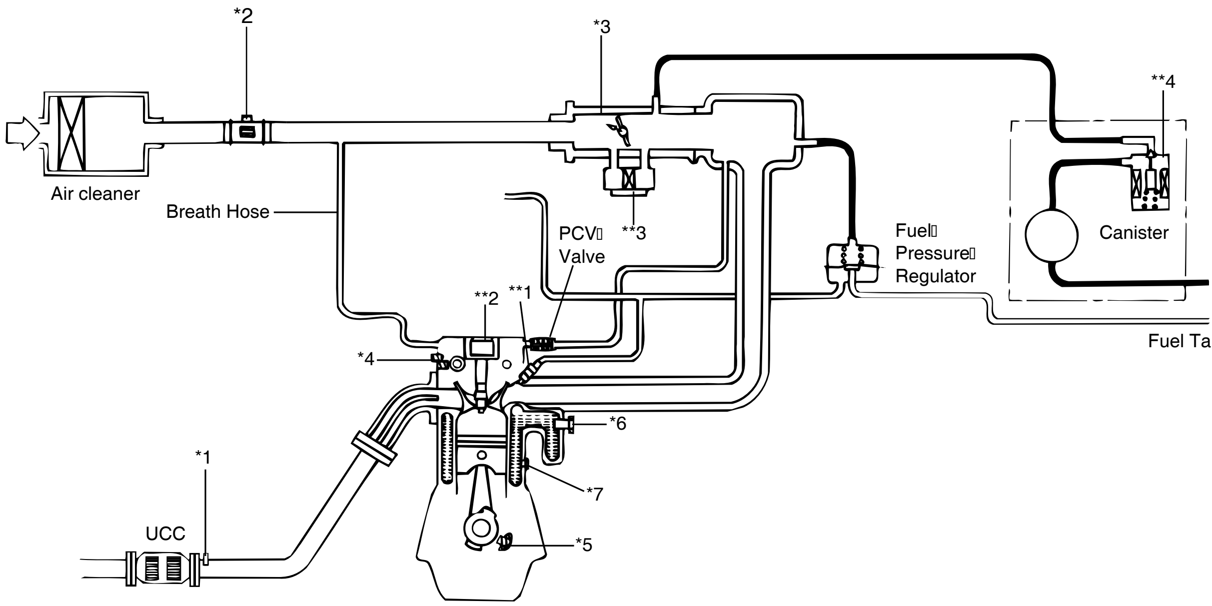
[UNLEADED]

*1. HEATER OXYGEN SENSOR (HO2S)
*2. HOT FILM SENSOR
*3. THROTTLE POSITION SENSOR
(With Idle Switch)
*4. CAMSHAFT POSITION SENSOR
(CMP SENSOR)
*5. CRANKSHAFT POSITION SENSOR
(CKP SENSOR)
*6. ENGINE COOLANT TEMP. SENSOR
(ECT Sensor)
*7. KNOCK SENSOR

o IGNITION SWITCH
o VEHICLE SPEED SENSOR
o COOLER LOAD SIGNAL
o "PNP" SWITCH (A/T ONLY)
o POWER STEERING SWITCH
o IGNITION DETECT SIGNAL
o BATTERY VOLTAGE

INPUT → ECM → OUTPUT

**1. FUEL INJECTOR
**2. IGNITION COIL
**3. ISC MOTOR
(Linear Solenoid Type)
**4. EVAP Canister Purge Solenoid Valve
o FUEL PUMP CONTROL
o MFI CONTROL RELAY
o COOLER RELAY
o IGNITION TIMING CONTROL
o DIAGNOSIS



ECM : Engine Control Module
EVAP : Evaporative Emission
UCC : Underfloor Catalytic Converter

EEAC007B

SCHEMATIC DRAWING (2.4 I4)

EEUC0080

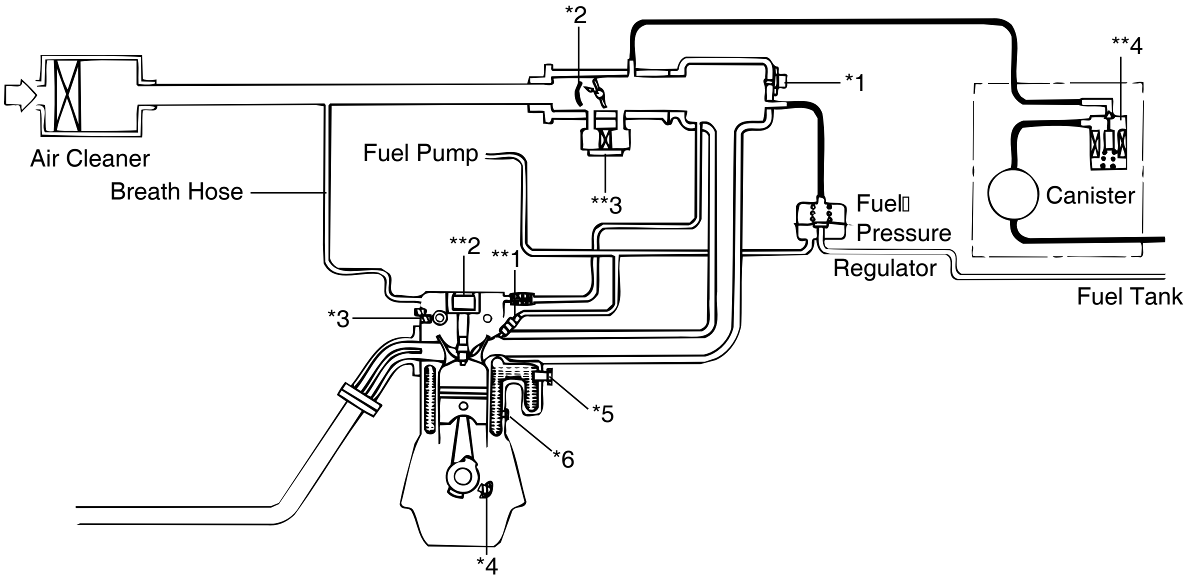
[LEADED]

*1. MAP & IAT SENSOR
*2. THROTTLE POSITION SENSOR
(With Idle Switch)
*3. CAMSHAFT POSITION SENSOR
(CMP SENSOR)
*4. CAMSHAFT POSITION SENSOR
(CKP SENSOR)
*5. ENGINE COOLANT TEMP. SENSOR
(ECT SENSOR)
*6. KNOCK SENSOR

o IGNITION SWITCH
o VEHICLE SPEED SENSOR
o COOLER LOAD SIGNAL
o "PNP" SWITCH (A/T ONLY)
o POWER STEERING SWITCH
o IGNITION DETECT SIGNAL
o BATTERY VOLTAGE
o VARIABLE REGISTER

INPUT → ECM → OUTPUT

**1. FUEL INJECTOR
**2. IGNITION COIL
**3. ISC MOTOR
(Linear Solenoid Type)
**4. EVAP Canister Purge Solenoid Valve
o FUEL PUMP CONTROL
o MFI CONTROL RELAY
o COOLER RELAY
o IGNITION TIMING
CONTROL
o DIAGNOSIS



ECM : Engine Control Module
EVAP : Evaporative Emission

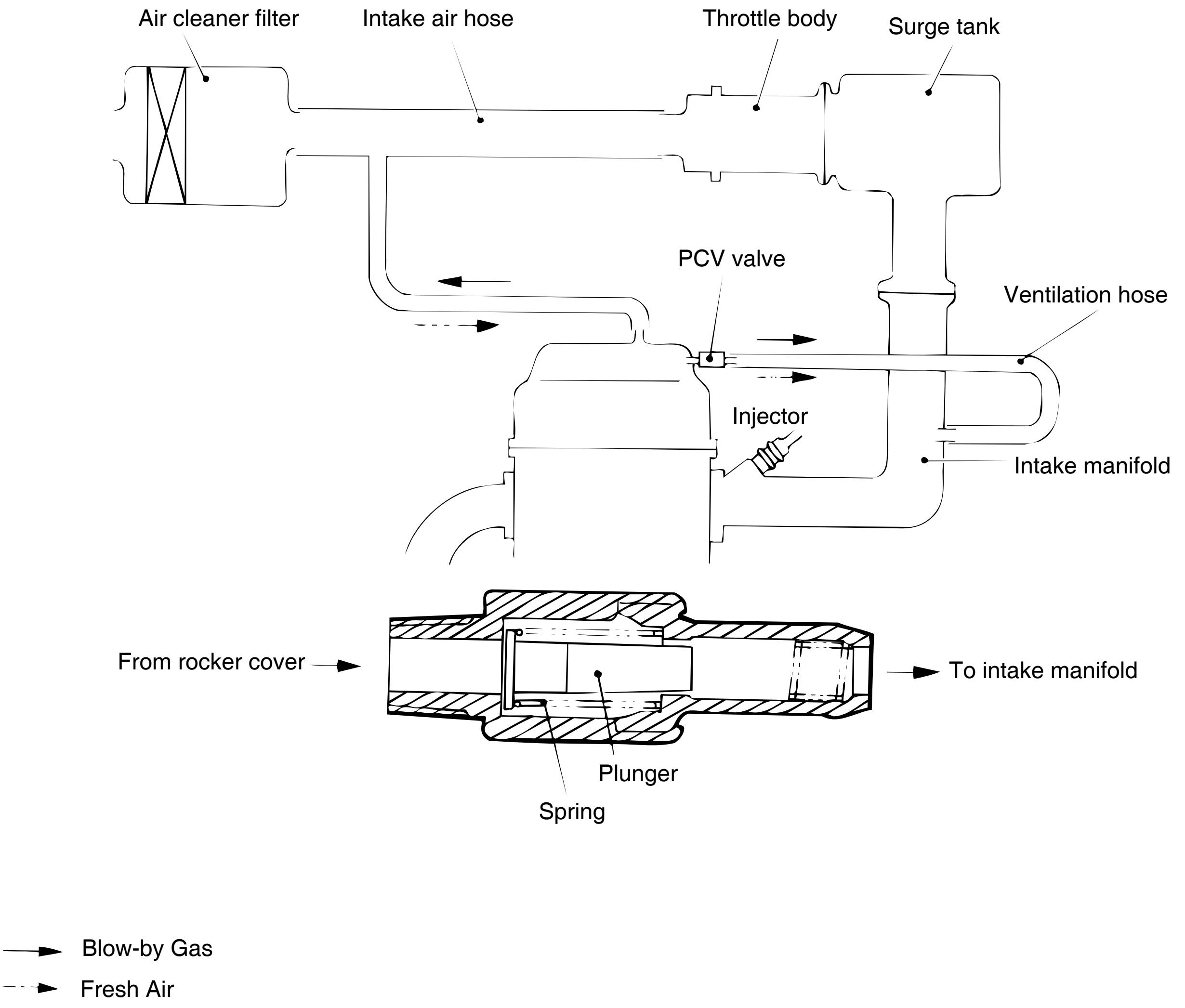
EEA9008A

CRANKCASE EMISSION CONTROL SYSTEM

POSITIVE CRANKCASE VENTILATION (PCV) VALVE EEAC5120

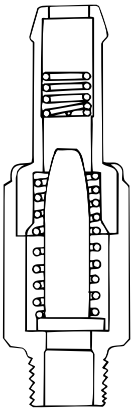
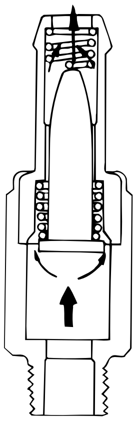
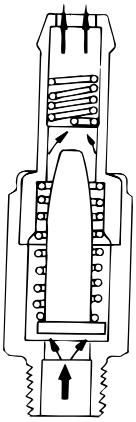
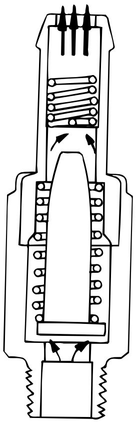
COMPONENTS

[I4]



EEAC512A

PCV VALVE OPERATING EEA90140

<table>
<tr><td colspan="2">Intake manifold side (No vacuum)

EEA9014A
Rocker cover side</td><td colspan="2">Intake manifold side (High vacuum)

EEA9014B
Rocker cover side</td></tr>
<tr><td>Engine condition</td><td>Not running</td><td>Engine condition</td><td>Idling or decelerating</td></tr>
<tr><td>PCV valve</td><td>Not operating</td><td>PCV valve</td><td>Fully operating</td></tr>
<tr><td>Vacuum passage</td><td>Restricted</td><td>Vacuum passage</td><td>Small</td></tr>
<tr><td colspan="2">Intake manifold side (Moderate vacuum)

EEA9014C
Rocker cover side</td><td colspan="2">Intake manifold side (Low vacuum)

EEA9014D
Rocker cover side</td></tr>
<tr><td>Engine condition</td><td>Normal operation</td><td>Engine condition</td><td>Accelerating and high load</td></tr>
<tr><td>PCV valve</td><td>Properly operating</td><td>PCV valve</td><td>Slightly operating</td></tr>
<tr><td>Vacuum passage</td><td>Large</td><td>Vacuum passage</td><td>Much large</td></tr>
</table>

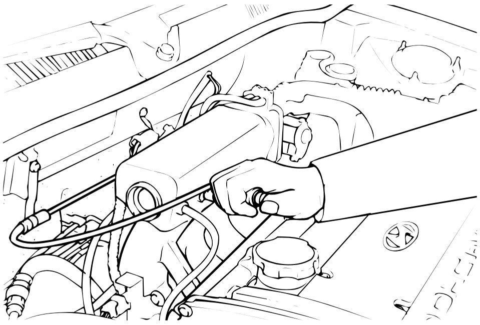
DISASSEMBLY EEA90150

1. Disconnect the ventilation hose from the positive crankcase ventilation (PCV) valve. Remove the PCV valve from the rocker cover and reconnect it to the ventilation hose.
2. Run the engine at idle and put a finger on the open end of the PCV valve and make sure that intake manifold vacuum is felt.

   NOTE

   The plunger inside the PCV valve should move back and forth.

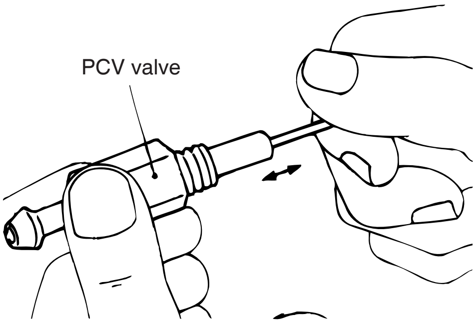
3. If vacuum is not felt, clean the PCV valve and ventilation hose in cleaning solvent, or replace if necessary.



EEA9015A

INSPECTION

1. Remove the positive crankcase ventilation valve.
2. Insert a thin stick into the positive crankcase ventilation valve from the threaded side to check that the plunger moves.
3. If the plunger does not move, the positive crankcase ventilation valve is clogged. Clean or replace it.



EEA9015B

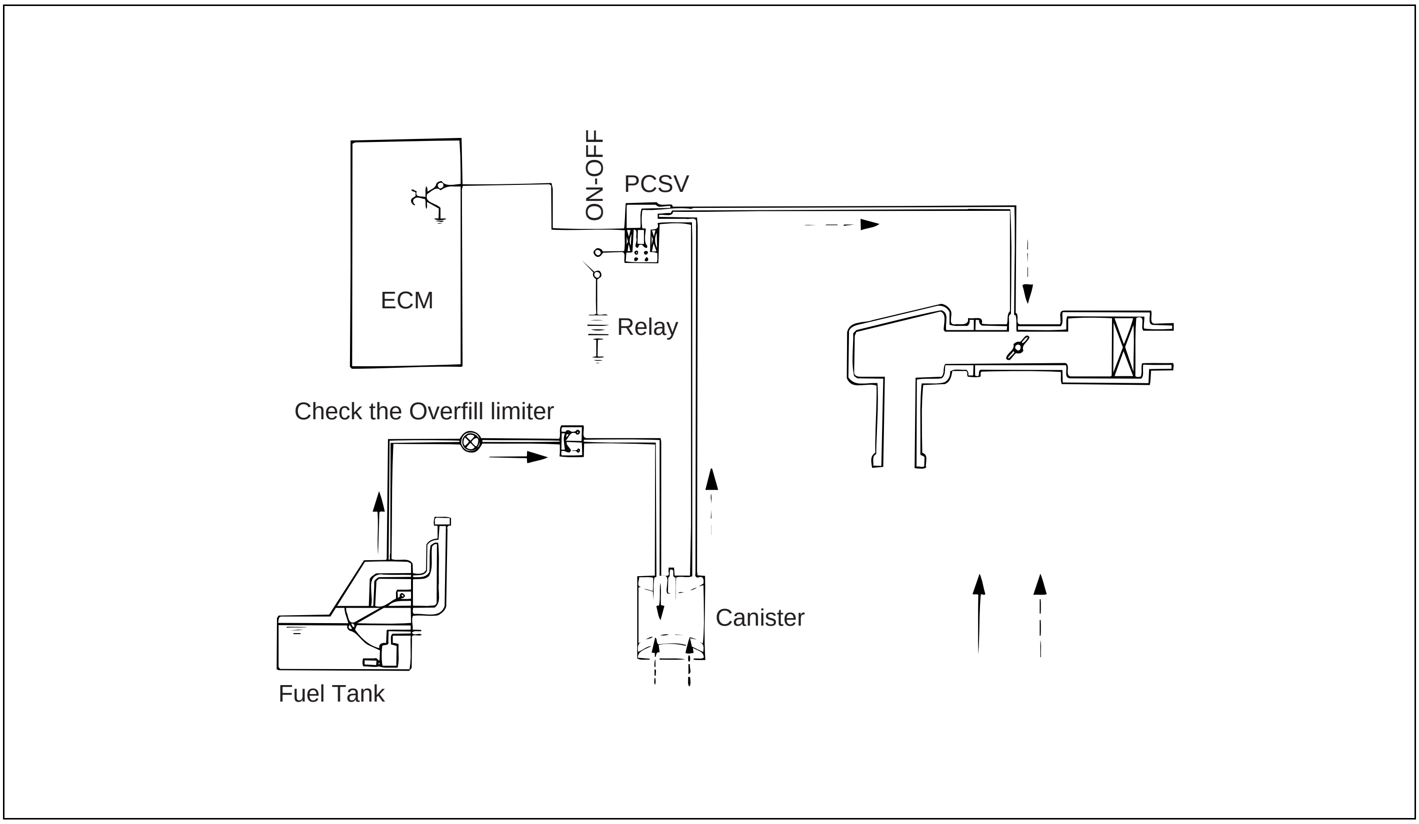
INSTALLATION

Install the positive crankcase ventilation valve and tighten to the specified torque.

Tightening torque
PCV valve : 8-12 Nm (80-120 kg·cm, 6-8 lb·ft)

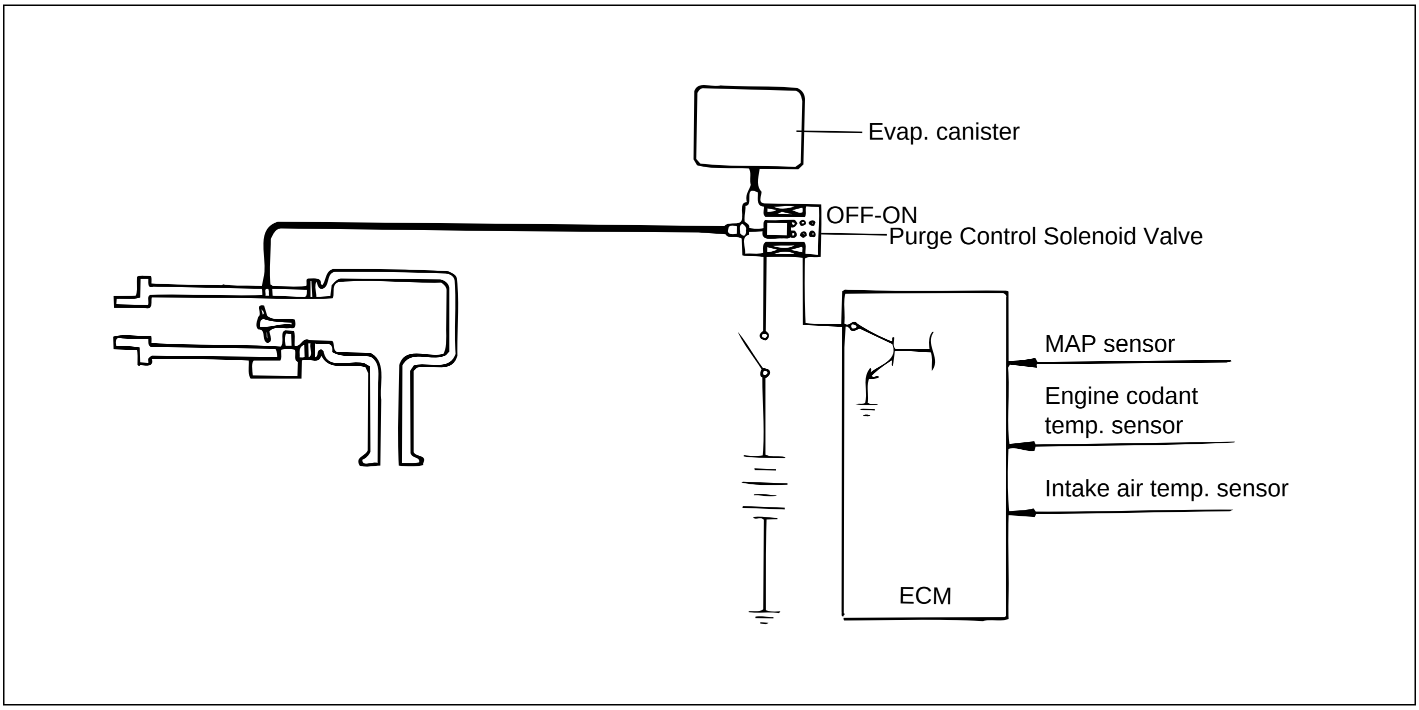
EVAPORATIVE EMISSION CONTROL SYSTEM

COMPONENTS EEUC0180



EEUC018A

EVAPORATIVE (EVAP) CANISTER PURGE SOLENOID VALVE EEUC0200

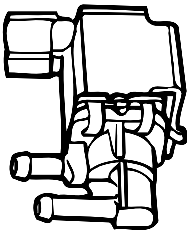


EEUC020A

EVAP CANISTER PURGE SOLENOID VALVE

NOTE

The EVAP Canister Purge Solenoid Valve is controlled by the ECM; when the engine coolant temperature is low, and also during idling, the valve closes so that evaporated fuel is not drawn into the surge tank. After engine warm-up during ordinary driving, it opens to let the stored vapors flow into the surge tank.

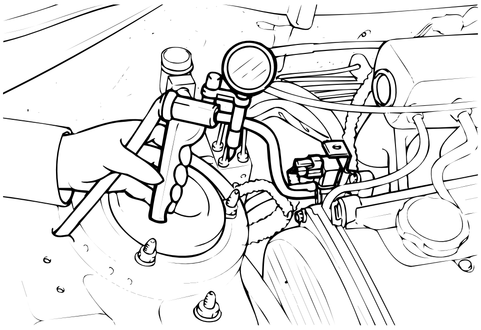


EEAA024A

INSPECTION

NOTE

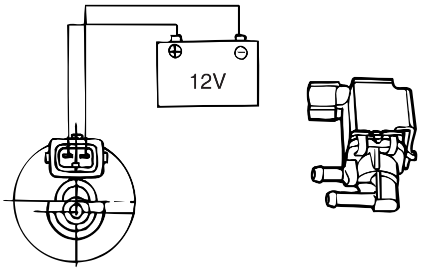
When disconnecting the vacuum hose, make an identification mark on it so that it can be reconnected to its original position.



EEA9020B

1. Disconnect the vacuum hose (black with red stripe) from the solenoid valve.
2. Detach the harness connector.
3. Connect a vacuum pump to the nipple to which the red-striped vacuum hose was connected.
4. Apply vacuum and check when voltage is applied to the EVAP Canister Purge Solenoid Valve and when the voltage is discontinued.

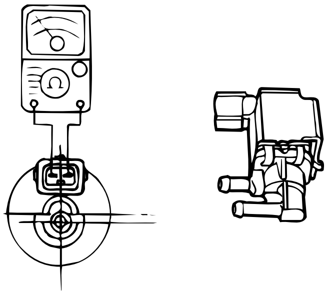
Battery voltage	Normal condition
When applied	Vacuum is released
When discontinued	Vacuum is maintained



EEAA020C

5. Measure the current between the terminals of the solenoid valve.

EVAP Canister Purge Solenoid Valve:
Coil at 20°C (68°F) : 0.45A or below (at 12V)
Coil resistance : 26Ω [at 20°C (68°F)]

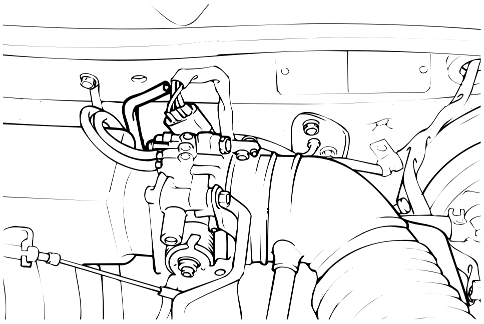


EEAA020D

VACUUM HOSE

Engine coolant temperature : 80-95°C (176-205°F)

1. Disconnect the vacuum hose from the intake manifold purge hose nipple and connect a hand vacuum pump to the nipple.

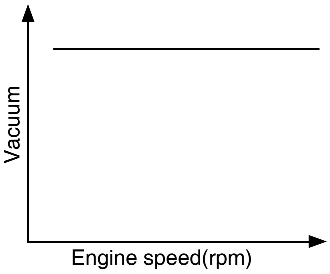


EEA9023A

2. Start the engine and check that, after raising the engine speed by racing the engine, vacuum remains fairly constant.

NOTE

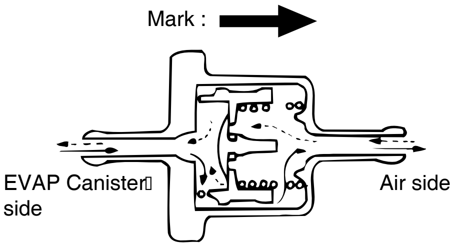
If there is no vacuum created the intake manifold port may be clogged and require cleaning.



EEA9023B

OVERFILL LIMITER (TWO WAY VALVE) EEAA0250

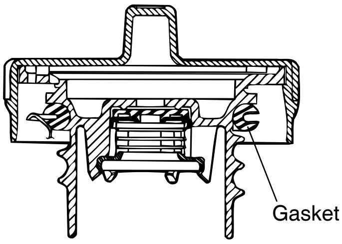
To inspect the overfill limiter (two-way valve), refer to the Fuel tank.



V5EC201D

FUEL FILER CAP EEAA0260

Check the gasket of the fuel filler cap, and the filler cap itself, for damage or deformation. Replace the cap if necessary.



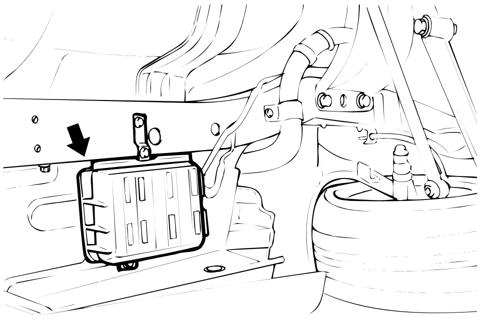
V5EC205A

EVAPORATIVE (EVAP) CANISTER EEHA0240

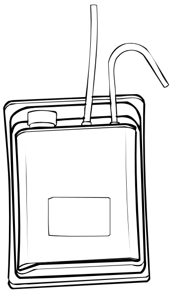
CANISTER

For monitoring, a CCV and an air filter exists as in the illustration.

1. Look for loose connections, sharp bends or damage to the fuel vapor lines.
2. Look for distortion, cracks or fuel leakage.
3. After removing the EVAP Canister, inspect for cracks or damage.



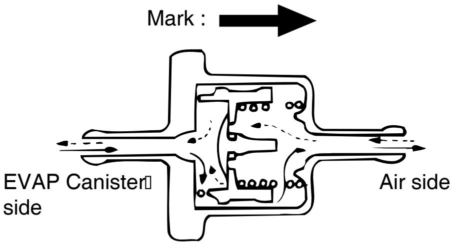
EEA9005E



EEHA005E

TWO-WAY VALVE

1. Inspect that air flows as shown.
2. Check to connect correctly such as the arrow mark on the valve.



V5EC201D

EXHAUST EMISSION CONTROL SYSTEM

VEHICLES WITH CATALYTIC CONVERTER EEA90270

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and PCM fuel control.

Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system. Additional control devices include a catalytic converter and the oxygen sensors which monitor mixture control.

These systems have been integrated into a highly effective system which controls exhaust emissions while maintaining good driveability and fuel economy.

AIR/FUEL MIXTURE RATIO CONTROL SYSTEM [MULTIPORT FUEL INJECTION (MFI) SYSTEM] EEA90280

The MFI system employs the signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, precisely regulating the air/fuel mixture ratio and reducing emissions.

This allows the engine to produce exhaust gases of the proper composition to permit the use of a three-way catalyst. The three-way catalyst is designed to convert the three pollutants (1) hydrocarbons (HC), (2) carbon monoxide (CO), and (3) oxides of nitrogen (NOx) into harmless substances. The two operating modes in the MFI system are as follows:

1. Open loop-air/fuel ratio is controlled by information programmed into the PCM during the manufacturing process.
2. Closed loop-air/fuel ratio varies by the PCM based on information supplied by the heated oxygen sensor.

Engine Electrical System

GENERAL .... EE - 2

IGNITION SYSTEM (DOHC) .... EE - 6

CHARGING SYSTEM .... EE - 9

STARTING SYSTEM .... EE -29

PREHEATING SYSTEM .... EE -40

GENERAL

SPECIFICATIONS EBUC0010

IGNITION

	2.4 I4
Type Primary coil resistance Secondary coil resistance	 0.86 ± 10% (Ω) 12.1 ± 15% (KΩ)

SPARK PLUG

	2.4 I4
Type Champion NGK Plug gap	 RN10PYP4 PGR5C-11 1.0-1.1 mm (0.039-0.043 in.)

STARTER MOTOR

	2.4 I4	Diesel
Type Voltage Output	Reduction drive (with planetary gear) 12V 1.2KW	Reduction drive (with planetary gear) 12V 2.0KW
No-load characteristics Terminal voltage Amperage Speed	 11V 90A or below 2,800 RPM	 11V 90A or below 2,800 RPM
Number of pinion teeth	8	13
Pinion gap	0.5-2.0 mm (0.0197-0.079 in.)	0.5-2.0 mm (0.0197-0.079 in.)

GENERATOR

	2.4 I4	Diesel
Type Rated output Voltage regulator type Regulator setting voltage Temperature compensated	Battery voltage sensing 13.5V / 95A Electronic built-in type 14.4 ± 0.3 V -10 ± 3 mV / °C	Battery voltage sensing 12V / 75A Electronic built-in type 14.4 ± 0.3 V -10 ± 3 mV / °C

BATTERY

	All Engines
Type Ampere hours 5HR Cold cranking [at -17.8°C (0°F)] Reverse capacity Specific gravity [at 25°C (77°F)]	MF 68 AH, MF 90 AH 55 AH or more 540 AH or more 122 min. 1.280 ± 0.01

NOTE

COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2 or greater at a specified temperature. REVERSE CAPACITY RATING is the amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5 at 26.7°C (80°F).

TIGHTENING TORQUE

Items	Nm	Kg·cm	lb·ft
Generator terminal (B+)	5-7	50-70	3.6-5.1
Starter motor terminal (B+)	10-12	100-120	7.3-8.8
Battery terminal	4-6	40-60	2.9-4.3
Spark plug	20-30	200-300	15-22

TROUBLESHOOTING EBUC0030

IGNITION SYSTEM

Trouble symptom	Probable cause	Remedy
Engine will not start or is hard to start (Cranks OK)	Ignition lock switch faulty	Replace ignition lock switch
	Ignition coil faulty	Inspect ignition coil
	Power transistor faulty	Inspect power transistor
	Spark plugs faulty	Replace plugs
	Ignition wiring disconnected or broken	Inspect wiring
	Spark plugs faulty	Replace plugs
Rough idle or stalls	Ignition wiring faulty	Inspect wiring
	Ignition coil faulty	Inspect ignition coil
	Spark plug cable faulty	Inspect spark plug cable
Engine hesitates/poor acceleration	Spark plugs faulty	Replace plugs
	Ignition wiring faulty	Inspect ignition coil
Poor mileage	Spark plugs faulty	Replace plugs

CHARGING SYSTEM

Trouble symptom	Probable cause	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off	Fuse blown	Check fuses
	Light burned out	Replace light
	Wiring connection loose	Tighten loose connections
	Electronic voltage regulator faulty	Replace voltage regulator
Charging warning indicator does not go out with engine running (Battery requires frequent recharging)	Drive belt loose or worn	Adjust tension or replace drive belt
	Battery cables loose, corroded or worn	Repair or replace cables
	Fuse blown	Check fuses
	Fusible link blown	Replace fusible link
	Electronic voltage regulator or generator faulty	Test generator
	Wiring faulty	Repair wiring
Engine hesitates/poor acceleration Overcharge	Drive belt loose or worn	Adjust tension or replace drive belt
	Wiring connection loose or open circuit	Tighten loose connection or repair wiring
	Fusible link blown	Replace fusible link
	Poor grounding	Repair
	Electronic voltage regulator or generator faulty	Test generator, if faulty, repair or replace.
	Worn battery	Replace battery
	Electronic voltage regulator faulty	Replace voltage regulator
	Voltage sensing wire faulty	Repair wire

STARTING SYSTEM

Trouble symptom	Probable cause	Remedy
Engine will not crank	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Transaxle range switch faulty (Vehicle with automatic transaxle only)	Adjust or replace switch
	Fusible link blown	Replace fusible link
	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
	Ignition lock switch faulty	Replace ignition lock switch
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn out	Repair or replace cables
	Starter motor faulty	Repair starter motor
Starter keeps running	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
Starter spins but engine will not crank	Short in wiring	Repair wiring
	Pinion gear teeth broken or starter motor faulty	Repair starter motor
	Ring gear teeth broken	Replace flywheel ring gear or torque converter

GLOW CONTROL SYSTEM (DIESEL)

Trouble symptom	Probable cause	Remedy
Engine will not start below 50°C	Wiring connection loose or bad wiring	Repair or replace wiring
	ECT sensor malfunction	Replace ECT sensor
	Glow plug malfunction	Repair or replace glow plug
	Glow plug control unit failed	Replace glow control unit
After first combustion, engine stall or rough idle below 50°C	Wiring connection loose or bad wiring	Repair or replace wiring
	Glow plug malfunction	Check the resistance of glow plug and replace, if necessary
	Glow plug relay malfunction	Check the relay and replace, if necessary
	Glow plug control unit failed	Check the control unit and replace, if necessary
Yellow glow lamp will not turn-ON	Open lamp	Replace lamp
	Wiring connection loose or bad wiring	Repair or replace wiring
	Shorted wiring	Repair or replace wiring
	Glow plug control unit failed	Replace control unit, if necessary

IGNITION SYSTEM (DOHC)

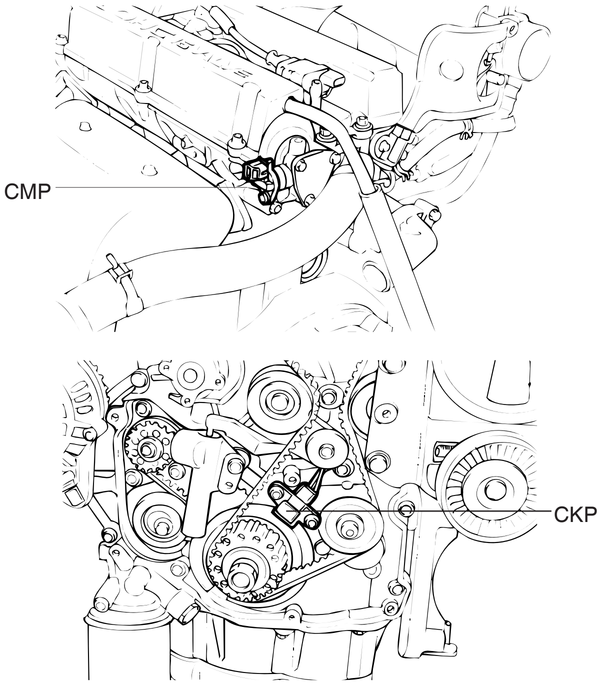
GENERAL INFORMATION EBA90040

Ignition timing is controlled by the Engine control module (ECM). The ignition timing data for the engine operating conditions are programmed in the memory of the ECM.

Engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based upon these sensor signals and the data stored in the ECM, signals to interrupt the primary current are sent to the power transistor. The ignition coil is activated and timing is controlled at the optimum point.

*CKP : Crankshaft Position

*CMP : Camshaft Position



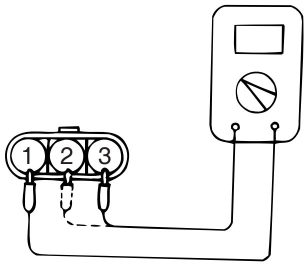
EBA9004A

IGNITION COIL (I4 : POWER TRANSISTOR BUILT-IN) EBJB5070

1. **Measurement of the primary coil resistance**
   Connect the negative (-) terminal of a 3V power supply to terminal 2 of the power transistor; then check whether there is continuity between terminal 3 and terminal 2 when terminal 1 and the positive (+) terminal are connected and disconnected.

Terminal 3 and (+) terminal	Terminal 1 and (+) terminal 2
Connected	Continuity (Approximately 0.86Ω)
Disconnected	Non continuity

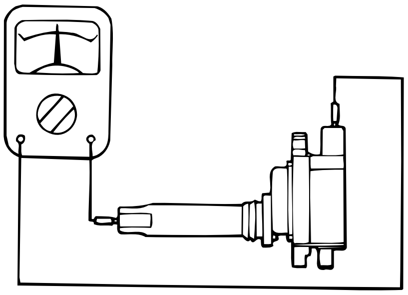
Replace the power transistor if there is malfunction.



EBHA007A

2. **Measurement of the secondary coil resistance**
   Measure the resistance between the high-voltage terminals of the ignition coil.

   Standard value: Approximately 12.1 kΩ



EBA9009D

REMOVAL AND INSTALLATION EBUC0060

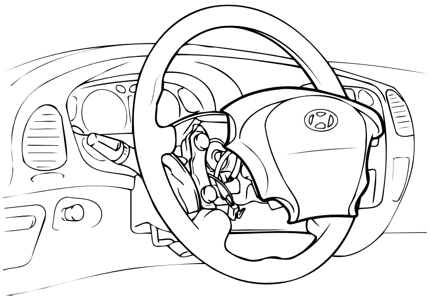
1. Disconnect the negative battery terminal.
2. Remove the air bag module.

⚠ ***CAUTION***

The SRS system is designed to retain enough power to deploy air bag for about 30 seconds even after battery has been disconnected, so serious injury may result from unintended air bag deployment if service is done on the SRS system immediately after battery cable is disconnected.

3. Loosen the tapping screw and lift up horn pad and remove it.
4. Remove the lock nut and the washer.

5. Pulling the dynamic damper forward, lift it up and remove it.

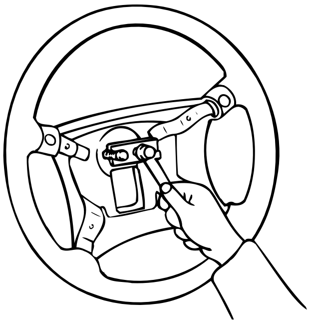


KPLA011A

6. Install the special tool (09561–11001) and remove the steering wheel.

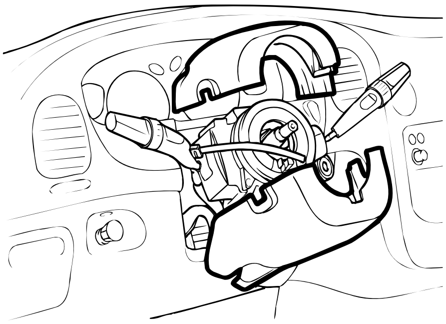
⚠ *CAUTION*

Do not hammer on the steering wheel to remove it.



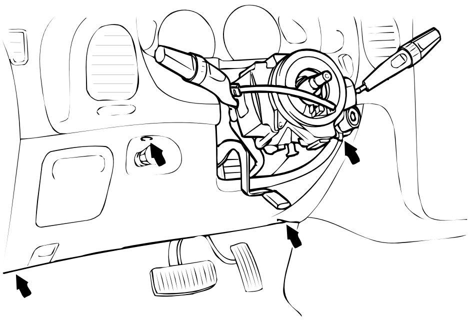
EBA9010B

7. Remove the steering column lower and upper shrouds.



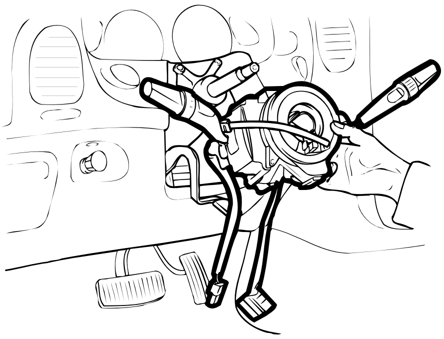
KPLA012A

8. Remove the lower cover.



KPLA013A

9. Disconnect the connectors and remove the multifunction switch.



KPLA014A

10. Remove the mounting bolts and separate ignition switch from steering column.

INSPECTION EBUC0070

1. Separate the connector located under the steering column.
2. Inspect the switch continuity between the terminals.
3. If continuity is not as specified, replace the switch

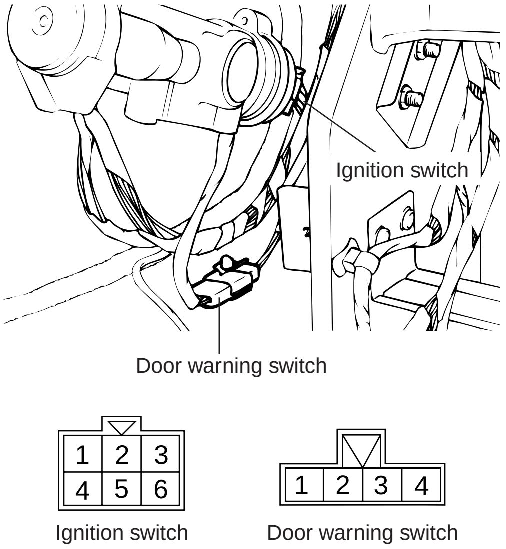
Terminal		Ignition switch						Door warning switch and key illumination				Lock	
Position	Key	1	2	3	4	5	6	1	2	3	4	RO	RE
LOCK	Removed									○	○	L	L
	Inserted											L	F
ACC				○	—	—	○					F	F
ON			○	○	○	—	○					F	F
START					○	○	○					F	F

NOTE

○—○ indicates that there is continuity between the terminal.

RO : Round the locking bar
RE : Return the locking bar
L : Lock
F : Free

EBUC007A



EBUC007B

HINTS

If the engine won't crank determine whether the condition exists with the transaxle range switch in the "PARK" or in the "NEUTRAL" position.

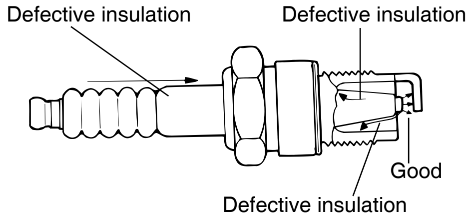
If the "NO-CRANK" condition occurs in one shift lever position but not another, a more probable cause is the transaxle range switch.

SPARK PLUG TEST EBUC0080

1. Remove the spark plug and connect to the spark plug cable.
2. Ground the spark plug outer electrode, and crank the engine.
3. Check to be sure that there is an electrical discharge between the electrodes at this time.

⚠ ***CAUTION***

When replacing the spark plug, should use the genuine parts having resistance.



EBA9009F

SPARK PLUG CABLES TEST

1. Disconnect, one at a time each of the spark plug cables while the engine is idling to check whether the engine's running performance changes or not.

⚠ ***CAUTION***

Wear rubber gloves while doing so.

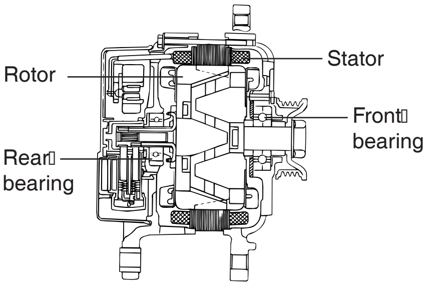
2. If the engine performance does not change, check theresistance of the spark plug, and check the spark plug itself.
3. Check the cap and outer shell for cracks.
4. Measure the resistance.

CHARGING SYSTEM

GENERAL INFORMATION EBBB0120

The charging system included a battery, an generator with a built-in regulator, and the charging indicator light and wire. The generator has six built-in diodes (three positive and three negative), each rectifying AC current to DC current. Therefore, DC current appears at generator "B" terminal.

In addition, the charging voltage of this generator is regulated by the battery voltage detection system. The generator is regulated by the battery voltage detection system. The main components of the generator are the rotor, stator, rectifier, capacitor brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



EBA9130A

INSPECTION EBBB0130

VOLTAGE DROP TEST OF GENERATOR OUTPUT WIRE

This test determines whether or not the wiring between the generator "B" terminal and the battery (+) terminal is good by the voltage drop method.

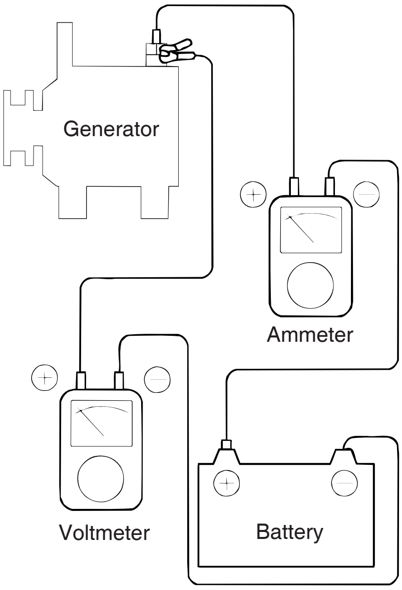
PREPARATION

1. Turn the ignition switch to "OFF".

   NOTE

   To find abnormal conditions of the connection, actions should not be taken on the two terminals and each connection during the test.

2. Connect a digital ammeter between the generator "B" terminal and battery (+). Connect the (+) lead wire of the voltmeter to the "B" terminal and the (-) lead wire to the battery (-) terminal.



EBBB013A

CONDITIONS FOR THE TEST

1. Start the engine.
2. Switch on the headlamps, blower motor and so on. And then, read the voltmeter under this condition.

RESULT

1. The voltmeter may indicate the standard value.

   Standard value : 0.2V max.

2. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the generator "B" terminal to the fusible link to the battery (+) terminal. Check for loose connections, color change due to an overheated harness, etc. Correct them before testing again.
3. Upon completion of the test, set the engine speed at idle. Turn off the head lamps, blower motor and the ignition switch.

OUTPUT CURRENT TEST

This test determines whether or not the generator gives an output current that is equivalent to the nominal output.

PREPARATION

1. Prior to the test, check the following items and correct as necessary.
   1) Check the battery installed in the vehicle to ensure that it is in good condition. The battery checking method is described in "BATTERY".

The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.

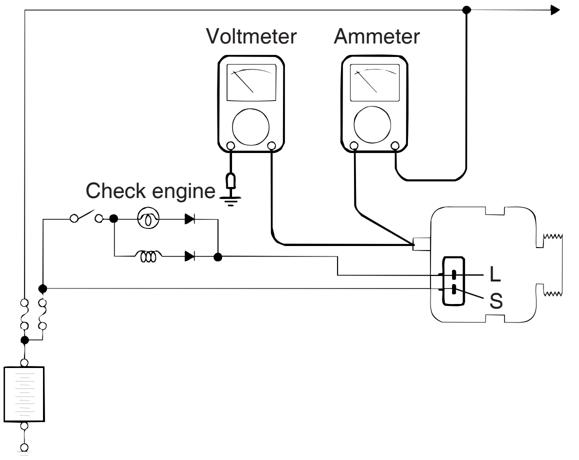
2) Check the tension of the generator drive belt. The belt tension check method is described in the section “EM”.

2. Turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Disconnect the generator output wire from the generator "B" terminal.
5. Connect a DC ammeter (0 to 100A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

NOTE

Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

6. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the generator "B" terminal and (-) lead wire to a good ground.
7. Attach an engine tachometer and connect the battery ground cable.
8. Leave the engine hood open.



EBBB013B

TEST

1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between the generator "B" terminal and battery (-) terminal, a blown fusible link or poor grounding is suspected.
2. Start the engine and turn on the headlights.
3. Set the headlights to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

NOTE

After the engine starts up, the charging current quickly drops. Therefore, the above operation must be done quickly to read the maximum current value correctly.

RESULT

1. The ammeter reading must be higher than the limit value. If it is lower but the generator output wire is in good condition, remove the generator from the vehicle and test it.

Limit value (95A generator) : 63A min.

NOTE

- *The nominal output current value is shown on the nameplate affixed to the generator body.*
- *The output current value changes with the electrical load and the temperature of the generator itself. Therefore, the nominal output current may not be obtained. If such is the case, keep the headlights on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.*
  The nominal output current may not be obtained if the temperature of the generator itself or ambient temperature is too high.
  In such a case, reduce the temperature before testing again.

2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.

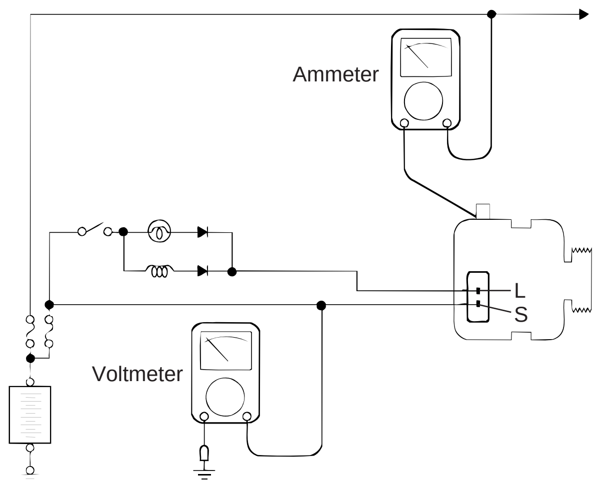
6. Connect the battery ground cable.

REGULATED VOLTAGE TEST

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

PREPARATION

1. Prior to the test, check the following items and correct if necessary.
    1) Check that the battery installed on the vehicle is fully charged. For battery checking method, see "BATTERY."
    2) Check the generator drive belt tension. For belt tension check, see “EM” section.
2. Turn ignition switch to "OFF."
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "S(L)" terminal of the generator and ground. Connect the (+) lead of the voltmeter to the "S(L)" terminal of the generator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the generator output wire from the generator "B" terminal.
6. Connect a DC ammeter (0 to 100A) in series between the "B" terminal and the disconnected output wire. Connect the (-) lead wire of the ammeter to the disconnected output wire.
7. Attach the engine tachometer and connect the battery ground cable.



EBBB013C

TEST

1. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

Voltage : Battery voltage

If it reads 0V, there is an open circuit in the wire between the generator "S(L)" terminal and the battery and the battery (+), or the fusible link is blown.

2. Start the engine. Keep all lights and accessories off.
3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the generator output current drops to 10A or less.

RESULT

1. If the voltmeter reading agrees with the value listed in the Regulating Voltage Table below, the voltage regulator is functioning correctly. If the reading is other than the standard value, the voltage regulator or the generator is faulty.

REGULATING VOLTAGE TABLE

Voltage regulator ambient temperature °C(°F)	Regulating voltage (V)
-20 (-4)	14.2-15.4
20 (68)	13.9-14.9
60 (140)	13.4-14.6
80 (176)	13.1-14.5

2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the voltmeter and ammeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.
6. Connect the battery ground cable.

GENERATOR OUTPUT LINE VOLTAGE DROP TEST EBBB0140

This test determines the condition of the wiring from the generator "B" terminal to the battery (+) terminal (including the fusible link).

1. Be sure to check the following before testing:
   - Generator installation and wiring connections
   - Generator drive belt tension
   - Fusible link
   - Abnormal noise from the generator while the engine is running.

2. Turn the ignition switch to the OFF position.

3. Disconnect the negative battery cable.

4. Disconnect the generator output wire from the generator "B" terminal. Connect a DC test ammeter with a range of 0-100A in series between the "B" terminal and the disconnected output wire. (Connect the (+) lead of the ammeter to the "B" terminal. Connect the (-) lead of the ammeter to the disconnected output wire.)

   NOTE

   An inductive-type ammeter which enables measurements to be taken without disconnecting the generator output wire is recommended. Using this equipment will lessen the possibility of a voltage drop caused by a loose "B" terminal connection.

5. Connect a digital-type voltmeter between the generator "B" terminal and the battery (+) terminal. (Connect the (+) lead of the voltmeter to the "B" terminal. Connect the (-) lead of the voltmeter to the battery (+) cable.)

6. Reconnect the negative battery cable.

7. Connect a tachometer or the scan tool.

8. Start the engine.

9. With the engine running at approx. 2500 r/min, turn the headlights and other lights on and off to adjust the generator load on the ammeter slightly above 30A.

   Limit: max. 0.3V

   NOTE

   When the generator output is high and the value displayed on the ammeter does not decrease to 30A, set the value to 40A. Read the value displayed on the voltmeter. In this case the limit becomes max. 0.4V.

10. If the value displayed on the voltmeter is still above the limit, a malfunction in the generator output wire may exist. Check the wiring between the generator "B" terminal and the battery (+) terminal (including fusible link). If a terminal is not sufficiently tight or if the harness has become discolored due to overheating, repair, the test again.

11. After the test, run the engine at idle.

12. Turn off all lights and turn the ignition switch to the OFF position.

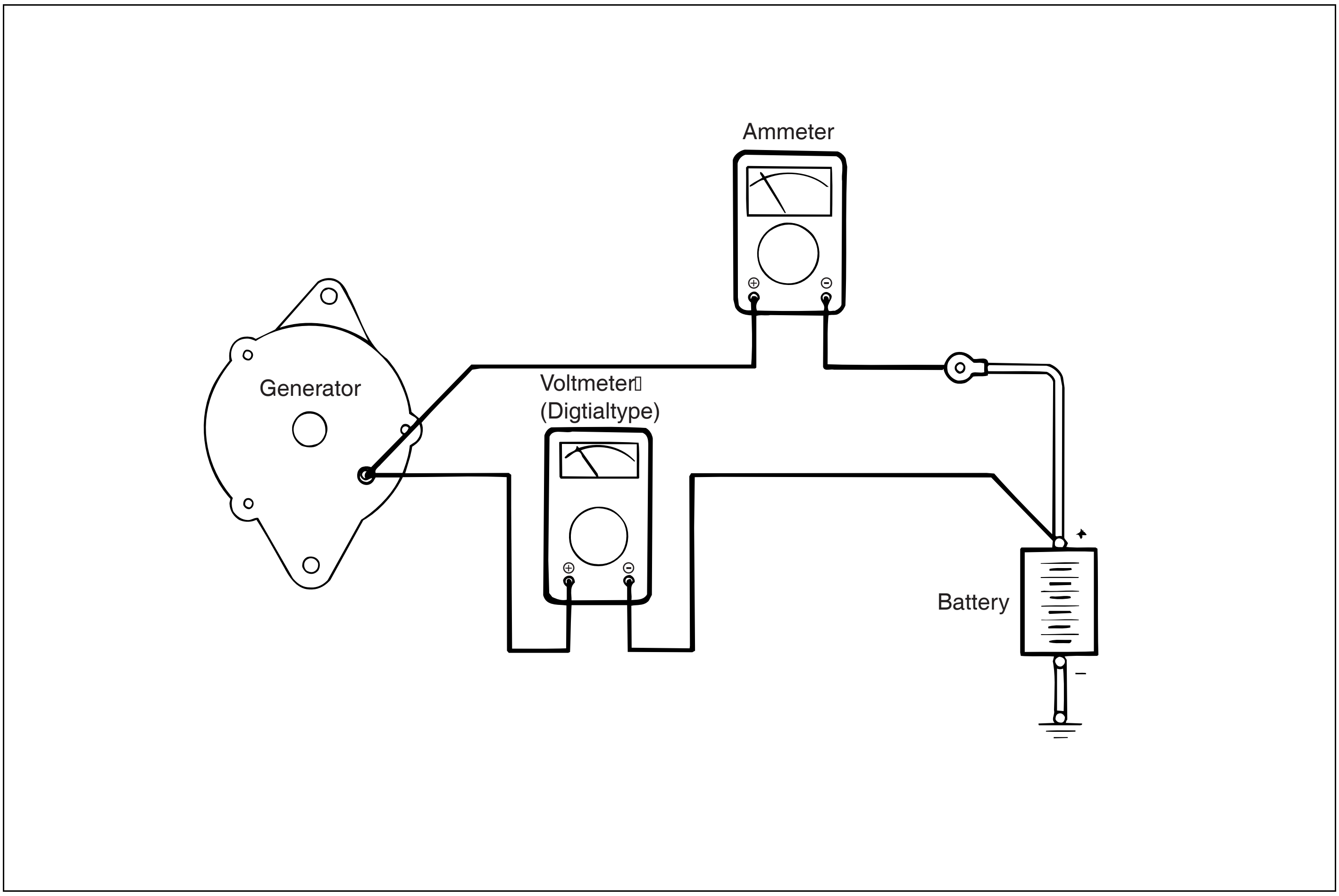
13. Disconnect the tachometer or the scan tool.

14. Disconnect the negative battery cable.

15. Disconnect the ammeter and voltmeter.

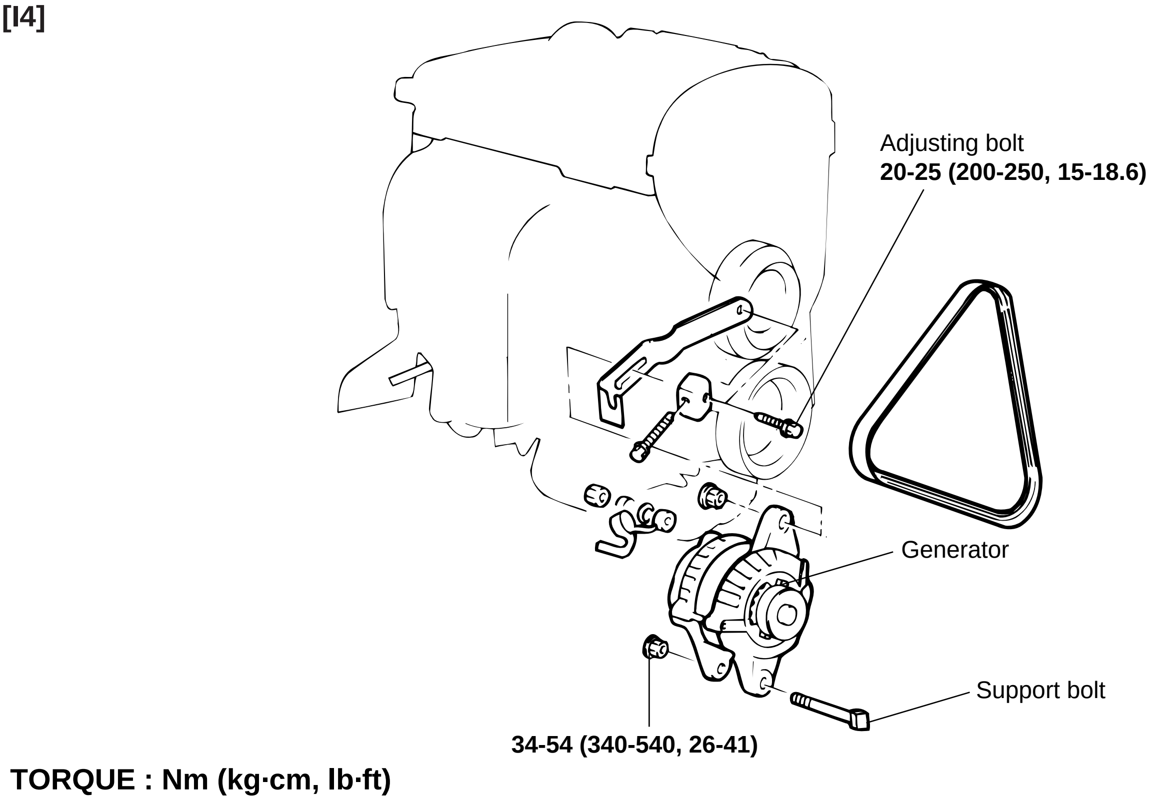
16. Connect the generator output wire to the generator "B" terminal.

17. Connect the negative battery cable.



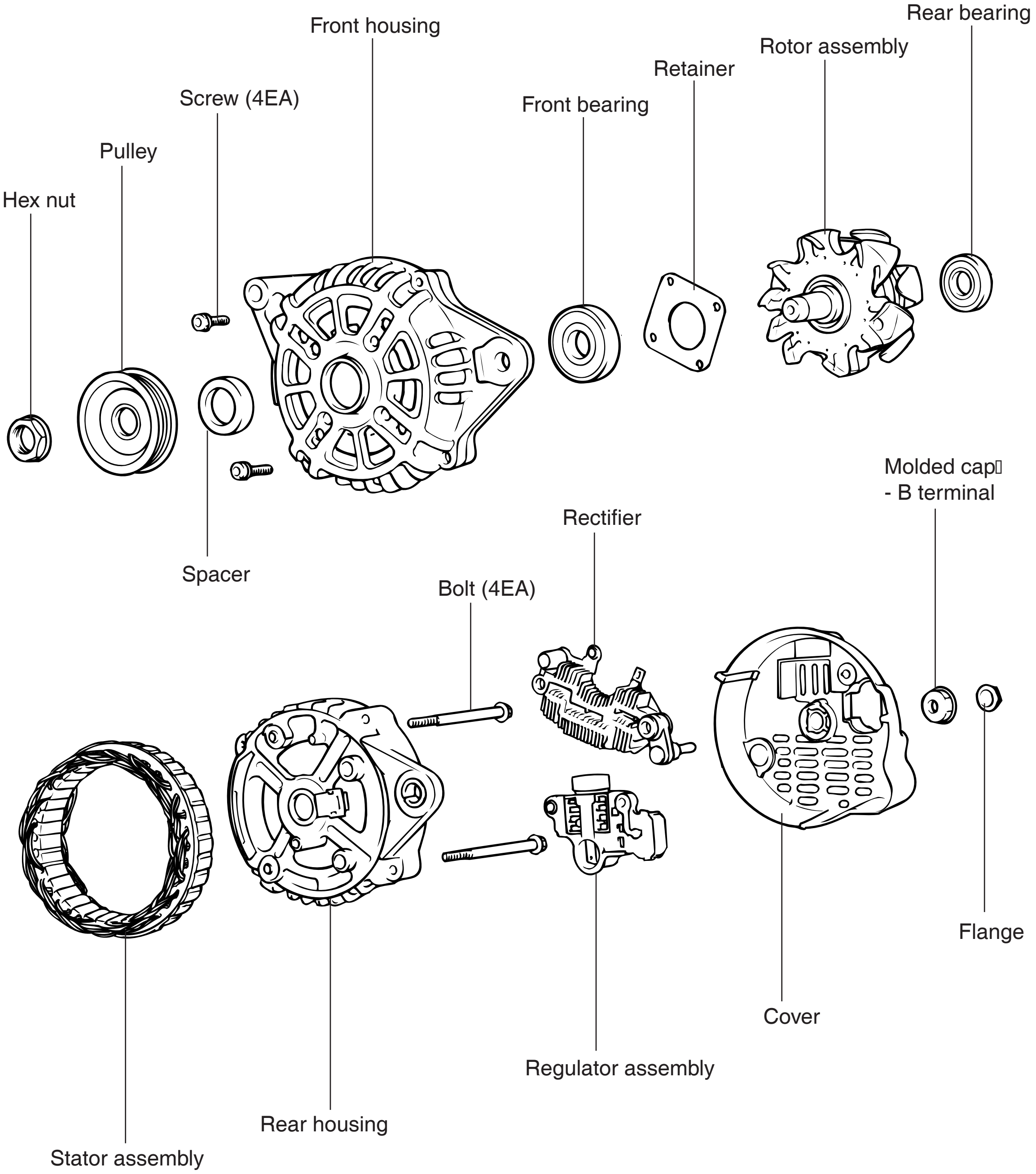
EBA9020C

REMOVAL AND INSTALLATION EBUC0150



EBUC015A

DISASSEMBLY AND REASSEMBLY EBBB0160



EBA9030A

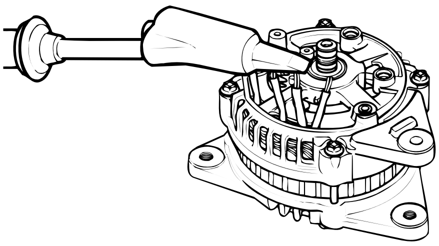
DISASSEMBLY EBUC0180

1. Remove the four through bolts.

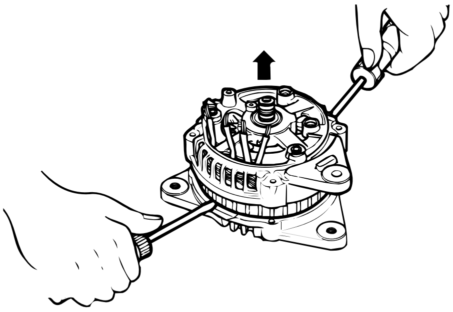
2. Insert a flat screwdriver between the front bracket and stator core, and pry downward.

⚠ *CAUTION*

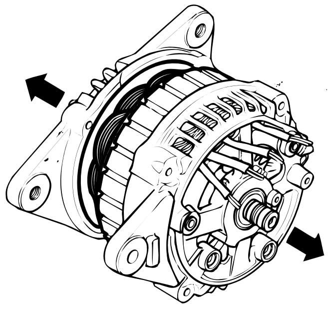
1. ***Do not insert the screwdriver too deeply, as there is a danger of damaging the stator coil.***
2. ***The rear cover may be hard to remove because a ring is used to lock the outer race of the rear bearing. To facilitate removal of rear cover, heat just the bearing box section with a 200-watt soldering iron. Do not use a heat gun as it may damage the diode assembly.***



KFW2018A



KFW2017A

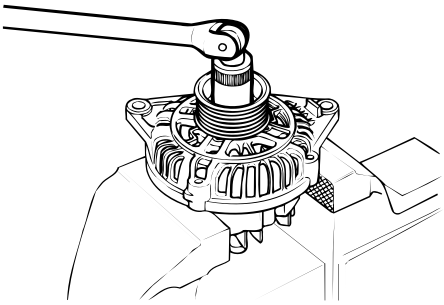


KFW2019A

3. Secure the rotor in a soft-jaw vise with the pulley side up.

⚠ *CAUTION*

Be careful that the vise jaws do not damage the rotor.



KFW2020A

4. Remove the pulley nut, spring washer, pulley, and spacer.

5. Remove the front bracket and two seals.

6. Remove the rotor from the vise.

7. Remove the brush holder screws, rectifier screws, and nut from the "B" terminal.

8. Remove the stator assembly from the rear bracket.

9. Detach the slinger from the brush holder.

10. If the stator is to be removed, unsolder the three stator leads to the main diodes on the rectifier.

⚠ *CAUTION*

1. ***When soldering or unsoldering, make sure that heat from soldering iron is not transmitted to the diodes for a long period.***
2. ***Do not exert excessive force on the leads of the diodes.***

11. When separating the rectifier from the brush holder, unsolder the two plates soldered to the rectifier.

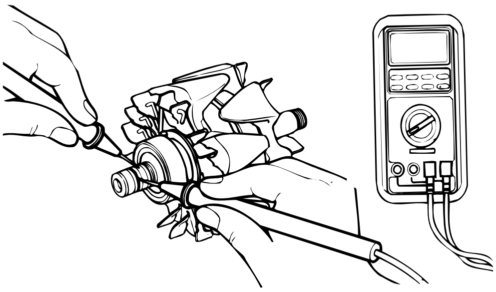
INSPECTION EBUC0190

ROTOR

1. Check the rotor coil for continuity. Make sure there is continuity between the slip rings.

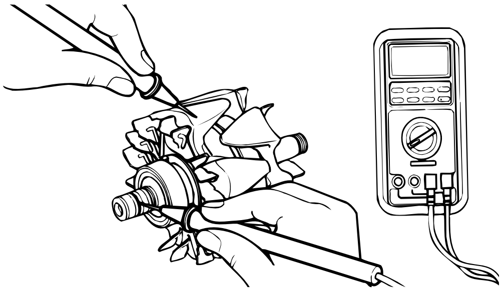
   If resistance is extremely low, there is a short. If there is no continuity or if there is a short circuit, replace the rotor assembly.

   Resistance value : Approx. 3.1Ω



KFW2021A

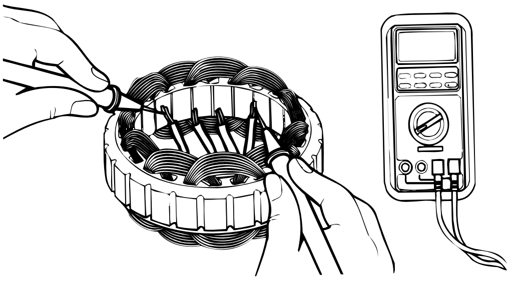
2. Check the rotor coil for a ground. Check that there is no continuity between the slip ring and the core. If there is continuity, replace the rotor assembly.



KFW2022A

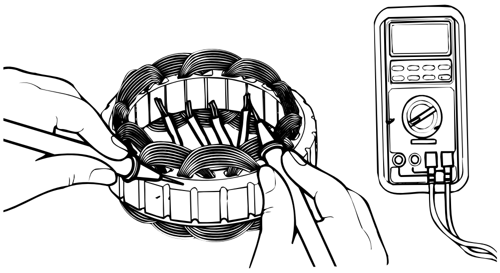
STATOR

1. Make a continuity check on the stator coil. Check that there is continuity between the coil leads. If there is no continuity, replace stator assembly.



KFW2023A

2. Check the coil for grounding. Check that there is no continuity between the coil and the core. If there is continuity, replace the stator assembly.

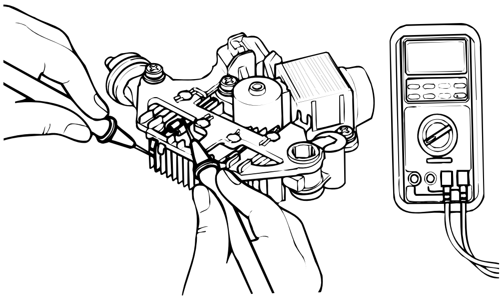


KFW2024A

RECTIFIERS

Positive rectifier test

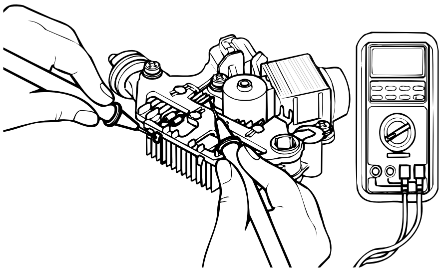
Check for continuity between the positive rectifier and stator coil lead connection terminal with an ohmmeter. The ohmmeter should read continuity in only one direction. If there is continuity in both directions, a diode is shorted. Replace the rectifier assembly.



KFW2025A

Negative rectifier test

Check for continuity between the negative rectifier and the stator coil lead connection terminal. The ohmmeter should read continuity in only one direction. If there is continuity in both directions, the diode is shorted, and the rectifier assembly must be replaced.

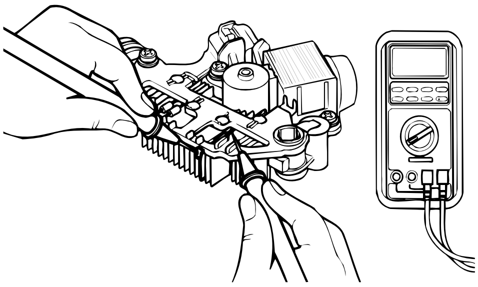


KFW2026A

Diode trio test

Check the three diodes for continuity by connecting an ohmmeter to both ends of each diode. Each diode should have continuity in only one direction.

If continuity is present in both directions, the diode is defective and the heatsink assembly must be replaced.

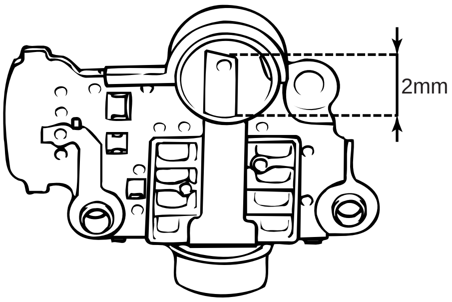


KFW2027A

BRUSH REPLACEMENT

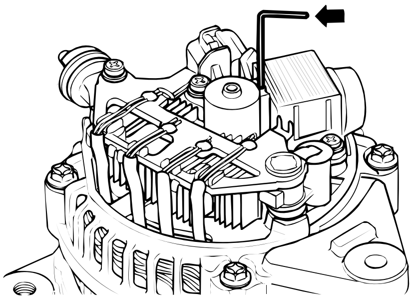
1. Measure the length of the brush protrusion shown in the illustration, and replace the brush if the measured value is below the limit value.

Limit : 2mm (0.8 in.) or less



EBA9030E

2. The brush can be removed if the solder of the brush lead wire is removed.



KFW2029A

3. When installing a new brush, insert the brush into the holder, and then solder the lead wire.

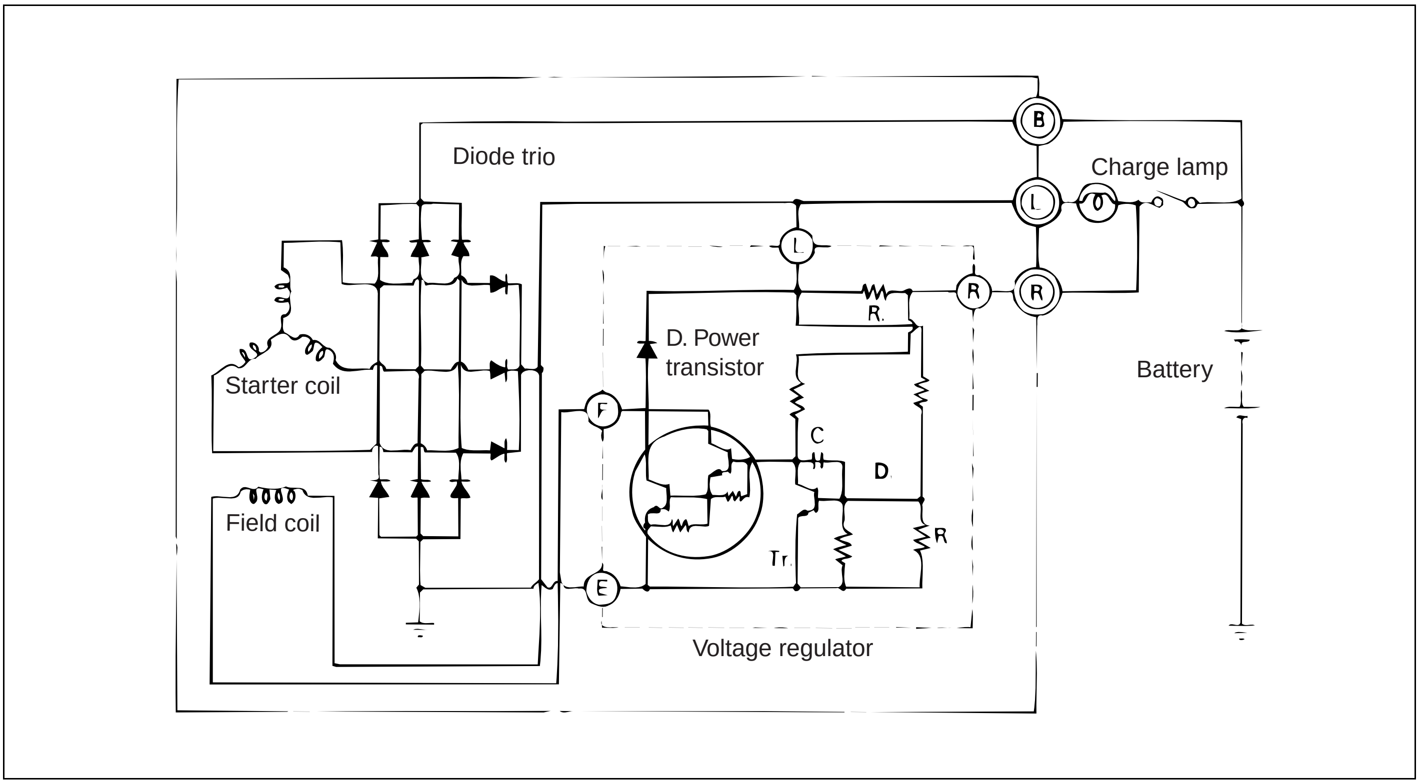
REASSEMBLY EBBB0190

Reassembly is the reverse of disassembly. Pay attention to the following:

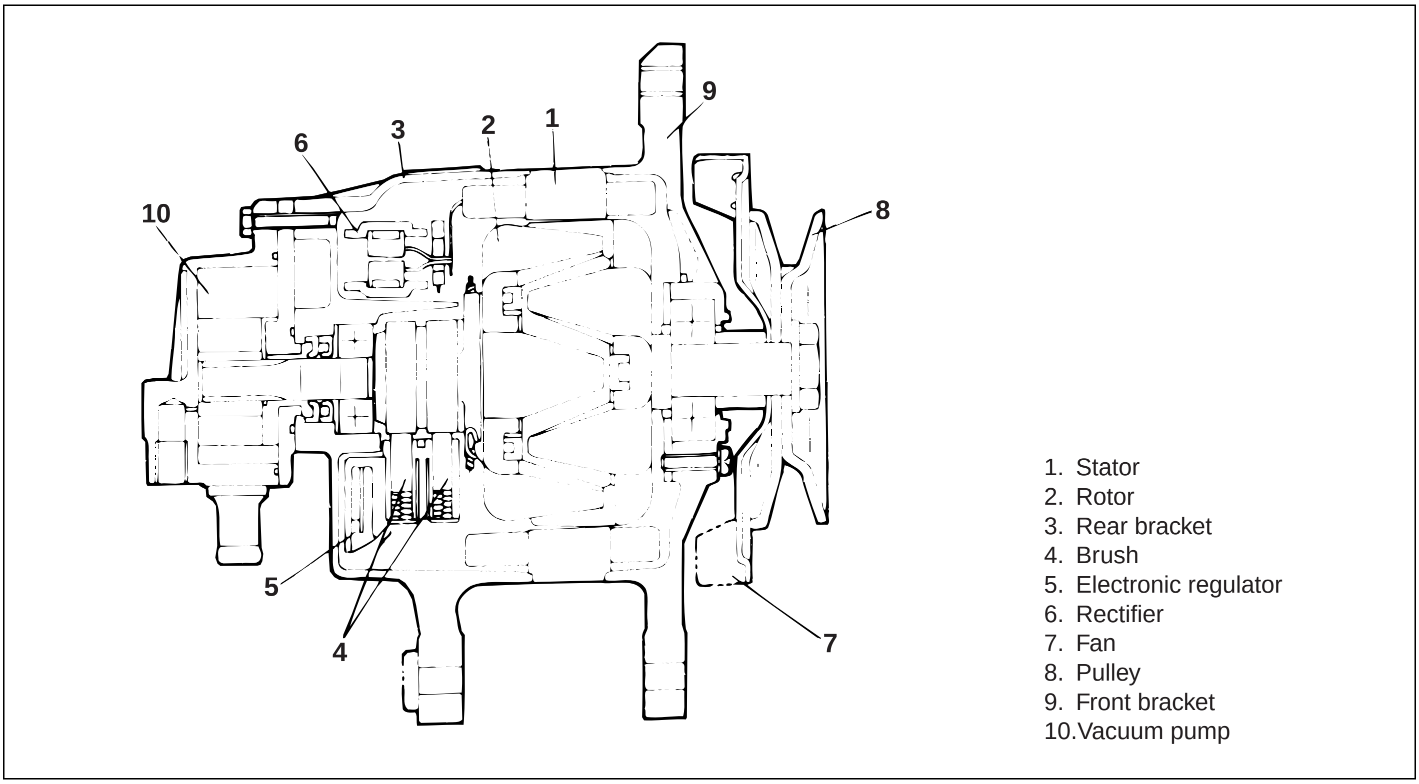
Before the rotor is attached to the rear bracket, insert a wire through the small hole in the rear bracket to hold the brush. After the rotor has been installed, the wire can be removed.

GENERATOR (DIESEL) EBMB0200

The conventional internal voltage detection type alternator controls the charging voltage regardless of the battery condition and according to the external load change so that it sometimes causes battery under or overcharging or causes flickering of meters and lamps due to ripples of generated voltage resulting from load fluctuation.
The figure below show the internal circuits of the alternator and voltage regulator.



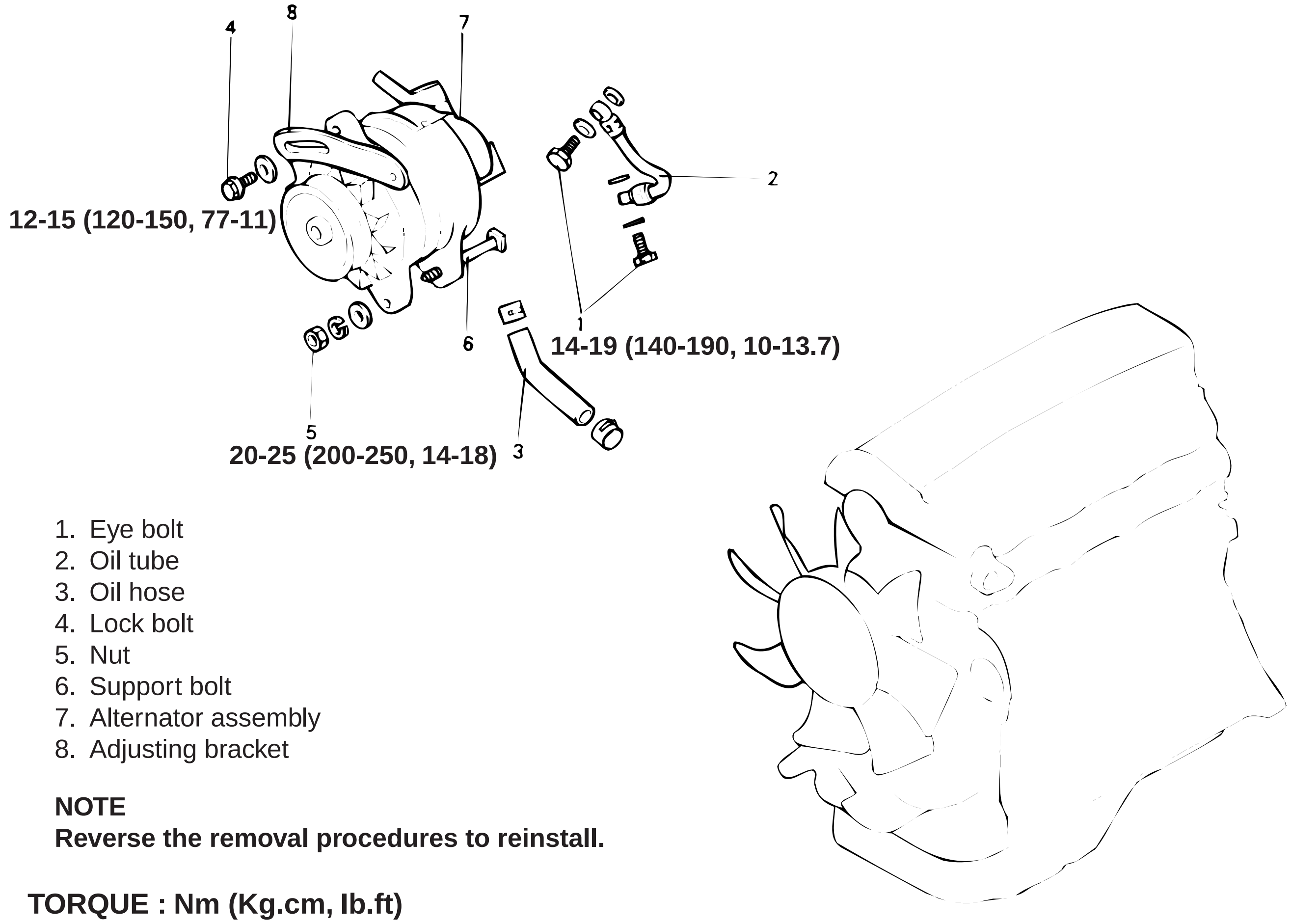
B7AD7415



1. Stator
2. Rotor
3. Rear bracket
4. Brush
5. Electronic regulator
6. Rectifier
7. Fan
8. Pulley
9. Front bracket
10. Vacuum pump

B7AD7400

REMOVAL AND INSTALLATION (DIESEL) EBMB0210



1. Eye bolt
2. Oil tube
3. Oil hose
4. Lock bolt
5. Nut
6. Support bolt
7. Alternator assembly
8. Adjusting bracket

NOTE
Reverse the removal procedures to reinstall.

TORQUE : Nm (Kg.cm, Ib.ft)

B7AD7395

INSTALLATION EBMB0220

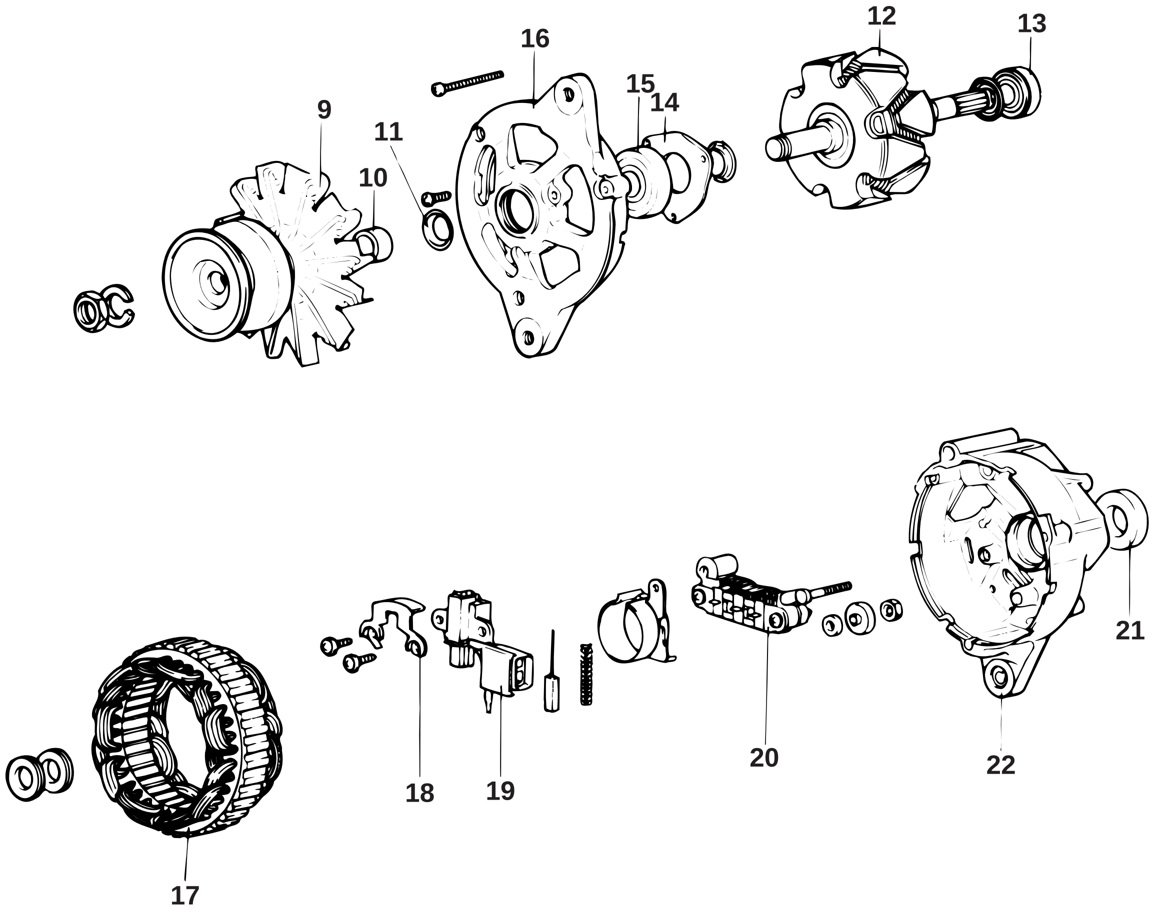
ALTERNATIOR ASSEMBLY

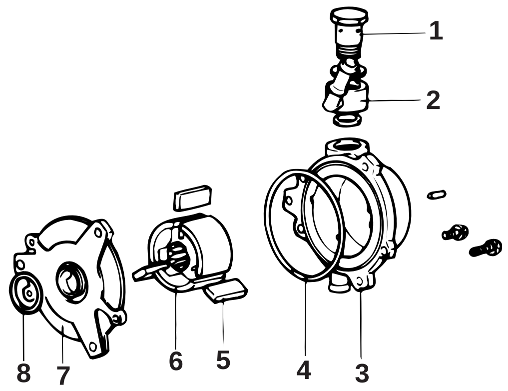
For belt tension, refer to Group EM Engine-Service adjustment procedures.

CAUTION

- ***Install the oil hose to the alternator in advance.***
  When the alternator is installed, connect the oil hose to the nipple on the oil pan side. Clamp the hose clip at the straight portion of the nipple.
- ***When the oil tube is installed, do not take a sharp bend nor bring the tube in contact with the cylinder block.***

DISASSEMBLY AND REASSEMBLY EBMB0230





1. Check valve
2. Nipple
3. Vacuum pump housing
4. O-ring
5. Rotor
6. Vane
7. Vacuum pump plate
8. O-ring
9. Pulley fan
10. Spacer
11. Seal
12. Rotor assembly
13. Rear bearing
14. Bearing retainer
15. Front bearing
16. Front bracket
17. Stator assembly
18. Plate
19. Regulator & brush holder
20. Rectifier Assembly
21. Oil seal
22. Rear bracket

NOTE
Reverse the disassembly procedures to reassemble.

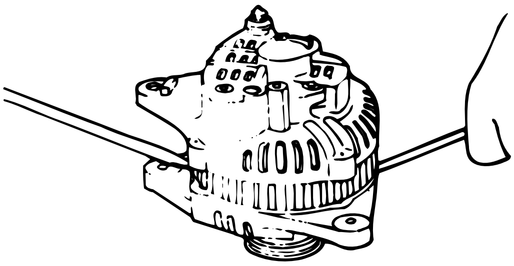
B7AD7420

DISASSEMBLY EBMB0240

FRONT BRACKET

1. With a screwdriver blade inserted between the front bracket and stator core, pry it to separate the stator and the front bracket.
2. If they are hard to separate, lightly strike the bracket with a plastic hammer while prying with the screwdriver.

> ⚠ ***CAUTION***
>
> ***Do not insert the screwdriver too deep as the stator core could be damaged.***

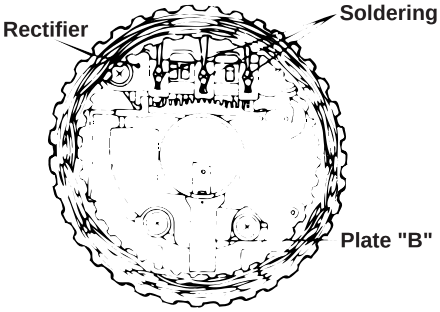


EBMB024A

STATOR ASSEMBLY, REGULATOR AND BRUSH HOLDER

> ⚠ ***CAUTION***
>
> - ***When soldering or unsoldering, use care not to expose the diode to soldering iron heat for extended time.***
>   ***Complete soldering or unsoldering in as short a time as possible.***
> - ***Do not overstress the diode leads.***

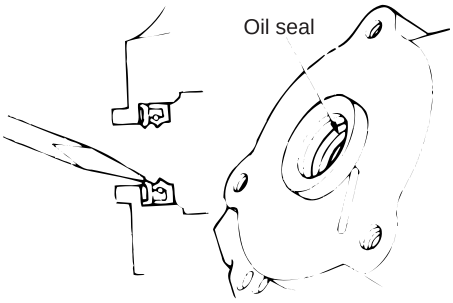
1. When removing the stator, unsolder the three stator leads from the main diodes.
2. When removing the rectifier from the brush holder, unsolder two soldered points.



B7AD7430

OIL SEAL

Push out and remove the oil seal using a screwdriver.



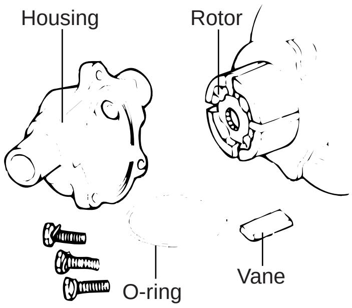
B7AD7435

INSPECTION EBMB0250

VACUUM PUMP

Check the following and replace if defective.

1. Check the rotor ends for streaks and damage.
2. Check the housing surface in contact with the rotor for streaks and damage.
3. Check the vanes for damage and break.

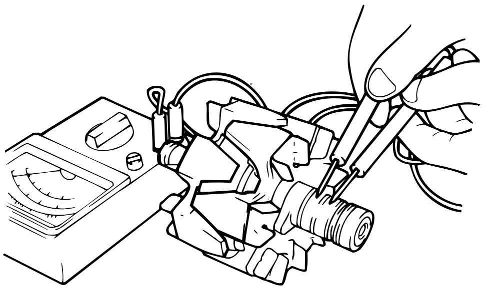


B7AD7440

ROTOR

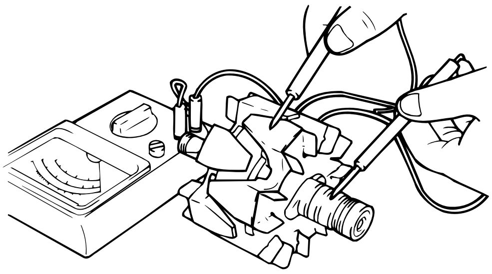
1. Check the rotor coil continuity. Make sure that there is continuity between slip rings.
   Measure the rotor resistance. If it is excessively small, it indicates a shorted rotor, If without continuity or shorted, replace the rotor assembly.

   Standard value : 3 - 5 ohms



B7ZN0440

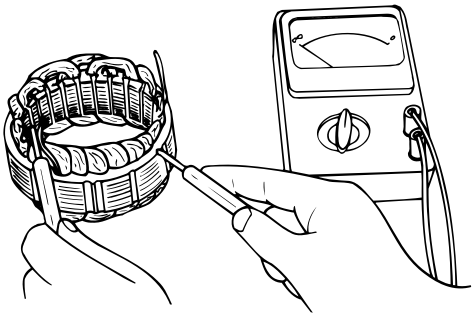
2. Check the rotor coil grounding. Make sure that there is no continuity between the slip ring and core. Replace the rotor assembly if there is continuity.



B7ZN0450

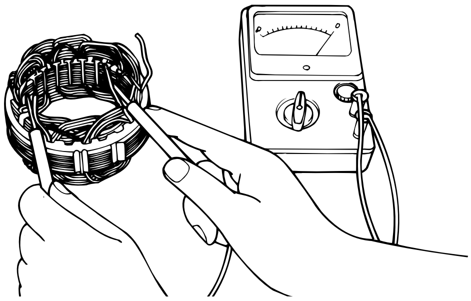
STATOR

1. Check the stator continuity. Make sure that there is continuity between coil leads. Replace the stator assembly if there is no continuity



B7ZN0470

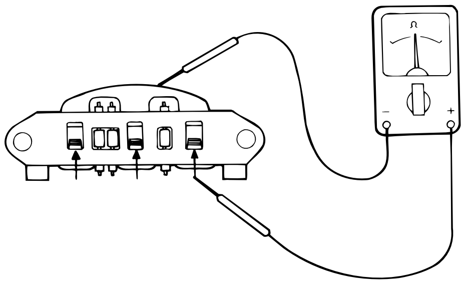
2. Check the coil grounding. Make sure that there is no continuity between the coil and core. Replace the stator assembly if there is continuity.



B7ZN0460

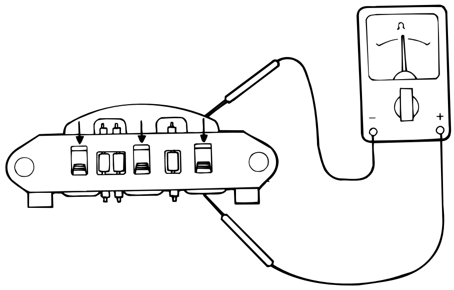
RECTIFIER

1. Inspection of (+) Heat Sink Assembly
   Using a circuit tester, check continuity between the (+) heat sink and the stator coil lead connection terminals. If there is continuity in both directions, the diode is shorted. Then, replace the rectifier assembly.



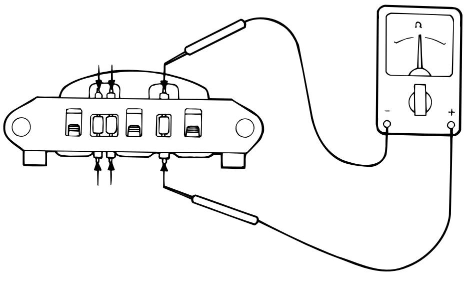
B7ZN0480

2. Inspection of (-) Heat Sink Assembly
   Check continuity between the (-) heat sink and the stator coil lead connection terminals. If there is continuity in both directions the diode is shorted. Then, replace the rectifier assembly.



B7ZN0490

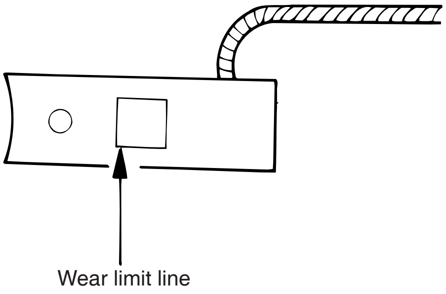
3. Inspection of Diode Trio
   With a circuit tester connected to both ends of each diode, check continuity of the three diodes. If there is continuity or no continuity in both directions, the diode is damaged. Then, replace the rectifier assembly.



B7ZN0500

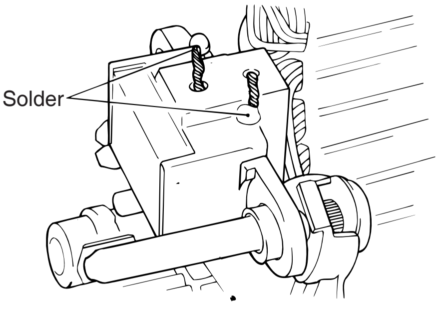
BRUSH

1. The brush must be replaced if worn to the wear limit line.



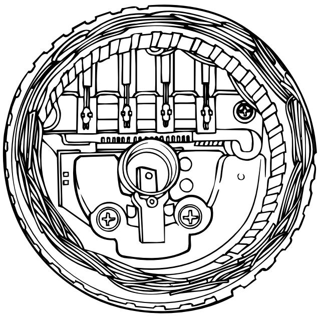
B7ZN0510

2. Unsolder the brush lead wires, and the brush and spring will come out.



B7ZN0520

3. When installing a new brush, push the brush into the holder as illustrated and solder the leads.

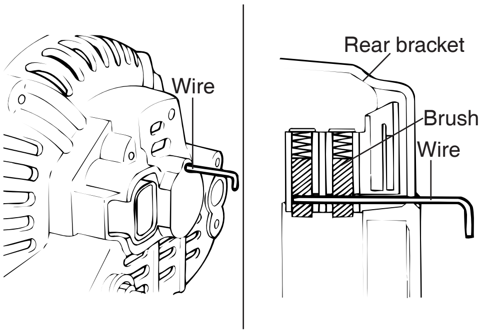


EBMB025A

REASSEMBLY EBMB0260

ROTOR ASSEMBLY

1. Before installing the rotor on the rear bracket, thread a steel wire through the small hole provided in the rear bracket to lift up the brush. After rotor installation, remove the steel wire.



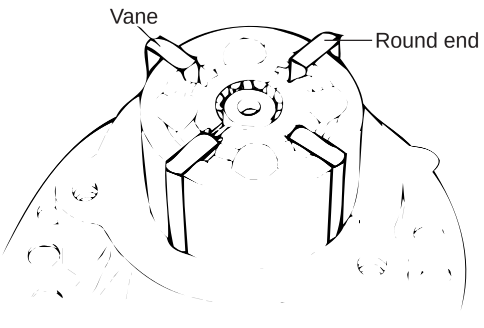
EBLB022A

2. When installing the rotor on the alternator rear bracket, wind vinyl tape round the splined shaft to prevent damage to the oil seal

B7AD7500

ROTOR AND VANES

1. Check well the housing, rotor, etc. for chips and foreign matter. Then, apply engine oil and install.
2. Install the vanes with round end facing outward.
3. Apply grease to the O-ring and fit in the housing groove when the bolts are tightened.



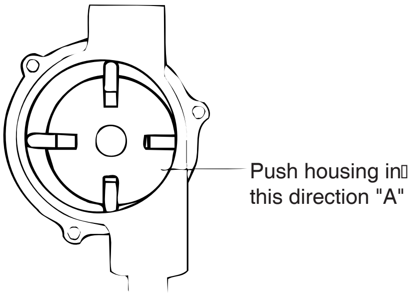
B7AD7505

4. When tightening the housing, lightly push it in the direction of arrow so as to minimize the clearance at “A” and tighten the bolts uniformly.

NOTE

After the assembly, be sure to conduct the performance test to check to see that the ultimate vacuum is as specified below.

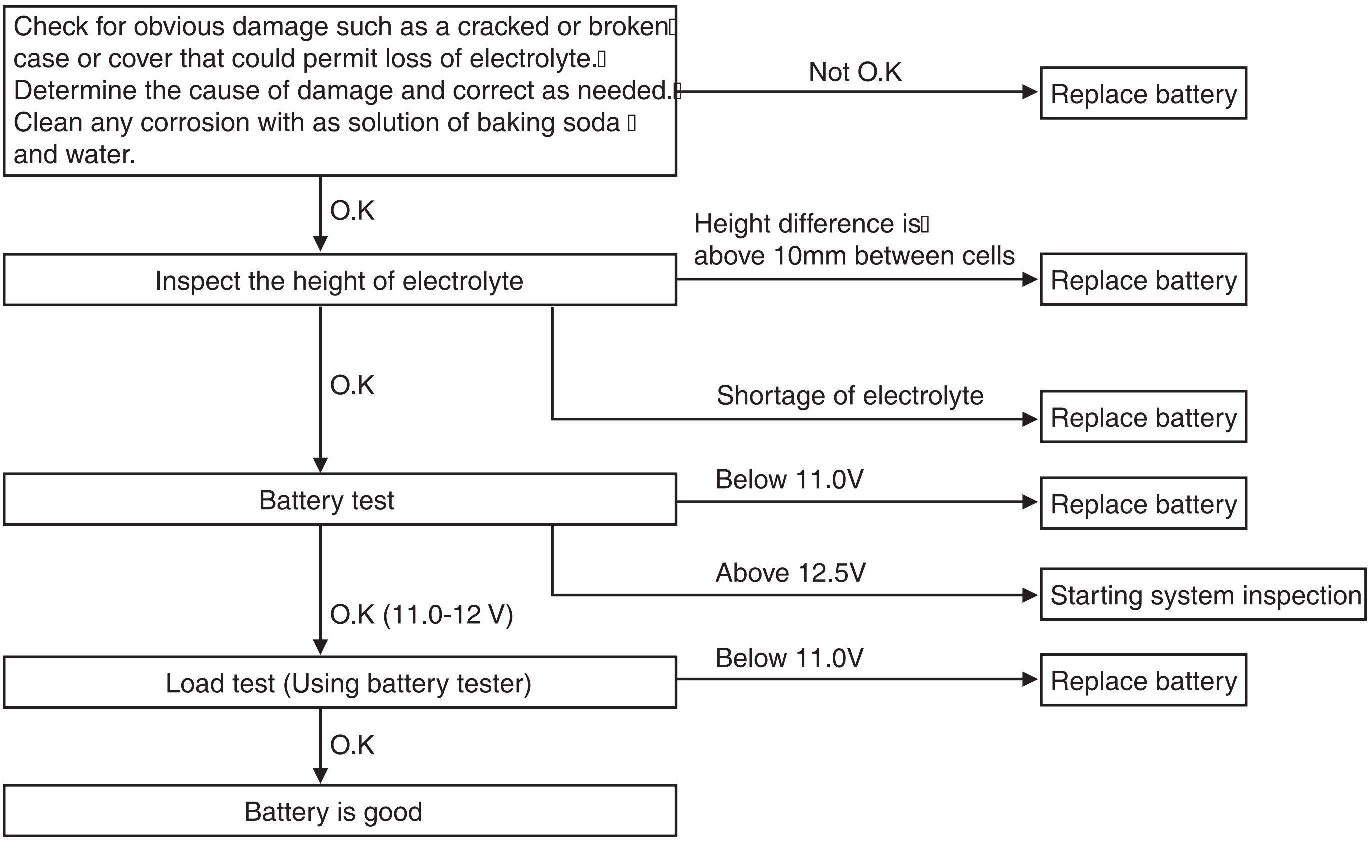
Standard value of ultimate vacuum :
600 mmHg or better at 3,000 rpm



B7AD7510

BATTERY VISUAL INSPECTION (1) EBBB0200

1. CHECKING FLOW



EBA9018B

2. CHECKING SHEET

Item	Trouble	Cause	Remedy	Responsibility	
				User	Manufacturer
1. Visual inspection	* Battery terminal damage	* Carelessness * Over tightening the battery cable	Replace	O	
	Cover Breakage	* Carelessness	Replace	O	
	* Electrolyte leakage				
	- Cover breakage	* Carelessness	Replace	O	
	- Cover leakage	* Bad cover seal	Replace		O
2. Electrolyte height inspection	* Electrolyte height between cells is over 10mm	* Cell shorted electrically	Replace		O
		* Vaporization caused by excessive temperature	Replace	O	
	* Shortage of electrolyte	* Electrolyte loss caused by over-charge	Replace	O	
3. Voltage inspection	1. Battery voltage >13.2V	1. Over charge	Replace * Check the electric system	O	
	2. 12.5V < Battery voltage < 12.9	2. Normal			
	3. 12.0V < Battery voltage < 12.4V (Simple discharge)	1. Insufficient charge	* Battery Load Test (Refer to Load Test below)	O	
	4. 11.0 V <Battery voltage <12.0 (Over discharge)	2. Internal failure		O	
	5. Battery voltage : 11.0V or less	1. Charge condition failure	Replace	O	
		2. Battery discharged for a long period		O	
		3. Internal circuit open			O

3. LOAD TEST

1. When discharging the battery during 15 seconds at half currency of Cold Cranking Power (CCP), the voltage of the battery should be as shown below.

REGULATING VOLTAGE TABLE

Ambient Temperature	Voltage
above 20°C	9.6V
~ 18°C	9.5V
~ 10°C	9.4V
~ 4°C	9.3V
~ -1°C	9.1V
~ -7°C	8.9V
~ -12°C	8.7V

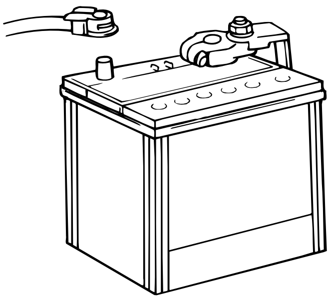
2. When the voltage is not within specification, repeat the load test again, and re-charge.
3. If the battery is left alone for 2 hours after re-charging and its output is over 12.5V, and the voltage after a load test is over the standard value, the battery can be used.

BATTERY VISUAL INSPECTION (2) EBBB0210

1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).
3. Remove the battery from the vehicle.

CAUTION

Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte. Heavy rubber gloves (not the household type) should be worn when removing the battery.

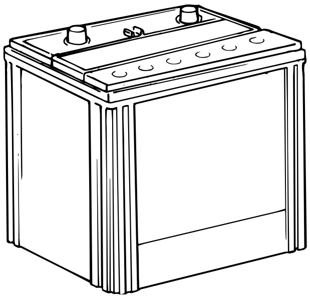


EBA9018C

4. Inspect the battery carrier for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described in Step(4).
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure the tops of the terminals are flush with the tops of the posts.
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

CAUTION

When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuits at the terminals of batteries being charged. A spark will occur when the circuit is broken. Keep open flames away from the battery.



EBA9018D

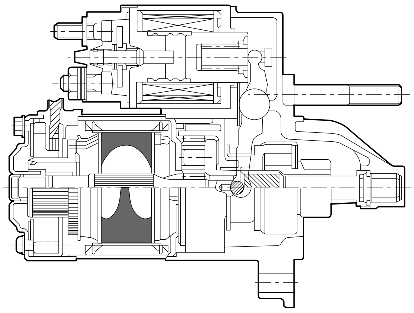
STARTING SYSTEM

GENERAL INFORMATION EBBB0290

The starting system includes the battery, starter motor, solenoid switch, ignition switch, inhibitor switch (A/T only), connection wires and the battery cables.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil. The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear. The contacts close and the starter motor cranks.

In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.

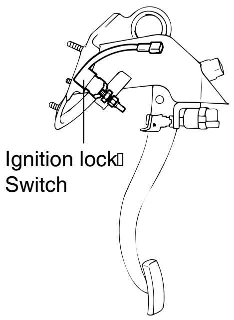


EBBB029A

EBHA0200

CHECK CLUTCH PEDAL (M/T)

Check that pedal height, pedal freeplay and clutch pedal clevis pin play are correct. (Refer to clutch group)



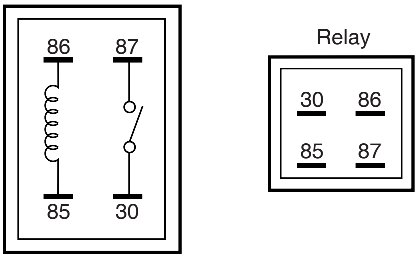
EBA9020D

CHECK STARTER RELAY

Remove the starter relay and check continuity between the terminals. If the continuity is not as specified, replace the relay.

Condition \ Terminal No.	85	86	87	30
When de-energized	○	○		
When energized	○	○	○	○

EBA9020E



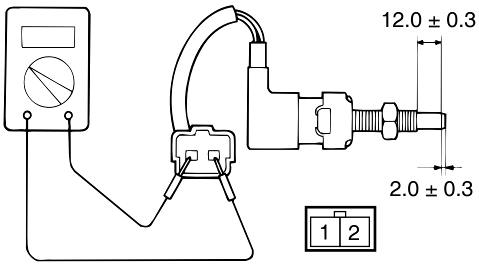
EBA9020F

CHECK IGNITION LOCK SWITCH

Remove the ignition lock switch and check continuity between the terminals. If the continuity is not as specified, replace the switch.

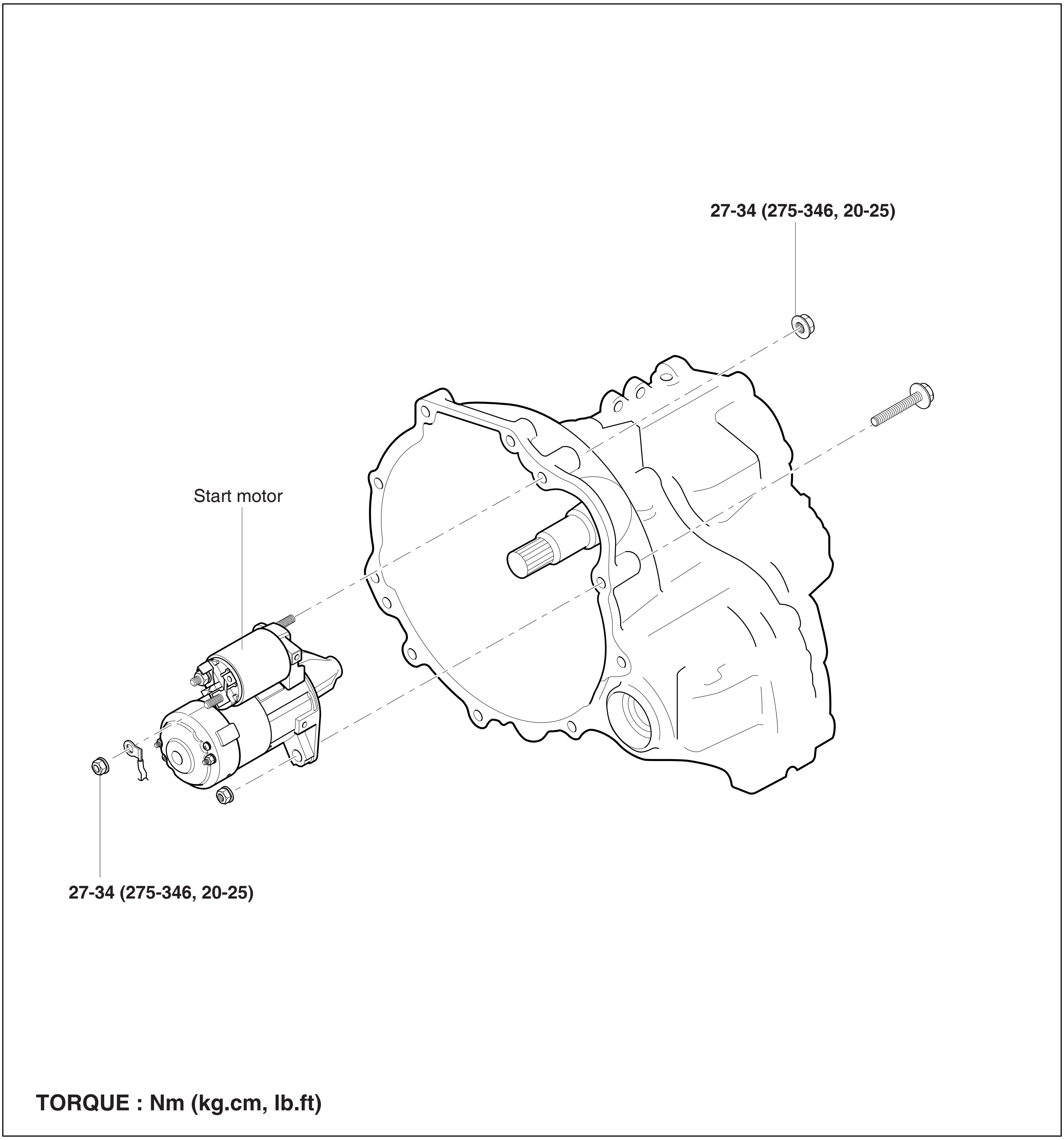
Condition \ Terminal	1	2
Pushed	○	○
Free		

EBA9020G



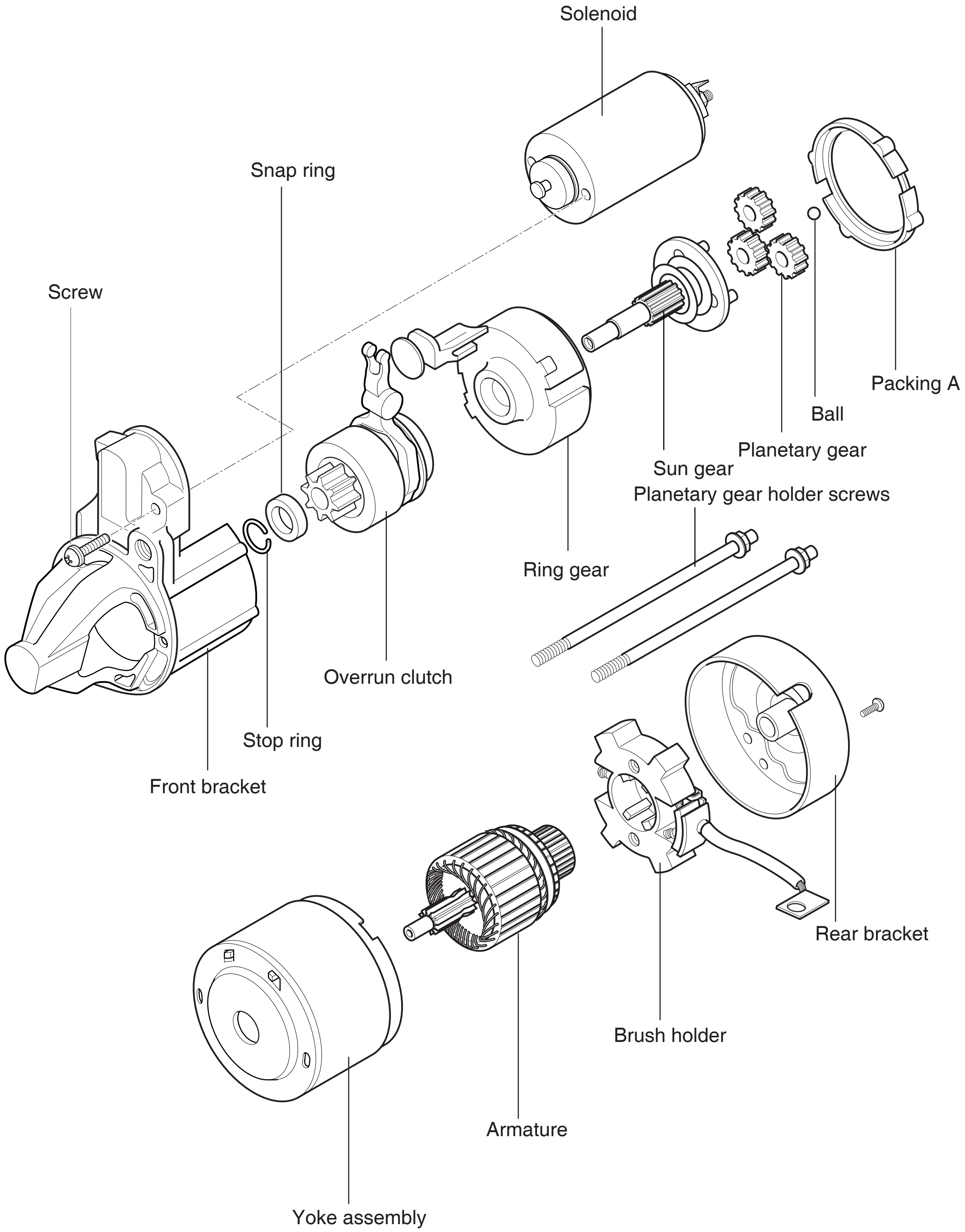
EBHA020A

REMOVAL AND INSTALLATION EBHA0210



1. Disconnect the battery ground cable.
2. Remove the speedometer cable and the shift cable.
3. Disconnect the starter motor connector and terminal.
4. Remove the starter motor assembly.
5. Installation is the reverse of removal.

COMPONENTS EBHA0220



EBHA306A

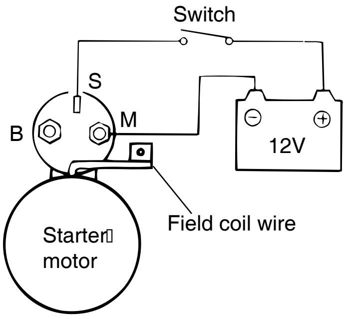
CHECKING FOR OPERATION EBHA0230

SERVICE ADJUSTMENT PROCEDURES FOR PINION GAP ADJUSTMENT

1. Disconnect the field coil wire from the M-terminal of the solenoid.
2. Connect a 12V battery the S-terminal and the M-terminal.
3. The pinion should move out.

CAUTION

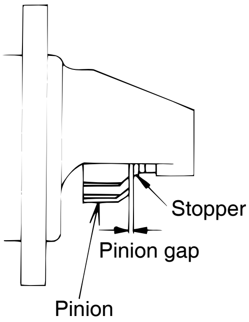
This test must be performed quickly (in less than 10 seconds) to prevent the coil from overheating.



EBA9023A

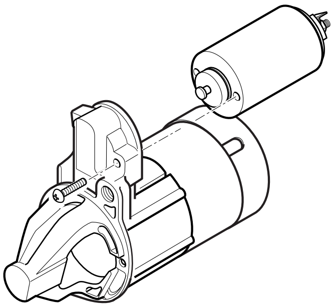
4. Check the pinion for stopper clearance (pinion gap) with a feeler gauge.

Pinion gap : 0.5-2.0 mm (0.02-0.079 in.)



EBA9023B

5. If the pinion gap is out of specification, adjust by adding or removing gaskets between the solenoid and the front bracket.



EBHA306D

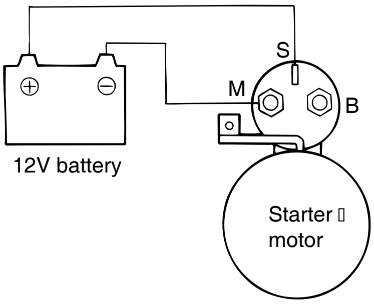
MAGNETIC SWITCH PULL-IN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the M- terminal.

CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. If the pinion moves out, then the pull-in coil is good. If it doesn't move out, replace the magnetic switch.



EBA9023D

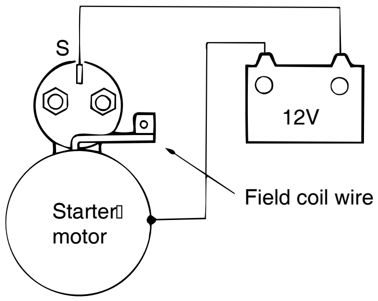
MAGNETIC SWITCH HOLD-IN TEST

1. Disconnect the field coil wire from the M-terminal of the magnetic switch.
2. Connect a 12V battery between the S-terminal and the body.

CAUTION

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. If the pinion moves out, everything is in order. If the pinion moves back and forth repeatedly, the hold-in circuit is open. If it is open, replace the magnetic switch.

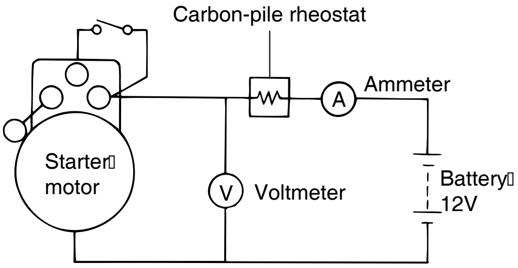


EBA9023E

FREE RUNNING TEST

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to the starter motor as follows:

2. Connect a test ammeter (100-ampere scale) and carbon pile rheostat as shown in the illustration.



EBA9023F

3. Connect a voltmeter (15-volt scale) across the starter motor.

4. Rotate the carbon pile to the off position.

5. Connect the battery cable from battery's negative post to the starter motor body.

6. Adjust the carbon pile until battery voltage reads 11 volts.

7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely:

   Current : Max. 90 Amps

   Speed : Min. 3,000 rpm

MAGNETIC SWITCH RETURN TEST

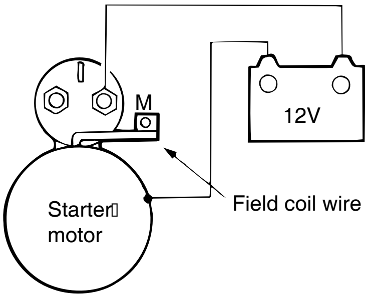
1. Disconnect field coil wire from the M-terminal of the magnetic switch.

2. Connect a 12V battery between M-terminal and the body.

NOTE

This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

3. Pull the pinion out and release it. If the pinion returns quickly to its original position, everything is in order. If it doesn't, replace the magnetic switch.



EBA9023G

INSPECTION EBHA0240

CHECKING THE COMMUTATOR

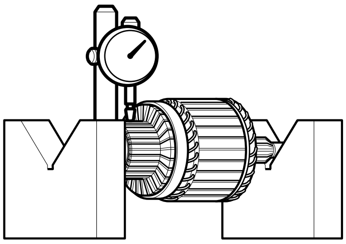
1. Place the armature on a pair of V-blocks, and check the run - out by using a dial gauge.

Standard value

Armature run - out : 0.05 mm (0.002 in.)

Limit

Armature run - out : 0.1 mm (0.0039 in.)



KFW2033A

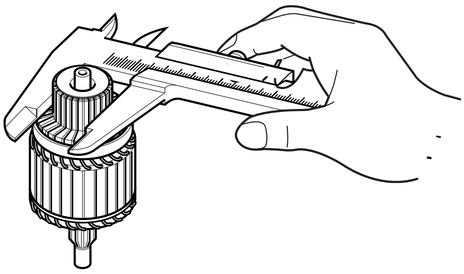
2. Check the outer diameter of the commutator.

Standard value

Outer diameter of the commutator : 29.4 mm (1.157 in.)

Limit

Outer diameter of the commutator : 28.4 mm (1.118 in.)



KFW2034A

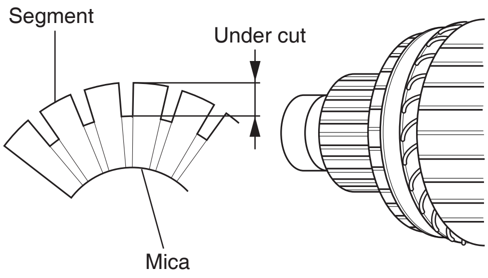
3. Check the depth of the undercut between segments.

Standard value

Depth of the undercut between segments
: 0.5mm (0.020 in.)

Limit

Depth of the undercut between segments
: 0.2mm (0.079 in.)

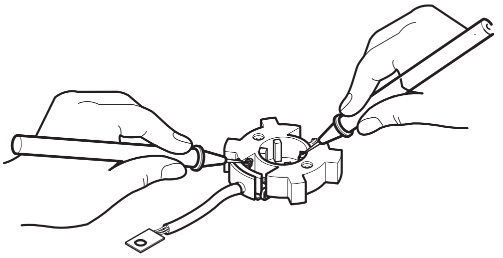


KFW2035A

BRUSH HOLDER

Check for continuity between the brush holder plate and the brush holder.

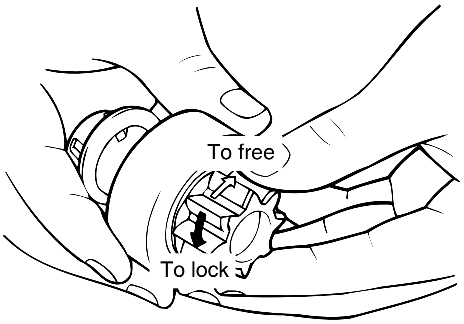
The normal condition is no continuity.



KFW2036A

OVERRUNNING CLUTCH

1. While holding the clutch housing, rotate the pinion. The drive pinion should rotate smoothly in one direction, but should not rotate in the opposite direction. If the clutch does not function properly, replace the overrun clutch assembly.
2. Inspect the pinion for wear or burrs. If the pinion is worn or burred, replace the overrun clutch assembly. If the pinion is damaged, also inspect the ring gear for wear or burrs.



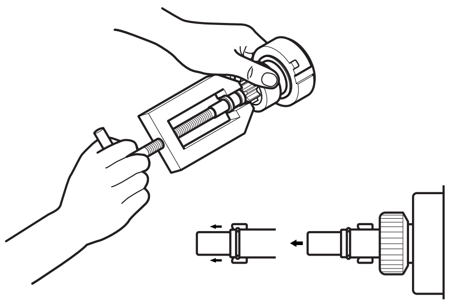
EBA9024E

FRONT AND REAR BRACKET BUSHING

Inspect the bushing for wear or burrs. If the bushing is worn or burred, replace the front bracket assembly or the rear bracket assembly.

REASSEMBLY OF THE STOP RING AND SNAP RING EBHA0250

Using a suitable pulling tool, pull the overrunning clutch stop ring over the snap ring.



KFW2043A

CLEANING THE STARTER MOTOR PARTS EBA90260

1. Do not immerse parts in cleaning solvent. Immersing the yoke and field coil assembly and/or armature will damage the insulation. Wipe these parts with a cloth only.

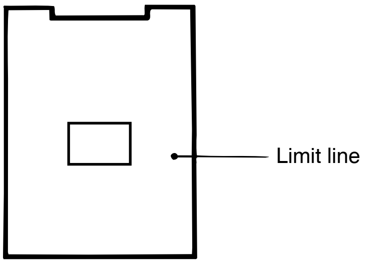
2. Do not immerse the drive unit in cleaning solvent. The overrun clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.

3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

REPLACEMENT OF BRUSHES AND SPRINGS EBA90270

1. Brushes that are worn out, or oil-soaked, should be replaced.

2. When replacing field coil brushes, crush worn out brushes with pliers, taking care not to damage the pigtail.

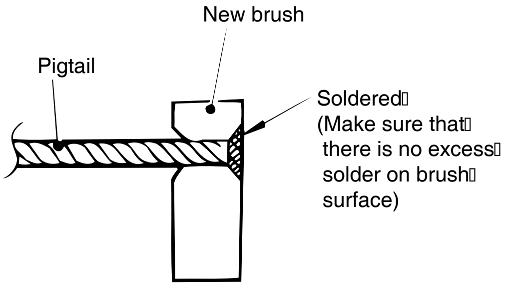


EBA9027A

3. Sand the pigtail end with sandpaper to ensure good soldering.

4. Insert the pigtail into the hole provided in the new brush and solder it. Make sure that the pigtail and excess solder do not come out onto the brush surface.

5. When replacing the ground brush, slide the brush from the brush holder by prying the retaining spring back.

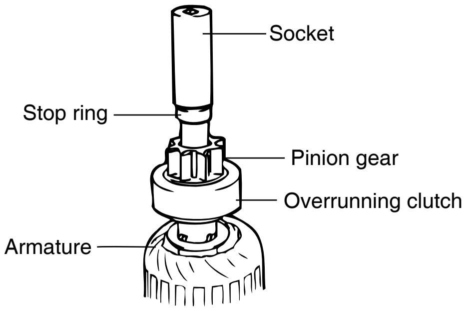


EBA9027B

DISASSEMBLY EBA90280

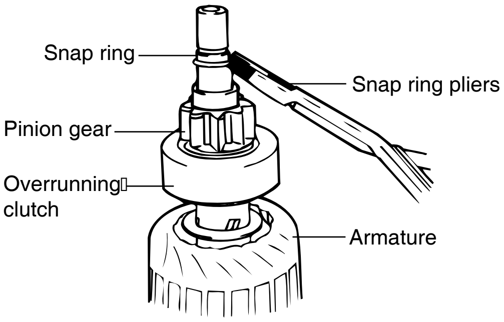
REMOVAL OF SNAP RING AND STOP RING

1. Press the stop ring to the snap ring side using a socket wrench, to the snap ring side.



EBA9028A

2. After removing the snap ring (using snap-ring pliers), remove the stop ring and the overrunning clutch.

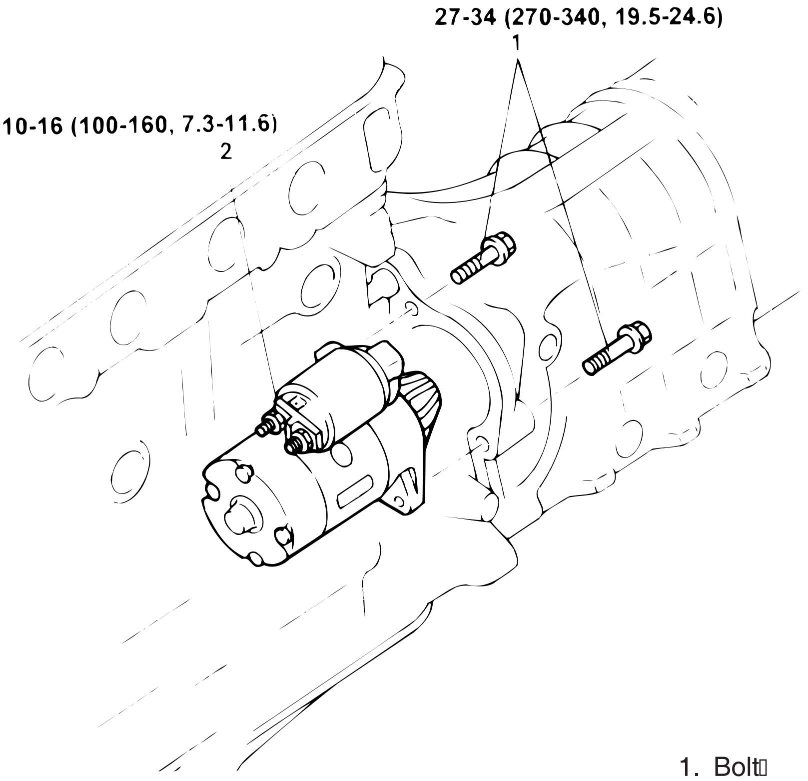


EBA9028B

REMOVAL AND INSTALLATLON (DIESEL)

EBMB0290

COMPONENTS



1. Bolt
2. Starting motor assembly

TORQUE : Nm (Kg.cm, lb.ft)

B7AD7520

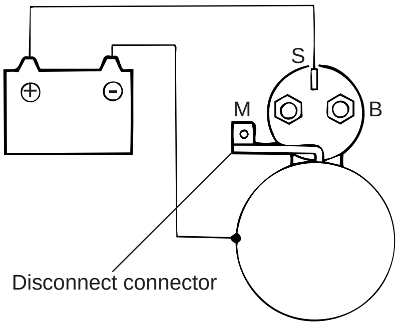
EBMB0300

PINION GAP ADJUSTMENT

1. Disconnect the field coil wire from the terminal M of the magnetic switch.
2. Connect a battery between the terminal S and starting motor body. (Connect the positive terminal of battery to the terminal S.)

NOTE

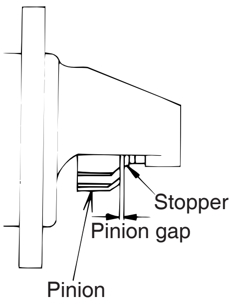
This test must be performed quickly within 10 seconds to prevent the switch coil from burning.



EBMB030A

3. When the battery is connected, the pinion moves out. Now, push back the pinion with a finger and measure the pinion stroke (the travel along which the pinion is pushed back).
This is the pinion gap.

4. If the pinion gap is not up to specification, adjust by adding or removing fiber washers between the magnetic switch and front bracket. Using more washers makes the gap smaller.



B7ZN0700

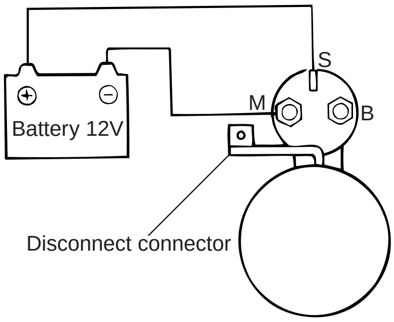
EBMB0310

PULL-IN TEST OF MAGNETIC SWITCH

The pull-in coil is in good condition if the plunger is pulled in to cause the pinion to move out when a battery is connected between the terminals S and M of the magnetic switch. If the pinion does not move out, replace the magnetic switch.

NOTE

The connector must be disconnected from terminal M for this test.
The test must be finished within 10 seconds.



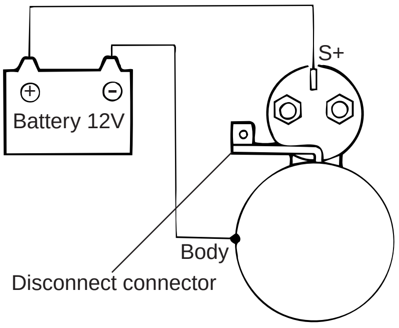
EBMB031A

HOLD-IN TEST OF MAGNETIC SWITCH

With a battery connected between the terminal S and body of magnetic, manually pull the pinion up to the pinion stopper. The hold-in coil is in good condition if the pinion remains out when releasing it.

NOTE

This test must be completed with 10 seconds.



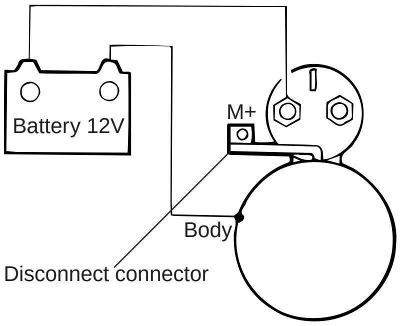
EBMB031B

RETURN TEST OF MAGNETIC SWITCH

With a battery connected between the terminal M and body of the magnetic switch, manually pull the pinion out to the pinion stopper. Body coils are fully operational if the pinion returns immediately when releasing it.

NOTE

This test must be completed within 10 seconds.

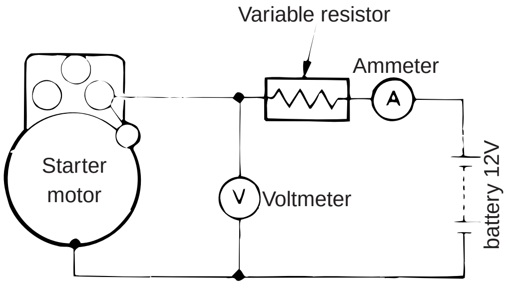


EBMB031C

NO-LOAD TEST

1. Set up a circuit as shown which connects a starter motor, battery, ammeter, voltmeter, and variable resistance.

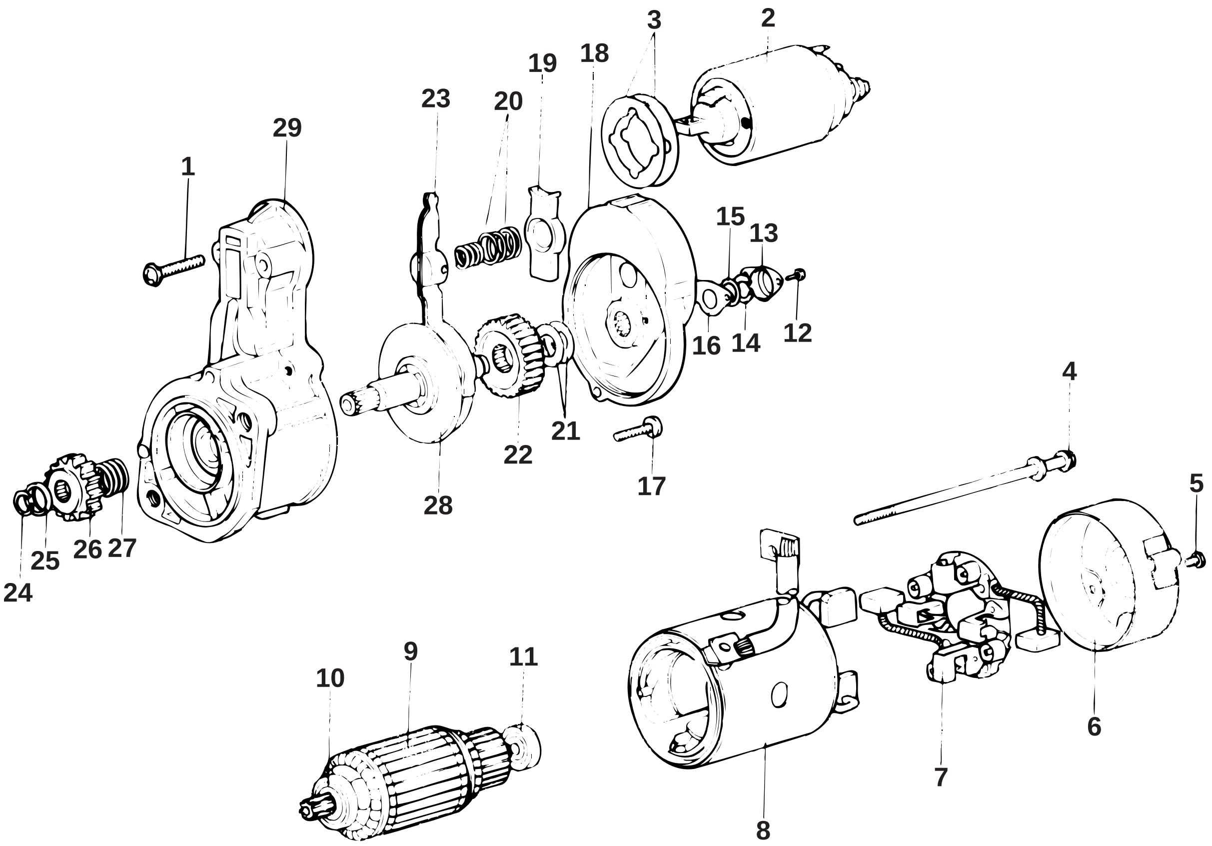
2. The starting motor should be in good condition if it turns smoothly and steadily when the switch is turned ON with a maximum variable resistance value. Adjust the variable resistor so that the voltmeter reads 11.5V. If the current and rpm are out of specification after this adjustment, troubleshoot according to the table below and take remedial action as required.



B7AD7550

Symptom	Possible cause
Large current with low rpm (torque also being small)	Contaminated bearing Armature coil rubbing pole piece Armature and field coil grounding Armature coil shorting
Large current with no rotation	Solenoid switch grounding Armature and field coil grounding Seized bearing
No current flowing with no rotation	Broken armature and field coils Broken brush and pigtail Improper contact between brush and commutator
Small current with low rpm (torque also being small)	Improper field coil connection (Note, however, that open or improperly connected shunt coil only will result in high rpm.)
Large current with high rpm (torque being small)	Shorted field coil

DISASSEMBLY AND REASSEMBLY EBMB0320



1. Screw
2. Magnetic
3. Fiber
4. Screw
5. Screw
6. Rear bracket
7. Brush holder assembly
8. Yoke assembly
9. Armature
10.Front bearing
11.Rear bearing
12. Screw
13.Cover
14.Snap ring
15.Washer
16.Plate
17.Screw
18.Center bracket
19.Packing
20.Lever spring
21.Washer
22.Gear
23.Lever
24.Snap ring
25.Stop ring
26.Pinion gear
27.Spring
28.Pinion shaft assembly
29.Front bracket

NOTE
Reverse the disassembly procedures to reassemble

B7AD7555

PREHEATING SYSTEM

GLOW SYSTEM EBMB0330

SPECIFICATIONS

SERVICE SPECIFICATIONS

Items	Auto glow system
Water temperature sensor resistance [at 20°C (68°F)] k Glow plug resistance [at 20°C (68°C)] m	2.92 - 3.58 250

TORQUE SPECIFICATIONS

Items	Nm	kg·cm	lb·ft
Water temperature sensor	8 - 10	80 - 100	6 - 7
Glow plug	15 - 20	150 - 200	11 - 14
Glow plug plate attaching nut	1 - 1.5	10 - 15	0.7 - 1.1

SEALANTS AND ADHESIVES

Items	Specified sealant and Adhesive
Water temperature sensor	3M Adhesive Nut Locking 4171 or equivalent

SERVICE ADJUSTMENT PROCEDURES EBMB0340

INSPECTION OF GLOW SYSTEM OPERATION

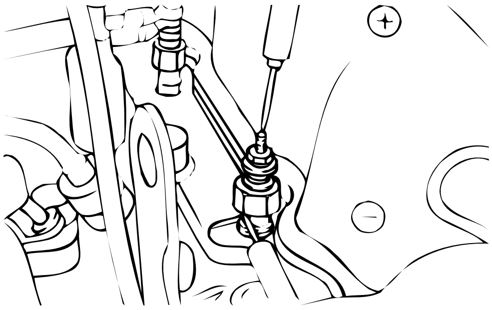
Conditions before inspection :
Battery voltage : 12V

1. Connect voltmeter between glow plug plate and plug body (ground).
2. Check indicated value on voltmeter with ignition switch ON.
3. Check that preheat indication lamp lights for about 6 seconds and indicates battery voltage (about 9V or over) for about 36 seconds immediately after ignition switch is turned on. [At cooling water temperature 20°C (68°F)]

NOTE

Continuity time varies depending upon cooling water temperature.

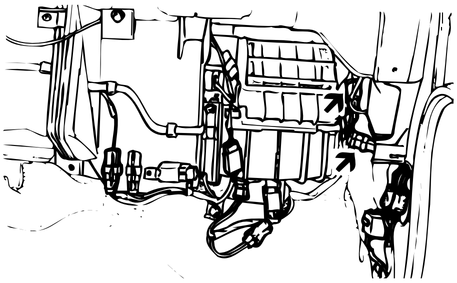
4. After checking 3, set ignition switch at START position.
5. The system is normal if battery voltage (about 9V or over) is generated for about 6 seconds during engine cranking and after start operation. [at cooling water temperature 20°C (68°F)]
6. When the voltage or continuity time is not normal, check the terminal voltage in glow control unit, and single parts.



B7AD7645

INSPECTION OF GLOW CONTROL UNIT

Check terminal voltage in glow control unit and continuity on harness side.



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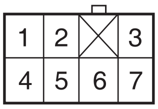
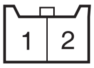


C007F001



C002F003

EBLB039A

1. Check with glow control unit connector connected. (M14)

Terminal	Connect area or measuring part	Measuring item	Tester connection	Check conditions	Standard value
1	Glow plug relay	Voltage	1 - ground	Ignition switch ON	Indicates battery voltage for about 30 seconds after ON

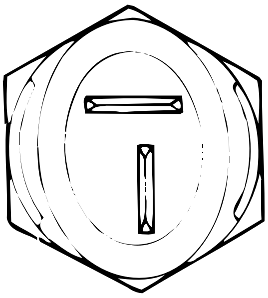
2. Remove glow control unit connector. Check with harness side connector. (M13)

Terminal	Connect area or measuring part	Measuring item	Tester connection	Check conditions	Standard value
1	Ignition switch	Voltage	1 - ground	During engine cranking	Battery voltage
2	Preheat indication lamp	Voltage	2 - ground	Constantly	Battery voltage
3	Ignition switch (IG1 power source)	Voltage	3 - ground	Ignition switch ON	Battery voltage
4	Water temperature sensor	Resistance	4 - ground	-20°C (-4°F) 0°C (30°F) 20°C (68°F) 40°C (104°F)	24.8 ± 2.5 kΩ 8.62 kΩ 3.25 kΩ 1.05 kΩ
5	Vacant terminal	-	-	-	-
6	Control unit earth	Continuity	6 - ground	Constantly	Continuity
7	Generator L terminal	Voltage	7 - ground	Ignition Switch On	1 - 4 V

INSPECTION OF ENGINE COOLANT TEMPERATURE SENSOR EBMB0350

1. Remove ECT sensor from intake manifold.
2. Check that ECT sensor resistance is within the standard value.

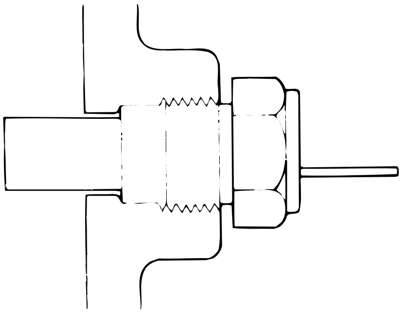
   Standard value : 3.25kΩ [at 20°C (68°F)]



B7AD7655

3. After checking, apply specified adhesive to coolant temperature sensor screw area to install intake manifold.

Specified adhesive : 3M Adhesive Nut Locking 4171 or equivalent

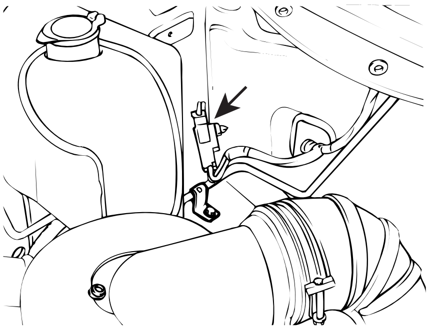


B7AD7660

INSPECTION OF STARTER RELAY EBMB0360

1. Remove starter relay from relay bracket.
2. Connect battery power source to terminal 1. Check continuity between terminals with terminal 3 grounded.

With power	Between terminals 4 and 5	Continuity
Without power	Between terminals 1 and 3	Continuity
	Between terminals 4 and 5	No Continuity



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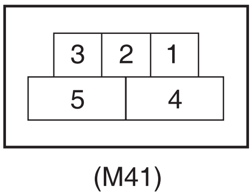
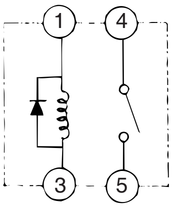


G6CL001T

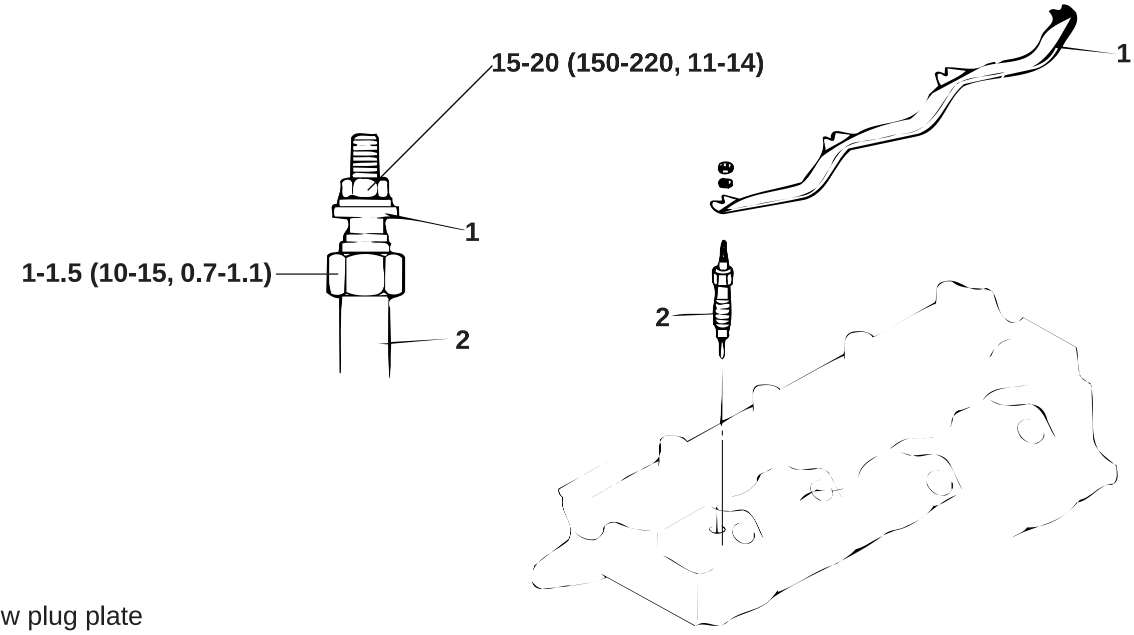


V5BE080A

EBLB041A

REMOVAL AND INSTALLATION EBMB0370

COMPONENTS



1. Glow plug plate
2. Glow plug

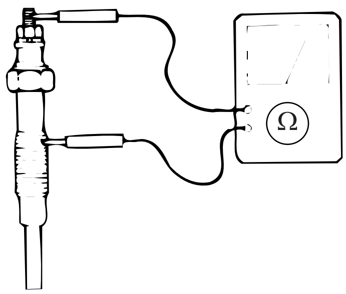
NOTE
Reverse the removal procedures to reinstall.

TORQUE : Nm (kg.cm,lb.ft)

EMBM037A

INSPECTION EBMB0380

GLOW PLUG



EBMB038A

1. Check the continuity between the terminal and body as illustrated. Replace if discontinuity or with large resistance.
   Standard value : 0.25Ω

   ⚠ ***CAUTION***

   Remove oil from plug before measuring as glow plug resistance is very small.

2. Check for rust on glow plug plate.
3. Check glow plug for damage.

Engine Mechanical System[2.4 I4]

GENERAL .... EM - 2

ENGINE BLOCK .... EM -21

MAIN MOVING SYSTEM .... EM -39

COOLING SYSTEM .... EM -53

INTAKE AND EXHAUST SYSTEM .... EM -65

CYLINDER HEAD ASSEMBLY .... EM -74

TIMING SYSTEM .... EM -80

GENERAL

SPECIFICATIONS ECUC0100

Description	Specification	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinders	4	
Bore	86.5 mm (3.41 in.)	
Stroke	100 mm (3.94 in.)	
Total displacement	2351 cc (143.5 cu.in.)	
Compression ratio	10 : 1	
Firing order	1 - 3 - 4 - 2	
Valve timing		
Intake valve		
Opens (BTDC)	18°	
Closes (ABDC)	54°	
Exhaust valve		
Opens (BBDC)	56°	
Closes (ATDC)	8°	
Cylinder head		
Flatness of gasket surface	Max. 0.03 mm (0.0012 in.)	0.2 mm (0.008 in.)
Flatness of manifold mounting surface	0.15 mm (0.0059 in.)	0.3 mm (0.012 in.)
Dimensions for reworking oversize valve seat hole		
Intake		
0.3 mm (0.012 in.) O.S.	35.3-35.325 mm (1.39-1.3907 in.)	
0.6mm (0.024 in.) O.S.	35.6-35.625 mm (1.40-1.4026 in.)	
Exhaust		
0.3 mm (0.012 in.) O.S.	33.3-33.325 mm (1.31-1.3120 in)	
0.6 mm (0.024 in.) O.S.	33.6-33.625 mm (1.32-1.3238 in.)	
Dimensions for reworking oversize valve guide hole (both intake and exhaust)		
0.05mm (0.002in.) O.S.	12.05-12.068 mm (0.4751 in.)	
0.25mm (0.010in.) O.S.	12.25-12.268 mm (0.4830 in.)	
0.50mm (0.020in.) O.S.	12.50-12.518 mm (0.4928 in.)	
Camshaft		
Cam height		
Intake	35.493 mm (1.3974 in.)	34.993 mm(1.3776in.)
Exhaust		
M/T	35.204 mm (1.3860 in.)	34.704 mm(1.3663in.)
A/T	35.204 mm (1.3860 in.)	34.704 mm(1.3663in.)
Journal O.D.	26 mm (1.02 in.)	
Bearing oil clearance	0.040 - 0.076 mm (0.0020 - 0.0030 in.)	
End play	0.1 - 0.15 mm (0.004 - 0.006 in.)	

Description	Specification	Limit
Valve		
Valve length		
Intake	109.5 mm (4.311 in.)	
Exhaust	109.7 mm (4.319 in.)	
Stem O.D.		
Intake	6.565-6.580 mm (0.2585-0.2591 in.)	
Exhaust	6.530-6.550 mm (0.2571-0.2579 in.)	
Face angle	45° - 45°5’	
Thickness of valve head (margin)		
Intake	1.0 mm (0.039 in.)	0.7 mm (0.028 in.)
Exhaust	1.5 mm (0.059 in.)	1.0 mm (0.039 in.)
Valve stem to valve guide clearance		
Intake	0.020-0.047 mm (0.0008-0.0019 in.)	0.1 mm (0.0039 in.)
Exhaust	0.050-0.085 mm (0.0020-0.0033 in.)	0.15 mm (0.0059 in.)
Valve guide		
Length		
Intake	45.5 mm (1.791 in.)	
Exhaust	50.5 mm (1.988 in.)	
Service over size	0.05, 0.25, 0.50 mm (0.002, 0.010, 0.020 in.)	
Valve seat		
Width of seat contact	0.9 - 1.3mm (0.035 - 0.051 in.)	
Seat angle	44° - 44°. 5’	
Service size	0.3 mm (0.012 in.), 0.6 mm (0.024 in.) oversize	
Valve spring		
Free length	45.82 mm (1.804 in.)	44.82 mm (1.7646 in.)
Load	25.3kg / 40mm (55.8 lb / 1.57 in.)	
	at installed height	4°
Out - of - square	Less than 1.5°	
Cylinder block		
Cylinder bore	86.5+0.03 mm (3.406+0.0012 in.)	
Out-of-round and taper of cylinder bore	Less than 0.01 mm (0.0004 in.)	
Flatness of gasket surface	Less than 0.05 mm (0.0020 in.)	0.1 mm (0.0039 in.)
Piston		
O.D.	86.47 - 86.5 mm (3.404 - 3.406 in.)	
Piston - to - cylinder clearance	0.02 - 0.04 mm (0.0008 - 0.0016 in.)	
Ring groove width		
No. 1	1.22 - 1.24 mm (0.048 - 0.049 in.)	
No. 2	1.51 - 1.53 mm (0.059 - 0.060 in.)	
Oil	2.81 - 2.83 mm (0.111 - 0.1114 in.)	
Service size	0.5 mm (0.020 in.) oversize	
Piston ring		
Side clearance		
No. 1	0.03 - 0.07 mm (0.0012 - 0.0028 in.)	
No. 2	0.02 - 0.06 mm (0.0008 - 0.0024 in.)	0.1 mm (0.0039 in.)
Oil ring	0.06 - 0.15 mm (0.0024 - 0.0059 in.)	
End gap		
No. 1	0.25 - 0.35 mm (0.0098 - 0.0138 in.)	0.8 mm (0.031 in.)
No. 2	0.40 - 0.55 mm (0.0157 - 0.0216 in.)	0.8 mm (0.031 in.)
Oil ring side rail	0.10 - 0.40 mm (0.0039 - 0.0157 in.)	1.0 mm (0.039 in.)

Description	Specification	Limit
Connecting rod		
Bend	0.05 mm (0.0020 in.)	
Twist	0. 1 mm (0.004 in.)	
Connecting rod big end to crankshaft side clearance	0.10 - 0.25 mm (0.0040 - 0.0098 in.)	0.4 mm (0.0157in.)
Piston pin installation force	1250 ± 500 kg (2756 ± 1100 lb.f)	
Connecting rod pin O.D	48 - 48.015 mm (1.890 - 1.8903 in.)	
Connecting rod bearing oil clearance	0.015 - 0.048 mm (0.0008 - 0.0020 in.)	0.1 mm (0.0039 in.)
Crankshaft main bearing oil clearance		
No. 1,2,4,5 journal	0.018 - 0.036 mm (0.0007 - 0.0014 in.)	0.1 mm (0.0039 in.)
No. 3 journal	0.024 - 0.042 mm (0.0009 - 0.0016 in.)	
Crankshaft		
Journal O.D.	56.982 - 57.000 mm (2.2434 - 2.2441 in.)	
Out - of - round of journal and pin	Less than 0.015 mm (0.0006 in.)	
Taper of journal and pin	Less than 0.005 (0.0002 in.)	
End play	0.05 - 0.25 mm (0.0020 - 0.0098 in.)	0.25 mm (0.0098 in.)
Flywheel		
Runout		0.13 mm (0.0051in.)
Oil pressure at idle	80 kPa	
[Oil temperature is 75-90°C (167-194°F)]	(11.6 psi)	
Oil pump		
Tip clearance		
Drive gear	0.16 - 0.21 mm (0.0063 - 0.0083 in.)	0.25 mm(0.0098in.)
Driven gear	0.18 - 0.21 mm (0.0071 - 0.0083 in.)	0.25 mm(0.0098in.)
Side clearance		
Drive gear	0.08 - 0.14 mm (0.0031 - 0.0055 in.)	0.25 mm (0.0098in.)
Driven gear	0.06 - 0.12 mm (0.0024 - 0.0047 in.)	0.25 mm (0.0098in.)
Relief spring		
Free length	46.6 mm (1.835 in.)	
Load [61 N (13.5 lb)]	40.1 mm (1.579in.)	
Right silent shaft		
Front journal diameter	18.467 - 18.480 mm (0.7270 - 0.7276 in.)	
Rear journal diameter	40.951 - 40.967mm (1.6516 - 1.6129in.)	
Oil clearance		
Front	0.020 - 0.061 mm (0.0008 - 0.0024 in.)	
Rear	0.050 - 0.091 mm (0.0020 - 0.0036 in.)	
Left silent shaft		
Front journal diameter	18.467 - 18.480mm (0.7270 - 0.7276in.)	
Rear journal diameter	40.951 - 40.967 mm (1.6122 - 1.6130 in.)	
Oil clearance		
Front	0.020 - 0.054 mm (0.0008 - 0.0021 in.)	
Rear	0.042 - 0.083 mm (0.0017 - 0.0033 in.)	
Cooling method	Forced circulation with electric fan	
Cooling system quantity	7.0 lit (7.4 U.S.qts., 6.1 Imp.qts.) [For DOHC]	
Thermostat		
Type	Wax pellet type with jiggle valve	
Normal opening temperature	82°C (180°F)	
Opening temperature range	80°C - 84°C (176°F - 183°F)	
Wide open temperature	95°C (203°F)	

Description	Specification	Limit
Radiator cap		
Main valve opening pressure	107.9±14.7 kPa (1.1±0.15 kg/cm² , 15.64±2.13 psi)	
Main valve closing pressure	83.4 kPa (0.85 kg/ cm², 12.1 psi)	
Vacuum valve opening pressure	-6.86 kPa (-0.07 kg/ cm², -1.00 psi)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	
Coolant temperature sensor		
Type	Thermister type	
Resistance		
20°C (68°F)	2.45±0.14 kΩ	
80°C (176°F)	0.3222 kΩ	

SERVICE STANDARDS

Standard value	
Coolant concentration	
Tropical area	40%
Other area	50%

LUBRICANT

Engine coolant	Ethylene glycol base for aluminum radiator

SEALANT

Engine coolant temperature sensor	LOCTITE 262, three bond No. 1324 or equivalent
Oil pressure switch	3M ATD No. 8660 or Three bond No. 1141E

NOTE

O.D.= Outer Diameter

I.D.= Inner Diameter

O.S.= Oversize Diameter

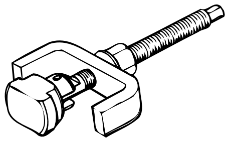
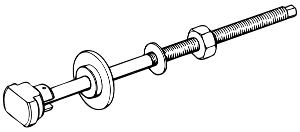
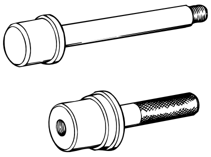
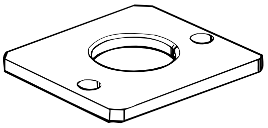
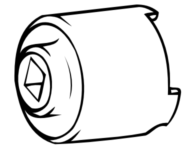
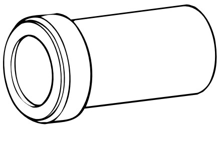
U.S. = Undersize Diameter

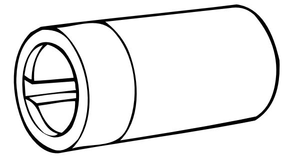
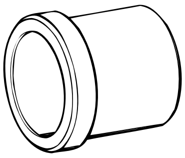
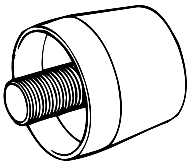
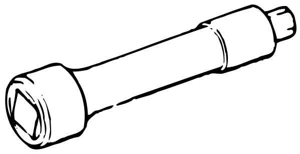
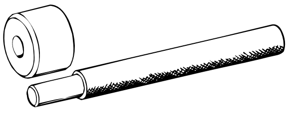
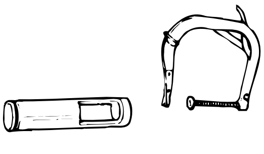
TIGHTENING TORQUE ECHA0200

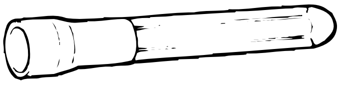
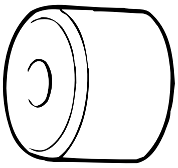
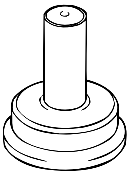
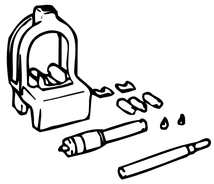
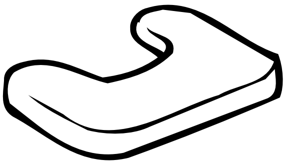
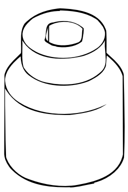
Item	Nm	kg·cm	Lb·ft
Engine mount insulator bolt	90 - 110	900 - 1100	65 - 80
Engine mounting bracket nuts	60 - 80	600 - 800	43 - 58
Engine mounting bracket bolts	60 - 80	600 - 800	43 - 58
Engine Support bracket bolt and nut	55 - 65	550 - 650	40 - 47
Front roll stopper bracket to cross member bolts	40 - 55	400 - 550	29 - 40
Front roll stopper insulator bolt and nut	50 - 65	500 - 650	36 - 47
Rear roll stopper bracket to cross member bolts	50 - 65	500 - 650	36 - 47
Rear roll stopper insulator bolt and nut	50 - 65	500 - 650	36 - 47
Transaxle mounting bracket bolts	60 - 80	600 - 800	43 - 58
Transaxle mounting insulator bolt	90 - 110	900 - 1100	65 - 80
Air conditioner compressor to bracket	23 - 27	230 - 270	17 - 20
Power steering oil pump to bracket	35 - 45	350 - 450	25 - 33
Front exhaust pipe to exhaust manifold	30 - 40	300 - 400	22 - 29
Rocker cover bolt	8 - 10	80 - 100	6 - 7
Center cover bolt	4 - 5	40 - 50	3 - 3.6
Camshaft sprocket bolt	80 - 100	800 - 1000	58 - 72
Camshaft bearing cap bolt	19 - 21	190 - 210	14 - 15
Crankshaft position sensor	10 - 13	100 - 130	7 - 9
Throttle body stay	15 - 22	150 - 220	11 - 16
Air cleaner body installation bolt	8 - 10	80 - 100	6 - 7
Crankshaft sprocket bolt	110 - 130	1100 - 1300	80 - 94
Damper pulley to crankshaft sprocket	20 - 30	200 - 300	14 - 22
Cylinder head bolt (cold engine)			
With new parts	63+Release all bolts +20+90°+90°	630+Release all bolts + 200 + 90° + 90°	46 + Release all bolts + 14 + 90° + 90°
Without new parts.	20 + 90° + 90°	200 + 90° + 90°	14 + 90° + 90°
Intake manifold stay	18 - 25	180 - 250	13 - 18
Tension pulley bracket bolt	23 - 27	230 - 270	17 - 20
Auto tensioner bolt	20 - 27	200 - 270	14 - 20
Tensioner pulley bolt	43 - 55	430 - 550	31 - 40
Idler pulley bolt	30 - 42	300 - 420	22 - 30
Front exhaust pipe clamp bolt	20 - 30	200 - 300	14 - 22
Oil pan (lower and upper)	10 - 12	100 - 120	7 - 9
Oil pan drain plug	35 - 45	350 - 450	25 - 33
Oil screen	15 - 22	150 - 220	11 - 16
Oil pump sprocket nut	50 - 60	500 - 600	36 - 43
Oil pressure switch	8 - 12	80 - 120	6 - 9
Oil filter bracket bolt	20 - 27	200 - 270	14 - 20
Oil pump cover bolt	15 - 18	150 - 180	11 - 13
Oil seal case bolt	10 - 12	100 - 120	7 - 9
Plug cap	20 - 27	200 - 270	14 - 20
Front case bolt (M6)	20 - 27	200 - 270	14 - 20
Driven gear bolt	34 - 40	340 - 400	25 - 29

Item	Nm	kg·cm	Lb·ft
Engine coolant pump pulley bolt	8 - 10	80 - 100	6 - 7
Timing belt upper cover	8 - 10	80 - 100	6-7
Timing belt lower cover	8 - 10	80 - 100	6 - 7
Relief plug	40 - 50	400 - 500	29 - 36
Flywheel	130 - 140	1300 - 1400	94 - 101
Drive plate	130 - 140	1300 - 1400	94 - 101
Timing belt rear right cover	10 - 12	100 - 120	7 - 9
Timing belt rear left cover (upper)	10 - 12	100 - 120	7 - 9
Connecting rod cap bolt	20 + 90°	200 + 90°	14 + 90°
Crankshaft bearing cap bolt	25 + 90°	250 + 90°	18 + 90°
Engine hanger			
M8	25 - 30	250 - 300	18 - 22
M10	35 - 55	350 - 550	25 - 40
Alternator support bolt	20 - 25	200 - 250	14 - 18
Alternator brace bolt			
M8x90	8 - 12	80 - 120	6 - 9
M8x40	20 - 25	200 - 250	14 - 18
Engine coolant pump to cylinder block bolt	20 - 27	200 - 270	14 - 20
Engine coolant temperature sensor	20 - 40	200 - 400	14 - 29
Engine coolant inlet fiting attaching bolt	10 - 15	100 - 150	7 - 11
Air cleaner mounting bolts	8 - 10	80 - 100	6 - 7
Resonator mounting bolt (Nut)	8 - 10	80 - 100	6 - 7
Throttle body to intake manifold	15 - 22	150 - 220	11 - 16
Intake manifold mounting bolt (M8)	15 - 20	150 - 200	11 - 14
Intake manifold mounting nut	30 - 42	300 - 420	22 - 30
Tension rod bracket bolt to tension rod	35 - 55	350 - 550	25 - 40
Ignition coil bolts	8 - 12	80 - 120	6 - 9
Power transistor bolts	10 - 12	100-120	7 - 9
Front exhaust manifold bolt to cylinder block	20 - 30	200 - 300	14 - 22
Center exhaust pipe nuts to catalytic converter	30 - 40	300 - 400	22 - 29
Center exhaust pipe bolts to main muffler	30 - 40	300 - 400	22 - 29
Center exhaust pipe bolt to bracket	10 - 15	100 - 150	7 - 11
Hanger bolt to body	10 - 15	100 - 150	7 - 11
Hanger bolt to main muffler	10 - 15	100 - 150	7 - 11
Exhaust manifold nuts (8)	25 - 30	250 - 300	18 - 22
Exhaust manifold nuts (10)	35 - 55	350 - 550	25 - 40
Oxygen sensor	40 - 50	400 - 500	29 - 36
Heat protector bolt to exhaust manifold	12 - 15	120 - 150	9 - 11
Air cleaner bracket bolt	10 - 13	100 - 130	7 - 9
Exhaust manifold cover to exhaust manifold bolt	12 - 15	120 - 150	9 - 11
Oxygen sensor to exhaust manifold	40 - 50	400 - 500	29 - 36
Front exhaust pipe bracket bolt	20 - 30	200 - 300	14 - 22
Main muffler hanger support bracket bolt	10 - 20	100 - 200	7 - 14
Oil level gauge	12 - 15	120 - 150	9 - 11
Stud bolt	30 - 40	300 - 400	22 - 29
Tensioner arm assembly	17 - 26	170 - 260	12 - 19
Balance shaft bolt	34 - 40	340 - 400	25 - 29
Starter bolt to cylinder block	27 - 35	270 - 350	20-25
Radiator fan motor bolt	8 - 10	80 - 100	6 - 7
Delivery pipe to cylinder block	10 - 13	100 -130	7 - 9

SPECIAL TOOLS ECAC0300

Tool (Number and name)	Illustration	Use
Counter balance shaft bearing puller (09212-32000)	 ECA9930K	Removal of counter balance shaft front bearing
Counter balance shaft bearing puller (09212-32100)	 ECA9930L	Removal of counter balance shaft rear bearing (use with 09212-32300)
Counter balance shaft bearing installer (09212-32200)	 ECA9930M	Installation of counter balance shaft front and rear bearing (use with 09212-32300)
Guide plate (09212-32300)	 ECA9930N	Removal and installation of counter balance shaft rear bearing (use with 09212-32100, 09212-32200)
Plug cap wrench (09213-33000)	 ECA9930O	Removal and installation of front case cap plug
Crankshaft front oil seal installer (09214-32000)	 ECA9930A	Installation of the crankshaft front oil seal (use with 09214-32100)

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal guide (09214-32100)	 ECA9930B	Installation of the crankshaft front oil seal (use with 09214-32000)
Camshaft oil seal installer (09221-21000)	 ECA9930C	Installation of the camshaft oil seal (use with 09221-21100)
Camshaft oil seal guide (09221-21100)	 E2121100	1. Used as a guide when pressing in the camshaft oil seal (use with 09221-21000)
Cylinder head bolt socket (09221-32001)	 ECHA001E	Removal and installation of cylinder head bolts
Valve guide installer (09222-21200A, 09222-21200B)	 ECA9930G	Removal and installation of valve guides
Valve spring compressor (09222-28000) Valve spring compressor holder (09222-28100)	 ECA9930E	Removal and installation of inlet and exhaust valves

Tool (Number and name)	Illustration	Use
Valve stem oil seal install (09222-28200)	 ECHA001G	Installation of valve stem oil seals
Valve guide installer adapter (09222-28400)	 ECHA001I	Installation of valve guides
Crankshaft rear oil seal installer (09231-21000)	 ECA9930H	1. Installation of the engine rear oil seal 2. Installation of the crankshaft real oil seal
Piston pin remover and installer kit (09234-33001)	 HFR20A10	Removal and installation of piston pins
Insert (09234-33002)	 ECA9930J	Removal and installation of piston pins (use with 09234-33001)
Cross member stud bolt socket (09624-38100)	 ECAC100B	Removal and installation of the cross member stud bolt

TROUBLESHOOTING ECHA0400

Symptom	Probable cause	Remedy
Low compression	Damaged cylinder head gasket	Replace gasket
	Worn or damaged piston rings	Replace rings
	Worn piston or cylinder	Repair or replace piston and/or cylinder block
	Worn or damaged valve seat	Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level	Check engine oil level
	Faulty oil pressure switch	Replace
	Clogged oil filter	Replace
	Worn oil pump gears or cover	Replace
	Thin or diluted engine oil	Change and find out cause
	Oil relief valve stuck (open)	Repair
	Excessive bearing clearance	Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine vibration	Loose engine roll stopper (front, rear)	Re-tighten
	Loose transaxle mount bracket	Re-tighten
	Loose engine mount bracket	Re-tighten
	Loose center member	Re-tighten
	Broken transaxle mount insulator	Replace
	Broken engine mount insulator	Replace
	Broken engine roll stopper insulator	Replace
Noisy valves	Thin or diluted engine oil (low oil pressure)	Change
	Worn or damaged valve stem or valve guide	Replace
Connecting rod and/main beaing noise	Insufficient oil supply	Check engine oil level
	Thin or diluted engine oil	Change and find out cause
	Excessive bearing clearance	Replace
Timing belt noise	Incorrect belt tension (alternator tensioner, timing belt)	Adjust belt tension
Low coolant level	Leakage of coolant	
	Damaged radiator core joint	Replace
	Corroded or cracked hoses (radiator hose, heater hose, etc)	Replace
	Faulty radiator cap valve or setting of spring	Replace
	Faulty thermostat	Replace
	Faulty engine coolant pump	Replace
Clogged radiator	Foreign material in coolant	Replace

Symptom	Probable cause	Remedy
Abnormally high coolant temperature	Faulty thermostat	Replace
	Faulty radiator cap	Replace
	Restricted of flow in cooling system	Replace
	Loose or missing drive belt	Adjust or replace
	Faulty engine coolant pump	Replace
	Faulty temperature sensor wiring	Repair or replace
	Faulty electric fan	Repair or replace
	Faulty thermo-sensor on radiator	Replace
	Insufficient coolant	Refill coolant
Abnormally low coolant temperature	Faulty thermostat	Replace
	Faulty temperature sensor wiring	Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection	Retighten
	Blocked or collapsed hose and pipe	Replace
Inoperative electrical cooling fan	Damaged, fuse	Replace or repair
Exhaust gas leakage	Loose connections	Retighten
	Broken pipe or muffler	Repair or replace
Abnormal noise	Detached baffle plate in muffler	Replace
	Broken rubber hanger	Replace
	Pipe or muffler contacting vehicle body	Correct
	Broken pipe or muffler	Repair or replace

CHECKING ENGINE OIL ECJA0500

1. Position a vehicle on a level surface.

2. Turn off the engine.

   NOTE

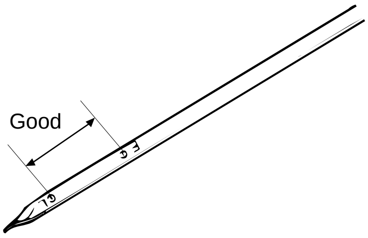
   If a vehicle that has not been used for a prolonged period, run the engine for several minutes.
   Turn off the engine and wait for 5 minutes at least, and then check the oil level.

3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the “L” mark), refill to the "F" mark.

   NOTE

   When refilling, use the proper grade of engine oil.

4. Check that the oil is not dirty or mixed with coolant or gasoline and it has the proper viscosity.

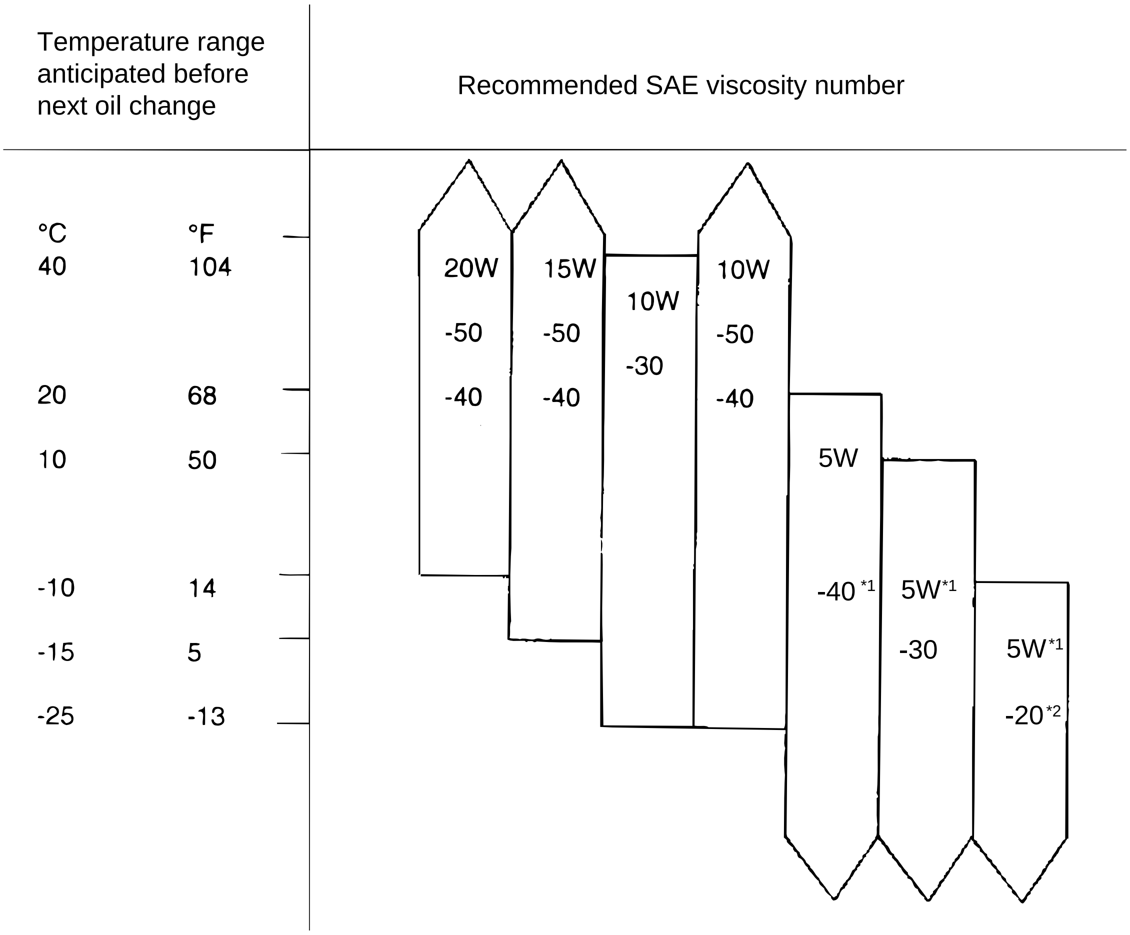


EDA9000A

SELECTION OF ENGINE OIL ECKB0100

Recommended API classification: SD OR ABOVE SE OR ABOVE [For EC.]

Recommended SAE viscosity grades:



***1 Restricted by driving condition and environment.**
***2 Not recommended for sustained high speed vehicle operation**

EDA9990B

NOTE

For best performance and maximum protection of all types of operation, select only those lubricants which:

1. *Satisfy the requirements of the API classification.*
2. *Have proper SAE grade number for expected ambient temperature range.*

Lubricantsv that do not have both an SAE grade number and an API service classification on the container should not be used.

CHANGING ENGINE OIL ECJA0700

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and the drain plug. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

Tightening torque

Oil pan drain plug :

35-45 Nm (350-450 kg.cm, 25-33 lb.ft)

NOTE

Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

Capacity

Drain and refill : 4.3 lit (4.53 U.S.qts., 3.78 Imp.qts.)

NOTE

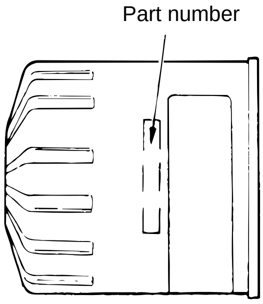
Do not overfill. This will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

REPLACING THE OIL FILTER ECJA0800

All Hyundai Motor Company engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter for all vehicles. The quality of aftermarket replacement filters is considerably diverse.

High quality replacement filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing a new filter.



ECA9970A

PROCEDURE FOR REPLACING THE OIL FILTER

1. Use a filter wrench to remove the oil filter.
2. Before installing a new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter to the specified torque.

Oil filter : 12-16 Nm (120-160 kg.cm, 9-12 lb.ft)

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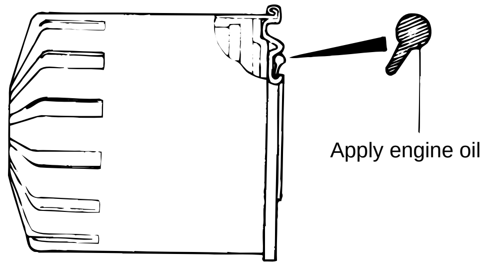
4. Start and run the engine and check for engine oil leak.
5. After turning off the engine, check the oil level and add oil as necessary.



ECA9970B

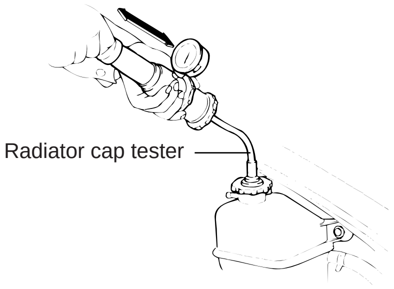
CHECKING COOLANT LEAK ECUC0200

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 KPa (21psi, 1.53 kg/cm²) pressure. Hold it for two minutes in that condition while checking for leakage from the radiator, hoses or connections.

NOTE

1. *Radiator coolant may be extremely hot. Do not open the system because hot, or scalding water could gush out causing personal injury. Allow the vehicle to cool before servicing this system.*
2. *When the tester is removed, be careful not to spill any coolant from it.*
3. *Be sure to clean away completely any from the area.*
4. *Be careful when installing and removing the tester and when testing, not to deform the filler neck of the radiator.*

4. If there is leakage, repair or replace with the appropriate part.



ECUC020A

RADIATOR CAP PRESSURE TEST

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the gauge stops moving.

Main valve opening pressure :

107.9kPa±14.7kPa (1.1±0.15 kg/cm², 15.64±2.13)

Main valve closing pressure :

83.4 kPa (0.85 kg/cm², 12.1 psi)

3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

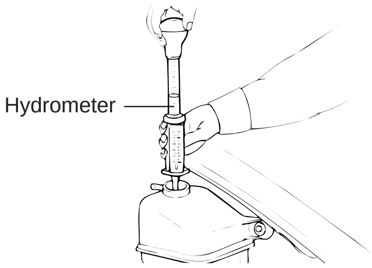
NOTE

Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.

ECA9090A

SPECIFIC GRAVITY TEST ECUC0300

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature, using the following table for reference.



ECUC030A

RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY

Coolant temperature °C (°F) and specific gravity					**Freezing temperature °C (°F)**	**Safe operating temperature °C (°F)**	**Coolant concentration (Specific volume)**
10 (50)	**20 (68)**	**30 (86)**	**40 (104)**	**50 (122)**			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15 (5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

Example

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

CAUTION

- ***If the concentration of the coolant is below 30%, its anti-corrosion properties will be adversely affected.***
- ***if the concentration is above 60%, both the anti-freeze and engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.***
- ***Do not mix types of anti-freeze.***

RECOMMENDED COOLANT

Antifreeze	Mixture ratio of anti freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

CHECKING COMPRESSION PRESSURE ECJA1100

1. Before checking engine compression, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.

2. Start the engine and wait until the engine coolant temperature reaches 80-95°C (176-205°F).

3. Turn off the engine and disconnect the spark plug cables.

4. Remove the spark plugs.

5. Crank the engine to remove any foreign material in the cylinders.

6. Insert the compression gauge into the spark plug hole.

7. Depress the accelerator pedal to open the throttle fully.

8. Crank the engine and read the gauge.

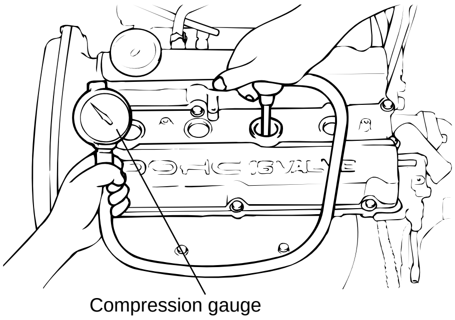
Standard value : 1200kpa (12.2Kg/cm², 170 psi)
Limit : 12.0 kg/cm² (1.18 MPa, 171 psi)

9. Repeat steps 6 to 8 for all cylinders, ensuring that the pressure difference for each of the cylinders is within the specified limit.

Limit : Max. 100 kpa (1.0 kg/cm² ,14 psi) between cylinders

10. If a cylinder's compression or pressure differential is outside the specification, add a small amount of oil through the spark plug hole, and repeat steps 6 to 9.
    1) If the addition of oil causes the compression to rise, it is likely that there may be wear between the piston ring and cylinder wall.
    2) If compression remains the same, valve seizure, poor valve seating or a compression leak from the cylinder head gasket are all possible causes.

Tightening torque
Spark plug : 20-30 Nm (200-300 kg.cm, 14-22 lb.ft)

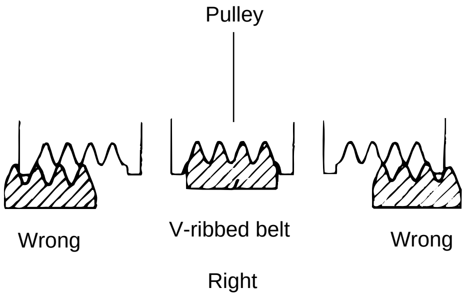


ECA9001A

ADJUSTING DRIVE BELT TENSION ECJA1200

1. Check that the belts are not damaged and are properly placed for the pulley grooves.

2. Apply 100 N (22 lbs.) force to the back and midway portion of the belt between the pulleys as shown in the illustration and measure the amount of deflection with a tension gauge.



ECA9980A

CAUTION

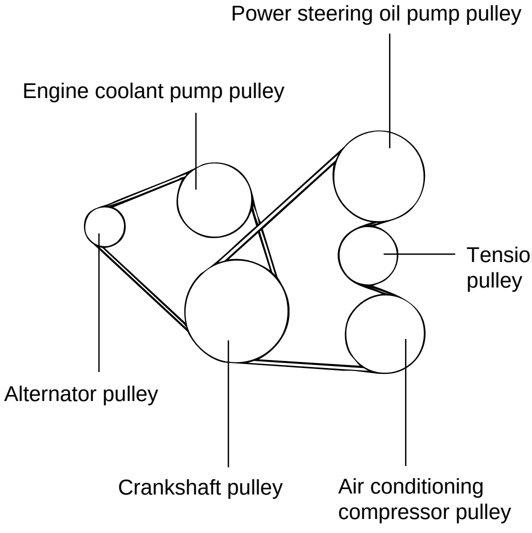
1. ***When installing the V-ribbed belt, check that the V-ribs are properly aligned.***
2. ***If noise or slippage is detected, check the belt for wear, damage, or breakage on the pulley contact surface, and check the pulley for scoring. Also check the amount that the belt is deflected.***

STANDARD VALUE:

Items		Inspection	Adjustment	
			New	Used
For alternator	Deflection mm (in.)	9.0-10.4 (0.35-0.41)	7.5-9.0 (0.30-0.35)	10 (0.40)
	Tension N (lb)	350-500 (79-112)	600-700 (135-157)	400 (90)
For air conditioner	Deflection mm (in.)	8 (0.31)	5.0-5.5 (0.20-0.22)	6.0-7.0 (0.24-0.28)
	Tension N (lb)	250-500 (56-112)	470-570 (106-128)	320-400 (72-90)
For power steering	Deflection mm (in.)	6.0-9.0 (0.24-0.35)	-	-

NOTE

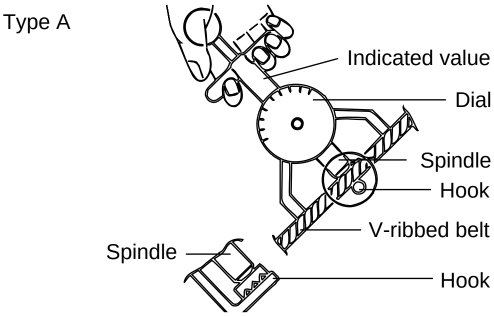
1. *The belt tension must be measured half-way between the specified pulleys.*
2. *When a new belt is installed, adjust the tension to the central value of the standard range indicated under "New" in the above table. Let the engine idle for 5 minutes or more, and check the standard value indicated under "Inspection."*
3. *When adjusting a belt which has been used, or a belt installed newly after 5 minutes or more of operation, refer to the standard value indicated under "Used" in the above table.*
4. *Refer to the standard value indicated under "Inspection" for periodic inspections.*



ECA9002A

TYPE A TENSION GAUGE

Do not let the dial section of the tension gauge contact other objects during measurement.

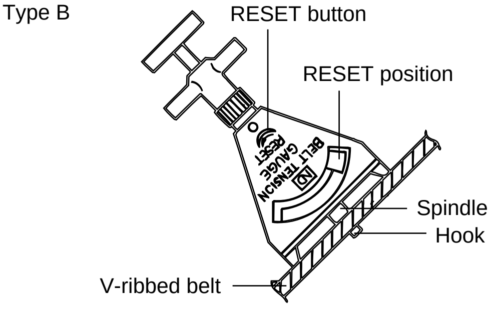


ECA9980C

TYPE B TENSION GAUGE

1. When measuring, turn the reset button in the direction of the arrow and set the gauge needle to the RESET position.

2. If the tension gauge is removed from the belt, the needle will still indicate the tension.Read the tension value after removing the gauge.



ECA9980D

ADJUSTING THE ALTERNATOR BELT

CAUTION

If the belt is too loose, it will cause noise or sudden wear.
If the belt is too tight, the engine coolant pump bearing or the alternator can be damaged.

1. Loosen the alternator nut "A" and the tension adjuster lock bolt "B".
2. Using the tension adjuster bolt, adjust the belt tension to the specification.
3. Tighten the adjuster lock bolt "B".
4. Tighten the alternator nut "A".
5. Check the tension or the deflection of belt, and readjust if necessary.

Tightening torque

Alternator nut A :

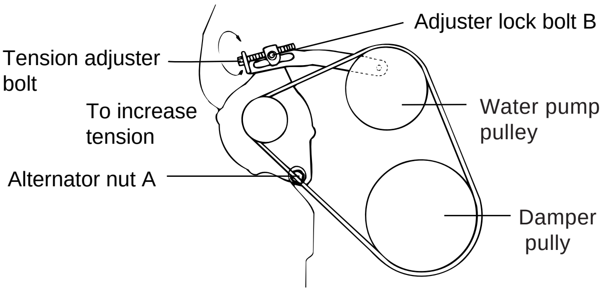
35 - 55 Nm (350 - 550 kg.cm, 25 - 40 lb.ft)

Adjuster lock bolt B :

20 - 25 Nm (200 - 250 kg.cm, 14 - 18 lb.ft)

Tension adjuster bolt :

8 - 12 Nm (80 - 120 kg.cm, 6 - 9 lb.ft)



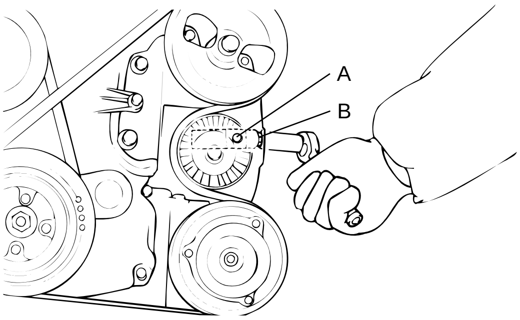
ECA9003A

ADJUSTING POWER STEERING AND AIR CONDITIONER BELTS

1. Loosen the tension pulley adjustment bolt A.
2. Adjust the belt deflection with adjustment bolt B.
3. Tighten bolt A.
4. Recheck the belt deflection and readjust, if necessary.

NOTE

Before rechecking, crank the engine one more revoltion.

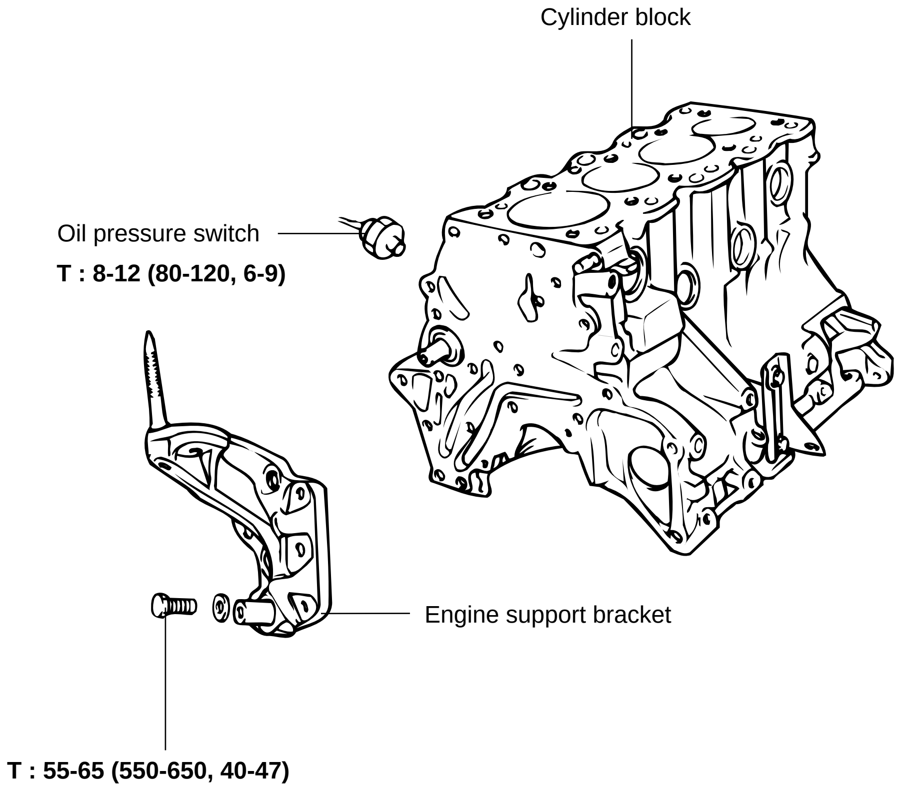


ECA9004A

ENGINE BLOCK

ENGINE BLOCK

COMPONENTS ECHA1500



TORQUE : Nm (kg·cm, lb·ft)

ECHA150A

DISASSEMBLY ECHA1600

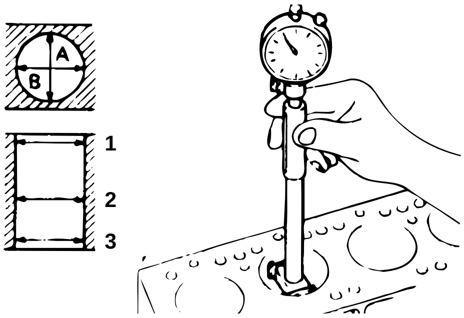
Remove the cylinder head, timing belt, front case, flywheel, pistons and crankshaft.

For further details, refer to the appropriate section.

INSPECTION ECAC1750

1. Check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects. Replace the block if defective.

2. Measure the cylinder bore with a cylinder gauge at the three levels indicated and in the directions of A and B.
   Level 1: No. 1 piston ring position at TDC
   Level 2 : Center of cylinder
   Level 3 : Bottom of cylinder



ECA9450A

3. If the cylinder bores show more than specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. New oversize piston and rings should be installed.

Standard value

Cylinder bore :

86.5+0.03 mm (3.41+0.0012 in)

Out - of - round and taper of cylinder bore :

Max. 0.01mm (0.0004 in)

---

4. If a ridge exists at the top of the cylinder, cut it away with a ridge reamer.

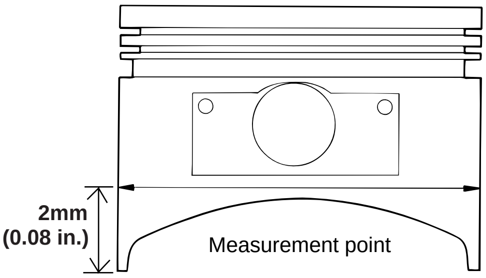
PISTON SERVICE SIZE AND MARK MM (IN.)

Identification Mark : 0.50
Size : 0.50 (0.020) O.S.

5. To rebore the cylinder bore to oversize, maintain the specified clearance between the oversize piston and the bore, and make sure that all pistons used are of the same oversize. The standard measurement of the piston outside diameter is taken at a level 2 mm (0.08 in.) above the bottom of the piston skirt and across the thrust faces.

Piston-to-cylinder clearance :

0.02 - 0.04 mm (0.0008 - 0.0016 in)



ECA9451A

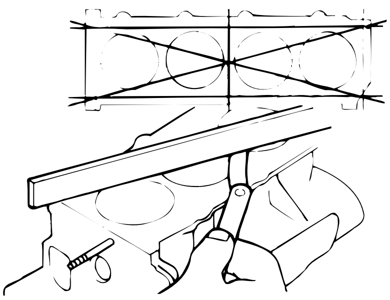
6. Check for damage and cracks.

7. Check the top surface of the cylinder block for flatness. If the top surface exceeds limits, surface to minimum limit or replace.

Standard value
Flatness of cylinder block : Max. 0.05mm(0.0020 in.)
Service limit
Flatness of cylinder block : 0.1mm(0.0039 in.)

NOTE

When the cylinder head is assembled, grinding less than 0.2 mm (0.008 in.) is permissible.



ECA9450B

BORING CYLINDER

1. Oversize pistons should be selected on the basis of the largest cylinder bore.

Identification Mark : 0.50
Size : 0.50 mm (0.020 in) O.S.

NOTE

The size of a piston is stamped on top of the piston.

2. Measure the outside diameter of the piston to be used.
3. On the basis of the measured O.D., calculate the new bore size.
   New bore size = Piston O.D + 0.02 to 0.04 mm (0.0008 to 0.0016 in.) (clearance between piston and cylinder) - 0.02 mm (0.0008 in.) (honing margin.)
4. Bore each of cylinders to the calculated size.

NOTE

To prevent distortion that may result from temperature rise during honing, bore the cylinders, holes in the firing order sequence.

5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Verify the clearance between the piston and cylinder.

NOTE

When boring cylinders, finish all four cylinders to the same oversize. Do not bore only one cylinder to the oversize.

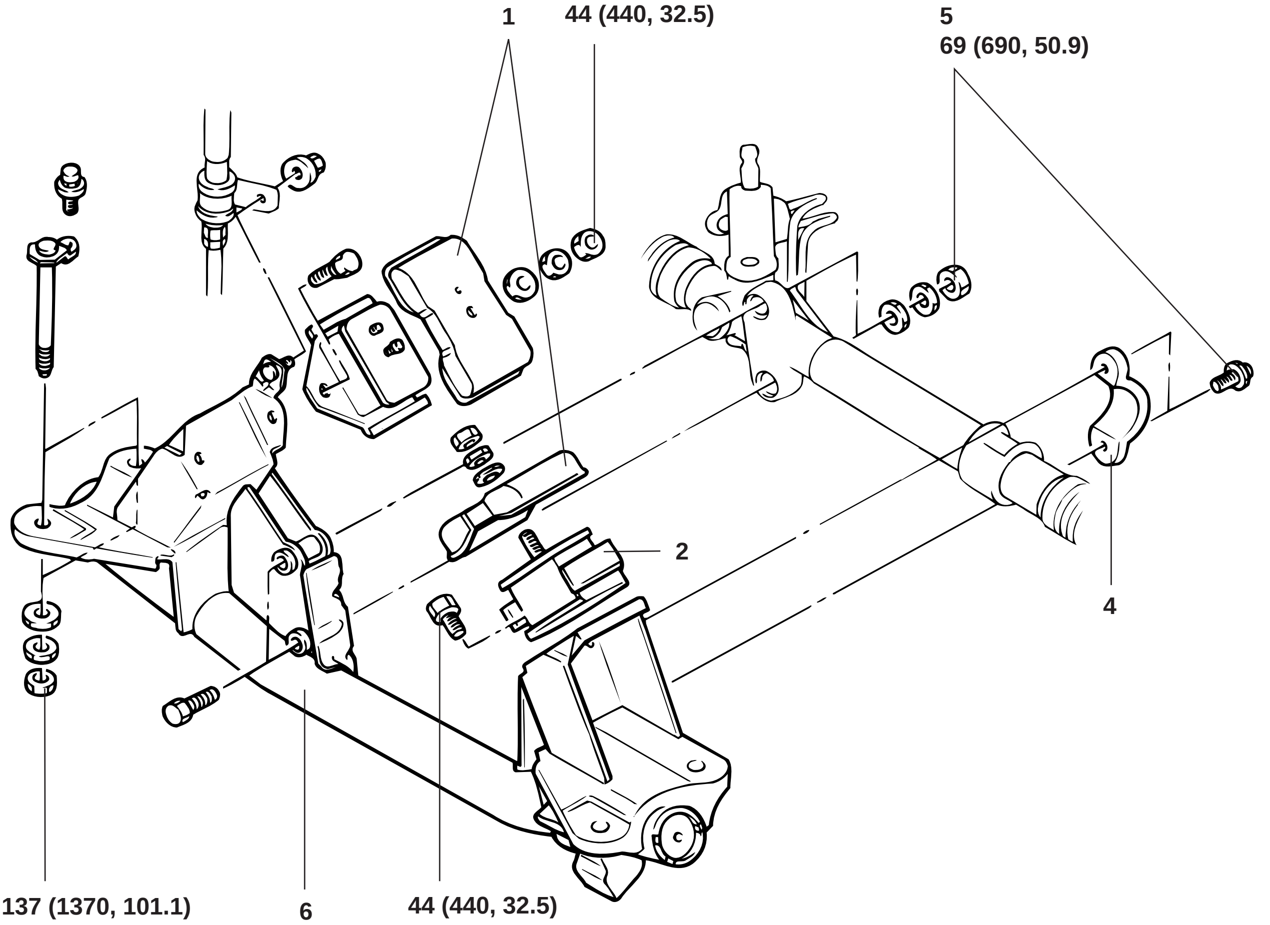
REASSEMBLY ECHA1800

Install the following parts by referring to their respective paragraphs.

1. Crankshaft
2. Flywheel
3. Piston
4. Cylinder head
5. Timing belt train
6. Front case

ENGINE MOUNTS

COMPONENTS ECUC0400



1. Insulator cover
2. Engine support front insulator
3. Power steering pressure hose installation nut
4. Clamp
5. Power steering gear and linkage installation nut
6. Engine support crossmember assembly

CAUTION : SRS
For vehicles with SRS, before removal of steering gear box, refer to GROUP RT, center front wheels and remove ignition key.
Failure to do so may damage SRS clock spring and render SRS system inoperative, risking serious driver injury.

TORQUE : Nm (kg·cm, lb.ft)

ECUC040A

REMOVAL ECUC0420

Place pieces of wood on jacks' contack surface, support the front engine mounting insulator, front engine supprot insulator assembly and engine oil pan, and then remove the insulator.

⚠ *CAUTION*

When supporting with the jacks, be careful not to damage each hose and cable.

INSPECTION ECUC0440

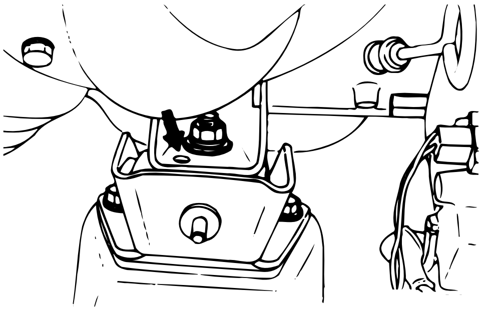
1. Check the insulator for deformation and cracks.
2. Check the insulator stopper plate for deformation and cranks.

INSPECTION ECUC0460

Align the protrusion of front engine support insulator assembly and the bore of front engine mounting insulator so as to install them together.

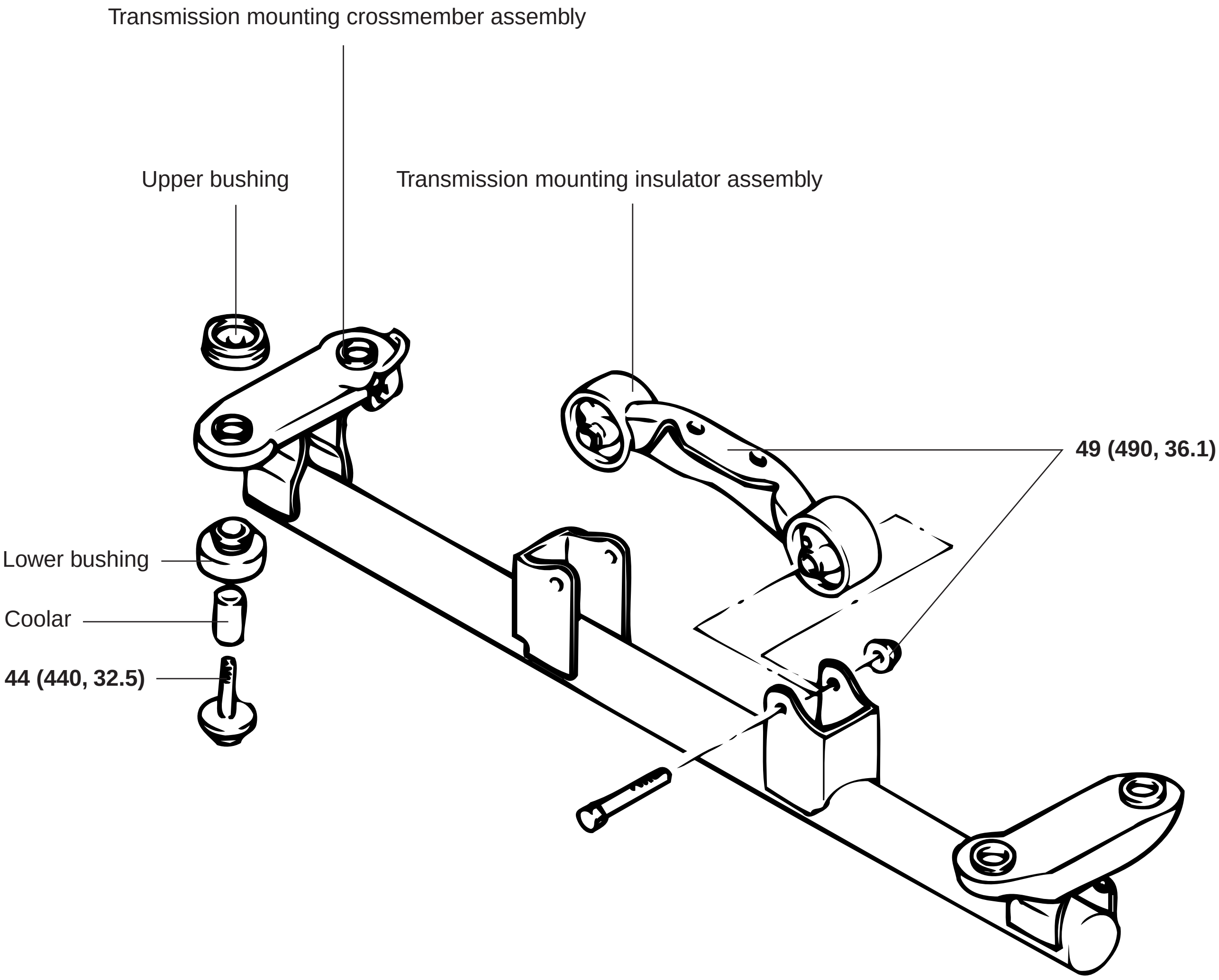
⚠ *CAUTION*

Do not allow fluid to remain on the insulator part.



ECLA007F

COMPONENTS ECUC0500



TORQUE : Nm (kg·cm, lb.ft)

ECUC050A

REMOVAL ECUC0520

Support the transmission with a jack and remove the rear engine insulator.

⚠ ***CAUTION***

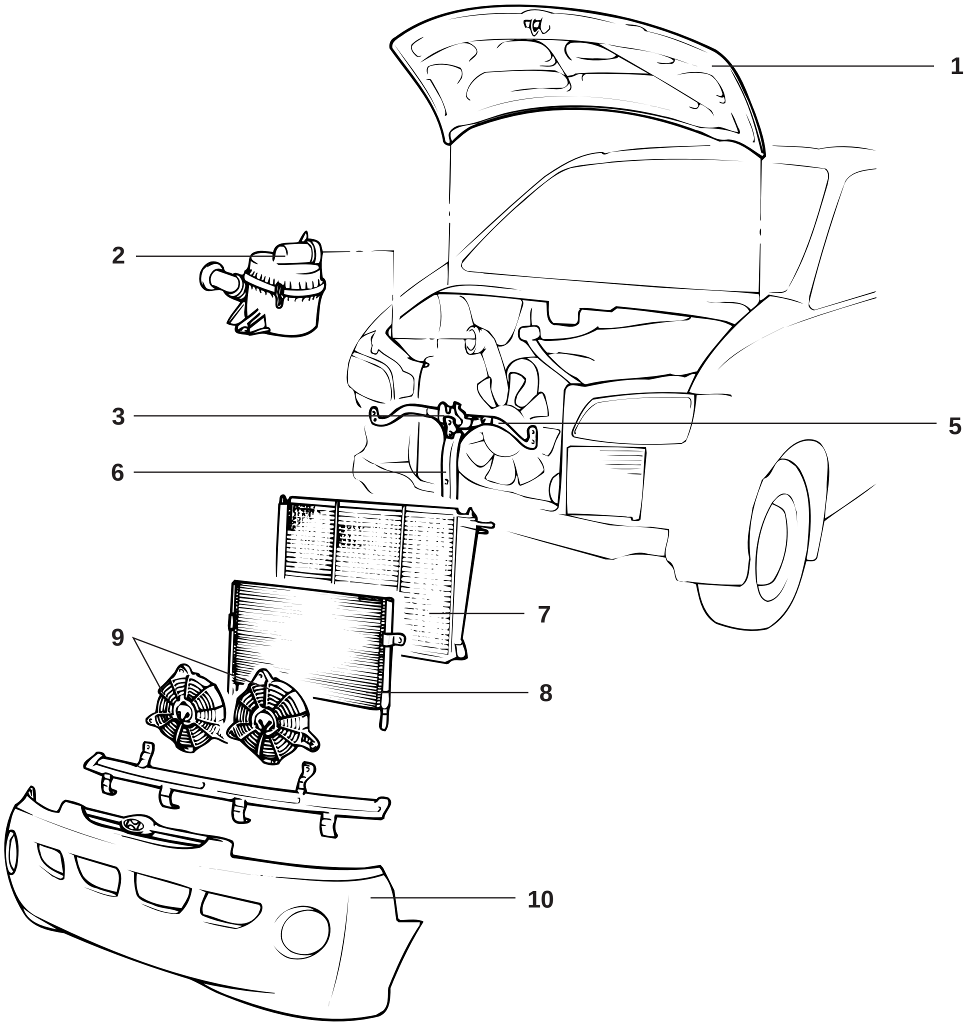
When supporting with a jack, be careful not to damage each hose and cable.

REMOVAL ECUC0540

Check the insulator for deformation and cranks.

ENGINE AND TRANSAXLE ASSEMBLY

COMPONENTS ECUC0600



1. Hood assembly
2. Air cleaner
3. Hood latch
4. Turn signal
5. Radiator support upper member
6. Radiator support center member
7. Radiator
8. A/Con condenser
9. Condenser fan LH,RH
10. Front bumper

ECUC060A

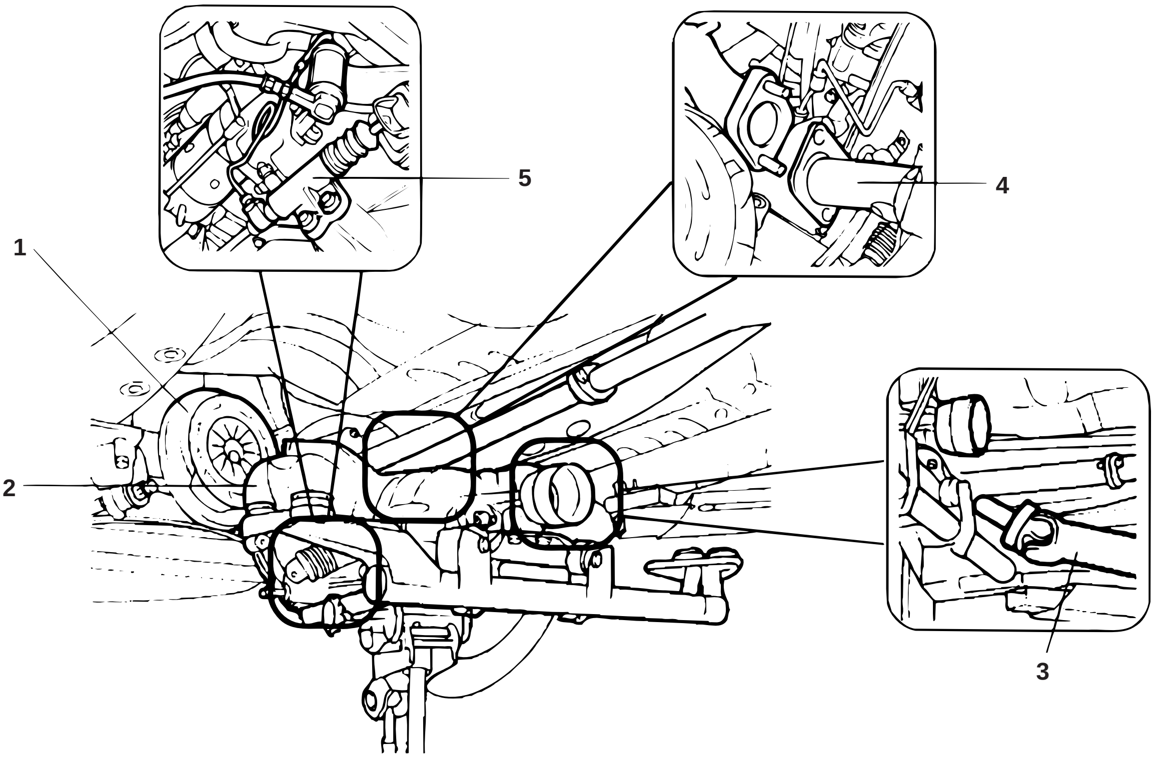
REMOVAL ECUC0700

1. Remove the battery (-) cable.
2. Remove the hood assembly.
3. Drain the engine coolant.
4. With the manifold gauge drain and recover the A/Con refrigerant (R134a).
5. Remove the air cleaner assembly.
6. Remove the turn-signal lamp (LH and RH).
7. Remove the front bumper assembly.
8. Remove the A/Con's front condenser fan (LH and RH).
9. Remove hood latch assembly.
10. Remove the radiator support center and upper members.
11. Remove the A/Con condenser assembly.
12. Remove the radiator fan shroud.
13. Disconnect the radiator upper, lower hoses and wiring on the engine side, then remove the radiator assembly.

    NOTE

    In case of A/T vehicle, disconnect the hiose of A.T.F cooler and insert cap in the hose for oil leakage.

14. Remove the wiper motor assembly.
15. Remove the battery and tray.
16. After removing the A/Con compressor or P/S pump then place stopper between rocker cover and dash panel for leaning (A/T : not necessary).



1. Engine assembly
2. Transmission assembly
3. Propellen shaft
4. Muffler
5. Clutch release cylinder

ECUC060B

17. Remove the propeller shaft.

18. Detach the clutch release cylinder assembly.

19. Detach the T.G.S cable speed meter cable, back up switch wiring connector and T/M earth wiring.

NOTE

In case of A/T vehicle, separate the A.T.F cooler pipe and hose, the remove the tube of A.T.F lever gauge.

20. Remove the bell housing cover.

NOTE

In case of A/T vehicle, detach the MT'G bolt of driver plate and torque converter.

21. Support the T/M assemblyhorizontally and safely, then remove the T/M support member and lower the T/M assembly.

22. Remove the exhaust front pipe, then remove the MT'G reat bolt of engine's LH/RH inslator.

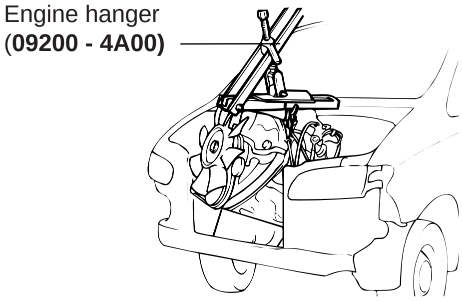
<Lowering the Lift>

23. Install the engine hanger (09200-4A000) for removing the engine.

24. Remove the MT'G FRT bolt of engine LH/RH insulator then remove the engine LH insulator after raising the engine a little up.

25. Raising up the engine slowly, remove the engine. Be careful not to touch the COEL TOP panel or head lamp support reinforce panel.

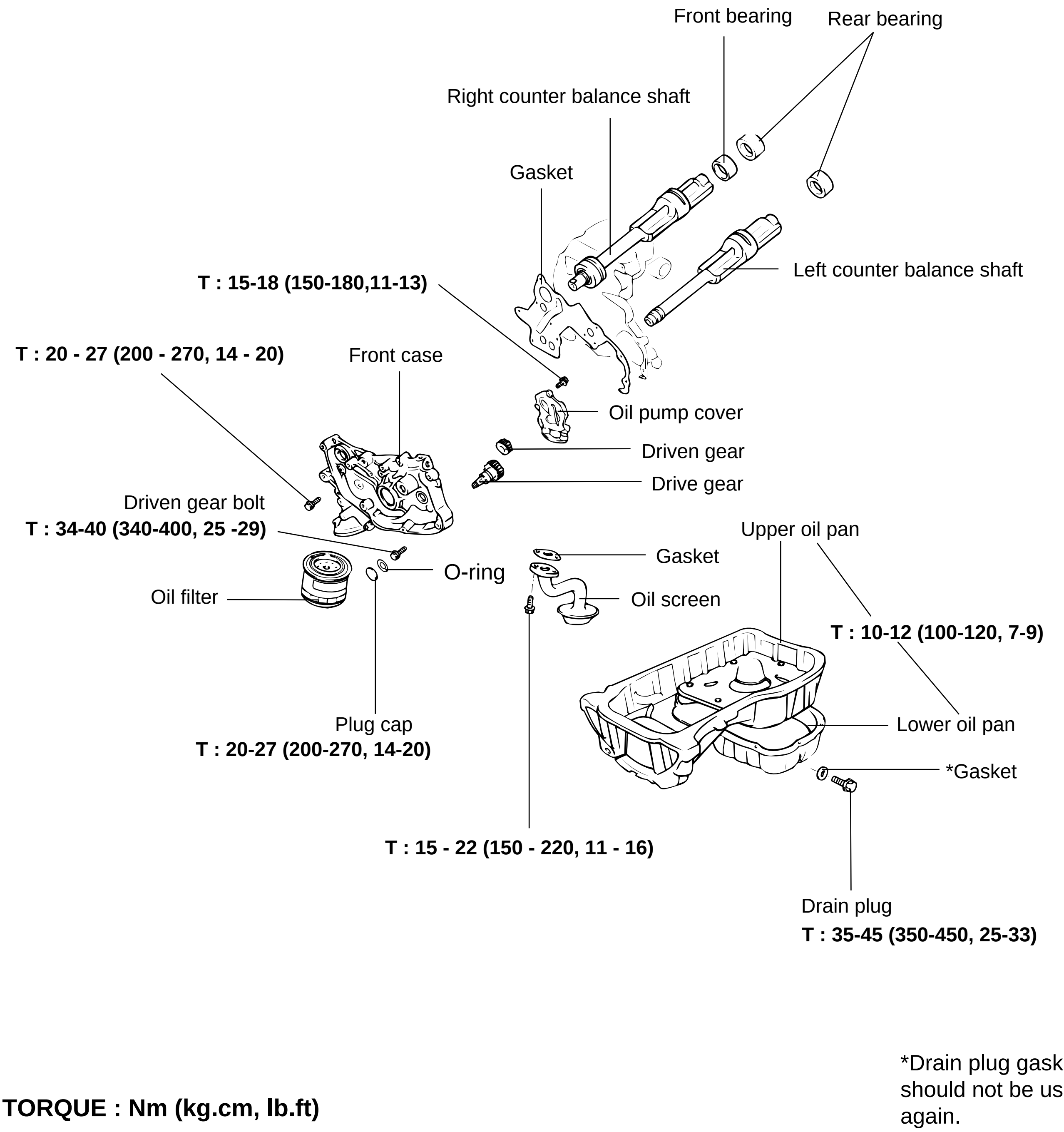
26. Place safely the engine on the engine support trolly.



ECUC060C

FRONT CASE

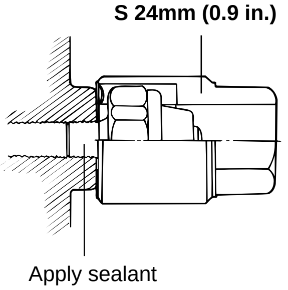
COMPONENTS ECAC2500



ECHA250A

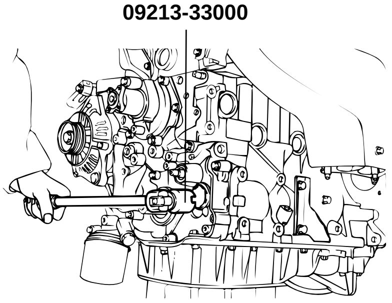
DISASSEMBLY ECHA2600

1. Remove the timing belt. Refer to "Timing Belt."
2. Remove all the oil pan bolts.
3. Tap the oil pan with a rubber hammer and remove the pan. (upper and lower parts)
4. Remove the oil screen and gasket.
5. Remove the front case assembly.
6. Remove the oil pressure switch.



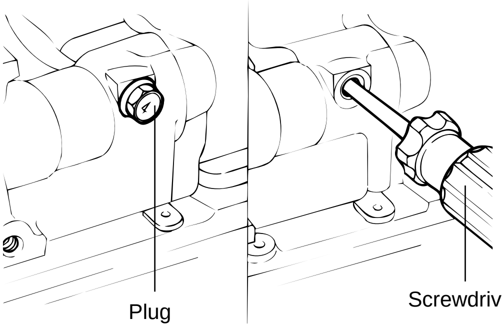
ECHA260A

7. Remove the oil filter bracket and gasket.
8. Using the special tool (09213-33000) remove the plug cap from the oil pump portion of the front case.



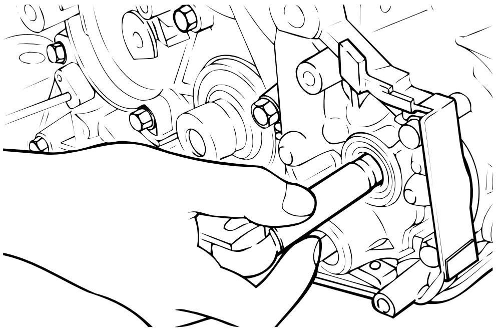
ECA9040A

9. Remove the plug on the left side of the cylinder block and insert a screw driver with an 8 mm (0.32 in.) diameter into the plug hole. The screwdriver must be inserted more than 60 mm (2.4 in.)



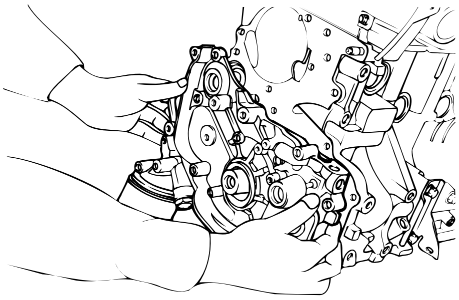
ECA9310C

10. Remove the oil pump driven gear and the left counter balance shaft retaining bolt.



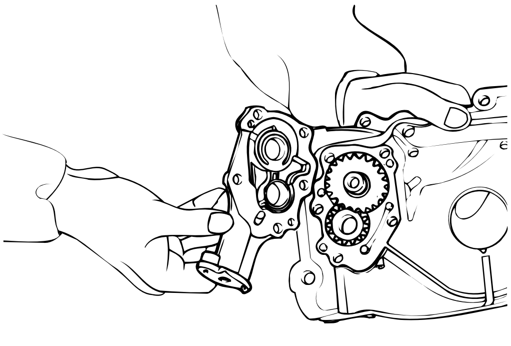
ECA9310D

11. Remove the front case mounting bolts and remove the front case assembly and gasket and then remove the two counter balance shafts from the cylinder block.



ECA9041A

12. Remove the oil pump cover from the front case.
13. Remove the oil pump gears from the front case.



ECA9042A

14. Remove the screw driver.
    (Step. 9)

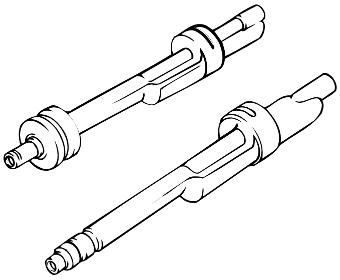
INSPECTION ECJA2700

FRONT CASE

1. Check all oil holes for clogging. Clean the holes if necessary.
2. Check the counter balance shaft front bearing for wear, damage and seizure. If there is anything wrong with the bearing, replace the front case.
3. Check the front case for cracks and other damage.
4. Replace a cracked or damaged front case.

COUNTER BALANCE SHAFT

1. Check the journals for wear or seizure.
2. If excessive wear or seizure is evident, check the bearing carefully.
3. If necessary, replace the counter balance shaft bearing or the shaft itself.



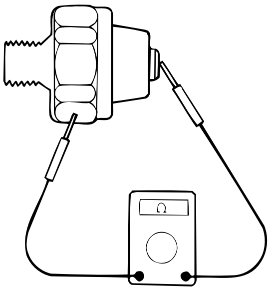
ECA9043A

OIL SEAL

1. Check the oil seal lip for wear and damage. Replace the oil seal if necessary.
2. Check the oil seal lip for deterioration. Replace the oil seal if necessary.

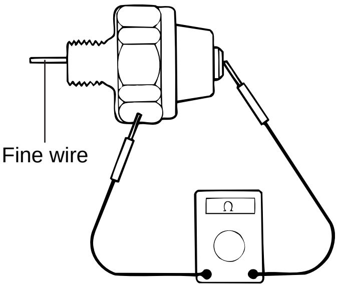
OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter.
   If there is no continuity, replace the oil pressure switch.



ECA9320D

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
3. If there is no continuity when a 50 kPa (7 psi) vacuum is applied through the oil hole, the switch is operating properly. Check for an air leak. If air leaks, the diaphragm is broken. Replace the switch.



ECA9320E

OIL PUMP

1. Assemble the oil pump gear to the front case and rotate it to verfy smooth rotation with no looseness.
2. Make sure that there is no ridge wear on the contact surface between the front case and the gear surface of the oil pump cover.

3. Install the drive and driven gears to the front case. Measure the tip clearance of the gears.

[Standard value]

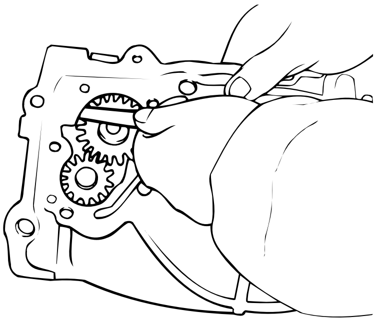
Drive gear : 0.16-0.21mm(0.0063-0.0083 in.)

Driven gear : 0.18-0.21mm(0.0071-0.0083 in.)

[Limit]

Drive gear : 0.25mm(0.0098 in)

Driven gear : 0.25mm(0.0098 in.)



ECA9044A

4. Check the side clearance.

[Standard value]

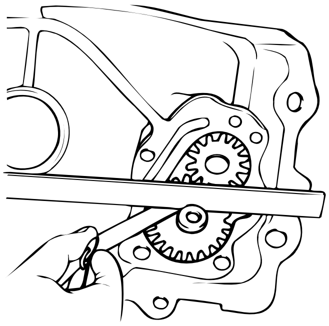
Drive gear : 0.08-0.14mm(0.0031-0.0055in.)

Driven gear : 0.06-0.12mm(0.0024-0.0047in.)

[Limit]

Drive gear : 0.25mm(0.0098 in)

Driven gear : 0.25mm(0.0098 in.)



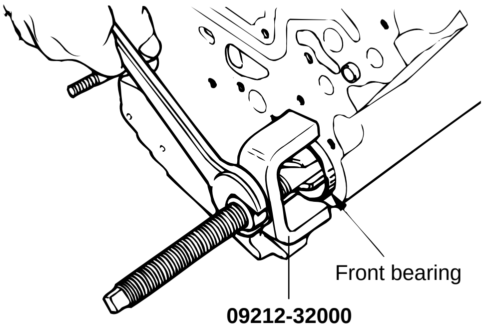
ECA9045A

COUNTER BALANCE SHAFT BEARING

ECJA2800

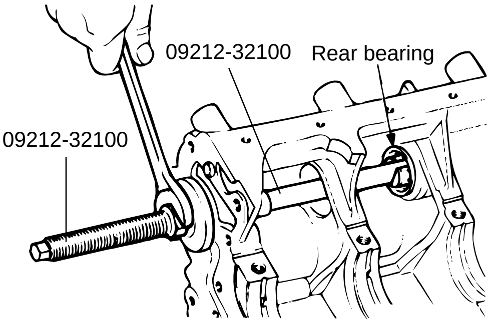
REPLACEMENT

1. Using a special tool, remove the front bearing of the right counter balance shaft from the cylinder block.



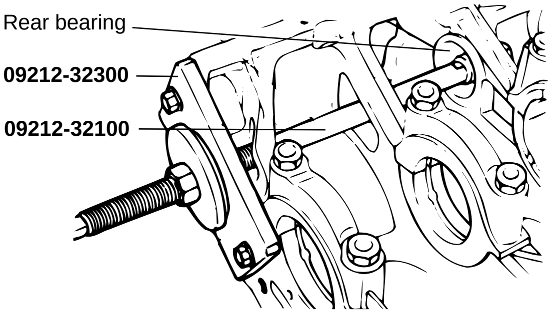
ECA9330A

2. Using a special tool, remove the rear bearing of the right counter balance shaft from the cylinder block.



ECHA280A

3. Using a special tool, remove the rear bearing of the left counter balance shaft from the cylinder block. At this time, install a special tool on the front surface of cylinder block to hold the bearing puller.

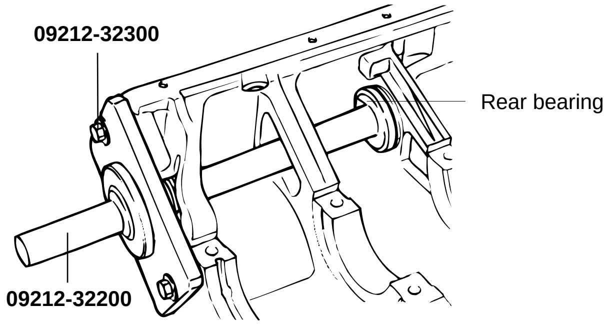


ECHA280B

4. Using a special tool, install the rear bearing of the left counter balance shaft to the cylinder block.

NOTE

1. Apply engine oil to the outside of rear bearing and bearing hole in cylinder block.
2. The left rear bearing has no oil holes.

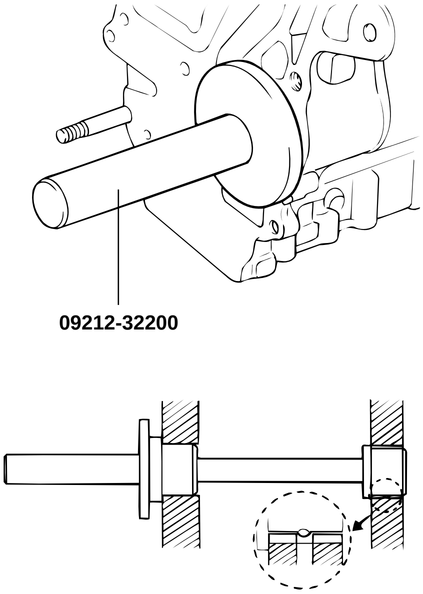


ECA9330D

5. Using a special tool, install the rear bearing of the right counter balance shaft to the cylinder block.

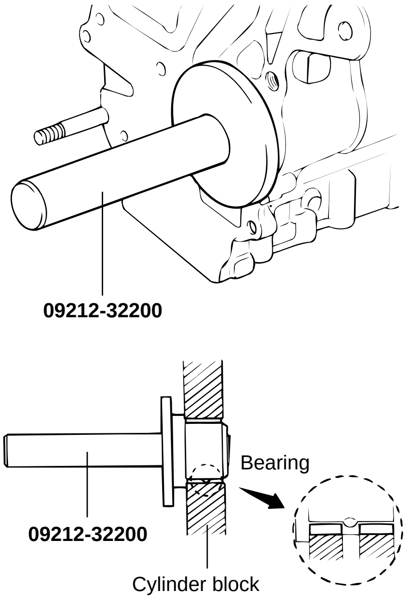
NOTE

1. Apply engine oil to the outside surface of the bearing.
2. Make sure that the bearing oil hole is aligned with the oil hole of cylinder block.



ECA9330E

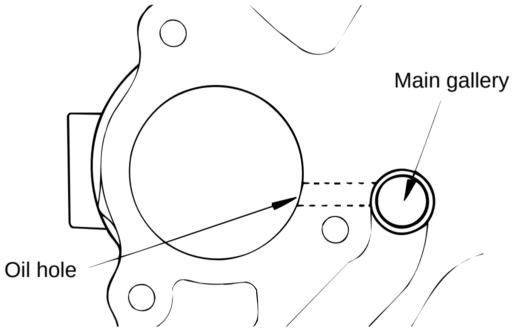
6. Using a special tool, install the front bearing of the right counter balance shaft to the cylinder block.



ECA9330F

NOTE

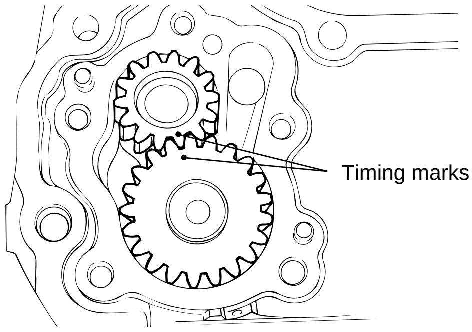
Make sure that the bearing oil hole is aligned with the oil hole cylinder block.



ECA9330G

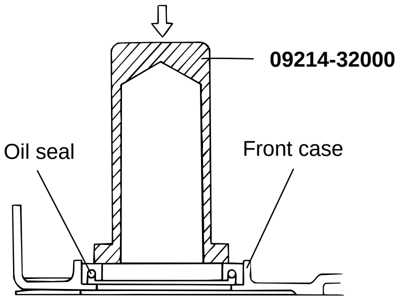
REASSEMBLY ECJA2900

1. Apply engine oil to the gear and align the two timing marks.



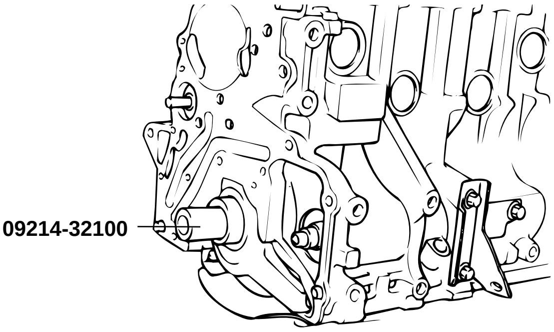
ECA9340A

2. Using the special tool, the crankshaft front oil seal installer (09214-32000), install the crankshaft front oil seal into the front case.



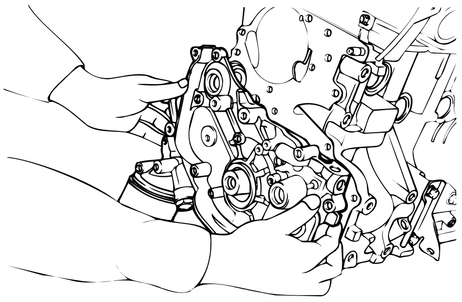
ECA9340B

3. Set the special tool (09214-32100) on the front end of the crankshaft and apply a thin coat of engine oil to the outer circumference of the special tool to install the front case.



ECA9046A

4. Install a new front case gasket to the front case assembly and tighten the flange bolts temporarily.



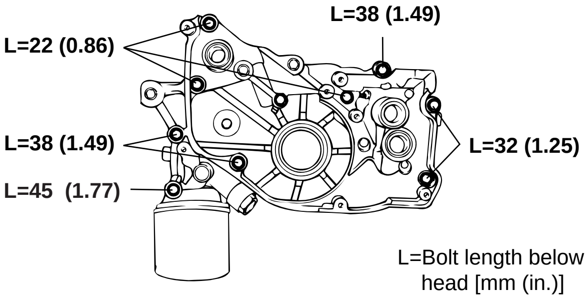
ECA9041A

5. Install the front case assembly with a new gasket. Tighten bolts to the specified torque.

FRONT CASE ASSEMBLY

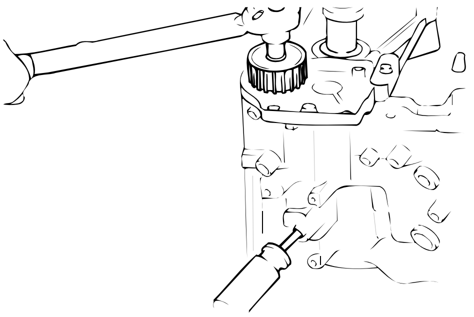
Tightening torque :

20-27Nm(200-270kg.cm, 14-20 lb.ft)



ECJA290B

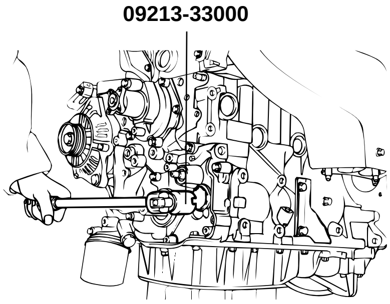
6. Insert a screwdriver into the plug hole in left side of cylinder block. After verifying that the shaft is in the proper position, replace the bolt and tighten it.



ECA9340F

7. Install a new O-ring to the groove of the front case.

8. Using a special tool, install the plug case and tighten it to the specified torque.



ECA9040A

PLUG CAP

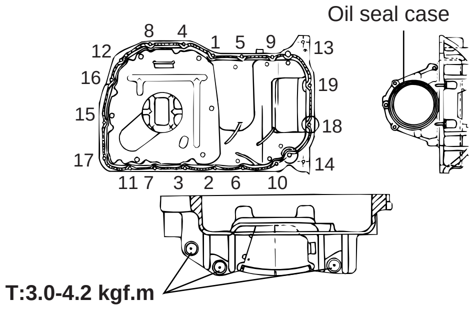
Tightening torque :

20-27 N.m (200-270 kg.cm, 14-20 lb.ft)

9. Apply sealant to the groove of the pan flange as shown.

NOTE

1. *Apply sealant approximately 4 mm (0.16 in.) in thickness.*
2. *After the application of the sealant, install the oil pan within 15 minutes.*



ECJA290A

10. Note the difference in bolt lengths at the locations shown.
Install the upper and lower oil pans and tighten the bolts to the specified torque.

Tightening torque

Oil pan bolt : 10-12Nm(100-120kg.cm, 7-9 lb.ft)

11. Using a 24 mm deep socket, install the oil pressure switch after applying sealant to the threaded area.

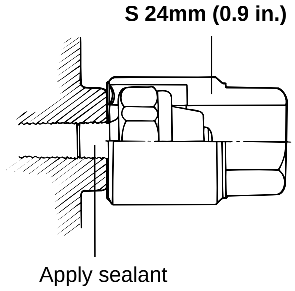
Sealant : Threebond 1104 or equivalent

NOTE

Do not torque the oil pressure switch excessively.

Tightening torque

Oil pressure switch : 8-12Nm(80-120kg.cm, 6-9 lb.ft)

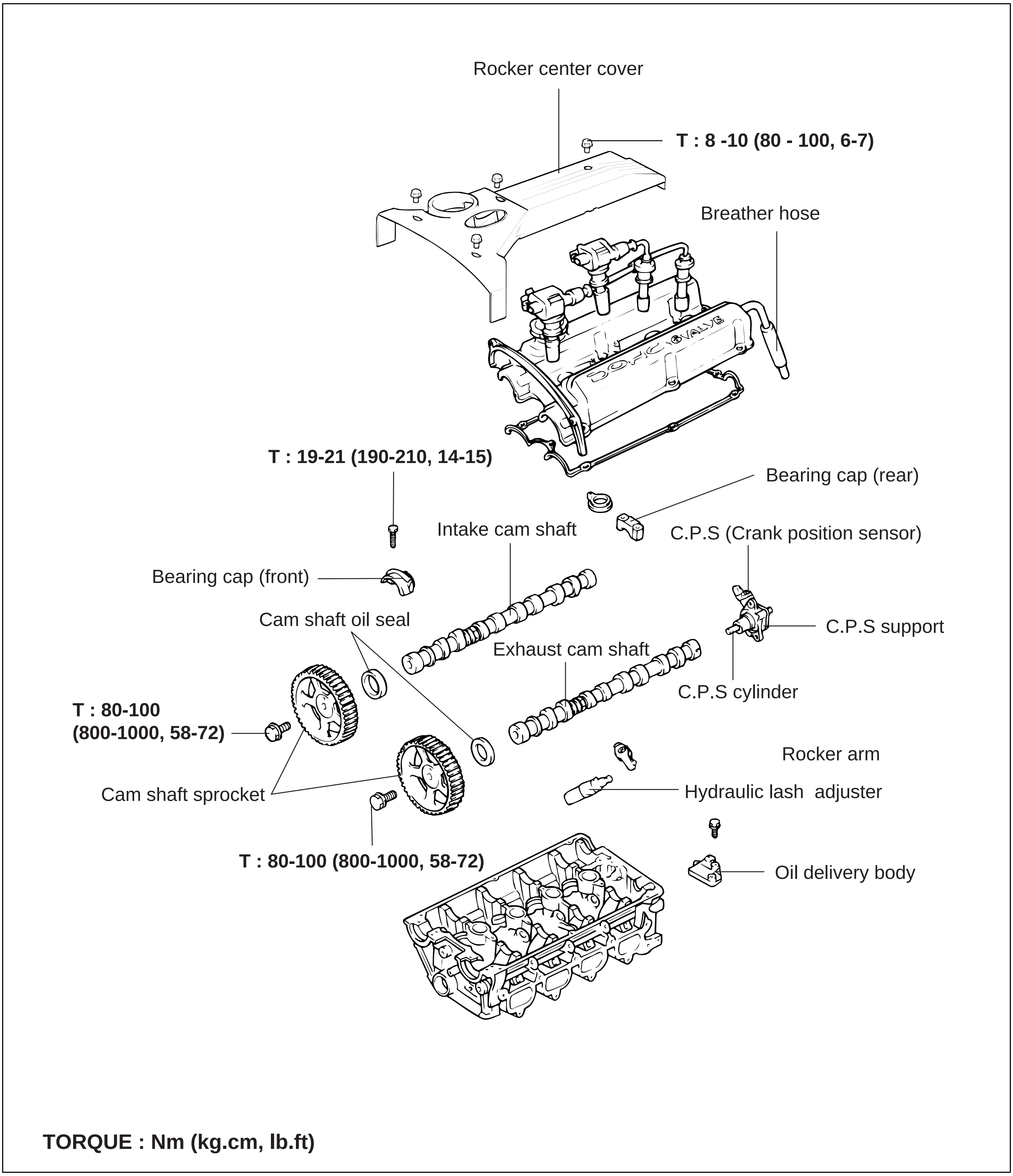


ECHA260A

MAIN MOVING SYSTEM

CAM SHAFT

COMPONENTS ECAC3000



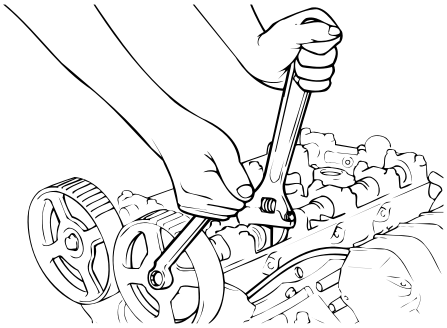
ECHA053A

DISASSEMBLY ECHA3100

1. Disconnect the negative terminal from the battery.
2. Drain the engine coolant.
3. Remove the breather hose between the air cleaner and the rocker cover.
4. Remove the air cleaner.
5. Remove the timing belt cover.
6. Remove the rocker cover and crank shaft position sensor.
7. Loosen the camshaft sprocket bolts then remove the camshaft sprockets.
8. Loosen the camshaft bearing cap bolts and remove the bearing caps, camshafts, rocker arms and lash adjusters.

⚠ ***CAUTION***

Loosen the cap bolts in increments to avoid bending the camshafts.

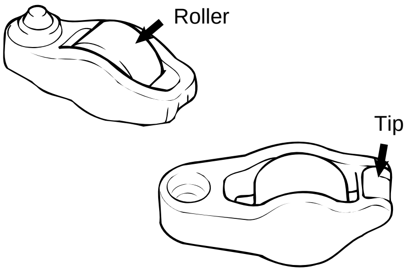


ECA9170C

INSPECTION ECUC0750

ROCKER ARMS

1. Check rotation of the roller. If they do not rotate smoothly or are loose, replace them.
2. Check the roller surface. Replace if there is any dent, damage or evidence fo seizure.
3. Check the valve contact surface for possible damage or evidence of seizure. Replace if necessary.

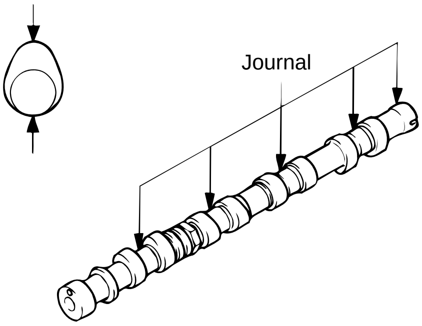


ECA9240A

CAMSHAFTS

1. Check the camshaft journals for wear. If the journals are badly worn, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or worn excessively, replace the camshaft.

Cam height
[Standard]
Intake : 35.493 mm (1.3974 in.)
Exhaust (M/T) : 35.204 mm (1.3860 in.)
[Limit]
Intake : 34.993 mm (1.3776 in.)
Exhaust (M/T) : 34.704 mm (1.3663 in.)



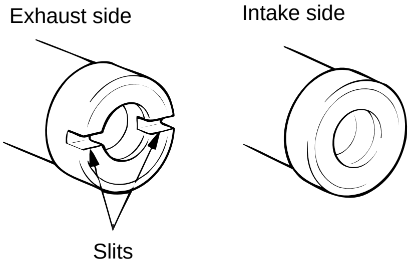
ECA9240B

REASSEMBLY ECJA3300

1. Install the camshafts on the cylinder head.
   Do not install the rocker arms yet.

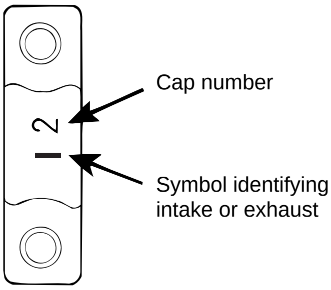
NOTE

1. *Apply engine oil to journals and cams of the camshafts.*
2. *The exhaust camshaft has a slit on its rear end for the crankshaft position sensor.*



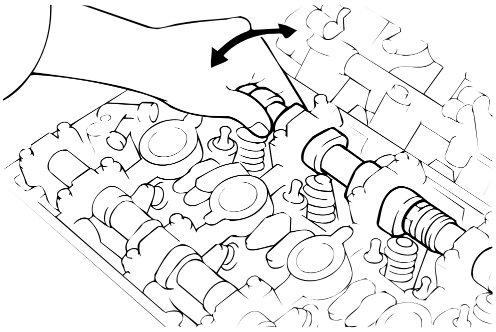
ECA9250A

2. Install the bearing caps. The markings on the caps are for for intake/exhaust identification.
   I : Intake camshaft. E : Exhaust camshaft



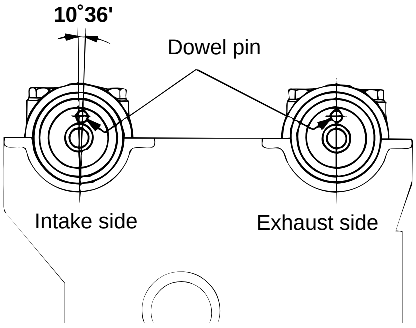
ECA9250B

3. Check that the camshaft can be easily turned by hand. After checking, remove the bearing caps and the camshafts, and then install the rocker arms.



ECA9250C

4. Make sure that the dowel pins on the camshaft sprocket ends are located on the top.



ECHA330A

5. Tighten the bearing caps to the specified torque in two or three increments as shown.

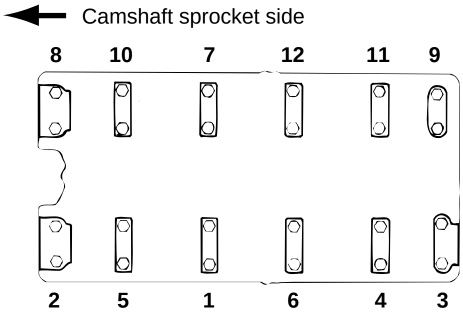
NOTE

Tighten the rocker arms uniformly.

Tightening torque

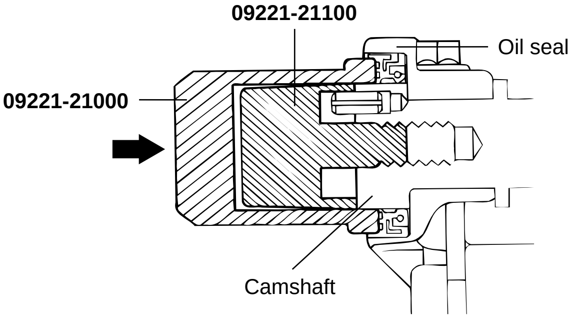
Bearing cap bolts:

19 - 21 Nm (190 - 210 kg.cm, 14 - 15 lb.ft)



ECHA330B

6. Using the special tools, camshaft oil seal Installer and guide (09221-21000, 09221-21100),. Be sure to apply engine oil to the external surface of the oil seal. Insert the oil seal along the camshaft front end and install it by driving the installer with a hammer until the oil seal is fully seated.



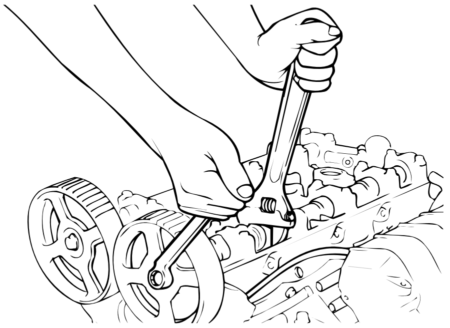
ECHA330C

7. Install the camshaft sprocket bolts to the specified torque.

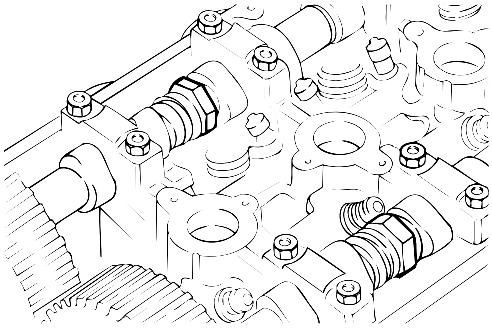
Tightening torque

Camshaft sprocket bolts :

80 - 100 Nm (800 - 1000 kg.cm, 58 - 72 lb.ft)



ECA9170C



ECA9210J

8. Install the rocker cover. Apply sealant as shown.

Tightening torque

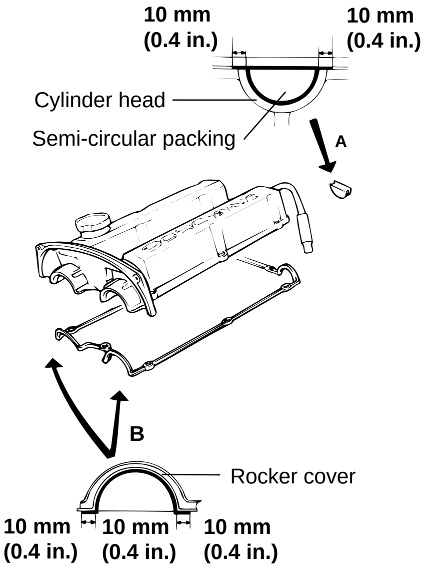
Rocker cover bolts : 8-10 Nm (80-100 kg.cm, 6-7 lb.ft)

Center cover bolts : 4-5 Nm (40-50 kg.cm, 3-4 lb.ft)

Sealant

A Portion : Threebond No. 10 or equivalent

B Portion : Threebond No. 1212D or equivalent

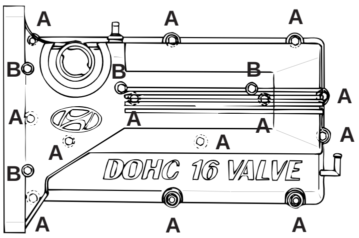


ECA9034A

Bolt

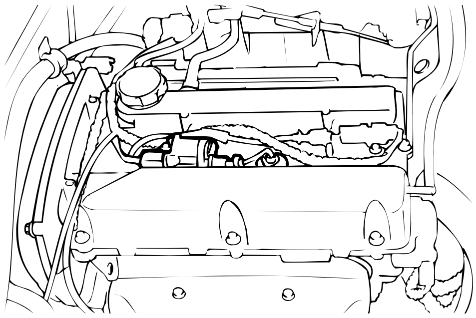
A : 13EA (Rocker cover bolts)

B : 4EA (Center cover bolts)



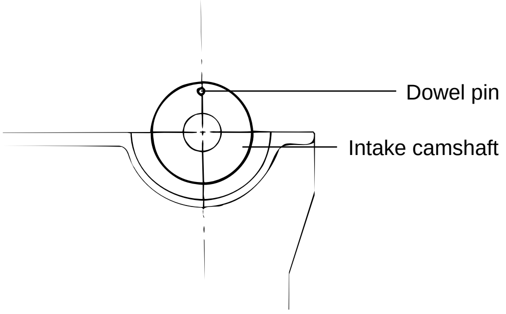
ECA9035A

9. Install the spark plugs, and ignition coils.Connect the secondary wires and then install the center cover.



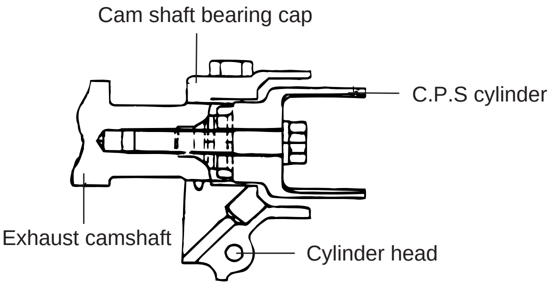
ECHA008A

10. Install the dowel pin on the sprocket side of the intake cam shaft.



ECA9250L

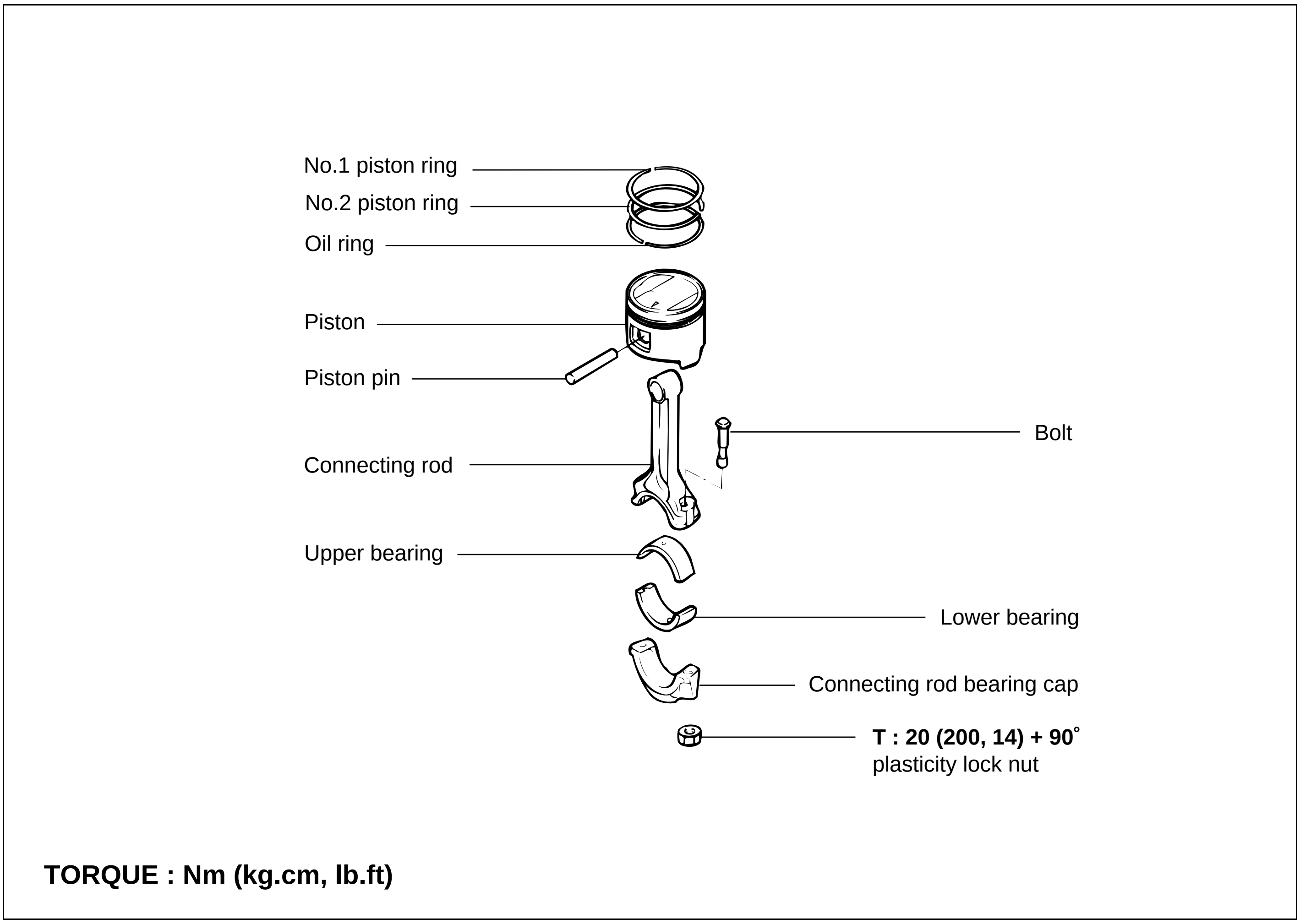
11. Install the crank position sensor support assembly after installing the crank position sensor cylinder on the exhaust camshaft.



ECHA008B

CONNECTING ROD

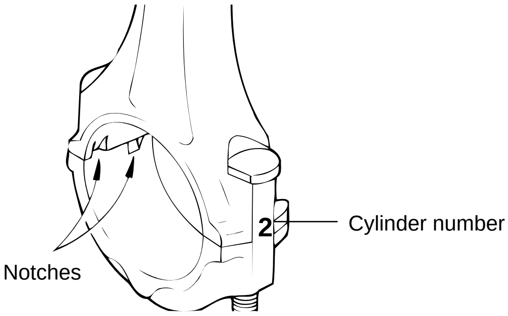
COMPONENTS ECAC3500



ECHA350A

DISASSEMBLY ECJA3600

CONNECTING ROD CAP



ECA9360A

NOTE

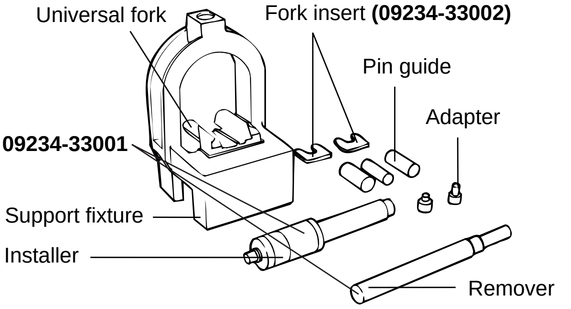
Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

1. Remove the connecting rod cap nuts and then remove the caps and the big end lower bearing. Mark for reassembly.

2. Push each piston-connecting rod assembly toward the top of the cylinder.

DISASSEMBLY AND REASSEMBLY OF PISTON PIN

1. Use the special tools 09234 - 33001 and 09234 - 33002, disassemble and reassemble the piston and connecting rod.

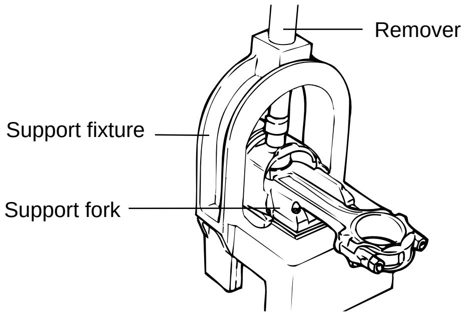


ECA9361A

2. The piston pin is a press fit in the rod little end, and the piston floats on the pin.

3. The tool consists of a support fixture with fork inserts, guides, adapters, an installer and a remover. The piston is supported in the support fixture while the pin is being installed or removed. Guides help position th pin as it is installed or removed, while the rod is supported by fork inserts.

4. To remove the pin from the piston, place the piston in the support fixture while the rod resting on the fork inserts. Pass the remover tool through the top of the support fixture and use it to press out the pin.



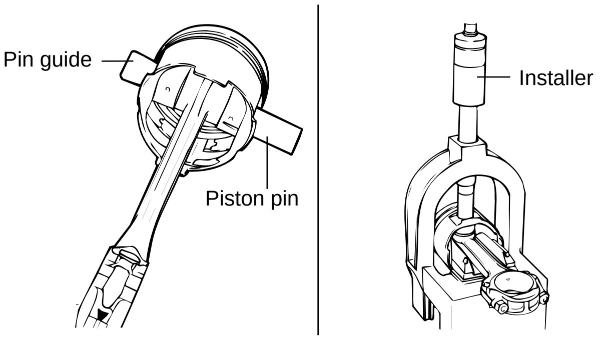
ECA9361B

5. To install a new pin, the proper fork inserts must be in place to support the rod.

6. Position the rod inside the piston. Insert the proper pin guide through on side of the piston and through the rod. Hand tap the pin guide so it is held by the piston. Insert the new pin into the piston from the other side and set the assembly into the support fixture with the pin guide facing down.

NOTE

The pin guide should be centered on the connecting rod though the piston. If assembled correctly, the pin guide will sit exactly under the center of the hole in the tool’s arch, and rest evenly on the fort inserts. If the wrong size pin guide is used, the piston and pin will not line up with the support fixture.

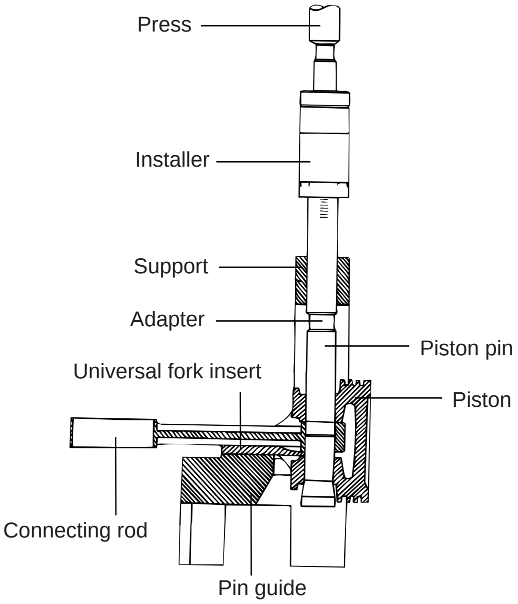


ECA9361C

7. Insert the installer tool through the hole in the arch of the support fixture and use an hydraulic press to force the piston pin through the rod little end. Continue pressing until the pin guide falls free and the installer tool seats against the top of the arch.

CAUTION

Do not exceed 1250±500 kg (2756±1102 lb) of force when stopping the installing arbor sleeve against the arch.



EOY055C

INSPECTION ECJA3700

PISTON AND PISTON PINS

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings. When the piston requires replacement, its rings should also be replaced.
3. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be smoothly pressed by hand into the pin hole (at room temperature).

PISTON RINGS

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in a ring groove to measure the side clearance. If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace only the piston ring only.

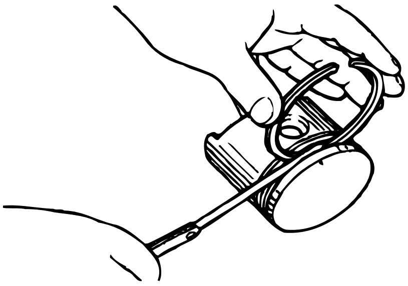
Standard value

Piston ring side clearance

No. 1 : 0.03-0.07mm(0.0012-0.0028 in.)

No. 2 : 0.02-0.06mm(0.0008-0.0024 in.)

Oil ring : 0.06-0.15 mm (0.0024-0.0059 in.)



ECA9370A

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

Piston ring end gap

[Standard dimensions]

No.1 : 0.25-0.35mm(0.0098-0.0138 in.)

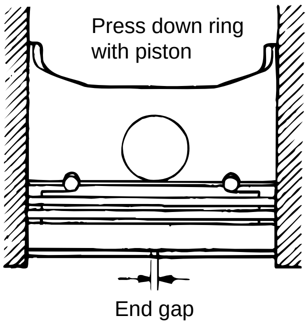
No.2 : 0.40-0.55mm(0.0157-0.0216 in.)

Oil ring side rail : 0.10-0.40mm(0.0039-0.0157 in.)

[Limit]

No.1, No.2 : 0.8mm(0.031 in.)

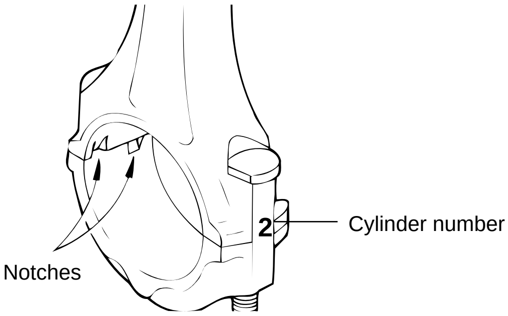
Oil ring side rail : 1.0mm(0.039 in.)



ECA9370B

CONNECTING RODS

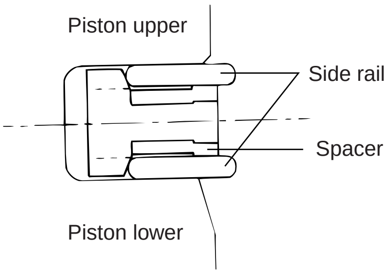
1. When the connecting rod cap is installed, make sure that cylinder numbers, marked on the rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged at either end of the thrust faces. If it has stratified wear in, or if the surface of, the inside diameter of the small end is severely rough, replace the rod.



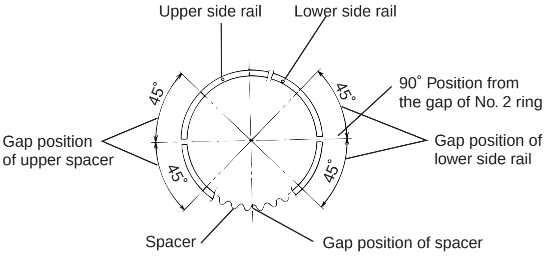
ECA9360A

REASSEMBLY ECJA3800

1. Install the spacer.



ECA9082A

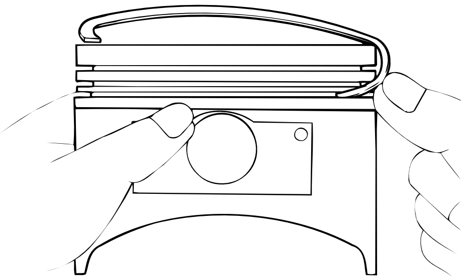


EDJA490A

2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it firmly, then press down with your finger the portion to be inserted into groove as illustrated.

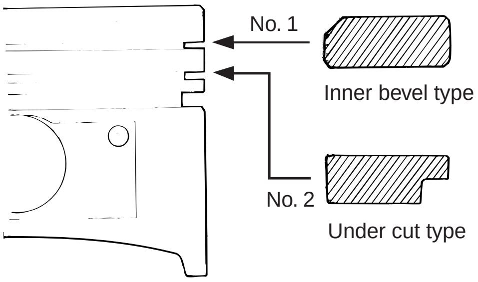
   Do not use a piston ring expander when installing the side rail.

3. Install the lower side rail by the same procedure as described in Step No. 2.



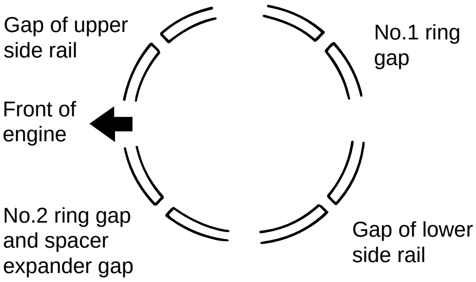
ECA9380B

4. Apply engine oil around the piston and piston grooves.
5. Using piston ring expander, install the No. 2 piston ring.
6. Install the No. 1 piston ring.



EDJA490B

7. Place each piston ring end gap as far apart from its neighboring gaps as possible. Make sure that gaps are not positioned in the thrust and pin directions.
8. Hold the piston rings firmly with a piston ring compressor as they are inserted into cylinder.



ECA9380D

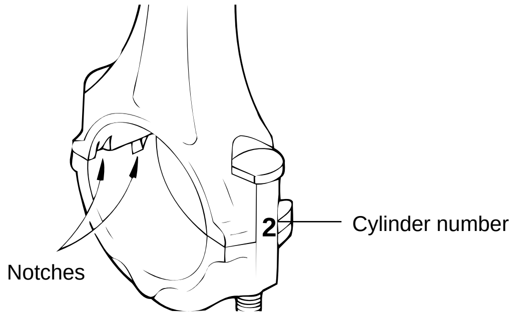
9. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
10. When the connecting rod cap is installed, make sure that the cylinder numbers put on the rod and cap at disassembly match.
11. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.

12. Tighten the connecting rod cap nuts.

Tightening torque

Connecting rod cap nuts :

20 Nm (200 kg.cm, 14 lb.ft) + 90°



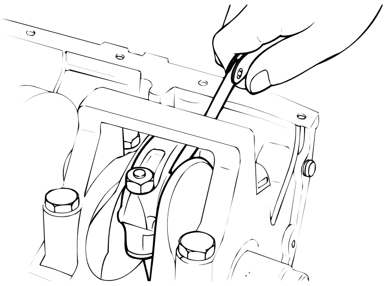
ECA9360A

13. Check the connecting rod side clearance.

Connecting rod side clearance

Standard : 0.10 - 0.25mm (0.004 - 0.0098 in)

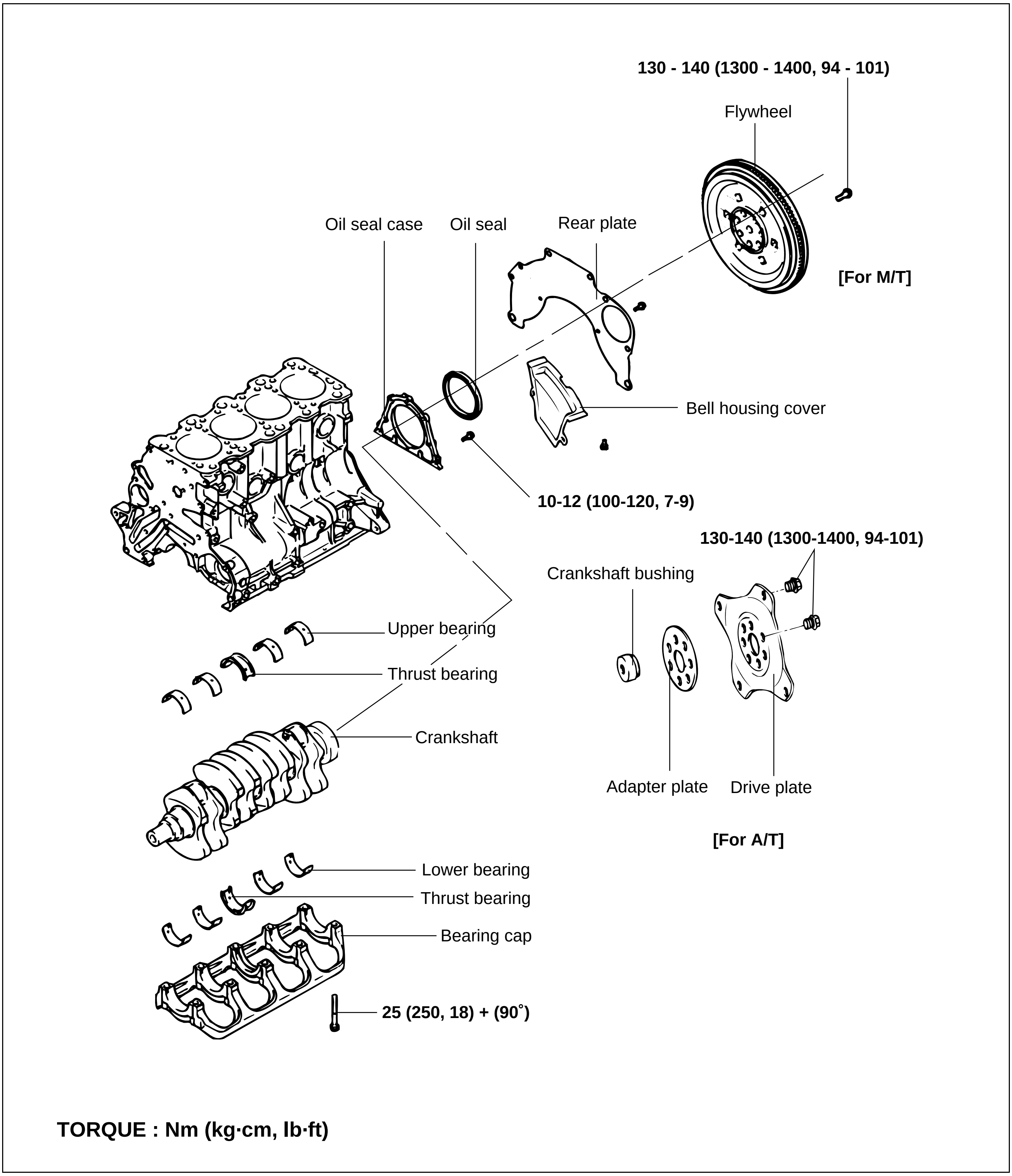
Limit : 0.4 mm (0.0157 in)



ECA9380F

CRANK SHAFT

COMPONENTS ECHA4000



ECHA400A

DISASSEMBLY ECJA4100

1. Remove the timing belt, front case, flywheel, cylinder head assembly and oil pan. For details, refer to the respective chapters.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

NOTE

Mark the main bearing caps to be able to reassembl in the original position and direction.

4. Remove the main bearing caps and the crankshaft. Keep the bearings in order according to the cap number.

INSPECTION ECJA4200

CRANKSHAFT

1. Check the crankshaft journals and pins for damage, uneven wear and cracks. Also check the oil holes for restrictions. Repair or replace any defective part.
2. Inspect the crankshaft journal for taper and out-of-round.

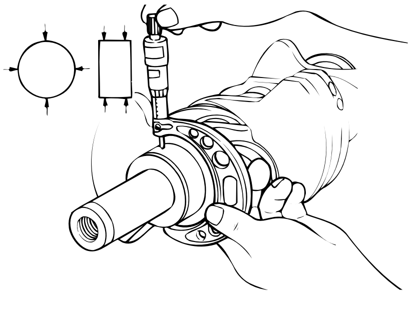
Standard value

Crankshaft journal O.D :

56.982-57.000mm(2.2434-2.2441 in.)

Crankshaft pin O.D :

44.980-45.000mm(1.7709-1.7717 in.)



ECA9410A

MAIN BEARINGS AND CONNECTING ROD BEARINGS

Visually inspect each bearing for peeling, melting, seizure and improper contact. Replace any defective bearings.

MEASURING OIL CLEARANCE

Check the oil clearance by measuring the outside diameter of the crankshaft journal as well as the the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured diameters.

Standard value

Oil clearance

Crankshaft main bearing

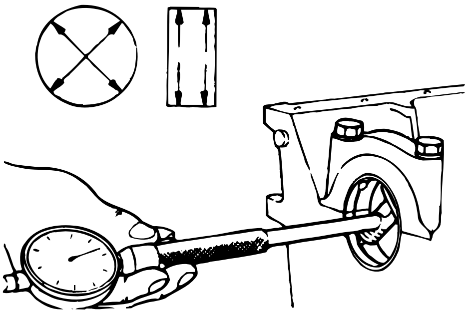
No.1,2,4,5 : 0.018-0.036 mm (0.0007-0.0014 in.)

No.3 : 0.024-0.042 mm (0.0009-0.0017 in.)

Connecting rod bearing :

0.015-0.048 mm (0.0006-0.0019 in.)

Limit : 0.1 mm (0.0039 in.)

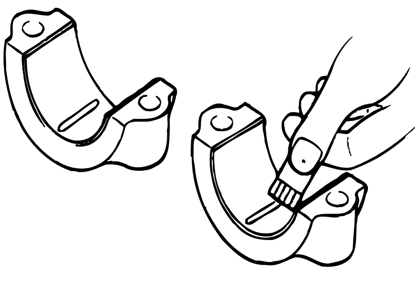


ECA9410B

HOW TO USE PLASTIC GAUGE

Plasticgauge may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.
2. Cut the plasticgauge to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plasticgauge at the widest part by using the scale printed on the gauge package. If the clearance exceeds the service limit, the bearing should be replaced or an undersize bearing should be used. When installing a new crankshaft, be sure to use standard size bearings. If the standard clearance can not be obtained even after replacing the bearing, the journal and pin should be ground to thr undersize and a bearing of the corresponding size should be installed.



ECA9410C

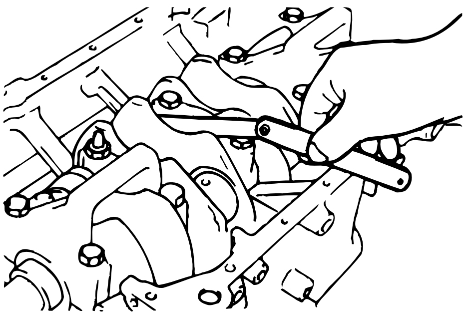
OIL SEAL

Check the front and rear oil seals for damage or worn surfaces. Replace any seat that is defective.

BEARING CAPS

After installing the bearing caps, make sure the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace the crankshaft bearings.

Standard value : 0.05 - 0.25 mm (0.0020 - 0.0098 in)



ECA9410D

DRIVE PLATE (A/T)

Replace distorted, damaged, or cracked drive plates.

FLYWHEEL (M/T)

1. Check the clutch disc contacting surface of the flywheel for damage and wear. Replace the flywheel if excessively damaged or worn.
2. Check the clutch disc contacting surface of the flywheel for run-out.

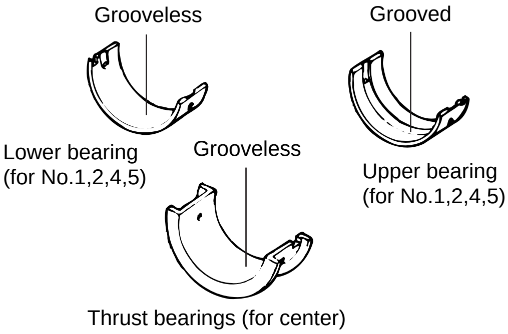
Limit

Flywheel run-out : 0.13mm(0.0051 in.)

3. Check the ring gear for damage, cracks and wear. Replace if necessary.

REASSEMBLY ECJA4300

1. Install a grooved main bearing (upper bearing) on the cylinder block side.
2. Install a grooveless main bearing (lower bearing) on the main bearing cap side.
3. Both upper and lower center thrust bearings are grooveless.



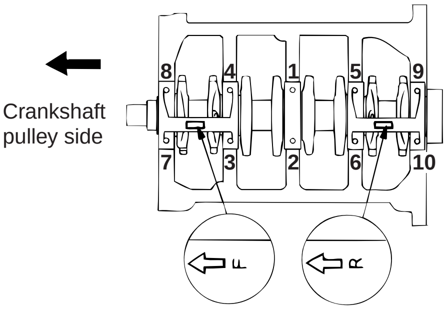
ECA9420A

4. Apply engine oil to journals and pins. Install the crankshaft.
5. Install the bearing caps with the arrow mark directed toward the front of the engine. The cap number must be correct.
6. Tighten the cap bolts to the specified torque.

Tightening torque

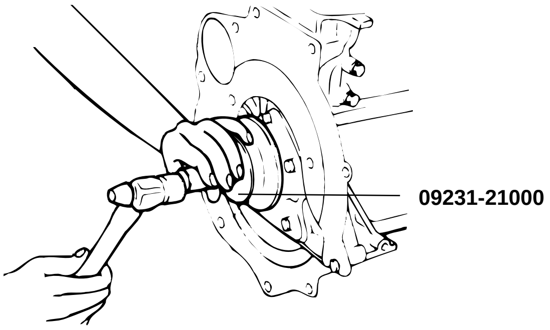
Main bearing cap bolts : 25 Nm (250, 18lb.ft) + (90°)

7. Cap bolts should be tightened evenly in 4 to 5 increments before they are tightened to the specified torque.
8. Make sure that the crankshaft turns freely and check the end play of the crankshaft.



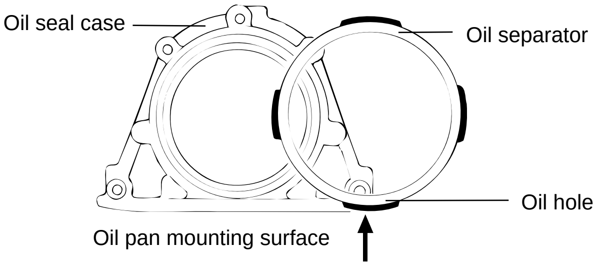
EOY062B

9. Using a special tool (09231–21000). Install the oil seal in the oil seal case. A new oil seal should be used.



ECA9420C

10. Install the oil seal into the oil seal case so that the oil hole in the separator may be directed downward (arrow in illustration)



ECA9053A

11. Install the new oil seal case gasket and oil seal case assembly.

Tightening torque

Oil seal case : 10-12N.m (100-120kg.cm, 7-9 lb.ft)

<For M/T>

12. Install the rear plate to the cylinder block.

13. Install the flywheel assembly and tighten the bolts to the specified torque.

Tightening torque

Flywheel bolt :

130 - 140 Nm (1300 - 1400kg.cm, 94 - 101 lb.ft)

<For A/T>

14. Install the adapter plate to the cylinder block.

15. Install the drive plate and tighten the bolts to the specified torque.

Tightening torque

Drive plate :

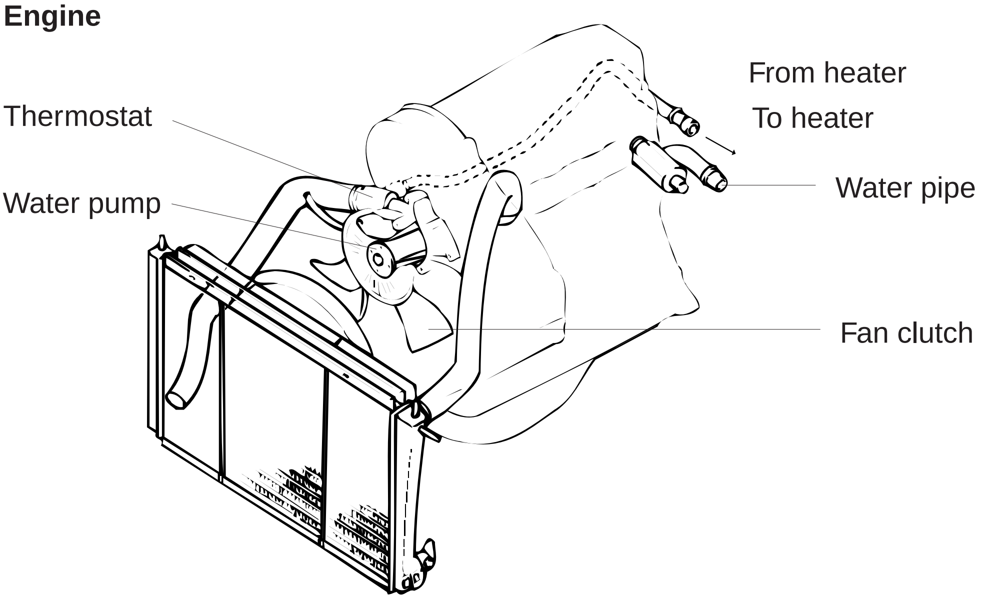
130 - 140 Nm (1300 - 1400kg.cm, 94 - 101lb.ft)

COOLING SYSTEM

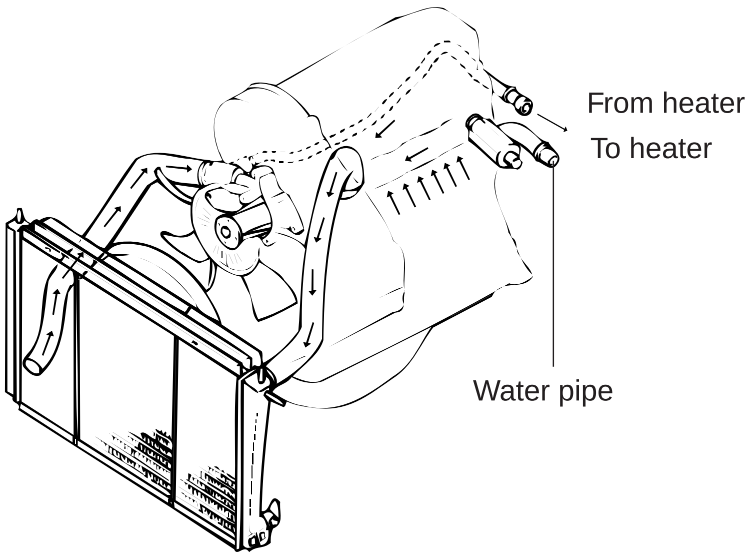
ENGINE COOLANT HOSE/PIPES

COMPONENTS ECUC0800

Cold Engine



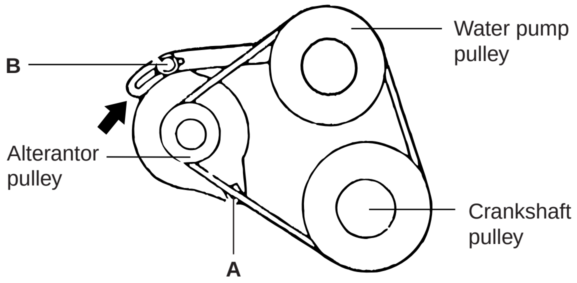
Hot Engine



ECUC080A

REMOVAL ECUC0900

1. Loosen the alternator support bolt “A”, nut and alternator brace bolt “B”.
2. Push the side of the alternator to relieve belkt tension, and remove the belt.
3. Remove the water pump pulley bolts and remove the water pump pulley.

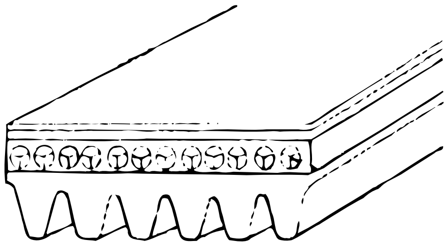


ECUC090A

INSPECTION ECUC1000

Check following items and replace if defective.

1. Loosen the alternator support bolt “A”, nut and alternator brace bolt “B”.
2. Push the side of the alternator to relieve belt tension, and remove the belt.
3. Remove the water pump pulley bolts and remove the water pump pulley.



ECUC090B

REMOVAL ECUC1100

1. Install the water pump pulley to the water pump pulley bracket and tighten the bolts firmly.

Tighting torque

Water pump pulley bolts :

7.8 - 9.8 Nm (80 - 100 kg·cm, 5.8 - 7.2 lb.ft)

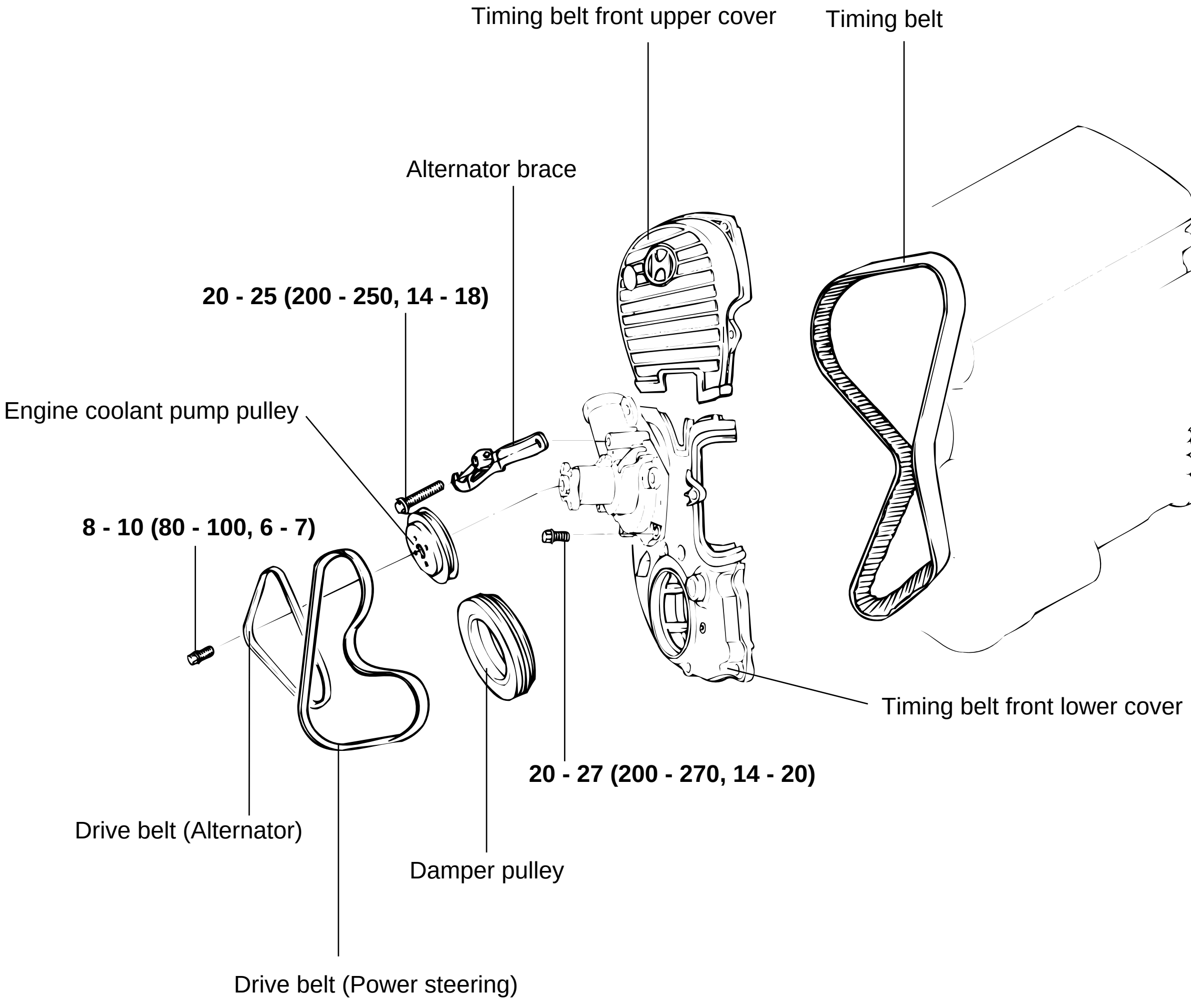
CAUTION

An overtensioned belt could cause not only premature wear of the belt but will also damage the water pump and atternator bearing.

2. After installing the belt, adjust the belt tension.

ENGINE COOLANT PUMP

COMPONENTS ECHA5000



TORQUE : Nm (kg·cm, lb·ft)

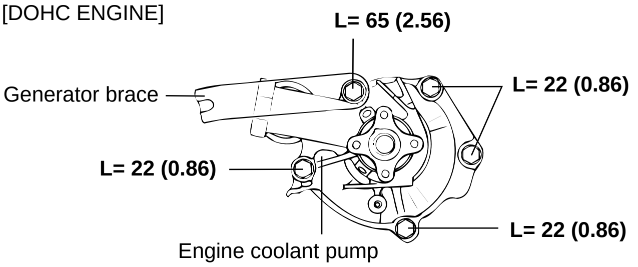
ECA9022A

REMOVAL ECHA5100

1. Drain the coolant and disconnect the coolant pump inlet pipe.
2. Remove the drive belt and engine coolant pump pulley.
3. Remove the timing belt covers and the timing belt tensioner.
4. Remove the engine coolant pump mounting bolts, then remove the alternator brace.
5. Remove the engine coolant pump assembly from the cylinder block.

INSPECTION ECJA5200

1. Check the pump for cracks, damage or wear. Replace the pump assembly if necessary.
2. Check the bearing for damage, abnormal noise, and sluggish rotation. Replace the pump assembly if necessary.
3. Check the seal for leaks. Replace the pump assembly if necessary.
4. Check for engine coolant leakage. If the engine coolant leaks, the seal is defective. Replace the engine coolant pump assembly.

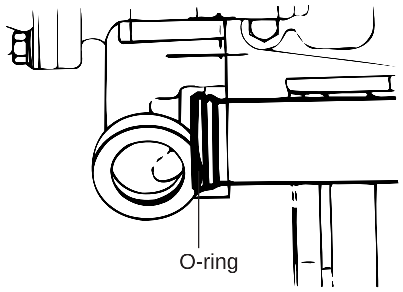


L=Length of bolt mm (in.)

ECA9062A

INSTALLATION ECHA5300

1. Clean the gasket surfaces of the engine coolant pump body and the cylinder block.
2. Install the new O-ring onto the groove on the front end of the engine coolant pipe, then wet the O-ring with water. Do not apply oil or grease.



ECHA013A

3. Install a new engine coolant pump gasket and engine coolant pump assembly. Tighten the bolts to the specified torque.

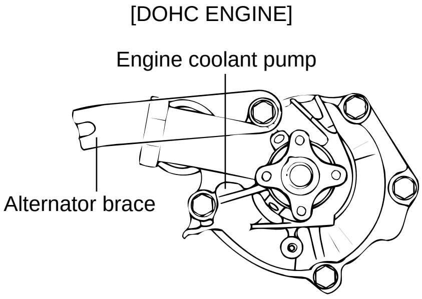
Tightening torque

Engine coolant pump bolt :

20-27Nm(200-270kg.cm, 14-20lb.ft)

---

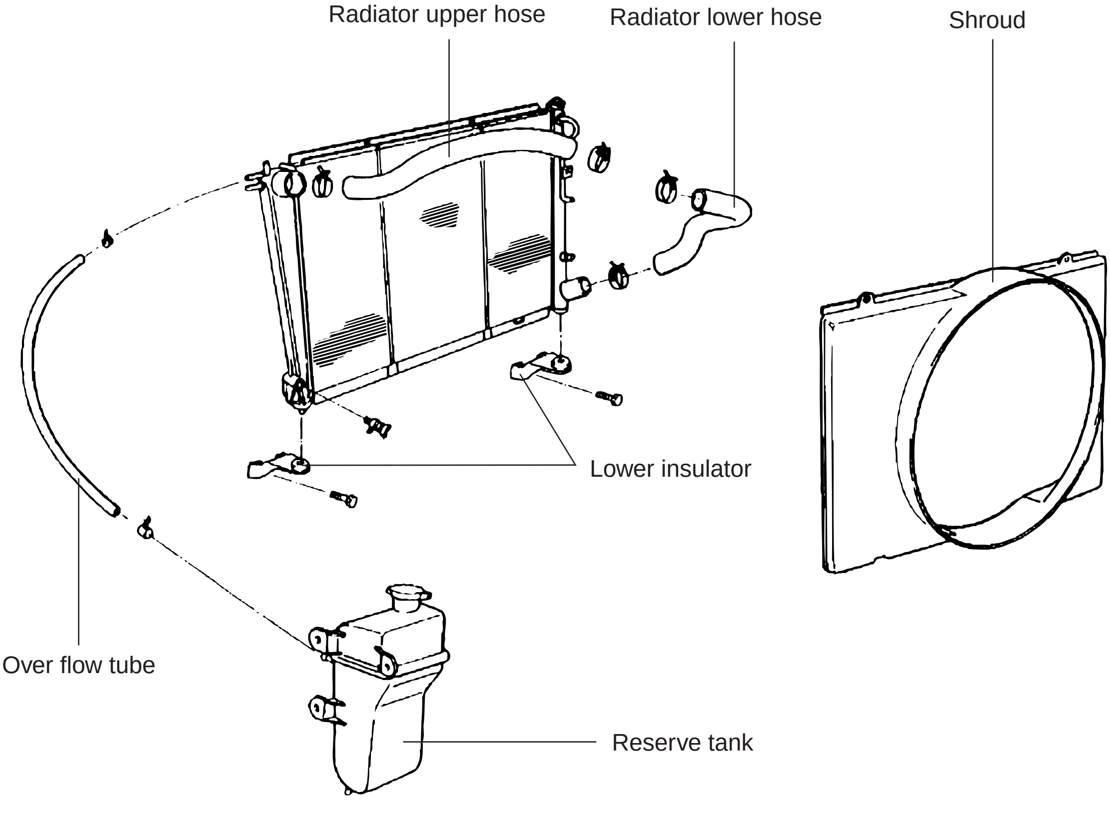
4. Install the timing belt tensioner and timing belt. Adjust the timing belt tension, then install the timing belt covers.
5. Install the engine coolant pump pulley and drive belt, then adjust the belt tension.
6. Refill the coolant.
7. Run the engine and check for leaks.



ECHA530A

RADIATOR

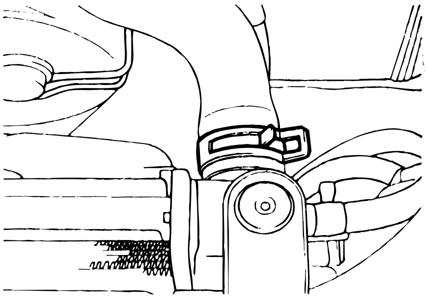
COMPONENTS ECUC1200



ECUC120A

INSPECTION ECUC1300

1. Disconnect the fan mator connector.
2. Loosen the radiator drain plug to drain the coolant.
3. Disconnect the upper and lower hoses and overflow tube after making marks on the radiator hose and the hose clamp.

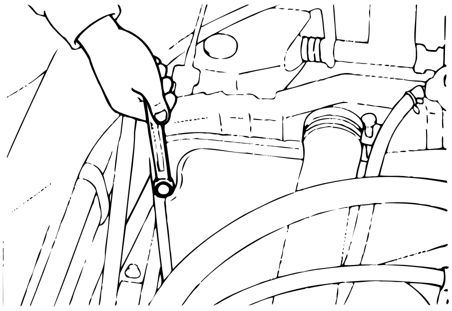


ECUC130A

4. Remove the radiator shroud bolts from the radiator.

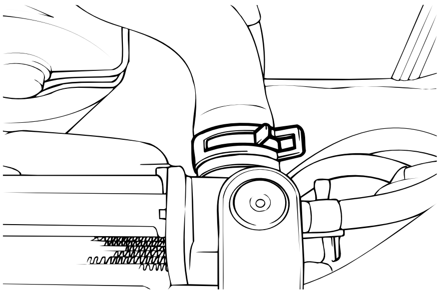
NOTE

Shround should be hung on the cooling fan, because it cannot be removed unless the radiator is taken out.



ECUC140A

5. Remove the radiator mounting bolt.



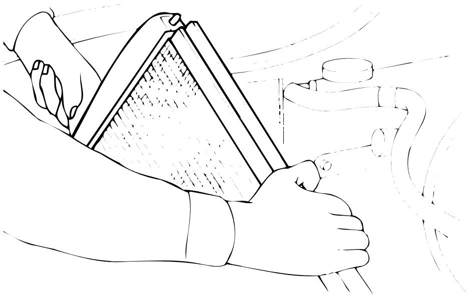
H7EM913A

6. Tilt radiator and take out obliquely upward.

NOTE

When the radiator is removed, make sure that the radiator core is not bent or crushed by other parts.

7. Remove the radiator shroud.



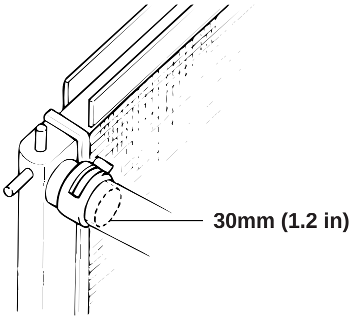
H7EM003A

INSPECTION ECHA5700

1. Check for foreign material between the radiator fins.
2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the automatic transaxle oil cooler hoses for cracking, damage or deterioration (only A/T).

INSTALLATION ECUC1350

1. Installation is in the reverse order of removal.
2. Connect radiator hoses until their length of connection are about 30mm (1.2 in) at both radiator and engine sides.



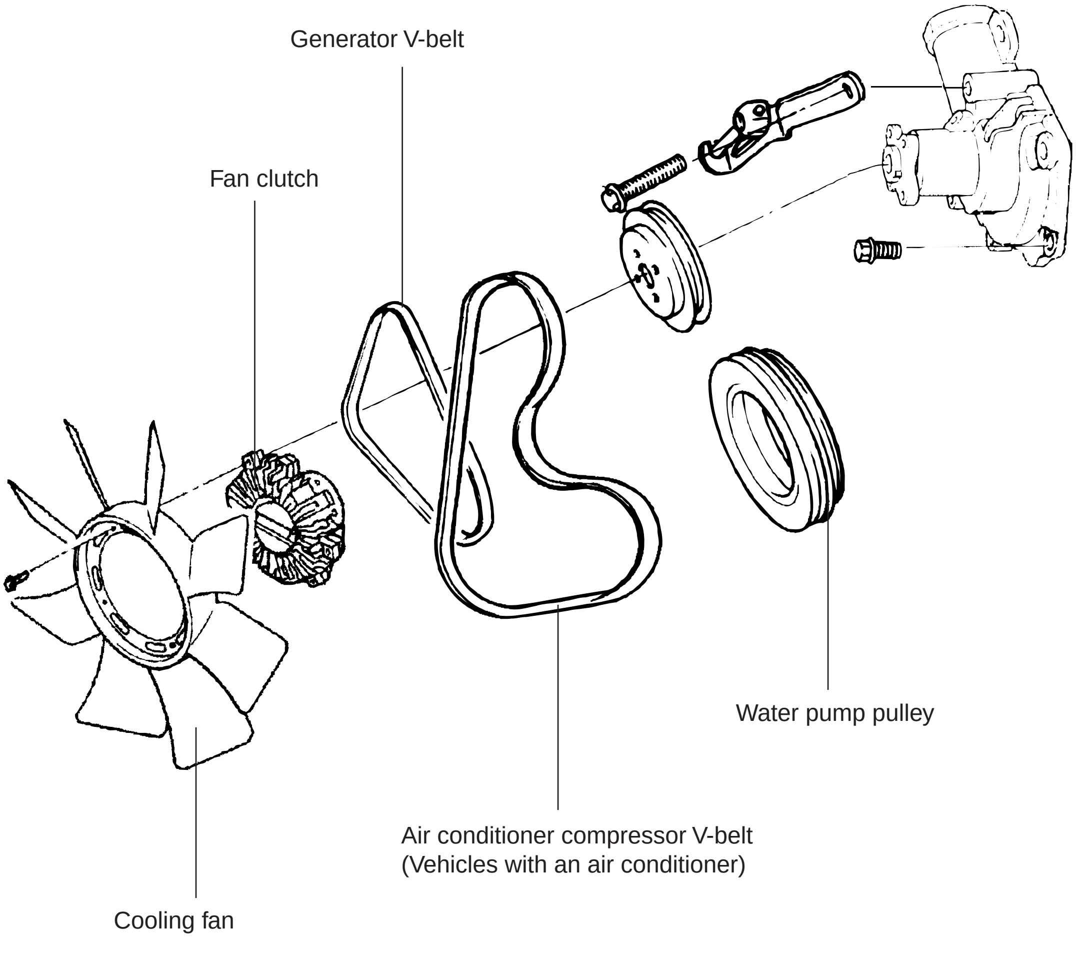
ECUC140B

INSPECTION AFTER INSTALLATION ECUC1400

1. Fill the radiator and reservoir tank with clean coolant mixture.
2. Run the engine until the coolant has warmed up enough so that the thermostat valve is open. Then, stop the engine.
3. Remove the radiator cap and pour the coolant into the filler neck of the radiator. Fill the reservoir tank with the coolant to the upper level. Replace the radiator cap.
4. Check that there are no leaks from the radiator, hoses or connections.

RADIATOR PAN ECUC1500

COMPONENTS

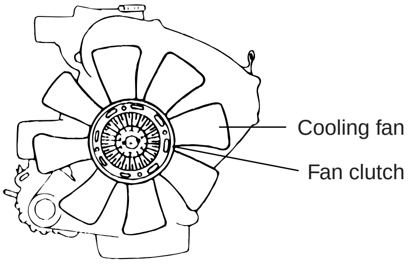


ECUC150A

INSPECTION ECUC1600

COOLING FAN

1. Check the blades for damaged and cracks.
2. Check for cracks and damage around bolt holes in fan hub.
3. If any portion of fan is damaged cracked, replace cooling fan.

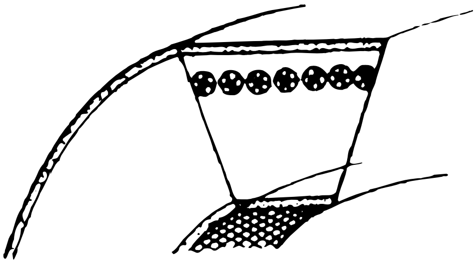


ECUC160A

BELT

A belt which has following defacts should be replaced.

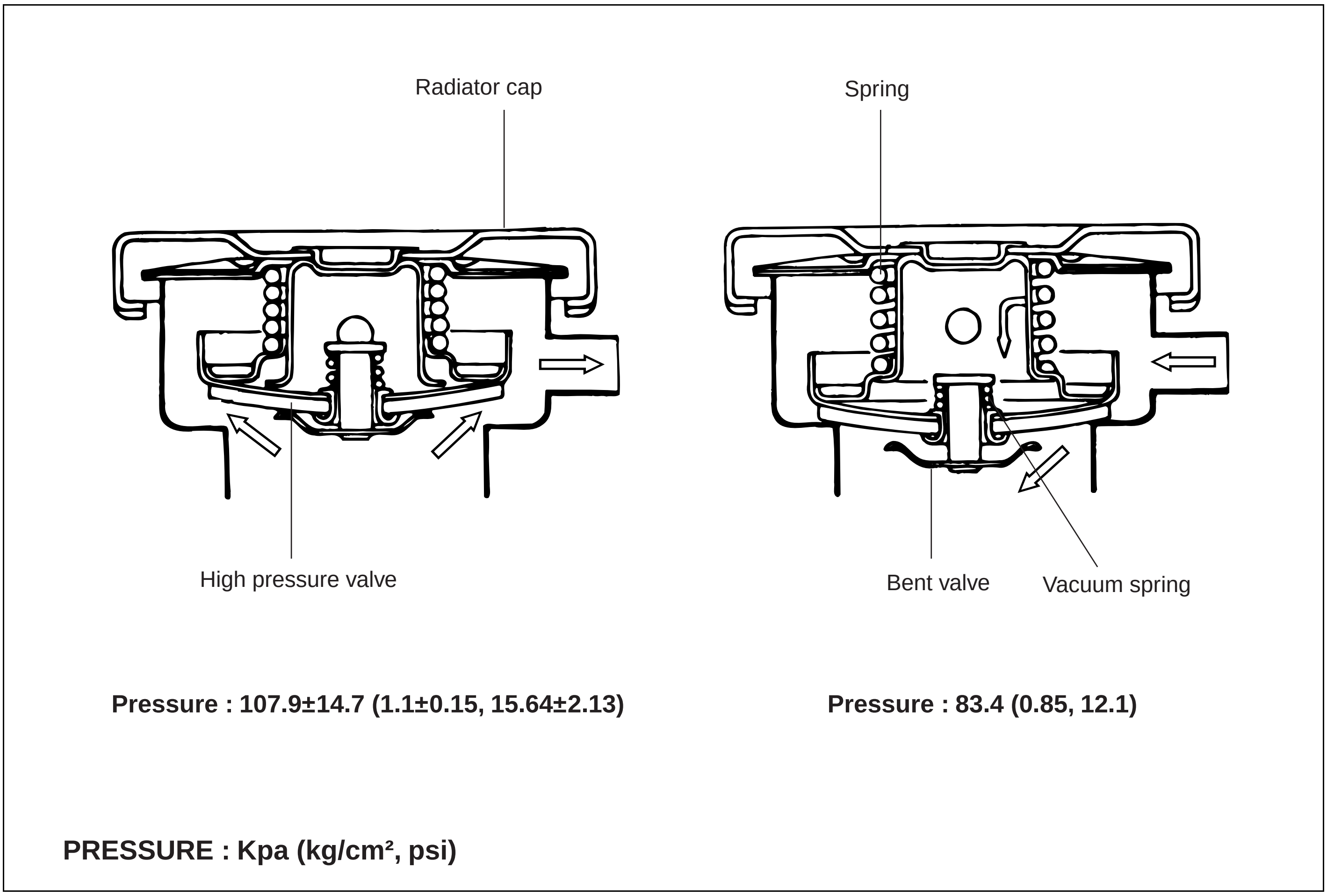
1. Damaged, peeled or cracked surface.
2. Oil or greasy surface.
3. A belt worn to such an extent that it is in contact with bottom of V groove in pulley.
4. Worn or hardened rubber.



ECUC160B

RADIATOR CAP

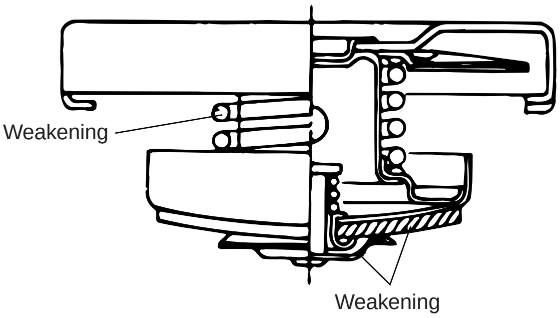
COMPONENTS ECHA5900



ECHA014A

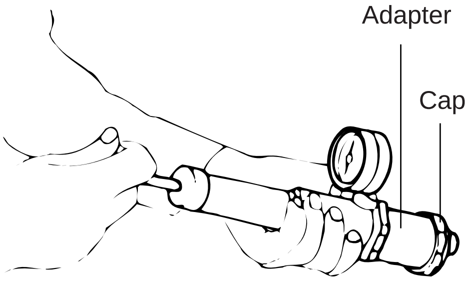
INSPECTION ECJA6300

1. Check the radiator cap for damage, cracks or weakening.



ECHA014B

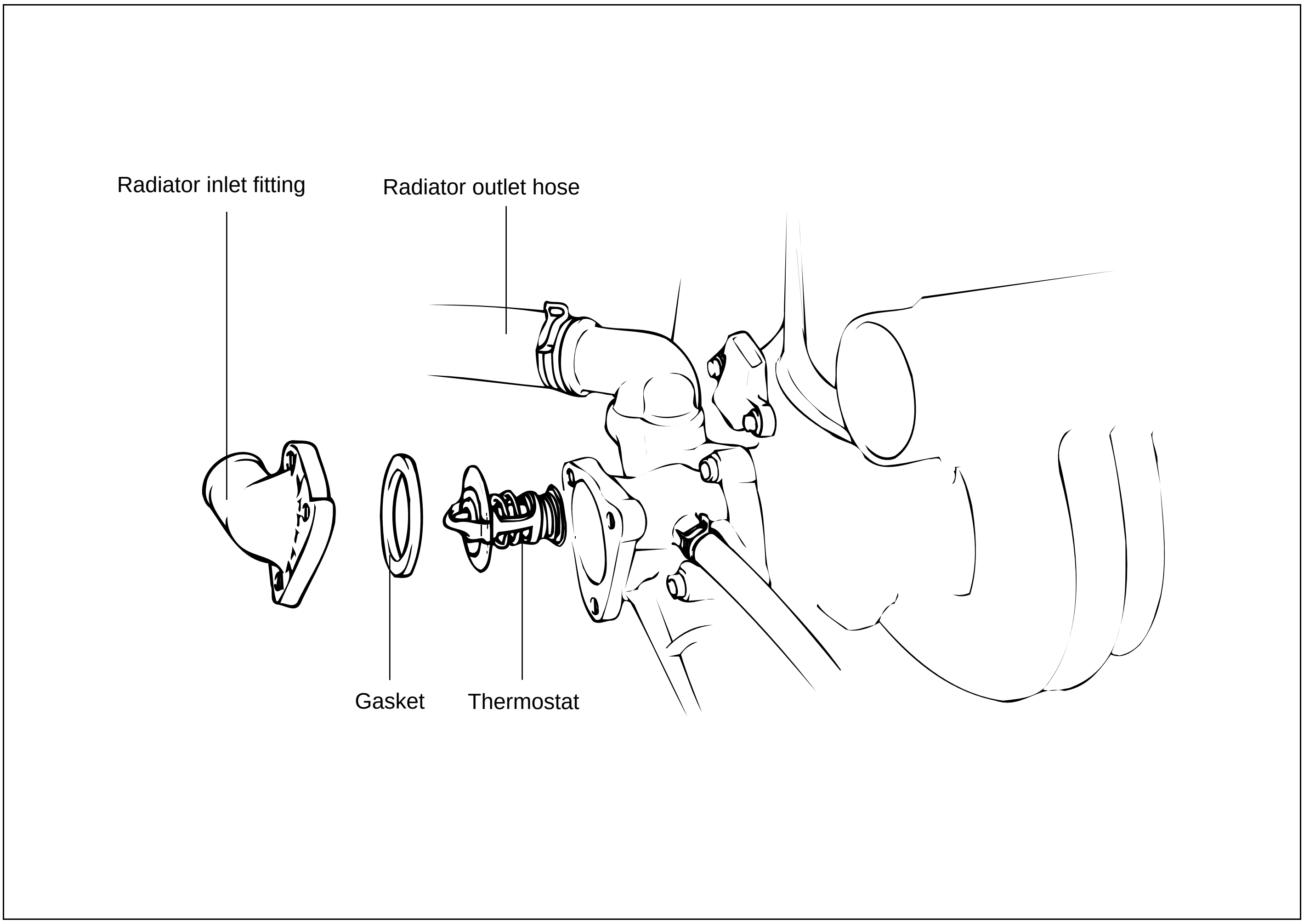
2. Connect the tester to the radiator cap.
3. Increase the pressure until the indicator stops moving.
4. Replace the radiator cap if the reading does not hold steady for about 10 seconds.



ECHA014C

THERMOSTAT

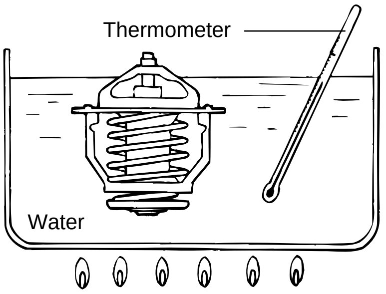
COMPONENTS ECHA6600



ECHA660A

REMOVAL ECHA6700

1. Drain the coolant so its level is below the thermostat.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.



ECA9600A

INSPECTION ECHA6800

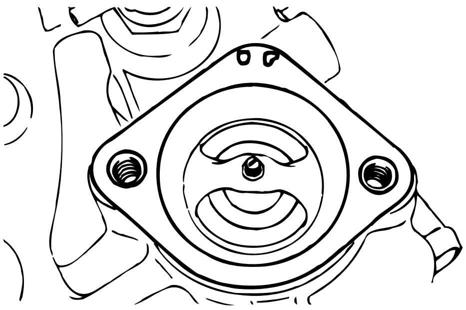
1. Heat the thermostat as shown in the illustration.
2. Check that the valve operates properly.
3. Verify the temperature at which the valve begins to open.

Valve opening temperature : 80-84°C(176-183.2°F)

Full opening temperature : 95°C(203°F)

INSTALLATION ECHA6900

1. Check that the flange of the thermostat is correctly seated in the socket of the thermostat housing.
2. Install the inlet fitting.



ECHA013B

Tightening torque

Engine coolant inlet fitting bolt :

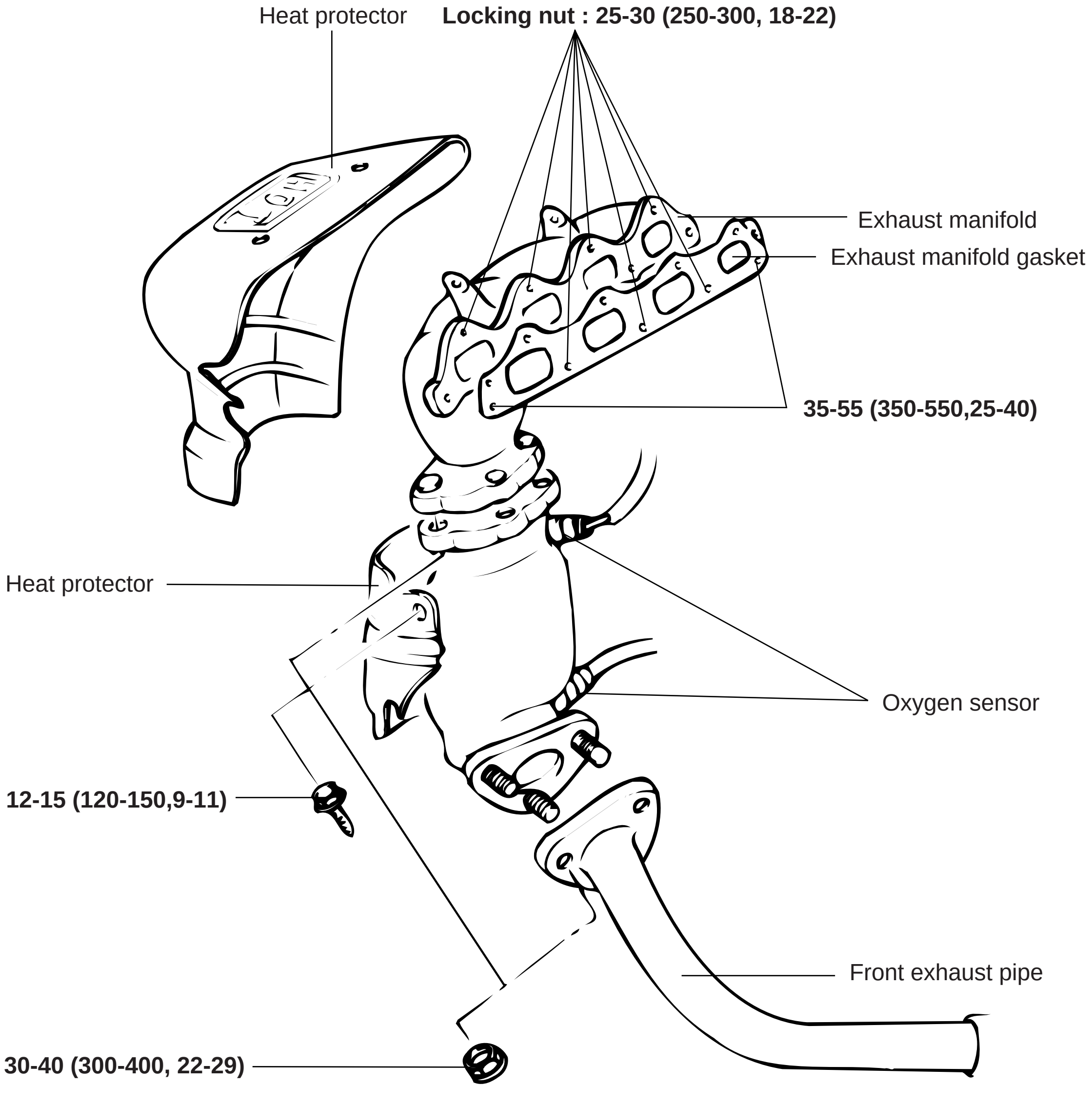
10 - 15 Nm (100 - 150 kg·cm, 7 - 11 lb.ft)

3. Refill the coolant.

INTAKE AND EXHAUST SYSTEM

EXHAUST PIPE

COMPONENTS ECAC7000



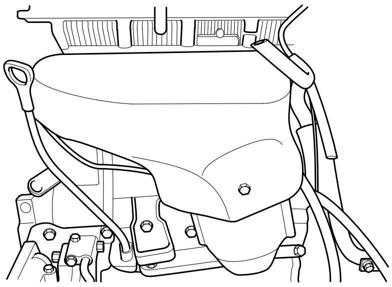
TORQUE : Nm (kg.cm, lb·ft)

ECA9071B

EXHAUST MANIFOLD

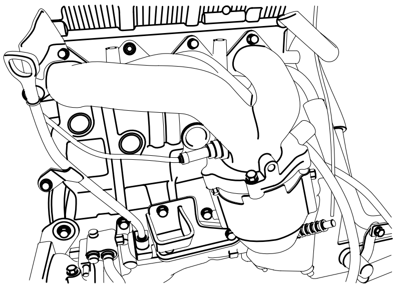
REMOVAL ECUC1800

1. Remove the heat protector.



ECUC180A

2. Remove the exhaust manifold.



ECUC180B

3. Remove the exhaust manifold gasket.

INSPECTION

1. Check for damage or cracking.
2. Using a straight edge and feeler gauge, check for distortion on the cylinder head matching surface.

Standard value : 0.15 mm (0.006 in.)

Service limit : 0.3 mm (0.012 in.)

3. Check the exhaust manifold for damage and cracking.

INSTALLATION ECUC1900

1. Install the exhaust manifold with its gasket.

Tightening torque

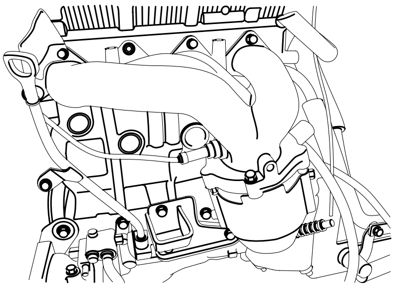
Exhaust manifold

M8 : 25-30 N.m (250-300 kg.cm, 18-22 lb.ft)

M10 : 35-55 N.m (350-550 kg.cm, 25-40 lb.ft

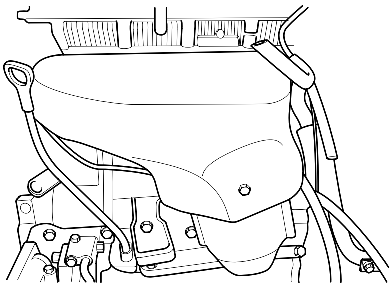
NOTE

Do not use the used exhaust manifold gasket.



ECUC180B

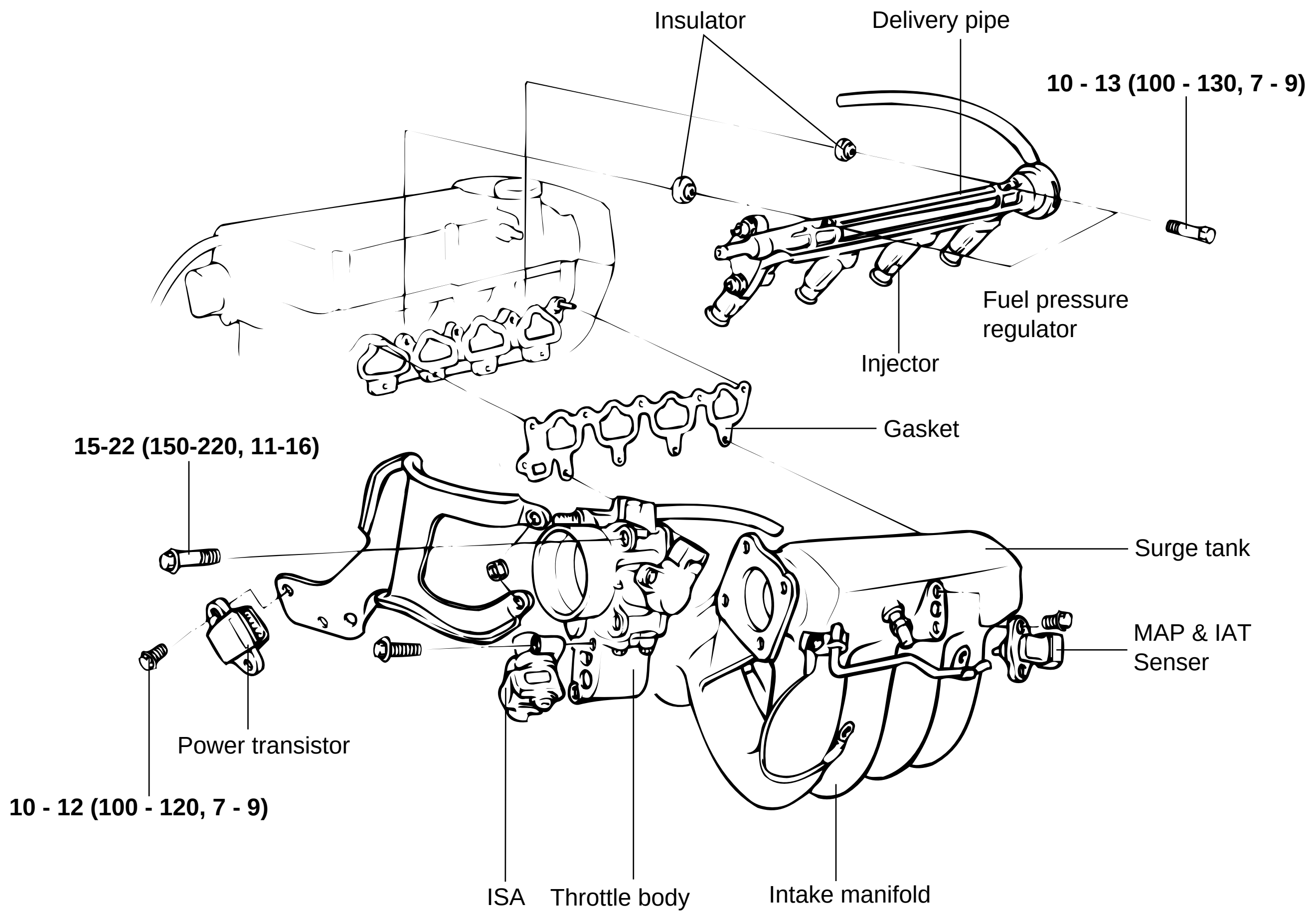
2. Install the heat protector.



ECUC180A

INTAKE MANIFOLD

COMPONENTS ECHA7500

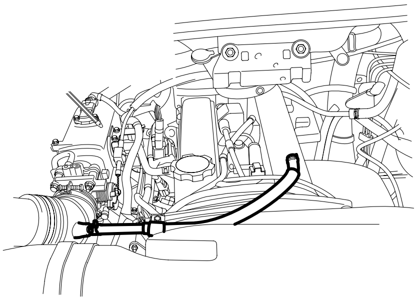


TORQUE : Nm (kg·cm, lb·ft)

ECA9067A

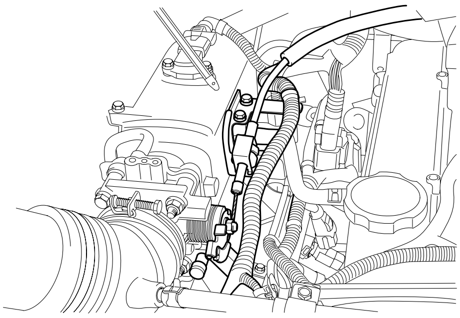
REMOVAL ECUC1950

1. Remove the air breather hose connected to the rocker cover.



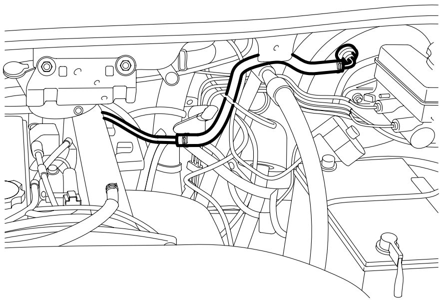
ECUC190A

2. Remove the accelerator cable.



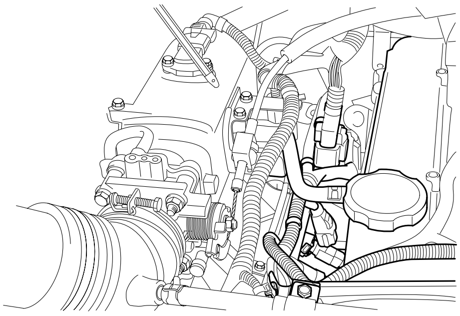
ECUC190B

3. Remove the engine coolant hose and throttle body.
4. Remove the P.C.V. valve and brake boost vacuum hose.
5. Disconnect the vacuum hose connector.



ECUC190C

6. Bleed off pressure in the fuel pipe line to prevent fuel from spilling and then disconnect the high pressure hose.
7. Disconnect the fuel injector harness connector.

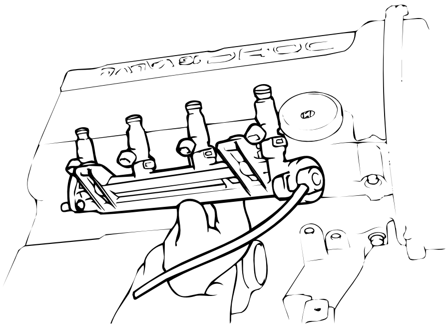


ECUC190D

8. Remove the delivery pipe with fuel injectors and the pressure regulator.

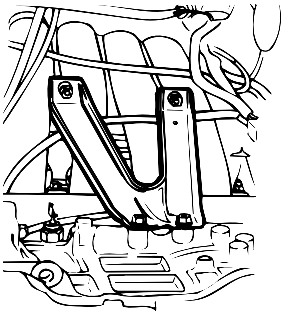
NOTE

When the delivery pipe is removed, do not drop the injectors.



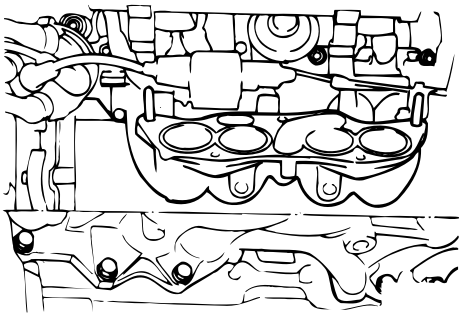
ECA9070A

9. Remove the intake manifold stay.



ECHA016C

10. Remove the intake manifold.



ECHA016J

INSPECTION ECHA7700

INTAKE MANIFOLD AND SURGE TANK

1. Check the parts for damage or cracking.
2. Check for restrictions in the vacuum outlet port, water or gas passages.
3. Check for flatness using a straight edge and feeler gauge.

Standard value : 0.15 mm (0.06 in.) or less

Service limit : 0.2 mm (0.0078 in.)

INSTALLATION ECUC2000

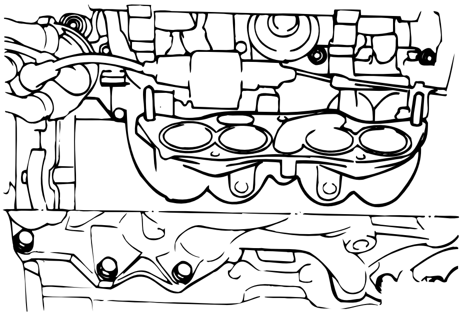
1. Install the intake manifold and new gasket to the specified torque.

Tightening torque

Intake manifold

Bolt : 15-20Nm (150-120 kg.cm, 11-14 lb.ft)

Nut : 30-42Nm (300-420 kg.cm, 22-30 lb.ft)

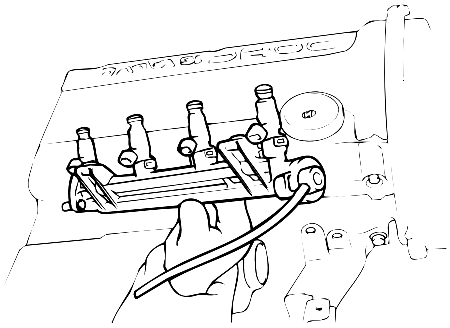


ECHA016J

2. Install the delivery pipe and injector assembly to the intake manifold.

NOTE

Make certain that there is no interferences between the injectors and injector ports on the intake manifold.



ECA9070A

3. Install the surge tank stay.
4. Connect the fuel injector connector and wiring harness and then install the cover.
5. Connect the vacuum hoses.

Tightening torque

Intake manifold stay and cylinder block :

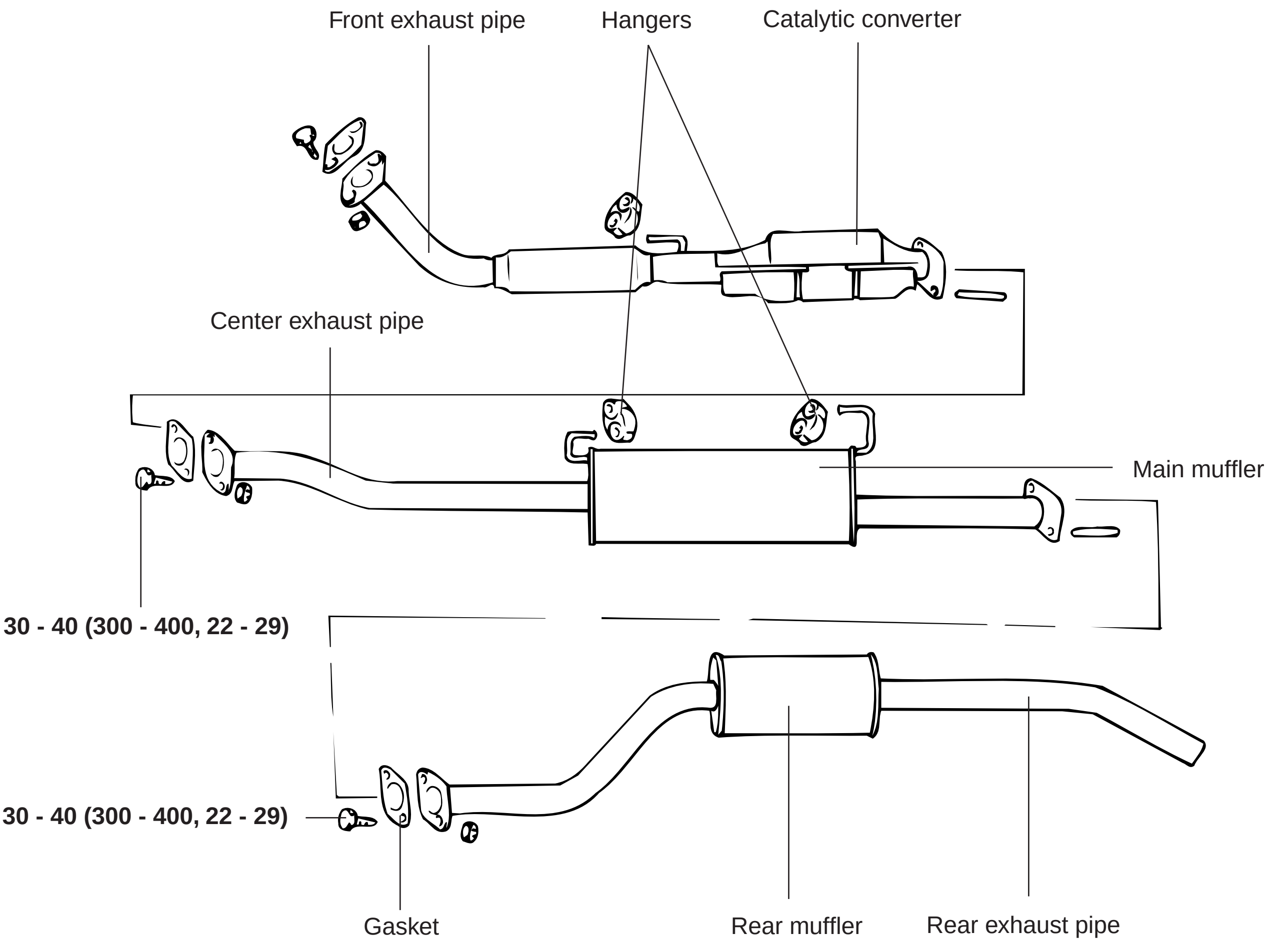
18 - 25 Nm (180 - 250 kg.cm, 13 - 18 lb.ft)

6. Connect the PCV valve and brake boost hoses.
7. Install the air breather hose.
8. Install the accelerator cable.

MUFFLER

COMPONENTS

ECUC2100



TORQUE : Nm (kg·cm, lb.ft)

ECUC210A

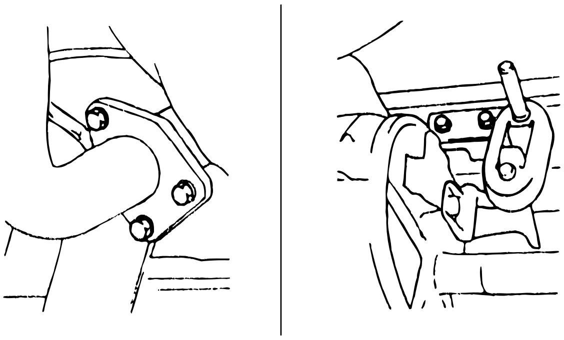
REMOVAL ECUC2200

MAIN MUFFLER

CAUTION

Before removing or inspecting the exhaust system, ensure that the exhaust system is cool.

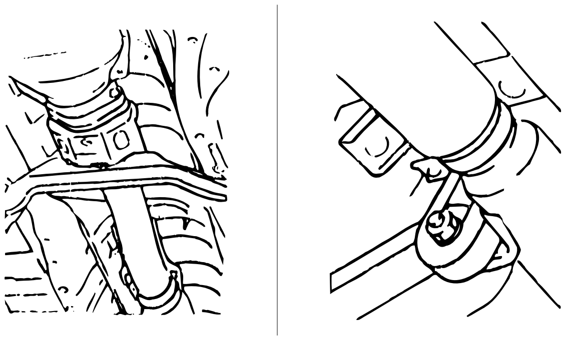
1. Disconnect the main muffler from the center exhaust pipe.
2. Remove the rubber hangers and remove the main muffler.



ECUC220A

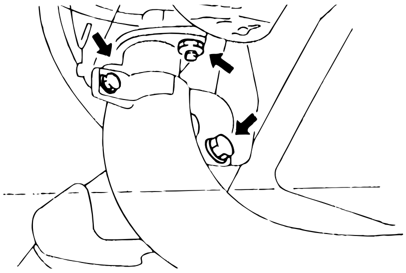
FRONT EXHAUST PIPE (INCLUDING CATALYTIC CONVERTER)

1. Remove the front exhaust pipe from the center exhaust pipe.



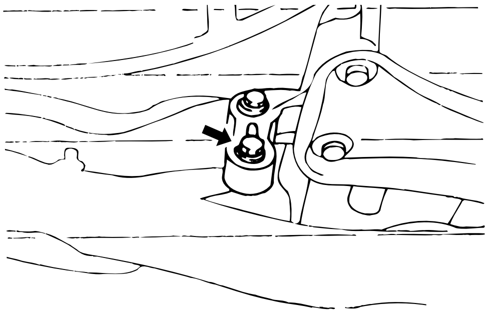
ECUC220B

2. Remove the front exhaust pipe bolts and exhaust manifold pipe mounting nuts.



ECUC220C

3. Remove the front exhaust pipe from the rubber hanger.



ECUC220D

INSPECTION ECHA8200

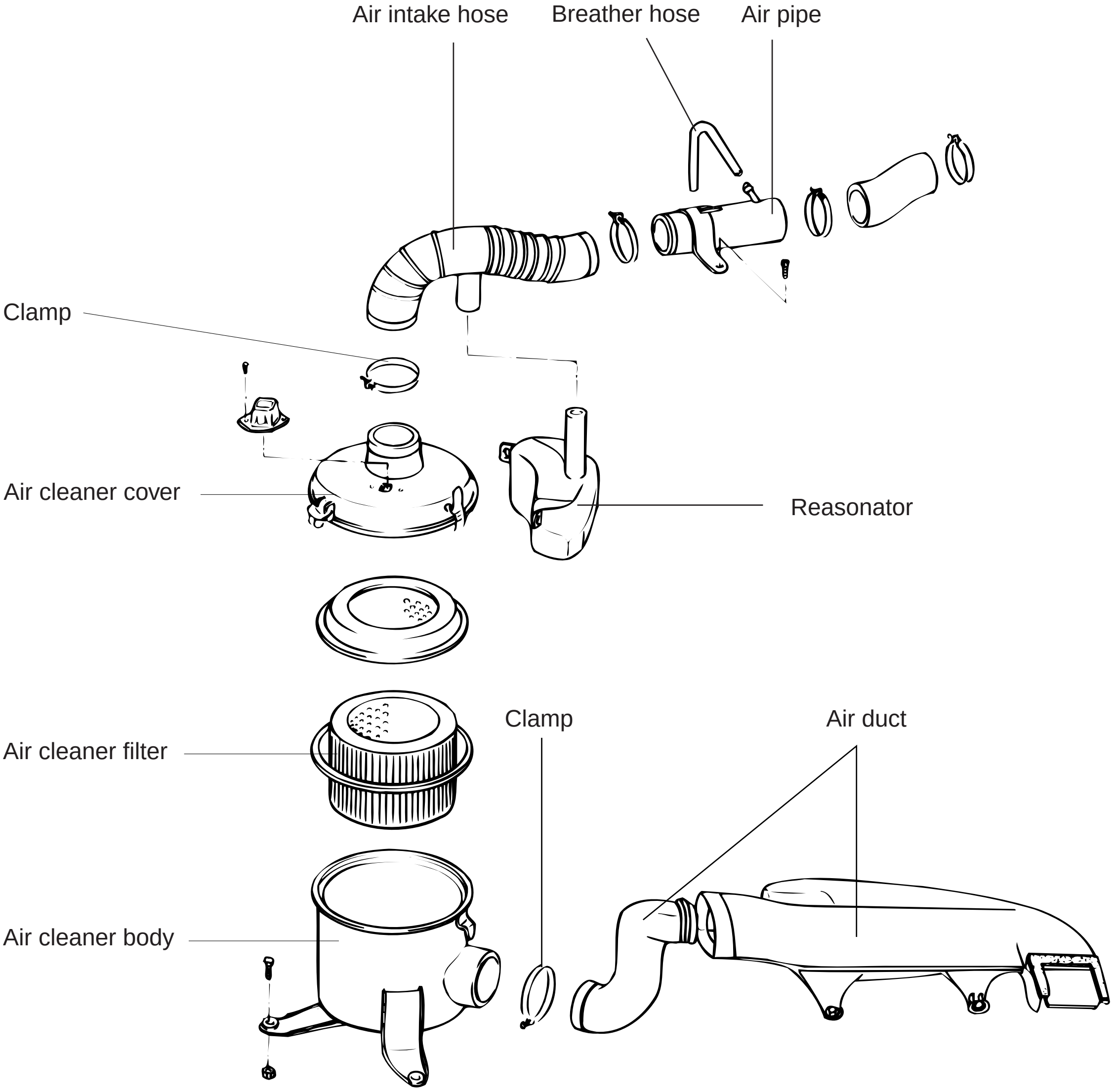
1. Check the mufflers and pipes for leaks, corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

INSTALLATION ECJA8300

1. Temporarily install the front exhaust pipe (catalytic converter assembly), the center exhaust pipe and the main muffler in this order.
2. Install the rubber hangers so that they hang equally (left and right).
3. Tighten the parts securely and then confirm that there is no interference with any of components.

AIR CLEANER (ACL)

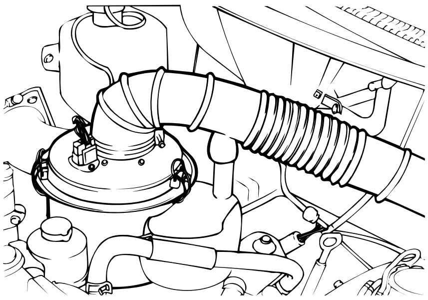
COMPONENTS ECUC2300



ECUC230A

REMOVAL ECUC2400

1. Disconnect the air flow sensor connector.
2. Remove the air intake hose at the air cleaner and the resonator.
3. Remove the three bolts attaching the air cleaner mounting brackets.
4. Detach the air cleaner.

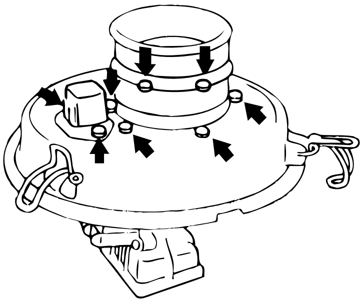


ECUC240A

5. Remove the air flow sensor from the air cleaner case.

⚠ *CAUTION*

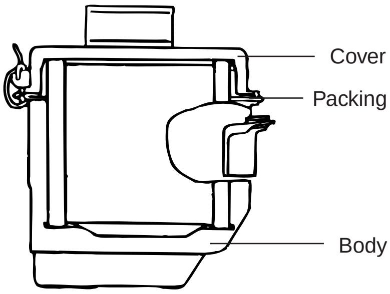
Do not pull on the air flow sensor wires because the grommet is attached to the air cleaner case.



ECUC240B

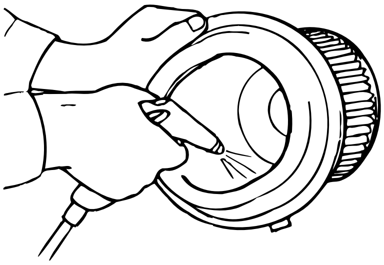
INSPECTION ECUC2500

1. Check the air cleaner body, cover, or filter for distortion, corrosion or damage.
2. Check the air duct for damage.



ECUC250A

3. Check the air cleaner element for restriction, contamination or damage. If the element is slightly restricted, remove the dust and debris by blowing compressed air from the inside of the element.



KDUB450B

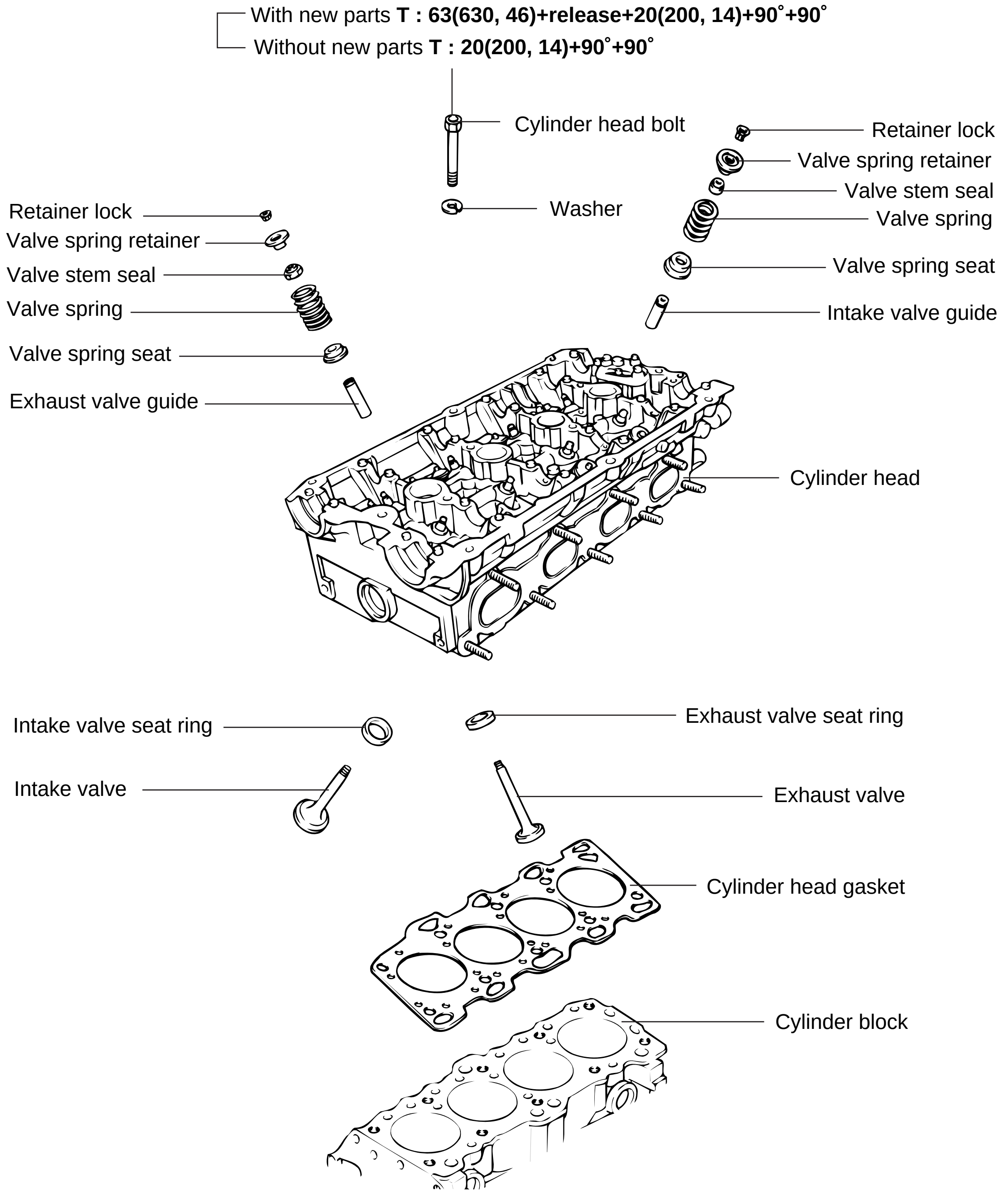
INSTALLATION ECHA8800

Install the air cleaner assembly following the reverse order of removal.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS ECHA9000

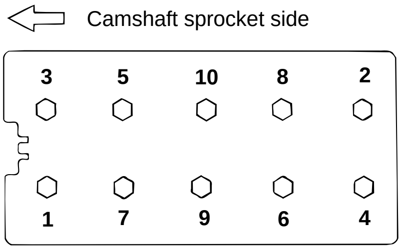


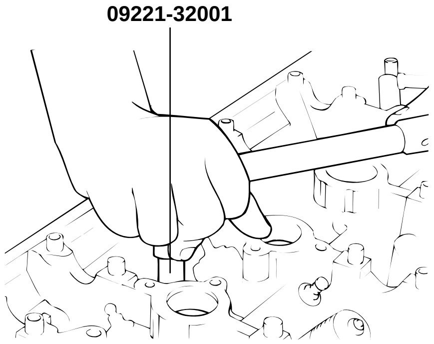
TORQUE : Nm (kg·cm, lb·ft)

ECHA900A

DISASSEMBLY ECJA9100

1. Using a special tool (09221 - 32001), remove the cylinder head bolts in the order shown in the illustration.



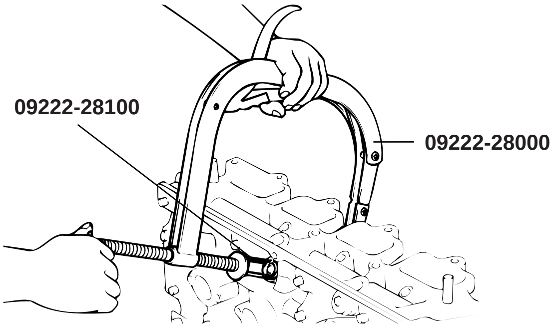


ECHA999B

2. Using the special tool (09222 - 28000, 09222 - 28100), remove the valve spring retainer lock. Then remove the spring retainer, valve spring, spring seat and valve.

NOTE

Arrange these parts so that they can be reinstalled in their original positions.

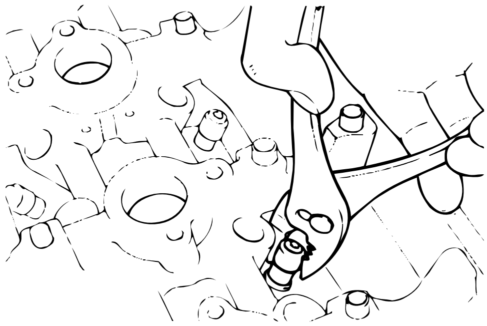


ECHA910B

3. Remove the valve stem seals with pliers.

NOTE

Do not reuse the valve stem seals.



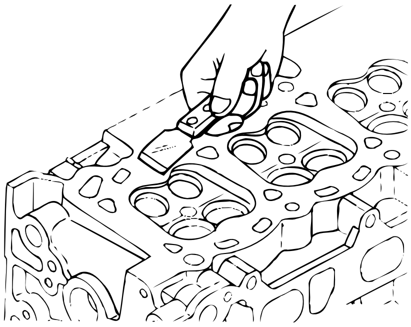
ECA9270C

INSPECTION ECHA9200

CYLINDER HEAD

1. Check the cylinder head for cracks, damage and coolant leakage. If cracked, replace the cylinder head.

2. Remove scale, sealing compound and carbon deposits completely. After cleaning the oil passages, apply compressed air to verify that the passages are not clogged.



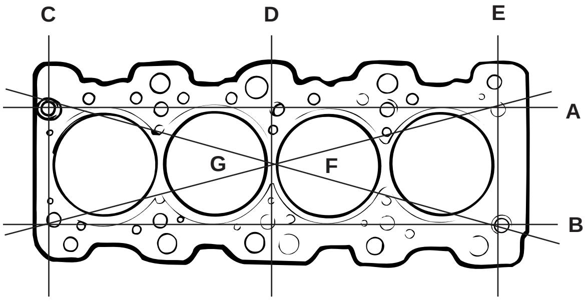
ECA9280A

3. Check the cylinder head surface for flatness in the direction as shown in the illustration. If flatness exceeds service limit in any direction, either replace the cylinder head or machine the cylinder head matching surface lightly.

Flatness of cylinder head gasket surface

Standard : Less than 0.03mm(0.0012 in.)

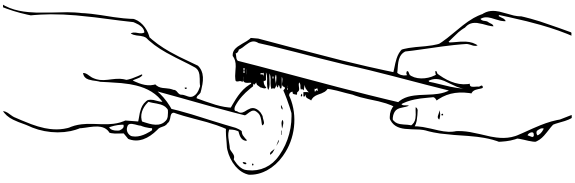
Limit : 0.2 mm (0.008 in.)



ECHA920A

VALVES

1. Using a wire brush, clean the valve thoroughly.



ECA9281A

2. Check each valve for wear, damage and distortion of the head and the stem at B Position. Replace, if necessary. If stem end, A, is hollowed out or worn, resurface as necessary. This correction must be limited to a minimum. Also resurface the valve face.
   Replace the valve if the margin has decreased to less than the service limit.

Margin

[Standard]

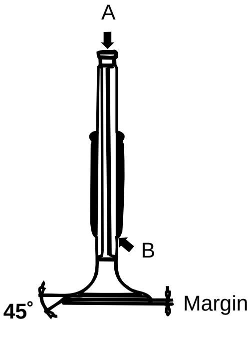
Intake : 1.0mm (0.040 in.)

Exhaust : 1.5mm (0.059 in.)

[Limit]

Intake : 0.7mm (0.028 in.)

Exhaust : 1.0mm (0.040 in.)



ECA9281B

VALVE SPRINGS

1. Check the free height of each valve spring. If they exceed the service limit, replace the springs.
2. Using a square, test the squareness of each spring. If a spring is excessively out- of-square, replace it.

Valve spring

[Standard]

Free height : 45.82mm(1.804 in.)

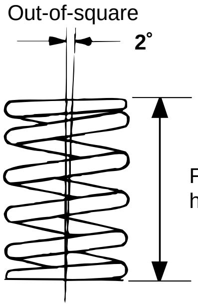
Load : 25.3kg/40mm (55.8 lb/1.57 in.)

Out of square : 1.5° or less

[Limit]

Free height : 44.82mm(1.7646in.)

Out of square : 4°



ECA9281C

VALVE GUIDES

Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with the next oversize part.

Valve stem-to-guide clearance

[Standard]

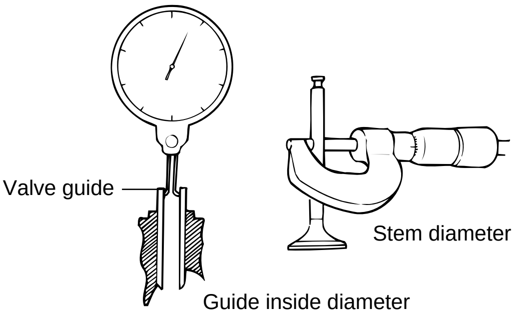
Intake : 0.020-0.047mm(0.0008-0.0020 in.)

Exhaust : 0.050-0.085mm(0.0020-0.0033 in.)

[Limit]

Intake : 0.1mm(0.0040 in)

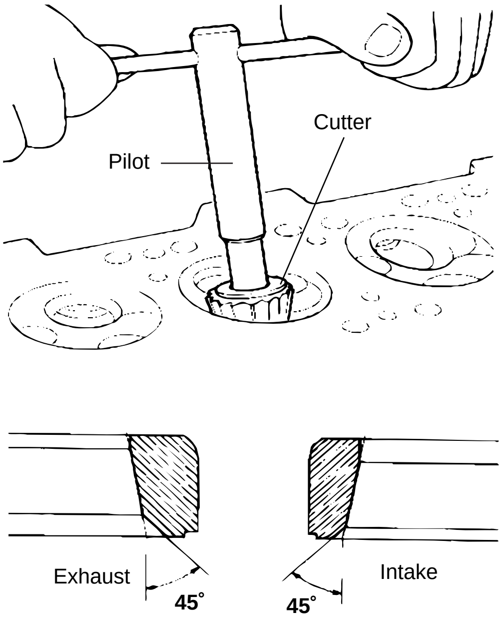
Exhaust : 0.15mm(0.0059 in.)



ECA9281D

RECONDITIONING VALVE SEAT

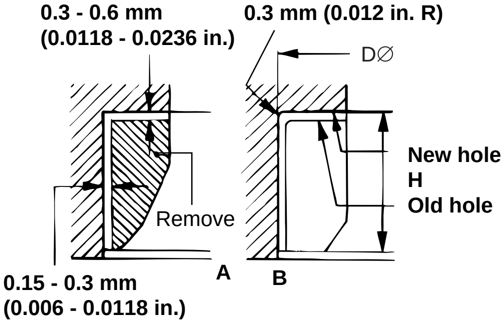
Check the valve seat for overheating and unequal contact with the valve face. Recondition or replace the seat if necessary. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it and then recondition the seat. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specificatons and centered on the valve face. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.



ECHA920B

REPLACING THE VALVE SEAT RING

1. Cut away the inner face of the valve seat to reduce the wall thickness.



ECA9281F

2. Enlarge the diameter of the valve seat so that it matches the specified oversize hole diameter of the new valve seat ring.
3. Heat the cylinder head to about 250°C (480°F) and press-fit an oversize seat ring for the bore in the cylinder head.
4. Using lapping compound, lap the valve to the new seat.

Valve seat contact width :

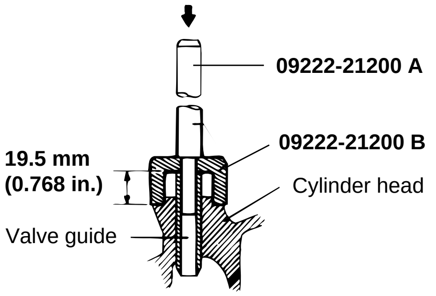
0.9 -1.3 mm (0.035-0.051 in.)

VALVE SEAT INSERT OVERSIZES

Description	Size mm (in.)	Size mark	Seat ring height H mm(in.)	Oversize hole diameter I.D. mm(in.)
Intake valve Seat ring	0.3(0.012) O.S. 0.6(0.024) O.S.	30 60	7.9-8.1 (0.311-0.319) 8.2-8.4 (0.323-0.331)	35.300-35.325 (1.3898-1.3907) 35.600-35.625 (1.4016-1.4026)
Exhaust valve Seat ring	0.3(0.012) O.S. 0.6(0.024) O.S	30 60	7.9-8.1 (0.311-0.319) 8.2-8.4 (0.323-0.331)	33.300-33.325 (1.3110-1.3120) 33.600-33.625 (1.3228-1.3238)

REPLACING VALVE GUIDE

1. Using the special tool (09222 - 21200A), withdraw the old valve guide toward the bottom of cylinder head.
2. Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.

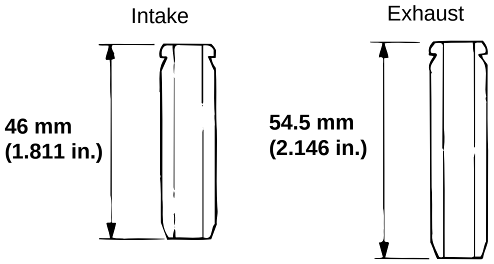


ECA9281G

3. Using the special tool (09222-21200 A, B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.

NOTE

Do not install a valve guide unless it is oversize.



ECA9281H

4. After the valve guide is press-fitted, insert a new valve and check for proper stem-to-guide clearance.
5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

VALVE GUIDE OVERSIZES

Over size mm (in.)	Size mark	Oversize valve guide hole size mm (in.)
0.05(0.002)	5	12.050-12.068 (0.4744-0.4751)
0.25 (0.010)	25	12.250-12.268 (0.4823-0.4830)
0.50 (0.020)	50	12.500-12.518 (0.4921-0.4928)

REASSEMBLY ECJA9300

NOTE

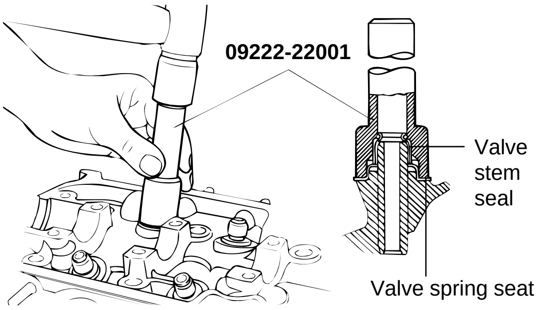
1. *Clean each part before assembly.*
2. *Apply engine oil to the sliding and rotating parts.*

1. Install the spring seats.
2. Using a special tool (09222 - 28200), tap the seal in position lightly.

NOTE

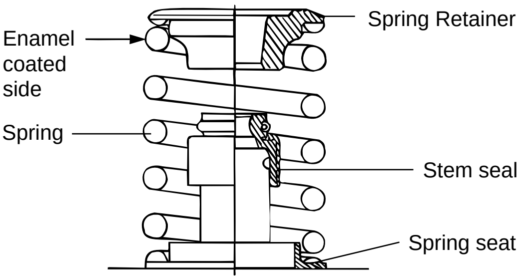
- *Do not reuse old valve stem seals.*
- *Incorrect installation of the seal could result in oil leakage past the valve guides.*

3. Apply engine oil to each valve. Insert the valve into the valve guide. Avoid pushing the valve into the seal by force. After inserting the valve, check that it moves smoothly.



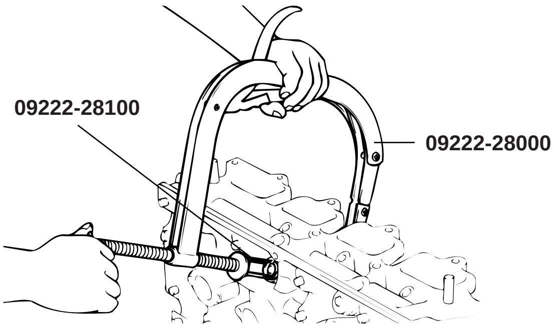
ECHA930A

4. Place valve springs so that the side coated with enamel faces the valve spring retainer and then install the retainer.



ECA9290B

5. Using the special tool (09222 - 28000, 09222 - 28100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



ECHA910B

NOTE

When the spring is compressed, Check that the valve stem seal is not pressed against the bottom of the retainer.

6. Clean both gasket surfaces of the cylinder block and cylinder head.

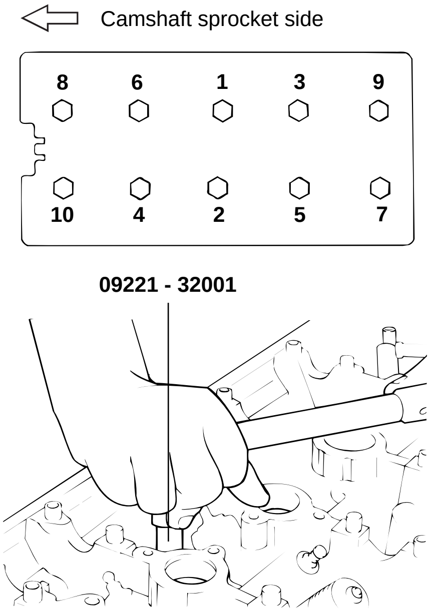
7. Verify the identification marks on the cylinder head gasket.

8. Install the gasket so that the surface with the identification mark faces toward the cylinder head.

NOTE

Check and measure the length of each head bolt. Maximum length : 99.4 mm (3.9 in.)

9. Tighten the bolts to the specified torque.



ECHA910A

Tightening torque

With used parts (head bolt, cylinder head, cylinder block) : 20Nm (200 kg.cm, 14 lb.ft)+90°+90°

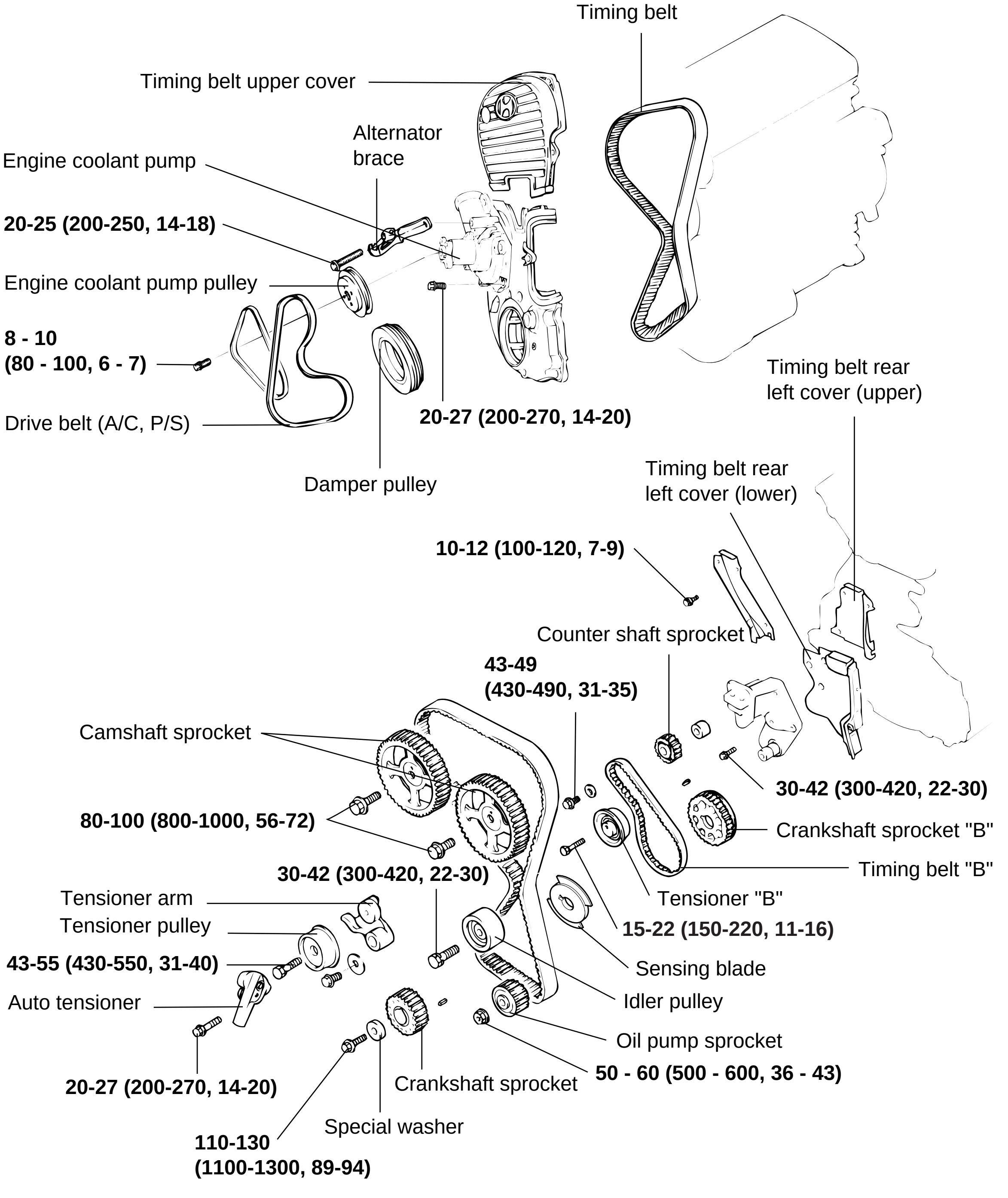
With new parts (even if only onething is replaced) :

64Nm (640 kg.cm, 46 lb.ft)+release+20Nm (200 kg.cm, 14 lb.ft)+90°+90°

TIMING SYSTEM

TIMING BELT

COMPONENTS ECAC9500



TORQUE : Nm (kg·cm, lb·ft)

ECAC950A

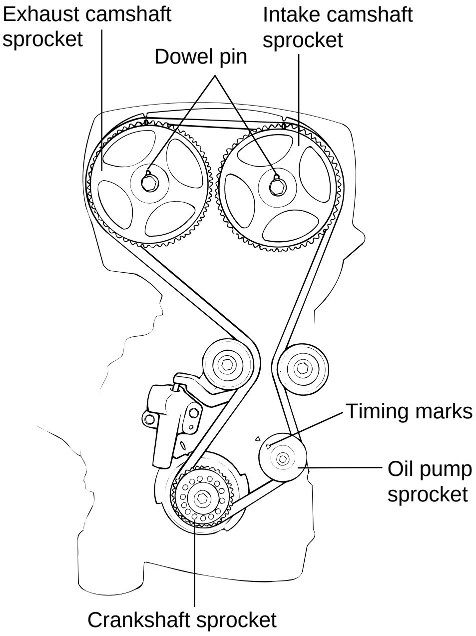
REMOVAL ECAC9600

CAUTION

Rotate the crankshaft clockwise and align the timing marks to set the No. 1 cylinder's piston to TDC.

At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with eachother and the dowel pin of the camshaft sprocket should be at the upper side.

1. Remove the crankshaft pulley, engine coolant pump pulley and drive belt.
2. Remove the timing belt cover.
3. Remove the auto tensioner.



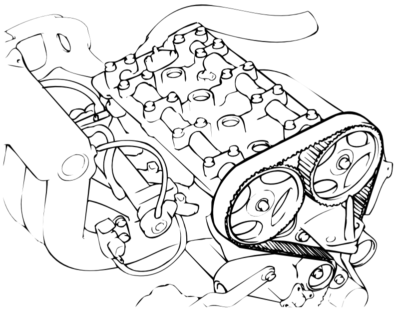
ECA9023A

NOTE

If the timing belt is reused, make an arrow mark indicating the turning direction (or the front of the engine) to make sure that the belt is reinstalled in the same direction as before.

In this case the timing marks on the camshaft sprocket and on the locker cover should be aligned and the dowell pins on the camshaft sprockets should be positioned upward.

4. Remove the timing belt.

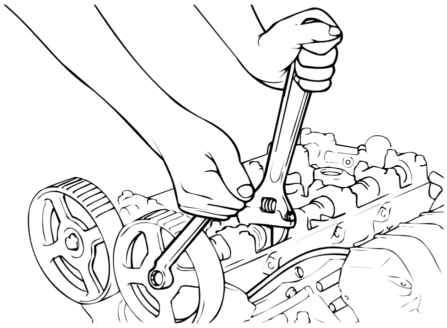


ECA9024A

5. Remove the camshaft sprockets.

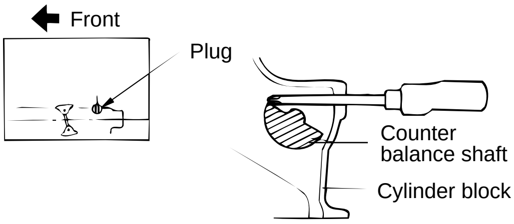
NOTE

Be careful not to damage the cylinder head and camshaft sprocket with the wrench.



ECA9170C

6. When the oil pump sprocket nut is removed, first remove the plug at the left side of the cylinder block and insert a screwdriver to keep the left counter balance shaft in position. Use a screwdriver with a shaft measuring 8 mm (0.3in.) in diameter which can be inserted by more than 60 mm (2.36 in.)
7. Remove the oil pump sprocket retaining nut and the oil pump sprocket.



ECA9170D

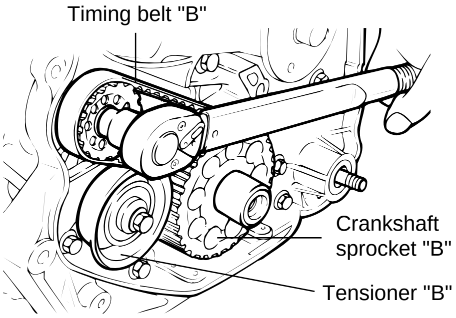
8. Loosen the right counter balance shaft sprocket mounting bolt until it can be loosened by hand.

9. Next, remove the tensioner "B" and then the timing belt "B."

CAUTION

After the timing belt "B" is removed, do not attempt to loosen bolts while holding the sprocket with pliers or any other tool.

10. Remove the crankshaft sprocket "B" from the crankshaft.

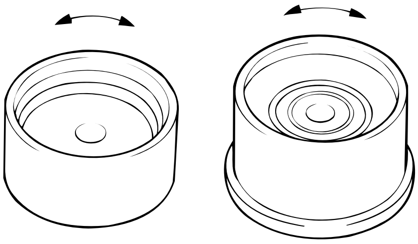


ECA9025A

INSPECTION ECAC9700

SPROCKETS, TENSIONER PULLEY AND IDLER PULLEY

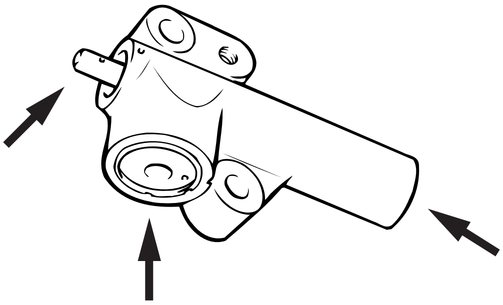
1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley and idler pulley for abnormal wear, cracks or damage. Replace if necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace if necessary.
3. Replace the pulley if there is a grease leak from its bearing.



ECAC950B

AUTO TENSIONER

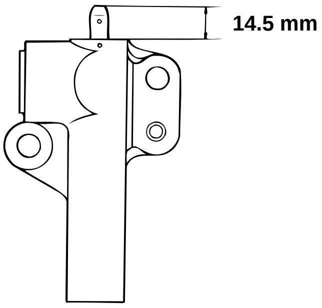
1. Check the auto tensioner for leaking and replace if necessary.
2. Check the rod end for wear or damage and replace if necessary.



ECA9026A

3. Measure the rod protrusion. If it is out of specification, replace the auto tensioner.

Standard value : 14.5 mm (0.57 in)

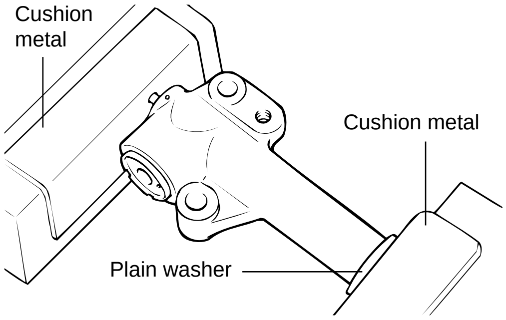


ECHA970A

4. Using a soft jaw vise , compress the auto tensioner rod. slowly. If the rod can be easily retracted, replace the auto tensioner. You should feel extensive resistance when pushing the rod in. And it must be compressed in sereral steps.

NOTE

Clamp the auto tensioner in the vise so that it is level. Use soft jaws in the vise to avoid damaging the auto tensioner.

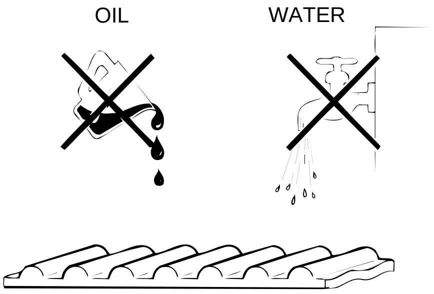


ECA9028A

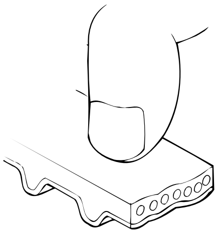
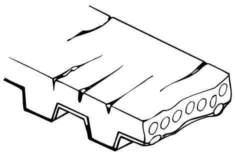
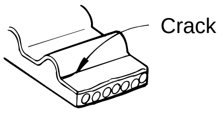
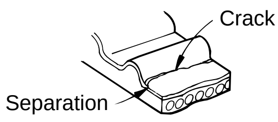
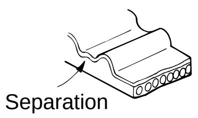
TIMING BELT

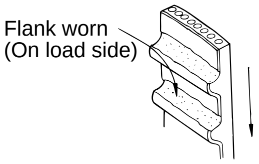
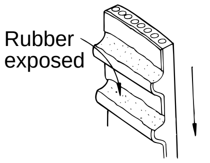
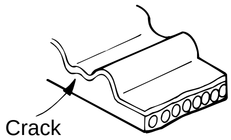
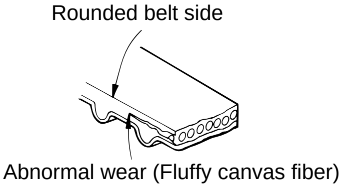
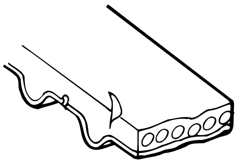
1. Check the belt for oil or dust deposit. Replace if necessary. Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.

2. When the engine is overhauled or belt tension is adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt with a new one.



ECA9200A

Description	Flaw conditions
1. Hardened back surface of rubber	Back surface is glossy, Non-elastic and so hard that, when your fingernail is pressed into it, no mark is produced.  ECA9200B
2. Cracked back surface of rubber	 ECA9200Y
3. Cracked or separating canvas	 ECA9200I  ECA9200J  ECA9200K

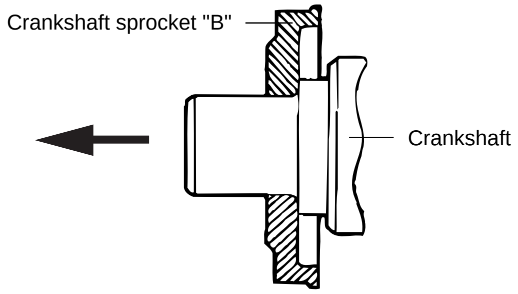
Description	Flaw conditions
4. Badly worn out teeth (initial stage)	Tooth flank shows canvas on the load side (Fluffy canvas fibers, rubber changed into white color and unclear canvas texture)  ECA9200C
5. Badly worn out teeth (last stage)	Tooth flank worn and rubber exposed on load side (tooth width reduced)  ECA9200D
6. Cracked tooth bottom	 ECA9200E
7. Missing tooth	 ECA9200F
8. Badly worn side of belt	 ECA9200G
9. Cracked side of belt	 ECA9200H

INSTALLATION ECAC9800

1. Install the crankshaft sprocket "B" into the crankshaft.

⚠ *CAUTION*

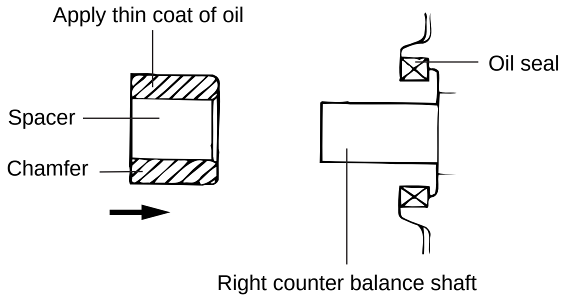
Pay attention to the direction of the flange. If it is installed in the wrong direction, a broken belt could result.



ECA9210A

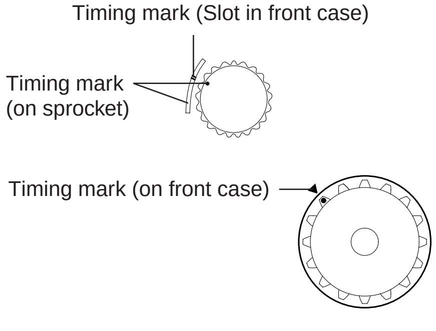
2. Apply engine oil to the outer surface of the spacer lightly and then install the spacer to the right counter balance shaft. Be sure to install in the direction shown in the illustration.

3. Install the counter balance shaft sprocket onto the right counterbalance shaft and then tighten its flange bolt by hand tightly.



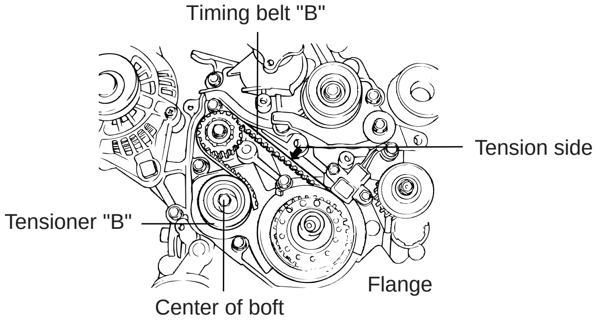
ECA9210B

4. Align the timing mark on each sprocket with the corresponding timing mark on the front case.



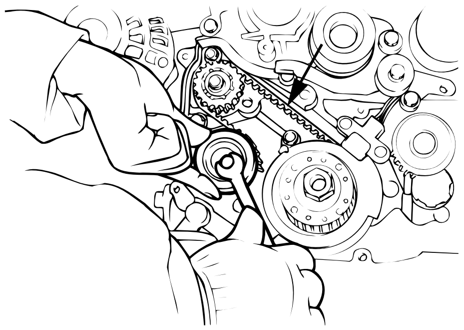
ECAC950C

5. When the timing belt "B" is installed, make certain that its tension side has no slack.
   Install the tensioner "B" so the center of the pulley is located on the left side of the mounting bolt and in the pulley flange faces the front of the engine.
   Align the timing mark on the right counter balance shaft sprocket with the timing mark on the front case.



ECA9084A

6. Lift the tensioner "B" to tighten the timing belt "B" so that its tension side is pulled tight. In this condition, tighten the bolt to secure tensioner "B". As the bolt is tightened, be careful to prevent the shaft from turning. If the shaft is turned, the belt will be tightened excessively.



ECA9083A

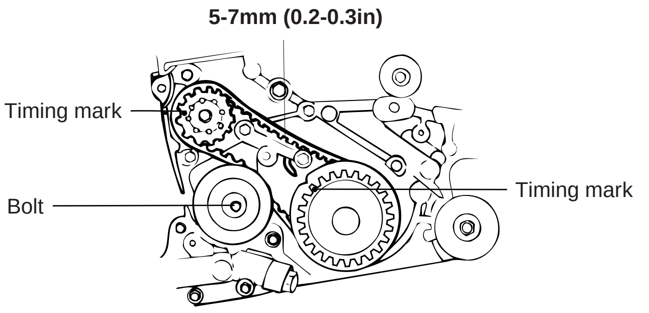
7. Check to ensure that the timing marks are in alignment.

8. Verify the tension of the timing belt.
   Method 1 : Verify that, when the center of the span on the tension side is depressed with an index finger in the direction of arrow, the deflection of the belt is within specification.

Belt deflection : 5-7 mm (0.20-0.28 in)

Method 2 : Measure the tension of the timing belt by using a tension gaugent.

Span length	Pressure	Torque
139mm (5.47 in.)	0.42 kg/cm² (42 kPa)	50-100Nm (500-1000kg.cm, 36-72 lb.ft)

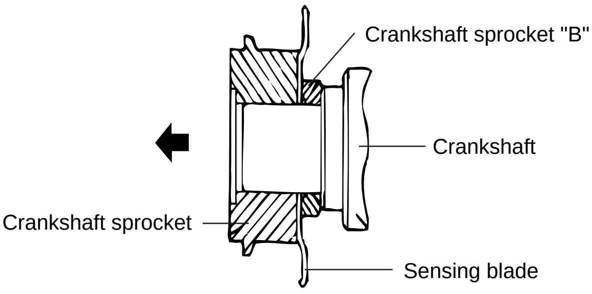


ECAC950D

9. Install the flange and crankshaft sprocket onto the crankshaft. Be sure to install the as shown in the illustration.

CAUTION

Pay attention to the direction of the flange. If it is installed in the wrong direction, a broken belt could result.



ECA9210G

10. Install the special washer and sprocket bolt to the crankshaft and then tighten the sprocket bolt.

Tightening torque

Crankshaft sprocket bolt :

110 - 130 Nm (1100 - 1300 kg.cm, 80 - 94 lb.ft)

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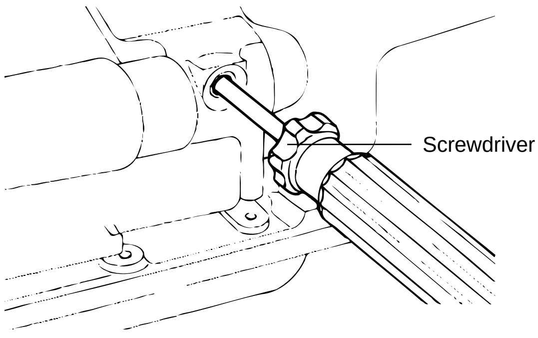
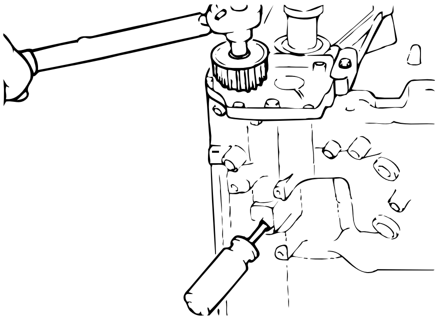
11. Insert a screwdriver through the plug hole in the left side of the cylinder block to keep the shaft in position.



ECA9210H

12. Install the oil pump sprocket and tighten the nut to the specified torque.



ECA9210I

Tightening torque

Oil pump sprocket :

50 - 60 Nm (500 - 600 kg.cm, 36 - 43 lb.ft)

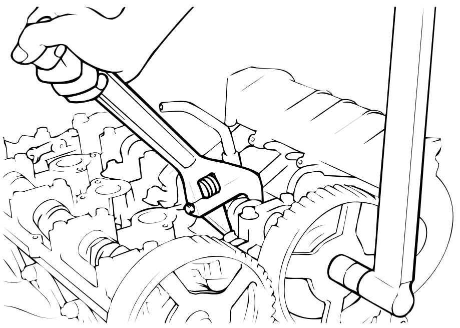
---

13. Install the camshaft sprocket and tighten the bolt to the specified torque.

Tightening torque

Camshaft sprocket bolt :

80-100 Nm (800-1000 kg.cm, 58-72 lb.ft)

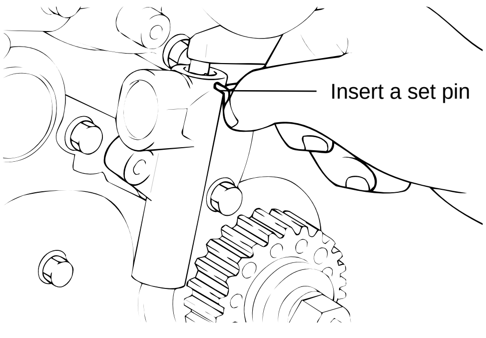


ECA9210K

14. Install the auto tensioner.

CAUTION

Leave the set pin installed in the auto tensioner.

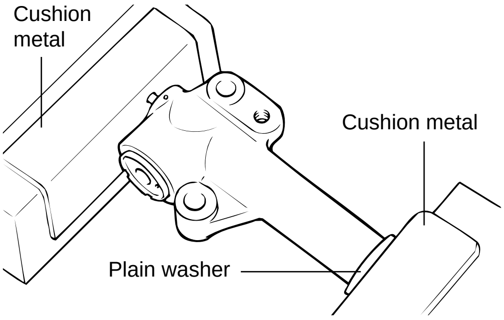


ECHA980A

NOTE

If the auto tensioner rod is in its fully extended position, reset it as follows.

1. *Clamp it in a vise equipped with soft jaws, in a level position. Use a plain washer if there is a plug at the bottom of the auto tensioner.*
2. *Compress the rod slowly with the vise until the set hole in the rod is aligned with set hole in the cylinder.*



ECA9028A

3. *Insert a set pin through the auto tensioner body and rod.*

CAUTION

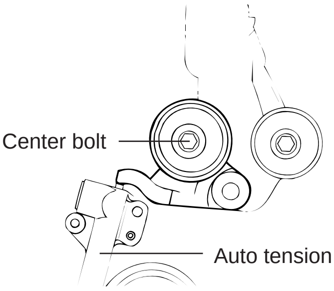
Leave the set pin installed in the auto tensioner.

15. Install the tensioner pulley onto the tensioner arm.

Tightening torque

Tensioner pulley :

43 - 55 Nm (430 - 550 kg.cm, 31 - 40 lb.ft)

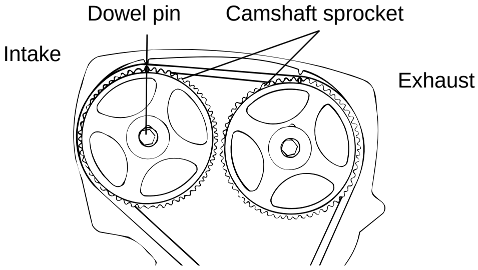


ECAC950E

16. Rotate the camshaft sprockets so that the dowel pin of the camshaft sprocket is at the upper side. Set the timing mark of sprocket correctly.

NOTE

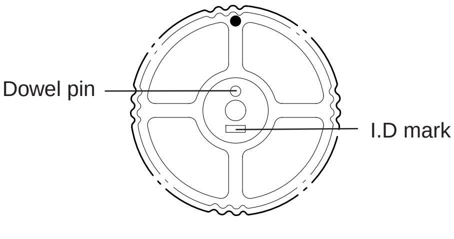
1. *Before installing the timing belt, if the timing mark of the camsprocket doesn't coincide with that of the rocker cover, do not rotate the cam sprocket more than 2 teeth of the sprocket in any direction. Rotating the sprocket more than 2 teeth may make the valve and piston touch each other.*
2. *If it is necessary to rotate the cam sprocket more than 2 teeth, rotate the crank sprocket counter clock wise first based on the timing mark.*
   After the camsprocket is properly timed return the crankshaft to TDC.



ECA9029A

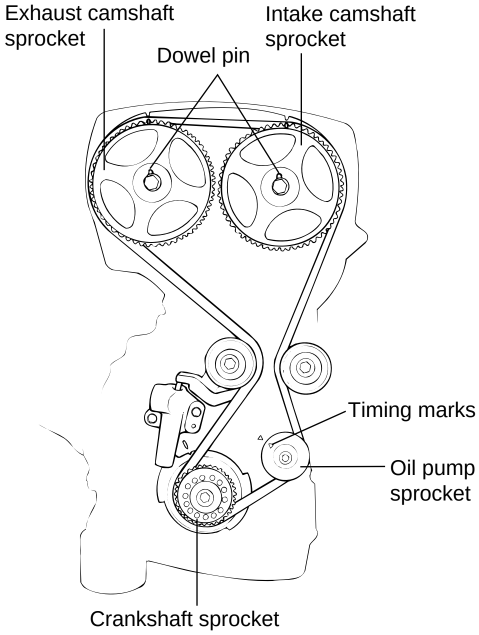
NOTE

When exhaust and intake camshaft sprocket is used and install it after checking I.D mark depending on the engine deplacemeat.



ECAC950F

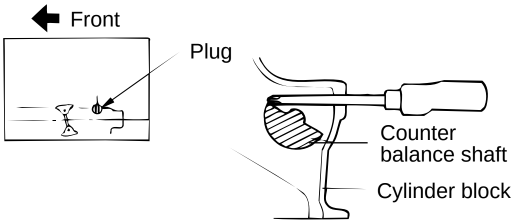
17. Align the timing mark on each sprocket with the corresponding timing mark and install the belt as the following order.
    Crankshaft sprocket - Oil pump sprocket - Idler pulley - Exhaust camshaft sprocket - Intake camshaft sprocket - Tensioner pulley



ECA9023A

NOTE

1. *Be sure that the piston of NO.1 cylinder is located in TDC position (Compression storke).*
2. *When aligning the timing mark on oil pump sprocket, remove the letf plug of cylinder block, and then check that the count balance shaft is in the specified position by inserting the screwdriver (Diameter : 8mm, inserting length : 60mm or more)*



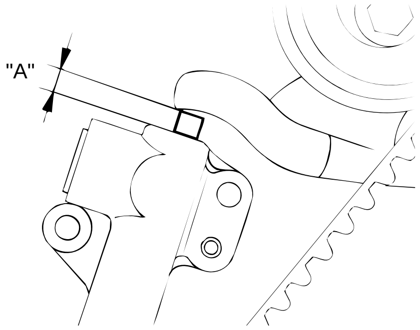
ECA9170D

3. *After checking the timing mark, install the lift plug of cylinder block.*
   Tightening torque : 2.7 - 3.4 kgf.m
   (Apply the liquid gasket : THREE BOND NO.1212B or equivalent)

18. Pull out the set pin.

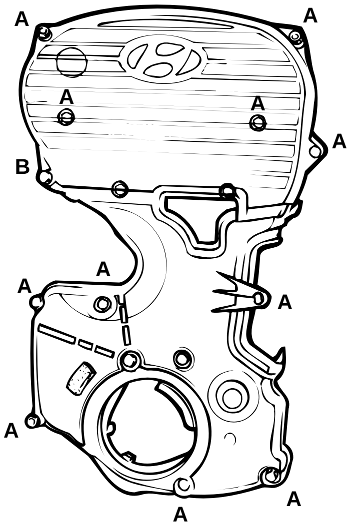
19. Rotate the crankshaft two turns clockwise and leave it for about 5 minutes. Then, measure the auto tensioner protrusion "A" (Distance between the tensioner arm and auto tensioner body) to ensure that it is within the specification.

Standard value : 5.5 - 9 mm (0.22 - 0.35 in)



ECA9210R

20. Install the timing belt lower cover and the timing belt upper cover.



A:8-10 N.m (80-100 kg.cm, 6-7 lb.ft)

B:10-12 N.m (100-120 kg.cm, 7-9 lb.ft)

ECHA980B

Engine Mechanical System [2.5 TCI]

GENERAL .... EMA - 2

ENGINE BLOCK .... EMA -26

MAIN MOVING SYSTEM .... EMA -38

COOLING SYSTEM .... EMA -45

LUBRICATION SYSTEM .... EMA -54

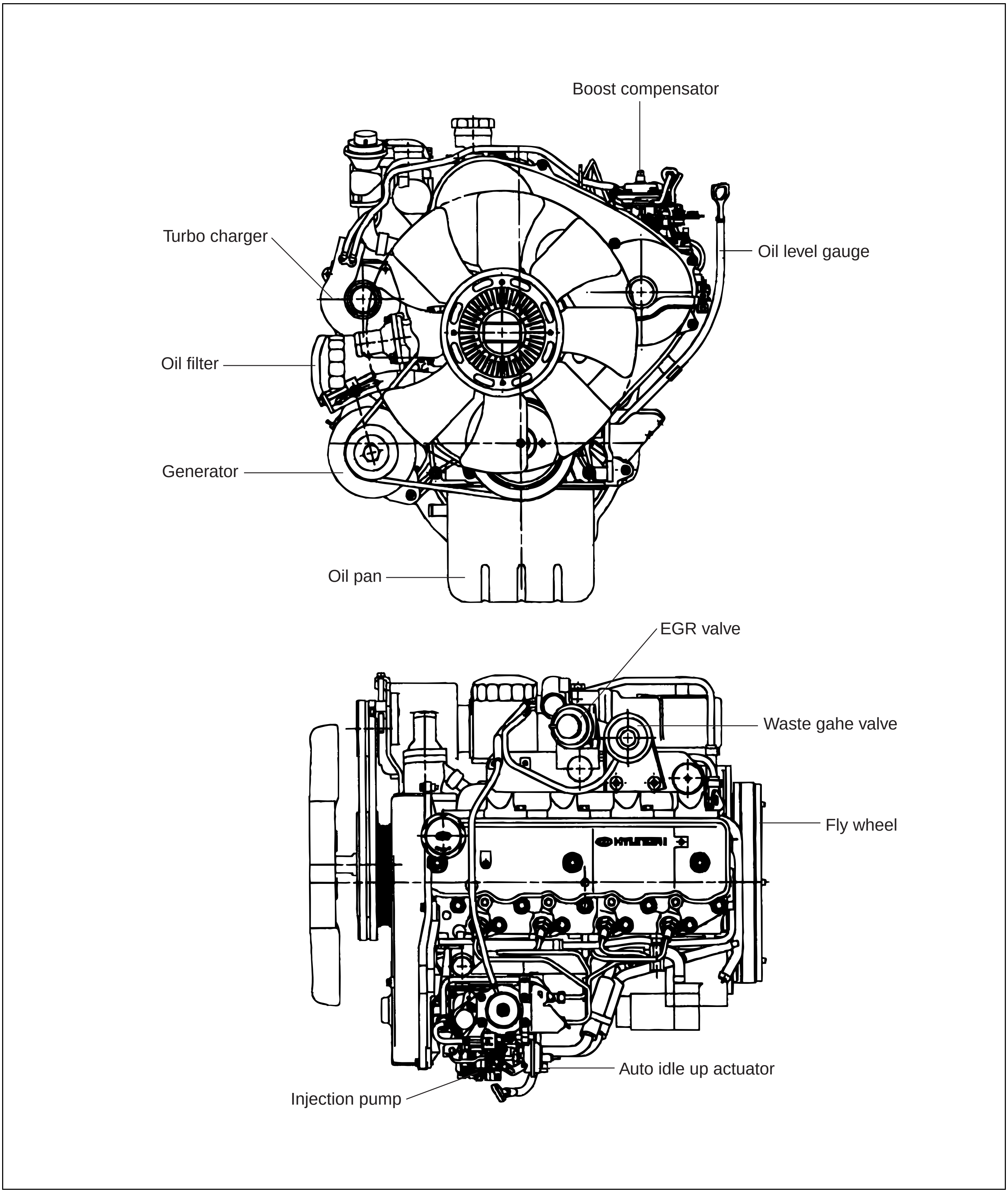
INTAKE AND EXHAUST SYSTEM .... EMA -59

CYLINDER HEAD ASSEMBLY .... EMA -69

TIMING SYSTEM .... EMA -77

GENERAL

GENERAL ECLB0010



ECLA001B

SPECIFICATIONS EDUC0100

	Standard	Limit
General		
Type		
TC, TCI	Diesel engine	
N/A		
No. of cylinders	4 in - line	
Valve mechanism	OHC	
Total displacement		
TC, TCI	2,467 cc	
N/A	2,607 cc	
Bor x stroke		
TC, TCI	91.1 × 95 mm	
N/A	91.1 × 100 mm	
Compression ratio		
TC, TCI	21	
N/A	22	
Compression pressure		
TC, TCI	27kg/250-400rpm	
N/A	30kg/290rpm	
Valve timing		
Intake valve	20°	
Opens (BTDC)	48°	
Closes (ABDC)		
Exhaust valve	54°	
Opens (BTDC)	22°	
Closes (ABDC)		
Firing order	1 - 3 - 4 - 2	
Cylinder head		
Flatness of gasket surface	0.05 mm (0.002 in.)	0.2 mm (0.0079 in.)
Flatness of maunting mounting surface	0.15 mm (0.006 in.)	0.3 mm (0.0118 in.)
Overall height	94.0 - 94.1 mm (3.701 - 3.705in.)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)		
0.05	13.050 - 13.068 mm (0.5138 - 0.5145)	
0.25	13.250 - 13.268 mm (0.5127 - 0.5224)	
0.50	13.500 - 13.518 mm (0.5315 - 0.5322)	
Oversize rework dimensions of intake valve seat ring hole		
0.30	43.300 - 43.325 mm (1.7047 - 1.7057 in.)	
0.60	43.600 - 43.625 mm (1.7165 - 1.7175 in.)	
Oversize rework dimensions of intake valve seat ring hole		
0.30	37.300 - 37.325 mm (1.4685 - 1.4695 in.)	
0.60	37.600 - 37.625 mm (1.4803 - 1.4813 in.)	
Camshaft		
Cam height		
Intake and Exhaust	37.05 mm (1.4587 in.)	36.55 mm (1.4389)
Journal diameter	29.94 - 29.95 mm (1.1787 - 1.1791in.)	
Oil clearance	0.05 - 0.08 mm (0.002 - 0.0031in.)	0.13 mm (0.005 in.)
End play	0.1 - 0.2 mm (0.0039 - 0.0079 in.)	0.4 mm (0.0157 in.)
Rocker arm		
I.D.	18.910 - 18.928 mm (0.7445 - 0.7452 in.)	0.08 mm (0.0031 in.)
Rocker arm - to - shaft clearance	0.012 - 0.050 mm (0.0005 - 0.0020 in.)	

	Standard	Limit
Rocker shaft		
O.D.	18.878 - 18.898 mm (0.7432 - 0.7440 in.)	
Valve		
Overall length		
Intake and Exhaust	136.5 mm (5.3740 in.)	
Stem diameter		
Intake	7.96 - 7.975 mm (0.3133 - 0.3140 in.)	
Exhaust	7.93 - 7.950 mm (0.3122 - 0.3130 in.)	
Face angle	45° - 45°30’	
Thickness of valve head (margin)		
Intake and Exhaust	2.0 mm (0.0787 in.)	1.0 mm (0.0394 in.)
Stem-to - guide clearance		
Intake	0.03 - 0.06 mm (0.0012 - 0.0024 in.)	0.10 mm (0.0039 in.)
Exhaust	0.05 - 0.09 mm(0.0020 - 0.0035 in.)	0.15 mm (0.0059 in.)
Valve spring		
Free height	49.1 mm (1.9331 in.)	48.1 mm (1.8937 in.)
Lode / Installed height	276 N (27.6 kg) / 40.4	
Out - of squareness	Max 2°	4°
Valve guide		
Overall lenght		
Intake	71 mm (2.7953 in.)	
Exhaust	74 mm (2.9134 in.)	
I.D.	8.0 - 8.02 mm (0.3150 - 0.3157 in.)	
O.D.	13.06 - 13.07 mm (0.5142 - 0.5146 in.)	
Valve seat		
Seat angle	45°	
Valve contack width	0.9 - 1.3 mm (0.0354 - 0.0512 in.)	
Sinkage		0.2 mm (0.0079 in.)
Silent shaft		
Journal diameter		
Right		
Front	18.300 - 18.467 mm (0.7205 - 0.7270 in.)	
Rear	42.975 - 42.991 mm (1.6920- 1.6926 in.)	
Left		
Front	18.959 - 18.980 mm (0.7464 - 0.7472 in.)	
Rear	42.975 - 42.991 mm (1.6919 - 1.6926 in.)	
Oil clearance		
Front	0.02 - 0.06 mm (0.0008 - 0.0024 in.)	
Rear	0.05 - 0.09 mm (0.0020 - 0.0035 in.)	
Piston		
O.D.	79.0 -79.2mm (3.1102 - 3.1181 in.)	
Piston - to cylinder clearance		
TC, TCI	0.04 - 0.08 (0.0016 - 0.0031 in.)	
N/A	0.03 - 0.05 mm (0.0012 - 0.0020 in)	

	Standard	Limit
Ring groove width		
No. 1 ring		
TC, TCI	2.601 - 2.603 mm (0.1024 - 0.1025 in)	
N/A	2.02 - 2.04 mm (0.0815 - 0.0823 in)	
No. 2 ring		
TC, TCI	2.100 - 2.102 mm (0.0827 - 0.0828 in.)	
N/A	2.07 -2.09 mm (0.0815 - 0.0823 in)	
Oil ring		
TC, TCI	4.010 - 4.035 mm (0.1579 - 0.1589 in.)	
N/A	3.01 - 3.035 mm (0.1185 - 0.1195 in)	
Service size	0.25, 0.50, 0.75, 1.00 oversize	
Piston ring		
End gap		
No. 1 ring		
TC, TCI	0.35 - 0.50 mm (0.0138 - 0.0197 in.)	0.8 mm (0.0315 in.)
N/A	0.25 - 0.40 mm (0.098 - 0.0157 in.)	
No. 2 ring		
TC, TCI	0.25 - 0.40 mm (0.0098 - 0.0157 in.)	0.8 mm (0.0315 in.)
N/A	0.45 - 0.60 mm (0.0177 - 0.0236 in.)	
Oil ring		
TC, TCI	0.25 - 0.45 mm (0.0098 - 0.0177 in.)	0.8 mm (0.0315 in.)
N/A	0.20 - 0.40 mm (0.0079 - 0.0157 in.)	
Ring - to - ring froove clearance		
No. 1 ring		
TC, TCI	0.056 - 0.076 mm (0.0022 - 0.0030 in.)	0.15 mm (0.0059)
N/A	0.03 - 0.07 mm (0.0019 - 0.0028 in.)	
No. 2 ring		
TC, TCI	0.046 - 0.066 mm (0.0018 - 0.0026 in.)	0.15 mm (0.0059)
N/A	0.08 - 0.12 mm (0.0031 - 0.0047 in.)	
Oil ring		
TC, TCI	0.02 - 0.065 mm (0.0008 - 0.0026 in.)	0.1 mm (0.0039)
N/A	0.02 - 0.065 mm (0.0008 - 0.0026 in.)	
Service size	0.25, 0.05, 0.75, 1.00	
Piston pin		
O.D.	28.994 - 29.0 mm (1.1415 - 1.1417 in.)	
Coonecting rod		
Big end center - to - small end center lenght	157.95 - 158.05 mm (6.2185 - 6.2224 in.)	
Bend	Max. 0.05 (0.0020)	
Twist	Max. 0.1 (0.0039)	
Big end side clearance	0.10 - 0.25 mm (0.0039 - 0.0098 in.)	
Crankshaft		
End play	0.05 - 0.18 mm (0.0020 - 0.0071 in.)	0.25 mm (0.0098 in.)
Journal O.D.	66 mm (2.5984 in.)	
Pin O.D.	53 mm (2.0866 in.)	
Out - of roundness and taper of journal and pin	0.05 mm (0.0020 in.)	
Oil clearance of journal	0.02 - 0.05 mm (0.0008 - 0.0020 in.)	0.1 mm (0.0039 in.)
Oil clearance of pin	0.02 - 0.05 mm (0.0008 - 0.0020 in.)	0.1 mm (0.0039 in.)
Journal		
0.25 U.S.	65.735 - 65.750 mm (2.5879 - 2.5886 in.)	
0.50 U.S.	65.485 - 65.500 mm (2.5781 - 2.5787 in.)	
0.75 U.S.	65.235 - 65.250 mm (2.5683 - 2.5689 in.)	
Pin		
0.25 U.S.	52.735 - 52.750 mm (2.0716 - 2.0768 in.)	
0.50 U.S.	52.485 - 52.500 mm (2.0663 - 2.0669 in.)	
0.75 U.S.	52.235 - 52.250 mm (2.0565 - 2.0571 in.)	

	Standard	Limit
Cylinder block		
I.D.	91.10 - 91.13 mm (3.5866 - 3.5878 in.)	
Flatness of gasket surface	0.05 mm (0.0020 in.)	
Overall height	318.45 - 318.55 mm (12.537 - 12.541 in.)	0.1 mm (0.0039 in.)
Flywheel		
Flatness	0.13 mm (0.0051 in.)	0.13 mm (0.0051 in.)
Oil pump		
Tip clearance		
Inner gear	0.22 - 0.35 mm (0.0087 - 0.0138in.)	0.5 mm (0.0197 in.)
Outer gear	0.12 - 0.22 mm (0.0047 - 0.0087 in.)	0.4 mm (0.0157 in.)
Side clearance		
Inner gear, Outer gear	0.04 - 0.10 mm (0.0016 - 0.0039 in.)	0.15 mm (0.0059 in.)
Body clearance		
Outer gear	0.12 - 0.22 mm (0.0047 - 0.0087 in.)	
Inner gear,	0.03 - 0.09 mm (0.0012 - 0.0035 in.)	
Oil pressure at engine idle speed	80 Kpa (0.8 kg/cm²) or more	
Cooling system	Water - cooled forced circulation system	
Drive belt	V type	
Water pump type	Centrifugal impeller	
Fan clutch type	Thermo type with plate type bimetal	
Thermostat type		
Type	Wax type with by - pass valve	
Coolant temperature gauge unit		
Type	Thermister type (2 elements)	
Thermostat		
Valve opening temperature (°C)	82	
Fully opening temperature (°C)	95	
Coolant temperature gauge unit		
Resistance		
Coolant temperature gauge element (Ω/°C)	90.5 - 117.5 / 70, 21.3 - 26.3 / 115	
Glow control element (Ω/°C)	22.3 - 27.3 / -20, 2.92 - 3.58 / 20	
Air cleaner	Paper filter type	
Muffler	Expansion resonance type	

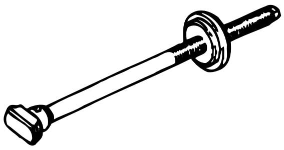
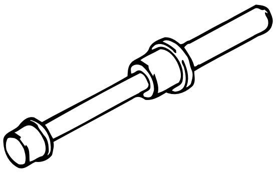
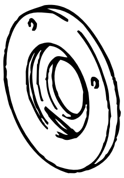
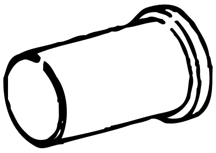
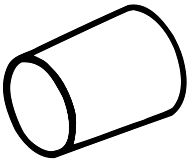
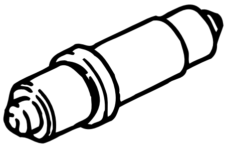
NOTE

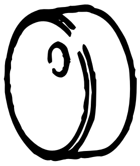
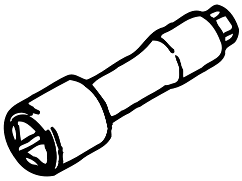
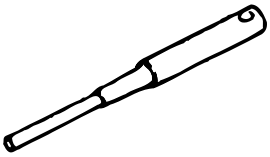
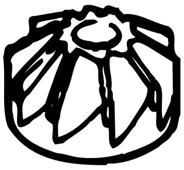
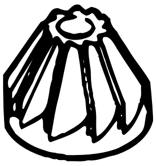
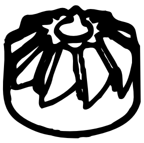
- *O.D. : Outer Diameter*
- *I.D. : Inner Diameter*
- *U.S. : Undersize Diameter*
- *O.S. : Oversize Diameter*

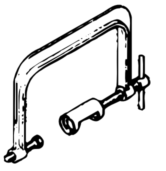
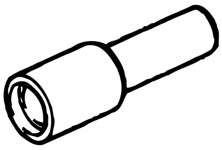
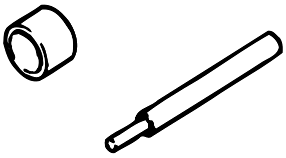
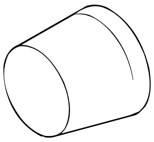
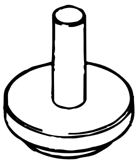
TORQUE SPECIFICATIONSSS ECLB0030

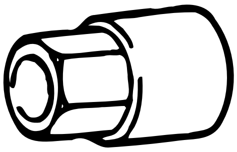
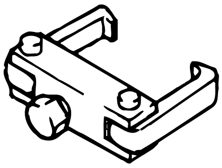
	Nm	kg.cm	lb.ft
Crankshaft pulley bolt	170 - 190	1700 - 1900	125 - 140
Camshaft sprocket bolt	65 - 75	650 - 750	48 - 55
Timing belt tensioner bolt	22 - 30	220 - 300	16 - 22
Injection pump sprocket nut	80 - 90	800 - 900	59 - 66
Silent shaft sprocket nut	34 - 40	340 - 400	25 - 30
Timing belt tensuioner “B” nut	22 - 30	220 - 300	16 - 22
Rocker cover bolt	5 - 7	50- 70	4 - 5
Rocker arm shaft bolt	35 - 40	350 - 400	25 - 29
Camshaft bearing cap bolt	19 - 21	190 - 210	13 - 15
Cylinder head bolt			
Cold engine	105 - 115	1050 - 1150	77 - 85
Hot engine	115 - 125	1150 - 1250	85 - 92
Oil pan bolt	6 - 8	60 - 80	4 - 6
Oil pan drain plug	35 - 45	350 - 450	26 - 33
Front case bolt (upper, lower)	12 - 15	120 - 150	9 - 11
Silent shaft driven gear bolt	34 - 40	340 - 400	25 - 30
Silent shaft plug cap	30 - 45	300 - 450	22 - 33
Silent shaft gear cover bolt	15 - 18	150 - 180	11 - 13
Connecting rod cap nut	45 - 48	450 - 480	33 - 35
Flywheel bolt	130 - 140	1300 - 1400	96 - 103
Crankshaft bearing cap bolt	75 - 85	750 - 850	55 - 63
Oil relief valve plug	30 - 45	300 - 450	22 - 33
Oil pump cover screw	9 - 14	90 - 140	7 - 10
Oil pressure switch	8 - 12	80 - 120	6 - 9
Oil filter bracket	12 - 15	120 - 150	9 - 11
Oil jet check valve	30 - 35	300 - 350	22 - 26
Ouil cooller by - pass valve	50 - 60	500 - 600	37 - 44
Cooling fan attaching bolt	10 - 12	100 - 120	7 - 8
Fan clutch attaching bolt	10 - 12	100 - 120	7 - 8
Water outlet fitting attaching bolt	10 - 13	100 - 130	7 - 9
Water pump attaching bolt	12 - 15	120 - 150	8 - 11
Coolant temperature gauge unit	30 - 40	300 - 400	22 - 30
Intake and exhaust manifold nuts and bolts	15 - 20	150 - 200	11 - 15
Heat protector to exhaust manifold	12 - 15	120 - 150	9 - 11
Exhaust pipe to exhaust manifold stud nuts	30 - 40	300 - 400	22 - 30
Exhaust pipe to muffler	30 - 40	300 - 400	22 - 30

SPECIAL TOOLS ECLB0040

Tool (Number and name)	Illustration	Use
Silent shaft bearing puller (09212 - 43100)	 ECLA002L	Removal of silent shaft rear bearing
Silent shaft bearing installer (09212 - 43200)	 ECLA002M	Installation of silent shaft rear bearing
Bearing installer stopper (09212 - 43300)	 ECLA002N	Removal of Right silent shaft rear bearing
Crank shaft front oil seal installer (09214 - 32000)	 ECLA002O	Installation of crankshaft front oil seal
Crankshaft front oil seal guide (09214 - 32100)	 ECLA002P	Guide for installation of crank shaft front oil seal
Connecting - rod small - end busing replacement tool (09214 - 43000)	 ECLA002J	Replacement of connecting - rod small - end bushing

Tool (Number and name)	Illustration	Use
Camshaft oil seal installer (09221 - 21000)	 ECLA002I	Installation of the camshaft oil seal
Cylinder head bolt wrench (09221 - 32000)	 ECLA002A	Loosening and tightening of cylinder head bolt.
Valve seat cutter pilot (09221 - 43200)	 ECLA002B	Correction of valve seat
Valve seat cutter 45° (09221 - 43300)	 ECLA002C	Correction of valve seat
Valve seat cutter 65° (09221 - 43400)	 ECLA002D	Correction of valve seat
Valve seat cutter 30° (09221 - 43500)	 ECLA002E	Correction of valve seat

Tool (Number and name)	Illustration	Use
Valve spring compressor (09222 - 21000)	 ECLA002G	Compression of valve spring
Valve stem seal installer (09222 - 32100)	 ECLA002H	Installation of valve stem seal
Valve guide installer (09222 - 32200)	 ECLA002F	Removal and Installation of valve guide
Silent shaft drive gear oil seal guide (09222 - 43200)	 ECLA002K	Installation of silent shaft drive oil seal
Crankshaft rear oil seal installer (09231 - 32000)	 ECLA002Q	Installation of crankshaft rear oil seal

Tool (Number and name)	Illustration	Use
Oil pressure switch wrench (09260 - 32000)	 ECLA002S	Removal and Installation of oil pressure switch
Injection pump sprocket puller (09314 - 43000)	 ECLA002R	Removal of injection pump sprocket

TROUBLESHOOTING ECLB0050

Symptom	Probable cause	Remedy
Low compression	Blown cylinder head gasket	Install new head gasket
	Worn or broken piston rings	Hone cylinder bores and install new rings
	Warped or pitted valves	Install new valve
	Excessive run - out of valve seats on valve faces	Reconditioning valve seats and valves
	Incorrect valve clearance	Adjust to specifications
Noisy valves	Worn valve guides	Install new valves land / or new valve guides with O.S.
	Excessive run - out of valve seats on valve faces	Reconditioning valve seats and valve
	Excessive camshaft end play	Correct end play
Connecting rod noise	Insufficient oil supply	Check engine oil level
	Low oil pressure	Check engine oil level, Inspect oil relief valve and spring
	Thin or diluted oil	Change oil to correct viscosity
	Excessive bearing clearance	Measure bearings for correct clearance
	Connecting rod journals out - of - roundness	Replace crankshaft or regrind journals
	Misaligned connecting rods	Replace bent connecting rods
Crankshaft bearing noise	Insufficient oil supply	Check engine oil level
	Lower oil pressure	Check engine oil level. Inspect oil relief valve and spring
	Thin or diluted oil	Change oil to correct viscos8ity
	Excessive bearing clearance	Measure bearings for correct clearances
	Excessive end play	Check No. 3 main bearing for wear on flanges Replace crankshaft or regrind journals
	Crankshaft journal out - of - roundness worn	Tighten to correct torque
	Loose flywheel	Correct cylinder wear

Symptom	Probable cause	Remedy
Piston noise	Execssive clearance due to cylinder wear	Replace piston
	Piston or piston pin worn	Install new piston
	Burnt piston	Install new rings
	Piston ring damaged	
Oil leak	Oil pan drain plug loose	Tighten to torque
	Oil pan mounting bolt loose	Tighten to correct torque
	Oil pan gasket broken	Install new gasket
	Crankshaft front oil seal defective	Install new oil seal
	Crankshaft rear oil seal dective	Install new oil seal
	Rocker cover gasket broken	Install new gasket
	Oil filter loose	Tighten to correct torque
	Oil filter gasket broken	Install new gasket
Oil consumption	Worn, scuffed, or broken rings	Hone cylinder bores and install new rings
	Carbon in oil ring slot	Install new rings
	Rings fitted too tight in grooves	Remove the rings. Check grooves. If groove is not proper width, replace pistion
	Worn valve guides	Install new valve and / or new valve guides with O.S.
	Faulty valve stem seals	Install new valve stem seals
Oil pressure drop	Low oil level	Check engine oil level
	Slow idle speed	Set idle speed to specification
	Faulty oil pressure switch	Install new switch
	Colgged oil filter	Install new oil filter
	Worn parts in oil pump	Replace worn parts or pump
	Thin or diluted oil	Change oil to correct viscosity
	Excessive bearing clearance	Measure bearings for correct clearance
	Oil relief valve stuck	Remove valve and inspect, clean and reinstall
	Oil pump cover bent or cracked	Install new oil pump
	Oil screen loose or clogged	Clean or replace screen
	Hole in oil pickup tube	Replace or repair tube
	Cracked, porous or plugged gallery	Repair or replace cylinder block
	Gallery plugs missing or misinstalled	Install plugs or repair

Symptom	Probable cause	Remedy
Overheat	Insufficient coolant	Replenish
	Antifreeze concentration too great	Correct
	Loose or broken drive belt	Correct or replace
	Inoperative fan clutch	Replace
	Damaged or blocked (insufficiently ventilated) radiator fins	Correct
	Water leaks	
	Damaged radiator core joint	Replace
	Corroded or cracked hoses (Radiator hose, heater hose, etc)	Replace
	Loose bolt or defective gasket in water outlet fitting (thermostat)	Correct or replace
	Faulty radiator cap valve or setting of spring	Replace
	Loose cylinder head bolt	Correct
	Damaged cylinder head gasket	Replace parts
	Cracked cylinder block	Replace
	Cracked cylinder head	Replace
	Faulty thermostat operation	Replace
	Faulty water pump operation	Replace
	Water passage clogged with slime or rust deposit or foreign substance	Clean
No rise in temperature	Faulty thermostat	Repair
Loss of power	Intake system	
	a. Clogged air cleaner	a. Clean or replace element
	b. Air leaks from intake system connection	b. Repair
	Exhaust system	
	a. Deformed muffler and exhaust pipe or deposited carbon	a. Repair or replace
	b. Gas leak from system	b. Retighten joints Repair or replace broken pipe or muffler
Unusual noise and vibration	Intake system	
	a. Loose clamping bolts and nuts of the intake system	a. Tighten
	Exhaust system	
	a. Loose clamping bolts and nuts oef the exhaust system	a. Tighten
	b. Damaged muffler and exhaust pipe	b. Replace
	Broken rubber hangers	c. Replace
	Interference of pipe or muffler with vehicle body	d. Corrcet

CHECKING ENGINE OIL ECJA0500

1. Position a vehicle on a level surface.
2. Turn off the engine.

NOTE

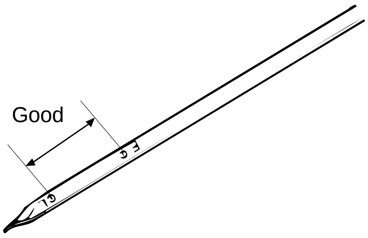
If a vehicle that has not been used for a prolonged period, run the engine for several minutes.
Turn off the engine and wait for 5 minutes at least, and then check the oil level.

3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the “L” mark), refill to the "F" mark.

NOTE

When refilling, use the proper grade of engine oil.

4. Check that the oil is not dirty or mixed with coolant or gasoline and it has the proper viscosity.



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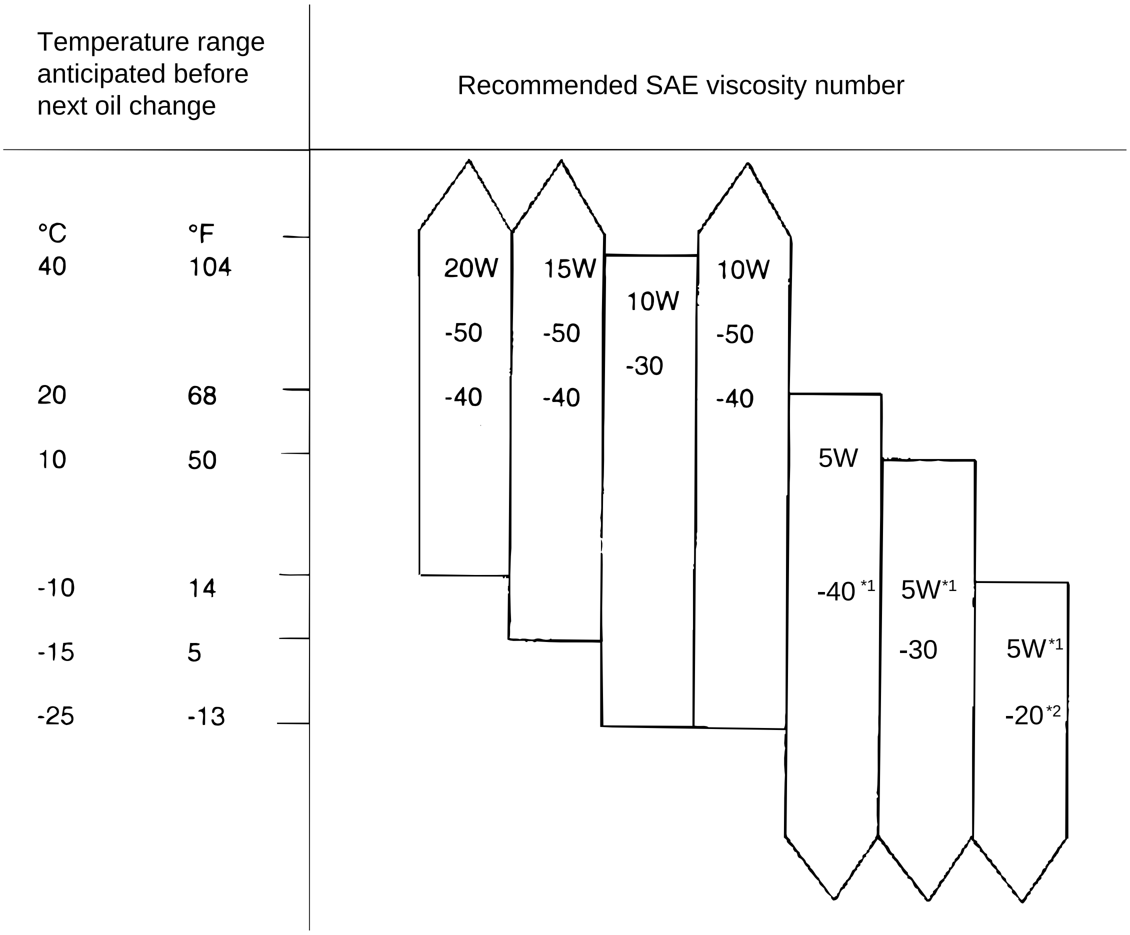
SELECTION OF ENGINE OIL ECLB0070

Recommended API classification: ABOVE CD

Recommended SAE viscosity grades:



***1 Restricted by driving condition and environment.**
***2 Not recommended for sustained high speed vehicle operation**

EDA9990B

NOTE

For best performance and maximum protection of all types of operation, select only those lubricants which:

1. *Satisfy the requirements of the API classification.*
2. *Have the proper SAE grade number for expected ambient temperature range.*

Lubricants which do not have both an SAE grade number and an API service classification on the container should not be used.

CHANGING ENGINE OIL ECLB0080

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and the drain plug. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

Tightening torque

Oil pan drain plug :

35 - 45 Nm (350 - 450 kg.cm, 25 - 33 lb.ft)

NOTE

Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

Capacity

Drain and refill : 6.1 lit (6.45 U.S.qts., 5.37 Imp.qts.)

NOTE

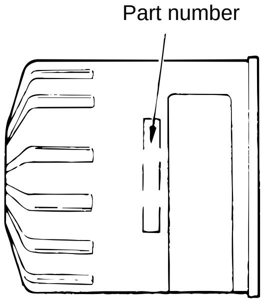
Do not overfill. This will cause oil aeration and loss of oil pressure.

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

REPLACING THE OIL FILTER ECJA0800

All Hyundai Motor Company engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter for all vehicles. The quality of aftermarket replacement filters is considerably diverse.

High quality replacement filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing a new filter.



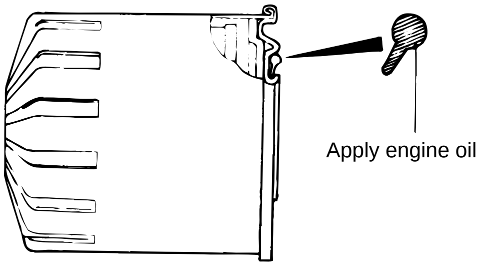
ECA9970A

PROCEDURE FOR REPLACING THE OIL FILTER

1. Use a filter wrench to remove the oil filter.
2. Before installing a new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter to the specified torque.

Oil filter : 12-16 Nm (120-160 kg.cm, 9-12 lb.ft)

4. Start and run the engine and check for engine oil leak.
5. After turning off the engine, check the oil level and add oil as necessary.



ECA9970B

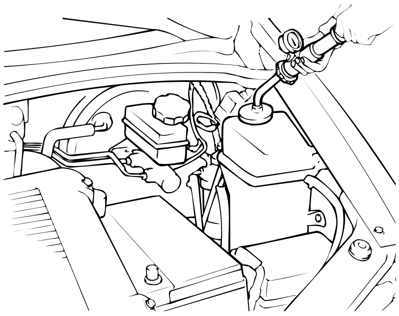
CHECKING COOLANT LEAK ECLB0100

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 KPa (21psi, 1.53 kg/cm²) pressure. Hold it for two minutes in that condition while checking for leakage from the radiator, hoses or connections.

   NOTE

   1. *Radiator coolant may be extremely hot. Do not open the system because hot, or scalding water could gush out causing personal injury. Allow the vehicle to cool before servicing this system.*
   2. *When the tester is removed, be careful not to spill any coolant from it.*
   3. *Be sure to clean away completely any coolant from the area.*
   4. *Be careful when installing and removing the tester and when testing, not to deform the filler neck of the radiator.*

4. If there is leakage, repair or replace with the appropriate part.



ECLA333Q

RADIATOR CAP PRESSURE TEST ECLB0110

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the gauge stops moving.

Main valve opening pressure :

107.9kPa±14.7kPa (1.1±0.15 kg/cm², 15.64±2.13)

Main valve closing pressure :

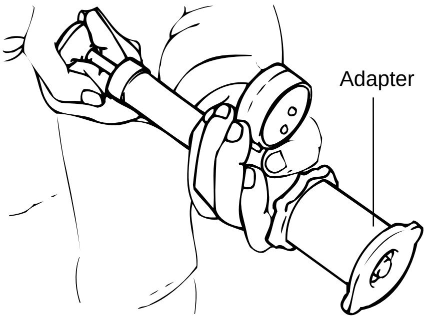
83.4 kPa (0.85 kg/cm², 12.1 psi)

---

3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

NOTE

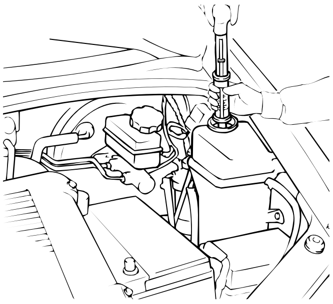
Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.



ECA9090A

SPECIFIC GRAVITY TEST ECLB0120

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature, using the following table for reference.



ECLA003S

RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY

Coolant temperature °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	**20 (68)**	**30 (86)**	**40 (104)**	**50 (122)**			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15 (5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

Example

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

CAUTION

- ***If the concentration of the coolant is below 30%, its anti-corrosion properties will be adversely affected.***
- ***if the concentration is above 60%, both the anti-freeze and engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.***
- ***Do not mix types of anti-freeze.***

RECOMMENDED COOLANT

Antifreeze	Mixture ratio of anti freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

CHECKING ENGINE COMPRESSION PRESSURE ECLB0130

1. Be sure that the engine oil, starting motor and battery are in the normal condition.

2. Start the engine and allow it to warm up until the temperature of the coolant reaches 80°C to 90°C (176°F to 194°F)

3. Loosen the nuts at the nozzle side of the infecdtion pipes, and disconnect the pipes from the nozzle holders.

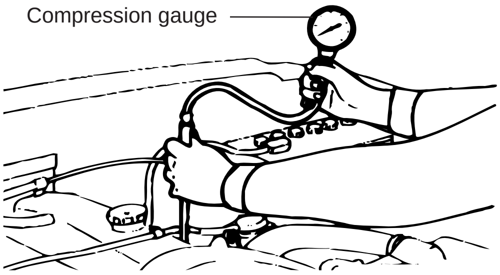
   ⚠ ***CAUTION***

   Caps must be used to prevent entry of foreign materials into the nozzles.

4. Remove the glow plug plate and all 4 glow plugs.

5. Set an engine tachometer in place.

6. Place a compression gauge adaptor and compression gauge in the glow plug hole.



ECLA005A

7. Crank the engine with the throttle valve fully open, and measure the compression at the place where the compression gauge indicator shows a stabilized reading.

Standard value (at engine speed of 250 rpm) :

1920 kPa (19.2 kg/cm², 278 psi)

Difference between each cylinder :

300 kPa (3.0 kg/cm², 43 psi) or less

8. If, after the measurement, the compression is below the limit, put a small amount of engine oil through the hlow plug hole into the cylinder, then measure the compression once again and determine the cause of the malfunction

9. If, after oil is added, the compression rises, the cause of the malfunction is a worn or damaged pistion ring and / or cylinder inner surface. If however, the compression does not rise, the cause is a bad valve or a bad gasket.

CHECKING AND ADJUSTMENT OF VALVE CLEARANCE ECLB0140

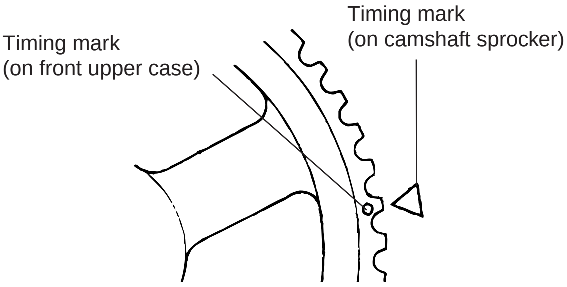
1. Start the engine and allow it to warm up until the temperature of the coolant reaches 80°C to 90°C (176°F to 194°F)

2. Check the infection timing and the idling speed, and adjust if bnecessary.

3. Remove the upper timing belt cover.

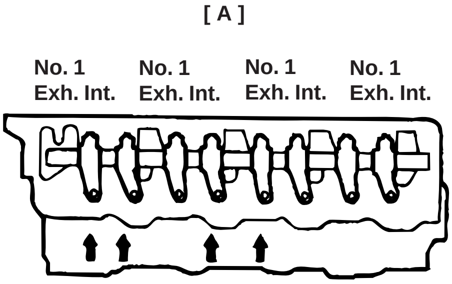
4. Remove the rocker cover.

5. Turn the crankshaft clockwise and align the timing mark on the camshaft sprocket with the timing mark on the top of the front upper case.



ECLA019H

6. Check that valve clearance indicated in the diagram (A) is at the standard value.



ECLA019I

Standard value

Hot engine

Intake : 0.25 mm (0.0098 in.)

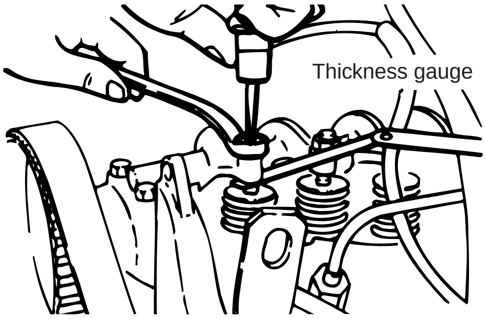
Exhaust : 0.25 mm (0.0098 in.)

Cold engine

Intake : 0.15 mm (0.0059 in.)

Exhaust : 0.15 mm (0.0059 in.)

7. If not within the standard value, loosen the adjusting screw locking nut and, while turning the adjusting screw, use a thickness gauge to adjust the valve clearance to the standard value.



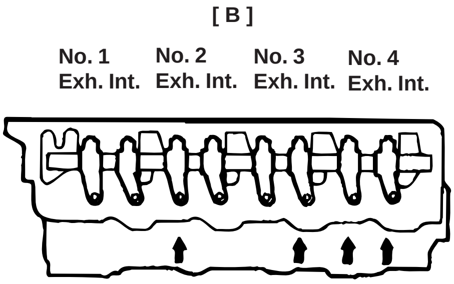
ECLA003E

8. Block the adjusting screw with a screwdriver, so that it cannot move and tighten the locknut to the specified torque.

Tightening torque :

12 - 18 Nm (120 - 180 kg.cm, 9 - 13 lb,.ft)

9. Rotate clockwise the crankshaft one complete turn (360 degree).
10. Check that valve clearance indicated in the diagram (B) is at the standard value.



ECLA019K

Standard value

Hot engine :

Intake : 0.25 mm (0.0098 in.)

Exhaust : 0.25 mm (0.0098 in.)

Cold engine :

Intake : 0.15 mm (0.0059 in.)

Exhaust : 0.15 mm (0.0059 in.)

11. If not within the standard value, repeat steps 7 to 8 to adjust the valve clearance of remaining valves.
12. When installing the rocker cover assembly to the cylinder head, apply a coating of the specified sealant to the semicircular packing and cylinder head top surfaces, and then tighten at the specified torque

Specified sealant :

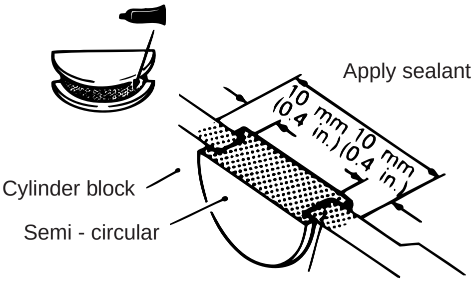
3M ART Part No. 8660 or equivalent

Tightening torque :

5 - 7 Nm (50 - 70 kg.cm, 4- 5 lb.ft)

CAUTION

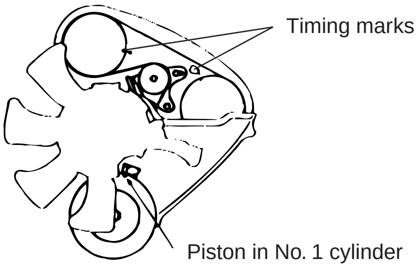
If they are overtorqued, a deformed rocker cover or oil leakage could result.



ECLA003F

ADJUSTMENT OF THE TIMING BELT TENSION ECLB0150

1. Remove the timing beklt upper cover and bring the pistion in No. 1 cylinder to top dead center on compression strocke. Check that the timing marks of sprockets are aligned.

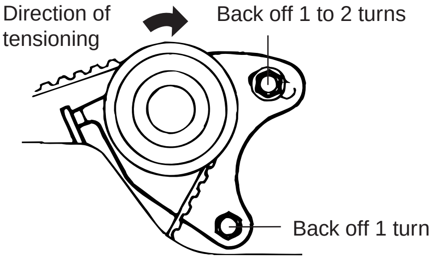


ECLA005B

2. Loosen the timing belt tensioner mounting bolts.

CAUTION

Do not loosen the belts more than necessary. They could drop in the lower cover.



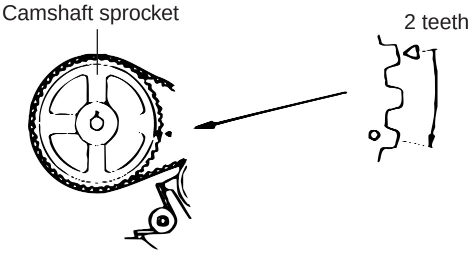
ECLA005C

3. Turn the crankshaft in normal direction (clockwise) through two camshaft sprocket teeth and hold it.

4. Tighten the tensioner mounting bolts.

NOTE

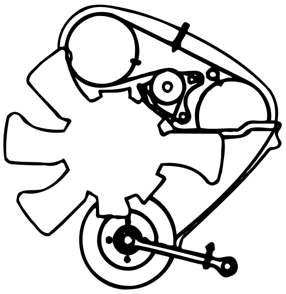
Tighten the upper bolts first and then the lower ones.



ECLA005D

5. Reverse the crankshaft to aligh the timing marks, and push down belt at a point halfway with forefinger to check that tension of belt is up to standard value.

Standard value : 4 - 5 mm (0.16 - 0.20 in.)

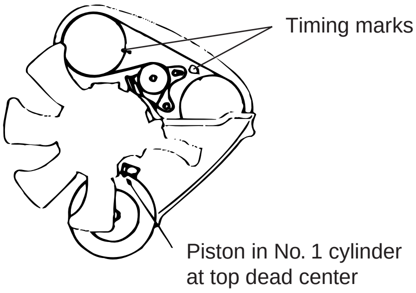


ECLA005E

6. Mount the timing belt upper cover.

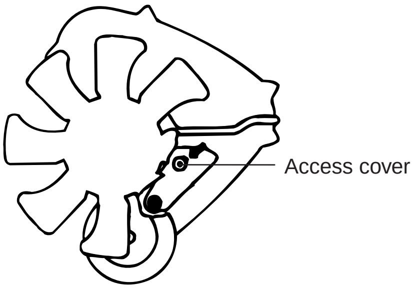
ADJUSTMENT OF THE TIMING BELT “B” TENSION

1. Remove the timing belt upper cover and bring the pistion in No. 1 cylinder to top dead center on compression stroke. Check that the timing marks of sprockets are aligned.



ECLA005B

2. Remove the access cover.



ECLA005F

3. Loosen the timing belt “B” tensioner mounting nut and bolt.

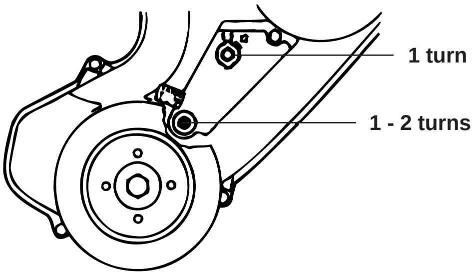
NOTE

Do not loosen the bolts (upper) more than necessary. Tyey could drop in the lower cover.

4. Tighten the tensioner mounting nut and bolt.

NOTE

Tighten the nut (lower) first and then the bolt (upper).



ECLA005G

5. Mount the access cover.
6. Mount the timing belt upper cover.

INSPECTION AND ADJUSTMENT OF THE BELT FLEX ECLB0160

1. Check the belt for damage or wear. Confirm that the belt is set correctly in pulley groove.

NOTE

If the belt “squeals” or slips, check belt for friction, damage or breaks and check pully contact surface for damage.

2. Press at 100N (10 kg,22lbs.) center of belt between pulleys as indicated in the diagram. Measure belt flex.

Standard value

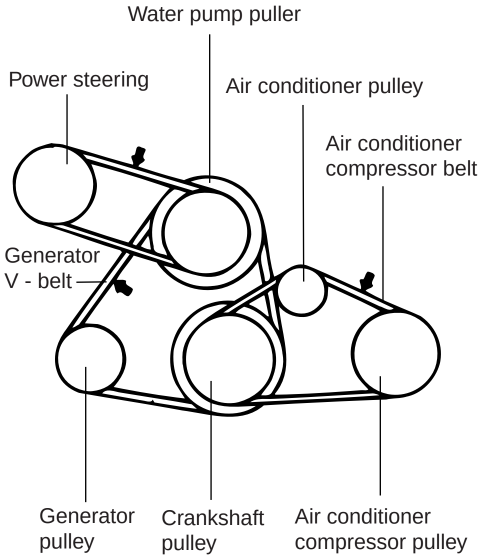
Air - conditioner compressor :

7 - 10 mm (0.28 - 0.39 in.)

Alternator : 10 - 13 mm (0.39 - 0.51 in.)

CAUTION

Measure the blet flex between specified pulleys (→).



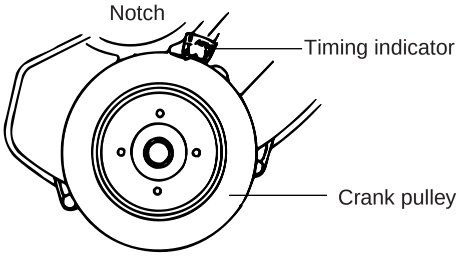
ECLA003A

INJECTION TIMING ADJUSTMENT ECLB0170

CAUTION

Injection timing should be adjusted with engine stationary.

1. Turn the crankshaft to place in No. 1 cylinder at top dead center on compression stroke.



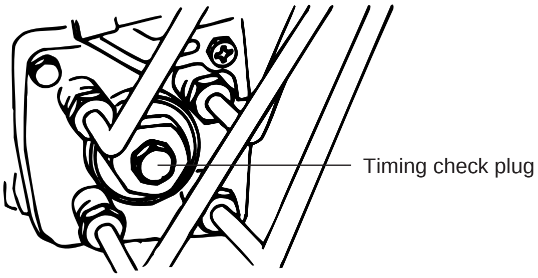
ECLA003G

2. Loosen (but do not remove) injection pipe union nuts (4 in all) on injection pump side. When loosening union nuts, hold delivery valve holder with a spanner to prevent it from rotating with nut.

3. Loosen two nuts and two bolts securing injection pump, but do not remove these nuts and bolts.

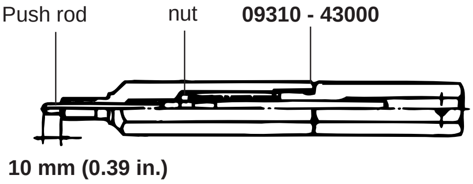
ECLA003H

4. Remove the timing check plug from injection pump head.



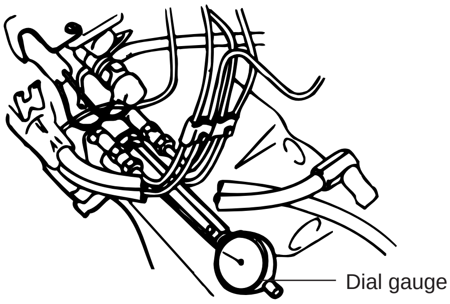
ECLA003J

5. Before installation of special tool, make sure that push rod is protruding by 10 mm (0.39 in.). Protrusion of push rod can be adjusted with an inner nut.



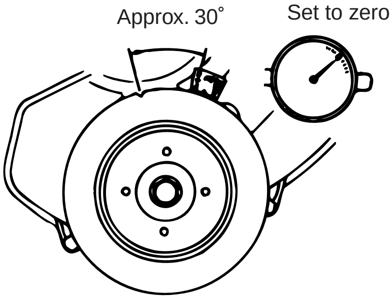
ECLA003K

6. Attach the special tool (09310 - 43000) and a dial indicator.



ECLA003L

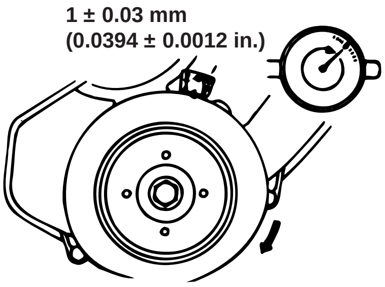
7. Turn the crankshaft to such a position that the notch on pulley is at approximately 30° before top dead center on compression stroke of piston in No. 1 cylinder. Then, set dial indicator to zero. Slightly turn the crankshaft clockwise and counterclockwise to make sure that the dial indicator pointer does not deviate from zero position. If it does, readjust pulley position so that the notch on pulley is at 30° before top dead center.



ECLA003M

8. Turn the crankshaft in the normal direction and position the notch of crankshaft at 9° ATDC (basic injection timing), then make sure that the dial indicator is indicating the standard value.

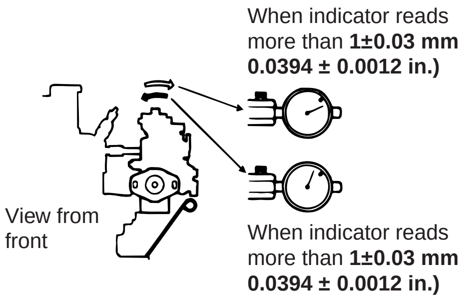
Standard value : 1 ± 0.03 mm (0.00394 ± 0.0012 in.)



ECLA003N

9. If the dial indicator does not indicate the specified value, tilt the injection pump body to the right or left until the indicator does indicate the standard value. Then, tighten injection pump mounting nuts and bolts to specified torque.

10. Repeat Steps 7 and 8 to check that adjustment has been made correctly.



ECLA003O

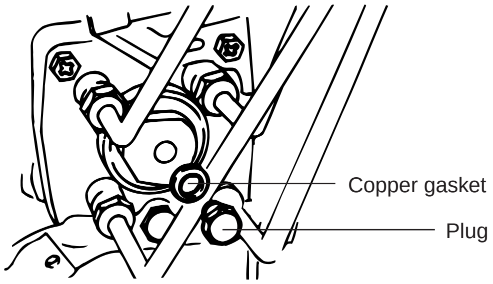
11. Remove the special tool and the dial indicator.

12. Install new copper gasket and timing check plug, then tighten plug to specified torque.

13. Tighten injection pipe nuts to specified torque. When nuts are tightened, hold delivery valve holder with a spanner to prevent it from rotating with nut.

Tightening torque :

23 - 37 Nm (230 - 370 kg.cm, 17 - 27 lb.ft)

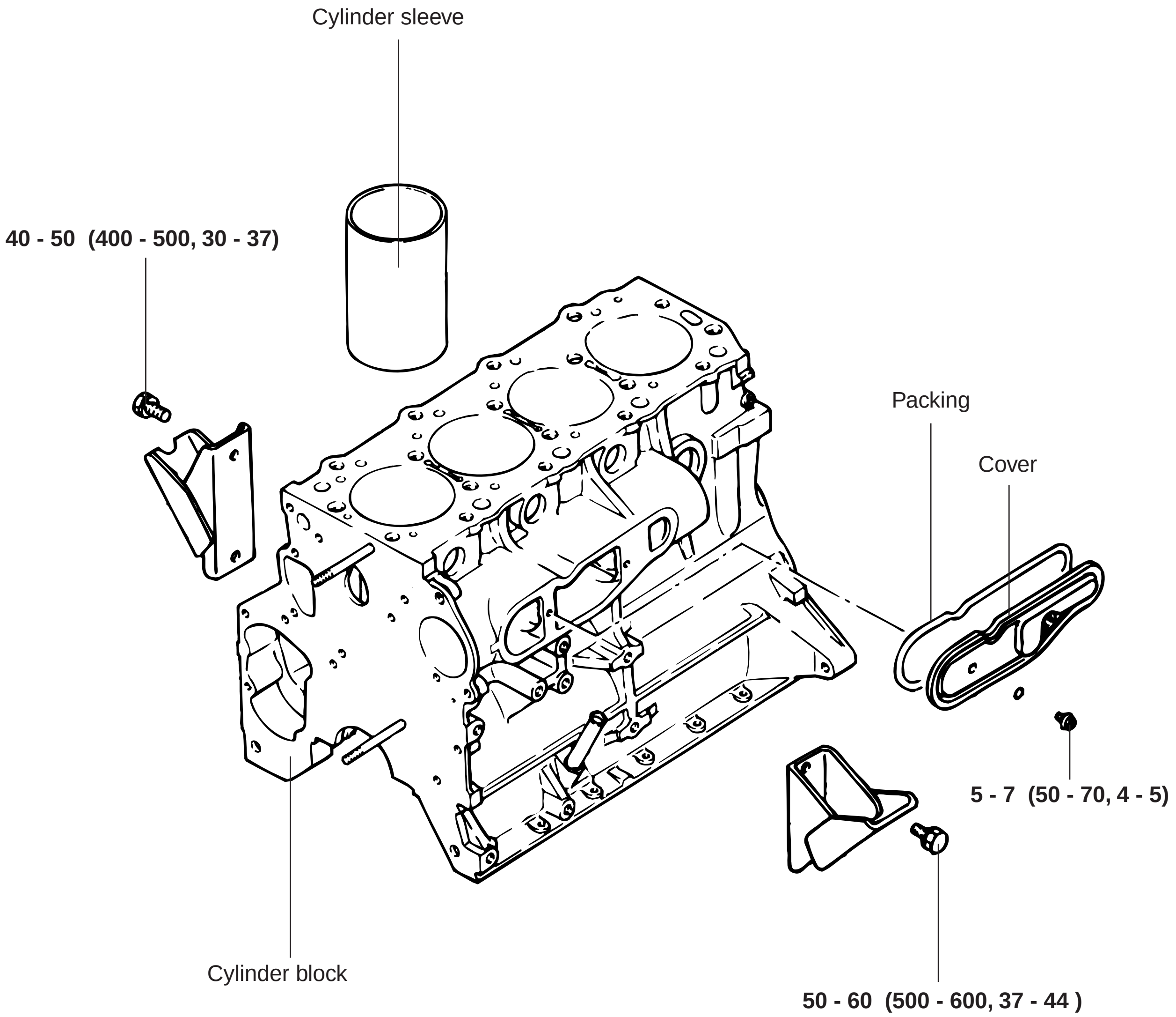


ECLA003P

ENGINE BLOCK

ENGINE BLOCK

COMPONENTS ECLB0200



TORQUE : Nm (kg.cm, lb.ft)

ECLA007A

INSPECTION ECLB0210

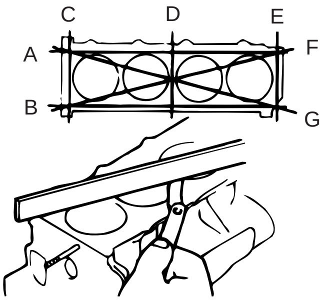
NOTE

1. *Before inspection and repair, clean parts to remove dirt, oil, carbon, deposits, and scale.*
2. *Before cleaning the cylinder block, be sure to check for evidences of water leaks and damage.*
3. *Romove contaminants from oil holes with compressed air and, at the same time, make sure that they are not blocked.*

CYLINDER BLOCK

1. Check for scratches, rust, and corrosion. Use also a flaw - detecting agent for the check. If defects are evident, correct or replace.

2. Using a straightedge and thickness gauge, check the cylinder block top surface for flatness. Lay the straightedge longways and crossways as indicated by A, B,... in illustration. If flatness is not within the limit, replace the cylinder block. At measurement, ensure that the cylinder block top surface is free from any traces of gasket material.



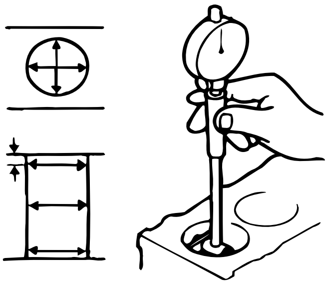
ECLA007B

Standard value : 0.05 mm (0.002 in.)

Limit : 0.1 mm (0.004 in.)

3. Check cylinder wall for scratches and seizure.
   If defects are evident, correct (to oversize) or replace.

4. Using cylinder gauge, measure the cylinder bore.
   If it wears out excessively, bore the cylinder to oversize and replace the piston and piston rings.
   Measurement points are as shown.



ECLA007C

Standard value : 91.1 mm (3.5866 in.)

BORING OF CYLINDER

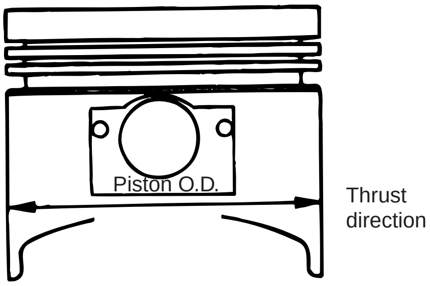
1. Using the maximum cylinder bore as a basis, determine the oversize piston to be used.

2. There are four oversize pistons available :
   0.25 mm (0.010 in.), 0.50 mm (0.020 in.), 0.75 mm (0.030 in.), and 1.00 mm (0.039 in.). bore the cylinder to obtain the specified clearance according to the piston O.D.

3. Based on the piston O.D. measured, calculate the boring dimension.

Boring dimension = Piston O.D. + 0.04 to 0.08 mm (0.0016 to 0.0031 in.) (piston to cylinder clearance) - 0.02 mm (0.0008 in.) (haning margin).

4. Bore cylinders to obtain the calculated boring dimension.



ECLA007D

NOTE

1. *To prevent thermal distortion due to temperature rise during boring operation, bore cylinders in the sequence of No. 2, 4, 1 and 3.*
2. *The cylinders must be honed to finish dimension.*
3. *Check clearance between piston and cylinder.*

Piston to cylinder clearance :

0.04 - 0.08 mm (0.0016 - 0.0031 in.)

NOTE

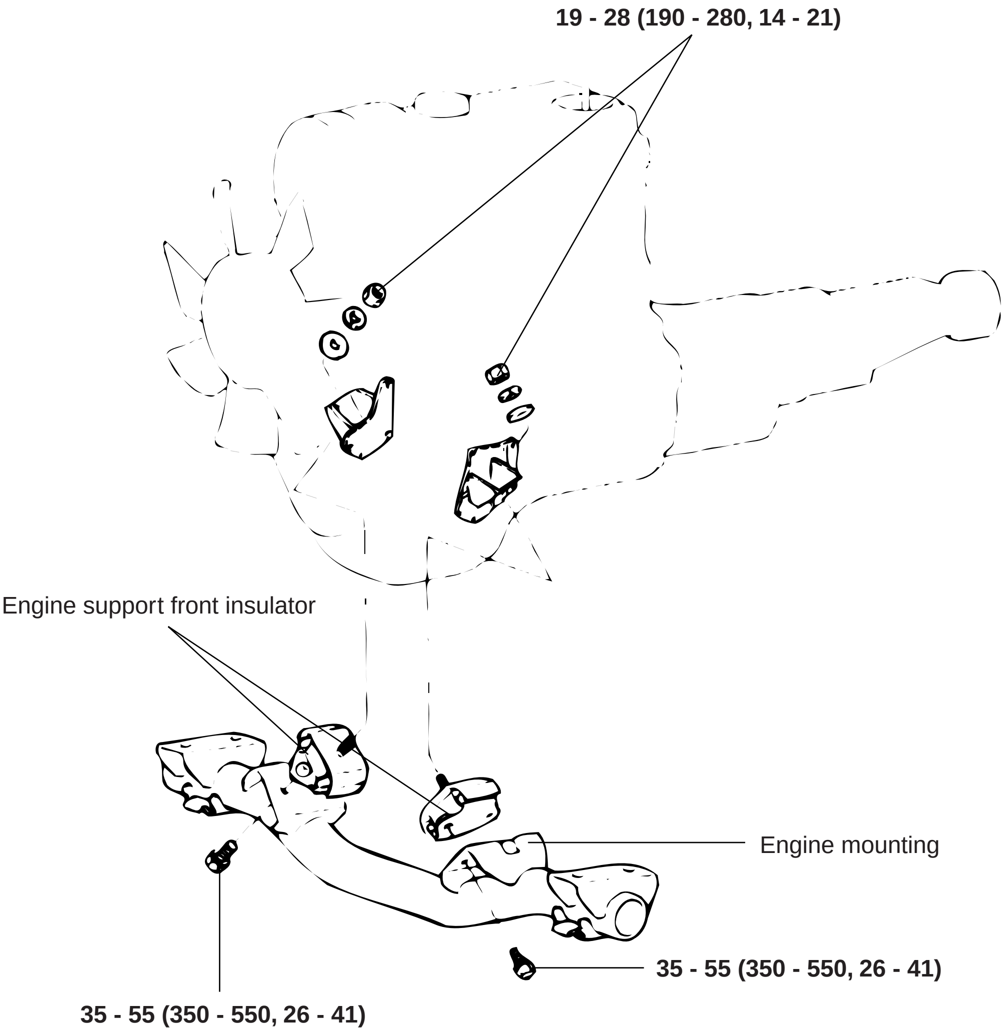
1. *When boring cylinders, finish all of four cylinders to the same oversize.*
2. *Don’t bore only one cylinder to oversize.*

ENGINE MOUNTS

ENGINE MOUNTING ECLB0220

COMPONENTS

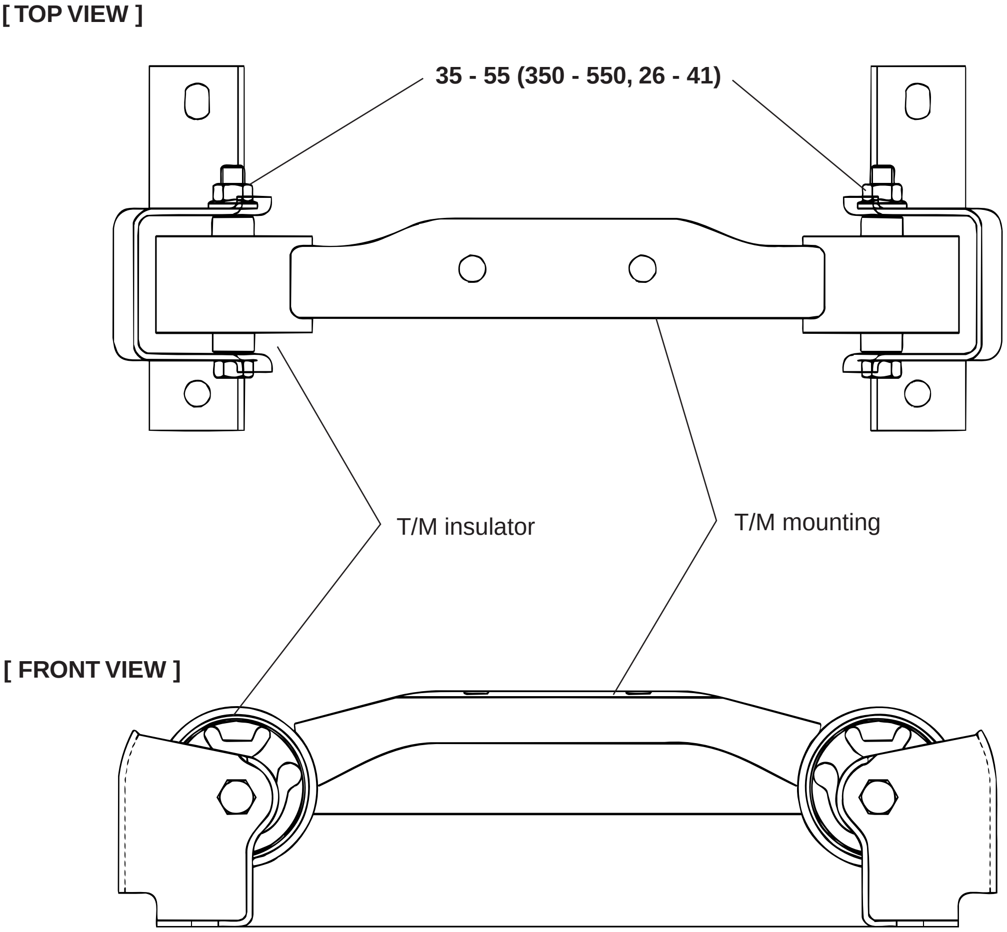
FRONT ENGINE MOUNTING



TORQUE : Nm (kg.cm, lb/.ft)

ECLA007E

T/M MOUNTING ECLB0230



TORQUE : Nm (kg.cm, lb.ft)

ECLB001A

INSPECTION ECLB0240

1. Check the insulator for damage, crack and deformation.

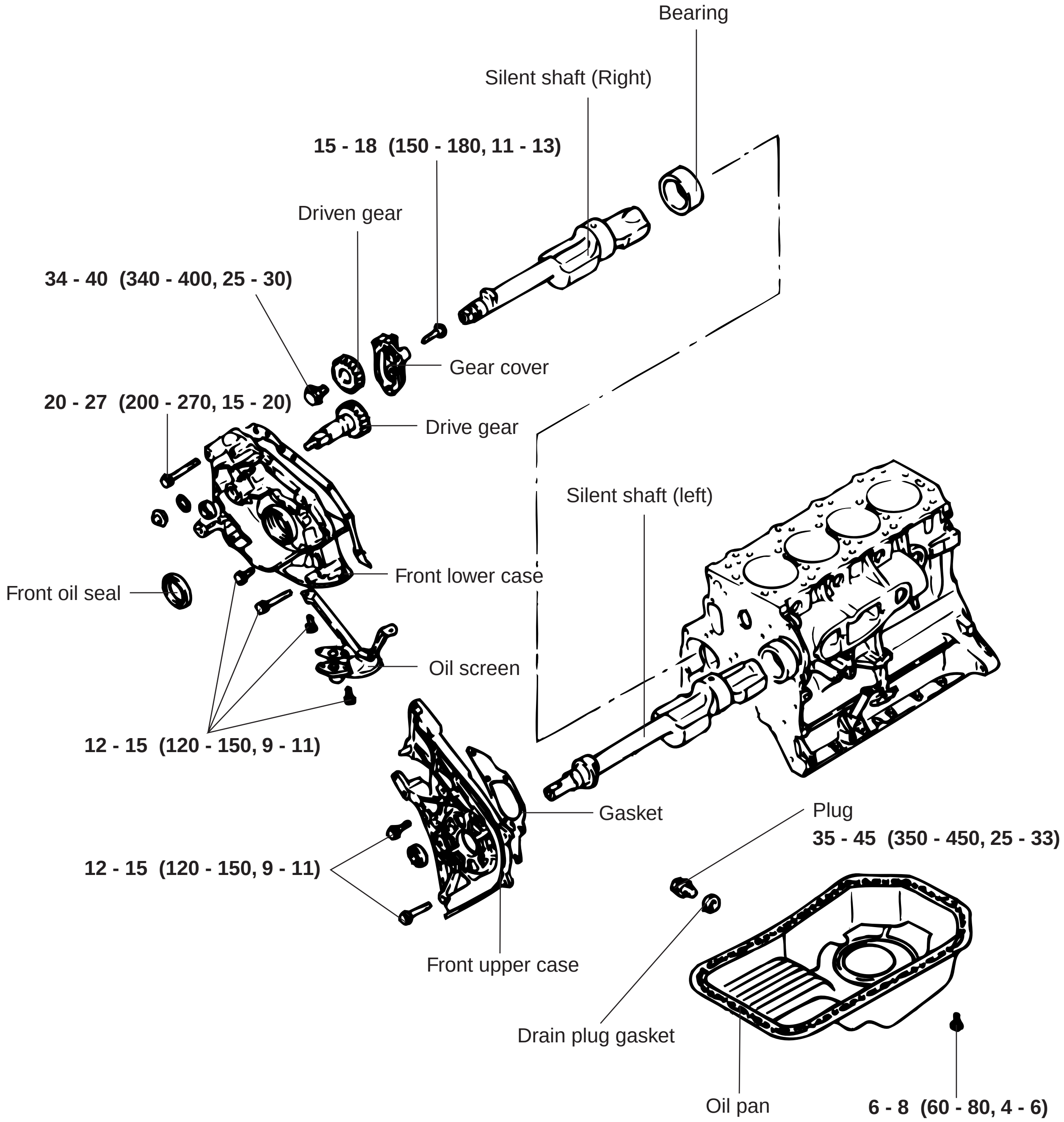
2. Check the insulator stopper plate for damage, crack and deformation.

NOTE

Be careful not to apply oil to the insulator.

FRONT CASE

COMPONENTS ECLB0250



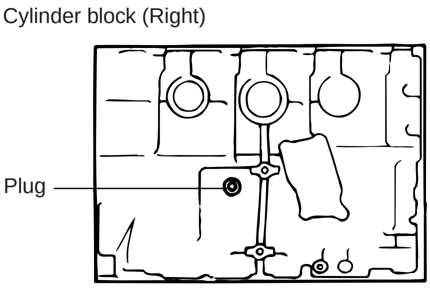
TORQUE : Nm (kg.cm, lb.ft)

ECLA007G

REMOVAL ECLB0260

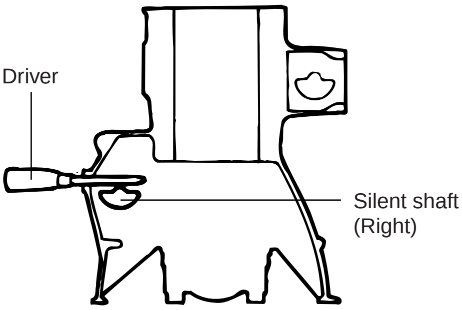
SILENT SHAFT

1. Remove the oil pan.
2. Remove the oil screen.
3. Remove the spacer from the forward end of the left silent shaft.
4. Remove the front upper case.
5. Remove the left silent shaft.
6. Remove the plug cap from the top of the right silent shaft drive gear.



ECLA007I

7. Slightly loosen the flange bolt at the forward end of the right silent shaft. When loosening the bolt, remove the plug on the right side of the cylinder block and insert a screwdriver to prevent rotation.



ECLA007J

8. Remove the front lower case and the silent shaft as an assembly.
9. Remove the left silent shaft from the front lower case.

OIL PUMP

1. Remove the oil pump cover from the front lower case.
2. Remove the oil pump outer gear. Put matching mark on the outer gear to insure correct reassembly.
3. Remove the silent shaft drive gear cover and then remove the drive gear and driven gear.

CAMSHAFT

1. Turn the crankshaft to bring the piston in No. 1 cylinder to the top dead center on the compression stroke. (The piston in cylinder is at the top dead center on the compression stroke when the dowel pin is at the topmost.)
2. Remove the timing belt upper cover. With the timing belt as installed, remove the camshaft sprocket, and place on the timing belt lower cover.
3. Remove the rocker shaft assembly.
4. Remove the camshaft bearing cap and take out the camshaft.

INSPECTION ECLB0270

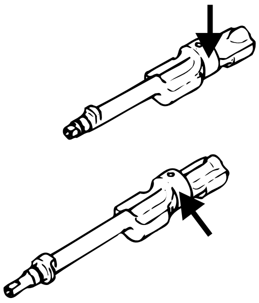
SILENT SHAFT

1. The oil holes must be free from clogging.
2. Check journal for seizure, damage, and contact with the bearing. If defects are evident, replace the silent shaft, bearing, or front case assembly.
3. Check the silent shaft for oil clearance. If wear is excessive, replace the silent shaft bearing, silent shaft, or front case assembly.

Oil clearance standard value

Front : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)

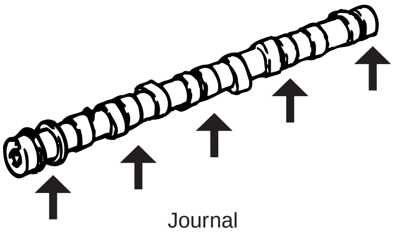
Rear : 0.05 - 0.09 mm (0.0020 - 0.0035 in.)



ECLA007K

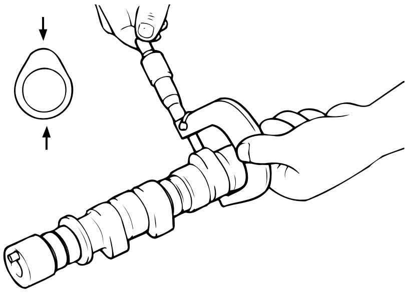
CAMSHAFT

1. Check the camshaft journal surfaces and, if damage or seizure is evident, replace the camshaft. If the camshaft journals are seized, check the cylinder head for damage. Check also the cylinder head oil holes for clogging.



ECLA019B

2. Check cam surfaces for abnormal wear and damage. If defects are evident, replace the camshaft, measure the lobe height and, if the limit is exceeded, replace the camshaft.



EDA9260A

Standard value

Intake and exhaust : 37.05 mm (1.4587 in.)

Limit

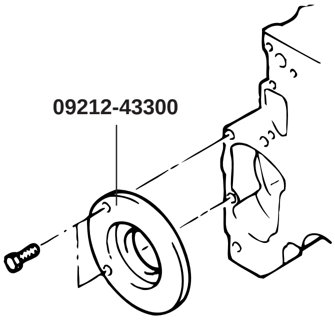
Intake and exhaust : 36.55 mm (1.4389 in.)

REPLACEMENT ECLB0280

SILENT SHAFT

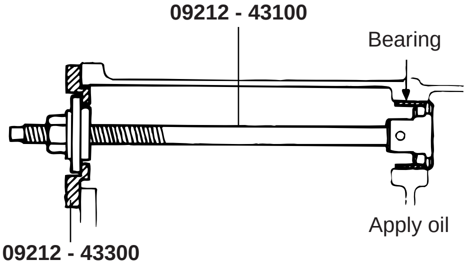
NOTE

Use Bearing Installer Stopper (special tool) only for removal and reinstallation of the right bearing.



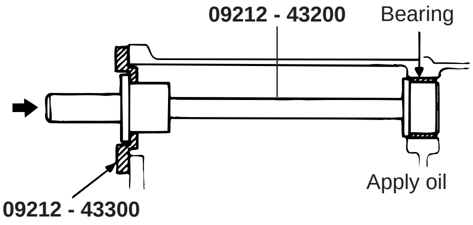
ECLA008A

1. Using Bearing Installer Stopper and Silent Shaft Bearing Puller (09212 - 43300, 09212 - 43100), remove two rear bearings from the cylinder block.



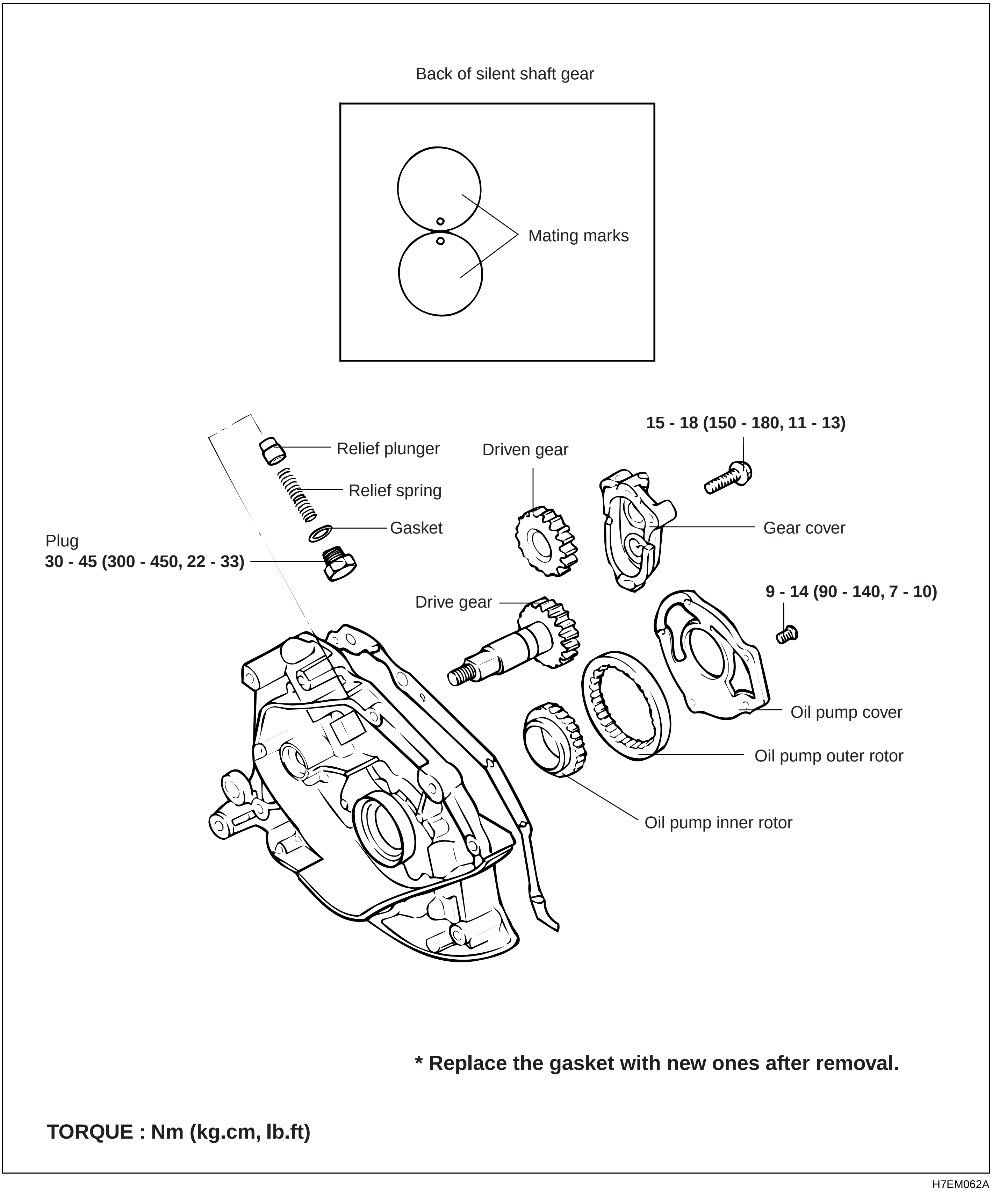
ECLA008B

2. Using Bearing Installer Stopper and Silent Shaft Bearing Installer (09212 - 43300, 09212 - 43200), press-fit bearing into cylinder block.



ECLA008C

INSTALLATION ECLB0290



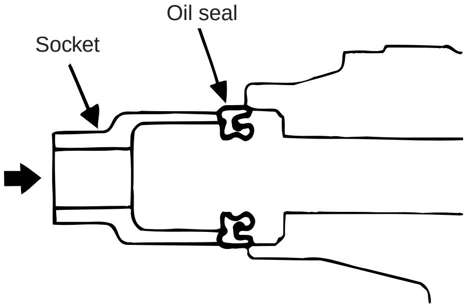
H7EM062A

OIL SEAL

When mounting the oil seal from the rear, too, fit the Oil Seal Guide to the drive gear shaft first to prevent the oil seal lips from being caught in steps in shaft during installation.

NOTE

Apply oil to outer surfaces of Oil Seal Guide.



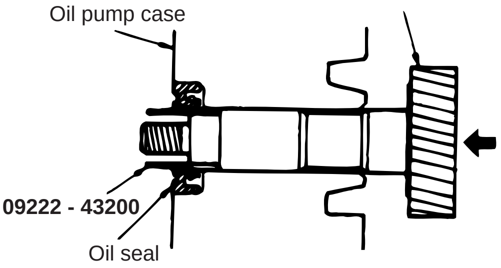
ECLA008E

SILENT SHAFT DRIVE GEAR

When mounting the drive gear from the rear because of the drive gear oil seal press-fitted in front lower case, first fit Oil Seal Guide (09222 - 43200) to the drive gear shaft before insertion.

NOTE

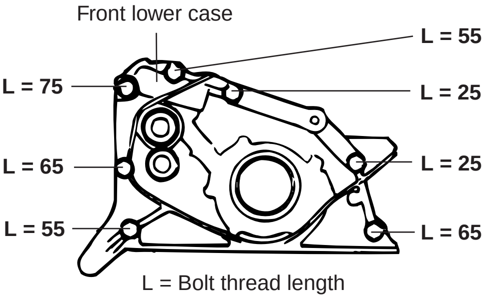
Apply oil to outer surfaces of Oil Seal Guide.



ECLA008G

FRONT LOWER CASE

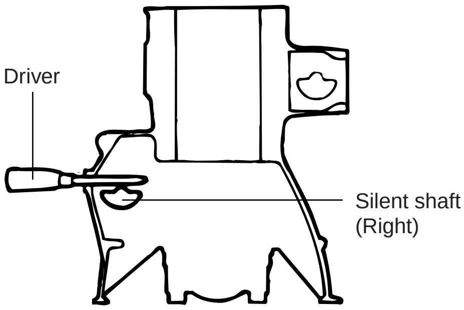
Tighten seven flange bolts to specification.



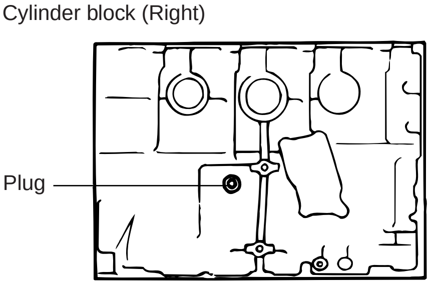
ECLA008H

FLANGE BOLT

When tightening the bolts, be sure to secure the silent shaft in position.



ECLA007J



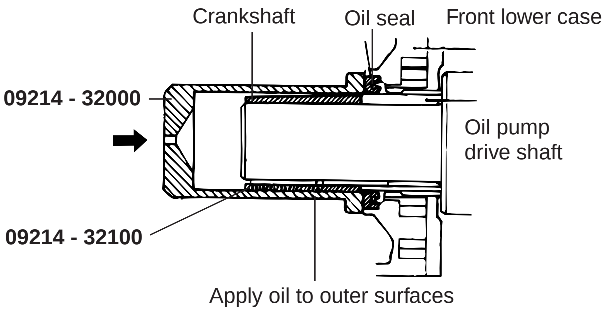
ECLA007I

CRANKSHAFT FRONT OIL SEAL

Using Oil Seal Installer and Guide (09214 - 32000, 09214 - 32100), install the crankshaft front oil seal.

NOTE

The oil pump drive shaft must be installed before installing the front oil seal.



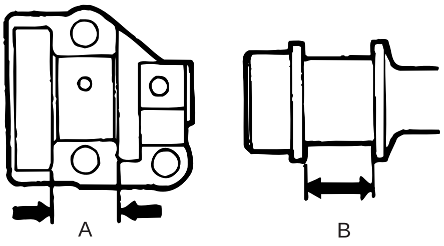
ECLA008I

CAMSHAFT

1. To obtain the end play, measure A and B. Replace parts if the limit is exceeded.
   End play = B - A

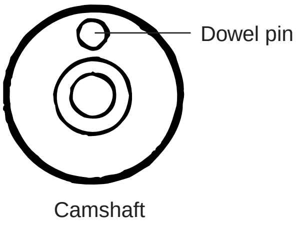
Standard value : 0.1 - 0.2 mm (0.0039 - 0.0079 in.)

Limit : 0.4 mm (0.0157 in.)



ECLA019C

2. Install the camshaft to the cylinder head with the dowel pin at the highest position.



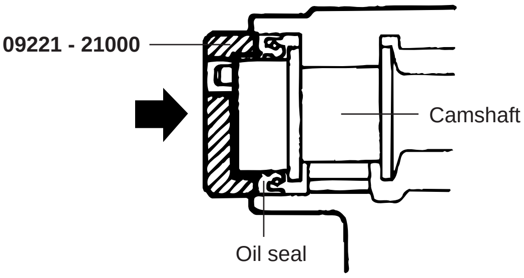
ECLA019D

CAMSHAFT OIL SEAL

1. Apply oil to the oil seal lips.
2. Using Camshaft Oil Seal installer (09221 - 21000), press-fit a new camshaft oil seal into the front bearing cap.

CAUTION

Drive in the shaft after the camshaft bearing cap is installed.
Apply oil to the oil seal lip.



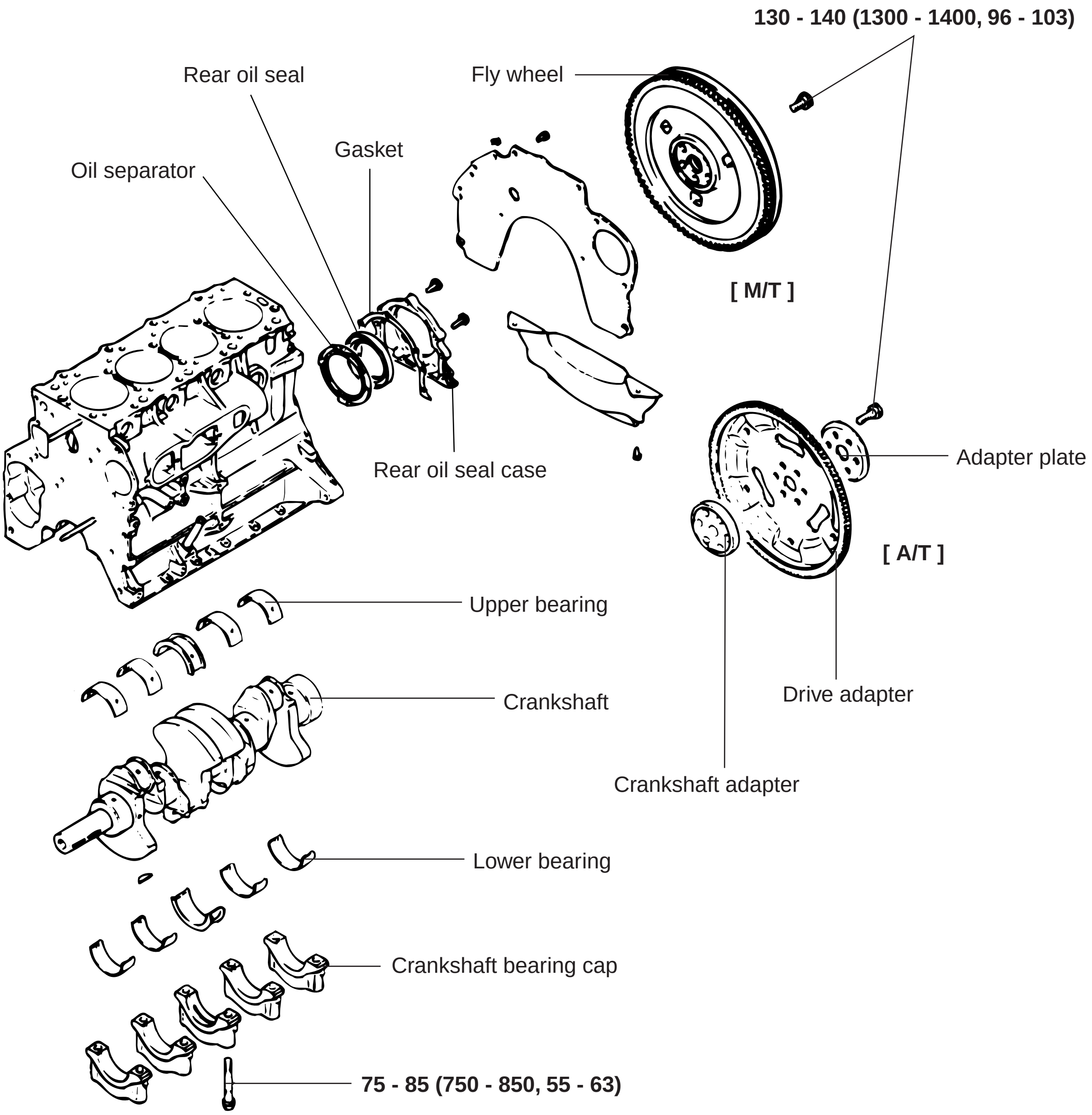
ECLA019E

MAIN MOVING SYSTEM

CRANK SHAFT

COMPONENTS

ECLB0300



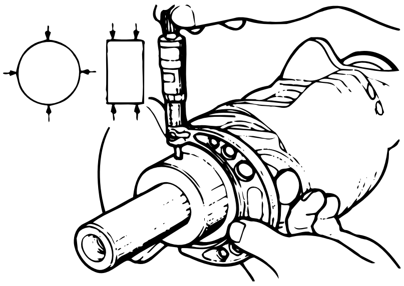
TORQUE : Nm (kg.cm, lb.ft)

ECLA009A

INSPECTION ECLB0310

CRANKSHAFT

1. Measure the journal and pin dimensions in directions A and B at front and rear (1 and 2) positions.
2. If worn excessively, grind to an undersize. If the service limit is exceeded, replace the crankshaft.



ECLA009B

Standard value

Journal O.D. : 66 mm (2.598 in.)

Pin O.D. : 53 mm (2.087 in.)

CRANKSHAFT OIL CLEARANCE

1. Determine the clearance from the diference between the O.D. of journal as well as pin O.D. and the I.D. of each bearing as assembled to the crankshaft. Measure the bearing I.D. in directions A and B at front and rear (1 and 2) positions.

Standard value

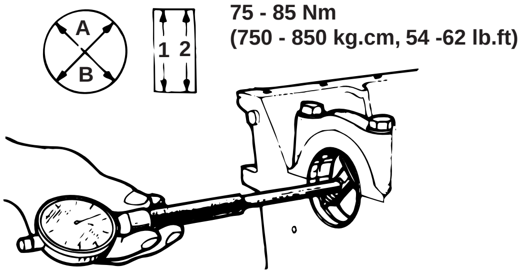
Oil clearance of journal :

0.02 - 0.05 mm (0.0008 - 0.002 in.)

Oil clearance of pin :

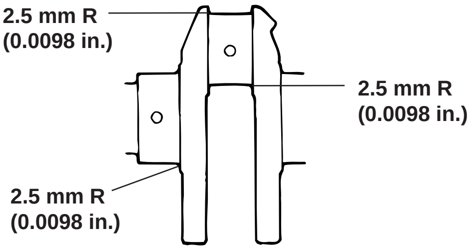
0.02 - 0.05 mm (0.0008 - 0.002 in.)

Limit : 0.1 mm (0.0039 in.)



ECLA009C

2. If the use of a new bearing still results in an oil clearance larger than the standard value, grind the crankshaft to the undersize and use a bearing of corresponding undersize.
3. When grinding the crankshaft to undersize, ensure correct fillet radius dimensions in journals and pins.

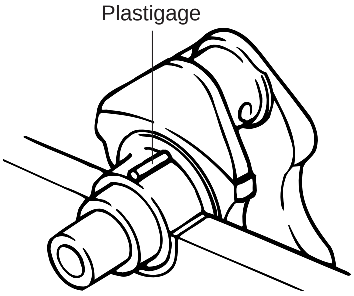


ECLA009D

CRANKSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)

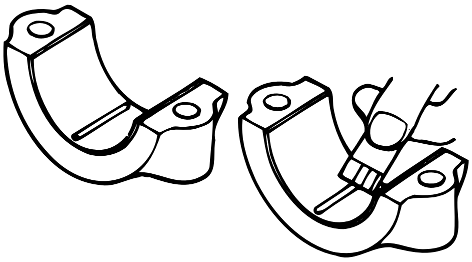
A Plastigage can be used to simplify the measurement of oil clearance. use the following procedure to check the oil clearance with a Plastigage (for journals).

1. Wipe crankshaft O.D. and bearing I.D. clean of oil.
2. Install the crankshaft.
3. Put a strip of Plastigage lengthwise in the center of the journal.



ECLA009E

4. Replace the main bearing cap carefully and tighten bolts to specification.
5. Remove bolts and carefully remove the main bearing cap.
6. Using the scale printed on the bag of plastigage, measure the amount the Plastigage has been flattened (the widest point).



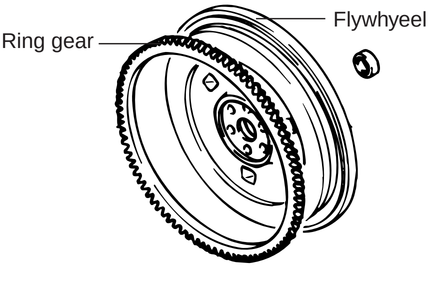
ECLA009F

CRANKSHAFT FRONT AND REAR OIL SEALS

1. Wear and damage in oil seal lips.
2. Deteriorated or hardened rubber.
3. Cracks or damage on oil seal case.

RING GEAR (MANUAL TRANSAXEL)

1. If the ring gear teeth are worn, damaged, or broken, replace the ring gear. If the teeth are damaged or broken, check the starting motor pinion. To remove the ring gear for replacement, tap its outer rim one place after another. Heating the gear makes it impossible to remove. To install the ring gear onto the flywheel, heat it up to 260-280°C (500-536°C) : it is a shrink fit in the flywheel.
2. Check the ball bearing for rotating condition and unusual noise. Ensure also that the packed grease is not leaking.



ECLA009G

FLYWHEEL

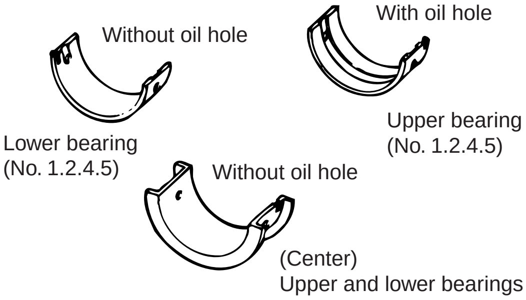
1. Check the flywheel clutch disc surface visually.
2. If ridge wear, streak, or seizure is evident, replace.
3. If the clutch disc surface runs out exceeding the limit, replace.

Limit : 0.13 mm (0.0051 in.)

INSTALLATION ECLB0320

CRANKSHAFT BEARING

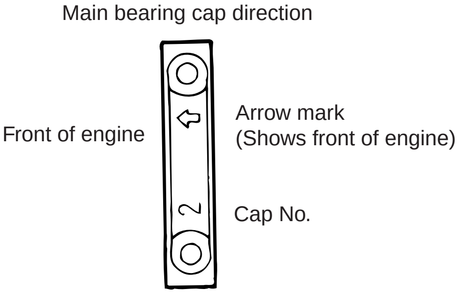
The upper main bearing is provided with an oil hole, whereas the lower bearing has no oil hole, There is no difference in center bearing (with flange) between upper and lower.



ECLA009H

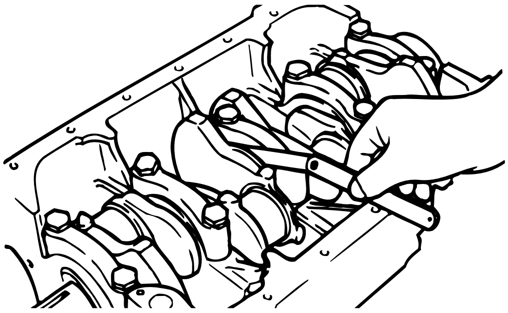
BEARING CAP

1. Install the main bearing to the cylinder block. Ensure the correct cap number and arrow mark direction.



ECLA009I

2. Check to ensure that the crankshaft turns smoothly and there is an adequate end play.



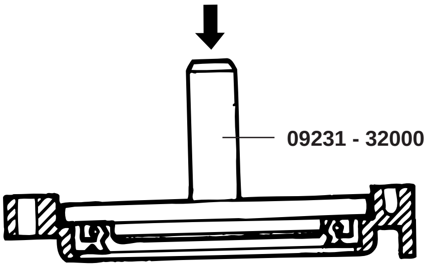
ECLA009J

Standard value : 0.05-0.18mm (0.0020-0.0071in.)

Limit : 0.25 mm (0.010 in.)

OIL SEAL CASE

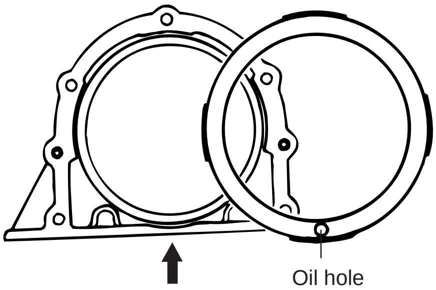
Using special tool, press-fit a new crankshaft rear oil seal into the oil seal case.



ECLA009K

OIL SEPARATOR

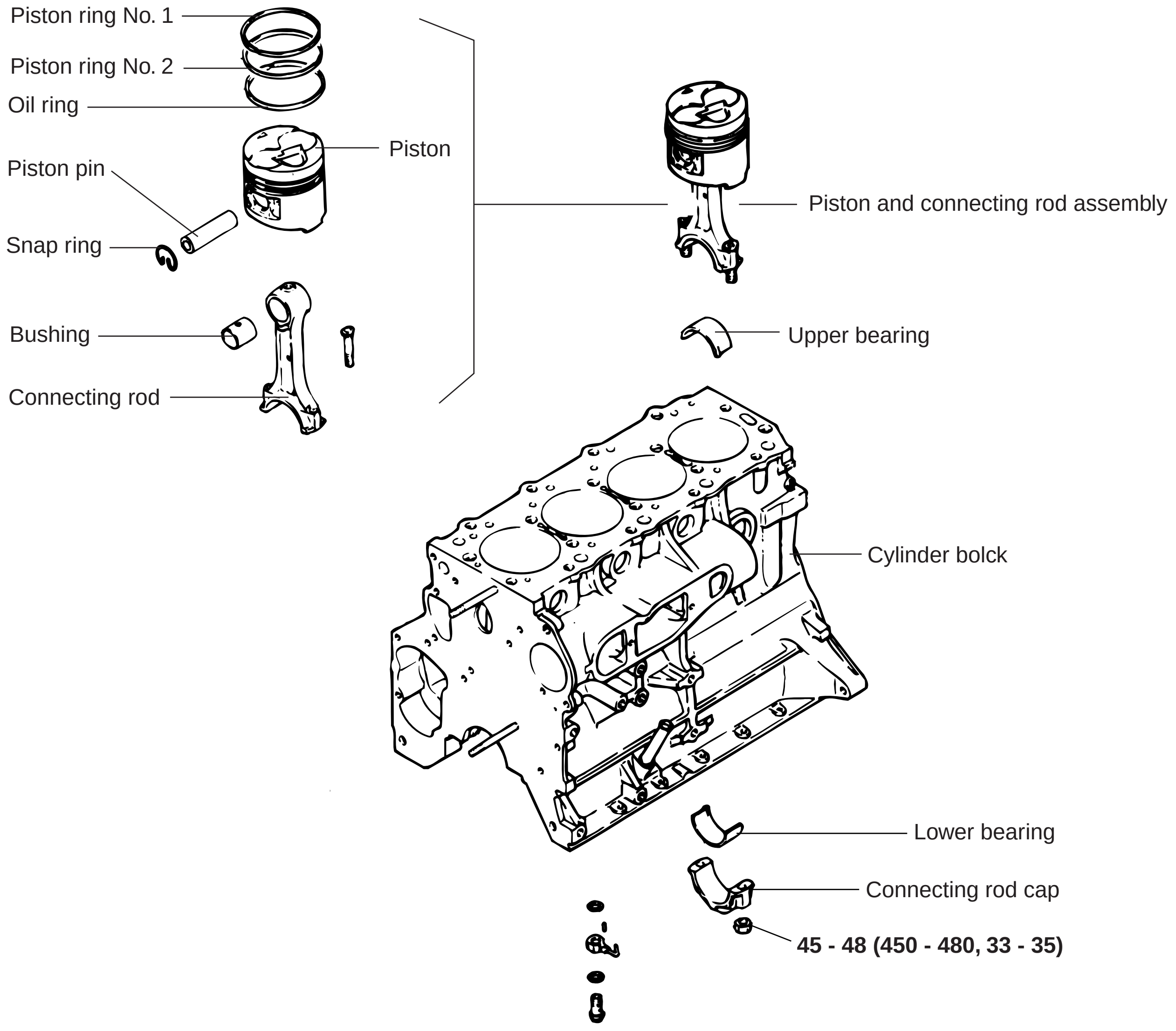
1. Push oil separator into the oil seal case.
2. Make sure that the oil hole in the separator comes at the bottom (indicated by an arrow in illustration.)



ECLA009L

PISTON

COMPONENTS ECLB0330



TORQUE : Nm (kg.cm, lb.ft)

ECLA010A

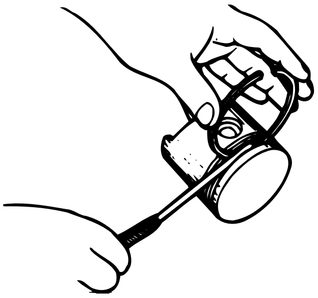
INSPECTION EDUC0200

PISTON

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be smoothly pressed by hand into the pin hole (at room temperature)

PISTON RING

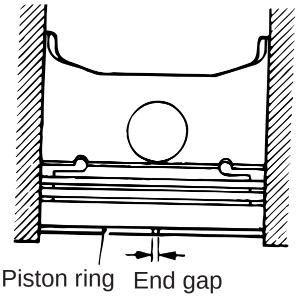
1. Check each piston ring for breakage, damage and abnormal wear.
   Replace the defective rings.
2. When the piston requires replacement, its ring should also be replaced.
3. Measure the clearance between piston ring and ring home.



ECLA010B

Standard Value : Ring - to - ring groove clearance
No. 1
TC, TCI : 0.056 - 0.076 mm (0.0022 - 0.0030 in)
N/A : 0.03 - 0.07 mm (0.0019 - 0.0028 in)
No. 2
TC, TCI : 0.046 - 0.066 mm (0.0018 - 0.0026 in)
N/A : 0.08 - 0.12 mm (0.0031 - 0.0047 in)
Oil ring : 0.02 - 0.065 mm (0.0008 - 0.0026 in)
TC, TCI : 0.02 - 0.065 mm (0.0008 - 0.0026 in)
N/A : 0.02 - 0.65 mm (0.0008 - 0.0026 in)
[Limit]
No. 1 : 0.15 mm (0.0059 in.)
No. 1 : 0.15 mm (0.0059 in.)
Oil ring : 0.1 mm (0.0039 in.)

4. Place a piston ring in the cylinder bore and set it square by pushing it down with piston.
5. Measure the end clearance using a thickness gauge.

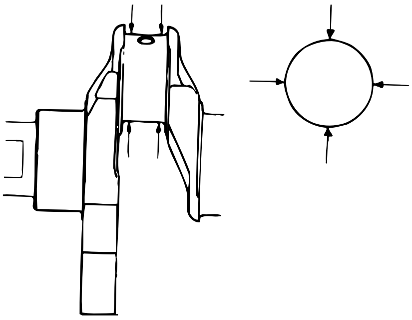


ECLA010D

Standard Value : End gap
No. 1
TC, TCI : 0.35 - 0.50 mm (0.0138 - 0.0197 in)
N/A : 0.25 - 0.04 mm (0.0098 - 0.0157 in)
No. 2
TC, TCI : 0.25 - 0.40 mm (0.0098 - 0.0157 in)
N/A : 0.45 - 0.60 mm (0.0177 - 0.0236 in)
Oil ring
TC, TCI : 0.25 - 0.45 mm (0.0098 - 0.0177 in)
N/A : 0.20 - 0.40mm (0.0079 - 0.0157 in)
Limit : 0.8 mm (0.0315 in.)

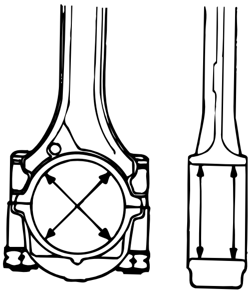
CONNECTING ROD BEARING

1. Check the bearing surfaces for uneven contact pattern, streaks, scratches, and seizure. If defects are evident, replace. If the surfaces are seriously nicked and seized, check also the crankshaft. If the crankshaft is also damaged, replace the crankshaft or grind to undersize for reuse.



ECLA010E

2. Measure the connecting rod bearing I.D. and crankshaft pin O.D. If the clearance (oil clearance) exceeds the limit, replace the bearing and, if necessary, the crankshaft. Or, grind the crankshaft to an undersize and, at the same time, replace the bearing with an undersize.



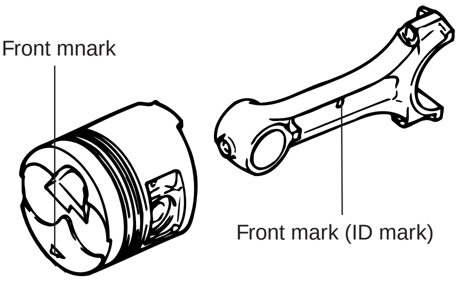
ECLA010F

Standard value :	0.02-0.05mm (0.0008-0.0020in.)
Limit :	0.10 mm (0.0039 in.)

INSTALLATION ECLB0350

CONNECTING ROD, PISTION PIN AND PISTON

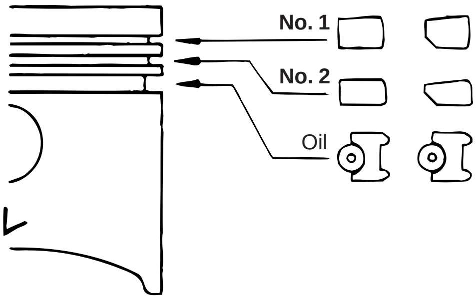
1. Match the piston with the connecting rod.
2. Line up the front marks and insert the piston pin. The piston pin must be smoothly pressed by hand into position. Replace the piston pin if there is excessive play.



ECLA010J

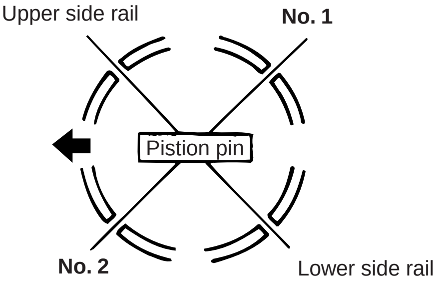
PISTON RING

1. Install the oil ring expander and oil ring to the piston. 2. Then, install No.2 piston ring and No.1 piston ring, in that order. Make sure that the ring side, on which manufacturer and size marks are stamped, faces to the piston crown.



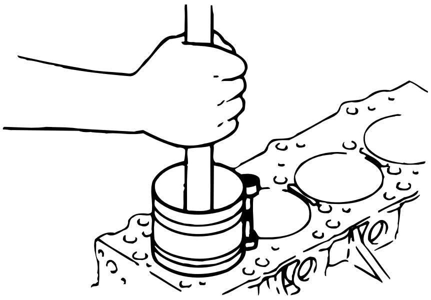
ECLA010L

2. Position ends of piston and oil (side rail, spacer) rings as illustrated.



ECLA010M

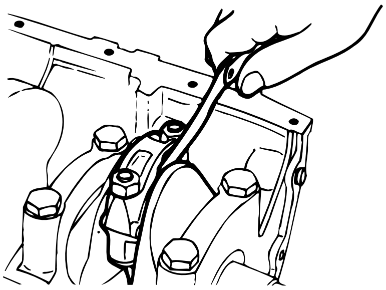
3. Insert the piston and connecting rod assembly from above the top of cylinder. Ensure that the front mark on piston crown and that (ID mark) on the connecting rod face toward the front of engine (to the crank pulley side).
4. Clamp firm the piston rings with the ring band and install the piston assembly into cylinder. Do not strike it hard into the piston, as broken piston ring or damaged crank pin could result.



ECLA010N

5. Make sure the clearance of connecting rod big end side.

Standard Value :	0.10 - 0.25 mm (0.0039 - 0.0098 in.)
Limit :	0.4 mm (0.0157 in.)

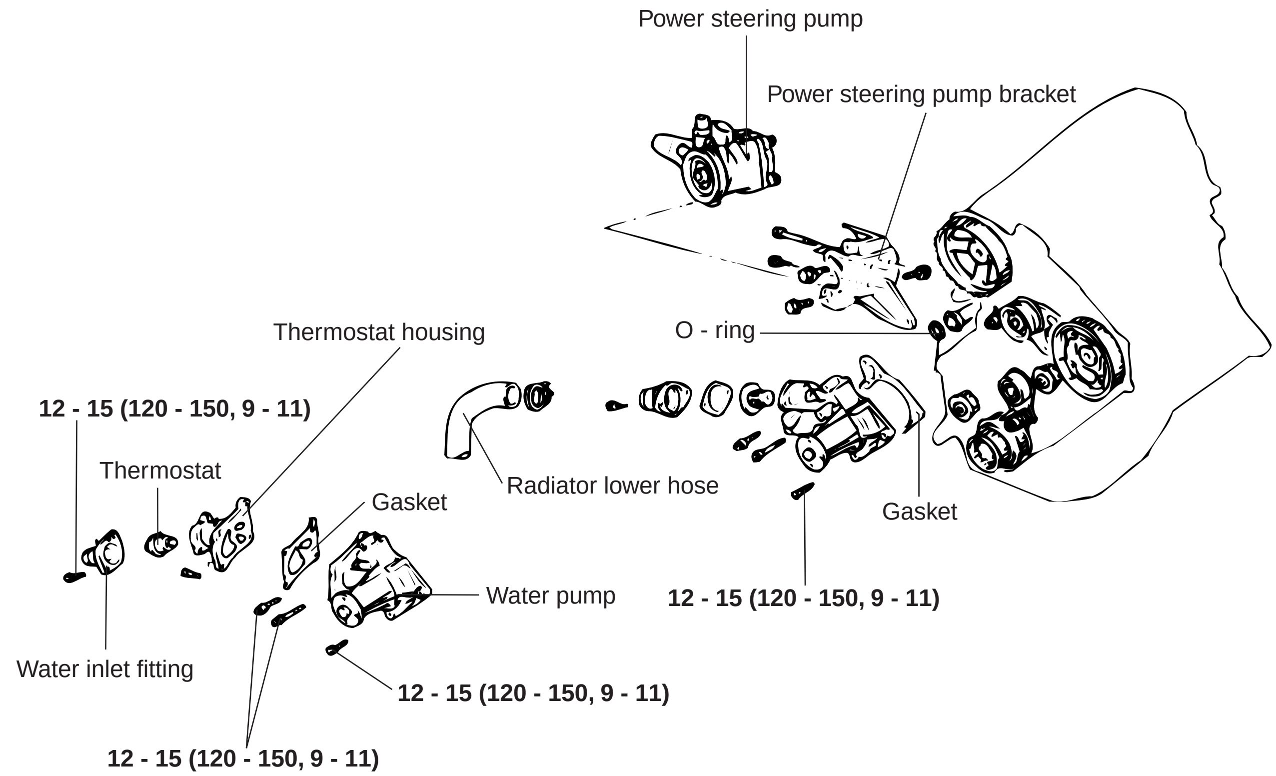


ECLA010O

COOLING SYSTEM

ENGINE COOLANT PUMP

COMPONENTS ECLB0400



*** Replace the gasket and O - ring with new ones after removal**

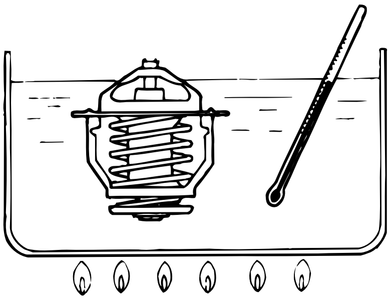
TORQUE : Nm (kg.cm, lb.ft)

ECLA011F

INSPECTION ECLB0410

THERMOSTAT

1. Check that valve closes tightly at room temperature.
2. Check for defects or damage.
3. Check for rust on valve. Remove if any.
4. Immerse thermostat in container of water. Stir to raise water temperature and check that thermostat opening valve temperature and the temperature with valve fully open [valve liftover 8.5 mm (0.33 in.)] are at the standard value.



ECLA011C

Standard value :

Opening valve temperature 82° C (180° F)

Full - open temperature 95° C (203° F)

NOTE

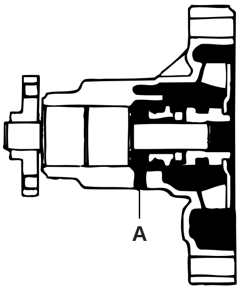
Measure valve heifht when fully close. Calculate lift by measuring the height when fully open.

BELT

1. Check the surface for damage, peeling or cracks.
2. Check the surface for presence of oil or grease.
3. Check the rubber for wear or hardening.

WATER PUMP

1. Check each part for cracks, damage or wear, and replace the water pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the water pump assembly if necessary.
3. Check the seal unit for leaks, and replace the water pump assembly if necessary.
4. Check for water leakage. If water leaks from hole “A” seal unit is defective. Replace as an assembly.

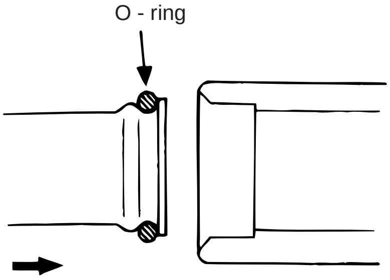


ECLA011B

INSTALLATION ECLB0420

WATER PIPE O - RING

Fit water pipe O-ring in the groove provided at water pipe end, wet the periphery of water pipe O-ring and insert water pipe.



ECLA011E

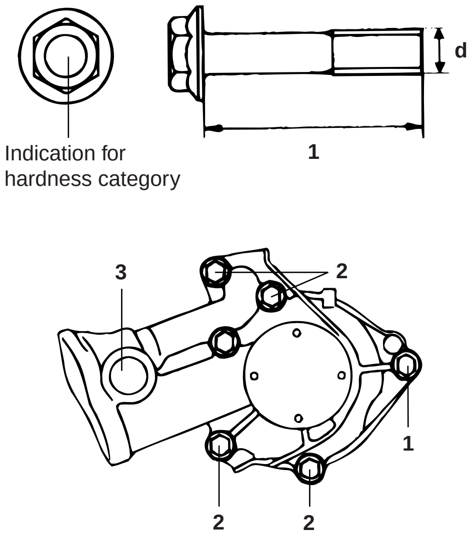
CAUTION

1. ***Do not apply oil and grease to water pipe O-ring.***
2. ***Keep the water pipe connections free of sand, dust, etc.***
3. ***Insert water pipe until its end bottoms.***

WATER PUMP

Water pump installation bolt size are different and caution must be paid to ensure that they are properly installed.

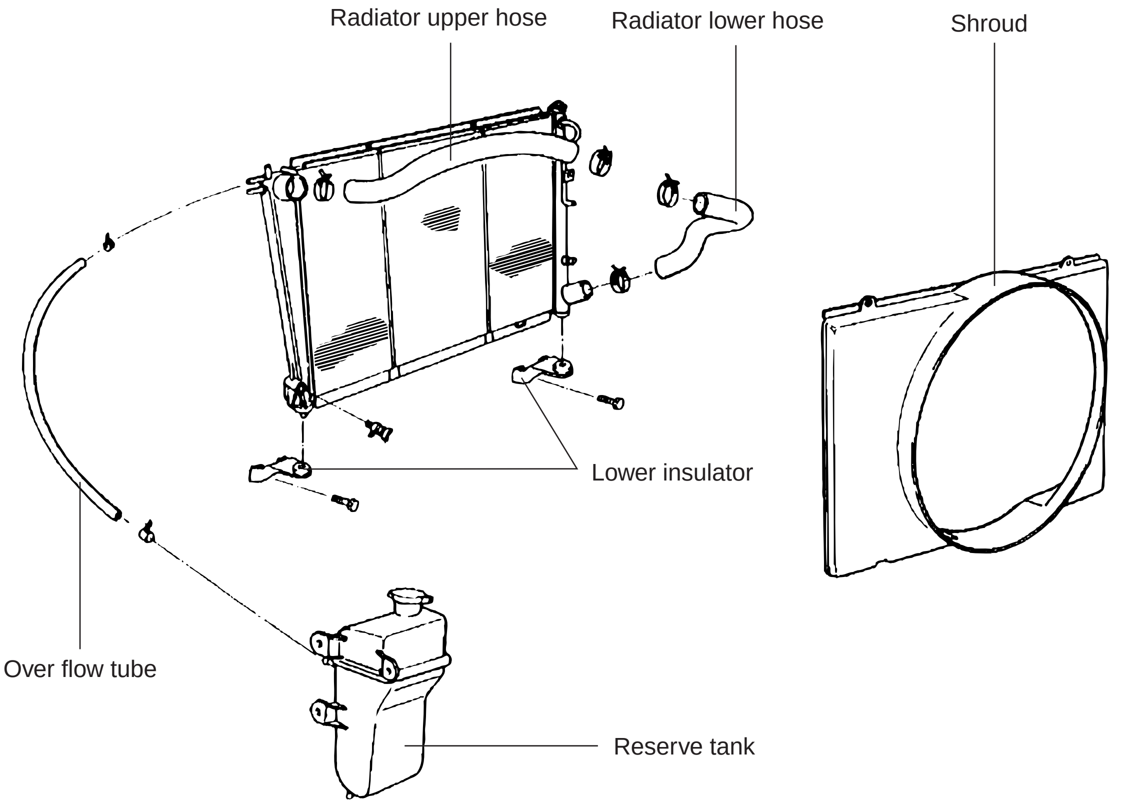
No	Hardness category (Head mark)	d × l mm (in.)	Torque Nm (kg.cm, lb.ft)
1	4T	8 × 25 (0.31 × 0.98)	12 - 15 (120 - 150, 9 - 11)
2	4T	8 × 40 (0.31 × 1.57)	
3	7T	8 × 70 (0.31 × 2.76)	20 - 27 (200 - 270, 15 - 20)



ECLA011D

RADIATOR

COMPONTETS EDUC0300

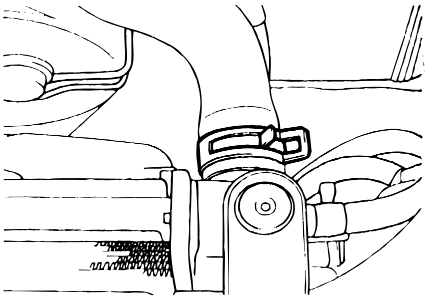


ECUC120A

REMOVAL EDUC0400

RADIATOR

1. Loosen the radiator drain plug to drain the coolant.
2. Disconnect the radiator hoses from the following parts.
   Upper hose ... from the radiator
   Lower hose ... from the engine.
3. Disconnect the overflow tube from the radiator.

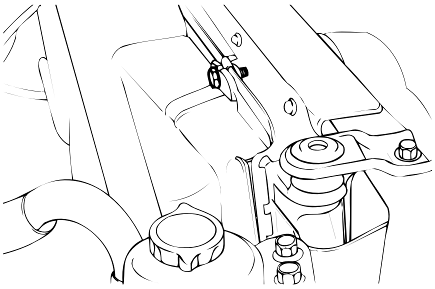


ECUC130A

4. Remove the radiator shroud bolts from the radiator.

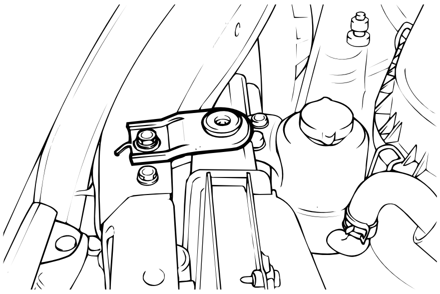
NOTE

Shroud should be hung on the cooling fan, because it cannot be removed unless the radiator is taken out.



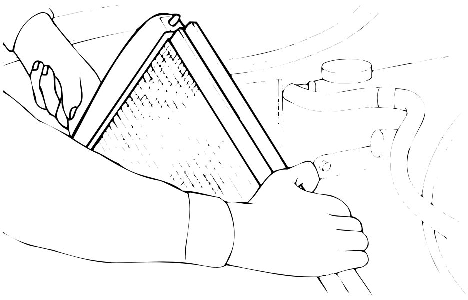
H7EM913B

5. Remove the radiator mounting bolts.



H7EM914A

6. Tilt radiator and take out obliquely upward.



H7EM003A

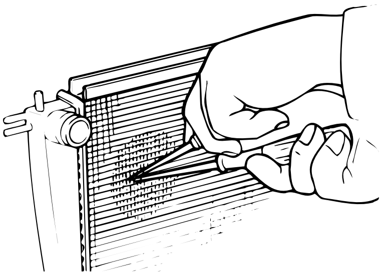
NOTE

When the radiator is removed, make sure that the radiator core is not bent or crushed by other parts.

7. Remove the radiator shroud.

CORRECTION OF RADIATOR FIN

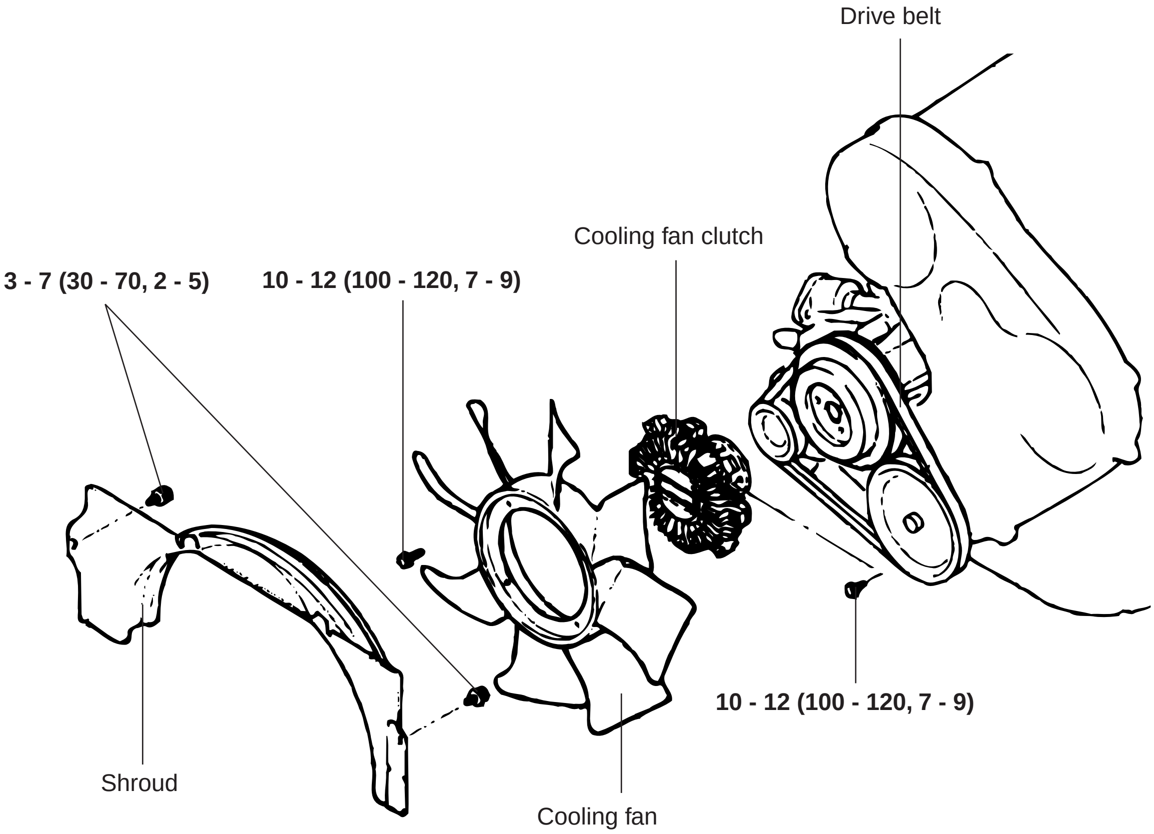
A bent or crushed portion shoude be corrected as shown.



H7EM003B

RADIATOR PAN MOTOR

COMPONENTS ECLB0450



TORQUE : Nm (kg.cm,lb.ft)

ECLA012B

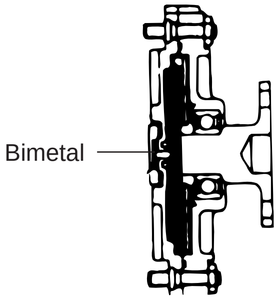
INSPECTION ECLB0460

COOLING FAN

1. Check the blades for damage and cracks.
2. Check for cracks and damage around bolt holes in fan hub.
3. If any portion of fan is damaged or cracked, replace cooling fan.

FAN CLUTCH

1. Check to ensure that fluid in fan clutch is not leaking at case joint and seals. If fluid quantity decreases due to leakage, fan speed will decrease and engine overheating might result.
2. When fan attached to engine is turned by hand, it should give a sense of some resistance. If fan turns lightly, it is defective.
3. In case of thermostatic control type, check for a broken bimetal.



ECLA012C

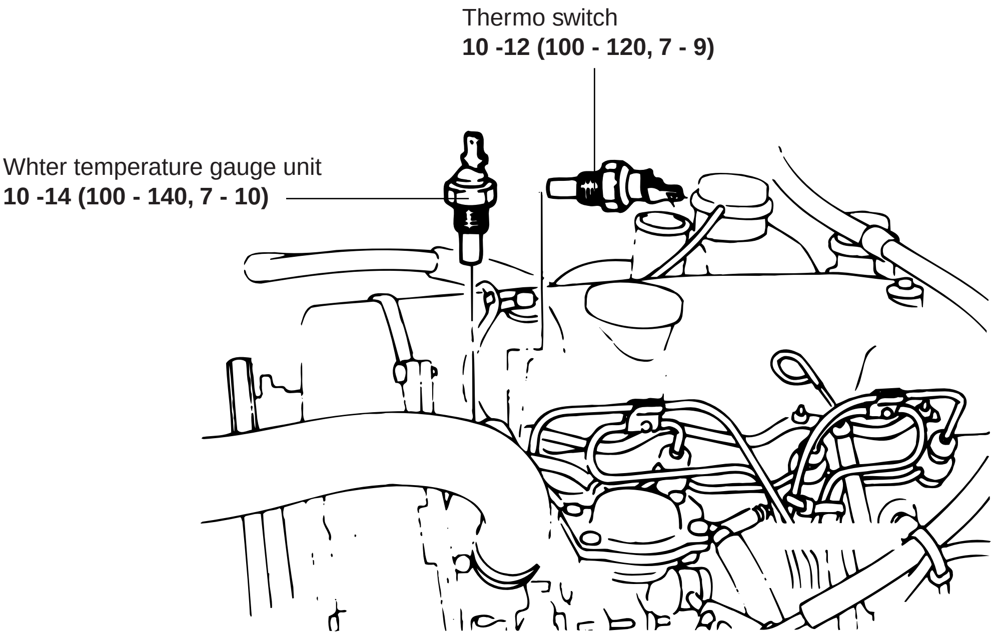
BELT

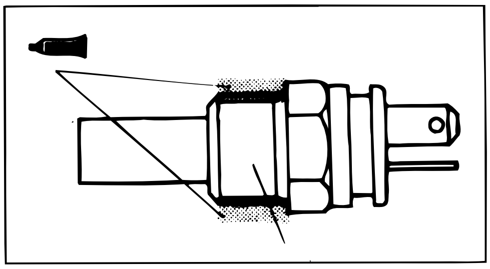
A belt which has following defects should be replaced.

1. Damaged, peeled or cracked surface.
2. Oil or greasy surface.
3. A belt worn to such an extent that it is in contact with bottom of V groove in pulley.
4. Worn or hardened rubber.

WATER TEMPERATURE GAUGE UNIT, THERMO SWITCH

ECLB0470





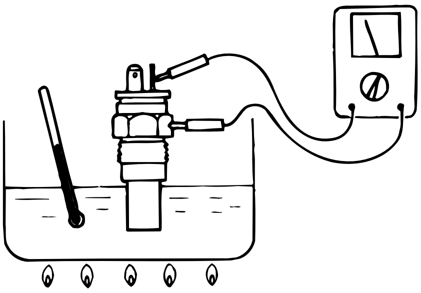
TORQUE : Nm (kg.cm,lb.ft)

ECLA012D

INSPECTION ECLB0480

WATER TEMPERATURE GAUGE UNIT

1. Put the sensor in water and increase the water temperature to measure the nesistance.

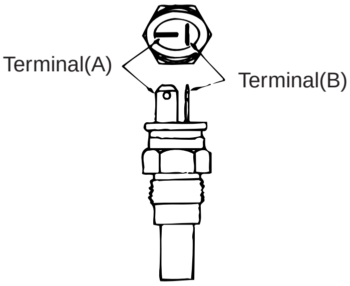


ECLA012E

2. If the measurement radically deviates from specification, replace.

3. Measure the resistance across terminal (A) and body for water temperature gauge element and across terminal (B) and body for glow control element.

Terminal (A)	0.4 Ω / 70° C
	23.8 Ω / 115° C
Terminal (B)	24.8 Ω / - 20° C
	3.25 Ω / 20° C

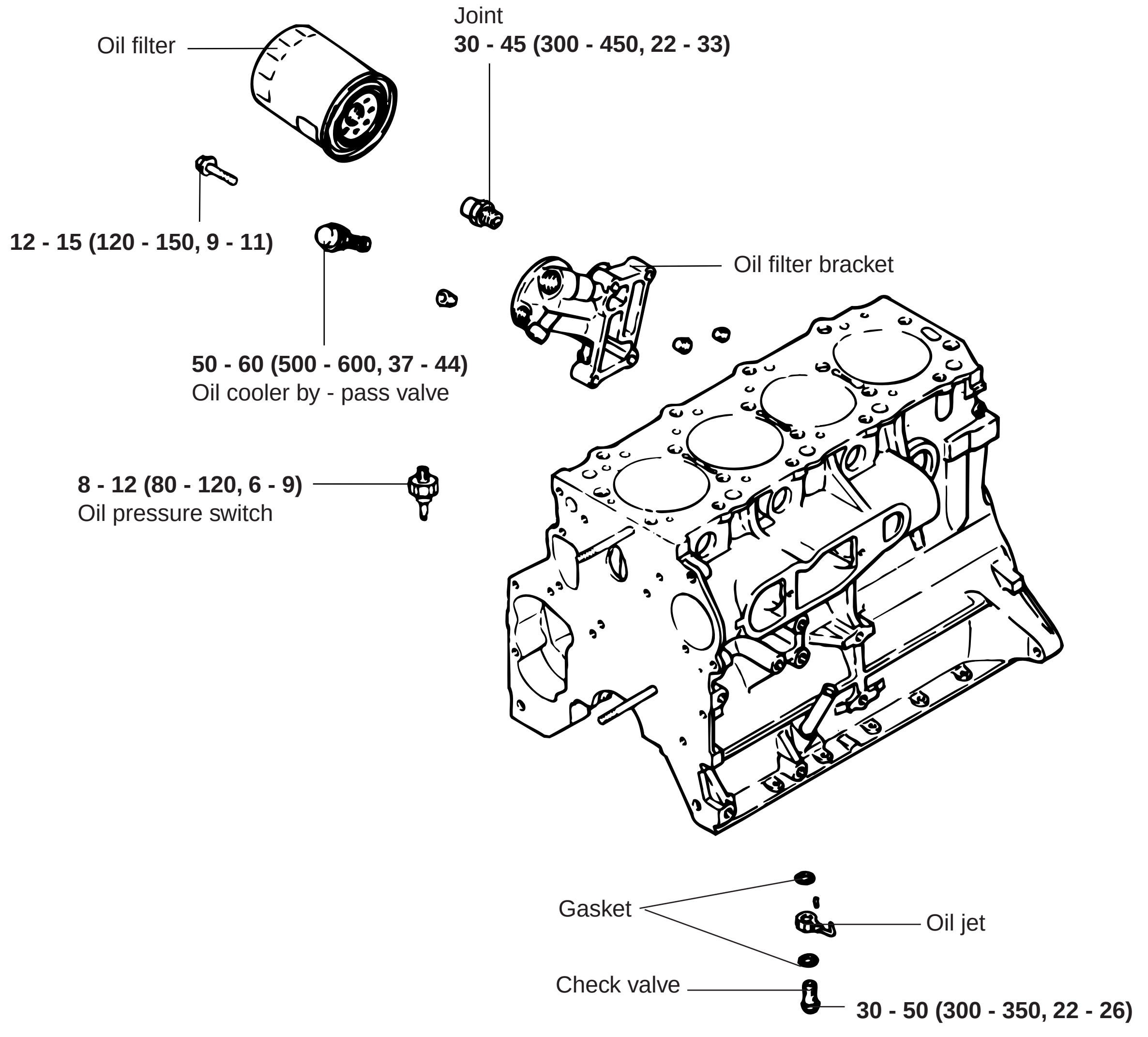


ECLA012F

LUBRICATION SYSTEM

OIL FILTER

COMPONENTS ECLB0500



*** Replace the gasket with new ones after removal.**

TORQUE : Nm (kg.cm,lb.ft)

ECLA013A

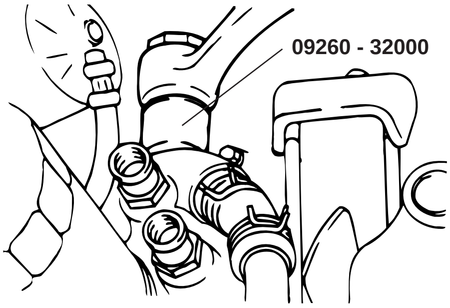
REMOVAL ECLB0510

OIL PRESSURE SWITCH

To remove the oil pressure switch, use Oil Pressure Switch Wrench (09260 - 32000).

NOTE

During removal, use care to prevent damage to the sealant applied to threads.



ECLA013B

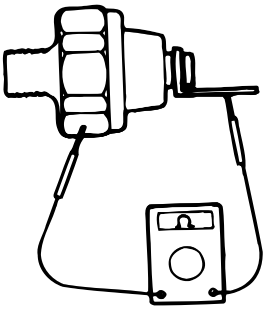
INSPECTION ECLB0520

OIL FILTER BRACKET

1. The oil filter mounting surface must be free from damage.
2. Check for cracks and oil leaks.
3. Make sure that the relief plunger slides smoothly and the relief spring is not damaged.

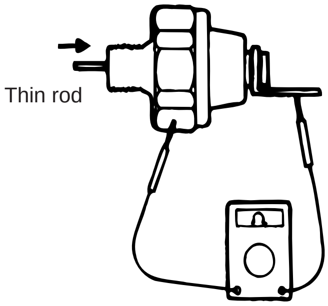
OIL PRESSURE SWITCH

1. Connect a tester (ohm range) between the terminal and the body of the switch to check for continuity. The switch is normal if there is continuity. If there is no continuity, replace the switch.



ECLA013C

2. Insert a thin rod in the oil hole of the switch and push it in lightly. The switch is normal if no continuity is detected (infinite resistance on the tester). If there is continuity, replace the switch.

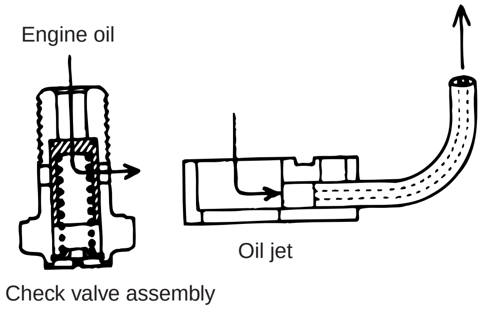


ECLA013D

3. Apply a 0.5 kg/cm² pressure to the oil hole.
   The switch is normal if there is no continuity.
   Also check for air leaks. If any air leaks are detected, the cause may be a broken diaphragm. Replace the switch if it leaks.

OIL JET, CHECK VALVE

1. Check the oil jet and check valve for clogging.
2. Check the oil jet for damage and deformation.



ECLA013E

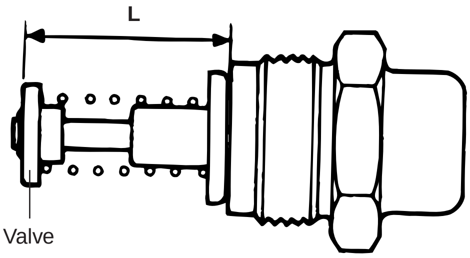
OIL COOLER BYPASS VALVE

1. Make sure that the valve moves smoothly.
2. Ensure that the dimension L measures the standard value under normal temperature and humidity.

Dimension L : 34.5 mm (1.36 in.)

3. The dimension must be the standard value when measured after the valve has been dipped in 100° C (212° F) oil.

Dimension L : 40 mm (1.57 in.) or more

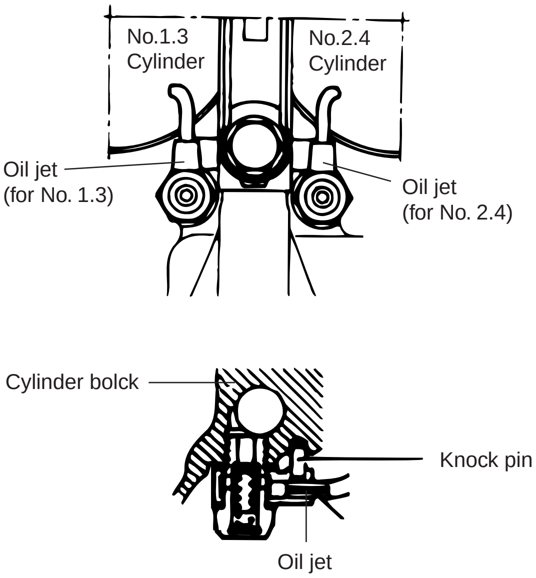


ECLA013F

INSTALLATION ECLB0530

OIL JET

There are two types of oil jets installed: one for No. 1 and 3, and the other for No. 2 and 4. Make sure that the correct one is installed with correct direction as shown.



ECLA013G

OIL PRESSURE SWITCH

Before installation, apply sealant to the switch threads.

NOTE

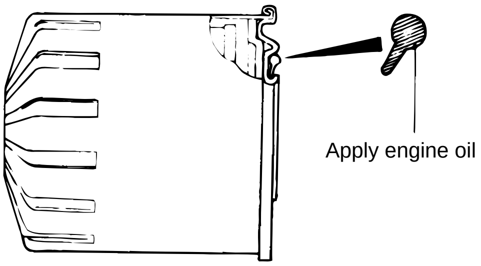
The sealant must not get into the thread top surface. Use care not to torque excessively.

OIL FILTER

Wipe clean the mounting surface on the filter bracket. Then, apply a thin coat of engine oil to filter O-ring and tighten oil filter hand-tight.

CAUTION

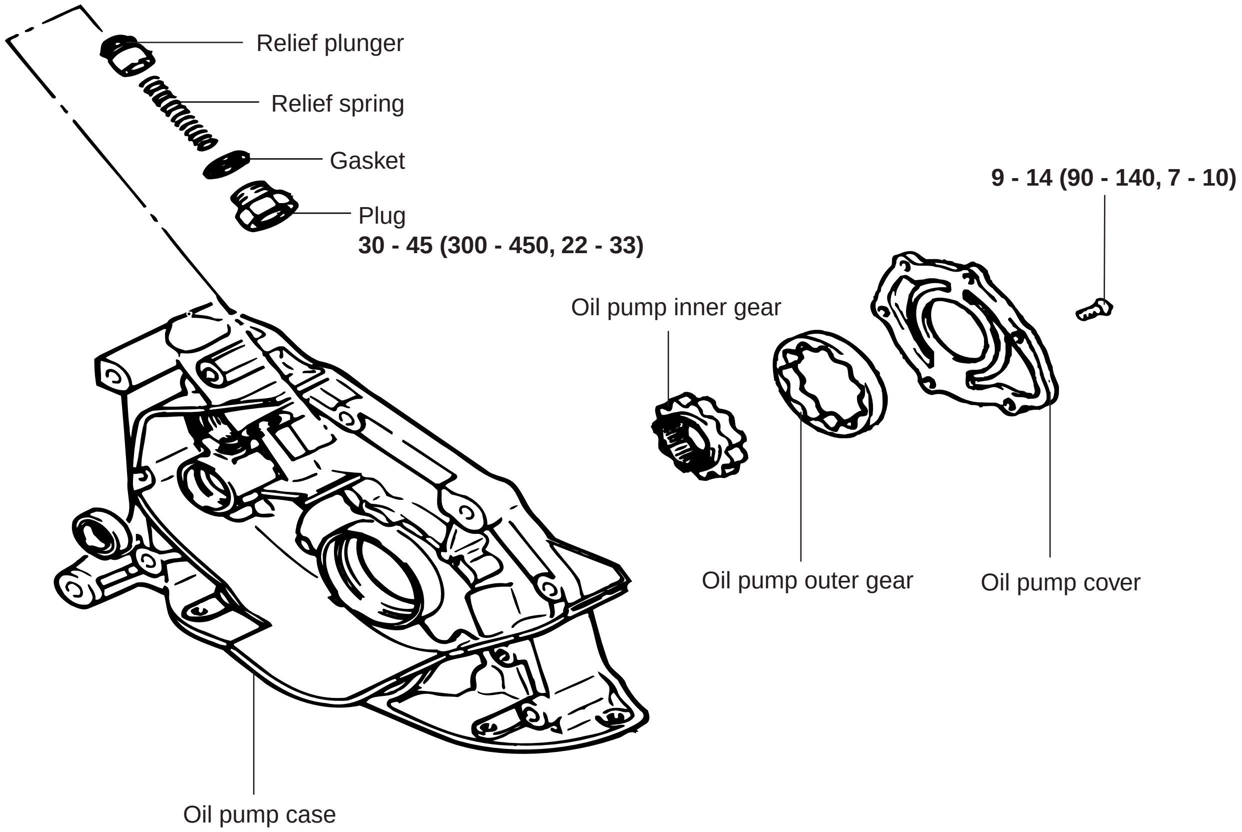
Never use a wrench to tighten the oil filter.



ECA9970B

OIL PUMP

COMPONENTS ECLB0540



*** Replace the gasket with new ones after removal.**

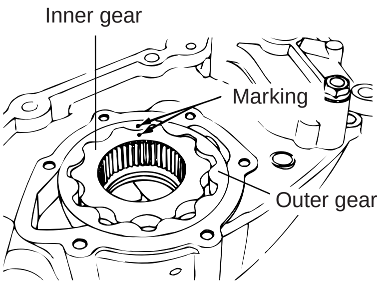
TORQUE : Nm (kg.cm,lb.ft)

ECLA014A

DISASSEMBLY ECLB0550

OIL PUMP

Before removing the oil pump outer and inner gears, mark the outer gear to make sure that it goes back to the position with correct direction.

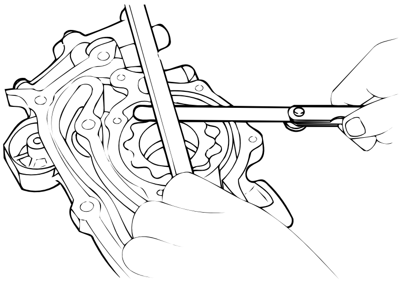


ECLA014B

INSPECTION ECLB0560

OIL PUMP

1. Install the outer and inner gear into the front case and make sure that they turn smoothly with no excessive play between them.
2. Check the side clearance (the front case and oil pump cover surface)



EDA9340B

Standard : 0.04 - 0.10 mm (0.0016 - 0.0039 in.)

Limit : 0.15 mm (0.0059 in.)

3. Check the body clearance.

[Standard]

Drive gear : 0.03 - 0.09 mm (0.0012 - 0.0035 in.)

Driven gear : 0.12 - 0.22 mm (0.0047 - 0.0087 in.)

[Limit]

Drive gear : 0.5 mm (0.0197 in.)

Driven gear : 0.4 mm (0.0157 in.)

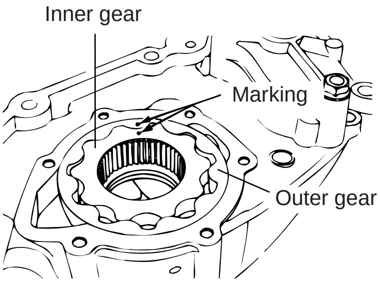
INSTALLATION ECLB0570

OIL PUMP

Install the outer gear, ensuring it is in position with correct direction according to the alignment mark made during disassembly.

NOTE

When installing the gears, be sure to apply engine oil to the entire surfaces of the gears.

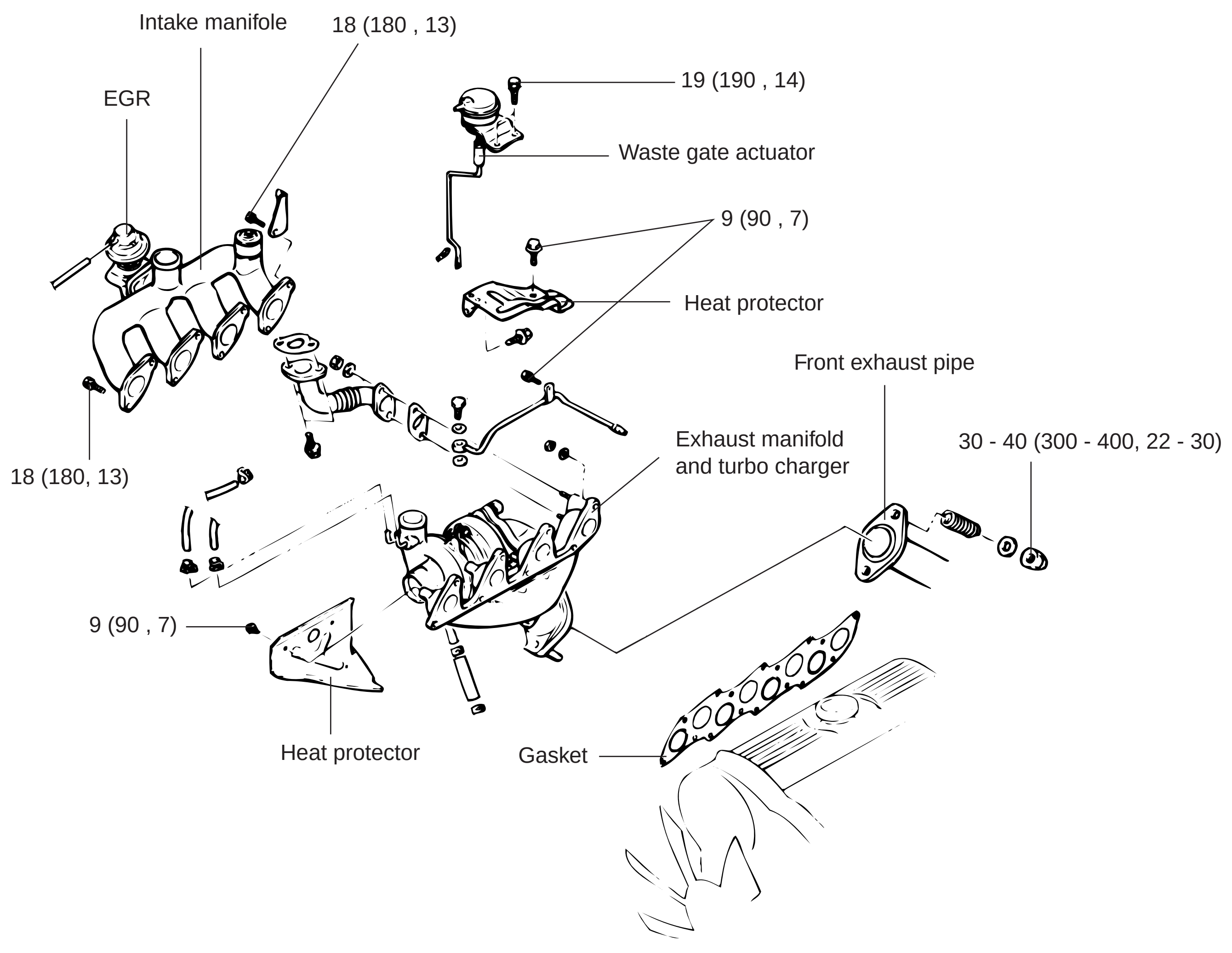


ECLA014B

INTAKE AND EXHAUST SYSTEM

EXHAUST MANIFOLD

COMPONENTS ECLB0600



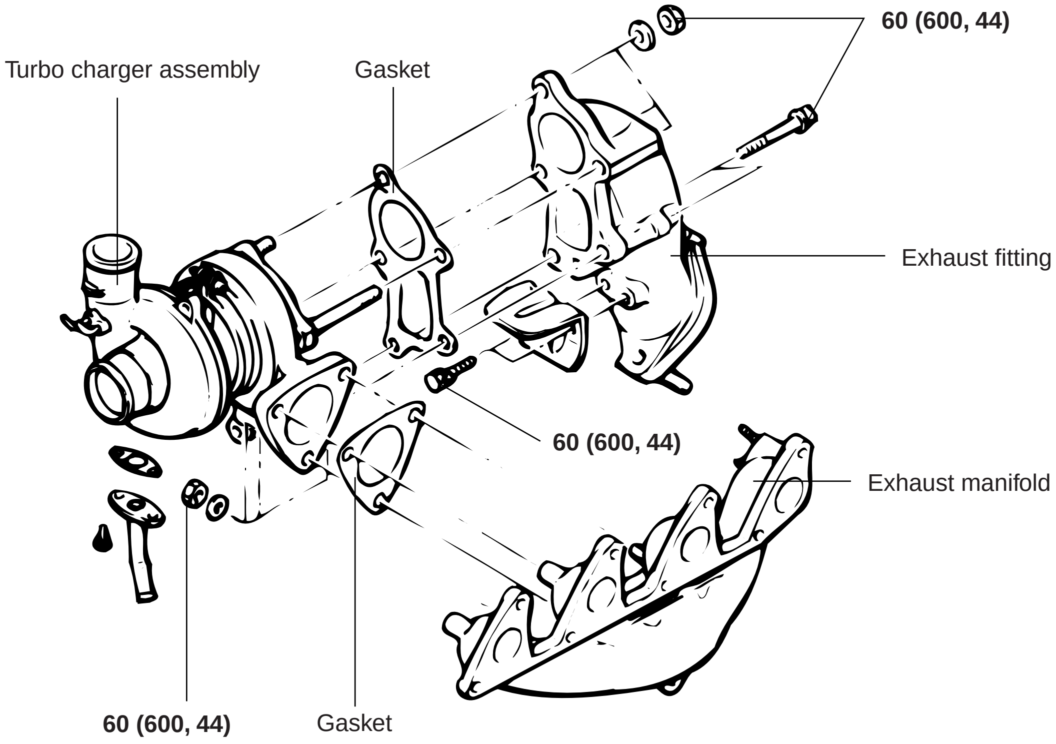
***Replace the gasket with new ones after removal.**

TORQUE : Nm (kg.cm, lb.ft)

ECLA015A

COMPONENTS ECLB0610

[TCI]



*** Replace the gasket with new ones after removal.**

TORQUE : Nm (kg.cm,lb.ft)

ECLA015B

INSPECTION ECLB0620

Check the following and replace if faulty.

INTAKE AND EXHAUST MANIFOLDS

1. Check the parts for cracks and damage.
2. Check the vacuum port, water passages and gas passages for clogging.
3. Using a straightedge and a thickness gauge, check distortion of the cylinder head mounting surface.

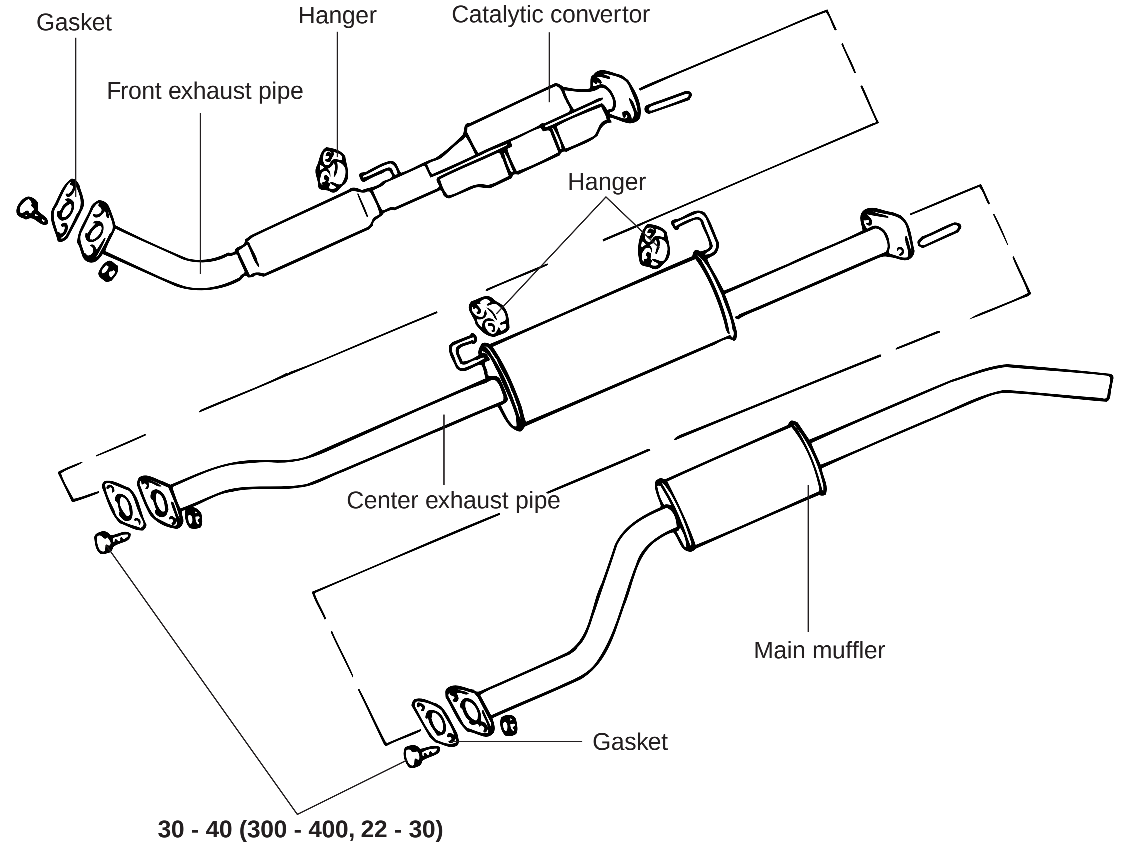
Standard value : 0.15 mm max.
Limit : 0.3 mm

EXHAUST MANIFOLD GASKET

The gasket may be reused if they are free from peeled or damaged surface.

MUFFLER

COMPONENTS ECLB0630



*** Replace the gasket with new ones after removal.**

TORQUE : Nm (kg.cm,lb.ft)

ECLB015E

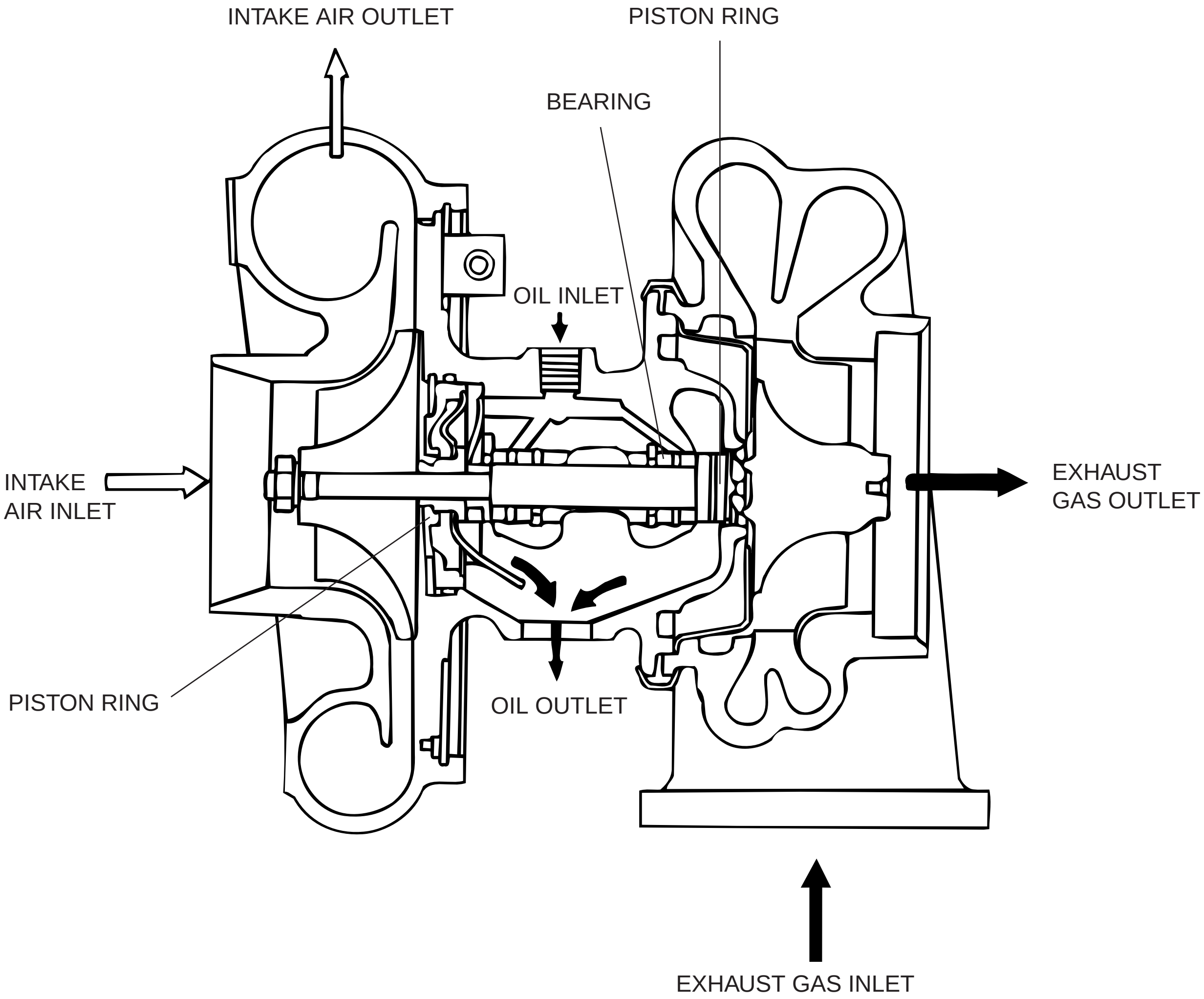
INSPECTION ECLB0640

1. Check the mufflers and pipes for corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

TURBO CHARGER (TC)

COMPONENTS

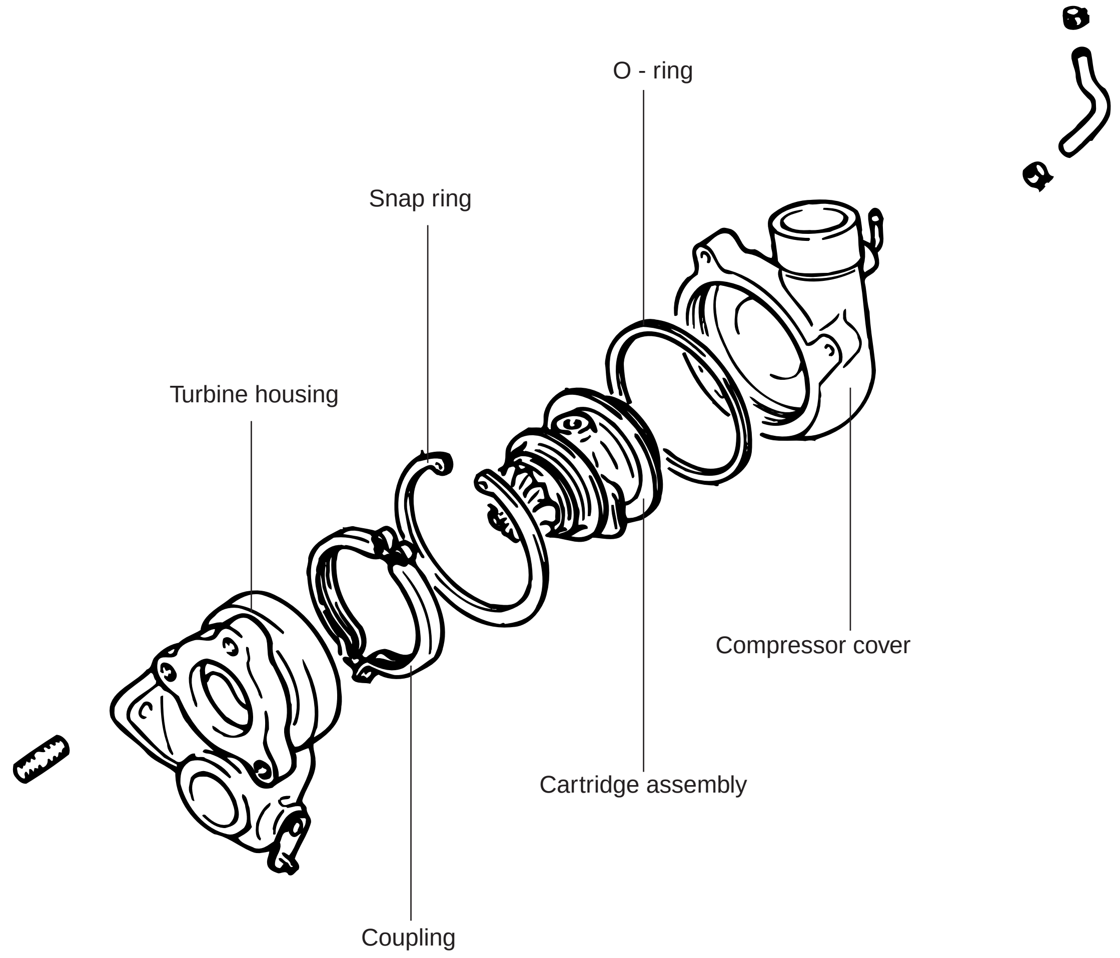
ECLB0650



TORQUE : Nm (kg.cm,lb.ft)

ECLB002A

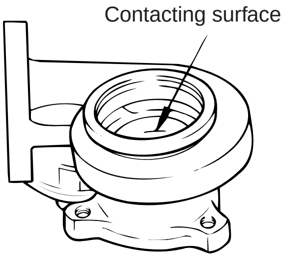
COMPONENTS ECLB0660



ECLA016A

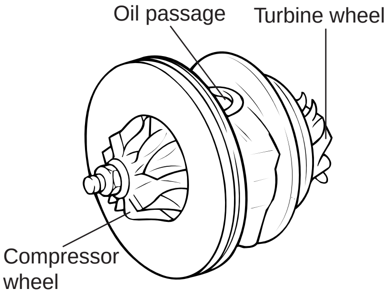
INSPECTION ECLB0680

1. Check the inner housing contacting turbine wheel for crack, pitching and other damages caused by overheat.
2. Make sure that the waste gate valve lever operates freely by hands.
3. Make sure there are no damages on the inner housing surface contacting compressor wheel.



ECLA016E

4. Turbine wheel and shaft assemblies with cracks in the blades or broken blades can not be used again. If the blades are slightly bent, it can be used again but severely bent blades can not be reused.



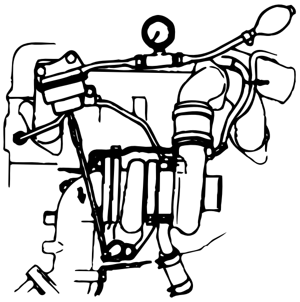
ECLA016F

5. Check if there are foreign materials disturbing the oil flow in the oil passage of cartridge assembly.

WASTE GATE INSPECTION

1. Check the waste gate rod operation under the pressure below.

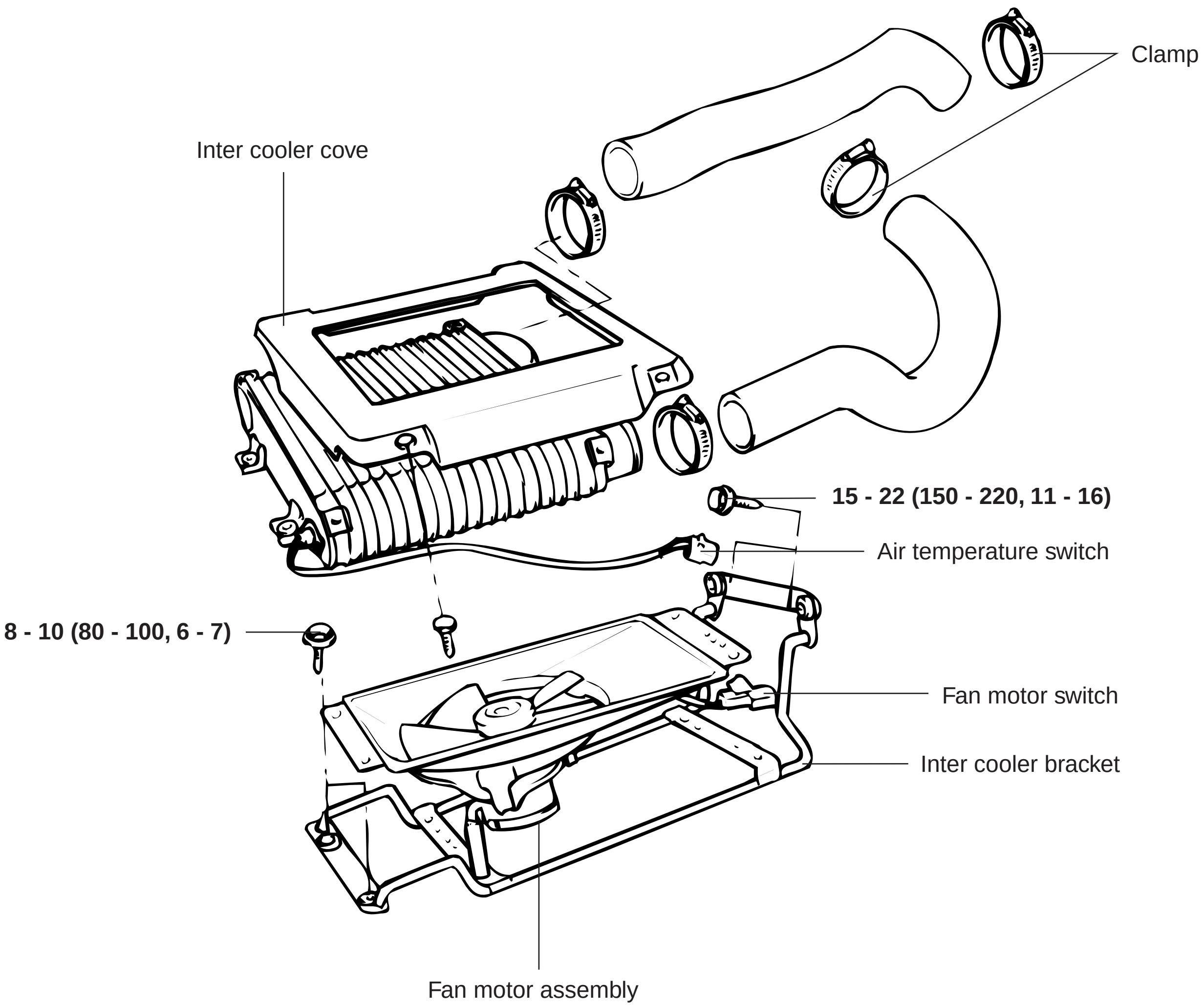
Nominal Value : 77.5 kPa (0.79 kgf / cm²)



ECLA016J

INTERCOOLER

COMPONENTS ECLB0700



TORQUE : Nm (kg.cm,lb.ft)

ECLA017A

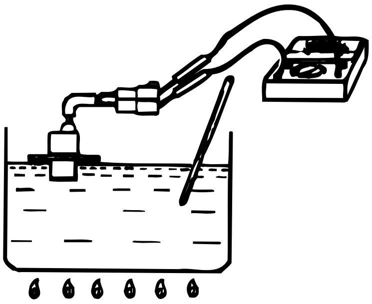
REMOVAL ECLB0710

1. Remove the intercooler cover.
2. Disconnect the fan motor and air temperature switch connector.
3. Remove the air hoses.
4. Remove the intercooler assembly.
5. Remove the fan motor assembly.
6. Remove the intercooler bracket.

INSPECTION ECLB0720

AIR TEMPERATURE SWITCH

1. Place the sensing part of sensor into the water.
2. Check the continnity according as the temperature increase.



ECLA017B

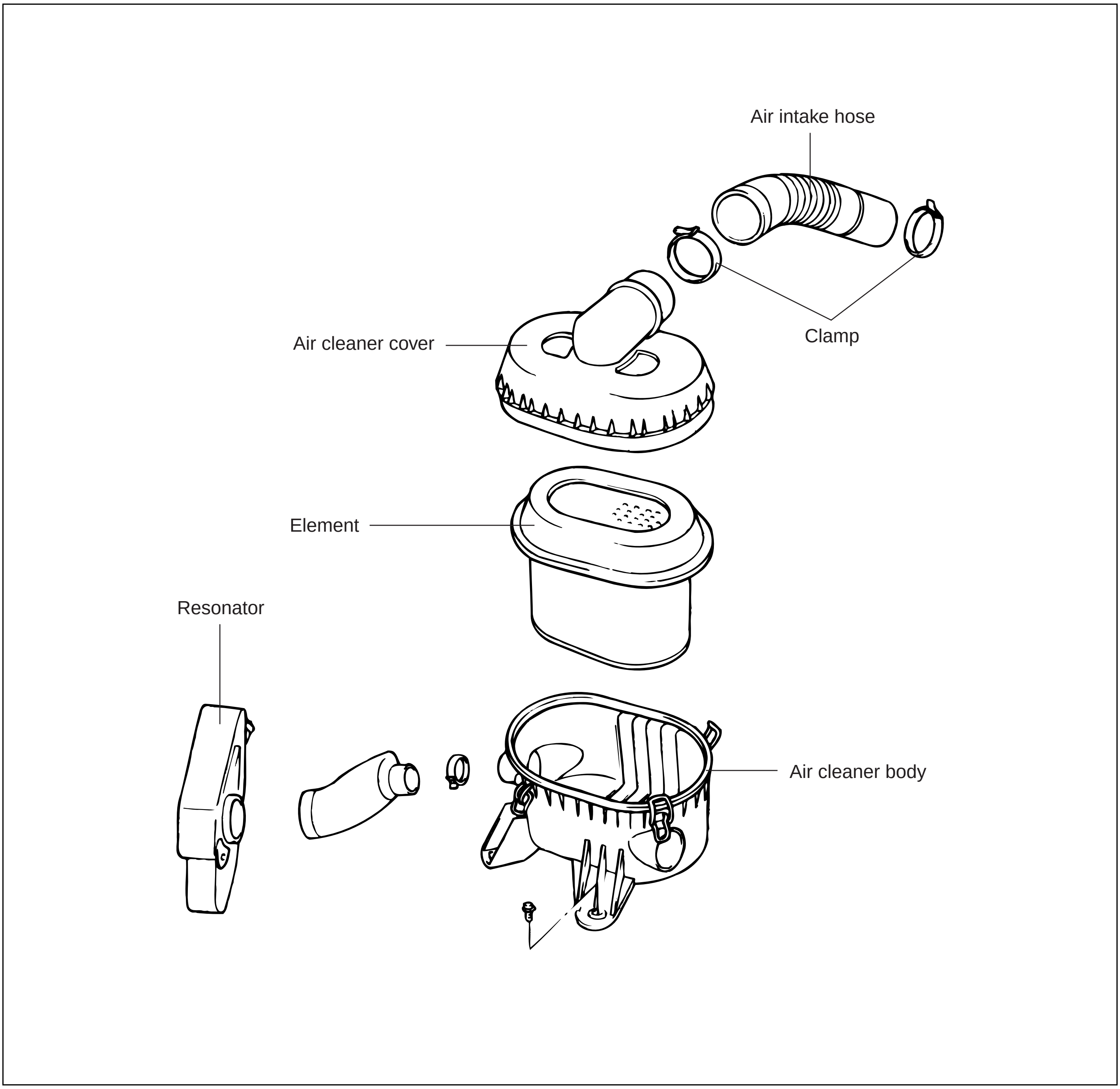
Temperature	Normal Condition
50°C or less	No - Continuity
60°C or more	Continuity

INTERCOOLER FAN MOTER

Check the working of fan when the vehicle speed is 60 km/h or less and intake air temperature is 50°C or more. (Revolution : 3500 rpm)

AIR CLEANER (ACL)

COMPONENTS ECLB0730



ECLB003A

REMOVAL EDUC0600

1. Disconnect the air flow sensor connector.
2. Remove the air intake hose and air duct connected to the air cleaner.
3. Remove the three bolts attaching the air cleaner mounting brackets.
4. Remove the air cleaner.

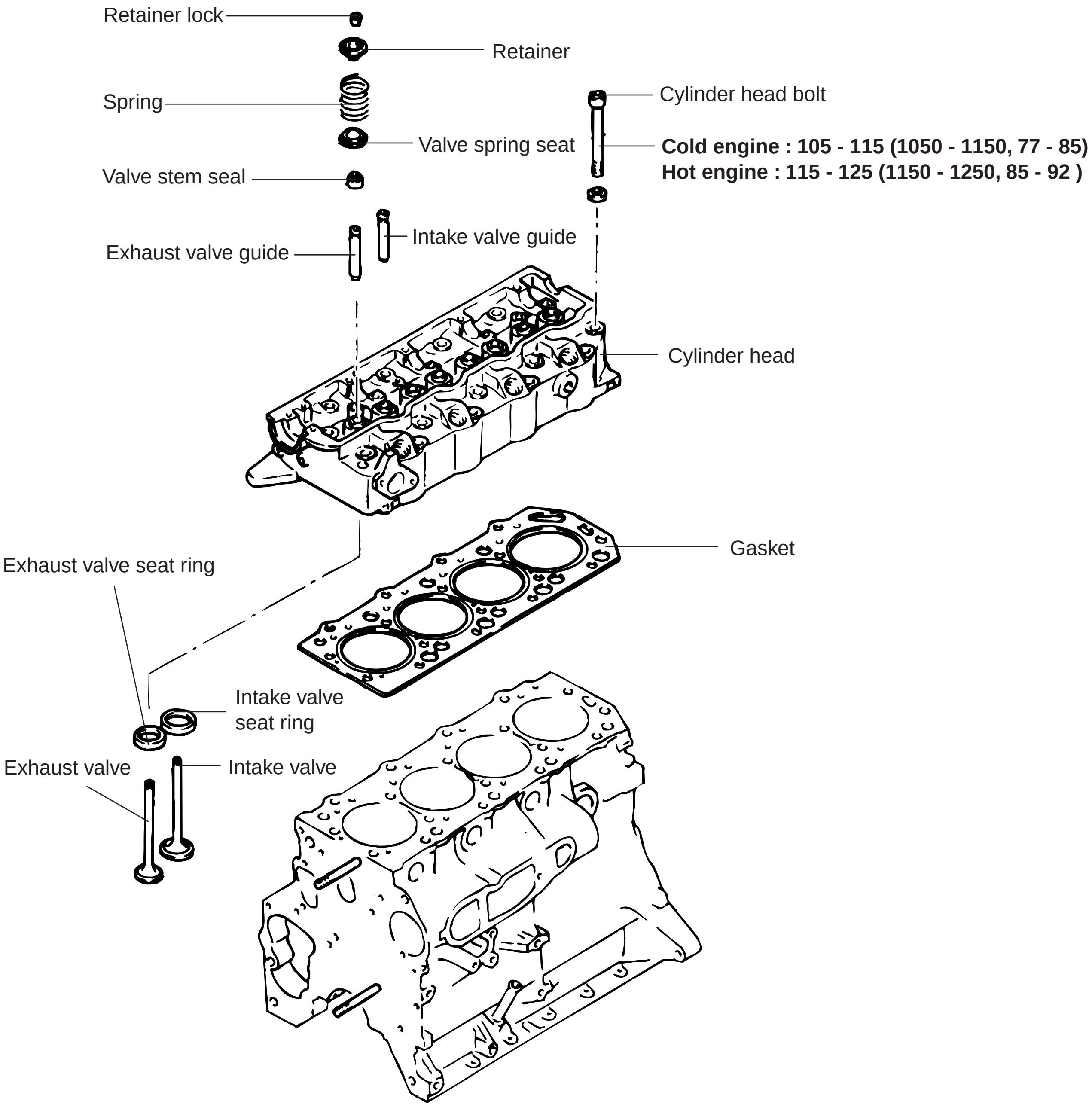
INSPECTION EDUC0700

1. Check the air intake hose, air cleaner cover for damage.
2. Check the air duct for damage.
3. Check the air cleaner element for restriction, contamination or damage.
   If the element is slightly restricted, remove dust and debris by blowing compressed air from the inside of the element. Replane the element if it cannot be cleaned.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS ECLB0800



TORQUE : Nm (kg.cm, lb.ft)

*** Replace the gasket with new ones after removal**

ECLA018A

DISASSEMBLY ECLB0810

CYLINDER HEAD

1. Remove the injection pipe assembly. When loosening the injection pipe nut, hold the nozzle holder and the delivery valve holder with a spanner to prevent them from turning with the nut.

   NOTE

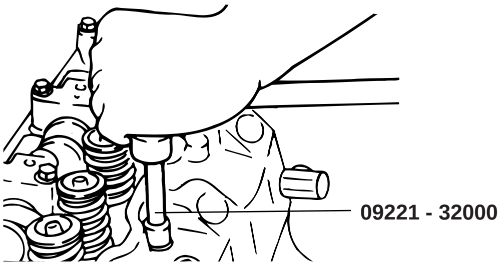
   After the injection pipe is removed, put a cap on the nozzle holder and the delivery valve holder to prevent ingress of dust and foreign matter.

2. Remove the timing belt upper cover.
3. Loosen the camshaft sprocket bolt to such an extent that it can be further loosened with fingers.
4. Bring the piston in No.1 cylinder to the top dead center on the compression stroke. Align the timing mark on the camshaft sprocket with that made on the upper case.
5. Manually remove the camshaft sprocket bolt.
6. With the timing belt engaged, remove the sprocket from the camshaft and place the assembly on the timing belt lower cover.

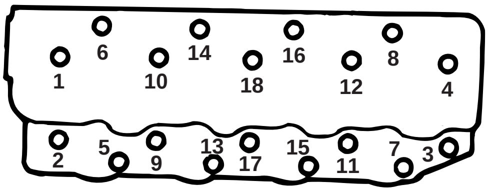
   CAUTION

   Do not turn the crankshaft once the sprocket is removed. Keep the timing belt tense.

7. Remove the rocker cover, rocker arm shaft assembly and camshaft.
8. Using the special tool, Cylinder Head bolt Wrench (09221-32000), loosen 18 Cylinder head bolts and remove them. Loosen the bolts in the sequence shown and in two to three steps.



ECLA018B

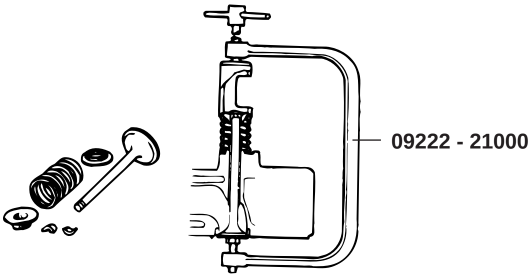


ECLA018C

9. Remove the cylinder head.
10. Remove the cylinder head gasket. Clean the cylinder head and cylinder block gasket surfaces.

VALVE AND VALVE SPRING

1. Remove the cylinder head assembly.
2. Remove the parts as illustrated below and store them separately for each cylinder.
   Using Valve Spring Compressor (09222-21000), remove the valve spring retainer lock.
   Keep the disassembled parts arranged according to the cylinder number and intake and exhaust.

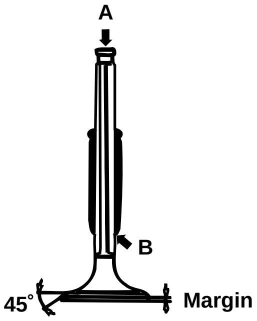


ECLA018D

INSPECTION ECLB0820

INTAKE VALVE, EXHAUST VALVE

1. If the valve stem develops wear (taper wear) or damaged, replace. If there is a dent in the stem end face (the surface in contact with the rocker arm adjust screw), replace.



ECA9281B

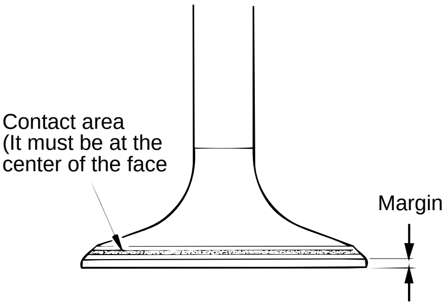
2. Check the valve face for contact. If the contact is not proper, correct with a valve refacer. The contact pattern with the valve seat must be even at the center of valve face.
3. Replace if the margin (valve head thickness) exceeds the limit.

Standard value

Intake and exhaust : 2.0 mm (0.0394 in.)

Limit

Intake and exhaust 1.0 mm (0.0394 in.)



EDA9300D

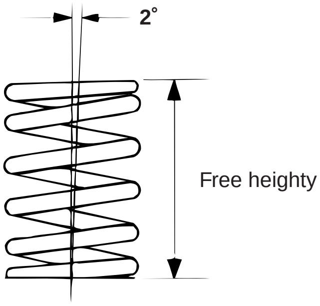
VALVE SPRING

1. Measure the free height of spring and replace if the limit is exceeded.

Standard value : 49.1 mm (91.933 in.)

Limit L : 48.1 mm (1.894 in.)

2. Measure the squareness of the spring and, if the limit is exceeded, replace.



B0Y041D

Standard value : 2° or less

Limit L : 4°

VALVE GUIDE

Measure the valve guide to stem clearance and, if the measurement exceeds the limit, replace the valve guide or valve, or both.

Standard value

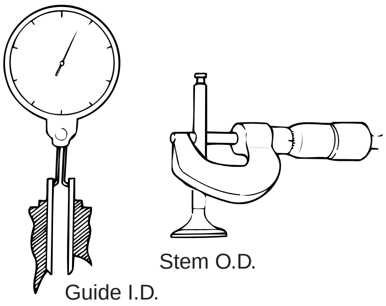
Intake : 0.03-0.06 mm (0.0012-0.0024 in.)

Exhaust : 0.05-0.09 mm (0.0012-0.0024 in.)

Limit

Intake : 0.10 mm (0.0394 in.)

Exhaust : 0.15 mm (0.0394 in.)



B0Y105D

CYLINDER HEAD

1. Before cleaning the cylinder head, check for water and oil leaks, damage, or cracks.
2. Remove oil, scale, sealant, and carbon deposits completely. After cleaning the oil passages, apply compressed air to ensure that the passages are not clogged.

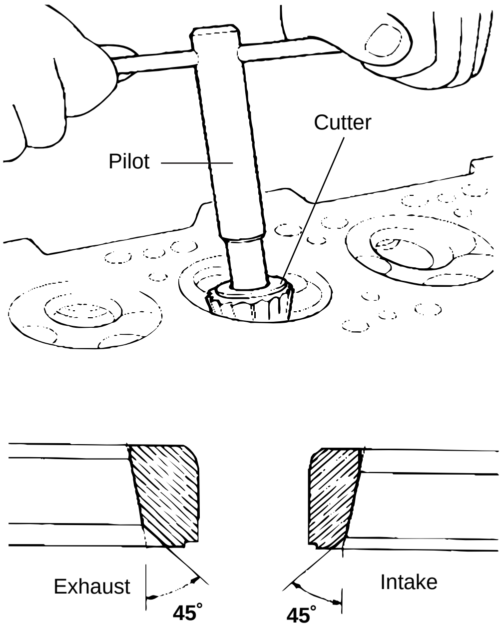
3. If there is gas leak from the cylinder head gasket surface, measure the surface flatness. If distortion exceeds the limit, replace the cylinder head.

Standard value : 0.05 mm (0.002 in.)
Limit L : 0.2 mm (0.008 in.)

4. Visually check the camshaft bearing internal surfaces for damage or seizure. If defects are evident, replace the bearing.

RECONDITIONING VALVE SEAT

Check the valve seat for overheating and improper contact with the valve face. Recondition or replace the seat if necessary. Bofore reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace if and then recondition the seat. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact widty should be within specificatons and centered on the valve face. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.

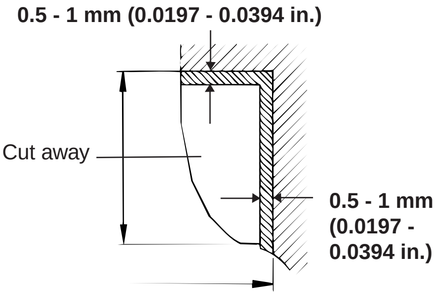


ECHA920B

Angle	No.
45°	09221 - 43300
65°	09221 - 43400
30°	09221 - 43500

VALVE SEAT REPLACEMENT PROCEDURE

1. Cut the valve seat to be replaced from the inside to thin the wall thickness. Then, replace the valve seat.



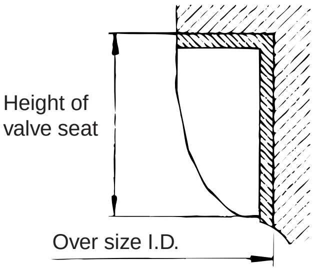
B0YR3940

2. Rebore the valve seat hole in cylinder head to the oversize valve seat diameter.

Intake valve seat ring hole diameter
0.30 O.S. : 43.300 - 43.325 mm (1.7047 - 1.7057 in.)
0.60 O.S. : 43.600 - 43.625 mm (1.7165 - 1.7175 in.)
Exhaust valve seat ring hole diameter
0.30 O.S. : 37.300 - 37.325 mm (1.4685 - 1.4695 in.)
0.60 O.S. : 37.600 - 37.625 mm (1.4803 - 1.4813 in.)

3. Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) or cool the valve seat in liquid nitrogen to prevent the cylinder head bore from abrasion.

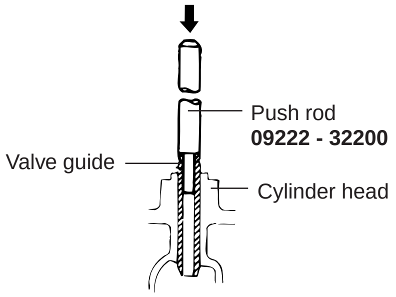
4. After installation, recondition the valve seat.



B0YR167A

VALVE GUIDE REPLACEMENT PROCEDURE

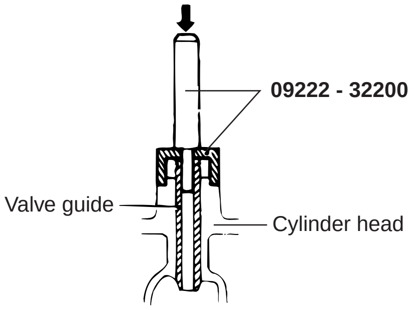
1. Using the push rod of Valve Guide installer (09222 - 32200) and apress, remove the valve guide forward cylinder block.



ECLA018F

2. Rebore valve guide hole to the new oversize valve guide outside diameter.

3. Using Valve Guide Installer (09222 - 32200), press-fit the valve guide, working from the the cylinder head top surface.



ECLA018G

NOTE

When valve guides have been replaced, check for valve contact and correct valve seats as necessary.

4. After installing valve guides, insert new valves in them to check for sliding condition.

Valve guide hole diameter	
0.05 O.S.:	13.050-13.068 mm (0.0012-0.0024 in.)
0.25 O.S.:	13.250-13.268 mm (0.5216-0.5223 in.)
0.50 O.S.:	13.500-13.518 mm (0.5315-0.5322 in.)

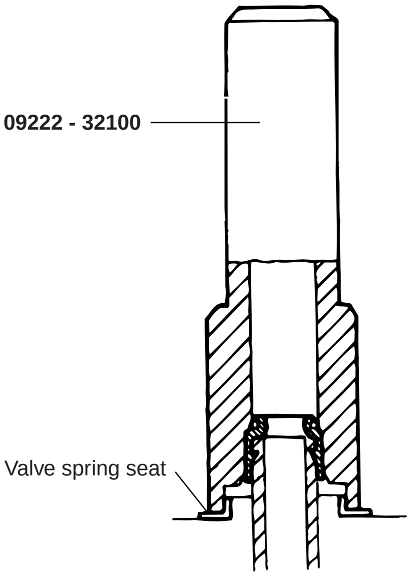
INSTALLATION ECLB0830

VALVE STEM SEAL

1. Using Valve Stem Seal Installer (09222 - 32100), install the valve stem seal into the valve guide.

NOTE

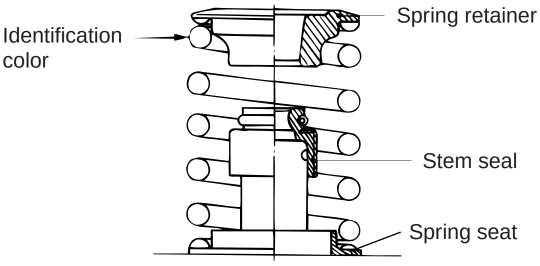
1. *The valve stem seal must be not reused.*
2. *The special tool must be used for the installation of the valve stem seal. Improper installation could result in oil consumption through valve guide.*



ECLA018I

VALVE SPRING

Direct the valve spring end with identification color to the rocker arm.



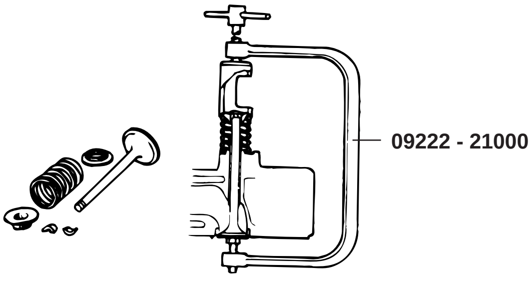
B0Y044B

VALVE SPRING RETAINER LOCK

Using a valve spring compressor (09222 - 21000), compress the spring and fit the retainer lock in position.

NOTE

The valve spring, if compressed excessively, causes the bottom end of retainer to be in contact with, and damages, the stem seal.



ECLA018D

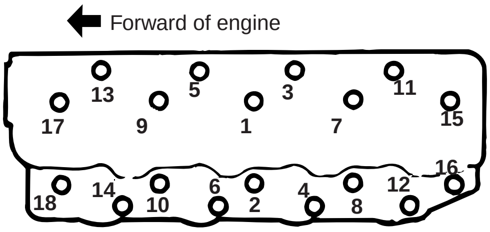
CYLINDER HEAD

1. Scrape off gasket adhered to cylinder head assembly.

CAUTION

Be careful that foreign material does not fall into coolant and oil passage ways.

2. Tighten in the numerical order indicated in the diagram in two or three groups with special tool.



ECLA018J

Specified torque

Cold engine :

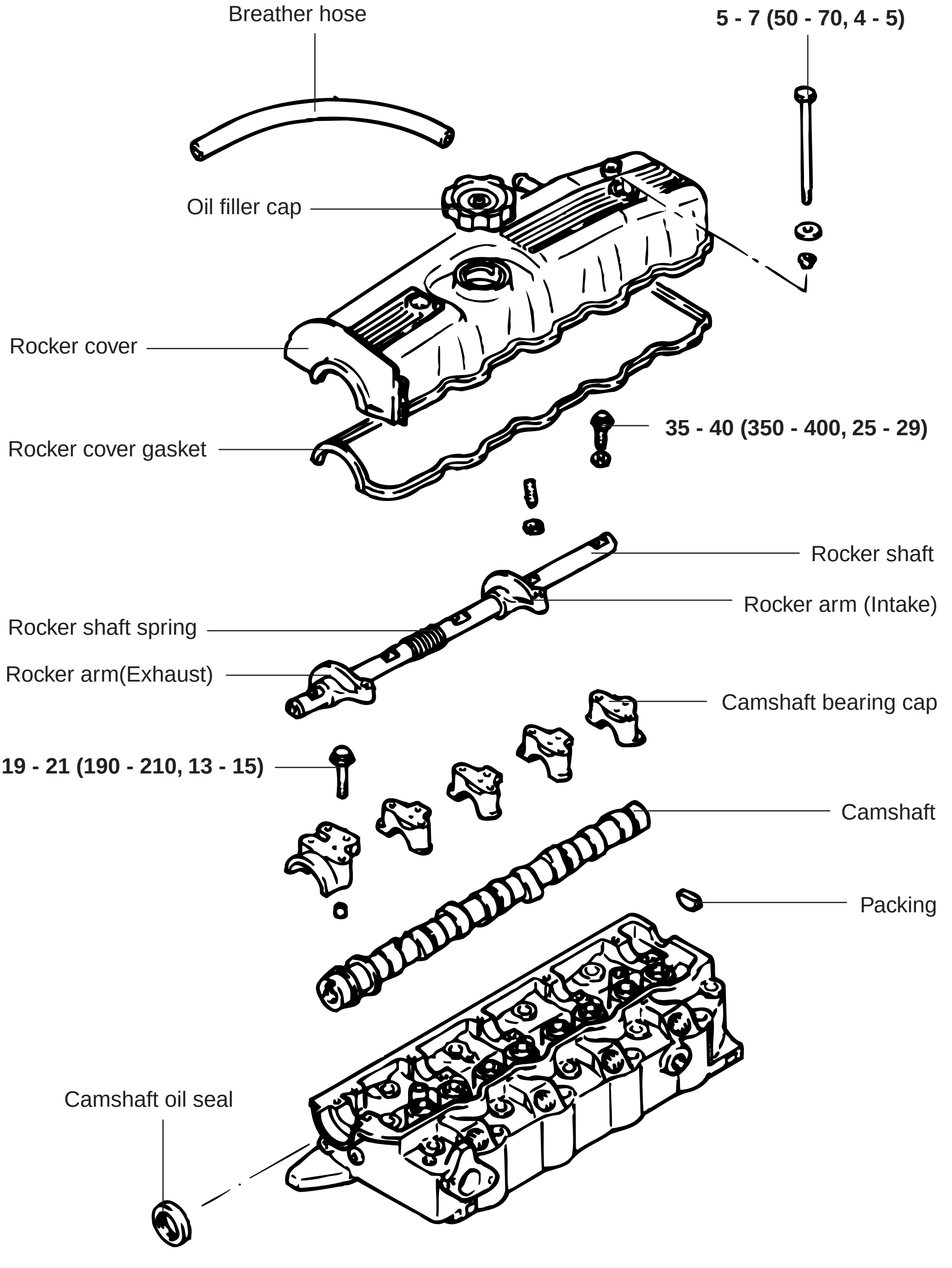
105 - 115 Nm (1050 - 1150 kg.cm, 77 - 85 lb.ft)

Hot engine :

115 - 125 Nm (1150 - 1250 kg.cm, 85 - 92 lb.ft)

ROCKER ARM

COMPONENTS ECLB0840



***Replace the gasket with new ones after removal.**

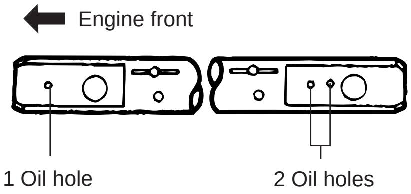
TORQUE : Nm (kg.cm, lb.ft)

ECLA019A

INSPECTION ECLB0845

ROCKER SHAFT

1. Check oil holes for clogging and clean as necessary.
2. Replace the shaft if damage or seizure is evident on the surfaces, to which rocker arms are installed.



ECLA019F

ROCKER ARM

1. Check the slipper surface (the surface in contact with the cams). Replace if damage or seizure is evident.
2. Check bore for damage and seizure. Replace if defects are evident.
3. Check the oil clearance

Standard : 0.01 - 0.04 mm (0.0004 -0.0016 in.)
Limit : 0.08 mm (0.0031 in.)

CHECKING AND ADJUSTMENT OF VALVE CLEARANCE

Refer to general part.

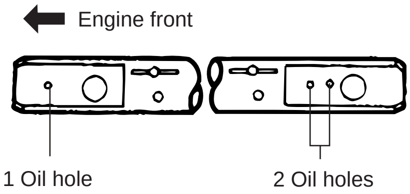
INSTALLATION ECLB0850

ROCKER ARM AND ROCKER SHAFT

Turn the crackshaft to bring the pistion in No 1. cylinder to the top dead center on the compression stroke. This reduces the cam lift to minimum and facilitates installation.

ROCKER SHAFT

1. Keep the oil hole side down.
2. Install the rocker shaft with its side having one oil hole facing to the front.



ECLA019F

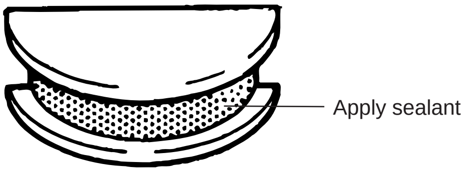
ROCKER ARM (EXHAUST AND INTAKE)

Install in correct position, confirming the identification marks.

SEMI - CRICULAR PACKING

Apply sealant to the portion indicated in illustration.

Specified sealant : 3M part No 8660 or equivalent

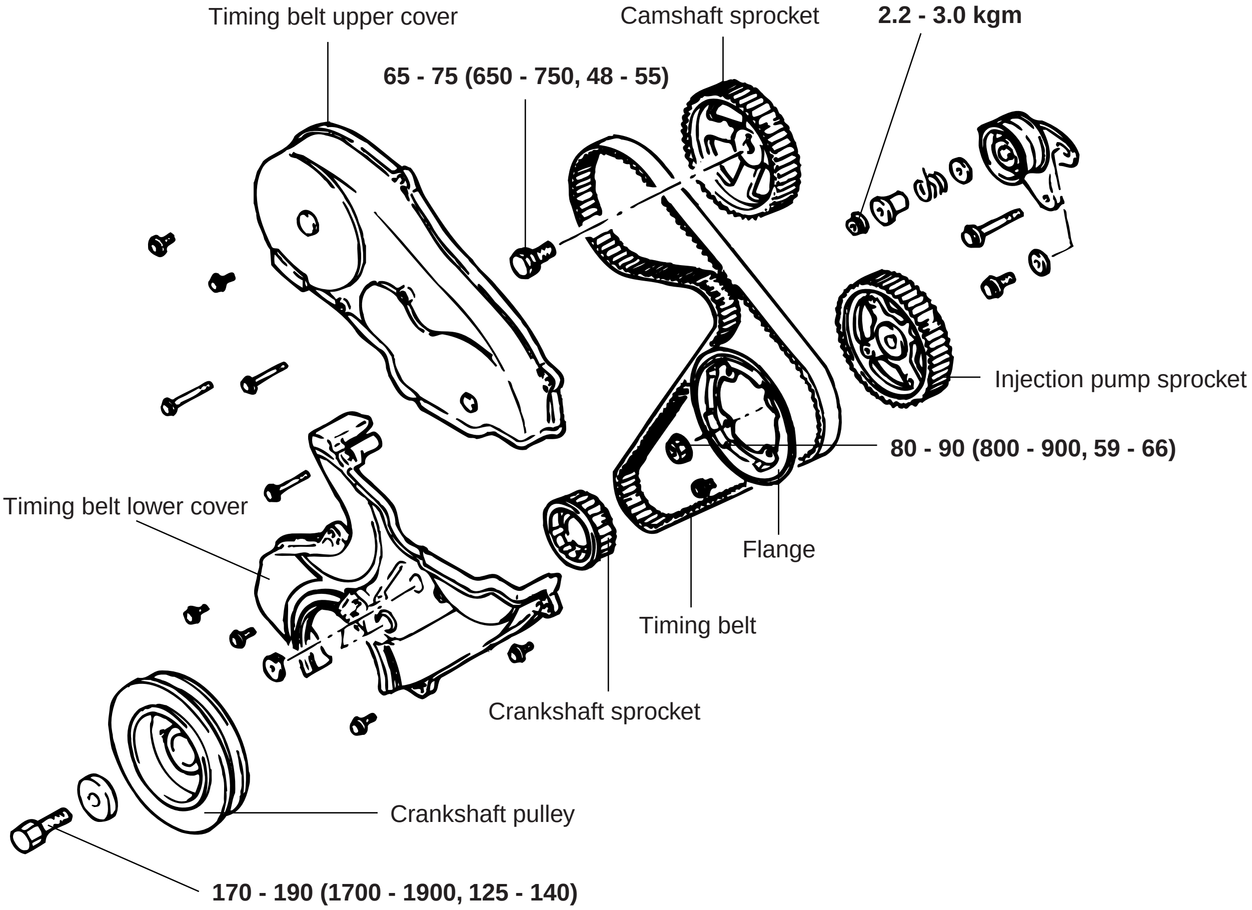


ECLA019G

TIMING SYSTEM

TIMING BELT

COMPONENTS ECLB0900



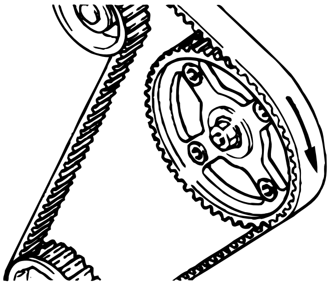
TORQUE : Nm (kg.cm, lb.ft)

ECLA020A

REMOVAL ECLB0910

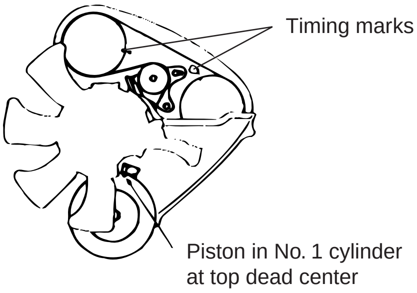
TIMING BELT

1. Remove the cooling fan, water pump, crankshaft pulley and timing belt cover.
2. Turn the crankshaft to bring the piston in No. 1 cylinder to the top dead center on the compression stroke.
3. Mark an arrow on the back of the timing belt and timing belt B with a chalk to indicate the direction of rotation. This ensures that the belt is installed in the same direction for reuse.



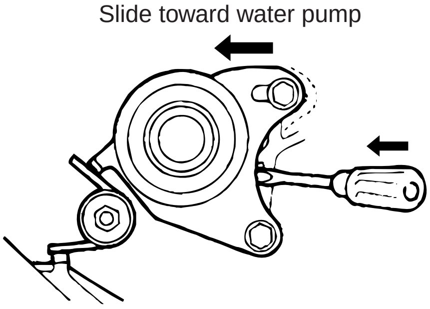
ECLA020B

4. The piston in No. 1 cylinder is at the top dead center on the compression stroke when all timing marks at the three places are aligned as shown.



ECLA005B

5. Slightly loosen the two bolts securing the tensioner. Then, slide the tensioner toward the water pump and tighten the bolts temporarily to secure the tensioner in place.
6. Remove the timing belt.



ECLA020C

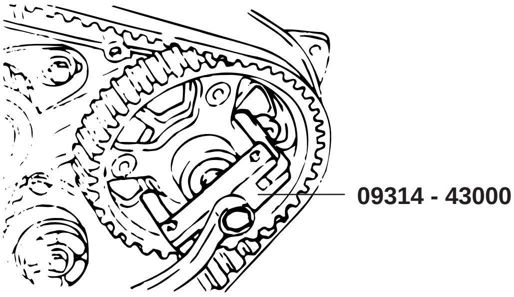
CAMSHAFT SPROCKET

1. Loosen the bolt securing the camshaft sprocket and remove the camshaft sprocket.
2. Remove the sprocket nut.

NOTE

Use care not to give shock to the fuel injection pump shaft, as it could result in defective fuel injection pump. Using Injection Pump Sprocket Puller (09314 - 43000) or suitable tool, remove the sprocket from injection pump.

3. Remove the tensioner and tensioner spring.



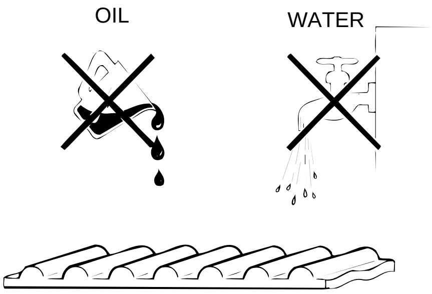
ECLA020D

INSPECTION ECLB0920

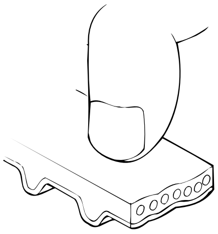
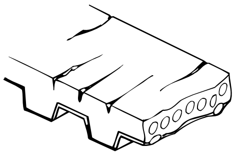
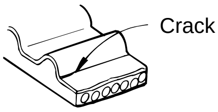
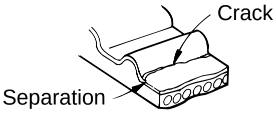
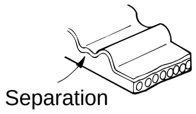
TIMING BELT

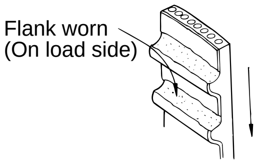
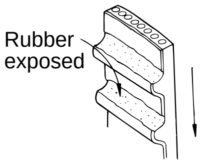
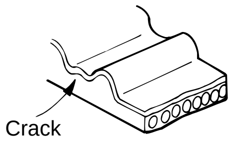
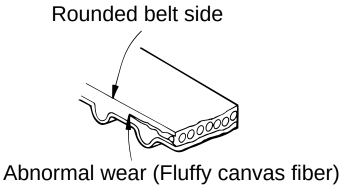
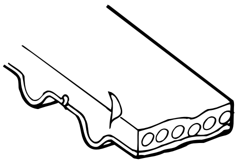
1. Check the belt for oil or dust deposits. Replace if necessary. Small deposits should be wipe away with a dry cloth or paper. Do not clean with solvent.

2. When the engine is overhauled or belt tension adjusted, check the belt in detail. If the following flaws are evident, replace the belt with a one.



ECA9200A

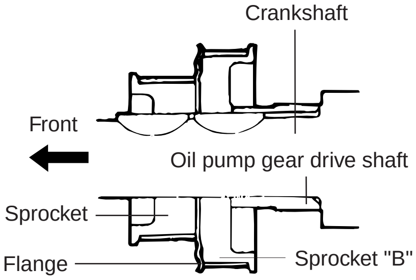
Description	Flaw conditions
1. Hardened back surface of rubber	Back surface is glossy, Non-elastic and so hard that, when your fingernail is pressed into it, no mark is produced.  ECA9200B
2. Cracked back surface of rubber	 ECA9200Y
3. Cracked or separating canvas	 ECA9200I  ECA9200J  ECA9200K
4. Badly worn out teeth (initial stage)	Canvas on load side tooth flank worn (Fluffy canvas fibers, rubber gone and color changed to white, and unclear canvas texture)

Description	Flaw conditions
	 ECA9200C
5. Badly worn out teeth (last stage)	Canvas on load side tooth flank worn down and rubber exposed (tooth width reduced)  ECA9200D
6. Cracked tooth bottom	 ECA9200E
7. Missing tooth	 ECA9200F
8. Side of belt bady worn	 ECA9200G
9. Side of belt cracked	**NOTE** *Normal belt should have precisely cut side as if produced by a sharp knife.*  ECA9200H

INSTALLATION ECLB0930

CRANKSHAFT SPROCKET

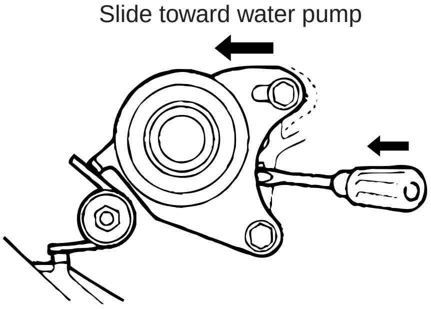
1. Mount the crankshaft sprocket to the crankshaft noting the direction of the sprocket as well as the flange.
2. Mount the camshaft sprocket and tighten the flange bolts to specified torque.



ECLA020E

TIMING BELT TENSIONER

Install the tensioner, tensioner spring and tensioner spacer and with the tensioner moved all the way to the water pump, temporarily tighten bolt A. Tighten bolt B not fully but finger - tight.



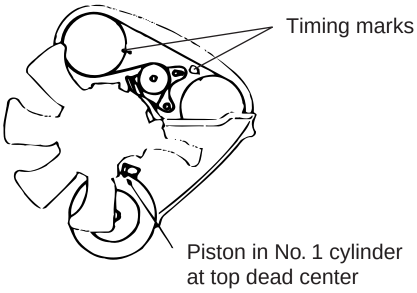
ECLA020C

TIMING BELT

1. Correctly line up timing marks on three sprockets.
2. While ensuring that the tension side of timing belt is not slack, install belt onto the crankshaft sprocket, injection pump sprocket, tensioner and camshaft sprocket, in that order.

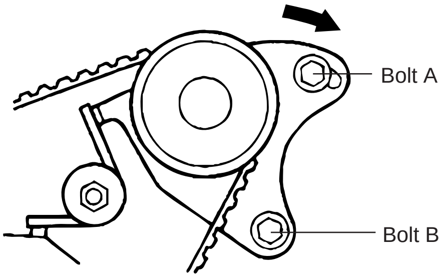
NOTE

When installing the belt onto the injection pump sprocket, keep the sprocket in position, as it tends to turn by itself at the timing mark alignment position. If the belt is to be reused, make sure that the arrow mark made during disassembly faces to the correct direction at reassembly.



ECLA005B

3. Check if all timing marks are aligned correctly.
4. Back off tensioner bolt A, that have previously been secured to the water pump side, one to two turns to give tension to the belt using tensioner spring tension.

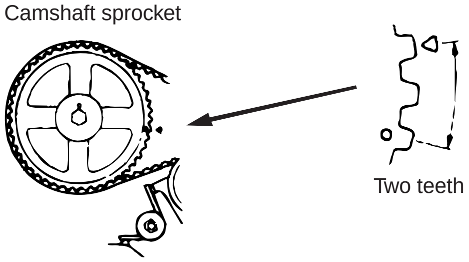


ECLA020F

5. Confirm that the timing belt is correctly engaged with three sprockets.
6. Turn crankshaft clockwise by the two teeth of the camshaft sprocket and keep the position.

CAUTION

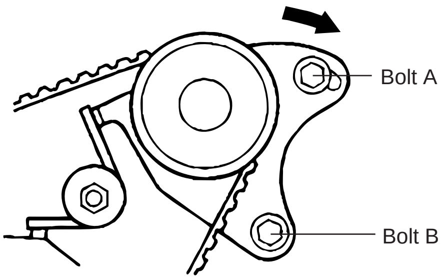
Never turn the crankshaft counterclockwise.



ECLA020G

7. Tighten the bolt A.

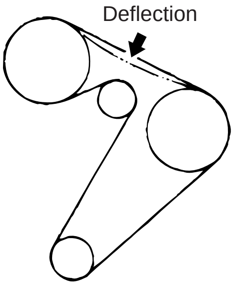
8. Tighten the bolt B.
   If the bolt B is tightened first, the tensioner should be turned together, causing an undue tension to be applied to the timing belt.



ECLA020F

9. Turn the crankshaft in the direction of backward rotation to line up timing marks. In this condition, ensure that the deflection when the center of belt is pushed by the index finger.

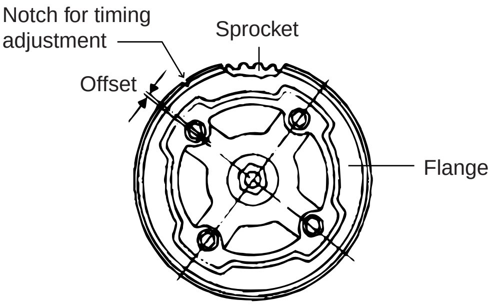
Standard : 4 - 5 mm (0.1575 - 0.1969 in.)



ECLA020H

FLANGE

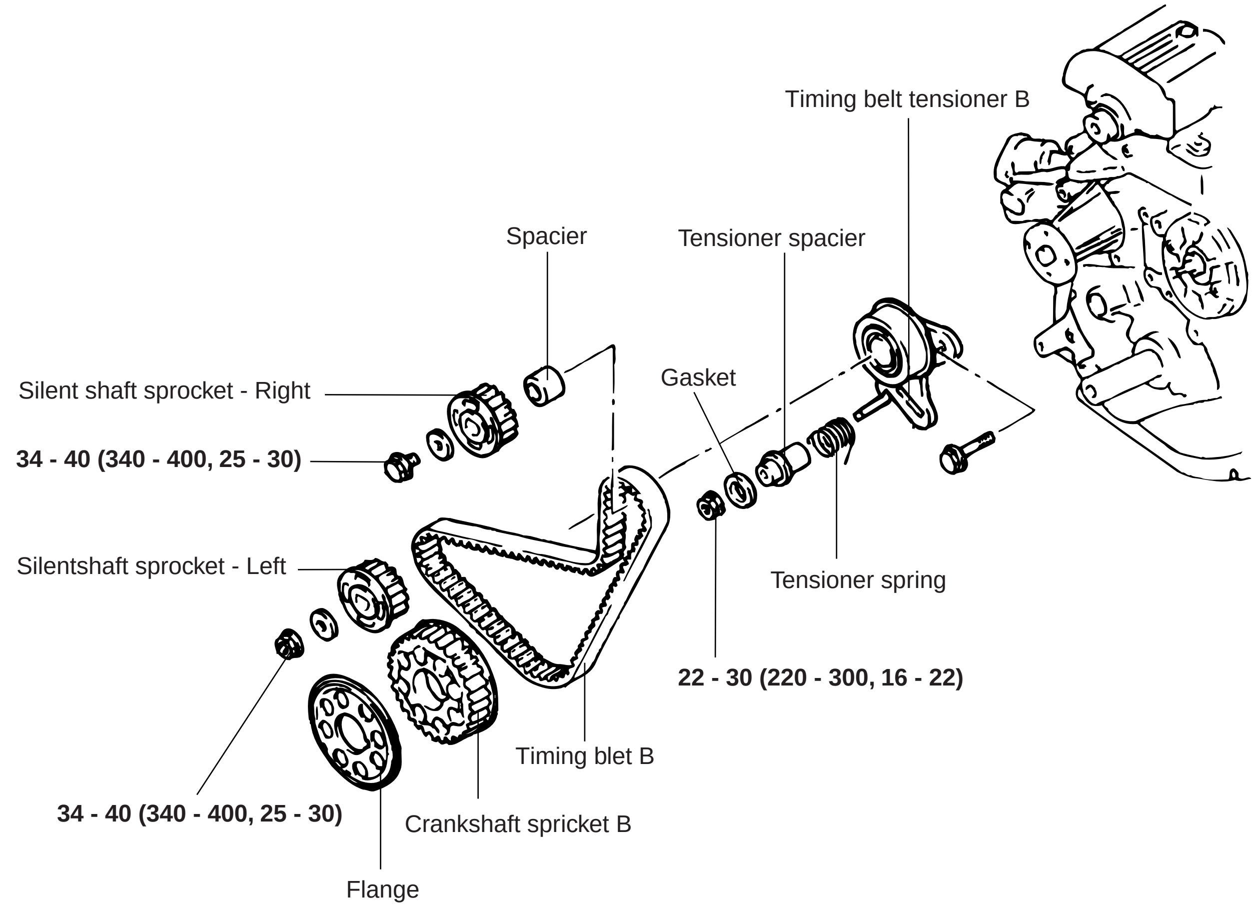
Note that bolt holes in the flange and those in the injection pump sprocket are offset positioned at one place. When assembling, position the jlange and sprocket as shown.



ECLA020I

TIMING BELT ECLB0940

COMPONENT



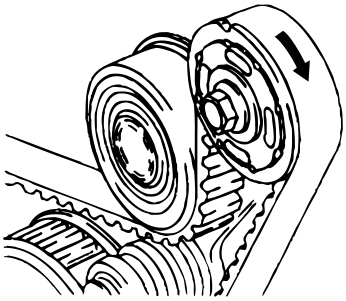
TORQUE : Nm (kg.cm, lb.ft)

ECLA021A

REMOVAL ECLB0950

TIMING BELT "B"

1. Remove the timing belt.
2. Using chalk or the like, put an arrow on the back of the timing belt "B" to indicate the direction of drive.



ECLA021B

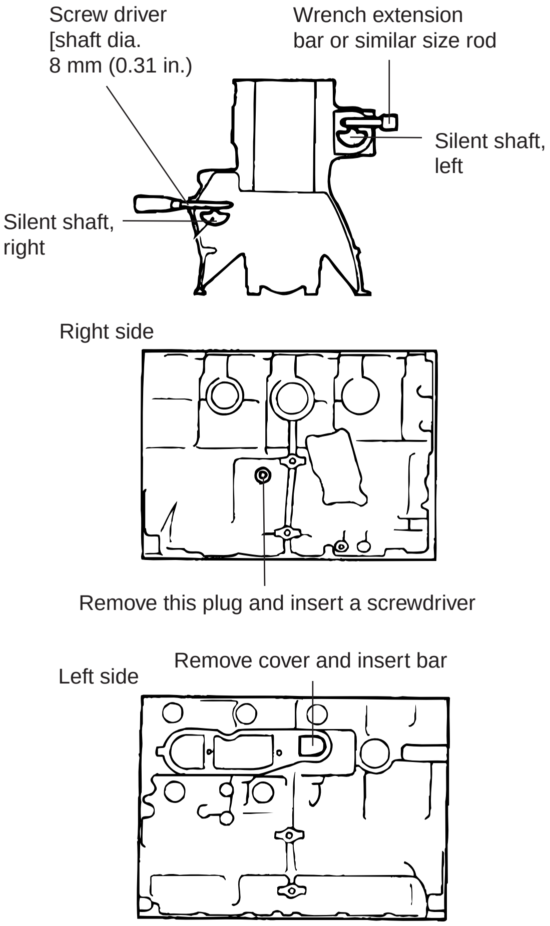
3. Slightly loosen the bolts and nuts securing the tensioner.
   Then, slide the tensioner toward the water pump and tighten the nuts to secure the tensioner in place temporarily.
4. Remove the timing belt " B"
5. Remove the crankshaft sprocket "B"
6. Remove the two silent shaft sprockets.
7. When loosening the nut and bolt for two silent shaft sprockets, be sure to lock the silent shaft as shown.

NOTE

1. *Water, oil, or grease on the belt shortens its life drastically. Use special care to ensure that the removed timing belt, sprockets, and tensioner are free from oil and grease.*
2. *Note also that these parts should not be cleaned. Replace them if seriously contaminated.*
3. *If there is oil on parks, check for oil leaks from oil seals in from case and camshaft.*

CAUTION

Keep the removed parts free from oil and grease. Do not use detergent to clean the timing belt "B", sprocket and tensioner. Wipe clean with rag if found dirty.
Replace if excessively contaminated with dirt, grease or oil.

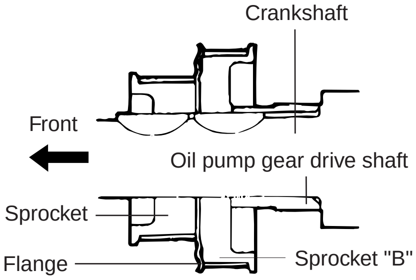


ECLA021C

INSTALLATION ECLB0960

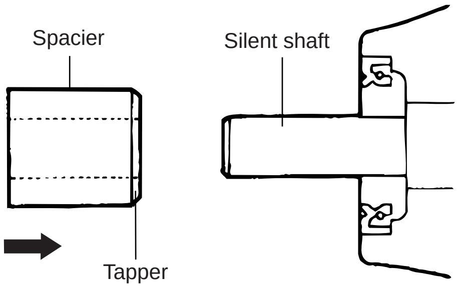
CRANKSHAFT SPROCKET “B”

1. Mount the crankshaft sprocket “B” to the crankshaft, noting the direction of the sprocket “B”.



ECLA020E

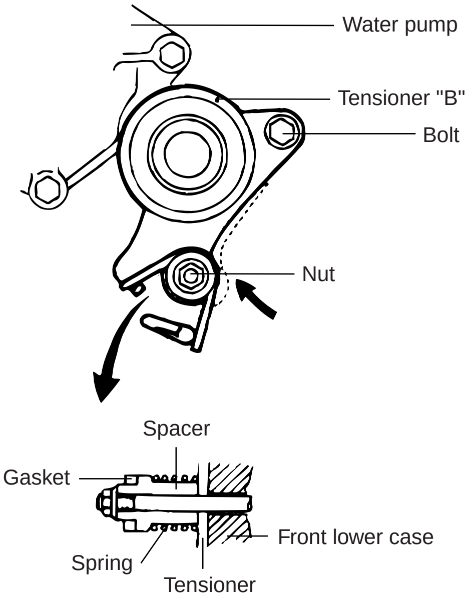
2. The spacer must be installed with its chamfered end facing toward the silent shaft. If the spacer is installed in the wrong direction, damage to oil seal will result.



ECLA021D

TIMING BELT “B” TENSIONER

Install the tensioner spring and spacer, with the tensioner moved all the way to the water pump, and tighten the nut. Tighten the bolt not fully put finger - tight.



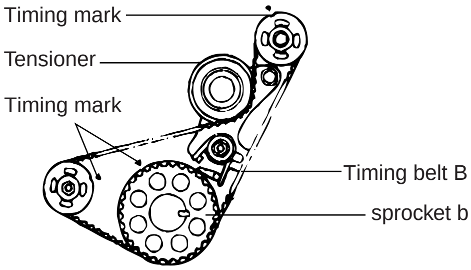
ECLA021E

TIMING BELT “B”

1. Line up timing marks on the crankshaft sprocket B, and right and left silent shaft sprockets.
2. With the timing belt B installed, ensure that its tension side is not slack.

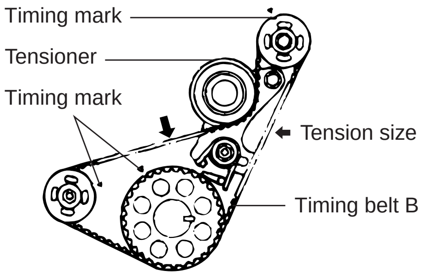
NOTE

If the belt is to be reused, make sure that the arrow mark made during disassembly faces to the correct direction at reinstallation.



ECLA021F

3. With the tension side of timing belt B kept tight by pushing the slack side (indicated by A in illustration) with a finger, make sure that the timing marks are properly aligned with each other.



ECLA021G

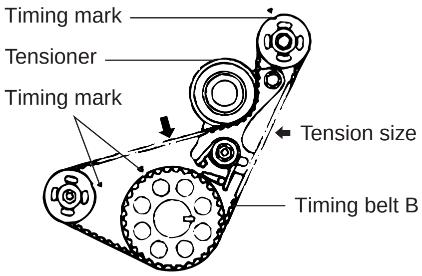
4. Back off tensioner B nut, that have previously been secured to the water pump side, one to two turns to give tension to the belt using tensioner spring tension.

5. Tighten the tensioner B attaching nut.

6. Tighten the tensioner B attaching bolt.

NOTE

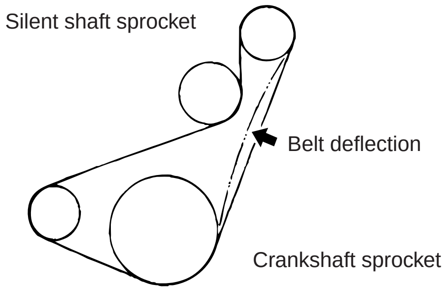
If the bolt is tightened first, the tension B should be turned together, resulting in reduced timing belt B tension.



ECLA021H

7. Ensure that the deflection is 4 to 5 mm (0.0394 to 0.1969 in.) when the belt is pushed by the index finger at the position indicated by and arrow.

Belt deflection : 4 - 5 mm (0.157 - 0.197 in.)



ECLA021I

Fuel System [Gasoline]

GENERAL .... FL - 2

MFI CONTROL SYSTEM .... FL -21

TROUBLESHOOTING FOR DTCS (MELCO EMS) .... FL -64

GENERAL

GENERAL SPECIFICATIONS EFUC3010

Items			Specifications
Throttle body	Throttle position sensor (TPS)	Type	Variable resistor
		Resistance at curb idle	3.5 ~ 6.5 KΩ
		Output voltage at curb idle	300 ~ 900 mV
	Idle speed control (ISC) actuator	Type	Double Coil
		Resistance	90 ~ 110 Hz
Sensors	Air flow sensor	Type	Hot Film sensor
	Intake air temperature (IAT) sensor	Type	Thermistor
		Resistance	2.33 ~ 2.97 KΩ at 20°C (68°F)
	Engine coolant temperature (ECT) sensor	Type	Thermistor
		Resistance	2.5 KΩ at 20°C (68°F)
			0.3 KΩ at 80°C (176°F)
	Heated oxygen sensor (HO2S)	Type	Zirconium
	Vehicle speed sensor	Type	Hall effect
	Camshaft position (CMP) sensor	Type	Hall effect
	Crankshaft position (CKP) sensor	Type	Magnetic type
Actuators	Injectors	Type, number	Electromagnetic type, 4
		Resistance	13 ~ 16Ω at 20°C (68°F)
	Evaporative emission purge control solenoid valve	Type	Duty cycle type
Fuel pressure regulator	Pressure regulator		300 ± 1.5 kPa (3.35 ± 0.06 kg/cm²)
Fuel tank	Tank capacity		65 lit (14.3 Imp.gal)
	Return system		Equipped
Canister	Volume/Nominal working capacity		3.0 liter/150g

SEALANT EFA90020

Item	Specified sealant
Engine coolant temperature sensor	LOCTITE 962T or equivalent

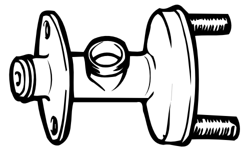
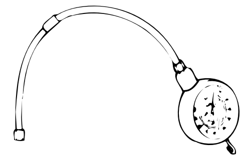
SERVICE STANDARDS EFUC3030

Items		Standard value
Basic ignition timing	Basic ignition timing	BTDC 8° ± 5° at curb idle
	Spark timing grounded	BTDC 5° ± 5° at curb idle
Curb idle speed (rpm)	D-range (A/T)	700 ± 100
	P,N-range (A/T, M/T)	750 ± 100 (A/C OFF)
		950 ± 100 (A/C ON)
Fuel pressure kPa (psi)	Vacuum hose disconnection	330 ~ 350 (47-50) at curb idle
	Vacuum hose connection	Approx. 270 (38) at curb idle
Evap canister purge control solenoid valve resistance		20-32Ω

TIGHTENING TORQUE EFJB0040

Item	Nm	Kg·cm	lb·ft
Delivery pipe installation bolt	10-15	100-150	7-11
Engine coolant temperature sensor	20-40	200-400	14-29
Heated oxygen sensor	40-50	400-500	29-36
Heated oxygen sensor connector bracket bolt	8-12	80-120	5.8-8.7
Fuel pressure regulator installation bolt	4-6	40-60	2.9-4.4
High pressure hose and fuel main pipe	30-40	300-400	22-29
High pressure hose and fuel filter	25-35	250-350	18-25
High pressure hose to delivery pipe	3-4	30-40	2.2-3
Fuel pump assembly to fuel tank	2-3	20-30	1.4-2.2
High pressure hose at fuel tank	30-40	300-400	1.4-2.2
Throttle body to surge tank	15-20	150-200	11-14
Accelerator arm bracket bolts	8-12	80-120	5.8-8.7
ISC actuator	6-8	60-80	4.4-5.8
Fuel sender to fuel tank	2-3	20-30	1.4-2.2

SPECIAL TOOLS EFA90050

Tool (Number and name)	Illustration	Use
09353-38000 Fuel pressure gauge adapter	 EFA9005A	Connection of fuel pressure gauge to delivery pipe for measurement of fuel pressure.
09353-24100 Fuel pressure gauge & hose	 EFA9005B	

TROUBLESHOOTING EFA90060

When troubleshooting an engine, it is important to start with an inspection of the basic systems. If one of the following conditions exists; (A) engine start failure, (B) unstable idling or (C) poor acceleration, begin by checking the following basic systems.

1. Power supply
   - Battery
   - Fusible link
   - Fuse

2. Body ground

3. Fuel supply
   - Fuel line
   - Fuel filter
   - Fuel pump

4. Ignition system
   - Spark plug
   - High-tension cable
   - Ignition coil

5. Emission control system
   - PCV system
   - Vacuum leak

6. Others
   - Ignition timing
   - Idle speed

Malfunctions in the MFI system are often caused by poor connections in the harness connectors. It is important to check all harness connectors and verify that they are securely connected.

TROUBLESHOOTING GUIDE CHART EFDA0070

Main Symptoms	STARTING							Poor Idling					Poor Driving	
	Unable to start			Difficult to start										
Sub-Symptoms Check points	Engine does not turn over	Starter runs but engine does not turn over	Incomplete combustion	Engine turns over	Always	When the engine is cold	When the engine is hot	Incorrect fast idle	High idle speed	Low idle speed	Rough idling	Engine hesitates or accelerates poorly	Surging	Knocking
Starter relay	1													
Starter	2	2		1										
Park/Neutral SW [A/T] or Clutch start SW [M/T]	3													
Flywheel [M/T] or Drive plate [A/T]		4												
Mass air flow sensor circuit			3							3	10	7		
Idle speed control actuator			4		3	3	3	3	3	2	7			2
Fuel pressure regulator			5		5	5	5				4	11	1	
ECT sensor circuit			6		4	1	1	2	2	1	2	8	6	
Compression			7		8						8	5		
Piston rings			8		9						9			
Ignition timing					10						11	14		
Timing mark			9								12			
Injectors			10		13	8	8		7	4	13	15	4	
PCM			11		14	9	9	4	8	5	14	16	5	
A/C circuit				2					6					
Connecting rod bearing				3										
Crankshaft bearing				4										
Fuel quality					1	2	2				1	3	3	
Spark plugs					2						3	4	2	
Fuel pump					6	6	6				5	12		
Fuel lines					7	7	7				6	13		
Ignition circuit			2		11									3
Intake air temp. sensor circuit					12	4	4		4			9		1
Accelerator pedal link								1	1					
TP Sensor circuit									5			6		
Cylinder head											15			
Clutch [M/T]												1		
Brakes not releasing properly												2		
Oxygen sensor circuit												10		
Crankshaft position sensor		3												
Battery voltage		1	1											

EFDA007A

Main Symptoms	Engine Stalls				Others			Refueling
Sub-Symptoms / Check points	Soon after starting	After accelerator pedal is depressed	After accelerator pedal is released	During A/C ON	Excessive fuel consumption	Engine overheats	Engine too cool	Hard to refuel Overflowing spit-Back
Fuel quality	1							
Fuel pressure regulator	2	4			2			
Fuel pump	3							
Fuel lines	4	5						
ISC actuator	5		1	2				
MAF sensor circuit	6	1	2		13			
ECT sensor circuit	7				11			
Injectors	8	6			10			
ECM	9	7	3	3	17			
TP Sensor circuit		2			12			
Spark plug		3			6	8		
A/C circuit				1	14			
Fuel leakage					1			
Accelerator pedal link					3			
Clutch [M/T]					4			
Brakes drag when pedal released					5			
Compression					7			
Piston ring					8			
Ignition timing					9			
Oxygen sensor circuit					15			
Intake air temp. sensor circuit					16			
Coolant leakage						1		
Cooling fan						2	1	
Thermo switch						3		
Radiator and radiator cap						4	2	
Thermostat						5		
Timing belt						6		
Engine coolant pump						7		
Oil pump						9		
Cylinder head						10		
Cylinder block						11		
ECT sender						12	3	
Crankshaft position sensor	11	8	4	4				
Fill vent valve hose-clogging								1
Canister fillter-Contamination								2
Fuel shut off valve-operation								3

EFDA007B

NOTE

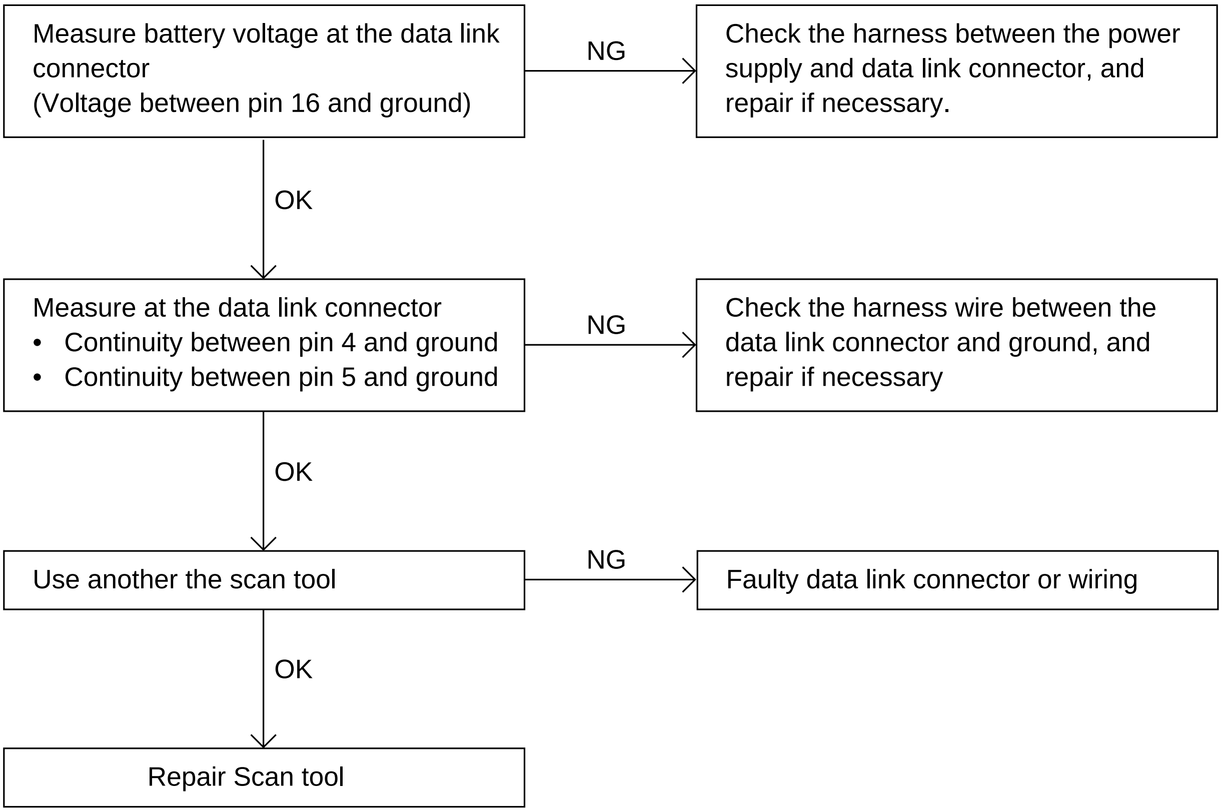
The number herein means the check order.

MFI TROUBLESHOOTING PROCEDURES

EFA90080

PROBLEM

Communication with scan tool is not possible.
(Cannot communicate with any system)



EFA9008A

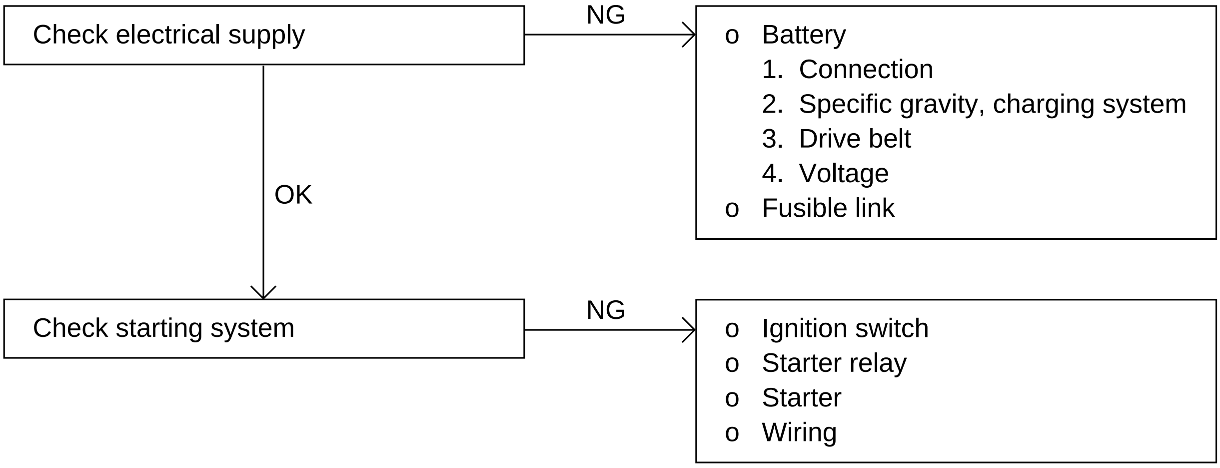
SCAN TOOL COMMUNICATION WITH PCM IS NOT POSSIBLE

EFA90090

Comment	Probable cause
One of the following causes may be suspected • No power supply to PCM • Defective ground circuit of PCM • Defective PCM • Improper communication line between PCM and scan tool	• Malfunction of PCM power supply circuit. • Malfunction of the PCM. • Open circuit between PCM and DLC.

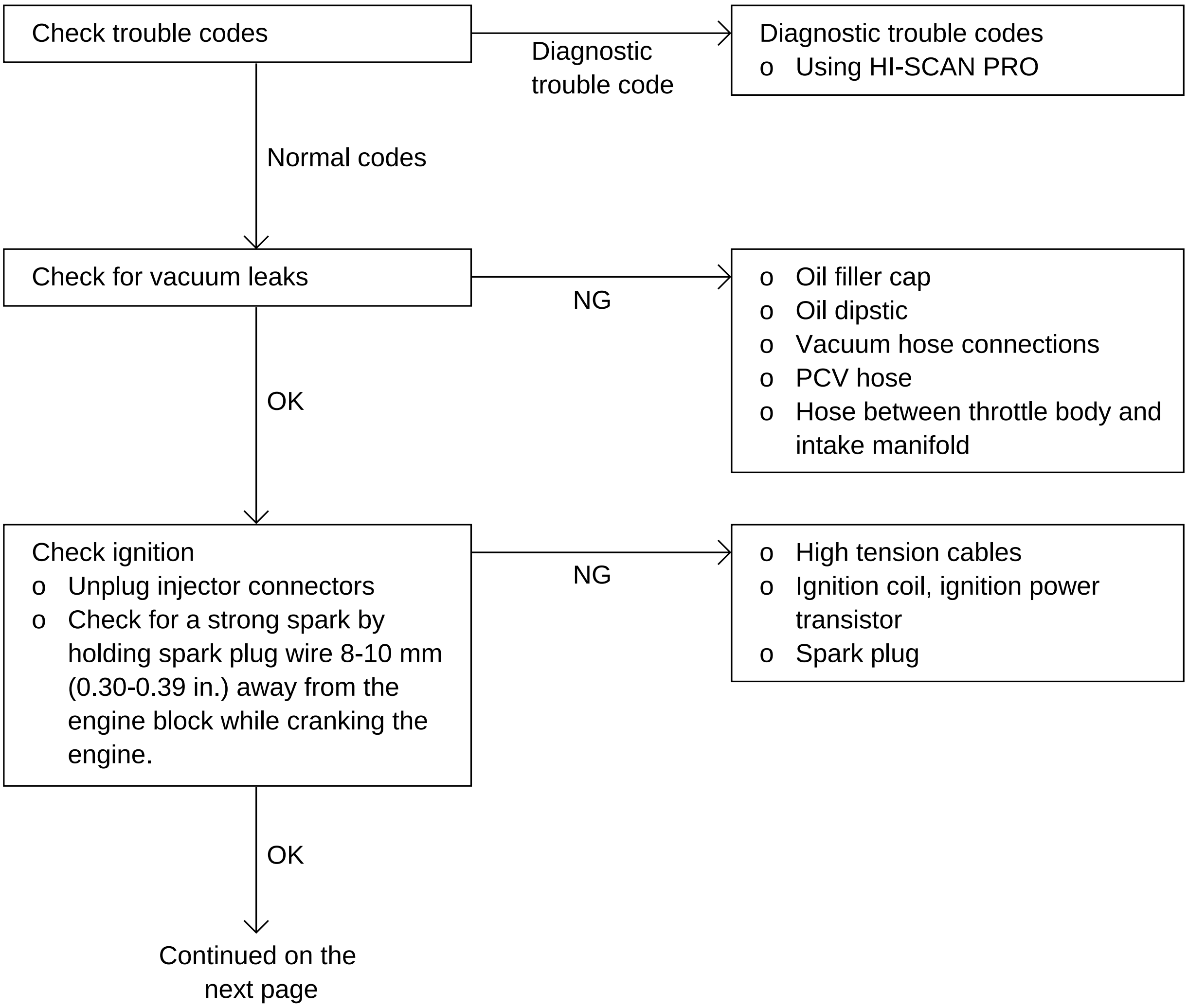
ENGINE WILL NOT START

EFA90100

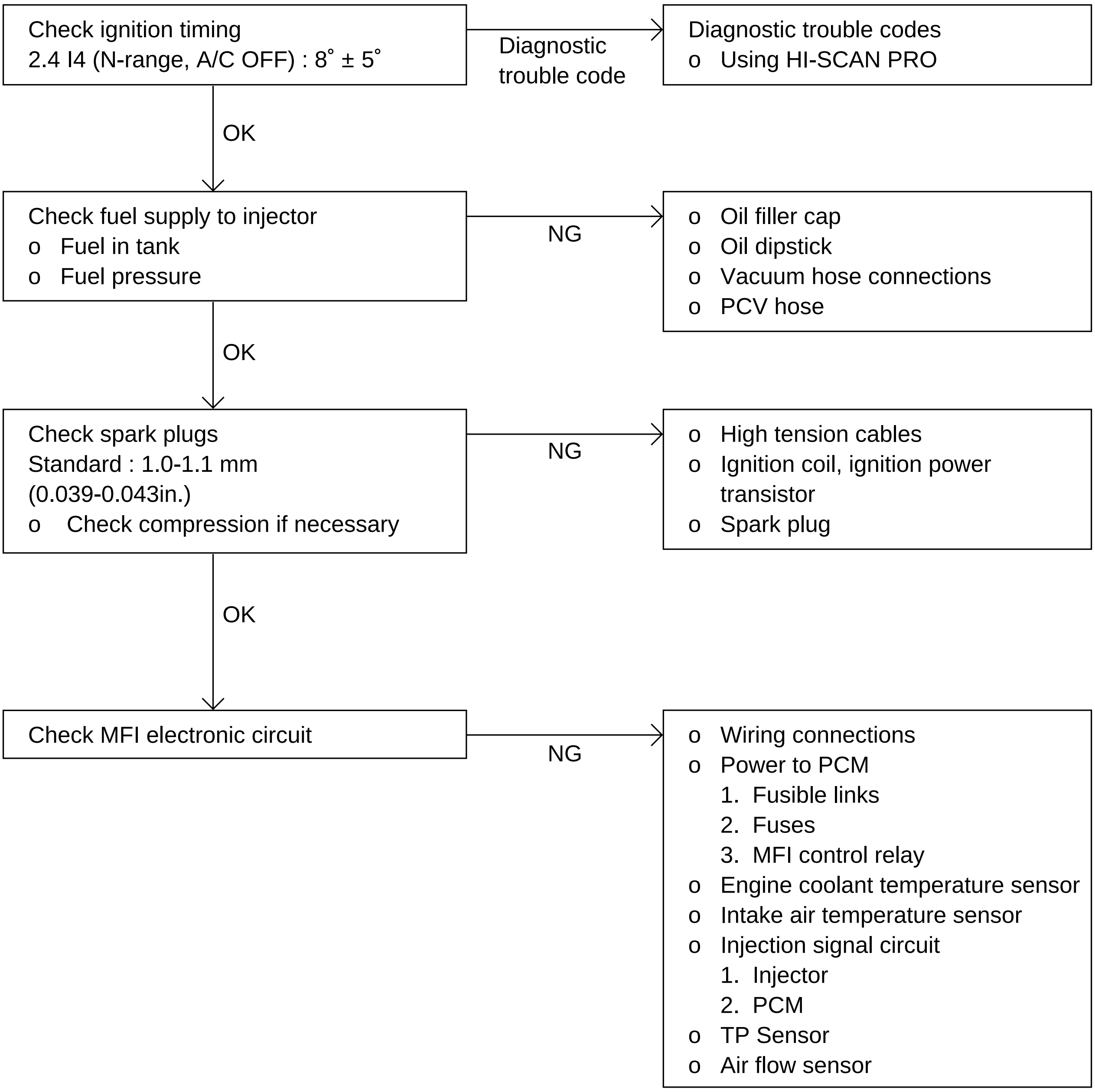


EFA9010A

DIFFICULT TO START (ENGINE CRANKS) EFAC3110



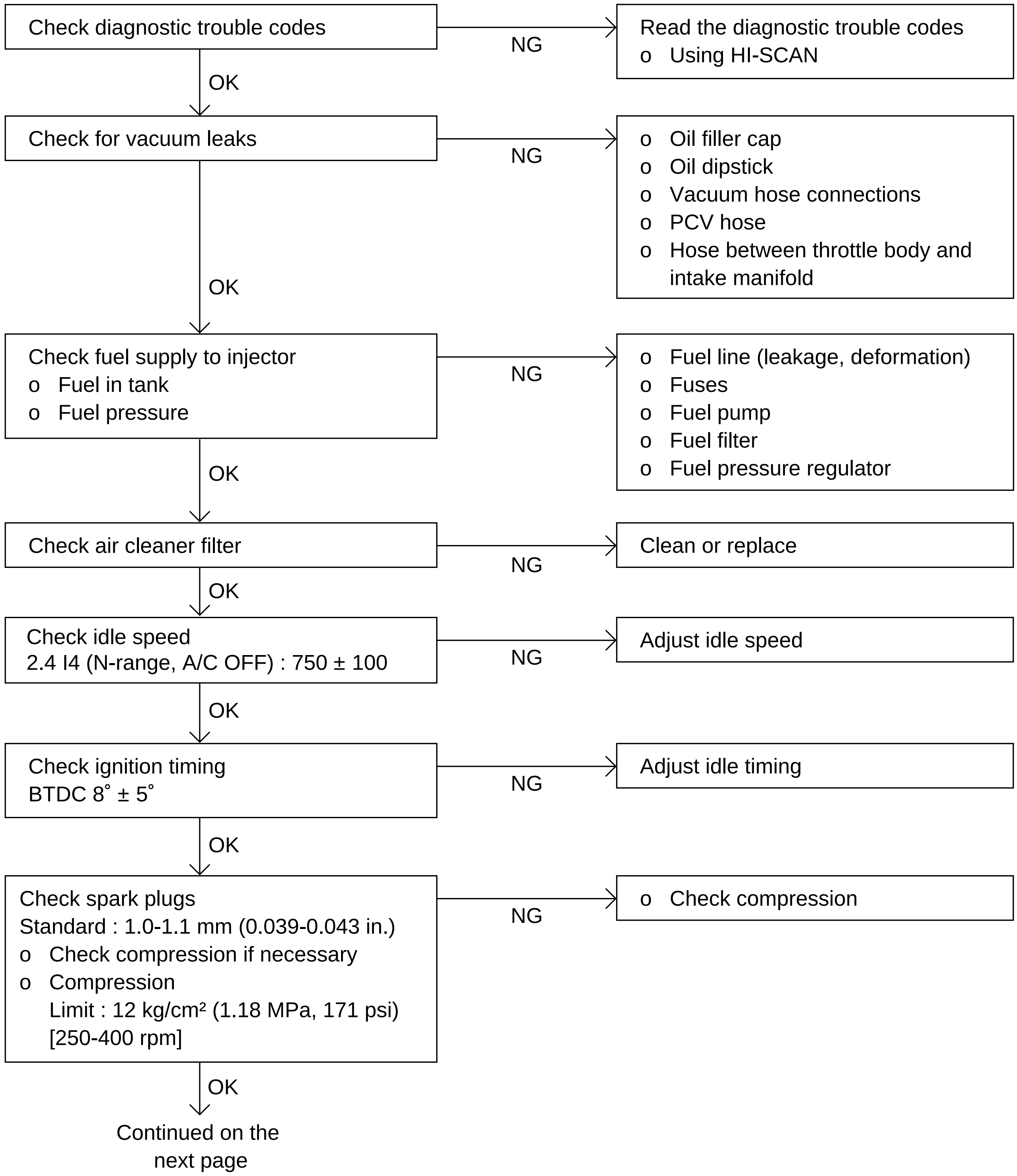
EFA9011A


Check ignition timing
2.4 I4 (N-range, A/C OFF) : 8˚ ± 5˚
Diagnostic trouble code
Diagnostic trouble codes
o Using HI-SCAN PRO
OK
Check fuel supply to injector
o Fuel in tank
o Fuel pressure
NG
o Oil filler cap
o Oil dipstick
o Vacuum hose connections
o PCV hose
OK
Check spark plugs
Standard : 1.0-1.1 mm
(0.039-0.043in.)
o Check compression if necessary
NG
o High tension cables
o Ignition coil, ignition power transistor
o Spark plug
OK
Check MFI electronic circuit
NG
o Wiring connections
o Power to PCM
1. Fusible links
2. Fuses
3. MFI control relay
o Engine coolant temperature sensor
o Intake air temperature sensor
o Injection signal circuit
1. Injector
2. PCM
o TP Sensor
o Air flow sensor

EFUC311B

ROUGH IDLE OR ENGINE STALLS

EFUC3120



Check diagnostic trouble codes

NG → Read the diagnostic trouble codes
- o Using HI-SCAN

OK ↓

Check for vacuum leaks

NG →
- o Oil filler cap
- o Oil dipstick
- o Vacuum hose connections
- o PCV hose
- o Hose between throttle body and intake manifold

OK ↓

Check fuel supply to injector
- o Fuel in tank
- o Fuel pressure

NG →
- o Fuel line (leakage, deformation)
- o Fuses
- o Fuel pump
- o Fuel filter
- o Fuel pressure regulator

OK ↓

Check air cleaner filter

NG → Clean or replace

OK ↓

Check idle speed
2.4 I4 (N-range, A/C OFF) : 750 ± 100

NG → Adjust idle speed

OK ↓

Check ignition timing
BTDC 8° ± 5°

NG → Adjust idle timing

OK ↓

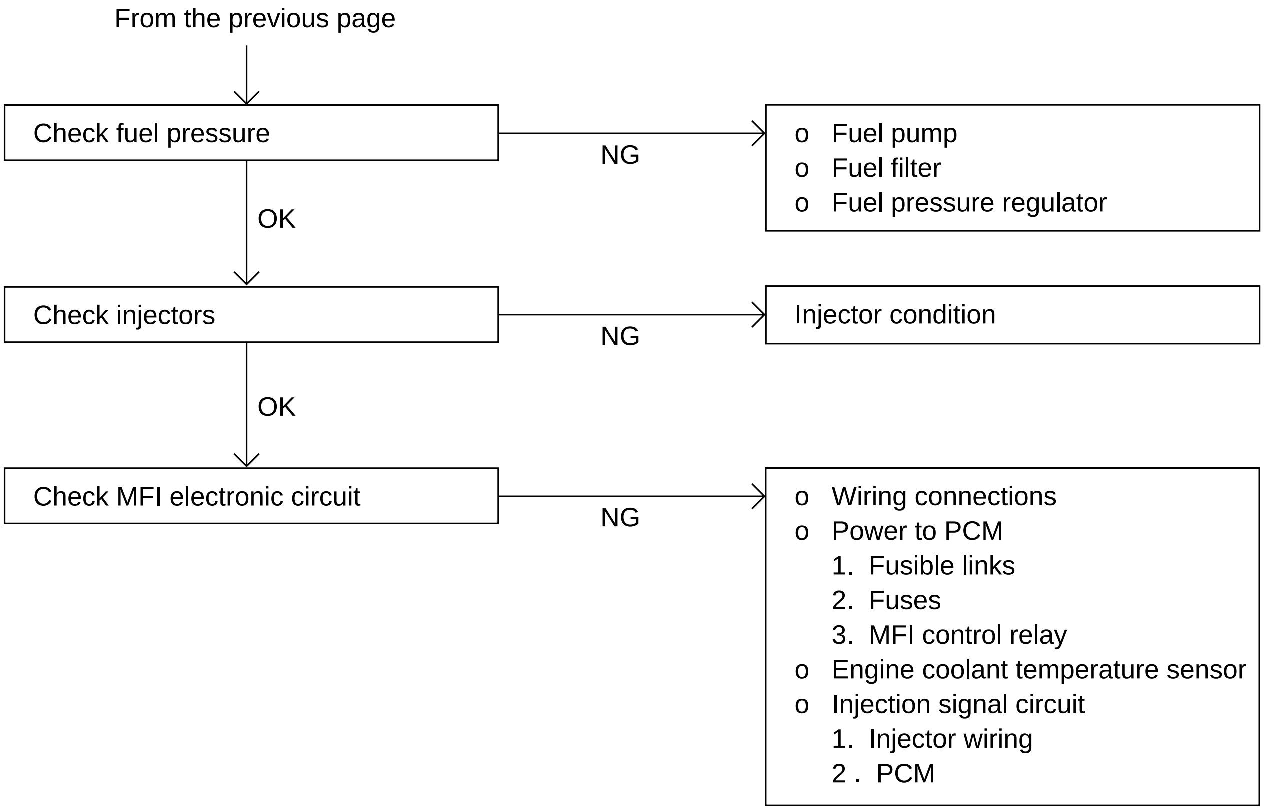
Check spark plugs
Standard : 1.0-1.1 mm (0.039-0.043 in.)
- o Check compression if necessary
- o Compression
  Limit : 12 kg/cm² (1.18 MPa, 171 psi)
  [250-400 rpm]

NG →
- o Check compression

OK ↓

Continued on the next page

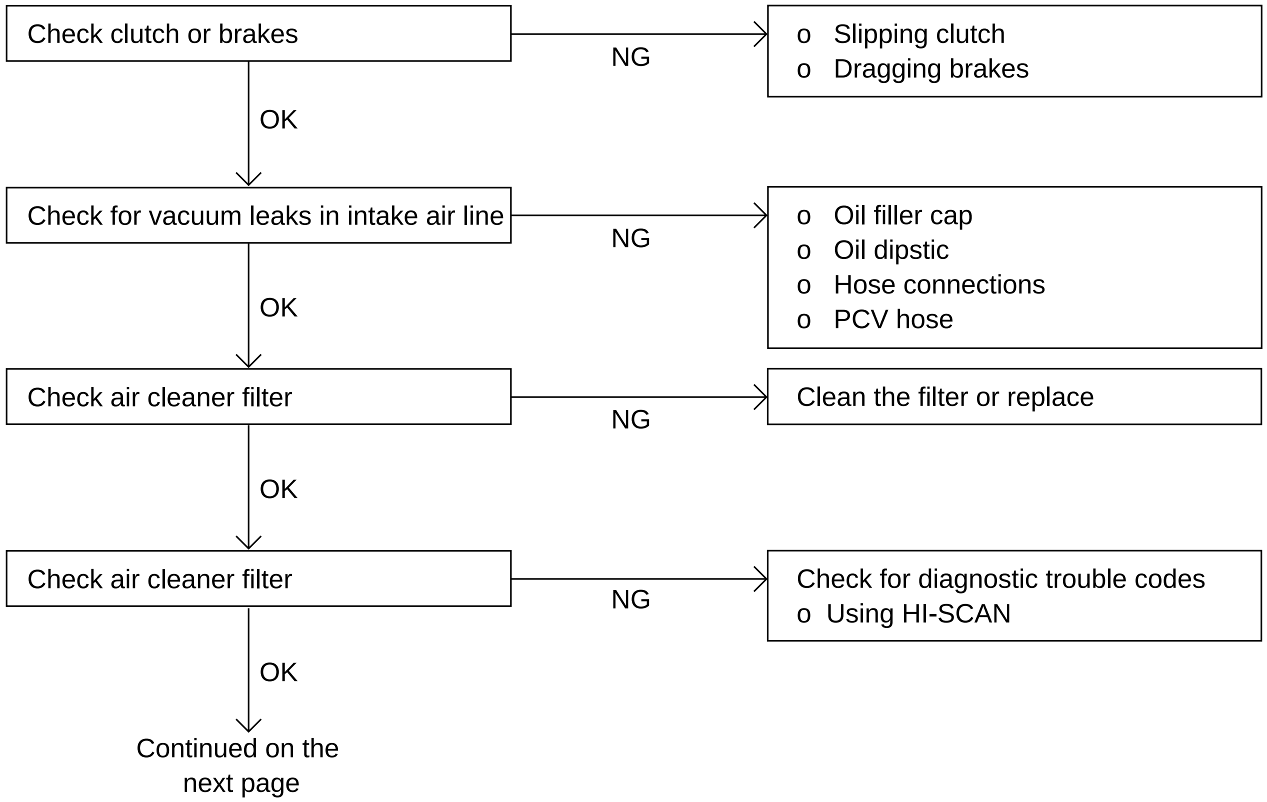
EFUC312A


From the previous page
Check fuel pressure
NG
o Fuel pump
o Fuel filter
o Fuel pressure regulator
OK
Check injectors
NG
Injector condition
OK
Check MFI electronic circuit
NG
o Wiring connections
o Power to PCM
1. Fusible links
2. Fuses
3. MFI control relay
o Engine coolant temperature sensor
o Injection signal circuit
1. Injector wiring
2 . PCM

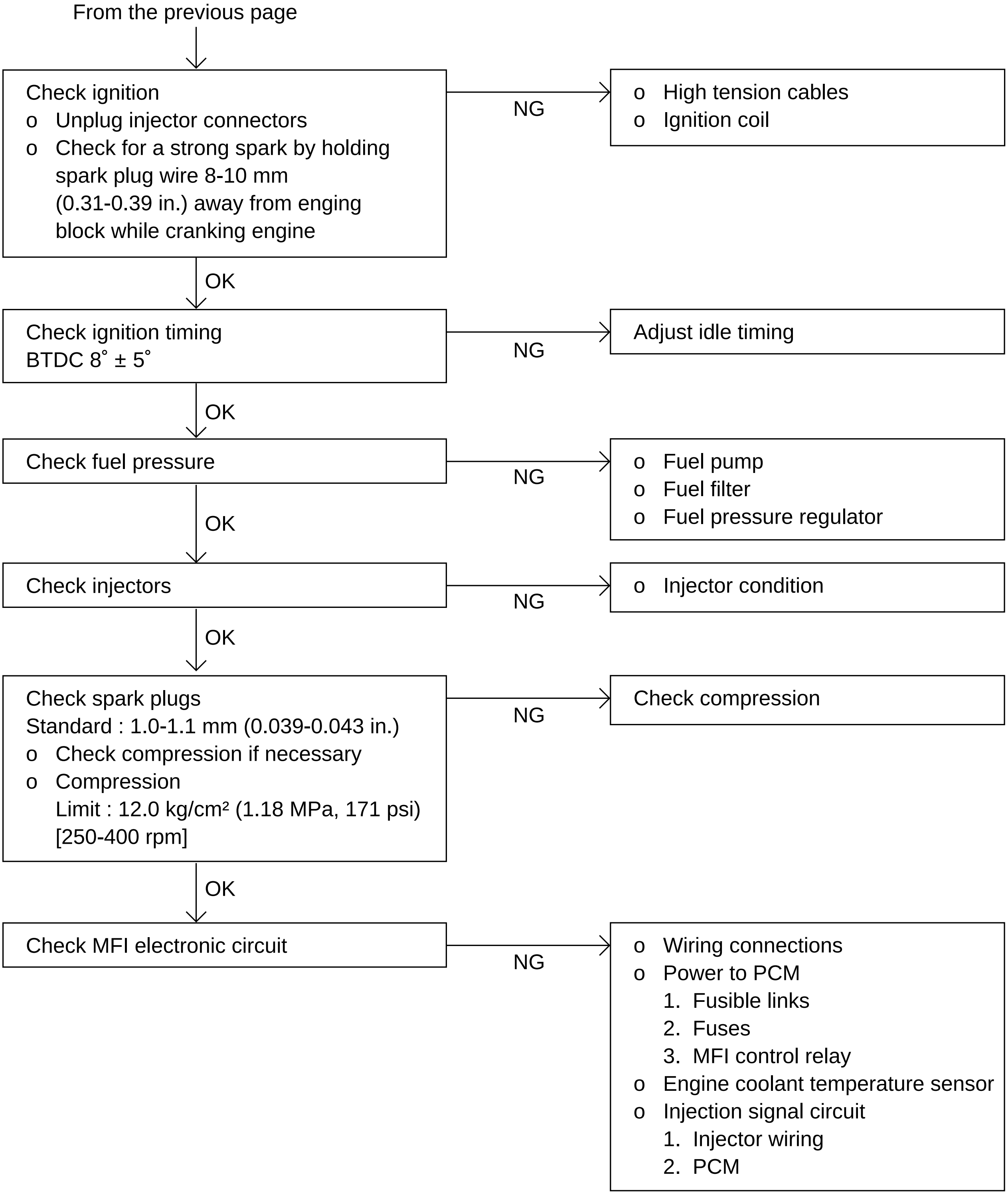
EFA9012B

ENGINE HESITATES OR ACCELERATES POORLY

EFUC3130



EFA9013A


From the previous page
Check ignition
o Unplug injector connectors
o Check for a strong spark by holding spark plug wire 8-10 mm (0.31-0.39 in.) away from enging block while cranking engine
NG
o High tension cables
o Ignition coil
OK
Check ignition timing
BTDC 8˚ ± 5˚
NG
Adjust idle timing
OK
Check fuel pressure
NG
o Fuel pump
o Fuel filter
o Fuel pressure regulator
OK
Check injectors
NG
o Injector condition
OK
Check spark plugs
Standard : 1.0-1.1 mm (0.039-0.043 in.)
o Check compression if necessary
o Compression
Limit : 12.0 kg/cm² (1.18 MPa, 171 psi)
[250-400 rpm]
NG
Check compression
OK
Check MFI electronic circuit
NG
o Wiring connections
o Power to PCM
1. Fusible links
2. Fuses
3. MFI control relay
o Engine coolant temperature sensor
o Injection signal circuit
1. Injector wiring
2. PCM

EFUC313B

TROUBLESHOOTING EFA90140

Trouble symptom	Probable cause	Remedy
Engine will not crank.	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn	Repair or replace cables
	Transaxle range switch faulty (Vehicle with automatic transaxle only)	Adjust or replace switch
	Fusible link blown	Replace fusible link
	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
Engine cranks slowly	Battery charge low	Charge or replace battery
	Battery cables loose, corroded or worn	Repair or replace cables
	Starter motor faulty	Repair starter motor
Starter keeps running	Starter motor faulty	Repair starter motor
	Ignition switch faulty	Replace ignition switch
Starter spins but engine will not crank	Pinion gear teeth broken or starter motor faulty	Repair starter motor
	Ring gear teeth broken	Replace flywheel ring gear or torque converter

FUEL TANK AND FUEL LINE EFA90150

Trouble symptom	Probable cause	Remedy
Engine malfunctions due to insufficient fuel supply	Bent or kinked fuel pipe or hose	Repair or replace
	Clogged fuel pipe or hose	Clean or replace.
	Clogged fuel filter of in-tank fuel filter	Replace
	Water in fuel filter	Replace the fuel filter or clean the fuel tank and fuel lines
	Dirty or rusted fuel tank interior	Clean or replace
	Malfunctioning fuel pump (clogged filter in the pump)	Replace
Evaporative emission system malfunction (when fuel filler cap is removed, pressure is released)	Incorrect routing of a vapor line	Correct
	Disconnected vapor line	Correct
	Folded, bent, cracked or clogged vapor line	Replace
	Faulty fuel tank cap	Replace
	Malfunctioning overfill limiter (two-way valve)	Replace

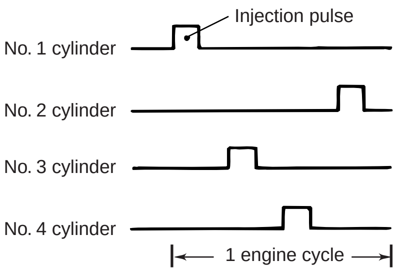
MULTIPORT FUEL INJECTION (MFI) EFAC0160

GENERAL INFORMATION

The Multiport Fuel Injection System consists of sensors which detect the engine conditions, the POWERTRAIN CONTROL MODULE (PCM) which controls the system based on signals from these sensors, and actuators which operate under the control of the PCM. The PCM carries out activities such as fuel injection control, idle air control and ignition timing control. In addition, the PCM is equipped with several diagnostic test modes which simplify troubleshooting when a problem occurs.

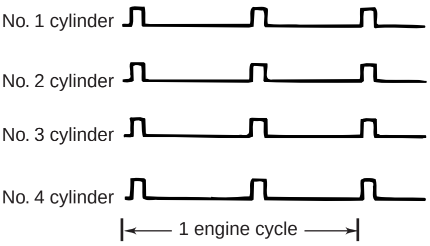
FUEL INJECTION CONTROL

The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions. A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel tank by the fuel pump with the pressure being regulated by the fuel pressure regulator. The fuel thus regulated is distributed to each of the injectors. This is called multiport. Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The PCM provides a richer air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance. In addition, when the engine is warm or operating under normal conditions, the PCM controls the air/fuel mixture by using the heated oxygen sensor signal to carry out "closed-loop" control in order to obtain the theoretical air/fuel mixture ratio that provides the maximum cleaning performance from the three way catalyst.



Sequential multiport fuel injection system

EFJB016A



Simultaneous multiport fuel injection system

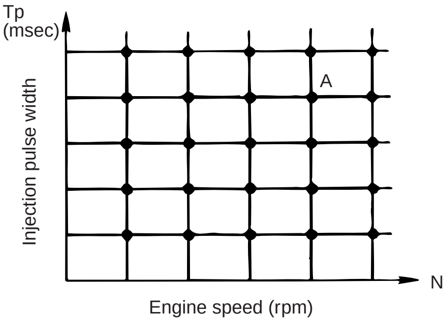
EFJB016B

IDLE SPEED CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that bypasses the throttle valve in accordance with changes in idling conditions and engine load during idling. The PCM drives the idle speed control (ISC) motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and air conditioning load. In addition, when the air conditioning switch is turned off and on while the engine is idling, the ISC motor operates to adjust the throttle valve bypass air amount in accordance with the engine load conditions in order to avoid fluctuations in the engine speed.

IGNITION TIMING CONTROL

The ignition power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing in order to provide the optimum ignition timing with respect to the engine operating conditions. The ignition timing is determined by the PCM from the engine speed, intake air volume, engine coolant temperature and atmospheric pressure.



EFAC016C

OTHER CONTROL FUNCTIONS EFA90170

1. Fuel Pump Control :
   Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.
2. A/C Compressor Clutch Relay Control :
   Turns the compressor clutch of the A/C ON and OFF.
3. Fan Relay Control :
   The radiator fan and condenser fan speeds are controlled in response to the engine coolant temperature and vehicle speed.
4. Evaporative Emission Purge Control (Refer to GROUP EC).

DIAGNOSTIC TEST MODE EFA90180

- When an abnormality is detected in one of the sensors or actuators related to emission control, the CHECK ENGINE/MALFUNCTION INDICATOR LAMP illuminates as a warning to the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnostic trouble code corresponding to the abnormality is output.
- The RAM data inside the PCM that is related to the sensors and actuators can be read by means of the scan tool. In addition, the actuators can be controlled under certain circumstances.

HOW TO COPE WITH INTERMITTENT MALFUNCTIONS EFA90190

Most intermittent malfunctions occur under certain conditions. If those conditions can be identified, the cause will be easier to find.

TO COPE WITH INTERMITTENT MALFUNCTION:

1. Ask the customer about the malfunction.
   Ask what it feels like, what it sounds like, etc. Then ask about driving conditions, weather, frequency of occurrence, and so on.
2. Determine the conditions from the customer's responses.
   Typically, almost all intermittent malfunctions occur from conditions like vibration, temperature and/or moisture change, poor connections. From the customer's replies, it should be deduced which condition exists.
3. Run a simulation test
   In the cases of vibration or poor connections, use the simulation tests below to attempt to duplicate the customer's complaint. Determine the most likely circuit(s) and perform the simulation tests on the connectors and parts of that circuit(s). Be sure to use the inspection procedures provided for diagnostic trouble codes and trouble symptoms. For temperature and/or moisture conditions related intermittent malfunctions, using common sense, try to change the conditions of the suspected circuit components, then use the simulation tests below.
4. Repair the malfunctioning part and try to duplicate the condition(s) again to verify that the intermittent malfunction has been eliminated.

SIMULATION TESTS

For these simulation tests, shake, then gently bend, pull and twist the wiring of each of these examples to duplicate the intermittent malfunction.

- Shake the connector up-and-down, right-and-left.
- Shake the wiring harness up-and-down, right-and-left.
- Vibrate the part or sensor.

SERVICE POINTS IN INSPECTING A BLOWN FUSE EFAA0200

Remove the fuse and measure the resistance between the load side of the fuse and ground. Set the switches of all circuits which are connected to this fuse to a condition of continuity. If the resistance is almost 0Ω at this time, there is a short somewhere between these switches and the load. If the resistance is not 0Ω, there is no short at the present time, but a momentary short has probably caused the fuse to blow.

The main causes of a short circuit are the following.

- Harness being crushed by the vehicle body.
- Damage to the outer casing of the harness due to wear or heat.
- Water getting into the connector or circuitry.
- Human error (mistakenly shorting a circuit, etc.).

INSPECTING THE MFI SYSTEM EFUC3210

If the MFI system components (sensors, PCM, injector, etc.) fail, the interruption or failure to supply the proper amount of fuel for various engine operating conditions will result. The following situations may be encountered:

1. Engine is hard to start or does not start at all
2. Unstable idle
3. Poor driveability

If any of the above conditions is noted, first check for trouble codes and make basic engine checks (ignition system malfunction, incorrect engine adjustment, etc.). Then, inspect the MFI system components.

ON-BOARD DIAGNOSTICS

- Diagnostic trouble codes are set as follows:
  After the PCM first detects a malfunction, a diagnostic trouble code is recorded when the engine is restarted and the same malfunction is re-detected. (The malfunction is detected in driving cycle). However, for fuel system rich/lean misfiring, a diagnostic trouble code is recorded on the first detection of the malfunction.
- Erasing diagnostic trouble codes:
  After recording the diagnostic trouble code, if the PCM does not re-detect the malfunction for 40 driving cycles, the diagnostic trouble code will be erased from the PCM memory. However, for fuel system rich/lean or misfiring, the diagnostic trouble code will be erased if both of the following conditions are met:
  - When driving conditions (engine speed, engine coolant temperature, etc.) are identical to those when the malfunction was first recorded.
  - When the PCM does not re-detect the malfunction for 80 driving cycles.

NOTE

A "driving cycle" is completed as soon as the vehicle goes into closed-loop operation.

MALFUNCTION INDICATOR LIGHT (MIL)

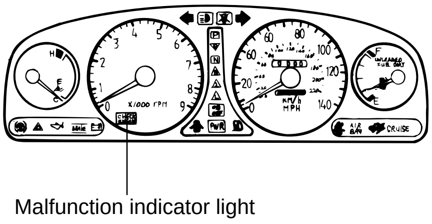
The MIL lights up to notify the driver that there is a problem with the vehicle.

However the MIL will go off automatically after 3 subsequent sequential driving cycles that do not redetected the same malfunctions.

Immediately after the ignition switch is turned on, the MIL is lit for 5 seconds to indicate that the light operates normally.

The following Items can be indicated by the MIL:

- Catalyst
- Fuel system
- Air flow sensor (MAF sensor)
- Intake Air Temperature Sensor (IAT sensor)
- Engine Coolant Temperature Sensor (ECT sensor)
- Throttle Position Sensor (TPS)
- Front Oxygen Sensor
- Rear Oxygen Sensor Heater
- Rear Oxygen Sensor
- Front Oxygen Sensor Heater
- Injector
- Misfire
- Crankshaft Position Sensor (CKP sensor)
- Camshaft Position Sensor (CMP sensor)
- Evaporative Emission Control System
- Vehicle Speed Sensor (VSS)
- Idle Speed Control
- PCM



EFA9021A

INSPECTING THE MALFUNCTION INDICATOR LAMP (MIL)

1. After turning the ignition key on, check that the light illuminates for 5 seconds without the engine running.
2. If the light does not illuminate, check for an open circuit in the harness, blown fuse and blown bulb.

SELF-DIAGNOSIS

The PCM monitors the input/output signals (some signals at all times and others under specified conditions). When the PCM detects an irregularity, it memorizes the diagnostic trouble code, and outputs the signal to the self-diagnosis output terminal. The diagnosis results can be read by a Generic Scan Tool (GST) or Hi-Scan Pro. A diagnostic trouble code (DTC) will remain in the PCM as long as battery power is maintained. The diagnostic trouble code will however be erased when the battery terminal or the powertrain control module (PCM) connector is disconnected or erased using the Generic Scan Tool.

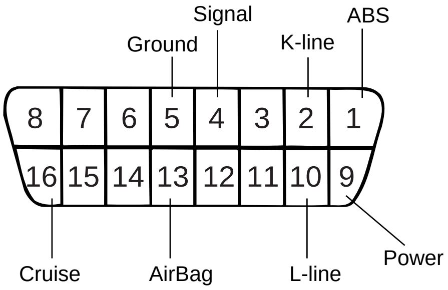
CHECKING PROCEDURE (SELF-DIAGNOSIS)

NOTE

1. *When battery voltage is excessively low, diagnostic trouble codes can not be read. Be sure to check the battery for voltage and the charging system before starting the test.*
2. *Codes are erased if the battery or the PCM connector is disconnected. Do not disconnect the battery before the diagnostic trouble codes are completely read and recorded.*

Inspection Procedure (Using Generic Scan Tool)

1. Turn OFF the ignition switch.
2. Connect the scan tool to the data link connector on the lower crash pad.
3. Turn ON the ignition switch.
4. Use the scan tool to check the diagnostic trouble code.
5. Repair the faulty part from the diagnosis chart.
6. Erase the diagnostic trouble code.
7. Disconnect the scan tool.

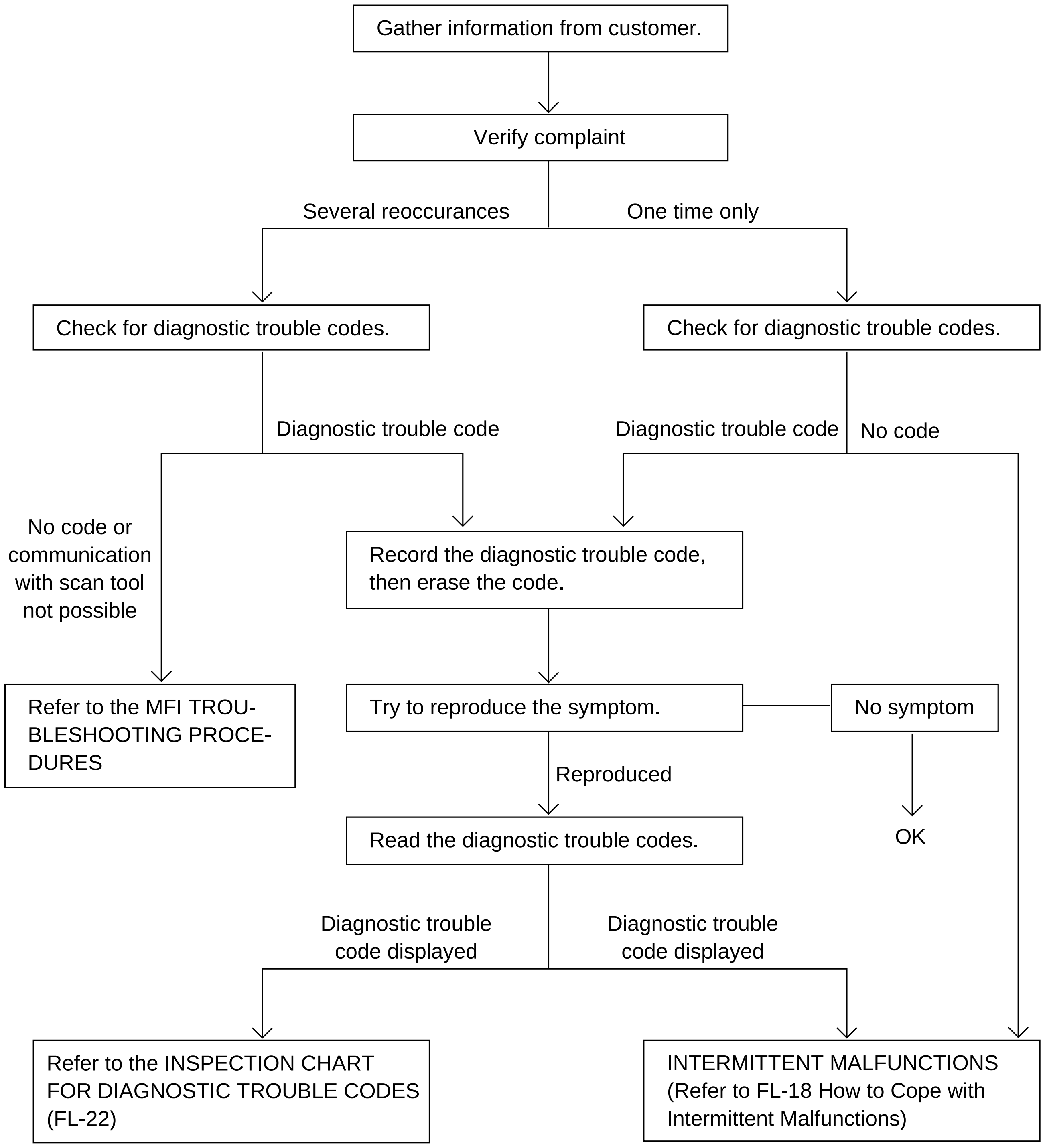


EFHA021B

MFI CONTROL SYSTEM

TROUBLESHOOTING EFUC3220

DIAGNOSTIC TROUBLESHOOTING FLOW



EFUC322A

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (FOR EOBD)

EFUC3230

DTC NO.	CONTENT	MEMORY	MIL
P0101	Mass Air Flow Circuit Range/Performance Problem	O	O
P0102	Mass Air Flow Circuit Low Input	O	O
P0103	Mass Air Flow Circuit High Input	O	O
P0112	Intake Air Temperature Circuit Low Input	O	O
P0113	Intake Air Temperature Circuit High Input	O	O
P0115	Engine Coolant Temperature Circuit Malfunction	O	O
P0116	Engine Coolant Temperature Circuit Range/Performance Problem	O	O
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control	O	O
P0122	Throttle Position Sensor Circuit Low Input	O	O
P0123	Throttle Position Sensor Circuit High Input	O	O
P0134	Excessive Time to Enter Closed Loop Fuel Control	O	O
P0133	Oxygen Sensor Circuit Malfunction (Bank 1, Sensor 1)	O	O
P0132	Oxygen Sensor Circuit Open (Bank 1, Sensor 1)	O	O
P0135	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)	O	O
P0136	Oxygen Sensor Circuit Open (Bank 1, Sensor 2)	O	O
P0140	Oxygen Sensor Circuit Short (Bank 1, Sensor 2)	O	O
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)	O	O
P0171	Fuel System Too Lean	O	O
P0172	Fuel System Too Rich	O	O
P0201	Injector Circuit Malfunction (Cylinder -1)	O	O
P0202	Injector Circuit Malfunction (Cylinder -2)	O	O
P0203	Injector Circuit Malfunction (Cylinder -3)	O	O
P0204	Injector Circuit Malfunction (Cylinder -4)	O	O
P0300	Random Misfire Detected	O	O
P0301	Misfire Detected (Cylinder -1)	O	O
P0302	Misfire Detected (Cylinder -2)	O	O
P0303	Misfire Detected (Cylinder -3)	O	O
P0304	Misfire Detected (Cylinder -4)	O	O
P0325	Knock Sensor Circuit Malfunction	O	X
P0335	Crankshaft Position Sensor Circuit Malfunction	O	O
P0340	Camshaft Position Sensor Circuit Malfunction	O	O
P0350	Ignition coil Malfunction	O	O
P0320	Ignition Failure Sensor Malfunction	O	X
P0421	Warm-up Catalyst Efficiency Below Threshold	O	O
P0443	Evaporative Emission Control System - Purge Control Valve Circuit Malfunction	O	O
P0500	Vehicle Speed Sensor Malfunction	O	O

DTC NO.	CONTENT	MEMORY	MIL
P0507	Idle Speed Control - High RPM	O	O
P1330	Spark Timing Adjust Malfunction	O	O

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES (FOR NON-EOBD)

EFUC3240

DTC NO.	CONTENT	Memory	MIL
P0100	Mass or Volume Air Flow Circuit Malfunction	O	O
P0110	Intake Air Temperature Circuit Malfunction	O	O
P0115	Engine Coolant Temperature Circuit Malfunction	O	O
P0120	Throttle Position Circuit Malfunction	O	O
P0130	O2 Sensor Circuit Malfunction (Bank 1, Sensor 1)	O	O
P0136	O2 Sensor Circuit Malfunction (Bank 1, Sensor 2)	O	O
P0201	Injector Circuit Malfunction (Cylinder -1,)	O	O
P0202	Injector Circuit Malfunction (Cylinder -2)	O	O
P0203	Injector Circuit Malfunction (Cylinder -3)	O	O
P0204	Injector Circuit Malfunction (Cylinder -4)	O	O
P0325	Knock Sensor Circuit Malfunction	O	X
P0335	Crankshaft Position Sensor Circuit Malfunction	O	O
P0340	Camshaft Position Sensor Circuit Malfunction	O	O
P0350	Ignition Coil Malfunction	O	O
P0500	Vehicle Speed Sensor Malfunction	O	X
P1330	Spark Timing Adjust Malfunction	O	O

TROUBLE AREA RELATED TO DTC EFUC3250

Note : Check items for each diagnostic item do not list all probable causes.

DTC No.	Diagnostic items	Trouble area
P0100 P0101	Mass or Volume Air Flow Circuit Range/performance Problem	• Dirty air cleaner • Oil cap or dipstick missing or not installed correctly • Air leak in intake system • Contaminated, deteriorated or damaged mass air flow sensor • Faulty mass air flow sensor or throttle position sensor • Poor connections between ECM and MAFS or TPS **_NOTE_** *If any codes relating to MAFS are present, do all repairs associated with them before proceeding with this troubleshooting area.*
P0102	Mass or Volume Air Flow Circuit Low Input	• Short to ground between MAFS and ECM • Signal line open between MAFS and ECM • Faulty MAFS
P0103	Mass or Volume Air Flow Circuit High Input	• Short to Battery between MAFS and ECM • Ground open between MAFS and EGI main relay • Ground open or Poor connections between open or short to battery between MAFS and ECM • Faulty MAFS
P0110 P0112	Intake Air Temperature Circuit Low Input	• Short to ground between IAT sensor and ECM • Short between IAT sensor wires • Faulty IAT sensor
P0113	Intake Air Temperature Circuit High Input	• Open or short to battery between IAT sensor and ECM • Faulty IAT sensor
P0115	Engine Coolant Temperature Circuit Malfunction	• Open or short to battery between ECTS and ECM • Short to ground between ECTS and ECM • Short between ECTS wires • Faulty ECTS
P0116	Engine Coolant Temperature Sensor Circuit Range/Performance Problem	• After engine start-up, the measured coolant temperature shows no variation after detecting the calculated coolant temperature variation (engine coolant temperature sensor input is stuck.) • Poor connections between ECT sensor and ECM • Misplaced, loose or corroded terminals • Foreign materials fouled ECTS • Faulty ECTS **_NOTE_** *If any codes relating to ECTS are present, do all repairs associated with them before proceeding with this troubleshooting area.*

DTC No.	Diagnostic items	Trouble area
P0120	Throttle Position Sensor Circuit Malfunction	• Poor connections between TPS and ECM • Misplaced, loose or corrodes terminals • Contaminated, deteriorated TPS • Open or short between TPS 5V reference and ECM • Open or short between TPS signal and ECM • Short between TPS wires • Faulty TPS
P0122	Throttle Position Sensor Circuit Low Input	• Short to GND between TPS and ECM • Open short to GND between TPS and ECM • Short to RND between ECM and fuel tank pressure sensor (FTPS) • Faulty TPS or FTPS
P0123	Throttle Position Sensor Circuit High Input	• Open or short to battery between TPS and ECM • Open between and ECM • Faulty TPS
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control	• After engine start-up, the elapsed time before feedback operation is initiated is too long (engine coolant temperature sensor input is insufficient for closed loop operation) • Poor connections between ECT sensor and ECM • Faulty ECTS
P0130	HO2S Circuit Malfunction (Bank 1, Sensor 1)	• Short to GND between HO2S and ECM • Faulty front HO2S
P0132	HO2S Circuit High Input (Bank 1, Sensor 1)	• Short to battery between HO2S and ECM • Faulty front HO2S
P0133	HO2S Circuit Slow Responsive (Bank 1, Sensor 1)	• Front and rear HO2S connections reversed • Faulty fuel delivery system • Leak in intake system • Leak in exhaust system • Faulty MAFS ground circuit • Faulty HO2S ***NOTE*** *If any misfire, purge solenoid valve, MAFS or HO2S heater codes are present, do all repairs associated with those codes before proceeding with this trouble area.*
P0134	HO2S Circuit No Activity Detected (Bank 1, Sensor 1)	• Contaminated, deteriorated or aged HO2S • Misplaced, bent, loose or corroded connector terminals • Faulty HO2S ***NOTE*** *If any misfire, purge solenoid valve or HO2S heater codes are present, do all repairs associated with those codes before proceeding this trouble area.*
P0135	HO2S Heater Circuit Malfunction (Bank 1, Sensor 1)	• Blown or missing HO2S fuse • Short to battery between front HO2S and ECM • Open between front HO2S and ECM • Faulty front HO2S
P0136	HO2S Circuit Malfunction (Bank 1, Sensor 2)	• Short between rear HO2S and ECM • Faulty rear HO2S

DTC No.	Diagnostic items	Trouble area
P0140	HO2S Circuit Short (Bank 1, Sensor 2)	• Short to GND between HO2S and ECM • Faulty front HO2S
P0141	HO2S Heater Circuit Malfunction (Bank 1, Sensor 2)	• blown or missing HO2S fuse • Short to battery between rear HO2S and ECM • Open between rear HO2S and ECM • Faulty rear HO2S
P0171	Fuel System Too Lean (Bank 1)	• Faulty ignition system (Ignition coil/spark plug/Ignition cable) • Faulty fuel delivery system (Fuel tank/Pressure regulator/Canister purge valve) • Clogged fuel injectors • Faulty fuel injectors • Leak in intake system • Leak in exhaust system • Faulty MAFS ***NOTE*** *If any codes relating to injectors, HO2S, ECTS or MAFS are stored, do all repairs associated with those codes before proceeding with this trouble area.*
P0172	Fuel System Too Rich (Bank 1)	• Faulty fuel delivery system (Fuel tank/Pressure regulator/Canister purge valve) • Faulty fuel injectors • Faulty MAFS ***NOTE*** *If any codes relating to injectors, HO2S, ECTS or MAFS are stored, do all repairs associated with those codes before proceeding with this trouble area.*
P0201	Injector Circuit High Input (Cylinder -1)	• Open between injector fuse and injector • Open or short to battery between injector and ECM • Faulty fuel injector
P0202	Injector Circuit High Input (Cylinder -2)	
P0203	Injector Circuit High Input (Cylinder -3)	
P0204	Injector Circuit High Input (Cylinder -4)	
P0300	Random Misfire Detected	• Vacuum leak in air intake system • CKP sensor circuit malfunction • Faulty CKP sensor • Ignition circuit malfunction • Faulty ignition coil or plug wire • Spark plug malfunction • Low compression due to blown head gasket, leaking valve or piston ring • Low/high fuel pressure due to faulty pressure regulator, restricted fuel lines, plugged fuel filter or faulty fuel pump • Fuel injector circuit malfunction • Faulty fuel injector ***NOTE*** *If any fuel injector codes (or pending codes) are present, do all repairs associated with those codes before proceeding with this trouble area.*
P0301	Misfire Detected (Cylinder -1)	
P0302	Misfire Detected (Cylinder -2)	
P0303	Misfire Detected (Cylinder -3)	
P0304	Misfire Detected (Cylinder -4)	

DTC No.	Diagnostic items	Trouble area
P0325	Knock Sensor Circuit Malfunction (Bank 1)	• Open or short to GND between knock sensor and ECM • Source of high resistance between knock sensor and ECM • Faulty knock sensor
P0335	Crankshaft Position Sensor Circuit Malfunction	• Short to GND between CKP sensor and ECM • Open or short to battery between CKP and ECM • Short between CKP sensor wires • Poor connection between CKP connector & harness connector • Out of allowable air gap • Faulty target wheel tolerance • Faulty CKP sensor
P0340	Camshaft Position Sensor Circuit Malfunction	• Short to GND between CMP sensor and ECM • Open or short to battery between CMP and ECM • Short between CMP sensor wires • Poor connection between CMP connector & harness connector • Faulty CMP sensor
P0350	Ignition Coil Primary/Secondary Circuit Malfunction	• Faulty ignition system • Poor connection • Faulty wires between ignition coil and ECM • Faulty ignition coil
P0420	Main catalyst efficiency deterioration (Bank 1)	• Catalytic converter deteriorated **NOTE** *If any codes relating to HO2S sensor. MAFS, injectors, a P0170 or a P0173 are present, do all repairs associated with them before proceeding with this trouble area.*
P0421	Main Catalyst Efficiency Deterioration (Bank 1)	• Catalytic converter deteriorated **NOTE** *If any codes relating to HO2S sensor. MAFS, injectors, a P0171 or a P0172 are present, do all repairs associated with them before proceeding with this trouble area.*
P0443	EVAP Emission Control System Purge Control Valve Circuit Malfunction	• Faulty PCSV • Open between PCSV and ECM
P0500	Vehicle Speed Sensor Circuit Malfunction	• Open between fuse and wheel speed sensor (WSS) used for wheel speed measurement • Open between WSS and GND • Open between WSS and ECM • Short to battery or GND between WSS and ECM • Faulty WSS

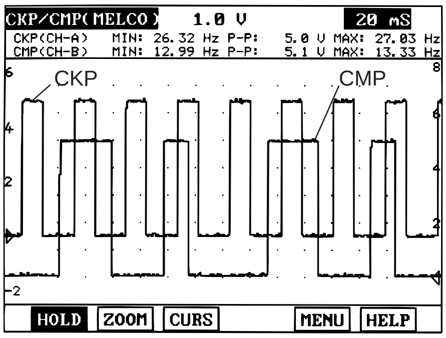
DTC No.	Diagnostic items	Trouble area
P0507	Idle Control System rpm Higher than Expected	• Improperly adjusted accelerator cable • Air leak in intake system between head and throttle plate • Faulty PCV valve or PSV • Poor connections in TPS circuit or faulty TPS • High resistance between IAC valve and ECM • Faulty IAC valve **NOTE** *If any codes relating to TPS, MAFS, fuel injector or IAC valve are present, do all repairs associated with them before proceeding with this troubleshooting area.*
P1330	Spark Timing Adjustment	• Open or short to battery between ROM change tool and ECM • Short to GND between ROM change tool and ECM • Open between ROM change tool and ECM

MAJOR SENSOR REFERENCE WAVE-FORMS EFUC3260

The followings are the major sensor reference wave-forms. Below is the data for CMP, Mass Air Flow Sensor, Throttle Position Sensor, Rear O2 Sensor, Front O2 Sensor and Injection Pulse when revving quickly up to 4800rpm under no load after warming up engine sufficiently. Each value is for reference, the exact values may vary.

* CMP AND CKP

Should increase gradually while depressing the accelerator pedal and should decrease gradually after releasing the pedal without any intermittent drop or rise.

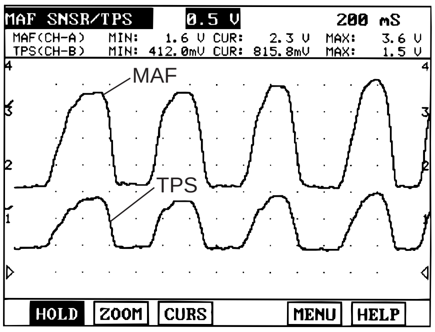


EFUC326A

* MAF SENSOR AND TPS

MAF should increase when depressing the accelerator pedal and should decrease at the moment “THRTL POS SEN” is closed (accelerator pedal is released).

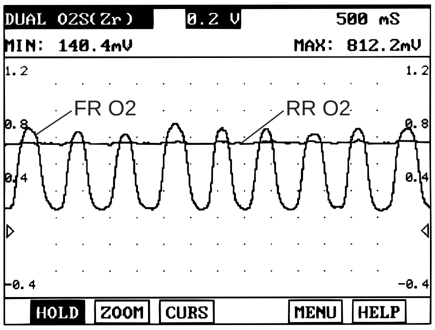
TPS should increase while depressing the accelerator pedal and should decrease while releasing it.



EFUC326B

* FR O2 SENSOR AND RR O2 SENSOR

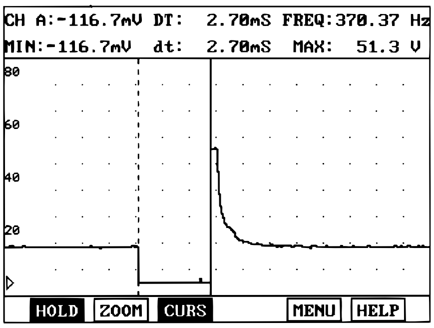
FR O2 and RR O2 sensor may increase immediately after depressing the accelerator pedal and may decrease after releasing the pedal.



EFUC326C

* INJ PULSE

Should increase when depressing the accelerator pedal and should decrease when the pedal is released.

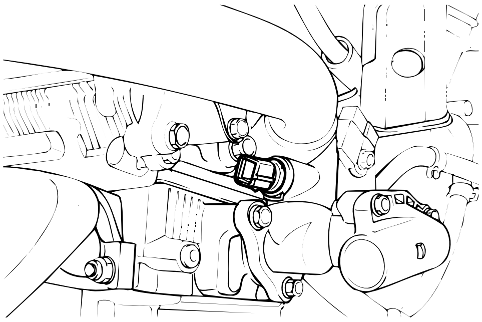


```
CH A:-116.7mV DT:  2.70mS FREQ:370.37 Hz
MIN:-116.7mV dt:  2.70mS MAX:  51.3 V
```

EFUC326D

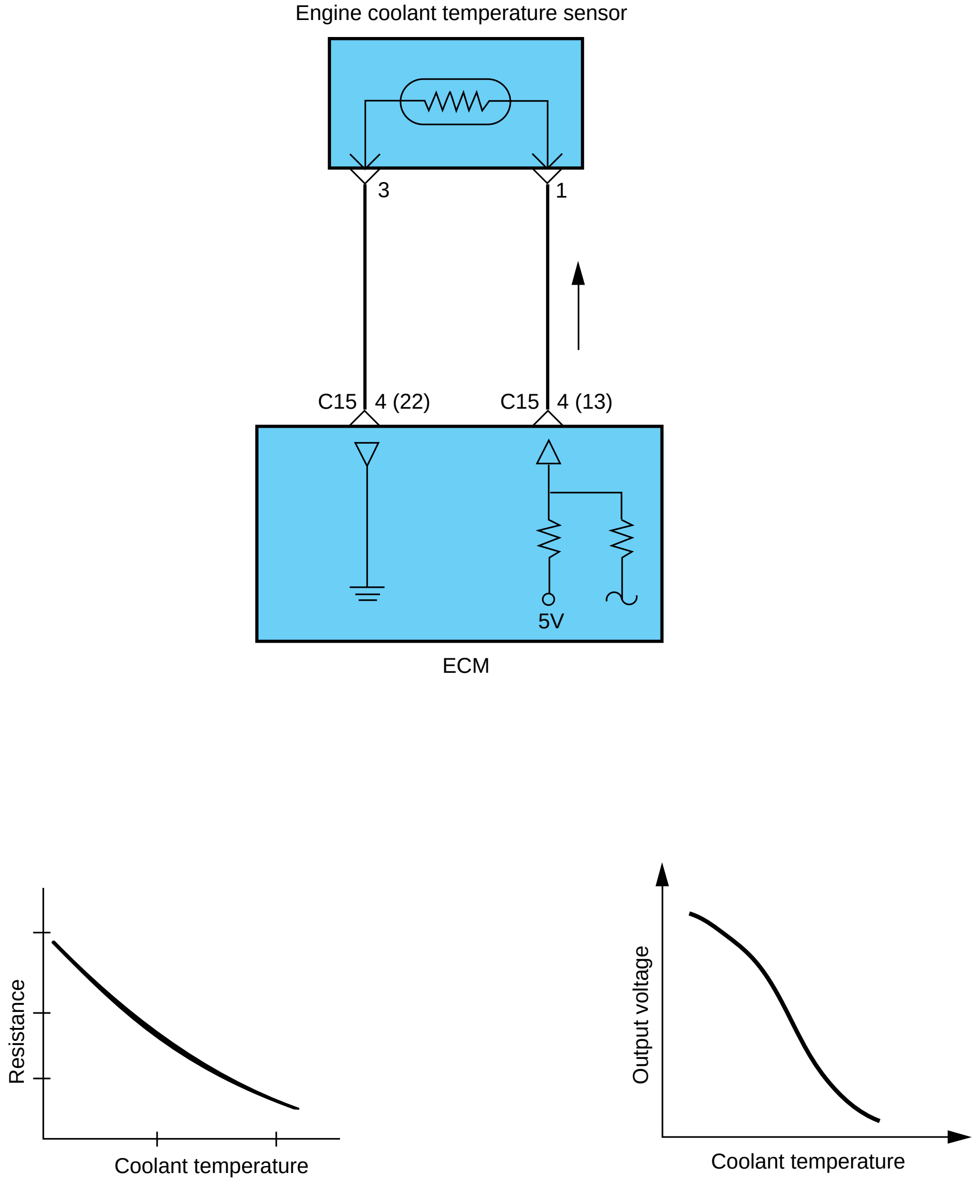
ENGINE COOLANT TEMPERATURE (ECT) SENSOR EFUC4030

This hot film type air flow sensor is composed of a hot film sensor, housing, and a metering duct (hybrid, sensor element). The mass air flow rate is measured by detection of heat transfer from a hot film probe. A change in the mass air flow rate will cause a change in the amount of heat being transferred from the hot film probe surface to the air flow. This results in a change in temperature of the hot film probe and a change of resistance.



EFA9026A

CIRCUIT DIAGRAM



EFUC403A

SENSOR CHECKING

USING HI-SCAN

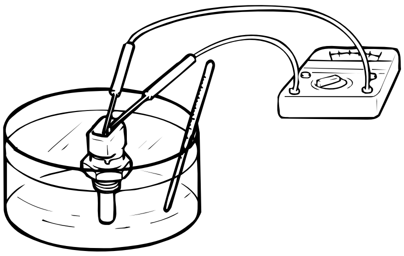
Check item	Data display	Check conditions	Intake air temperature	Test specification
Engine coolant temperature sensor	Sensor temperature	Ignition switch : ON or engine running	When -20°C (-4°F)	-20°C
			When 0°C (32°F)	0°C
			When 20°C (68°F)	20°C
			When 40°C (104°F)	40°C
			When 80°C (176°F)	80°C

USING MULTI-METER

1. Remove engine coolant temperature sensor from the intake manifold.

2. With temperature sensing portion of engine coolant temperature sensor immersed in hot engine coolant, check resistance.

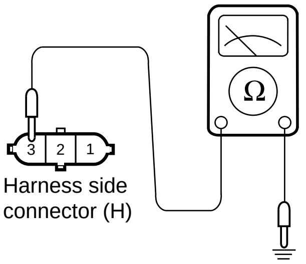
Temperature [°C (°F)]	Resistance (kΩ)
0 (32)	5.9
20 (68)	2.5
40 (104)	1.1
80 (176)	0.3



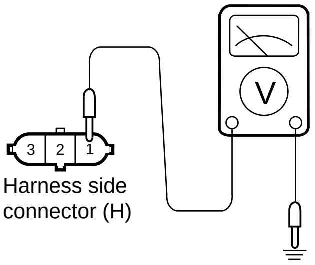
EFA9028A

3. If the resistance deviates from the standard value greatly, replace the sensor.

HARNESS INSPECTION PROCEDURE

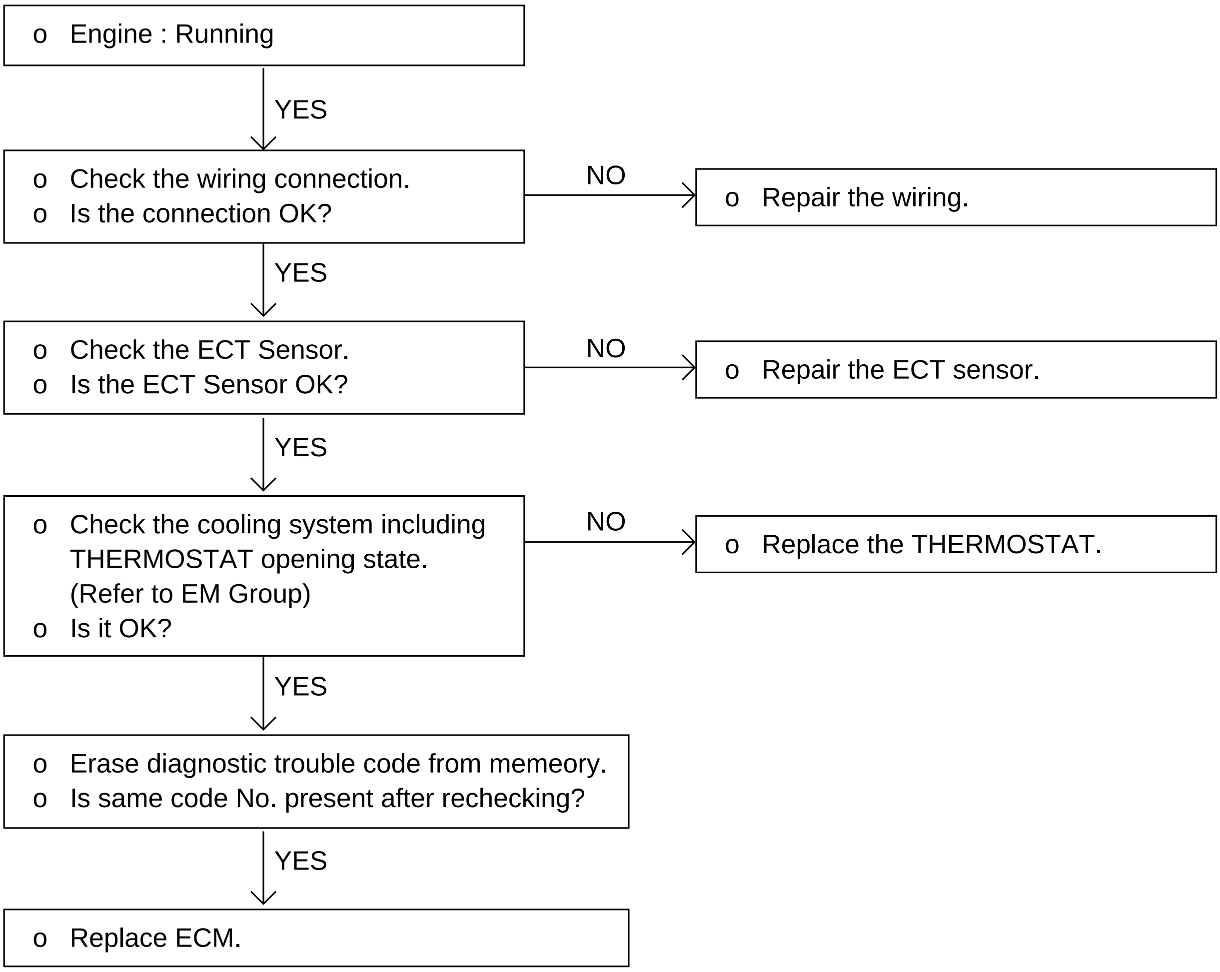
1 	Check for continuity of the ground circuit. o Connector: Disconnected	**OK** ⇨	**2**
		NG ⇨	Repair the harness.

EFUC403B

2 	Measure the power supply voltage. o Connector: Disconnected o Ignition switch: ON o Voltage (V): 4.5-4.9V	**OK** ⇨	**END**
		NG ⇨	Repair the harness.

EFUC403C

TROUBLESHOOTING PROCEDURES



DTC : Diagnosis Trouble Code
ECM : Engine Control Module
ECT : Engine coolant Temperature

EFUC403D

USING VOLTMETER

Check item	Coolant temperature	Test specification
Engine coolant temperature sensor output voltage	When 0°C	4.05V
	When 20°C	3.44V
	When 40°C	2.72V
	When 80°C	1.25V

TROUBLESHOOTING HINTS

If the fast idle speed is not enough or the engine gives off dark smoke during the engine warm-up operation, the engine coolant temperature sensor might be the cause.

INSTALLATION

1. Apply sealant LOCTITE 962T or equivalent to threaded portion.
2. Install engine coolant temperature sensor and tighten it to specified torque.

Tightening torque
Engine coolant temperature sensor :
20-40 Nm (200-400 kg.cm, 14-29 lb.ft)

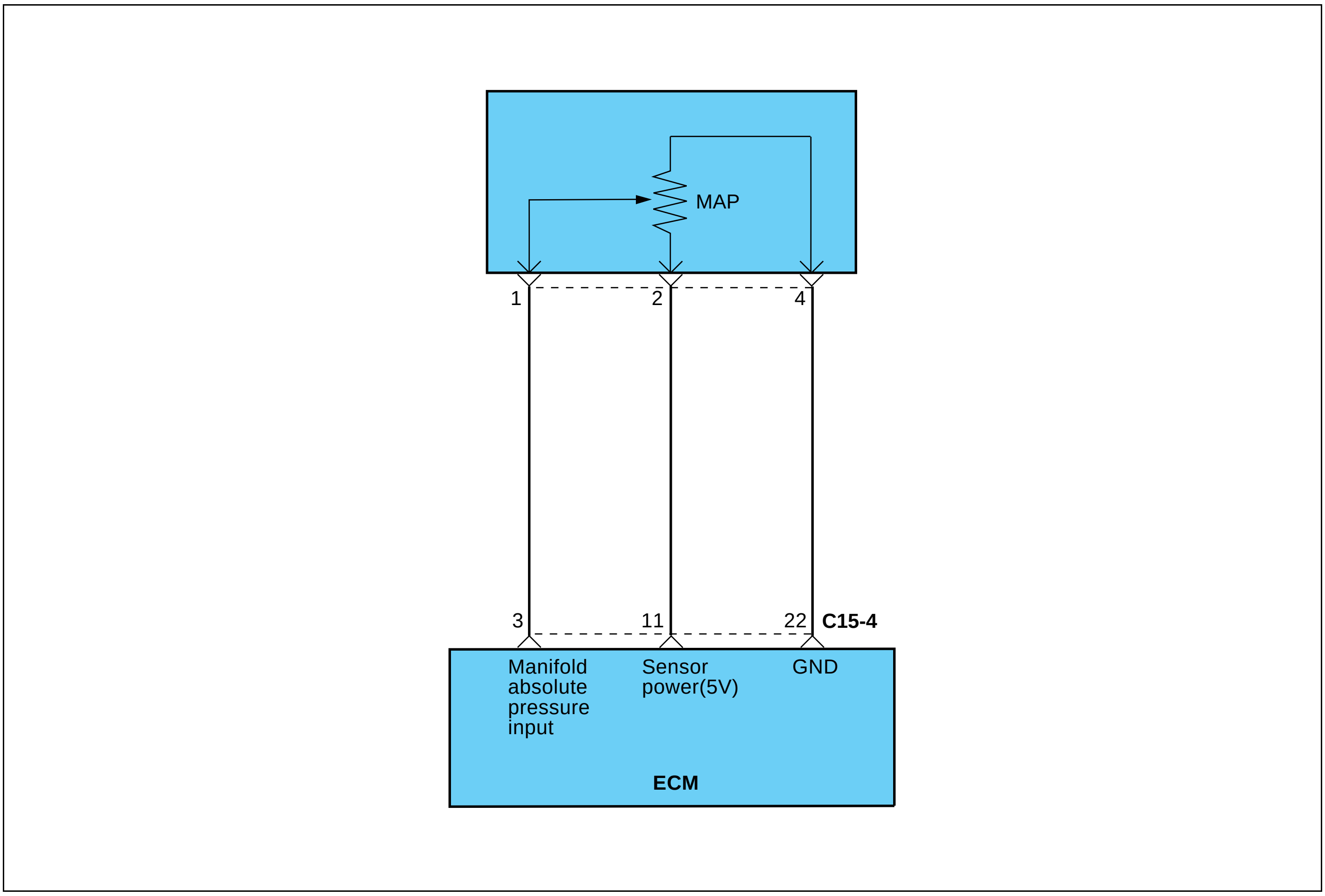
3. Securely connect the harness connector.

MANIFOLD ABSOLUTE PRESSURE(MAP) SENSOR EFUC4050

The manifold absolute pressure(MAP) sensor converts intake manifold pressure into a voltage signal. The engine control module(ECM) uses this signal to determine the condition of the engine load.

The intake air temperature(IAT) sensor, built in the MAP sensor, is a resistor-based sensor for detecting the intake air temperature.
According to the intake air temperature information from the sensor, the ECM provides necessary fuel injection amount control.

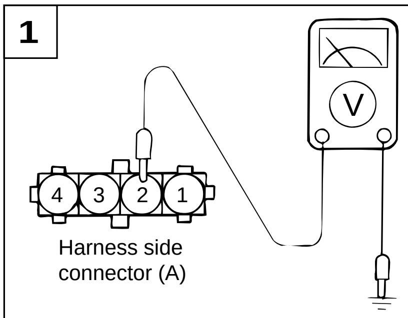
CIRCUIT DIAGRAM



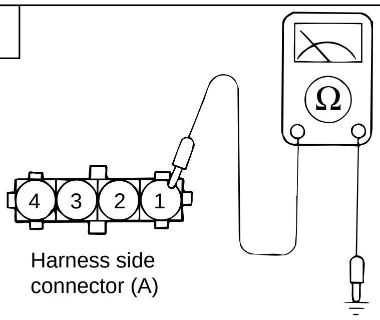
EFUC405A

Check item	Data display	Check conditions	Engine state	Test specification
MAP sensor	Inlet manifold pressure	• Engine coolant temperature : 18°C (65.4°F) • Lamps, electric cooling fan, accessory units: All OFF • Transaxle: Neutral (P range for vehicle with A/T) • Steering wheel: Neutral	Idle	0.8-2.4V
			When the accel pedal is depressed suddenly at idle	Rise from 0.8-2.4V

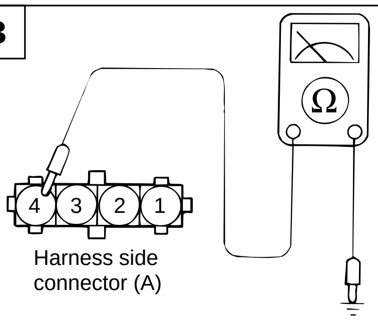
HARNESS INSPECTION PROCEDURE

1 	Measure the power supply voltage. o Connector: Disconnected. o Ignition switch : ON. o Voltage (V) : 4.8-5.2 V.	**OK** ⇨ **NG** ⇨	**2** Repair the harness.

EFAA705B

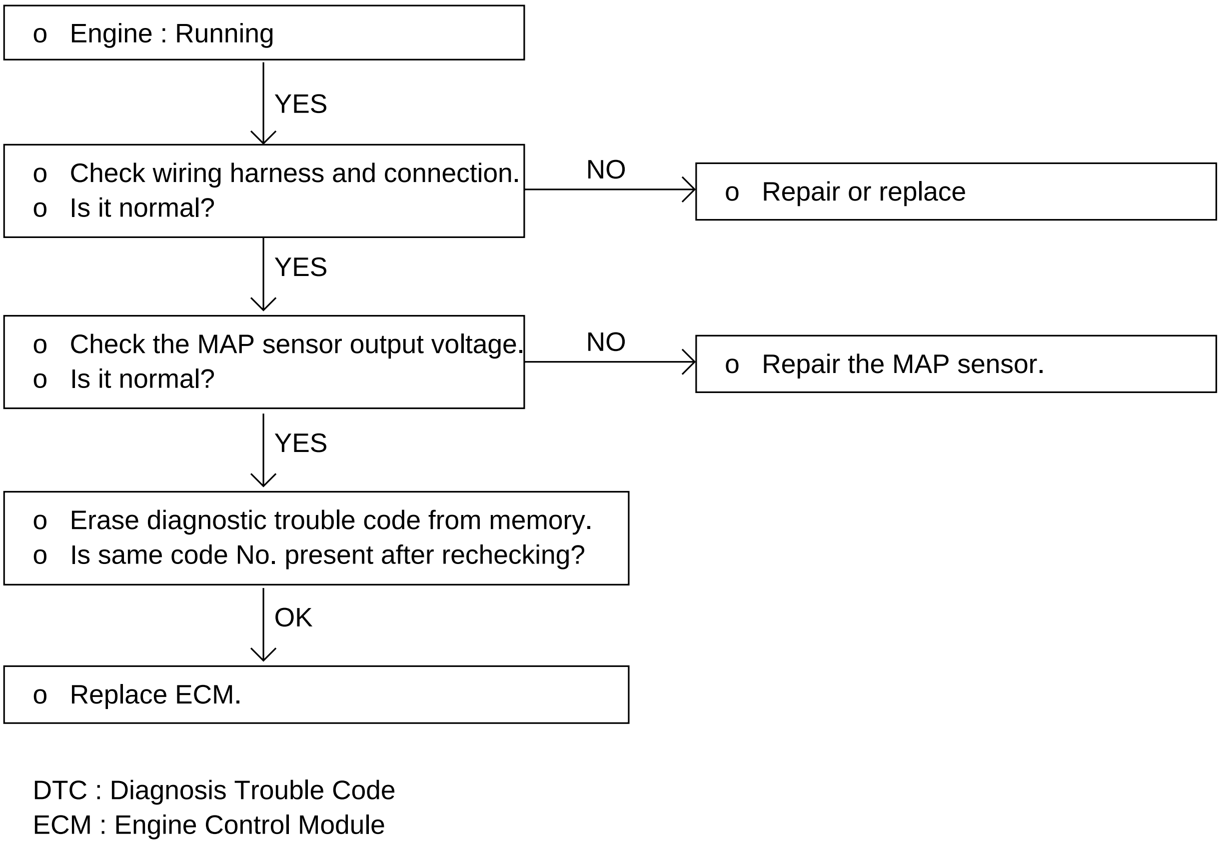
2 	Check for an open-circuit, or a short-circuit to ground between the engine control module and the mass air flow sensor. o MAP sensor circuit : Disconnected o Engine control module : Disconnected	**OK** ⇨ **NG** ⇨	**3** Repair the harness.

EFAA705C

3 	Check for continuity of the ground circuit. o Connector : Disconnected.	**OK** ⇨ **NG** ⇨	**END !** Repair the harness.

EFAA705D

TROUBLESHOOTING PROCEDURES [MAP SENSOR]



EFAA705E

TROUBLESHOOTING HINTS

The MIL (Malfunction Indicator Lamp) is ON or the DTC (Diagnostic Trouble Code) is displayed on the HI-SCAN under the following conditions:

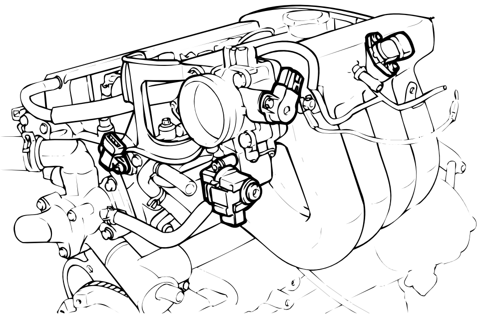
1. When the manifold pressure is 4.5V or more for 4 second.
2. When the manifold pressure is 0.2V or lower for 4 second.

SENSOR INSPECTION [MAP SENSOR]

1. Connect the voltmeter between 1 and 4 of the MAP sensor connector
   Terminal 4 : MAP sensor ground
   Terminal 1 : MAP sensor output

2. Measure the voltage of terminals.

Engine state	Test specification
Ignition SW. ON.	4 - 5V
At idle	0.8 - 2.4V



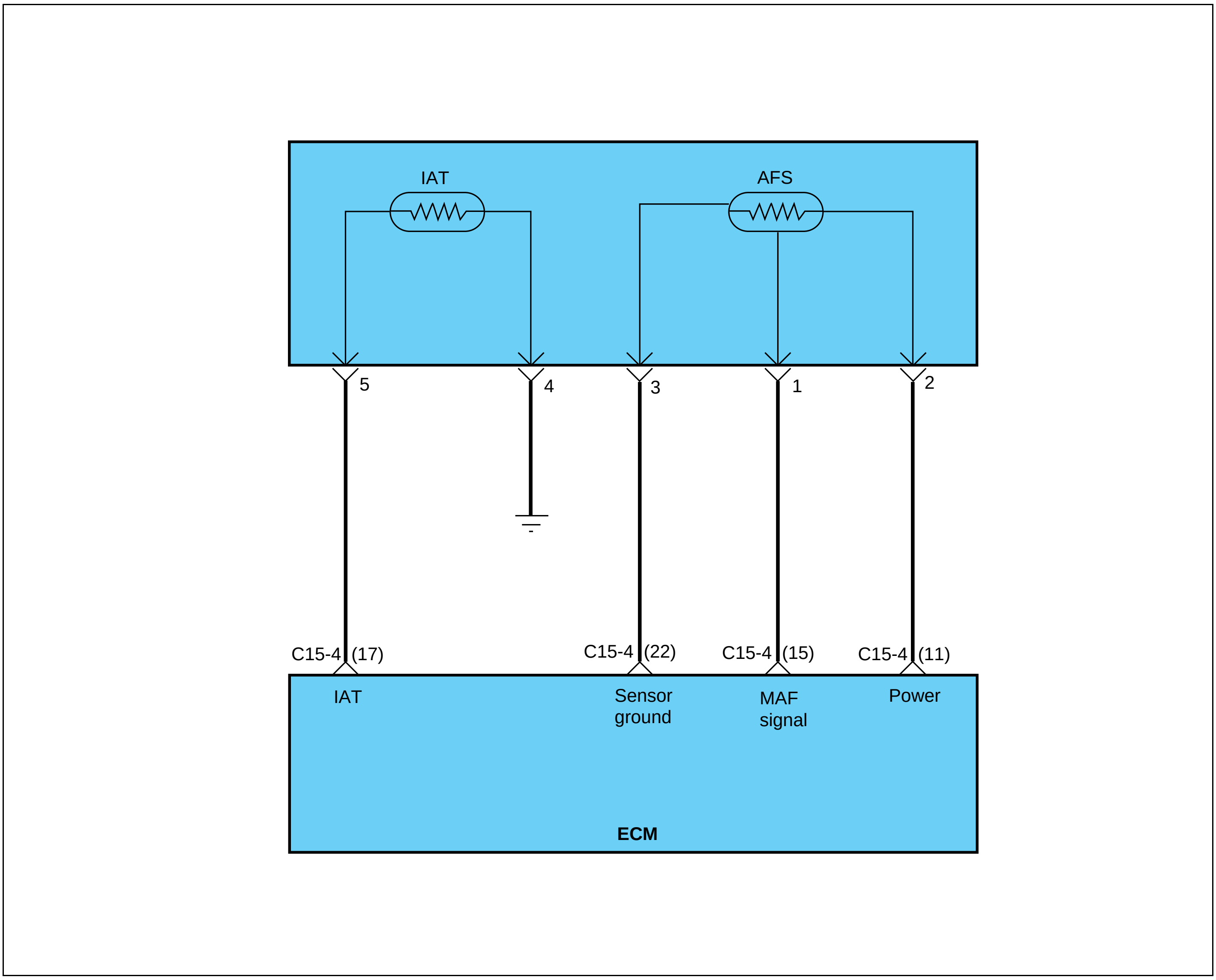
EFAA705F

3. If the voltage deviates from the standard value, replace the MAP sensor assembly.

MASS AIR FLOW (MAF) SENSOR & INTAKE AIR TEMPERATURE (IAT) SENSOR EFUC4060

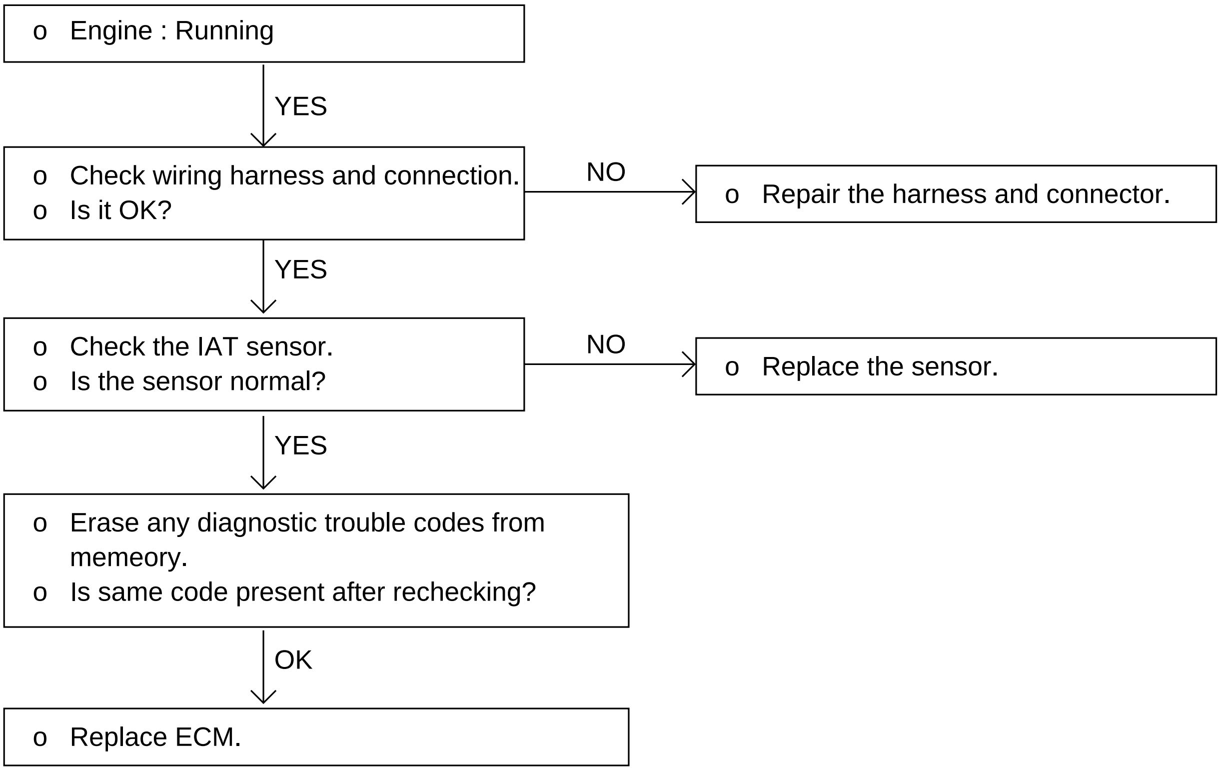
This hot film type air flow sensor is composed of a hot film sensor, housing, metering duct (hybrid, sensor element). Mass air flow rate is measured by detection of heat transfer from a hot film probe because the change of the mass air flow rate causes change in the amount of heat being transferred from the hot film probe surface to the air flow. The air flow sensor generates a pulse so it repeatedly opens and closes between the 5V voltage supplied from the engine control module. This results in the change of the temperature of the hot film probe and in the change of resistance.

CIRCUIT DIAGRAM



EFUC406A

TROUBLESHOOTING PROCEDURES



DTC : Diagnosis Trouble Code
ECM : Engine Control Module

EFUC406E

TROUBLESHOOTING HINTS

1. If the engine stalls occasionally, start the engine and shake the MAF sensor harness. If the engine stalls, check for poor contact at the MAF sensor connector.
2. If the MAF sensor output voltage is other than 0 when the ignition switch is turned on (do not start the engine). Check for a faulty MAF sensor or ECM.
3. If the engine can be idle even if the MAF sensor output voltage is out of specification, check for the following conditions;
   - Disturbed air flow to the MAF sensor, check for disconnected air duct, and clogged air cleaner filter.
   - Poor combustion in the cylinder, check for faulty ignition plug, ignition coil, injector, and incorrect comparison.
4. Check the mounting direction of AFS.

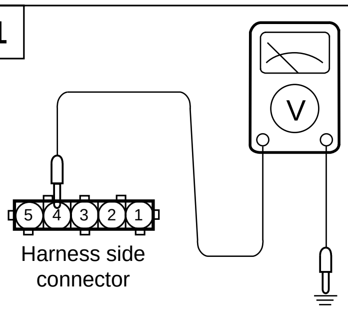
Check item	Check condition	Test specification
Mass air flow sensor output voltage	Idle rpm	0.5V
	2000 rpm	1.0V

NOTE

- *When the vehicle is new [within initial operation of about 500 km (300 miles)], the mass air flow sensor air quantity will be about 10% higher.*
- *Use an accurate digital voltmeter.*
- *Before checking, warm up the engine until the engine coolant temperature reaches 80 to 90°C (176 to 198°F)*

HARNESS INSPECTION PROCEDURE

1



Measure the power supply voltage.

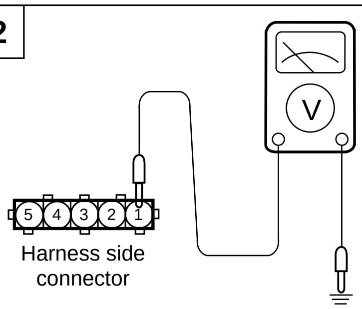
- o Connector : Disconnected.
- o Ignition switch : ON.
- o Voltage (V) : Battery voltage.

OK ⇨ **2**

NG ⇨ Repair the harness

EFUC406B

2



Check for an open circuit, or a short circuit to ground between the powertrain control module and the mass air flow sensor.

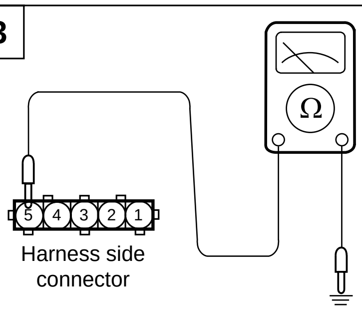
- o PCM connector : Disconnected.
- o Mass air sensor connector : Disconnected.

OK ⇨ **3**

NG ⇨ Repair the harness

EFUC406C

3



Check for continuity of the ground circuit.

- o Connector : Disconnected.

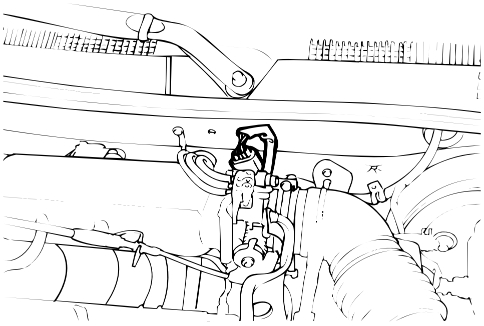
OK ⇨ **END !**

NG ⇨ Repair the harness

EFUC406D

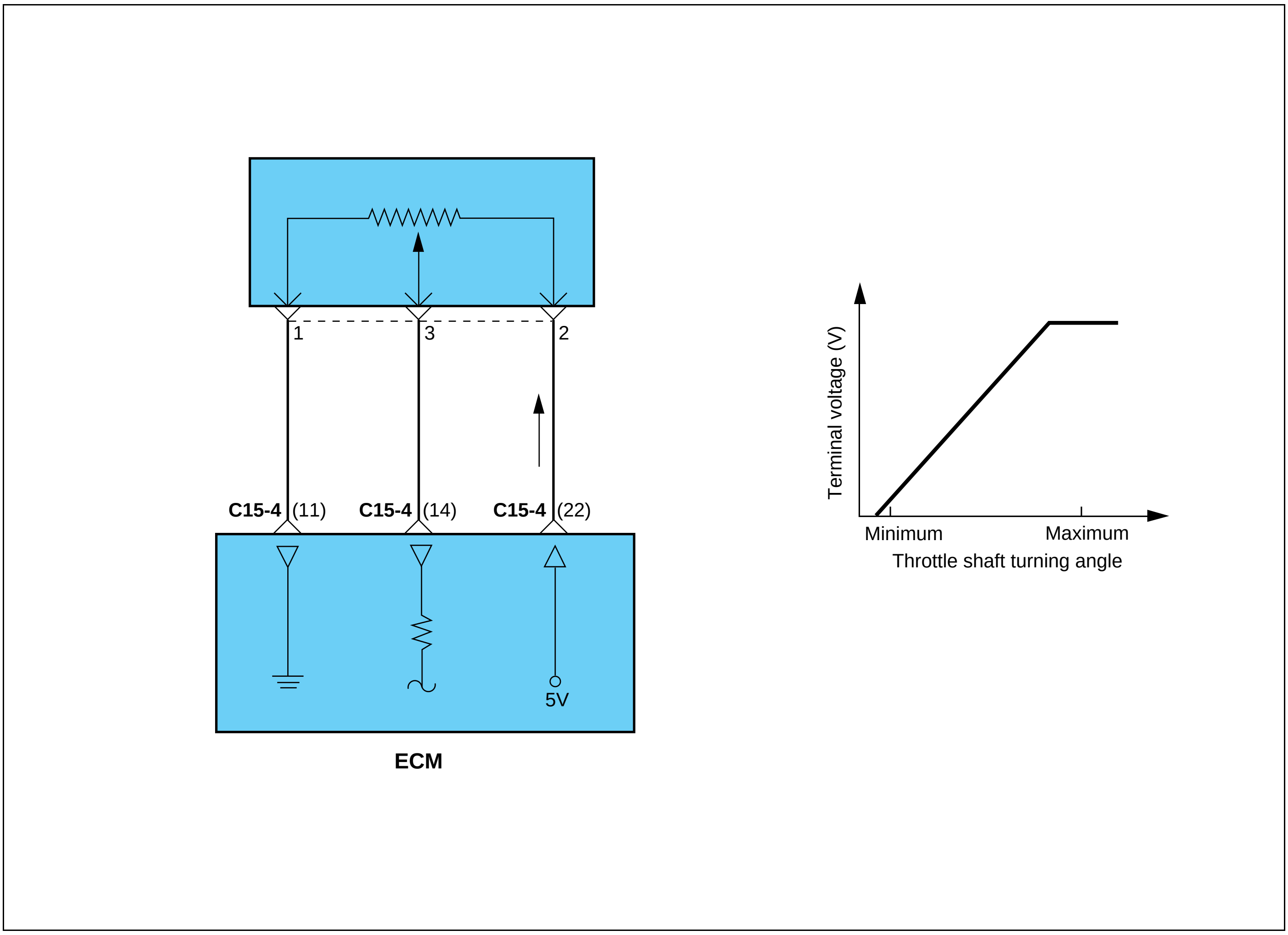
THROTTLE POSITION (TP) SENSOR EFUC4070

The TP Sensor is a variable resistor type that rotates with the throttle body throttle shaft to sense the throttle valve angle. As the throttle shaft rotates, the output voltage of the TP Sensor changes. The ECM detects the throttle valve opening based on voltage change.



EFA9049A

CIRCUIT DIAGRAM



EFUC407A

SENSOR CHECKING

USING HI-SCAN

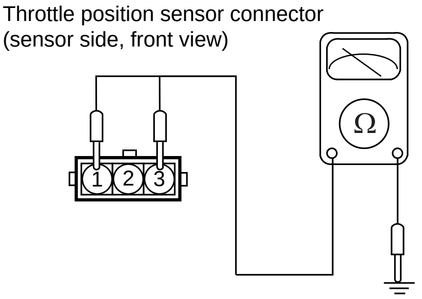
Check item	Data display	Check conditions	Throttle valve	Test specification
Throttle position sensor	Sensor voltage	Ignition switch : ON	At idle position	300-900 mV (I4)
			Open slowly	Increases with valve opening
			Open widely	4,250-4,700 mV

USING VOLTMETER

1. Disconnect the throttle position sensor connector.
2. Measure resistance between terminal 2 (sensor ground) and terminal 1 (sensor power).

Standard value : 3.5 - 6.5 kΩ

3. Connect a pointer type ohmmeter between terminal 2 (sensor ground) and terminal 3 (sensor output).

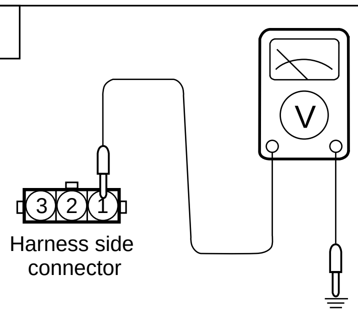


EFUC407E

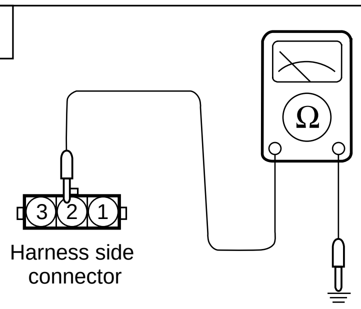
4. Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.
5. If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

Tightening torque
TP Sensor : 1.5-2.5 Nm (15-25 kg·cm, 1.1-1.8 lb·ft)

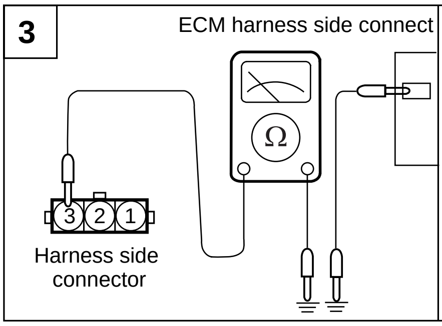
HARNESS INSPECTION PROCEDURE

1		Measure the power supply voltage of the throttle position sensor. o Connector: Disconnected o Ignition switch: ON o Voltage (V): 4.5-5.0V	**OK** ⇨	**2**
			NG ⇨	Repair the harness.

EFUC407B

2		Check for continuity of the ground circuit. o Connector : Disconnected	**OK** ⇨	**3**
			NG ⇨	Repair the harness.

EFUC407C

3		Check for an open-circuit, or a short-circuit or ground between the powertrain control module and the throttle position sensor. o Throttle position sensor connector : Disconnected o PCM connector : Disconnected	**OK** ⇨	**END !**
			NG ⇨	Repair the harness.

EFUC407D

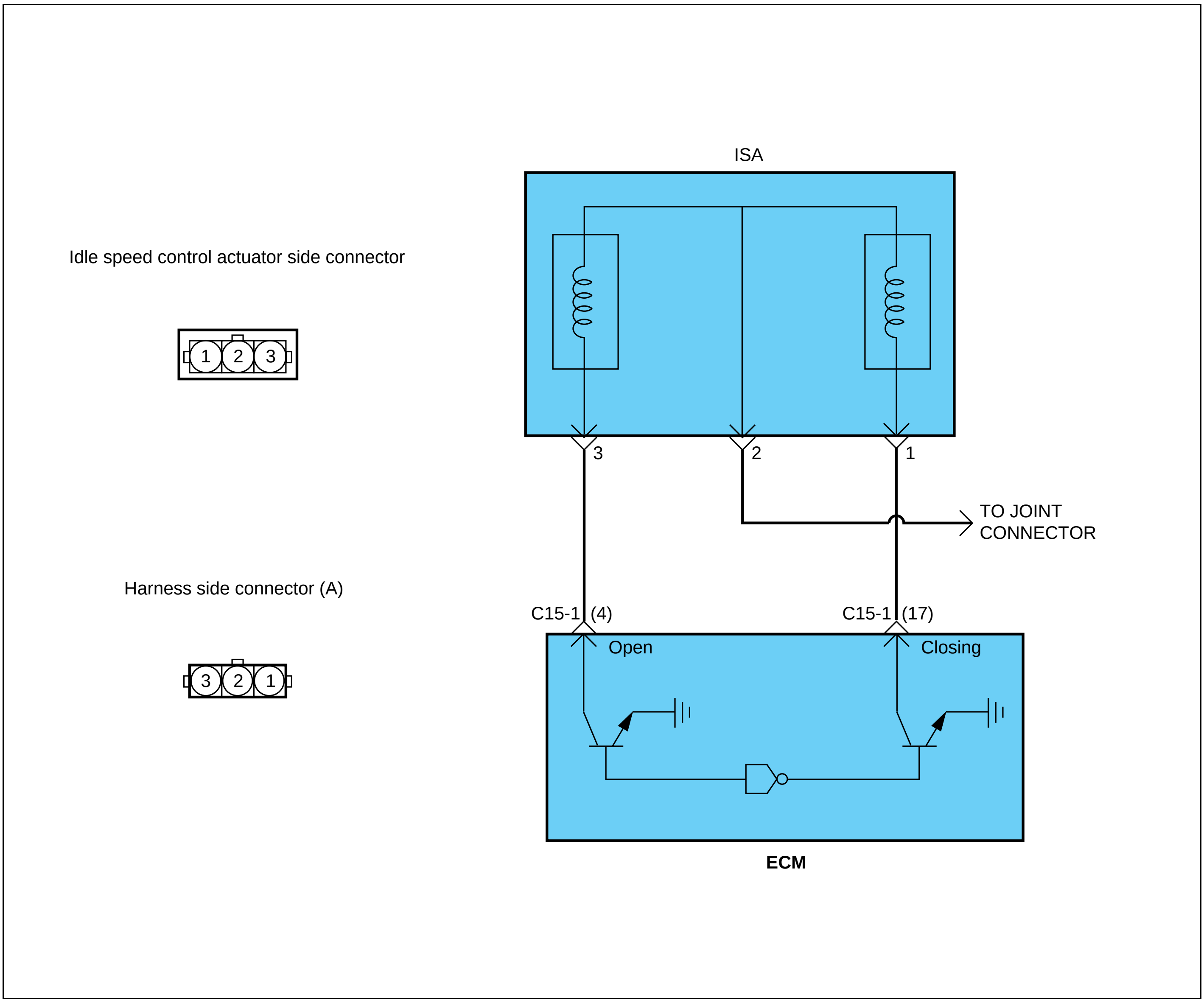
TROUBLESHOOTING HINTS

The TPS signal is important in the control of the automatic transaxle. Shift shock and other trouble will occur if the sensor is faulty.

IDLE SPEED CONTROL ACTUATOR EFUC4080

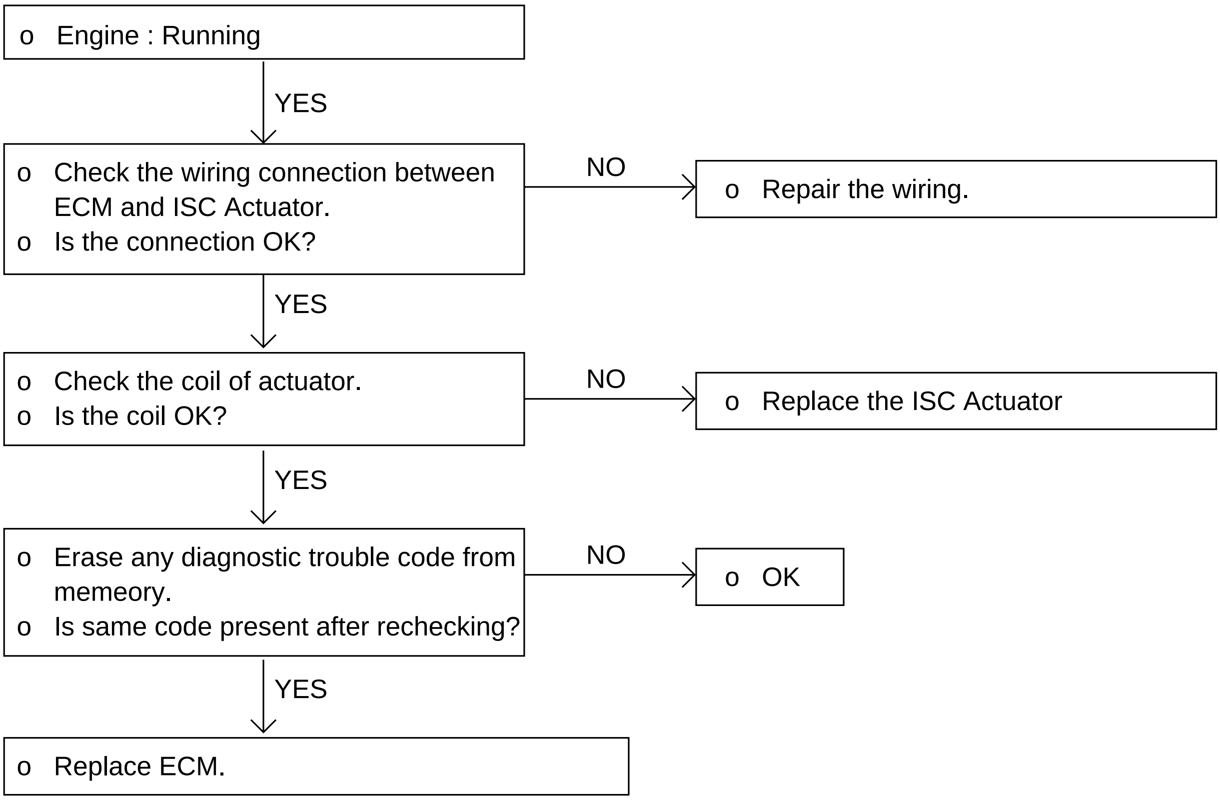
The idle speed control actuator is the double coil type and has two coils. The two coils are driven by separate driver stages in the ECM. Depending on the pulse duty factor, the equilibrium of the magnetic forces of the two coils will result in different angles of the motor. In parallel to the throttle valve, a bypass hose line is arrange, where the idle speed, actuator is inserted in.

CIRCUIT DIAGRAM



EFUC408A

TROUBLESHOOTING PROCEDURES



DTC : Diagnosis Trouble Code
ECM : Engine Control Module

EFUC408E

TROUBLESHOOTING HINTS

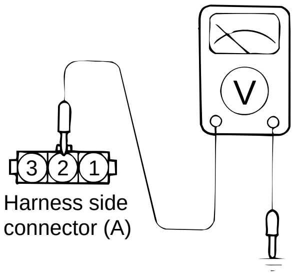
The MIL is ON or the DTC is displayed on the HI-SCAN under the following conditions;

- When the primary voltage side in ECM is in short or open circuit.
- The ignition closed loop control in ECM is out of order.
- Open or short circuit is observed in idle air control system when ignition switch is turned onl.

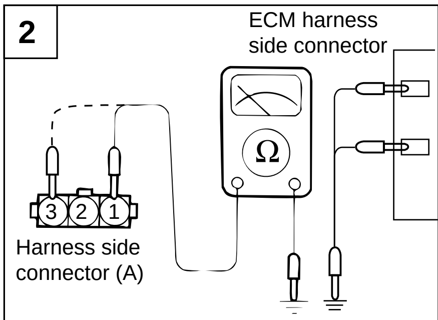
USING HI-SCAN

Check item	Check condition	HI-SCAN display	Type
Idle speed control actuator o Actuator	Start the engine	ISCA	Activate

HARNESS INSPECTION PROCEDURE

1 	Measure the power supply voltage of the actuator. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	**OK** ⇨	**2**
		NG ⇨	Repair the harness. Check the power supply

EFUC408B

2 	Check for an open-circuit, or a short-circuit to ground between the ECM and the idle speed control actuator. o ECM connector : Disconnected o Idle speed actuator connector : Disconnected	**OK** ⇨	**END !**
		NG ⇨	Repair the harness.

EFUC408C

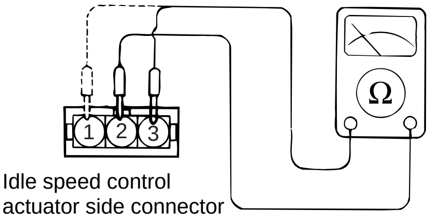
ACTUATOR INSPECTION

1. Disconnect the connector at the idle speed control actuator.
2. Measure the resistance between terminals.

Standard value
Terminal 3 and 2 : 10.5 - 14Ω
Terminal 1 and 3 : 10 - 12.5Ω [at 20°C (68°F)]

---

3. Connector the connector to the idle speed control actuator

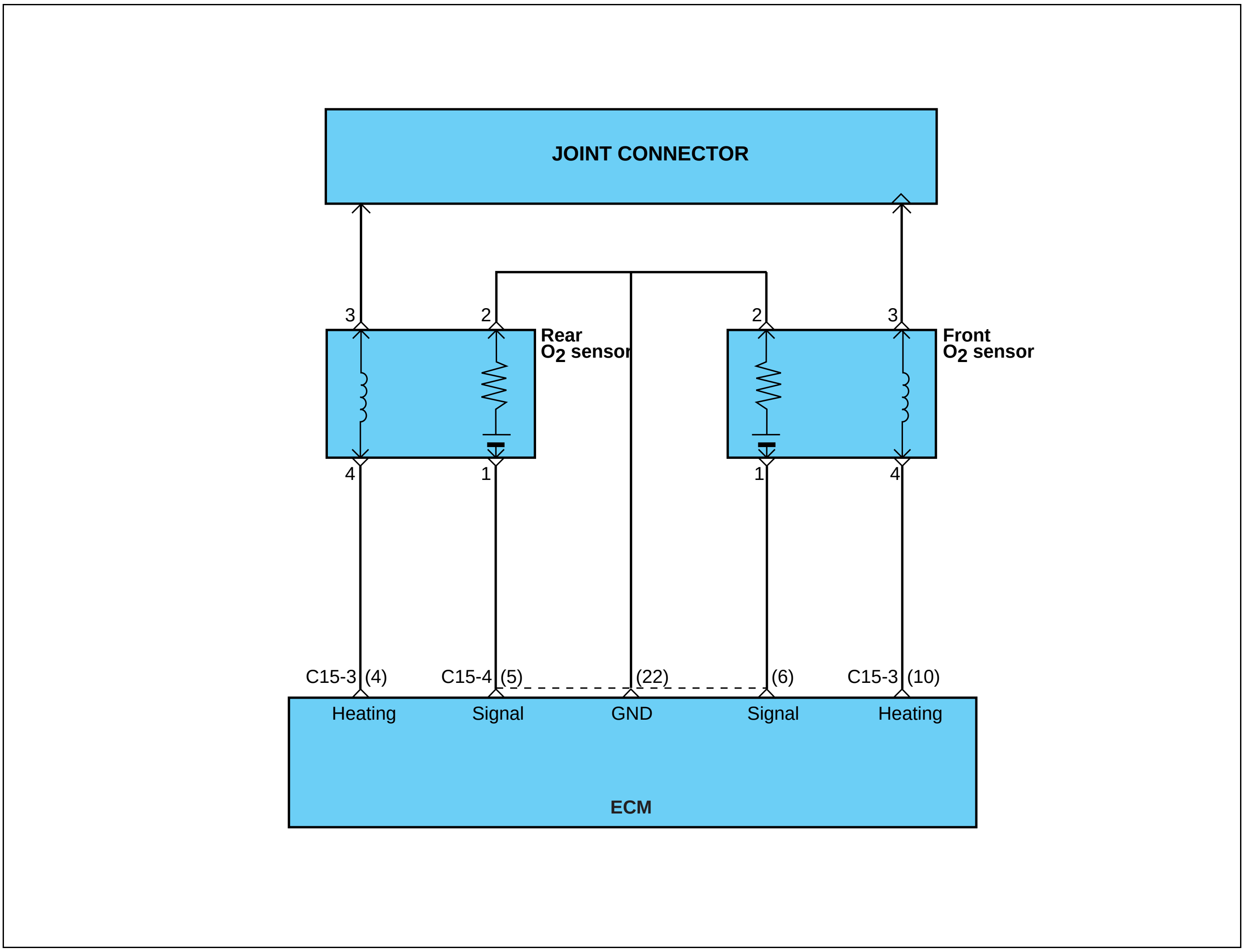


EFAA717D

HEATED OXYGEN SENSOR (HO2S) EFUC4090

The heated oxygen sensor senses the oxygen concentration in exhaust gas, converts it into a voltage, which is sent to the ECM. The oxygen sensor outputs about 1V when the air fuel ratio is richer than the theoretical ratio, and outputs about 0V when the ratio is leaner (higher oxygen concentration in exhaust gas.). The ECM controls the fuel injection ratio based on this signal so that the air fuel ratio is maintained at the theoretical ratio. The oxygen sensor has a heating element which ensures the sensor performance during all driving conditions.

CIRCUIT DIAGRAM



EFUC409A

1. If the HO2S is defective, abnormally high emissions may occur.
2. If the HO2S check results are normal, but the sensor output voltage is out of specification, check for the following items (related to air fuel ratio control system):
   - Defective injector
   - Air leaks in the intake manifold
   - Defective volume air flow sensor, intake air temperature sensor, barometric pressure sensor and engine coolant temperature sensor.

Check item	Check conditions	Engine state	Test specification
Oxygen sensor	Engine: Warm-up (make the mixture lean by engine speed reduction, and rich by racing)	When sudden deceleration from 4,000 rpm	200mV or lower
		When engine is suddenly raced	600-1,000 mV
	Engine: Warm-up (using the heated oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the ECU)	Idle	400 mV or lower - (oscilate) 600-1,000 mV
		2,000 rpm	

INSPECTION

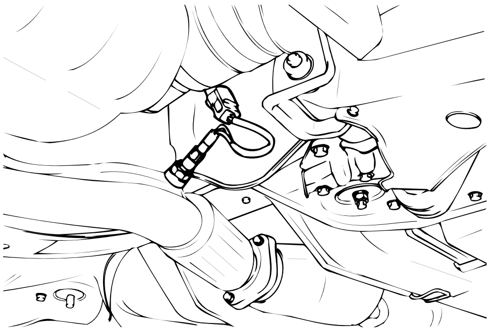
NOTE

- *Before checking, warm up the engine until the engine coolant temperature reaches 80 to 95°C (176 to 205°F).*
- *Use an accurate digital voltmeter.*

1. Disconnect the oxygen sensor connector, and measure the resistance between terminal 3 and terminal 4.

Standard value

Temperature °C (°F)	Resistance (Ω)
400 (752)	30 or more



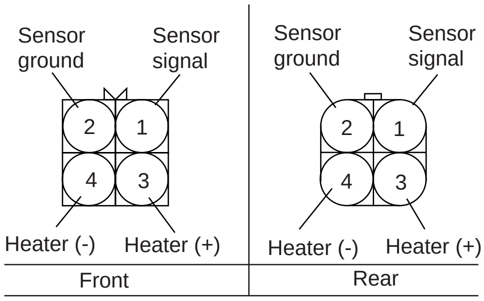
EFAA719E

2. Replace the oxygen sensor if there is a malfunction.
3. Apply battery voltage directly between terminal 3 and terminal 4.

NOTE

Be careful when applying the voltage. Damage will result if the terminals are incorrect or are short circuited.

4. Connect a digital-type volmeter between terminal 1 and terminal 2.



Heated oxygen sensor harness side connector

EFAA719F

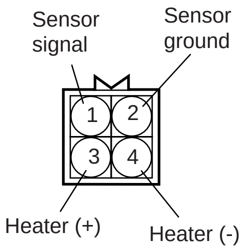
5. While repeatedly racing the engine, measure the oxygen sensor output voltage.

Engine	**Oxygen sensor output voltage**	**Resistance (Ω)**
Race	Min. 0.6V	30 or more

6. If there is a problem, there may be an oxygen sensor malfunction.

Tightening torque
Heated oxygen sensor :

40-50 Nm (400-500 kg.cm, 29-36 lb.ft)

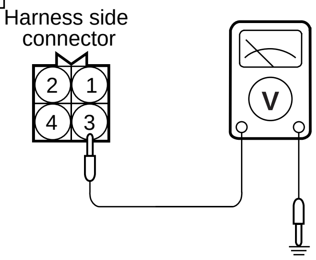


Heated oxygen sensor side connector (FRONT, REAR)

EFAA719G

HARNESS INSPECTION PROCEDURES

1



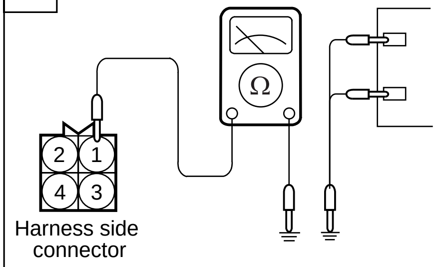
Measure the power supply voltage of the heated oxygen sensor.
o Connector: Disconnected
o Ignition switch: ON
o Voltage (V): Battery voltage

OK ⇨ **2**

NG ⇨ Repair the harness.

EFHA719B

2



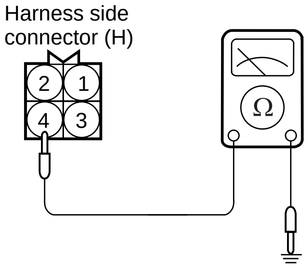
Check for open circuit, or a short circuit to ground between the PCM and the oxygen sensor.
o Oxygen sensor connector : Disconnected
o PCM connector : Disconnected

OK ⇨ **3**

NG ⇨ Repair the harness.

EFHA719C

3



Check for continuity of the ground circuit.
o Connector : Disconnected

OK ⇨ **END !**

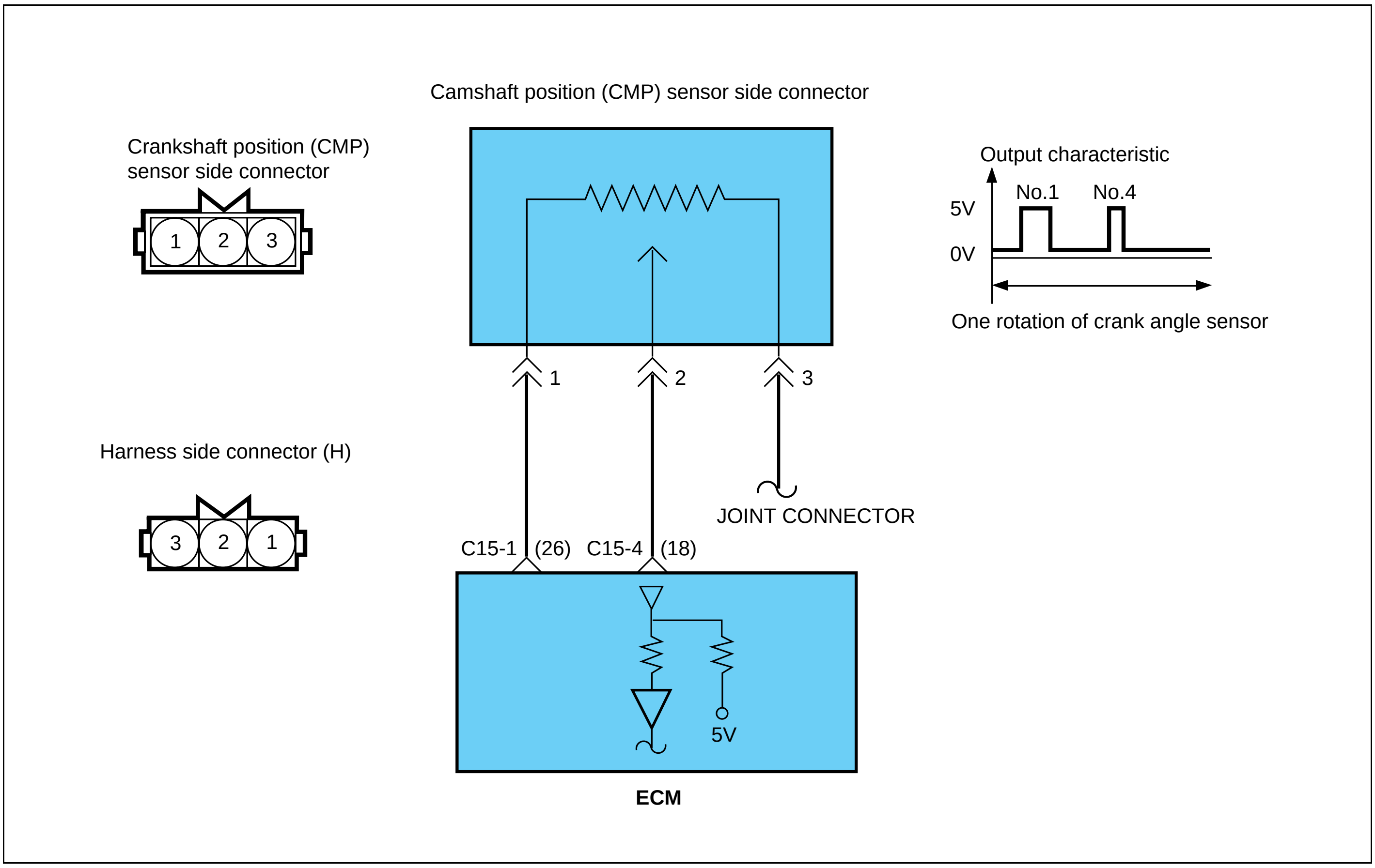
NG ⇨ Repair the harness.

EFHA719D

CAMSHAFT POSITION SENSOR EFUC4100

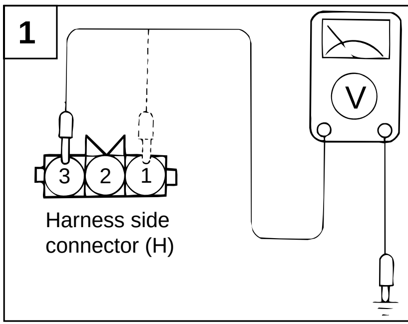
The CMP sensor senses the camshaft position sensor on compression stroke of the No.1 and No.4 cylinders, converts it into a pulse signal, and inputs it to the ECM. The ECM then computes the fuel injection sequence, etc. based on the input signal.

CIRCUIT DIAGRAM

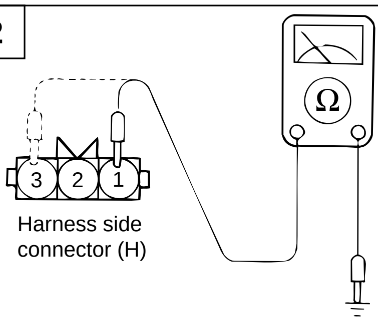


EFUC410A

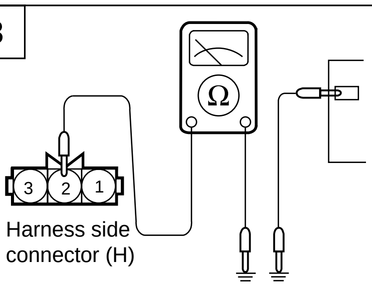
HARNESS INSPECTION PROCEDURE

1 	Measure the power supply voltage. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	**OK** ⇨	**2**
		NG ⇨	Repair the harness.

EFAA723B

2 	Check for continuity of the ground circuit. o Connector : Disconnected	**OK** ⇨ **NG** ⇨	**3** Repair the harness.

EFAA723C

3 	Check for continuity of the ground circuit. o Connector: Disconnected o Ignition switch : ON o Voltage : 4.8-5.2 V	**OK** ⇨ **NG** ⇨	**END !** Repair the harness.

EFUC410D

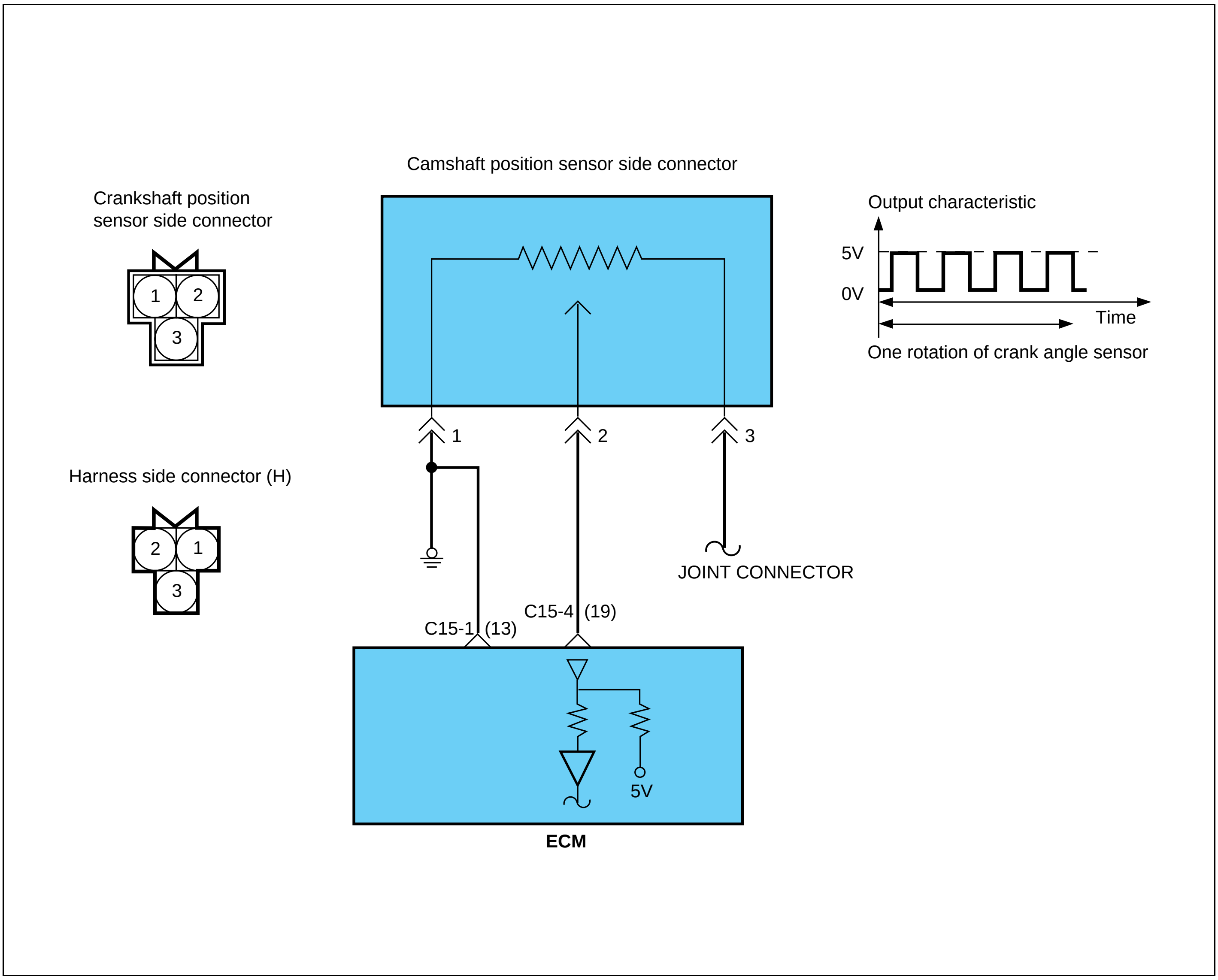
TROUBLESHOOTING HINTS

If the CMP Sensor does not operate correctly, correct sequential injection is not made so that the engine may stall or run irregularly at idle or fail to accelerate normally.

CRANKSHAFT POSITION SENSOR EFUC4110

The crankshaft position sensor senses the crank angle (piston position) of each cylinder and converts it into a pulse signal. Based on the input signal, the ECM computes the engine speed and controls the fuel injection timing and ignition timing.

CIRCUIT DIAGRAM



EFUC411A

TROUBLESHOOTING HINTS

1. If unexpected shocks are felt during driving or the engine stalls suddenly, shake the crankshaft position sensor harness. If this causes the engine to stall, check for poor sensor connector contact.
2. If the tachometer reads 0 rpm when the engine is cranked, check for faulty crank angle sensor, broken timing belt or ignition system problems.
3. If the engine can be run at idle even if the crank angle sensor reading is out of specification, check the following:
   - Faulty engine coolant temperature sensor
   - Faulty idle speed control motor
   - Poorly adjusted reference idle speed

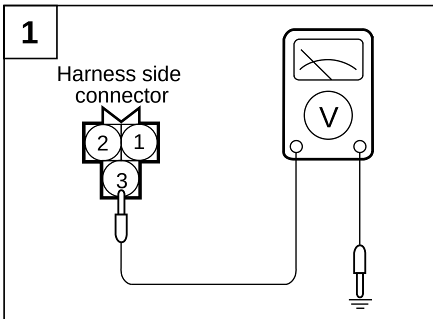
USING GST

Check Item	Check conditions	Check content	Normal state
Crankshaft position sensor	• Engine cranking • Tachometer connected (check on and off ignition coil by tachometer)	Compare cranking speed and multi-tester reading	Indicated speed agrees

Check Item	Check conditions	Coolant temperature	Test specification
Crankshaft position sensor	• Engine: Running at idle • Idle position switch: ON	When -20°C (-4°F)	1,500-1,700 rpm
		When 0°C (-32°F)	1,350-1,550 rpm
		When 20°C (-68°F)	1,200-1,400 rpm
		When 40°C (-104°F)	1,000-1,200 rpm
		When 80°C (-176°F)	650-850 rpm

HARNESS INSPECTION PROCEDURE

1



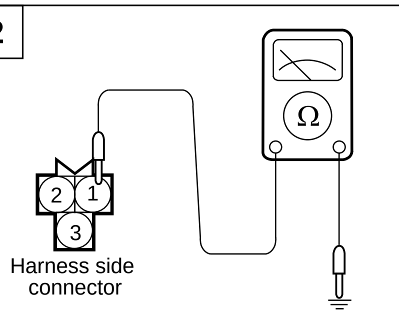
Measure the power supply voltage.
- o Connector: Disconnected
- o Ignition switch: ON
- o Voltage (V): Battery voltage

OK ⇨ **2**

NG ⇨ Repair the harness.

EFAA725C

2



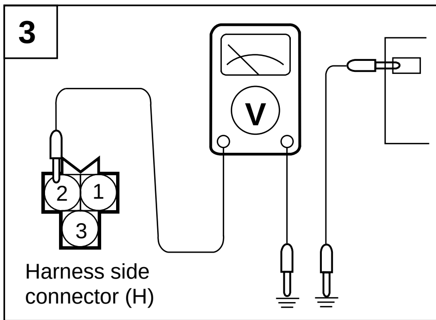
Check for continuity of the ground circuit.
- o Connector : Disconnected

OK ⇨ **3**

NG ⇨ Repair the harness.

EFAA725D

3



Check for continuity of the ground circuit.
- o Connector : Disconnected
- o Ignition switch : ON
- o Voltage : 4.8-5.2 V

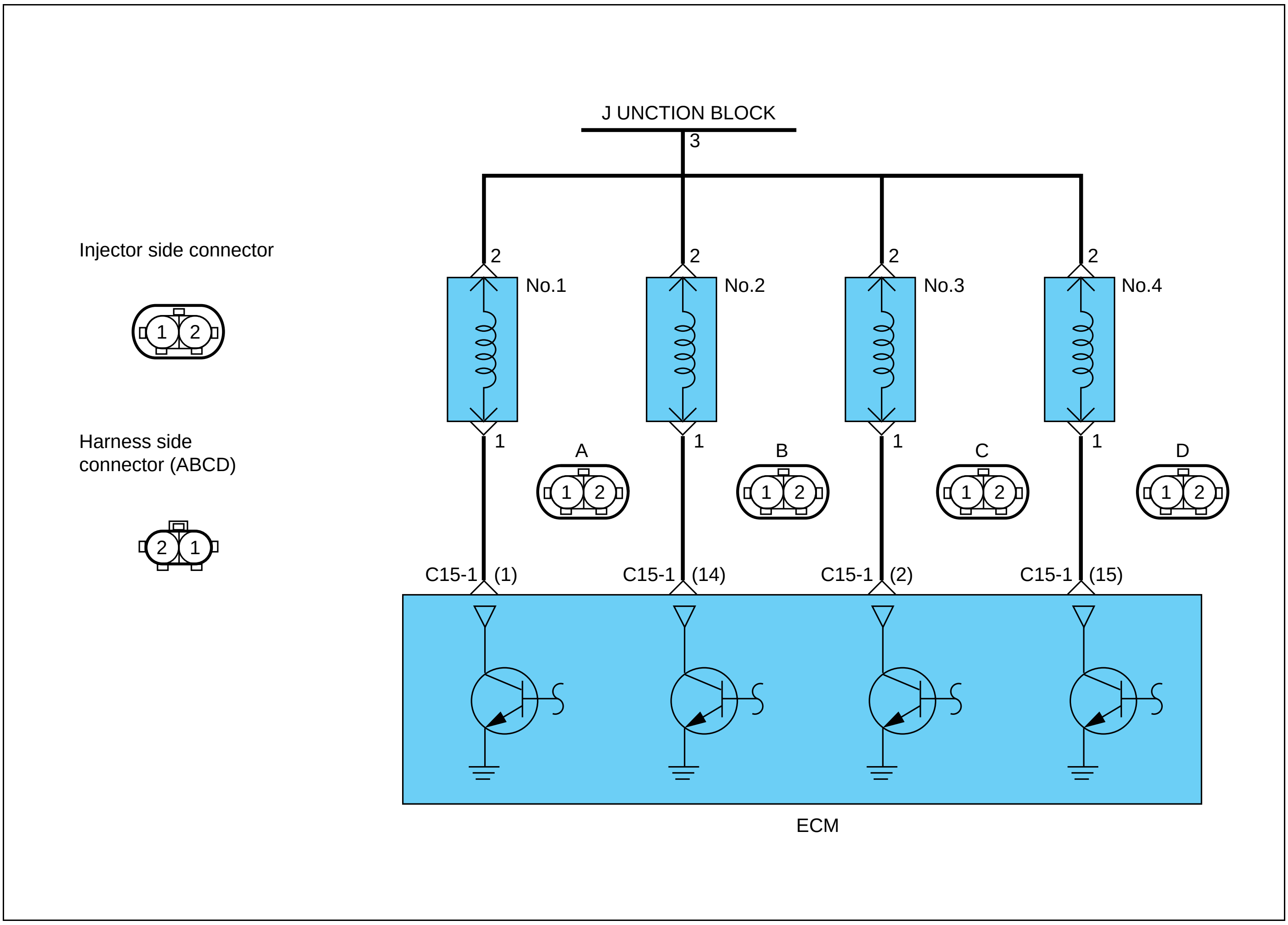
OK ⇨ **END !**

NG ⇨ Repair the harness.

EFUC411E

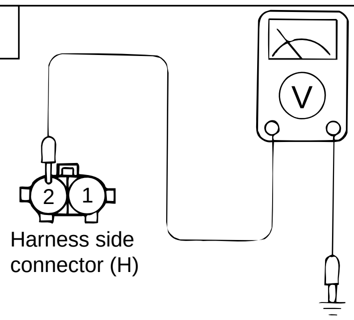
FUEL INJECTOR EFUC4120

The injectors injector fuel according to a signal coming from the ECM. The amount of fuel injected by the injectors is determined by the time which the solenoid valve is energized.

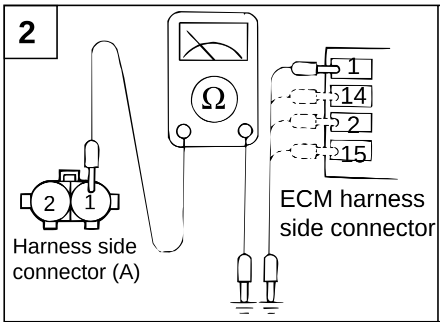


EFUC412A

HARNESS INSPECTION PROCEDURE

1 	Measure the power supply voltage. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	**OK** ⇨ **NG** ⇨	**2** Repair the harness.

EFAA727B

2 	Check for an open-circuit, or a short-circuit to ground between the engine control module and the injector. o ECM connector : Disconnected o Injector connector : Disconnected	**OK** ⇨ **NG** ⇨	**END !** Repair the harness.

EFUC412C

TROUBLESHOOTING HINTS

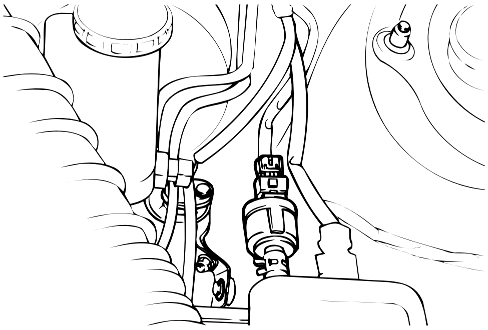
1. If the engine is hard to start when hot, check for fuel pressure and injector leaks.
2. If the injector does not operate when the engine is cranked, then check the followings;
    - Faulty power supply circuit to the ECM, faulty ground circuit
    - Faulty control relay
    - Faulty crankshaft position (CKP) sensor, camshaft position (CMP) sensor

3. If there is any cylinder whose idle state remains unchanged when the fuel injection of injectors is cut one after another during idling, check for the following items about such cylinder.
    - Injector and harness
    - Ignition plug and high tension cable
    - Compression pressure

4. If the injection system is ok but the injector drive time is out of specification, check for the following items.
    - Poor combustion in the cylinder (faulty ignition plug, ignition coil, compression pressure, etc.)

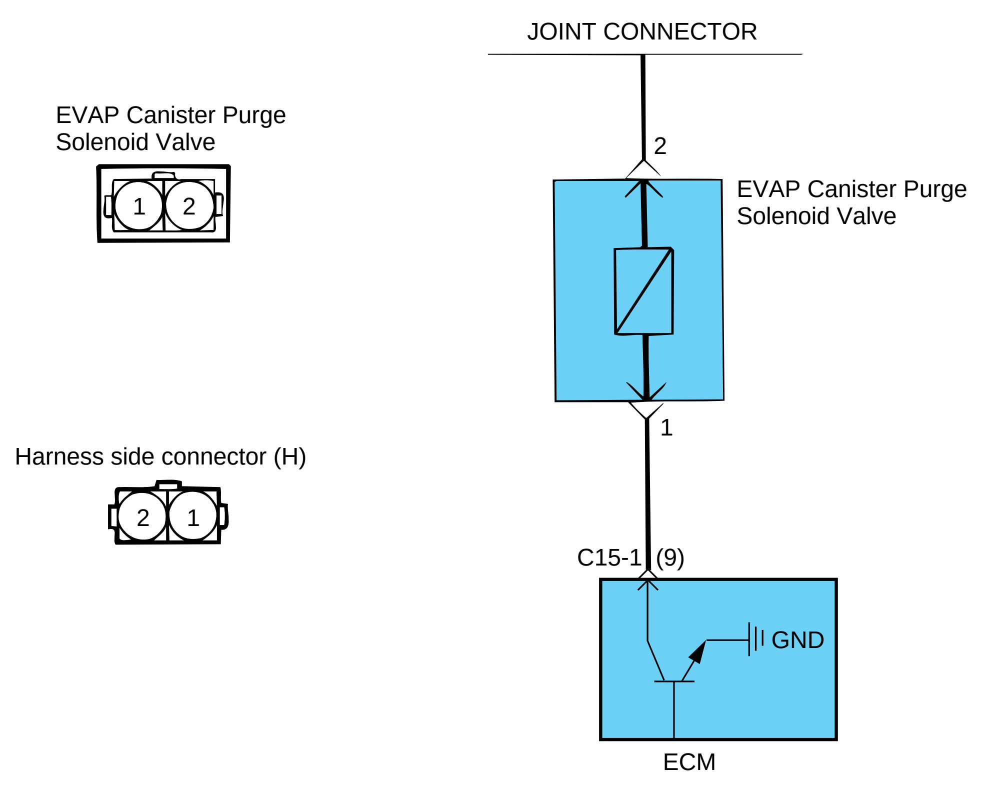
EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE EFUC4130

The evaporative emission canister purge solenoid valve is a duty control type, which controls purge air from the evaporative emission canister



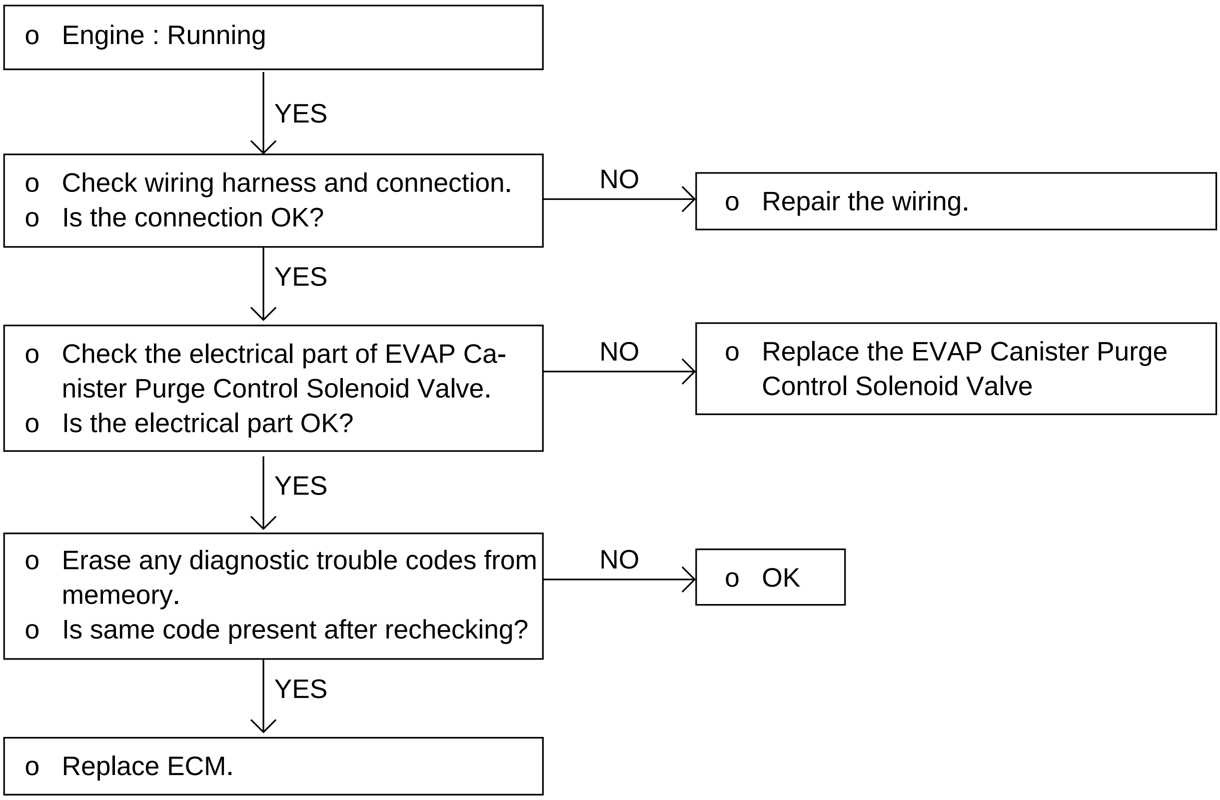
EFA9089A

CIRCUIT DIAGRAM



EFUC413A

TROUBLESHOOTING PROCEDURES



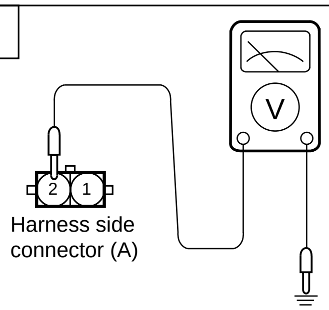
DTC : Diagnosis Trouble Code
ECM : Engine Control Module

EFUC413B

USING HI-SCAN

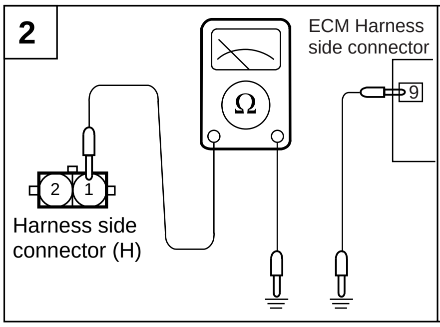
Check Item	Check conditions	HI-SCAN display	Type
Evaporative emission canister purge solenoid valve • Actuator test	IG. S/W ON (Do not start)	PCSV	Activate

HARNESS INSPECTION PROCEDURE



1	Measure the power supply voltage. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	**OK** ⇨	**2**
		NG ⇨	Repair the harness.

EFUC413C

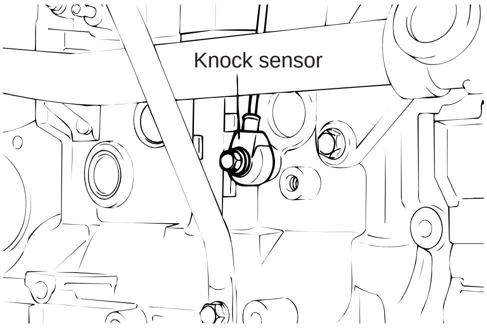


2	Check for an open-circuit, or a short-circuit to ground between the evaporative emission canister purge solenoid valve and the engine control module. o Engine control module connector : Disconnected o Evgaporative emission canister purge solenoid valve connector : Disconnected	**OK** ⇨	**END !**
		NG ⇨	Repair the harness.

EFUC413D

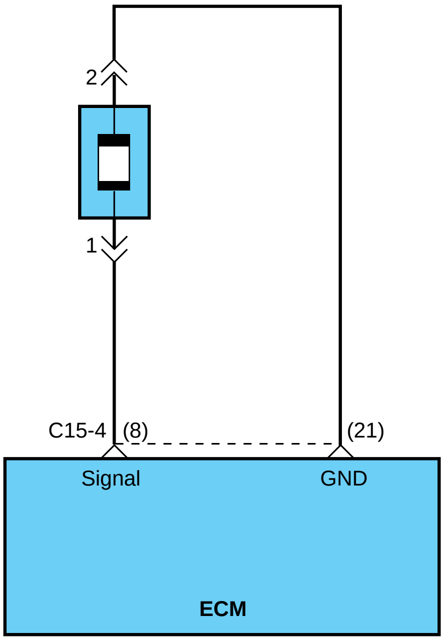
KNOCK SENSOR EFUC4140

The knock sensor is attached to the cylinder block and senses engine knocking conditions. A knocking vibration from the cylinder block is applied as pressure to the piezo-electric element. This vibrational pressure is then converted into a voltage signal which is delivered as output. If engine knocking occurs, ignition timing is retarded to suppress it.



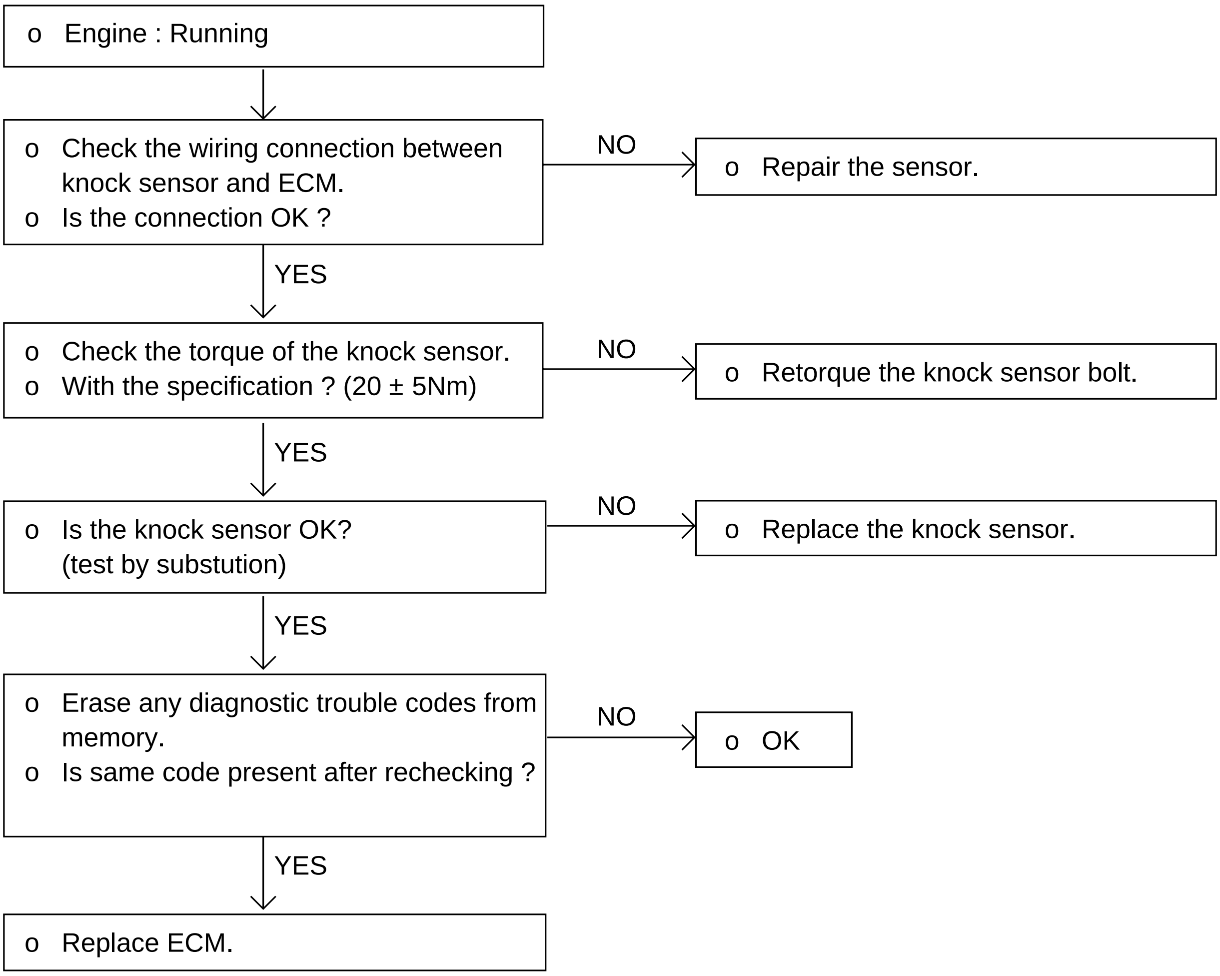
EFA9094A

CIRCUIT DIAGRAM



EFUC414A

TROUBLESHOOTING PROCEDURES



o Engine : Running

o Check the wiring connection between knock sensor and ECM.
o Is the connection OK ?

o Repair the sensor.

o Check the torque of the knock sensor.
o With the specification ? (20 ± 5Nm)

o Retorque the knock sensor bolt.

o Is the knock sensor OK? (test by substution)

o Replace the knock sensor.

o Erase any diagnostic trouble codes from memory.
o Is same code present after rechecking ?

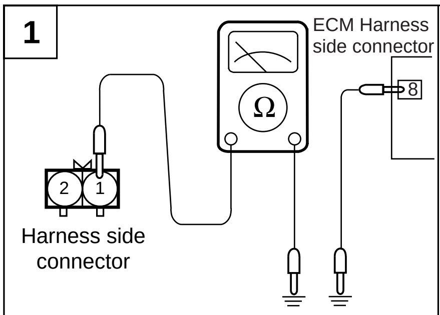
o OK

o Replace ECM.

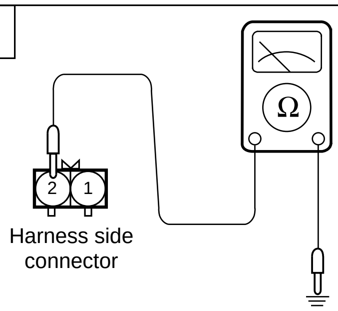
DTC : Diagnosis Trouble Code
ECM : Engine Control Module

EFUC414B

HARNESS INSPECTION PROCEDURE

1 	Check for an open-circuit, or a short-circuit to ground between the ECM and the knock sensor o ECM connector : Disconnected o Knock sensor connector : Disconnected	**OK** ⇨ **NG** ⇨	**2** Repair the harness.

EFUC414C

2 	Check for continuity of the ground circuit o Connector : Disconnected	**OK** ⇨ **NG** ⇨	**END !** Repair the harness.

EFUC414D

SENSOR INSPECTION

1. Disconnect the knock sensor connector.
2. Measure resistance between the terminal 1 and 2.

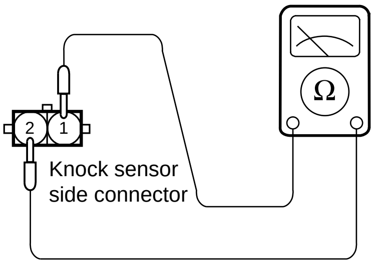
Standard value : about 5MΩ [at 20°C (68°F)]

3. If the resistance is continual, replace the knock sensor.

Knock sensor :
16-28Nm (160-250 kg·cm, 11.8-18.4 lb·ft)

4. Measure the capacitance between the terminal 1 and 2.

Standard value : 800-1600 pF

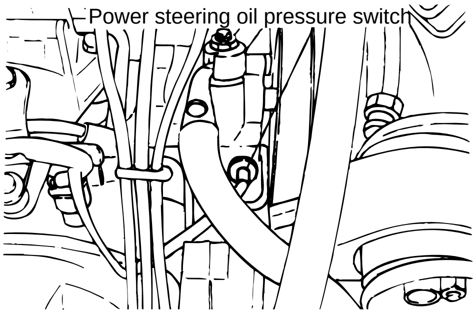


EFUC414E

POWER STEERING PRESSURE (PSP) SWITCH

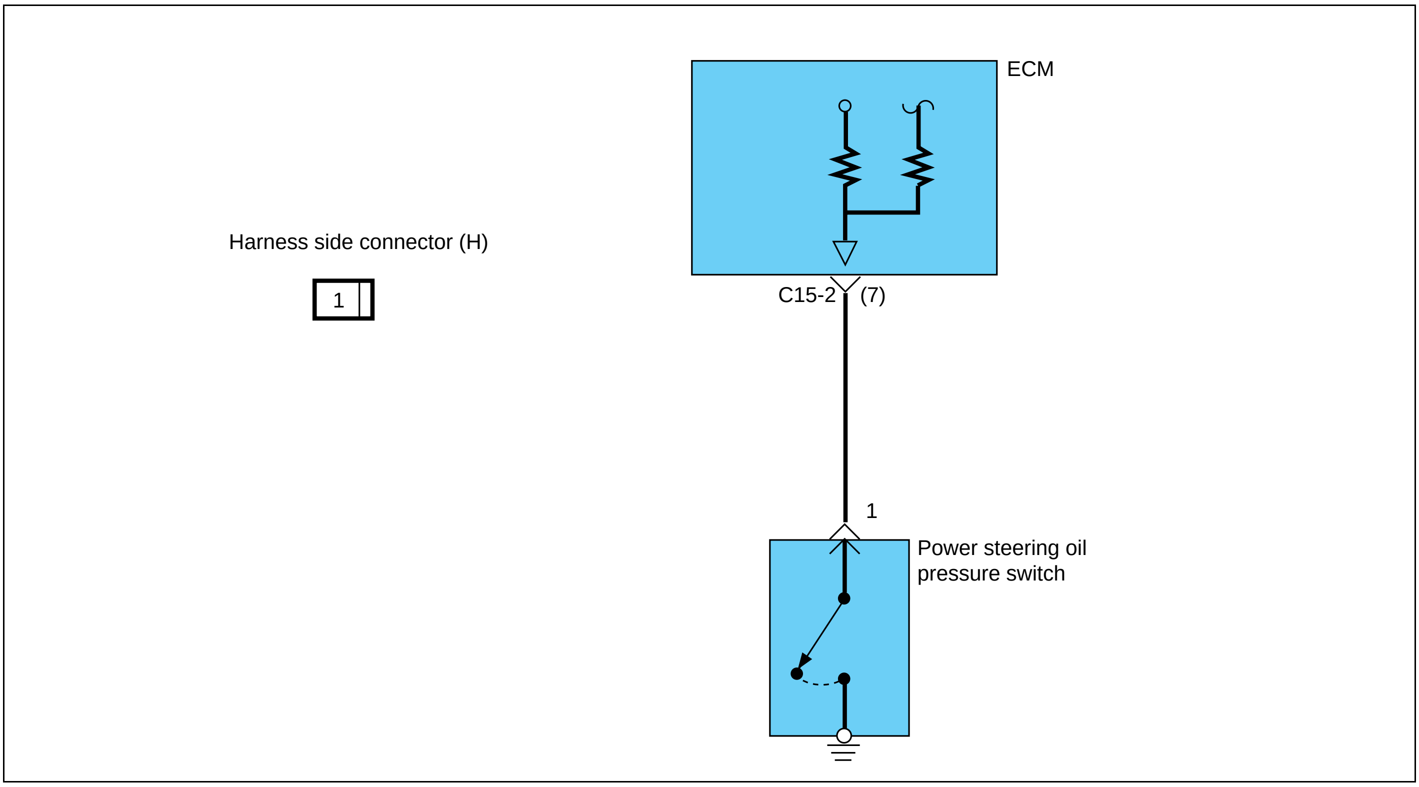
EFUC4150

The power steering oil pressure switch senses the power steering load into low/high voltage and inputs it to ECM, which then controls the idle speed control motor based on this signal.



EFA9103A

CIRCUIT DIAGRAM

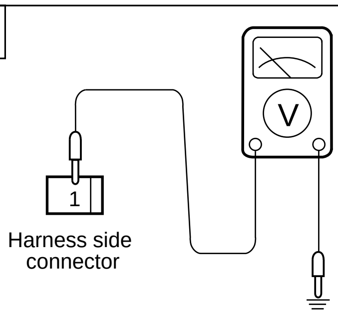


EFUC415A

USING HI-SCAN

Check item	Data display	Check conditions	Steering wheel	Normal indication
Power steering oil pressure switch	Switch state	Engine : Idling	Steering wheel neutral position (wheels straightahead direction)	OFF
			Steering wheel half turn	ON

HARNESS INSPECTION PROCEDURE

1 	Measure the power supply voltage. o Connector: Disconnect o Ignition switch: ON o Voltage (V): Battery voltage **OK** ⇨	**END !**
	NG ⇨	Repair the harness.

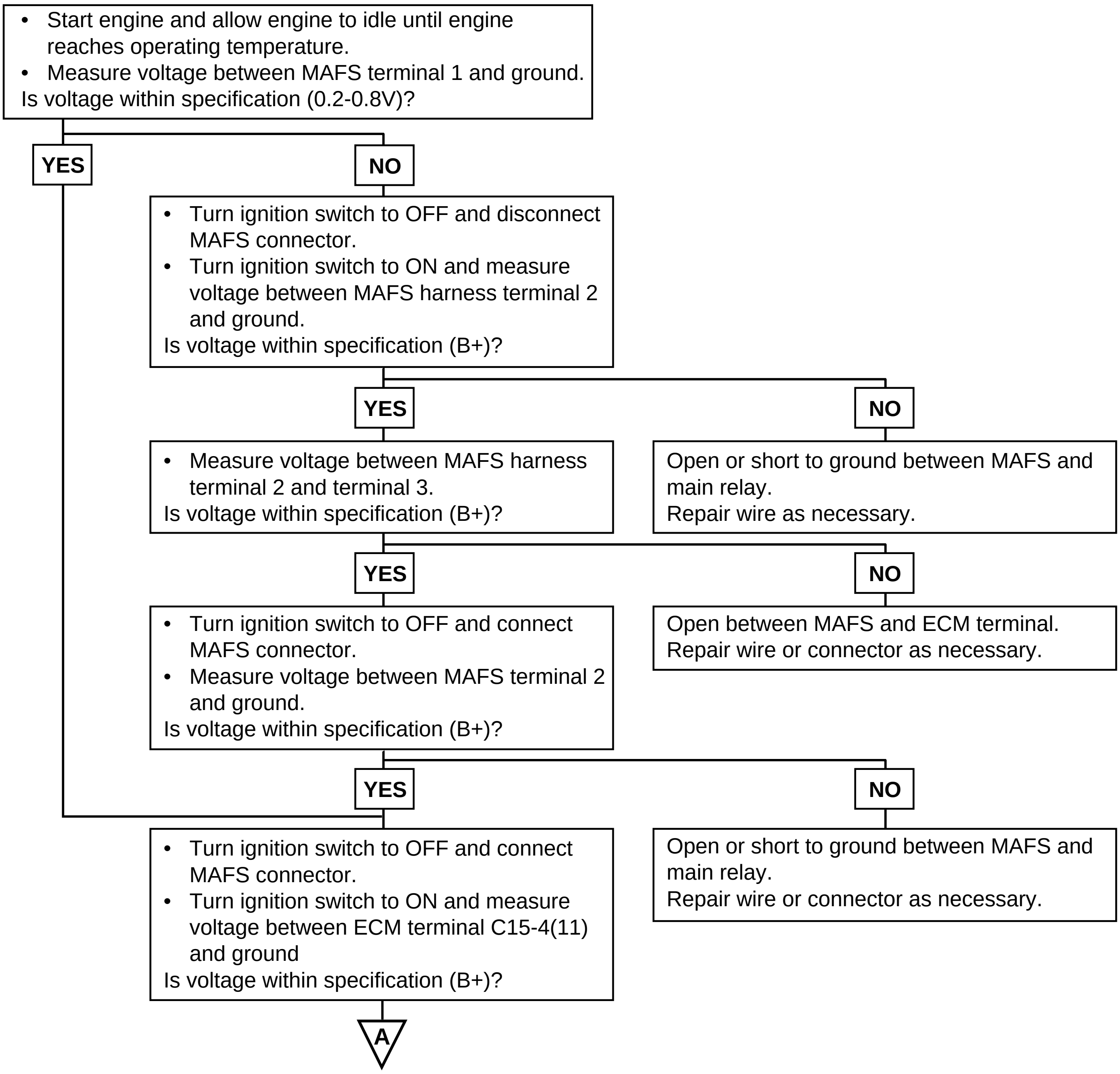
EFAA735B

TROUBLESHOOTING FOR DTCS (MELCO EMS)

DIAGNOSTIC ITEM EFUC5010

DTC	Diagnostic item
P0101	Mass Air Flow Circuit Range/Performance Problem
P0102	Mass Air Flow Circuit Low Voltage
P0103	Mass Air Flow Circuit High Voltage

TEST PROCEDURE



- Start engine and allow engine to idle until engine reaches operating temperature.
- Measure voltage between MAFS terminal 1 and ground.

Is voltage within specification (0.2-0.8V)?

- Turn ignition switch to OFF and disconnect MAFS connector.
- Turn ignition switch to ON and measure voltage between MAFS harness terminal 2 and ground.

Is voltage within specification (B+)?

- Measure voltage between MAFS harness terminal 2 and terminal 3.

Is voltage within specification (B+)?

Open or short to ground between MAFS and main relay.
Repair wire as necessary.

- Turn ignition switch to OFF and connect MAFS connector.
- Measure voltage between MAFS terminal 2 and ground.

Is voltage within specification (B+)?

Open between MAFS and ECM terminal.
Repair wire or connector as necessary.

- Turn ignition switch to OFF and connect MAFS connector.
- Turn ignition switch to ON and measure voltage between ECM terminal C15-4(11) and ground

Is voltage within specification (B+)?

Open or short to ground between MAFS and main relay.
Repair wire or connector as necessary.

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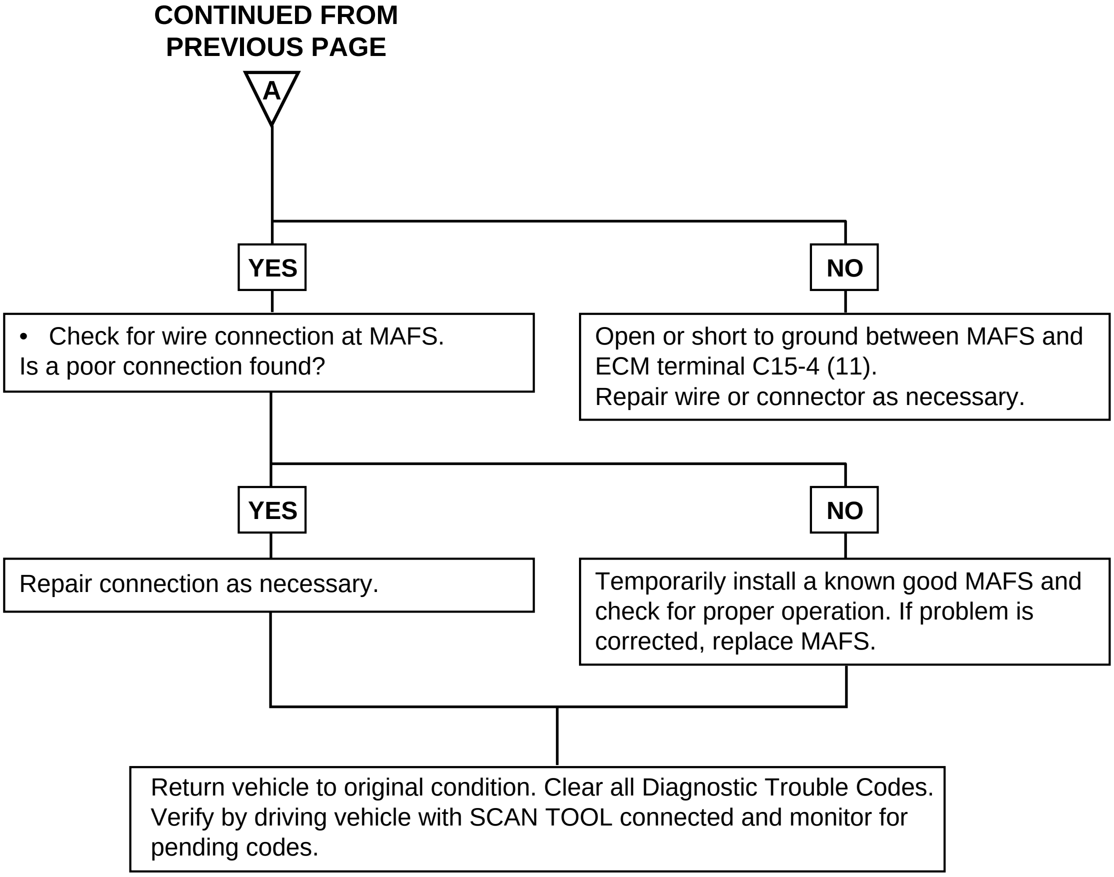
NEXT PAGE

EFUC501A



- Check for wire connection at MAFS.

Is a poor connection found?

Open or short to ground between MAFS and ECM terminal C15-4 (11).
Repair wire or connector as necessary.

Repair connection as necessary.

Temporarily install a known good MAFS and check for proper operation. If problem is corrected, replace MAFS.

Return vehicle to original condition. Clear all Diagnostic Trouble Codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFUC5020

DTC	Diagnostic item
P0112 P0113	Intake Air Temperature Low Voltage Intake Air Temperature High Voltage

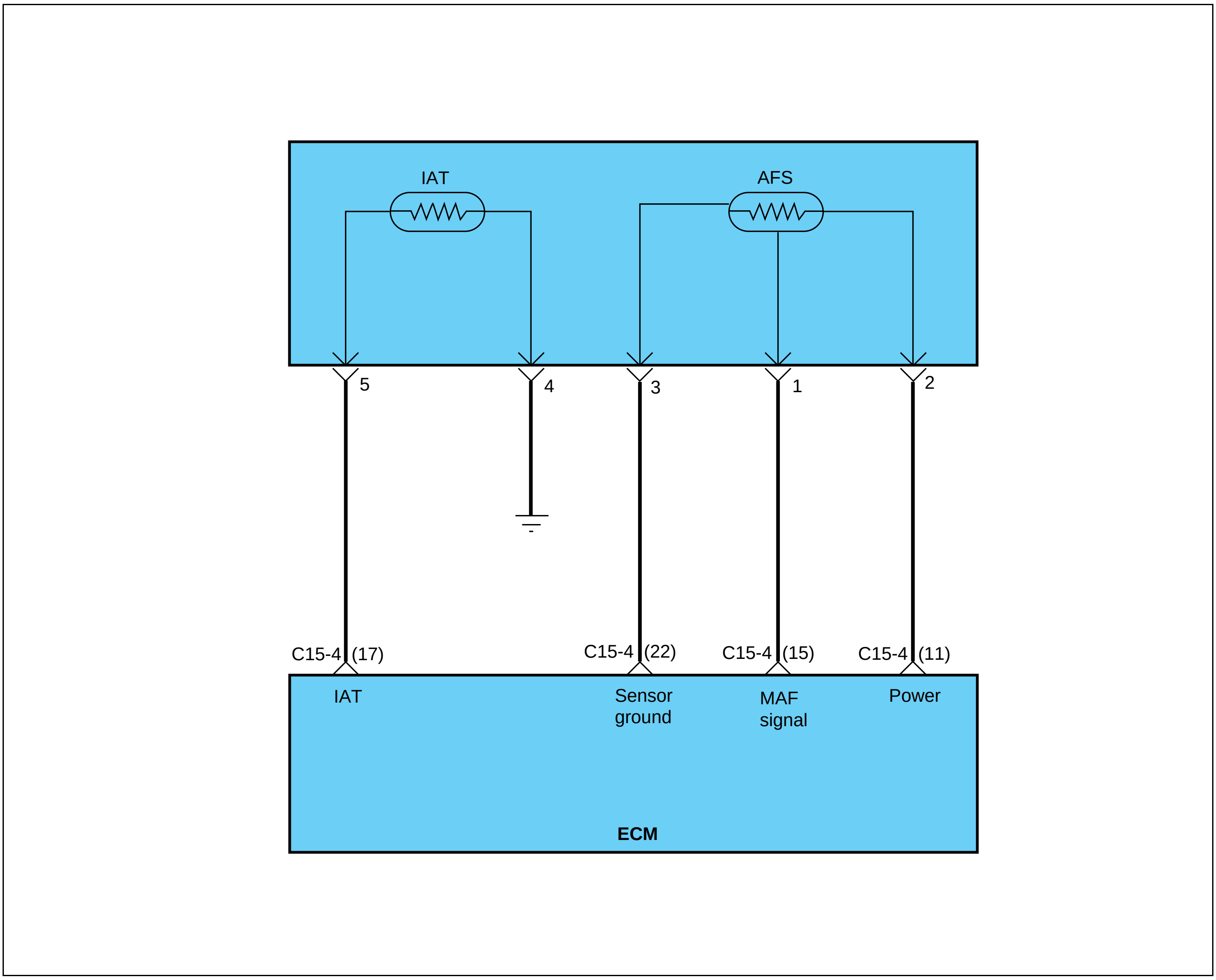
DESCRIPTION

The Intake Air Temperature (IAT) sensor is in the MAF sensor. The IAT sensor is a variable resistor whose resistance changes as the temperature of the air flowing through the air intake changes. The Engine Control Module (ECM) uses the IAT sensor input to adjust fuel injector pulse width. When the temperature sensed is cold, the PCM enriches fuel mixture by increasing injector pulse width; as the air warms, the injector pulse width time is shortened.

TROUBLESHOOTING GUIDE

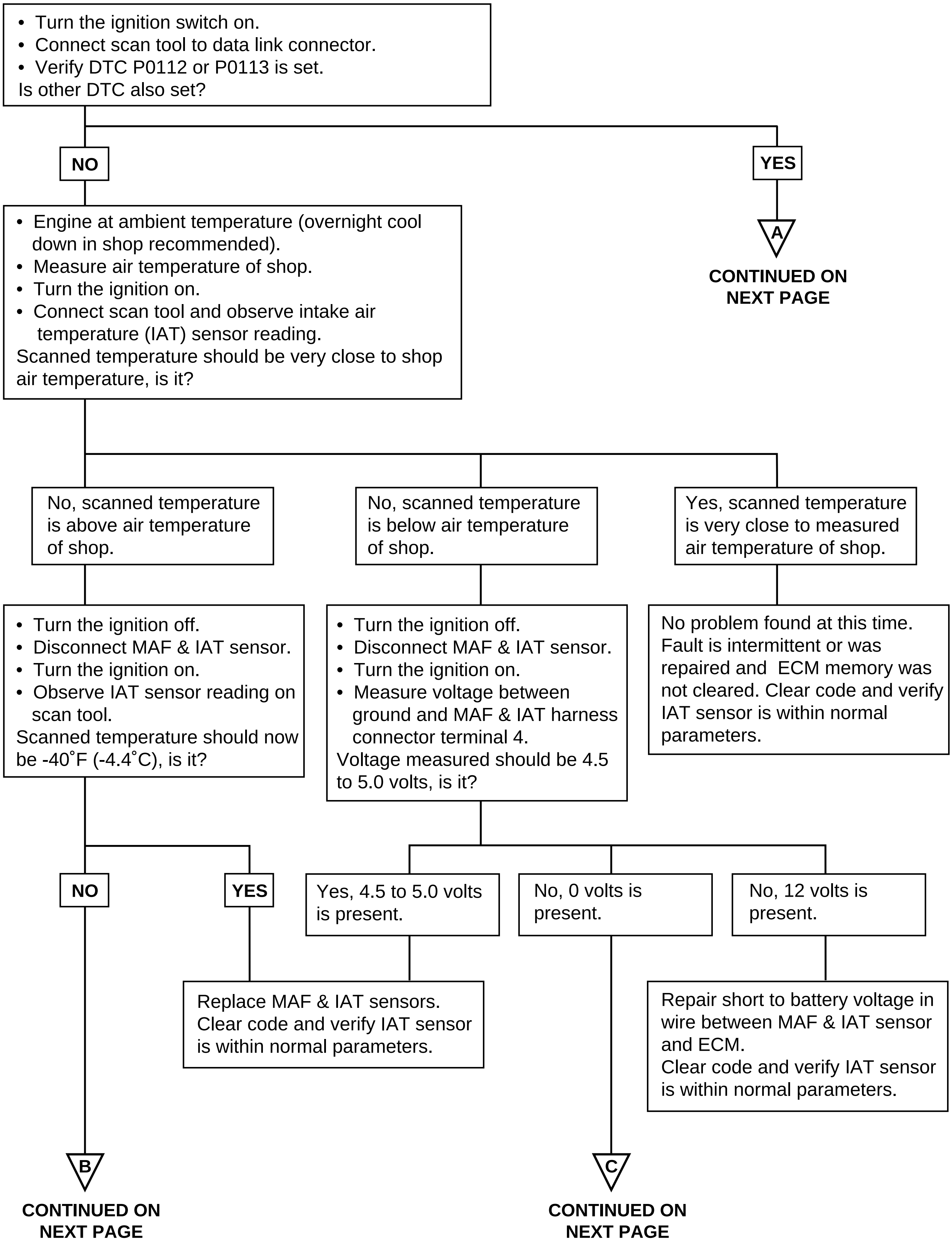
DTC detection condition	Probable cause
Background • The intake air temperature sensor converts the intake air temperature to a voltage and outputs it. • The powertrain control module checks whether the voltage is within a specified range. Check Area • Sixty seconds or more have passed since the engine was started. Judgment Criteria • Sensor output voltage has continued to be 4.6V or higher [corresponding to an intake air temperature of -45°C (-49°F) or lower] for 4 sec. • Sensor output voltage has continued to be 0.2V or lower [corresponding to an intake air temperature of 125°C (257°F) or higher] for 4 sec.	• MAF sensor failed • Open or shorted mass air flow sensor circuit, or loose connector • Engine control module failed

CIRCUIT DIAGRAM

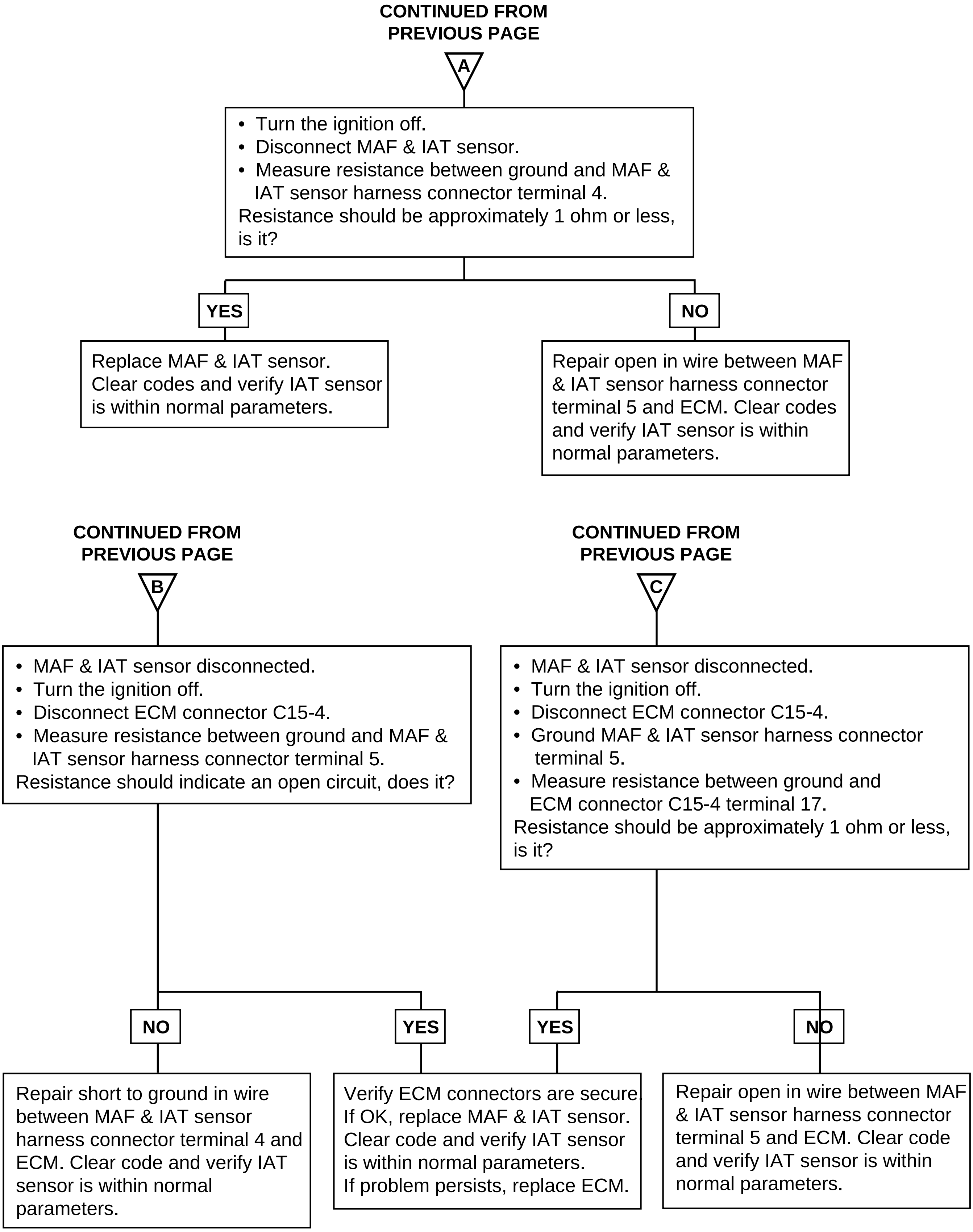


EFUC406A

TEST PROCEDURE



EFUC502B



- Turn the ignition off.
- Disconnect MAF & IAT sensor.
- Measure resistance between ground and MAF & IAT sensor harness connector terminal 4.

Resistance should be approximately 1 ohm or less, is it?

Replace MAF & IAT sensor. Clear codes and verify IAT sensor is within normal parameters.

Repair open in wire between MAF & IAT sensor harness connector terminal 5 and ECM. Clear codes and verify IAT sensor is within normal parameters.

- MAF & IAT sensor disconnected.
- Turn the ignition off.
- Disconnect ECM connector C15-4.
- Measure resistance between ground and MAF & IAT sensor harness connector terminal 5.

Resistance should indicate an open circuit, does it?

Repair short to ground in wire between MAF & IAT sensor harness connector terminal 4 and ECM. Clear code and verify IAT sensor is within normal parameters.

Verify ECM connectors are secure. If OK, replace MAF & IAT sensor. Clear code and verify IAT sensor is within normal parameters.
If problem persists, replace ECM.

- MAF & IAT sensor disconnected.
- Turn the ignition off.
- Disconnect ECM connector C15-4.
- Ground MAF & IAT sensor harness connector terminal 5.
- Measure resistance between ground and ECM connector C15-4 terminal 17.

Resistance should be approximately 1 ohm or less, is it?

Repair open in wire between MAF & IAT sensor harness connector terminal 5 and ECM. Clear code and verify IAT sensor is within normal parameters.

EFUC502C

EFUC5030

DTC	Diagnostic item
P0115 P0116	Engine Coolant Temperature Circuit Malfunction Engine Coolant Temperature Sensor Drift

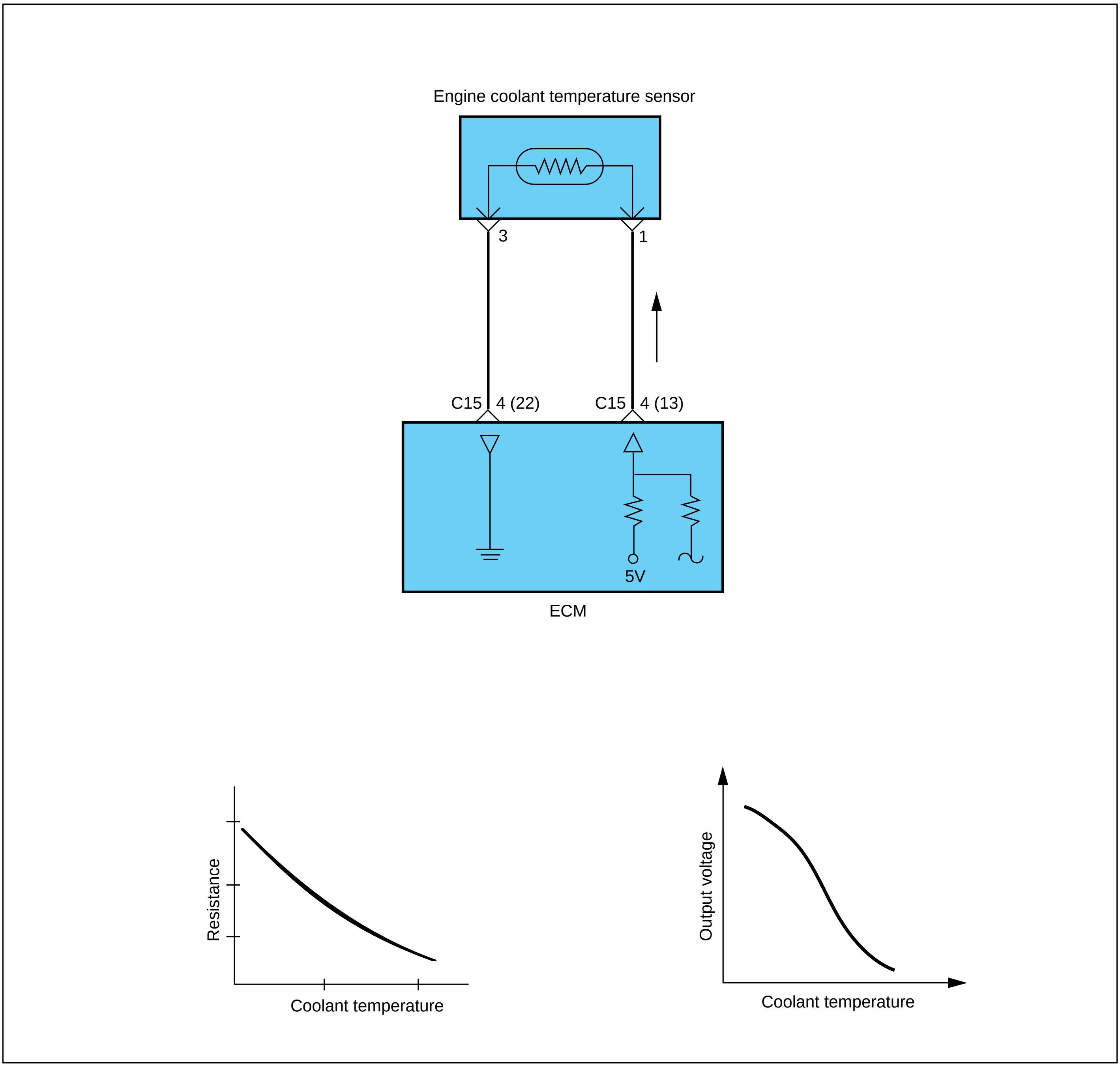
DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is located in the coolant passage of the cylinder head. The ECT sensor is a variable resistor whose resistance changes as the temperature of the engine coolant flowing past the sensor changes. When the coolant temperature is low, the sensor resistance is high; when the coolant temperature is high, the sensor resistance is low. The Engine Control Module (ECM) checks ECT voltage fifty times per second and uses the information to adjust the fuel injector pulse width and ignition timing. When the temperature sensed is very cold, the ECM enriches the fuel mixture.

TROUBLESHOOTING GUIDE

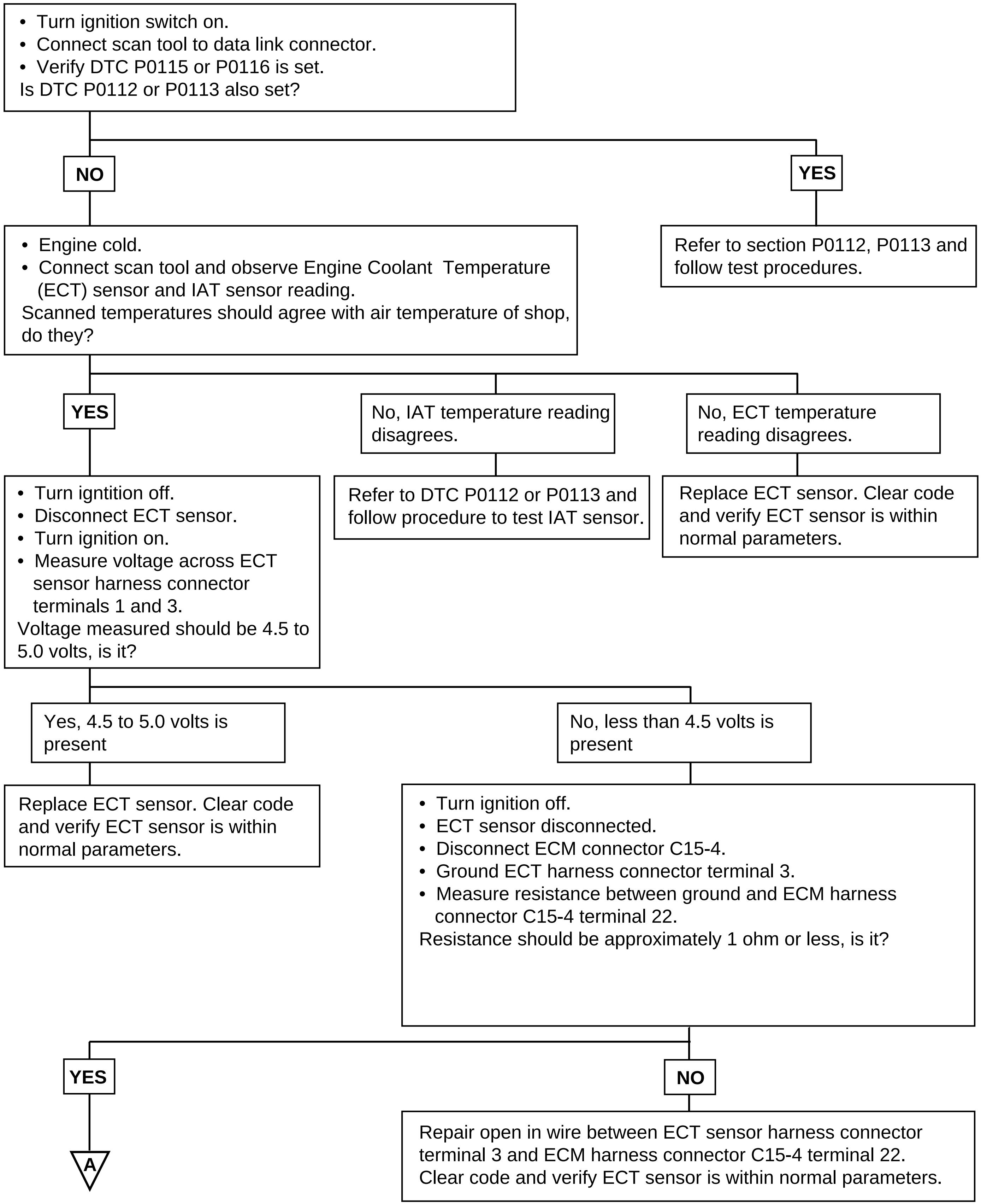
DTC detection condition	Probable cause
Background • The engine coolant temperature sensor converts the engine coolant temperature to a voltage and outputs it. • The Engine Control Module checks whether the voltage is within a specified range. In addition, it checks that the engine coolant temperature (signal) does not drop while the engine is warming up. Check Area, Judgment Criteria • Sensor output voltage has continued to be 4.6V or higher [corresponding to a coolant temperature of -45°C (-49°F) or lower] for 4 sec. • Sensor output voltage has continued to be 0.1V or lower [corresponding to a coolant temperature of 140°C (284°F) or higher] for 4 sec. Check Area, Judgment Criteria • Sensor output voltage increased from a value lower than 1.6V to a value higher than 1.6V [Coolant temperature decreases from a higher than 40°C (104°F) temperature to a lower than 40°C (104°F) temperature.]. • Then the sensor output voltage has continued to be 1.6V or higher for 5 min. Check Area • The Engine Coolant Temperature is approx. 40°C (104°F) or less after starting sequence is completed. Judgment Criteria • Approx. 60 - 300 seconds have passed for the engine coolant temperature to rise to about 40°C (104°F) after starting sequence was completed.	• Engine Coolant Temperature sensor failed. • Open or shorted Engine Coolant Temperature sensor circuit, or loose connector. • Engine Control Module failed.

CIRCUIT DIAGRAM



EFUC403A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0115 or P0116 is set.

Is DTC P0112 or P0113 also set?

NO

- Engine cold.
- Connect scan tool and observe Engine Coolant Temperature (ECT) sensor and IAT sensor reading.

Scanned temperatures should agree with air temperature of shop, do they?

YES

Refer to section P0112, P0113 and follow test procedures.

YES

- Turn igntition off.
- Disconnect ECT sensor.
- Turn ignition on.
- Measure voltage across ECT sensor harness connector terminals 1 and 3.

Voltage measured should be 4.5 to 5.0 volts, is it?

No, IAT temperature reading disagrees.

Refer to DTC P0112 or P0113 and follow procedure to test IAT sensor.

No, ECT temperature reading disagrees.

Replace ECT sensor. Clear code and verify ECT sensor is within normal parameters.

Yes, 4.5 to 5.0 volts is present

Replace ECT sensor. Clear code and verify ECT sensor is within normal parameters.

No, less than 4.5 volts is present

- Turn ignition off.
- ECT sensor disconnected.
- Disconnect ECM connector C15-4.
- Ground ECT harness connector terminal 3.
- Measure resistance between ground and ECM harness connector C15-4 terminal 22.

Resistance should be approximately 1 ohm or less, is it?

YES

NO

Repair open in wire between ECT sensor harness connector terminal 3 and ECM harness connector C15-4 terminal 22. Clear code and verify ECT sensor is within normal parameters.

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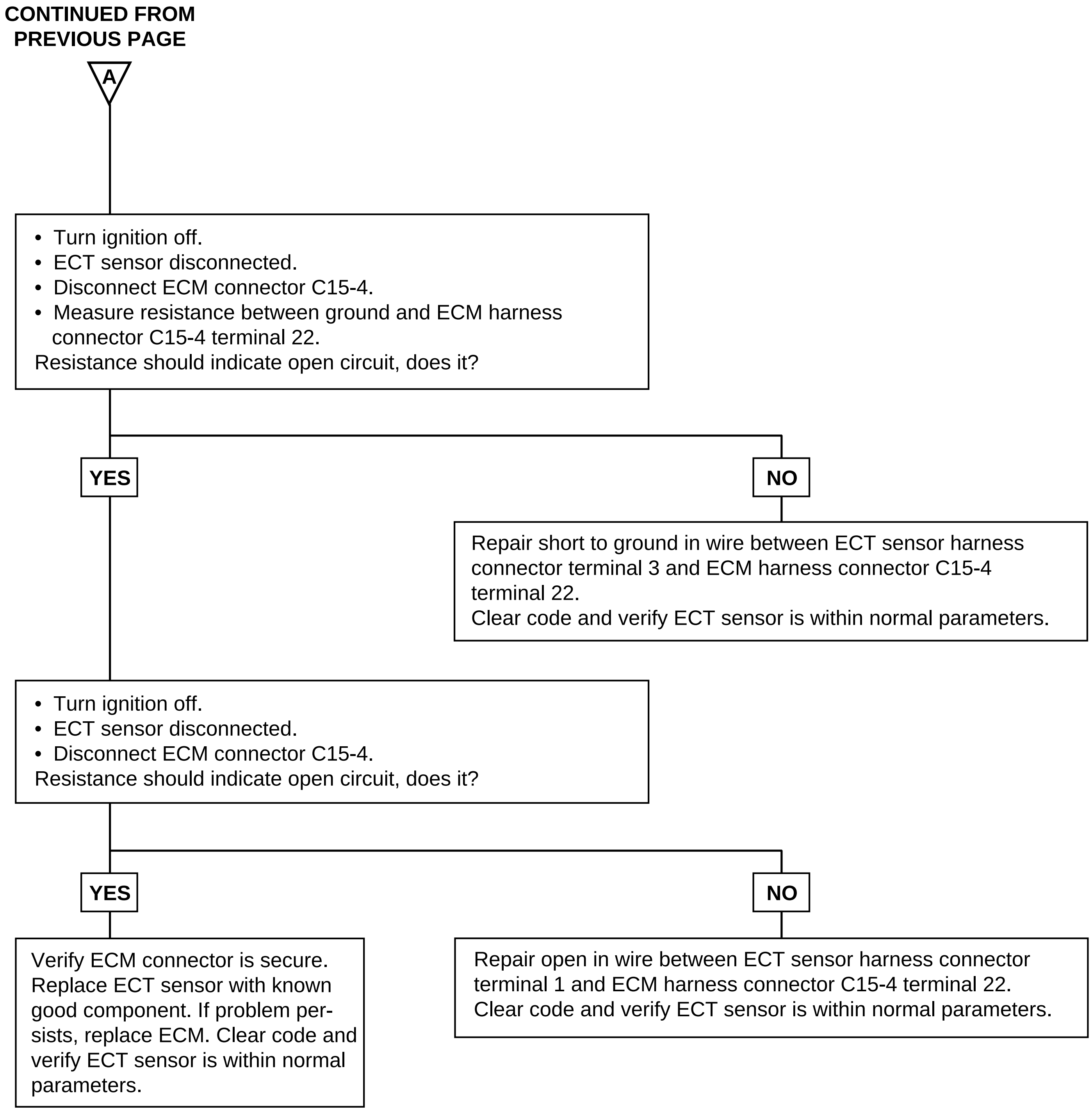


- Turn ignition off.
- ECT sensor disconnected.
- Disconnect ECM connector C15-4.
- Measure resistance between ground and ECM harness connector C15-4 terminal 22.

Resistance should indicate open circuit, does it?

Repair short to ground in wire between ECT sensor harness connector terminal 3 and ECM harness connector C15-4 terminal 22.
Clear code and verify ECT sensor is within normal parameters.

- Turn ignition off.
- ECT sensor disconnected.
- Disconnect ECM connector C15-4.

Resistance should indicate open circuit, does it?

Verify ECM connector is secure. Replace ECT sensor with known good component. If problem persists, replace ECM. Clear code and verify ECT sensor is within normal parameters.

Repair open in wire between ECT sensor harness connector terminal 1 and ECM harness connector C15-4 terminal 22.
Clear code and verify ECT sensor is within normal parameters.

EFUC503C

EFUC5040

DTC	Diagnostic item
P0122 P0123	Throttle Position Sensor Low Voltage Throttle Position Sensor High Voltage

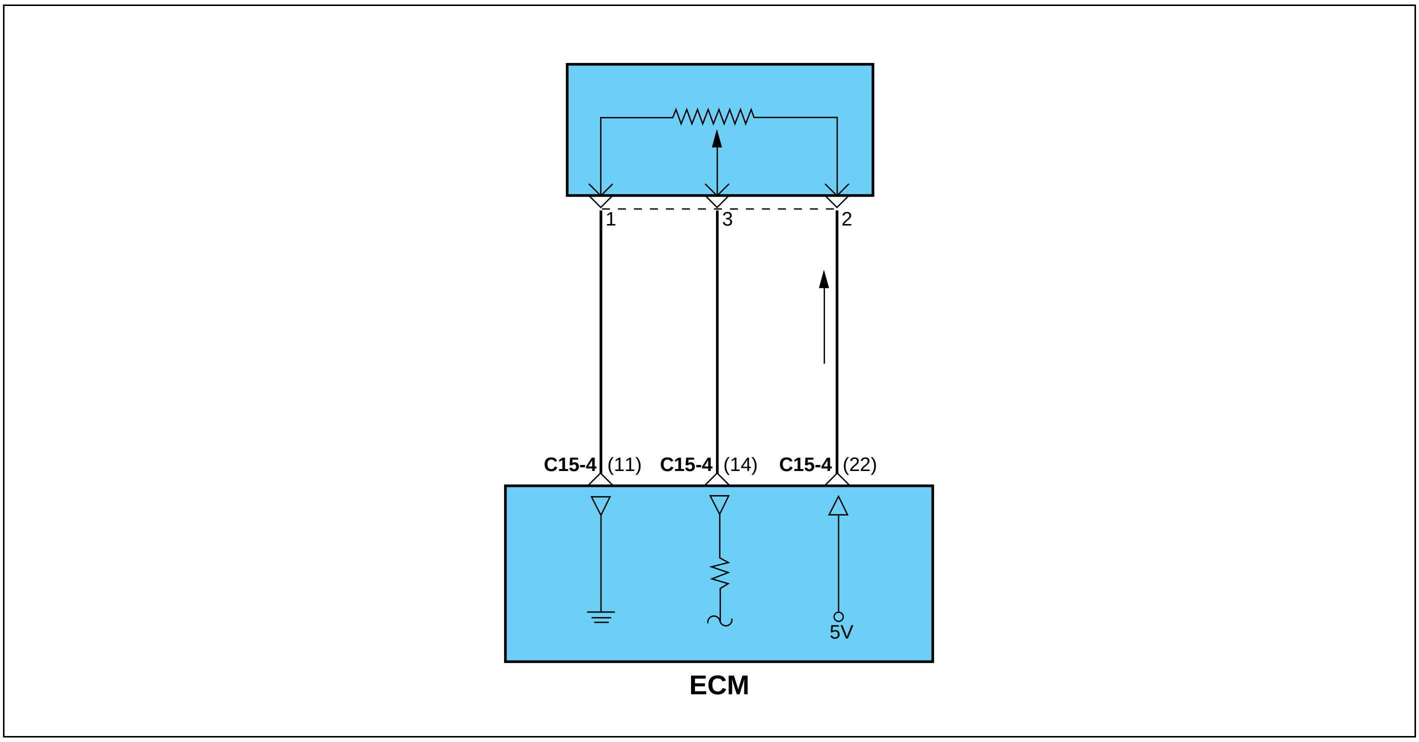
DESCRIPTION

The throttle position (TP) sensor mounts on the side of the throttle body and is connected to the throttle blade shaft. The TP sensor is a variable resistor (potentiometer) whose resistance changes according to the throttle blade shaft position. During acceleration, the TP sensor resistance decreases; during deceleration, the TP sensor resistance increases. The TP sensor also includes an idle position switch. The switch is closed in the idle position. The Engine Control Module (ECM) applies a reference voltage to the TP sensor and then measures the voltage that is present on the TP sensor signal circuit. The ECM uses the TP sensor signal to adjust the timing and injector pulse width. The TP sensor signal along with the MAP sensor signal is used by the ECM to calculate the engine load.

TROUBLESHOOTING GUIDE

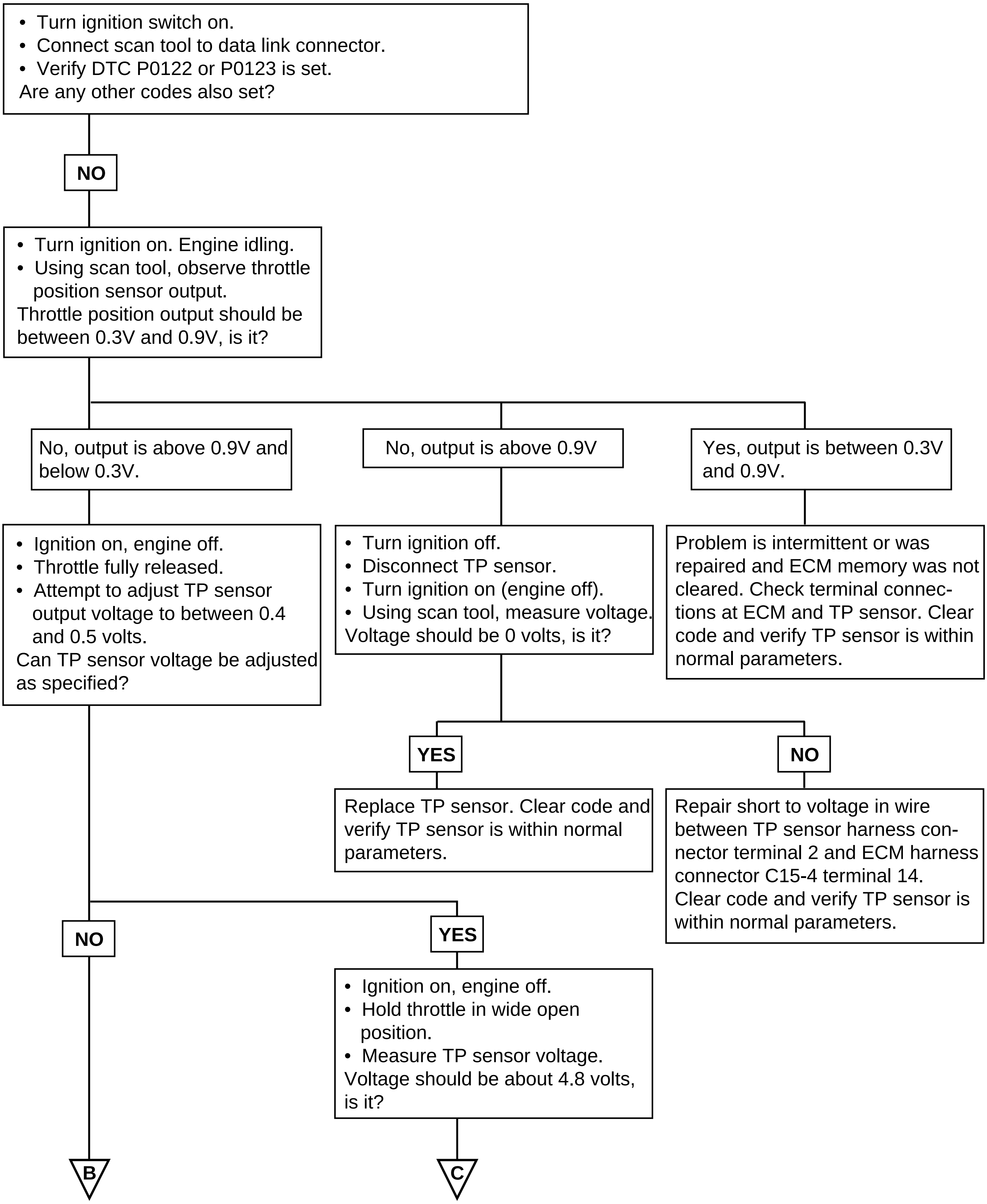
DTC detection condition	Probable cause
Background • The Throttle Position sensor outputs a voltage which is proportional to the throttle valve opening angle. • The Engine Control Module checks whether the voltage output by the throttle position sensor is within a specified range. In addition, it checks that the voltage output does not become too large while the engine is idling. Check Area, Judgment Criteria • With the close Throttle Position switch se to ON, the sensor output voltage has continued to be 2V or higher for 4 sec. • Sensor output voltage has continued to be 0.2V or lower for 4 sec. Check Area • Engine speed is between 500 and 3,000 r/min. • Engine load is lower than 30%. Judgment Criteria • Sensor output voltage has continued to be 4.6V or higher for 4 sec.	• Throttle Position sensor failed or maladjusted. • Open or shorted Throttle Position sensor circuit, or loose connector. • Closed Throttle Position switch ON malfunction. • Closed Throttle Position switch signal wire shorted. • Engine control module failed.

CIRCUIT DIAGRAM



EFUC504A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0122 or P0123 is set.

Are any other codes also set?

- Turn ignition on. Engine idling.
- Using scan tool, observe throttle position sensor output.

Throttle position output should be between 0.3V and 0.9V, is it?

No, output is above 0.9V and below 0.3V.

- Ignition on, engine off.
- Throttle fully released.
- Attempt to adjust TP sensor output voltage to between 0.4 and 0.5 volts.

Can TP sensor voltage be adjusted as specified?

- Ignition on, engine off.
- Hold throttle in wide open position.
- Measure TP sensor voltage.

Voltage should be about 4.8 volts, is it?

No, output is above 0.9V

- Turn ignition off.
- Disconnect TP sensor.
- Turn ignition on (engine off).
- Using scan tool, measure voltage.

Voltage should be 0 volts, is it?

Replace TP sensor. Clear code and verify TP sensor is within normal parameters.

Repair short to voltage in wire between TP sensor harness connector terminal 2 and ECM harness connector C15-4 terminal 14. Clear code and verify TP sensor is within normal parameters.

Yes, output is between 0.3V and 0.9V.

Problem is intermittent or was repaired and ECM memory was not cleared. Check terminal connections at ECM and TP sensor. Clear code and verify TP sensor is within normal parameters.

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EFUC504B

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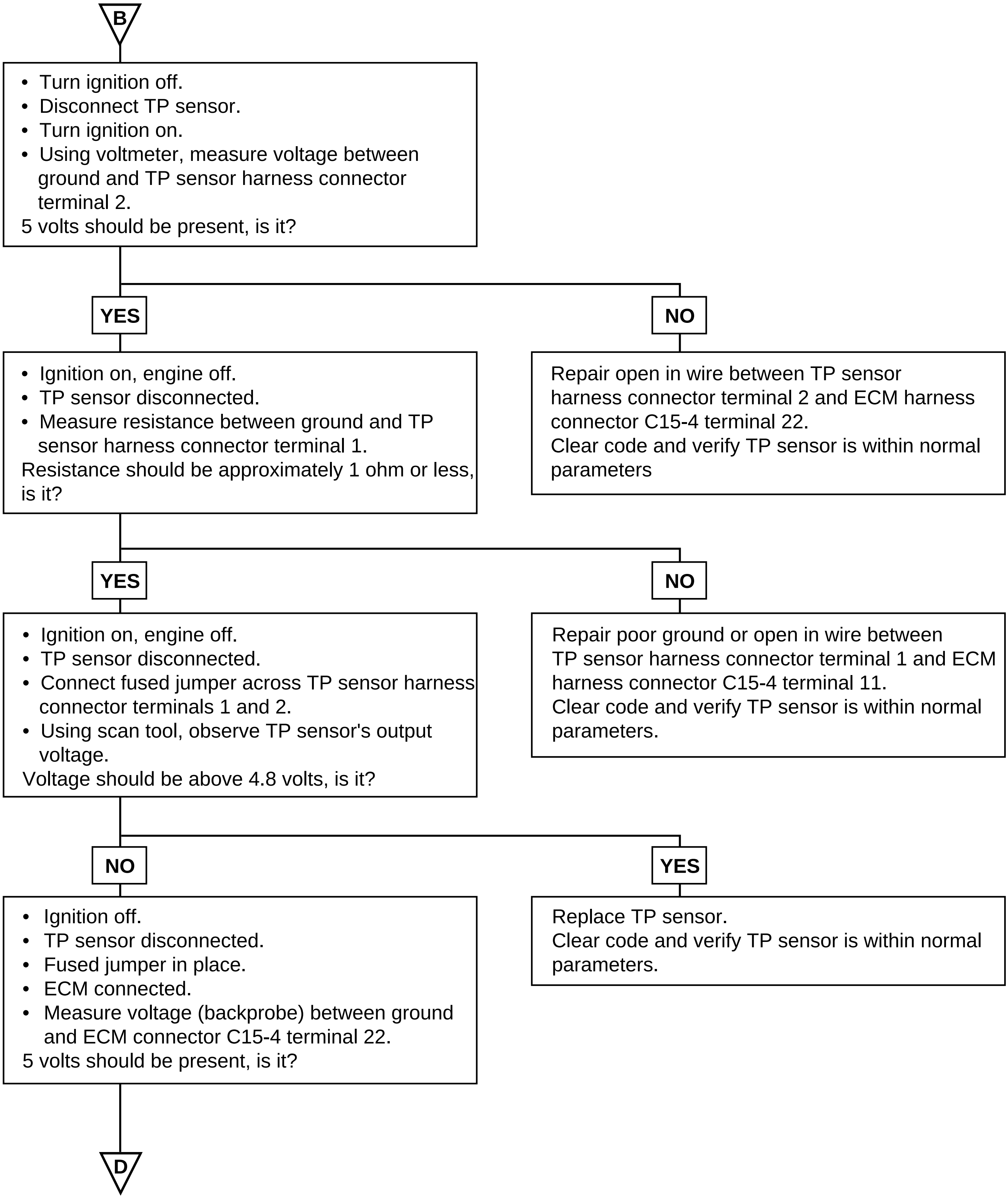

- Turn ignition off.
- Disconnect TP sensor.
- Turn ignition on.
- Using voltmeter, measure voltage between ground and TP sensor harness connector terminal 2.

5 volts should be present, is it?

YES

- Ignition on, engine off.
- TP sensor disconnected.
- Measure resistance between ground and TP sensor harness connector terminal 1.

Resistance should be approximately 1 ohm or less, is it?

NO

Repair open in wire between TP sensor harness connector terminal 2 and ECM harness connector C15-4 terminal 22.
Clear code and verify TP sensor is within normal parameters

YES

- Ignition on, engine off.
- TP sensor disconnected.
- Connect fused jumper across TP sensor harness connector terminals 1 and 2.
- Using scan tool, observe TP sensor's output voltage.

Voltage should be above 4.8 volts, is it?

NO

Repair poor ground or open in wire between TP sensor harness connector terminal 1 and ECM harness connector C15-4 terminal 11.
Clear code and verify TP sensor is within normal parameters.

NO

- Ignition off.
- TP sensor disconnected.
- Fused jumper in place.
- ECM connected.
- Measure voltage (backprobe) between ground and ECM connector C15-4 terminal 22.

5 volts should be present, is it?

YES

Replace TP sensor.
Clear code and verify TP sensor is within normal parameters.

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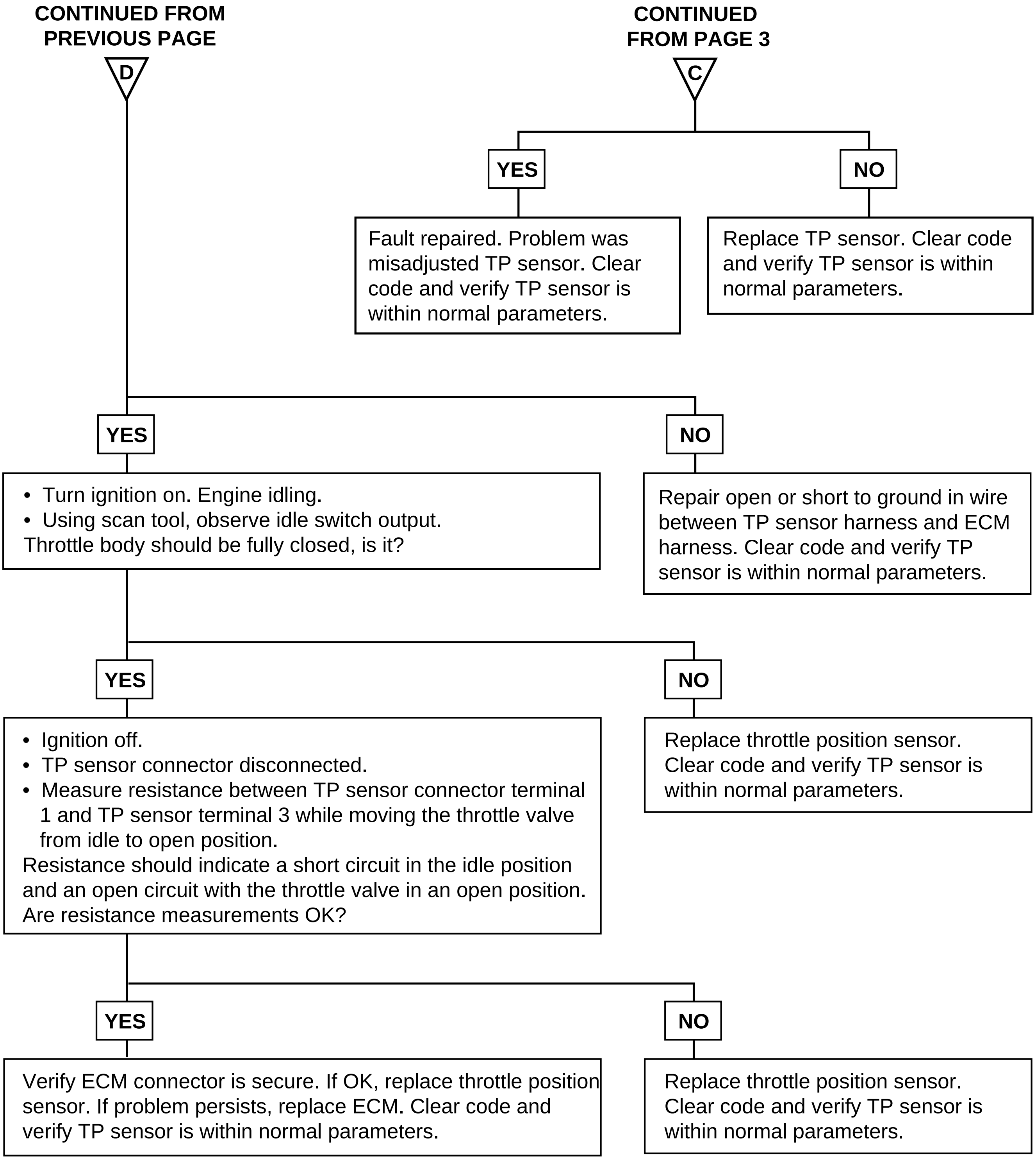
NEXT PAGE

EFUC504C



Fault repaired. Problem was misadjusted TP sensor. Clear code and verify TP sensor is within normal parameters.

Replace TP sensor. Clear code and verify TP sensor is within normal parameters.

- Turn ignition on. Engine idling.
- Using scan tool, observe idle switch output.

Throttle body should be fully closed, is it?

Repair open or short to ground in wire between TP sensor harness and ECM harness. Clear code and verify TP sensor is within normal parameters.

- Ignition off.
- TP sensor connector disconnected.
- Measure resistance between TP sensor connector terminal 1 and TP sensor terminal 3 while moving the throttle valve from idle to open position.

Resistance should indicate a short circuit in the idle position and an open circuit with the throttle valve in an open position. Are resistance measurements OK?

Replace throttle position sensor. Clear code and verify TP sensor is within normal parameters.

Verify ECM connector is secure. If OK, replace throttle position sensor. If problem persists, replace ECM. Clear code and verify TP sensor is within normal parameters.

Replace throttle position sensor. Clear code and verify TP sensor is within normal parameters.

EFUC504D

EFUC5050

DTC	Diagnostic item
P0125	Insufficient Coolant Temperature For Closed Loop Fuel Control

DESCRIPTION

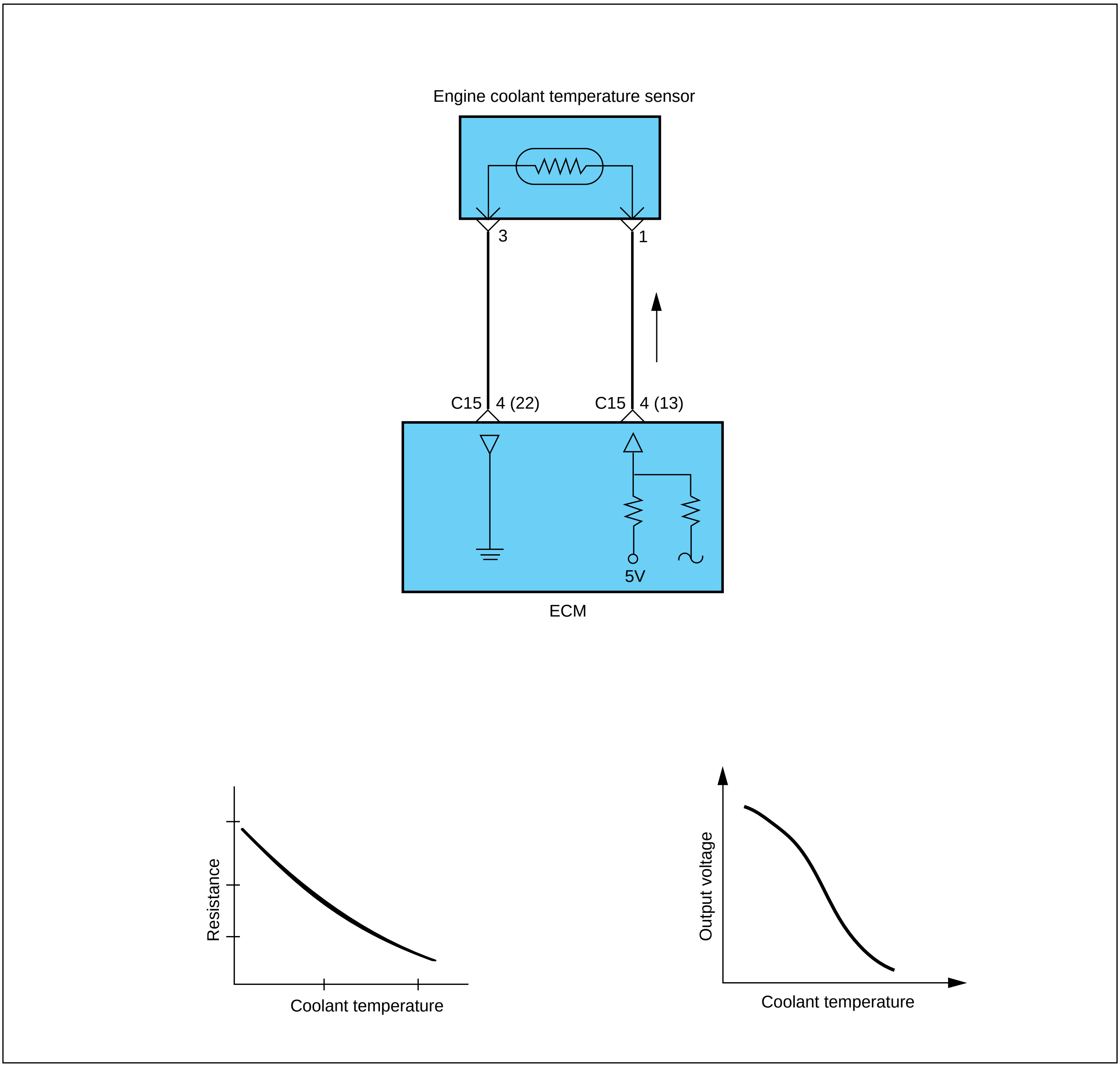
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic inverter, the air ratio must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the ECM of the LEAN condition (small electromotive force: 0V). When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the ECM of the RICH condition (large electromotive force: 1V).

The ECM judges by the voltage from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal voltage, the ECM is unable to perform accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the Zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low) current flows to the heater to heat the sensor for accurate oxygen concentration detection.

TROUBLESHOOTING GUIDE

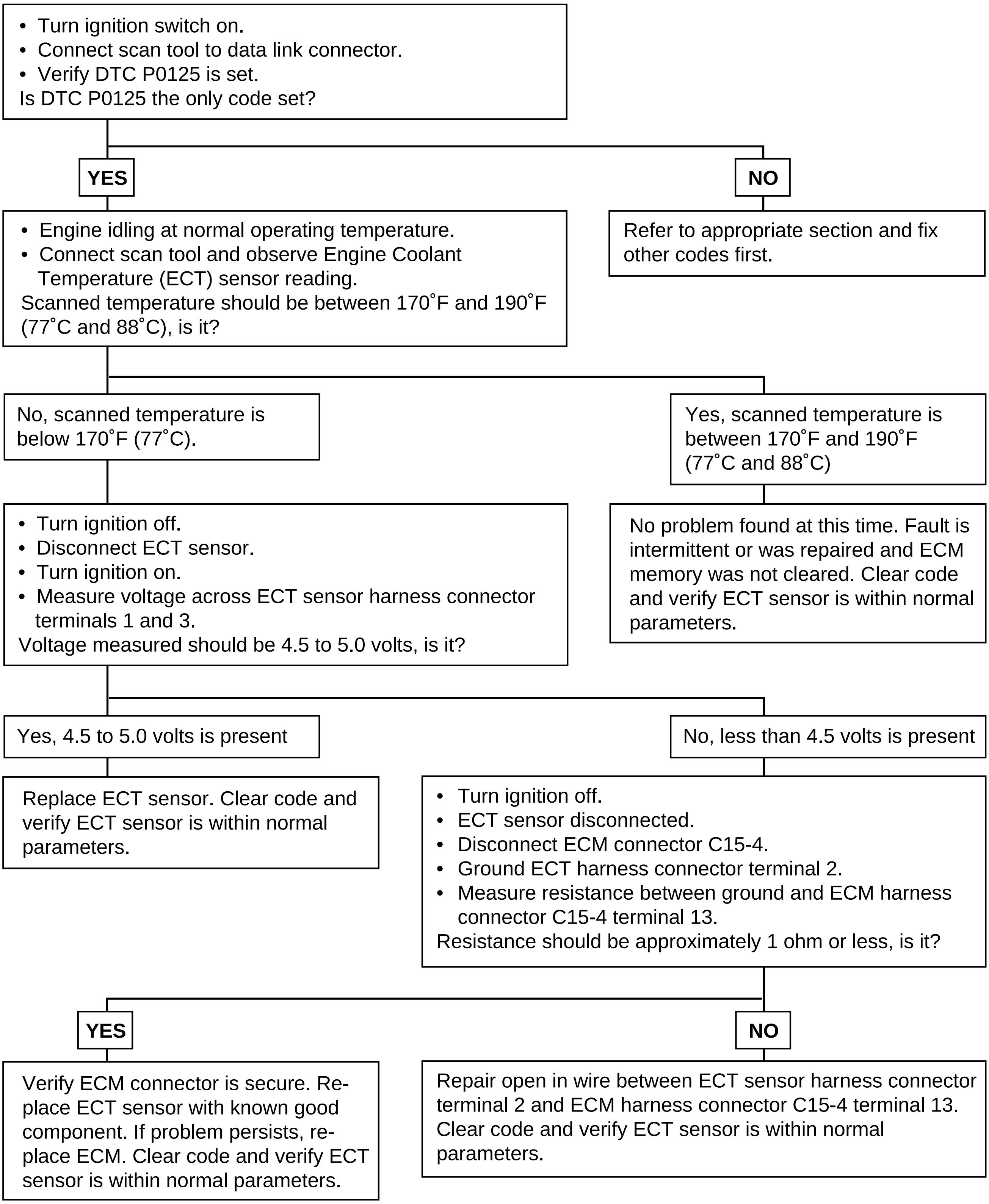
DTC detection condition	Probable cause
Background • The MFI system reduces exhaust emissions by means of closed-loop fuel control. • The engine control module checks the time taken until closed-loop fuel control commences. Check Area • Engine coolant temperature is higher than 80°C (176°F) • Intake air temperature is -10°C (14°F) or more. • Atmospheric pressure is 76 kPa (11.0 psi) or more. • Engine speed is between approx. 2,400 and 3,500 r/min. • Engine load is 26 - 60%. • In operation within air-fuel-ratio feeback zone. • Monitoring time: 128 sec. Judgment Criteria • Multiport fuel injection system doesn't enter the closed loop control within approx. 30 sec. • Monitored only once per trip.	• Heated oxygen sensor failed • Injector failed • Fuel pressure regulator failed • Fuel pump failed • Fuel filter clogged • Air intake in exhaust system • Exhaust gas leaks • Engine control module failed

CIRCUIT DIAGRAM



EFUC403A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0125 is set.

Is DTC P0125 the only code set?

- Engine idling at normal operating temperature.
- Connect scan tool and observe Engine Coolant Temperature (ECT) sensor reading.

Scanned temperature should be between 170˚F and 190˚F (77˚C and 88˚C), is it?

Refer to appropriate section and fix other codes first.

No, scanned temperature is below 170˚F (77˚C).

- Turn ignition off.
- Disconnect ECT sensor.
- Turn ignition on.
- Measure voltage across ECT sensor harness connector terminals 1 and 3.

Voltage measured should be 4.5 to 5.0 volts, is it?

Yes, scanned temperature is between 170˚F and 190˚F (77˚C and 88˚C)

No problem found at this time. Fault is intermittent or was repaired and ECM memory was not cleared. Clear code and verify ECT sensor is within normal parameters.

Yes, 4.5 to 5.0 volts is present

Replace ECT sensor. Clear code and verify ECT sensor is within normal parameters.

No, less than 4.5 volts is present

- Turn ignition off.
- ECT sensor disconnected.
- Disconnect ECM connector C15-4.
- Ground ECT harness connector terminal 2.
- Measure resistance between ground and ECM harness connector C15-4 terminal 13.

Resistance should be approximately 1 ohm or less, is it?

Verify ECM connector is secure. Replace ECT sensor with known good component. If problem persists, replace ECM. Clear code and verify ECT sensor is within normal parameters.

Repair open in wire between ECT sensor harness connector terminal 2 and ECM harness connector C15-4 terminal 13. Clear code and verify ECT sensor is within normal parameters.

EFUC505B

EFUC5060

DTC	Diagnostic item
P0133 P0132 P0134	Oxygen Sensor Circuit Malfunction (Bank 1, sensor 1) Oxygen Sensor Circuit Open (Bank 1, sensor 1) Excessive Time to Enter Closed Loop Fuel Control

DESCRIPTION

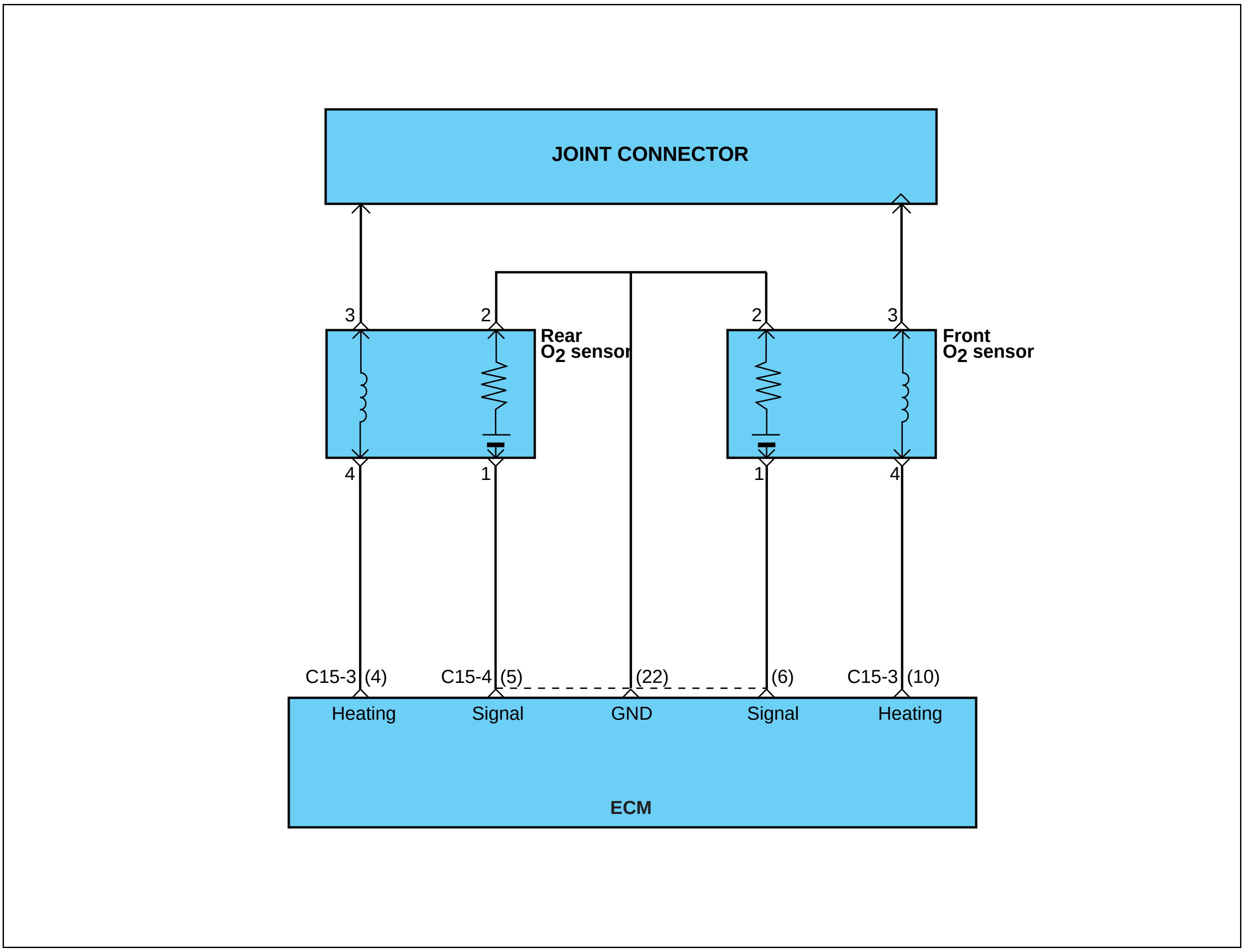
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic inverter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the ECM of the LEAN condition (small electromotive force: 0V). When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the ECM of the RICH condition (large electromotive force: 1V).

The ECM determined by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the ECM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the Zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

TROUBLESHOOTING GUIDE

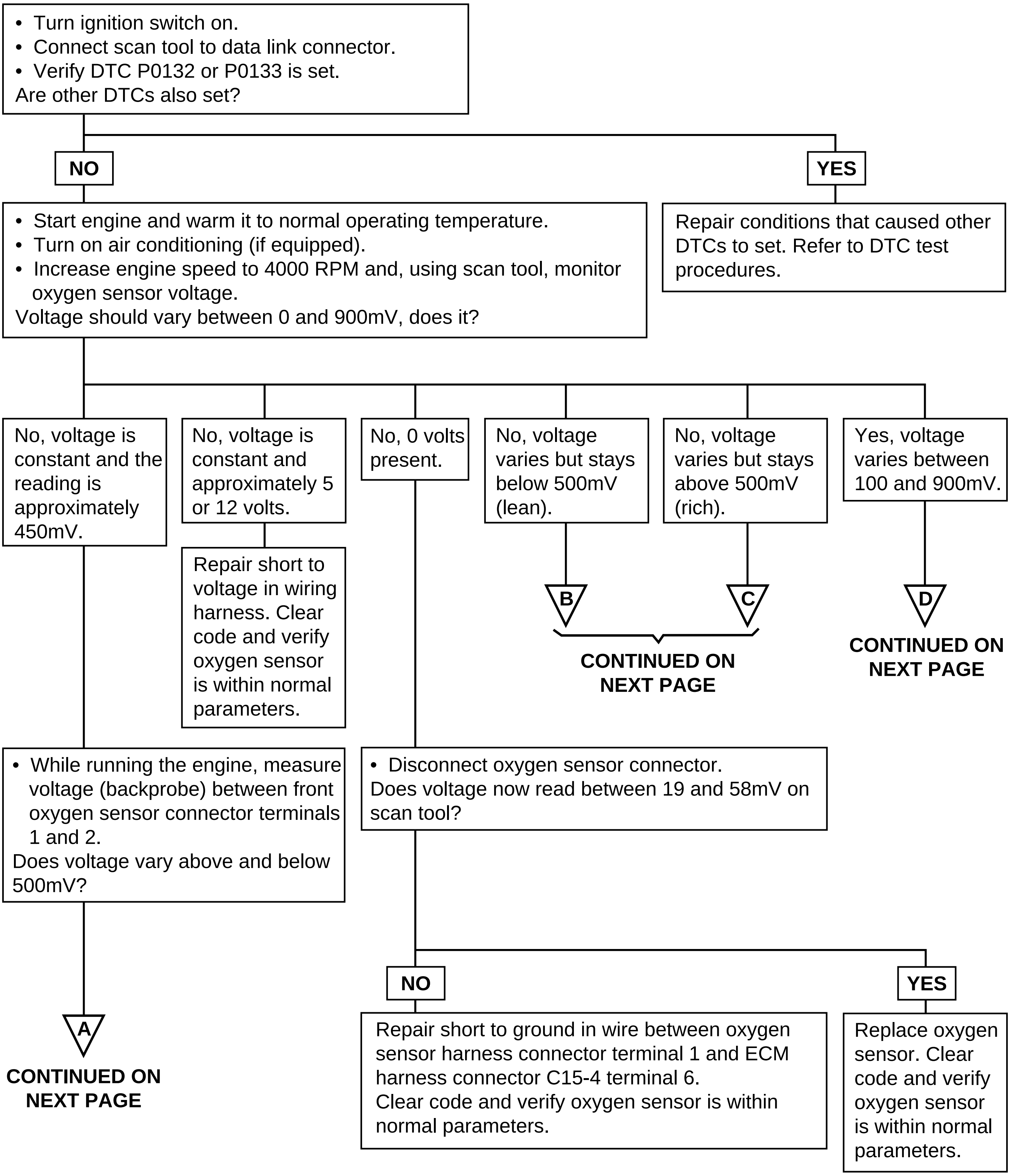
DTC detection condition	Probable cause
Background • When the heated oxygen sensor begins to deteriorate, the oxygen sensor signal response becomes poor. • The Engine Control Module forcibly varies the air/fuel mixture to make it leaner and richer and checks the response speed of the heated oxygen sensor. In addition, the Engine Control Module also checks for an open circuit in the heated oxygen sensor output line. Check Area • Coolant temperature sensor: Normal. • Heated oxygen sensor signal voltage has continued to be 0.1V or lower for 3 min. or more after the staring sequence was completed. • Engine Coolant Temperature is higher than 80°C (176°F). • Engine speed is higher than 1,200 r/min. • Engine load is 25% or more. Judgment Criteria • Input voltage supplied to the engine control module interface circuit is 4.5V or more when 5V is applied to the heated oxygen sensor output line via a resistor. Check Area • Coolant temperature sensor: Normal. • Engine Coolant Temperature is 50°C (122°F) or more. • Engine speed is between 1,500 and 3,000 r/min or 1,100 and 3,000 r/min. • Engine load is 25 - 60%. • Intake air temperature is -10°C (14°F) or more. • Under the closed loop air-fuel control. • Monitoring Time: 8sec. Judgment Criteria • When the air-fuel ratio is focibly changed (lean to rich and rich to lean), the heated oxygen sensor signal doesn't provide response within 1.28 sec. • Monitored only once per trip.	• Heated oxygen sensor deteriorated • Open circuit in heated oxygen sensor output line • Engine control module failed

CIRCUIT DIAGRAM



EFUC409A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0132 or P0133 is set.

Are other DTCs also set?

- Start engine and warm it to normal operating temperature.
- Turn on air conditioning (if equipped).
- Increase engine speed to 4000 RPM and, using scan tool, monitor oxygen sensor voltage.

Voltage should vary between 0 and 900mV, does it?

Repair conditions that caused other DTCs to set. Refer to DTC test procedures.

No, voltage is constant and the reading is approximately 450mV.

No, voltage is constant and approximately 5 or 12 volts.

No, 0 volts present.

No, voltage varies but stays below 500mV (lean).

No, voltage varies but stays above 500mV (rich).

Yes, voltage varies between 100 and 900mV.

Repair short to voltage in wiring harness. Clear code and verify oxygen sensor is within normal parameters.

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- While running the engine, measure voltage (backprobe) between front oxygen sensor connector terminals 1 and 2.

Does voltage vary above and below 500mV?

- Disconnect oxygen sensor connector.

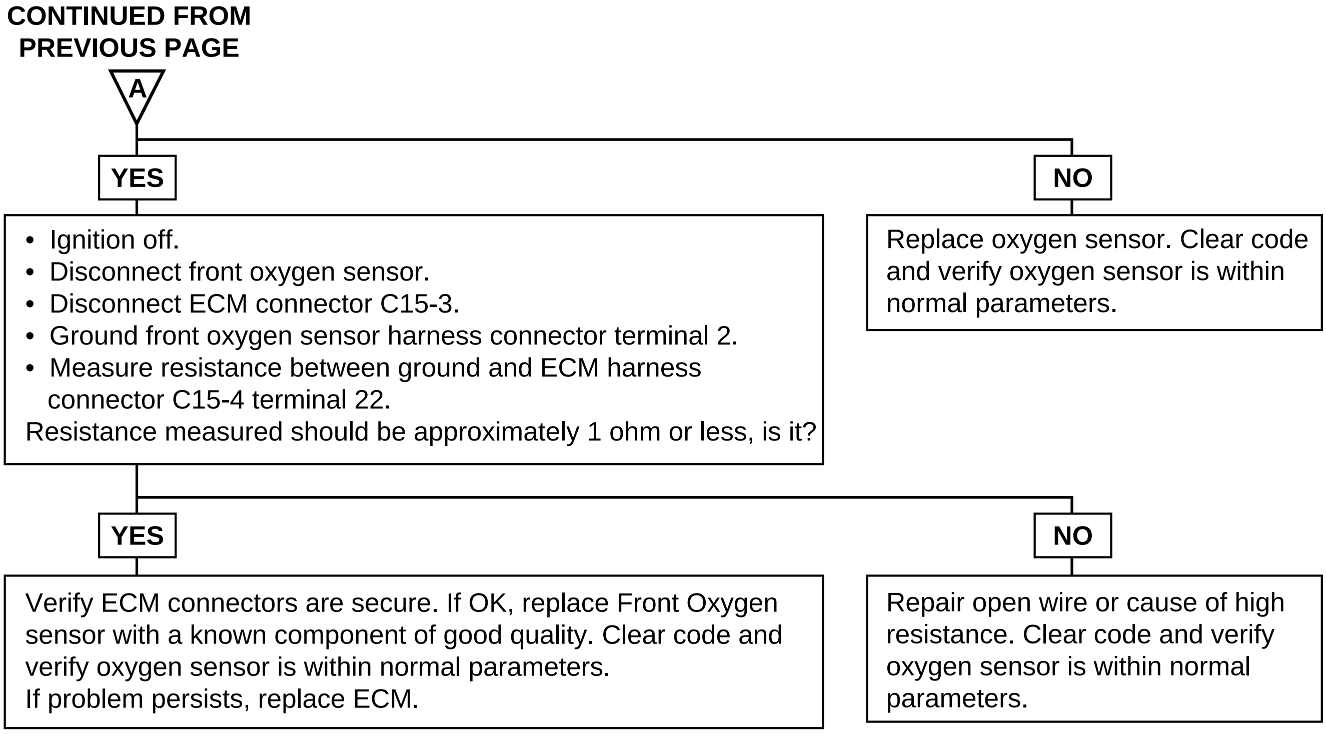
Does voltage now read between 19 and 58mV on scan tool?

CONTINUED ON NEXT PAGE

Repair short to ground in wire between oxygen sensor harness connector terminal 1 and ECM harness connector C15-4 terminal 6.
Clear code and verify oxygen sensor is within normal parameters.

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

EFUC506B



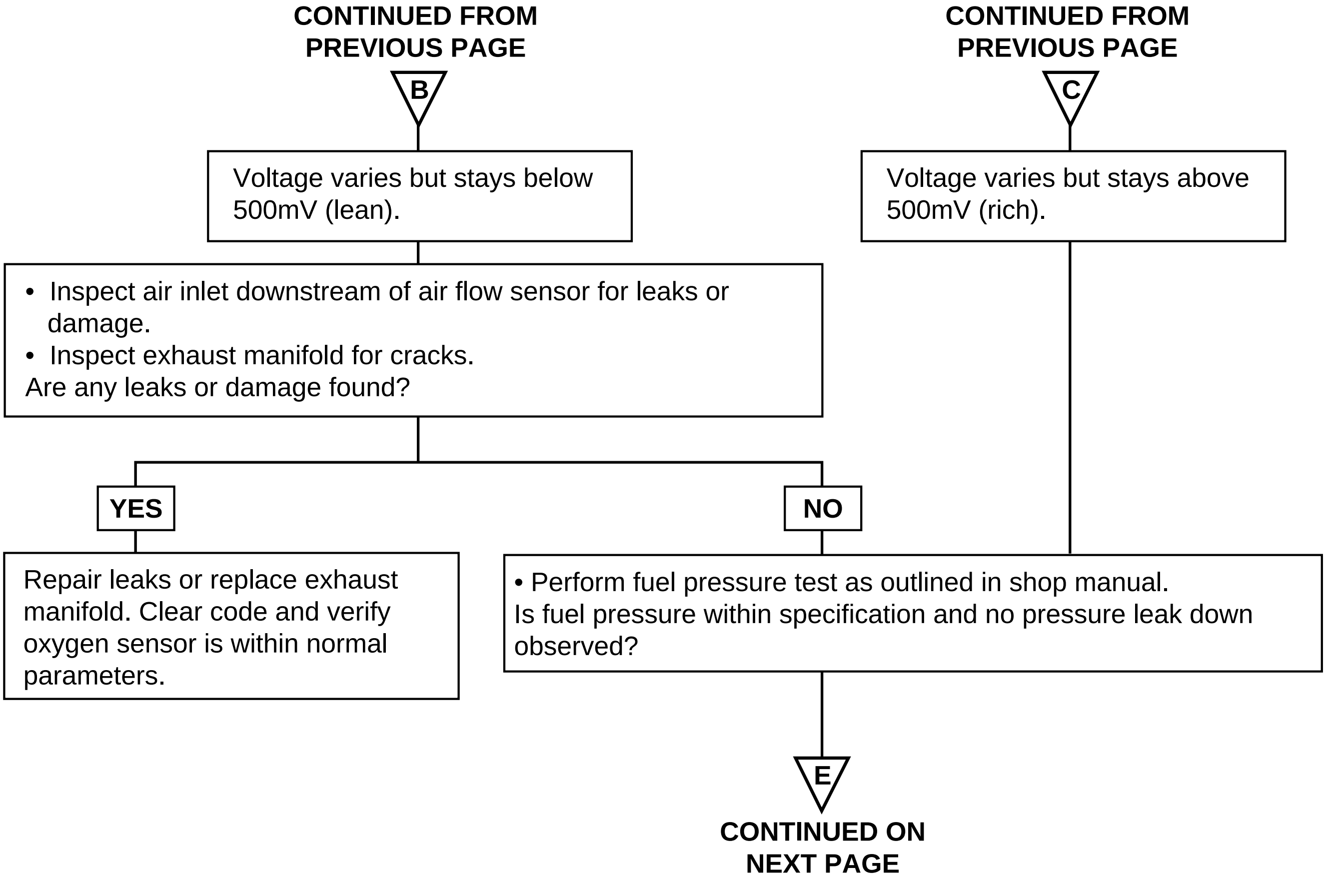
- Ignition off.
- Disconnect front oxygen sensor.
- Disconnect ECM connector C15-3.
- Ground front oxygen sensor harness connector terminal 2.
- Measure resistance between ground and ECM harness connector C15-4 terminal 22.

Resistance measured should be approximately 1 ohm or less, is it?

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

Verify ECM connectors are secure. If OK, replace Front Oxygen sensor with a known component of good quality. Clear code and verify oxygen sensor is within normal parameters.
If problem persists, replace ECM.

Repair open wire or cause of high resistance. Clear code and verify oxygen sensor is within normal parameters.



Voltage varies but stays below 500mV (lean).

Voltage varies but stays above 500mV (rich).

- Inspect air inlet downstream of air flow sensor for leaks or damage.
- Inspect exhaust manifold for cracks.

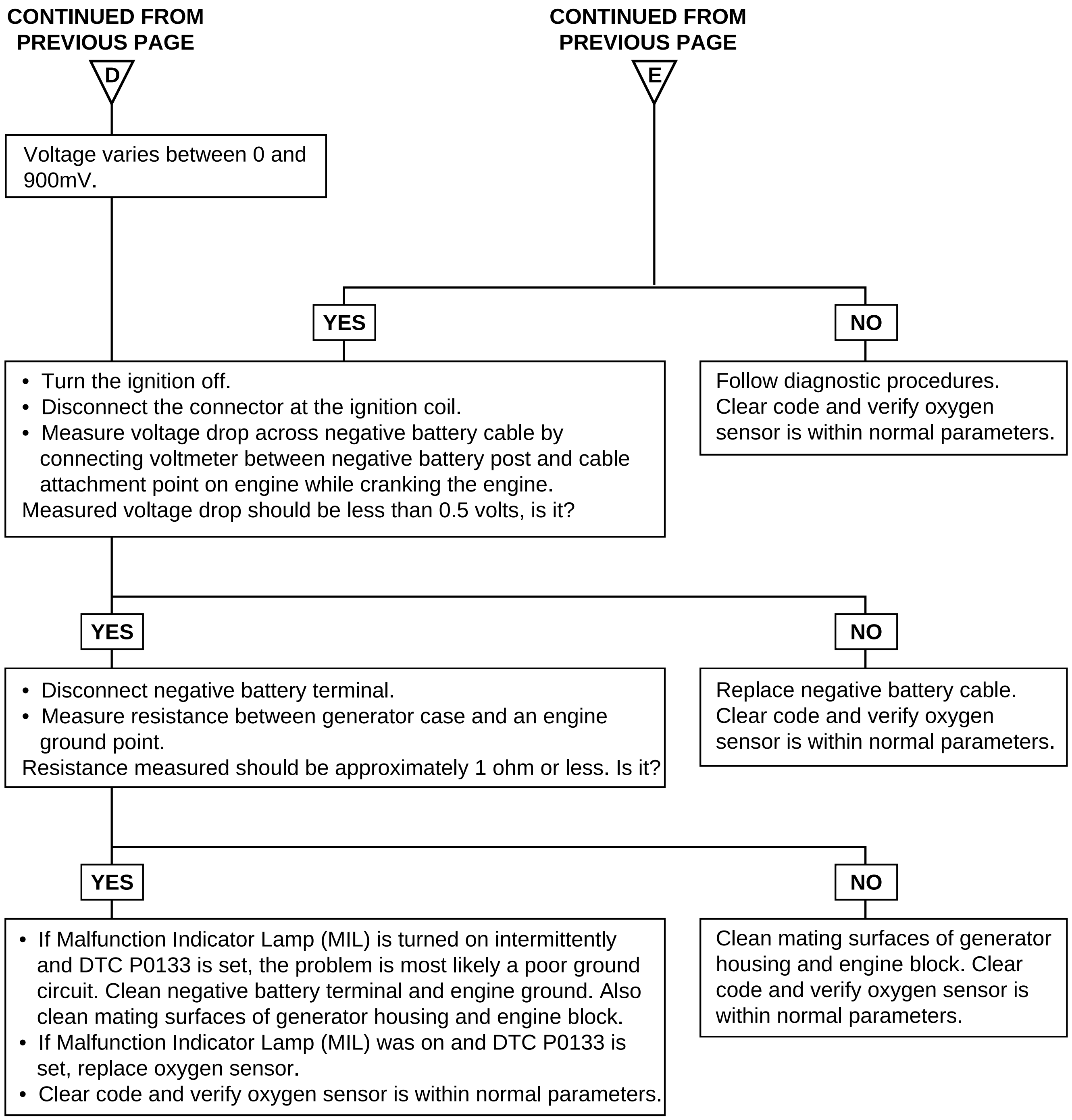
Are any leaks or damage found?

Repair leaks or replace exhaust manifold. Clear code and verify oxygen sensor is within normal parameters.

- Perform fuel pressure test as outlined in shop manual.

Is fuel pressure within specification and no pressure leak down observed?

EFUC506C



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D

Voltage varies between 0 and 900mV.

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E

YES

- Turn the ignition off.
- Disconnect the connector at the ignition coil.
- Measure voltage drop across negative battery cable by connecting voltmeter between negative battery post and cable attachment point on engine while cranking the engine.

Measured voltage drop should be less than 0.5 volts, is it?

NO

Follow diagnostic procedures. Clear code and verify oxygen sensor is within normal parameters.

YES

- Disconnect negative battery terminal.
- Measure resistance between generator case and an engine ground point.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Replace negative battery cable. Clear code and verify oxygen sensor is within normal parameters.

YES

- If Malfunction Indicator Lamp (MIL) is turned on intermittently and DTC P0133 is set, the problem is most likely a poor ground circuit. Clean negative battery terminal and engine ground. Also clean mating surfaces of generator housing and engine block.
- If Malfunction Indicator Lamp (MIL) was on and DTC P0133 is set, replace oxygen sensor.
- Clear code and verify oxygen sensor is within normal parameters.

NO

Clean mating surfaces of generator housing and engine block. Clear code and verify oxygen sensor is within normal parameters.

HP0133D

EFUC5070

DTC	Diagnostic item
P0135	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)

DESCRIPTION

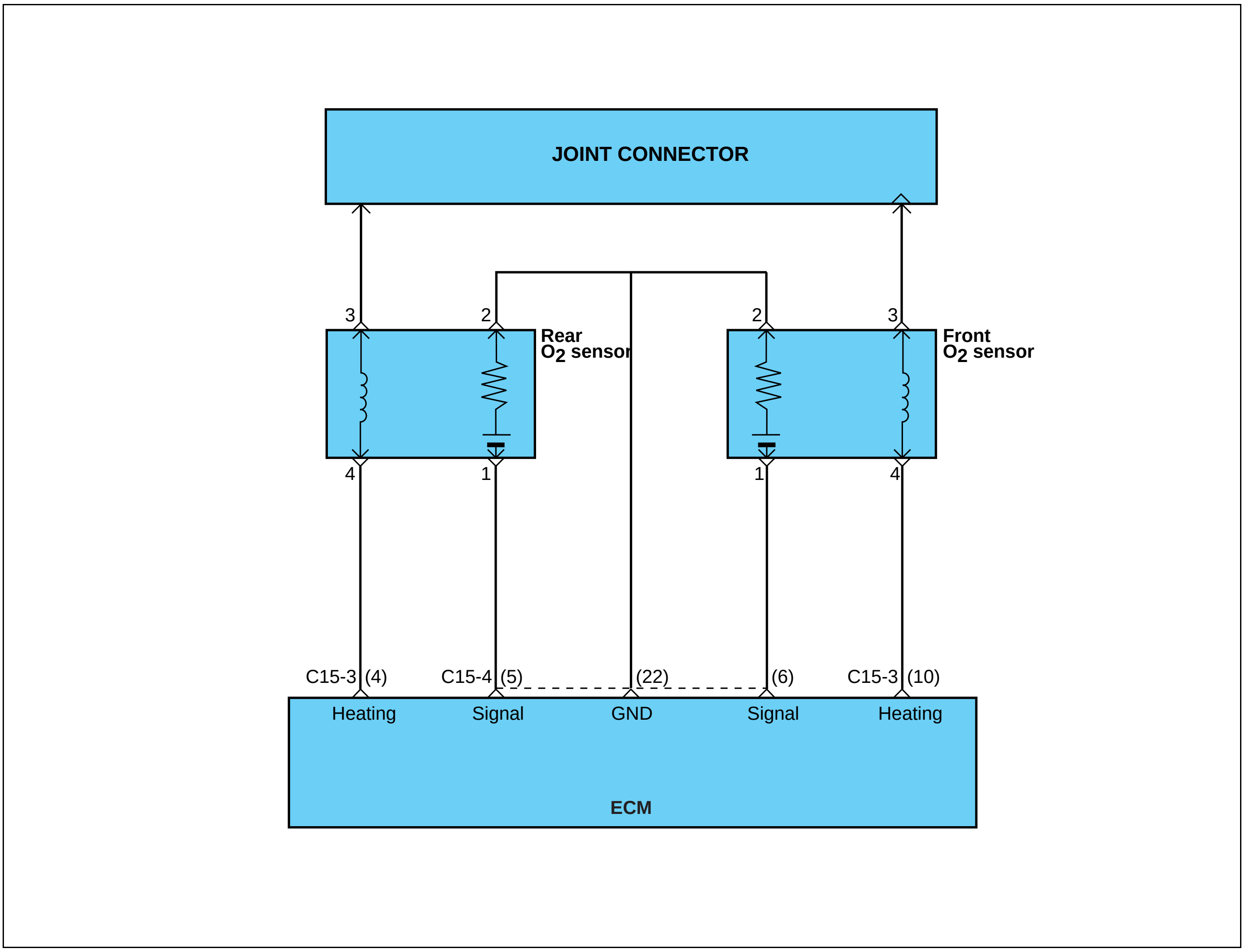
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic inverter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the ECM of the LEAN condition (small electromotive force: 0V). When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the ECM of the RICH condition (large electromotive force: 1V).

The ECM determined by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the ECM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the Zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

TROUBLESHOOTING GUIDE

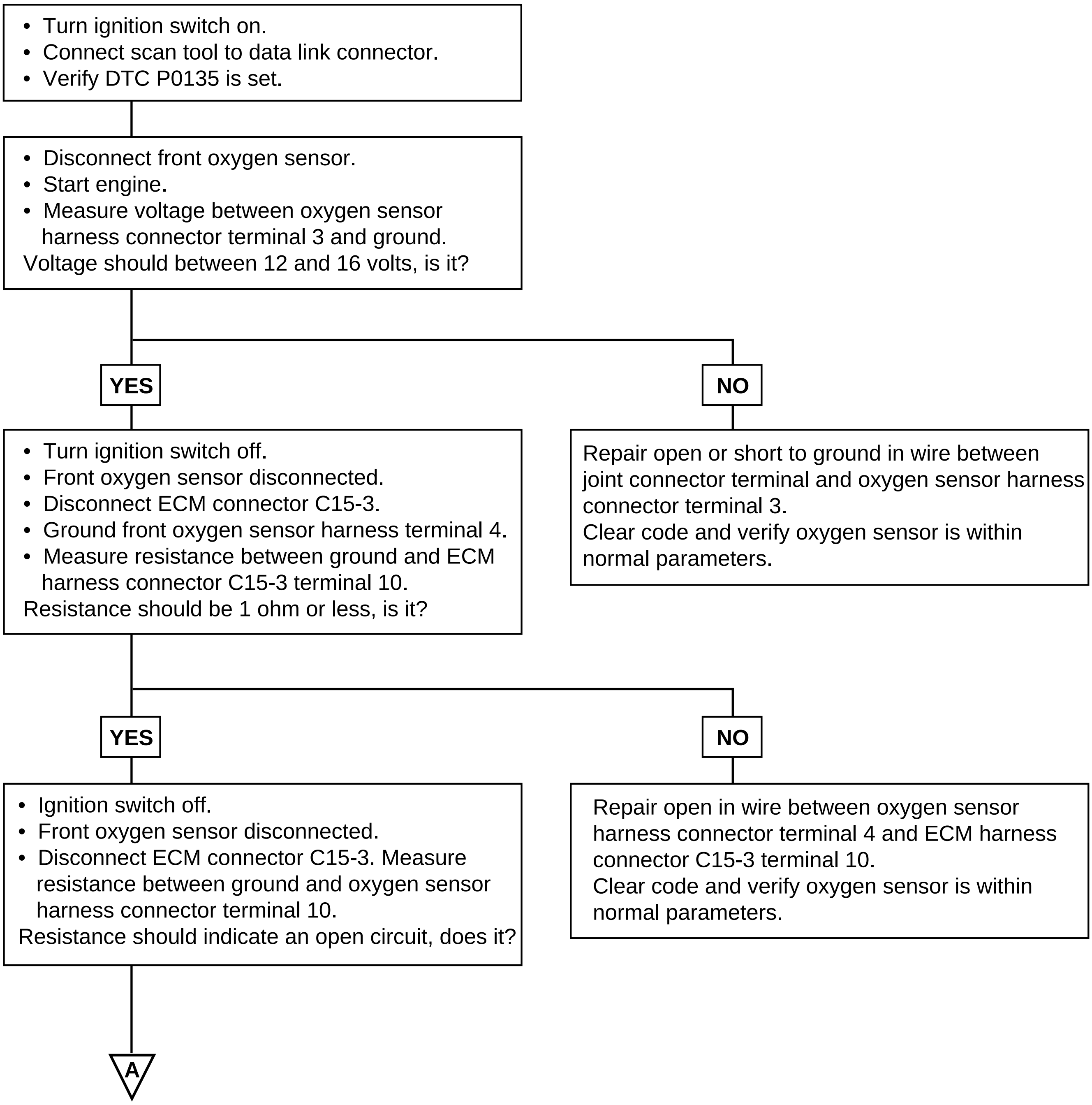
DTC detection condition	Probable cause
Background • The Engine Control Module checks whether the heater current is within a specified range when the heater is energized. Check Area • Battery voltage is between 12 and 16V. Judgment Criteria • Heater current of the front heated oxygen sensor heater (Bank 1 Sensor 1) has continued to be 0.2 A or less, or 3.5 A or higher for 6 sec. • Monitored only once per trip.	• Open or shorted oxygen sensor heater circuit • Open circuit in oxygen sensor heater • Engine control module failed

CIRCUIT DIAGRAM



EFUC409A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0135 is set.

- Disconnect front oxygen sensor.
- Start engine.
- Measure voltage between oxygen sensor harness connector terminal 3 and ground.

Voltage should between 12 and 16 volts, is it?

- Turn ignition switch off.
- Front oxygen sensor disconnected.
- Disconnect ECM connector C15-3.
- Ground front oxygen sensor harness terminal 4.
- Measure resistance between ground and ECM harness connector C15-3 terminal 10.

Resistance should be 1 ohm or less, is it?

Repair open or short to ground in wire between joint connector terminal and oxygen sensor harness connector terminal 3.
Clear code and verify oxygen sensor is within normal parameters.

- Ignition switch off.
- Front oxygen sensor disconnected.
- Disconnect ECM connector C15-3. Measure resistance between ground and oxygen sensor harness connector terminal 10.

Resistance should indicate an open circuit, does it?

Repair open in wire between oxygen sensor harness connector terminal 4 and ECM harness connector C15-3 terminal 10.
Clear code and verify oxygen sensor is within normal parameters.

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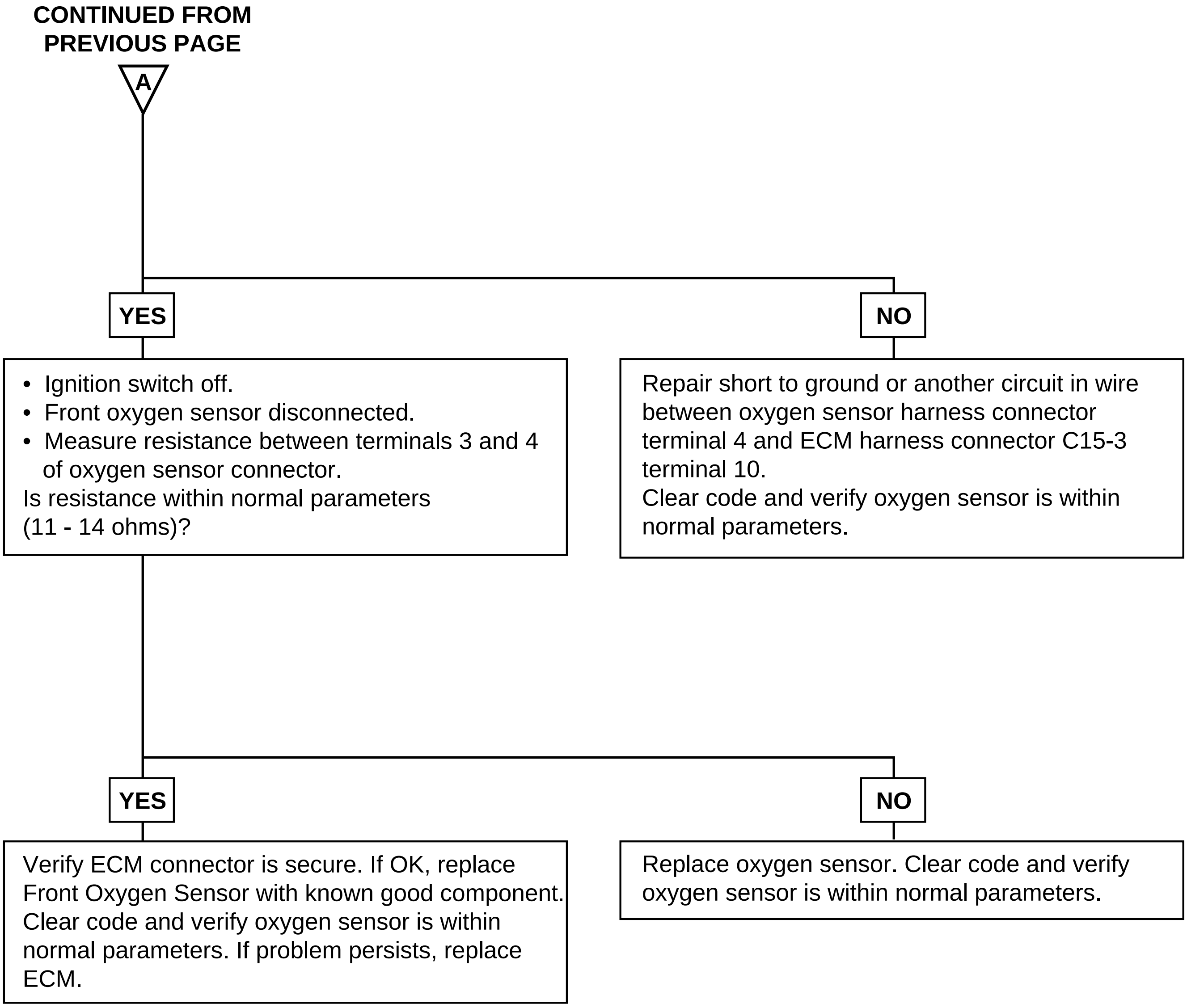
EFUC507B



- Ignition switch off.
- Front oxygen sensor disconnected.
- Measure resistance between terminals 3 and 4 of oxygen sensor connector.

Is resistance within normal parameters (11 - 14 ohms)?

Repair short to ground or another circuit in wire between oxygen sensor harness connector terminal 4 and ECM harness connector C15-3 terminal 10.
Clear code and verify oxygen sensor is within normal parameters.

Verify ECM connector is secure. If OK, replace Front Oxygen Sensor with known good component. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace ECM.

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

EFUC507C

EFUC5080

DTC	Diagnostic item
P0136 P0140	Oxygen Sensor Circuit Open (Bank 1, Sensor 2) Oxygen Sensor Circuit Short (Bank 1, Sensor 2)

DESCRIPTION

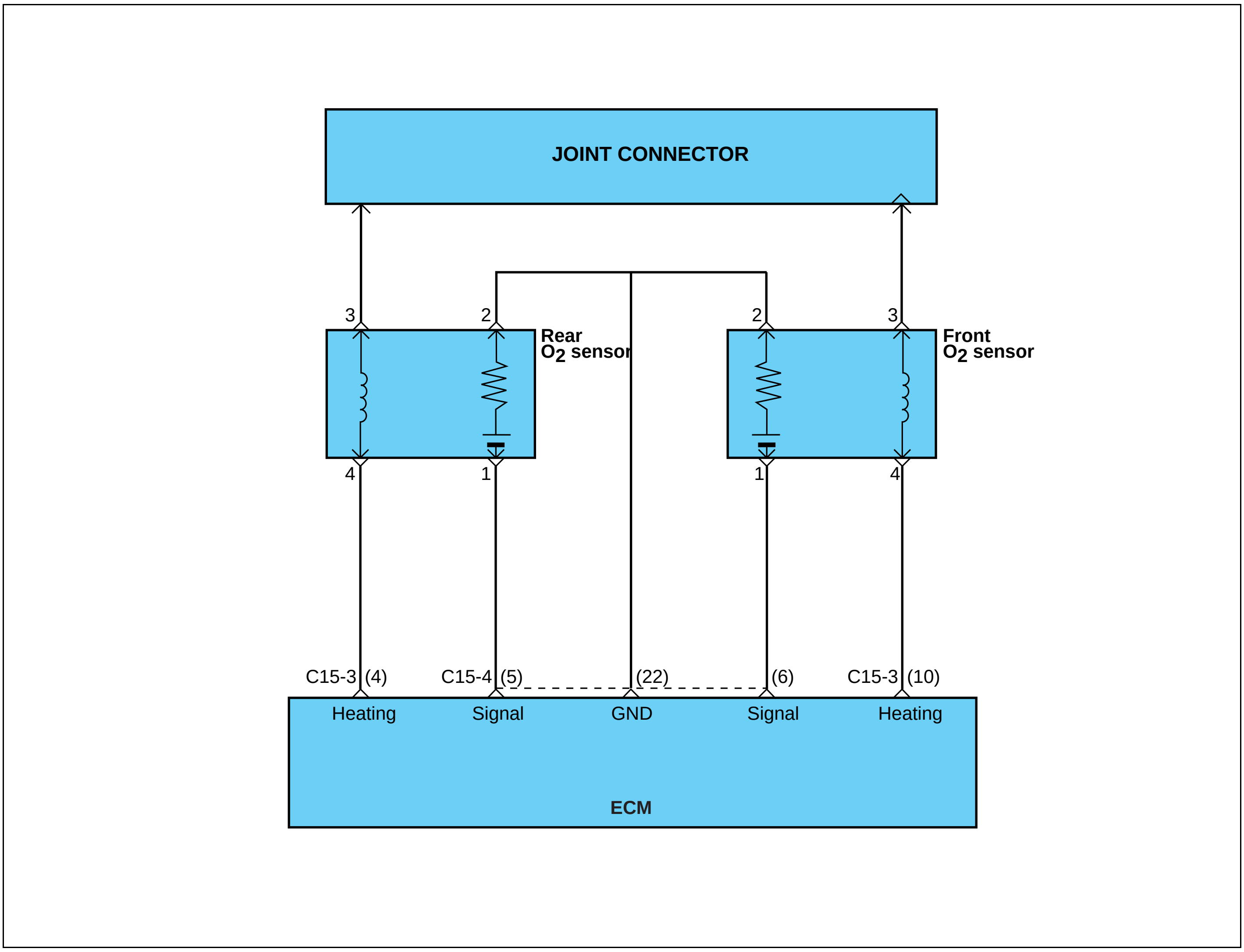
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic inverter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the ECM of the LEAN condition (small electromotive force: 0V). When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the ECM of the RICH condition (large electromotive force: 1V).

The ECM determined by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the ECM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the Zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

TROUBLESHOOTING GUIDE

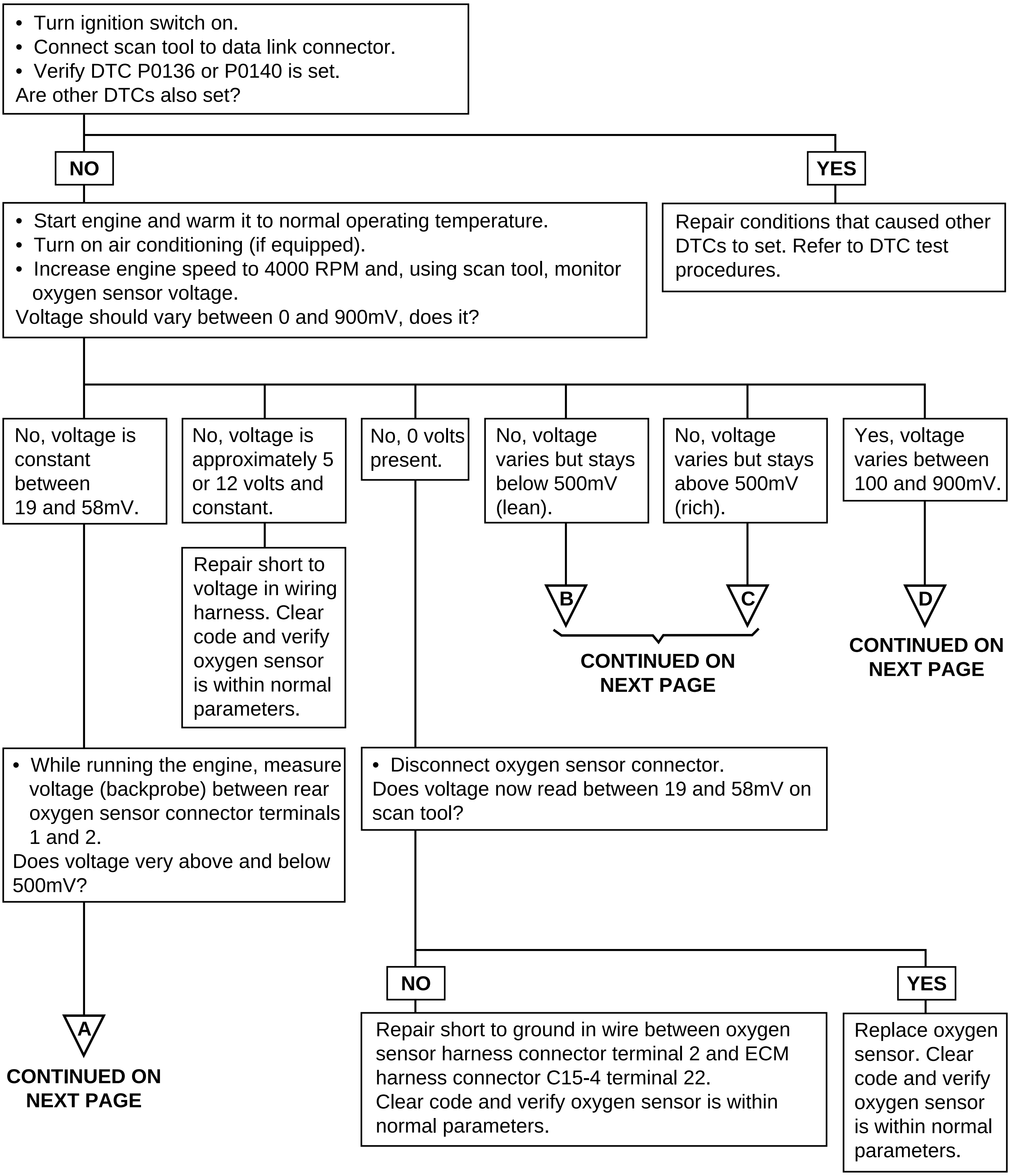
DTC detection condition	Probable cause
Background • The Engine Control Module checks for an open circuit in the heated oxygen sensor output line. Check Area • Coolant temperature sensor: Normal. • Heated oxygen sensor signal voltage has continued to be 0.1V or lower for 3 min. or more after the staring sequence was completed. • Engine coolant temperature is 80°C (176°F) or more. • Engine speed is higher than 1,200 r/min. • Engine load is 25% or more. • Monitoring Time: 7 - 10 sec. Judgment Criteria • Input voltage supplied to the engine control module interface circuit is 4.5V or more when 5V is applied to the heated oxygen sensor output line via a resistor. • Making the air-fuel ratio 15% richer doesn't result in raising the heated oxygen sensor output voltage beyond 0.1V.	• Heated oxygen sensor failed • Open circuit in heated oxygen sensor output line • Engine control module failed

CIRCUIT DIAGRAM



EFUC409A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0136 or P0140 is set.

Are other DTCs also set?

YES: Repair conditions that caused other DTCs to set. Refer to DTC test procedures.

NO:

- Start engine and warm it to normal operating temperature.
- Turn on air conditioning (if equipped).
- Increase engine speed to 4000 RPM and, using scan tool, monitor oxygen sensor voltage.

Voltage should vary between 0 and 900mV, does it?

No, voltage is constant between 19 and 58mV.

- While running the engine, measure voltage (backprobe) between rear oxygen sensor connector terminals 1 and 2.

Does voltage very above and below 500mV?

CONTINUED ON NEXT PAGE

No, voltage is approximately 5 or 12 volts and constant.

Repair short to voltage in wiring harness. Clear code and verify oxygen sensor is within normal parameters.

No, 0 volts present.

- Disconnect oxygen sensor connector.

Does voltage now read between 19 and 58mV on scan tool?

NO: Repair short to ground in wire between oxygen sensor harness connector terminal 2 and ECM harness connector C15-4 terminal 22. Clear code and verify oxygen sensor is within normal parameters.

YES: Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

No, voltage varies but stays below 500mV (lean).

No, voltage varies but stays above 500mV (rich).

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Yes, voltage varies between 100 and 900mV.

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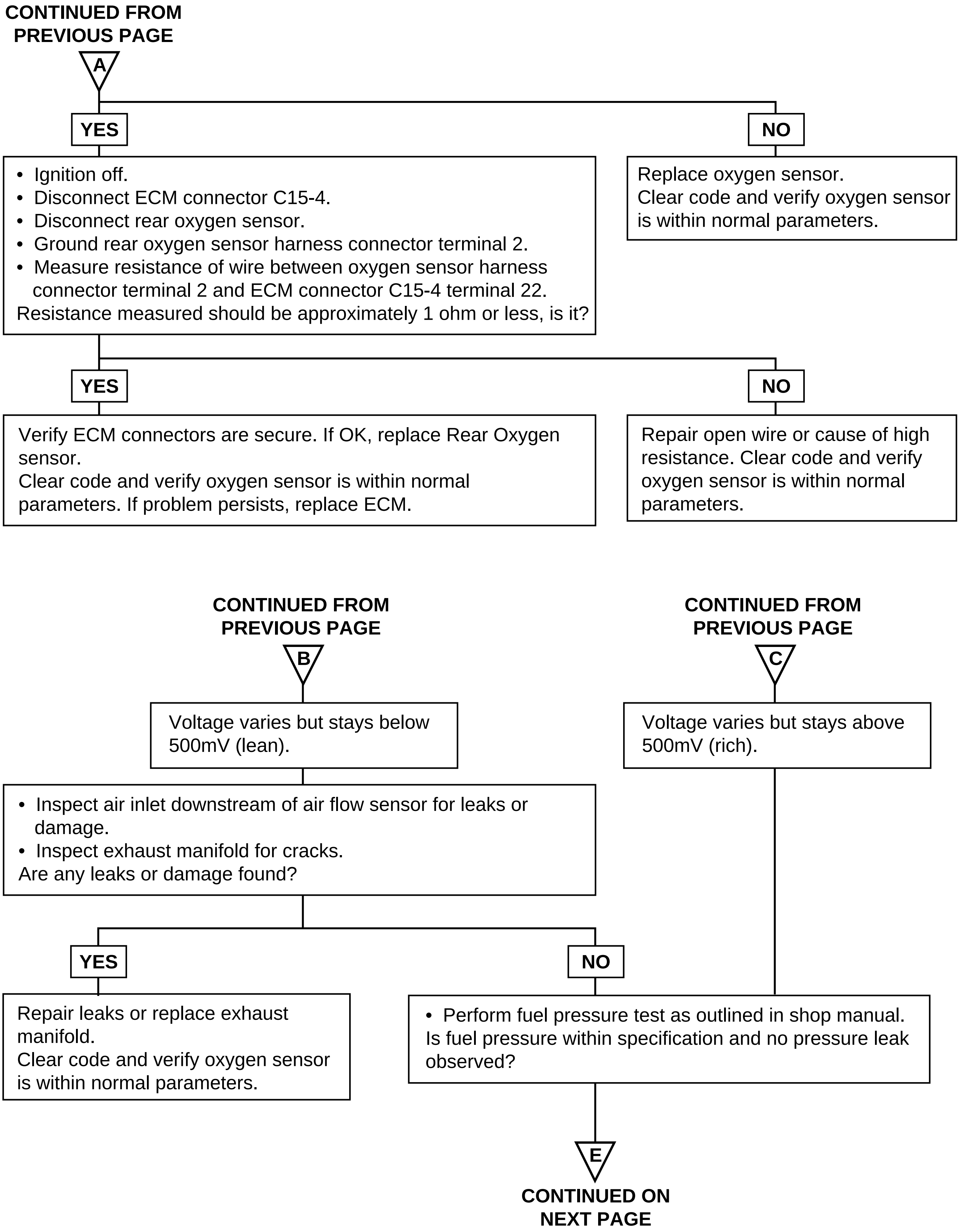


- Ignition off.
- Disconnect ECM connector C15-4.
- Disconnect rear oxygen sensor.
- Ground rear oxygen sensor harness connector terminal 2.
- Measure resistance of wire between oxygen sensor harness connector terminal 2 and ECM connector C15-4 terminal 22.

Resistance measured should be approximately 1 ohm or less, is it?

Replace oxygen sensor.
Clear code and verify oxygen sensor is within normal parameters.

Verify ECM connectors are secure. If OK, replace Rear Oxygen sensor.
Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace ECM.

Repair open wire or cause of high resistance. Clear code and verify oxygen sensor is within normal parameters.

Voltage varies but stays below 500mV (lean).

Voltage varies but stays above 500mV (rich).

- Inspect air inlet downstream of air flow sensor for leaks or damage.
- Inspect exhaust manifold for cracks.

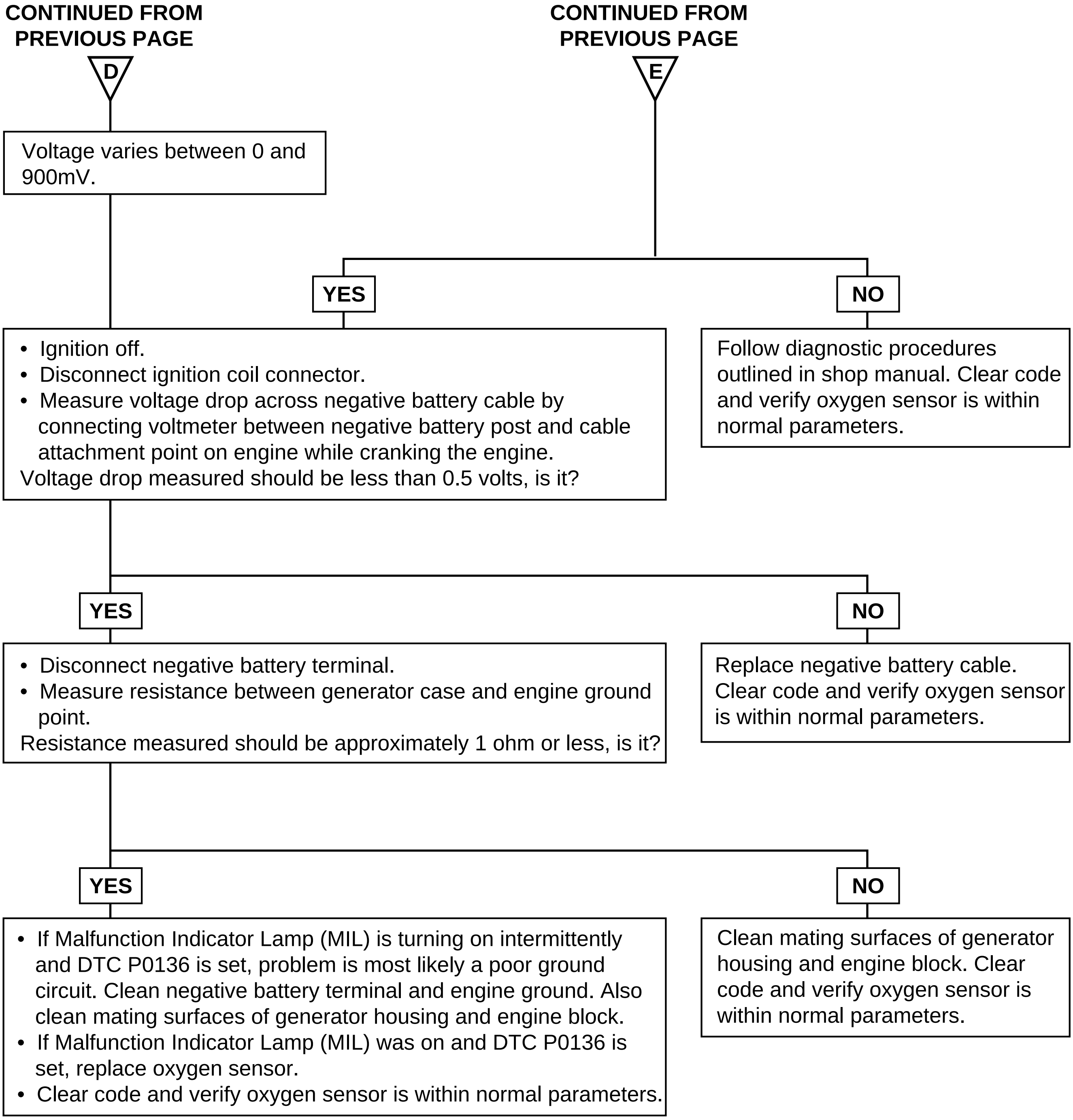
Are any leaks or damage found?

Repair leaks or replace exhaust manifold.
Clear code and verify oxygen sensor is within normal parameters.

- Perform fuel pressure test as outlined in shop manual.

Is fuel pressure within specification and no pressure leak observed?

EFUC508C



Voltage varies between 0 and 900mV.

- Ignition off.
- Disconnect ignition coil connector.
- Measure voltage drop across negative battery cable by connecting voltmeter between negative battery post and cable attachment point on engine while cranking the engine.

Voltage drop measured should be less than 0.5 volts, is it?

Follow diagnostic procedures outlined in shop manual. Clear code and verify oxygen sensor is within normal parameters.

- Disconnect negative battery terminal.
- Measure resistance between generator case and engine ground point.

Resistance measured should be approximately 1 ohm or less, is it?

Replace negative battery cable. Clear code and verify oxygen sensor is within normal parameters.

- If Malfunction Indicator Lamp (MIL) is turning on intermittently and DTC P0136 is set, problem is most likely a poor ground circuit. Clean negative battery terminal and engine ground. Also clean mating surfaces of generator housing and engine block.
- If Malfunction Indicator Lamp (MIL) was on and DTC P0136 is set, replace oxygen sensor.
- Clear code and verify oxygen sensor is within normal parameters.

Clean mating surfaces of generator housing and engine block. Clear code and verify oxygen sensor is within normal parameters.

EFUC508D

EFUC5090

DTC	Diagnostic item
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)

DESCRIPTION

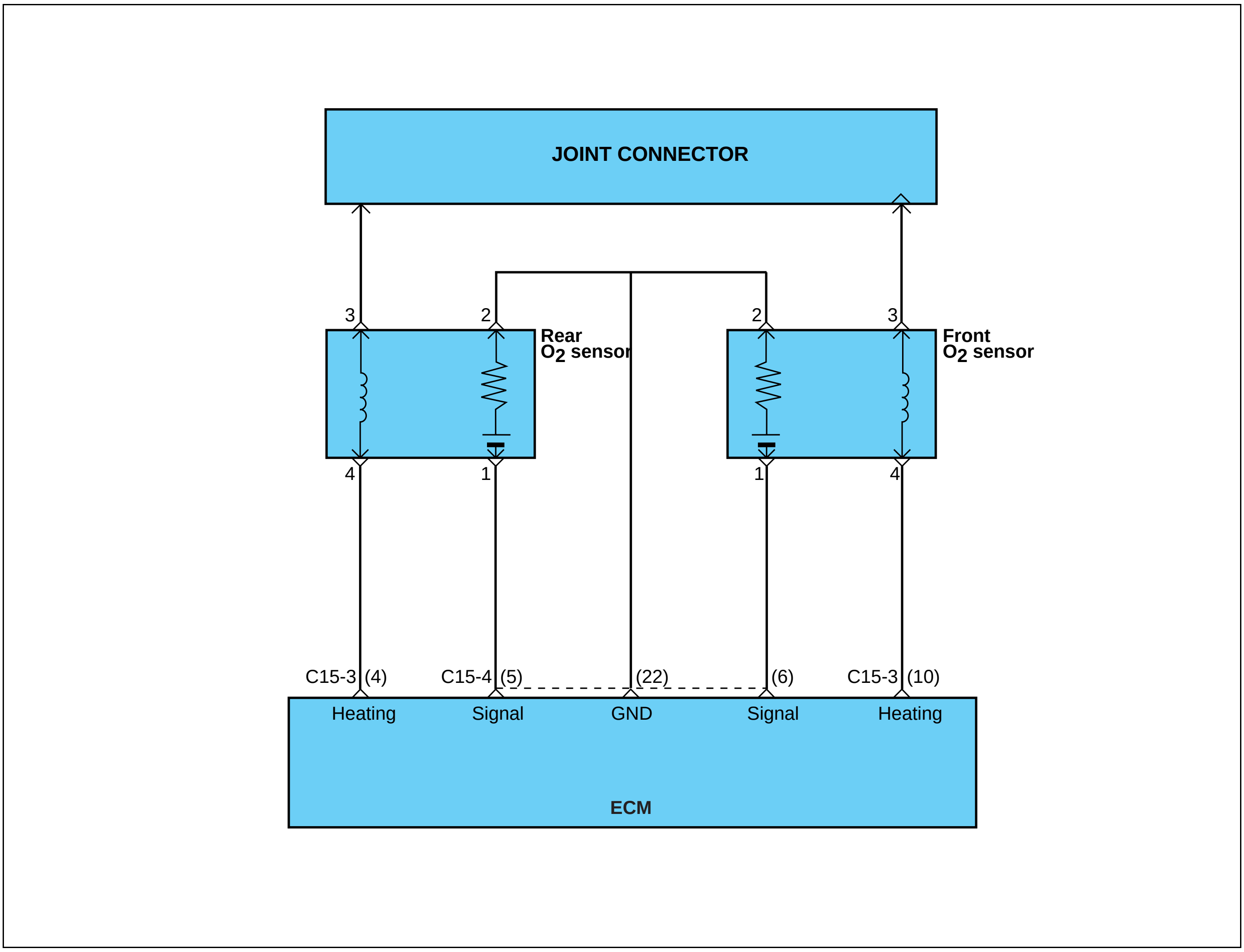
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic inverter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel ratio. The oxygen sensor has the characteristic whereby its output voltage changes suddenly in the vicinity of the stoichiometric air-fuel ratio. This characteristic is used to detect the oxygen concentration in the exhaust gas and provide feedback to the computer for control of the air-fuel ratio. When the air-fuel ratio becomes LEAN, the oxygen concentration in the exhaust increases and the oxygen sensor informs the ECM of the LEAN condition (small electromotive force: 0V). When the air-fuel ratio is RICHER than the stoichiometric air-fuel ratio the oxygen concentration in the exhaust gas is reduced and the oxygen sensor informs the ECM of the RICH condition (large electromotive force: 1V).

The ECM determined by the electromotive force from the oxygen sensor whether the air-fuel ratio is RICH or LEAN and controls the injection time accordingly. However, if malfunction of the oxygen sensor causes output of abnormal electromotive force, the ECM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the Zirconia element. The heater is controlled by the ECM. When the intake air volume is low (the temperature of the exhaust gas is low), current flows to the heater to heat the sensor for accurate oxygen concentration detection.

TROUBLESHOOTING GUIDE

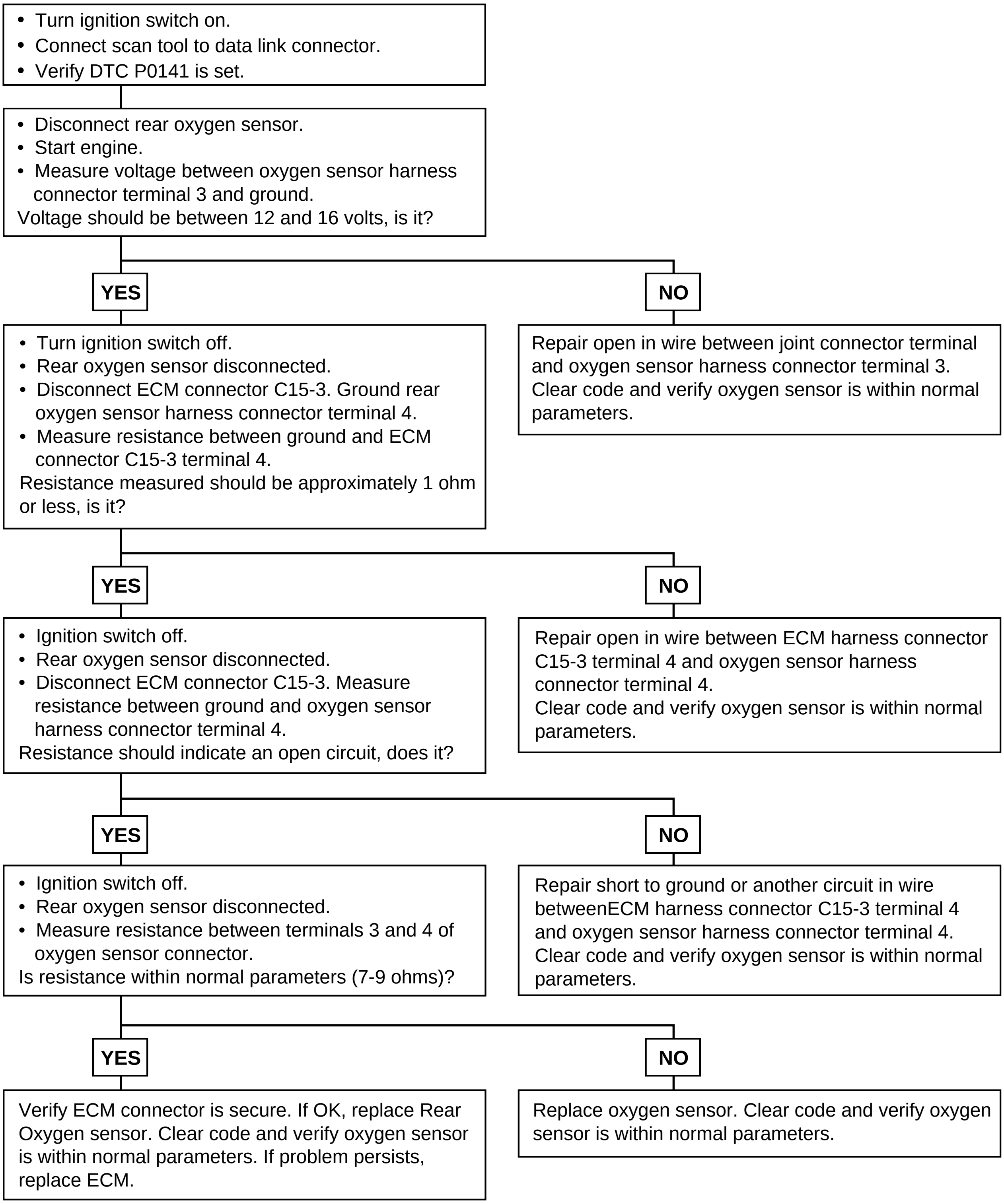
DTC detection condition	Probable cause
Background • The Engine Control Module checks whether the heater current is within a specified range when the heater is energized. Check Area • Battery voltage is between 12 and 16V. Judgment Criteria • Heater current of the front heated oxygen sensor heater (Bank 1 Sensor 2) has continued to be 0.2 A or less, or 3.5 A or more for 6 sec. • Monitored only once per trip.	• Open or shorted oxygen sensor heater circuit • Open circuit in oxygen sensor heater • Engine control module failed

CIRCUIT DIAGRAM



EFUC409A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0141 is set.

- Disconnect rear oxygen sensor.
- Start engine.
- Measure voltage between oxygen sensor harness connector terminal 3 and ground.

Voltage should be between 12 and 16 volts, is it?

YES

- Turn ignition switch off.
- Rear oxygen sensor disconnected.
- Disconnect ECM connector C15-3. Ground rear oxygen sensor harness connector terminal 4.
- Measure resistance between ground and ECM connector C15-3 terminal 4.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair open in wire between joint connector terminal and oxygen sensor harness connector terminal 3. Clear code and verify oxygen sensor is within normal parameters.

YES

- Ignition switch off.
- Rear oxygen sensor disconnected.
- Disconnect ECM connector C15-3. Measure resistance between ground and oxygen sensor harness connector terminal 4.

Resistance should indicate an open circuit, does it?

NO

Repair open in wire between ECM harness connector C15-3 terminal 4 and oxygen sensor harness connector terminal 4.
Clear code and verify oxygen sensor is within normal parameters.

YES

- Ignition switch off.
- Rear oxygen sensor disconnected.
- Measure resistance between terminals 3 and 4 of oxygen sensor connector.

Is resistance within normal parameters (7-9 ohms)?

NO

Repair short to ground or another circuit in wire betweenECM harness connector C15-3 terminal 4 and oxygen sensor harness connector terminal 4.
Clear code and verify oxygen sensor is within normal parameters.

YES

Verify ECM connector is secure. If OK, replace Rear Oxygen sensor. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace ECM.

NO

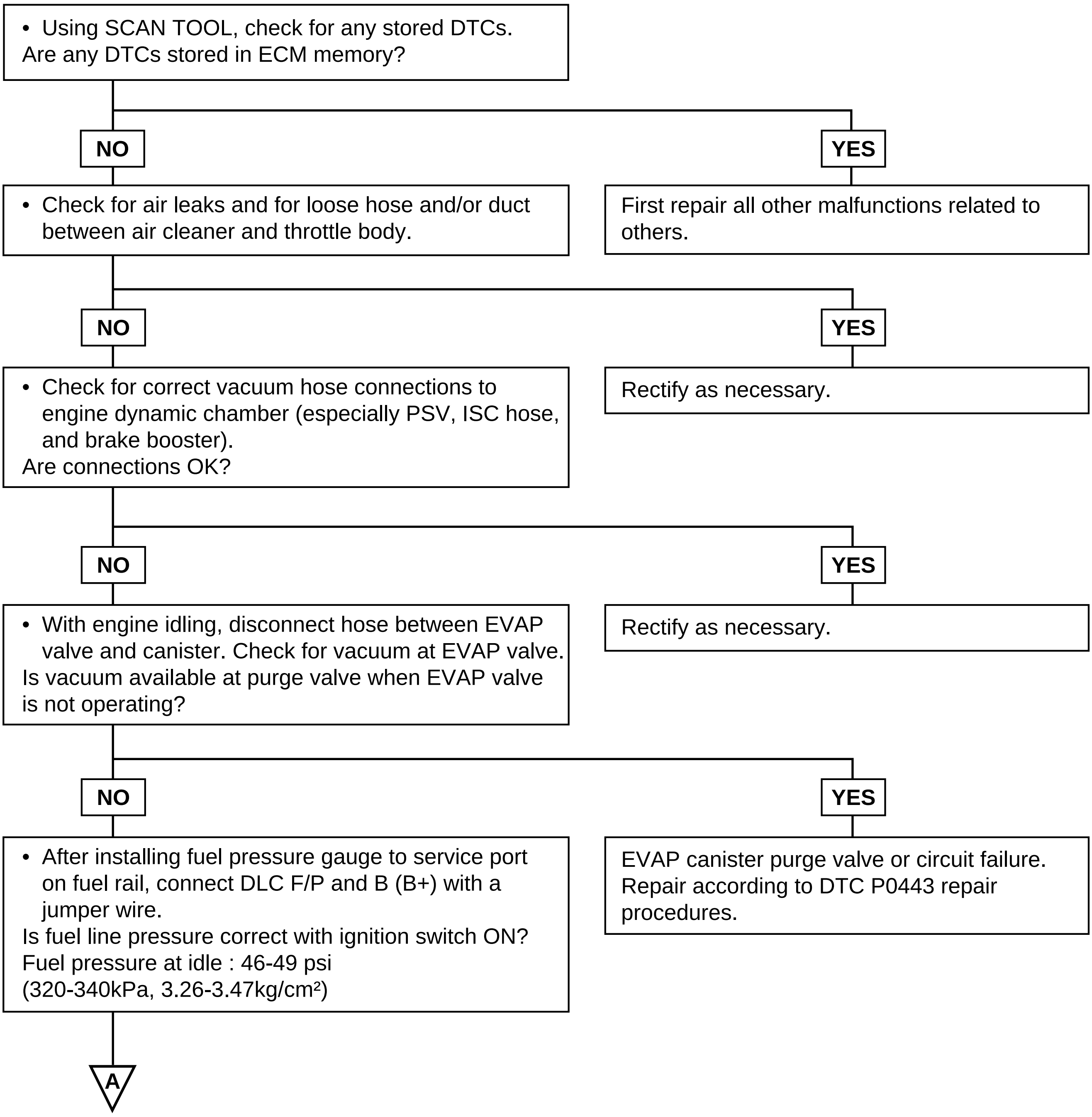
Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

EFUC509B

EFUC5100

DTC	Diagnostic item
P0171 P0172	Fuel System Too Lean (Bank 1) Fuel System Too Rich (Bank 1)

TEST PROCEDURE



- Using SCAN TOOL, check for any stored DTCs.

Are any DTCs stored in ECM memory?

- Check for air leaks and for loose hose and/or duct between air cleaner and throttle body.

First repair all other malfunctions related to others.

- Check for correct vacuum hose connections to engine dynamic chamber (especially PSV, ISC hose, and brake booster).

Are connections OK?

Rectify as necessary.

- With engine idling, disconnect hose between EVAP valve and canister. Check for vacuum at EVAP valve.

Is vacuum available at purge valve when EVAP valve is not operating?

Rectify as necessary.

- After installing fuel pressure gauge to service port on fuel rail, connect DLC F/P and B (B+) with a jumper wire.

Is fuel line pressure correct with ignition switch ON?

Fuel pressure at idle : 46-49 psi

(320-340kPa, 3.26-3.47kg/cm²)

EVAP canister purge valve or circuit failure. Repair according to DTC P0443 repair procedures.

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EFUC510B

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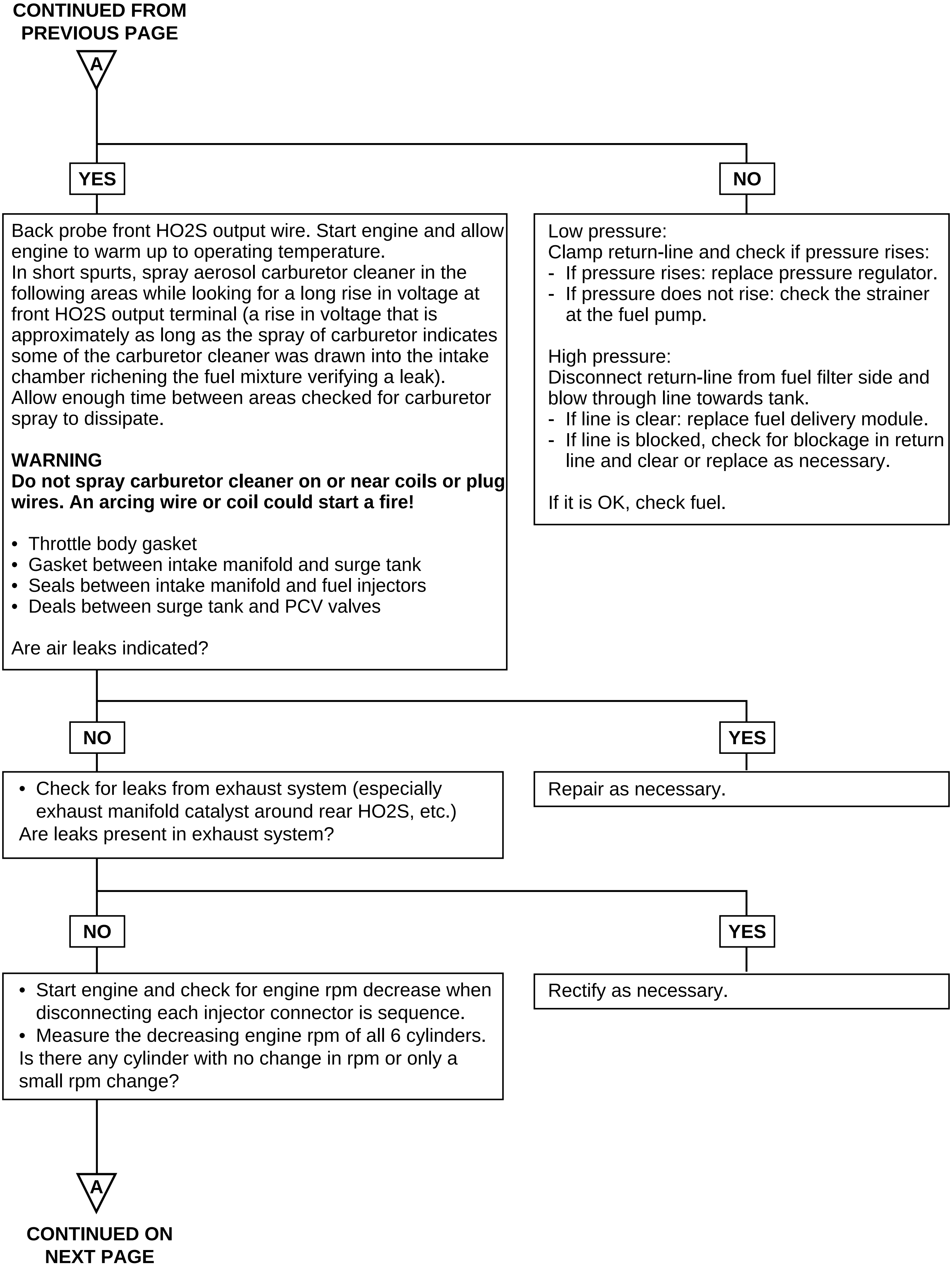

YES

Back probe front HO2S output wire. Start engine and allow engine to warm up to operating temperature.
In short spurts, spray aerosol carburetor cleaner in the following areas while looking for a long rise in voltage at front HO2S output terminal (a rise in voltage that is approximately as long as the spray of carburetor indicates some of the carburetor cleaner was drawn into the intake chamber richening the fuel mixture verifying a leak).
Allow enough time between areas checked for carburetor spray to dissipate.

WARNING
Do not spray carburetor cleaner on or near coils or plug wires. An arcing wire or coil could start a fire!

- Throttle body gasket
- Gasket between intake manifold and surge tank
- Seals between intake manifold and fuel injectors
- Deals between surge tank and PCV valves

Are air leaks indicated?

NO

Low pressure:
Clamp return-line and check if pressure rises:
- If pressure rises: replace pressure regulator.
- If pressure does not rise: check the strainer at the fuel pump.

High pressure:
Disconnect return-line from fuel filter side and blow through line towards tank.
- If line is clear: replace fuel delivery module.
- If line is blocked, check for blockage in return line and clear or replace as necessary.

If it is OK, check fuel.

NO

- Check for leaks from exhaust system (especially exhaust manifold catalyst around rear HO2S, etc.)

Are leaks present in exhaust system?

YES

Repair as necessary.

NO

- Start engine and check for engine rpm decrease when disconnecting each injector connector is sequence.
- Measure the decreasing engine rpm of all 6 cylinders.

Is there any cylinder with no change in rpm or only a small rpm change?

YES

Rectify as necessary.

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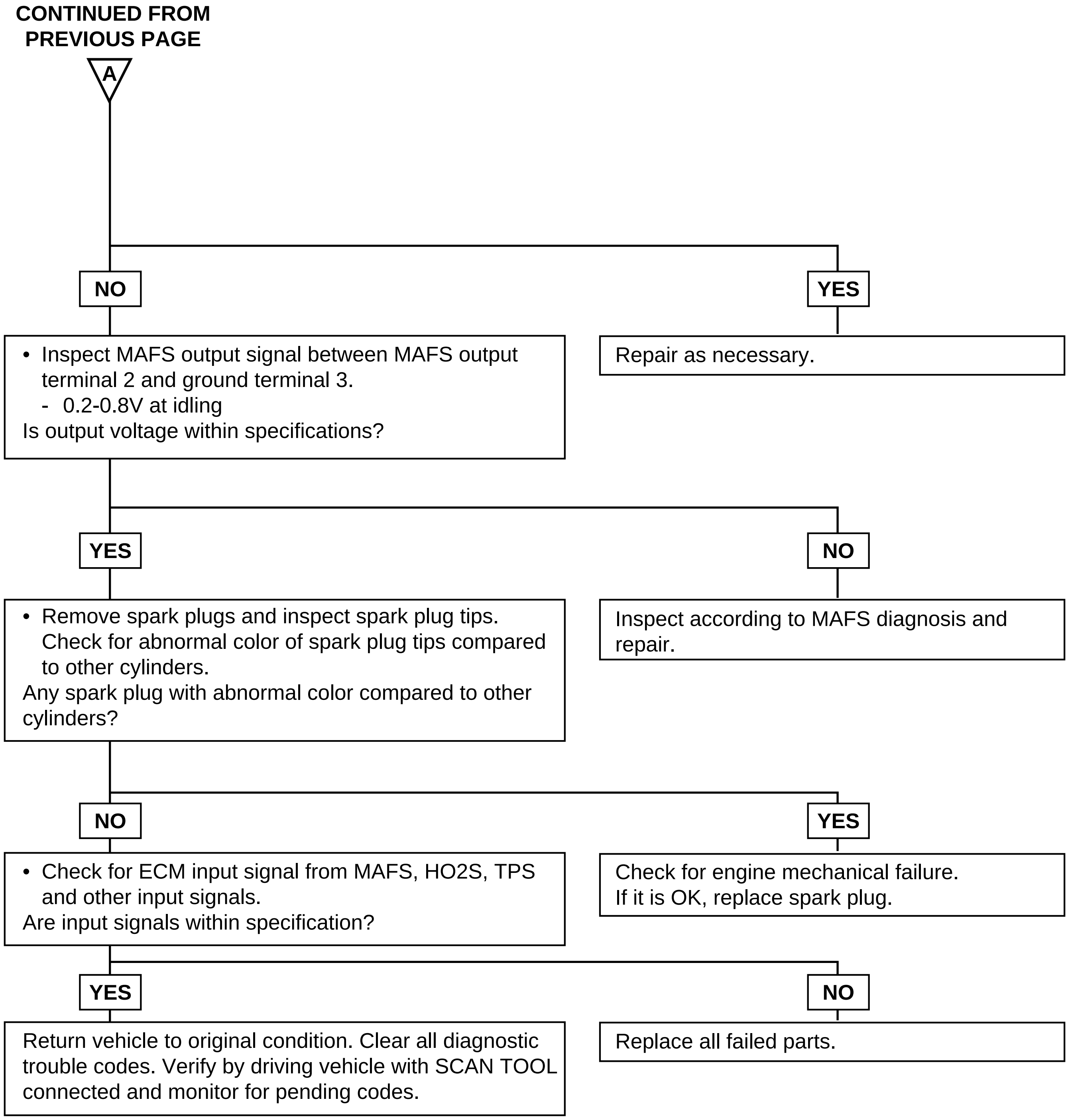
EFAC611B



- Inspect MAFS output signal between MAFS output terminal 2 and ground terminal 3.
  - 0.2-0.8V at idling

Is output voltage within specifications?

Repair as necessary.

- Remove spark plugs and inspect spark plug tips. Check for abnormal color of spark plug tips compared to other cylinders.

Any spark plug with abnormal color compared to other cylinders?

Inspect according to MAFS diagnosis and repair.

- Check for ECM input signal from MAFS, HO2S, TPS and other input signals.

Are input signals within specification?

Check for engine mechanical failure.
If it is OK, replace spark plug.

Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

Replace all failed parts.

EFAC611C

EFUC5110

DTC	Diagnostic item
P0201, P0202 P0203, P0204	Injector Circuit Malfunction (Cylinder-1, Cylinder-2, Cylinder-3, Cylinder-4)

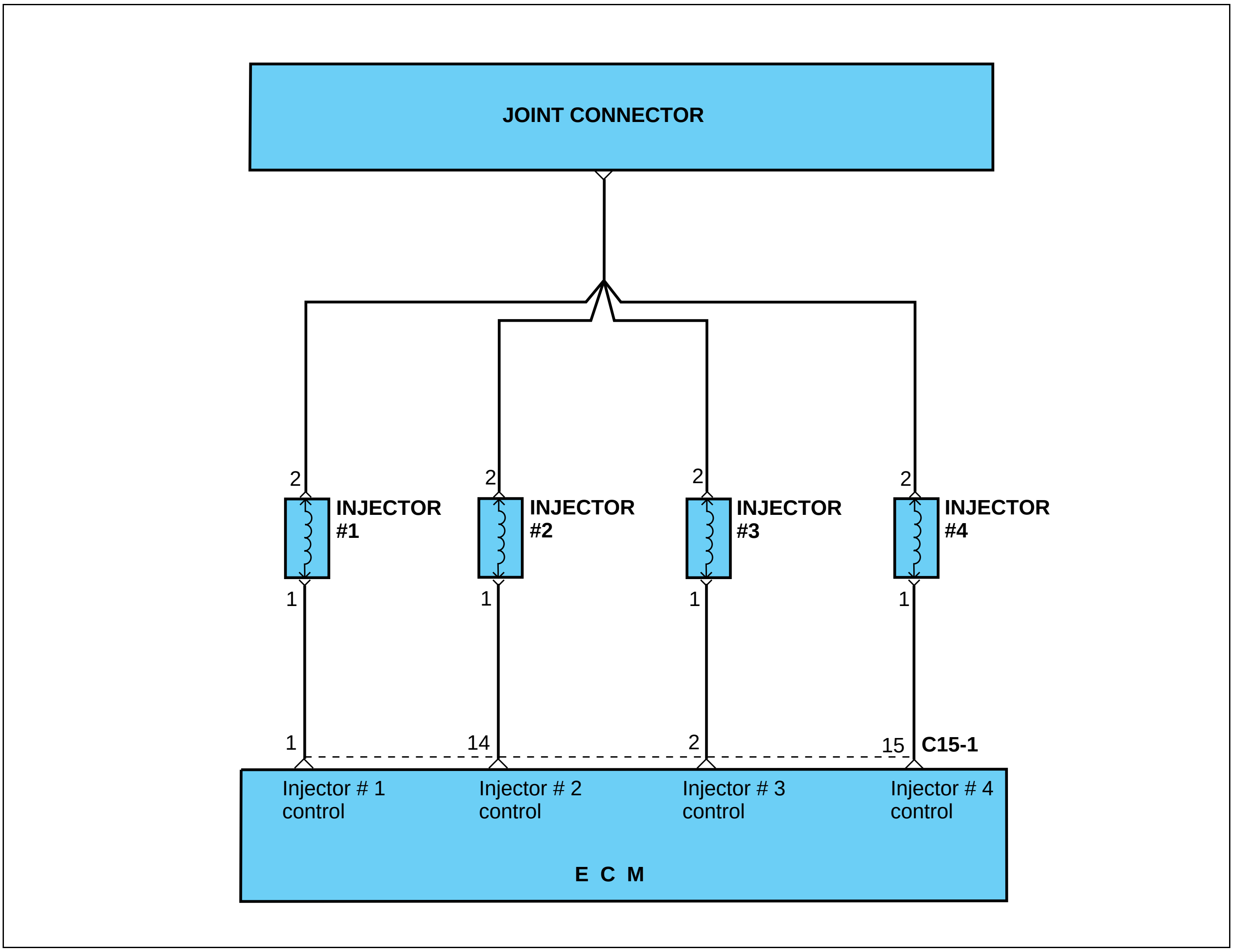
DESCRIPTION

The fuel injectors are solenoid operated valves that are normally closed. When a fuel injector solenoid is energized (pulsed) the injector needle valve moves, allowing pressurized fuel to pass through the injector and mix with the air entering the engine. Each fuel injector (there is one for each engine cylinder) is mounted in the intake manifold and is positioned to spray fuel into a cylinder head intake port.
The Engine Control Module (ECM) controls injector timing and pulse width (how long the fuel injectors are turned on). The ECM pulses the fuel injectors based on information provided by its network of engine sensors. The ECM uses the crankshaft position sensor to determine when to pulse the injectors. Engine coolant temperature, intake air temperature, air flow and throttle position data are all used by the ECM to calculate injector pulse width.
The ECM also uses its network of sensors to determine whether all injectors should be pulsed at the same time (simultaneous injection) or each injector should be pulsed individually (sequential injection). Sequential injection is almost always used during normal engine operation and simultaneous injection may be used when the engine is being cranked.

TROUBLESHOOTING GUIDE

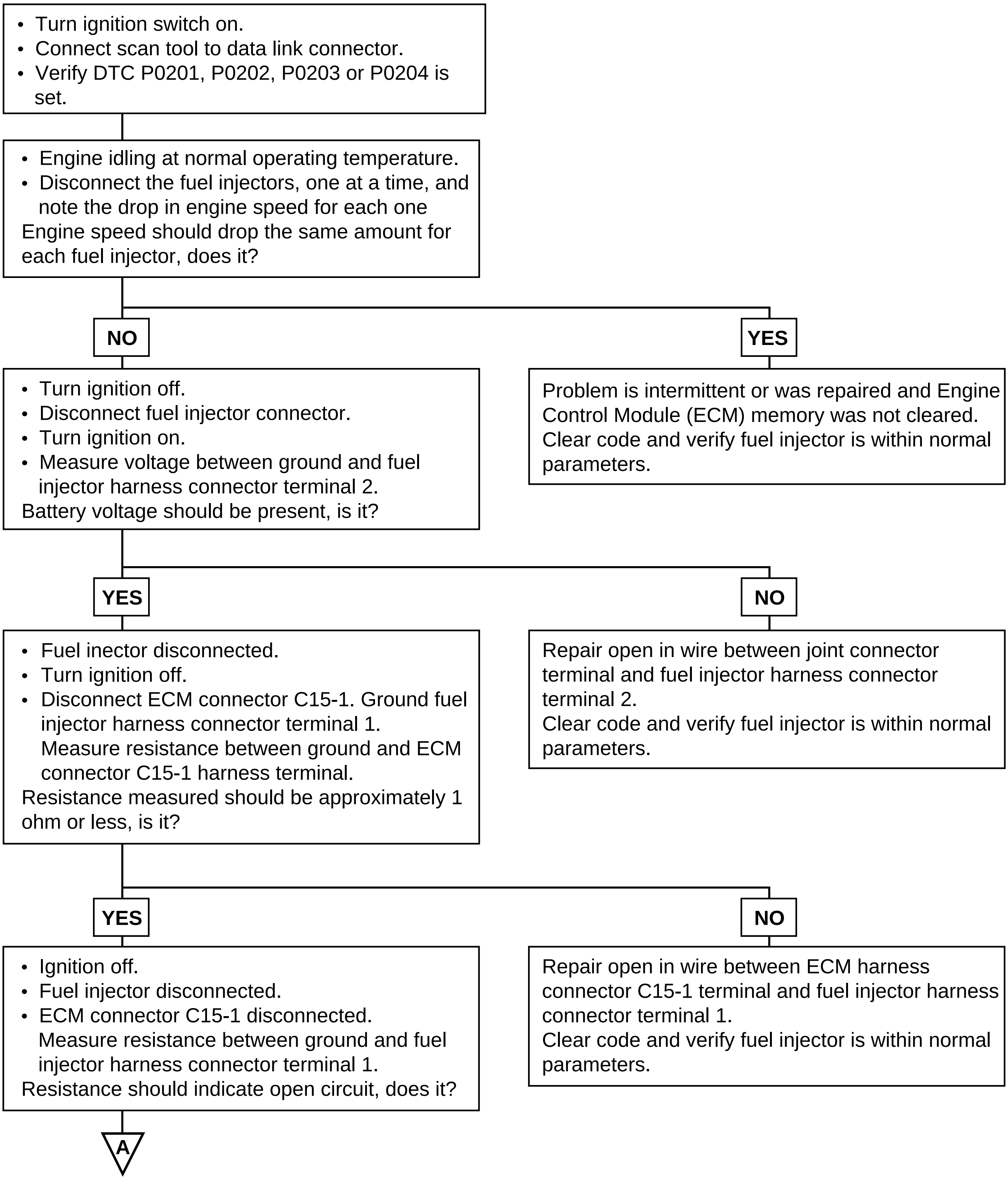
DTC detection condition	Probable cause
Background • A surge voltage is generated when the injectors are driven and the current flowing to the injector coil, is shut off. • The engine control module checks this surge voltage. Check Area • Engine speed is between 50 and 1,000 r/min • Throttle position sensor output voltage is 1.16V or less. • Monitoring Time: 4 sec. Judgment Criteria • Injector coil surge voltage (system voltage +2V) has not been detected for 4 sec.	• Injector failed • Open or shorted injector circuit, or loose connector • Engine control module failed

CIRCUIT DIAGRAM



EFUC511A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0201, P0202, P0203 or P0204 is set.

- Engine idling at normal operating temperature.
- Disconnect the fuel injectors, one at a time, and note the drop in engine speed for each one

Engine speed should drop the same amount for each fuel injector, does it?

NO

- Turn ignition off.
- Disconnect fuel injector connector.
- Turn ignition on.
- Measure voltage between ground and fuel injector harness connector terminal 2.

Battery voltage should be present, is it?

YES

Problem is intermittent or was repaired and Engine Control Module (ECM) memory was not cleared. Clear code and verify fuel injector is within normal parameters.

YES

- Fuel inector disconnected.
- Turn ignition off.
- Disconnect ECM connector C15-1. Ground fuel injector harness connector terminal 1. Measure resistance between ground and ECM connector C15-1 harness terminal.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair open in wire between joint connector terminal and fuel injector harness connector terminal 2.
Clear code and verify fuel injector is within normal parameters.

YES

- Ignition off.
- Fuel injector disconnected.
- ECM connector C15-1 disconnected. Measure resistance between ground and fuel injector harness connector terminal 1.

Resistance should indicate open circuit, does it?

NO

Repair open in wire between ECM harness connector C15-1 terminal and fuel injector harness connector terminal 1.
Clear code and verify fuel injector is within normal parameters.

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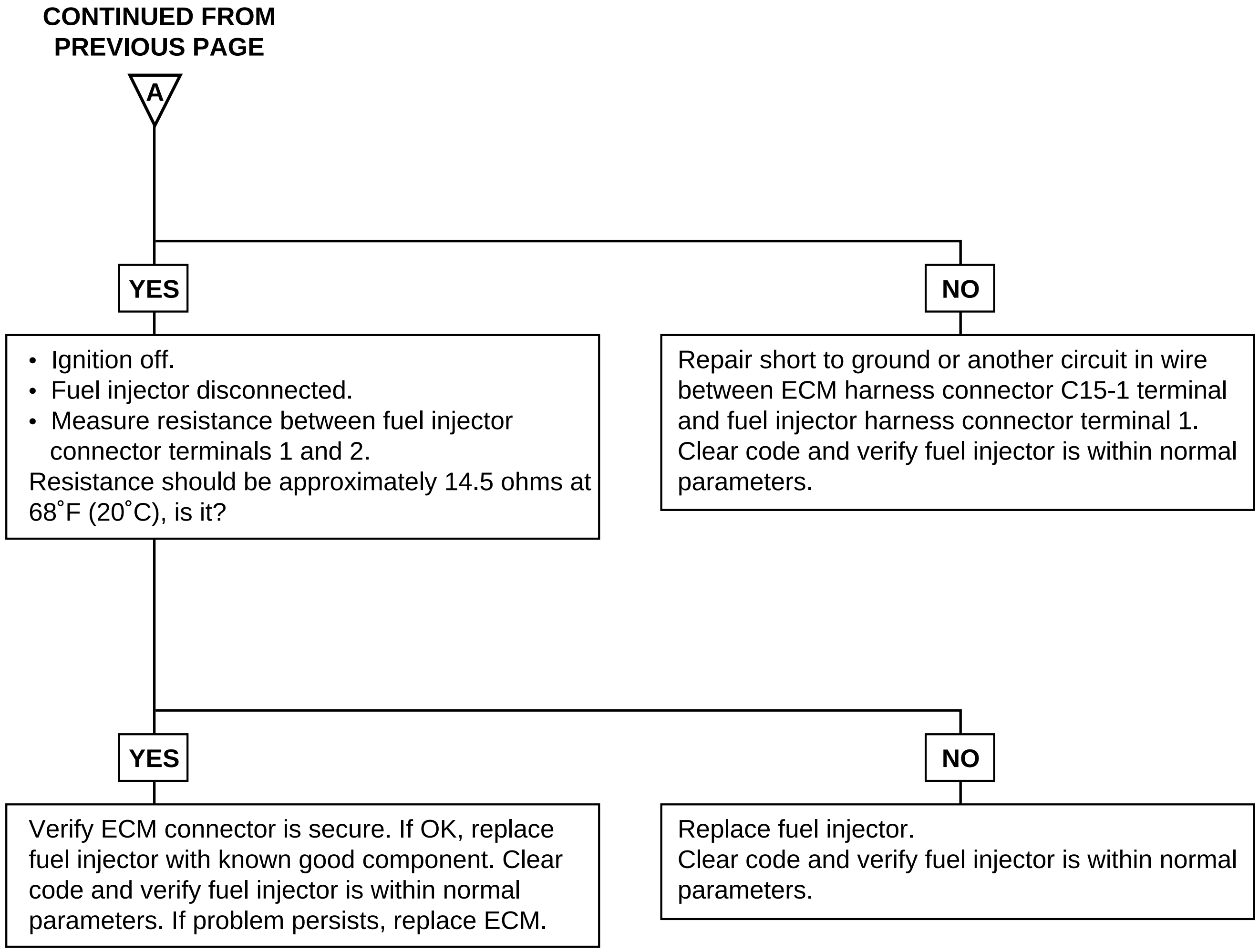
EFUC511B



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YES

- Ignition off.
- Fuel injector disconnected.
- Measure resistance between fuel injector connector terminals 1 and 2.

Resistance should be approximately 14.5 ohms at 68˚F (20˚C), is it?

NO

Repair short to ground or another circuit in wire between ECM harness connector C15-1 terminal and fuel injector harness connector terminal 1. Clear code and verify fuel injector is within normal parameters.

YES

Verify ECM connector is secure. If OK, replace fuel injector with known good component. Clear code and verify fuel injector is within normal parameters. If problem persists, replace ECM.

NO

Replace fuel injector.
Clear code and verify fuel injector is within normal parameters.

EFUC511C

EFUC5120

DTC	Diagnostic item
P0300	Random Misfire Detected

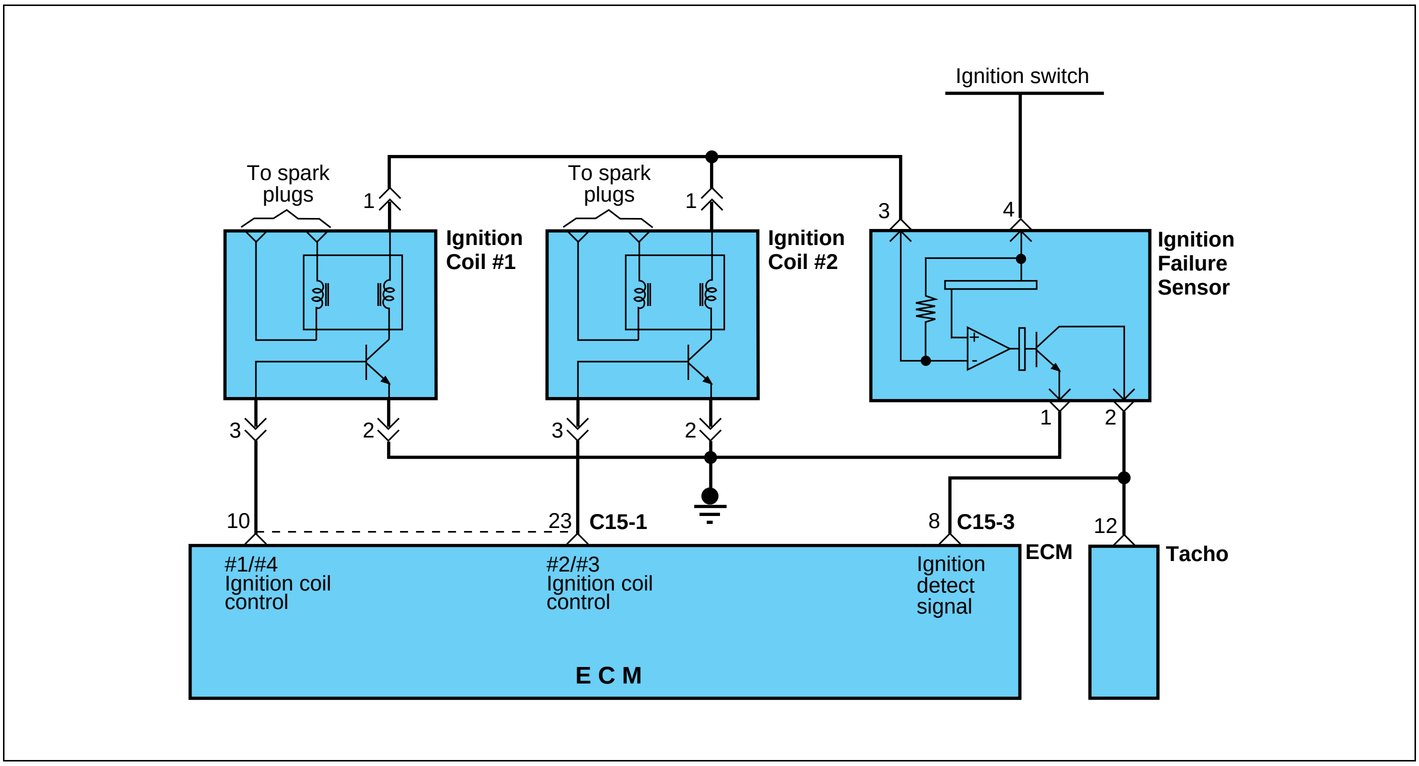
DESCRIPTION

With the ignition switch ON or START, voltage is applied to the ignition coil. The ignition coil consists of two coils. High tension leads go to each cylinder from the ignition coil. The ignition coil fires two spark plugs every power stroke (the cylinder under compression and the cylinder on the exhaust stroke). Coil number one fires cylinders 1 and 4. Coil number two fires cylinders 2 and 3.
The ignition power transistor, controlled by the Engine Control Module (ECM), provides a switching circuit to ground for energizing the primary ignition coils. When a primary ignition coil is energized and deenergized, the secondary coil produces a high voltage spike across the attached spark plugs. At the same time, the tach interface (part of the ignition power transistor) provides the ECM and Transaxle Control Module (TCM) with an RPM signal.

TROUBLESHOOTING GUIDE

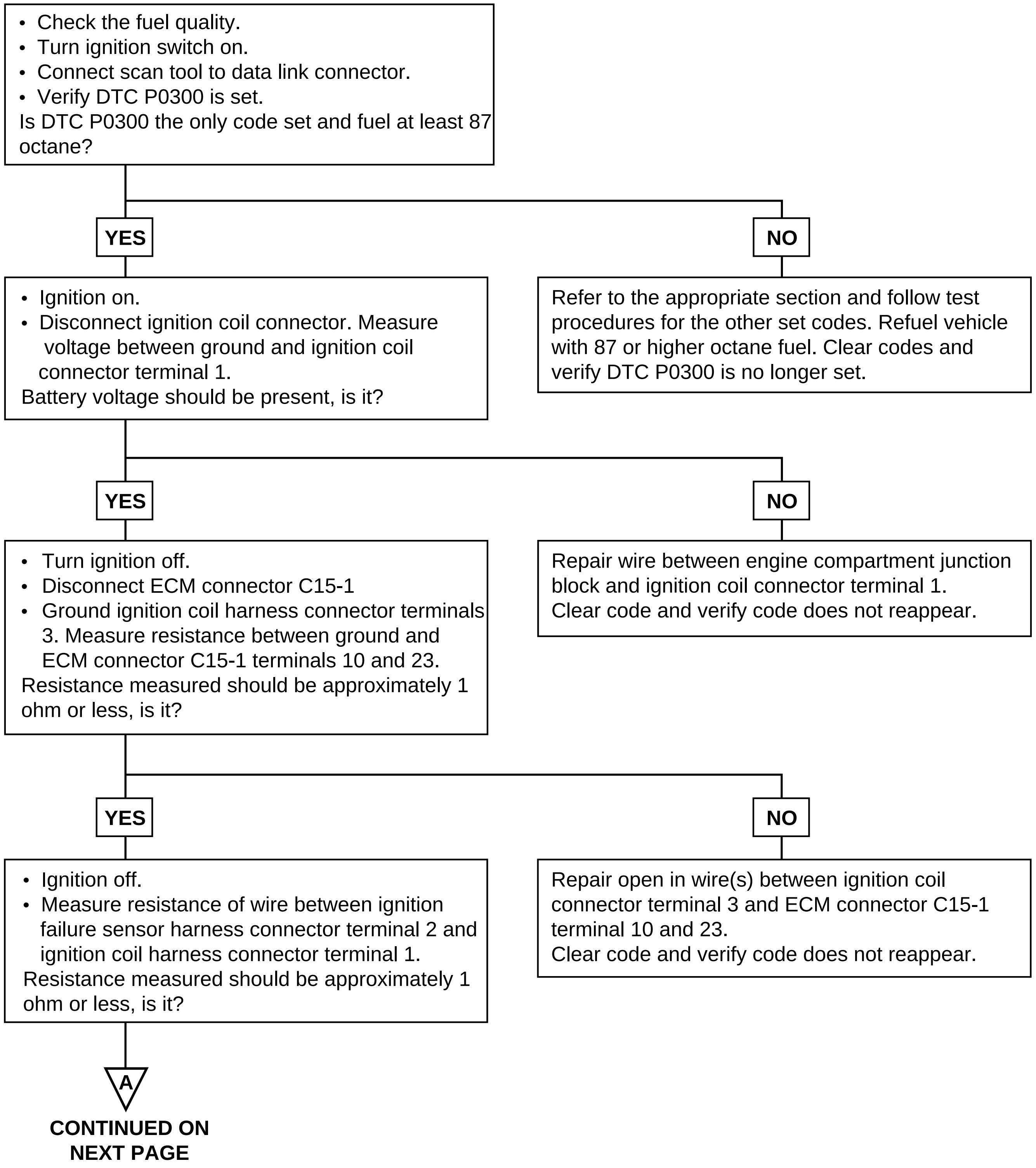
DTC detection condition	Probable cause
Background • If a misfiring occurs while the engine is running, the engine speed suddenly changes. • The Engine Control Module checks for changes in the engine speed. Check Area • Five seconds or more have passed after the engine was started. • Engine speed is between 500 and 6,000 r/min. • Engine Coolant Temperature is higher than -10°C(14°F). • Intake air temperature is higher than -10°C (14°F). • Running free from sudden accelerations/decelerations such as shift change. Judgment Criteria (change in the angular acceleration of the crankshaft is used for misfire detection.) • Misfire has occurred more frequently than allowed during the last 200 revolutions [when the catalyst temperature is higher than 950°C (1,742°F)]. • Misfire has occurred more frequently than the allowed number of times (2%) during 1,000 motor revolutions.	• Ignition system related part(s) failed • Poor crankshaft position sensor signal • Incorrect air/fuel ratio • Low compression pressure • Engine coolant temperature sensor failed • Timing belt missing teeth • Injector failed • Engine control module failed

CIRCUIT DIAGRAM



EFUC512A

TEST PROCEDURE



- Check the fuel quality.
- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0300 is set.

Is DTC P0300 the only code set and fuel at least 87 octane?

YES

- Ignition on.
- Disconnect ignition coil connector. Measure voltage between ground and ignition coil connector terminal 1.

Battery voltage should be present, is it?

NO

Refer to the appropriate section and follow test procedures for the other set codes. Refuel vehicle with 87 or higher octane fuel. Clear codes and verify DTC P0300 is no longer set.

YES

- Turn ignition off.
- Disconnect ECM connector C15-1
- Ground ignition coil harness connector terminals 3. Measure resistance between ground and ECM connector C15-1 terminals 10 and 23.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair wire between engine compartment junction block and ignition coil connector terminal 1. Clear code and verify code does not reappear.

YES

- Ignition off.
- Measure resistance of wire between ignition failure sensor harness connector terminal 2 and ignition coil harness connector terminal 1.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair open in wire(s) between ignition coil connector terminal 3 and ECM connector C15-1 terminal 10 and 23. Clear code and verify code does not reappear.

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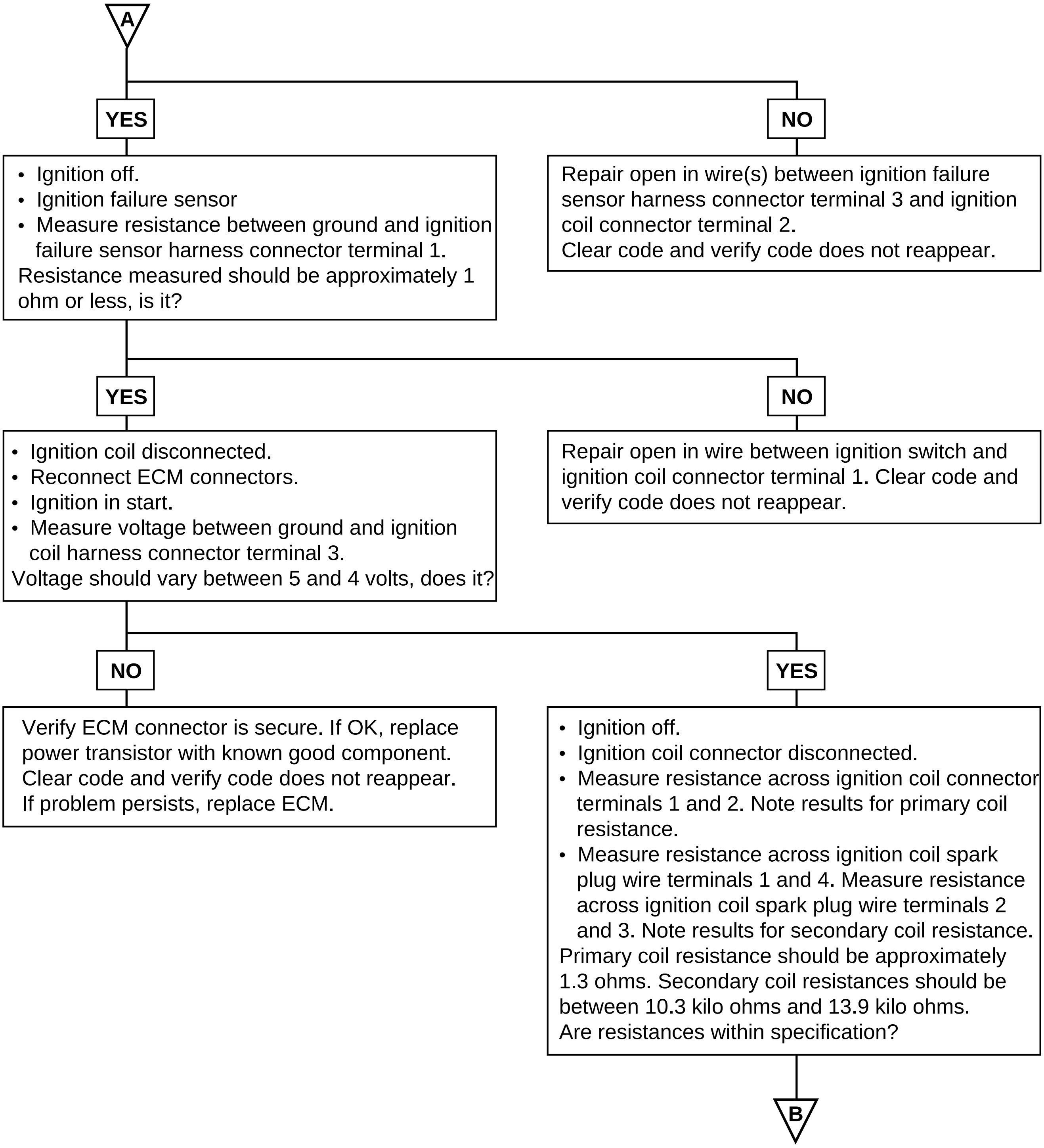

- Ignition off.
- Ignition failure sensor
- Measure resistance between ground and ignition failure sensor harness connector terminal 1.

Resistance measured should be approximately 1 ohm or less, is it?

Repair open in wire(s) between ignition failure sensor harness connector terminal 3 and ignition coil connector terminal 2.
Clear code and verify code does not reappear.

- Ignition coil disconnected.
- Reconnect ECM connectors.
- Ignition in start.
- Measure voltage between ground and ignition coil harness connector terminal 3.

Voltage should vary between 5 and 4 volts, does it?

Repair open in wire between ignition switch and ignition coil connector terminal 1. Clear code and verify code does not reappear.

Verify ECM connector is secure. If OK, replace power transistor with known good component. Clear code and verify code does not reappear. If problem persists, replace ECM.

- Ignition off.
- Ignition coil connector disconnected.
- Measure resistance across ignition coil connector terminals 1 and 2. Note results for primary coil resistance.
- Measure resistance across ignition coil spark plug wire terminals 1 and 4. Measure resistance across ignition coil spark plug wire terminals 2 and 3. Note results for secondary coil resistance.

Primary coil resistance should be approximately 1.3 ohms. Secondary coil resistances should be between 10.3 kilo ohms and 13.9 kilo ohms.
Are resistances within specification?

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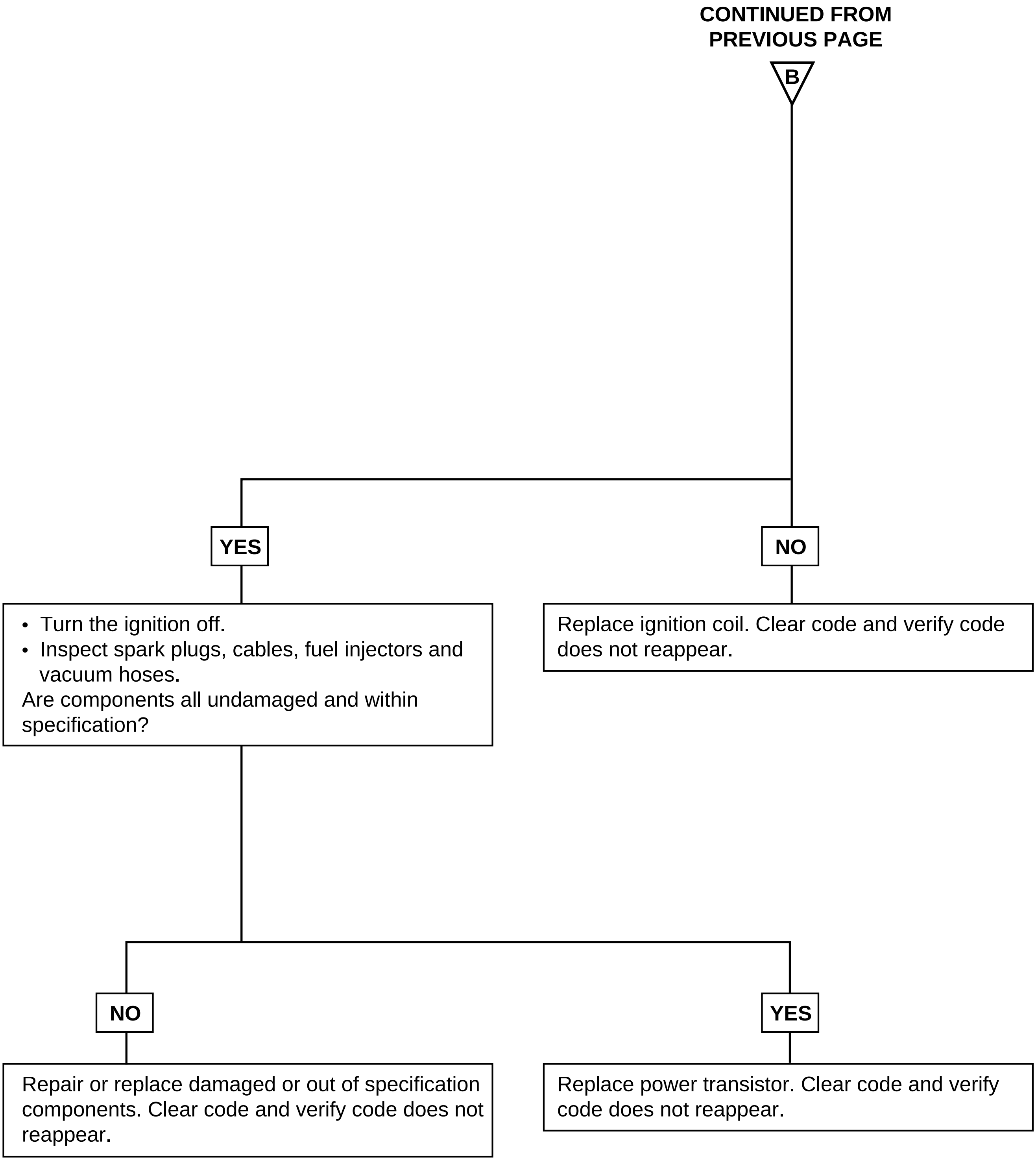
EFUC512C



- Turn the ignition off.
- Inspect spark plugs, cables, fuel injectors and vacuum hoses.

Are components all undamaged and within specification?

Replace ignition coil. Clear code and verify code does not reappear.

Repair or replace damaged or out of specification components. Clear code and verify code does not reappear.

Replace power transistor. Clear code and verify code does not reappear.

P0300D

EFUC5130

DTC	
P0301, P0302, P0303, P0304,	Misfire detected (Cylinder-1, Cylinder-2, Cylinder-3, Cylinder-4)

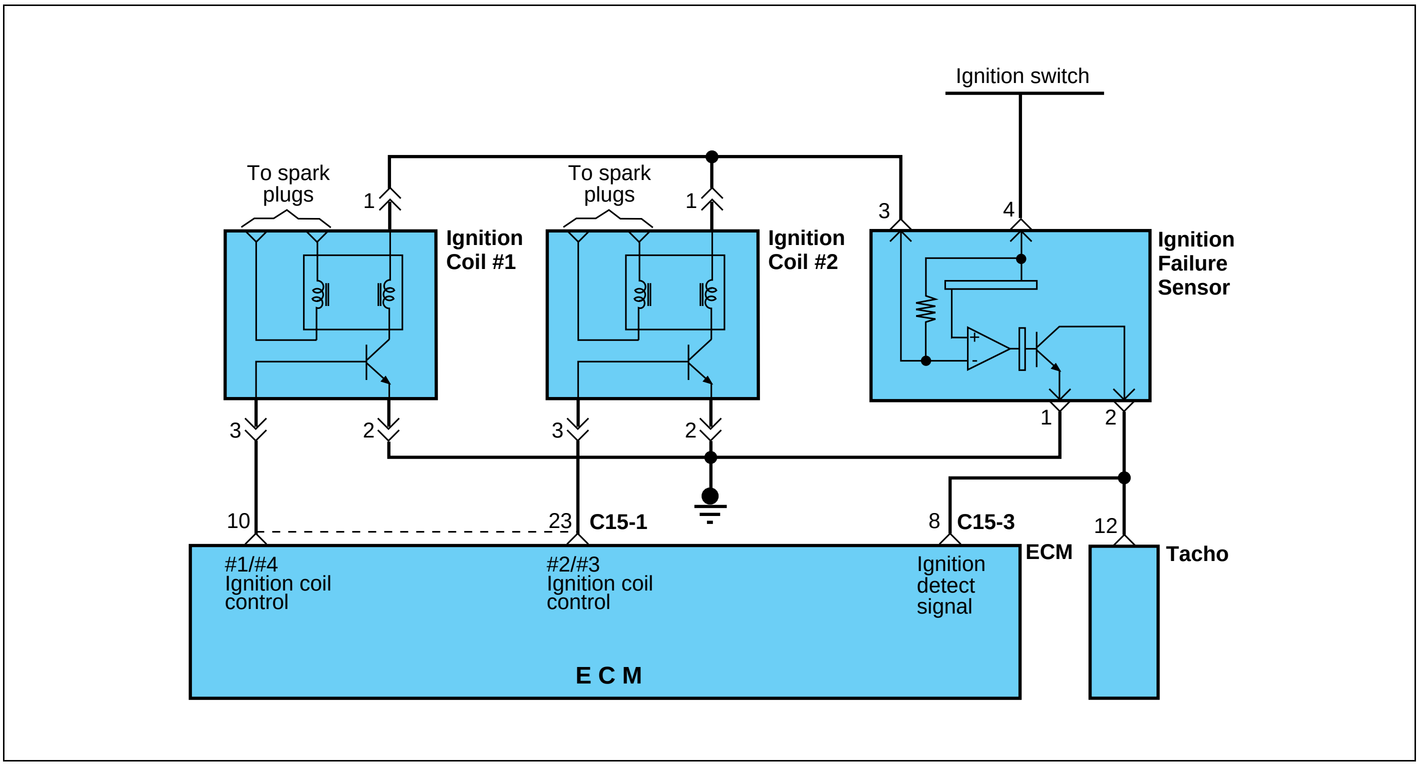
DESCRIPTION

Refer to Random Misfire Detected (P0300).

TROUBLESHOOTING GUIDE

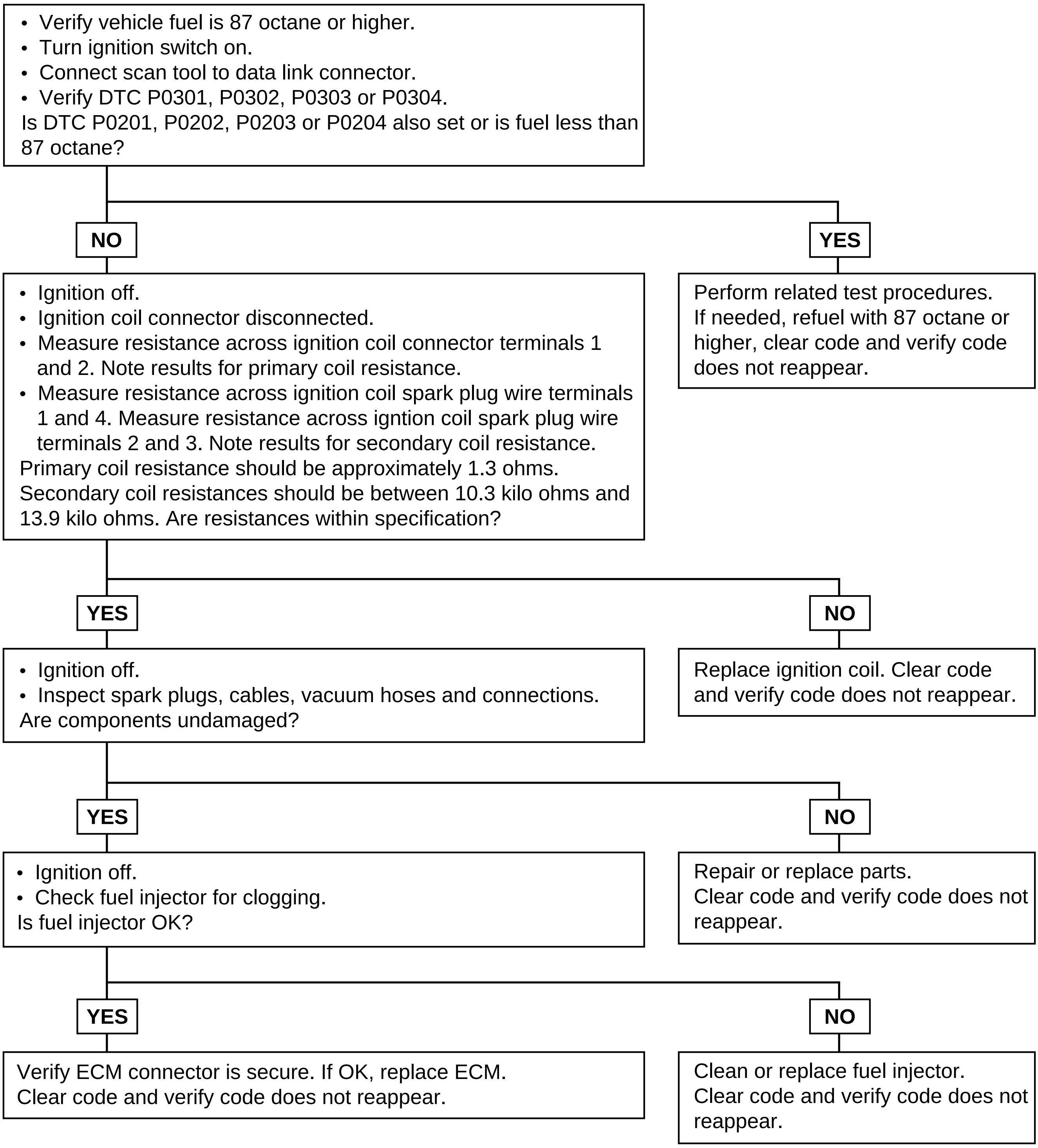
DTC detection condition	Probable cause
Background • If a misfiring occurs while the engine is running, the engine speed suddenly changes. • The Engine Control Module checks for changes in the engine speed. Check Area • Five seconds or more have passed after the engine was started. • Engine speed is between 500 and 6,000 r/min. • Engine Coolant Temperature is higher than -10°C (14°F). • Intake air temperature is higher than -10°C (14°F). • Running free from sudden accelerations/decelerations such as shift change. Judgment Criteria (change in the angular acceleration of the crankshaft is used for misfire detection.) • Misfire has occurred more frequently than allowed for during the last 200 revolutions [when the catalyst temperature is higher than 950°C (1,742°F)]. • Misfire has occurred more frequently than the allowed number of times (2%) during 1,000 motor revolutions.	• Ignition system related part(s) failed • Poor crankshaft position sensor signal • Incorrect air/fuel ratio • Low compression pressure • Engine coolant temperature sensor failed • Timing belt missing teeth • Injector failed • EGR valve failed • Engine control module failed

CIRCUIT DIAGRAM



EFUC512A

TEST PROCEDURE



- Verify vehicle fuel is 87 octane or higher.
- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0301, P0302, P0303 or P0304.

Is DTC P0201, P0202, P0203 or P0204 also set or is fuel less than 87 octane?

NO

- Ignition off.
- Ignition coil connector disconnected.
- Measure resistance across ignition coil connector terminals 1 and 2. Note results for primary coil resistance.
- Measure resistance across ignition coil spark plug wire terminals 1 and 4. Measure resistance across igntion coil spark plug wire terminals 2 and 3. Note results for secondary coil resistance.

Primary coil resistance should be approximately 1.3 ohms. Secondary coil resistances should be between 10.3 kilo ohms and 13.9 kilo ohms. Are resistances within specification?

YES

Perform related test procedures. If needed, refuel with 87 octane or higher, clear code and verify code does not reappear.

YES

- Ignition off.
- Inspect spark plugs, cables, vacuum hoses and connections.

Are components undamaged?

NO

Replace ignition coil. Clear code and verify code does not reappear.

YES

- Ignition off.
- Check fuel injector for clogging.

Is fuel injector OK?

NO

Repair or replace parts. Clear code and verify code does not reappear.

YES

Verify ECM connector is secure. If OK, replace ECM. Clear code and verify code does not reappear.

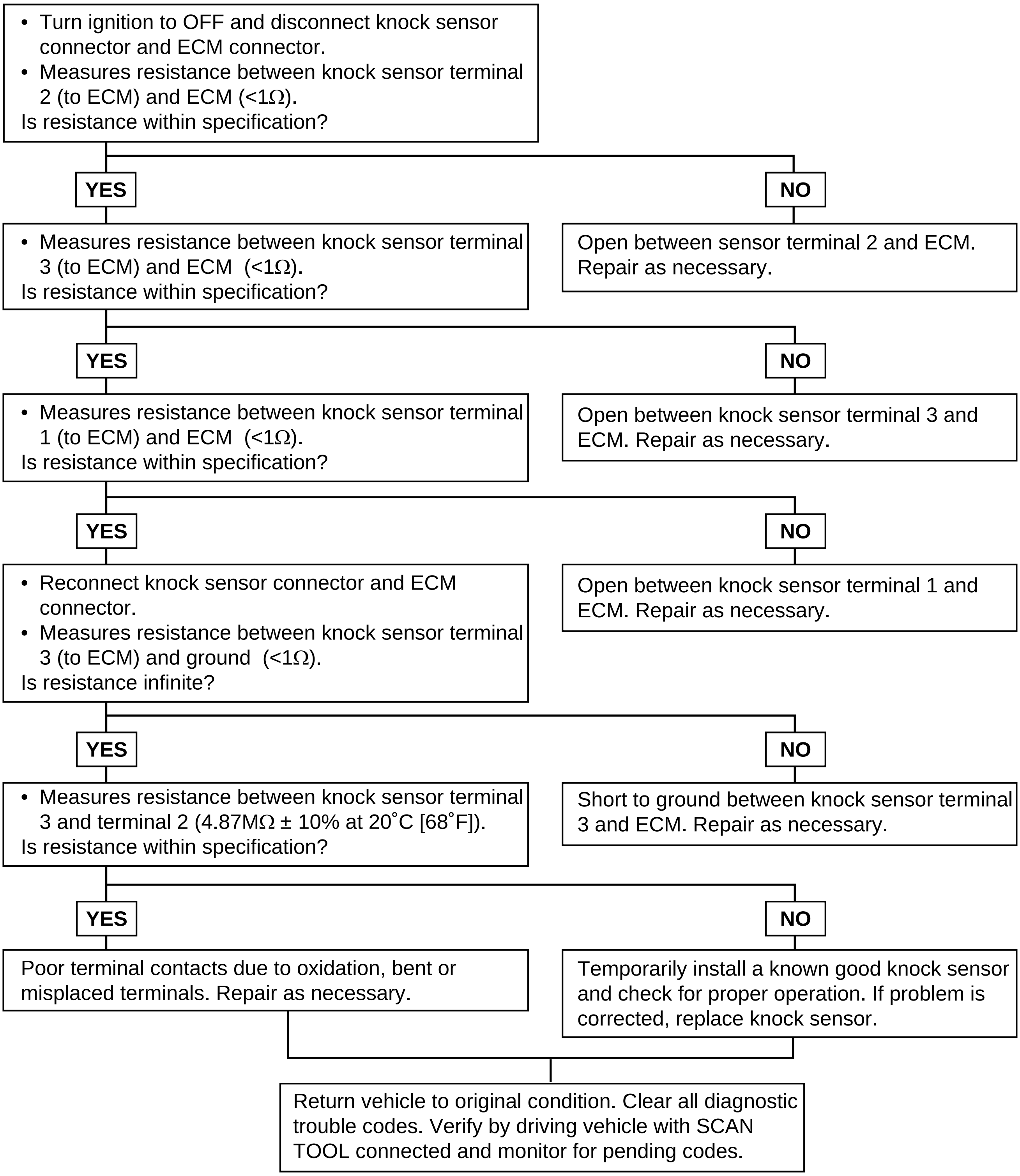
NO

Clean or replace fuel injector. Clear code and verify code does not reappear.

EFUC5140

DTC	Diagnostic item
P0325	Knock Sensor Circuit Malfunction (Bank 1)

TEST PROCEDURE



- Turn ignition to OFF and disconnect knock sensor connector and ECM connector.
- Measures resistance between knock sensor terminal 2 (to ECM) and ECM (<1Ω).

Is resistance within specification?

YES

- Measures resistance between knock sensor terminal 3 (to ECM) and ECM (<1Ω).

Is resistance within specification?

NO

Open between sensor terminal 2 and ECM. Repair as necessary.

YES

- Measures resistance between knock sensor terminal 1 (to ECM) and ECM (<1Ω).

Is resistance within specification?

NO

Open between knock sensor terminal 3 and ECM. Repair as necessary.

YES

- Reconnect knock sensor connector and ECM connector.
- Measures resistance between knock sensor terminal 3 (to ECM) and ground (<1Ω).

Is resistance infinite?

NO

Open between knock sensor terminal 1 and ECM. Repair as necessary.

YES

- Measures resistance between knock sensor terminal 3 and terminal 2 (4.87MΩ ± 10% at 20˚C [68˚F]).

Is resistance within specification?

NO

Short to ground between knock sensor terminal 3 and ECM. Repair as necessary.

YES

Poor terminal contacts due to oxidation, bent or misplaced terminals. Repair as necessary.

NO

Temporarily install a known good knock sensor and check for proper operation. If problem is corrected, replace knock sensor.

Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

EFUC514B

EFUC5150

DTC	Diagnostic item
P0335	Crankshaft Position Sensor Circuit Malfunction

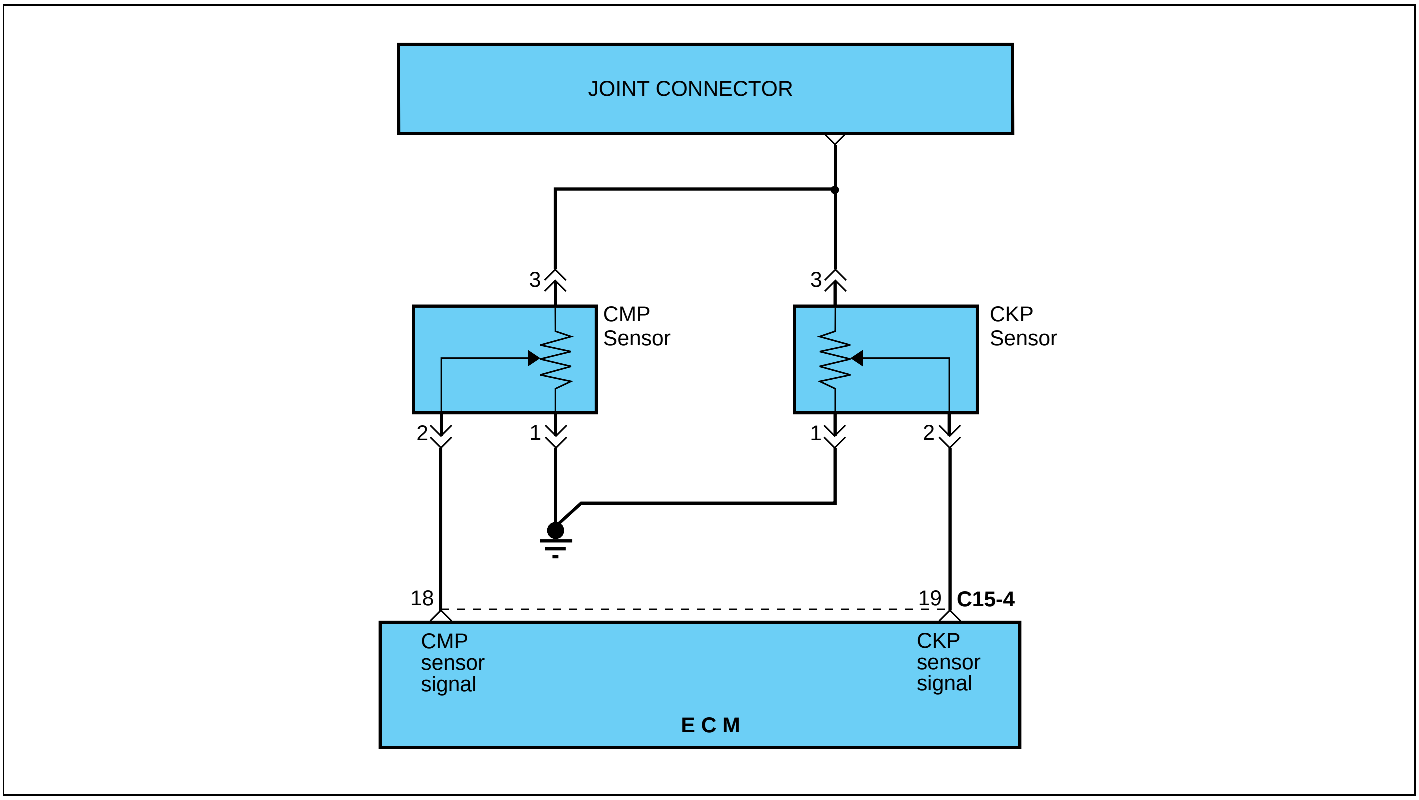
DESCRIPTION

The Crankshaft Position (CKP) sensor consists of a magnet and coil located next to the flywheel. The voltage signal from the CKP sensor allows the Engine Control Module (ECM) to determine the engine of the RPM and Crankshaft Position.

TROUBLESHOOTING GUIDE

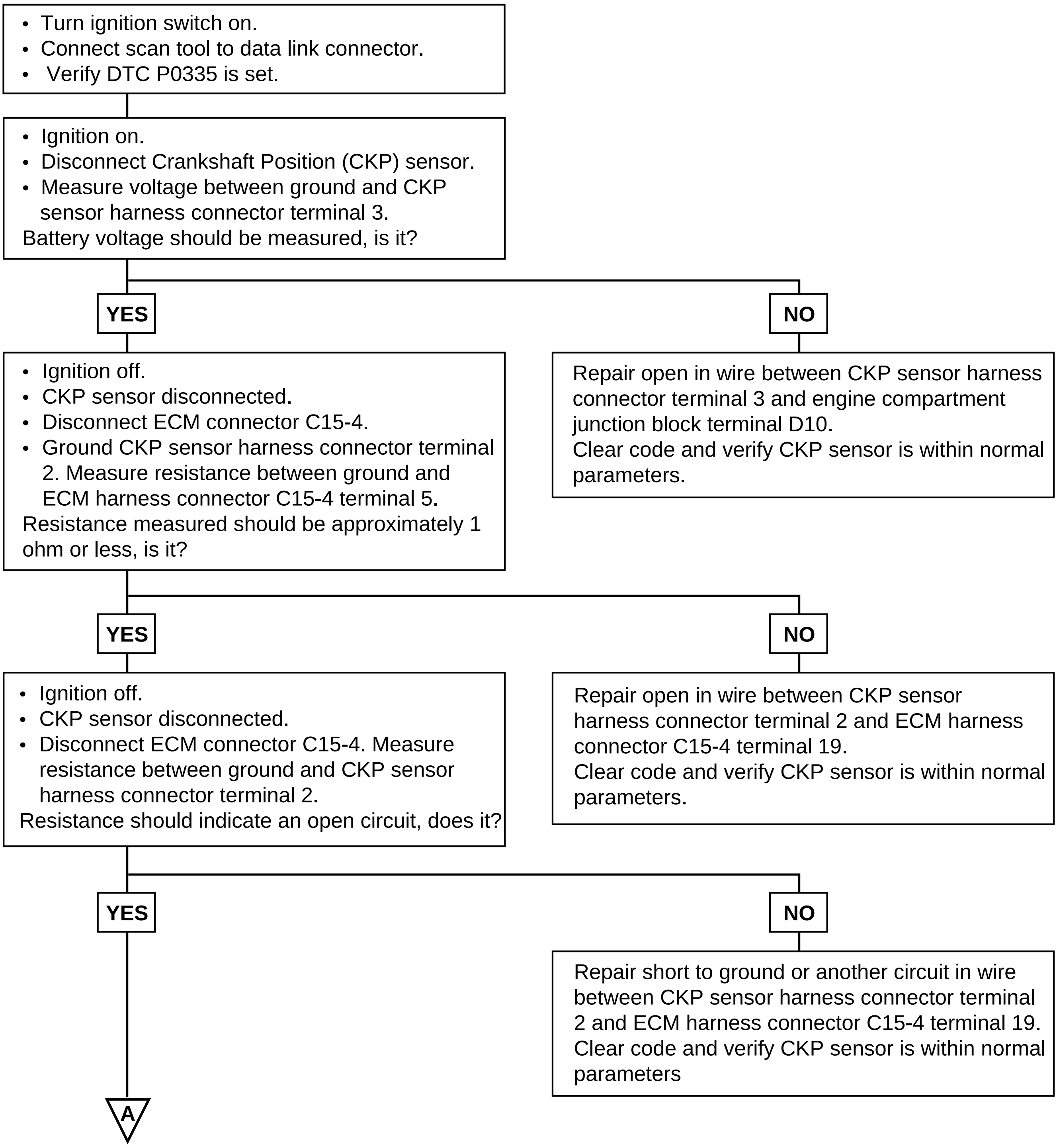
DTC detection condition	Probable cause
Background • When the engine is running, the Crankshaft Position sensor outputs a pulse signal. • The Engine Control Module checks whether the pulse signal is input while the engine is cranking. Check Area • Engine is being cranked. Judgment Criteria • Sensor output voltage has not changed (no pulse signal is input) for 4 sec. Check Area, Judgment • Normal signal pattern has not been input for cylinder identification from the crankshaft position sensor signal and camshaft position sensor signal for 4 sec.	• Crankshaft position sensor failed • Open or shorted crankshaft position sensor circuit • Engine control module failed

CIRCUIT DIAGRAM



EFUC515A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0335 is set.

- Ignition on.
- Disconnect Crankshaft Position (CKP) sensor.
- Measure voltage between ground and CKP sensor harness connector terminal 3.

Battery voltage should be measured, is it?

YES

- Ignition off.
- CKP sensor disconnected.
- Disconnect ECM connector C15-4.
- Ground CKP sensor harness connector terminal 2. Measure resistance between ground and ECM harness connector C15-4 terminal 5.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair open in wire between CKP sensor harness connector terminal 3 and engine compartment junction block terminal D10.
Clear code and verify CKP sensor is within normal parameters.

YES

- Ignition off.
- CKP sensor disconnected.
- Disconnect ECM connector C15-4. Measure resistance between ground and CKP sensor harness connector terminal 2.

Resistance should indicate an open circuit, does it?

NO

Repair open in wire between CKP sensor harness connector terminal 2 and ECM harness connector C15-4 terminal 19.
Clear code and verify CKP sensor is within normal parameters.

YES

NO

Repair short to ground or another circuit in wire between CKP sensor harness connector terminal 2 and ECM harness connector C15-4 terminal 19.
Clear code and verify CKP sensor is within normal parameters

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EFUC515B

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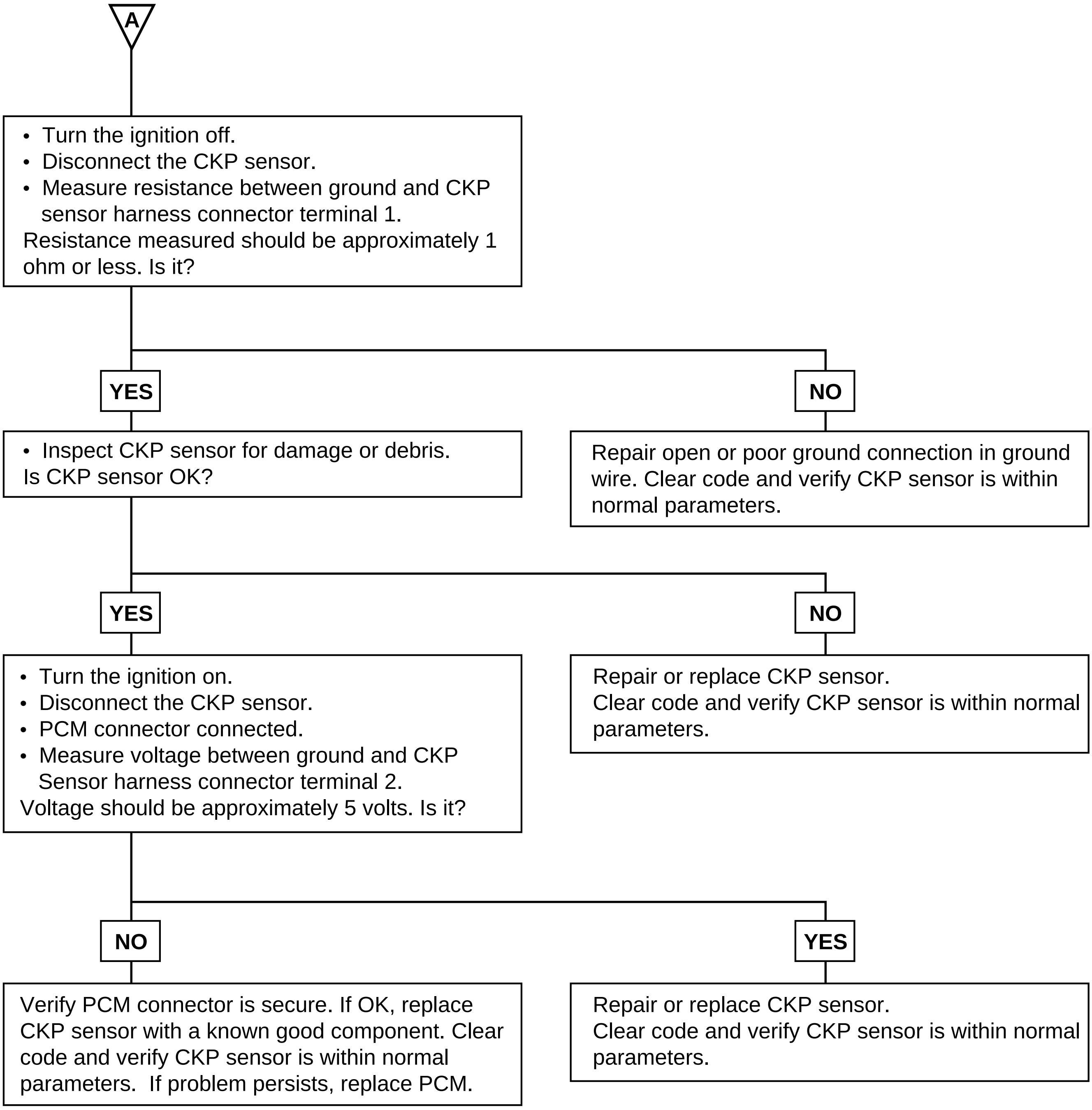


- Turn the ignition off.
- Disconnect the CKP sensor.
- Measure resistance between ground and CKP sensor harness connector terminal 1.

Resistance measured should be approximately 1 ohm or less. Is it?

YES

- Inspect CKP sensor for damage or debris.

Is CKP sensor OK?

NO

Repair open or poor ground connection in ground wire. Clear code and verify CKP sensor is within normal parameters.

YES

- Turn the ignition on.
- Disconnect the CKP sensor.
- PCM connector connected.
- Measure voltage between ground and CKP Sensor harness connector terminal 2.

Voltage should be approximately 5 volts. Is it?

NO

Repair or replace CKP sensor.
Clear code and verify CKP sensor is within normal parameters.

NO

Verify PCM connector is secure. If OK, replace CKP sensor with a known good component. Clear code and verify CKP sensor is within normal parameters. If problem persists, replace PCM.

YES

Repair or replace CKP sensor.
Clear code and verify CKP sensor is within normal parameters.

P0335C

EFUC5160

DTC	Diagnostic item
P0340	Camshaft Position Sensor Circuit Malfunction

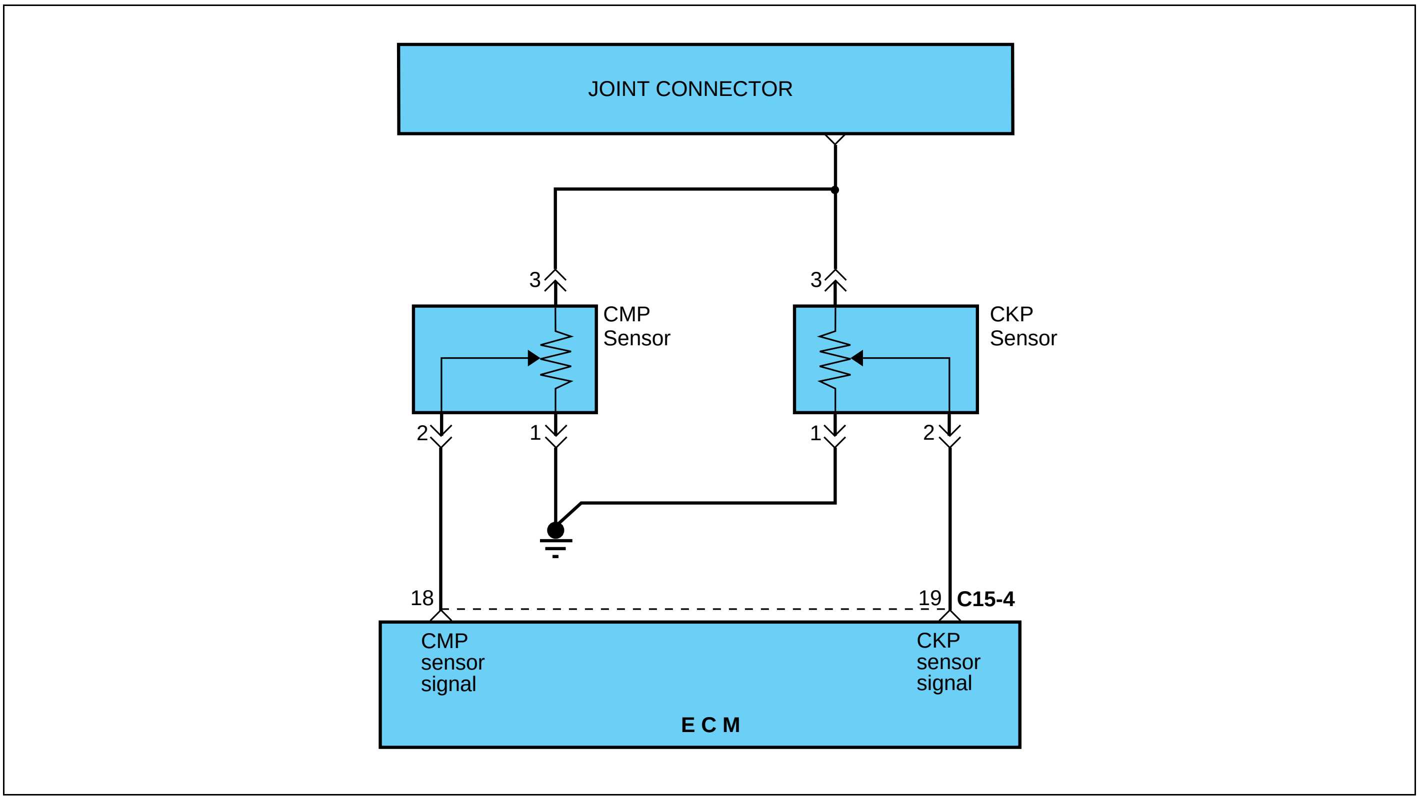
DESCRIPTION

The Camshaft Position (CMP) sensor senses the Top Dead Center (TDC) point of the #1 cylinder in the compression stroke. The CMP sensor signal allows the ECM to determine the fuel injector sequence starting point.

TROUBLESHOOTING GUIDE

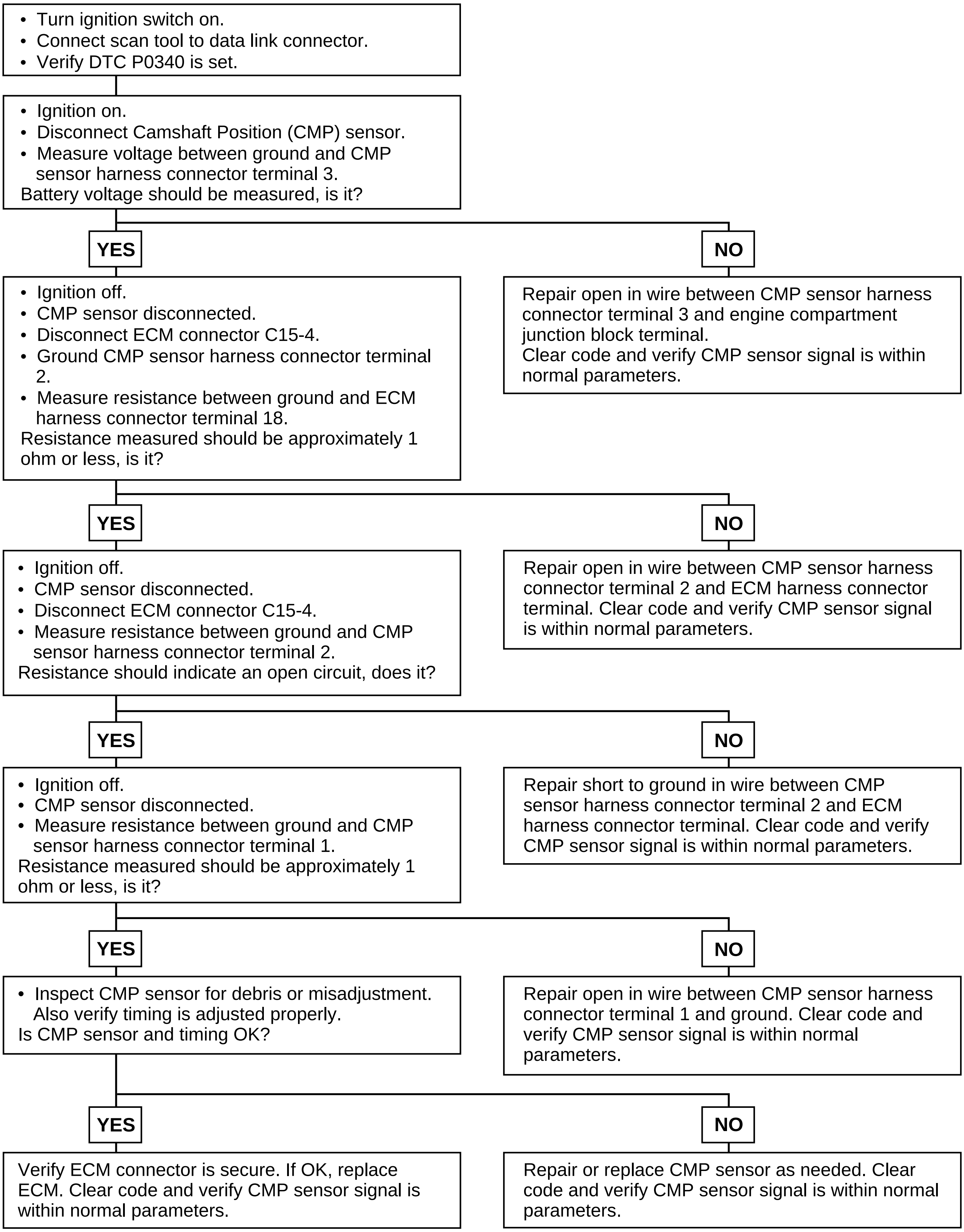
DTC detection condition	Probable cause
Background • When the engine is running, the Camshaft Position sensor outputs a pulse signal. • The Engine Control Module checks whether the pulse signal is input. Check Area, Judgement Criteria • Sensor output voltage has not changed (no pulse signal is input) for 4 sec. Check Area, Judgement Criteria • Normal signal pattern has not been input for cylinder identification from the camshaft position sensor signal for 4 sec.	• Camshaft Position sensor malfunction • Open or shorted camshaft position sensor circuit or loose connector • Engine control module failed

CIRCUIT DIAGRAM



EFUC515A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0340 is set.

- Ignition on.
- Disconnect Camshaft Position (CMP) sensor.
- Measure voltage between ground and CMP sensor harness connector terminal 3.

Battery voltage should be measured, is it?

YES

- Ignition off.
- CMP sensor disconnected.
- Disconnect ECM connector C15-4.
- Ground CMP sensor harness connector terminal 2.
- Measure resistance between ground and ECM harness connector terminal 18.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair open in wire between CMP sensor harness connector terminal 3 and engine compartment junction block terminal.
Clear code and verify CMP sensor signal is within normal parameters.

YES

- Ignition off.
- CMP sensor disconnected.
- Disconnect ECM connector C15-4.
- Measure resistance between ground and CMP sensor harness connector terminal 2.

Resistance should indicate an open circuit, does it?

NO

Repair open in wire between CMP sensor harness connector terminal 2 and ECM harness connector terminal. Clear code and verify CMP sensor signal is within normal parameters.

YES

- Ignition off.
- CMP sensor disconnected.
- Measure resistance between ground and CMP sensor harness connector terminal 1.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair short to ground in wire between CMP sensor harness connector terminal 2 and ECM harness connector terminal. Clear code and verify CMP sensor signal is within normal parameters.

YES

- Inspect CMP sensor for debris or misadjustment. Also verify timing is adjusted properly.

Is CMP sensor and timing OK?

NO

Repair open in wire between CMP sensor harness connector terminal 1 and ground. Clear code and verify CMP sensor signal is within normal parameters.

YES

Verify ECM connector is secure. If OK, replace ECM. Clear code and verify CMP sensor signal is within normal parameters.

NO

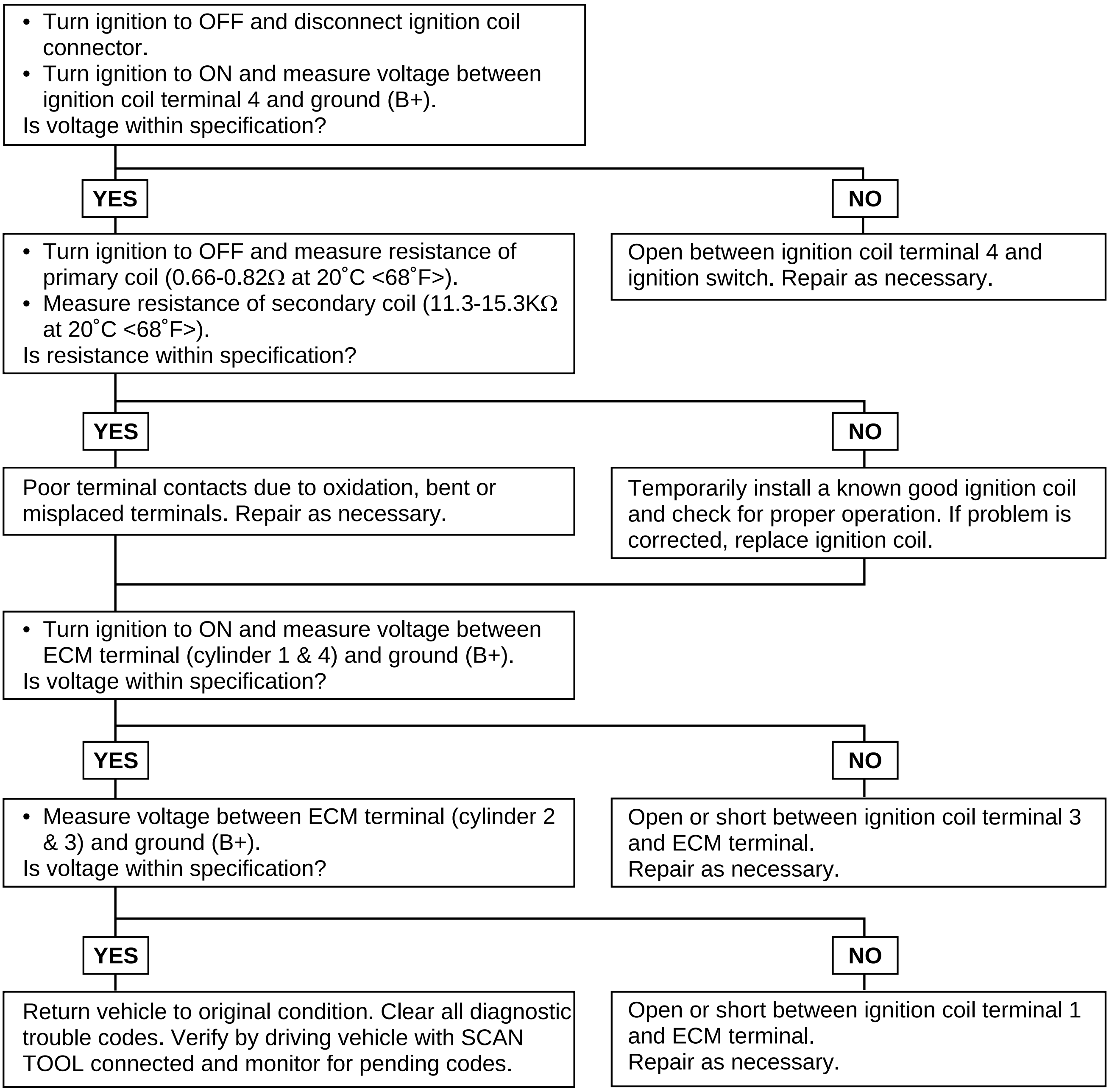
Repair or replace CMP sensor as needed. Clear code and verify CMP sensor signal is within normal parameters.

EFUC516B

EFUC5170

DTC	Diagnostic item
P0350	Ignition Coil Primary/Secondary Circuit Malfunction

TEST PROCEDURE



- Turn ignition to OFF and disconnect ignition coil connector.
- Turn ignition to ON and measure voltage between ignition coil terminal 4 and ground (B+).

Is voltage within specification?

YES:

- Turn ignition to OFF and measure resistance of primary coil (0.66-0.82Ω at 20˚C <68˚F>).
- Measure resistance of secondary coil (11.3-15.3KΩ at 20˚C <68˚F>).

Is resistance within specification?

NO:

Open between ignition coil terminal 4 and ignition switch. Repair as necessary.

YES:

Poor terminal contacts due to oxidation, bent or misplaced terminals. Repair as necessary.

NO:

Temporarily install a known good ignition coil and check for proper operation. If problem is corrected, replace ignition coil.

- Turn ignition to ON and measure voltage between ECM terminal (cylinder 1 & 4) and ground (B+).

Is voltage within specification?

YES:

- Measure voltage between ECM terminal (cylinder 2 & 3) and ground (B+).

Is voltage within specification?

NO:

Open or short between ignition coil terminal 3 and ECM terminal.
Repair as necessary.

YES:

Return vehicle to original condition. Clear all diagnostic trouble codes. Verify by driving vehicle with SCAN TOOL connected and monitor for pending codes.

NO:

Open or short between ignition coil terminal 1 and ECM terminal.
Repair as necessary.

EFUC517B

EFAC5850

DTC	Diagnostic item
P0421	Warm Up Catalyst Efficiency Below Threshold (Bank 1)

DESCRIPTION

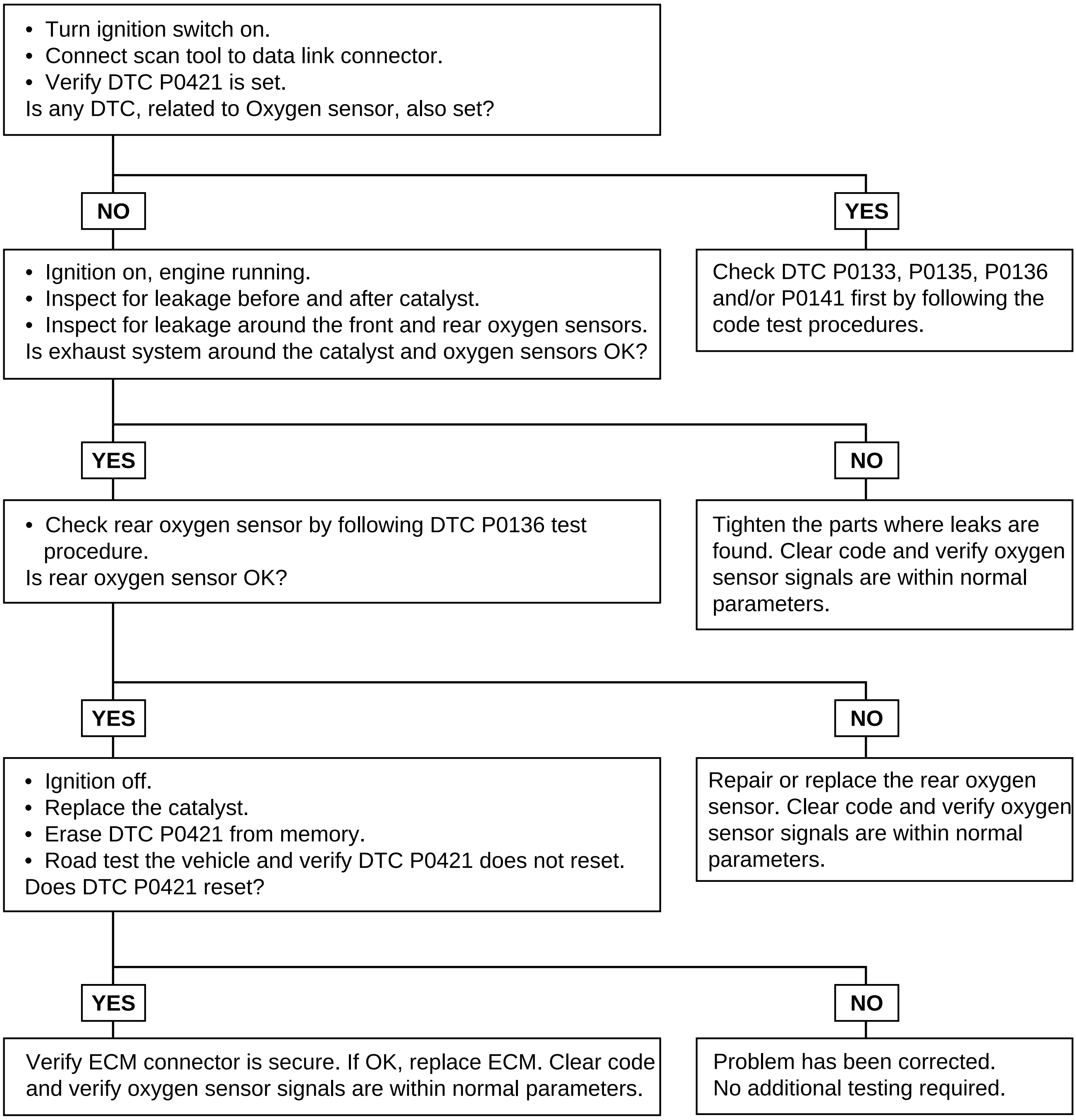
The ECM compares the waveform of the oxygen sensor located in front of the catalyst with the waveform of the oxygen sensor located after the catalyst to determine whether or not catalyst performance has deteriorated. Air-fuel ratio feedback compensation keeps the waveform of the oxygen sensor in front of the catalyst repeatedly changing back and forth from rich to lean.

If the catalyst is functioning normally, the waveform of the oxygen sensor after the catalyst switches back and forth between rich and lean much more slowly than the waveform of the oxygen sensor in front of the catalyst. But when both waveforms change at a similar rate, it indicates that catalyst performance has deteriorated.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Background • The signal from the heated oxygen sensor which follows the catalytic converter differs from that which precedes the catalytic converter. This is because the catalytic converter purifies exhaust gas. When the catalytic converter has deteriorated, the signal from the heated oxygen sensor which follows the catalytic converter becomes similar to that which precedes the catalytic converter. • The Engine Control Module checks the outputs of the heated oxygen sensor signals. Check Area • Engine speed is 3,000 r/min or higher. • Closed throttle position switch: OFF • Under the closed loop air-fuel ratio control • Monitoring Time: 140 sec. Judgment Criteria • The front or rear heated oxygen sensor signal is abnormal.	• Catalytic converter deteriorated • Heated oxygen sensor failed • Engine control module failed

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0421 is set.

Is any DTC, related to Oxygen sensor, also set?

Check DTC P0133, P0135, P0136 and/or P0141 first by following the code test procedures.

- Ignition on, engine running.
- Inspect for leakage before and after catalyst.
- Inspect for leakage around the front and rear oxygen sensors.

Is exhaust system around the catalyst and oxygen sensors OK?

Tighten the parts where leaks are found. Clear code and verify oxygen sensor signals are within normal parameters.

- Check rear oxygen sensor by following DTC P0136 test procedure.

Is rear oxygen sensor OK?

Repair or replace the rear oxygen sensor. Clear code and verify oxygen sensor signals are within normal parameters.

- Ignition off.
- Replace the catalyst.
- Erase DTC P0421 from memory.
- Road test the vehicle and verify DTC P0421 does not reset.

Does DTC P0421 reset?

Verify ECM connector is secure. If OK, replace ECM. Clear code and verify oxygen sensor signals are within normal parameters.

Problem has been corrected. No additional testing required.

EFAC585B

EFUC5190

DTC	Diagnostic item
P0443	Evaporative Emission Control System Purge Control Valve Circuit Malfunction

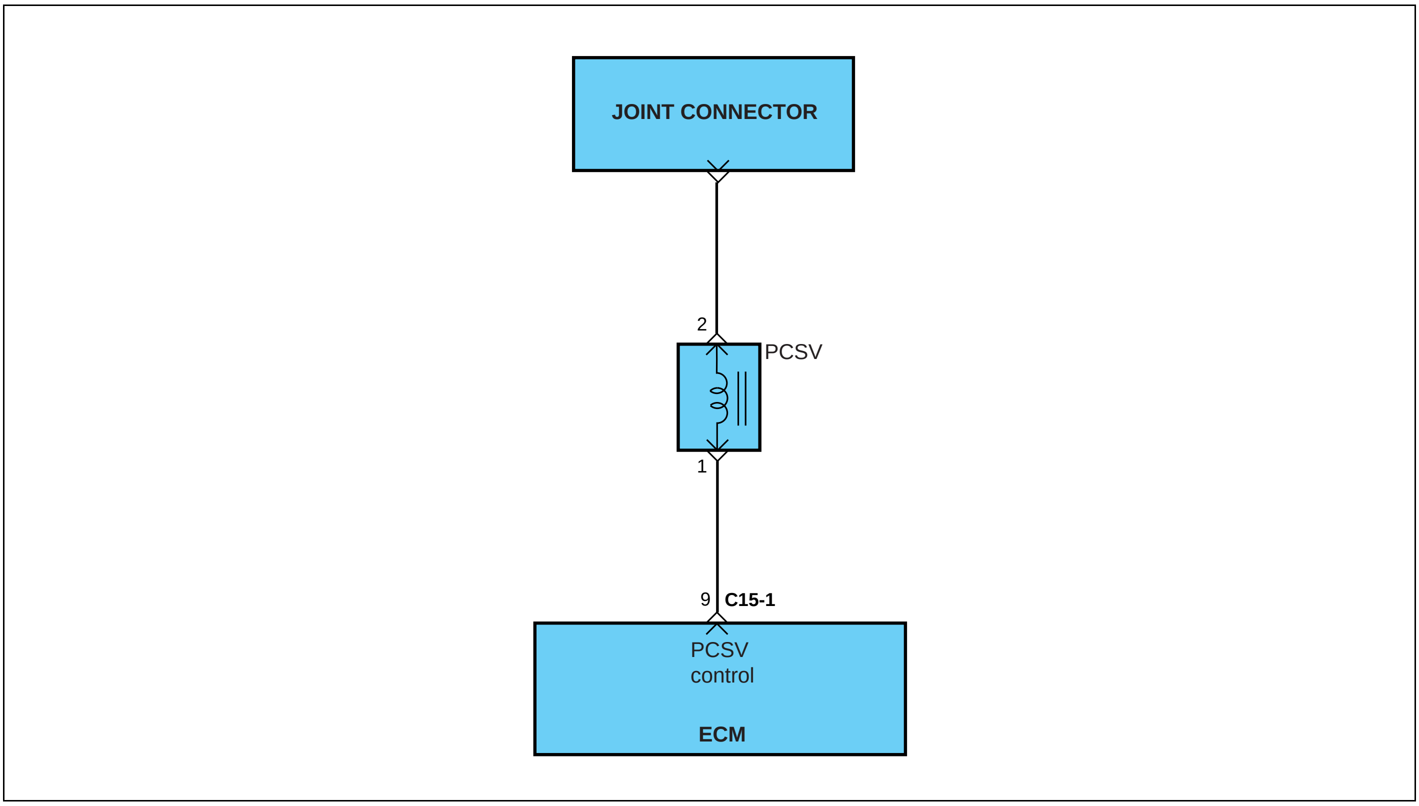
DESCRIPTION

The evaporative system reduces hydrocarbon emission by trapping fuel tank vapors until they can be burned as part of the incoming fuel charge. Evaporating fuel is stored in a charcoal canister until it can be flushed into the intake manifold.

TROUBLESHOOTING GUIDE

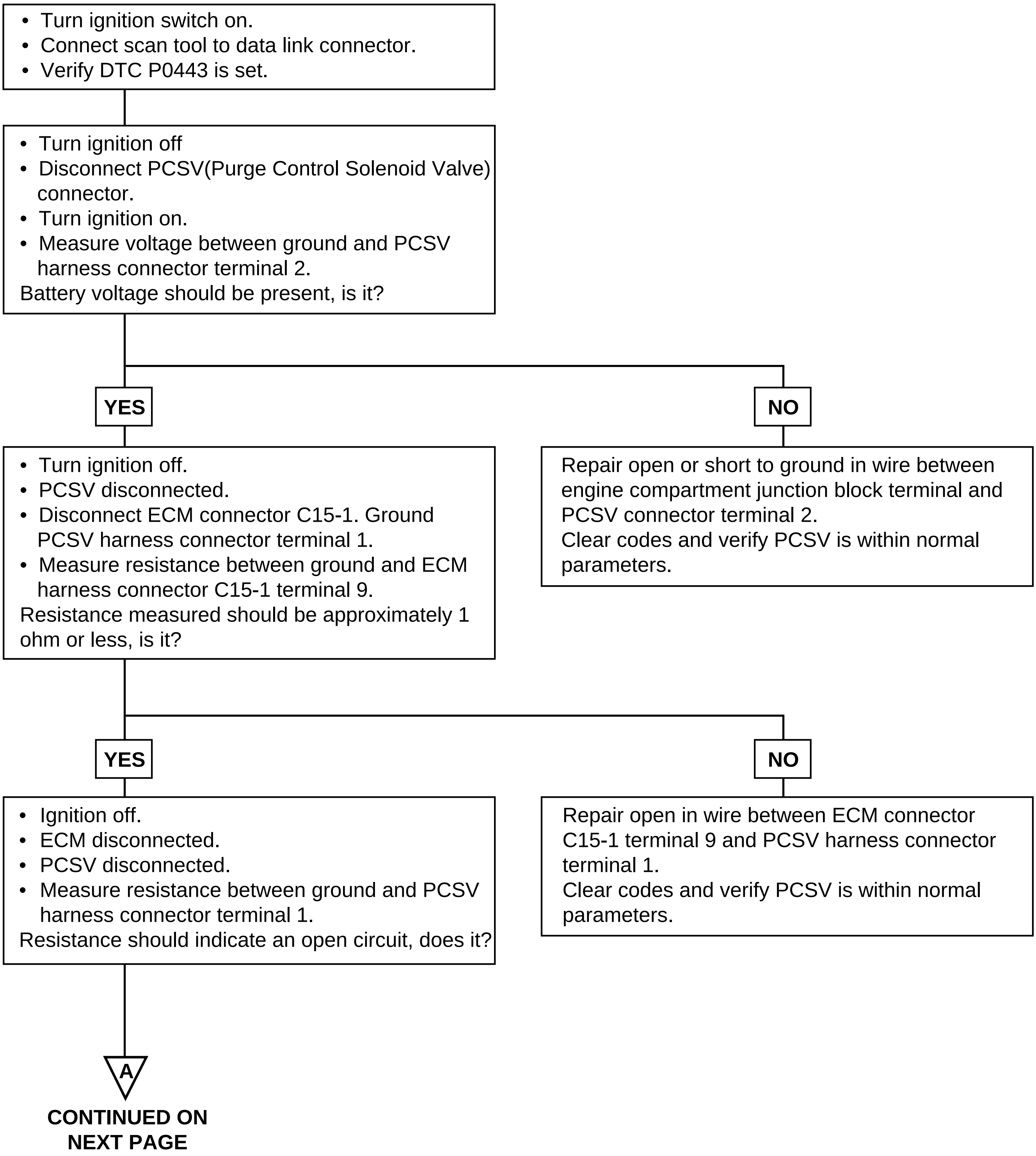
DTC detection condition	Probable cause
Background • The engine control module checks current flows in the evaporative emission purge solenoid drive circuit when the solenoid is ON and OFF. Check Area • Battery voltage is 10V or higher. Judgment Criteria • Solenoid coil surge voltage (system voltage +2V) is not detected when the EVAP emission vent solenoid is turned on/off.	• Evaporative emission purge solenoid failed • Open or shorted evaporative emission purge solenoid circuit, or loose connector • Engine control module failed

CIRCUIT DIAGRAM



EFUC519A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0443 is set.

- Turn ignition off
- Disconnect PCSV(Purge Control Solenoid Valve) connector.
- Turn ignition on.
- Measure voltage between ground and PCSV harness connector terminal 2.

Battery voltage should be present, is it?

YES

- Turn ignition off.
- PCSV disconnected.
- Disconnect ECM connector C15-1. Ground PCSV harness connector terminal 1.
- Measure resistance between ground and ECM harness connector C15-1 terminal 9.

Resistance measured should be approximately 1 ohm or less, is it?

NO

Repair open or short to ground in wire between engine compartment junction block terminal and PCSV connector terminal 2.
Clear codes and verify PCSV is within normal parameters.

YES

- Ignition off.
- ECM disconnected.
- PCSV disconnected.
- Measure resistance between ground and PCSV harness connector terminal 1.

Resistance should indicate an open circuit, does it?

NO

Repair open in wire between ECM connector C15-1 terminal 9 and PCSV harness connector terminal 1.
Clear codes and verify PCSV is within normal parameters.

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EFUC519B

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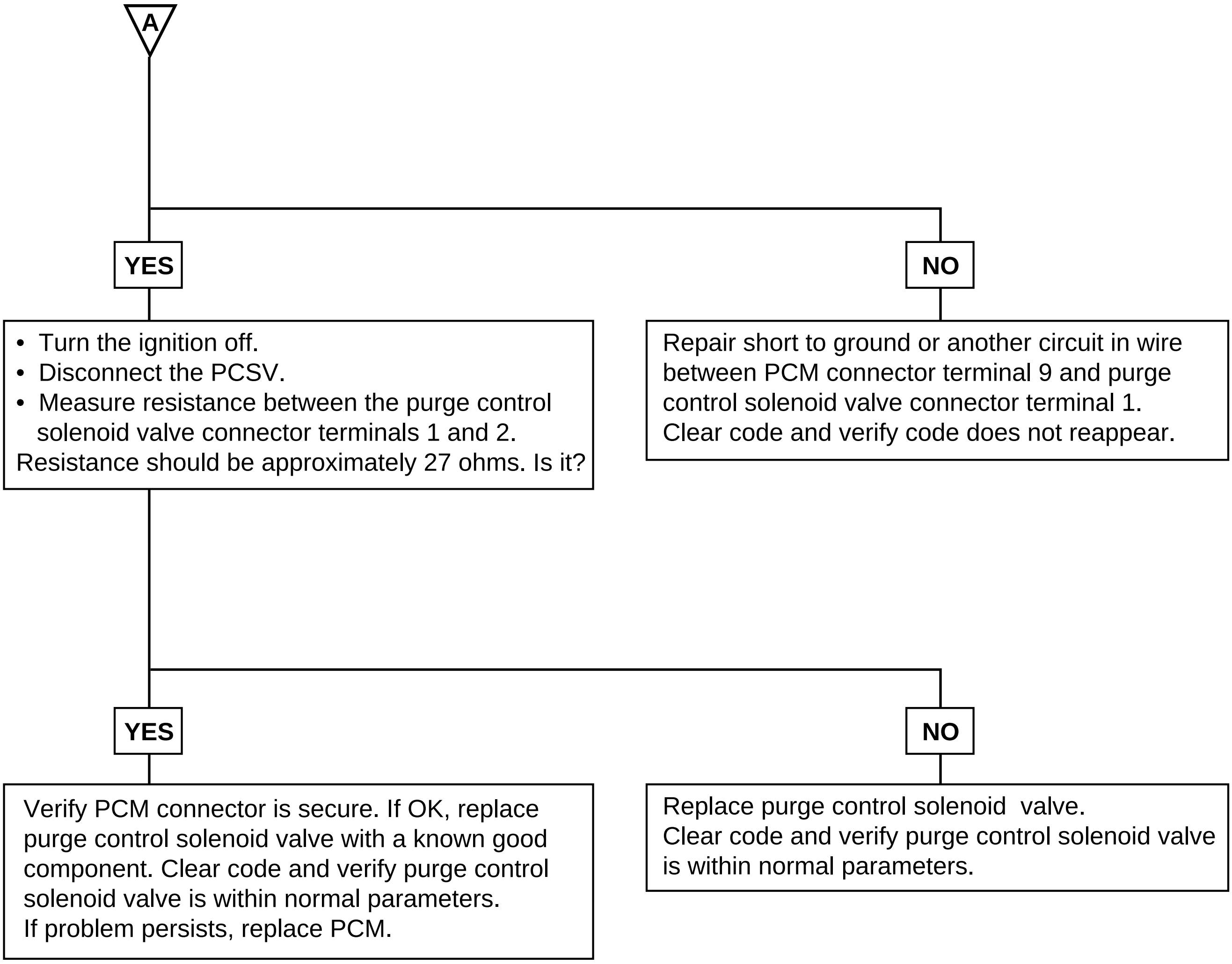


- Turn the ignition off.
- Disconnect the PCSV.
- Measure resistance between the purge control solenoid valve connector terminals 1 and 2.

Resistance should be approximately 27 ohms. Is it?

Repair short to ground or another circuit in wire between PCM connector terminal 9 and purge control solenoid valve connector terminal 1.
Clear code and verify code does not reappear.

Verify PCM connector is secure. If OK, replace purge control solenoid valve with a known good component. Clear code and verify purge control solenoid valve is within normal parameters.
If problem persists, replace PCM.

Replace purge control solenoid valve.
Clear code and verify purge control solenoid valve is within normal parameters.

EFUC519C

EFUC5200

DTC	Diagnostic item
P0500	Vehicle Speed Sensor Malfunction

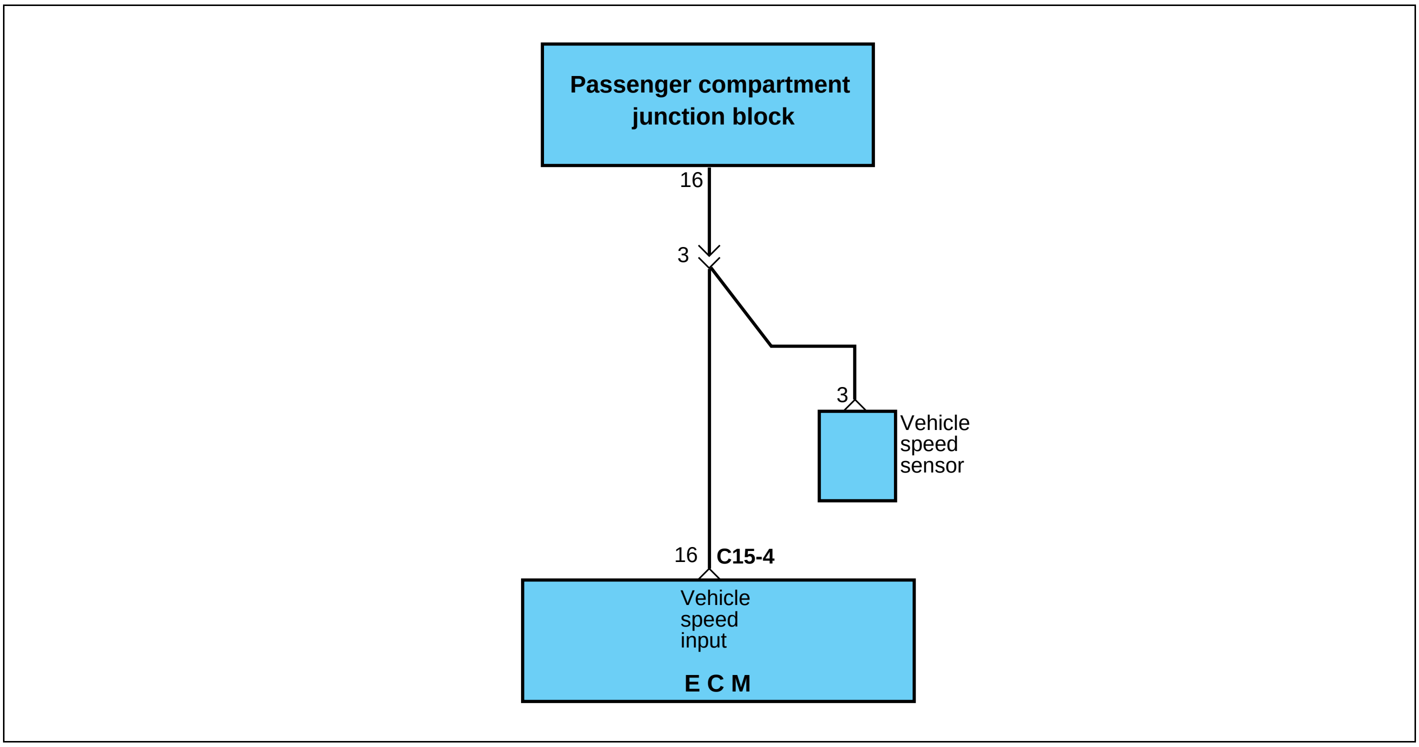
DESCRIPTION

The vehicle speed sensor outputs a pulse signal while the vehicle is driven.
The engine control module checks whether the pulse signal is output.

TROUBLESHOOTING GUIDE

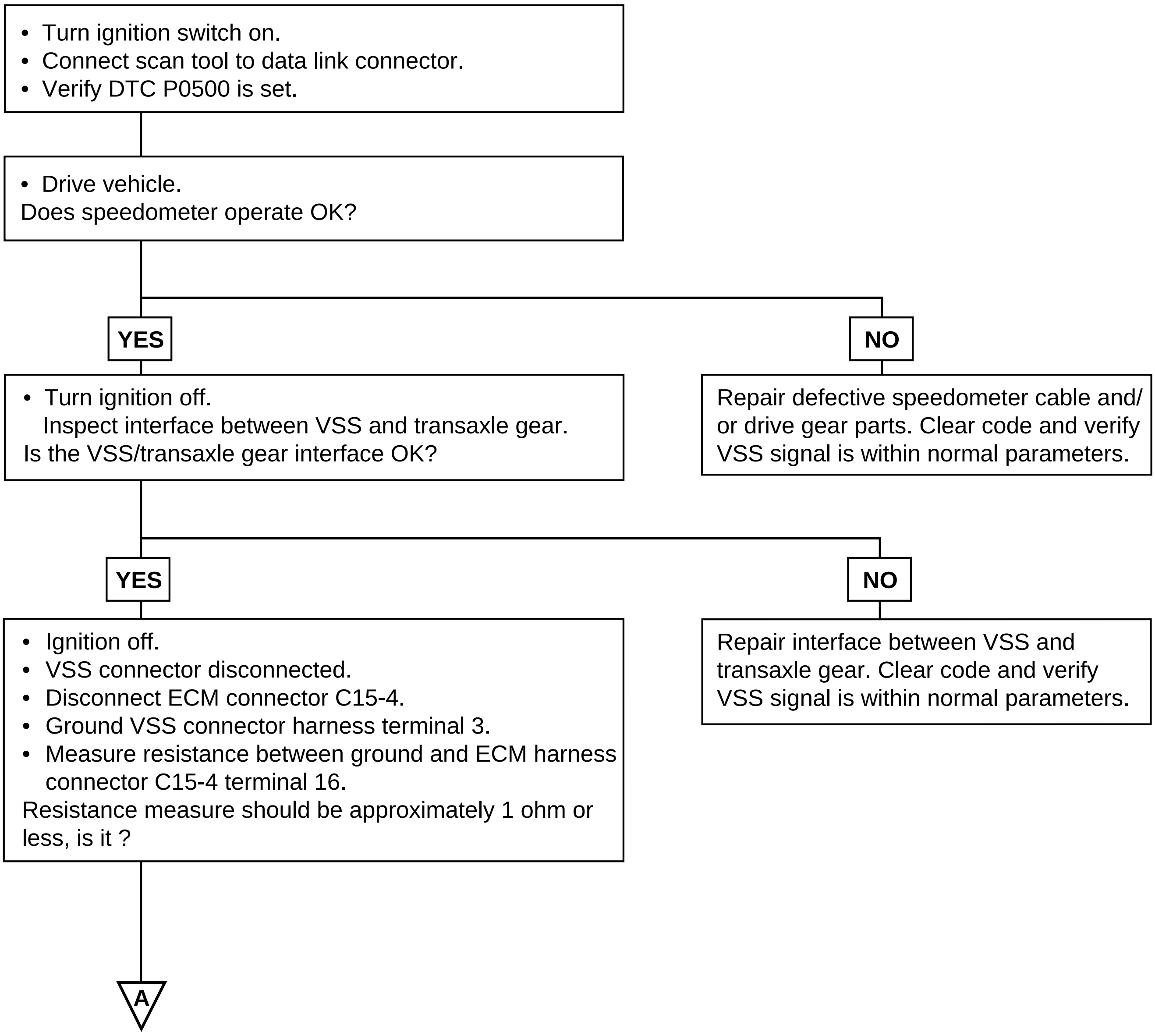
DTC detection condition	Probable cause
Background • The vehicle speed sensor outputs a pulse signal while the vehicle is driven. • The engine control module checks whether the pulse signal is outputted. Check Area • Closed throttle position switch: OFF • Engine speed is 3,000 r/min or more. • Engine load is 70% or more. Judgment Criteria • Sensor output voltage has not changed (no pulse signal is input) for 4 sec.	• Vehicle speed sensor failed • Open or shorted vehicle-speed sensor circuit, or loose connector • Engine control module failed

CIRCUIT DIAGRAM



EFUC520A

TEST PROCEDURE



- Turn ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0500 is set.

- Drive vehicle.

Does speedometer operate OK?

YES

- Turn ignition off.

  Inspect interface between VSS and transaxle gear.

Is the VSS/transaxle gear interface OK?

NO

Repair defective speedometer cable and/or drive gear parts. Clear code and verify VSS signal is within normal parameters.

YES

- Ignition off.
- VSS connector disconnected.
- Disconnect ECM connector C15-4.
- Ground VSS connector harness terminal 3.
- Measure resistance between ground and ECM harness connector C15-4 terminal 16.

Resistance measure should be approximately 1 ohm or less, is it ?

NO

Repair interface between VSS and transaxle gear. Clear code and verify VSS signal is within normal parameters.

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EFUC520B

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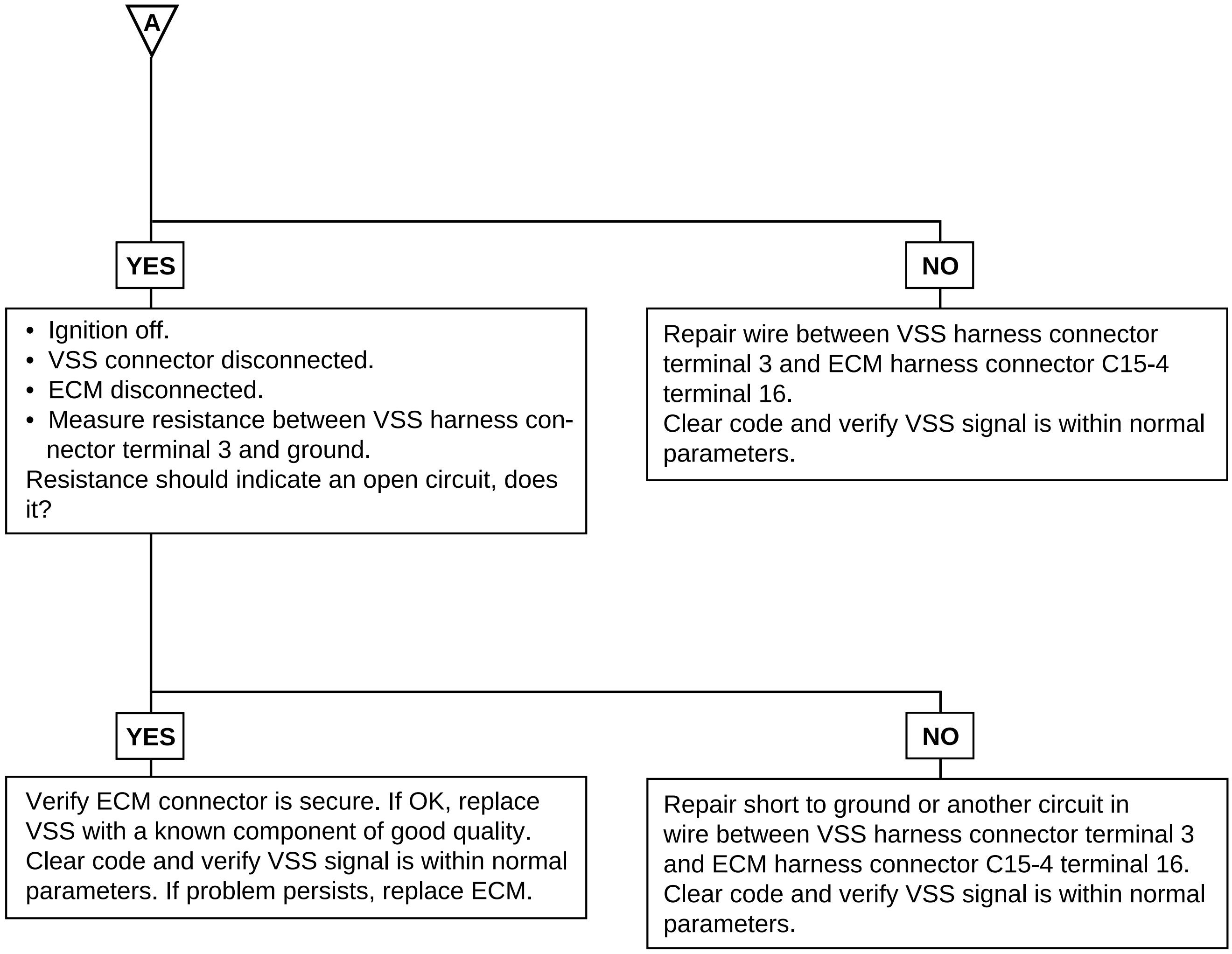


- Ignition off.
- VSS connector disconnected.
- ECM disconnected.
- Measure resistance between VSS harness connector terminal 3 and ground.

Resistance should indicate an open circuit, does it?

Repair wire between VSS harness connector terminal 3 and ECM harness connector C15-4 terminal 16.
Clear code and verify VSS signal is within normal parameters.

Verify ECM connector is secure. If OK, replace VSS with a known component of good quality. Clear code and verify VSS signal is within normal parameters. If problem persists, replace ECM.

Repair short to ground or another circuit in wire between VSS harness connector terminal 3 and ECM harness connector C15-4 terminal 16.
Clear code and verify VSS signal is within normal parameters.

EFUC520C

EFUC5210

DTC	Diagnostic item
P0507	Idle Speed Control - High RPM

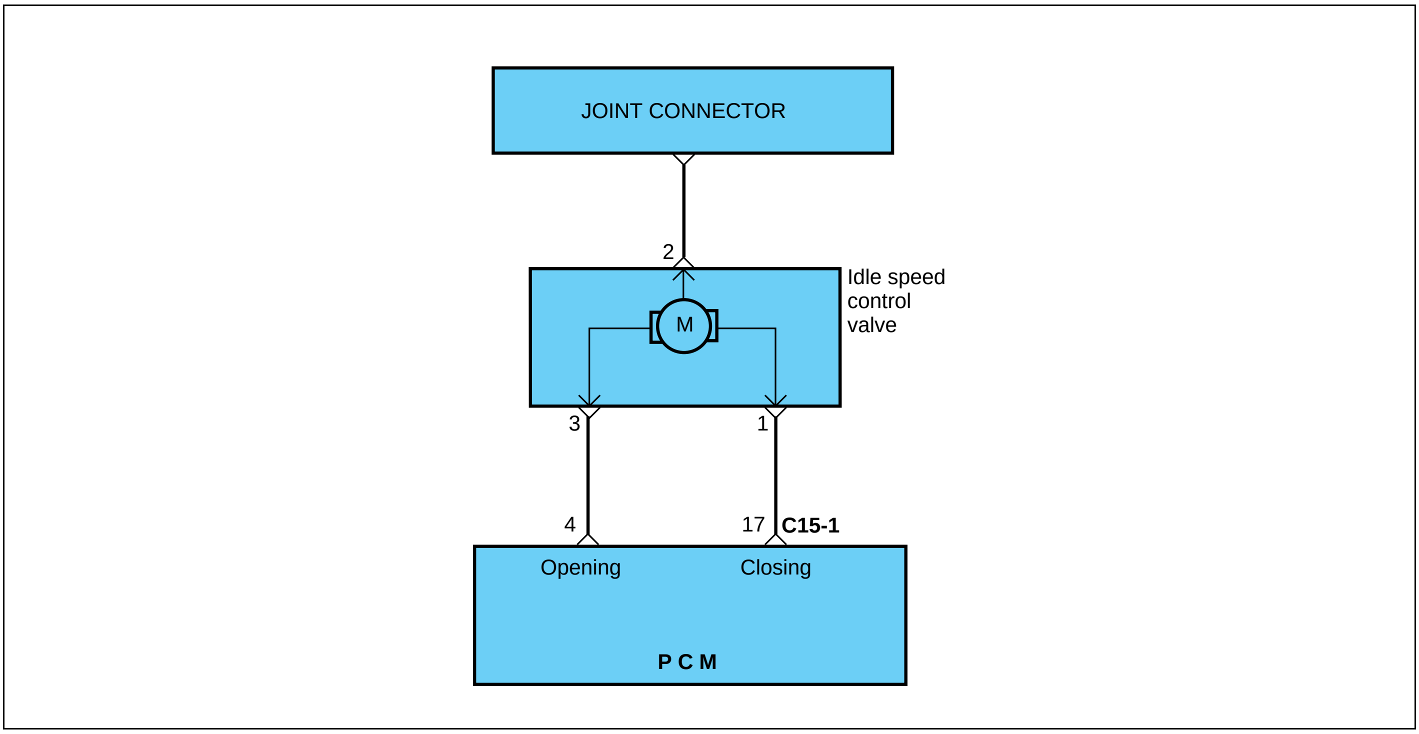
DESCRIPTION

The intake air volume at idle is controlled by opening or closing the idle speed control valve provided in the air path that bypasses the throttle valve.
If there is a malfunction of the ISC system, the actual engine speed will not be identical to the target engine speed.
The engine control module checks the difference between the actual engine speed and the target engine speed.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Background • If there is a malfunction of the ISC system, the actual engine speed will not be identical to the target engine speed. • The engine control module checks the difference between the actual engine speed and the target engine speed. Check Area • Under the closed loop idle speed control. Judgment Criteria • Actual idle speed has continued to be higher than the target idle speed by 300 r/min or more for 10 sec. Check Area • During idling speed closed-loop control • The maximum atmospheric temperature is 45°C (113°F) or less at the last drive. • Long term fuel trim is at -8% to +8%. • Engine coolant temperature is approx. 80°C (176°F) or more. • Battery voltage is 10V or more. • Intake air temperature is -10°C (14°F) or more. Judgment Criteria • Actual idle speed is 200 r/min or more higher than the target idle speed for 10 seconds. Check Area • During idle speed closed loop control. • Power steering pressure switch is off. • Engine load is 40% or less. • Intake air temperature is -10°C (14°F) or more. Judgment Criteria • Actual idle speed is 120 r/min or more lower than the target idle speed for 10 seconds.	• Idle speed control motor failed • Open or shorted idle speed control motor circuit, or loose connector • Engine control module failed

CIRCUIT DIAGRAM



EFUC521A

Fuel System [Diesel]

GENERAL .... FLB - 2

INJECTION PUMP-MECHANICAL .... FLB -11

FUEL DELIVERY SYSTEM-DIESEL .... FLB -22

GENERAL

SPECIFICATIONS EFLB0010

Fuel injection pump	
Injection pump	
Type	Distribution type
Turning direction	Clockwise as viewed from drive side
Injection sequence	1 - 3 - 4 - 2
Governor type	Centrifugal type
Timer type	Hydraulic
Feed pump type	Vane type
Control equipment	
Fast idle mechanism	Manual type
Injection nozzle and holder	
Type	Screw-on type
Nozzle	
Type	Throttle type
Engine control system	Pedal-operated cable type, incorporating electric engine stop mechanism interlocked with starter switch Throttle button type
Fuel tank	
Capacity lit. (U.S. gals., Imp.gals.)	65 (17.2, 14.4)

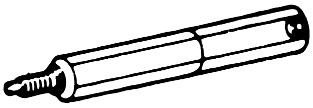
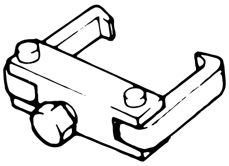
SERVICE SPECIFICATIONS EFLB0030

	Standard	Limit
Fuel injection pump		
Injection timing (when plunger lift 1 mm)	4° ATDC	
Cam lift mm	2.2	
Plunger diameter mm	10	
Delivery valve opening pressure kPa (kg/cm^2)	2,150 (21.5)	
Fuel cut solenoid	Rated voltage : 12V; Resistance : 8Ω	
Injection nozzle		
Injection orifice (Number-diameter) mm	1-1.02	
Breaking pressure kPa (kg/cm^2)	12,000-13,000 (120-130)	11,000 (110)
Idle speed rpm	750 ± 30	
Engine control system		
Cable length		
Accelerator control cable mm	L : 2725-2735 A + B : 125-129	
Throttle cable mm	L : 642-648 C : 60-62	
Throttle knob stroke mm	25 or more	

TORQUE SPECIFICATIONS EFLB0050

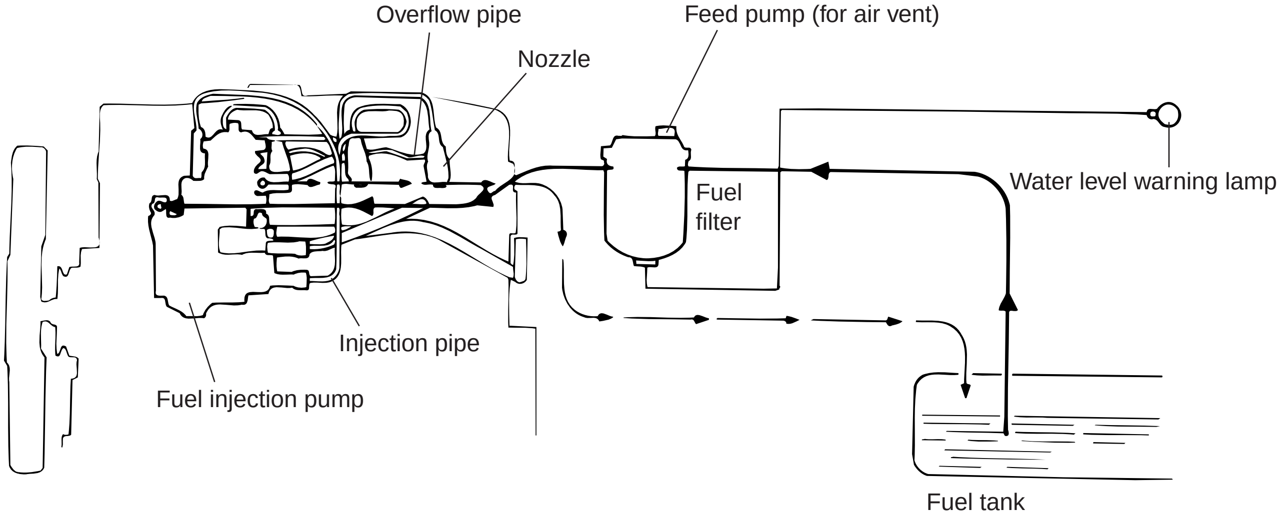
	Nm	Kg·m	lb·ft
Injection pipe clamp bolts	4 - 6	0.4 - 0.6	3 - 4
Injection pipe union nuts	23 - 37	2.3 - 3.7	17 - 27
Pump bracket-to-cylinder block bolts	18 - 25	1.8 - 2.5	13 - 18
Injection pump-to-pump bracket bolts	20 - 27	2.0 - 2.7	14 - 19
Injection pump mounting nuts	15 - 22	1.5 - 2.2	11 - 16
Fuel return pipe nuts	30 - 40	3.0 - 4.0	22 - 29
Injection nozzle	50 - 60	5.0 - 6.0	36 - 43
Retaining nut-to-nozzle body	35 - 40	3.5 - 4.0	25 - 29
Pump sprocket nut	80 - 90	8.0 - 9.0	58 - 65
Fuel tank mounting bolts	15 - 22	1.5 - 2.2	11 - 16

SPECIAL TOOLS EFLB0070

Tool (Number and name)	Illustration	Use
09310-43000 Prestroke measuring adapter	 C1043000	Injection timing adjustment
09314-43000 Injection pump sprocket puller	 C1443000	Removal of injection pump sprocket

GENERAL INFORMATION EFLB0080

A distribution-type fuel injection pump is installed in the front upper case and is driven by the timing belt. The fuel is drawn from the fuel tank by a pump inside the fuel injection pump and sent to the injection pump through a filter which contains a water separator. The fuel under pressure enters the pump chamber, where the fuel pressure is regulated by a regulating valve. From the pump chamber, the fuel is sent through the distributor head passage and then the inlet port in the barrel to the high pressure chamber above the plunger. The plunger pumps the fuel and the highly pressurized fuel is injected from the nozzle in accordance with the injection sequence. The excess fuel in the pump housing chamber is returned through the overflow valve and the overflow pipe to the fuel tank. The injection pump is cooled and lubricated by means of fuel circulation. The excess fuel at the nozzle holder is also returned through the overflow pipe with unions on the injection pump to the fuel tank. Since the injection pump is lubricated by fuel, water in the fuel will shorten the pump life to a great degree. Therefore, special care must be taken to prevent the entry of water, dust, etc. into the system.



AU012

TROUBLESHOOTING EFLB0090

FUEL INJECTION SYSTEM

Symptom	Probable cause	Remedy
Engine does not start	Cranking speed too low	Repair starting system or charge or replace battery so that engine cranks at a minimum of 150 rpm.
	No voltage at fuel cut-off solenoid on injection pump	Check for voltage with test light. If necessary, replace fuse or faulty wires.
	Fuel cut-off solenoid on injection pump loose or faulty	Tighten solenoid. Check that solenoid clicks when key is turned off and on. Replace faulty solenoid.
	No voltage at glow plug bus	If test light shows no voltage at bus with key at “ON” position, test relay and wiring.
	Glow plug faulty	Test and, if necessary, replace glow plug.
	Air in fuel system	Bleed fuel system.
	Injection pump not delivering fuel	If no fuel emerges from a looseness injection pipe during cranking, check timing belt and fuel supply from filter.
	Injection pipes misconnected	Connect pipes in correct location
	Injection timing incorrect	Adjust injection timing.
	Faulty injection nozzles	Check and, if necessary, repair or replace nozzles.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Try to start engine with new pump installed. If necessary, replace pump permanently.
Idle speed incorrect or idle rough irregular	Idle speed incorrectly adjusted	Check and, if necessary, adjust the idle speed.
	Accelerator control binding	Check that accelerator lever on pump is not loose, then adjust accelerator cable.
	Loose fuel hose between filter and injection pump	Replace hose or secure with clamps, bleed air from system.
	Air in fuel system	Bleed fuel system.
	Inadequate fuel supply owing to clogged fuel filter, or fuel return line and injection pipes leaking, dirty, kinked, or squeezed at connections	Inspect and, if necessary, replace lines and hoses or replace fuel filter.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Try engine at idle with new pump installed. If necessary, replace pump permanently.
	Engine lugging in too high a gear	Observe correct shift speeds.

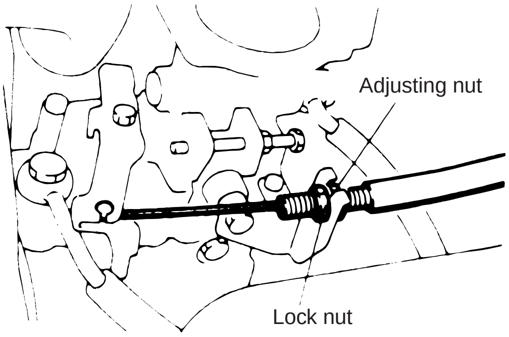
Symptom	Probable cause	Remedy
Smoky exhaust (black, blue or white)	Engine not reaching correct operating temperature	Check and, if necessary, replace cooling system thermostat.
	Maximum rpm incorrect	Check and if necessary, replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Restricted exhaust system	Check exhaust system for dents and obstructions.
	Engine mechanical faulty, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Observe exhaust with new pump installed if necessary, replace pump permanently.
Poor power output, slow acceleration (speedometer accurate, clutch not slipping)	Injection pump accelerator lever loose or not reaching maximum rpm adjusting screw	Tighten lever, check that accelerator pedal travel is not restricted, then adjust accelerator cable.
	Maximum rpm incorrect	Check and, if necessary, replace injection pump.
	Air cleaner filter dirty	Clean or replace air cleaner filter.
	Inadequate fuel supply owing to clogged fuel filter, or fuel return line and injection pipes leaking, dirty, kinked, or squeezed at connections	Inspect and, if necessary, replace lines and hoses, replaced fuel filter.
	Air in fuel system	Bleed fuel system.
	Ice or solidified wax in fuel lines. (winter time only)	Move car to a warm garage until ice or wax has become liquid, then bleed fuel system.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical faults, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Check acceleration and speed with new pump installed. If necessary, replace pump permanently.

Symptom	Probable cause	Remedy
Excessive fuel consumption	Air cleaner filter dirty	Clean or replace air cleaner filter.
	Fuel leaks	Check and, if necessary, replace or tighten all pipes, hoses and connections.
	Return pipe and hose blocked	Check return line for kinks and dents. Replace faulty lines. If line is clogged, blow it out with compressed air, then bleed fuel system.
	Idle speed too fast or maximum rpm too high	Check and, if necessary, adjust idle speed or replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair or replace injection nozzles.
	Injection timing incorrect	Adjust injection timing.
	Engine mechanical fault, as described earlier under this heading	Test compression and, if necessary, repair engine.
	Faulty injection pump	Check fuel consumption with new pump installed, if unnecessary, replace pump permanently.
Excessive accelerator pedal effort required (Incomplete pedal return included)	Rusty pedal arm	Clean and lubricate.
	Incorrect routing	Ensure bending radius of 150 mm or more and correct excessively bent portion.
	Rusty cable	Replace
	Shift throttle cable	Lubricate link and shaft.
Broken accelerator control cable	Binding cable end	Remove rust and burrs from cable end.
	Incorrect perpendicularity of cable end mounting point	Correct ends on the lever side.
	Incorrect perpendicularity between cable end and cable	Correct or replace parts.
Engine does not stop	Faulty starting switch operation	Correct or replace part.
	Broken harness between starting switch and fuel cut solenoid	Replace harness

INSPECTION AND ADJUSTMENT EFLB0150

ACCELERATOR CABLE

1. Warm engine until stabilized at idle.
2. Confirm idle rpm is at prescribed rpm.
3. Stop engine.
4. Confirm there are no sharp bends in accelerator cable.
5. Check inner cable for correct slack.

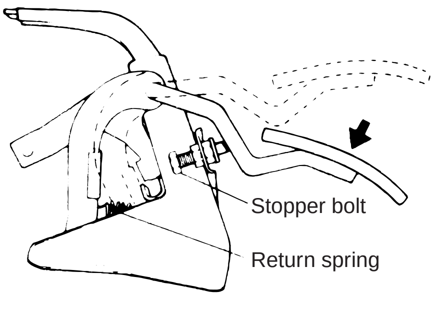


AU003

6. If there is too much slack, adjust slack by the following procedures.
    1) Loosen adjusting nut. Fully close throttle lever.
    2) Tighten adjusting nut until throttle lever just starts moving.
    Return 1 turn and lock with lock nut. This adjusts accelerator cable play to standard value.

Standard value : approx. 1 mm (0.04 in.)

    3) Adjust so that accelerator pedal stopper touches pedal arm when throttle lever is fully opened.
    4) After adjusting, confirm that throttle level fully opens and closes by operating pedal.



AU004

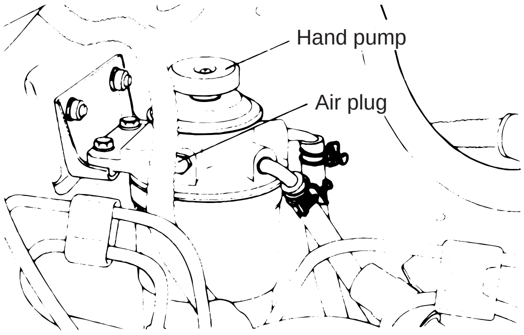
ADJUSTMENT EFLB0160

EVACUATION OF AIR FROM FUEL LINE

Evacuate air after following services.

- When fuel is drained and re-filled for service.
- When fuel filter is replaced.
- When main fuel line is removed.

1. Loosen fuel filter air plug.
2. Place rags around air plug hole. Operate hand pump repeatedly until no bubbles come from plug hole. Tighten air plug.
3. Repeat until hand pump operation becomes stiff.



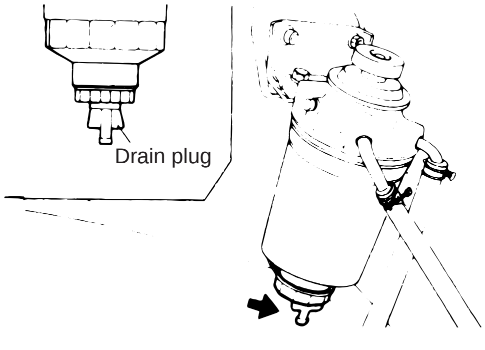
AU005

ADJUSTMENT EFLB0170

EVACUATION OF WATER FROM FUEL FILTER

Water is in the filter when fuel filter indicator lights. Evacuate water by the following procedures.

1. Loosen drain plug.
2. Drain water with hand pump. Finger-tighten drain plug.



AU006

INSPECTION AND ADJUSTMENT EFLB0180

INJECTION NOZZLE

INJECTION START PRESSURE

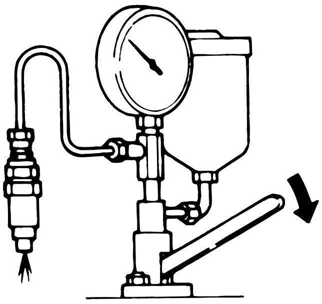
1. Set injection nozzle in nozzle tester and check the following.
2. Move nozzle tester handle at about one stroke per second.
3. The pressure gauge pointer rises slowly and swings when injection is made. Read the position at which the pointer started to swing. Check the injection start pressure is the standard value.

Standard value :

12,000-13,000 kPa
(120-130 kg/cm², 1,707-1,848 psi)

Limit :

11,000 kPa (110 kg/cm², 1,565 psi) or less



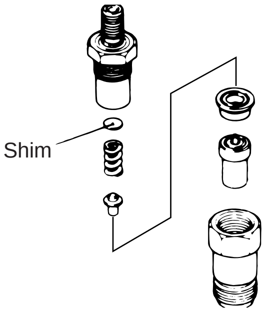
AU007

4. If the nozzle is faulty, disassemble and adjust injection start pressure to the standard value by changing the shim thickness. Injection pressure increases by approx. 1,000 kPa (10 kg/cm², 142 psi) as shim thickness is increased by 0.1 mm (0.0039 in.).

CAUTION

When disassembling nozzle holder, be careful not to allow entry of dirt or water.

5. If the injection start pressure can not be adjusted by changing the shim thickness, replace nozzle assembly.



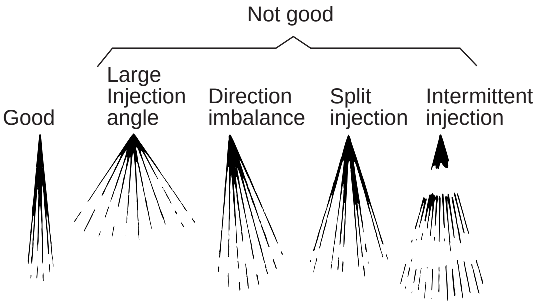
EFLB018B

INJECTION STATUS

1. Move nozzle tester handle at about 1 stroke per second.

[Needle valve vibration]
Inject on is normal if the characteristic intermittent sound is heard as the handle is operated, and vibration of the needle valve is felt at the handle.

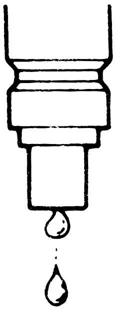
[Spray]
Check that the spray is good, as illustrated in the figure, in the test, the spray may be bolt shaped with a course mist and fuel may remain. This is phenomenon common in this type of inspection, and the nozzle function is normal.



EFLB018C

2. Move nozzle tester handle at 4 to 6 strokes per second.
3. Confirm the spray is cone shaped with an angle of about 15°. This indicates a good condition.
4. If the injection is not good, disassemble nozzle and replace nozzle tip or entire assembly.

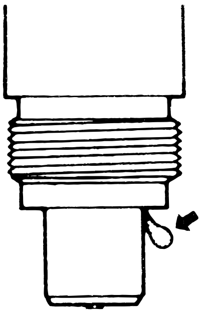
5. Confirm fuel does not drip after injection.
6. If dripping, disassemble injection nozzle and replace nozzle tip or entire assembly.



EFLB018D

NOZZLE OIL-SEAL

1. Maintain internal nozzle pressure (pressure gauge indication value) with the nozzle tester at 10,000-11,000 kPa (100-110 kg/cm^2, 1,422-1,565 psi). Check for fuel leaking from nozzle tip in this condition.
2. If there is leakage, disassemble injection nozzle and replace nozzle tip or entire assembly.



EFLB018E

INJECTION PUMP-MECHANICAL

INSPECTION EFLB1010

FUEL INJECTION PUMP AND INJECTION NOZZLE ON VEHICLE

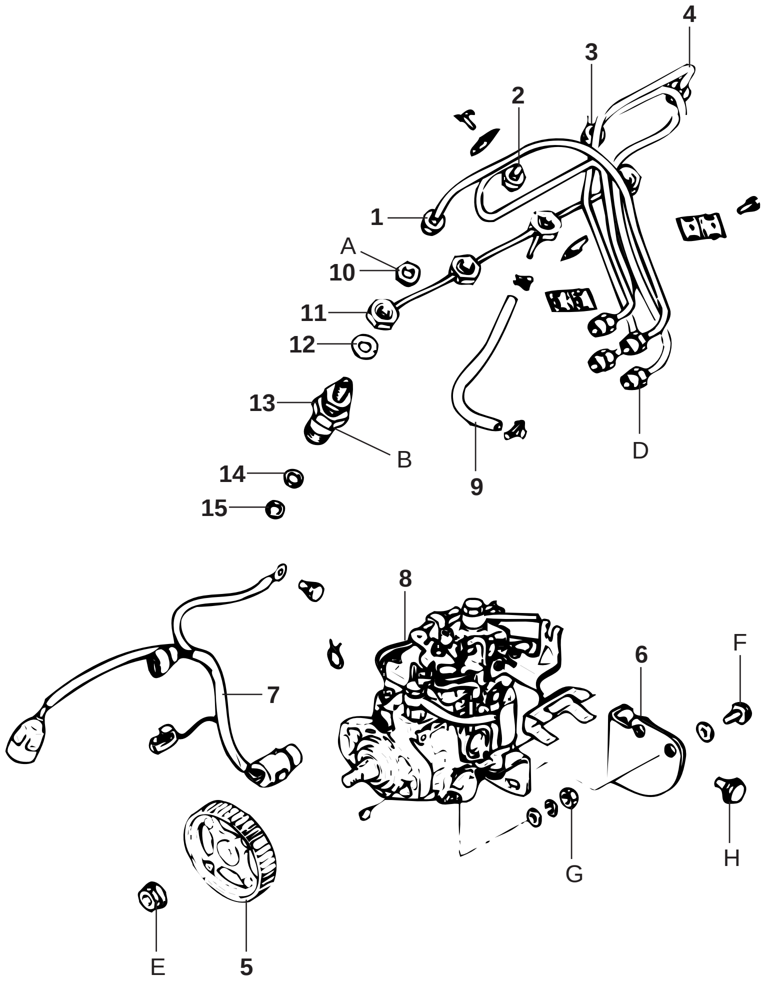
If found defective, replace the injection pump as assembly.

NOTE

Limit the injection pump adjustment to the idle adjustment.

Description	Check procedure	Criteria
Idling run	Measure rpm	702-780 rpm
Color of exhaust gas	Give fast acceleration under no load and check color of exhaust gas. (Measure smoke value).	Voluminous black smoke is unacceptable. (Smoke ref. value : within 50%)
Timer	Operate accelerator lever to maintain an engine speed of approx. 1,500 rpm. In this condition, manually operate accelerator switch knob to see how engine speed changes.	Engine noise changes.
Fuel cut solenoid	Turn on and off ignition switch	Actuating sound (click) is heard.

COMPONENTS EFLB1030



1. Injection pipe No.1
2. Injection pipe No.2
3. Injection pipe No.3
4. Injection pipe No.4
5. Injection pump sprocket
6. Injection pump bracket
7. Injection pump harness assembly
8. Fuel injection pump
9. Fuel hose
10. Fuel return pipe nut
11. Fuel return pipe
12. Gasket
13. Injection nozzle
14. Holder gasket
15. Nozzle gasket

NOTE
Reverse the removal procedures to reinstall

	Nm	kg·m	lb·ft
A	30-40	3.0-4.0	21-29
B	50-60	5.0-6.0	36-43
C	4-6	0.4-0.6	3-4
D	23-37	2.3-3.7	16-27
E	80-90	8.0-9.0	58-65
F	20-27	2.0-2.7	14-19
G	15-22	1.5-2.2	10-16
H	18-25	1.8-2.5	13-18

EFLB103A

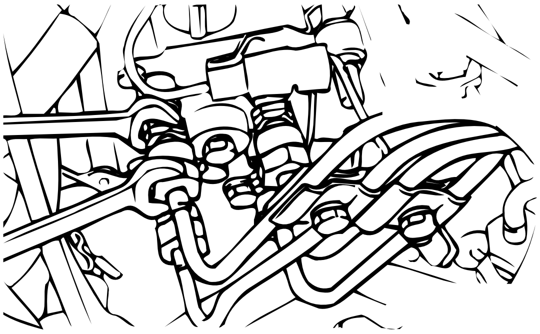
REMOVAL EFLB1050

INJECTION PIPE

When loosening the union nuts, hold delivery valve holder on fuel injection pump head or hexagon nut of fuel return pipe with a wrench to prevent it from rotating along with the union nut.

⚠ **CAUTION**

Because VE type injection pipe is different from DPC type injection pipe, be careful when you install. (VE type injection pipe is coated yellow)



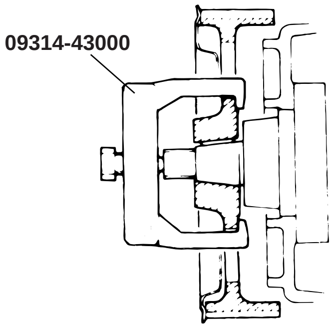
EFLB105A

INJECTION PUMP SPROCKET

Use the special tool to remove the injection pump sprocket.

⚠ **CAUTION**

Jarring the sprocket may cause injection pump malfunction.



EFLB105B

FUEL INJECTION PUMP

When removing the fuel return pipe nut, hold the fuel return pipe by the hexagon nut with a wrench.

⚠ **CAUTION**

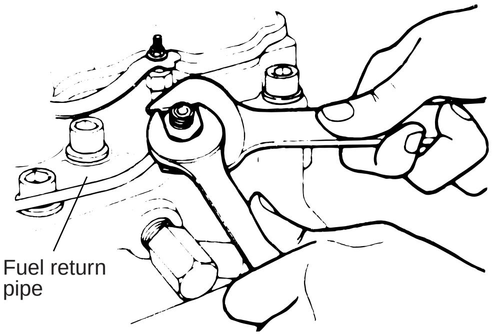
If you remove the hexagon nut without holding the fuel return pipe nut, the pipe might be damaged. So you must remove the hexagon nut with holding return pipe.

FUEL RETURN PIPE NUT

When removing the fuel return pipe nut, hold the fuel return pipe by the hexagon nut with a wrench.

⚠ **CAUTION**

If you remove the hexagon nut without holding the fuel return pipe nut, the pipe might be damaged. So you must remove the hexagon nut with holding return pipe.



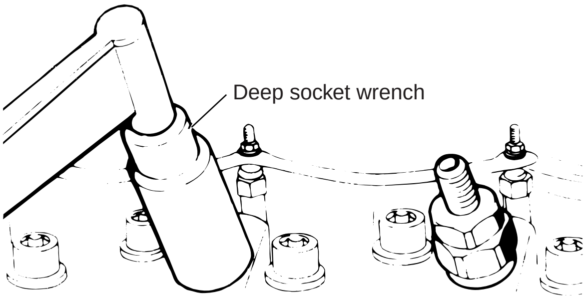
EFLB105C

INJECTION NOZZLE

Using a deep socket wrench, loosen the injection nozzle and remove.

⚠ **CAUTION**

Write the number of the cylinder on the injection nozzle that has been removed.
Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage land combustion chamber.

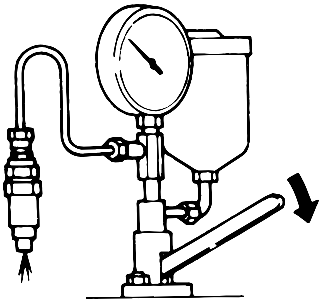


EFLB105D

INSPECTION EFLB1070

INJECTION NOZZLE

Make the following checks and, if defects are found, correct or replace.



AU007

CHECKING OF INJECTION PRESSURE

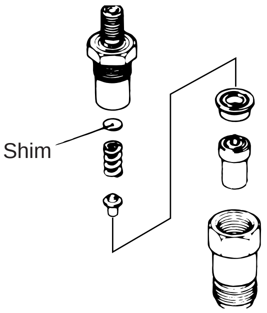
1. Mount nozzle on nozzle tester and operate tester handle to bleed the nozzle.
2. Operate tester handle at a rate of approximately one stroke/sec and read the pressure gauge.
   If the pressure reading is below the service limit, disassemble nozzle and adjust it by replacing the interior shim so that the pressure reading will be within the standard value range.

Standard value :
12,000-13,000 kPa (120-130 kg/cm²)

Service limit :
11,000 kPa (110 kg/cm²)

NOTE

1. *Increase of 0.1 mm shim thickness will result in increase of pressure to 1,000 kPa (10 kg/cm²).*
2. *20 different shims available ranging in thickness from 1.00-1.95 mm.*



EFLB018B

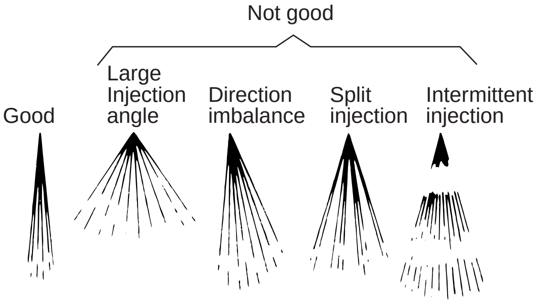
CHECKING OF SPRAY CHARACTERISTICS

1. Operate tester handle at a rate of approximately on stroke/sec. When the tester handle is moved, the nozzle should inject fuel producing a characteristic intermittent noise, and vibration of needle valve should be palpable at the tester handle.

NOTE

Fuel may remain at the nozzle tip after injection. This sometimes occurs when checking the nozzle but it does not mean that the nozzle is malfunctioning.

2. Spray condition
   Only one shows the good spray condition, others being poor. Spray may be shaped like a rod with coarse fuel particles and the gas oil may be present at the orifice after injection. This is a symptom that occurs uniquely during this inspection and does note represent any abnormal condition of the nozzle.
3. Operate the tester handle 4 to 6 strokes per second. The shape of spray is conical with an angle of about 30 degree.



EFLB018C

NOZZLE OIL TIGHTENESS

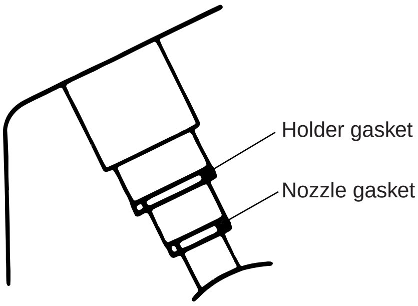
Operate the nozzle tester so that the interior pressure of the nozzle is maintained at a pressure gauge reading of 10,000-11,000 kPa (100-110 kg/cm²) and check nozzle tip for fuel leakage.

INSTALLATION EFLB1090

NOZZLE GASKET AND HOLDER GASKET

1. Clean nozzle holder installation area of the cylinder head.

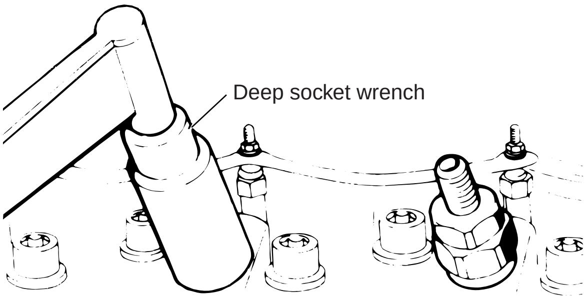
2. Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.



EFLB109A

INJECTION NOZZLE

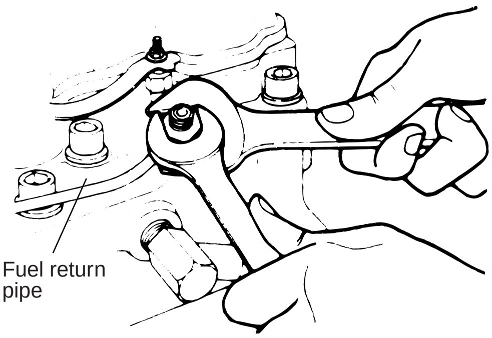
Install the injection nozzle in the cylinder head and tighten to the specified torque, using a deep socket wrench.



EFLB105D

FUEL RETURN PIPE NUT

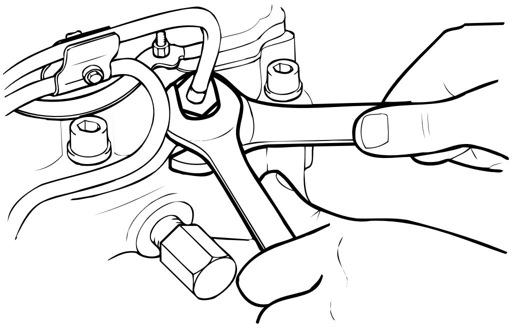
While holding the fuel return pipe by the hexagon nut with a wrench, tighten the fuel return pipe nut to the specified torque.



EFLB105C

INJECTION PIPE

When tightening the injection pipe nuts, hold the delivery valve holder or the fuel return pipe by the hexagon nut with a wrench in order to prevent it from rotating along with the nut.



EFLB109B

ADJUSTMENT EFLB1110

1. Loosen (but do not remove) two nuts and two bolts holding the injection pump.

2. Loosen (but do not remove) the 4 nuts on the injection pump side which hold the injection pipes.

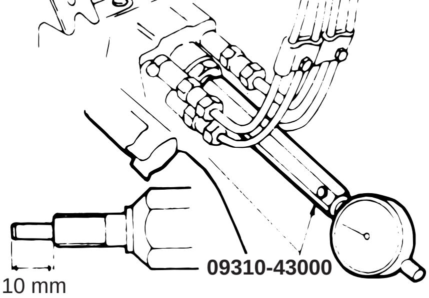
⚠ ***CAUTION***

When loosening the nuts, hold the delivery valve holder with a wrench to prevent it from turning along with the nut.

3. Remove the plug from the rear of injection pump, and attach the special tool and dial indicator.

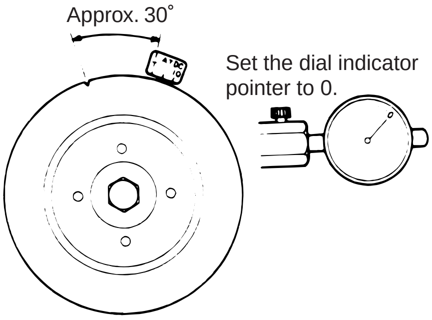
⚠ ***CAUTION***

Before installing the adapter, make sure that the push rod projects 10mm. Push rod projection can be adjusted by means of the interior nut.



EFLB111A

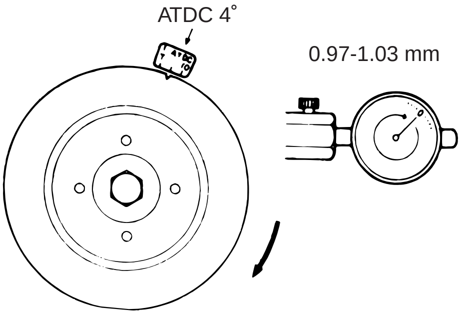
4. Set the notch on the crank pulley at approximately 30° BTDC of the compression stroke of the No.1 cylinder. With the notch in this position, set the dial indicator at zero. Turn the crank pulley slightly in both directions to make sure that the dial indicator pointer does not deviate from the zero position.
   If the pointer deviates, the notch position is not correct. Readjust it to 30° BTDC.



EFLB111B

5. Turn the crankshaft clockwise to bring the notch on the pulley to 4° ATDC, and check to be sure that the dial indicator reading is within the standard value range.

Standard value : 0.97-1.03 mm



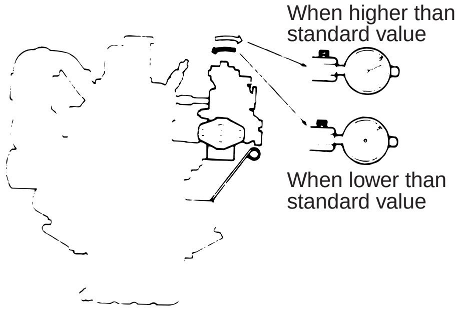
EFLB111C

6. If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range. Then, temporarily tighten the injection pump nuts and bolts.

7. Repeat Steps 4 and 6 to make sure that the adjustment has been correctly performed.

8. Remove the dial indicator and the special tool.

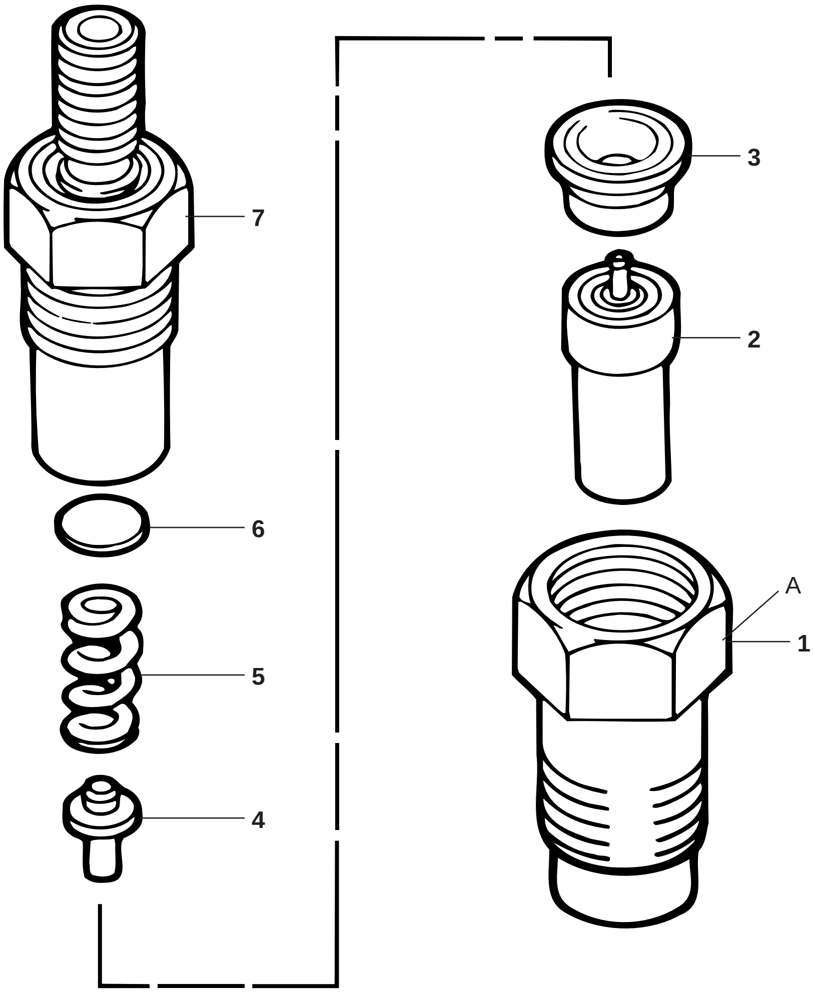
9. Tighten the bolts and nuts to the specified torque.



EFLB111D

INJECTION NOZZLE HOLDER EFLB1130

COMPONENTS



1. Retaining nut
2. Nozzle tip
3. Spacer
4. Retaining pin
5. Pressure spring
6. Shim
7. Nozzle holder body

NOTE

Reverse the disassembly procedures to reassembly.

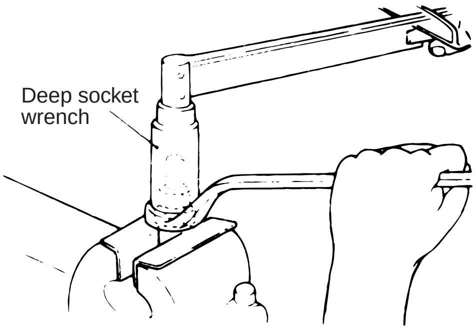
	Nm	kg·m	lb·ft
A	35-40	3.5-4.0	25-29

EFLB113A

DISASSEMBLY EFLB1150

RETAINING NUT

1. Lightly clamp the retaining nut with a cushion bracket
2. Hold the retaining nut with a box wrench, and loosen the nozzle holder body using a deep socket wrench.

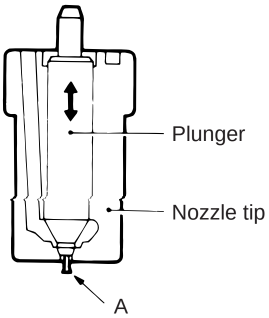


EFLB115A

INSPECTION EFLB1170

NOZZLE TIP

1. Check the nozzle tip for carbon deposits: Scrape off carbon deposits with a piece of wood land clean each part with patrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
2. While the nozzle tip is submerged in diesel fuel, check that the needle valve slides smoothly. If the needle valve does not slide smoothly, replace the nozzle tip. When replacing the nozzle tip, completely wash off the anticorrosive oil from the new nozzle tip with clean diesel fuel before using it.
3. Check plunger tip “A” for deformation and breakage. If “A” is damaged or broken replace it.



EFLB117A

DISTANCE PIECE

Check the surface in contact with the nozzle holder body by using minimum.

PRESSURE SPRING

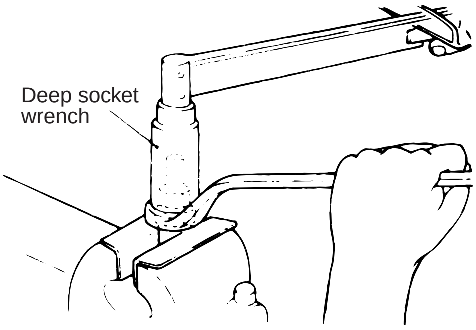
Check spring for weakness and breakage.

REASSEMBLY EFLB1190

RETAINING NUT

1. Finger-tighten the nozzle holder body.
2. Lightly clamp the retaining nut in a vise with cushion plates.
3. While holding the retaining nut with a box wrench, tighten the nozzle holder body to the specified torque with a deep socket wrench.

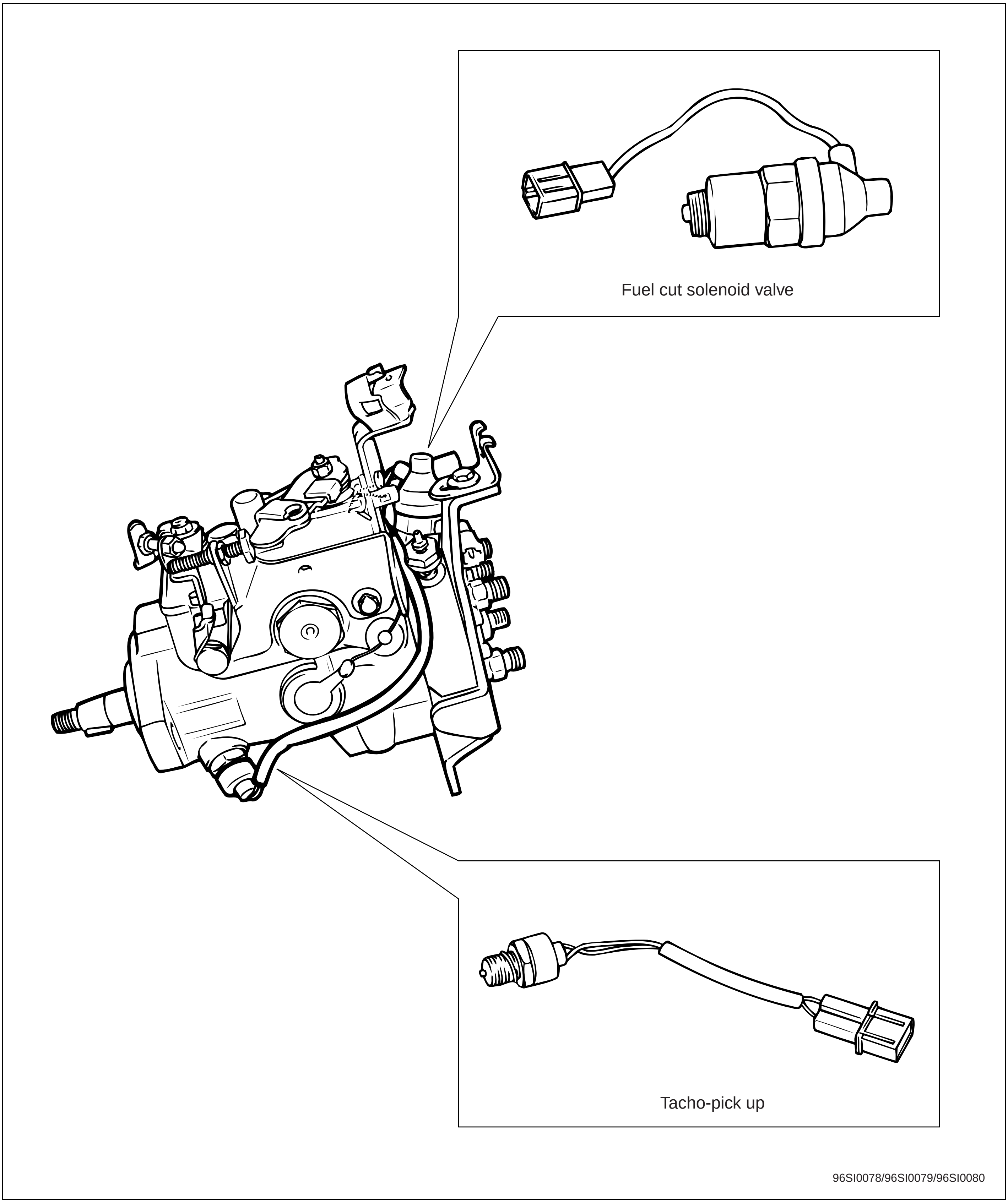
Tightening torque : 35-40 Nm (3.5-4.0 kgm)



EFLB115A

LUCAS INJECTION PUMP EFLB1210

COMPONENTS



EFLB121A

INSPECTION AND ADJUSTMENT EFLB1230

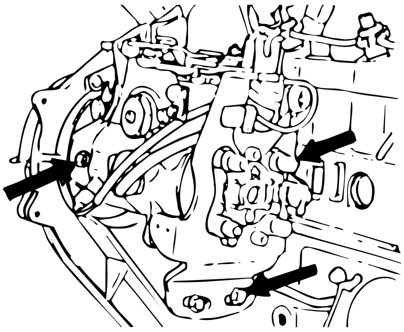
INJECTION TIMING

- Preparation
  - Turn off the engine.
  - Set the timing belt in normal mounting condition.
  - Set the transmission in neutral position

1. Untighten the upper installation nut and bolt of injection pump and also untighten the injection pump and also untighten the injection pipe halfway.

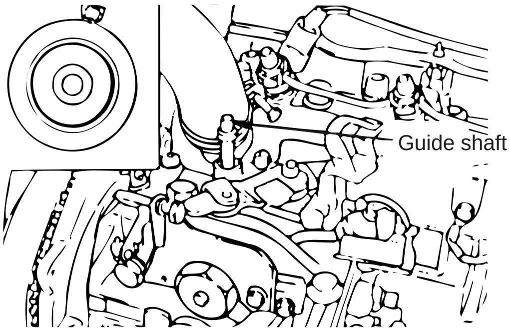
CAUTION

When untightening injection pipe nut, hold the valve holder with spanner so that the delivery valve holder shall not be turned together.



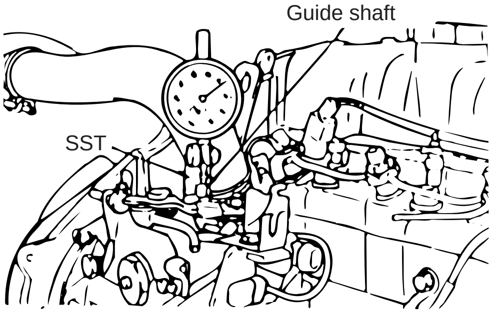
EFLB123A

2. Using box wrench, turn the crankshaft pulley to mate the V-groove at ATDC 4°.
Disconnect the timing check plug of injection pump, then insert the SST (Timing Measurement Guide Shaft).



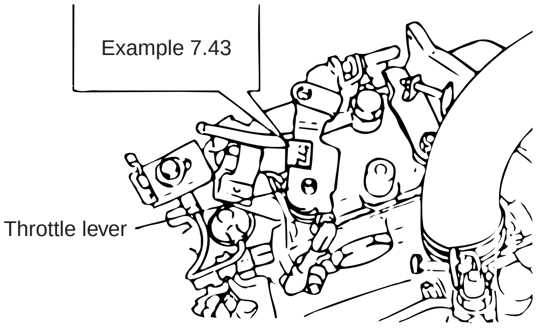
EFLB123B

3. Set the dial gauge to zero (0) after dial gauge installation special tool and dial gauge are installed to timing check guide shaft.



EFLB123C

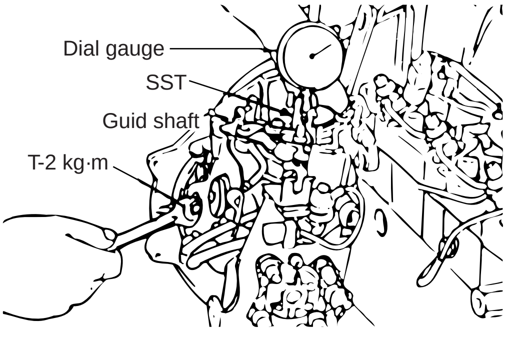
4. With the V-groove of crankshaft pulley being positioned at ATDC 4°by turning the crankshaft clockwise of 1 rotation, check to sure that the dial indicator reading is within the value indicated on throttle lever.
   - If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range.



EFLB123D

5. Tighten the injection pump nut and bolt and injection pipe nut. Turn the crankshaft pulley counterclockwise more than 90° and then match to ATDC 4°by turning the crankshaft clockwise. And, check the dial gauge indicating value and adjusting value.

Limited Value : ± 0.05 mm



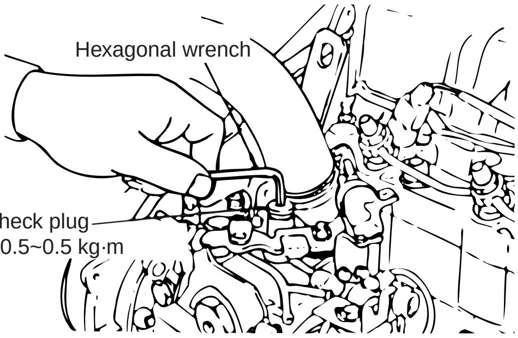
EFLB123E

6. Remove the timing adjusting data and SST and Guide Shaft, then assemble the check plug using hexagon wrench.

INSPECTION AND ADJUSTMENT EFLB1240

IDLE RPM

1. Set the vehicle in the following conditions before inspection and adjustment.
   - Engine coolant temperature : 80-90
   - Lights, accessories : OFF
   - Transmission position : Neutral
2. Check that the valve clearance is within standard value.
3. Check that the injection timing within standard value

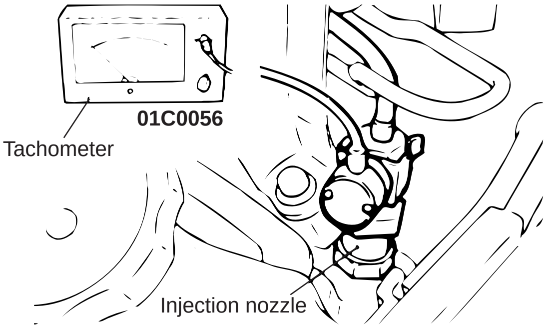


EFLB123F

4. Set the tachometer to injection nozzle or injection pipe.

NOTE

When setting tachometer to injection pipe, fully loosen the assembly clamp of pipe prior to set.

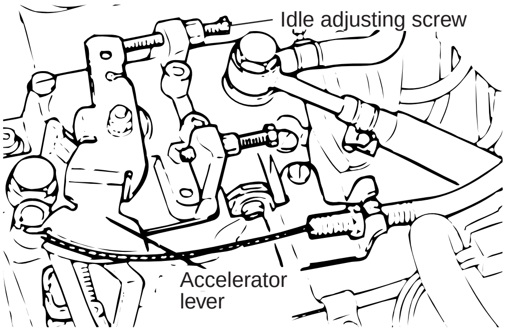


EFLB123G

5. Check that the idle rpm is with standard value.

Standard Value : 750 ± 50 rpm

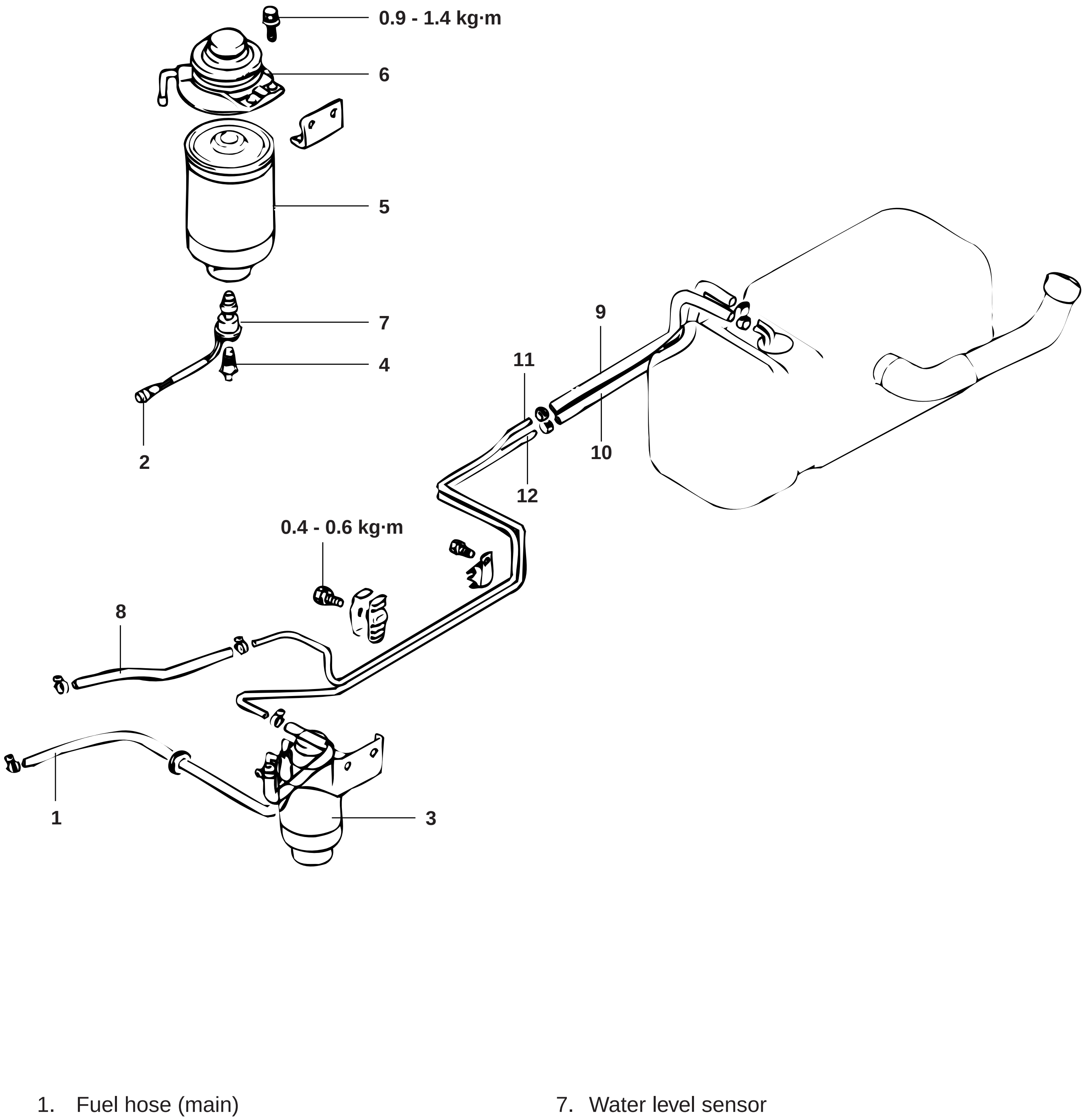
6. If the idle rpm is over the standard value, loosen the lock nut of idle adjusting screw to the standard value.
7. After adjustment, completely tighten the lock nut.



EFLB123H

FUEL DELIVERY SYSTEM-DIESEL

COMPONENTS EFLB2010

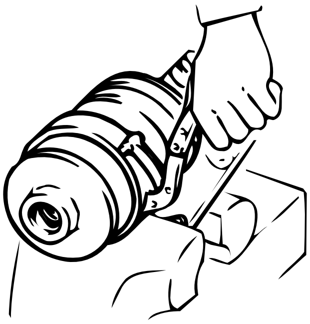


1. Fuel hose (main)
2. Water level sensor connector
3. Fuel filter
4. Drain plug
5. Fuel filter cartridge
6. Fuel filter pump
7. Water level sensor
8. Fuel return hose (main)
9. Fuel hose (connection)
10. Fuel return hose (connection)
11. Fuel main pipe
12. Fuel return pipe

EFLB201A

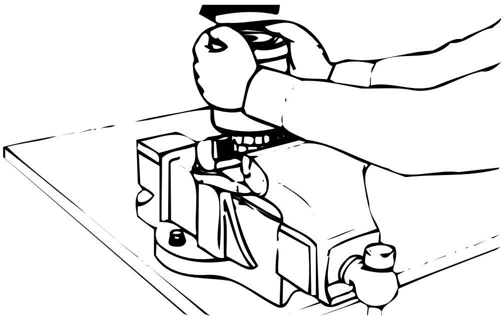
REMOVAL EFLB2030

1. Fuel filter cartridge
   With holding fuel filter pump in vice, remove the fuel filter cartridge using fuel filter wrench.



EFLB203A

2. Water level sensor
   With holding water level sensor in vice, turn and remove the fuel filter cartridge with both hands.



EFLB203B

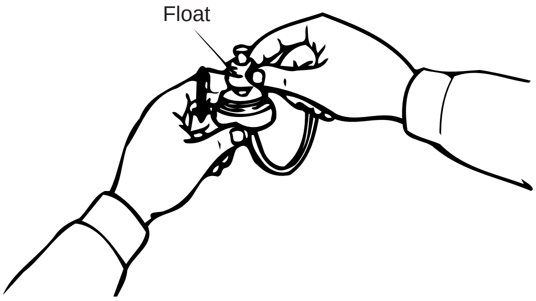
INSPECTION EFLB2050

1. Normal inspection

   1) Check hose and pipe for crack, cooking, blaze and clog.

   2) Check fuel filter for clog and damage.

2. Operation of water level sensor
   Connect circuit tester to water level sensor connector. If the circuit is discontinuity or continuity when the float is moved up or down, the water level sensor is good.



EFLB205A

REPLACEMENT EFLB2070

Fuel filter

1. Lower the fuel tank pressure by removing fuel filler cap.

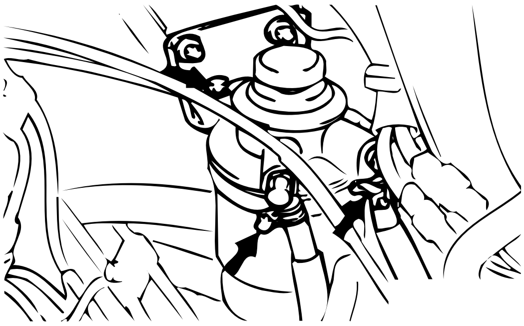
2. Disconnect the connector of water level sensor.

3. Remove fuel filter cartridge from fuel filter pump body with hand.

4. Disconnect fuel lose(main) from fuel filter pump.

5. Remove fuel filter pump.

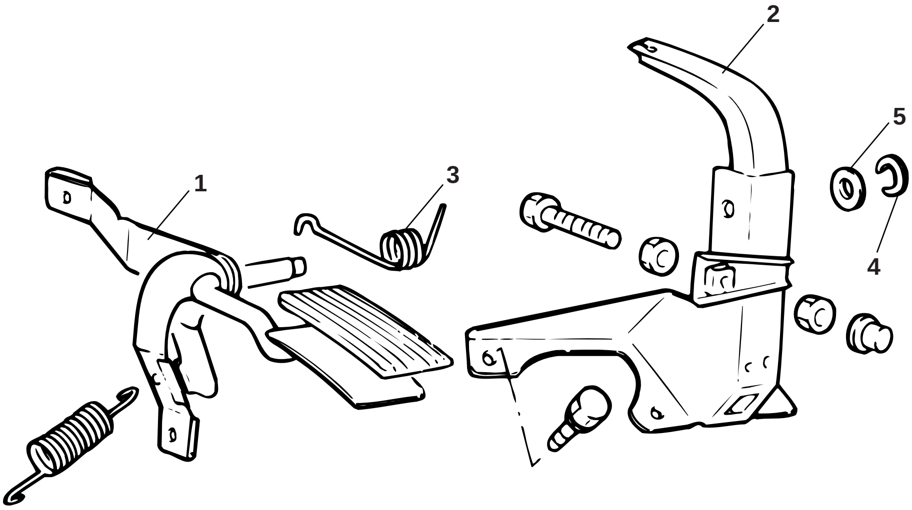
6. Replace fuel filter.



EFLB207A

ENGINE CONTROL EFLB2090

ACCELERATOR PEDAL

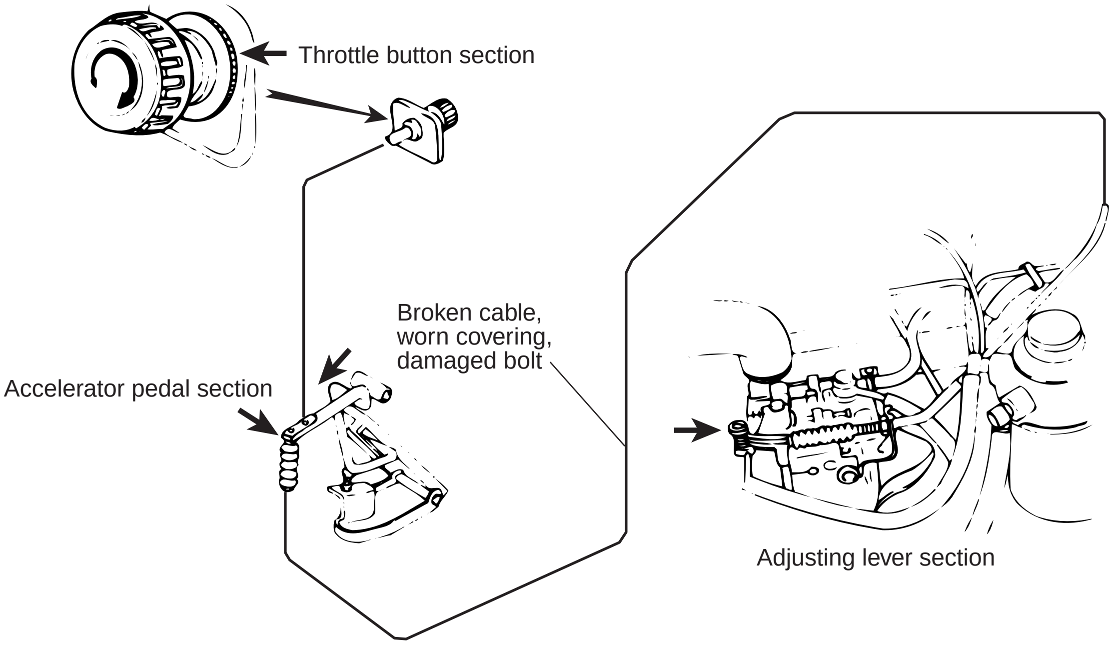


1. Accelerator pedal assembly
2. Bracket assembly
3. Return spring
4. Snap ring
5. Plain washer

NOTE
Reverse the disassembly procedures to reassemble.

EFLB209A

THROTTLE CONTROL EFLB2110



EFLB211A

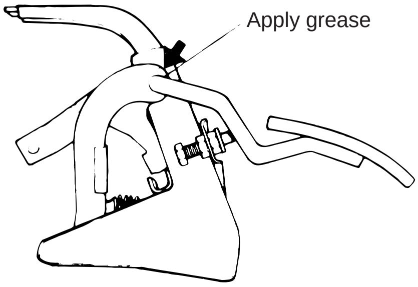
REASSEMBLY EFLB2130

ACCELERATOR PEDAL

Apply grease to accelerator pedal slide-contacting surface.

RETURN SPRING

Apply grease to inner surface.



EFLB213A

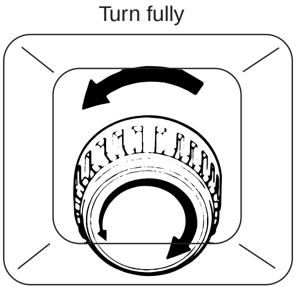
CABLE INSTALLATION AND ADJUSTMENT EFLB2150

THROTTLE CABLE

Turn the throttle button fully in the opposite direction to that of arrow indicated on the button. With the inner cable most protruded, install the accelerator pedal arm or accelerator lever. At that time, make sure that when the engine speed reaches the lowest speed, the inner cable is in the most protruded state.

NOTE

1. *Make this adjustment with the cab tilt and tilt handle down.*
2. *Route each cable so that it may not come in contact with the edge of sheet metal.*
3. *The routing radius of each cable shall 150 mm or more.*



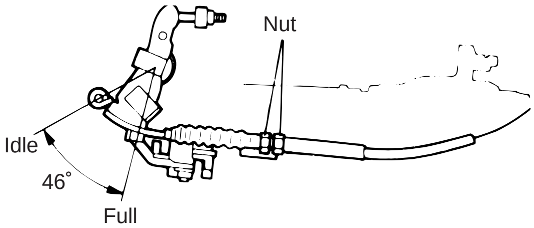
EFLB215A

ACCELERATOR CONTROL CABLE

Turn the throttle button in the opposite direction to that of arrow indicated on the button and make sure that the accelerator pedal does not move. Install the accelerator control cable to the adjusting lever and secure the engine side of the cable by tightening the nut.

NOTE

Do not move the engine side adjusting lever when the accelerator control cable is installed.

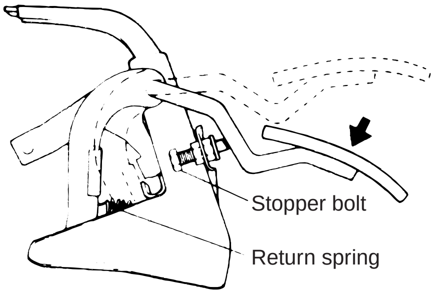


EFLB215B

ACCELERATOR PEDAL STOPPER

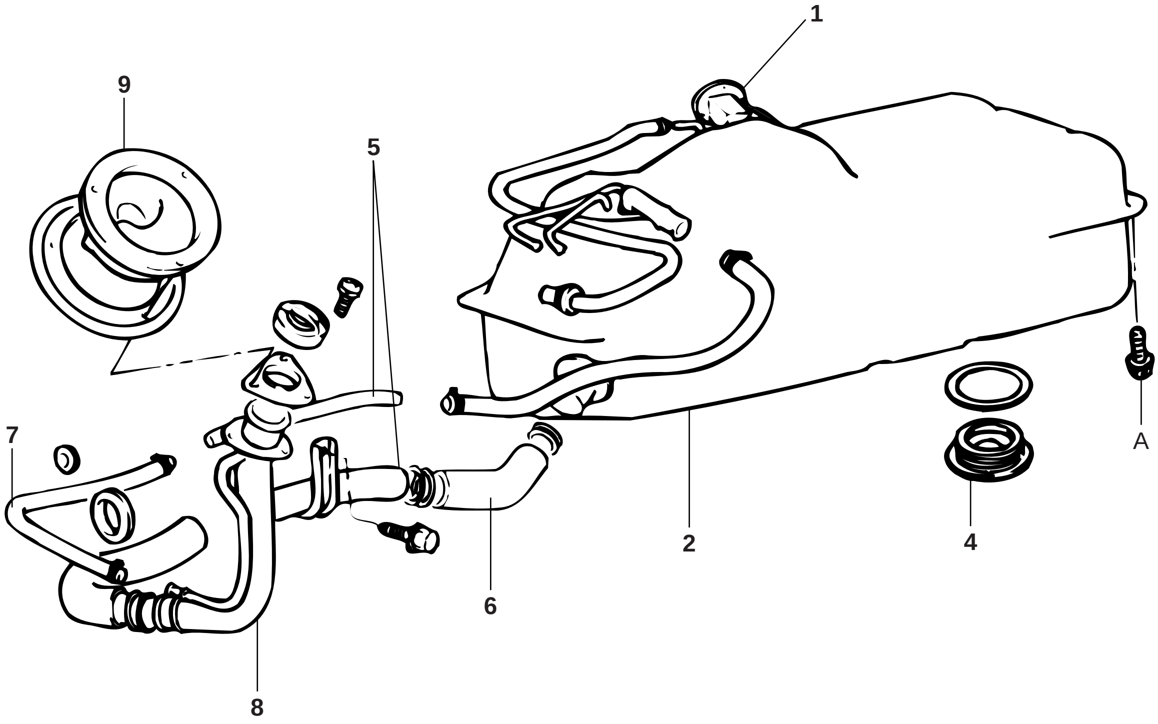
Make adjustment so that when the engine side adjusting lever is in contact with the fuel stopper, clearance between accelerator pedal and adjusting bolt is equal to dimension A.

Dimension A : 0 - 5 mm



AU004

COMPONENTS EFLB2170



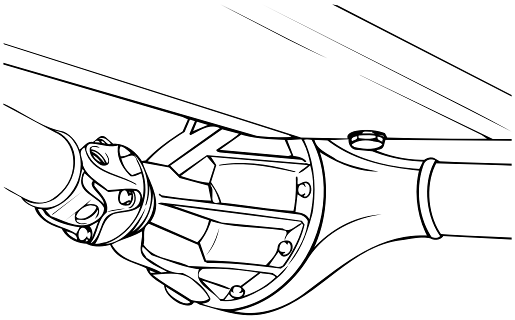
1. Fuel gauge unit
2. Breather hose
3. Fuel tank
4. Drain plug
5. Filler and breather pipe assembly
6. Filler hose
7. Breather hose
8. Filler neck
9. Filler neck cover

	Nm	kg·m	lb·ft
A	15-22	1.5-2.2	11-16

EFLB217A

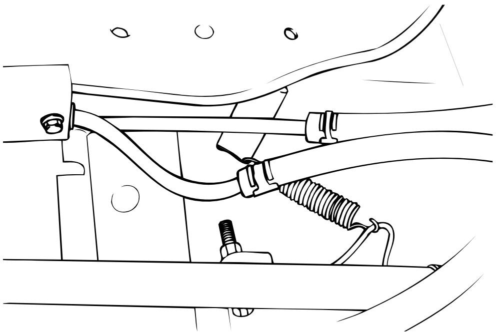
REMOVAL EFLB2190

1. Discharge fuel with the drain plug removed.



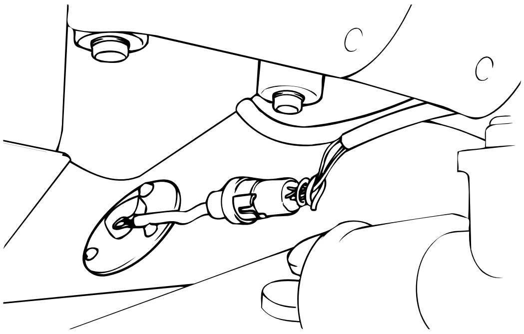
EFLB219A

2. Disconnect the fuel feed hose and return hose.



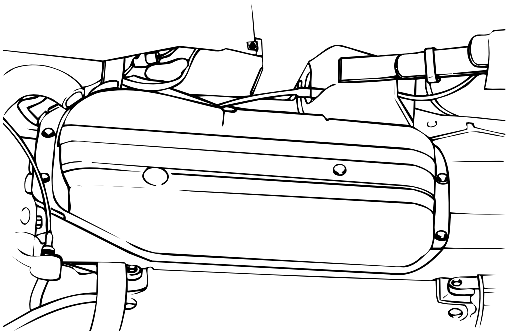
EFLB219B

3. Disconnect the fuel gauge unit connector.



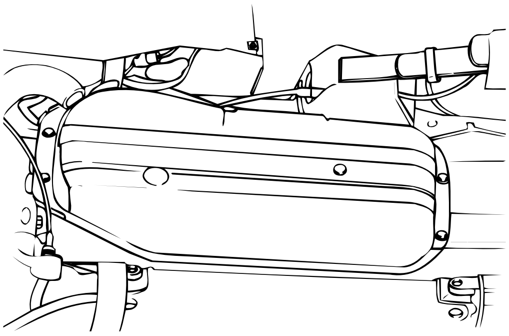
EFLB219C

4. Disconnect the breather hose and filler hose.



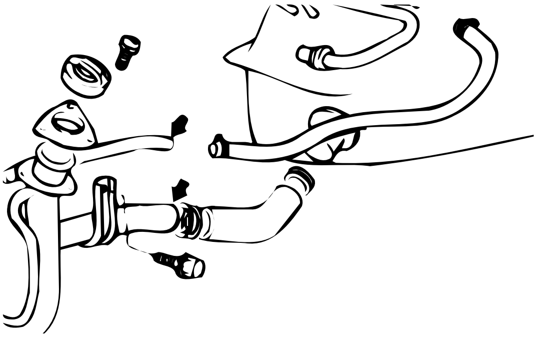
EFLB219D

5. Remove the fuel tank.
   Remove the fuel gauge unit if necessary.



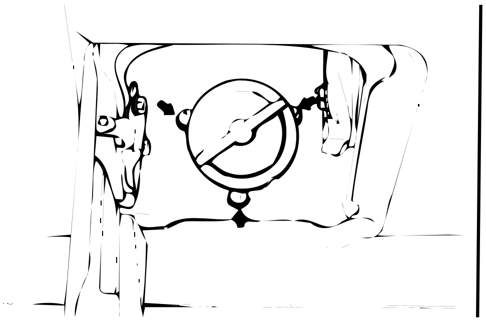
EFLB219D

6. Remove the filler neck and filler pipe by the following procedure.
   1) Disconnect the filler and breather hose from filler and breather pipes.



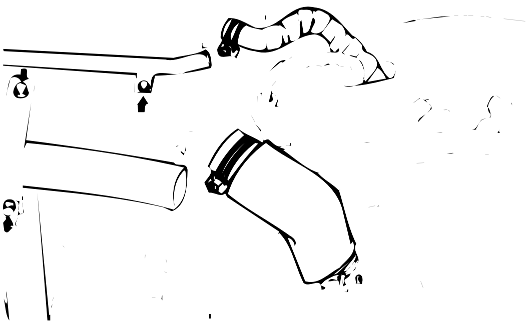
EFLB219E

   2) Pull out the filler neck cover and then remove the filler neck.



EFLB219F

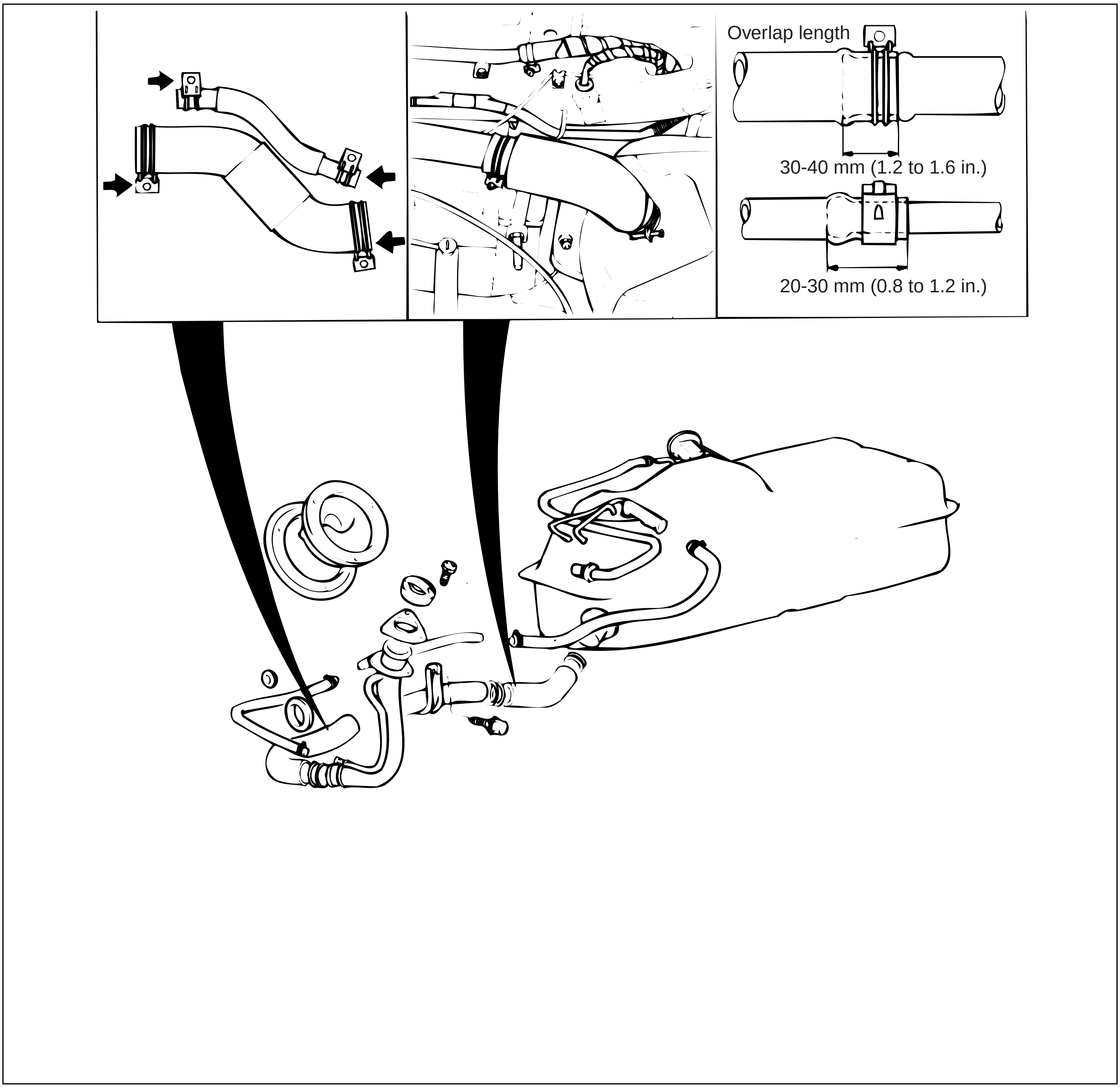
3) Remove the filler and breather pipe assembly.



EFLB219G

INSTALLATION EFLB2210

When hose are connected to pipes, make that specified overlap length are observed. Tighten hose clamps as position shown in the illustration to prevent the hoses from interfering with other parts.



EFLB221A