Fuel System [Diesel 2.5]

GENERAL

SPECIFICATIONS EFMB3010

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.)	75 (19.8, 16.6)

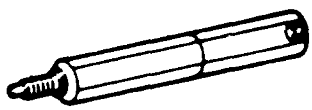
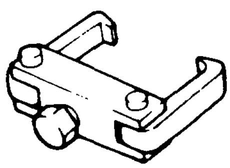
SERVICE SPECIFICATIONS EFMB3030

	Standard	Limit
Fuel injection pump		
Injection timing (when plunger lift 1 mm)	9° ATDC	
Cam lift mm	2.2	
Plunger diameter mm	10	
Delivery valve opening pressure (bar)	25.8 bar	
Fuel cut solenoid	Rated voltage : 12V; Resistance : 8Ω	
Injection nozzle		
Injection orifice (Number-diameter) mm	1-1.02	
Breaking pressure (bar)	150 bar	132 bar
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

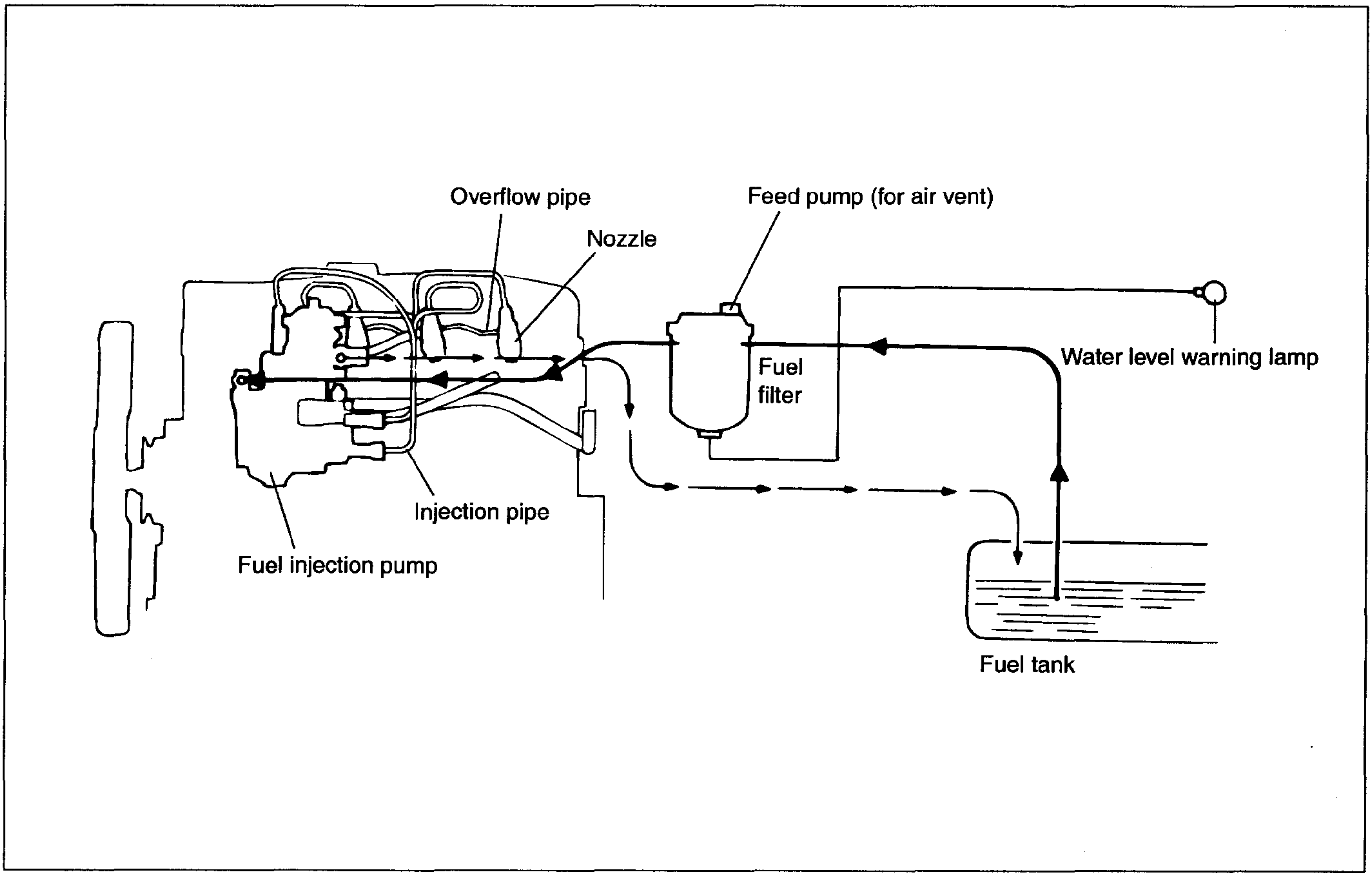
	Nm	Kg·m	lb·ft
Injection pipe clamp bolts	4 - 6	0.4 - 0.6	3 - 4
Injection pipe union nuts	23 - 37	2.3 - 3.7	17 - 27
Pump bracket-to-cylinder block bolts	18 - 25	1.8 - 2.5	13 - 18
Injection pump-to-pump bracket bolts	20 - 27	2.0 - 2.7	14 - 19
Injection pump mounting nuts	15 - 22	1.5 - 2.2	11 - 16
Fuel 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

<table>
<tr><th>Tool (Number and name)</th><th>Illustration</th><th>Use</th></tr>
<tr><td>09310-43000
Prestroke measuring adapter</td><td>
C1043000</td><td>Injection timing adjustment</td></tr>
<tr><td>09314-43000
Injection pump sprocket puller</td><td>
C1443000</td><td>Removal of injection pump sprocket</td></tr>
</table>

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.

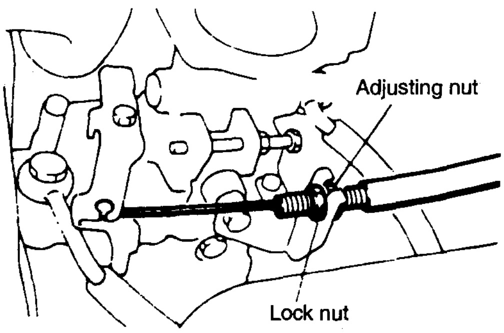
Symptom	Probable cause	Remedy
Smoky exhaust (black, blue or white)	Engine not reaching correct operating temperature	Check and, if necessary, replace cooling system thermostat.
	Maximum rpm incorrect	Check and if necessary, replace injection pump.
	Faulty injection nozzles	Check and, if necessary, repair 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.

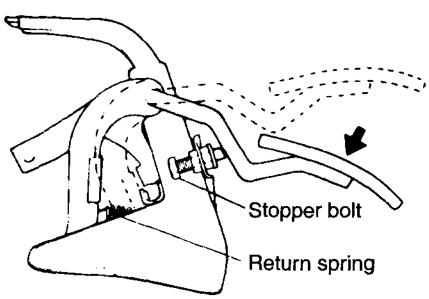


AU003

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

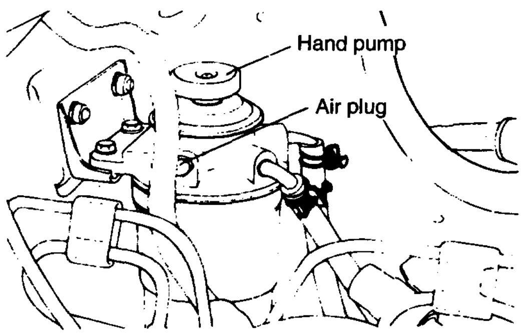
ADJUSTMENT EFLB0160

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.



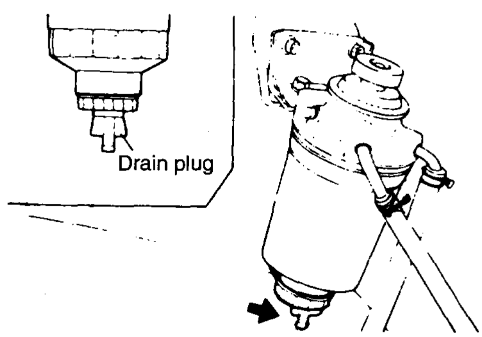
AU005

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 EFMB3180

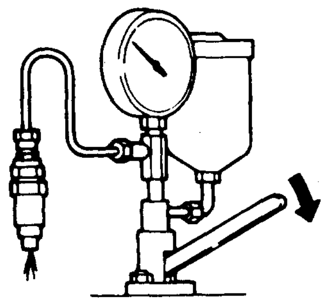
INJECTION NOZZLE

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 : 150 bar

Limit : 132 bar or less



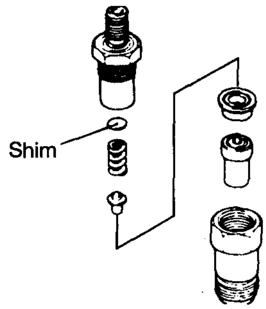
AU007

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. 12 bar 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

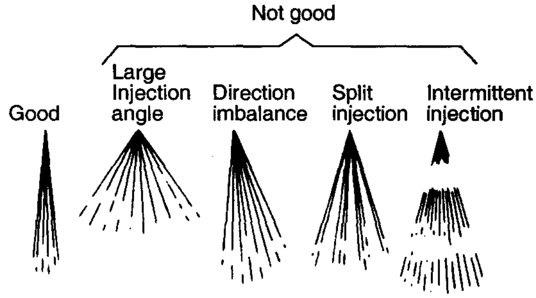
1. Move nozzle tester handle at about 1 stroke per second.

[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]

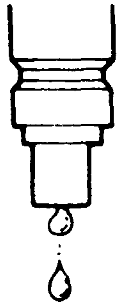
Check that the spray is good, as illustrated in the figure, in the test, the spray may be bolt shaped with a course mist and fuel may remain. This is phenomenon common in this type of inspection, and the nozzle function is normal.



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.

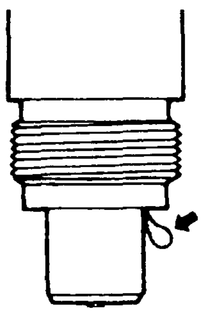
6. If dripping, disassemble injection nozzle and replace nozzle tip or entire assembly.



EFLB018D

NOZZLE OIL-SEAL

1. Maintain internal nozzle pressure (pressure gauge indication value) with the nozzle tester at 120 - 132 bar. 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

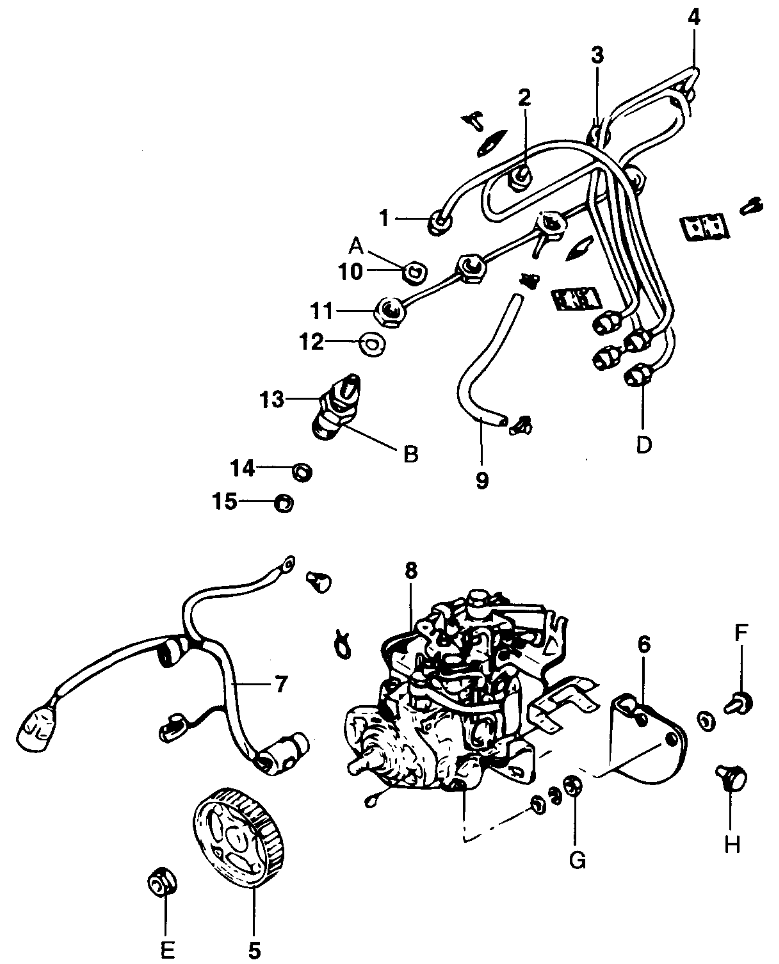
If found defective, replace the injection pump as assembly.

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

	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

NOTE
Reverse the removal procedures to reinstall

EFLB103A

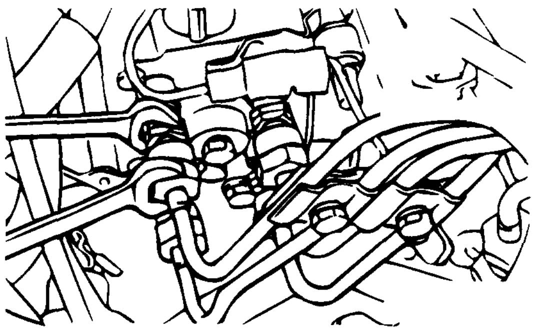
REMOVAL EFLB1050

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)



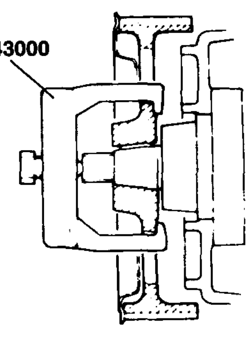
EFLB105A

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

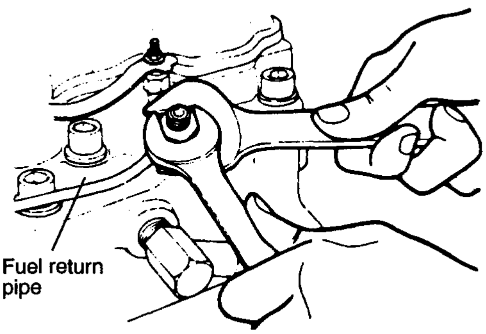
If you remove the hexagon nut without holding the fuel return pipe nut, the pipe might be damaged. So you must remove the hexagon nut with holding return pipe.

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.



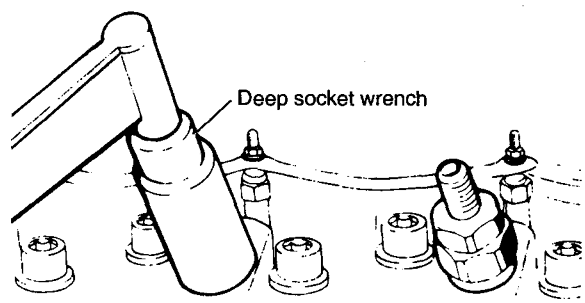
EFLB105C

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.

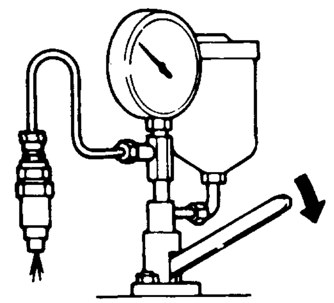


EFLB105D

INSPECTION EFMB3070

INJECTION NOZZLE

Make the following checks and, if defects are found, correct or replace.



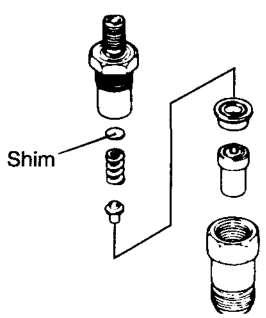
AU007

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 :	150 bar
Service limit :	132 bar

> **NOTE**
>
> 1. *Increase of 0.1 mm shim thickness will result in increase of pressure to 12 bar.*
> 2. *20 different shims available ranging in thickness from 1.00-1.95 mm.*



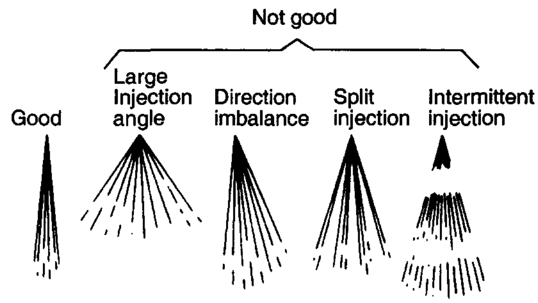
EFLB018B

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

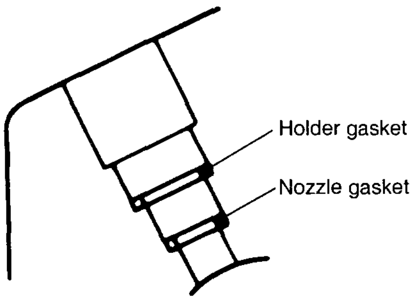
NOZZLE OIL TIGHTENESS

Operate the nozzle tester so that the interior pressure of the nozzle is maintained at a pressure gauge reading of 120 - 132 bar and check nozzle tip for fuel leakage.

INSTALLATION EFLB1090

NOZZLE GASKET AND HOLDER GASKET

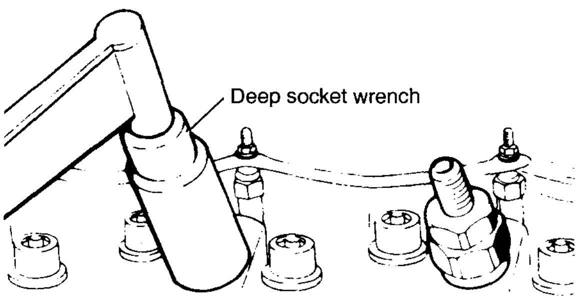
1. Clean nozzle holder installation area of the cylinder head.
2. Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.



EFLB109A

INJECTION NOZZLE

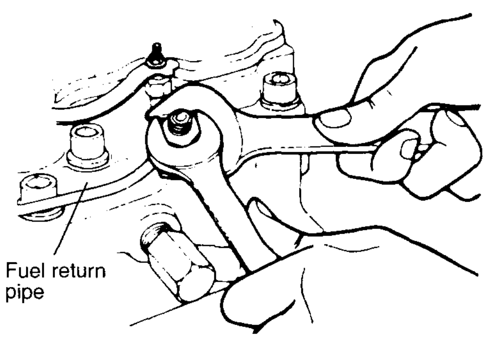
Install the injection nozzle in the cylinder head and tighten to the specified torque, using a deep socket wrench.



EFLB105D

FUEL RETURN PIPE NUT

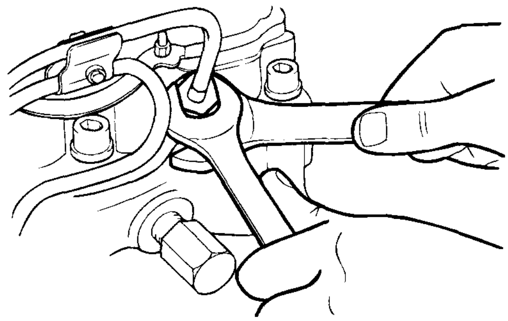
While holding the fuel return pipe by the hexagon nut with a wrench, tighten the fuel return pipe nut to the specified torque.



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.

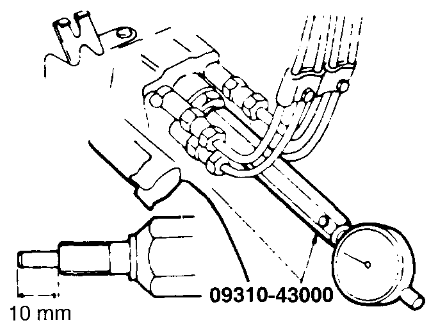
   ⚠ *CAUTION*

   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.

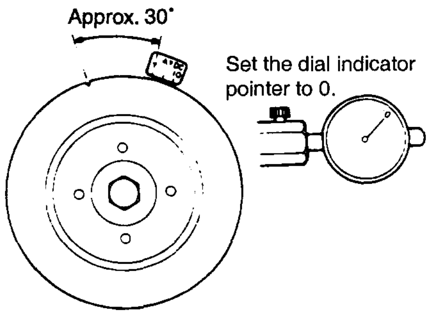
   ⚠ *CAUTION*

   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

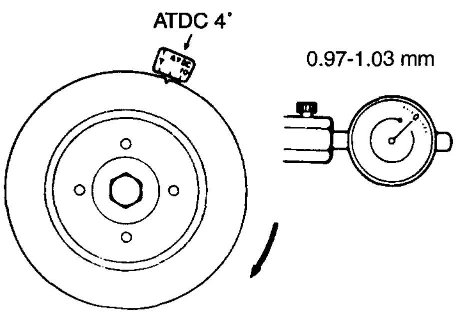
4. Set the notch on the crank pulley at approximately 30° BTDC of the compression stroke of the No.1 cylinder. With the notch in this position, set the dial indicator at zero. Turn the crank pulley slightly in both directions to make sure that the dial indicator pointer does not deviate from the zero 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



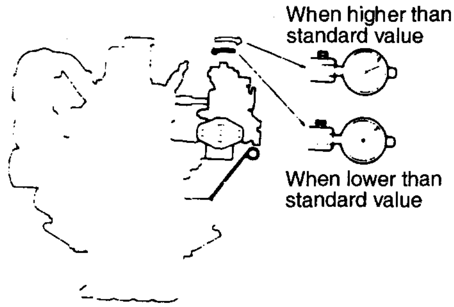
EFLB111C

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.

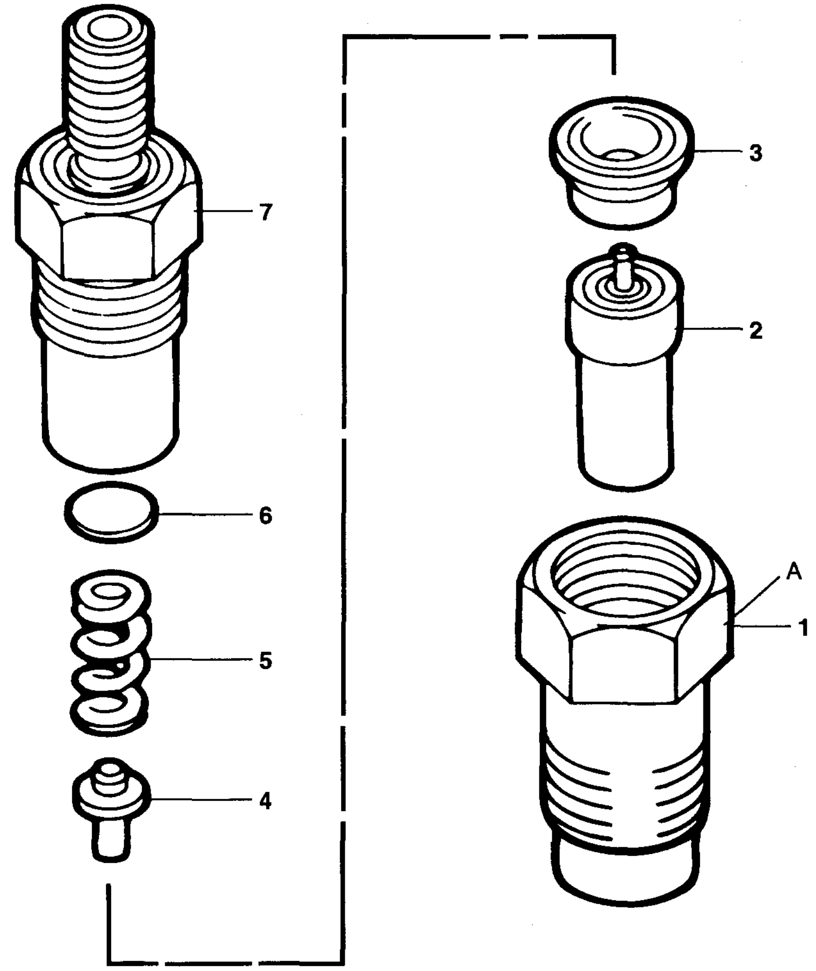
9. Tighten the bolts and nuts to the specified torque.



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.

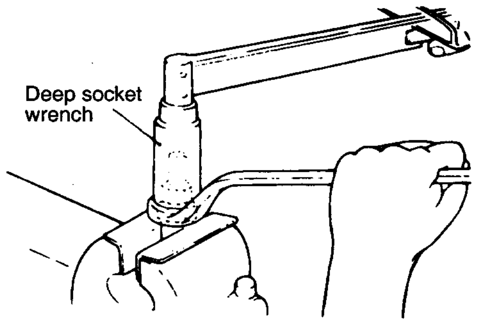
	Nm	kg·m	lb·ft
A	35-40	3.5-4.0	25-29

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.

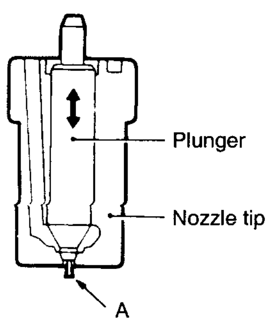


EFLB115A

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

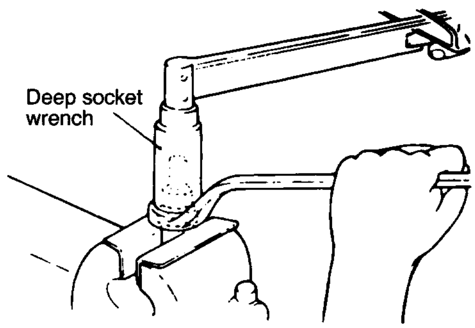
Check spring for weakness and breakage.

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.

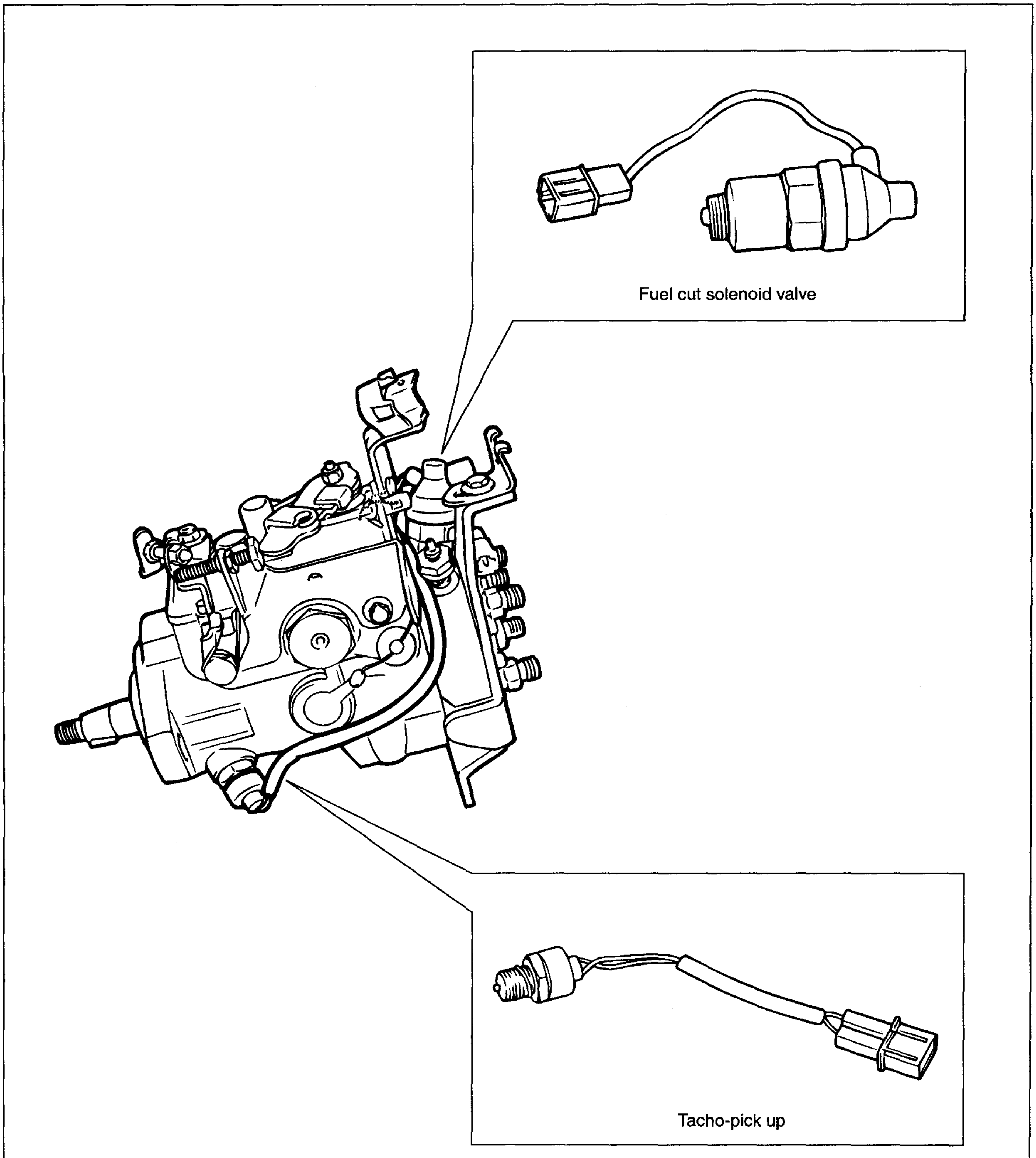
Tightening torque : 35-40 Nm (3.5-4.0 kgm)



EFLB115A

LUCAS INJECTION PUMP EFLB1210

COMPONENTS



EFLB121A

INSPECTION AND ADJUSTMENT EFLB1230

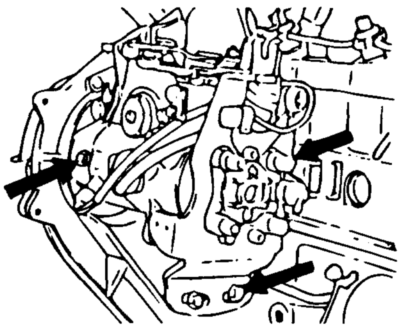
INJECTION TIMING

- 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.

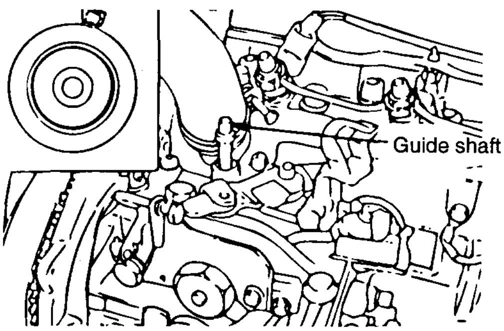
CAUTION

When untightening injection pipe nut, hold the valve holder with spanner so that the delivery valve holder shall not be turned together.



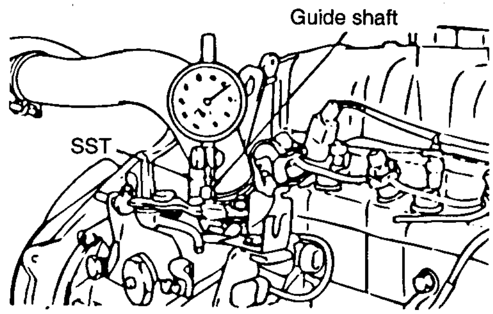
EFLB123A

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).



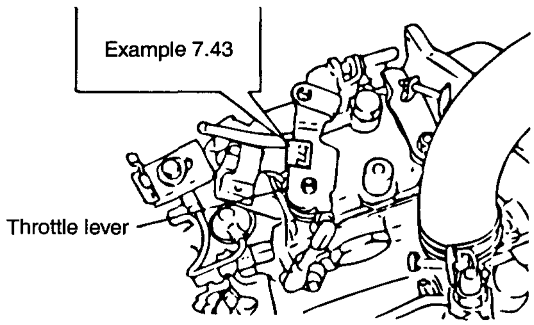
EFLB123B

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

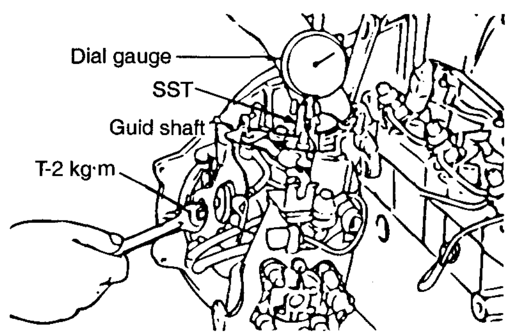
4. With the V-groove of crankshaft pulley being positioned at ATDC 4°by turning the crankshaft clockwise of 1 rotation, check to sure that the dial indicator reading is within the value indicated on throttle lever.
   - If dial indicator reading is not within the standard value range, tilt the injection 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



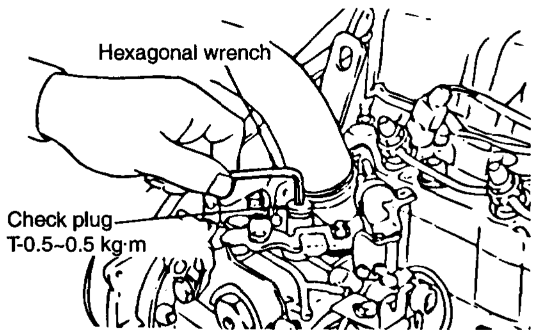
EFLB123E

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

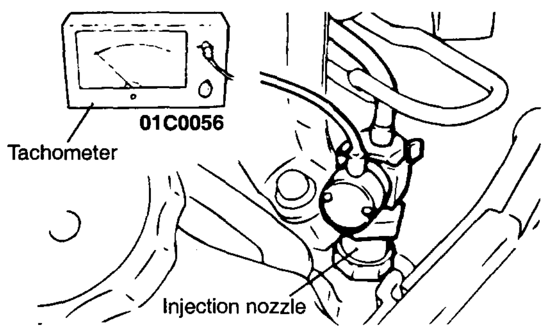


EFLB123F

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.

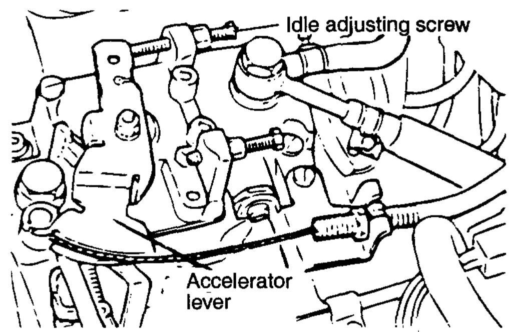


EFLB123G

5. Check that the idle rpm is with standard value.

Standard Value : 750 ± 50 rpm

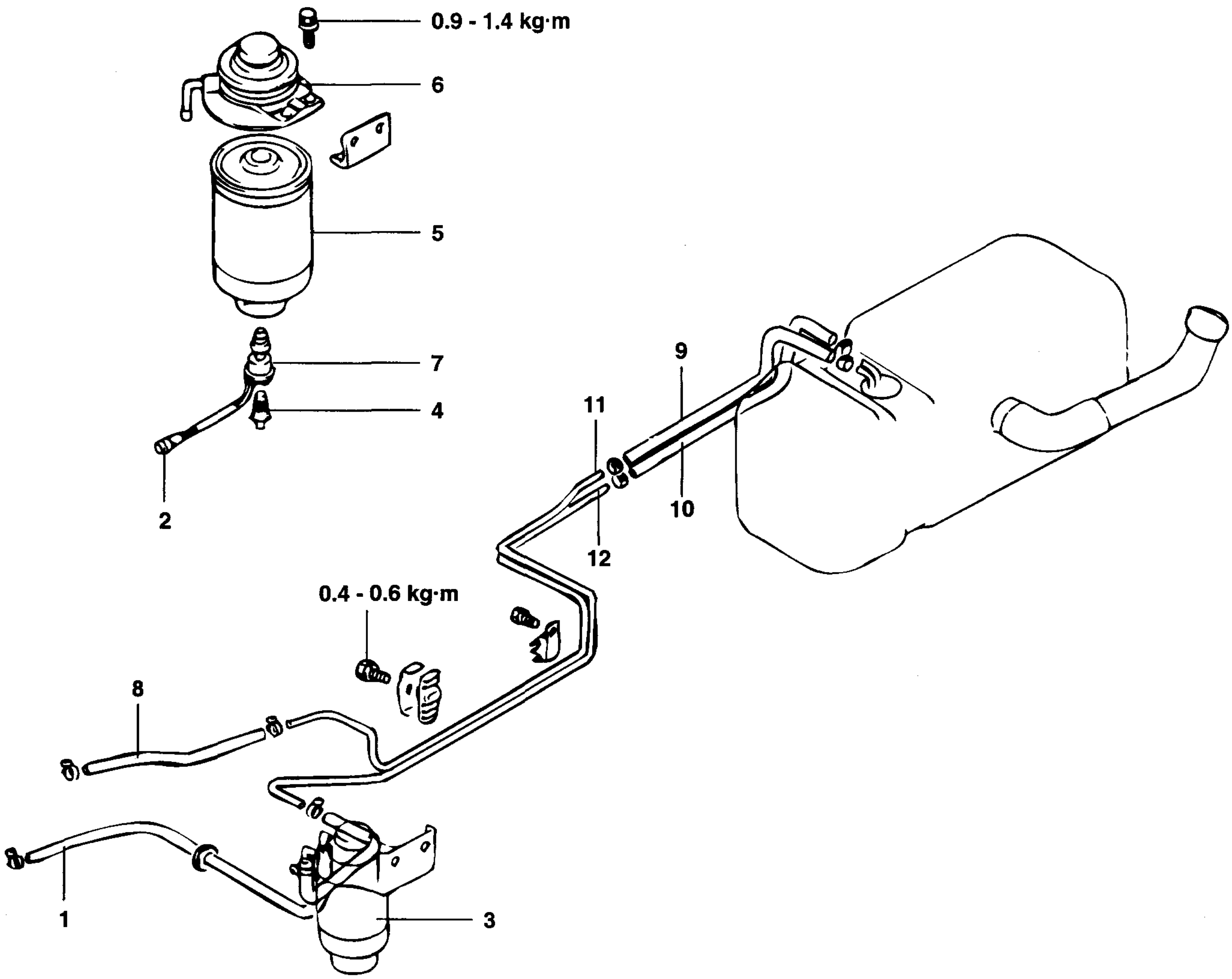
6. If the idle rpm is over the standard value, loosen the lock nut of idle adjusting screw to the standard value.
7. After adjustment, completely tighten the lock nut.



EFLB123H

FUEL DELIVERY SYSTEM-DIESEL

COMPONENTS EFLB2010

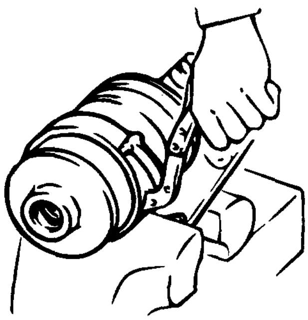


1. Fuel hose (main)
2. Water level sensor connector
3. Fuel filter
4. Drain plug
5. Fuel filter cartridge
6. Fuel filter pump
7. Water level sensor
8. Fuel return hose (main)
9. Fuel hose (connection)
10. Fuel return hose (connection)
11. Fuel main pipe
12. Fuel return pipe

EFLB201A

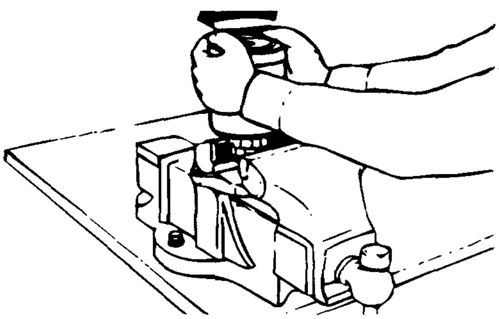
REMOVAL EFLB2030

1. Fuel filter cartridge
With holding fuel filter pump in vice, remove the fuel filter cartridge using fuel filter wrench.



EFLB203A

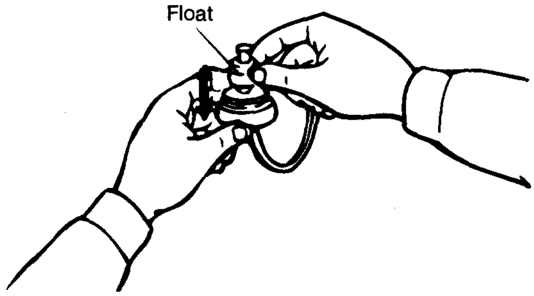
2. Water level sensor
With holding water level sensor in vice, turn and remove the fuel filter cartridge with both hands.



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.

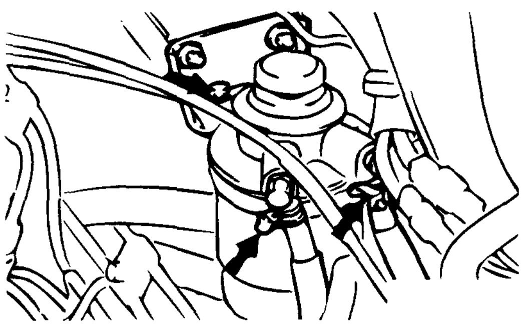


EFLB205A

REPLACEMENT EFLB2070

Fuel filter

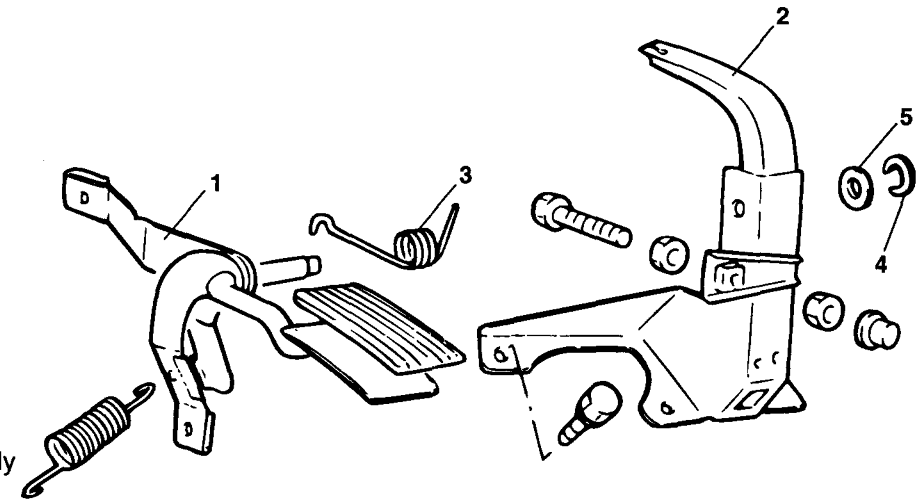
1. Lower the fuel tank pressure by removing fuel filler cap.
2. Disconnect the connector of water level sensor.
3. Remove fuel filter cartridge from fuel filter pump body with hand.
4. Disconnect fuel lose(main) from fuel filter pump.
5. Remove fuel filter pump.
6. Replace fuel filter.



EFLB207A

ENGINE CONTROL EFLB2090

ACCELERATOR PEDAL

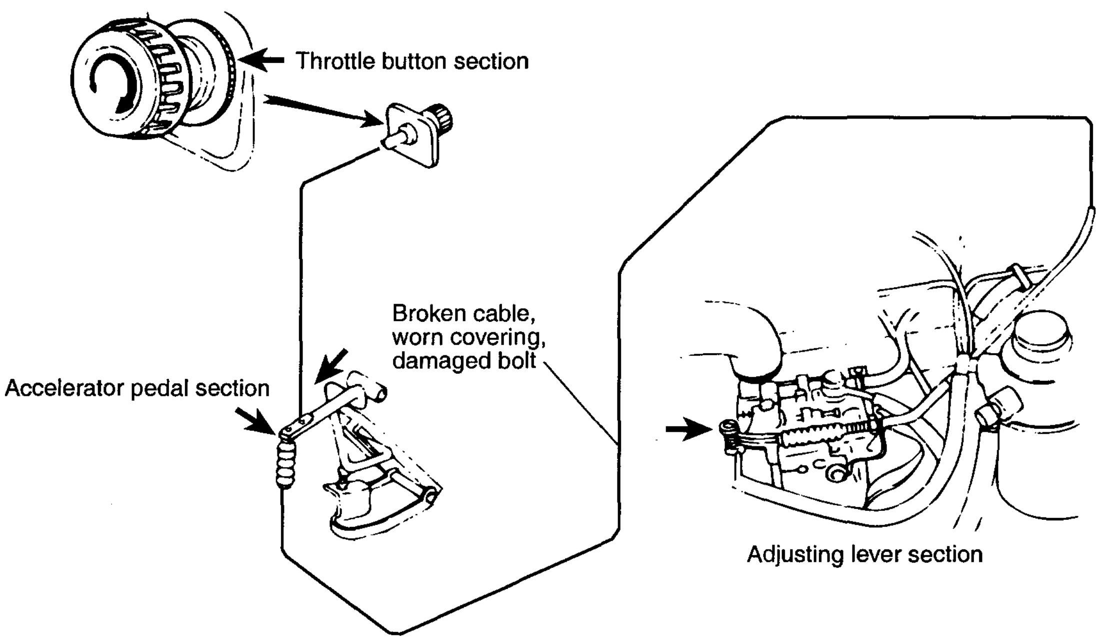


1. Accelerator pedal assembly
2. Bracket assembly
3. Return spring
4. Snap ring
5. Plain washer

NOTE
Reverse the disassembly procedures to reassemble.

EFLB209A

THROTTLE CONTROL EFLB2110



EFLB211A

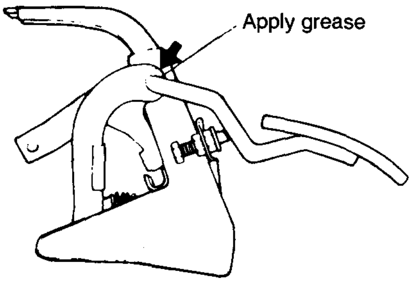
REASSEMBLY EFLB2130

ACCELERATOR PEDAL

Apply grease to accelerator pedal slide-contacting surface.

RETURN SPRING

Apply grease to inner surface.



EFLB213A

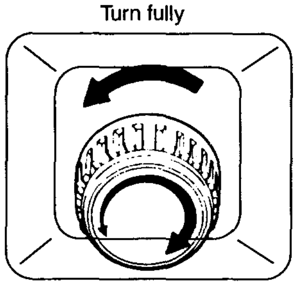
CABLE INSTALLATION AND ADJUSTMENT EFLB2150

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.*



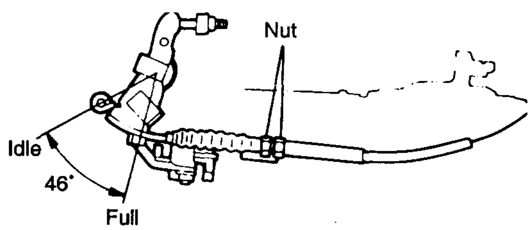
EFLB215A

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.

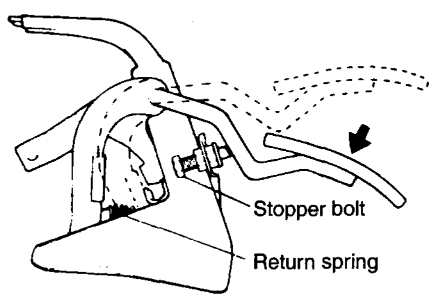


EFLB215B

ACCELERATOR PEDAL STOPPER

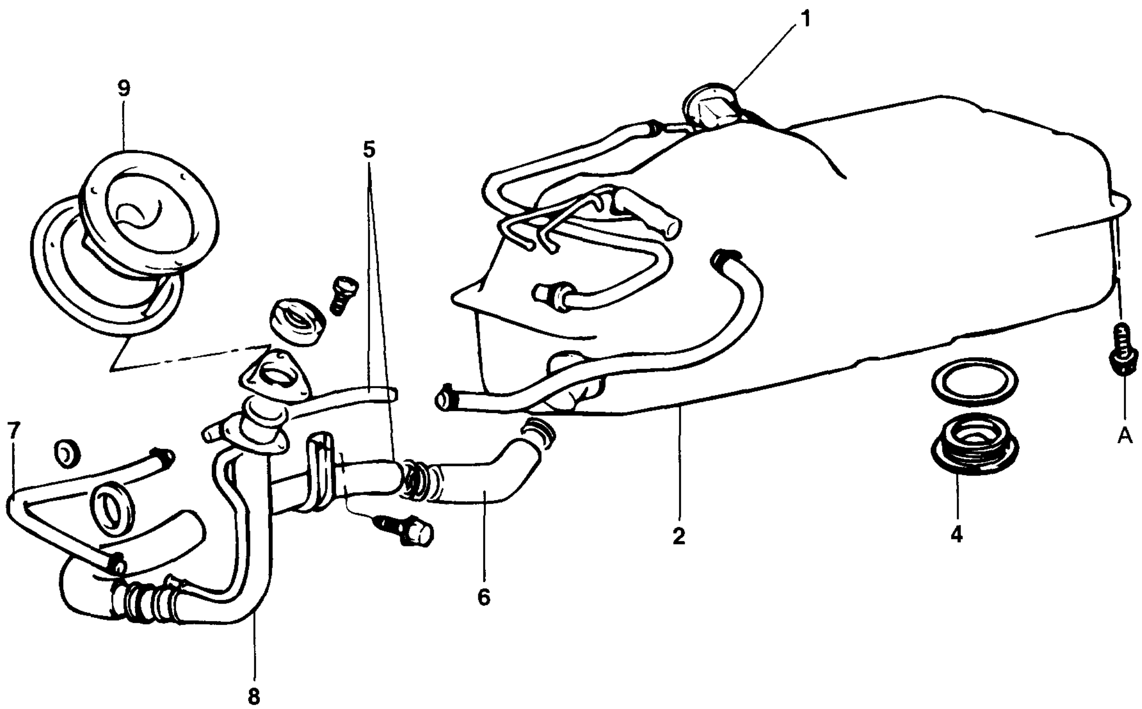
Make adjustment so that when the engine side adjusting lever is in contact with the fuel stopper, clearance between accelerator pedal and adjusting bolt is equal to dimension A.

Dimension A : 0 - 5 mm



AU004

COMPONENTS EFLB2170



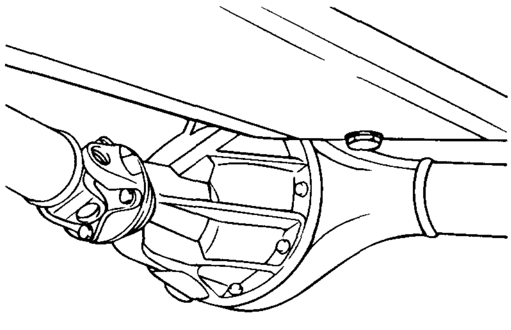
1. Fuel gauge unit
2. Breather hose
3. Fuel tank
4. Drain plug
5. Filler and breather pipe assembly
6. Filler hose
7. Breather hose
8. Filler neck
9. Filler neck cover

	Nm	kg·m	lb·ft
A	15-22	1.5-2.2	11-16

EFLB217A

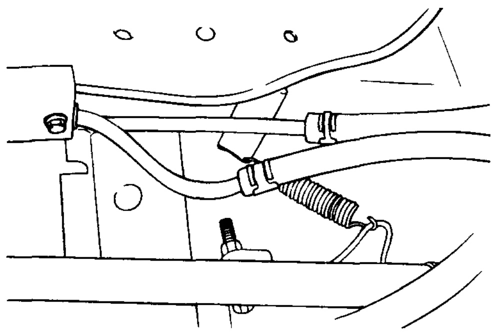
REMOVAL EFLB2190

1. Discharge fuel with the drain plug removed.



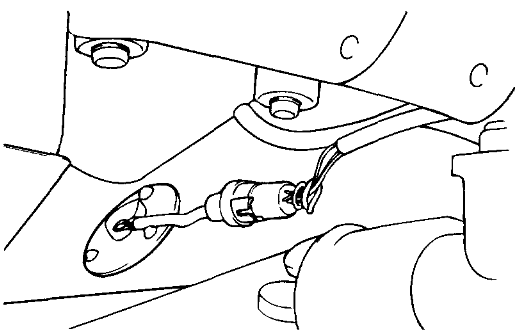
EFLB219A

2. Disconnect the fuel feed hose and return hose.



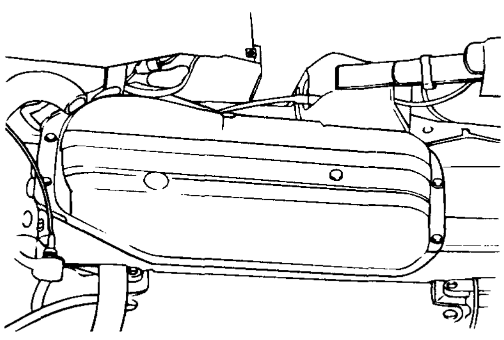
EFLB219B

3. Disconnect the fuel gauge unit connector.



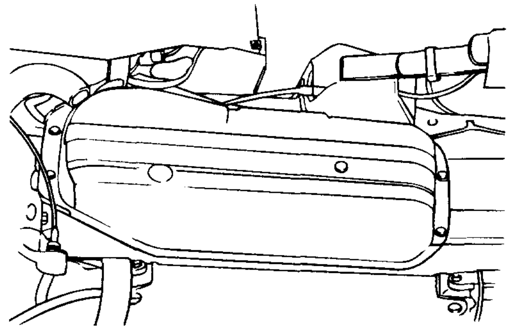
EFLB219C

4. Disconnect the breather hose and filler hose.



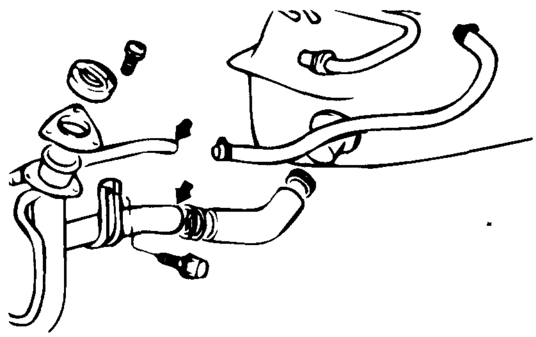
EFLB219D

5. Remove the fuel tank.
   Remove the fuel gauge unit if necessary.



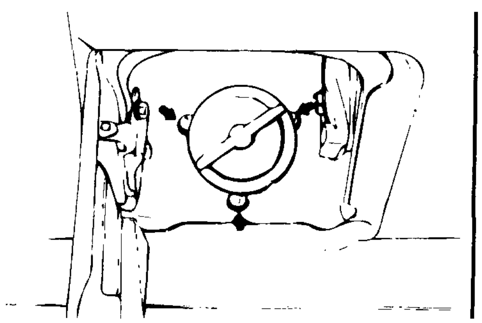
EFLB219D

6. Remove the filler neck and filler pipe by the following procedure.
   1) Disconnect the filler and breather hose from filler and breather pipes.



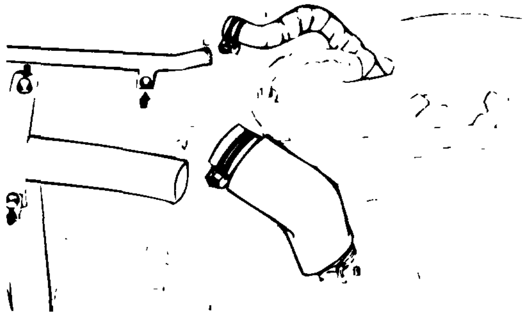
EFLB219E

   2) Pull out the filler neck cover and then remove the filler neck.



EFLB219F

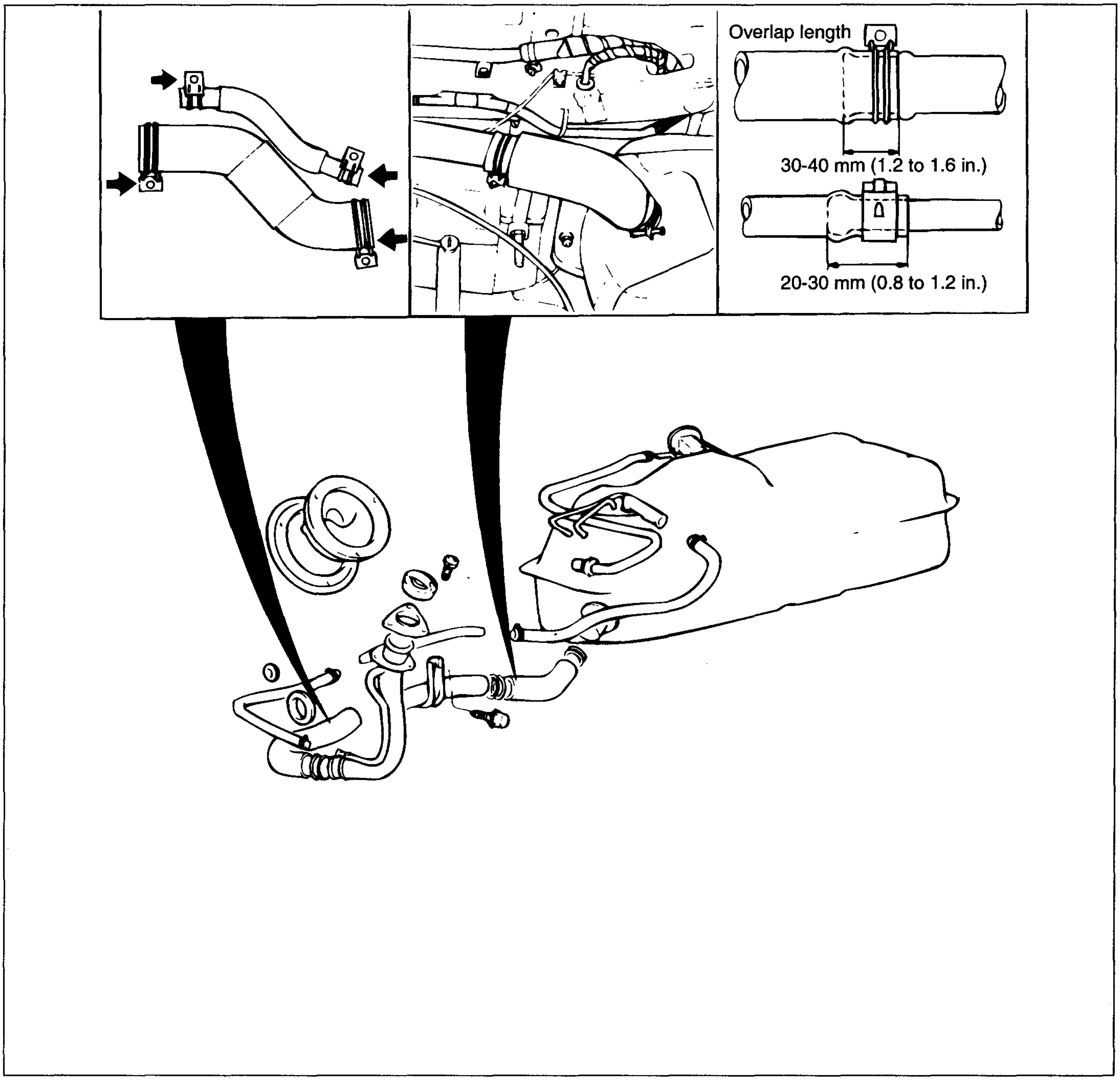
3) Remove the filler and breather pipe assembly.



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

Fuel System [Covec-F 2.5]

GENERAL

DESCRIPTION EFMB6010

This Supplement shop manual consists of two parts, service manual for construction & operation and self-diagnosis system. The first part, service manual for construction & operation, describes construction and operation of the micro-computor controlled fuel injection quantity and injection timing control system COVEC-F (Computed VE pump Control system Full). And the second part, service manual for self-diagnosis system, describes the self-diagnosis system of the microcomputer controlled fuel injection quantity and injection timing control system COVEC-F (Computed VE pump Control system-Full). This supplement is intended for use by vehicle maintenance technicians or persons with an adequate knowledge of injection pumps.

CONSTRUCTION & OPERATION

OUTLINE

The COVEC-F fuel injection system (Computed VE pump Control system-Full) is a distributor type fuel injection system that uses a micro-computor to control fuel injection quantity and injection timing. COVEC-F was developed to improve the power performance of small diesel engines, to improve driving comfort, as well as to decrease pollution.

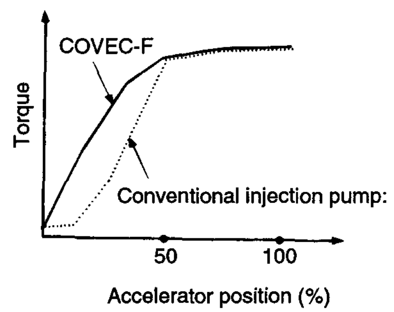
SPECIFICATIONS

Item	Specification
No of cylinders	4, 6
Direction of rotation	Clockwise and counter clockwise
Maximum speed	Approx 3,000 r/min
Plunger diameters	8, 9, 10, 11, 12mm
Injection timing adjustment	TCV duty ratio control
Injection quantity control	Electronic control of control sleeve position
Weight	Approx 6.5kg
Prevention of reverse rotation	Constructed so that fuel injection is not performed at reverse rotation
Additional devices	Not necessary

FEATURES EFMB6030

IMPROVED POWER PERFORMANCE

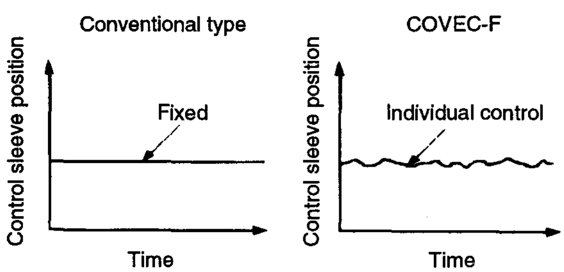
The left hand figure shows the relationship between accelerator position and output torque. Compared to conventional injection pumps, COVEC-F provides the most suitable injection quantity corresponding to accelerator position. This enables increased torque at a lower accelerator position, which improves power performance.



EFMB603A

INCREASED COMFORT

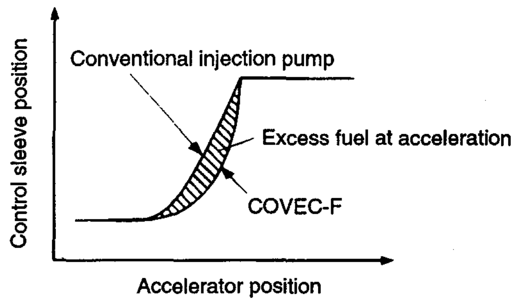
On conventional injection pumps, minute variations of control sleeve position are not performed. COVEC-F, however, detects variations in speed at each engine combustion at idling, and in response to this controls the control sleeve position to increase or decrease the fuel injection quantity. In this way, each cylinder's injection quantity is controlled for each injection to decrease engine vibration and improve comfort.



EFMB603B

DECREASED SMOKE AT ACCELERATION

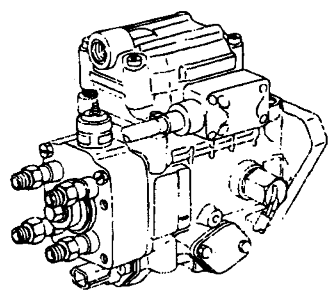
Injection quantity is increased at acceleration to increase engine output. With conventional injection pumps, this excess fuel results in the generation of smoke. With COVEC-F, however, fuel injection quantity is precisely controlled, even at acceleration, to prevent the generation of smoke without adversely affecting engine response.



EFMB603C

ADDITIONAL DEVICES UNNECESSARY

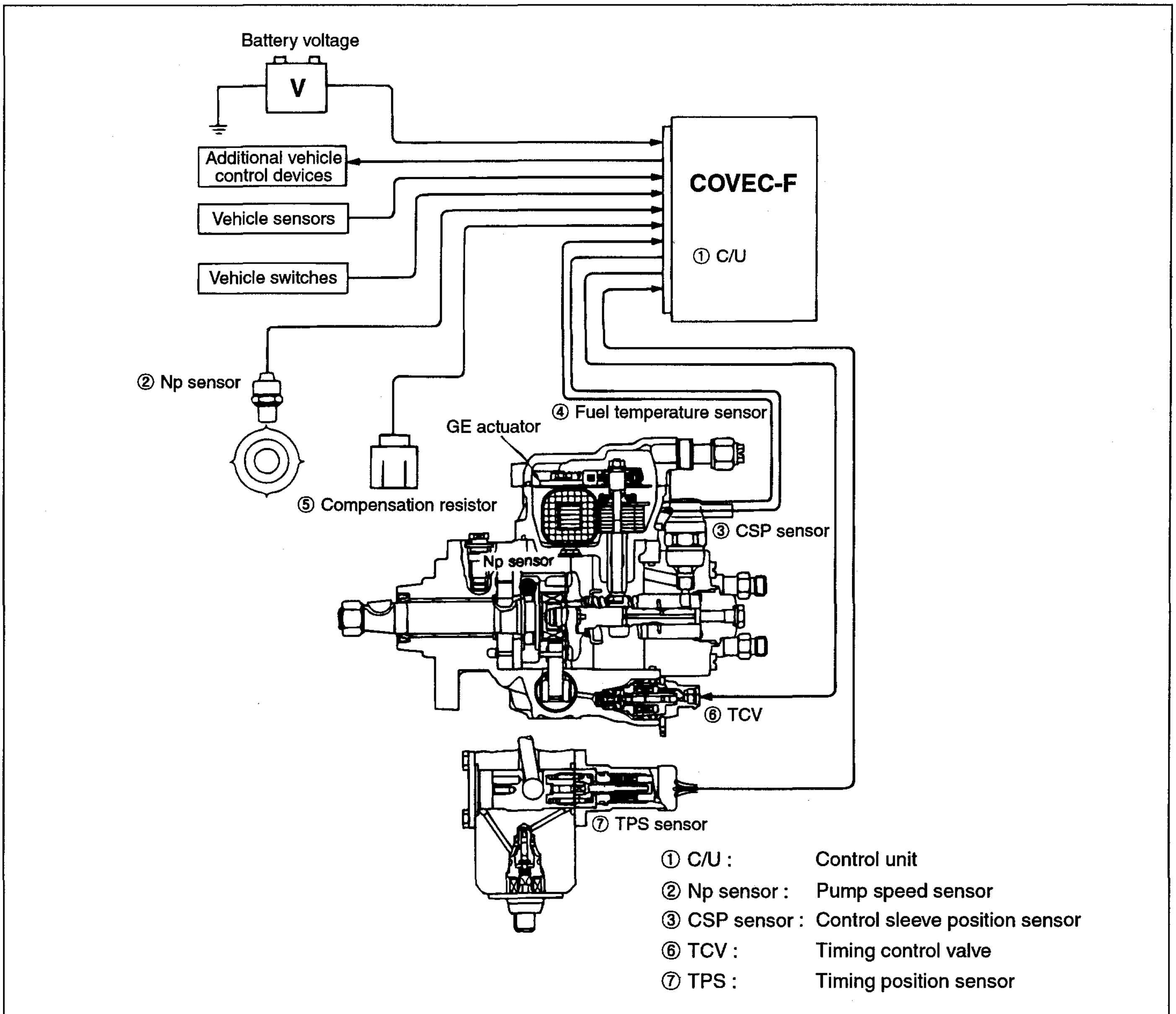
Additional devices such as a boost compensator, aneroid compensator, or injection timing compensation devices are unnecessary as compensation is performed electronically in response to signals from the various sensors. Because of this, the exterior of the injection pump is greatly simplified, enabling better utilization of space around the injection pump.



KFMB503D

SYSTEM OUTLINE EFMB6060

The figure below shows an outline of the COVEC-F-II system.

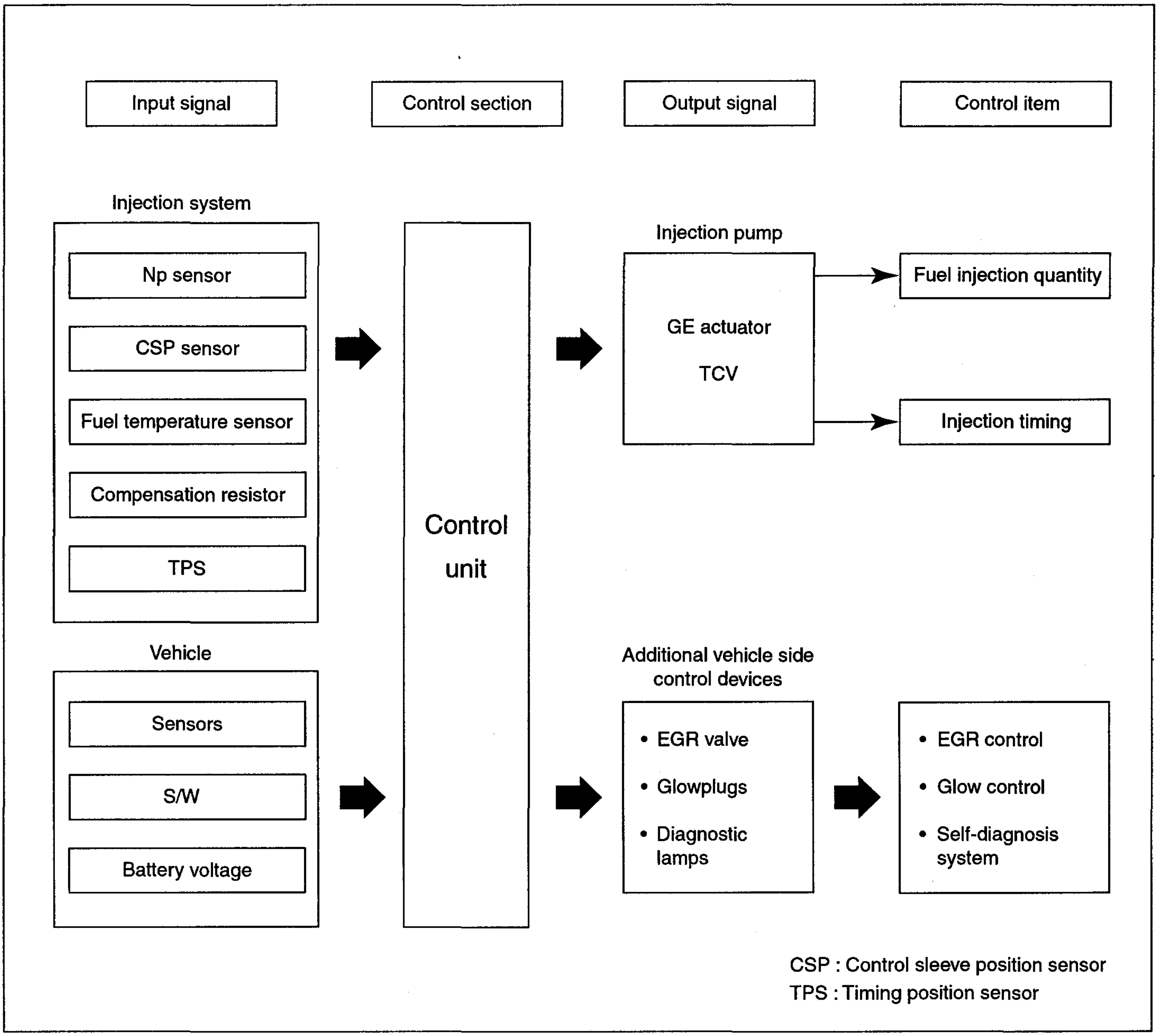


EFMB606A

No	Part name	Function
1	Control unit	Running condition comparison, processing
2	Np sensor	Detects pump speed
3	CSP sensor	Detects control sleeve position
4	Fuel temperature sensor	Detects fuel temperature
5	Compensation resistor	Compensation
6	TCV	Adjusts injection timing
7	TPS	Detects timer piston position

SYSTEM CONTROL EFMB6090

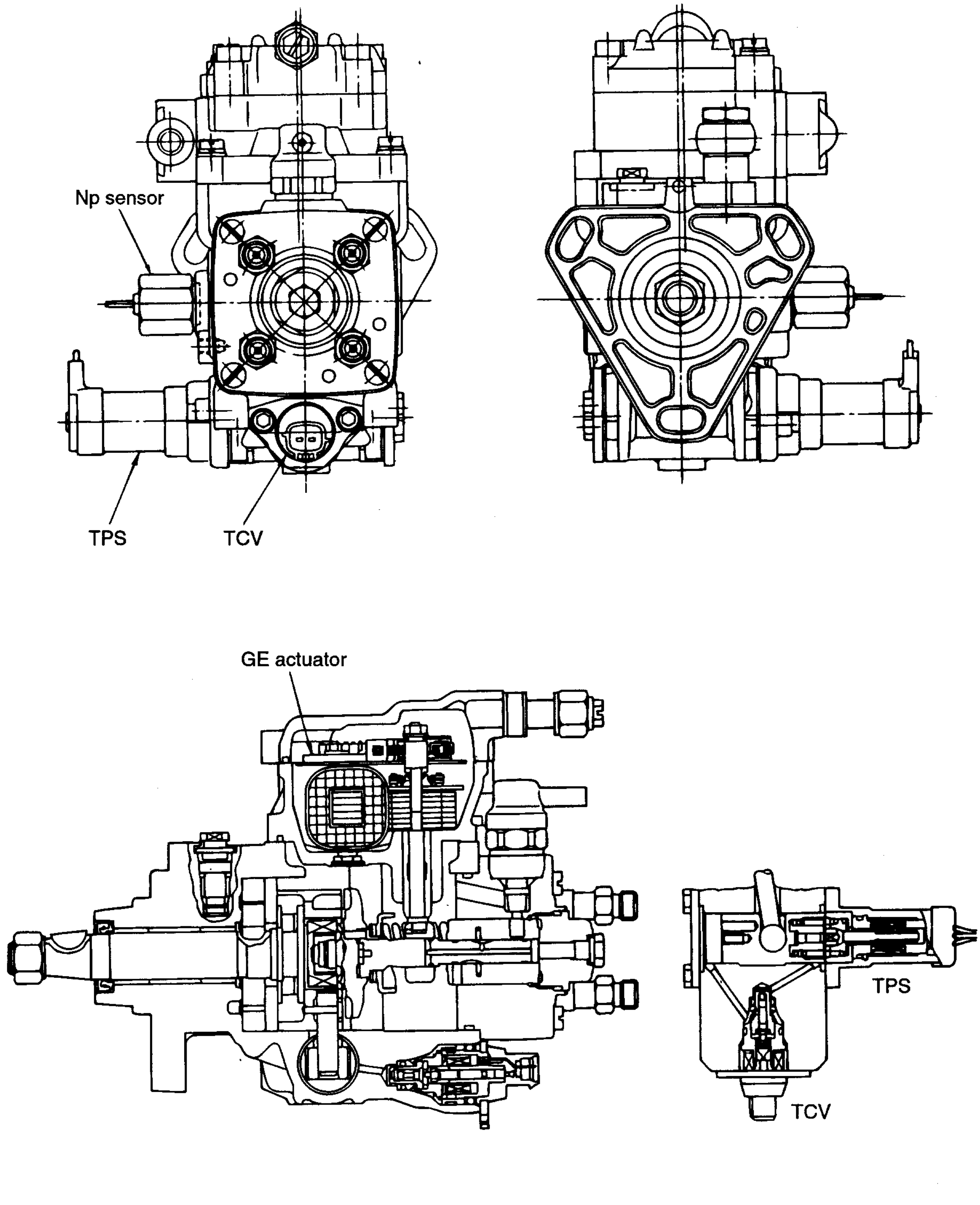
COVEC-F detects physical signals as electrical signals from each sensor and switch. The control unit processes this information to electronically control injection timing and injection quantity.



EFMB609A

CONSTRUCTION EFMB6120

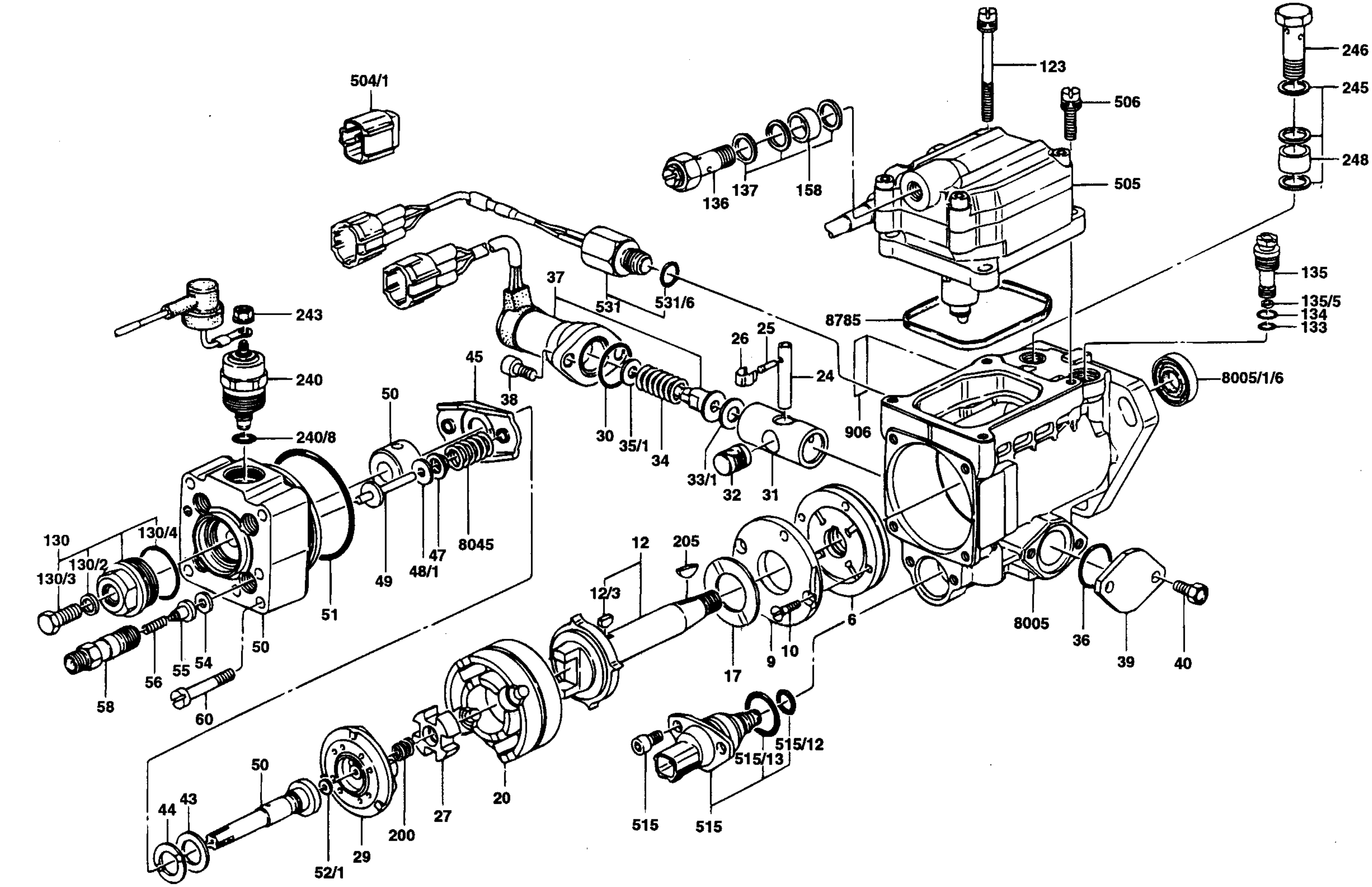
EXTERIOR AND CROSS-SECTIONAL VIEWS



EFMB612A

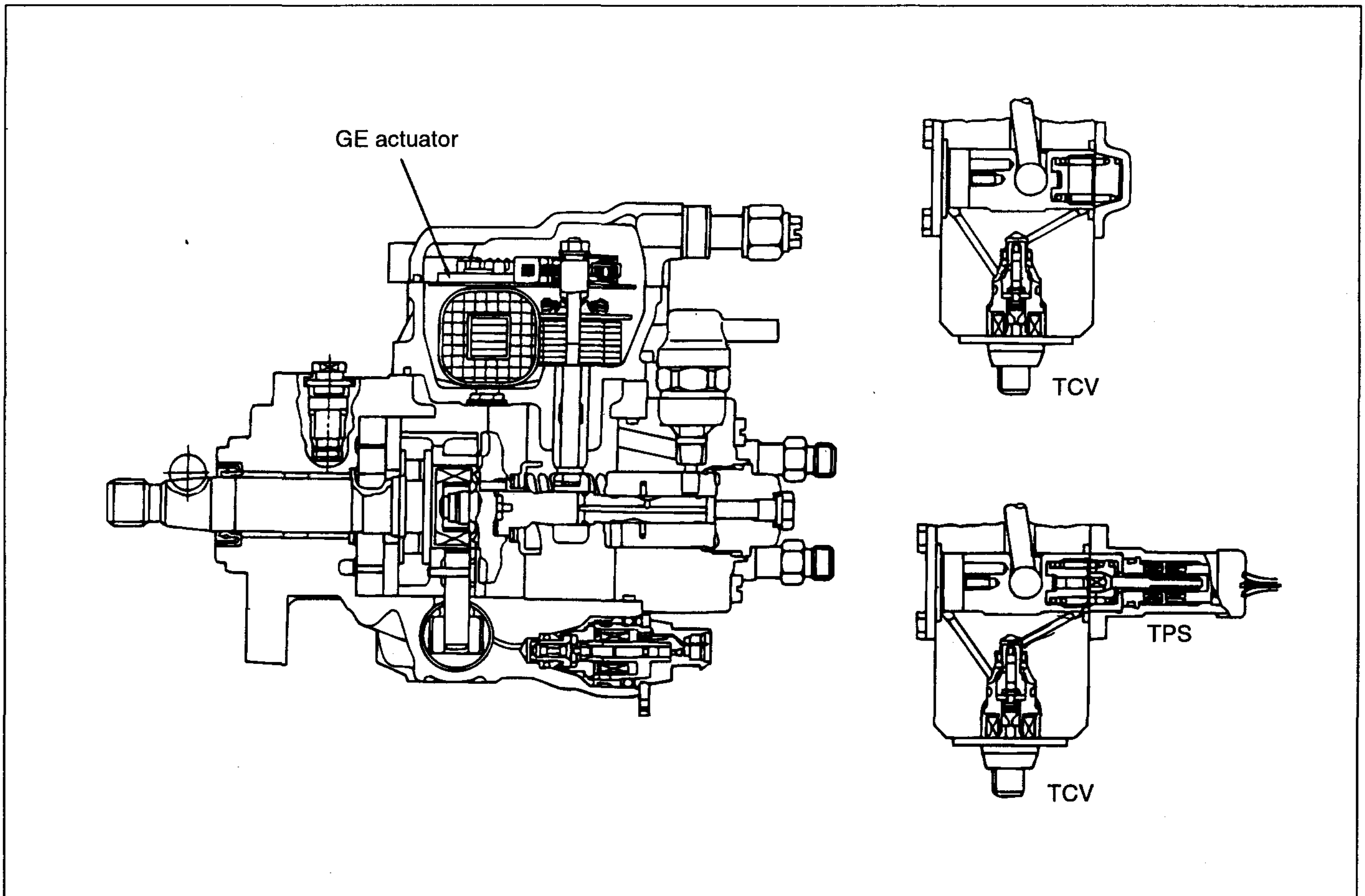
EXPLODED VIEW

EFMB6140



CONSTRUCTION EFMB6160

COVEC-F BODY

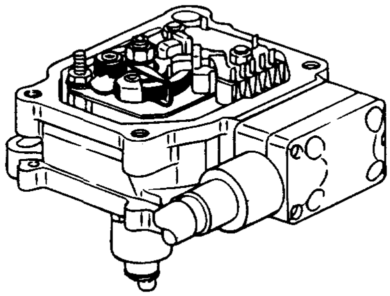


EFMB616A

Refer to the VE type injection pump service manual for conventional injection pump construction and parts with common construction.
Fuel intake and pressure delivery by COVEC-F is identical to that of the conventional injection pump. The inside of the pump is separated into a governor chamber, where fuel injection quantity control is performed, and a pump chamber, where fuel intake and delivery are performed.
The conventional injection pump is controlled by a centrifugal governor. COVEC-F, however, utilizes a GE actuator (ie, an electronic governor). Flyweights are not utilized. Therefore, there is no control lever at the upper cover. Instead, the control unit cable is connected to the upper part of the injection pump. Also, the conventional injection pump utilizes a flyweight holder gear (with 23 teeth) to detect pump speed. COVEC-F, however, utilizes a sensing gear plate provided on the drive shaft to detect pump speed. The number of projections on the gear plate corresponds to the number of engine cylinders.
A TCV (timing control valve) is provided at the lower part of the pump body between the timer's high pressure and low pressure chambers to adjust pressure to that necessary for advance timing. The conventional injection pump is sometimes equipped with a check valve inside the overflow valve. With COVEC-F, however, the overflow valve is always equipped with a check valve to prevent overflow until a fixed pressure is reached. COVEC-F-II is provided with a TPS (timing position sensor) at the lower part of the injection pump to detect timer piston position.

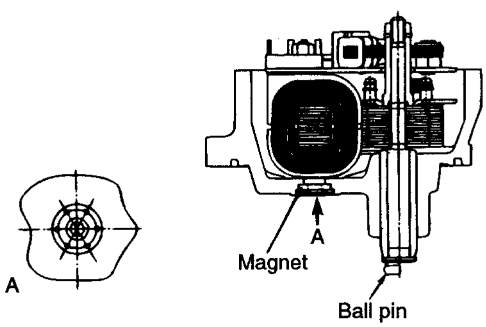
GE ACTUATOR (ELECTRONIC GOVERNOR)

The GE actuator is attached to the governor chamber at the upper part of the injection pump.



EFMB616B

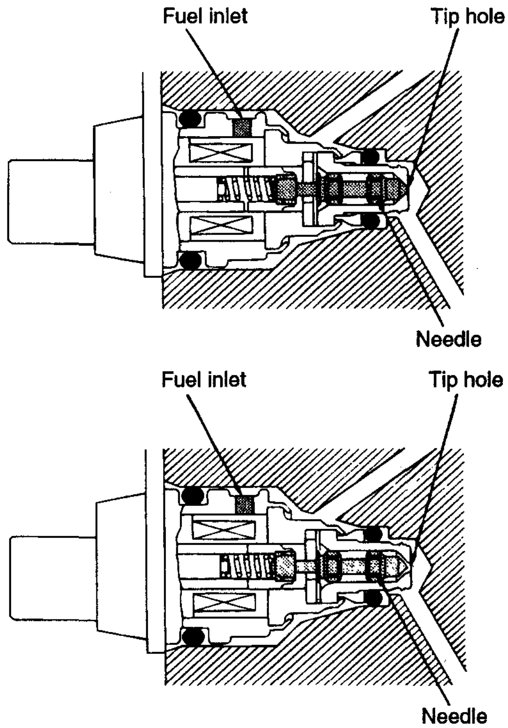
The governor chamber and the pump chamber are connected through a magnet filter, and the fuel oil flowing into the governor chamber cools the coil.
The magnet filter also prevents iron filings from entering the inside of the GE actuator. The tip of the shaft pressfitted to the rotor is equipped with a ball pin which is eccentric to the shaft. This ball pin is inserted into a hole in the control sleeve.



EFMB616C

DECREASED SMOKE AT ACCELERATION

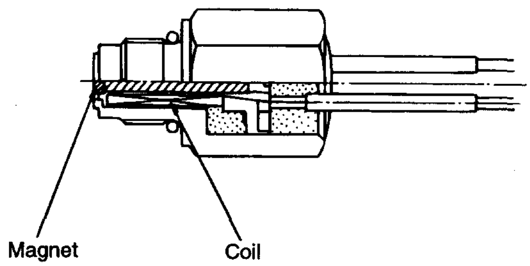
The TCV has a fuel inlet located in the center of the side of the TCV body. The fuel inlet is equipped with a filter. This inlet connects through the inside of the TCV to a hole in the end of the TCV body. A needle valve inside the TCV seats inside this end hole. When current is applied to the TCV, the needle valve is pulled to the left (see right hand figure) by a magnet to open the end seat. Injection timing is varied by timer piston movement transferred to the roller holder, as with conventional injection pumps. Previously, though, the pressure inside the timer's high pressure chamber controlling the timer piston varied in accordance with pump speed. With COVEC-F, however, the TCV controls pressure inside the high pressure chamber.



EFMB616D

NP SENSOR (PUMP SPEED SENSOR)

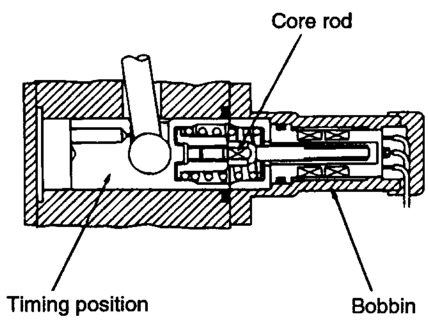
The Np sensor detects pump speed necessary for the various controls, and outputs signals to the control unit. The Np sensor is constructed of a permanent magnet and an iron pole, and a coil. The magnetic field is varied by sensing gear movement, and the voltage generated is detected as a speed signal.



EFMB616E

TPS SENSOR (TIMING POSITION SENSOR)

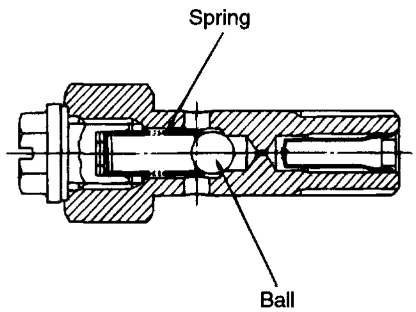
The TPS is installed on the timer's low pressure side. The TPS is constructed of a core rod and a bobbin, and detects timer piston position electrically.



EFMB616F

OVERFLOW VALVE (WITH CHECK VALVE)

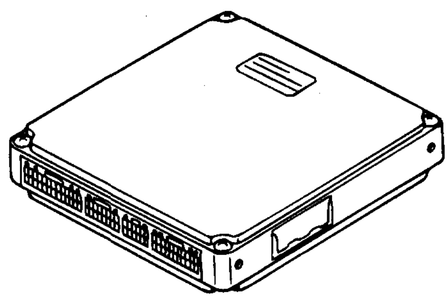
The overflow valve is installed on the end face of the GE actuator cover (ie, on the distributor head side). The check valve is constructed with a ball and spring to prevent overflow until the pump chamber pressure reaches a specified value.



EFMB616G

CONTROL UNIT

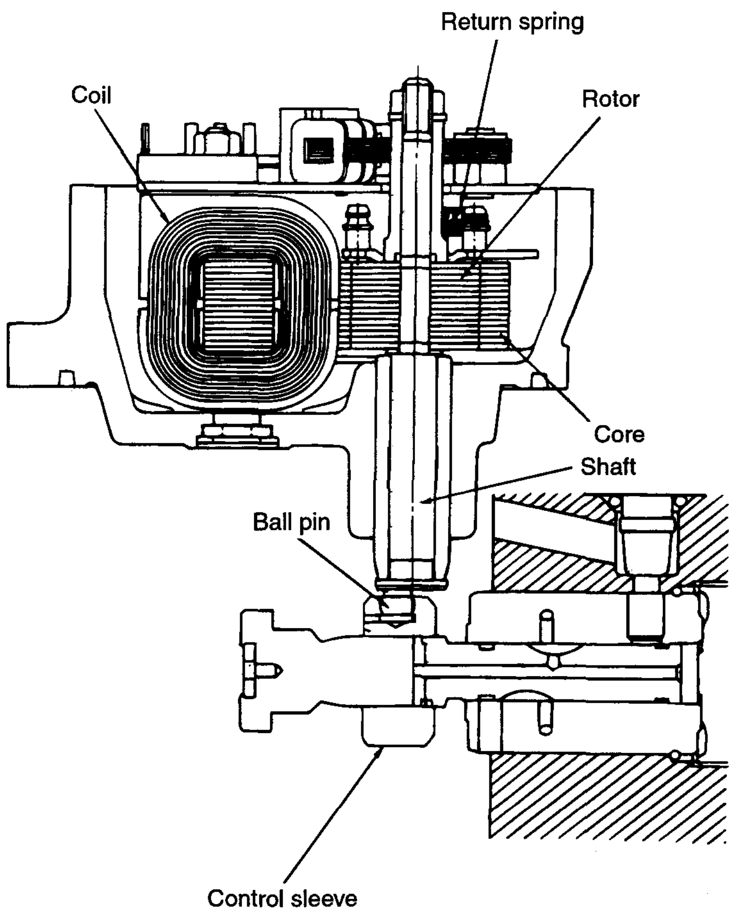
The control unit is installed on the vehicle. The control unit receives information signals detected by each sensor. Based on this information, the control unit then performs comparative calculations using programmed set values, and then instantaneously outputs optimum control signals to each control section. The control unit also includes a fault diagnosis system.



EFMB616H

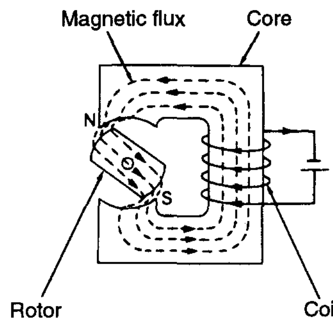
OPERATION EFMB6180

GE ACTUATOR (ELECTRONIC GOVERNOR)



EFMB618A

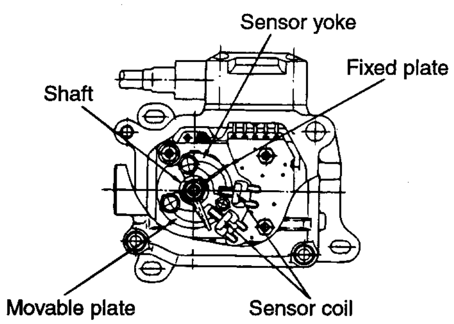
Unlike the conventional injection pump, COVEC-F adjusts fuel injection quantity electromagnetically. Control sleeve position is detected by the control sleeve position sensor and fed back to the control unit.
When the coil is energized, the core generates magnetic flux to rotate the rotor within a specific range. The intensity of the magnetic flux generated by the coil is determined by the input current. The rotor is rotated until the intensity of the core's magnetic flux equals the force of the rotor's return spring.



EFMB618B

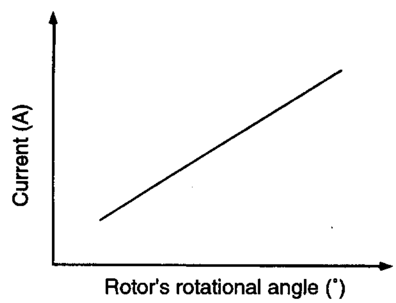
The control sleeve position sensor detects rotational angle. It is installed at the top of the GE actuator to detect whether the control sleeve position (ie, the rotor's angle of rotation) specified by the current is in fact the correct

position. The control sleeve position sensor consists of a sensor yoke, a sensor coil, a movable plate and a fixed plate. The movable plate is connected directly to and rotates with the shaft.
The fixed plate compensates for temperature induced inductance variations.



EFMB618C

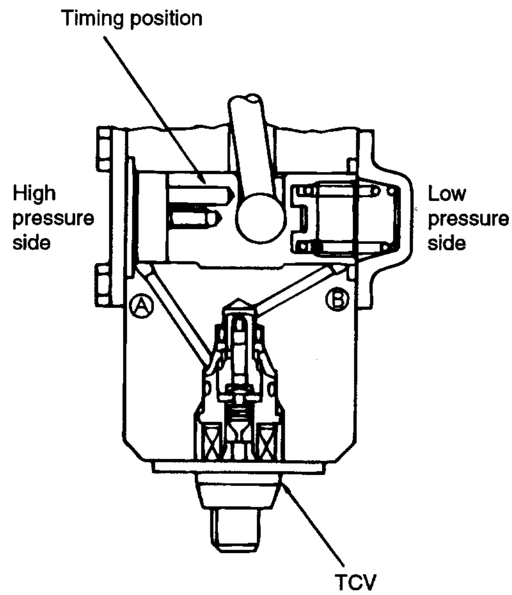
The control sleeve position sensor converts differences in the inductances of the upper and lower coils into angles, and feeds this back to the control unit. The control unit compares the target angle with the actual angle measured, and compensates the current so that the angle corresponds to the target angle.



EFMB618D

TCV (TIMING CONTROL VALVE)

The TCV is located at the lower part of the injection pump. Two holes (A and B) in the pump housing connect to the TCV. Hole A connects the timer piston's high pressure chamber to the fuel inlet side of the TCV. A filter is installed at this inlet to exclude foreign matter.
Hole B connects the timer piston's low pressure chamber to the fuel outlet at the tip of the TCV. Installed between the timer piston's high and low pressure chambers, the TCV adjusts high pressure chamber pressure by opening and closing the needle.
When current is not flowing to the TCV, the tip of the needle completely separates the high and low pressure chambers. When current is applied, the needle tip seat is opened, the high and low pressure chambers are connected, and the high pressure chamber pressure decreases. The timer piston is then moved by the timer spring to a position that balances the high pressure chamber pressure.
Accompanying this, the roller holder rotates to vary the injection timing. Injection timing can therefore be varied by utilizing the ON-OFF duty ratio of the current flowing to the TCV. Injection timing is controlled by duty. All characteristics and control signals are processed with TCV drive signal duty ratios. Also, the frequency of the TCV drive signal can be varied to correspond to the frequency of injection pump speed.



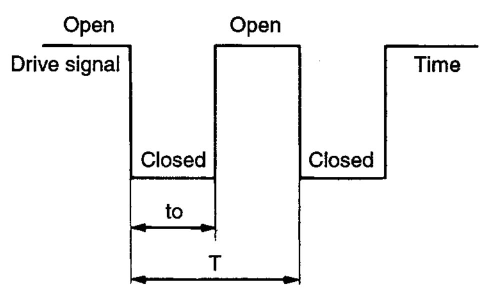
EFMB618E

Duty ratio is the ratio of the time that the timing control valve is closed per unit of time (ie, per cycle).

Duty ratio = to/T x 100(%)

NOTE

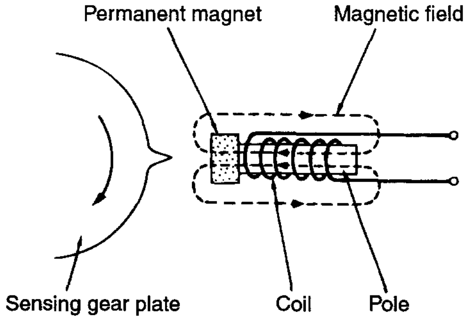
Injection timing is retarded when the duty ratio decreases from 100%.



EFMB618F

NP SENSOR (PUMP SPEED SENSOR)

When the drive shaft rotates, the sensing gear plate projections pass through the pump speed sensor's magnetic field to generate AC voltage at the coil. This voltage is input to the control unit, converted to a pulse signal, and used as a pump speed signal.



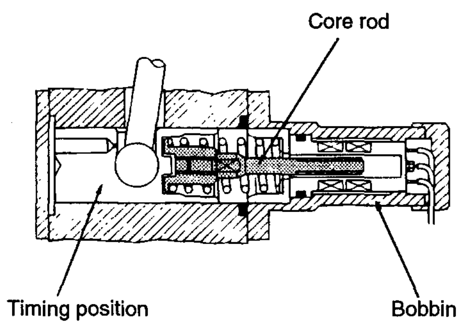
EFMB618G

TPS (TIMING POSITION SENSOR)

The TPS detects variations in the core rod inductance to measure timer piston position.

- Reference (standard point)

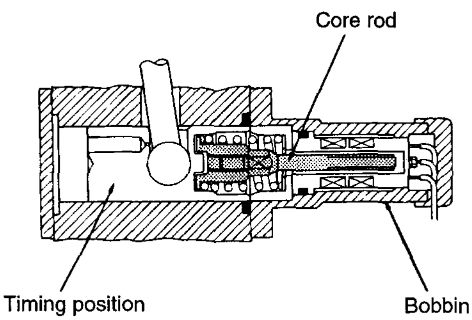
T_A = 0mm



EFMB618H

- Reference (Operation)

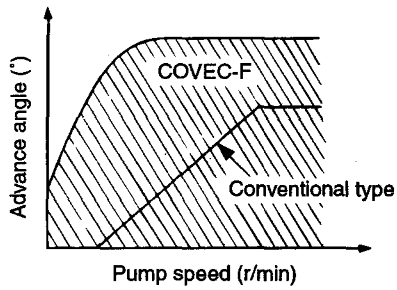
T_A = advance angle direction



EFMB618I

CHECK VALVE

The right hand figure shows the advance characteristics of the conventional injection pump and the possible range of advance control of COVEC-F.
With the conventional VE type injection pump, fuel pressure is increased in accordance with increases in speed to obtain advance characteristics.
With COVEC-F, the overflow valve is equipped with a check valve so that even at starting rotation, there is sufficient pressure to control advance. Therefore, as shown at left, the possible control range is much wider.



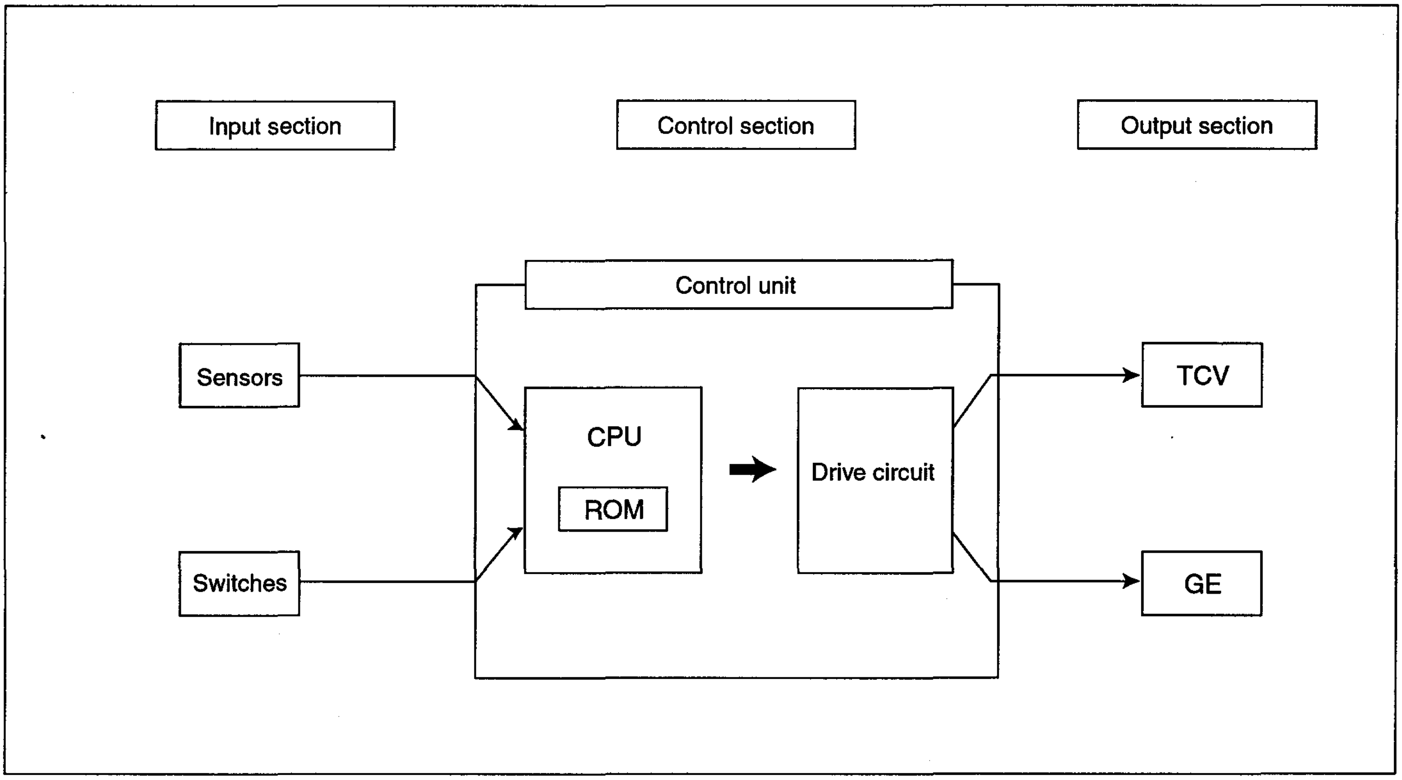
EFMB618J

CONTROL UNIT

Information signals detected by each sensor and switch are input to the control unit's micro-computor. Based on these information signals, characteristic data as well as compensation data recorded in the ROM (read only memory) are read into the CPU (central processing unit). Comparative calculations are then performed utilizing this data and information signals are output.

The control signals output by the micr-computor are then converted to drive signals. These are then input to the GE actuator and the TCV to control fuel injection quantity and injection timing.

In addition to this, COVEC-F also has a function that continually compensates real values to target values (feedback control) to perform optimum control of the diesel engine and ensure precision and endurance.



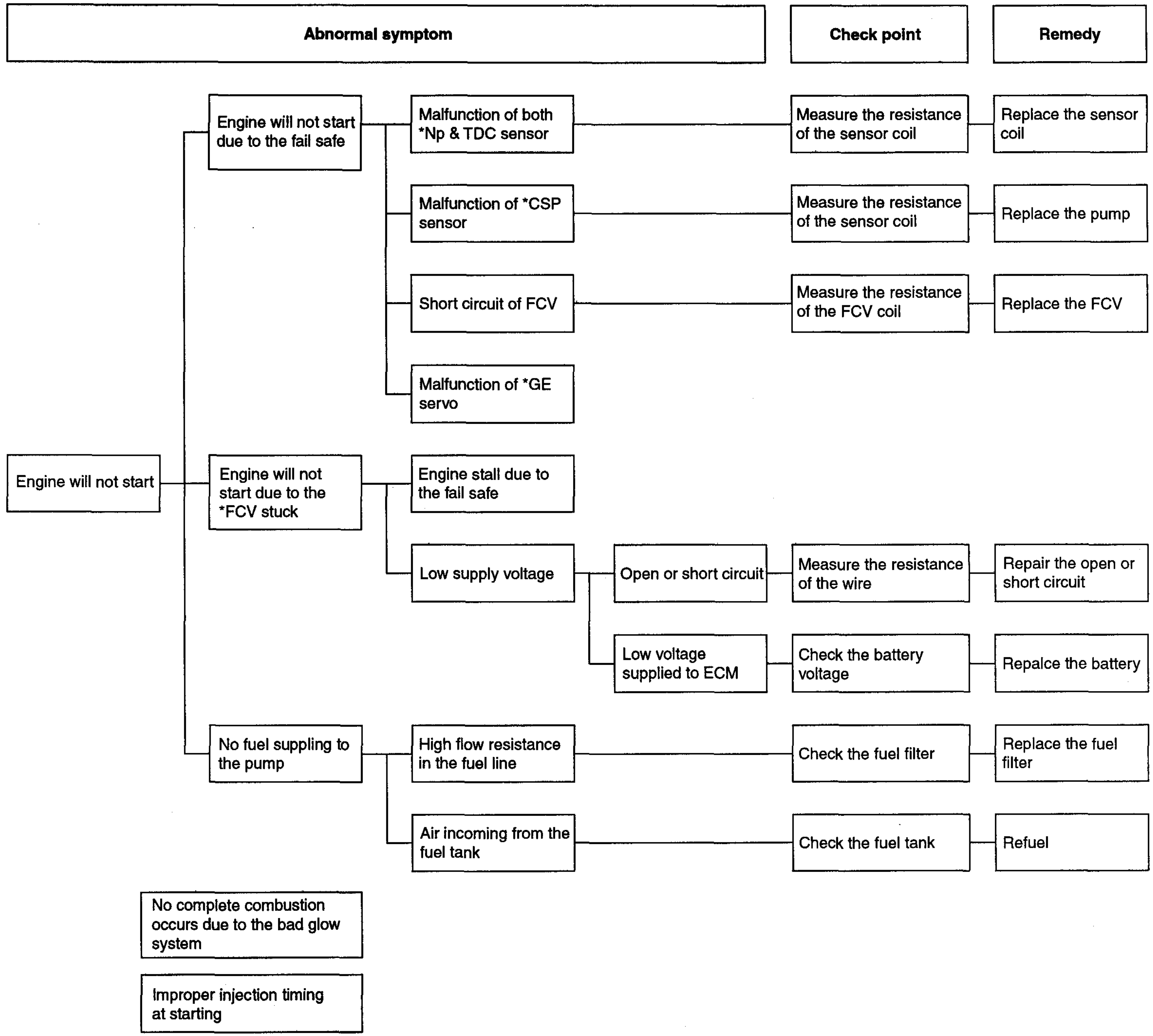
EFMB618K

DIAGNOSIS

TROUBLESHOOTING FOR ENGINE WITH ZEXEL COVEC-F

EFMB6810

ENGINE WILL NOT START



EFMB681A

EFMB681B

ENGINE STALL

Abnormal symptom				Check point	Remedy
Sudden engine stall in driving	Engine stall due to the fail safe	Malfunction of both Np & TDC sensor		Measure the resistance of the sensor coil	Replace the sensor coil
		Malfunction of CSP sensor		Measure the resistance of the sensor coil	Replace the pump
		Malfunction of GE servo			
	Engine stall due to the FCV close	Engine stall due to the fail safe			
		Low supply voltage	Open or short circuit	Measure the resistance of the wire	Repair the open or short circuit
			Low voltage supplied to ECM	Check the battery voltage	Repalce the battery
	Engine stall due to the no fuel suppling to the pump	High flow resistance in the fuel line		Check the fuel filter	Replace the fuel filter
		Air incoming from the fuel tank		Check the fuel tank	Refuel

EFMB6811

EFMB6812

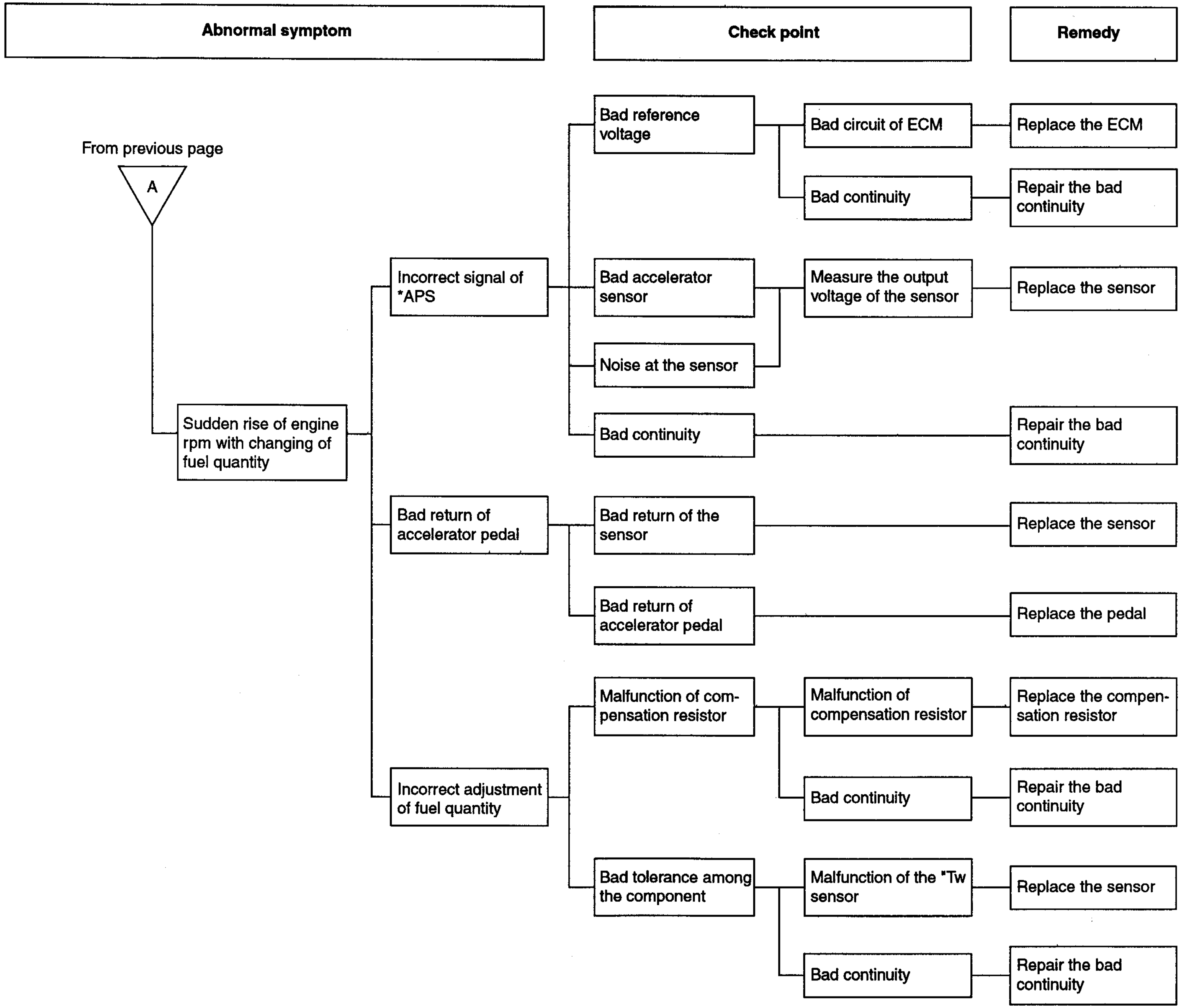
SUDDEN RISE OF ENGINE RPM

EFMB681C

Abnormal symptom → **Check point** → **Remedy**

- Sudden rise of engine rpm
  - Sudden rise of engine rpm without changing of fuel quantity
    - Incorrect voltage of GE
      - Incorrect output of CSP sensor
        - Looseness of sensor plagte → Tighten the nut
        - Looseness of moving plate → Tighten the nut
        - Looseness of CSP sensor coil → Tighten
      - Malfunction of the CSP sensor
        - CSP sensor stuck to the LO side
          - Repair the open circuit of CSP(-)
          - Repair the open circuit of CSP(MDL)
          - Repair the short circuit of CSP(+), CSP(MDL)
          - Repair the bad continuity
    - Malfunction of the GE motor
      - GE motor stuck to the FULL side
        - Open circuit of GE ground → Repair the open circuit of GE ground
        - Open circuit of wiring → Repair the open circuit of wiring
    - Incorrect signal of *Tf
      - Incorrect signal of *Tf
        - Bad Tf sensor → Replace the sensor
        - Bad continuity → Repair the bad continuity
  - A

Continued on next page


Abnormal symptom
Check point
Remedy
From previous page
A
Sudden rise of engine rpm with changing of fuel quantity
Incorrect signal of *APS
Bad reference voltage
Bad circuit of ECM
Replace the ECM
Bad continuity
Repair the bad continuity
Bad accelerator sensor
Noise at the sensor
Measure the output voltage of the sensor
Replace the sensor
Bad continuity
Repair the bad continuity
Bad return of accelerator pedal
Bad return of the sensor
Replace the sensor
Bad return of accelerator pedal
Replace the pedal
Incorrect adjustment of fuel quantity
Malfunction of com-pensation resistor
Malfunction of compensation resistor
Replace the compen-sation resistor
Bad continuity
Repair the bad continuity
Bad tolerance among the component
Malfunction of the *Tw sensor
Replace the sensor
Bad continuity
Repair the bad continuity

EFMB681D

SELF DIAGNOSIS SYMPTOM

EFMB6813

EFMB681E

○ : Effect much
△ : Effect little

ITEM	Symptom / Main cause	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibrtion	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
Fuel cut solenoid valve	Poor connection or looseness of terminal	○				○			△				Tightening torque : 2.0-2.5kg·m
	Valve fail (Open or being stuck)	○				○					○		Check the resistance or output signal Inspect the part after removal
TCV	Poor connection or looseness of connector	○	○	○	△	△	○	○	○	○			Check the installation condition
	Malfunction of TCV (Open or being stuck)	○	○	○	△	△	○	○	○	○			Check the resistance or output signal
	TCV filter clogged (O-ring torn)	○	○	○	△	△	○	○	○	○			
CSP sensor	Bad output of CSP sensor	○	○	○	○	○	○	○	○	○		○	Check the resistance or output signal
	Malfunction of CSP sensor(open or short)	○	○	○	○	○	○	○	○	○			
GE actuator	Bad output of GE coil	○	○	○	○	○	○	○	○	○	△	△	Check the resistance or output signal
	Malfunction of GE coil (open or short)	○	○	○	○	○	○	○	○	○	△		
Fuel temp. sensor	Malfunction of fuel temp. sensor	○	○				○	○		○			Check the resistance or output signal
	Bad output of sensor	○	○		△		○	○		○			Check the characteristic of resistance for temp. range
Compensation resistor	Compensation resistor poor connection	○	○	○	△	△	○	○	△	○			Check the open or short
	Wrong resistor	○	○	○	△	△	○	○	△	○			Check the compensation resistor
Np sensor (TDC sensor is good)	Bad installation noise				○								Tightening torque : 2.0-2.5kg·m Compensation resistor

EFMB681F

ITEM	Symptom / Main cause	Hard to start	Rough idling	Lack of power/ poor accelera-tion	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibrtion	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
Np sensor (TDC sensor is good)	Malfunction of sensor (open or short)				○				△				Check the resistance and output signal
Np sensor (with faulty TDC sensor)	Bad installation, noise		○			○							Tightening torque:2.0-2.5kg·m Check the output signal
	Malfunction of sensor (open or short)					○							Check the resistance and output signal
TPS	Bad installation and output signal	○	○	○	△	△	○	○	○	○			Tightening torque:0.7-0.9kg·m Check the output signal
	Malfunction of sensor (open or short)	○	○	○	△	△	○	○	○	○			Check the resistance
Boost sensor	Bad installation and output signal			○			△	△		△			Inspect the installation condition
	Malfunction of sensor (open or short)			○			△	△		△			Check the output signal's characteristic
TDC sensor (with good Np sensor)	Bad installation, noise Malfunction of sensor (open or short)		○	○			○	○	○	○		○	Inspect the installation condition and fly wheel Check the output signal's characterstic
TDC sensor (with faulty Np sensor)	Bad installation, noise Malfunction of sensor (open or short)		○	○	○	○	○	○	○	○			
*ECT sensor	Bad installation and output signal	○	○	△			○	○	△	○		△	Inspect the installation condition
	Malfunction of sensor (open or short)	△	○	△			○	○	△	○		△	Check the output signal's characteristic
VSP	Bad installation and output signal			○					○				Check the output signal's characteristic
	Malfunction of sensor (open or short)			○					○				Check the wiring harness
APS sensor	Malfunction of sensor (open or short)	△	○	○	○		○	○		○		○	Check the output signal's characteristic

ITEM	Symptom / Main cause	Hard to start	Rough idling	Lack of power/ poor acceleration	Bad return of overrun rpm	Engine stop	Much black smoke	Much white smoke	Knocking and vibrtion	Poor fuel economy	Impossible to stop the engine	Sudden rise of engine rpm	Check point
IDLE switch	Open or short		○		○					△		○	Check the resistance and output signal
Neutral switch	Bad installation and output signal (open and short)					△							Tightening torque:2.0-2.5kg·m Check the output signal
ECU	Power system (open or short)	○											Check the resistance and output signal
	Bad output signal of PWM signal for TCM (open or short)			○					○				Tightening torque:0.7-0.9kg·m Check the output signal
ECU	Bad output signal of barometric pressure sensor			○			○	○		○			Check the resistance
	Bad communication for IMMOB (open or short)	○				○							Inspect the installation condition
T/C waste gate (boost hose)	Malfunction (stuck)			○			○			○			Check the output signal's characteristic
Glow relay	Open or short	○	○					○					Inspect the installation condition and fly wheel Check the output signal's characterstic
EGR solenoid valve	Being stuck, bad operation			○			○			○			

EFMB681G

NOTE
Abbreviation marked * are listed below.

Np : Injection pump speed sensor
CSP : Control sleeve position
FCV : Fuel cut valve
GE : Electronic governor
Tf : Fuel temperature sensor
APS : Acceleration position sensor
Tw : Water temperature sensor
TCV : Timing control valve
ECT : Engine coolant temperature
IMMOBI : Immobilizer

SELF-DIAGNOSIS PRECAUTIONS EFMB6815

WARNING

The following definitions and warming signs are used in this service manual. These are extremely important to safe operation. Important points are described to prevent bodily injury and property damage. They must be fully understood before beginning COVEC-F self diagnosis system operation.

CAUTION

Improper maintenance can result in injury or property damage.

MEANINGS OF MARKS

The following marks are used in this service manual to facilitate correct COVEC-F self diagnosis system operation.

ADVICE

Procedures that must be performed to enable the best possible COVEC-F self diagnosis system operation.

NOTE

Information assisting in the best possible COVEC-F self diagnosis system operation.

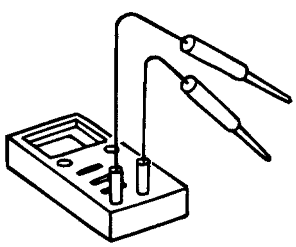
PREPARATION

Prepare the following.

- Circuit tester

NOTE

The circuit tester is used during inspection procedures to check the continuity and resistances of each electrical component.



Circuit tester

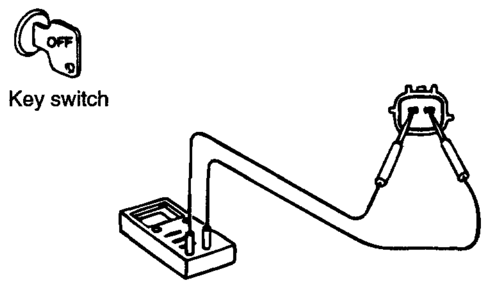
PCOVT001

CIRCUIT TESTER USE

- Turn the engine's key switch OFF when checking continuity or resistance.

CAUTION

If the key switch is on when checking continuity or resistance, electrical components may be damaged.

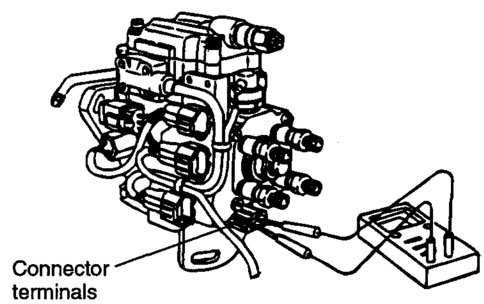


PCOVT002

- Do not damage connector terminals when checking continuity or resistance. Do not push the tester pins into the female terminals.

CAUTION

New faults may arise if the connector terminals are damaged.

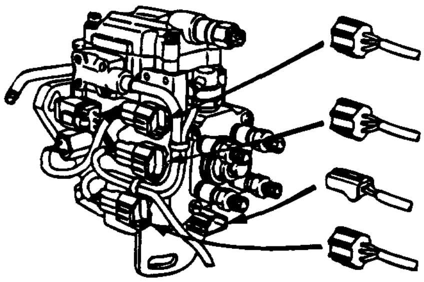


PCOVT003

- Always reconnect connectors in their original positions after checking continuity or resistance.

CAUTION

New faults or improper operation may arise if connectors are not remstalled in their original positions.



PCOVT004

SELF-DIAGNOSIS FROM FAILURE MODE EFMB6820

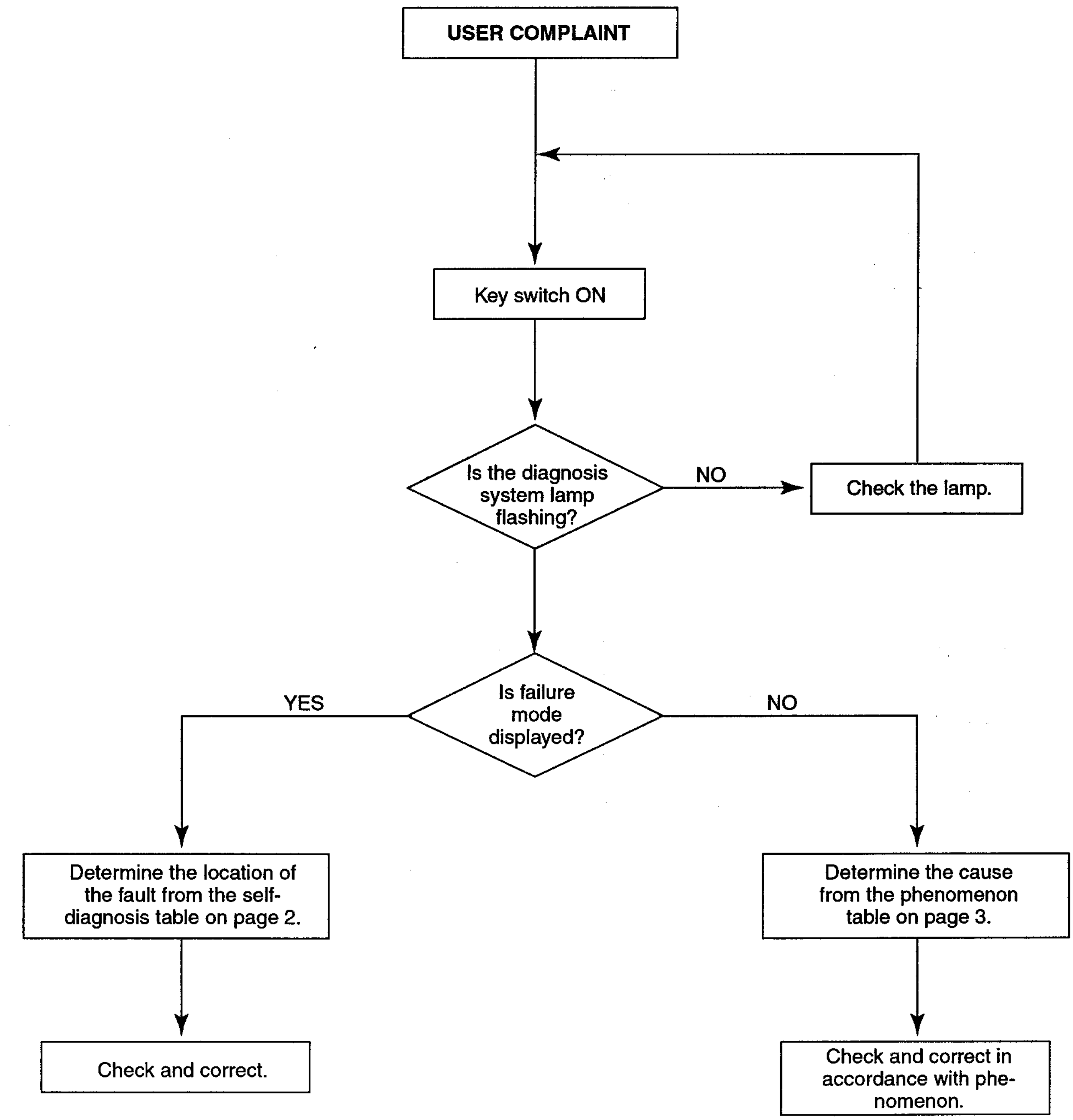
The COVEC-F system includes a self-diagnosis system which alerts the operator to system malfunctions. The control unit continually monitors the signals input from each sensor and the GE actuator for abnormal values.

FAILURE MODE TABLE

No.	DTC No.	CONTENTS	MIL
1	P0105	BAROMETRIC SENSOR-MAL.	X
2	P0110	INT. AIR TEMP. CIRCUIT-MAL.	X
3	P0115	ENG. COOLANT TEMP-MAL.	O
4	P0120	ACCEL P. SNSR-MAL.	X
5	P0121	APS. RANGE/PERFORMANCE-MAL.	O
6	P0180	FUEL TEMP. SNSR. CIRCUIT-MAL.	X
7	P0320	ENGINE SPEED INPUT CIRCUIT-MAL.	X
8	P0335	CRANKSHAFT P. SNSR-MAL.	X
9	P0500	VEHICLE SPEED SNSR-MAL.	X
10	P0600	IMMOBILIZER COMMUNICATION-MAL.	O
11	P0605	CONTROL MODULE(EEPROM) ROM-MAL.	X
12	P0613	ECU-MALFUNCTION	X
13	P1116	BOOST PRESSURE SENSOR-MAL.	O
14	P1120	ELECTRIC GOVERNOR-MAL.	O
15	P1122	BOOST PRESSURE CONTROL VALVE-MAL.	O
16	P1123	TIMER POSITION SENSOR-MAL.	X
17	P1127	CONTROL SLEEVE POSITION SNSR.-MAL.	O
18	P1131	INJECTION QUANTITY ADJUST-MAL.	X
19	P1135	INJECTION TIMING SERVO-MAL.	X
20	P1324	GLOW RELAY-MALFUNCTION	O
21	P1522	BATTERY VOLTAGE ERROR	O
22	P1525	5V SOURCE VOLTAGE	X
23	P1621	FUEL CUT VALVE-MAL.	O

Use the follwing chart to check the system when malfunctions occur.

Advice
When the key switch in ON, leave each electrical component's connector connected.

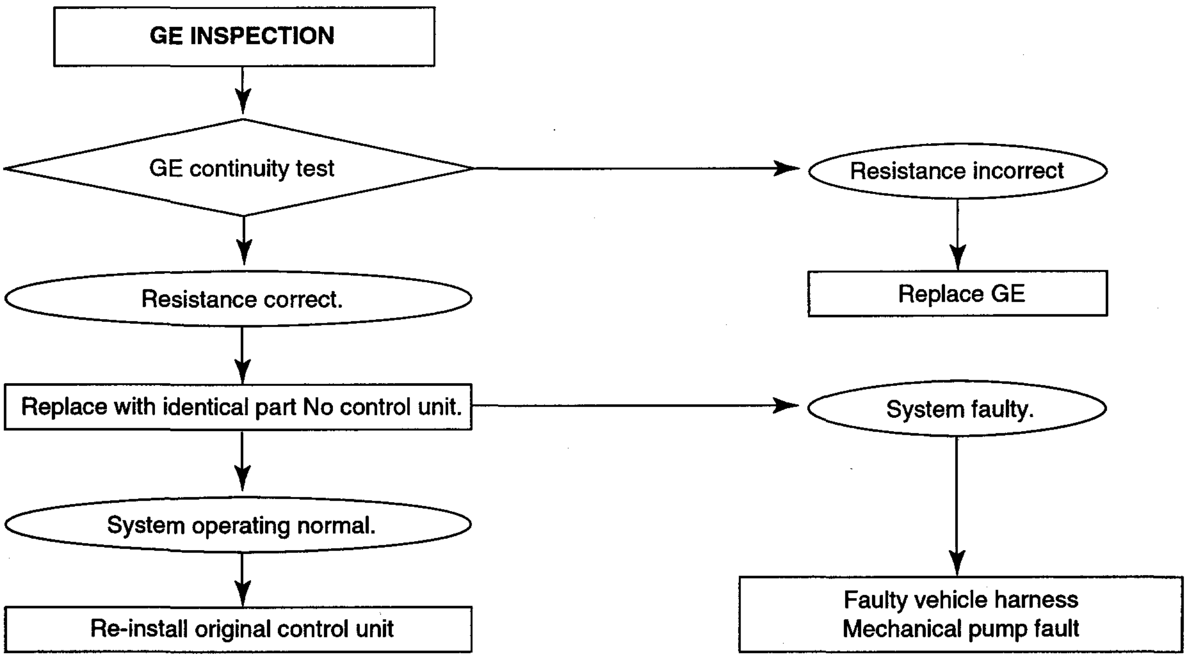


EFMB682A

INSPECTION OF PARTS EFMB6860

GE ACTUATOR

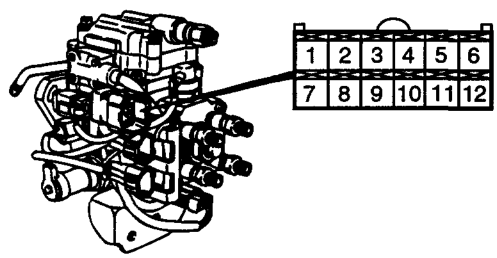
Advice
Turn the key switch OFF.



EFMB686A

1. GE actuator terminals

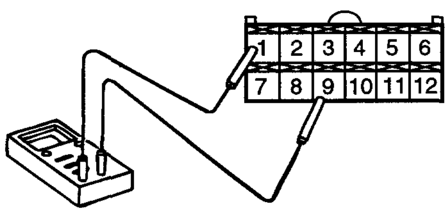
Terminal	Component	Remarks
1	GE (-)	GE (-)
2	TCV (+)	Timing control valve (+)
3	CSP (+)	Oscillate (+)
4	Adj (+)	Adjustment resistor (+)
5	Adj (-)	Adjustment resistor (-)
6	FCV	Fuel Cut Valve
7	CSP (-)	Oscillate (-)
8	TF (-)	Fuel Temperature (-)
9	GE (+)	GE (+)
10	TCV (-)	Timing control valve (-)
11	CSP	Neutral
12	TF (+)	Fuel temperature (+)



EFMB686B

2. Check the GE actuator resistances.
- Reference values

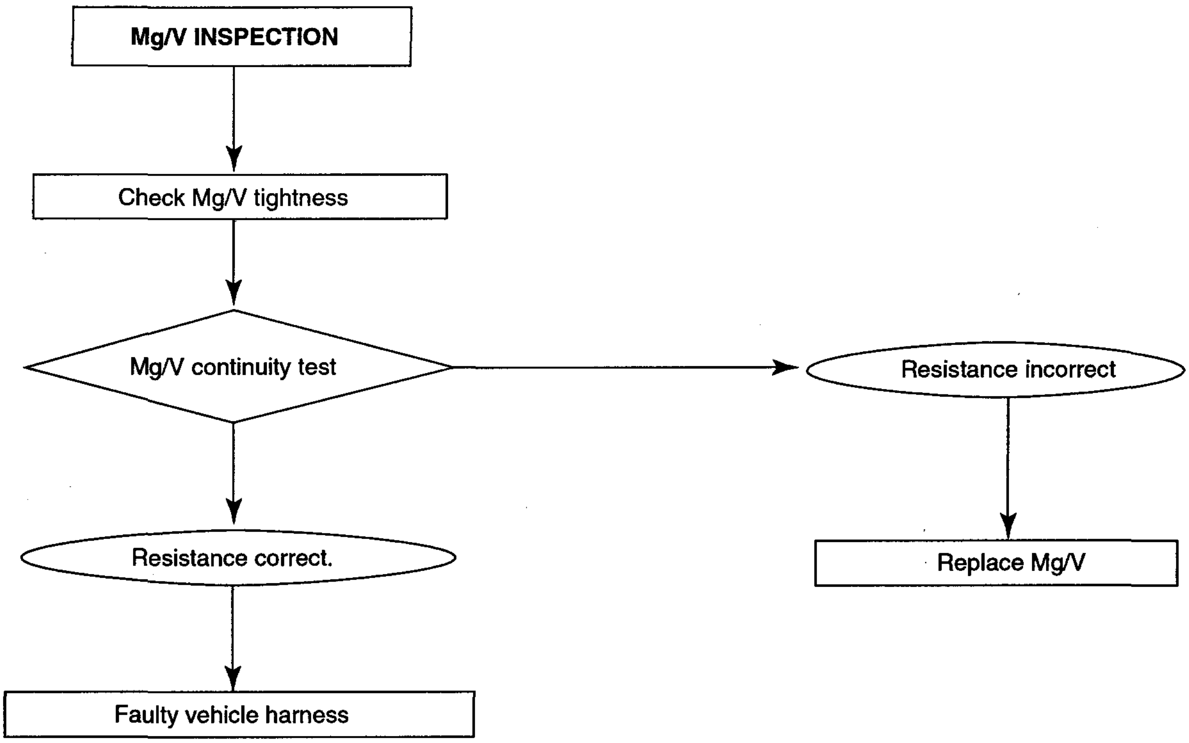
Terminal	Resistance	Temperature (°C)
1 - 9	0.71 ± 0.13Ω	23
3 - 7	11.8 ± 0.6Ω	23
3 - 11	5.9 ± 0.3Ω	23
7 - 11	5.9 ± 0.3Ω	23



EFMB686C

EFMB6880

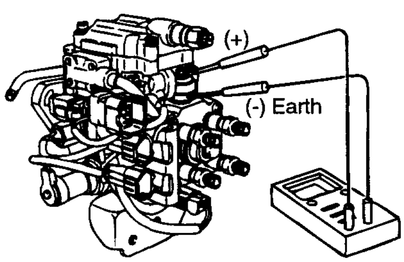
Advice
Turn the key switch OFF.



EFMB688A

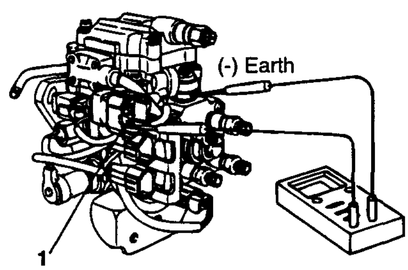
1. Check Mg/V resistance.
• Reference Values

Resistance (Ω)	Temperature (°C)	Remarks
8.6 ± 1.1	23 ± 10	



EFMB688B

2. Confirm that there is continuity between the Mg/V body's earth (-) and the GE actuator connector terminal no 6.

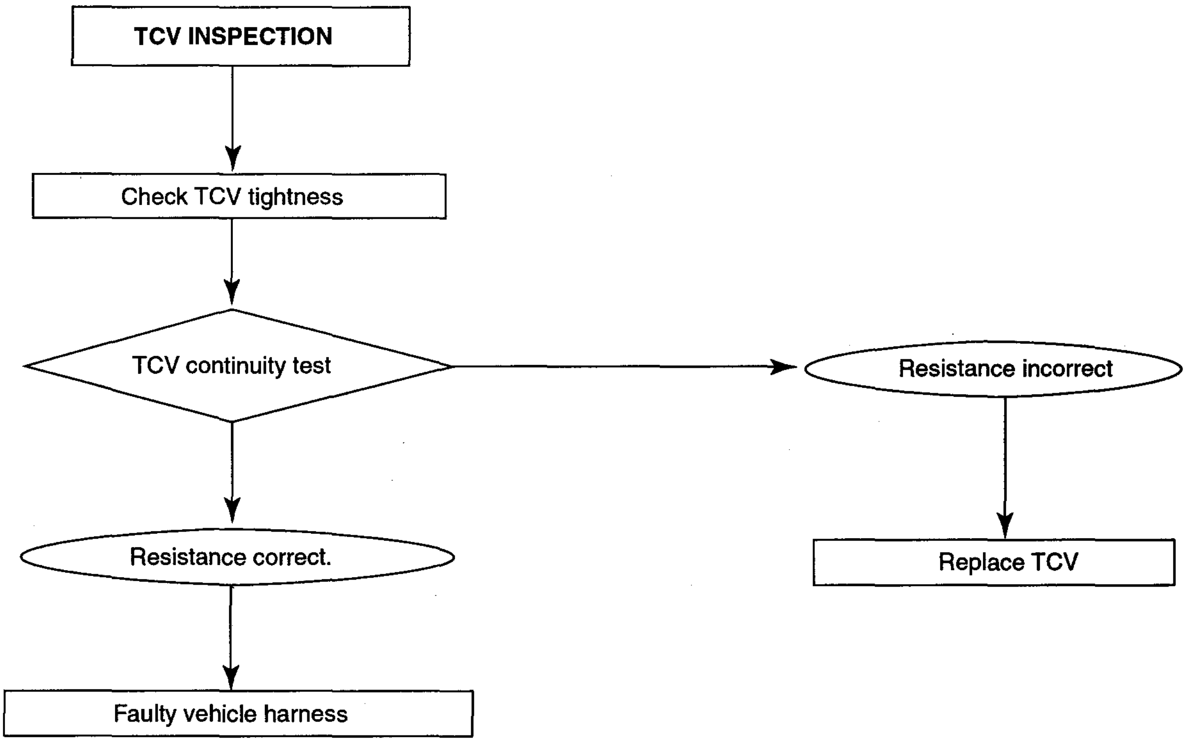


EFMB688C

EFMB6900

TCV (TIMING CONTROL VALVE)

Advice
Turn the key switch OFF.



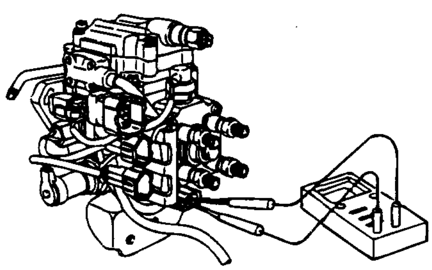
EFMB690A

1. Check Mg/V resistance.

2. Check TCV resistance.

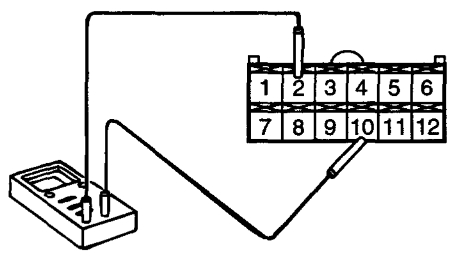
• Reference Values

Resistance (Ω)	Temperature (°C)	Remarks
11.0 ± 0.7	20 ± 10	



EFMB690B

3. Confirm that there is continuity between the GE actuator connector terminal no 2 and no 10.

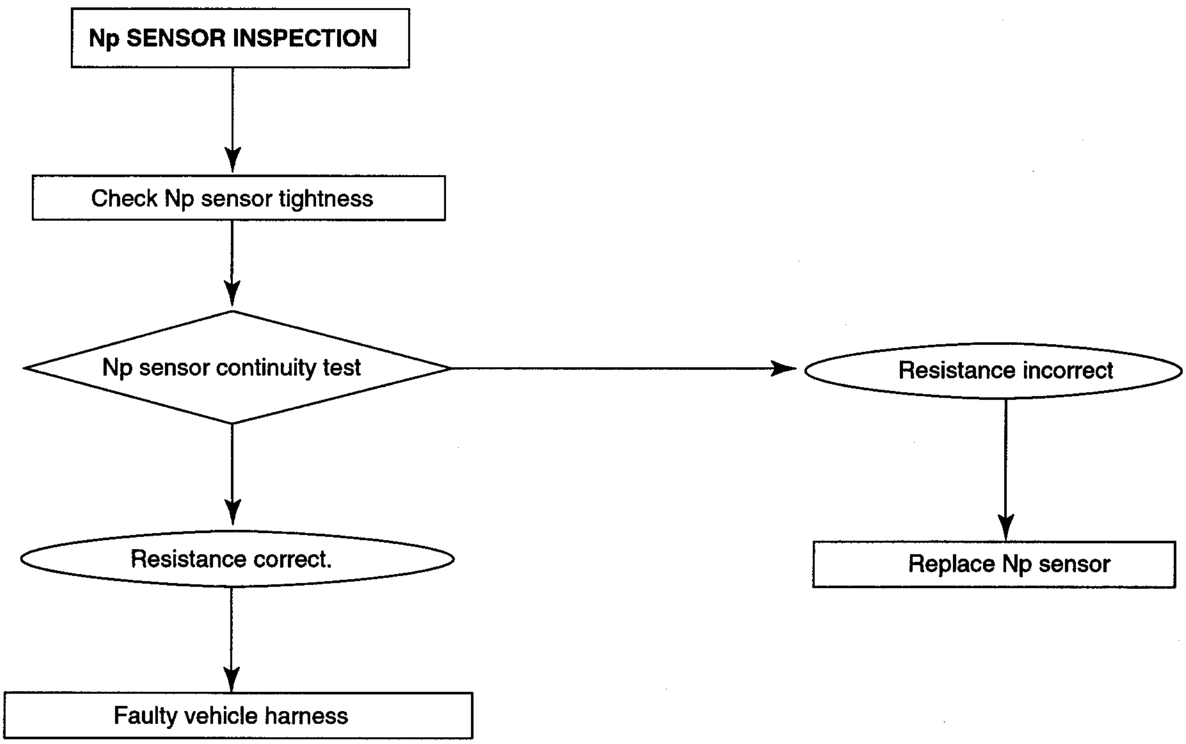


EFMB690C

EFMB6920

NP SENSOR

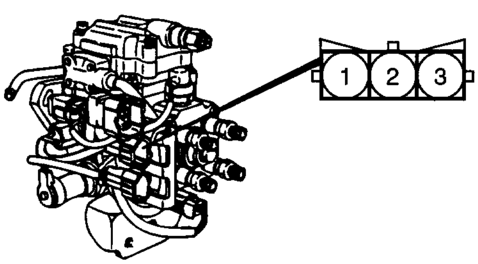
Advice
Turn the key switch OFF.



EFMB692A

1. Np sensor terminals.

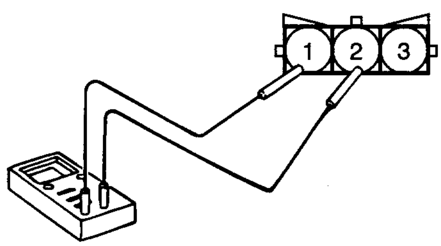
Terminal No	Component wiring	Remarks
1	SIGNAL	Output
2	GND	
3	Blind plug	2.6V



EFMB692B

• Reference Values

Terminal No	Resistance (kΩ)	Temperature (°C)
1 - - 2	1.65 ± 0.15	25 ± 5



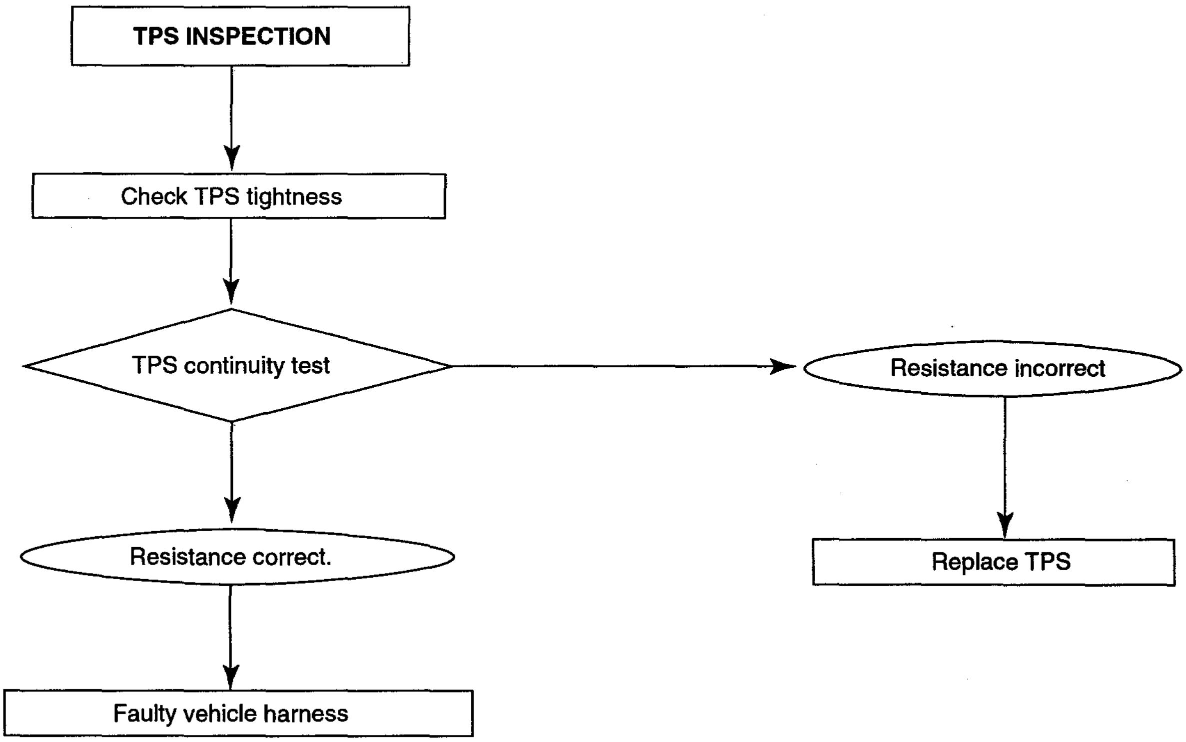
EFMB692C

2. Check Np sensor resistance.

EFMB6940

TPS (TIMING POSITION SENSOR)

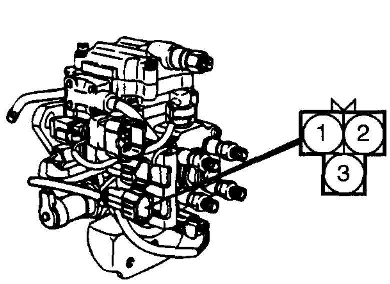
Advice
Turn the key switch OFF.



EFMB694A

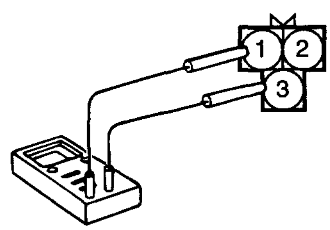
1. TPS terminals.

Terminal No	Component wiring	Remarks
1	OSC (+)	Oscillate (+)
2	OSC (-)	Oscillate (-)
3	MDL	



• Reference Values

Terminal No	Resistance (kΩ)	Temperature (°C)
1 - - 3 2 - - 3	82 ± 5.7 82 ± 5.7	25 ± 10 25 ± 10



EFMB694C

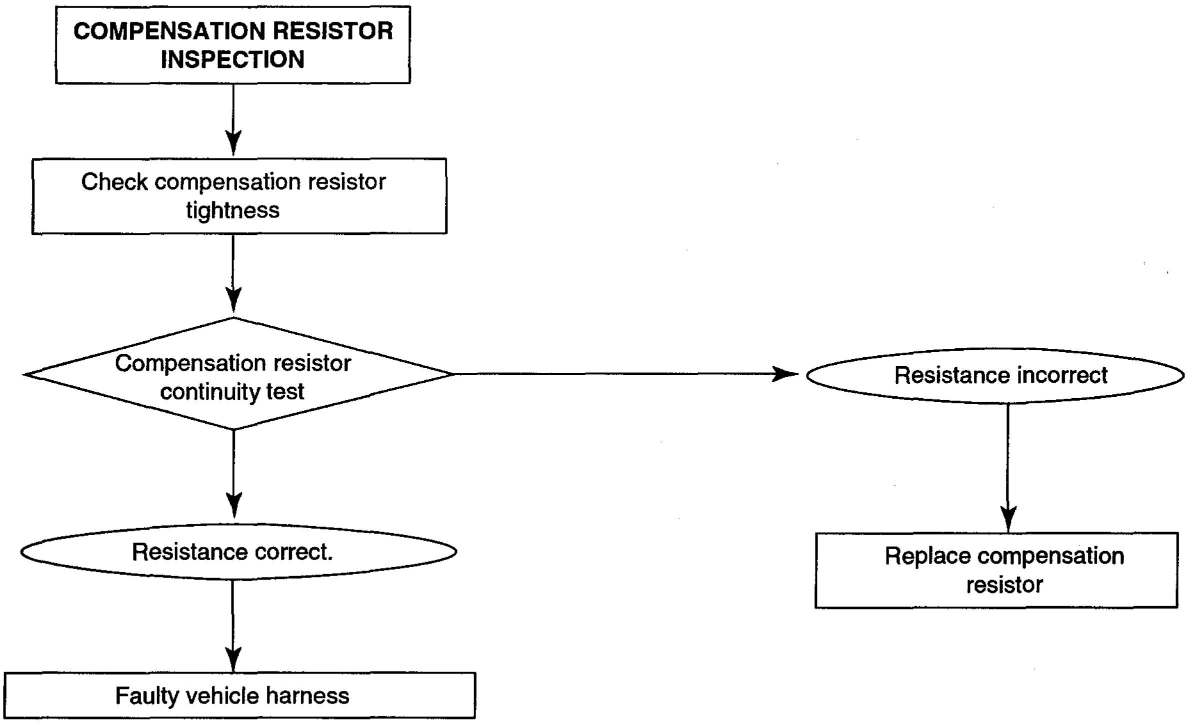
EFMB694B

2. Check TPS resistance.

EFMB6960

COMPENSATION RESISTOR

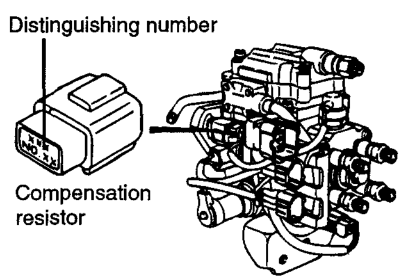
Advice
Turn the key switch OFF.



EFMB696A

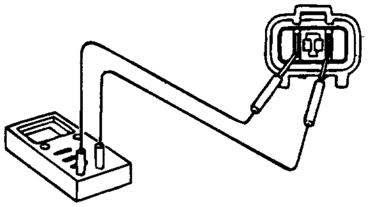
1. GE actuator terminals

Compensation resistor (No, kΩ)	Distinguishing No.	Part No.
No1, 0.18	945	146649-4500
No2, 0.30	946	146649-4600
No3, 0.43	947	146649-4700
No4, 0.62	948	146649-4800
No5, 0.82	949	146649-4900
No6, 1.10	950	146649-5000
No7, 1.50	951	146649-5100
No8, 2.00	952	146649-5200
No9, 2.70	953	146649-5300
No10, 3.90	954	146649-5400
No11, 5.60	955	146649-5500
No12, 8.20	956	146649-5600
No13, 15.0	957	146649-5700



EFMB696B

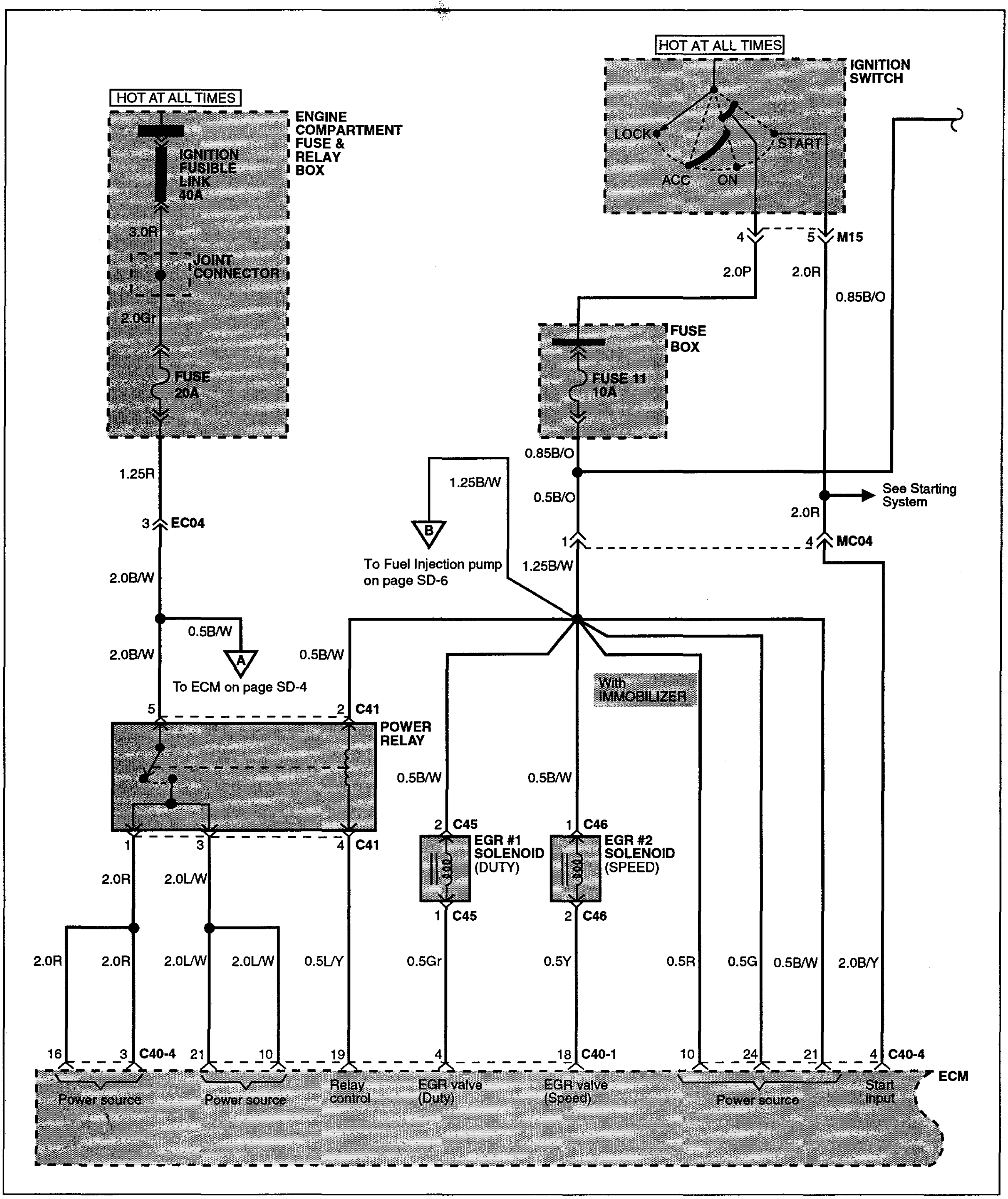
2. Measure the compensation resistance, referring to the above table.
   Resistance tolerance : ± 5%



EFMB696C

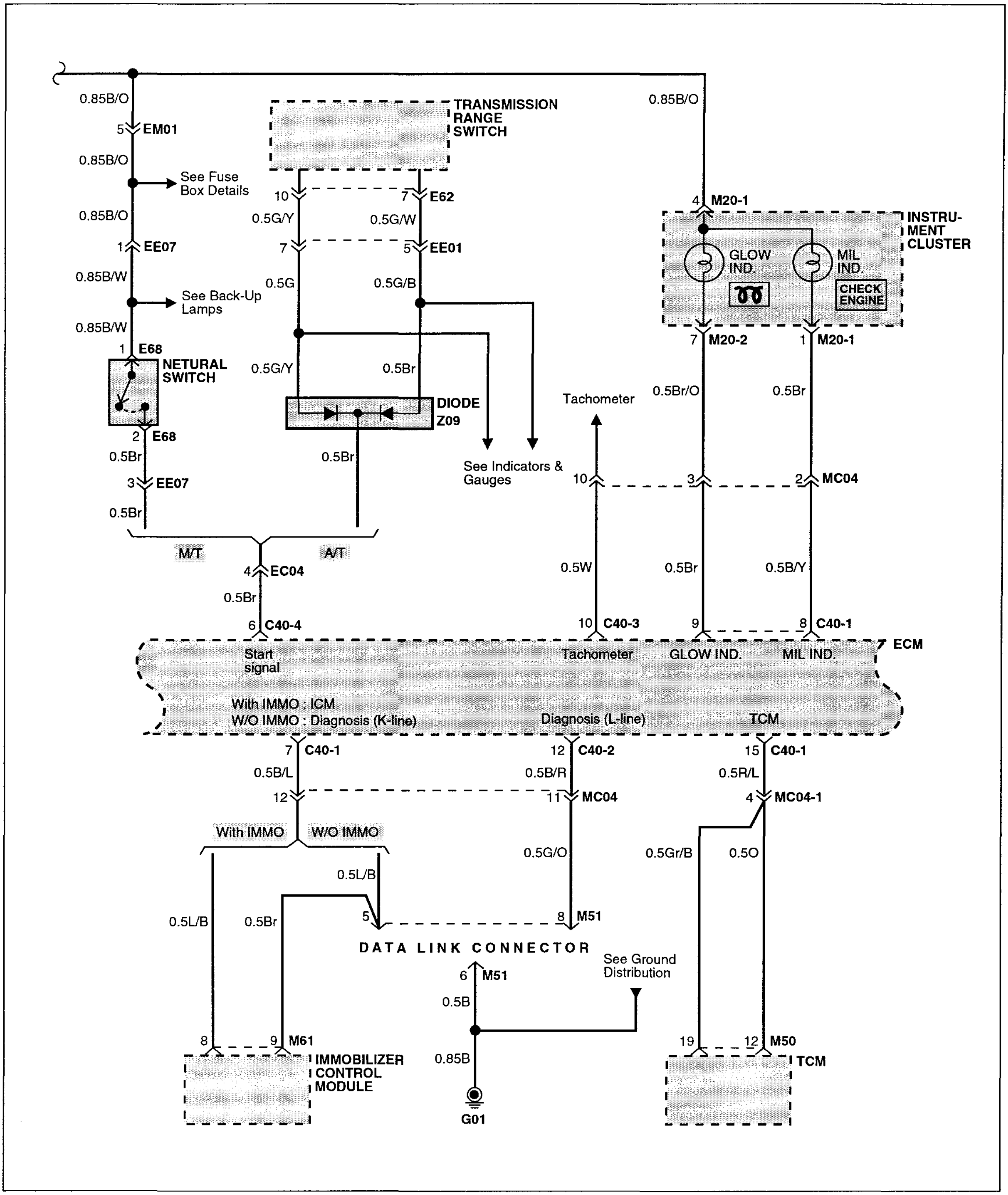
SCHEMATIC DIAGRAM EFMB6970

ENGINE CONTROL SYSTEM (1)



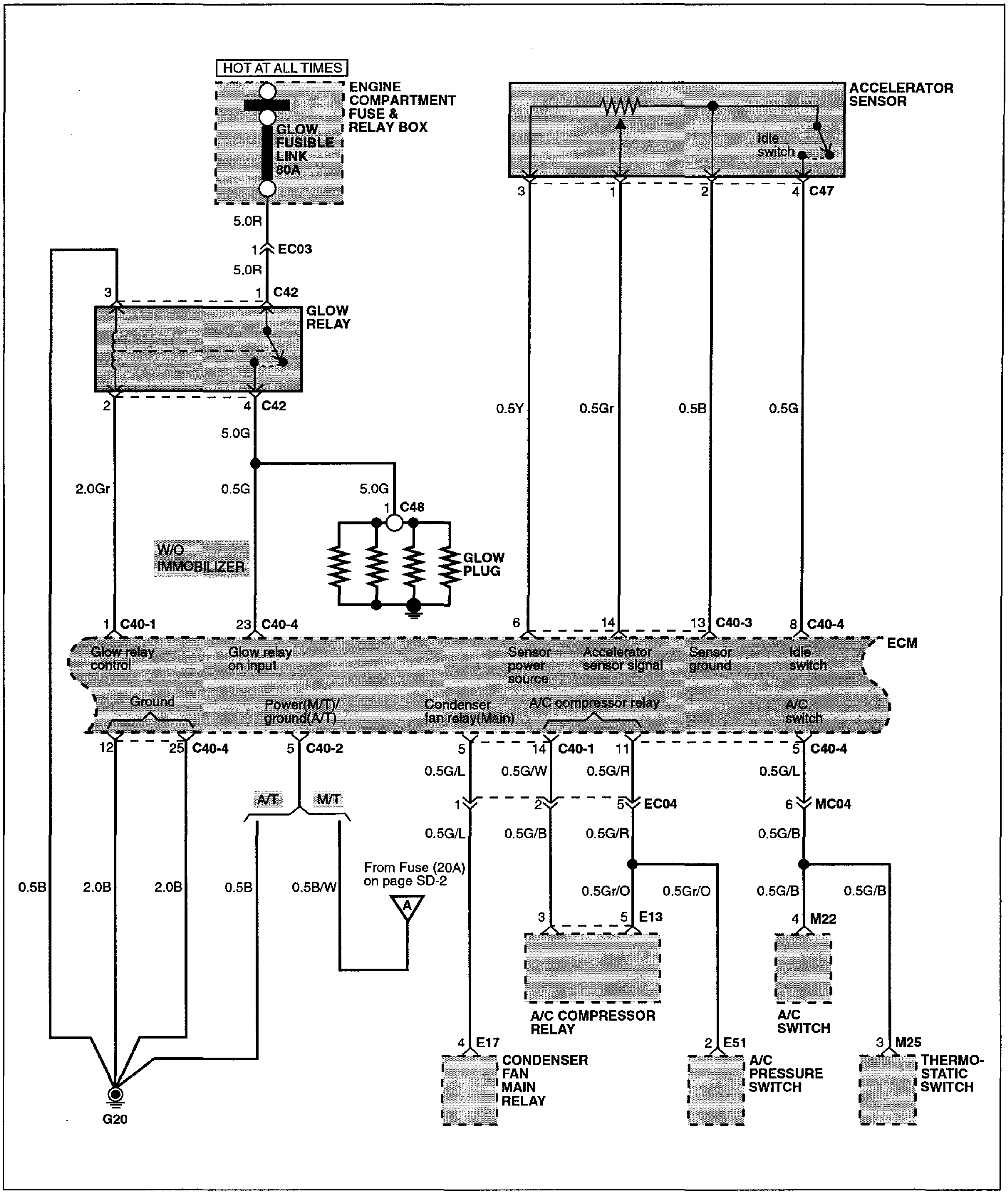
EFMB697A

ENGINE CONTROL SYSTEM (2)



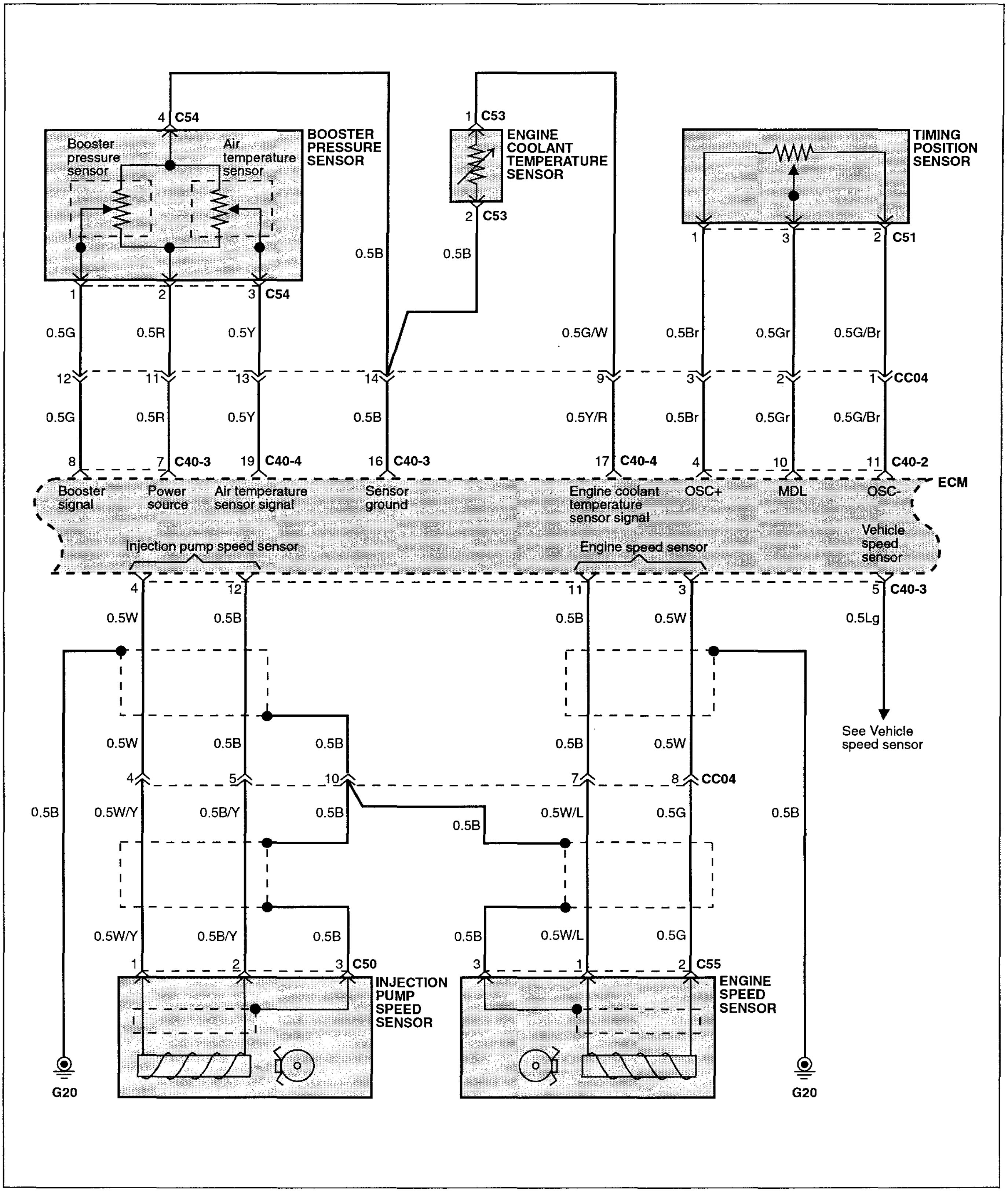
EFMB697B

ENGINE CONTROL SYSTEM (3)



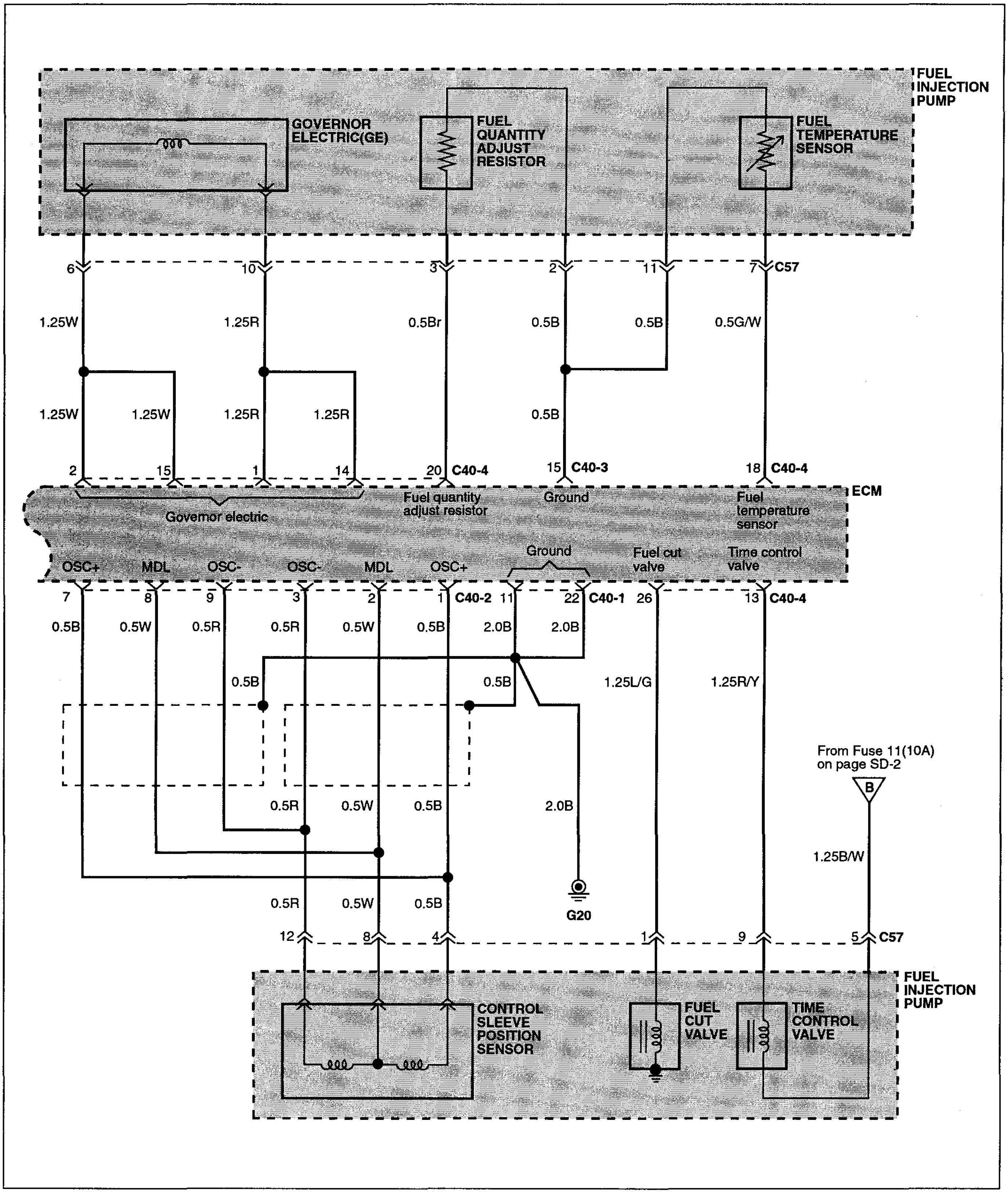
EFMB697C

ENGINE CONTROL SYSTEM (4)



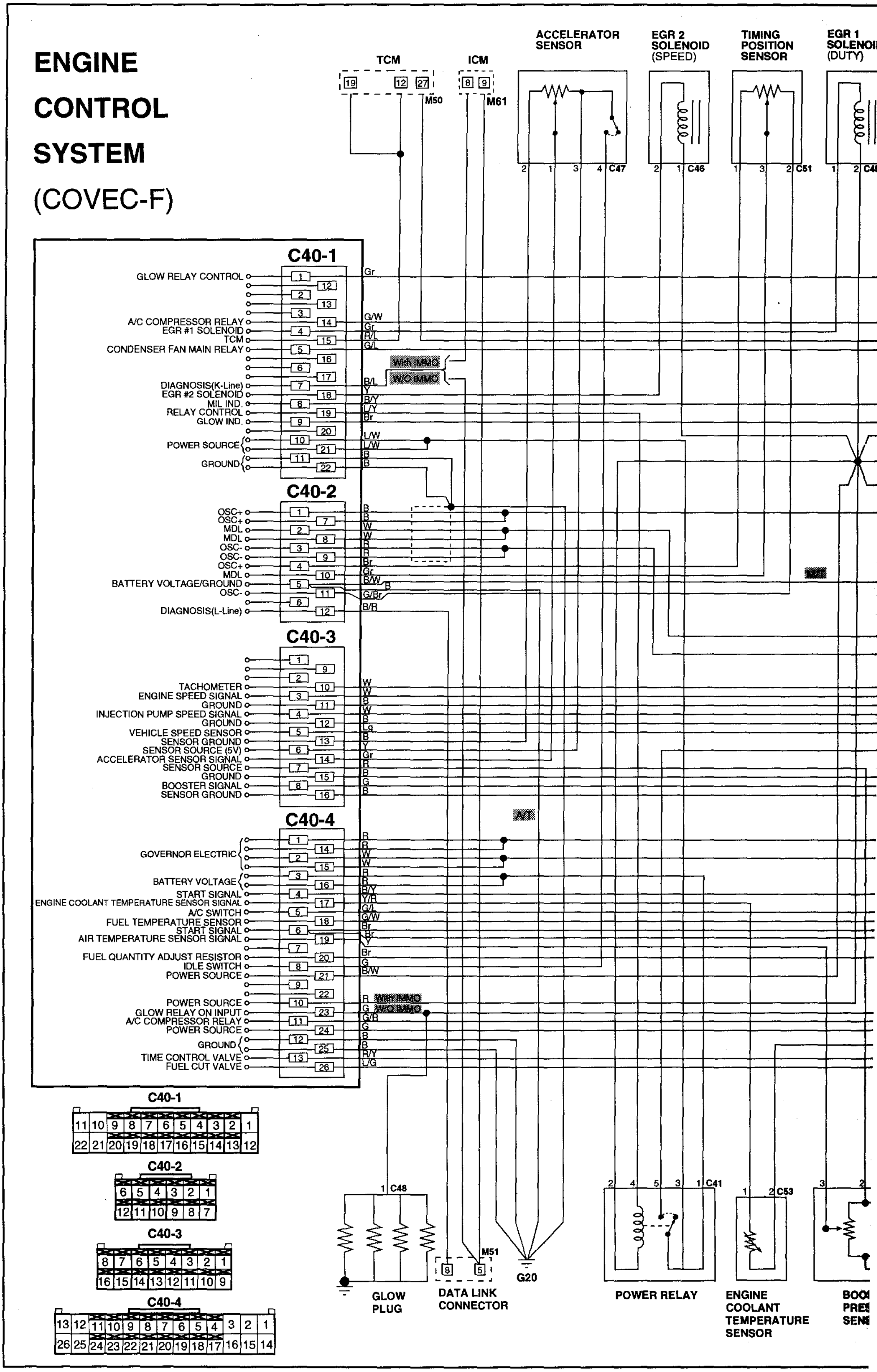
EFMB697D

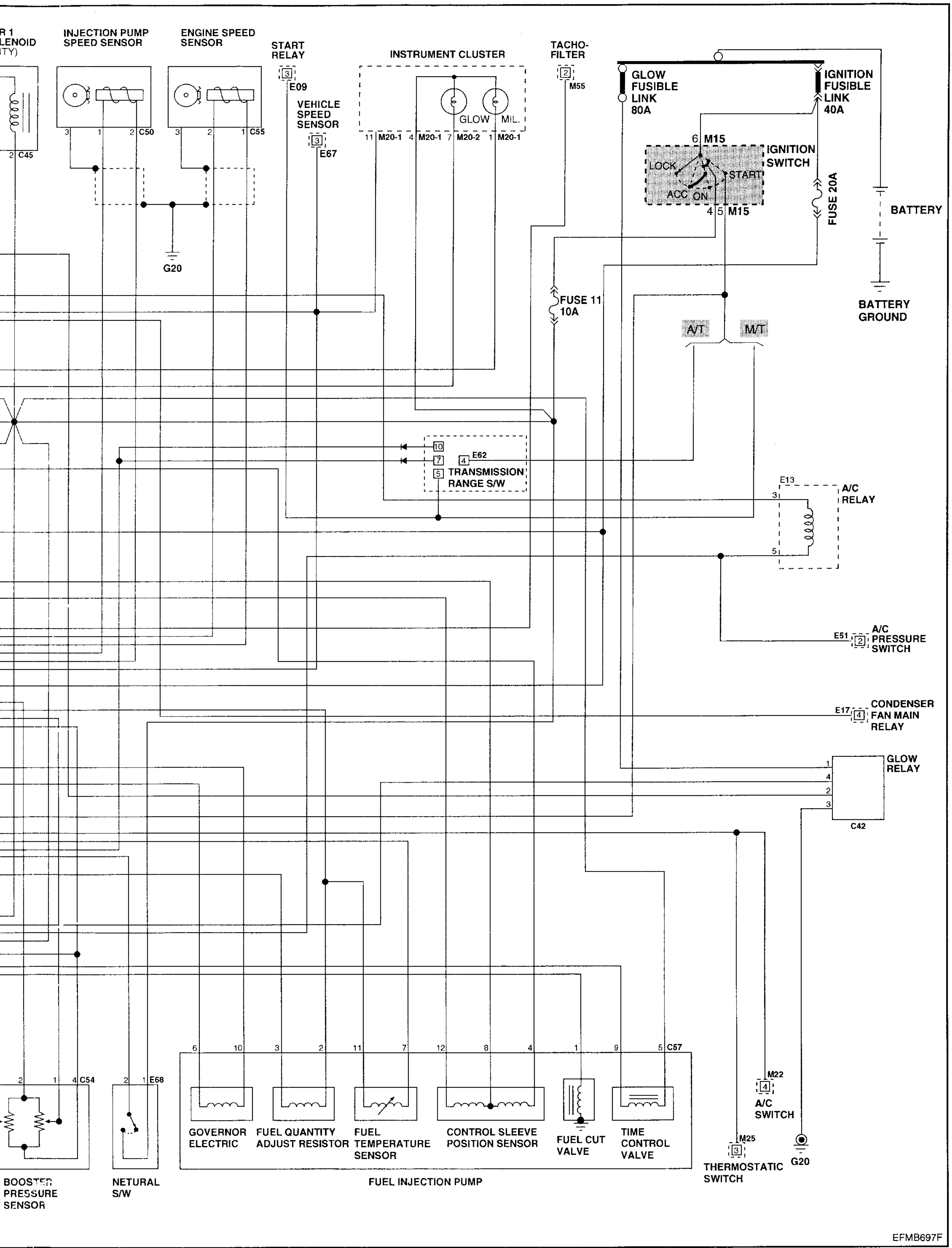
ENGINE CONTROL SYSTEM (5)



EFMB697E

ENGINE CONTROL SYSTEM (COVEC-F)




INJECTION PUMP SPEED SENSOR
ENGINE SPEED SENSOR
START RELAY
INSTRUMENT CLUSTER
TACHO-FILTER
GLOW FUSIBLE LINK 80A
IGNITION FUSIBLE LINK 40A
VEHICLE SPEED SENSOR
GLOW
MIL.
IGNITION SWITCH
LOCK
ACC
ON
START
FUSE 20A
BATTERY
BATTERY GROUND
G20
FUSE 11 10A
A/T
M/T
TRANSMISSION RANGE S/W
A/C RELAY
A/C PRESSURE SWITCH
CONDENSER FAN MAIN RELAY
GLOW RELAY
GOVERNOR ELECTRIC
FUEL QUANTITY ADJUST RESISTOR
FUEL TEMPERATURE SENSOR
CONTROL SLEEVE POSITION SENSOR
FUEL CUT VALVE
TIME CONTROL VALVE
FUEL INJECTION PUMP
A/C SWITCH
THERMOSTATIC SWITCH
BOOSTER PRESSURE SENSOR
NETURAL S/W
EFMB697F

Fuel System [Gasoline 3.5]

GENERAL

SPECIFICATION EFMB0010

Fuel tank Capacity	 75 lit.
Fuel filter Type	 High pressure type
Fuel pump Type Driven by	 Electrical, in-tank type Electric motor
Throttle body Throttle position sensor (TP Sensor) Type Output voltage at curb idle Output voltage at WOT Idle speed control (ISC) motor Type Resistance Idle position switch Type	 Variable resistor type 0.3 - 0.9V 4.5 - 5.0V Step motor type 28 - 32Ω at 20°C (68°F) Contact type (Built in TPS)
Input sensor Mass air flow sensor Type Intake air temperature (IAT) sensor Type Resistance Engine coolant temperature (ECT) sensor Type Resistance Heated oxygen sensor (HO2S) Type Vehicle speed sensor Type Camshaft position (CMP) sensor Type Crankshaft position (CKP) sensor Type	 Hot film type Thermistor type 2.33 - 2.97kΩ or 2.5 - 2.7V at 20°C (68°F) 0.31 - 0.43kΩ or 0.6 - 0.8V at 80°C (176°F) Thermistor type 2.4kΩ or 2.5 - 2.7V at 20°C (68°F) 0.3kΩ or 0.5 - 0.7V at 80°C (176°F) Zirconia sensor Hall IC type Hall effect sensor Hall effect sensor
Output actuator Injector Type Number Coil resistance	 Electromagnetic type 6 13 - 16Ω at 20°C (68°F)
Fuel pressure regulator Fuel pressure	 320 - 340kPa (3.26 - 3.47kg/cm², 46 - 49 psi)

SEALANT EFBB0020

Engine coolant temperature sensor	LOCTITE 962T or equivalent

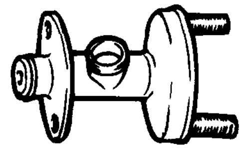
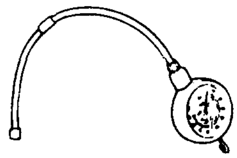
SERVICE STANDARD EFMB0030

Actual ignition timing			BTDC 5° ± 2°
Curb idle speed	N-range	A/CON : OFF	800 ± 100
		A/CON : ON	800 ± 100
	D-range	A/CON : OFF	800 ± 100
		A/CON : ON	800 ± 100

TIGHTENING TORQUE EFBB0040

Item	Nm	Kg.cm	lb.ft
Delivery pipe installation bolt	10 - 13	100 - 130	7 - 9
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	7 - 11	70 - 110	5 - 8
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	22 - 29
Throttle body to surge tank	10 - 13	100 - 130	7.2 - 9
Fuel tank drain plug	15 - 25	150 - 250	11 - 18
Fuel filter mounting bolts	9 - 14	90 - 140	6.5 - 10
Accelerator arm bracket bolts	8 - 12	80 - 120	5.8 - 8.7
ISC motor (stepper motor)	2.5 - 4.5	25 - 45	1.8 - 3.3
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 checking engine trouble, 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

Trouble with the MFI system is often caused by poor contact of the harness connectors. It is important to check all harness connectors and verify that they are securely connected.

TROUBLESHOOTING GUIDE CHART EFDA0070

Main Symptoms / Sub-Symptoms / Check points	STARTING							Poor Idling						Poor Driving	
	Unable to start			Difficult to start											
	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 / Sub-Symptoms / Check points	Engine Stalls				Others			Refueling
	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

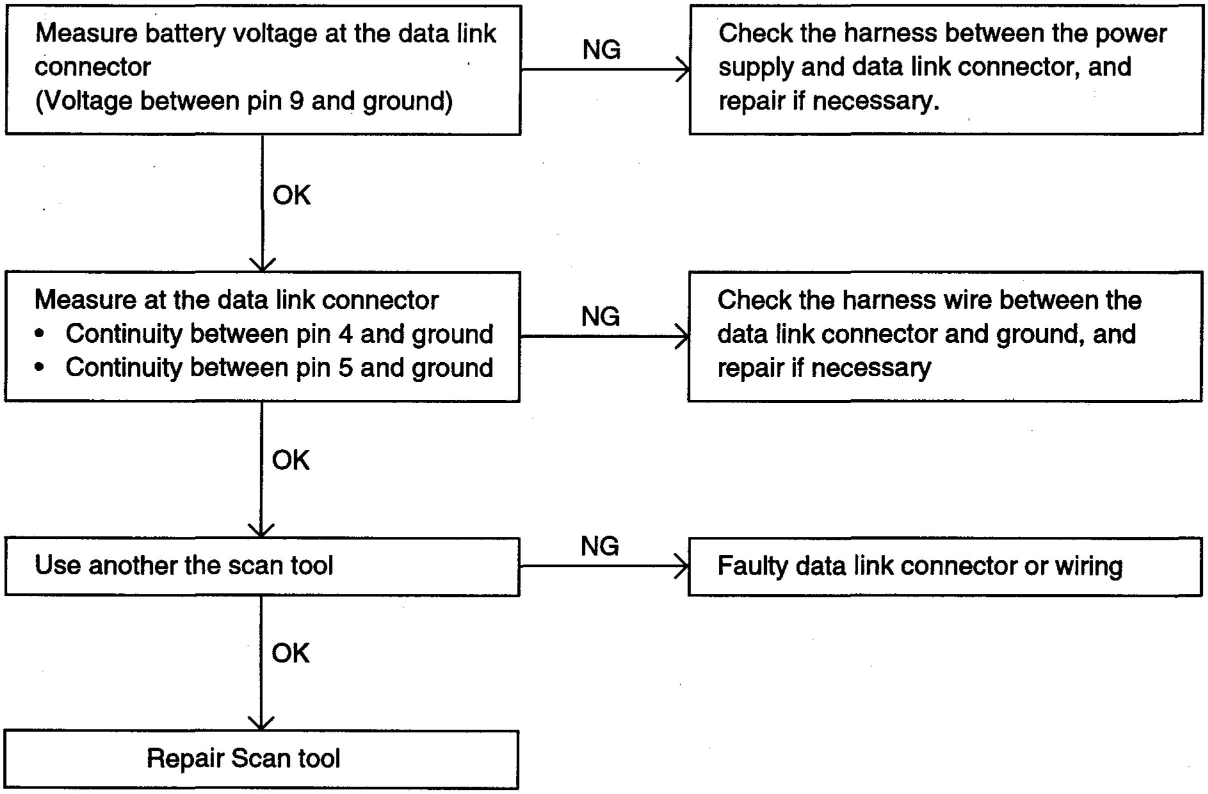
NOTE

The number herein means the check order.

MFI TROUBLESHOOTING PROCEDURES EFA90080

PROBLEM

Communication with scan tool is not possible.
(Cannot communicate with any system)

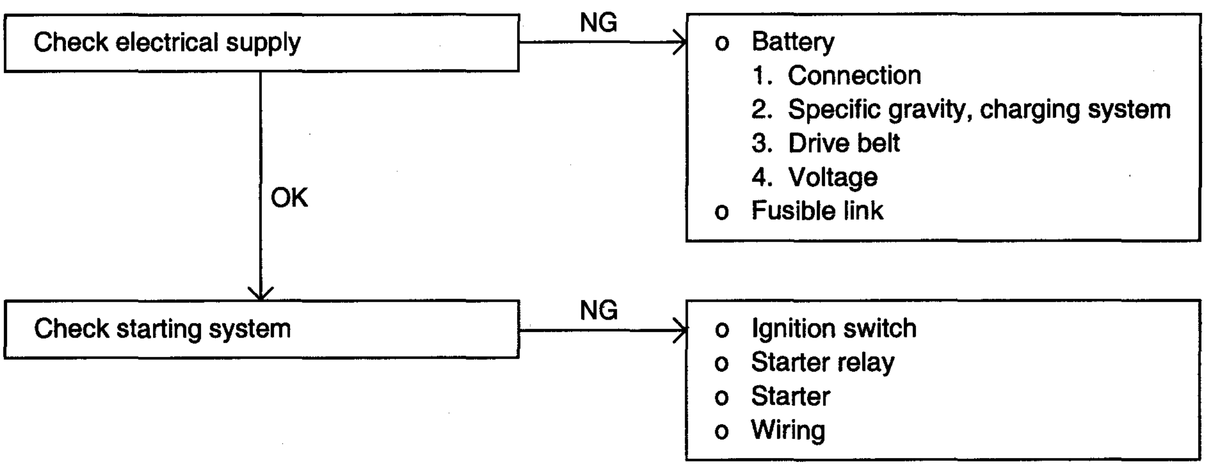


EFA9008A

SCAN TOOL COMMUNICATION WITH PCM IS NOT POSSIBLE EFA90090

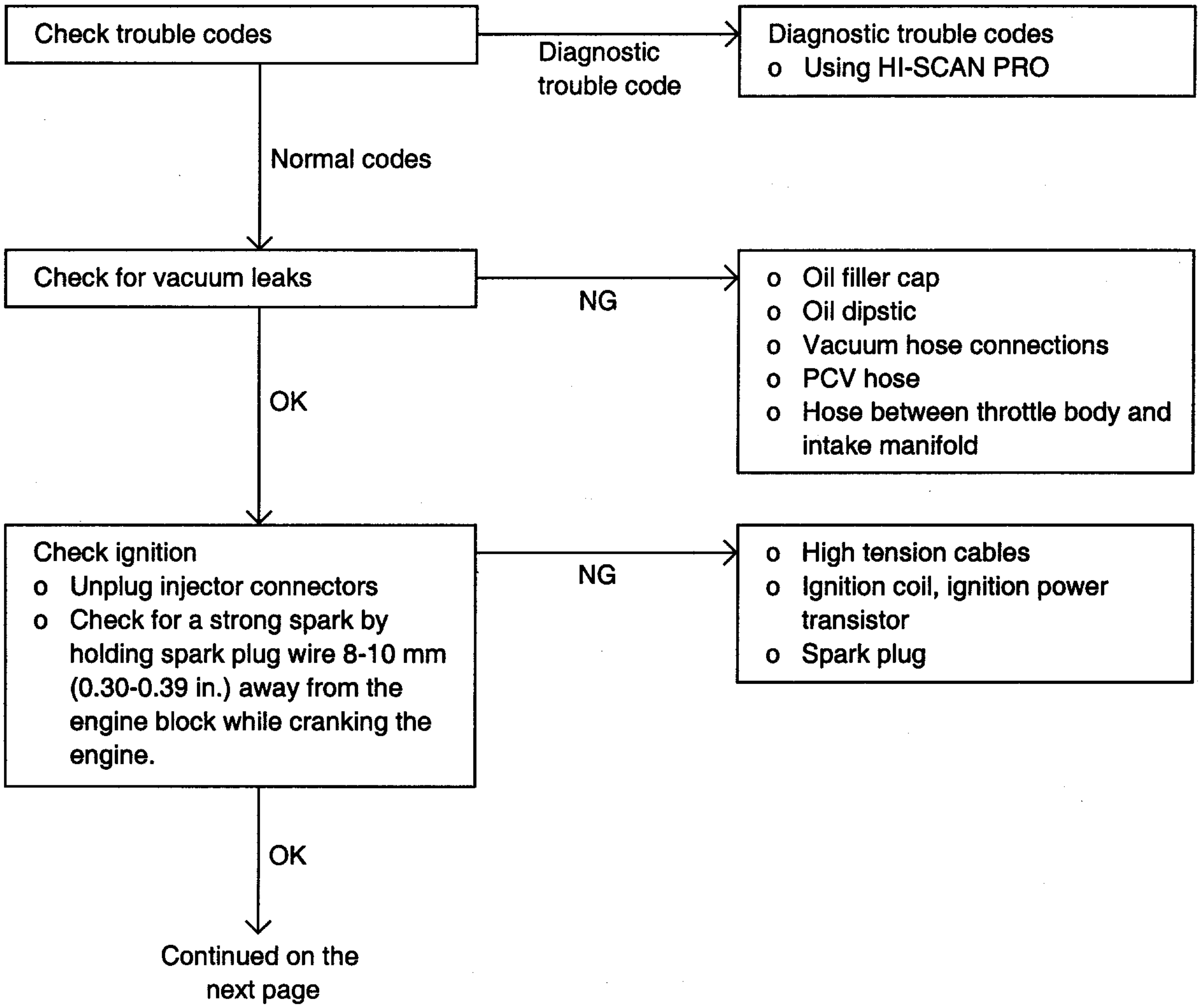
Comment	Probable cause
One of the following causes may be suspected • No power supply to PCM • Defective ground circuit of PCM • Defective PCM • Improper communication line between PCM and scan tool	• Malfunction of PCM power supply circuit. • Malfunction of the PCM. • Open circuit between PCM and DLC.

ENGINE WILL NOT START EFA90100



EFA9010A

DIFFICULT TO START (ENGINE CRANKS) EFMB0110



EFA9011A

Check ignition timing
800 ± 100 : (at N-range, A/C OFF)

→ 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

EFMB011B

ROUGH IDLE OR ENGINE STALLS EFMB0120

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
800 ± 100 : (at N-range, A/C OFF)
- NG → Adjust idle speed
- OK ↓

Check ignition timing :
BTDC 5˚ ± 2˚ (at curb idle)
- 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

EFMB012A

From the previous page

Check fuel pressure → NG →
- o Fuel pump
- o Fuel filter
- o Fuel pressure regulator

OK ↓

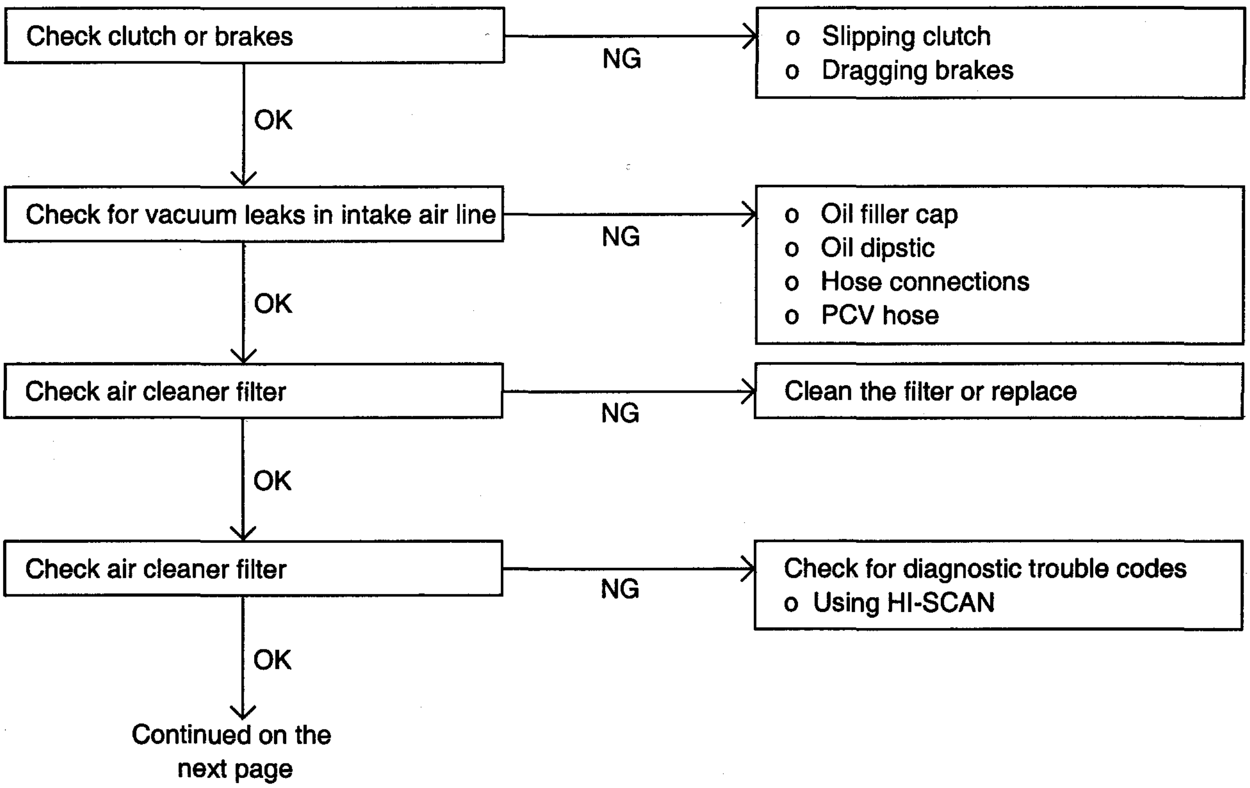
Check injectors → NG → Injector condition

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 EFBB0130



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 5° ± 2° (at curb idle)

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

EFBB013B

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) EFBB0160

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

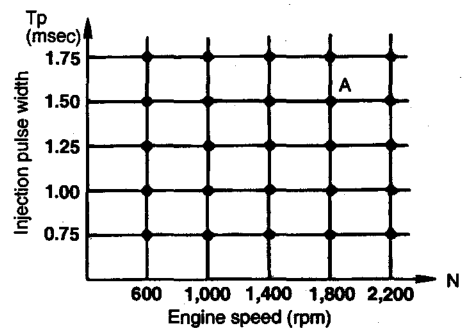
The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions. A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel 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.

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.



EFJB016C

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 ECM 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. Use the 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. Verify that the intermittent malfunction is eliminated.
   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 shortage 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 EFBB0210

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 complete as soon as the vehicle goes into closed-loop operation.

MALFUNCTION INDICATOR LIGHT (MIL)

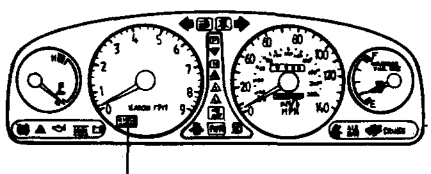
The MIL lights up to notify the driver that there is a problem with the vehicle.

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
- Manifold Absolute Pressure (MAP) Sensor
- Idle Switch
- EGR System



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)

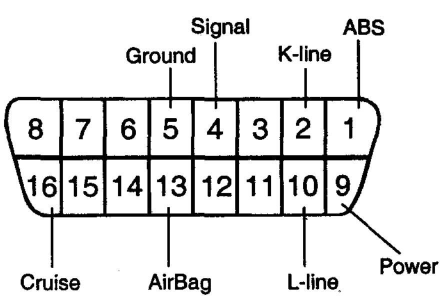
NOTE

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 Hi-Scan Pro to check the diagnostic trouble code.
5. Repair the faulty part from the diagnosis chart.
6. Erase the diagnostic trouble code.
7. Disconnect the Hi-Scan Pro.

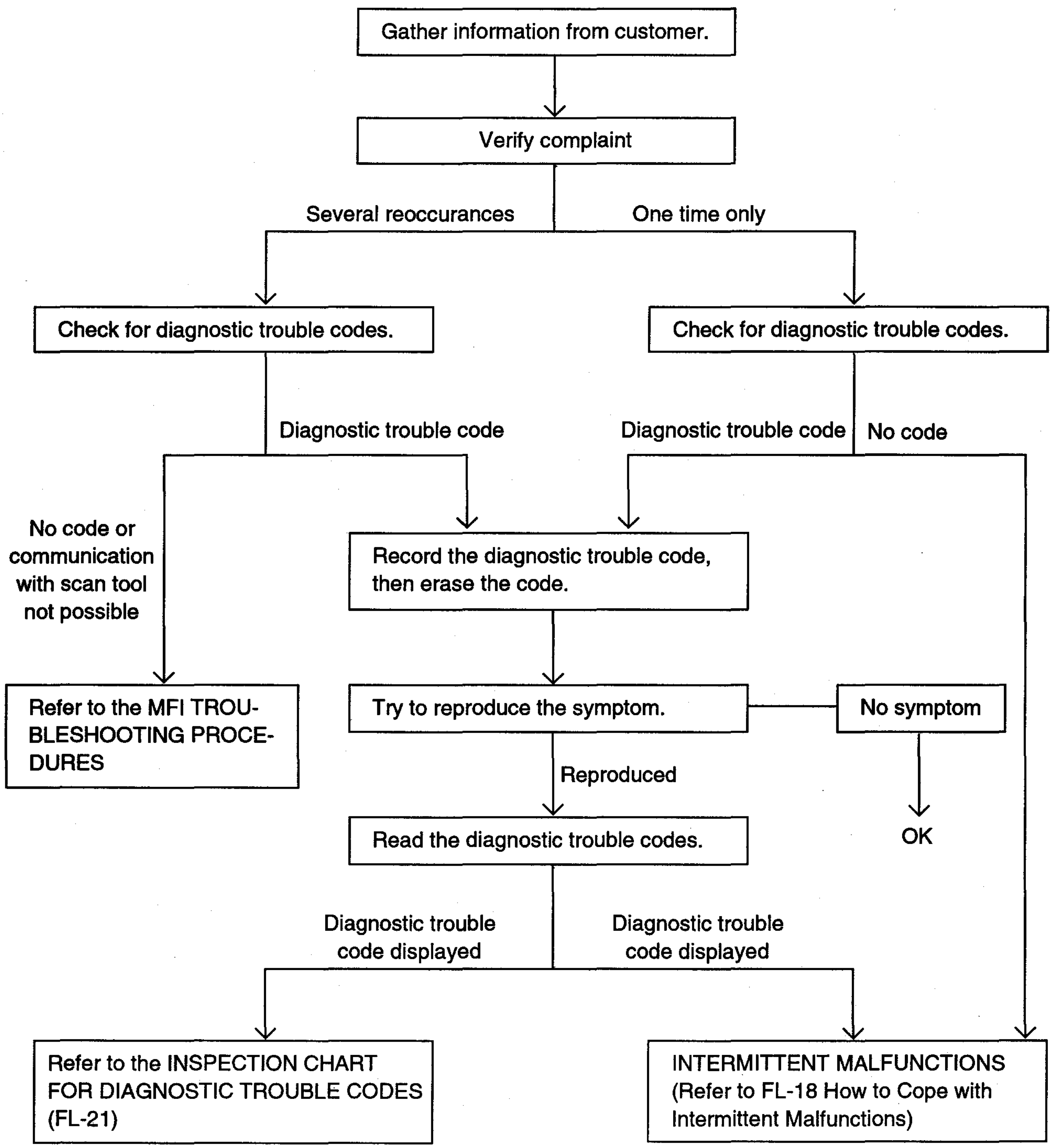


EFHA021B

MFI CONTROL SYSTEM

TROUBLESHOOTING EFMB0220

DIAGNOSTIC TROUBLESHOOTING FLOW



EFMB022A

INSPECTION CHART FOR DIAGNOSTIC TROUBLE CODES EFMB0240

DTC NO.	CONTENT	EOBD	NON-EOBD
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem	O	-
P0100	Mass or Volume Air Flow Sensor Malfunction	-	O
P0102	Mass or Volume Air Flow Circuit Low Voltage	O	-
P0103	Mass or Volume Air Flow Circuit High Voltage	O	-
P0110	Intake Air Temp. Sensor Malfunction	-	Δ
P0112	Intake Air Temp. Circuit Low Voltage	O	-
P0113	Intake Air Temp. Circuit High Voltage	O	-
P0115	Engine Coolant Temp. Circuit Malfunction (open/short)	O	O
P0116	Engine Coolant Temp. Circuit Drift	O	-
P0120	Throttle Position Sensor Malfunction	-	Δ
P0122	Throttle Position Sensor Circuit Low Voltage	O	-
P0123	Throttle Position Sensor Circuit High Voltage	O	-
P0125	Excessive Time to Enter Closed Loop Control (ECT sensor)	O	-
P0130	Oxygen Sensor Malfunction (Bank 1)	-	O
P0132	Oxygen Sensor Circuit Malfunction - Open (Bank 1, Sensor 1)	O	-
P0133	Oxygen Sensor Circuit Malfunction - Response rate (Bank 1, Sensor 1)	O	-
P0134	Oxygen Sensor Circuit Malfunction - No Activity (Bank 1, Sensor 1)	O	-
P0135	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)	O	-
P0136	Oxygen Sensor Circuit Malfunction - Open (Bank 1, Sensor 2)	O	-
P0140	Oxygen Sensor Circuit Malfunction - Short (Bank 1, Sensor 2)	O	-
P0141	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)	O	-
P0150	Oxygen Sensor Circuit Malfunction - Response rate (Bank 2, Sensor 1)	O	O
P0152	Oxygen Sensor Circuit Malfunction - Open (Bank 2, Sensor 1)	O	-
P0154	Oxygen Sensor Circuit Malfunction - No Activity (Bank 2, Sensor 1)	O	-
P0155	Oxygen Sensor Circuit Malfunction - Heater open/short (Bank 2, Sensor 1)	O	-
P0156	Oxygen Sensor Circuit Malfunction - Open (Bank 2, Sensor 2)	O	-
P0160	Oxygen Sensor Circuit Malfunction - Short (Bank 2, Sensor 2)	O	-
P0161	Oxygen Sensor Circuit Malfunction - Heater open/short (Bank 2, Sensor 2)	O	-
P0171	Fuel System Too Lean - (Bank 1)	O	-
P0172	Fuel System Too Rich - (Bank 1)	O	-
P0174	Fuel System Too Lean - (Bank 2)	O	-
P0175	Fuel System Too Rich - (Bank 2)	O	-
P0201	Injector Circuit Malfunction (Injector -1)	O	Δ

DTC NO.	CONTENT	EOBD	NON-EOBD
P0202	Injector Circuit Malfunction (Injector -2)	O	Δ
P0203	Injector Circuit Malfunction (Injector -3)	O	Δ
P0204	Injector Circuit Malfunction (Injector -4)	O	Δ
P0205	Injector Circuit Malfunction (Injector -5)	O	Δ
P0206	Injector Circuit Malfunction (Injector -6)	O	Δ
P0300	Random Misfire Detected	O	-
P0301	Misfire Detected (Cylinder -1)	O	-
P0302	Misfire Detected (Cylinder -2)	O	-
P0303	Misfire Detected (Cylinder -3)	O	-
P0304	Misfire Detected (Cylinder -4)	O	-
P0305	Misfire Detected (Cylinder -5)	O	-
P0306	Misfire Detected (Cylinder -6)	O	-
P0325	Knock Sensor Circuit Malfunction	Δ	Δ
P0335	Crankshaft Position Sensor Circuit Malfunction	O	Δ
P0340	Camshaft Position Sensor Circuit Malfunction	O	Δ
P0350	Ignition Coil Malfunction	O	Δ
P0320	Ignition Failure Sensor Malfunction	Δ	-
P0421	Warm-up Catalyst Efficiency Below Threshold - (Bank 1)	O	-
P0431	Warm-up Catalyst Efficiency Below Threshold - (Bank 2)	O	O
P0443	Purge Control Solenoid Valve Malfunction	O	O
P0500	Vehicle Speed Sensor Malfunction	O	Δ
P0506	Idle Speed Control RPM Lower Than Expected	O	-
P0507	Idle Speed Control RPM Higher Than Expected	O	-
P0510	Idle Switch Malfunction	O	-
P1330	Spark Timing Adjust Malfunction	O	Δ

NOTE

"O" means DTC and MIL-ON.
"Δ" means only DTC-ON.
"-" means not applicable.

TROUBLE AREA RELATED TO DTC EFMB0250

NOTE

Check items for each diagnostic items do not list all possible causes.

DTC No.	Diagnostic items	Check items (Remedy)	Memory	MIL*
P0100	Mass Air Flow Circuit Malfunction	• Open or short in mass air flow sensor circuit • Mass air flow sensor • PCM	O	O
P0110	Intake Air Temperature Circuit Malfunction	• Harness and connector • Intake air temperature sensor • Open or short in intake air temp. sensor circuit • Intake air temp. sensor • PCM	O	-
P0115	Engine Coolant Temperature Circuit Malfunction	• Harness and connector • Engine coolant temperature sensor • Open or short in engine coolant temp. sensor circuit • PCM	O	O
P0120	Throttle Position Circuit Malfunction	• Harness and connector • Throttle position sensor • Idle switch • Open or short in throttle position sensor circuit • PCM	O	-
P0130	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 1)	• Harness and connector • Oxygen sensor	O	O
P0136	Oxygen Sensor Circuit Malfunction (Bank 1 Sensor 2)	• Harness and connector • Oxygen sensor (rear)	O	O
P0201	Injector Circuit Malfunction - Cylinder 1	• Harness and connector • Injector	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
P0205	Injector Circuit Malfunction - Cylinder 5		O	O
P0206	Injector Circuit Malfunction - Cylinder 6		O	O
P0220	TPS 2 (Sub) for ETS Malfunction	• Harness and connector • Throttle position sensor • Open or short in TPS circuit • PCM	O	O
P0325	Knock Sensor 1 Circuit Malfunction	• Open or short between knock sensor and PCM • Harness and connector • Knock sensor	O	O

DTC No.	Diagnostic items	Check items (Remedy)	Memory	MIL*
P0335	Crankshaft Position Sensor Circuit Malfunction	• Harness and connector • Open or short in crankshaft position sensor • Crankshaft position sensor • PCM	O	O
P0340	Camshaft Position Sensor Circuit Malfunction	• Harness and connector (If harness and connector are normal replace camshaft position sensor)	O	O
P0350	Ignition Primary/Secondary Circuit Malfunction	• Harness and connector • Bad connection between PCM and spark plugs • Bad ignition system	O	O
P0500	Vehicle Speed Sensor Malfunction	• Harness and connector • Vehicle speed sensor	O	O
P1330	Spark Timing Adjust Signal	• PCM malfunction • Harness and connector	O	O

NOTE

** O : MIL(Malfunction Indication Lamp) lights up.*

Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Heated oxygen sensor (front)	Engine: Warm (Air/fuel mixture is made leaner when decelerating, and is made richer when racing.)	When at 4,000 r/min, engine is suddenly decelerated	200mV or less	P0130	-
		When engine is suddenly raced	600-1,000mV		
	Engine: Warm (The heated oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the PCM.)	Engine is idling	400mV or less ⇔ 600-1,000mV (Changes)		
		2,500 r/min			
Mass air flow sensor *1	• Engine coolant temperature: 80-90°C (176-203°F) • Lights, electric cooling fan and all accessories: OFF • Transaxle: Neutral (A/T: P range)	Engine is idling	0-2V	-	-
		3,000 r/min	2-4V		
		Engine is idling	Voltage increases in respones to racing		

Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is -20°C (-4°F)	-20°C (-4°F)	P0110	-
		When intake air temperature is 0°C (32°F)	0°C (32°F) 3.4-3.6V		
		When intake air temperature is 20°C (68°F)	20°C (68°F) 2.5-2.7V		
		When intake air temperature is 40°C (104°F)	40°C (104°F) 1.7-1.9V		
		When intake air temperature is 80°C (176°F)	80°C (176°F) 0.6-0.8V		
Throttle position sensor	Ignition switch: ON	Set to idle position	300-900mV (6-20%)	P0120	-
		Gradually open	Increases in proportion to throttle opening angle		
		Open fully	4500-5000mV (80-100%)		
Power supply voltage	Ignition switch: ON		Battery positive voltage	-	-
Cranking signal (Ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF	-	-
		Engine: Cranking	ON		
Engine coolant temperature sensor	Ignition switch: ON or with engine running	When engine coolant temperature is -20°C (-4°F)	-20°C (-4°F)	P0115	-
		When engine coolant temperature is 0°C (32°F)	0°C (32°F) 3.4-3.6V		
		When engine coolant temperature is 20°C (68°F)	20°C (68°F) 2.5-2.7V		
		When engine coolant temperature is 40°C (104°F)	40°C (104°F) 1.5-1.7V		
		When engine coolant temperature is 80°C (176°F)	80°C (176°F) 30.5-0.7V		

Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Crankshaft position sensor	• Engine: Cranking • Tachometer: Connected	Compare the rpm of the tachometer with the one of the scan tool.	Identical	P0335	-
	• Engine: Idling • Idle position switch: ON	When engine coolant temperature is -20°C (-4°F)	1300-1500r/min		
		When engine coolant temperature is 0°C (32°F)	1300-1500r/min		
		When engine coolant temperature is 20°C (68°F)	1150-1350r/min		
		When engine coolant temperature is 40°C (104°F)	950-1150r/min		
		When engine coolant temperature is 80°C (176°F)	650-850r/min		
Vehicle speed sensor	Drive at 40 km/h (25 miles/h)		Approx. 40 km/h	P050	-
Idle position switch	Ignition switch: ON Check by operating accelerator pedal repeatedly	Throttle valve: Set to idle position	ON	P0510	-
		Throttle valve: Slightly open	OFF *4		
A/C switch	Engine: Idling (When A/C switch is ON, A/C compressor should be operating.)	A/C switch: OFF	OFF	-	-
		A/C switch: ON	ON		
Park/Neutral position switch <AT>	Ignition switch: ON	P or N	P or N	-	-
		D, 2, L or R	D, 2, L or R		
Injectors *2	Engine: Cranking	When engine coolant temperature is 0°C (32°F) (Injection is carried out for all cylinders simultaneously)	13.8-20.6ms	-	-
		When engine coolant temperature is 20°C (68°F)	34-51ms		
		When engine coolant temperature is 80°C (176°F)	8.8-13.2ms		

Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Injectors *3	• Engine coolant temperature: 80-95°C (176-203°F) • Lights, electric cooling fan and all accessories: OFF • Transaxle: Neutral (A/T : P range)	Engine is idling	2.6-3.8ms		
		2,500 r/min	2.3-3.5ms		
		When engine is suddenly raced	Increases		
Ignition coils and ignition power transistors	• Engine: After having warmed up • Timing light is set. (The timing light is set in order to check actual ignition timing.)	Engine is idling	7-23° BTDC	-	-
		2,500 r/min	27-47° BTDC		
A/C compressor clutch relay	Engine: After having warmed up/Engine is idling	A/C switch: OFF	OFF (Compressor clutch is not operating)	-	-
		A/C switch: ON	ON (Compressor clutch is operating)		
Heated oxygen sensor (rear)	• Transaxle: 2nd gear <M/T> L range <A/T> • Drive with wide open throttle	3,500 r/min	600-1,000mV	P0136	-

NOTE

1. *In a new vehicle [driven approximately 500km (300mile) or less], the mass air flow sensor output voltage is sometimes 10% higher than the standard voltage.*
2. *The injector drive time represents the time when the cranking speed is at 250 r/min or below when the power supply voltage is 11V.*
3. *In a new vehicle [driven approximately 500km (300mile) or less], the injector drive time is sometimes 10% longer than the standard time.*
4. *The idle position switch normally turns off when the voltage of the throttle position sensor is 50-100mV higher than the voltage at the idle position. If the idle position switch turns back on after the throttle position sensor voltage has risen by 100mV and the throttle valve has opened, the idle position switch and the throttle position sensor need to be adjusted.*

ACTUATOR TEST REFERENCE TABLE EFBB0260

Drive contents	Inspection item	Inspection contents		Normal condition	Inspection procedure	Reference page
Injectors	Cut fuel to No.1 injector	Engine: Warm, idle (Cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)		Idle speed drops equally for each injector	Code No. P0201, P0202, P0203, P0204, P0205, P0206,	-
	Cut fuel to No.2 injector					
	Cut fuel to No.3 injector					
	Cut fuel to No.4 injector					
	Cut fuel to No.5 injector					
	Cut fuel to No.6 injector					
Fuel pump	Fuel pump operates and fuel is recirculated.	• Engine: Cranking • Fuel pump: Activated Inspect according to both the above conditions	Pinch the return hose with fingers to feel the pulse of the fuel being recirculated.	Pulse is felt.	-	-
			Listen near the fuel tank for the sound of fuel pump operation.	Sound of operation is heard		
Evaporative emission purge solenoid	Solenoid valve turns from OFF to ON.	Ignition switch: ON		Clicks when solenoid valve is driven.	P0443	-
Radiator fan (Hi) Condenser fan (Hi)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at high speed.	-	-
Radiator fan (Hi) Condenser fan (Low)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at low speed.	-	-

CHECK AT THE POWER-TRAIN CONTROL MODULE (PCM) EFMB0270

TERMINAL VOLTAGE CHECK CHART

1. Connect a needle-nosed wire probe (paper clip etc.) to a voltmeter probe.
2. Insert the needle-nosed wire probe into each of the PCM connector terminals from the wire side, and measure the voltage while referring to the check chart.

NOTE

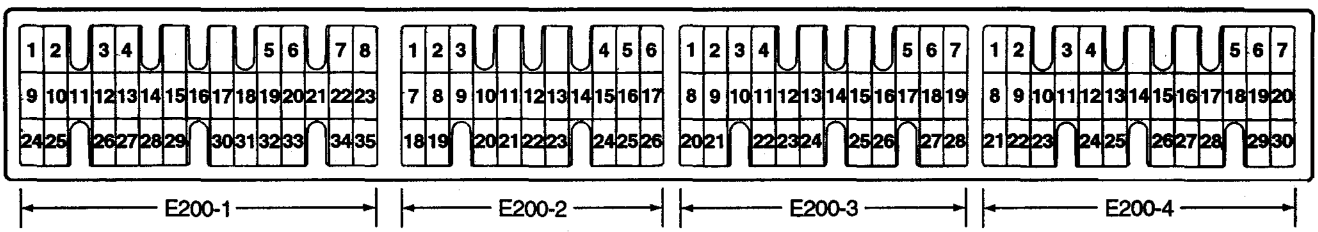
- *Measure voltage with the PCM connectors connected.*
- *You may find it convenient to pull out the PCM to make it easier to reach the connector terminals.*
- *Checks don't have to be carried out in the order given in the chart.*

CAUTION

Short-circuiting the positive(+) probe between a connector terminal and ground could damage the vehicle wiring, the sensor, PCM, or all three. Use care to prevent this!

4. If voltmeter shows any deviation from standard value, check the corresponding sensor, actuator and related electrical wiring, then repair or replace.
5. After repair or replacement, recheck with the voltmeter to confirm that the repair has corrected the problem.

POWER-TRAIN CONTROL MODULE (PCM) CONNECTOR TERMINAL ARRANGEMENT



EFMB027A

Terminal No.	Check item	Check condition (Engine condition)	Normal condition
E200-1 (1)	No. 1 injector	• Engine: Warm, idle • Suddenly depress the accelerator pedal	From 11-14V, momentarily drops slightly
E200-1 (9)	No. 2 injector		
E200-1 (24)	No. 3 injector		
E200-1 (2)	No. 4 injector		
E200-1 (10)	No. 5 injector		
E200-1 (25)	No. 6 injector		
E200-1 (6)	EGR solenoid	Ignition switch: ON	B+
		• Engine: Idle • Suddenly depress the accelerator pedal.	From B+, momentarily drops
E200-1 (20)	Fuel pump relay	Ignition switch: ON	B+
		Engine: Idle	0-0.5V
E200-1 (34)	Evaporative emission purge solenoid	Engine: Warm, 3000 r/min	Low: 0-1V High: B+

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
E200-1 (11)	IG COIL 1/4	Engine: 3000 r/min		Low: 0-0.1V High: 0.5-3V
E200-1 (12)	IG COIL 2/5			
E200-1 (13)	IG COIL 3/6			
E200-2 (1)	Power supply	Ignition switch: ON		B+
E200-2 (7)				
E200-1 (17)	Fan motor relay (High)	Radiator fan is not operating [Engine coolant temperature is 90°C (194°F) or less]		B+
		Radiator fan is not operating at high speed [Engine coolant temperature is 105°C (221°F) or more]		0-1V
E200-1 (18)	Fan motor relay (Low)	Radiator fan is not operating [Engine coolant temperature is 90°C (194°F) or less]		B+
		Radiator fan is not operating at low speed [Engine coolant temperature is 90-105°C (194-221°F) or more]		0-1V
E200-1 (21)	A/C compressor clutch relay	• Engine: Idle • A/C switch: OFF → ON (A/C compressor is operating)		B+ or momentarily 6V or more→ 0-3V as A/C clutch cycles
E200-2 (3)	Engine ignition detect signal	Engine: Idle		Low: 0-0.5V High: 4.5-5V
E200-1 (8)	Generator G terminal	• Engine: Warm, idle (radiator fan: OFF) • Headlight: OFF → ON • Rear defogger switch: OFF → ON • Stop light: OFF → ON		Low: 0-1V High: 2-3V
E200-2 (14)	Generator FR terminal	• Engine: Warm, idle (radiator fan: OFF) • Headlight: OFF → ON • Rear defogger switch: OFF → ON • Stop light: OFF → ON		Voltage falls by 0.2-3.5V
E200-1 (22)	Check engine/ Malfunction indicator lamp	Ignition switch: OFF → ON		0-3V → 9-13V (After several seconds have elapsed)
E200-2 (12)	Power steering pressure switch	Engine: Warm, idle	When steering wheel is stationary	B+
			When steering wheel is turned	0-3V
E200-2 (9)	MFI relay (Power supply)	Ignition switch: OFF		B+
		Ignition switch: ON		0-3V
E200-2 (22)	A/C pressure switch	Engine: Idle	Turn the A/C switch OFF	0-3V
			Turn the A/C switch ON (A/C compressor is operating)	B+
E200-2 (18)	Ignition switch-ST	Engine: Cranking		8V or more

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
E200-2 (24)	Intake air temperature sensor	Ignition switch: ON	When intake air temperature is 0°C (32°F)	3.4-3.6V
			When intake air temperature is 20°C (68°F)	2.5-2.7V
			When intake air temperature is 40°C (104°F)	1.7-1.9V
			When intake air temperature is 80°C (176°F)	0.6-0.8V
E200-3 (3)	Heated oxygen sensor (Rear, Left)	• Transaxle: 2nd <M/T>, L range <A/T> • Driving with the throttle widely open • Engine: 3500 r/min or more		0.6-1.0V
E200-3 (4)	Heated oxygen sensor (Rear, Right)			
E200-3 (1)	Heated oxygen sensor (Front, Left)	Engine: Warm, 2500 r/min (Check using a digital type voltmeter)		0 ⇔ 0.8V (Change repeatedly)
E200-3 (2)	Heated oxygen sensor (Front, Right)			
E200-2 (26)	Backup power supply	Ignition switch: OFF		B+
E200-2 (4)	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C (32°F)	3.4-3.6V
			When engine coolant temperature is 20°C (68°F)	2.5-2.7V
			When engine coolant temperature is 40°C (104°F)	1.5-1.7V
			When engine coolant temperature is 80°C (176°F)	0.5-0.7V
E200-3 (8)	Throttle position sensor	Ignition switch: ON (Check for smooth voltage increase as throttle is moved from idle position to wide open throttle)	Idle	0.3-0.9V
			Wide open throttle valve	4.5-5.0V
E200-3 (10)	Vehicle speed sensor	• Ignition switch: ON • Move the vehicle slowly forward		0 ⇔ 5V (Change repeatedly)
E200-3 (9)	Closed throttle position switch	Ignition switch: ON	Set throttle valve to idle position	0-1V
			Slightly open throttle valve	4V or more
E200-2 (16)	Camshaft position sensor	Engine: Cranking		0.4-3.0V
		Engine: Idle		0.5-2.0V

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
E200-2 (5)	Crankshaft position sensor	Engine: Cranking		0.4-4.0V
		Engine: Idle		1.5-2.5V
E200-2 (15)	Mass air flow sensor	Engine: Idle		0-2V
		Engine: 3000 r/min		2-4V
E200-4 (21)	Park/Neutral position switch <A/T>	Ignition switch: ON	Set selector lever to P or N	0-3V
			Set selector lever to D,2,L or R	8-14V
E200-1 (26)	Heated oxygen sensor heater (Rear, Left)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+
E200-1 (27)	Heated oxygen sensor heater (Rear, Right)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+
E200-1 (3)	Heated oxygen sensor heater (Front, Left)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+
E200-1 (4)	Heated oxygen sensor heater (Front, Right)	Engine: Warm, idle		0-3V
		Engine: 5000 r/min		B+

TERMINAL RESISTANCE AND CONTINUITY CHECK EFMB0280

1. Turn the ignition switch to OFF.
2. Disconnect the PCM connector.
3. Measure the resistance and check for continuity between the terminals of the PCM harness-side connector while referring to the check chart.

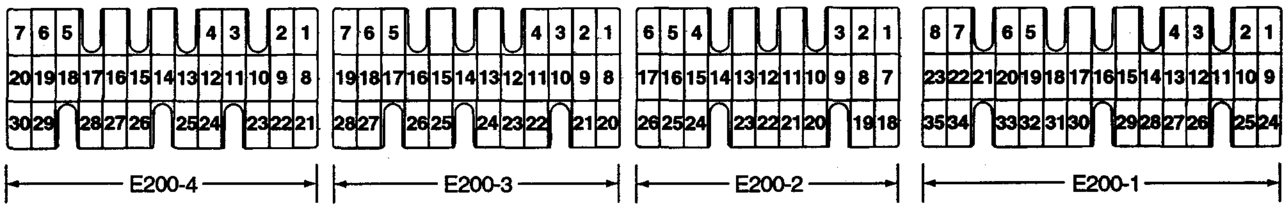
NOTE

- *When measuring resistance and checking continuity, a harness for checking connect pin pressure should be used instead of inserting a test probe.*
- *Checks do not have to be carried out in the order given in this chart.*

CAUTION

If resistance or continuity checks are performed on the wrong terminals, damage to the vehicle wiring, sensors, PCM, and/or ohmmeter may occur. Use care to prevent this!

3. If the ohmmeter shows any deviation from the normal condition, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
4. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.



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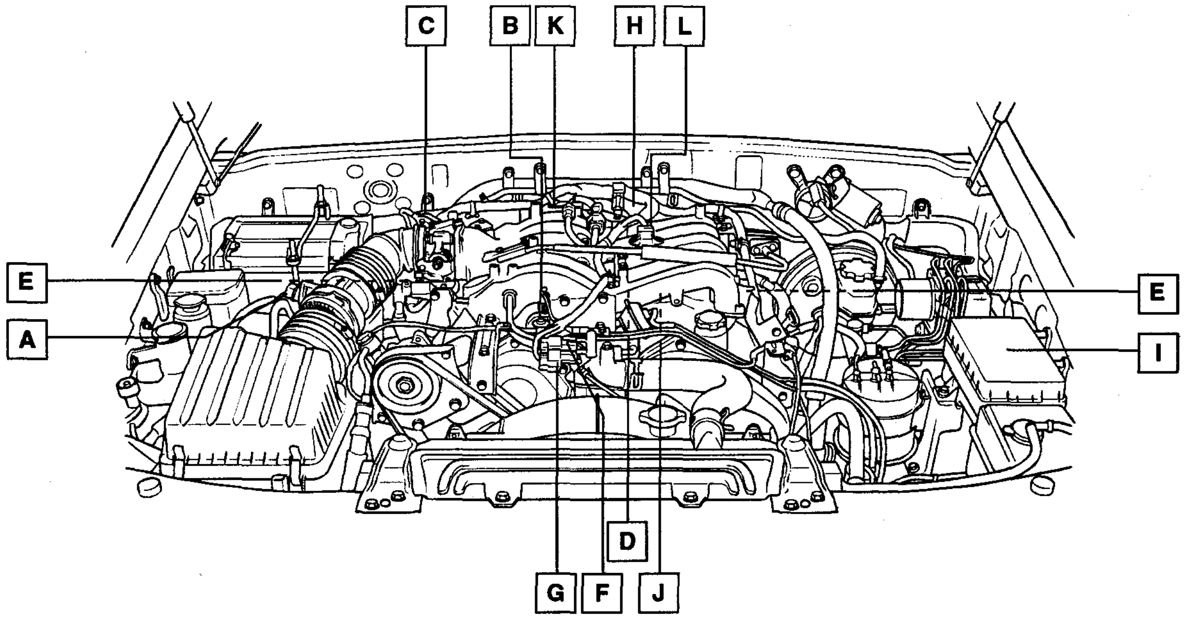
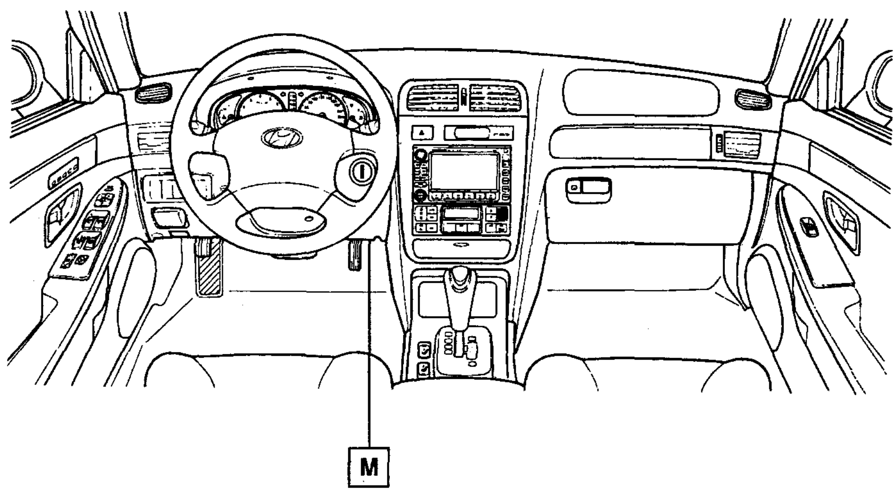
Terminal No.	Inspection item	Normal condition (Check condition)
E200-1 (1) - E200-2 (1)	No.1 injector	13-16Ω [At 20°C (68°F)]
E200-1 (9) - E200-2 (1)	No.2 injector	
E200-1 (24) - E200-2 (1)	No.3 injector	
E200-1 (2) - E200-2 (1)	No.4 injector	
E200-1 (10) - E200-2 (1)	No.5 injector	
E200-1 (25) - E200-2 (1)	No.6 injector	
E200-1 (6) - E200-2 (1)	EGR solenoid	62-74Ω [At 20°C (68°F)]
E200-1 (34) - E200-2 (1)	Evaporative emission purge solenoid	24.5-27.5Ω [At 20°C (68°F)]
E200-2 (2) - Body ground	PCM ground	Continuity (0Ω)
E200-1 (3) - E200-2 (1)	Heated oxygen sensor heater (Front, Left)	7-40Ω [At 20°C (68°F)]
E200-1 (4) - E200-2 (1)	Heated oxygen sensor heater (Front, Right)	
E200-1 (26) - E200-2 (1)	Heated oxygen sensor (Rear, Left)	7-40Ω [At 20°C (68°F)]
E200-1 (27) - E200-2 (1)	Heated oxygen sensor (Rear, Right)	

Terminal No.	Inspection item	Normal condition (Check condition)
E200-2 (24) - E200-2 (17)	Intake air temperature sensor	5.3-6.7Ω [When intake air temperature is 0°C (32°F)]
		2.3-3.0Ω [When intake air temperature is 20°C (68°F)]
		1.0-1.5Ω [When intake air temperature is 40°C (104°F)]
		0.30-0.42Ω [When intake air temperature is 80°C (176°F)]
E200-2 (4) - E200-2 (17)	Engine coolant temperature sensor	5.1-6.5Ω [When coolant temperature is 0°C (32°F)]
		2.1-2.7Ω [When coolant temperature is 20°C (68°F)]
		0.9-1.3Ω [When coolant temperature is 40°C (104°F)]
		0.26-0.36Ω [When coolant temperature is 80°C (176°F)]
E200-3 (9) - E200-2 (17)	Closed throttle position switch	Continuity (When throttle valve is at idle position)
		No continuity (When throttle valve is slightly open)
E200-4 (21) - Body ground	Park/Neutral position switch <A/T>	Continuity (When select lever is at P or N)
		No continuity (When select lever is at D,2,L or R)

COMPONENT INSPECTION EFMB0290

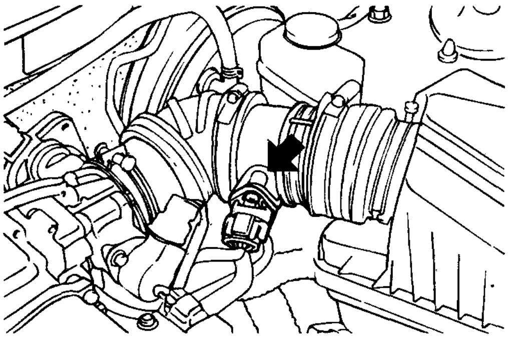
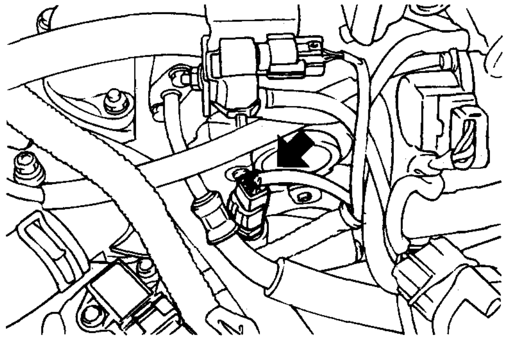
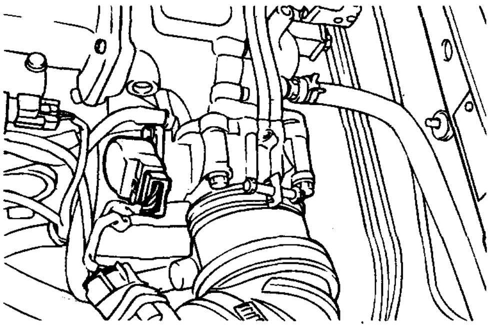
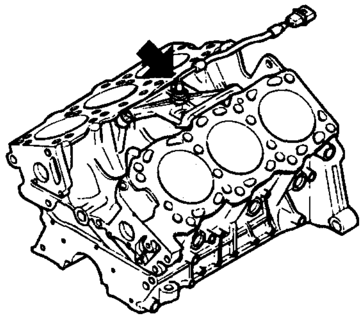
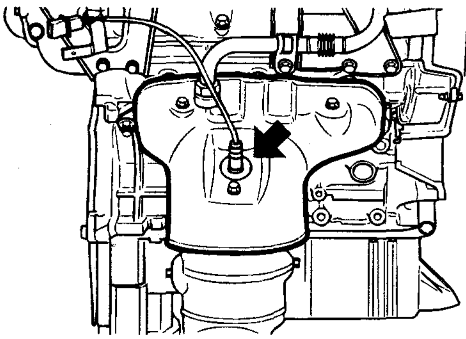
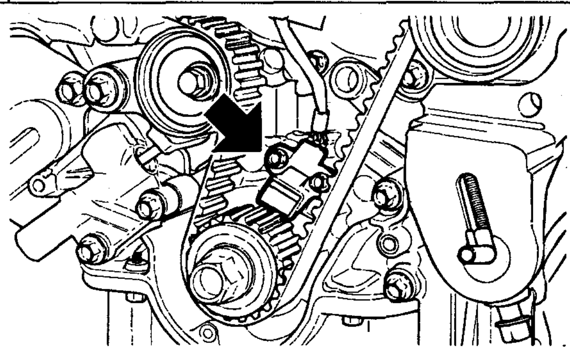
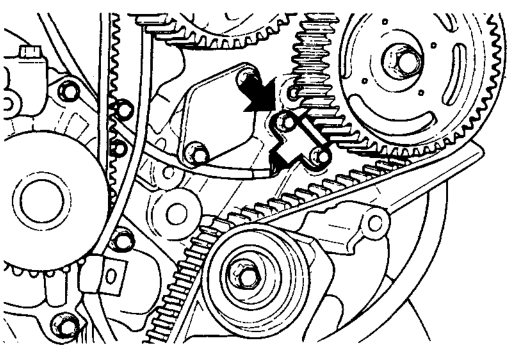
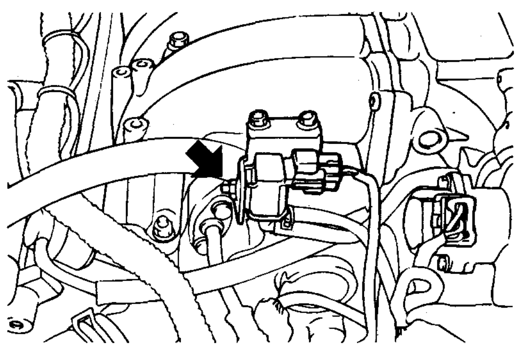
LOCATION OF MFI COMPONENTS

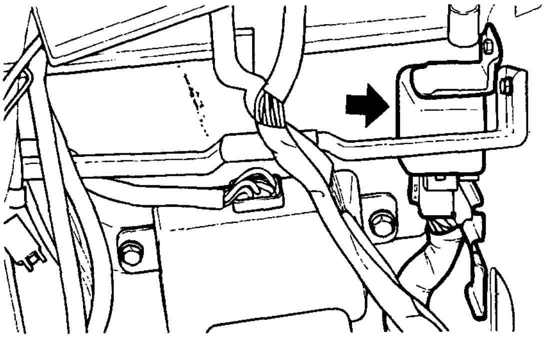
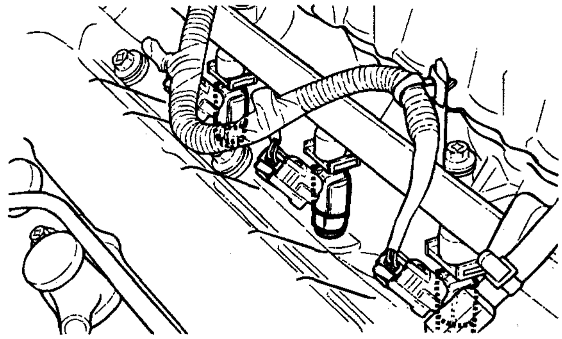
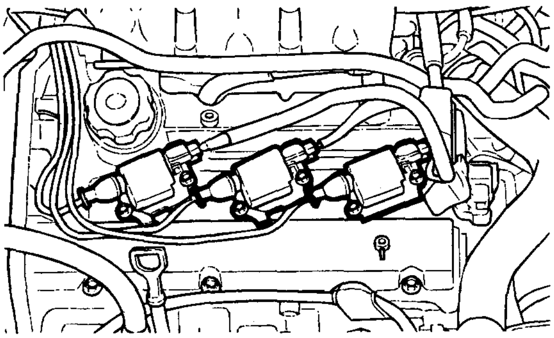
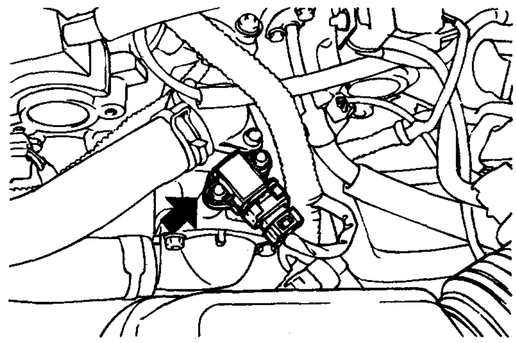
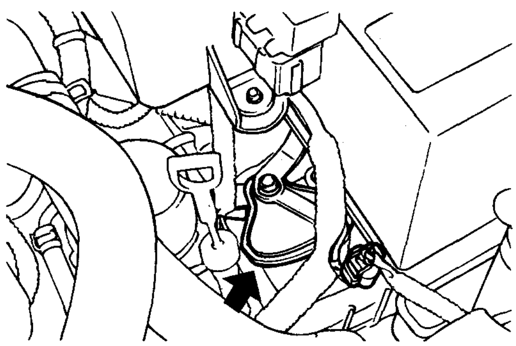




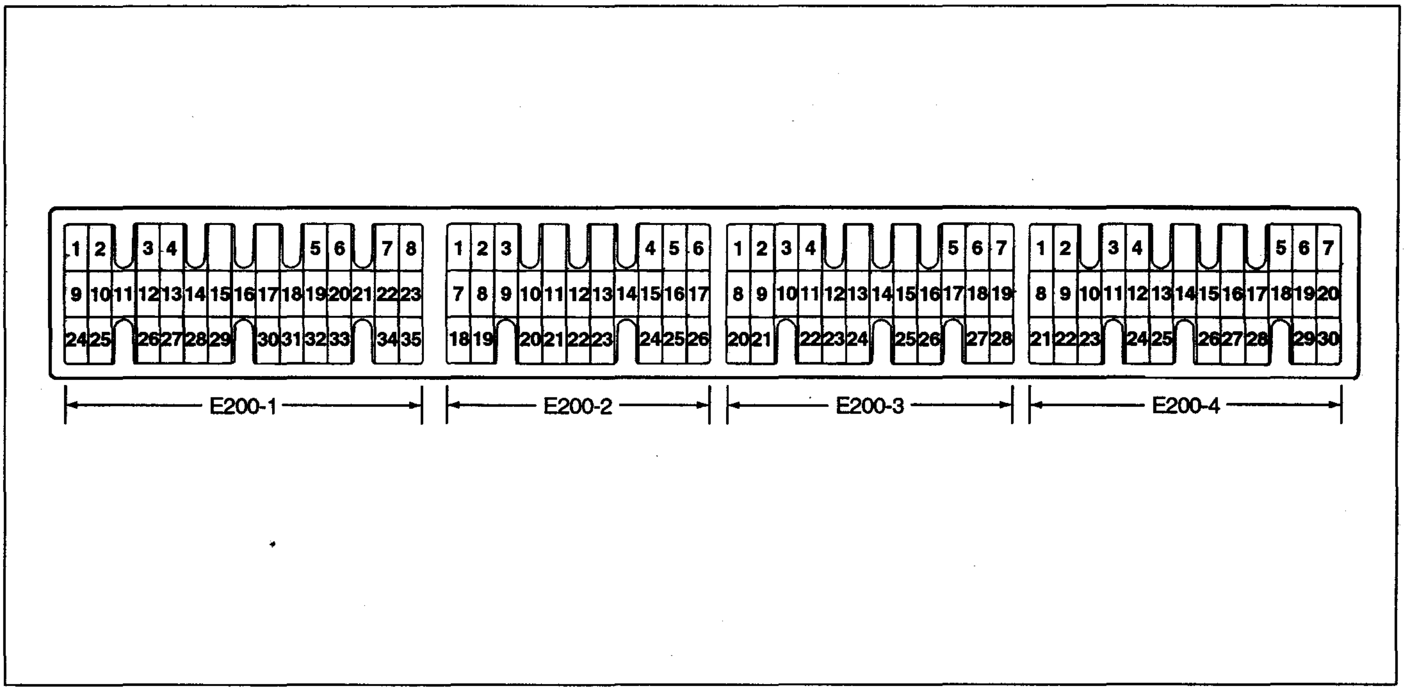
A AFS & IAT-sensor	H PCSV
B Engine coolant temperature sensor	I Control relay
C TPS (including idle switch)	J Injector
D Knock sensor	K Ignition coil
E O2 sensor	L Ignition failure sensor
F Crankshaft position sensor	M DLC connector
G Camshaft position sensor	

EFMB029A

A	AFS & IAT-sensor	B	Engine Coolant temp. sensor
 EFB9009A		 EFB9010A	
C	TPS (Including idle switch) & ETS	D	Knock sensor
 EFMB005A		 KFW5014A	
E	O2 sensor	F	Crankshaft Position Sensor
 KFW3244A		 KFW5202A	
G	Camshaft Position Sensor	H	PCSV
 KFW5203A		 EFB9007A	

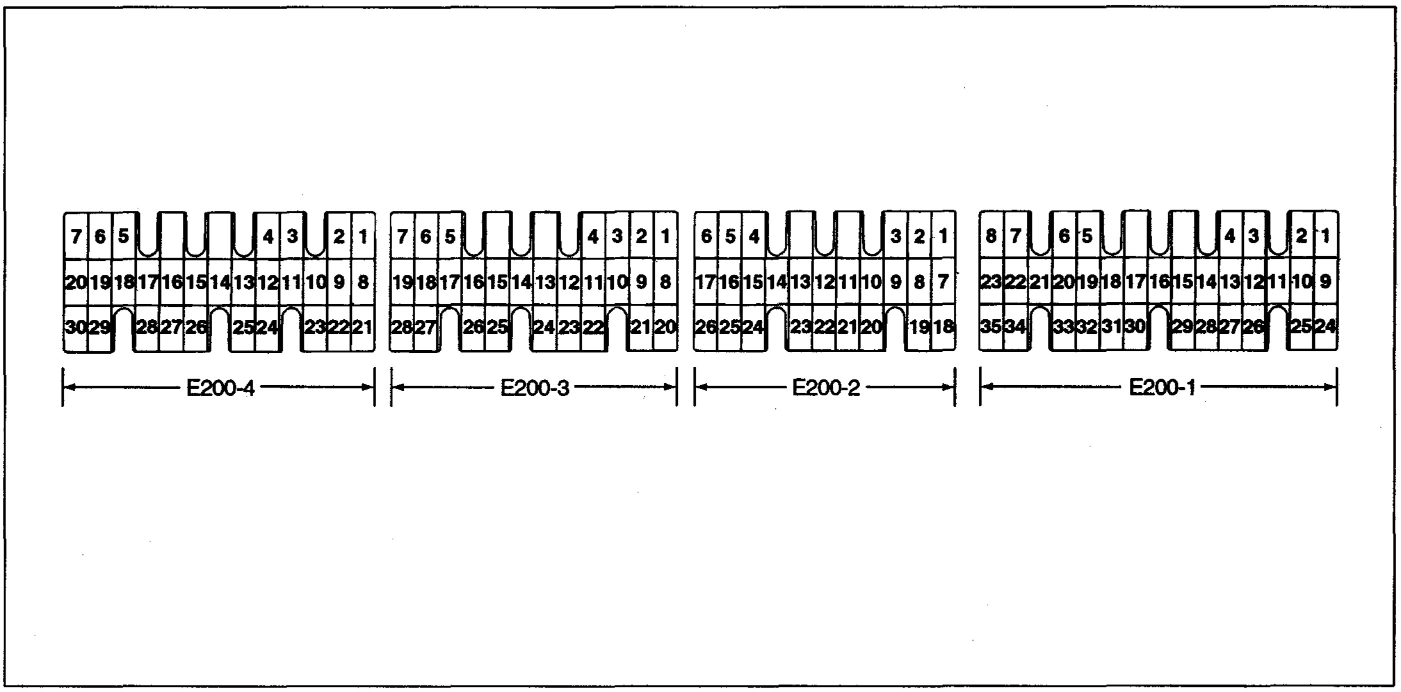
I	Control relay	J	Injector
	 KFW5221A		 KFW5018A
K	Ignition coil	L	Igniting failure sensor
	 KFW5222A		 EFB9006A
M	Inhibitor switch		
	 EFB9008A		

PCM CONFIGURATION



EFMB029C

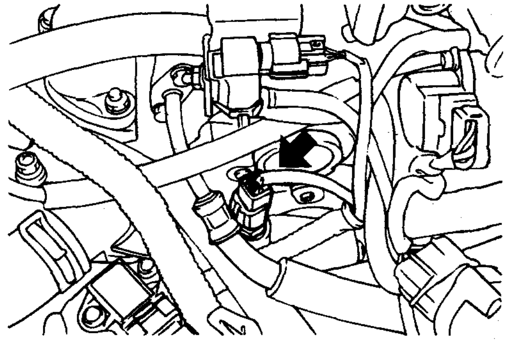
PCM HARNESS CONFIGURATION



EFMB029D

ENGINE COOLANT TEMPERATURE (ECT) SENSOR EFMB1010

The engine coolant temperature sensor installed in the engine coolant passage of the cylinder head detects the engine coolant temperature and emits signals to the PCM. This part employs a thermistor which is sensitive to changes in temperature. The electric resistance of the thermistor decreases in response to a temperature rise (NTC). The PCM determines engine coolant temperature by the sensor output voltage and provides optimum fuel enrichment when the engine is cold.



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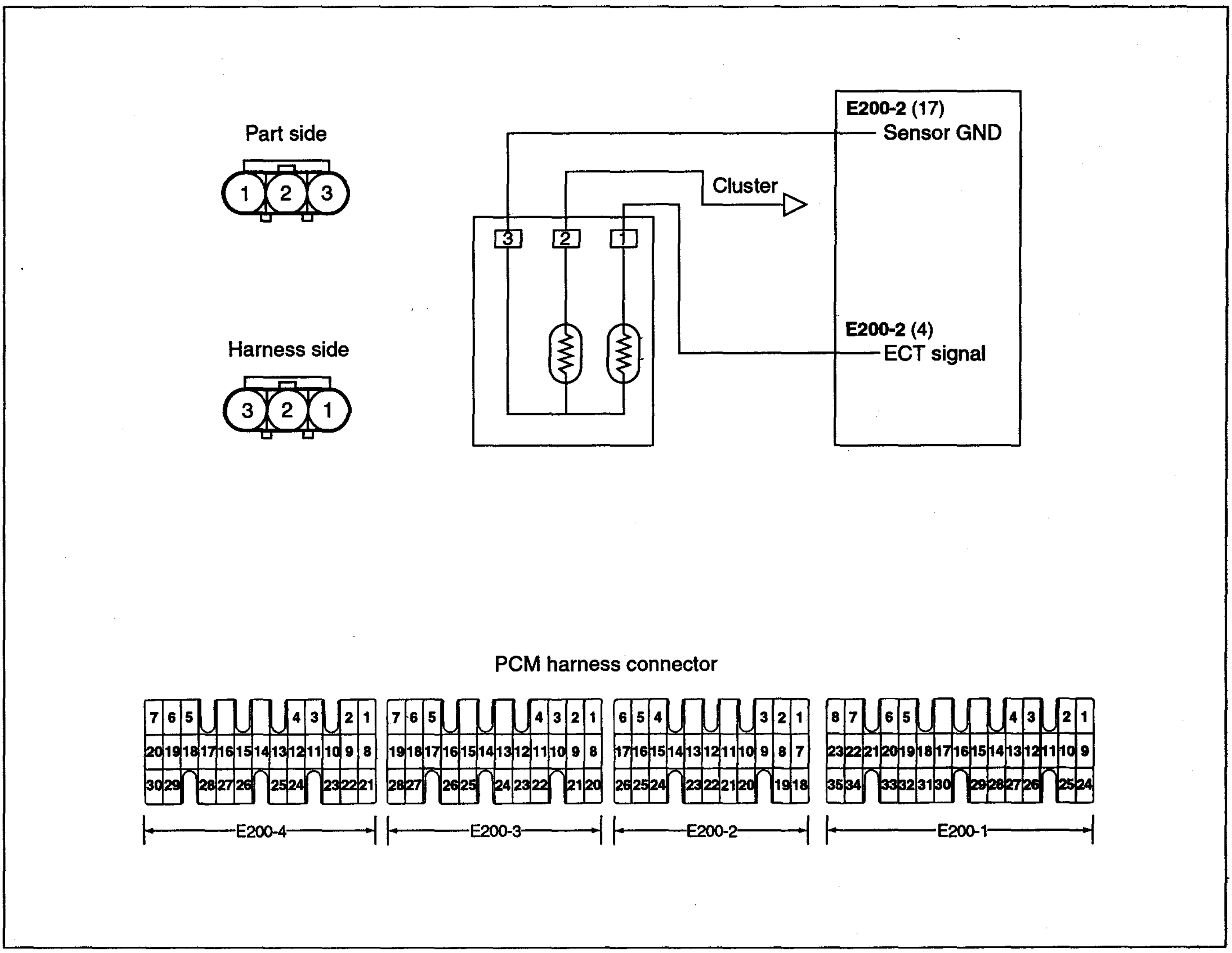
CIRCUIT DIAGRAM



EFMB101A

SENSOR CHECKING

USING HI-SCAN (PRO)

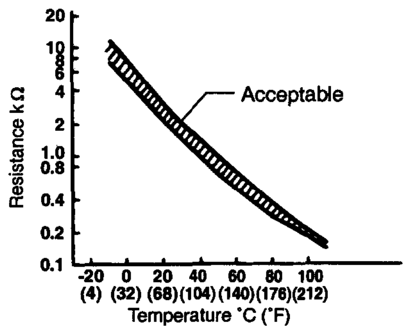
Check item	Data display	Check conditions	Intake air temperature	Test specification
Engine coolant temperature sensor	Sensor temperature	Ignition switch : ON or engine running	When -20°C (-4°F)	-20°C
			When 0°C (32°F)	0°C
			When 20°C (68°F)	20°C
			When 40°C (104°F)	40°C
			When 80°C (176°F)	80°C

USING MULTI-METER

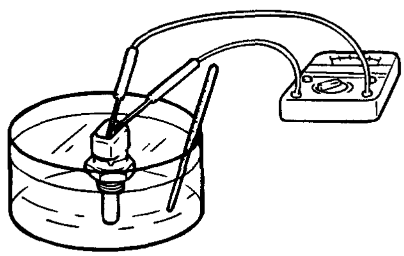
1. Remove the engine coolant temperature sensor from the intake manifold.

2. With the temperature sensing portion of the engine coolant temperature sensor immersed in hot engine coolant, check the resistance.

Temperature [°C (°F)]	Resistance (kΩ)
0 (32)	5.9
20 (68)	2.5
40 (104)	1.1
80 (176)	0.3



EFJB703D

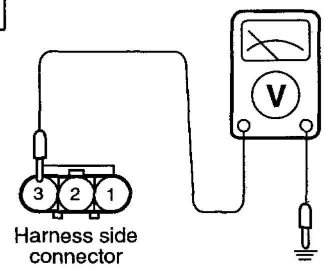


EFA9028A

3. If the resistance deviates from the standard value greatly, replace the sensor.

HARNESS INSPECTION PROCEDURES

1



Check for continuity of the ground circuit.

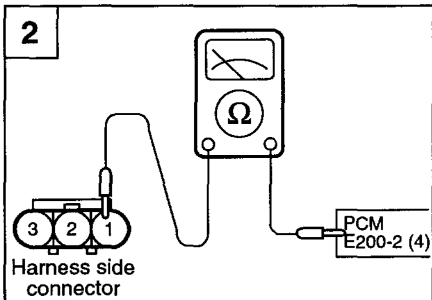
o Connector: Disconnected

OK ⇨ **2**

NG ⇨ Repair the harness.

EFMB101B

2



Measure the power supply voltage.

o Connector: Disconnected

o Ignition switch: ON

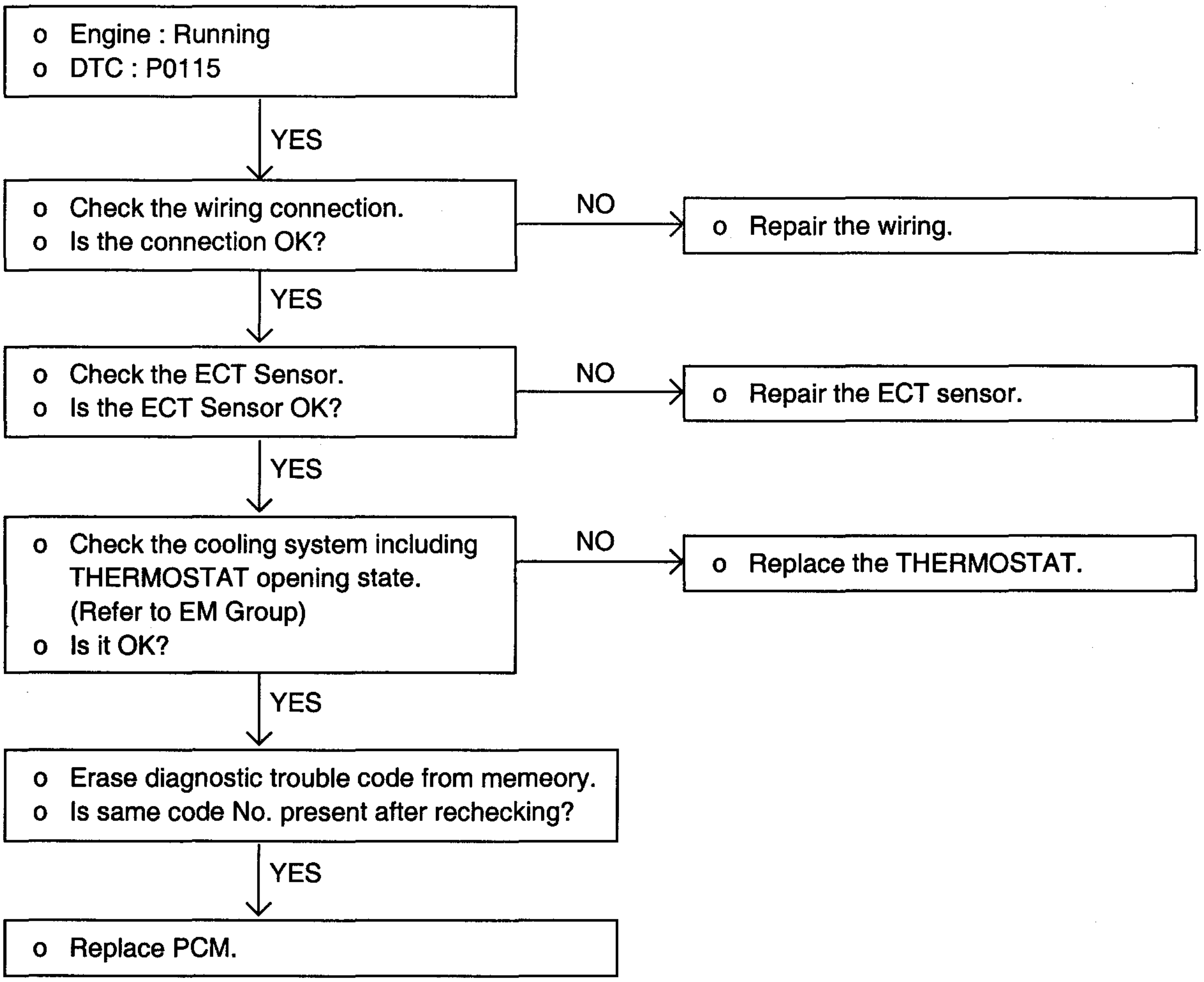
o Voltage (V): 4.5-4.9V

OK ⇨ **END !**

NG ⇨ Repair the harness.

EFMB101C

TROUBLESHOOTING PROCEDURES



DTC : Diagnosis Trouble Code
PCM : Powertrain Control Module
ECT : Engine coolant Temperature

EFA9030A

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

TROUBLEHSOOTING HINTS

If the fast idle speed is not adequate or the engine gives off dark smoke during warm-up, the engine coolant temperature sensor might be the cause.

INSTALLATION

1. Apply sealant LOCTITE 962T or the equivalent to the threaded portion.
2. Install the engine coolant temperature sensor and tighten it to the specified torque.

Tightening torque
Engine coolant temperature sensor :
20-40 Nm (200-400 kg·cm, 14-29 lb·ft)

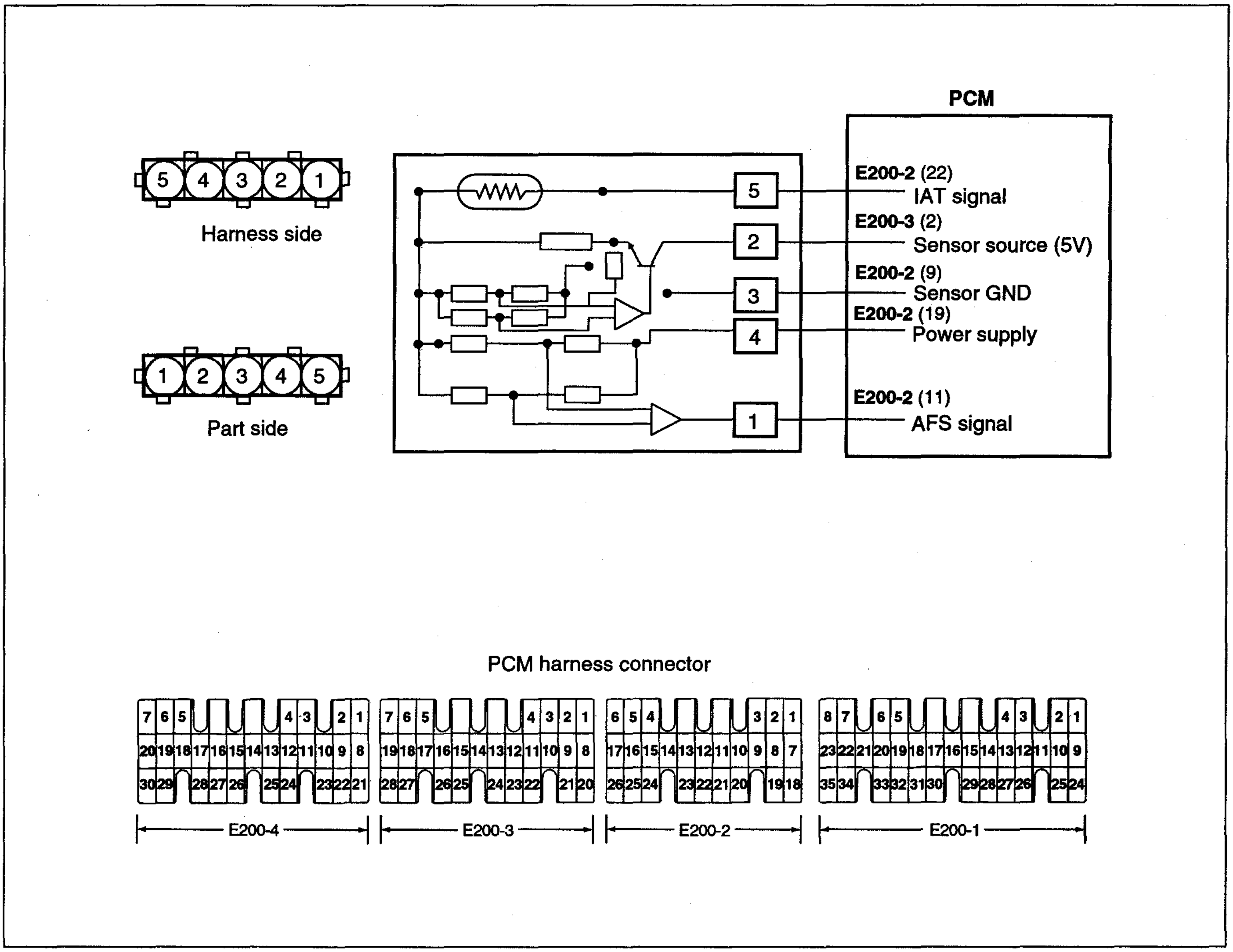
3. Securely connect the harness connector.

MASS AIR FLOW(MAF) SENSOR & INTAKE AIR TEMP.(IAT) SENSOR EFMB1030

This hot film type air flow sensor is composed of a hot film sensor, housing and metering duct (hybrid sensor element). Mass air flow rate is measured because the change of the mass air flow rate causes a 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 powertrain control module.

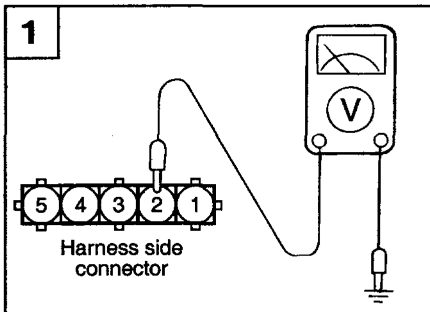
The intake air temperature sensor (IAT Sensor), located in the intake air hose, is a resistor-based sensor for detecting the intake air temperature. The intake air temperature information from the sensor helps the PCM provide the necessary fuel injection.

CIRCUIT DIAGRAM

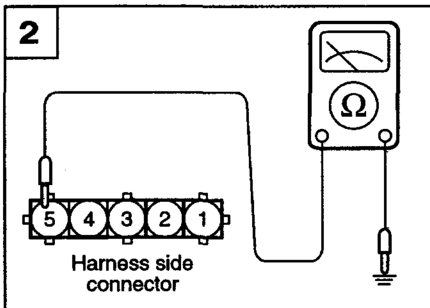


EFMB103A

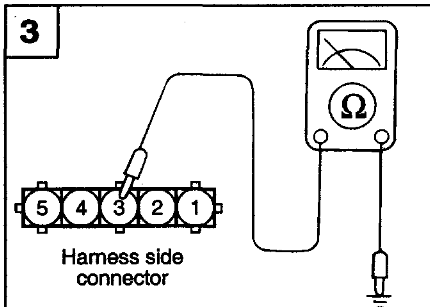
HARNESS INSPECTION PROCEDURES

1		Measure the power supply voltage for the IAT sensor. o Connector: Disconnected. o Ignition switch : ON. o Voltage (V) : 4.8-5.2 V.	OK ⇨	2
			NG ⇨	Repair the harness.

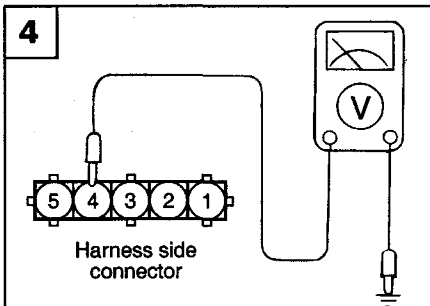
EFJB705B

2		Check for an open circuit, or a short circuit to ground between the powertrain control module and the IAT sensor. o Connector : Disconnected o PCM connector : Disconnected	OK ⇨	3
			NG ⇨	Repair the harness.

EFMB705C

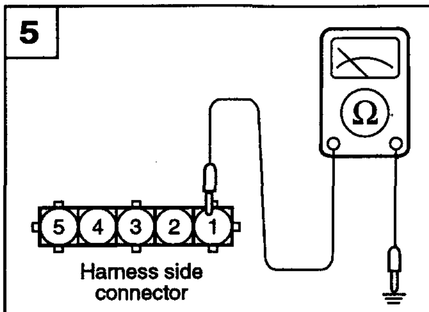
3		Check for continuity of the ground circuit. o Connector : Disconnected.	OK ⇨	4
			NG ⇨	Repair the harness.

EFJB705D

4		Check the power supply(Bat) voltage for MAF sensor. o Connector : Disconnected o PCM connector : Connected o Voltage : Battery voltage	OK ⇨	5
			NG ⇨	Repair the harness.

EFJB705E

5



Check for an open-circuit, or a short-circuit to ground between the PCM and MAF sensor.
- o Connector : Disconnected
- o PCM connector : Disconnected

OK ⇒ **END !**

NG ⇒ Repair the harness.

EFMB705F

TROUBLESHOOTING PROCEDURES

- o Engine : Running

↓ YES

- o Check the wiring harness and connections.
- o Is it normal?

NO → o Repair or replace

↓ YES

- o Check the MAF & IAT sensor output voltage.
- o Is it normal?

NO → o Repair the MAF & IAT sensor.

↓ YES

- o Erase diagnostic trouble codes from memeory.
- o Is same code present after rechecking?

NO → o OK

↓ YES

- o Replace PCM.

DTC : Diagnosis Trouble Code
PCM : Powertrain Control Module

EFJB705G

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 PCM.
3. If the engine can idle even if the MAF sensor output voltage is out of specification, check for the following conditions;
   - Disturbed air flow in the MAF sensor, disconnected air duct, and clogged air cleaner filter.
   - Poor combustion in the cylinder, faulty ignition plug, ignition coil, injector, and incorrect comparison.
4. Even if no AFS malfunction occurs, check the mounting direction of the AFS.

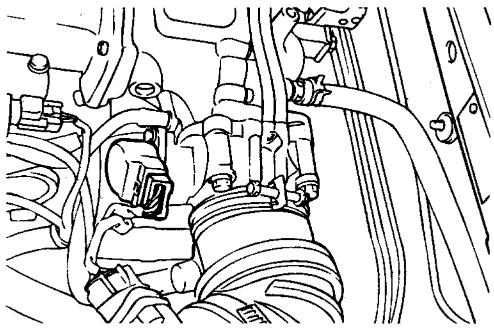
Check item	Check condition	Test specification
Mass air flow sensor output voltage	Idle rpm	0.5V
	2000 rpm	1.0V

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).*

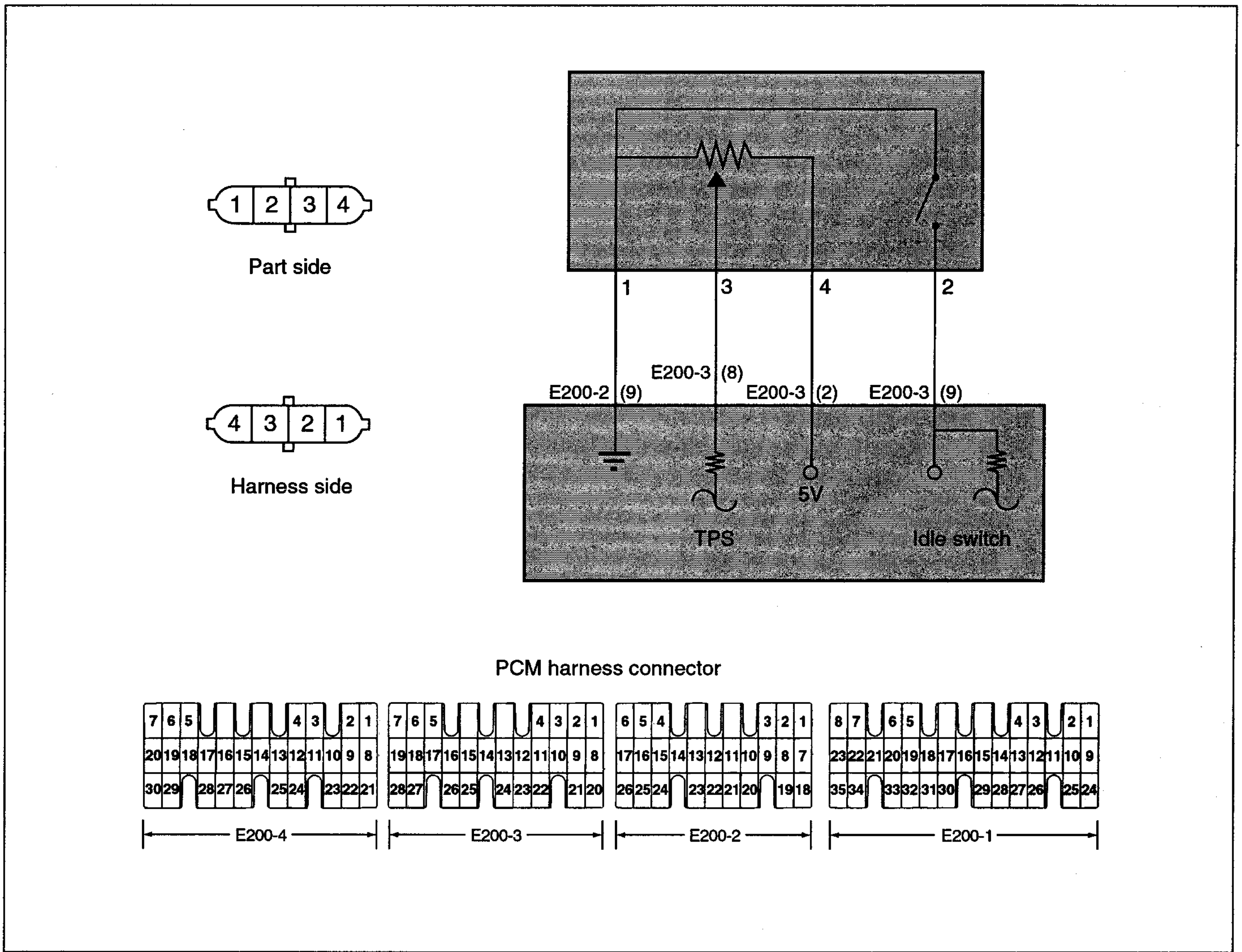
THROTTLE POSITION SENSOR (TPS) EFMB1050

The TPS is a variable resistor type that rotates with the throttle shaft to sense the throttle valve angle. As the throttle shaft rotates, the output voltage of the TPS changes. The PCM detects the throttle valve opening based on this voltage change.



EFMB005A

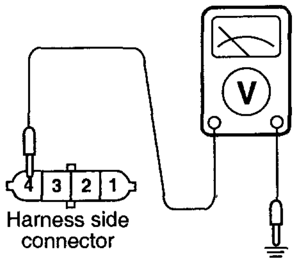
CIRCUIT DIAGRAM



EFMB105A

HARNESS INSPECTION PROCEDURES

1



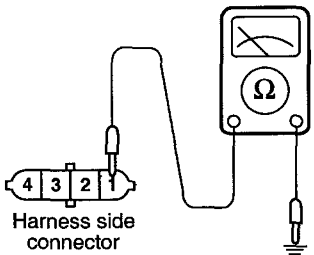
Measure the power supply voltage of the throttle position sensor.
- o Connector : Disconnected
- o Ignition switch : ON
- o Voltage (V) : 4.25 - 4.7

OK ⇨ **2**

NG ⇨ Repair the harness.

EFBB105B

2



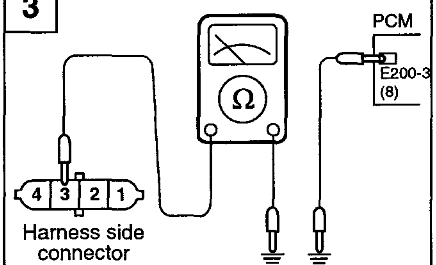
Check for continuity of the ground circuit.
- o Connector : Disconnected

OK ⇨ **3**

NG ⇨ Repair the harness.

EFBB105C

3



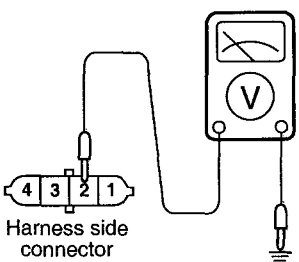
Check for an open-circuit, or a short-circuit to ground between the powertrain control module and the throttle position sensor.
- o Throttle position sensor connector : Disconnected
- o Powertrain Control Module connector : Disconnected

OK ⇨ **4**

NG ⇨ Repair the harness.

EFMB105D

4



Measure the power supply voltage of the TPS.
- o Connector: Disconnected
- o Ignition switch: ON
- o Voltage (V): 4V or more

OK ⇨ **END !**

NG ⇨ Repair the harness.

EFBB105E

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.

SENSOR CHECKING

USING HI-SCAN (PRO)

Check item	Data display	Check conditions	Throttle valve	Test specification
Crankshaft position sensor	Sensor voltage	Ignition switch : ON	At idle position	300-900 mV
			Open slowly	Increases with valve opening
			Open wide	4,250-4,700 mV

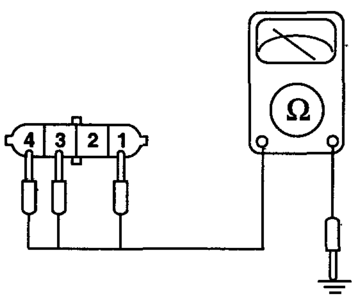
Using voltmeter

1. Disconnect the throttle position sensor connector.
2. Measure resistance between terminal 1 (sensor ground) and terminal 4 (sensor power).

Standard value : 3.5 - 6.5 kΩ

3. Connect a pointer type ohmmeter between terminal 1 (sensor ground) and terminal 3 (sensor output).
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)



EFBB105F

SENSOR CHECKING (IDLE SWITCH)

USING HI-SCAN (PRO)

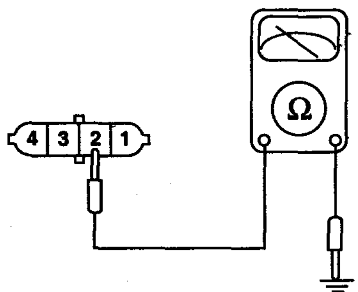
Check item	Data display	Check conditions	Throttle valve	Normal indication
Idle position switch • Service data item	Switch state	Ignition switch : ON (check by operating accelerator pedal repeatedly)	At idle position	ON
			Open a little	OFF

Using voltmeter

1. Disconnect the throttle position sensor connector.
2. Check the continuity between terminal 3 and sensor ground.

TPS voltage	Continuity
Higher than 300-900mV	Non-conductive (∞Ω)
300-900mV	Conductive (0Ω)

3. If out of specification, replace the throttle position sensor.

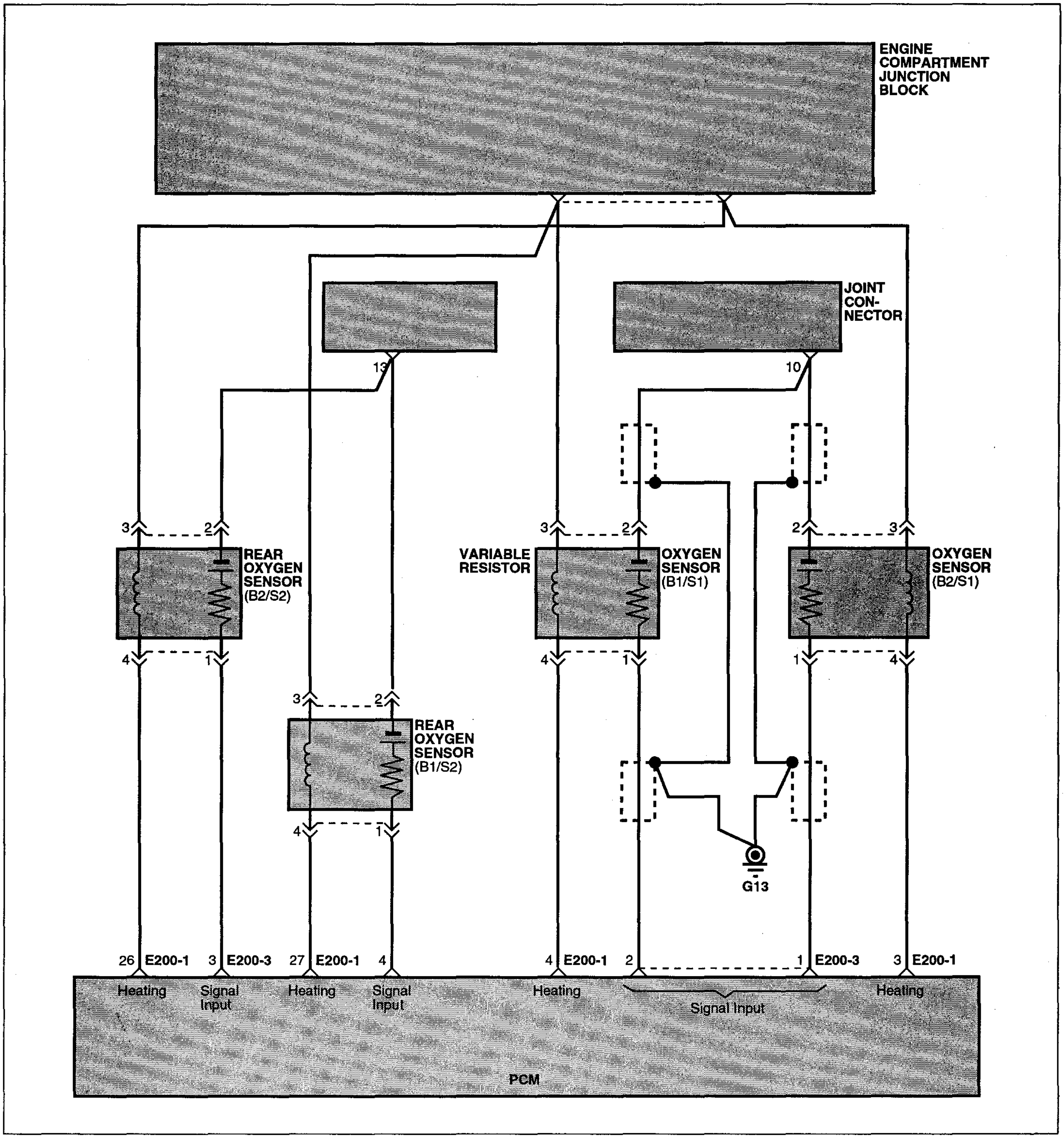


EFBB105G

HEATED OXYGEN SENSOR (HO2S) EFMB1090

The heated oxygen sensor senses the oxygen concentration in exhaust gas and converts it into a voltage which is sent to the PCM. For Zirconium type sensors, 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 PCM controls the fuel injection ratio based on this signal so that the air fuel ratio is maintained at the stoichiometric ratio. The oxygen sensor has a heating element which ensures sensor performance during all driving conditions.

CIRCUIT DIAGRAM



EFMB109A

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 (I4)
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 PCM)	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

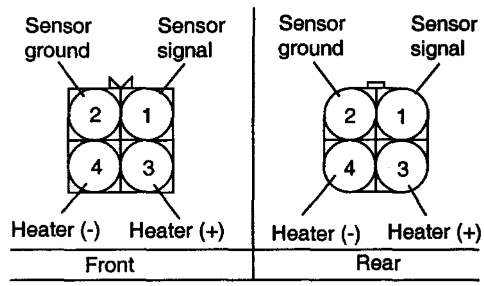
EFAA719E

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 terminals 1 and 2 are connected to any voltage.

4. Connect a high-impedance digital-type volmeter between terminal 1 and terminal 2.

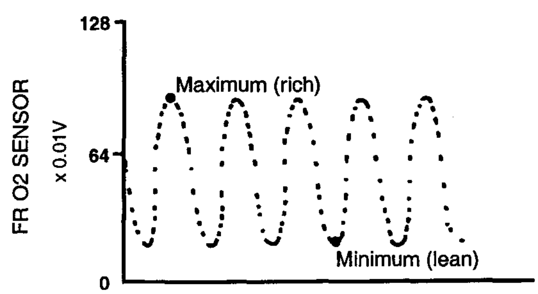


Heated oxygen sensor harness side connector

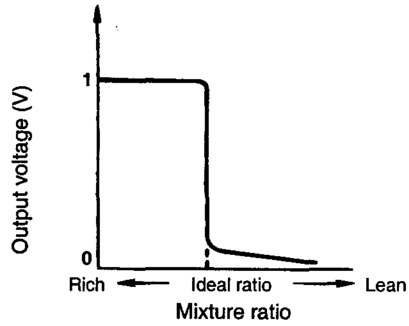
EFAA719F

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



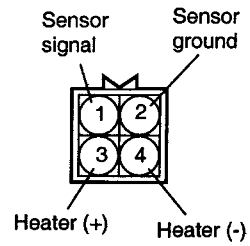
EFJB719H



EFJB719I

6. If there is a problem, there may be an oxygen sensor malfunction.

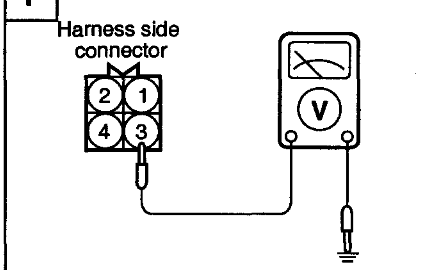
Tightening torque
Heated oxygen sensor :
40-50 Nm (400-500 kg·cm, 29-36 lb·ft)



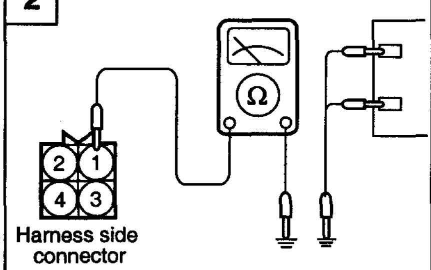
Heated oxygen sensor side connector (FRONT, REAR)

EFAA719G

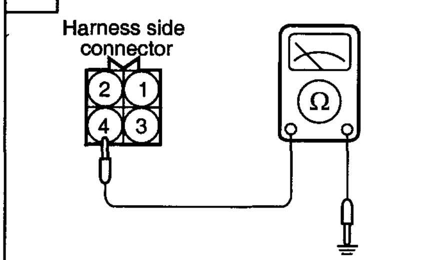
HARNESS INSPECTION PROCEDURES

1 	Measure the power supply voltage of the heated oxygen sensor. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	**OK** ⇨ **NG** ⇨	2 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** ⇨ **NG** ⇨	3 Repair the harness.

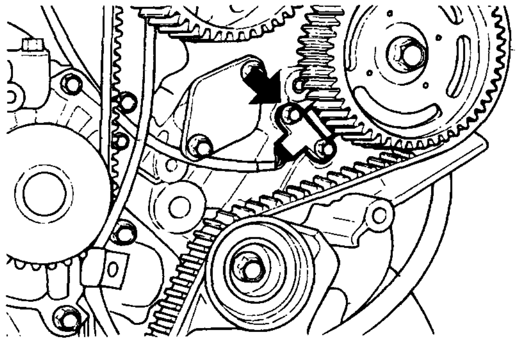
EFHA719C

3 	Check for continuity of the ground circuit. o Connector : Disconnected	**OK** ⇨ **NG** ⇨	**END !** Repair the harness.

EFHA719D

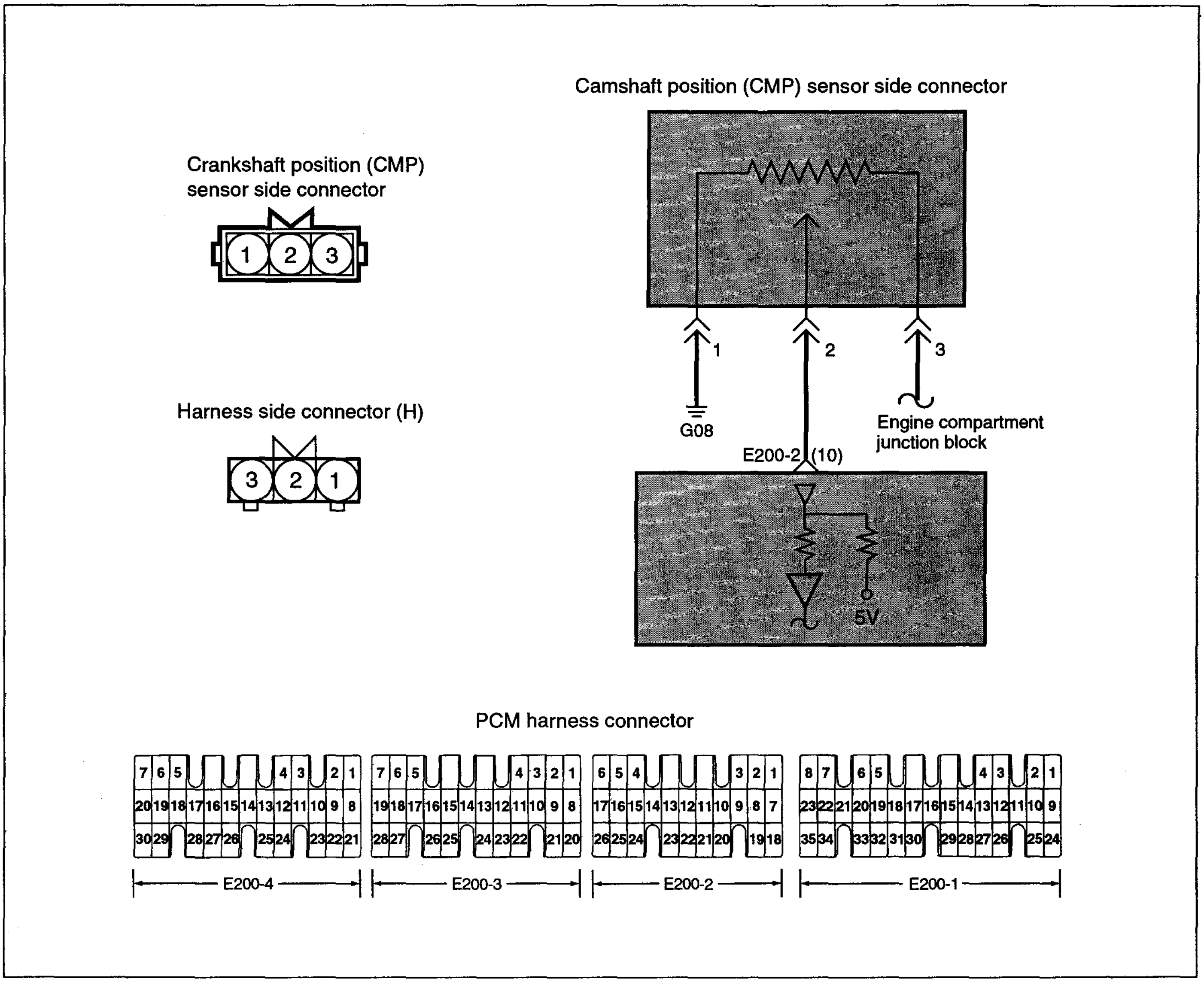
CAMSHAFT POSITION SENSOR EFMB1110

The CMP is a Hall-effect sensor that detects the camshaft position on the compression stroke of the No.1 cylinders, converts it into a pulse signal, and inputs it to the PCM. The PCM then computes the fuel injection sequence, etc. based on the input signal.



KFW5203A

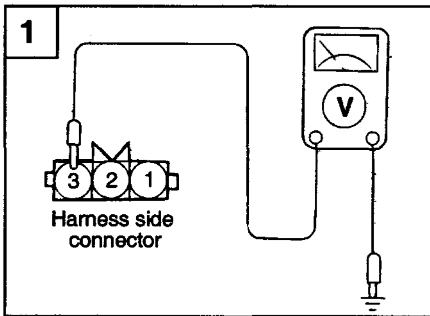
CIRCUIT DIAGRAM



EFMB111A

HARNESS INSPECTION PROCEDURES

1



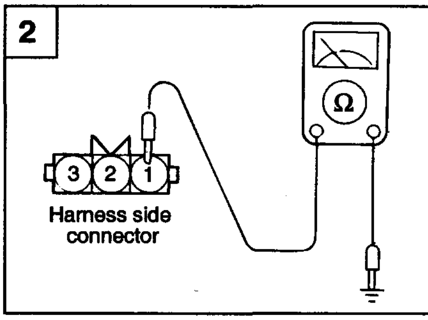
Measure the power supply voltage.
o Connector: Disconnected
o Ignition switch: ON
o Voltage (V): Battery voltage

OK ⇨ **2**

NG ⇨ Repair the harness.

EFHA723B

2



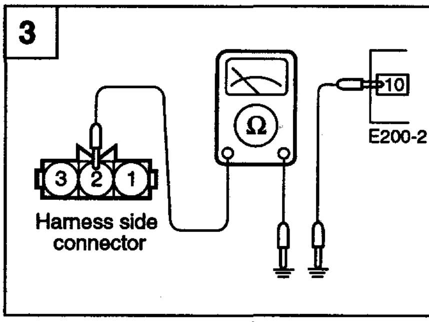
Check for continuity of the ground circuit.
o Connector : Disconnected

OK ⇨ **3**

NG ⇨ Repair the harness.

EFHA723C

3



Check the signal voltage.
o Connector: Disconnected
o Ignition switch : ON
o Voltage : 4.8-5.2 V

OK ⇨ **END !**

NG ⇨ Repair the harness.

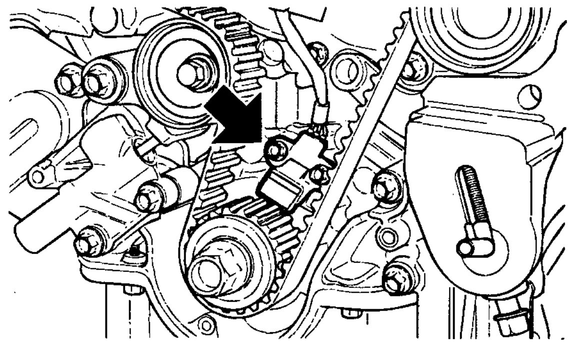
EFMB111D

TROUBLESHOOTING HINTS

If the CMP Sensor does not operate correctly, sequential injection is may not occur and the engine may stall or run irregularly at idle or fail to accelerate normally.

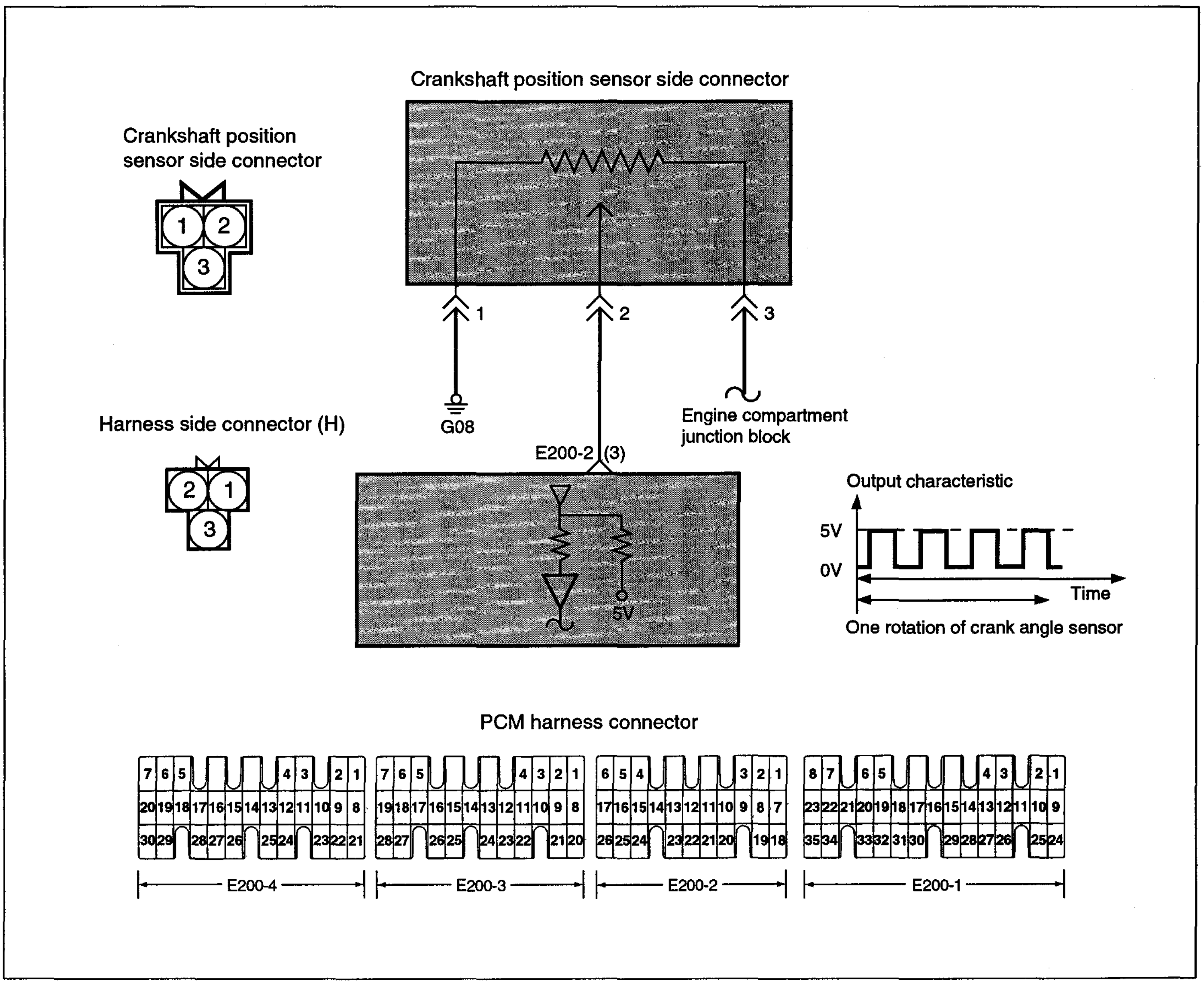
CRANKSHAFT POSITION SENSOR EFMB1130

The crankshaft position sensor is a Hall-effect sensor that senses the crank angle (piston position) of each cylinder and converts it into a pulse signal. Based on the input signal, the PCM computes the engine speed and controls the fuel injection timing and ignition timing.



KFW5202A

CIRCUIT DIAGRAM



EFMB113A

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
4. The engine will run without a crank angle sensor signal, but will not start. Once the sensor detects TDC, the data is stored until the next re-start.

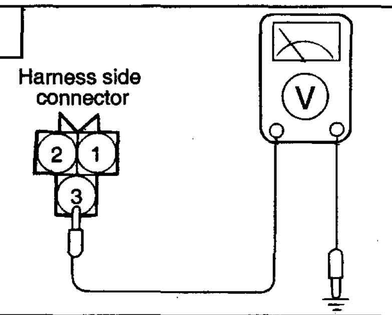
USING HI-SCAN (PRO)

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)	Idle rpm

HARNESS INSPECTION PROCEDURES

1



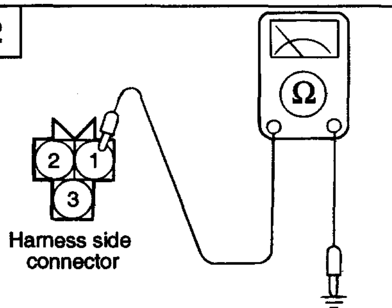
Measure the power supply voltage.
o Connector: Disconnected
o Ignition switch: ON
o Voltage (V): Battery voltage

OK ⇒ 2

NG ⇒ Repair the harness.

EFAA725C

2



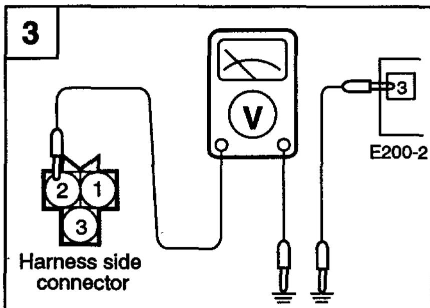
Check for continuity of the ground circuit.
o Connector : Disconnected

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

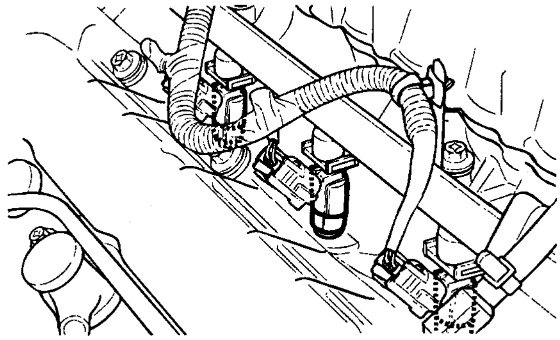
OK ⇒ **END !**

NG ⇒ Repair the harness.

EFMB113E

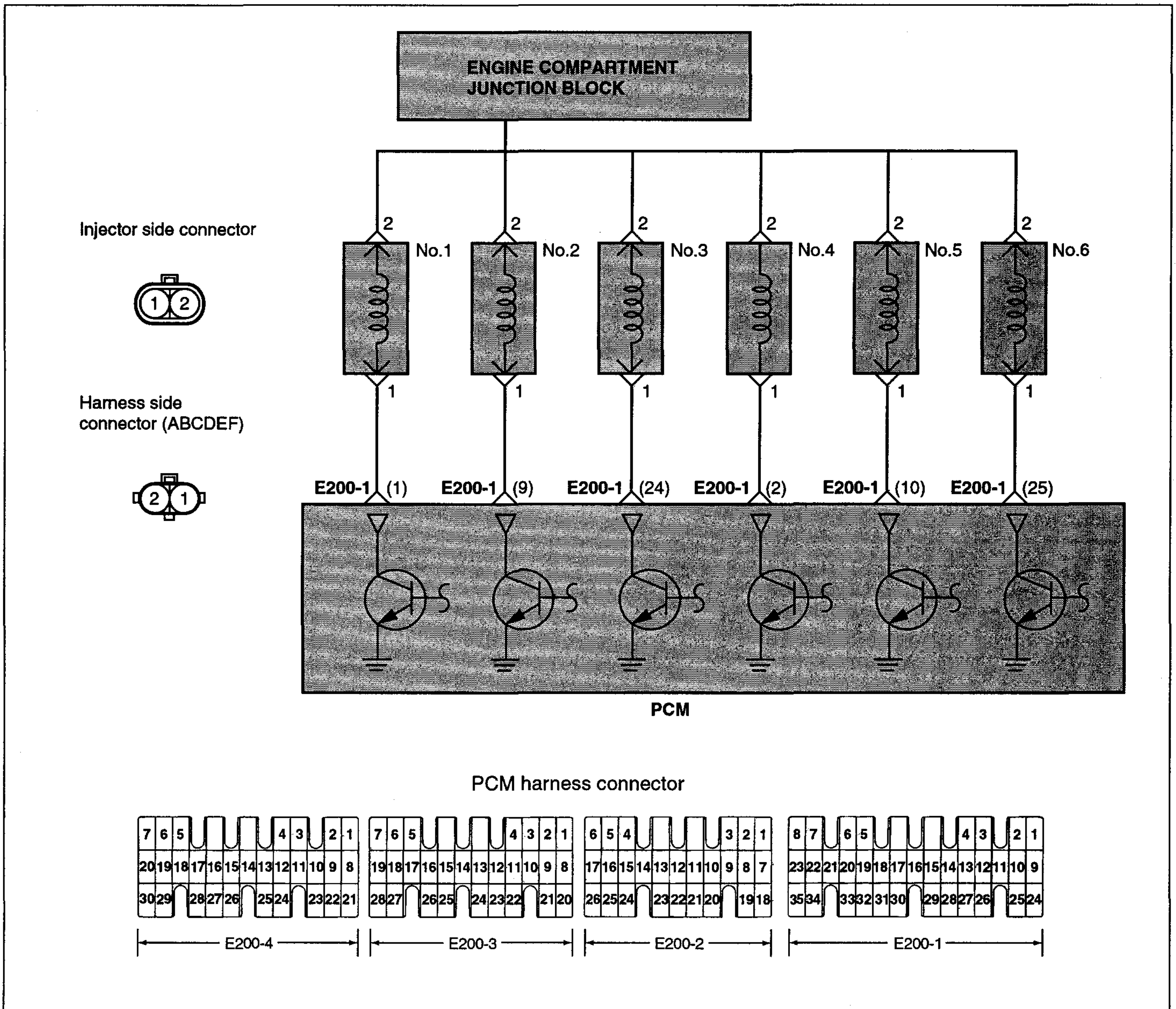
FUEL INJECTOR EFMB1150

The injectors inject fuel according to a signal coming from the PCM. The amount of fuel injected by the injectors is determined by the time during which the solenoid valve is energized. The amount of time the solenoid value is energized is determined by the pulse width of the signal from the PCM.



KFW5018A

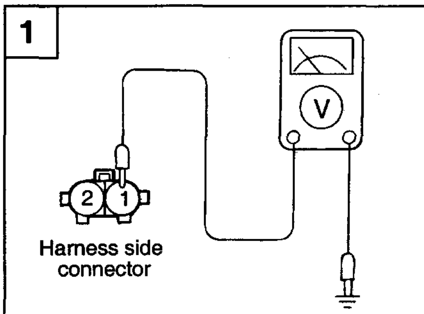
CIRCUIT DIAGRAM



EFMB115A

HARNESS INSPECTION PROCEDURES

1



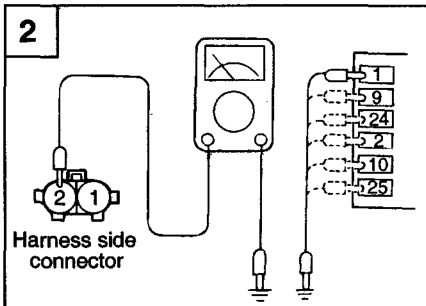
Measure the power supply voltage.
o Connector: Disconnected
o Ignition switch: ON
o Voltage (V): Battery voltage

OK ⇨ **2**

NG ⇨ Repair the harness.

EFHA729B

2



Check for an open circuit, or a short circuit to ground between the powertrain control module and the injector.
o PCM connector : Disconnected
o Injector connector : Disconnected

OK ⇨ **END !**

NG ⇨ Repair the harness.

EFBB115C

INJECTOR CHECKING

USING HI-SCAN

Check Item	Data display	Check conditions	Check content	Test specification
Injector	Drive time	Engine: Cranking	0°C (32°F)	Approx. 17 ms
			20°C (68°F)	Approx. 35 ms
			80°C (176°F)	Approx. 8.5 ms

Check Item	Data display	Check conditions	Engine state	Test specification
Injector	Drive time	• Engine coolant temperature: 80 to 95°C (176 to 205°F) • Lamps, electric cooling fan, accessory modules: All OFF • Transaxle: Neutral (P range for vehicle with A/T) • Steering wheel: Neutral	Idle rpm	2.2-2.9 ms
			2,000 rpm	1.8-2.6 ms
			Rapid racing	To increase

NOTE

- *The injector drive time is when the supply voltage is 11V and the cranking speed is less than 250 rpm.*
- *When engine coolant temperature is lower than 0°C (32°F), the PCM fires all four cylinders simultaneously.*
- *When the vehicle is new (within initial operation of about 500 km [300 miles]), the injector drive time may be about 10% longer.*

Check Item	Item No.	Drive content	Check condition	Normal state
Injector • Actuator test	01	No. 1 injector shut off	Engine: Idling after warm-up (Shut off the injectors in sequence during and after engine warm-up; check the idle condition)	Idle should become unstable as injector shuts off.
	02	No. 2 injector shut off		
	03	No. 3 injector shut off		
	04	No. 4 injector shut off		
	05	No. 5 injector shut off		
	06	No. 6 injector shut off		

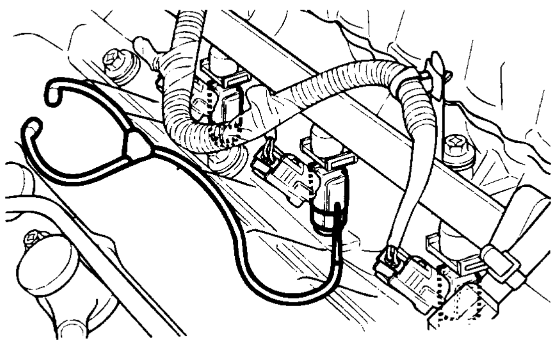
USING STETHOSCOPE AND VOLTMETER

Operation Sound Check

1. Using a stethoscope, check the injectors for a clicking sound at idle. Check that the sound is produced at shorter intervals as the engine speed increases.

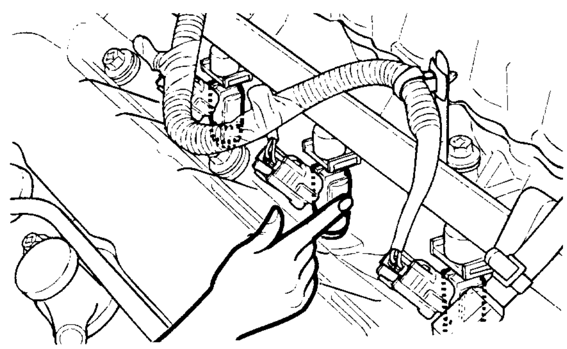
NOTE

Ensure that the sound from an adjacent injector is not being transmitted along the delivery pipe to an inoperative injector.



KFW5019A

2. If a stethoscope is not available, check the injector operation with your finger. If no vibration is felt, check the wiring connector, injector or injection signal from the PCM.



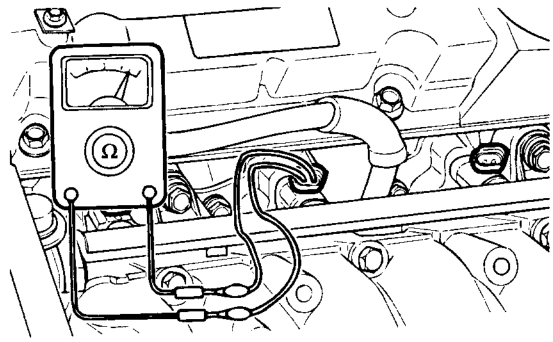
KFW5020A

Resistance Measurement Between Terminals

3. Disconnect the connector at the injector.
4. Measure the resistance between terminals.

Standard value : 13-16Ω [at20°C (68°F)]

5. Re-connect the connector to the injector.



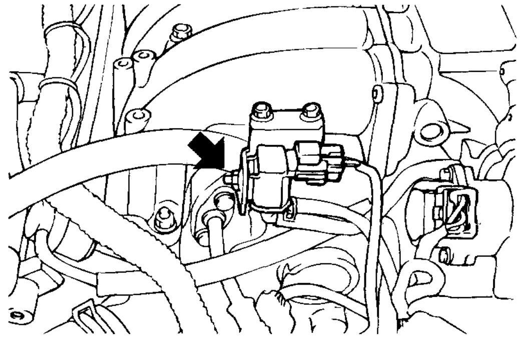
KFW5021A

TROUBLESHOOTING HINTS

1. If the engine is hard to start when hot, check for fuel pressure and injector leaks.
2. If the injectors do not operate when the engine is cranked, then check the followings:
   - Defective power supply circuit to the PCM, faulty ground circuit
   - Defective control relay
   - Defective crankshaft position (CKP) sensor or camshaft position (CMP) sensor
3. If there is any cylinder whose idle state remains unchanged when the fuel injectors are cut one after another during idling, check for the following items about that a 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.)
   - Loose EGR valve seating

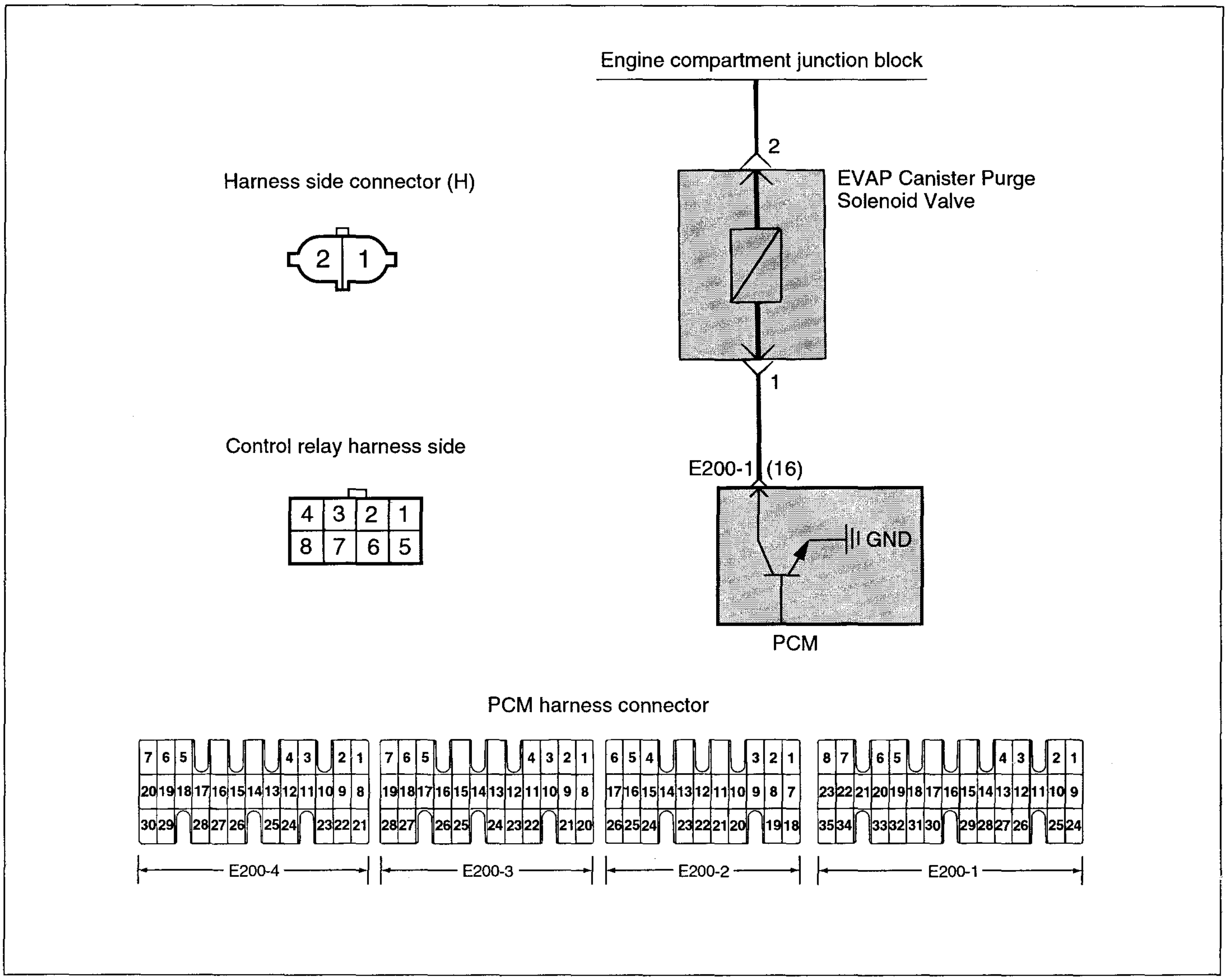
EVAPORATIVE EMISSION CANISTER PURGE CONTROL SOLENOID VALVE EFMB1170

The evaporative emission canister purge control solenoid valve is a duty control type, which controls purge air from the evaporative emission canister.



EFB9007A

CIRCUIT DIAGRAM



EFMB117A

TROUBLESHOOTING PROCEDURES

o Engine : Running

YES ↓

o Check wiring harness and connection.
o Is the connection OK?

NO → o Repair the wiring.

YES ↓

o Check the electrical part of EVAP Canister Purge Control Solenoid Valve.
o Is the electrical part OK?

NO → o Replace the EVAP Canister Purge Control Solenoid Valve

YES ↓

o Erase any diagnostic trouble codes from memeory.
o Is same code present after rechecking?

NO → o OK

YES ↓

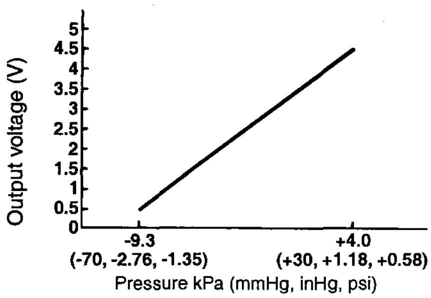
o Replace PCM.

DTC : Diagnosis Trouble Code
PCM : Powertrain Control Module

EFAA731B

USING HI-SCAN (PRO)

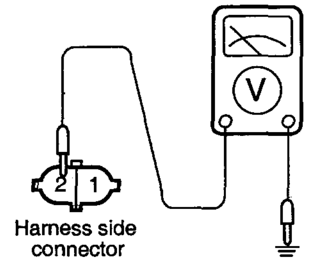
Check Item	Check conditions	HI-SCAN display	Type
Evaporative emission canister purge solenoid valve • Actuator test	IG. S/W ON (Do not start)	PCSV	Activate



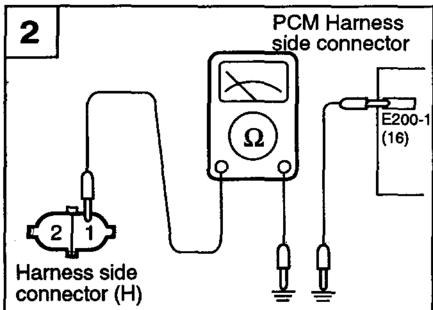
(Relative to atmospheric pressure)

EFJB731E

HARNESS INSPECTION PROCEDURES

1 	Measure the power supply voltage. o Connector: Disconnected o Ignition switch: ON o Voltage (V): Battery voltage	**OK** ⇨ **NG** ⇨	**2** Repair the harness.

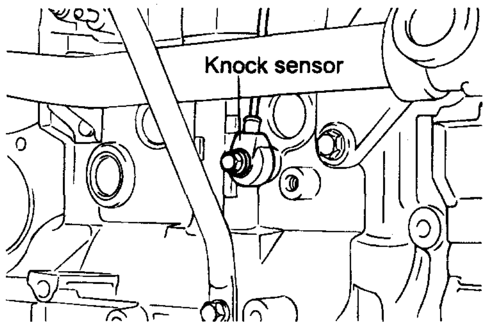
EFBB117B

2 	Check for an open circuit, or a short circuit to ground between the evaporative emission canister purge solenoid valve and the powertrain control module. o PCM connector : Disconnected o Evaporative emission canister purge solenoid valve connector : Disconnected	**OK** ⇨ **NG** ⇨	**END !** Repair the harness.

EFMB117C

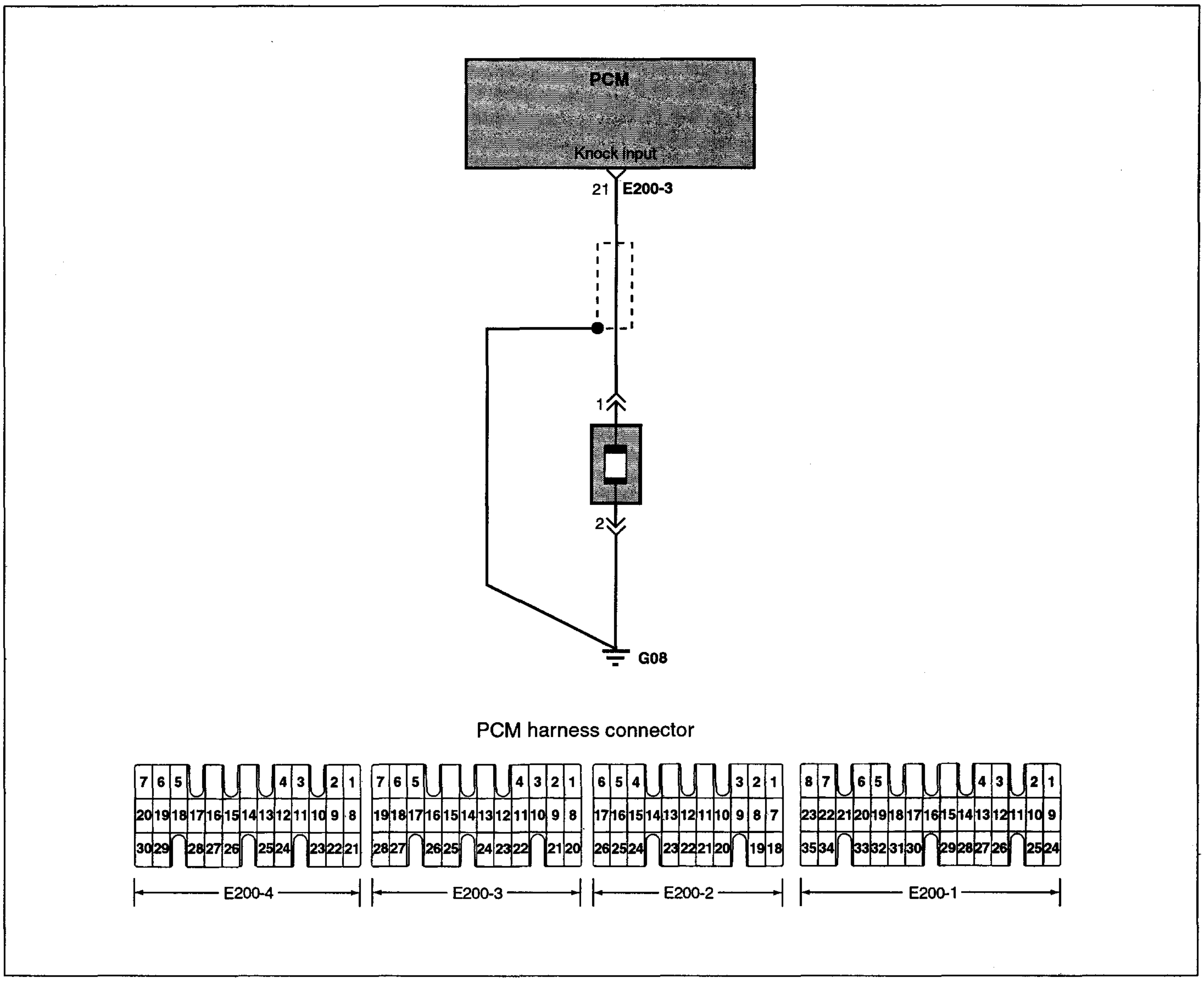
KNOCK SENSOR EFMB1190

The knock sensor is a piezoelectric device attached to the cylinder block that senses pressure from engine knocking conditions. This vibrational pressure is then converted into a voltage signal which is delivered as output. If engine knock occurs, ignition timing is retarded to suppress it.



EFA9094A

CIRCUIT DIAGRAM



EFMB119A

TROUBLESHOOTING PROCEDURES

- o Engine : Running

↓

- o Check the wiring connection between knock sensor and PCM.
- o Is the connection OK ?

NO → o Repair the sensor.

YES ↓

- o Check the torque of the knock sensor.
- o With the specification ? (20 ± 5Nm)

NO → o Retorque the knock sensor bolt.

YES ↓

- o Is the knock sensor OK? (test by substution)

NO → o Replace the knock sensor.

YES ↓

- o Erase any diagnostic trouble codes from memory.
- o Is same code present after rechecking ?

NO → o OK

YES ↓

- o Replace PCM.

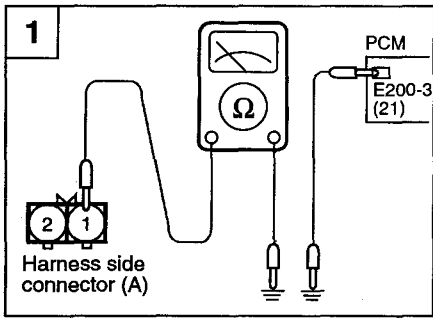
DTC : Diagnosis Trouble Code
PCM : Powertrain Control Module

EFAA733B

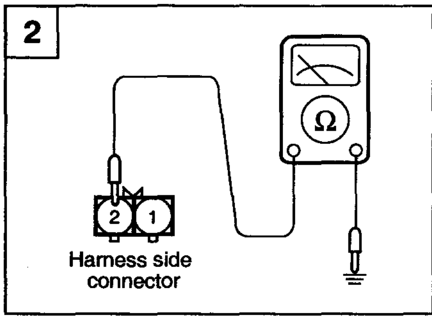
TROUBLESHOOTING HINTS

1. The MIL is ON or the DTC is displayed on the HI-SCAN PRO under the following condition:
   - When the knock sensor signal is not detected, even though the engine is in an overload condition.
   - When the knock sensor signal is abnormally low.

HARNESS INSPECTION PROCEDURES

1		Check for an open circuit, or a short circuit to ground between the PCM and the knock sensor o PCM connector : Disconnected o Knock sensor connector : Disconnected	OK ⇨	2
			NG ⇨	Repair the harness. A1 - E200-3 : 21

EFMB119C

2		Check for continuity of the ground circuit o Continuity	OK ⇨	END !
			NG ⇨	Repair the harness.

EFBB119D

SENSOR INSPECTION

1. Disconnect the knock sensor connector.
2. Measure the resistance between terminals 2 and 3.

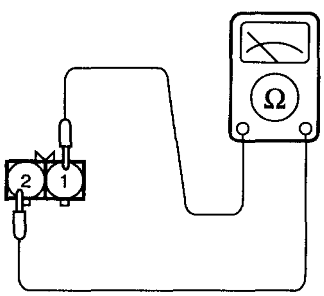
Standard value : about 5MΩ [at 20°C (68°F)]

3. If the resistance is zero, 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 2 and 3.

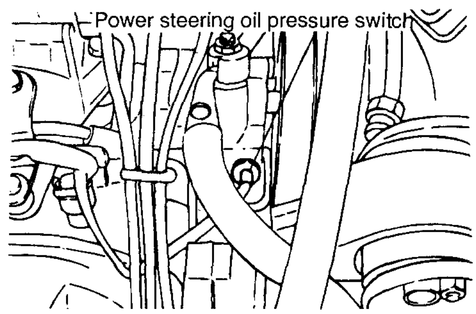
Standard value : 800-1600 pF



EFBB119E

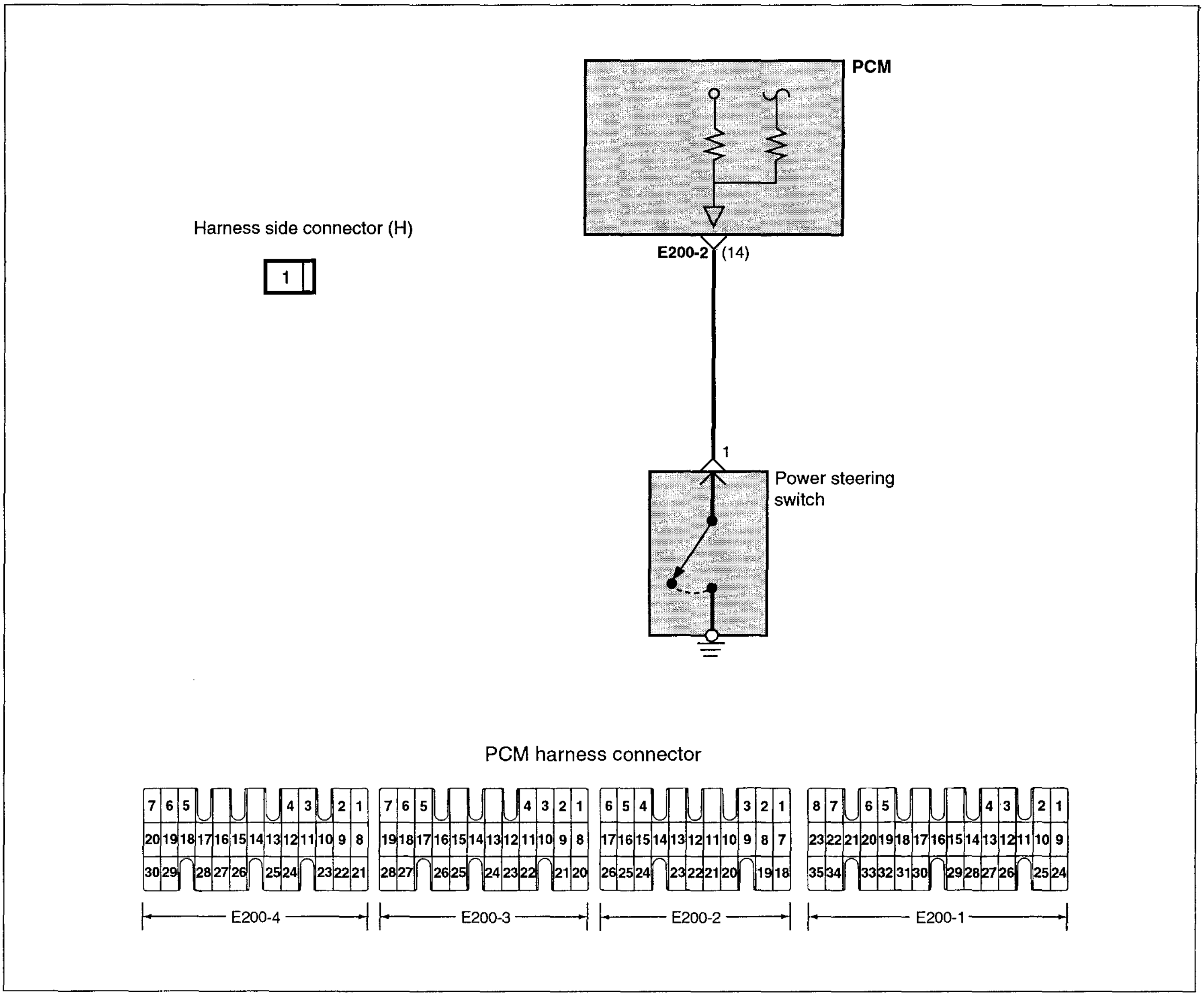
POWER STEERING PRESSURE SWITCH EFMB1210

The power steering oil pressure switch senses the power steering load and inputs it to PCM, which then adjusts the idle speed control motor to maintain idle speed when the power steering pump puts a load on the engine.



EFA9103A

CIRCUIT DIAGRAM

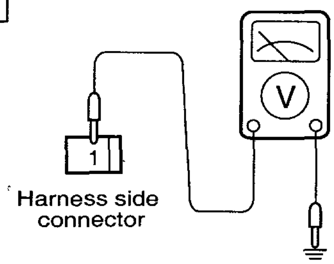


EFMB121A

USING HI-SCAN (PRO)

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

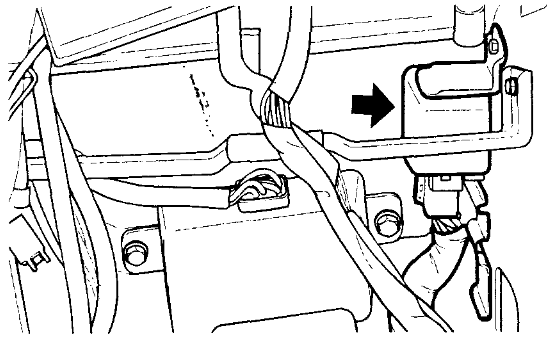
HARNESS INSPECTION PROCEDURES

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

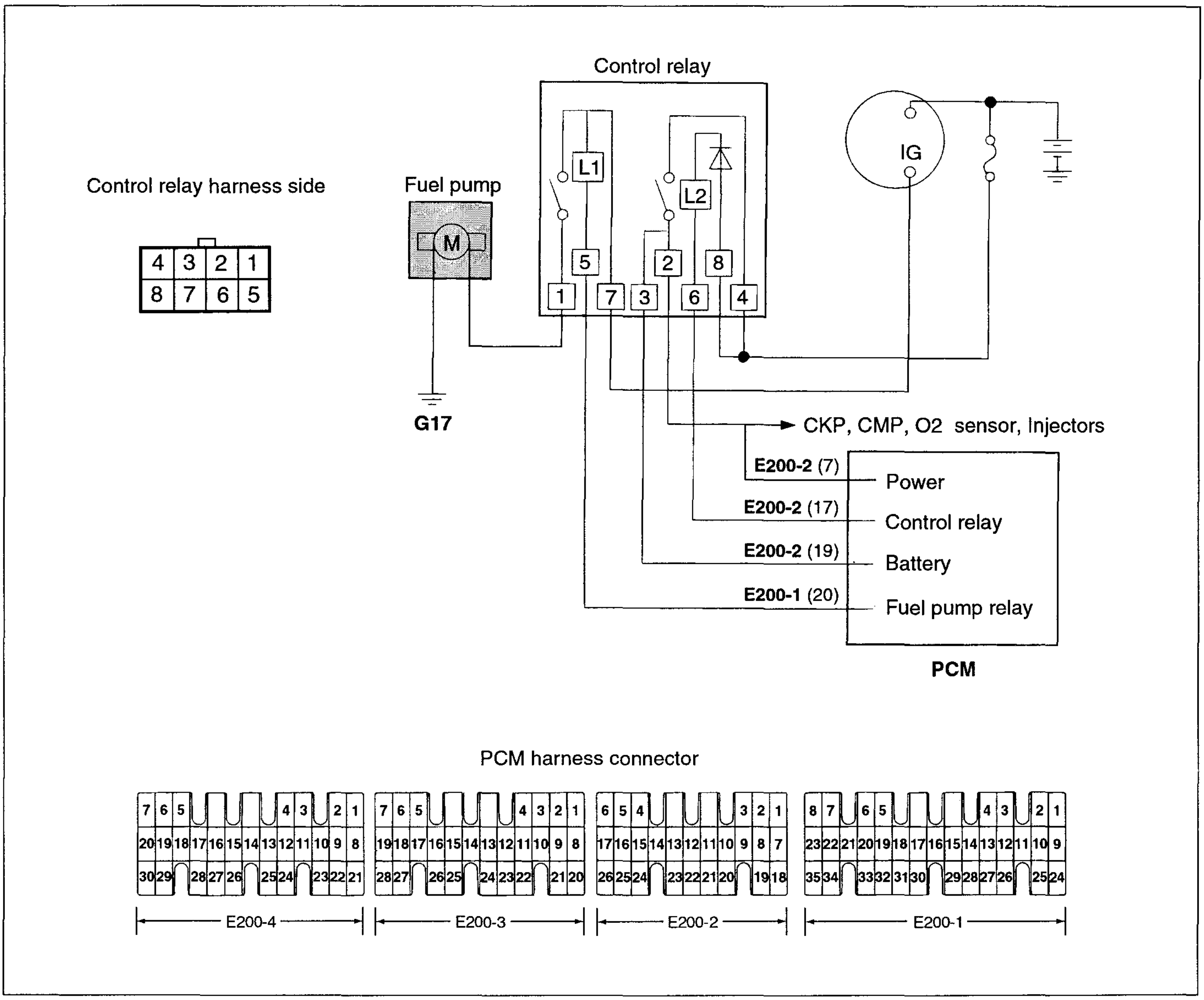
CONTROL RELAY EFMB1230

When the ignition switch is turned on, battery voltage is applied from the ignition switch to the PCM, turning ON the ignition power transistor and energizing the MFI control relay coil. This turns ON the MFI control relay switch, and supplies power from the battery to the PCM through the MFI control relay switch.



KFW5221A

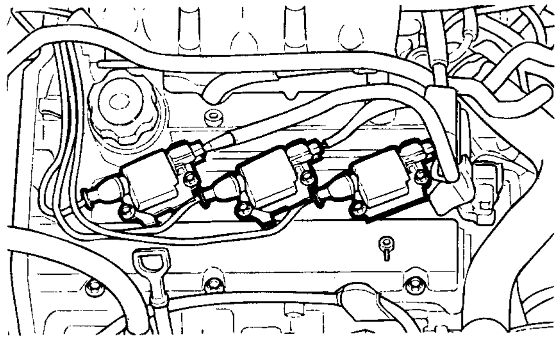
CIRCUIT DIAGRAM



EFMB123A

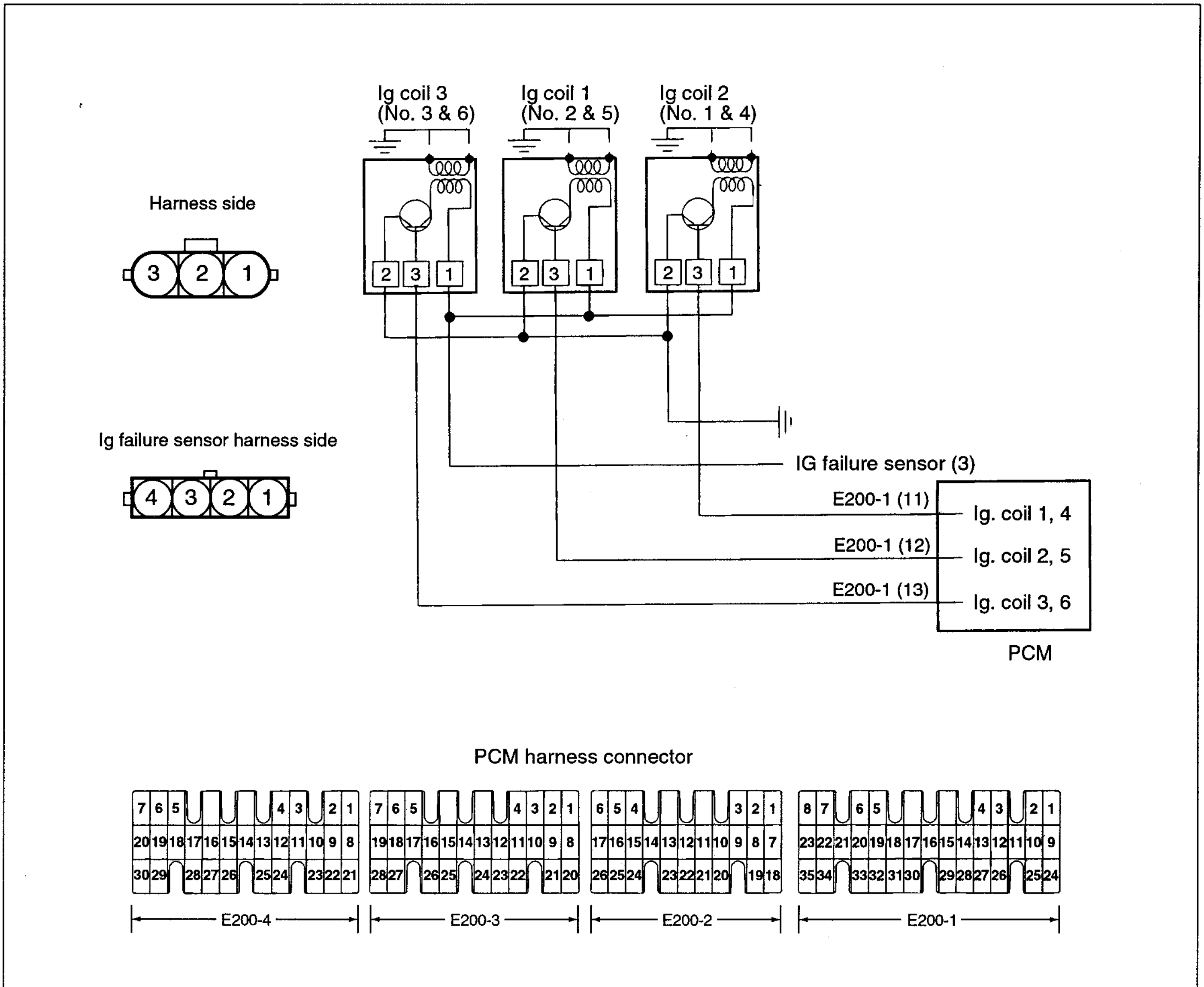
IGNITION COIL EFMB1250

The ignition power transistor functions to control the ignition timing by controlling the ignition coil primary current through signals from the PCM.



KFW5222A

CIRCUIT DIAGRAM



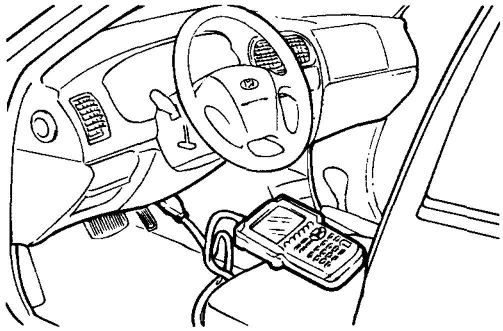
EFMB125A

THROTTLE POSITION SENSOR(TPS) INSPECTION EFMB2060

1. Connect a HI-SCAN (PRO) to the data link connector.

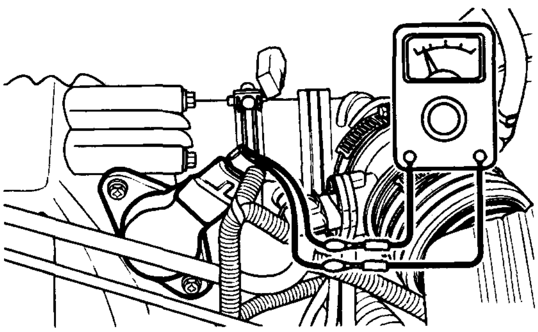
NOTE

Before inspecting the TPS, verify the basic idle speed is as specified.



EFA9100A

2. If a HI-SCAN (PRO) is not used, connect a digital type voltmeter between ground and TPS output terminal.



EFMB206A

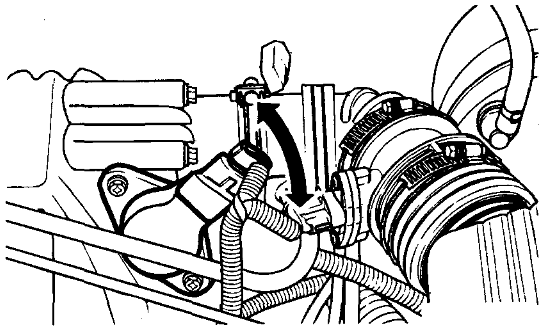
3. Turn the ignition switch to the ON position(do not start engine) and check that TPS output voltage is as specified. If a HI-SCAN (PRO) is used, read the TPS voltage.

Standard value (ETS vehicle) : 300-900mV

4. If it is out of specification, loosen TPS mounting screws and adjust by turning the TPS.

NOTE

- *Turning the TP Sensor clockwise increases the output voltage.*
- *Tighten the screws securely after adjustment.*



EFMB206B

5. Turn the ignition switch to the OFF position.

THROTTLE BODY CLEANING EFBB2120

NOTE

Disconnect the intake air hose from the throttle body, and check the throttle valve surface for dirt. Spray cleaning solvent on the face of the valve to remove dirt.

1. Warm up the engine, then stop it.
2. Remove the intake air hose from the throttle body.
3. Plug the bypass passage inlet of the throttle body.

NOTE

Make sure the solvent does not enter the by-pass passage.

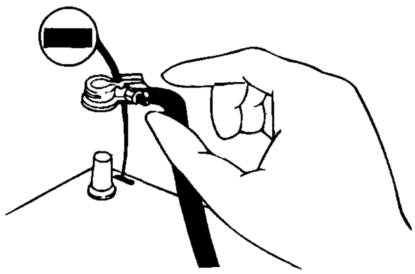
4. Spray cleaning solvent into the valve through the throttle body intake port and let it soak for about 5 minutes. After 5 minutes open the valve and wipe it clean with a soft rag.

CAUTION

Keep the throttle valve closed while spraying to avoid charging the intake path with solvent.

5. Start the engine, race it several times and allow the engine to run near idle for 1 minute.
6. Repeat Steps 4 and 5.
7. Unplug the bypass passage inlet.
8. Attach the intake air hose.

9. Disconnect the battery ground cable for more than 10 seconds.



EFA9112B

FUEL FILTER REPLACEMENT EFBB2070

1. Lift up the vehicle.

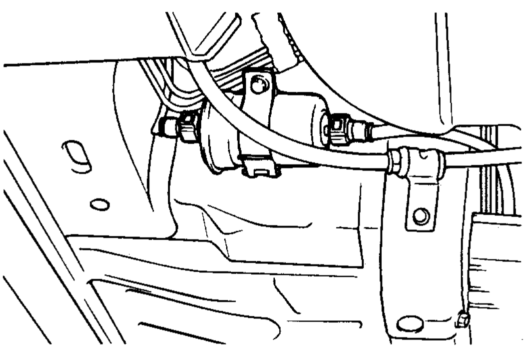
2. Reduce the internal pressure of the fuel lines and hoses and make the following operations.
   - Disconnect the fuel pump harness connector at the fuel tank rear side.
   - Start the engine and after it stops, turn the ignition switch to OFF.
   - Disconnect the battery negative (-) terminal.
   - Connect the fuel pump harness connector.

3. Remove the two fitting nuts while holding the fuel filter nuts securely.

4. Remove the fuel filter mounting bolts, and then remove the fuel filter from the fuel filter clamp.

Tightenging torque
Fuel filter fitting nut :

30-40 Nm (300-400 kg·ch, 22.1-29.5 lb·ft)

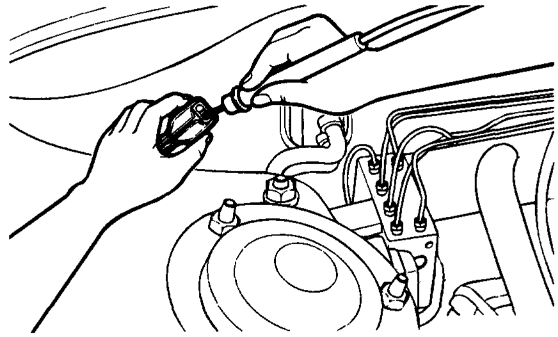


EFA9157A

FUEL PUMP OPERATION CHECK EFBB2080

1. Turn the ignition switch to the OFF position.

2. Apply battery voltage to the fuel pump drive connector to check that the pump operates.

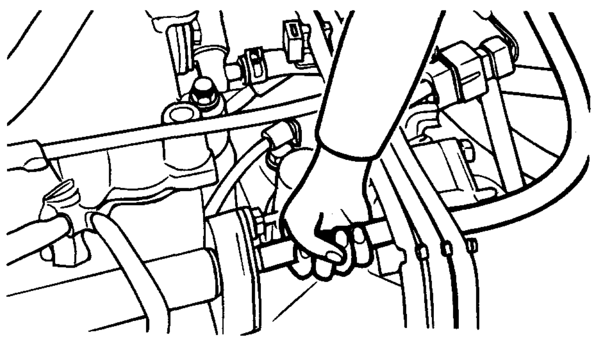


KFW5022A

NOTE

The fuel pump is an in-tank type and its operating sound is hard to hear without removing the fuel tank cap.

3. Pinch the hose to check that fuel pressure is felt.



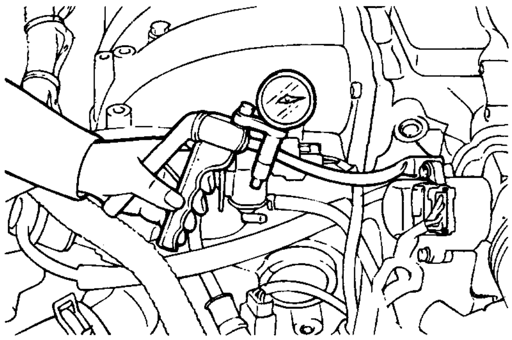
HEW31006

EVAP CANISTER PURGE PORT VACUUM CHECK EFBB2090

CHECKING CONDITION

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

1. Disconnect the vacuum hose from the throttle body EVAP Canister purge hose fitting and connect a vacuum pump.

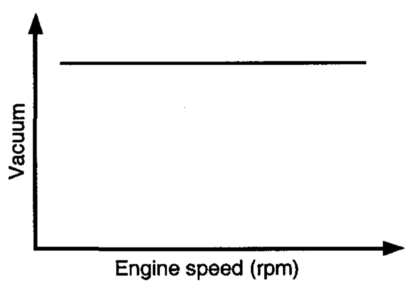


EEB9015A

2. Start the engine and check to see that, after increasing the engine speed, vacuum rises fairly constantly.

NOTE

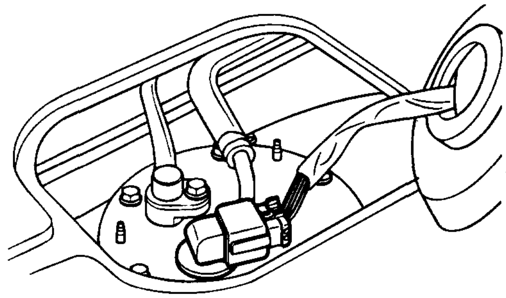
If there is no vacuum, it is possible that the throttle body port may be restricted and may require cleaning.



EFA9109B

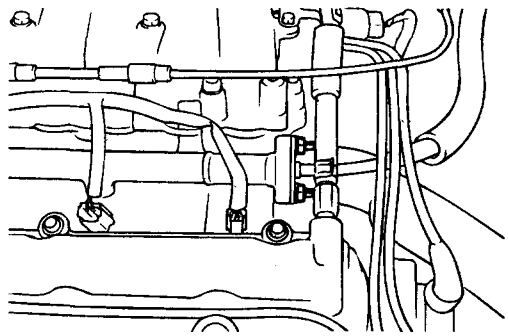
FUEL PRESSURE TEST EFBB2100

1. Reduce the internal pressure of the fuel lines and hoses:
   - Disconnect the fuel pump harness connector
   - Start the engine and after it stalls, turn the ignition switch to the OFF position
   - Disconnect the battery negative (-) terminal
   - Connect the fuel pump harness connector



KFW5023A

2. Remove the bolt connecting the fuel line to the fuel delivery pipe.



EFA9141A

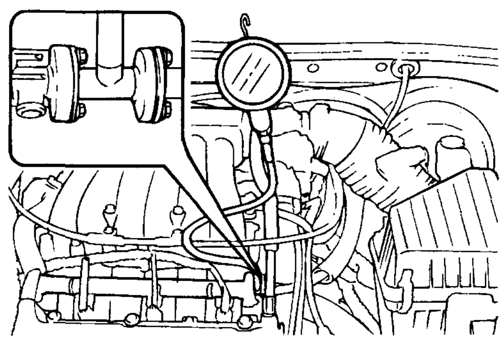
CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by residual pressure in the fuel line.

3. Using the fuel pressure gauge adapter, install the fuel pressure gauge to the fuel pressure gauge adaptor. Tighten the bolt to the specified torque.

Fuel pressure gauge to fuel delivery pipe :

25-35 Nm (250-350 kg·cm, 18-26 lb·ft)



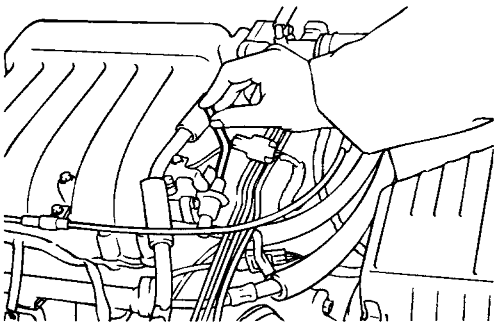
EFA9141B

4. Connect the battery's negative (-) terminal.

5. Apply battery voltage to the terminal for the pump drive and activate the fuel pump. With fuel pressure applied, check that there is no fuel leakage from the pressure gauge or connection part.
6. Start and run the engine at curb idle speed.
7. Disconnect the vacuum hose from the pressure regulator, and plug the hose end. Measure the fuel pressure at idle.

Standard value :

320-340 kPa (3.26-3.47 kg/cm², 46-49 psi)



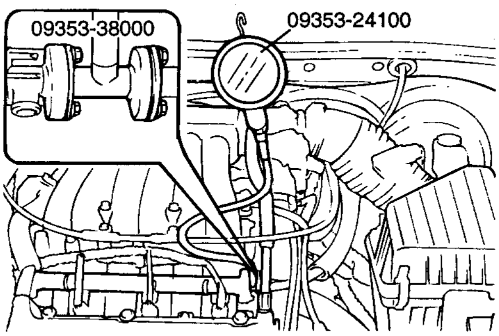
EFBB210C

8. Measure the fuel pressure when the vacuum hose is connected to the pressure regulator.

Standard value :

Approx.255 kPa (2.57 kg/cm², 37 psi)

9. If the results of the measurements made in steps (7) and (8) are not within the standard value, use the table below to determine the probable cause, and make the necessary repairs.



EFBB210A

Condition	Probable cause	Remedy
Fuel pressure is too low	• Clogged fuel filter • Fuel leakage to the return side, caused by poor seating of the fuel-pressure regulator	• Replace fuel filter • Replace fuel pressure regulator
	• Low discharge pressure of the fuel pump	• Check the in-tank fuel hose for large or replace the fuel pump
Fuel pressure is too high	• Sticking fuel pressure regulator • Clogged or bent fuel return hose or pipe	• Replace fuel pressure regulator • Repair or replace hose or pipe
There is no difference in fuel pressure when the vacuum hose is connected and when it is not.	• Clogged, or damaged vacuum hose or nipple • Sticking or poor seating of the fuel pressure regulator	• Repair or replace the vacuum hose or the nipple • Repair or replace hose or pipe

10. Stop the engine and check for a change in the fuel pressure gauge reading, which should hold for approximately 5 minutes. If the gauge indication drops, observe the rate at which it drops. Determine and remove the causes according to the following table.

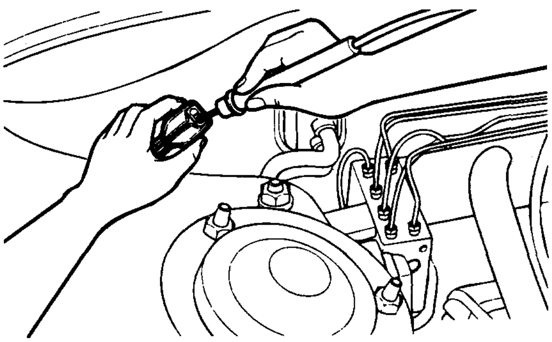
Condition	Probable cause	Remedy
Fuel pressure drops slowly after engine is stopped	• Injector leakage	• Replace injector
Fuel pressure drops immediately after engine is stopped	• The check valve within the fuel pump is open	• Replace fuel pump

11. Reduce the pressure in the fuel line.
12. Disconnect the hose and the gauge.

CAUTION

Cover the hose connection with a shop towel to prevent splashing of fuel caused by fuel residual pressure in the fuel line.

13. Replace the O-ring at the end of the hose.
14. Connect the fuel hose to the delivery pipe and tighten to the specified torque.
15. Check for fuel leakage.
    - Apply battery voltage to the fuel pump drive terminal to operate the fuel pump.
    - With pressure, check the fuel line for leaks.

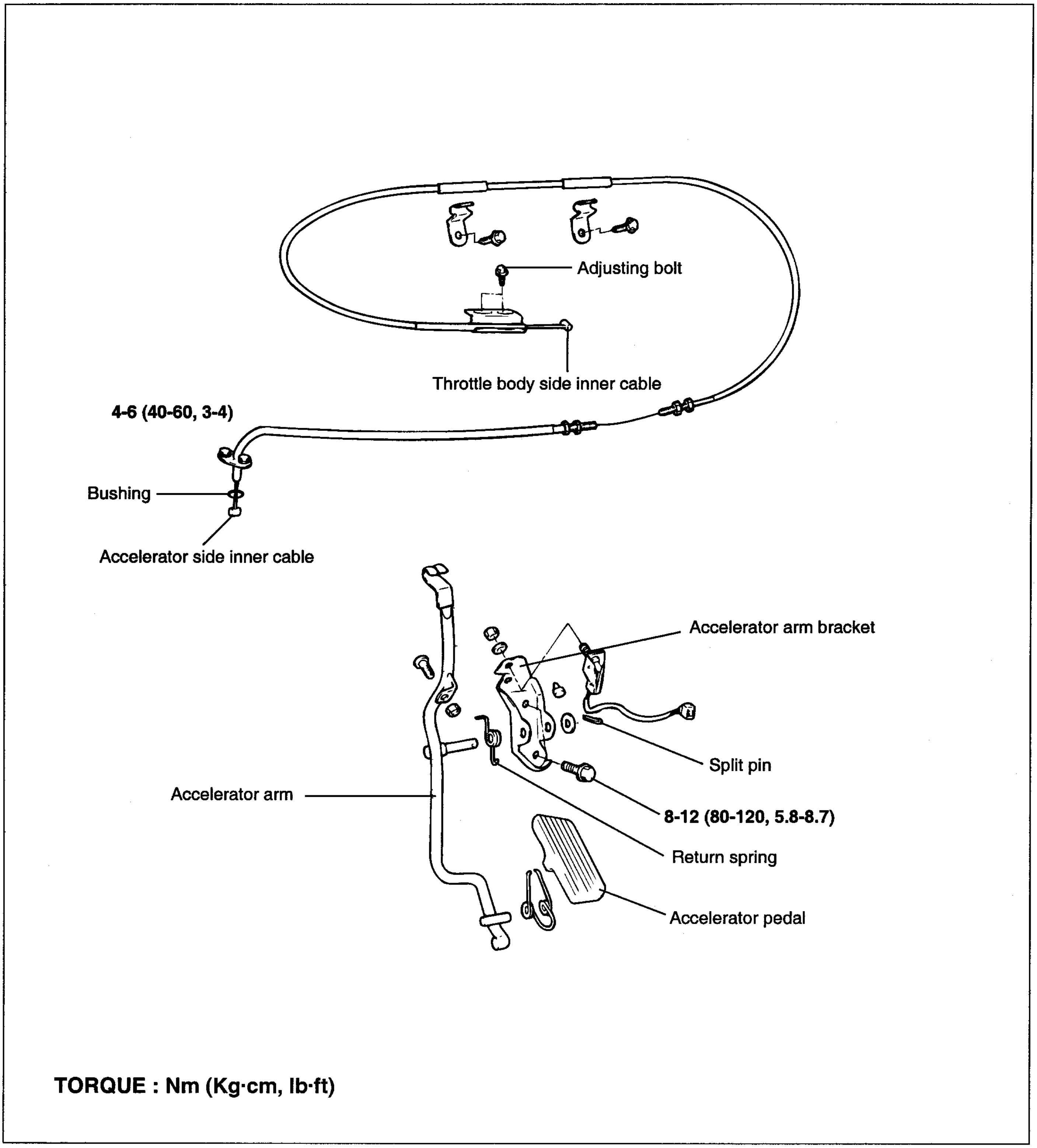


KFW5022A

FUEL DELIVERY SYSTEM

ACCELERATOR PEDAL EFBB2190

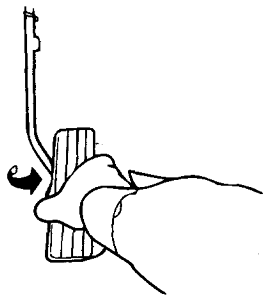
COMPONENTS



EFBB219A

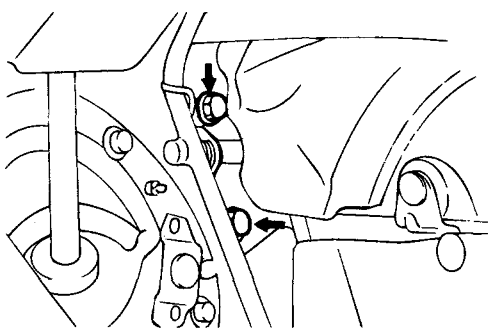
REMOVAL EFA91220

1. Remove the bushing and inner cable of the accelerator arm.
2. Pull the left side of the accelerator pedal toward you, and then remove the accelerator pedal from the accelerator arm.



EFA9122A

3. Loosen the bolts of the accelerator arm bracket and remove.



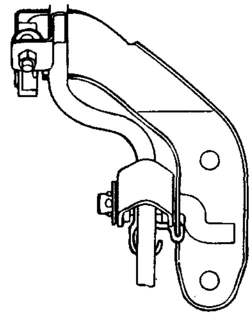
EFA9122B

INSPECTION EFA91230

1. Check the inner and outer cable for damage.
2. Check the cable for smooth movement.
3. Check the accelerator arm for deformation.
4. Check the return spring for deterioration.
5. Check the connection of the bushing to the inner cable.
6. Check the accelerator for proper operation.

INSTALLATION EFA91240

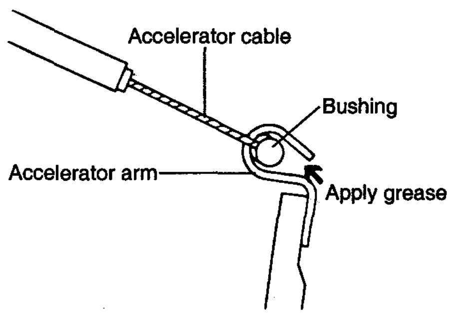
1. When installing the return spring and accelerator arm, apply multi-purpose grease around each moving point of the accelerator arm.



EFA9124A

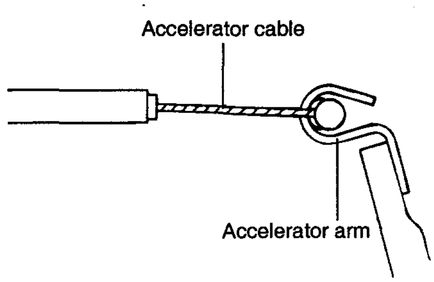
2. Apply sealant to the bolt mounting hole and tighten the accelerator arm bracket.

Tightening torque
Accelerator arm bracket bolts :
8-12 Nm(80-120 kg·cm, 6-7 lb·ft)



EFA9124B

3. Securely install the resin bushing of the accelerator cable on the end of the accelerator arm.



EFA9124C

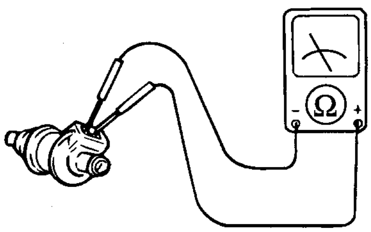
FUEL INJECTOR EFA91260

INSPECTION

1. Measure the resistance of the injectors between the terminals using an ohmmeter.

Resistance : 13-16Ω[at 20°C (68°F)]

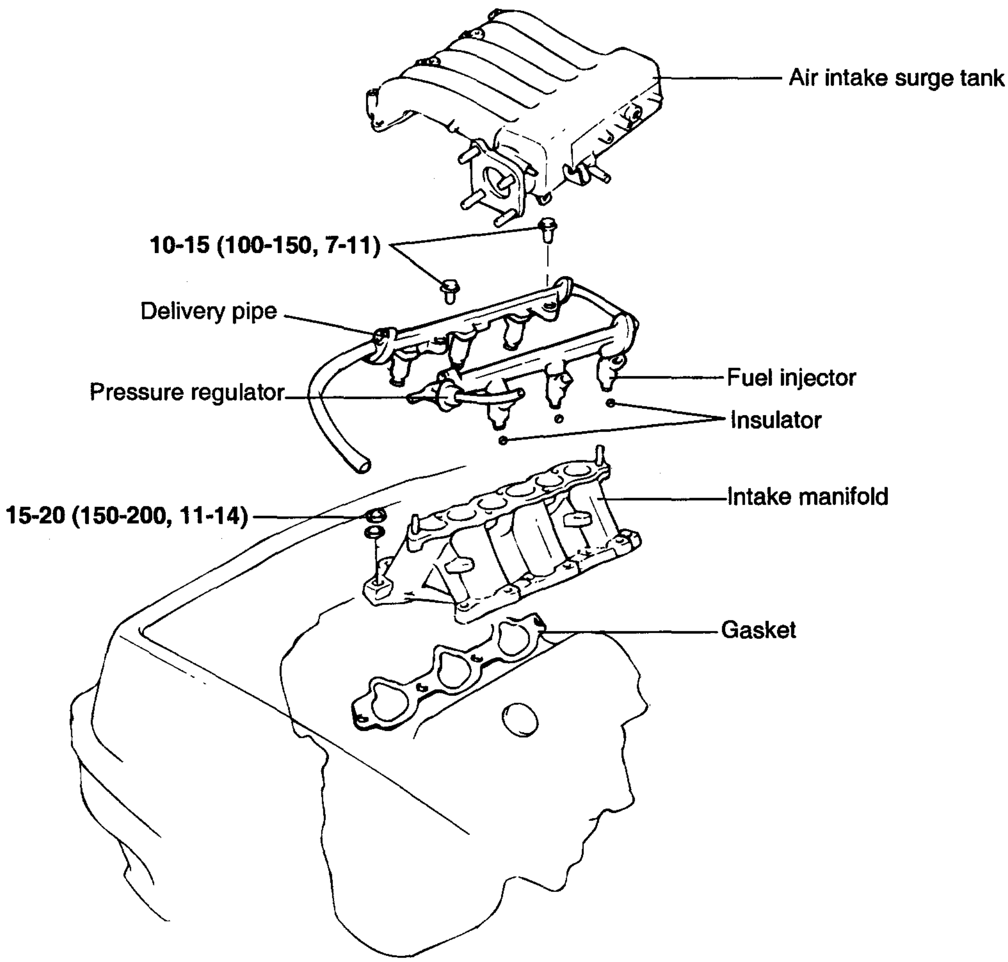
2. If the resistance is not within specification, replace the injector.



EFA9126A

FUEL LINE EFBB2280

COMPONENTS



TORQUE : Nm (kg·cm, lb·ft)

EFBB228A

REMOVAL EFA91290

1. Release residual pressure from the fuel line to prevent fuel from spilling.

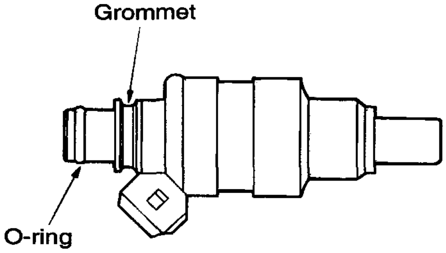
CAUTION

Cover the hose connection with rags to prevent splashing of fuel from residual pressure in the fuel line.

2. Remove the delivery pipe with the fuel injector and pressure regulator.

INSTALLATION EFA91300

1. Install a new grommet and O-ring to the injector.
2. Apply a coating of solvent, spindle oil or gasoline to the injector O-ring.

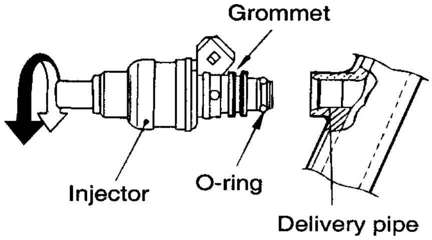


EFA9130A

3. While turning the injector left and right, install it onto the delivery pipe.
4. Be sure the injector turns smoothly.

NOTE

If injector does not turn smoothly, the O-ring may be jammed. Remove the injector and re-insert it into the delivery pipe and re-check.



EFA9130B

FUEL LINE AND VAPOR LINE EFBB2320

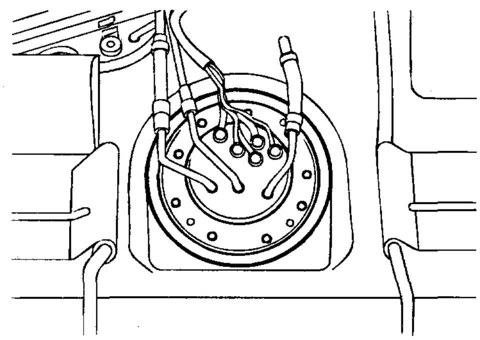
REMOVAL

1. Remove the fuel tank cap to lower the fuel tank's internal pressure. Raise the vehicle and disconnect the fuel pump connector.

CAUTION

- ***Reduce the fuel pressure before disconnecting the fuel line and hose, or fuel will spill out.***
- ***Cover the pipe connection with a shop towel to prevent splashing of fuel from residual pressure in the fuel line.***

2. Remove the fuel pump installation screws, then remove the fuel pump assembly from the fuel tank



EFHA006A

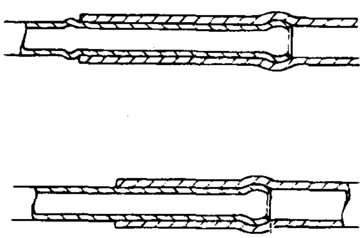
3. Remove the fuel return hose and line.
4. Remove the fuel vapor hose and line

INSPECTION EFJB1330

1. Check the hoses and pipes for cracking, bending, deformation or restrictions.
2. Check the EVAP Canister for restrictions.
3. Check the fuel pump assembly for restrictions and damage.

INSTALLATION EFBB2340

1. Install the fuel vapor hose and return hoses.
   - If the fuel line has a stepped section, connect the fuel hose to the line securely, as shown in the illustration.
   - If the fuel line does not have a stepped section, connect the fuel hose to the line securely.



EFA9134A

2. Install the fuel filter and tighten the fuel filter bracket.

3. Tighten the two fitting nuts while holding the fuel filter nuts.

Tighting torque

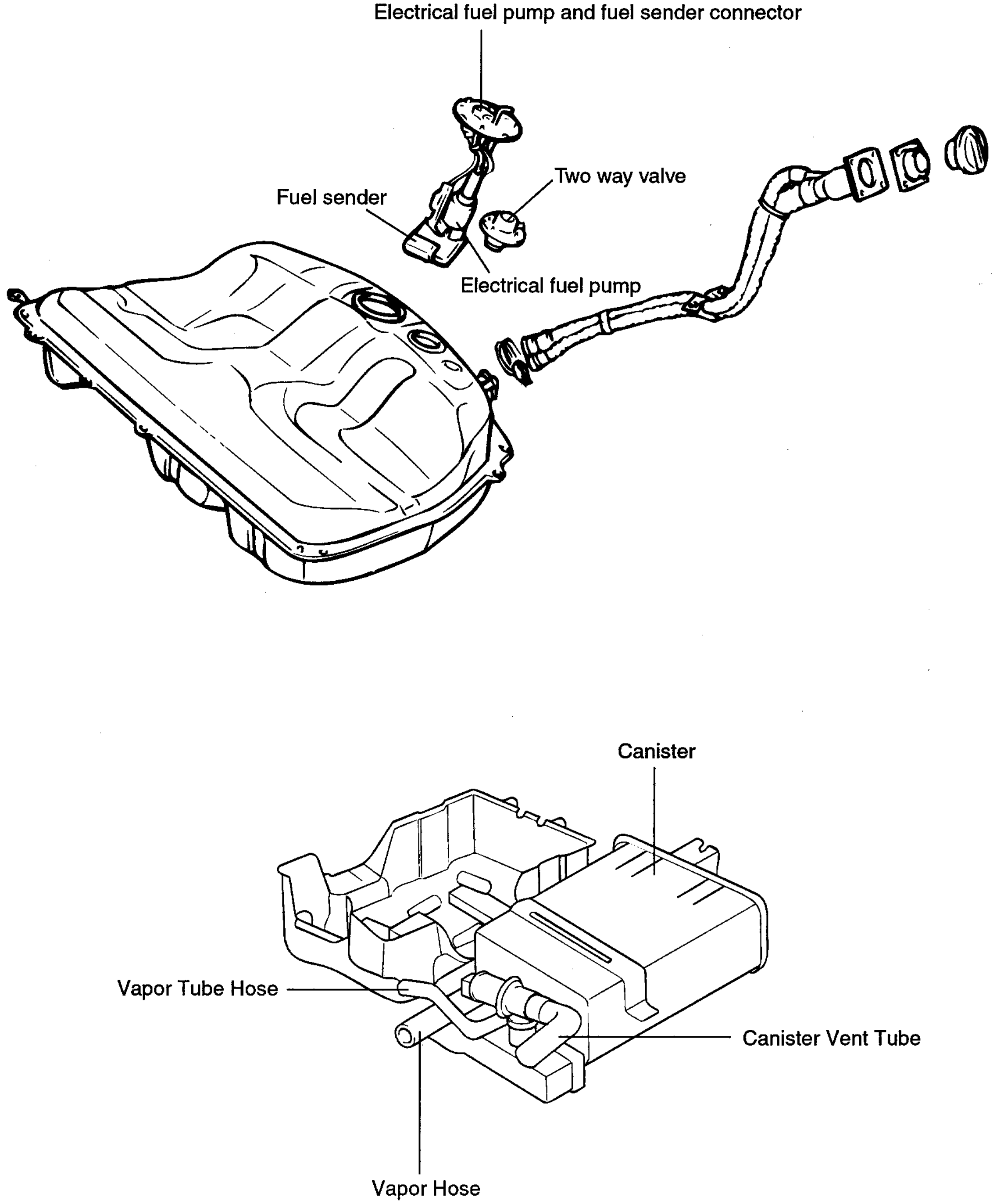
Fuel filter fitting nuts :

20-40 Nm (300-400 kg·cm, 22.1-29.5 lb·ft)

4. Install the clips and make sure that they do not interfere with other components.

FUEL TANK EFMB2350

COMPONENTS



EFMB235A

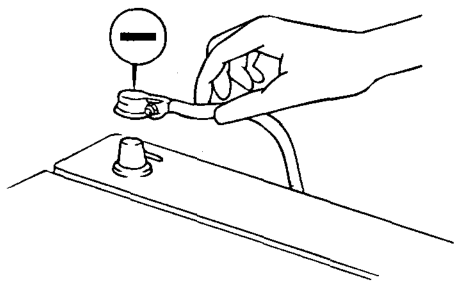
REMOVAL EFJB1360

1. To reduce the internal pressure of the fuel main pipes and hose, first start the engine and then disconnect the electrical fuel pump connector located near the fuel tank.

⚠ CAUTION

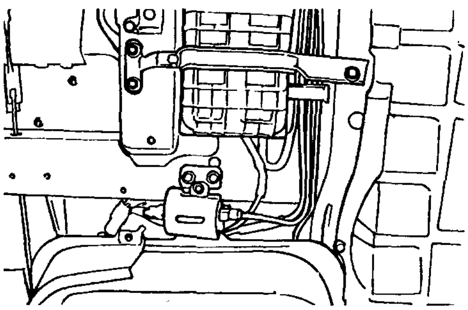
Be sure to reduce the fuel pressure before disconnecting the fuel main pipe and hose, otherwise fuel will spill out.

2. Disconnect the battery cable from the negative terminal of the battery.



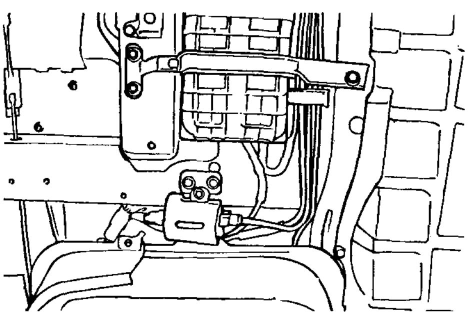
EFA9136A

3. Remove the fuel tank cap.
4. Disconnect the return hose and vapor hose.



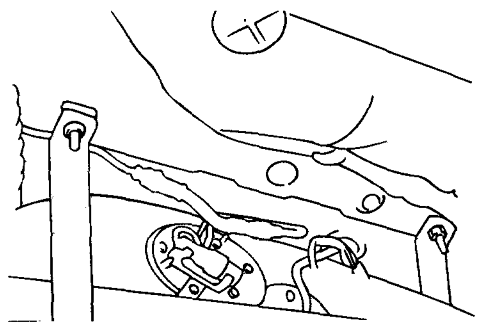
EFHA136C

5. Disconnect the fuel pump connector.
6. Disconnect the high pressure hose from the fuel tank.



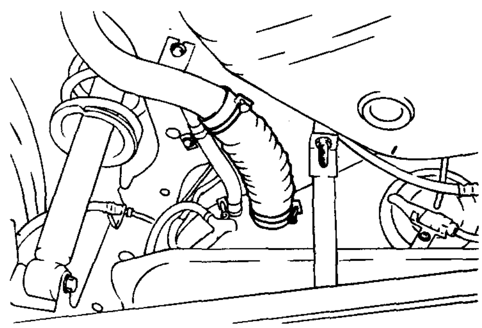
EFHA136C

7. Loosen the two self-locking nuts that hold the tank in position and remove the two tank bands.



EFA9136D

8. Detach the fuel filler hose and leveling hose.
9. Remove the fuel vapor hose and the fuel tank.

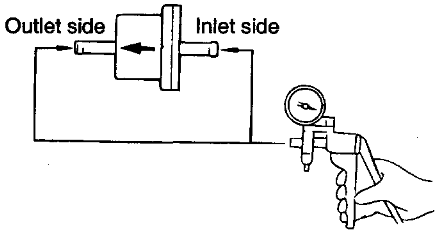


EFA9136E

INSPECTION EFA91370

1. Check the hoses and the pipes for cracks or damage.
2. Check the fuel tank cap for proper operation.
3. Check the fuel tank for deformation, corrosion or cracking.
4. Check the fuel tank inside for dirt or contamination.
5. Check the in-tank fuel filter for damage or restriction.
6. Test the two-way valve for proper operation.
7. Using a vacuum hand pump, check the operation of the two-way valve.

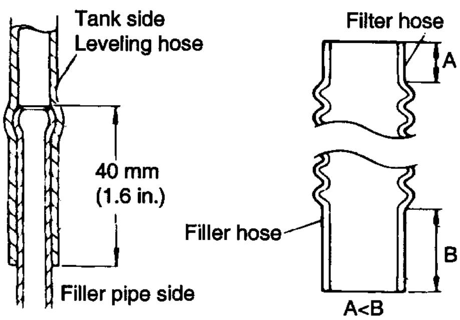
Valve pump	Guide lines for acceptance or rejection
When connected to inlet side	Negative pressure generated and vacuum maintained
When connected to outlet side	No negative pressure generated



EFA9137A

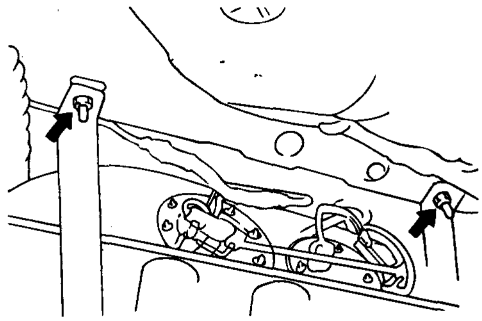
INSTALLATION EFJB1380

1. Connect the leveling hose to the tank at approximately 40 mm (1.6 in.) of the filler neck.
2. When connecting the filler hose, connect the end with the shorter straight pipe to the tank side.



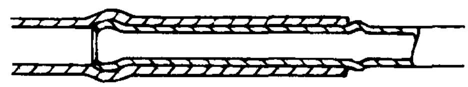
EFA9138A

3. Confirm that the pad is fully bonded to the fuel tank. Install the fuel tank by tightening the self-locking nuts to the tank bands until the rear end of the tank band contacts the body.



EFA9138B

4. Connect the vapor hose and return hose. Attach the fuel hose to the line as shown in the illustration.

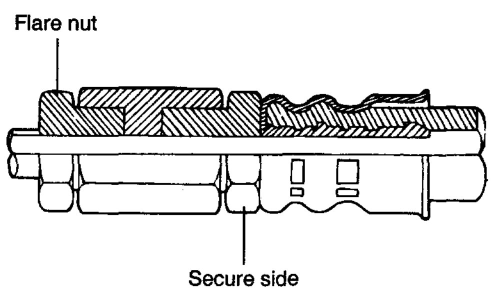


EFA9138C

5. To connect the high pressure hose to the fuel pump, temporarily tighten the flare nut by hand, and then tighten it to the specified torque. Be careful that the fuel hose does not twist.

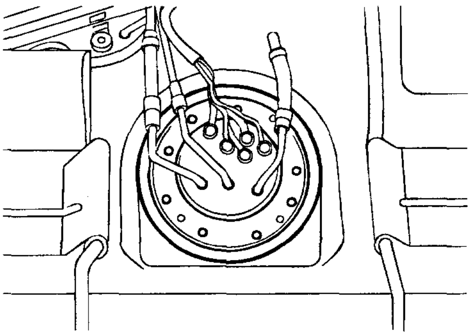
Tighttening torque
High pressure hose flare nut :
30-40 Nm(300-400 kg·cm, 22-29 lb·ft)

NOTE
When tightening the flare nut, be careful not to bend or twist the line to prevent damage to the fuel pump connection.



EFA9138D

6. Connect the electrical fuel pump assembly connector.



EFHA006A

TROUBLESHOOTING FOR DTC

DIAGNOSTIC ITEM EFMB5000

DTC	Diagnostic item
P0100	Mass Air Flow Sensor Malfunction
P0101	Mass Air Flow Circuit Rang/Performance Problem
P0102	Mass Air Flow Circuit Low Voltage
P0103	Mass Air Flow Circuit High Voltage

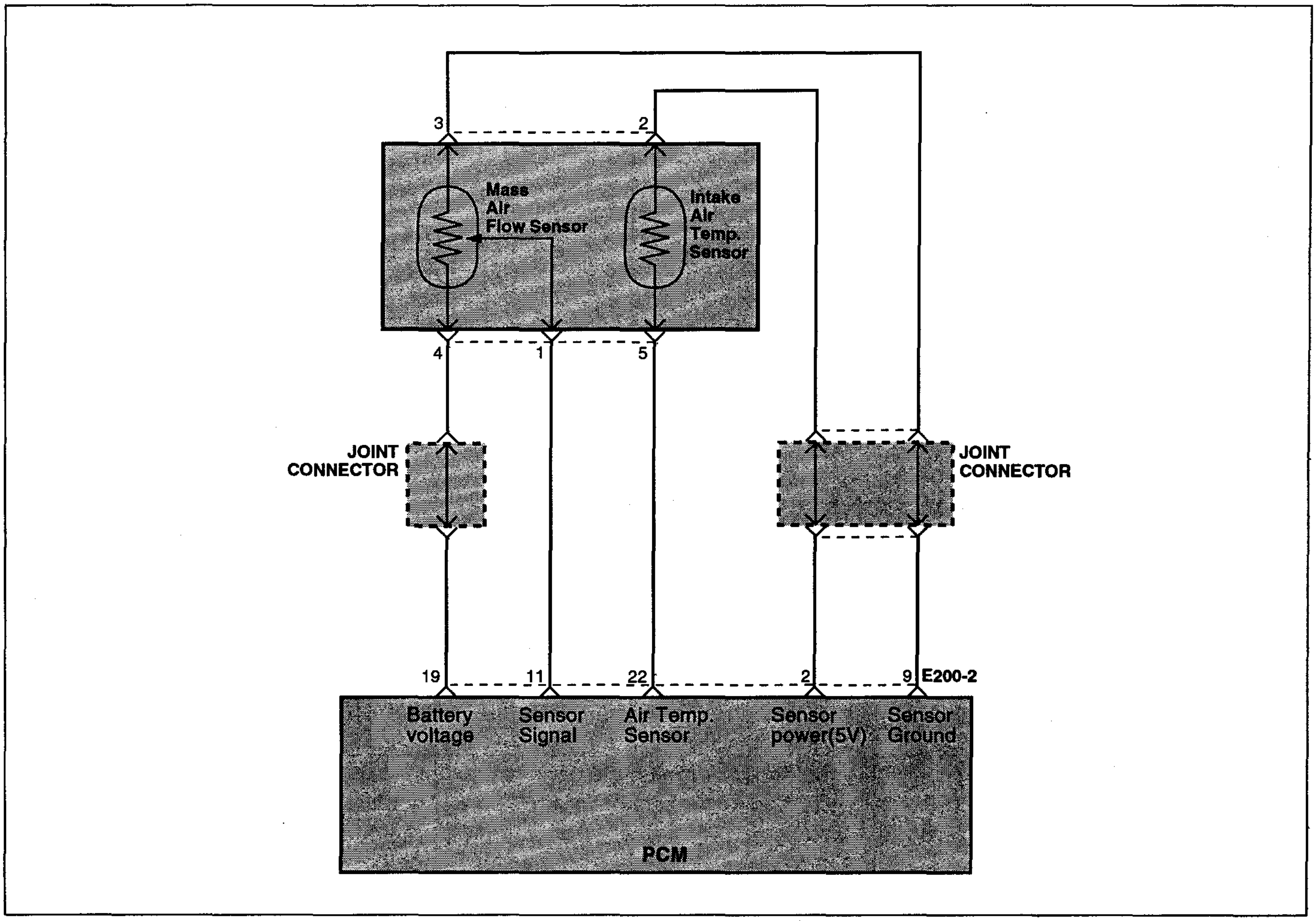
DESCRIPTION

The Mass Air Flow (MAF) sensor is located near the air cleaner.
The sensor measures the mass of air passing through the air intake and generates a voltage signal. The Powertrain Control Module(PCM) receives the voltage generated by the sensor and uses the signal to set fuel injector base pulse width and ignition timing.
The resistance of the sensor decreases as mass air flow increases. Voltage and current flow is increased to maintain the film's temperature and resistivity.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Background • While the engine is running, the mass air flow sensor outputs a voltage signal which corresponds to the mass of air flow. • The Powertrain Control Module checks whether the voltage of this signal is at or above the set value. Check Area • At idle rpm • Or engine speed is 3000 r/min or more Judgment Criteria • Sensor output voltage has continued to be 0.5V or lower for 4 sec. Check Area • Throttle position sensor voltage is 12V or lower. • Engine speed is 2000 rpm or less. Judgment Criteria • Sensor output voltage has continued to be 4.5V or higher for 4 seconds.	• Mass air flow sensor failed • Open or shorted mass air flow sensor circuit, or loose connector • Powertrain control module failed

CIRCUIT DIAGRAM



EFMB705A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0100, P0101, P0102 or P0103 is set.

Is DTC P0112 or P0113 also set?

YES → A

CONTINUED ON NEXT PAGE

NO

- Start engine.
- Using scan tool, monitor MAF sensor signal.

Is signal within normal parameters?

No, signal is always below normal.

- Disconnect MAF sensor.
- Ignition on, engine off.
- Measure voltage between ground and MAF sensor harness connector terminal 4.

Battery voltage should be present, is it?

YES

Check sensor for restrictions such as leaves or other debris. If OK, replace MAF sensor. Clear code and verify MAF is within normal parameters.

→ B

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NO

Repair open in wire supplying battery voltage to MAF sensor. Clear code and verify MAF sensor is within normal parameters.

Yes, signal is within normal parameters.

Problem is intermittent or was repaired and Powertrain Control Module (PCM) memory was not cleared. Check terminal connections at PCM and MAF sensor. Clear code and verify MAF is within normal parameters.

No, signal varies, but sometimes falls below normal

Check MAF sensor for restrictions such as leaves or other debris. Also, check sensor terminals for corrosion or loose connections. If OK, replace MAF sensor. Clear code and verify MAF is within normal parameters.

MP0100B

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A

- Turn the ignition off.
- Disconnect MAF sensor.
- Measure resistance between ECM connector E200-2 terminal 22 and MAF sensor harness connector terminal 5.

Resistance should be approximately 1 ohm or less, is it?

YES

Replace MAF sensor. Clear code and verify MAF is within normal parameters.

NO

Repair open in wire between MAF sensor harness connector terminal 5 and ECM connector E200-2 terminal 22. Clear code and verify MAF is within normal parameters.

CONTINUED FROM PREVIOUS PAGE

B

YES

- Ignition off, PCM and MAF sensor still disconnected.
- Ground MAF sensor harness connector terminal 3.
- Measure resistance between ground and ECM connector E200-2 terminal 9.

Resistance should be approximately 1 ohm or less, is it?

YES

Verify PCM connectors are secure. If OK, replace MAF sensor with a known good component.
Clear code and verify MAF sensor is within normal parameters. If problem persists, replace ECM.

NO

Repair open in wire between MAF sensor harness connector terminal 3 and PCM. Clear code and verify MAF is within normal parameters.

MP0100C

EFMB5020

DTC	Diagnostic item
P0110 P0112 P0113	Intake Air Temperature Sensor Malfunction Intake Air Temperature Circuit Low Voltage Intake Air Temperature Circuit High Voltage

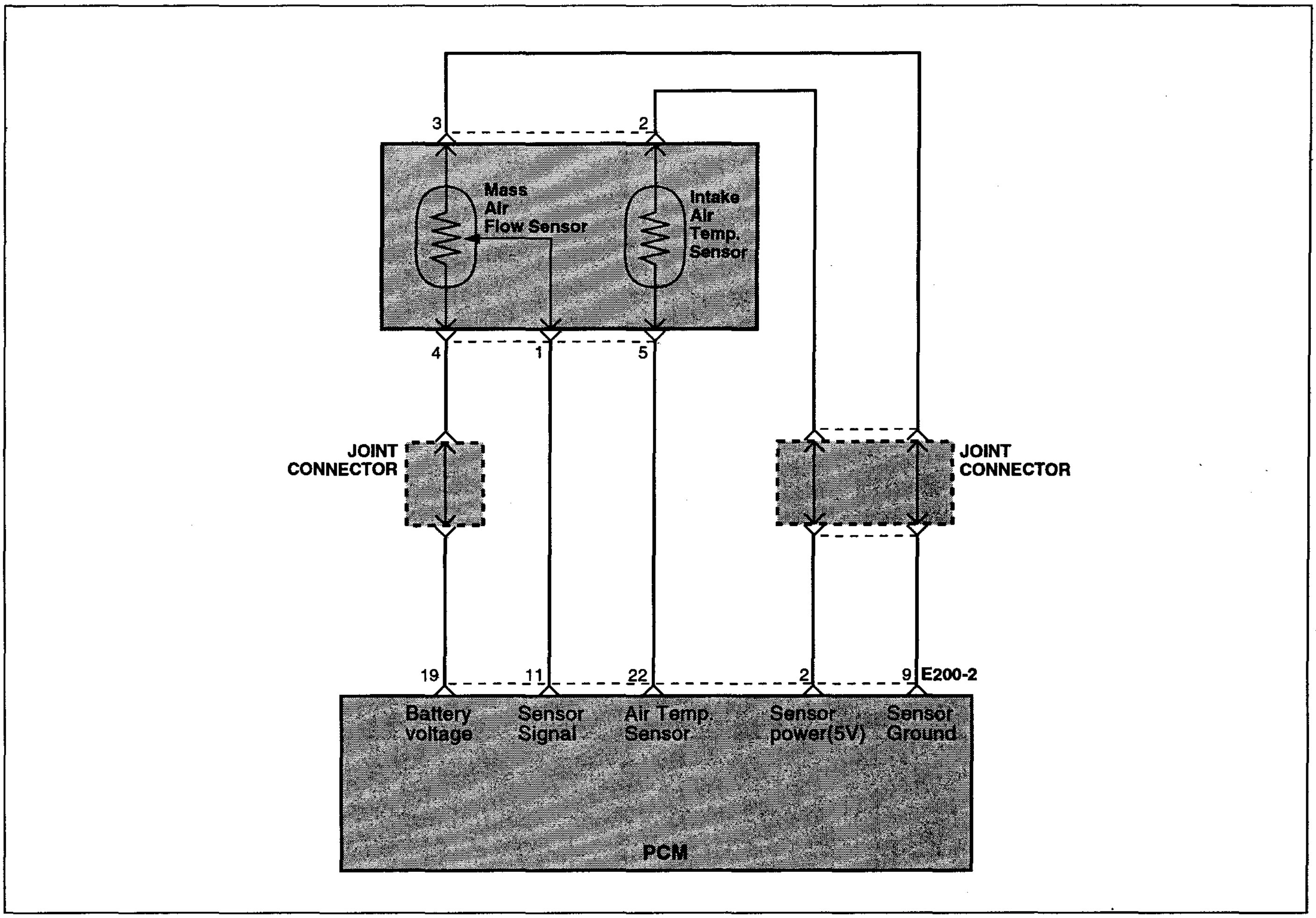
DESCRIPTION

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 Powertrain Control Module (PCM) 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.	• IAT sensor failed • Open or shorted mass air flow sensor circuit, or loose connector • powertrain control module failed

CIRCUIT DIAGRAM



EFMB705A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0110, P0112 or P0113 is set.

Is other DTC also set?

NO

- Engine at ambient temperature (overnight cool down in shop recommended).
- Measure air temperature of shop.
- Turn the ignition on.
- Connect scan tool and observe intake air temperature (IAT) sensor reading.

Scanned temperature should be very close to shop air temperature, is it?

YES

A

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No, scanned temperature is above air temperature of shop.

No, scanned temperature is below air temperature of shop.

Yes, scanned temperature is very close to measured air temperature of shop.

- Turn the ignition off.
- Disconnect MAF & IAT sensor.
- Turn the ignition on.
- Observe IAT sensor reading on scan tool.

Scanned temperature should now be -40˚F (-4.4˚C), is it?

- Turn the ignition off.
- Disconnect MAF & IAT sensor.
- Turn the ignition on.
- Measure voltage between ground and MAF & IAT harness connector terminal 2.

Voltage measured should be 4.5 to 5.0 volts, is it?

No problem found at this time. Fault is intermittent or was repaired and PCM memory was not cleared. Clear code and verify IAT sensor is within normal parameters.

NO

YES

Yes, 4.5 to 5.0 volts is present.

No, 0 volts is present.

No, 12 volts is present.

Replace MAF & IAT sensors. Clear code and verify IAT sensor is within normal parameters.

Repair short to battery voltage in wire between MAF & IAT sensor and PCM. Clear code and verify IAT sensor is within normal parameters.

B

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C

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MP0110B

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A

- Turn the ignition off.
- Disconnect MAF & IAT sensor.
- Measure resistance between ground and MAF & IAT sensor harness connector terminal 3.

Resistance should be approximately 1 ohm or less, is it?

YES

Replace MAF & IAT sensor. Clear codes and verify IAT sensor is within normal parameters.

NO

Repair open in wire between MAF & IAT sensor harness connector terminal 3 and PCM. Clear codes and verify IAT sensor is within normal parameters.

CONTINUED FROM PREVIOUS PAGE

B

- MAF & IAT sensor disconnected.
- Turn the ignition off.
- Disconnect PCM connector.
- Measure resistance between ground and MAF & IAT sensor harness connector terminal 5.

Resistance should indicate an open circuit, does it?

NO

Repair short to ground in wire between MAF & IAT sensor harness connector terminal 5 and PCM. Clear code and verify IAT sensor is within normal parameters.

YES

Verify PCM connectors are secure If OK, replace MAF & IAT sensor. Clear code and verify IAT sensor is within normal parameters. If problem persists, replace ECM.

CONTINUED FROM PREVIOUS PAGE

C

- MAF & IAT sensor disconnected.
- Turn the ignition off.
- Disconnect PCM connector C44-2.
- Ground MAF & IAT sensor harness connector terminal 1.
- Measure resistance between ground and PCM connector C44-2 terminal 9.

Resistance should be approximately 1 ohm or less, is it?

YES

Verify PCM connectors are secure If OK, replace MAF & IAT sensor. Clear code and verify IAT sensor is within normal parameters. If problem persists, replace ECM.

NO

Repair open in wire between MAF & IAT sensor harness connector terminal 5 and PCM. Clear code and verify IAT sensor is within normal parameters.

MP0110C

EFMB5030

DTC	Diagnostic item
P0115 P0116 P0125	Engine Coolant Temperature Circuit Malfunction (Open/Short) Engine Coolant Temperature Circuit Drift Insufficient Coolant Temperature For Feed-Back Control

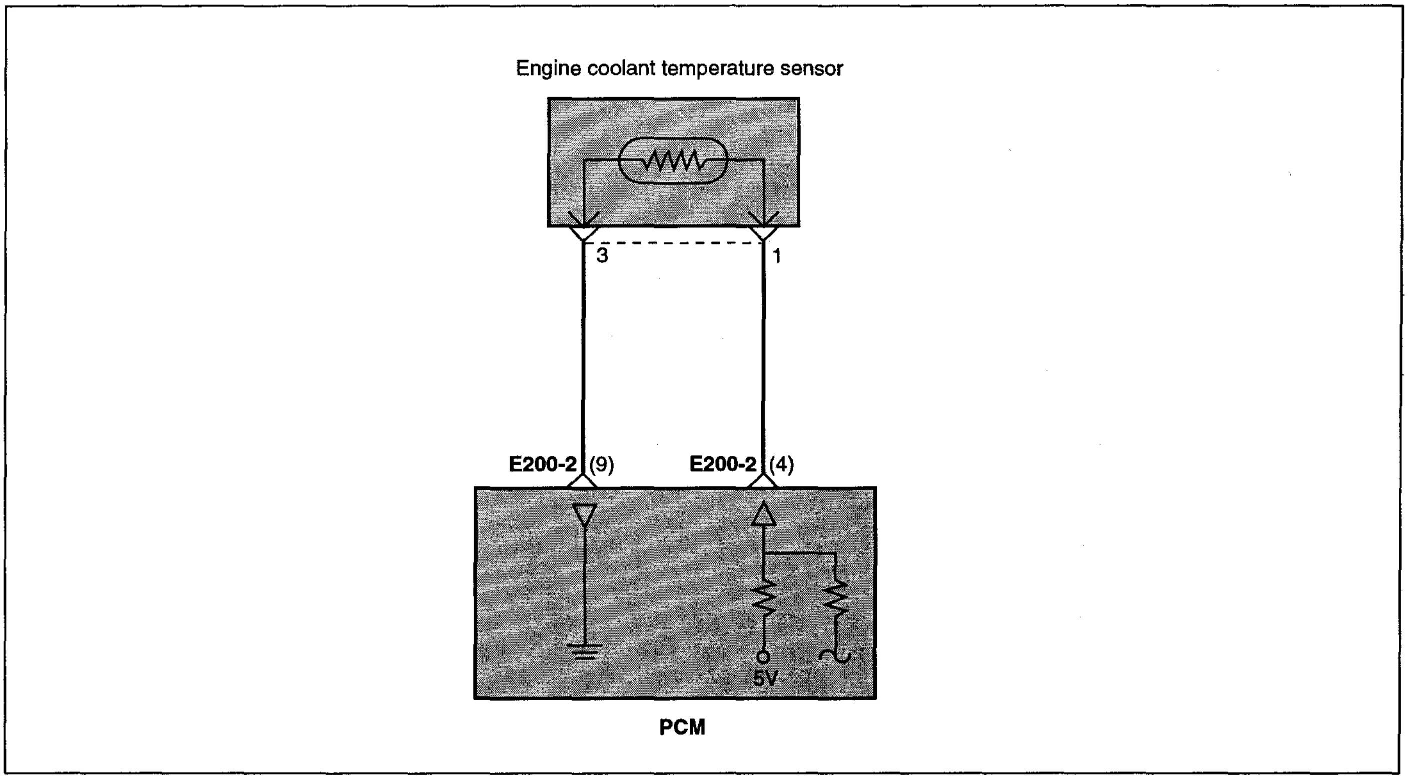
DESCRIPTION

The Engine Coolant Temperature (ECT) sensor is located in a 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 Powertrain Control Module (PCM) checks ECT voltage fifty times per second and uses the information to help adjust the fuel injector pulse width and ignition timing. When the temperature sensed is very cold, the PCM 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 Powertrain 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. Malfunction; out-of-range • 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. Malfunction; out-of-range • Sensor output voltage increased from a value lower than 1.6V to a value higher than 1.6V [Coolant temperature decreases from higher than 40°C (104°F) temperature to lower than 40°C (104°F) temperature.]. • Sensor output voltage has continued to be 1.6V or higher for 5 min. Judgment Criteria, Proper Performance • The Engine Coolant Temperature is approx. 40°C (104°F) or less after starting sequence is completed. • 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. • Powertrain Control Module failed.

CIRCUIT DIAGRAM



MP0115A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0115, P0116 or P0125 is set.

Is DTC P0112, P0113 also set?

NO

- Engine cold.
- Connect scan tool and observe Engine Coolant Temperature (ECT) sensor and IAT sensor readings.

Scanned temperatures should agree with air temperature of shop. Do they?

YES

Refer to section P0112, P0113 and follow those test procedures.

YES

- Turn ignitition off.
- Disconnect ECT sensor.
- Turn the 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, 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 any codes and verify ECT sensor is within normal parameters.

No, less than 4.5 volts is present

- Turn the ignition off.
- Disconnect the ECT sensor.
- Disconnect PCM connector E200-2.
- Ground ECT harness connector terminal 3.
- Measure resistance between ground and PCM harness connector E200-2 terminal 9.

Resistance should be approximately 1 ohm or less. Is it?

YES

A

CONTINUED ON NEXT PAGE

NO

Repair open circuit between ECT sensor harness connector terminal 3 and PCM harness connector E200-2 terminal 9. Clear all codes and verify ECT sensor is within normal parameters.

MP0115B

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A

- Turn the ignition off.
- Disconnect the ECT sensor.
- Disconnect PCM connector E200-2.
- Measure resistance between ground and PCM harness connector E200-2 terminal 9.

Resistance should indicate an open circuit. Does it?

YES

- Turn the ignition off.
- Disconnect the ECT sensor.
- Disconnect PCM connector E200-2.

Measure resistance between ground and ECT sensor harness connector terminal 1.

Resistance should indicate an open circuit. Does it?

YES

Verify PCM connector is secure. Replace ECT sensor with a known good component. If problem persists, replace PCM. Clear code and verify ECT sensor is within normal parameters.

NO

Repair open circuit between ECT sensor harness connector terminal 1 and PCM harness connector E200-2 terminal 4. Clear any codes and verify ECT sensor is within normal parameters.

NO (first check)

Repair short to ground between ECT sensor harness connector terminal 3 and PCM harness connector E200-2 terminal 9. Clear all codes and verify ECT sensor is within normal parameters.

MP0115C

EFMB5040

DTC	Diagnostic item
P0120 P0122 P0123	Throttle Position Circuit Malfunction Throttle Position Circuit Low Voltage Throttle Position Circuit High Voltage

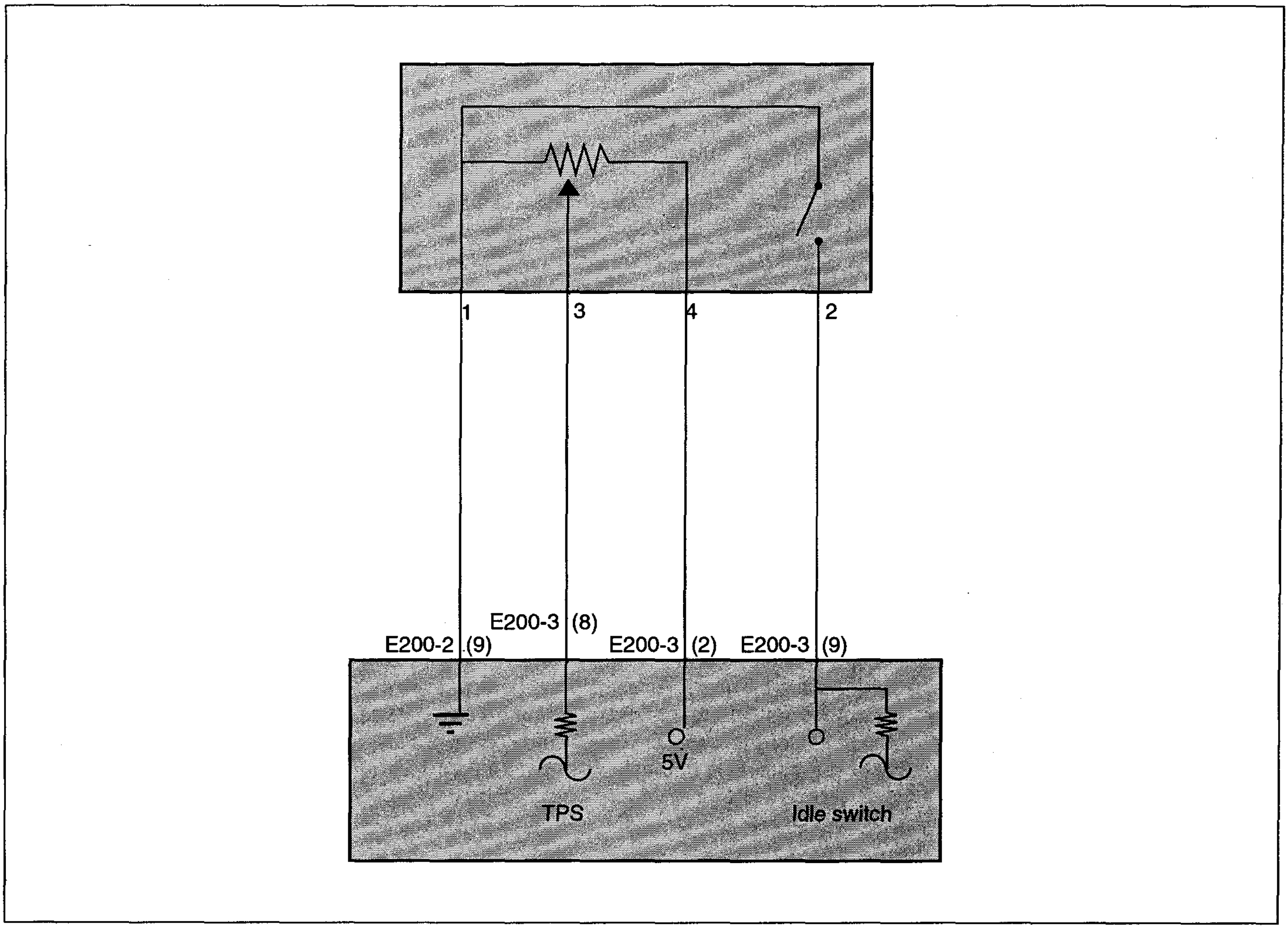
DESCRIPTION

The throttle position sensor (TPS) mounts on the side of the throttle body and is connected to the throttle blade shaft. The TPS is a variable resistor (potentiometer) whose resistance changes according to the throttle blade shaft position. During acceleration, the TPS resistance decreases; during deceleration, the TPS resistance increases. The TPS also includes an idle position switch. The switch is closed in the idle position. The Powertrain Control Module (PCM) applies a reference voltage to the TPS and then measures the voltage that is present on the TPS signal circuit. The PCM uses the TPS signal to adjust the timing and injector pulse width. The TPS signal along with the MAP sensor signal is used by the PCM 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 Powertrain 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. Malfunction; out-of-range • With the close Throttle Position switch set 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. Operating parameters • Engine speed is between 500 and 3,000 rpm. • Engine load is lower than 30%. Proper Performance • 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. • Powertrain control module failed.

CIRCUIT DIAGRAM



MP0120A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0120, P0122 or P0123 is set.

Are any other codes also set?

NO

- Turn the ignition on with the 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 or below 0.3V.

- Turn the ignition on, with the engine off.
- Throttle should be 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?

No, output is above 0.9V

- Turn the ignition off.
- Disconnect TP sensor.
- Turn the ignition on (engine off).
- Using scan tool, measure voltage.

Voltage should be 0 volts. Is it?

Yes, output is between 0.3V and 0.9V.

Problem is intermittent or was repaired, and PCM memory was not cleared. Check terminal connections at PCM and TP sensors. Clear any codes and verify TP sensor is within normal parameters.

YES

Replace TP sensor. Clear any codes and verify TP sensor is within normal parameters.

NO

Repair short to voltage in wire between TP sensor harness connector terminal 4 and PCM harness connector E200-2 terminal 2. Clear any codes and verify TP sensor is within normal parameters.

NO

B

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YES

- Ignition on, engine off.
- Hold throttle in wide open position.
- Measure TP sensor voltage.

Voltage should be about 4.8 volts, is it?

C

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MP0120C

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B

- Turn the ignition off.
- Disconnect TP sensor.
- Turn the ignition on.
- Using a voltmeter, measure voltage between ground and TP sensor harness connector terminal 4.

5 volts should be present. Is it?

YES

- Turn the ignition on with the engine off.
- Disconnect the TP sensor.
- 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 4 and PCM harness connector E200- terminal 2.
Clear any codes and verify TP sensor is within normal parameters.

YES

- Connect a fused jumper across TP sensor harness connector terminal 1 and terminals 4.
- 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 PCM harness connector E200-2 terminal 2.
Clear code and verify TP sensor is within normal parameters.

NO

- Turn the ignition off.
- Fused jumper in place.
- Measure voltage (backprobe) between PCM connector E200-3 terminal 2 and ETS connector E200-2 terminal 4.

5 volts should be present. Is it?

YES

Replace TP sensor.
Clear code and verify TP sensor is within normal parameters.

D

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MP0120D

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D

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C

YES

Fault repaired. Problem was misadjusted TP sensor. Clear any codes and verify TP sensor is within normal parameters.

NO

Replace TP sensor. Clear any codes and verify TP sensor is within normal parameters.

YES

- Turn the ignition on with the engine idling.
- Using scan tool, observe idle output.

Idle switch should be closed. Is it?

NO

Repair open or short to ground.
Clear any codes and verify TP sensor is within normal parameters.

YES

- Turn the ignition off.
- Disconnect the TP sensor.
- Measure resistance between TP sensor connector terminal 2 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?

NO

Replace throttle position sensor.
Clear code and verify TP sensor is within normal parameters.

YES

Verify PCM connector is secure. If OK, replace the TP sensor. If problem persists, replace PCM. Clear any codes and verify TP sensor is within normal parameters.

NO

Replace the TP sensor.
Clear any codes and verify TP sensor is within normal parameters.

MP0120E

EFMB5060

DTC	Diagnostic item
P0132 P0133 P0150 P0152	Oxygen Sensor Circuit Malfunction -Open (Bank 1, Sensor 1) Oxygen Sensor Circuit Malfunction (Bank 1, Sensor 1) Oxygen Sensor Circuit Malfunction (Bank 2, Sensor 1) Oxygen Sensor Circuit Malfunction Open (Bank 2, Sensor 1)

DESCRIPTION

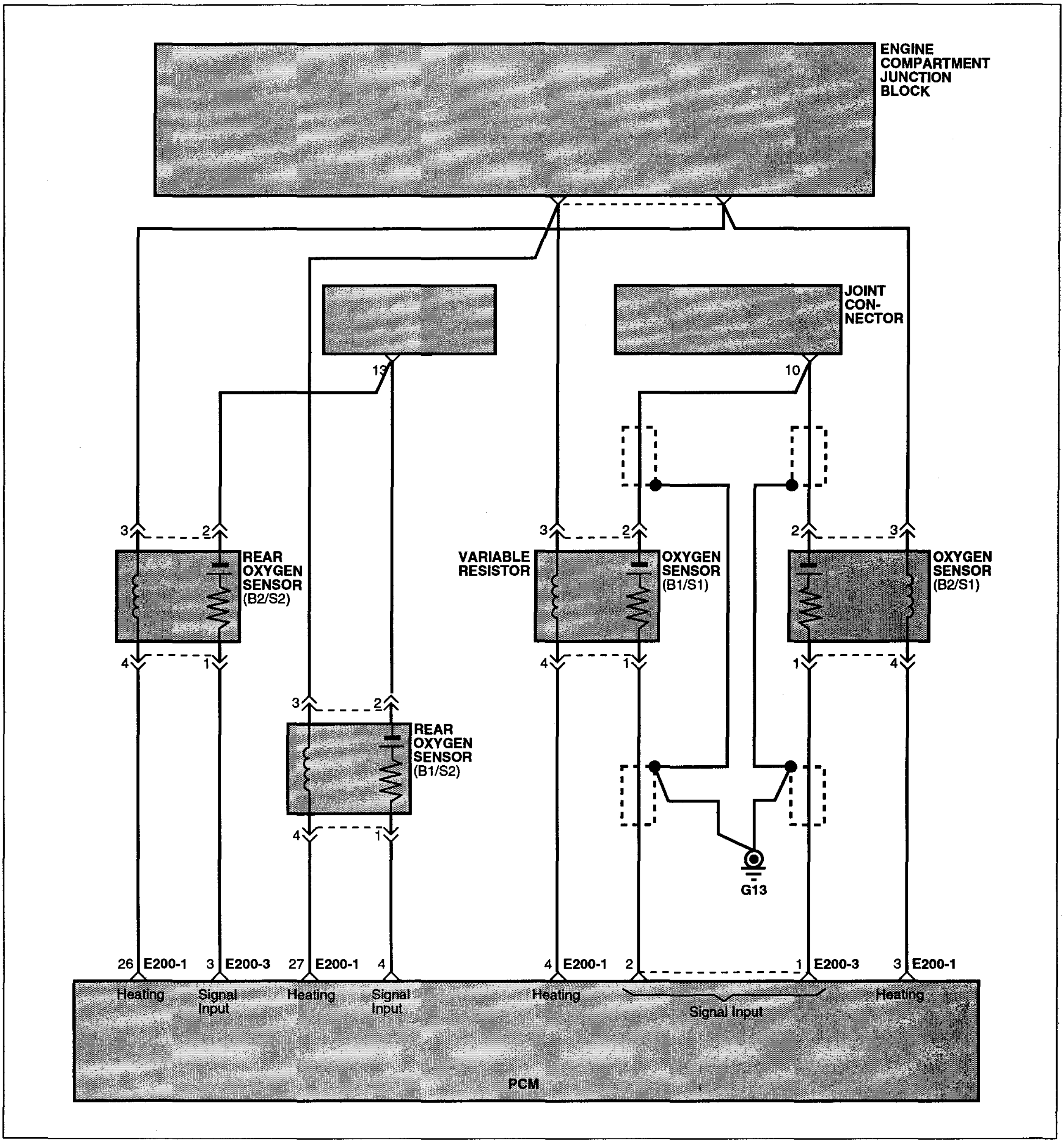
To obtain a high purification rate for the CO, HC and NOx components of the exhaust gas, a three way catalytic converter is used, but for the most efficient use of the three-way catalytic converter, the ratio of the air must be precisely controlled so that it is always close to the stoichiometric air-fuel 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 PCM of the LEAN condition. 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 PCM of the RICH condition.

The PCM determines 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 PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. 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 Powertrain 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 Powertrain Control Module also checks for an open circuit in the heated oxygen sensor output line. Malfunction; out-of-range • 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 Powertrain Control Module interface circuit is 4.5V or more when 5V is applied to the heated oxygen sensor output line via a resistor. Proper Operation • 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. Failure Criteria • When the air-fuel ratio is forcibly 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 • Powertrain control module failed

CIRCUIT DIAGRAM



EFMB109A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0132, P0133, P0150 or P0152 is set.

Are other DTCs also set?

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?

YES

First, repair conditions that caused other DTCs to be set. Refer to DTC test procedures.

No, voltage is constant and the reading is between 19 and 58mV.

- While running the engine, measure voltage (backprobe) between front oxygen sensor connector terminals 1 and 2.

Does voltage read above and below 500mV?

A

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No, voltage is constant and approximately 5 or 12 volts.

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 1 and ground. 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).

B

No, voltage varies but stays above 500mV (rich).

C

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Yes, voltage varies between 100 and 900mV.

D

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MP0132B

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A

YES

- Turn the ignition off.
- Disconnect front oxygen sensor.
- Disconnect PCM connector.
- Ground front oxygen sensor harness connector terminal 1.
- Measure resistance between ground and the related PCM harness connector E200-3 terminal.

Resistance measured should be approximately 1 ohm or less. Is it?

YES

Verify PCM 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 PCM.

NO

Repair open wire or cause of high resistance. Clear code and verify oxygen sensor is within normal parameters.

NO

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

CONTINUED FROM PREVIOUS PAGE

B

Voltage varies but stays below 500mV (lean).

- Inspect air inlet downstream of air flow sensor for leaks or damage.
- Inspect exhaust manifold for cracks.

Are any leaks or damage found?

YES

Repair leaks or replace exhaust manifold. Clear code and verify oxygen sensor is within normal parameters.

NO

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C

Voltage varies but stays above 500mV (rich).

- Perform a fuel pressure test

Is fuel pressure within specification and no pressure leak down is observed?

E

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MP0133C

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Voltage varies between 0 and 900mV.

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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

EFMB5070

DTC	Diagnostic item
P0135 P0155	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 1) Oxygen Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)

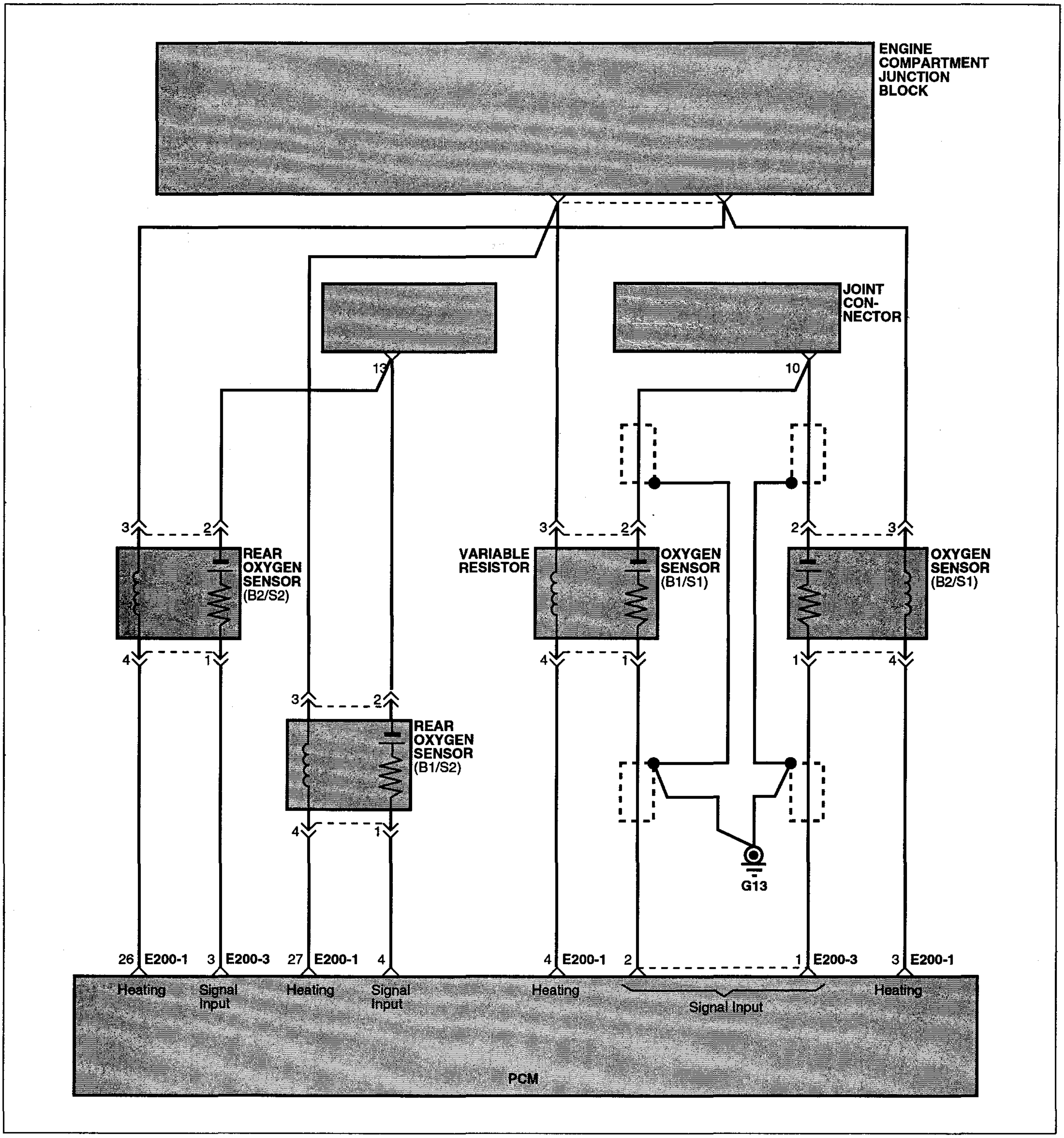
DESCRIPTION

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 converter, 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 PCM of the LEAN condition. 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 PCM of the RICH condition.
The PCM determines 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 PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. 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 Powertrain 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 • The heater current of the front heated oxygen sensor heater (Bank 1 Sensor 1 and Bank 2 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 • Powertrain control module failed

CIRCUIT DIAGRAM



EFMB109A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0135 or P0155 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?

YES

- Turn the ignition switch off.
- Disconnect the front oxygen sensor.
- Disconnect the related PCM connector.
- Ground front oxygen sensor harness terminal 4.
- Measure resistance between ground and PCM harness connector E200-1 terminal 4 or E200-3 terminal 1.

Resistance should be 1 ohm or less. Is it?

NO

Repair open or short to ground in wire between engine compartment junction block terminal and oxygen sensor harness connector terminal 3.
Clear code and verify oxygen sensor is within normal parameters.

YES

- Turn the ignition switch off.
- Disconnect the front oxygen sensor.
- Disconnect the related PCM connector.
- 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 oxygen sensor harness connector terminal 4 and the related PCM harness connector terminal.
Clear code and verify oxygen sensor is within normal parameters.

A

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MP0135B

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A

YES

- Turn the ignition switch off.
- Disconnect the front oxygen sensor.
- Measure resistance between terminals 3 and 4 of oxygen sensor connector.

Is resistance within normal parameters (11 - 14 ohms)?

NO

Repair short to ground or another circuit in wire between oxygen sensor harness connector terminal 4 and the related PCM harness connector terminal.
Clear code and verify oxygen sensor is within normal parameters.

YES

Verify PCM connector is secure. If OK, replace Front Oxygen Sensor with a known good component. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

NO

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

MP0135C

EFMB5080

DTC	Diagnostic item
P0136	Oxygen Sensor Circuit Malfunction - Open (Bank 1, Sensor 2)
P0156	Oxygen Sensor Circuit Malfunction - Open (Bank 2, Sensor 2)
P0140	Oxygen Sensor Circuit Malfunction - Short (Bank 1, Sensor 2)
P0160	Oxygen Sensor Circuit Malfunction - Short (Bank 2, Sensor 2)

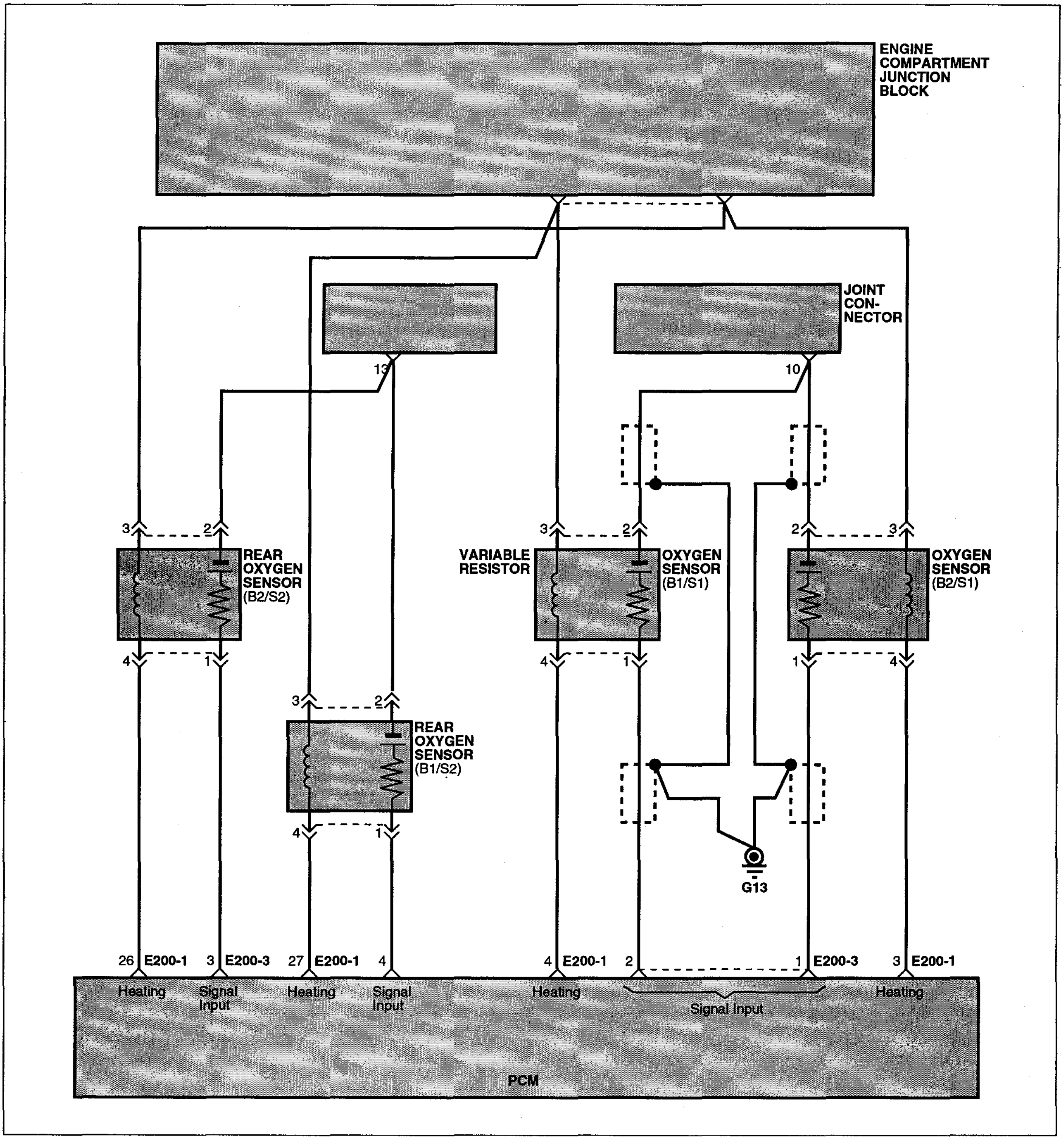
DESCRIPTION

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 converter, 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 PCM of the LEAN condition. 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 PCM of the RICH condition.
The PCM determines 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 PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. 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

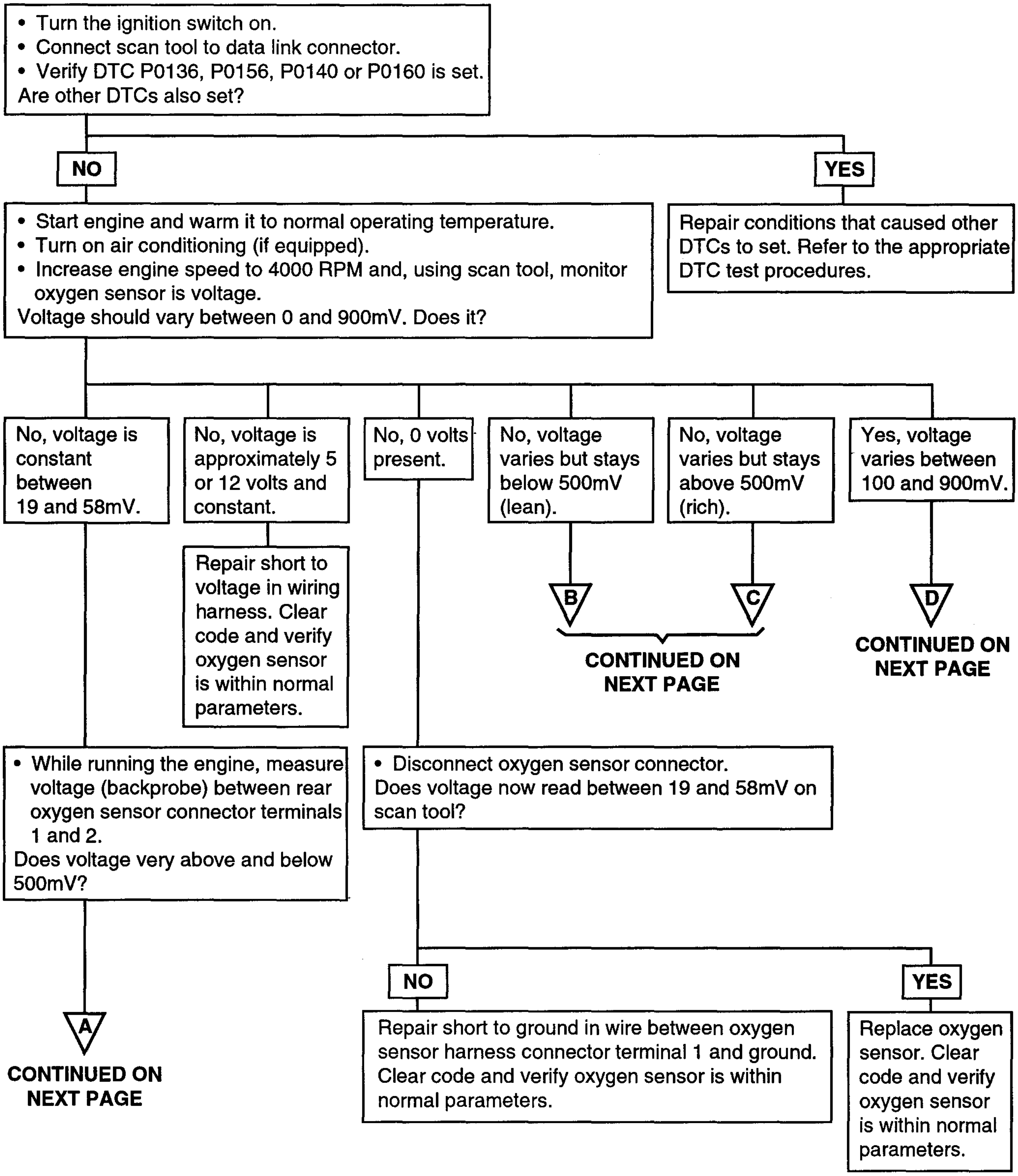
DTC detection condition	Probable cause
Background • The Powertrain Control Module checks for an open circuit in the heated oxygen sensor output line. Normal values • Coolant temperature sensor: Normal. • Heated oxygen sensor signal voltage has continued to be 0.1V or lower for 3 min. or more after the 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. Items to Check • Input voltage supplied to the Powertrain 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 • Powertrain control module failed

CIRCUIT DIAGRAM



EFMB109A

TEST PROCEDURE



MP0136B

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A

YES

- Turn the ignition off.
- Disconnect the related PCM connector.
- Disconnect rear oxygen sensor.
- Ground rear oxygen sensor harness connector terminal 1.
- Measure resistance of wire between oxygen sensor harness connector terminal 1 and the related PCM connector terminal.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Replace oxygen sensor.
Clear code and verify oxygen sensor is within normal parameters.

YES

Verify PCM connectors are secure. If OK, replace Rear Oxygen sensor.
Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

NO

Repair open wire or cause of high resistance. Clear code and verify oxygen sensor is within normal parameters.

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B

Voltage varies but stays below 500mV (lean).

- Inspect air inlet downstream of air flow sensor for leaks or damage.
- Inspect exhaust manifold for cracks.

Are any leaks or damage found?

YES

Repair leaks or replace exhaust manifold.
Clear code and verify oxygen sensor is within normal parameters.

NO

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C

Voltage varies but stays above 500mV (rich).

- Perform a fuel pressure test.

Is fuel pressure within specification and no pressure leak is observed?

E

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MP0136C

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Voltage varies between 0 and 900mV.

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YES

- Turn the 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?

NO

Follow diagnostic procedures outlined in shop manual. Clear code and verify oxygen sensor is within normal parameters.

YES

- Disconnect negative battery terminal.
- Measure resistance between generator case and 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 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 P0139 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.

BP0136D

EFMB5090

DTC	Diagnostic item
P0141 P0161	Oxygen Sensor Heater Circuit Malfunction (Bank 1, Sensor 2) Oxygen Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)

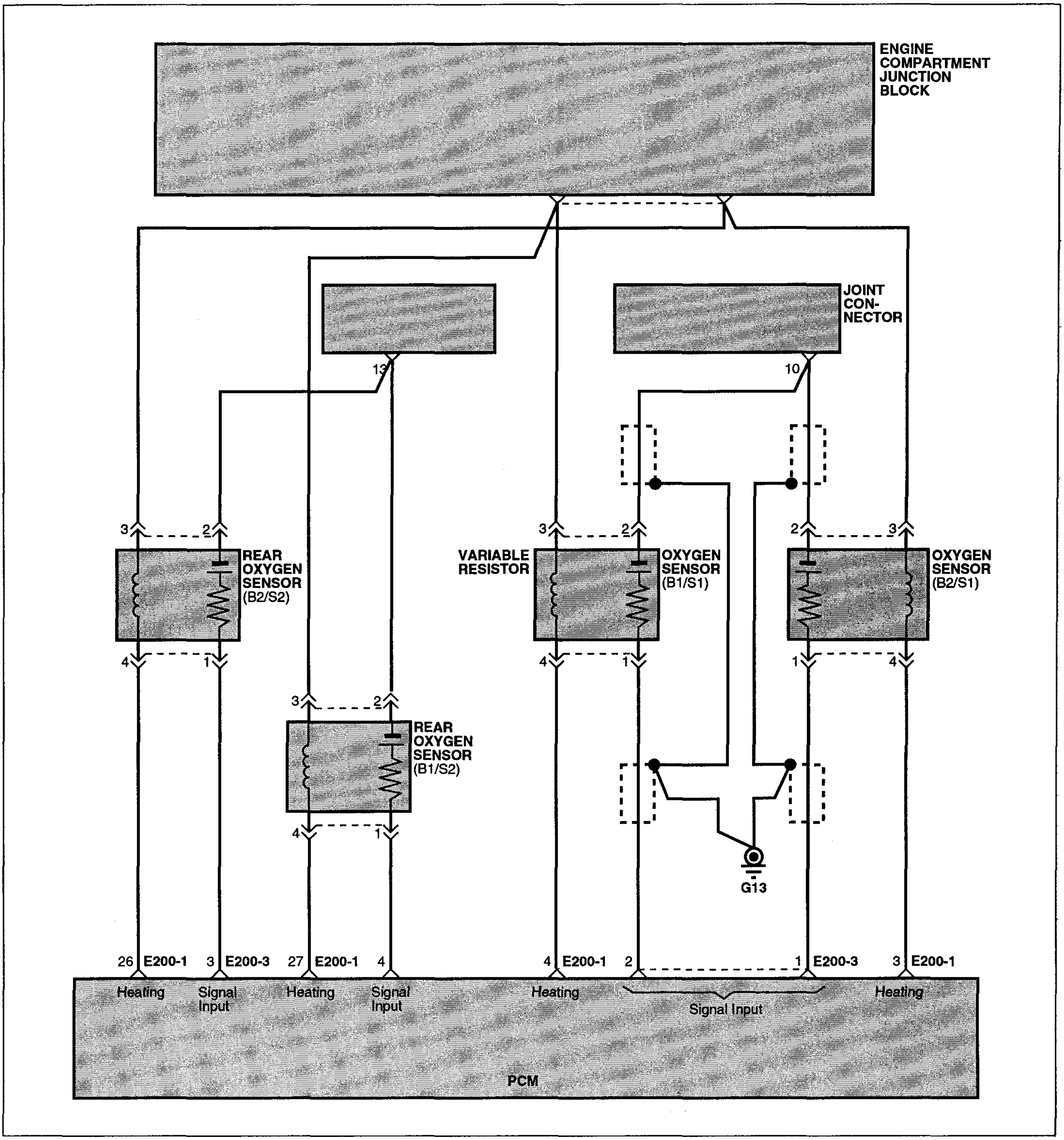
DESCRIPTION

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 converter, 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 PCM of the LEAN condition. 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 PCM of the RICH condition.
The PCM determines 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 PCM is unable to perform an accurate air-fuel ratio control. The heated oxygen sensors include a heater which heats the sensing element. The heater is controlled by the PCM. 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 Powertrain 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 • The heater current of the front heated oxygen sensor heater (Bank 1 Sensor 1 and Bank 2 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 • Powertrain control module failed

CIRCUIT DIAGRAM



EFMB109A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0141 or P0161 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?

NO

Repair open in wire between engine comportment junction block terminal and oxygen sensor harness connector terminal 3.
Clear code and verify oxygen sensor is within normal parameters.

YES

- Turn the ignition switch off.
- Disconnect the rear oxygen sensor disconnected.
- Disconnect the related PCM connector. Ground rear oxygen sensor harness connector terminal 4.
- Measure resistance between ground and the related PCM connector terminal.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Repair open in wire between the related PCM harness connector terminal and oxygen sensor harness connector terminal 4.
Clear code and verify oxygen sensor is within normal parameters.

YES

- Turn the ignition switch off.
- Disconnect the rear oxygen sensor disconnected.
- Disconnect PCM connector C44-1. Measure resistance between ground and oxygen sensor harness connector terminal 4.

Resistance should indicate an open circuit. Does it?

NO

Repair short to ground or another circuit in wire between the related PCM harness connector terminal 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)?

YES

Verify PCM connector is secure. If OK, replace Rear Oxygen sensor. Clear code and verify oxygen sensor is within normal parameters. If problem persists, replace PCM.

NO

Replace oxygen sensor. Clear code and verify oxygen sensor is within normal parameters.

MP0141B

EFMB5100

DTC	Diagnostic item
P0201, P0202 P0203, P0204 P0205, P0206	Injector Circuit Malfunction (Cylinder-1, Cylinder-2, Cylinder-3, Cylinder-4, Cylinder-5, Cylinder-6)

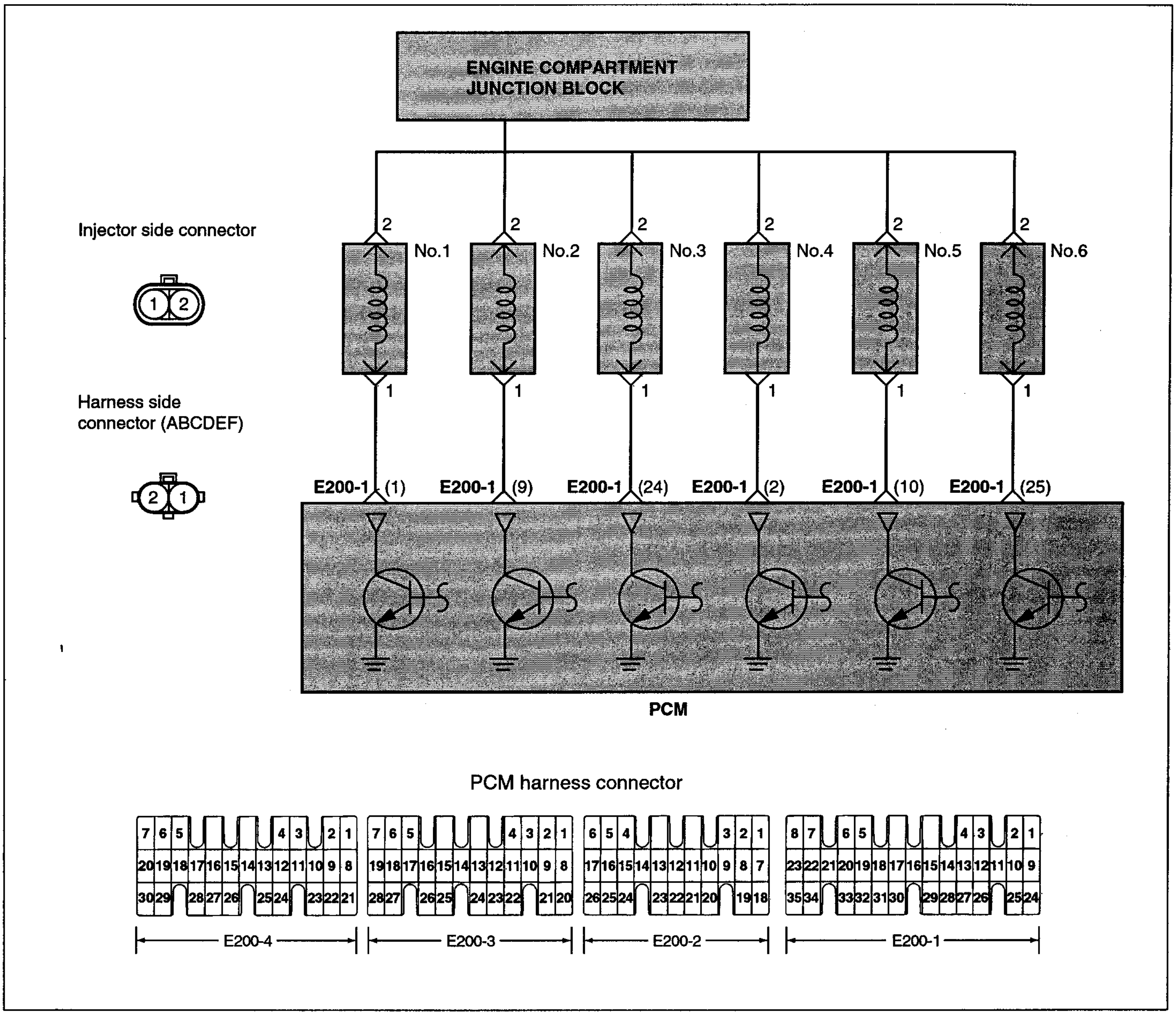
DESCRIPTION

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 Powertrain Control Module (PCM) controls injector timing and pulse width (how long the fuel injectors are turned on). The PCM pulses the fuel injectors based on information provided by its network of engine sensors. The PCM 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 PCM to calculate injector pulse width. The PCM 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 Powertrain Control Module checks this surge voltage. Normal Operation • The engine speed is between 50 and 1,000 r/min • Throttle position sensor output voltage is 1.16V or less. • Monitoring Time: 4 sec. Malfunction • Injector coil surge voltage (system voltage +2V) has not been detected for 4 sec.	• Failed injector • Open or shorted injector circuit, or loose connector • Failed powertrain control module

CIRCUIT DIAGRAM



EFMB115A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0201, P0202, P0203, P0204, P0205 or P0206 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 the ignition off.
- Disconnect fuel injector connector.
- Turn the 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 Powertrain Control Module (PCM) memory was not cleared.
Clear code and verify fuel injector functions.

YES

- Disconnect the fuel inector.
- Turn the ignition off.
- Disconnect the related PCM connector. Ground fuel injector harness connector terminal 1.
- Measure resistance between ground and the related PCM connector.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Repair open in wire between engine compartment junction block and fuel injector's harness connector terminal 2.
Clear code and verify fuel injector functions.

YES

- Turn the ignition off.
- Disconnect the fuel injector.
- PCM connector disconnected.
- Measure resistance between ground and fuel injector harness connector terminal 1.

Resistance should indicate an open circuit. Does it?

NO

Repair open in wire between the related PCM harness connector terminal and fuel injector harness connector terminal 1.
Clear code and verify fuel injector functions.

A

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MP0201B

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A

YES

- Turn the ignition off.
- Disconnect the fuel injector.
- 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 the related PCM harness connector terminal and fuel injector harness connector terminal 1.
Clear code and verify fuel injector functions.

YES

Verify PCM connector is secure. If OK, replace fuel injector with a known good component. Clear code and verify fuel injector operates.
If problem persists, replace PCM.

NO

Replace fuel injector.
Clear code and verify fuel injector operates.

MP0201C

EFMB5110

DTC	Diagnostic item
P0300	Random Misfire Detected

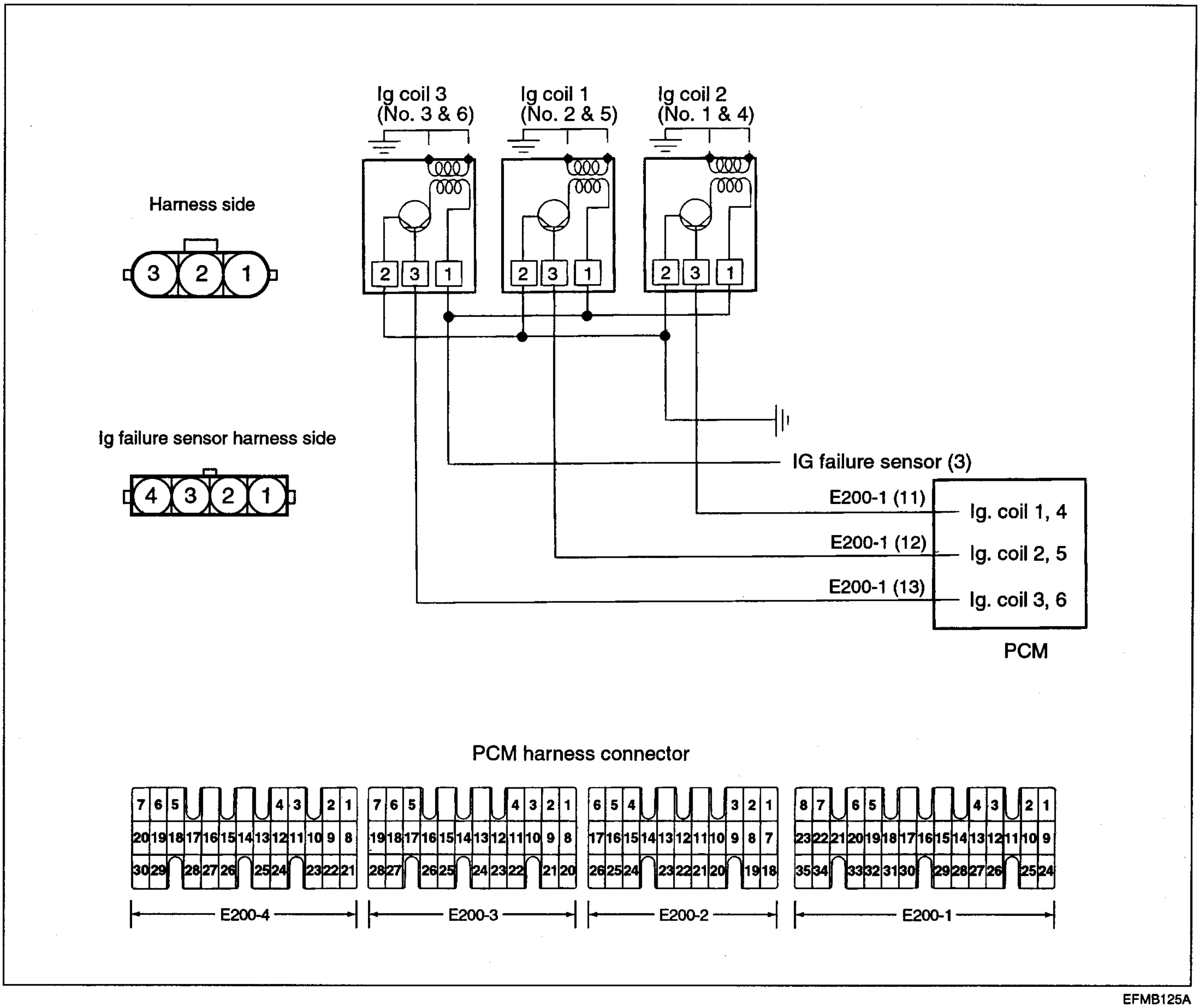
DESCRIPTION

With the ignition switch ON or START, voltage is applied to the ignition coil. 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 5. And coil number three fires cylinders 3 and 6.
The ignition power transistor, controlled by the Powertrain Control Module (PCM), 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 tachometer interface (part of the ignition power transistor) provides the PCM and Transaxle Control Module (TCM) with an RPM signal.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Background • If a misfire occurs while the engine is running, the engine speed suddenly changes. • The Powertrain Control Module checks for changes in the engine speed by monitoring the CKP signal. Normal Operation • Five seconds or more have passed after the engine has started. • The engine speed is between 500 and 6,000 r/min. • The engine Coolant Temperature is higher than -10°C(14°F). • The intake air temperature is higher than -10°C (14°F). • There is no sudden acceleration/deceleration such as during a shift change. Abnormal Operation (a change in the rate of angular acceleration by the crankshaft is monitored for misfire detection.) • A misfire has occurred more frequently than allowed during the last 200 revolutions [when the catalyst temperature is higher than 950°C (1,742°F)]. • A misfire has occurred more frequently than the allowed number of times (2%) during 1,000 motor revolutions.	• Failed ignition system part(s) • Poor crankshaft position sensor signal • Incorrect air/fuel ratio • Low compression • Failed engine coolant temperature sensor • Timing belt missing teeth • Failed injector • Failed powertrain control module

CIRCUIT DIAGRAM



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.
- Ground ignition coil harness connector terminals 2. Measure resistance between ground and PCM connector E200-1 terminals 11, 12 and 13.

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 3 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 2 and ECM connector E200-1 terminal 11, 12 and 13.
Clear code and verify code does not reappear.

A

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MP0300B

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A

YES

- Turn the ignition off.
- Measure resistance between ground and ignition failure sensor harness connector terminal 3.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Repair open in wire(s) between ignition failure sensor harness connector terminal 3 and ignition coil connector terminal 1.
Clear code and verify code does not reappear.

YES

- Disconnect the ignition coil.
- Reconnect PCM connectors.
- Put the ignition switch in the start position.
- Measure voltage between ground and ignition coil harness connector terminal 3.

Voltage should vary between 5 and 4 volts. Does it?

NO

Repair open in wire between engine compartment junction block and ignition coil connector terminal 3. Clear code and verify code does not reappear.

NO

Verify PCM connector is secure. If OK, replace power transistor with a known good component.
Clear code and verify code does not reappear.
If problem persists, replace PCM.

YES

- Turn the ignition off.
- Disconnect the ignition coil.
- 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 5. And measure resistance across ignition coil spark plug wire terminal 3 and 6.
  Note results for secondary coil resistance.

Primary coil resistance should be approximately 1.3 ohms. Secondary coil resistance should be between 10.3K ohms and 13.9K ohms.
Are resistances within specification?

B

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MP0300C

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B

YES

- Turn the ignition off.
- Inspect spark plugs, cables, fuel injectors and vacuum hoses.

Are components all undamaged and within specification?

NO

Repair or replace damaged or out of specification components. Clear code and verify code does not reappear.

YES

Replace power transistor. Clear code and verify code does not reappear.

NO

Replace ignition coil. Clear code and verify code does not reappear.

P0300D

EFMB5120

DTC	Diagnostic item
P0301, P0302, P0303, P0304, P0305, P0306	Misfire detected (Cylinder-1, Cylinder-2, Cylinder-3, Cylinder-4, Cylinder-5, Cylinder-6)

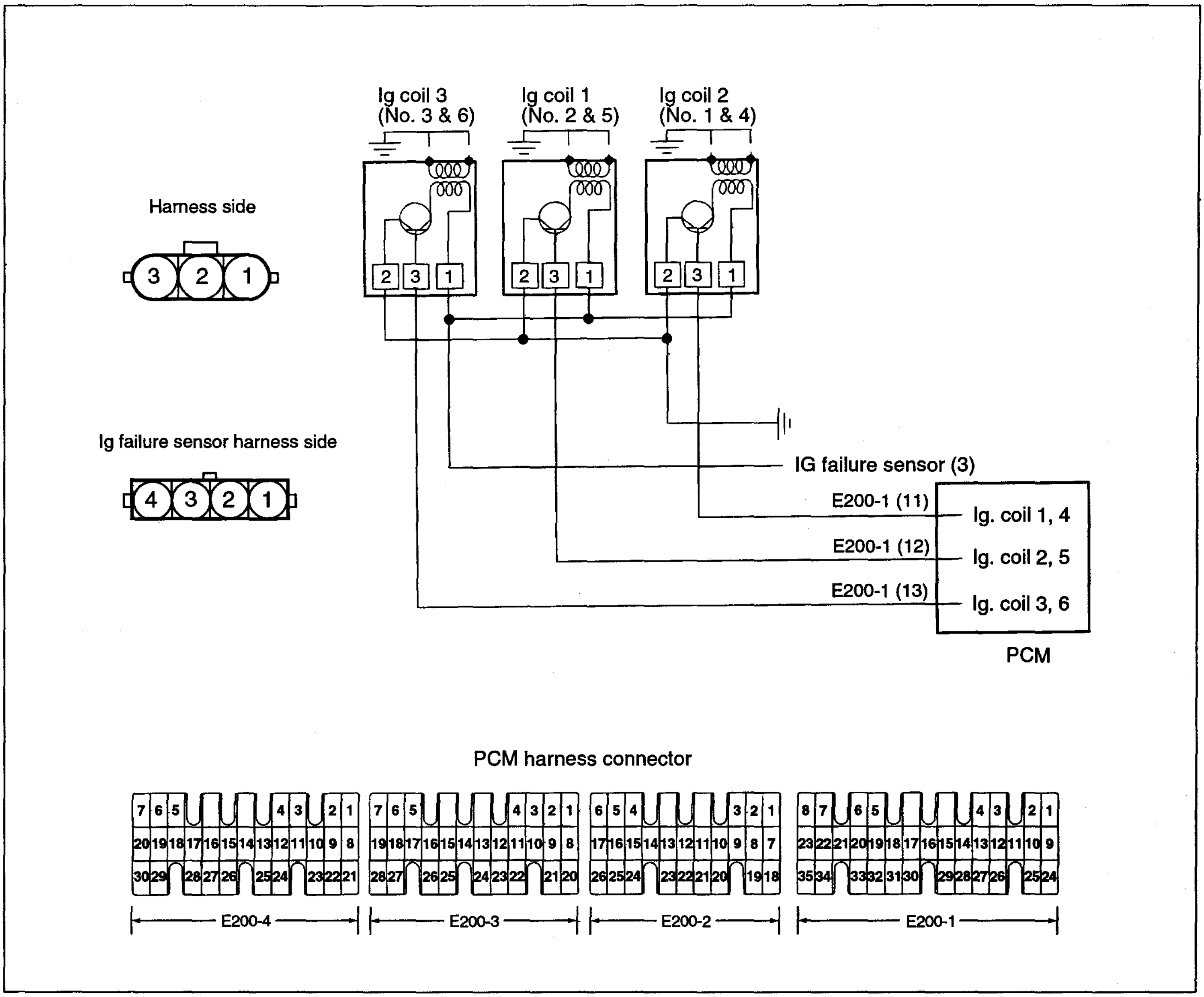
DESCRIPTION

With the ignition switch ON or START, voltage is applied to the ignition coil. 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 5. And coil number three fires cylinders 3 and 6.
The ignition power transistor, controlled by the Powertrain Control Module (PCM), 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 tachometer interface (part of the ignition power transistor) provides the PCM and Transaxle Control Module (TCM) with an RPM signal.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Background • If a misfire occurs while the engine is running, the engine speed suddenly changes. • The Powertrain Control Module checks for changes in the engine speed. Normal Operation • Five seconds or more have passed after the engine was started. • The engine speed is between 500 and 6,000 rpm. • The engine Coolant Temperature is higher than -10°C (14°F). • The intake air temperature is higher than -10°C (14°F). • The engine is not making sudden acceleration/deceleration such as during a shift. Malfunction Criteria (a change in the angular acceleration of the crankshaft is used for misfire detection.) • A 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)]. • A misfire has occurred more frequently than the allowed number of times (2%) during 1,000 motor revolutions.	• Failed ignition system related part(s) • Poor crankshaft position sensor signal • Incorrect air/fuel ratio • Low compression • Failed engine coolant temperature sensor • Timing belt missing teeth • Failed injector • Failed EGR valve • Failed powertrain control module

CIRCUIT DIAGRAM



EFMB125A

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, P0304, P0305 or P0306.

Is DTC P0201, P0202, P0203, P0204, P0205 or P0206 also set or is fuel less than 87 octane?

NO

- Turn the ignition off.
- Disconnect the ignition coil.
- 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 5. And measure resistance across ignition coil spark plug wire terminal 3 and 6.
  Note results for secondary coil resistance.

Primary coil resistance should be approximately 1.3 ohms. Secondary coil resistance should be between 10.3 Kohms ohms and 13.9 Kohms 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

- Turn the 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

- Turn the 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 PCM connector is secure. If OK, replace PCM. Clear code and verify code does not reappear.

NO

Clean or replace fuel injector. Clear code and verify code does not reappear.

BP0301B

EFMB5130

DTC	Diagnostic item
P0335	Crankshaft Position Sensor Circuit Malfunction

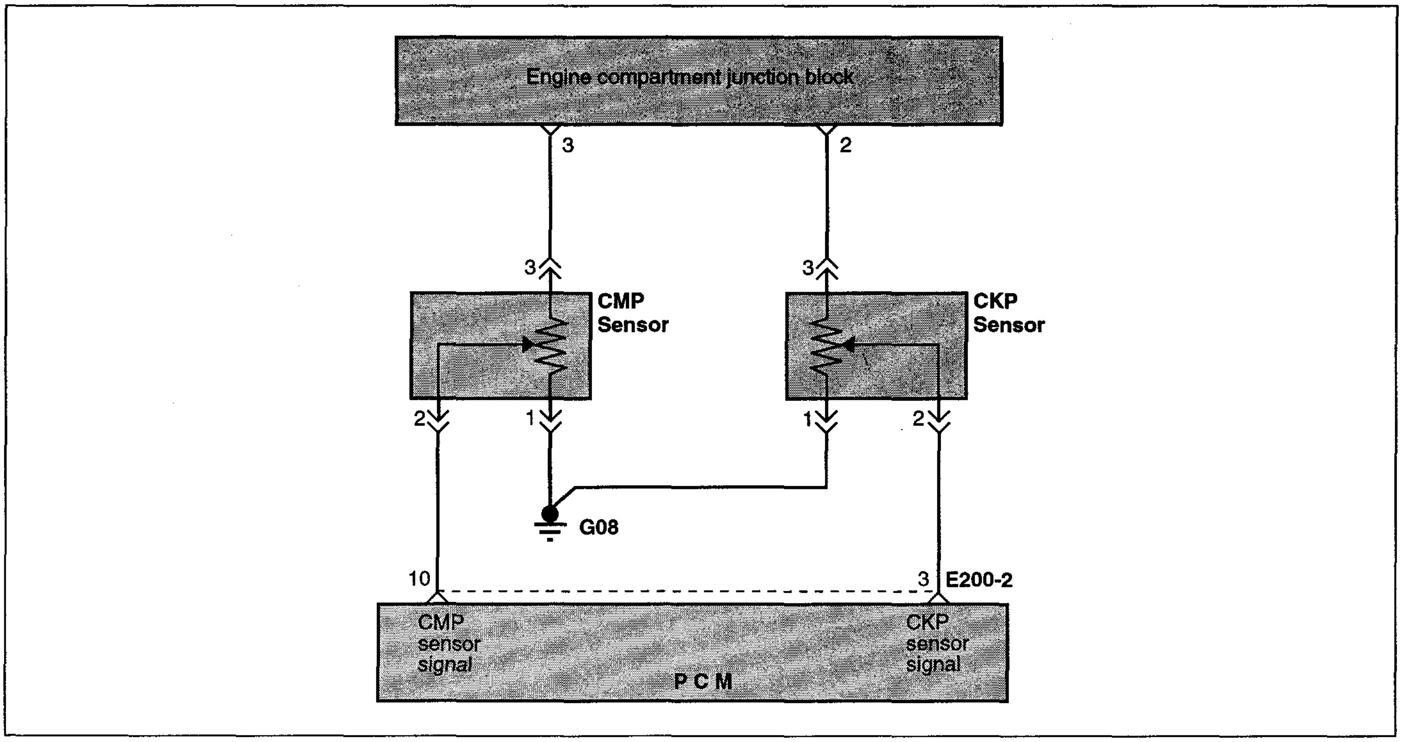
DESCRIPTION

The Hall-effect Crankshaft Position (CKP) sensor consists of a magnet and coil located next to the flywheel. The voltage signal from the CKP sensor allows the Powertrain Control Module (PCM) 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 Powertrain Control Module checks whether the pulse signal is input while the engine is cranking. Normal Operating condition • Engine is being cranked. Normal Operation • Sensor output voltage has not changed (no pulse signal is input) for 4 sec. Malfunction • Normal signal pattern has not been input for cylinder identification from the crankshaft position sensor signal and camshaft position sensor signal for 4 sec.	• Failed crankshaft position sensor • Open or shorted crankshaft position sensor circuit • Failed powertrain control module

CIRCUIT DIAGRAM



MP0335A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0335 is set.

- Turn the ignition on.
- Disconnect Crankshaft Position (CKP) sensor.
- Measure voltage between ground and CKP sensor harness connector terminal 3.

Battery voltage should be present. Is it?

YES

- Turn the ignition off.
- Disconnect the CKP sensor.
- Disconnect PCM connector E200-2.
- Ground CKP sensor harness connector terminal 2. Measure resistance between ground and PCM harness connector E200-2 terminal 3.

Resistance measured should be approximately 1 ohm or less. Is it?

NO

Repair open in wire between CKP sensor harness connector terminal 3 and Joint connector teminal. Clear code and verify CKP sensor is within normal parameters.

YES

- Turn the ignition off.
- Disconnect the CKP sensor.
- Disconnect PCM connector E200-2. 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 PCM harness connector E200-2 terminal 3.
Clear code and verify CKP sensor is within normal parameters.

YES

A

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NO

Repair short to ground or another circuit in wire between CKP sensor harness connector terminal 2 and PCM harness connector E200-2 terminal 3. Clear code and verify CKP sensor is within normal parameters.

MP0335B

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A

- 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 3.

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.

MP0335C

EFMB5140

DTC	Diagnostic item
P0340	Camshaft Position Sensor Circuit Malfunction

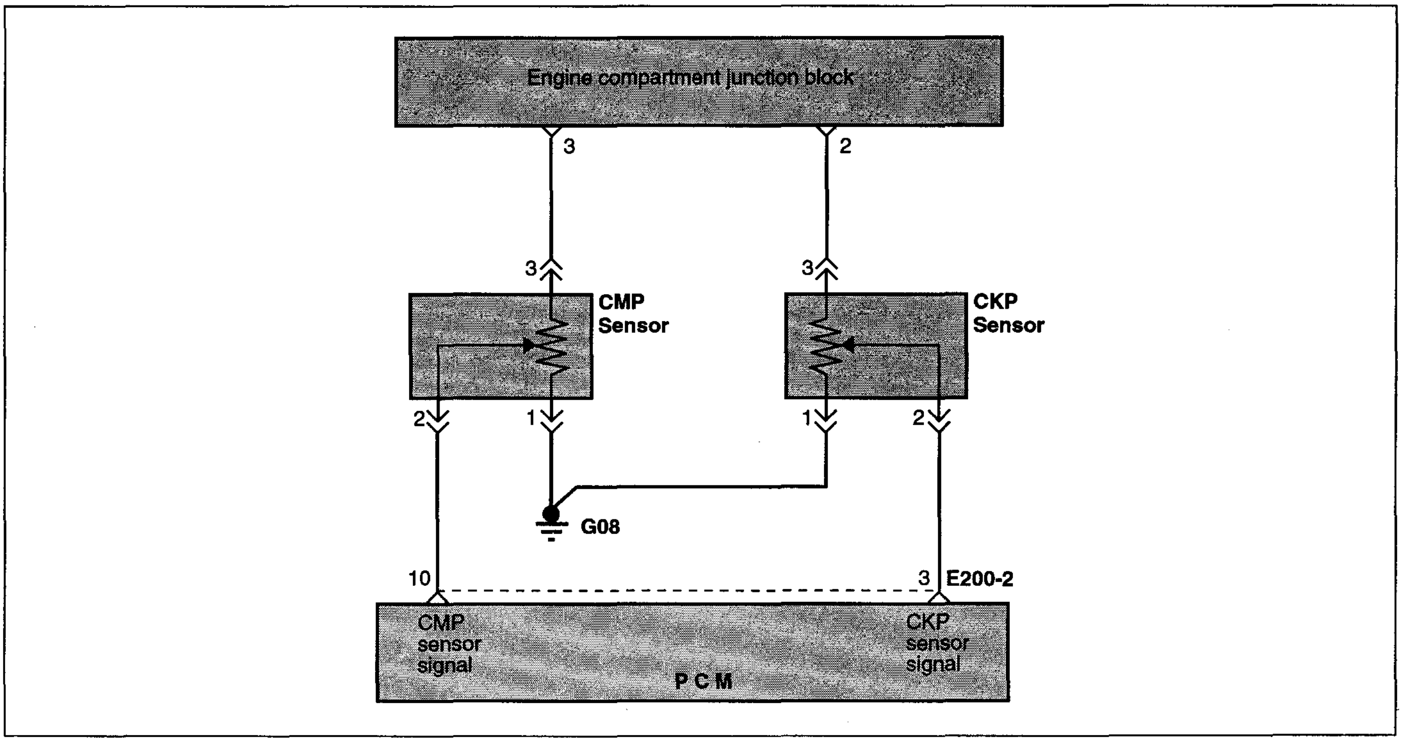
DESCRIPTION

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 PCM to determine when to operate the fuel injectors.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Normal Operation • When the engine is running, the Camshaft Position sensor outputs a pulse signal. • The Powertrain Control Module checks whether the pulse signal is input. Malfunction • 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 • Powertrain control module failed

CIRCUIT DIAGRAM



MP0335A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0340 is set.

- Turn the ignition on.
- Disconnect Camshaft Position (CMP) sensor.
- Measure voltage between ground and CMP sensor harness connector terminal 3.

Battery voltage should be present. Is it?

YES

- Turn the ignition off.
- Disconnect the CMP sensor.
- Disconnect PCM connector E200-2.
- Ground CMP sensor harness connector terminal 2.
- Measure resistance between ground and PCM harness connector E200-2 terminal 10.

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.
Clear code and verify CMP sensor signal is within normal parameters.

YES

- Turn the ignition off.
- Disconnect the CMP sensor.
- Disconnect PCM connector E200-2.
- 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 PCM harness connector terminal. Clear code and verify CMP sensor signal is within normal parameters.

YES

- Turn the ignition off.
- Disconnect the CMP sensor.
- 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 PCM 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 PCM connector is secure. If OK, replace PCM. 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.

MP0340B

EFBB5170

DTC	Diagnostic item
P0421 P0431	Warm Up Catalyst Efficiency Below Threshold (Bank 1) Warm Up Catalyst Efficiency Below Threshold (Bank 2)

DESCRIPTION

The PCM compares the waveform of the front oxygen sensor with the waveform of the rear oxygen sensor to determine whether or not catalyst performance has deteriorated. Air-fuel ratio feedback compensation keeps the waveform of the front oxygen sensor repeatedly changing back and forth from rich to lean.

If the catalyst is functioning normally, the waveform of the rear oxygen sensor switches back and forth between rich and lean much more slowly than the waveform of the front oxygen sensor. When both waveforms change at a similar rate, catalyst performance has deteriorated.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Normal Operation • The signal from the rear Oxygen sensor differs from the front Oxygen sensor. This is because the catalytic converter purifies, the exhaust gas. When the catalytic converter has deteriorated, the signal from the rear becomes similar to that of the front. • The Powertrain Control Module checks the outputs of both oxygen sensor signals. Normal Operation • Engine speed is 3,000 rpm or higher. • Closed throttle position switch: OFF • Closed loop operation • Monitoring Time: 140 sec. Malfunction • The front and rear Oxygen sensor signals are similar.	• Catalytic converter deteriorated • Heated oxygen sensor failed • Powertrain control module failed

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool.
- Verify DTC P0421 or P0431 is set.

Is DTC P0133, P0135, P0136 and/or P0141 also set?

YES

Check DTC P0133, P0135, P0136 and/or P0141 first by following the code test procedures.

NO

- Turn the ignition on with the 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?

NO

Tighten the parts where leaks are found. Clear code and verify oxygen sensor signals are within normal parameters.

YES

- Check rear oxygen sensor by following DTC P0136 test procedure.

Is rear oxygen sensor OK?

NO

Repair or replace the rear oxygen sensor. Clear code and verify oxygen sensor signals are within normal parameters.

YES

- Turn the 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?

YES

Verify PCM connector is secure. If OK, replace PCM. Clear code and verify oxygen sensor signals are within normal parameters.

NO

Problem has been corrected.
No additional testing required.

BP0421B

EFMB5190

DTC	Diagnostic item
P0443	Purge Control Solenoid Valve Malfunction

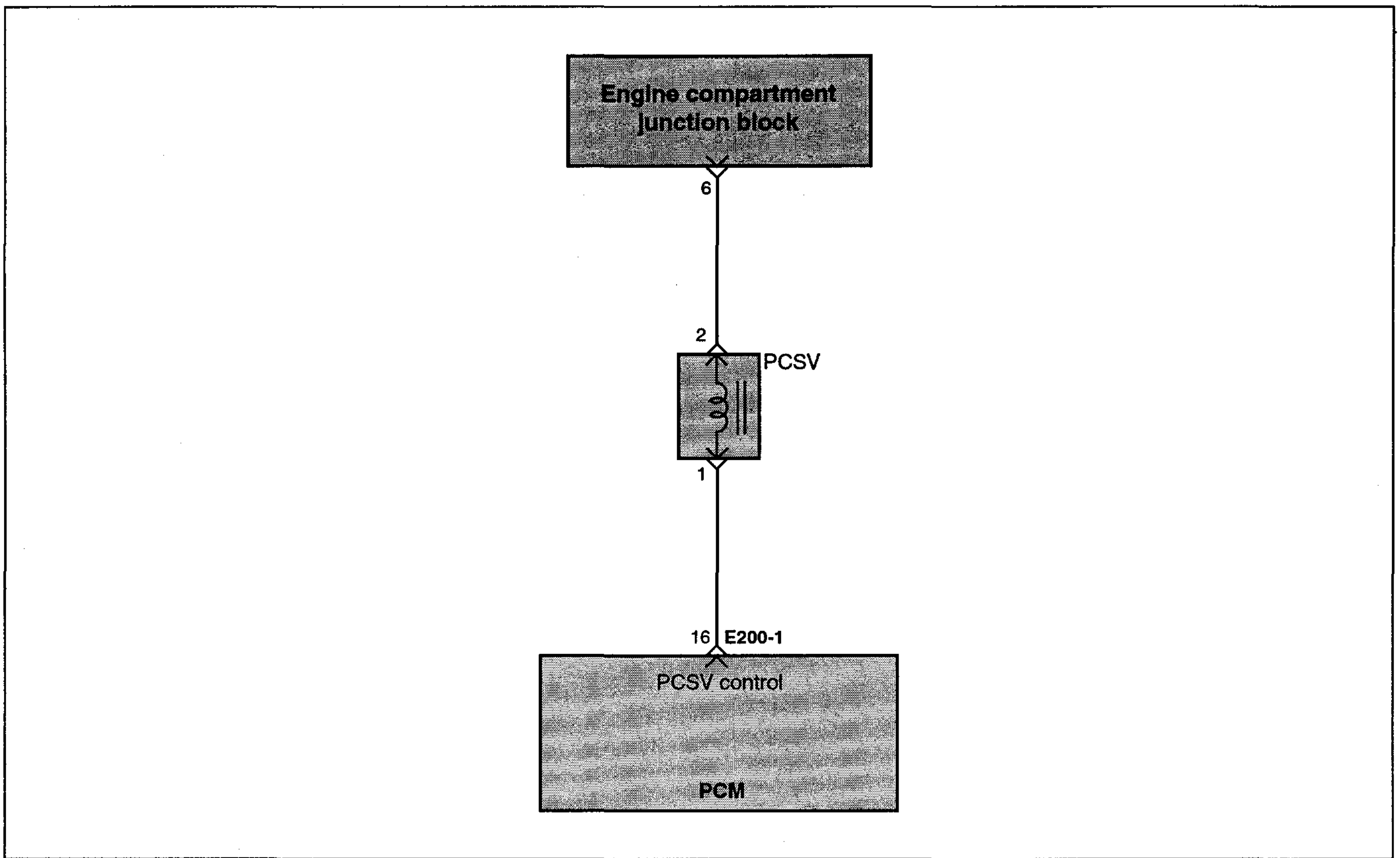
DESCRIPTION

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
Normal Operation • The Powertrain Control Module checks current flows in the evaporative emission purge solenoid drive circuit when the solenoid is ON and OFF. Normal Operation • Battery voltage is 10V or higher. Malfunction • The solenoid coil surge voltage (system voltage +2V) is not detected when the EVAP emission vent solenoid is turned on/off.	• Evaporative emission purge control solenoid valve failed • Open or shorted evaporative emission purge solenoid circuit, or loose connector • Powertrain control module failed

CIRCUIT DIAGRAM



MP0443A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0443 is set.

- Turn the ignition off
- Disconnect PCSV(Purge Control Solenoid Valve) connector.
- Turn the ignition on.
- Measure voltage between ground and PCSV harness connector terminal 2.

Battery voltage should be present. is it?

YES

- Turn the ignition off.
- Disconnect the PCSV.
- Disconnect PCM connector E200-1. Ground PCSV harness connector terminal 1.
- Measure resistance between ground and PCM harness connector E200-1 terminal 16.

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

- Turn the ignition off.
- Disconnect the PCM.
- Disconnect the PCSV solenoid valve.
- Measure resistance between ground and purge control solenoid valve harness connector terminal 1.

Resistance should indicate an open circuit. Does it?

NO

Repair open in wire between PCM connector E200-1 terminal 16 and PCSV harness connector terminal 1.
Clear code and verify PCSV is within normal parameters.

A

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MP0443B

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YES

- 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?

NO

Repair short to ground or another circuit in wire between PCM connector terminal 16 and purge control solenoid valve connector terminal 1.

YES

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.

NO

Replace purge control solenoid valve.
Clear code and verify purge control solenoid valve is within normal parameters.

MP0443C

EFMB5220

DTC	Diagnostic item
P0500	Vehicle Speed Sensor Malfunction

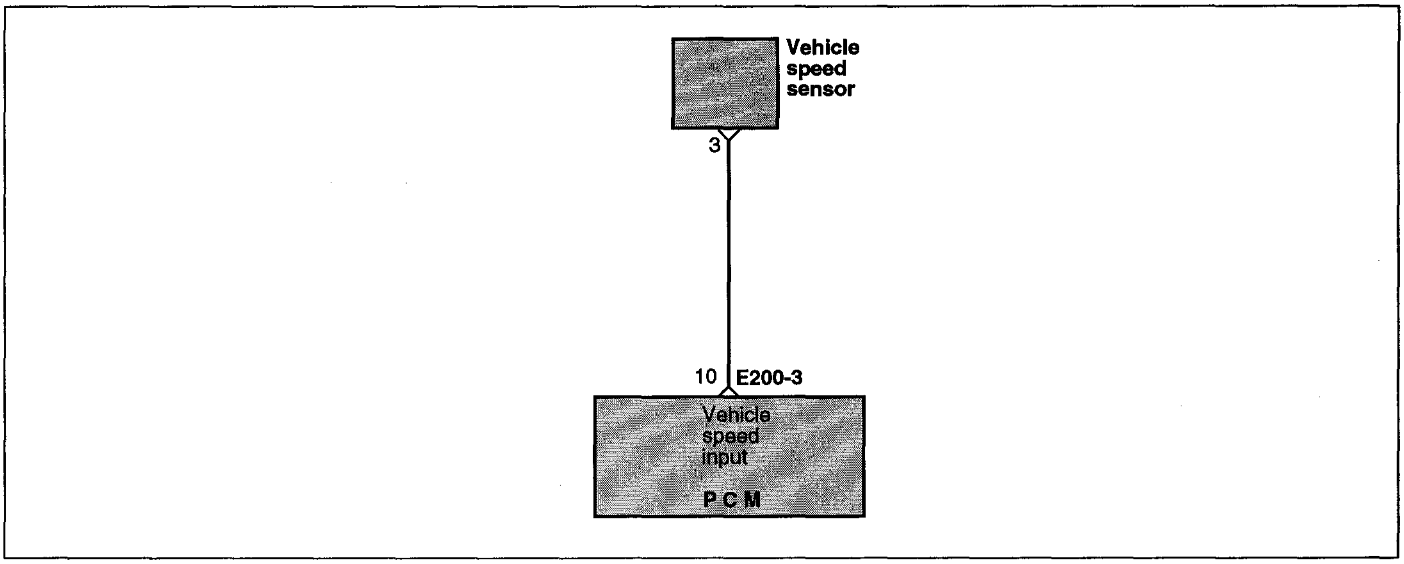
DESCRIPTION

The vehicle speed sensor outputs a pulse signal while the vehicle is driven.
The powertrain control module checks whether the pulse signal is present.

TROUBLESHOOTING GUIDE

DTC detection condition	Probable cause
Normal Operation • The vehicle speed sensor outputs a pulse signal while the vehicle is driven. • The Powertrain Control Module checks whether the pulse signal is present. Normal Operation • Closed throttle position switch: OFF • Engine speed is 3,000 rpm or more. • Engine load is 70% or more. Malfunction • Sensor output voltage has not changed (no pulse signal is input) for 4 sec.	• Failed vehicle speed sensor • Open or shorted vehicle-speed sensor circuit, or loose connector • Failed powertrain control module

CIRCUIT DIAGRAM



MP0500A

TEST PROCEDURE

- Turn the ignition switch on.
- Connect scan tool to data link connector.
- Verify DTC P0500 is set.

- Drive vehicle.

Does speedometer operate OK?

YES

- Turn the ignition off.
- Inspect 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.
- Disconnect the VSS.
- Disconnect PCM connector E200-3.
- Ground VSS connector harness terminal 3.
- Measure resistance between ground and PCM harness connector E200-3 terminal 10.

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.

A

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MP0500B

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YES

- Turn the ignition off.
- Disconnect the VSS.
- Disconnect the PCM.
- Measure resistance between VSS harness connector terminal 3 and ground.

Resistance should indicate an open circuit. Does it?

NO

Repair wire between VSS harness connector terminal 3 and PCM harness connector E200-3 terminal 10.
Clear code and verify VSS signal is within normal parameters.

YES

Verify PCM 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 PCM.

NO

Repair short to ground or another circuit in wire between VSS harness connector terminal 3 and PCM harness connector E200-3 terminal 10.
Clear code and verify VSS signal is within normal parameters.

MP0500C

Engine Mechanical System [3.5 V6]

GENERAL

SPECIFICATIONS EDMB0010

Description	Specification	Limit
General		
Type	V-type, DOHC	
Number of Cylinders	6	
Bore	93 mm (3.661 in.)	
Stroke	85.8 mm (3.3779 in.)	
Total displacement	3497 cc	
Compression ratio	10.0	
Firing order	1 - 2 - 3 - 4 - 5 - 6	
Idle R.P.M	800 ± 100	
Ignition timing at idling speed	BTDC 5° ± 2°	
Valve timing		
Intake valve		
Opens (BTDC)	11.5°	
Closes (ABDC)	60.5°	
Exhaust valve		
Opens (BBDC)	43.5°	
Closes (ATDC)	20.5°	
Camshaft		
Drive mechanism	Cogged type belt	
Cam height intake	35.098 - 35.298 mm (1.3818 - 1.3897 in.)	
Cam height exhaust	34.81 - 35.01 mm (1.3705 - 1.3783 in.)	
Journal diameter	25.951 - 25.970 mm (1.0220 - 1.0224 in.)	
Bearing oil clearance	0.05 - 0.09 mm (0.0007 - 0.0024 in.)	
End play	0.1 - 0.15 mm (0.0039 - 0.0059 in.)	
Cylinder head		
Flatness of gasket surface	Max. 0.03 mm (0.0012 in.)	0.05 mm
Flatness of maunting		
Surface		
Intake	Max. 0.10 mm (0.0039 in.)	0.10 mm
Exhaust	Max. 0.15 mm (0.0059 in.)	0.15 mm
Valve guide hole diameter		
0.05 (0.002) O.S.	12.05 - 12.068 mm (0.474 - 0.475 in.)	
0.25 (0.010) O.S.	12.25 - 12.268 mm (0.482 - 0.483 in.)	
0.50 (0.20) O.S.	12.50 - 12.518 mm (0.492 - 0.493 in.)	
Intake valve seat ring hole diameter		
0.3 (0.012) O.S.	36.30 - 36.325 mm (1.429 - 1.430 in.)	
0.6 (0.024) O.S.	36.60 - 36.625 mm (1.441 - 1.442 in.)	
Exhaust valve seat ring hole diameter		
0.3 (0.012) O.S.	33.30 - 33.325 mm (1.311 - 1.312 in.)	
0.6 (0.024) O.S.	33.60 - 33.625 mm (1.323 - 1.324 in.)	

Description	Specification	Limit
Valve		
Overall length		
Intake	106.28 mm (4.184 in.)	
Exhaust	105.4 mm (4.150 in.)	
Stem diameter		
Intake	6.565 - 6.580 mm (0.258 - 0.259 in.)	
Exhaust	6.530 - 6.550 mm (0.257 - 0.258 in.)	
Face angle	45° - 45.5°	
Margin		
Intake	1.0 mm (0.0394 in.)	
Exhaust	1.5 mm (0.059 in.)	
Clearance (stem - to - guide)		
Intake	0.02 - 0.05 mm (0.0009 - 0.0020 in.)	
Exhaust	0.05 - 0.085 mm (0.0020 - 0.0033 in.)	
Valve spring		
Free height	46.4 mm (1.8268 in.)	41.5 mm (1.6339 in.)
Lode	24.0 kg / 37.9 mm (53 lb / 1.492 in.)	55.8 kg / 28.9 mm
Out of squareness	Max 2°	(123 lb / 1.378 in.)
Valve guide		
Length		
Intake	45.5 mm (1.7913 in.)	
Exhaust	50.5 mm (1.9882 in.)	
Service oversize	0.05, 0.25, 0.50	
Valve seat contact width		
Intake	0.9 - 1.3 mm (0.035 - 0.051 in.)	
Exhaust	0.9 - 1.3 mm (0.035 - 0.051 in.)	
Service oversize	0.30, 0.60	
Seat angle		
Intake	20°	
Exhaust	45°	
Piston		
Diameter (Standard)	92.96 - 92.99 mm (3.659 - 3.661 in.)	
Clearance (Piston-to-cylinder)	0.03 - 0.05 mm (0.0012 - 0.0020 in.)	
Ring froove width		
No. 1	1.503 - 1.505 mm (0.0592 - 0.05925 in.)	
No. 2	1.501 - 1.503 mm (0.0591 - 0.0592 in.)	
Oil	3.010 - 3.030 mm (0.1185 - 0.1193 in.)	
Piston for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.) 0.75 mm (0.030 in.), 1.00 mm (0.040 in.) Oversize	

Description	Specification	Limit
Piston ring		
Number of rings per piston	3	
Compression ring type	2	
Oil ring	1	
Compression ring type		
No. 1	Barrel type, steel	
No. 2	Taper type, special cast iron	
Oil ring type	3-piece type	
Ring end gap		
No. 1	0.30 - 0.45 mm (0.0118 - 0.0177 in.)	
No. 2	0.45 - 0.60 mm (0.0177 - 0.0236 in.)	
Oil ring side rail	0.2 - 0.7 mm (0.0079 - 0.0276 in.)	
Ring side clearance		
No. 1	0.04 - 0.08 mm (0.0008 - 0.0031 in.)	
No. 2	0.02 - 0.06 mm (0.0016 - 0.0024 in.)	
Ring for service	0.25mm (0.010 in.), 0.50 mm (0.020 in.) 0.75 mm (0.030 in.), 1.00 (0.039 in.), Oversize	
Connecting rod		
Piston pin press - in load	7500 - 17,500 N (750 - 1,750 kg, 1,653 - 3,858 lb)	
Side clearance (Big end)	0.10 - 0.25 mm (0.0039 - 0.0098 in.)	
Bend	0.05 mm or less/100 mm (0.0020 in. or less/3.937 in.)	
Twist	0.1 mm or less/100 mm (0.0039 in. or less/3.937 in.)	
Bearing		
Oil clearance	0.022 - 0.040 mm (0.0009 - 0.0016 in.)	0.1 mm (0.004 in.)
Pin diameter	21.974 - 21.985 mm (0.8651 - 0.8655 in.)	
Crankshaft		
Journal O.D.	63.982 - 64.00 mm (2.519 - 2.5197 in.)	
Pin O.D.	54.982 - 55.00 mm (2.165 - 2.1653 in.)	
Out - of - roundness of journal and pin	Max. 0.03 mm (0.0012 in.)	
Taper of journal and pin	Max. 0.005 mm (0.0002 in.)	
End play	0.05 - 0.25 mm (0.002 - 0.0098 in.)	
Main bearing		0.3 mm (0.012 in.)
Oil clearance	0.018 - 0.036 mm (0.0007 - 0.0014 in.)	
Cylinder block		
Cylinder bore	93 mm (3.661 in.)	
Flatness of gasket surface	Max. 0.05 mm (0.002 in.)	
Out - of - roundness and taper	Max. 0.02 mm (0.0008 in.)	0.05 mm (0.002 in.)
Oil pump		
Side clearance		
Body clearance	0.100 - 0.181 mm (0.0039 - 0.0071 in.)	
Side clearance	0.040 - 0.095 mm (0.0016 - 0.0037 in.)	
Tip clearance	0.06 - 0.018 mm (0.0024 - 0.0071 in.)	
Relief spring		
Free length	46.3 mm (1.823 in.)	
Load	3.4 kg / 39.1 mm (7.5 lb. / 1.54 in.)	
Oil filter		
Type	Cartridge, full flow	

Description	Specification	Limit
Engine oil pressure	80 kPa (11.4 psi) or more [Conditions : Oil temperature is 75 to 90°C (167 to 194°F)]	
Cooling method	Engine coolant cooling, forced circulation with electric fan	
Cooling system Quantity	 11 lit (11.62 U.S.qts., 9.7 Imp.qts)	
Thermostat Type Normal opening temperature Opening temperature range Wide open temperature	 Wax pellet type with jiggle valve 82°C (179.6°F) 80°C - 84°C (176 - 183.2°F) 95°C (203°F)	
Radiator cap Main valve opening pressure Main valve closing pressure Vacuum valve opening pressure	 86.1 - 124.5 kPa (0.98 - 1.27 kg/cmk, 13.94 - 18.06 psi) 83.4 kPa (0.85 kg/cmk, 12.1 psi) - 6.86 kPa (- 0.07 kg/cm², - 1.00 psi)	
Air cleaner Type Element	 Dry type Unwoven cloth type	
Exhaust pipe Muffler Suspension system	 Expansion resonance type Rubber hangers	

SERVICE STANDARD

Stanard value

Coolant concentration

Tropical area : 40%

Other area : 50%

LUBRICANT

Engine coolant : Ethylene glycol base for aluminum radiator

SEALANT

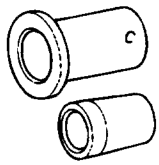
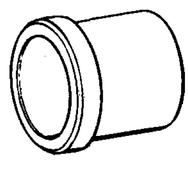
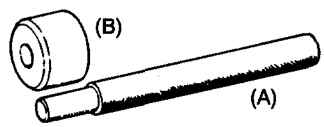
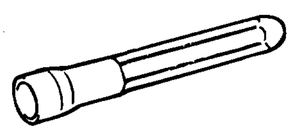
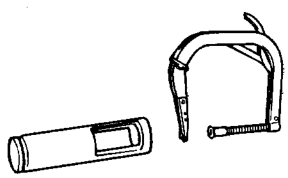
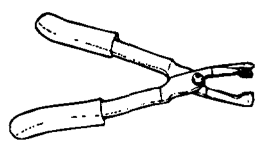
Engine coolant temperature sensor	Three bond No.2310 or equivalent LOCTITE 962T or equivalent

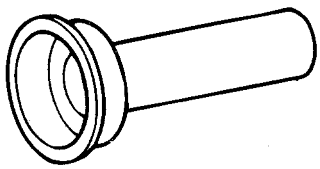
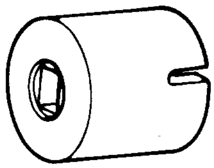
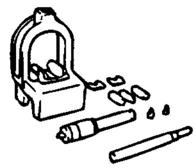
TIGHTENING TORQUE EDMB0020

	Nm	kg.cm	lb.ft
Crankshaft bolt	180 - 190	1,800 - 1,900	130 - 138
Timing belt tensioner	20 - 27	200 - 1,100	15 - 20
Comshaft sprocket bolt	90 - 110	900 - 1000	65 - 80
Cylinder head cover bolts	5 - 6	50 - 60	4 - 5
Main bearing cap bolts	90 - 100	900 - 1000	65 - 72
Connecting rod nuts	35 + 92°	350 + 92°	26 + 92°
Cylinder head bolts			
Cold engine	105 - 115	1050 - 1150	75 - 82
Oil pan drain plug	35 - 45	350 - 450	26 - 32
Lower oil pan bolt	10 - 12	100 - 120	7.2 - 9
Upper oil pan bolt			
[10 × 380 mm (0.937 × 1.4961 in.)]	30 - 42	300 - 420	22 - 30
[8 × 22 mm (0.3150 × 0.8661 in.)]	19 - 28	190 - 280	14 - 20
[171.5 mm (6.7519 in.)]	5 - 7	50 - 07	3.7 - 5
[152.5 mm (6.7520 in.)]	5 - 7	50 - 07	3.7 - 5
Oil screen bolt	15 - 22	150 - 220	11 - 15
Oil pump case bolts	12 - 15	120 - 150	9 - 10
Oil relief valve plug	40 - 50	400 - 500	29 - 36
Oil pressure switch	8 - 12	80 - 120	5.8 - 8.7
Oil pump cover screw	8 - 15	80 - 150	5.8 - 11
Oil filter	17 - 25	170 - 250	12 - 18
Drive plate and adaptor plate bolt	73 - 77	730 - 770	53 - 55
Air cleaner body installation bolt	8 - 12	80 - 120	6 - 9
Surge tank stay	15 - 20	150 - 150	11 - 14
Air intake surge tank to intake manifold (bolt)	15 - 20	150 - 200	11 - 14
Air intake surge tank to intake manifold (nut)	15 - 20	150 - 200	11 - 14
Intake manifold to engine	12 - 15	120 - 150	9 - 10
Heat protector to exhaust manifold	12 - 15	120 - 150	14
Exhaust manifold to engine	27 - 33	270 - 330	20 - 40
Oil level gauge guide to engine	12 - 15	120 - 150	9 - 11
Water outlet fitting bolt	17 - 20	170 - 200	12.3 - 14.5
Power steering oil pump bracket to front cylinder head assembly	17 - 26	170 - 260	12 - 19
Power steering oil pump to bracket	17 - 26	170 - 260	12 - 19
Crank position sensor wheel screw	5 - 6	50 - 60	4 - 5
Engine mounting insulator bolt.	30 - 40	300 - 400	22 - 30
Engine mounting bracket bolt and nut.	65 - 85	650 - 850	48 - 63
	33 - 50	330 - 500	24 - 37
Transaxle mounting bracket bolts.	30 - 42	300 - 400	22 - 31
Transaxle mounting insulator bolt.	30 - 42	300 - 420	22 - 31
Starter to engine bolt.	27 - 34	270 - 340	20 - 25
Generator inlet pipe to front cylinder head assembly	12 - 15	120 - 150	9 - 11
Fuel hose clamp to rtear cylinder head assembly	12 - 15	120 - 150	9 - 11
Transaxle mounting plate	10 - 12	100 - 120	7 - 9

	Nm	kg.cm	lb.ft
Rear plate	10 - 12	100 - 120	7.3 - 8.6
Oil seal case	10 - 12	100 - 120	7.3 - 8.6
Crankshaft pulley bolt	180 - 190	1,800 - 1,900	130 - 138
Timing belt cover bolt	10 - 12	100 - 120	7 - 9
Engine hanger bracket to engine	20 - 27	200 - 270	14 - 20
Generator mount bracket to engine	20 - 30	200 - 300	14 - 22
Generator mount nut (Engine front case side)	20 - 30	200 - 300	14 - 22
Generator mount bolt (Generator mount bracket side)	20 - 30	200 - 300	14 - 22
Startor to engine (Nut)	20 - 30	200 - 300	14 - 22
Drive belt pulley bolt	35 - 55	350 - 550	26 - 40
Drive belt tensioner bolt	45 - 50	450 - 500	33 - 36
Engine coolant pump to cylinder block bolt head mark "7" bolt	15 - 22	150 - 2200	11 - 15
Engine coolant temperature sensor	20 - 40	200 - 400	14 - 29
Engine coolant inlet fitting attaching bolt	17 - 20	170 - 200	12 - 14
Air cleaner mounting bolts	8 - 12	80 - 120	6 - 9
Intake manifold to cylinder head nuts	12 - 15	120 150	9 - 11
Throttle body to surge tank bolts	10 - 13	100 - 130	7 - 9.5
Exhaust manifold to cylinder head nuts	25 - 30	250 - 300	18 - 22
Exhaust manifold heat protector to exhaust manifold bolts	12 - 15	120 - 150	9 - 11
Oxygen sensor to exhaust manifold	40 - 50	400 - 500	29 - 36
Front exhaust pipe to exhaust manifold nuts	30 - 40	300 - 400	22 - 29
Front exhaust pipe to catalytic converter bolts	40 - 60	400 - 600	29 - 43
Catalytic converter to center exhaust pipe nuts	30 - 40	300 - 400	22 - 29
Center exhaust pipe to main muffler nuts	30 - 40	300 - 400	22 - 29
Main muffler hanger support bracket bolts	10 - 15	100 - 150	7 - 11
Delivery pipe installation bolts	10 - 15	100 - 150	7 - 11
Timing belt tensioner pulley bolt	43 - 55	430 - 550	31 - 40
Timing belt idler pulley bolt	50 - 60	500 600	36 - 43
Timing belt tensioner arm FIXED BOLT	35 - 55	350 550	26 - 40
Auto tensioner fixed bolt	20 - 27	200 - 270	14 - 20
Startor to engine (Bolt)	27 - 34	270 - 340	20 - 25
Camshaft bearing cap			
Outer	19 - 21	190 - 210	14 - 15
Inner	10 - 12	110 - 120	7 - 9

SPECIAL TOOLS ECBB0300

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)	 HFR20A01	Installation of the crankshaft front oil seal
Camshaft oil seal installer (09221-21000)	 HFR20A02	Installation of the camshaft oil seal
Valve guide installer (09222-22000 (B)) (09221-29000 (A))	 KFW3003A	Removal and installation of the valve guide
Valve stem oil seal installer (09222-22001)	 KFW3002A	Installation of the valve stem oil seal
Valve spring compressor (09222-28000)	 J20008F	Removal and installation of the intake or exhaust valve
Valve stem oil seal remover (09222-29000)	 KFW3009A	Removal of the valve stem oil seal

Tool (Number and name)	Illustration	Use
Crankshaft rear oil seal installer (09231-33000)	 KFW3004A	Installation of the crankshaft rear oil seal
Crankshaft wrench (09231-33100)	 KFW3008A	Used if the crankshaft needs to be rotated to attach the timing belt, etc.
Piston pin remover and installer (09234-33001) Fork insert (09234-33003)	 HFR20A10	Removal and installation of the piston pin

TROUBLESHOOTING ECBB0400

Symptom	Probable cause	Remedy
Knocking of crankshaft and bearing	Worn main bearing Seized bearing Bent crankshaft Excessive crankshaft end play	Replace Replace Replace Replace thrust bearing
Piston and connecting rod knock	Worn bearing Seized bearing Worn piston pin Worn piston in cylinder Broken piston ring Improper connecting rod alignment	Replace Replace Replace piston and pin or connecting rod Recondition cylinder Repair or replace Replace
Noisy valves	Faulty auto-lash adjuster Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide	Replace Change Replace
Excessively worn cylinder and piston	Shortage of engine oil Dirty engine oil Poor quality of engine oil Improperly assembled piston and connecting rod Improper piston ring end clearance Dirty air cleaner	Add or replace Check oil level on daily basis Replace Use proper oil Repair or replace Replace Clean air cleaner assembly and replace the air filter
Connecting rod and main beaing noise	Insufficient oil supply Thin or diluted engine oil Excessive bearing clearance	Check engine oil level Change and determine cause Replace
Damaged crankshaft bearing	Shortage of engine oil Low oil pressure Poor quality of engine oil Worn or out-of -round of crankshaft journal Restricted oil passage in crankshaft Worn bearing Bearing improperly installed Non-concentric crankshaft or bearing	Add or replace Check oil level on daily basis Adjust or repair Use proper engine oil Replace Clean Replace bearing and check engine oil and lubrication system Replace Replace
Timing belt noise	Incorrect belt tension	Replace
Low compression	Blown cylinder head gasket Worn or damaged piston rings Worn piston or cylinder Worn or damaged valve seat	Replace gasket Replace rings Repair or replace piston and/or cylinder block Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level Faulty oil pressure switch Clogged oil filter Worn oil pump gears or cover Thin or diluted engine oil Oil relief valve stuck (open) Excessive bearing clearance	Check engine oil level Replace Replace Replace Change and determine cause Repair Replace

Symptom	Probable cause	Remedy
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine rolling and vibration	Loose engine roll stopper (front, rear) Loose transaxle mount bracket Loose engine mount bracket Loose center member Broken transaxle mount insulator Broken engine mount insulator Broken engine roll stopper insulator	Re-tighten Re-tighten Re-tighten Re-tighten Replace Replace Replace
Low coolant level	Leakage of coolant Damaged radiator core joint Corroded or cracked hoses (Radiator hose, heater hose, etc) Faulty radiator cap valve or setting of spring Faulty thermostat Faulty engine coolant pump	 Replace Replace Replace Replace Replace
Clogged radiator	Foreign material in coolant	Replace
Abnormally high coolant temperature	Faulty thermostat Faulty radiator cap Restriction of flow in cooling system Loose or missing drive belt Faulty engine coolant pump Faulty temperature gauge or wiring Faulty electric fan Faulty thermo-sensor on radiator Insufficient coolant	Replace parts Replace Replace Adjust or replace Replace Repair or replace Repair or replace Replace Refill coolant
Abnormally low coolant temperature	Faulty thermostat Faulty temperature gauge or wiring	Replace Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection Blocked or collapsed hose and pipe	Replace Repair or replace
Inoperative electrical cooling fan	Damaged	Replace or repair
Exhaust gas leakage	Loose connections Broken pipe or muffler	Re-tighten Repair or replace
Abnormal noise	Detached baffle plate in muffler Broken rubber hanger Pipe or muffler contacting vehicle body Broken pipe or muffler	Replace Replace Correct Repair or replace

CHECKING ENGINE OIL EDHA0500

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

NOTE

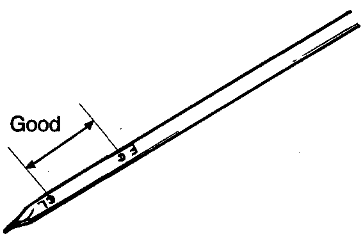
In the case of a vehicle that has not been used for a prolonged period, run the engine for several minutes. Turn off the engine and wait for 5 minutes at least, then check the oil level.

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 that it has the proper viscosity.

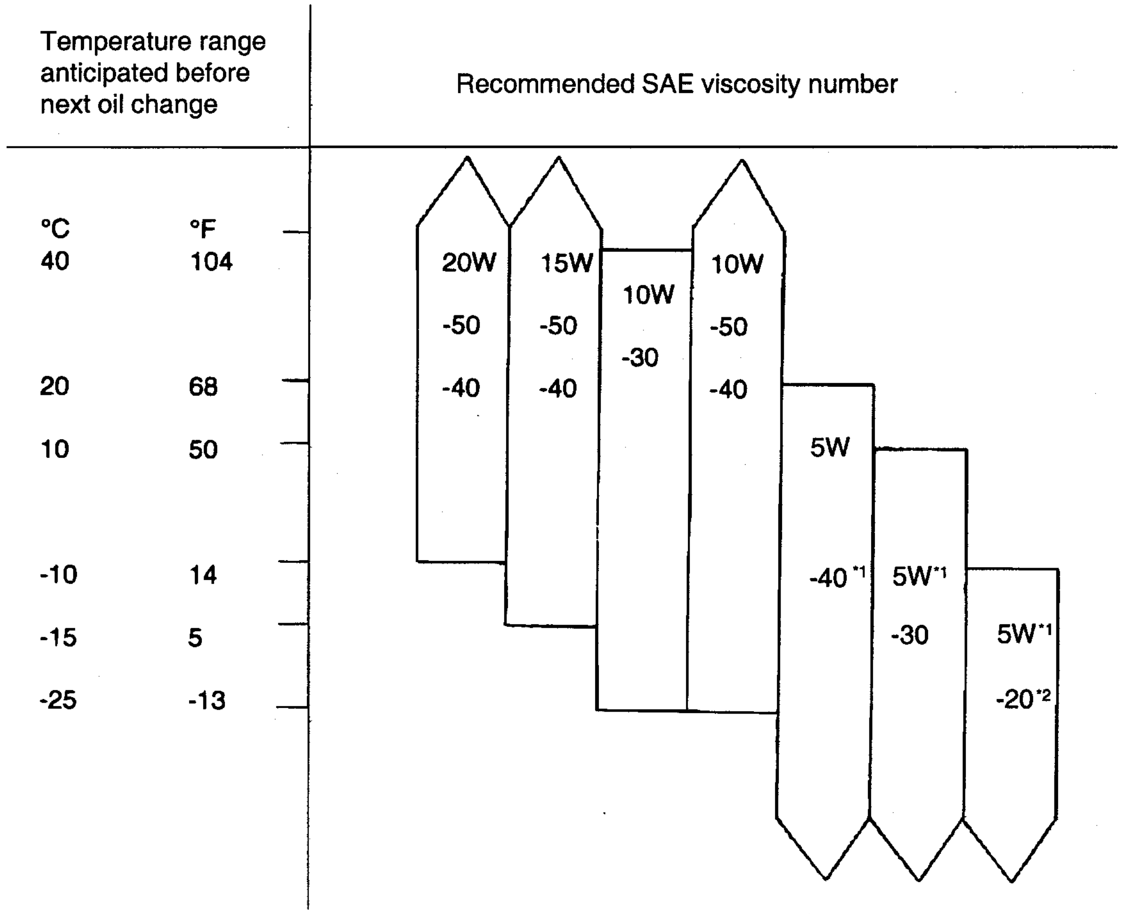


EDA9000A

SELECTION OF ENGINE OIL ECBB0600

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 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.

CHANGE ENGINE OIL EDMB0030

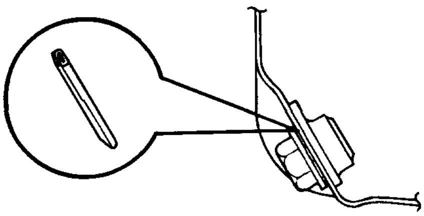
1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and oil filter and then drain plug.
   Drain the engine oil.
4. Tighten the drain plug to the specified torque.

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.



EDB9001A

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

Drain and Refill

Oil quantity : 4.4 lit (5 U.S. qts., 4.2 Imp. qts.)

NOTE

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

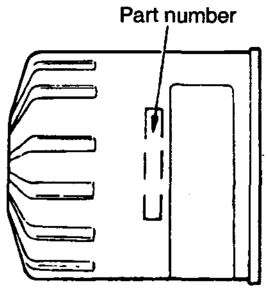
6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

REPLACEMENT OIL FILTER ECBB0800

FILTER SELECTION

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 after market replacement filters is various considerably.

High quality of 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

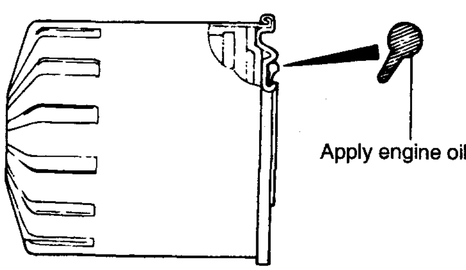
PROCEDURE FOR REPLACING OIL FILTER

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 of the specified torque.

Tightening torque

Oil filter : 17 - 25 Nm (170 - 250 kg.cm, 12 - 18 lb.ft)

4. Start and run the engine and check engine oil leaks.
5. After stopping the engine, check the oil level and add oil as necessary.



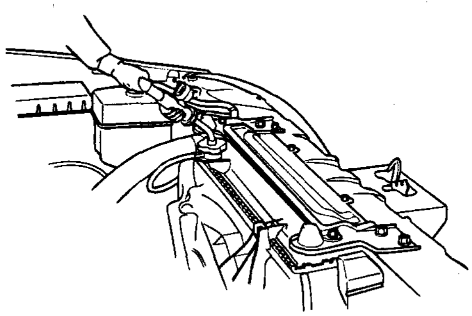
ECA9970B

CHECKING COOLANT LEAK CHECK EDMB0040

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 for two minutes, then check for leakage from the radiator, hoses or connections.

> ***CAUTION***
> 1. ***Radiator coolant may be extremely hot. Do not open the system while hot, or scalding engine coolant 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 apropriate part.



KDMB002A

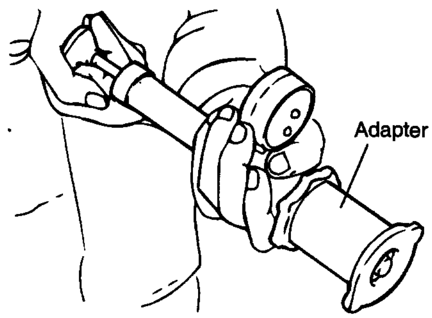
RADIATOR CAP PRESSURE TEST EDHA1000

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

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)

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.

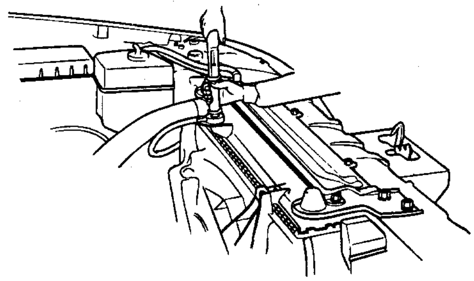
> ***NOTE***
> *Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.*



ECA9090A

SPECIFIC GRAVITY TEST EDMB0050

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. Use the following table for reference.



KDMB002B

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 property will be adversely affected.***
- ***If the concentration is above 60%, the 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.***

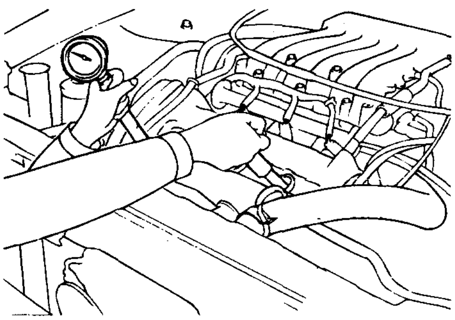
RECOMMENDED COOLANT

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

CHECKING COMPRESSION PRESSURE EDHA1200

1. Before checking the 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. Stop 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 : 1,200kpa(12.2 kg/cm², 170psi)
Limit : 1,050kpa(10.7kg/cm², 149psi)



EDHA015A

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

Limit : Max. 100kpa (1.0 kg/cm², 14psi) 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 possible that the piston ring is be worn.
    2) If the compression remains the same, valve seizure, poor valve seating or a compression leak in the cylinder head gasket are all possible causes.

Tightening torque

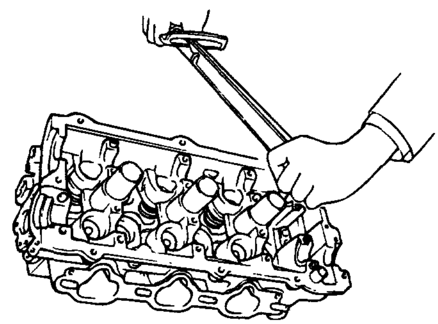
Spark plug : 20-30 Nm (200-300 kg.cm, 14-22 lb.ft)

TIGHTENING CYLINDER HEAD BOLTS ECBB1300

1. First loosen slightly and then tighten to the specified torque.

Tightening torque

Cylinder head bolts cold [Engine temperature approximately 20°C (68°F)] :
105 - 115 Nm (1050 - 1150 kg.cm, 75 - 82 lb ft.)

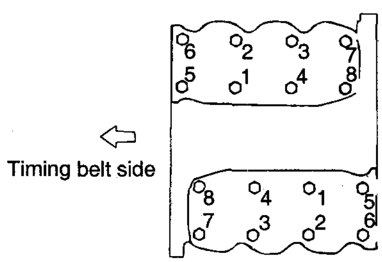


EDA9010A

2. Be sure to follow the specific torque sequence as shown in the illustration.

NOTE

Run the engine to normal operating temperature and let it cool, then re-torque the bolts to specifications.



EDA9060B

ADJUSTING VALVE CLEARANCE EDHA1400

As the intake and exhaust valves are equipped with hydraulic lash adjusters, there is no need to adjust the valve clearance. The proper function of the hydraulic lash mechanism may be determined by checking for tappet noise. When there is a tappet noise or any unusual noise, check the hydraulic lash adjuster by removing and bleeding or replacing it.

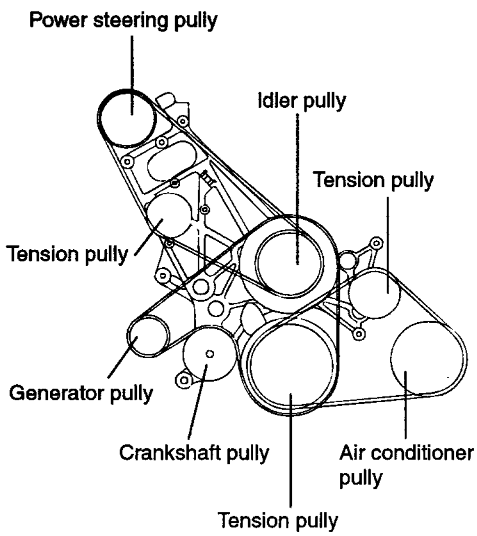
ADJUSTING DRIVE BELT AND TENSIONER EDMB0060

1. Hang the belt on the pulley of the tensioner and install the tensioner.
   (If the tensioner is already installed, loosen its mounting bolts to allow belt installation.)

Tightening torque

Tensioner assembly bolt :

45 - 50 Nm (450 - 500 kg.cm, 33 - 36 lb.ft)



EDMB006A

2. Install drive belt.

3. Adjust the drive belt tension to specification by turing the adjusting bolt clockwise or counterclockwise.

Standard Value

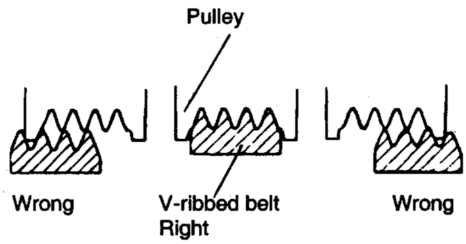
Air - conditioner compressor

: 7 - 10 mm (0.28 - 0.039 in.)

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

Power steering: 8 - 11 mm (0.31 - 0.43 in.)

4. When installing the belt on the pulley, make sure it is centered on the pulley.

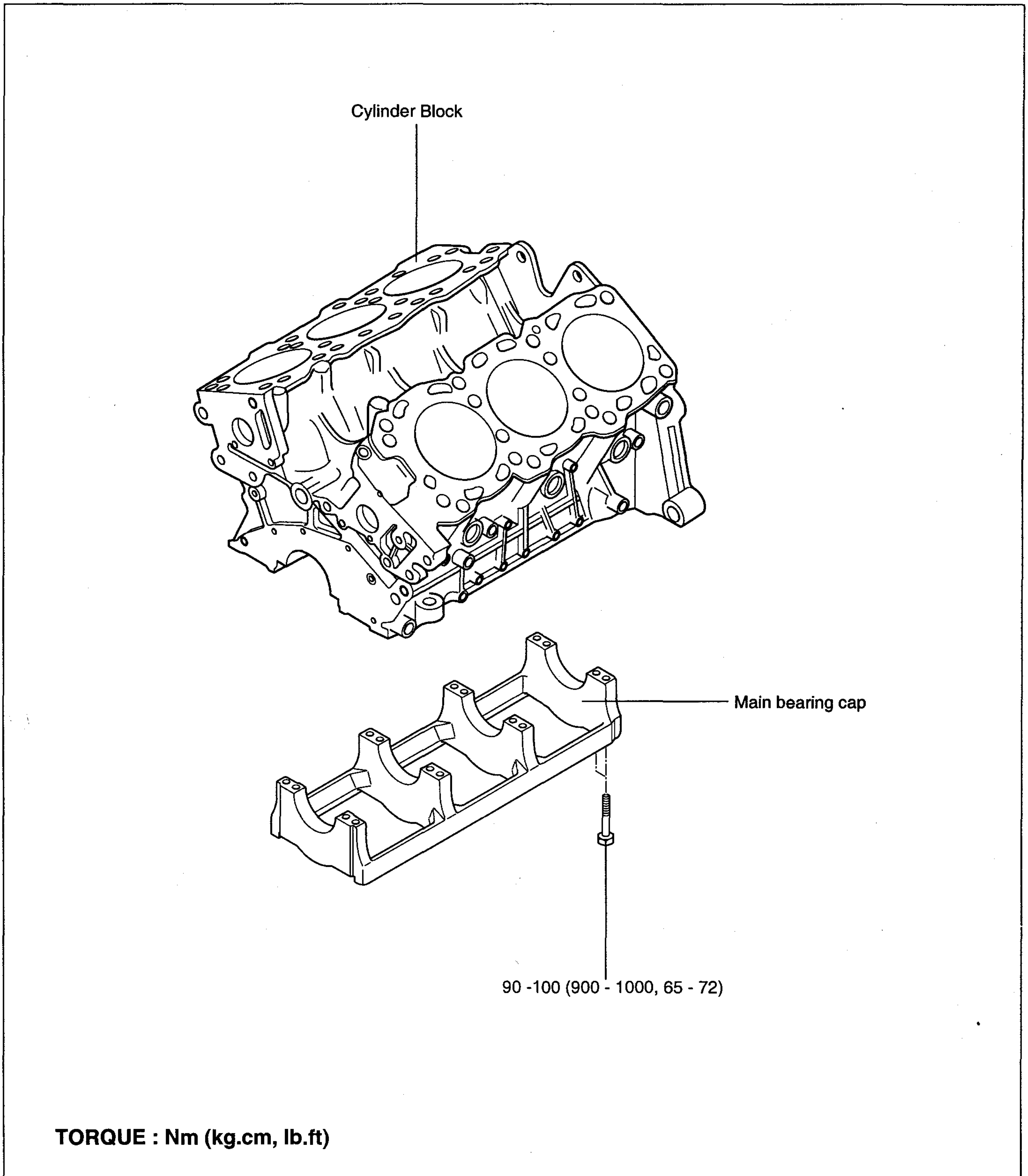


EOYR0020

ENGINE BLOCK

ENGINE BLOCK

COMPONENTS EDMB0100



EDMB010A

REMOVAL EDMB0110

Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate, oil pan and oil pump case.

For further details, refer to the appropriate section.

INSPECTION EDMB0120

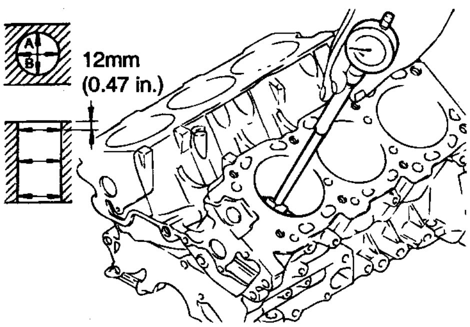
CYLINDER BLOCK

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, in the directions A and B.

   Level 1 : No.1 piston ring position at TDC

   Level 2: Center of cylinder

   Level 3 : Bottom of cylinder



EDA9460A

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

Standard value

Cylinder bore : 93 - 93.03 mm (3.661 - 3.6625 in.)

Out-of-round and taper of cylinder bore :

Max. 0.02 mm (0.0008 in.)

4. If a ridge exists at the top of the cylinder, cut it off with a ridge reamer.
5. Oversize pistons are available in four sizes.

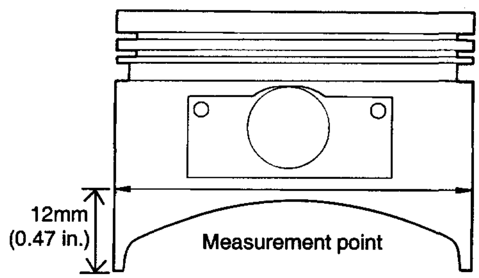
Piston service size and mark mm (in.)

0.25 (0.010) O.S : 0.25
0.50 (0.020) O.S : 0.50
0.75 (0.030) O.S : 0.75
1.00 (0.040) O.S : 1.00

6. To rebore the cylinder bore to the oversize, maintain the specified clearance between the oversize piston and the bore and make sure that all used pistons are the same oversize. The standard measurement of the piston outside diameter is taken at a level of 12mm (0.47 in.) above the bottom of the piston skirt and across the thrust faces.

Piston-to-cylinder clearance :

0.03 - 0.05 mm (0.0012 - 0.0020 in.)



ECBB444A

7. Check for damage or cracks in the cylinders.
8. Check the top surface of the cylinder block for flatness. If the top surface exceeds the limit, grind to the minimum limit or replace.

Standard value

Flatness of gasket surface :

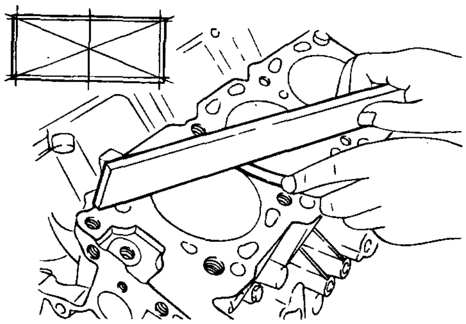
Max. 0.03 mm (0.0012 in.)

Service limit

Flatness of gasket surface : 0.05 mm (0.0020 in.)

CAUTION

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



EDA9460B

BORING CYLINDER EDMB0130

1. Oversize pistons should be selected according to the largest bore cylinder.

Identification Mark	Size
0.25	0.25 mm (0.010 in.)
0.50	0.50 mm (0.020 in.)
0.75	0.75 mm (0.030 in.)
1.00	1.00 mm (0.040 in.)

NOTE

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

2. Measure the outside diameter of the piston to be used.
3. According to the measured O.D., calculate the new bore size.
   New bore size = Piston O.D + 0.03 to 0.05 mm (0.0012 to 0.002 in.) (clearance between piston and cylinder) - 0.01 mm (0.0004 in.) (honing margin.)
4. Bore each of the cylinders to the calculated size.

CAUTION

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

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

Standard : 0.03 - 0.05 mm (0.0012 - 0.0020 in.)

NOTE

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

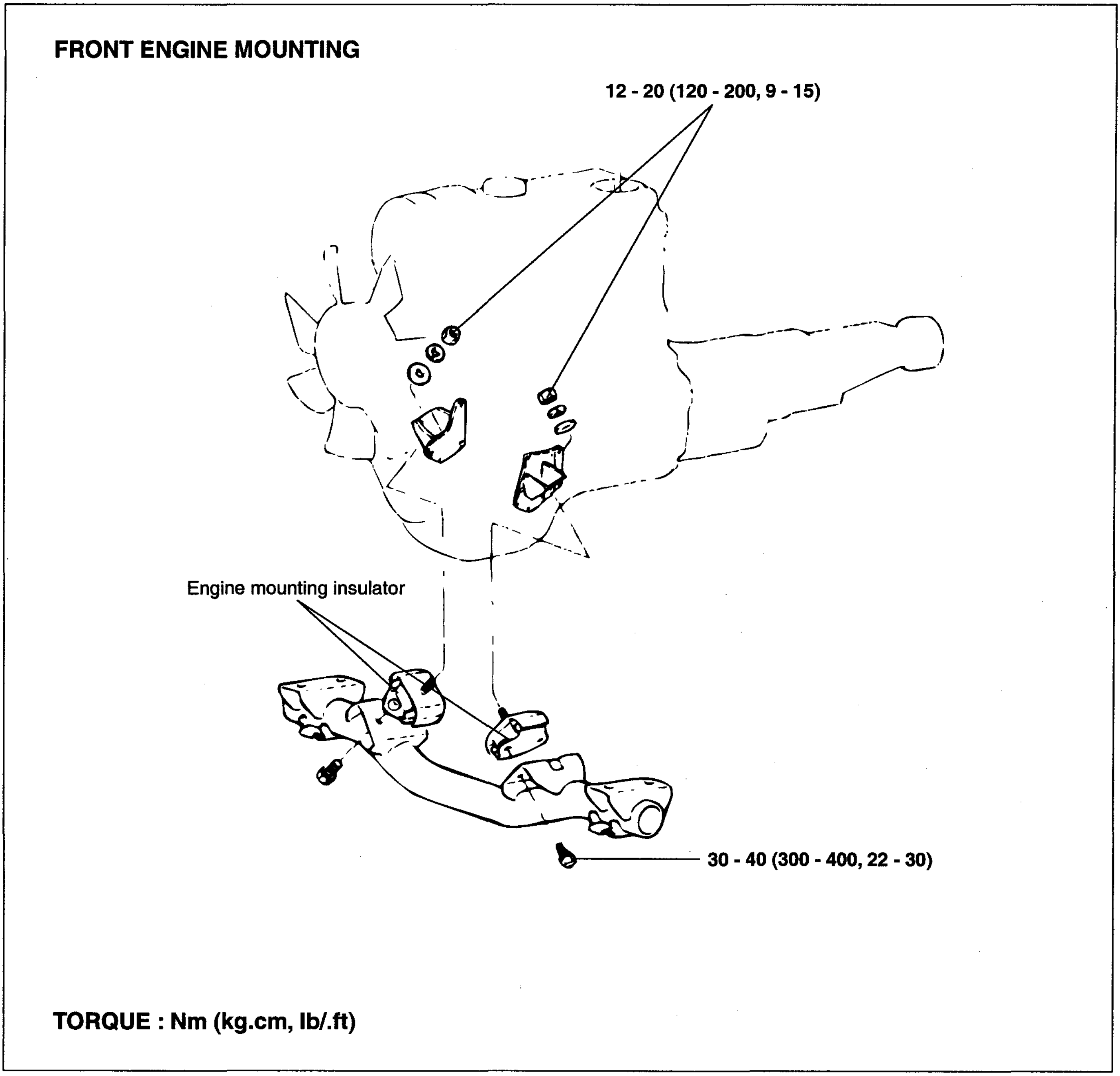
REASSEMBLY EDHA2500

Install the following parts by referring to their respective sections.

1. Crankshaft
2. Drive plate
3. Piston
4. Cylinder head
5. Timing belt
6. Oil pump case

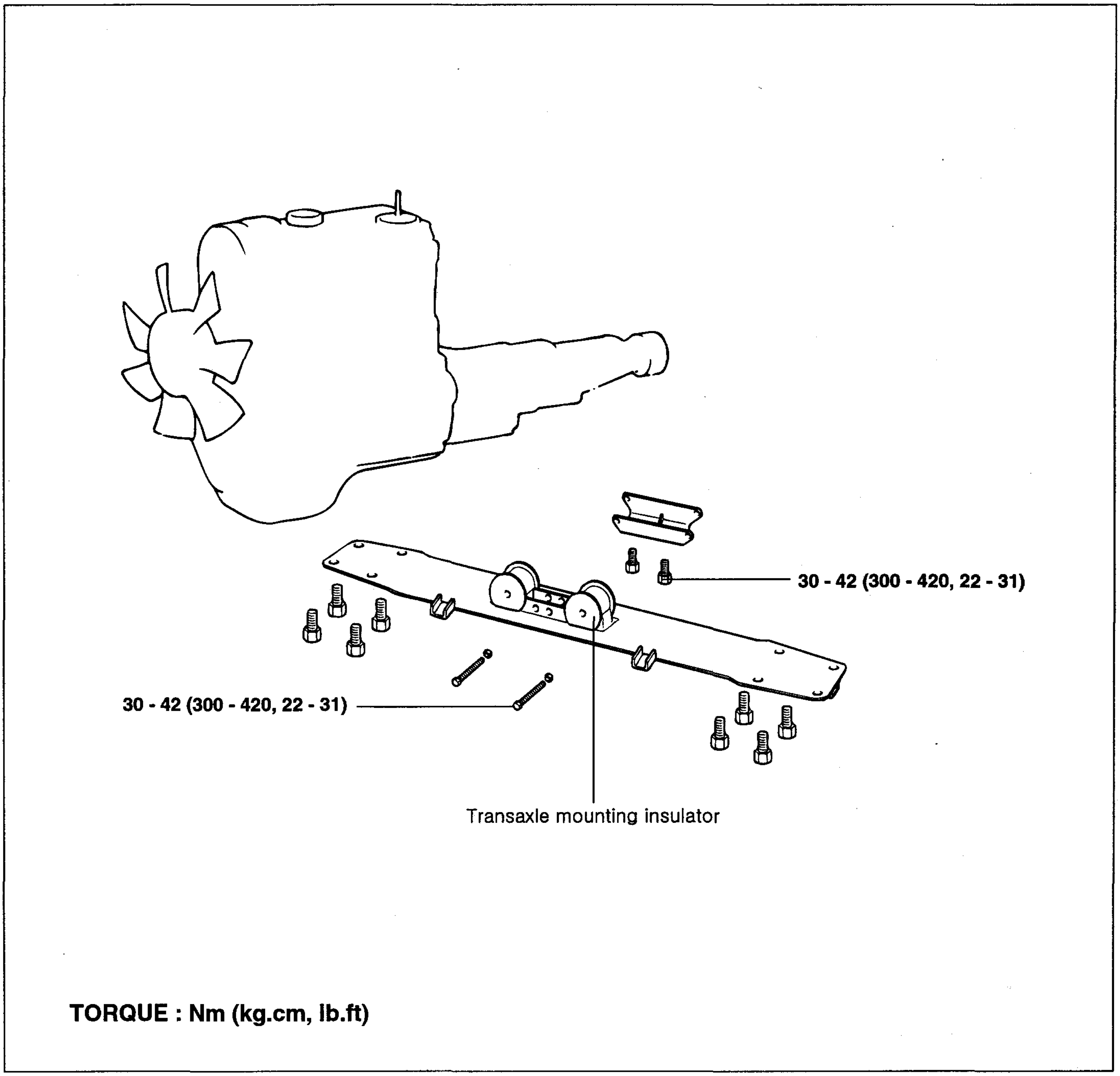
ENGINE MOUNTS

COMPONENTS EDMB0150



EDMB015A

T/M MOUNTING EDMB0160



EDMB016A

INSPECTION EDMB0170

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

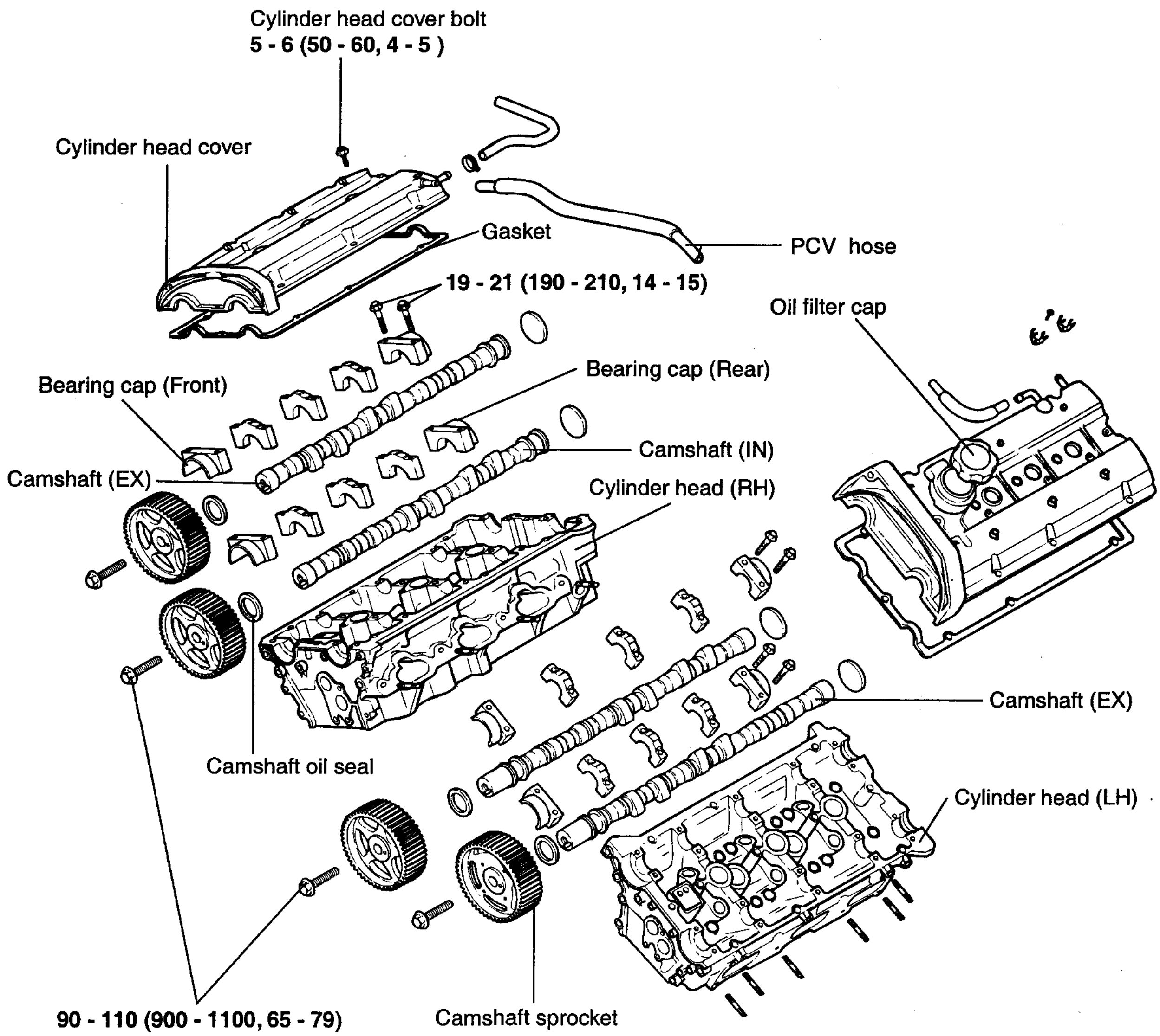
NOTE

Be careful not to apply oil to the insulator.

MAIN MOVING SYSTEM

CAM SHAFT

COMPONENTS ECBB3000

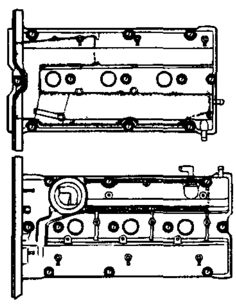


TORQUE : Nm (kg.cm, lb.ft)

EDB9029A

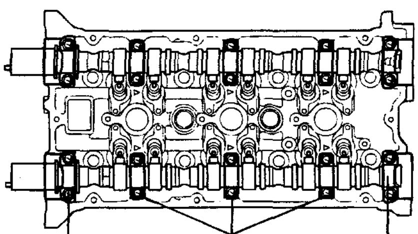
DISASSEMBLY EDMB0200

1. Remove intake manifold.
2. Disconnect the breather hose and the engine harness.
3. Remove the power steering pulley, air conditioner pulley, crankshaft pulley, idler pulley and tensioner pulley.
4. Remove the timing belt cover.
5. Loosen the auto tensioner.
6. Remove the timing belt from the camshaft sprocket.
7. Remove the spark plug cables.
8. Loosen the cylinder head cover bolts and then remove it.



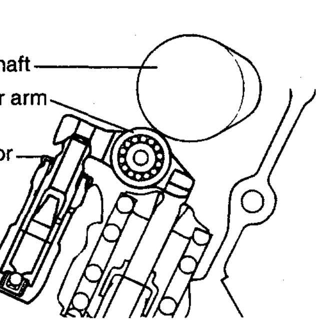
EDB9030A

9. Remove the camshaft sprockets.
10. Remove the camshaft bearing caps.



EDB9030B

11. Remove the camshafts.



EDB9030C

INSPECTION EDMB0210

CAMSHAFTS

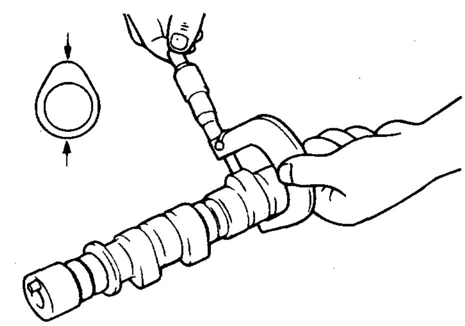
1. Check the camshaft journals for wear. If the journals are badly worn out, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or excessively worn out, replace the camshaft.

Cam height

[Standard]

Intake : 35.098 - 35.298 mm (1.3818 - 1.3897 in.)

Exhaust : 34.81 - 35.01 mm (1.3705 - 1.3783 in.)



EDA9260A

3. Check the cam surface for abnormal wear or damage, and replace if necessary.
4. Check each bearing for damage. If the bearing surface is excessively damaged, replace the cylinder head assembly or camshaft bearing cap, as necessary.

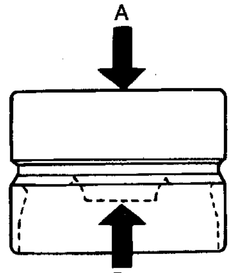
Camshaft end play : 0.1-0.15mm(0.0039-0.0059 in.)

OIL SEAL (CAMSHAFT FRONT)

1. Check the lips for wear. If lip threads are worn out, replace the oil seal with new one.
2. Check a contact surface of oil seal lip on camshaft. If there stratified wear, replace the camshaft.

HLA (HYDRAULIC LASH ADJUSTER)

With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.

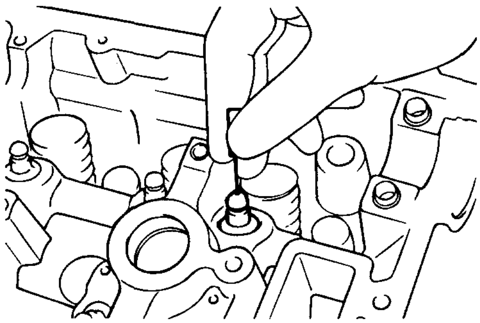


EDA9260B

Problem	Possible cause	Action
1. Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2. Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high pressure chamber on the HLA,allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm. If it doesn't disappear,refer to step 7 below.
3. Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
4. Continuous noise when the engine is started after excessivly craking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA.	
5. Continuous noise when the engine is running after changing the HLA.		***CAUTION*** ***Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.***
6. Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system.
	Deteriorated oil.	Check oil quality. If deteriorated, replace with specitied type.
7. Noise cotinues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA. **WARNING** **Be careful with the hot HLAS.**

AUTO LASH ADJUSTER

1. Check auto - lash adjusters for free play by inserting a small wire through the air bleed hole in the rocker arm and push the autolash adjuster check ball down very lightly.
2. While lightly holding the check ball down move the rocker arm up and down to check for free play. If there is no play replace the auto - lash adjuster.

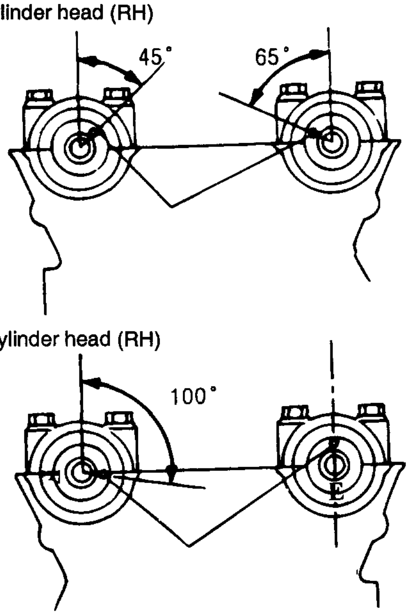


EDB9030E

REASSEMBLY ECBB3250

CAMSHAFT AND BEARING CAP

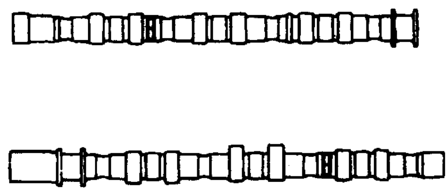
1. Rotate the crankshaft and No. 1 cylinder is in TDC (Compression stroke)
2. Check the position of the rocker arm whether it is exactly installed on the lash adjuster and valve or not.
3. Install the camshaft dowel pin as illustration.



EDB9034A

4. The left and right banks of the camshafts are different and you should be careful not to confuse them.

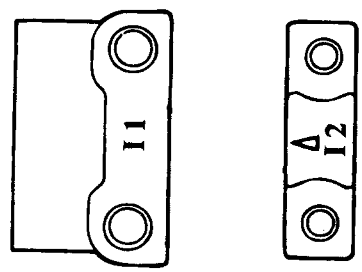
Identification signal
Left bank
Intake (IN) : F
Exhaust (Ex) : E
Right bank
Intake (IN) : G
Exhaust (Ex) : H



EDB9034B

5. Confirm the identification mark and the number. Bearing caps of No.3, No.4, and No.5 have the front mark and arrange the front mark upon the cylinder head while installing the bearing caps.

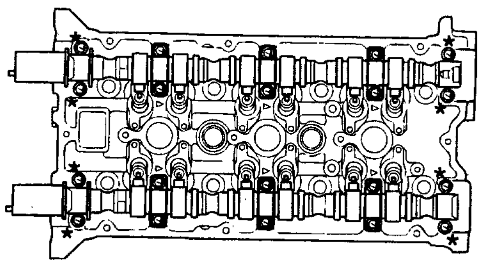
Identification mark
Intake : I
Exhaust : E



EDB9034C

6. Tighten the bearing cap by 2 or 3 steps

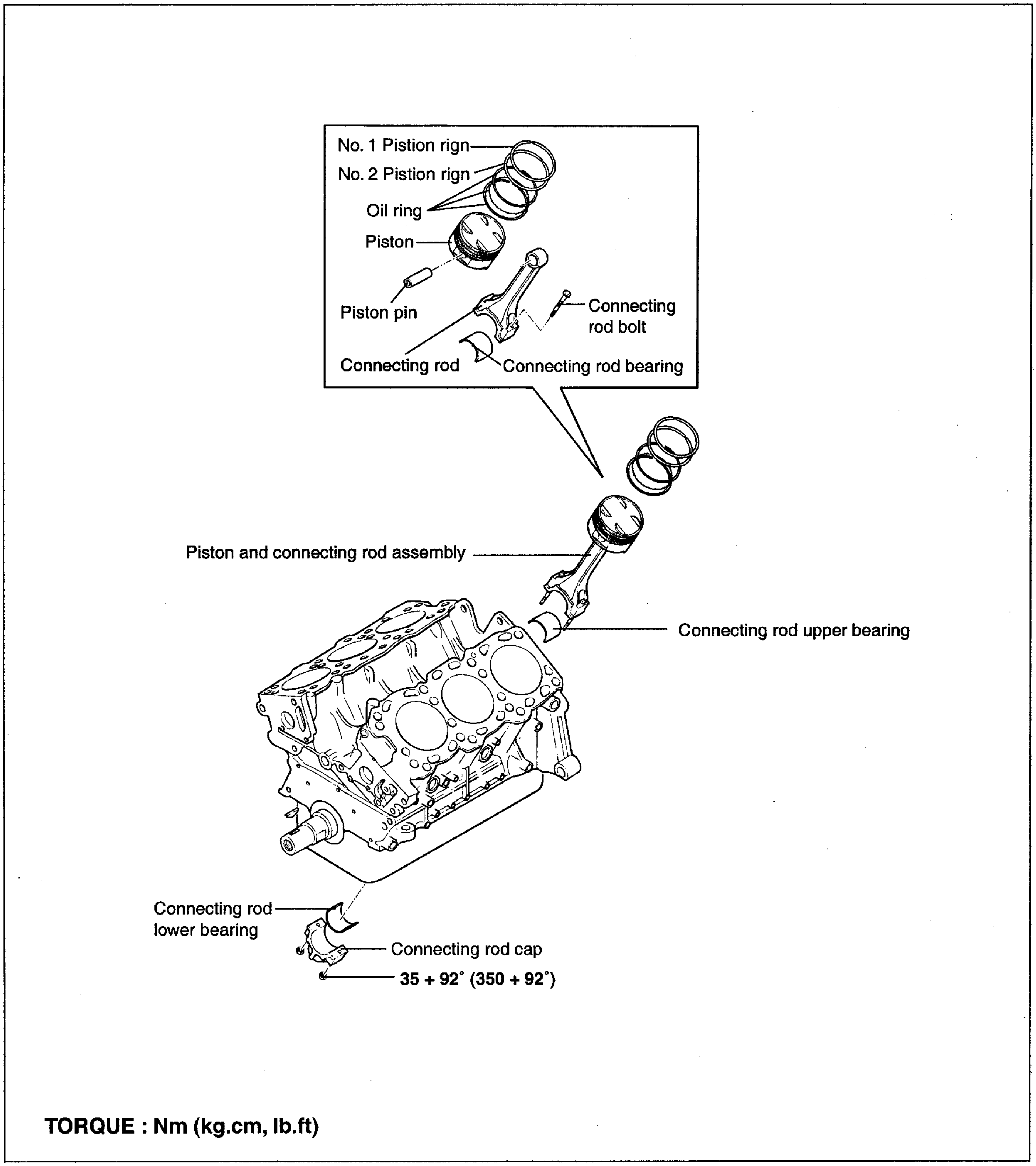
Tightening Torque
Outer (*) 16 EA : 1.9 - 2.1 kg.m
Inner 24 EA : 1.0 - 1.2 kg.m



EDB9034D

CONNECTING ROD

COMPONENTS EDMB0230



EDMB023A

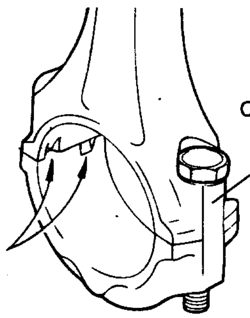
DISASSEMBLY ECBB3400

CONNECTING ROD CAP

CAUTION

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

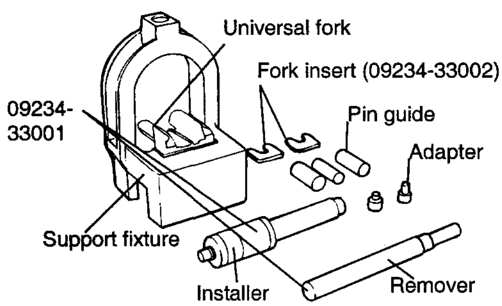
1. Remove the connecting rod cap bolts, then remove the caps and the big end lower bearing mark for reassembly.
2. Push each piston connecting rod assembly toward the top of the cylinder.



ECBB444D

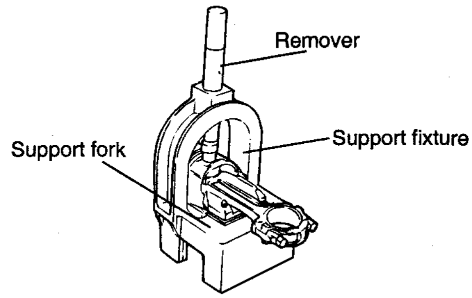
DISASSEMBLY AND REASSEMLY OF THE PISTON PIN

1. Using the special tools 09234 - 33001 and 09234 - 3002, 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 the 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 with 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.

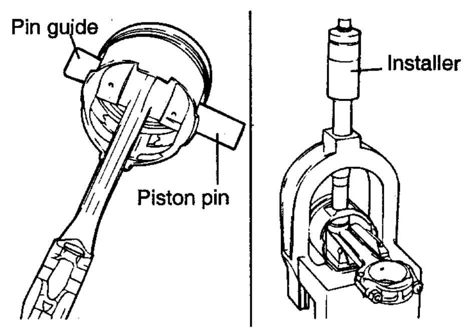


EDA9048A

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 one 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 through 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 fork inserts. If the wrong size pin guide is used, the piston and pin will not 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 750 ± 1,750 kg (1,653 ± 3,858 lb) of force when the installing tool seats angainst the top of the arch.

INSPECTION ECBB3500

PISTONS 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 pressed smoothly 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 the 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 rings.

Piston ring side clearance
No.1 : 0.04 - 0.08 mm (0.0016 - 0.0031 in.)
No.2 : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)

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 : 0.30 - 0.45 mm (0.012 - 0.018 in.)
No.2 : 0.45 - 0.60 mm (0.018 - 0.024 in.)
Oil ring side rail : 0.2-0.7 mm (0.0079 - 0.0276)

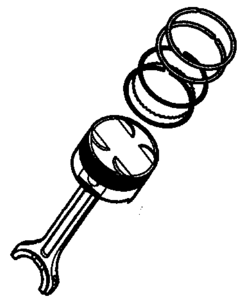
When replacing the ring without correcting the cylinder bore, check the gap with the ring situated at the lower part of cylinder that is less worn out.

PISTON RING SERVICE SIZE AND MARK

Standard	None
0.25 mm (0.010 in.) O.S	25
0.50 mm (0.020 in.) O.S	50
0.75 mm (0.030 in.) O.S	75
1.00 mm (0.040 in.) O.S	100

NOTE

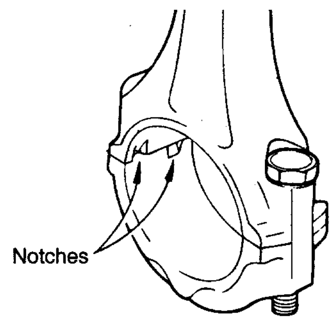
The mark can be found on the upper side of the ring next to the end.



KFW3037C

CONNECTING RODS

1. When the connecting rod cap is installed, make sure that the cylinder numbers, marked on rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches 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 a stratified wear, or if the surface of the inside diameter of the small end is severely rough, replace the rod.



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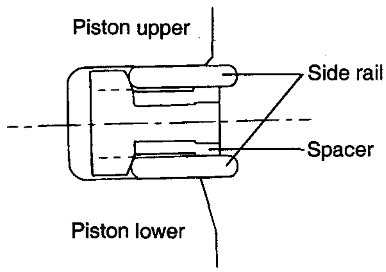
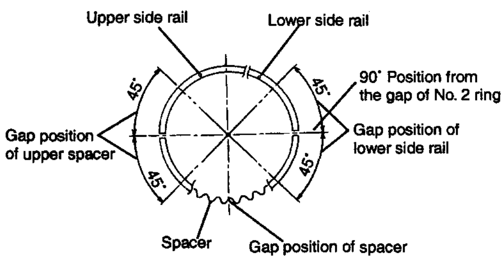
REASSEMBLY ECBB3600

1. Install the spacer.



ECA9082A



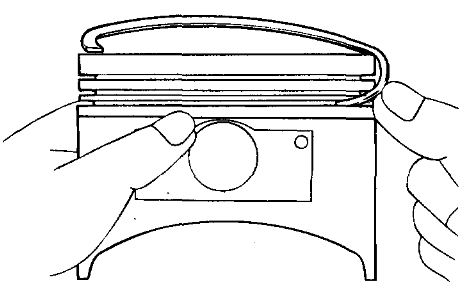
EDJA490A

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, and press down with finger on the portion to be inserted into the groove (as illustrated).

⚠ CAUTION

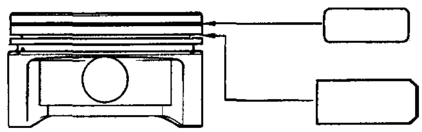
Do not use a piston ring expander when installing the side rail.

3. Install the lower side rail by the same procedure described in Step 2.



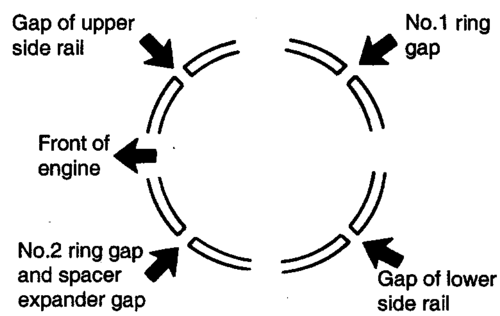
ECA9380B

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



KFW3055A

7. Position each piston ring end gap as far away from its neighboring gaps as possible. Make sure that the 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.

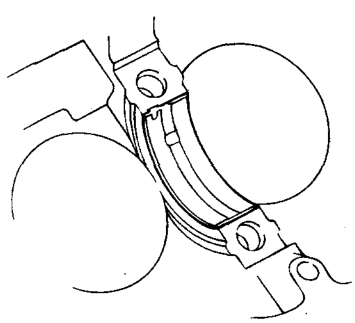


ECA9380D

9. Install the upper main bearings in the cylinder block.
10. Install the lower main bearings in the main bearing caps.

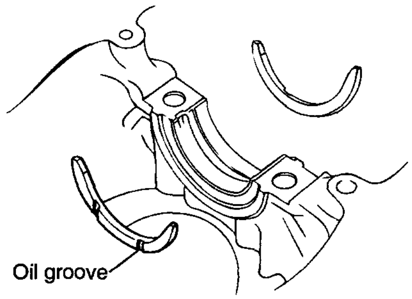
⚠ CAUTION

Install the bearing so it matches the oil hole in the block.



EDA9390E

11. Install the thrust washers in the No. 3 main bearing cap with the oil grooves facing outward.



EDA9390F

12. 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.

13. When the connecting rod cap is installed, make sure that any cylinder numbers placed on the rod and cap at disassembly match.

14. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.

15. When assembling, bolts should be fastened using the plastic angle technique as follows.

    1) Apply oil to the threads and matching areas.

    2) Tighten the connecting rod bolt.

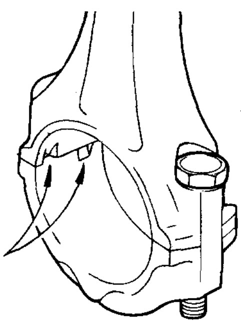
Tighting torque

Connecting rod bolt :

50 - 55 Nm (500 - 550 kg.cm, 36 - 37 lb.ft)

⚠ *CAUTION*

After removing the connecting rod bolt, do not use it again.
When using a new bolt, do not tighten the bolt more than 3 times.



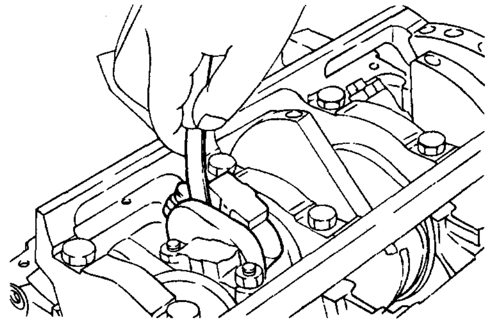
EDA9047A

16. Check the connecting rod side clearance.

Connecting rod side clearance

Standard : 0.10-0.25 mm (0.0039-0.0098 in.)

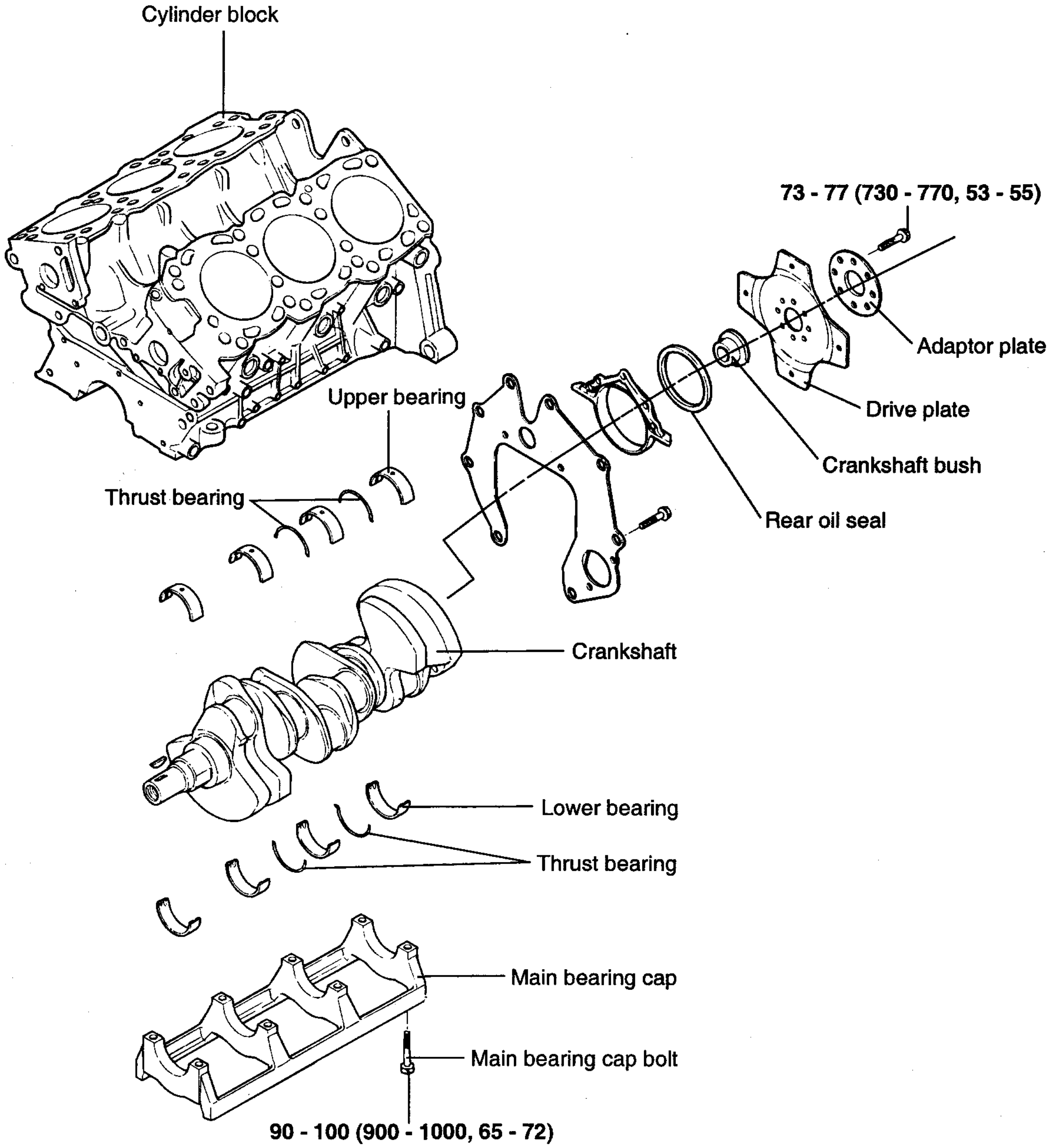
Limit : 0.4 mm (0.0157 in.)



EDA9051A

CRANK SHAFT

COMPONENTS ECBB3700



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

ECBB001B

DISASSEMBLY ECBB3800

1. Remove the timing belt train, front case, 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 reassemble in the original position and direction.

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

INSPECTION EDMB0250

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 parts.

2. Inspect the crankshaft journal and pin for out-of-round and taper.

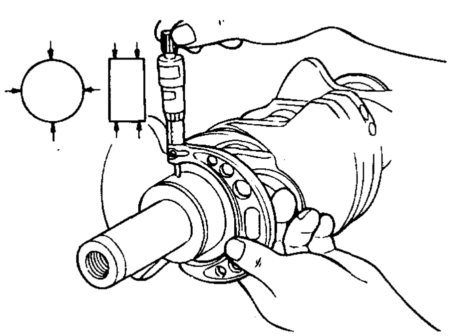
Standard value

Crankshaft journal O.D :

63.982 - 64.00 mm (2.519 - 2.5197 in.)

Crankshaft pin O.D :

54.982 - 55.00 mm (2.165 - 2.1653 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 for oil clearance by measuring the outside diameter of the crankshaft journal and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside diameters.

Standard value

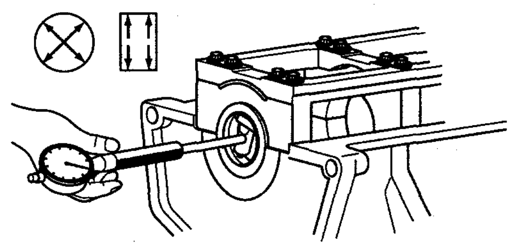
Oil clearance

Crankshaft main bearing :

0.018 - 0.036 mm (0.0007 - 0.0014 in.)

Connecting rod bearing :

0.022 - 0.048 mm (0.0009 - 0.002 in.)



KFW3058A

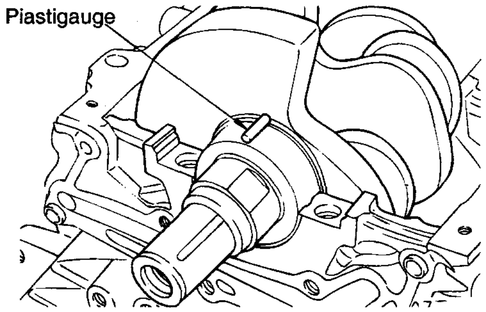
PLASTIGAUGE METHOD

Plastigauge may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.

2. Cut the plastigauge 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 plastigauge 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 the undersize and a bearing of the corresponding size should be installed.



EDA9420C

OIL SEAL

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

DRIVE PLATE (A/T)

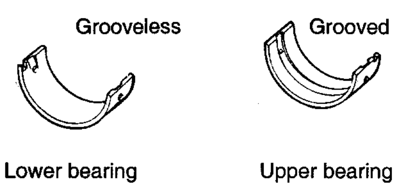
Replace distorted, damaged, or cracked drive plates.

REASSEMBLY ECBB4000

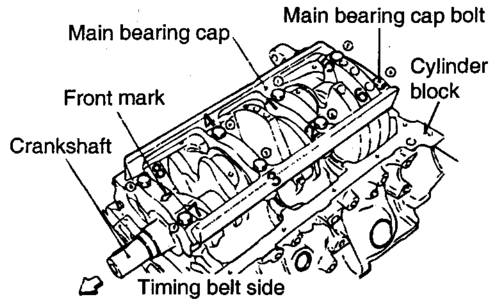
MAIN BEARING

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

Tightening torque
Main bearing cap bolts :
90 - 100 Nm (900 - 1000 kg.cm, 65 - 72 lb.ft)



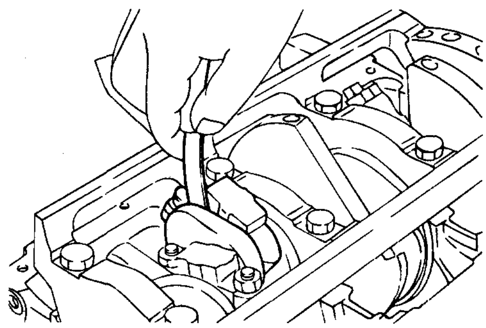
EDA9420D



B0Y183D

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

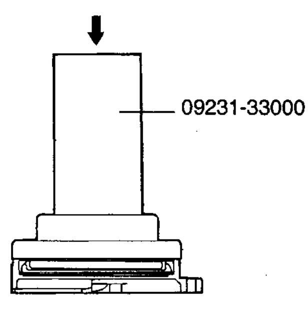
Crankshaft end play
Standard : 0.070 - 0.250mm (0.0028 - 0.0098 in.)
Limit : 0.35 mm (0.014 in.)



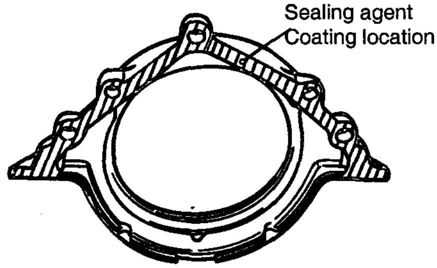
EDA9051A

8. Using special tool(09231-33000), install the rear oil seal in oil seal case.
9. Apply sealant to the area shown in the illustration. Install the oil seal case in the cylinder block.

Tightening torque
Oil seal case bolt :
10-12Nm (100 - 120 kg.cm, 7 - 9 lb.ft)



EDA9430C



EDA9430D

10. Tighten the rear plate to the specified torque.

Tightening torque
Rear plate : 10 - 12 Nm (100 - 120 kg.cm, 7 - 9 lb.ft)

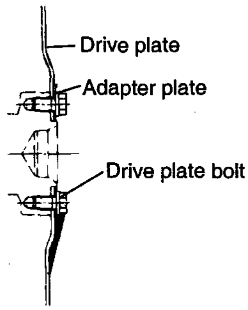
11. Tighten the drive plate and the adapter plate (A/T).

Tightening torque

Drive plate and adapter plate bolt :

73 - 77 Nm (730 - 770 kg.cm, 53 - 56 lb.ft)

(A/T)

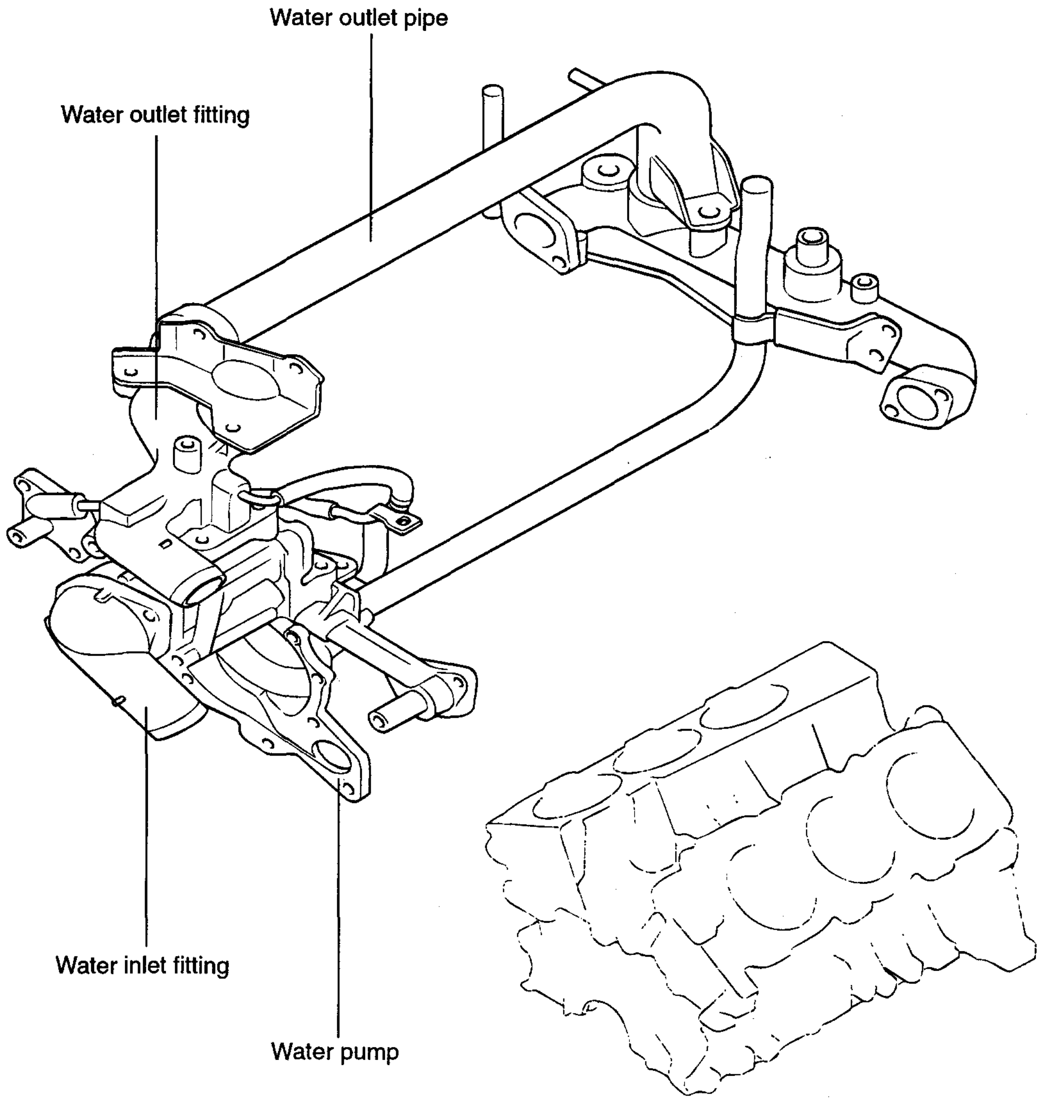


EDJA530A

COOLING SYSTEM

ENGINE COOLANT HOSE/PIPES

COMPONENTS EDMB0270



EDMB027A

INSPECTION EDHA6100

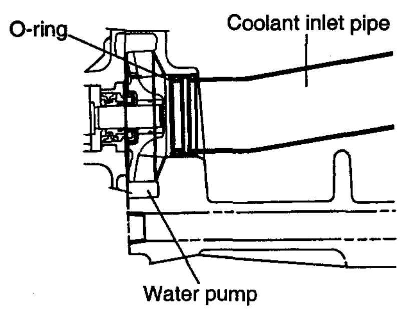
Check the engine coolant pipe and hose for cracks, damage and restrictions. Replace if necessary.

REASSEMBLY EDJA4700

Fit the O-ring in the groove of the engine coolant inlet pipe end. Wet the periphery of the O-ring with water and insert the engine coolant inlet pipe.

NOTE

1. *Do not apply oil or grease to the engine coolant pipe O-ring.*
2. *Keep the engine coolant pipe connections free of sand, dust, etc.*
3. *Insert the engine coolant pipe into the end of the engine coolant pump inlet.*
4. *Whenever installing the engine coolant inlet pipe, always replace the O-ring with a new one.*

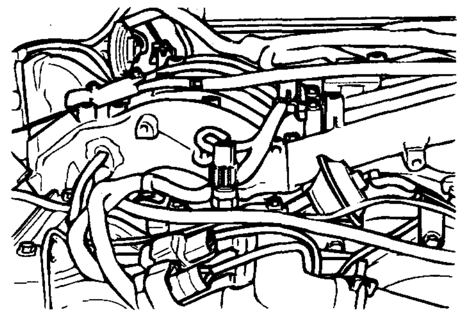


HEW2513B

COOLANT TEMPERATURE SENSOR EDMB0280

REMOVAL

1. Drain the engine coolant.
2. Remove the engine harness after disconnecting the ground cable of the battery.
3. Remove the engine coolant sensor.



KDMB003E

INSTALLATION ECBB5400

1. Apply sealant to the sensor's threads. Tighten it to the specified torque.

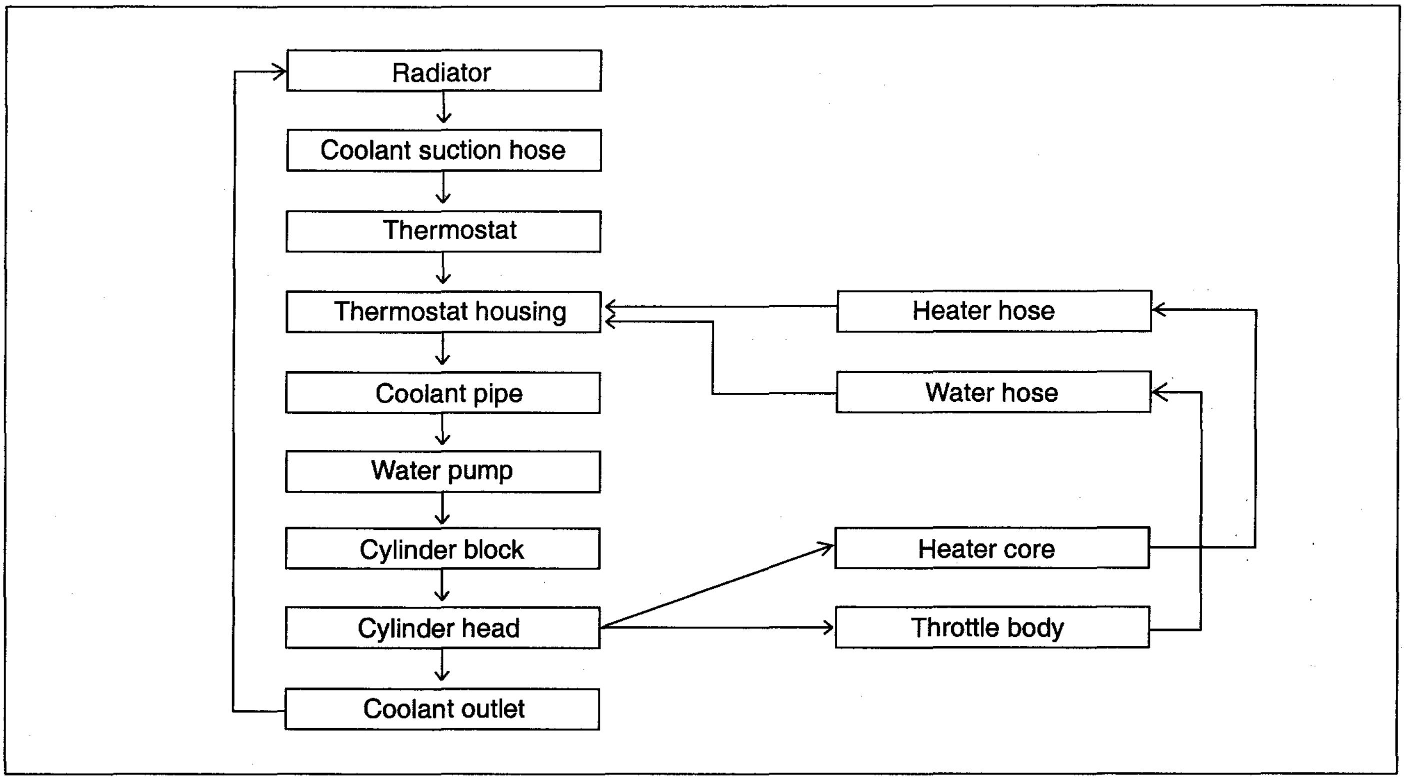
Recommended sealant :
Three bond NO. 2310 or LOCTITE 962T

Tightening torque
The coolant sensor :
20-40Nm(200-400 kg.cm, 14-29 lb.ft)

2. Connect the coolant sensor to the harness.
3. Connect the ground cable of battery.
4. Refill the coolant.

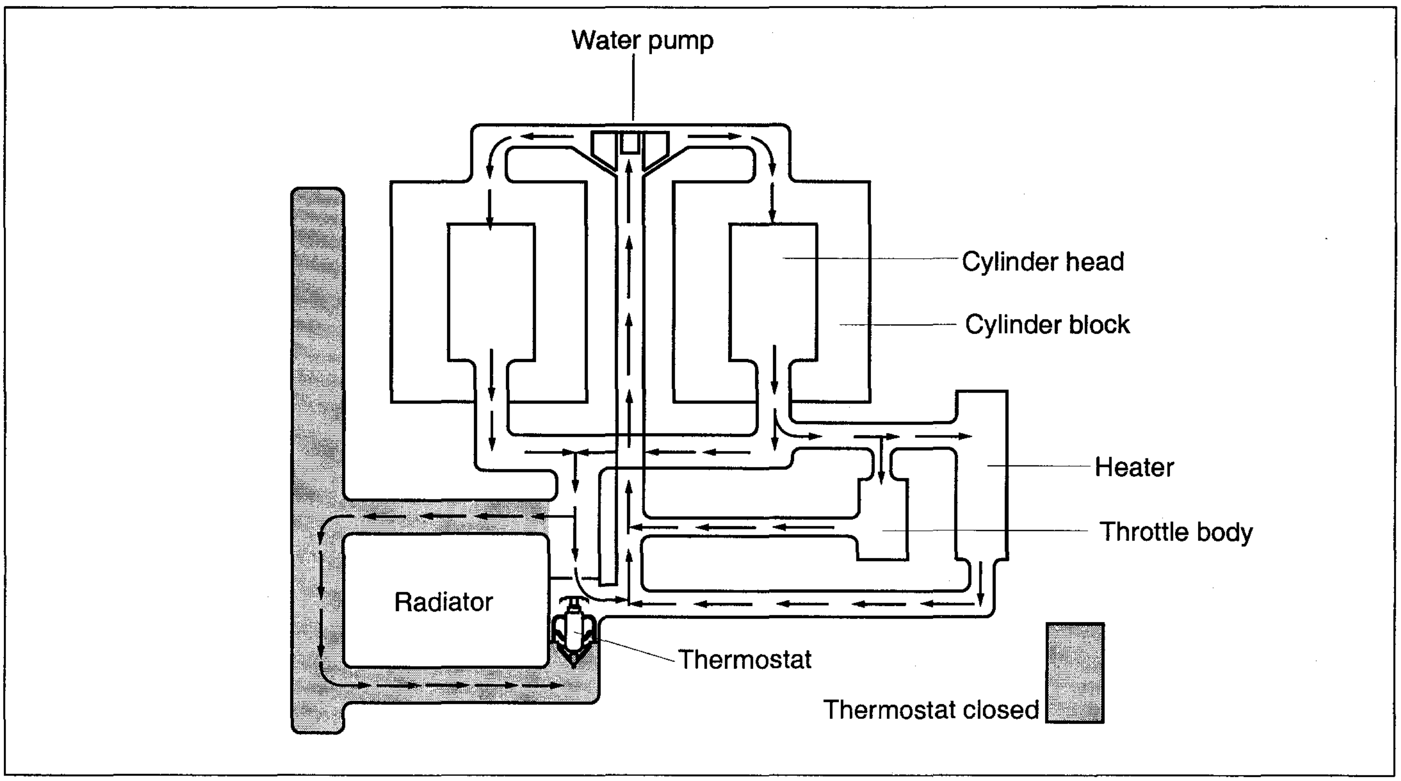
SCHEMATIC DIAGRAM ECBB5500

INLET CONTROL



EDHA650A

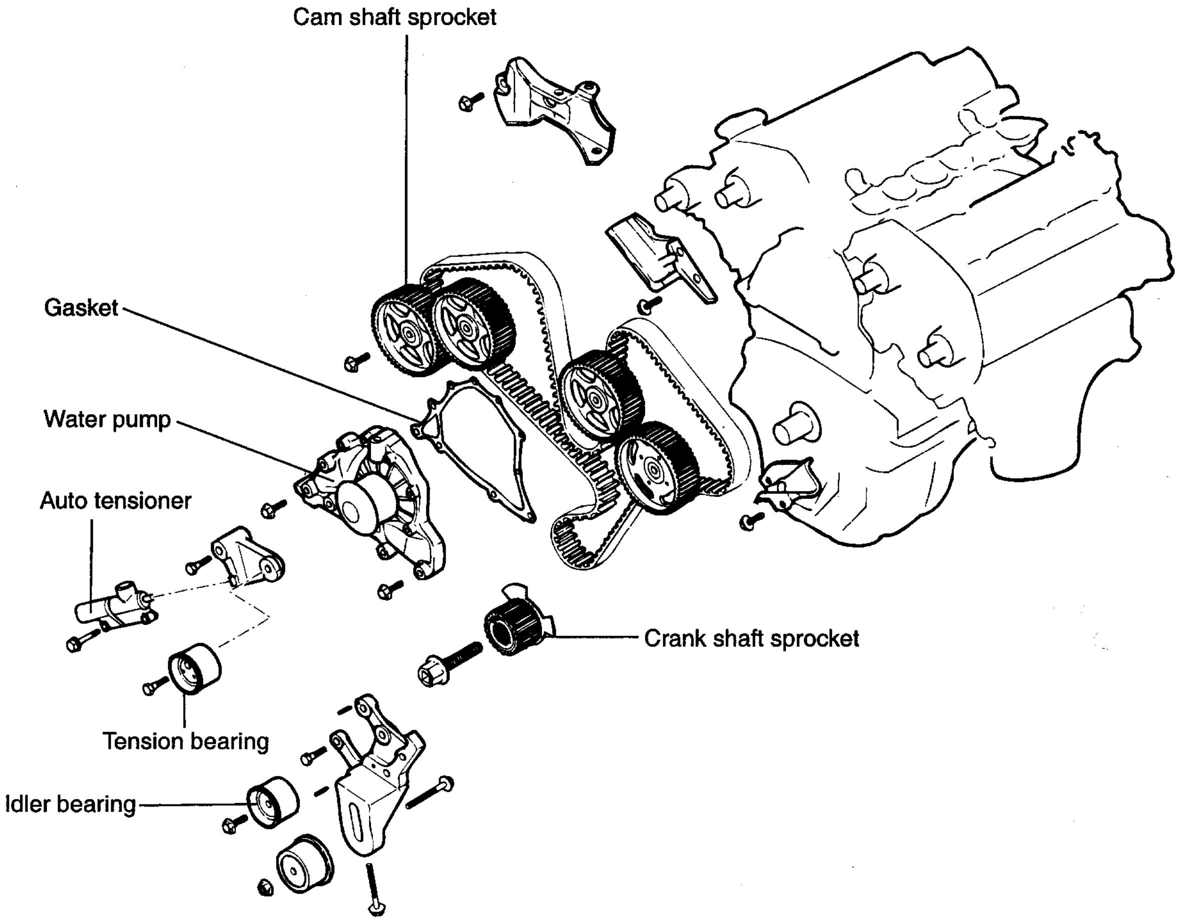
FLOW CHART



KFW3201A

ENGINE COOLANT PUMP

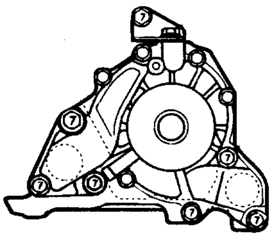
COMPONENTS ECBB5600



ECBB001E

REMOVAL ECBB5700

1. Using the drain plug, drain the coolant.
2. Remove the drive belt and the engine coolant pump pulley.
3. Remove the timing belt cover, the auto tensioner and idler pulley.
4. Remove the engine coolant pump mounting bolts.
5. Remove the engine coolant pump assembly from the cylinder block.



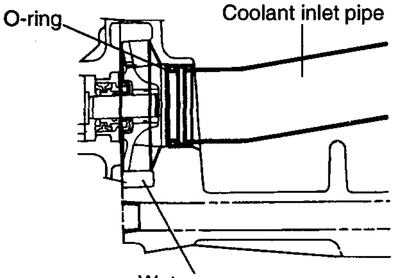
ECB9500L

INSPECTION EDHA7300

1. Check the engine coolant pump for cracks, damage or wear, and replace the pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation and replace the pump assembly if necessary.
3. Check the seal it for leaks and replace the pump assembly if necessary.

INSTALLATION ECBB5900

1. Clean the gasket surfaces of the engine coolant pump body and the cylinder block.



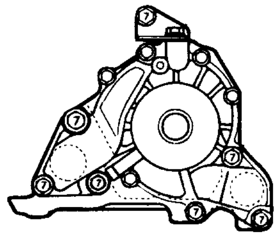
HEW2513B

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

Tightening torque

Engine coolant pump bolt :

Head mark "7" : 15-22 (150-220, 11-16)

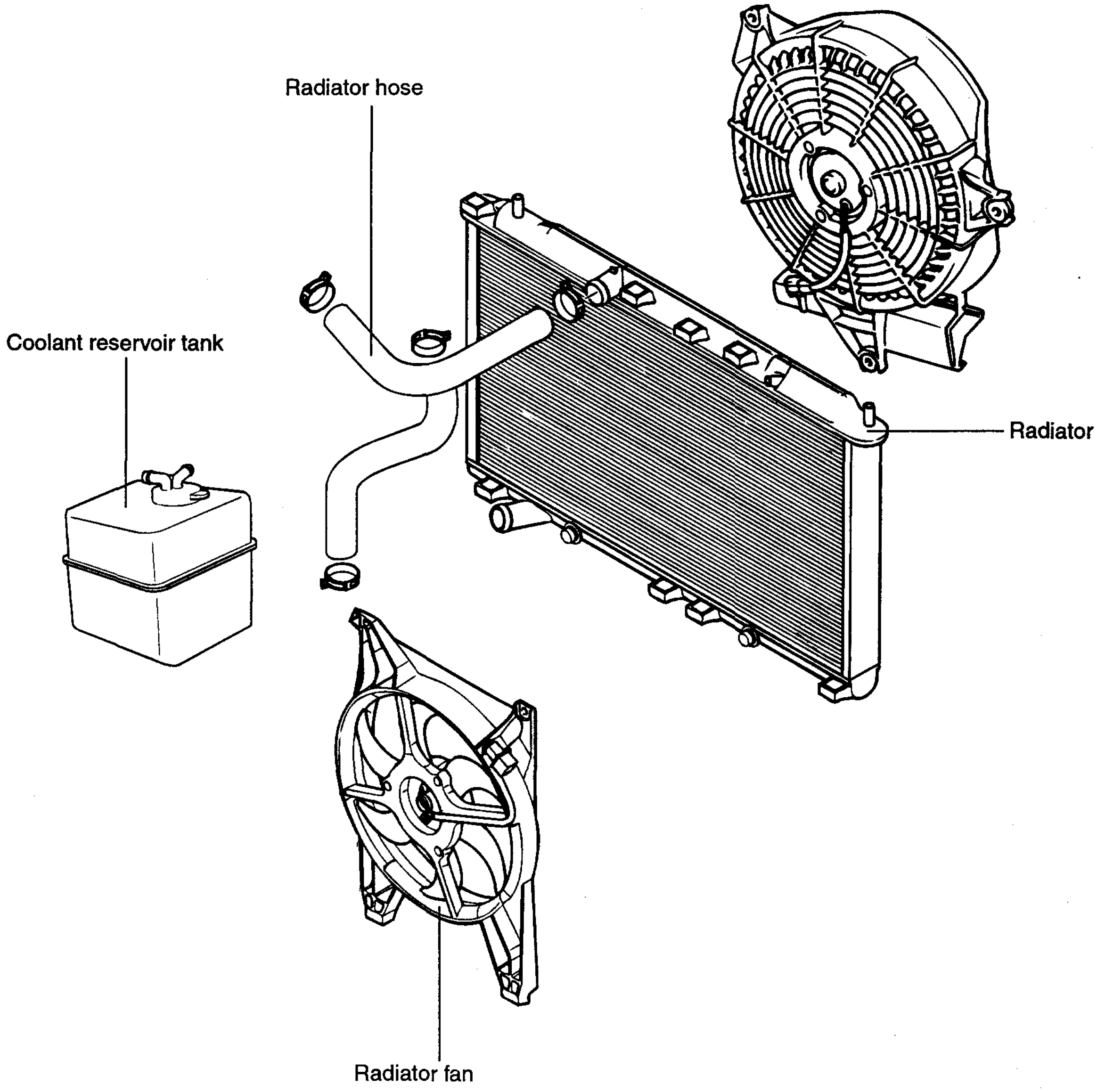


ECB9500L

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

RADIATOR

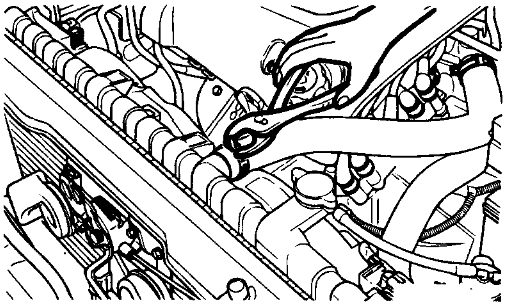
COMPONENTS EDMB0300



EDMB030A

REMOVAL ECBB6100

1. Disconnect the ground cable from the battery terminal.
2. Disconnect the fan motor connector.
3. Loosen the radiator drain plug to drain the coolant.
4. Disconnect the upper and lower hoses and overflow tube after marking the radiator hose and the hose clamp the ease reassembly.



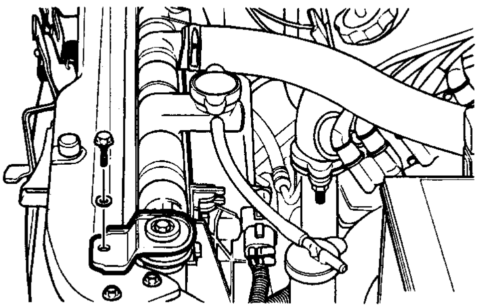
ECB9500B

5. For vehicles with automatic transaxles, disconnect the oil cooler hoses from the automatic transaxle.

⚠ *CAUTION*

Cover or plug the hose and inlets of the radiator so that dust and other foreign material etc. can not enter after the hose is disconnected from the radiator.

6. Remove the radiator mounting bolt.



ECB9500C

7. Remove the radiator and the fan motor.
8. Remove the radiator fan motor and condenser fan motor from the radiator.

INSPECTION EDHA8000

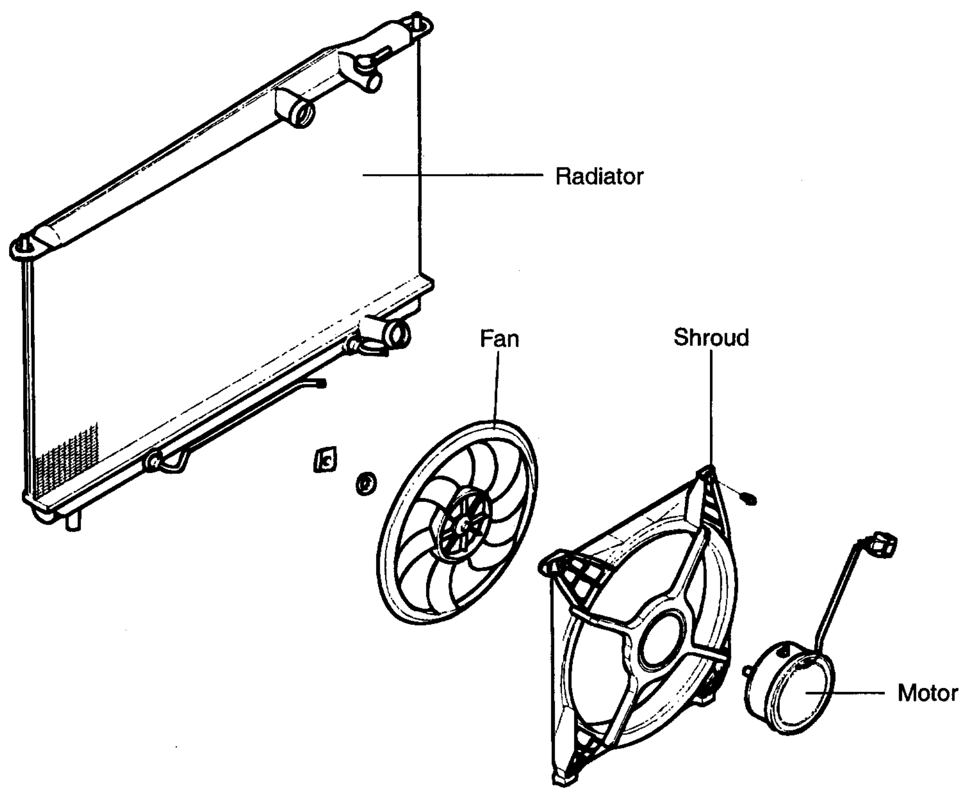
1. Check for foreign material between the radiator fins.
2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the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

INSTALLATION EDJA6300

1. Fill the radiator and reservoir tank with a clean coolant mixture.
2. Run the engine until the coolant warms up enough so that the thermostat valve opens and then turn off the engine.
3. Remove the radiator cap and pour the coolant up to the filler neck of the radiator. Fill the reservoir tank to the upper level.
4. Check that there are no leaks from the radiator, hoses or connections.

RADIATOR PAN MOTOR

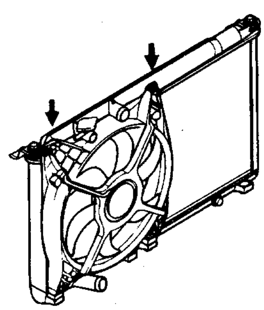
COMPONENTS ECBB6400



ECB9500D

REMOVAL ECBB6500

1. Disconnect the ground cable from the battery cable.
2. Disconnect the connectors from the fan motor and the harness from the shroud.
3. For vehicles with automatic transaxles, remove the oil cooler hose from the shroud.
4. Remove the four bolts holding the shroud.
5. Remove the shroud with the fan motor.
6. Remove the fan mounting clip and detach the fan from the fan motor.
7. Remove the three screws and detach the fan motor.

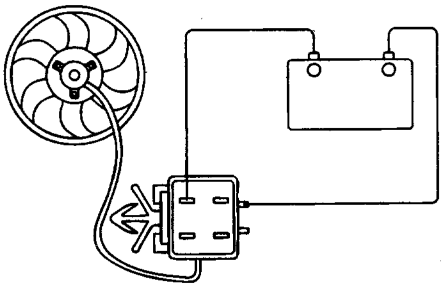


ECB9500E

INSPECTION ECBB6600

RADIATOR FAN MOTOR AND CONDENSER FAN MOTOR

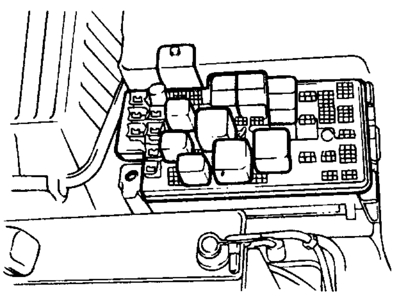
1. Check that the radiator fan rotates when battery voltage is applied between the terminals.
2. Check that there are no abnormal noises while the motor is running.



ECB9500F

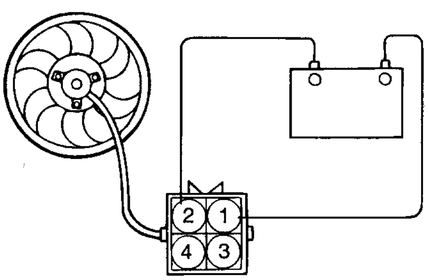
RADIATOR FAN MOTOR RELAY

1. Remove the radiator fan motor relay (High and Low) from the relay box in the engine room.



EDA9094A

2. Check to be sure that the radiator fan rotates when battery voltage is applied between the terminals (as shown table below).
3. Check to see that adnormal nioses are not produced while the motor is turning.



EDA9097A

Item \ Terminal	1	2	3	4	MOTOR SPEED
RADIATOR FAN MOTOR	⊕		⊖		LOW
	⊕	⊕		⊖	MIDDLE
	⊕	⊕	⊖	⊖	HIGH
CONDENSER FAN MOTOR		⊕	⊖		LOW
	⊕	⊕		⊖	MIDDLE
	⊕	⊕	⊖	⊖	HIGH

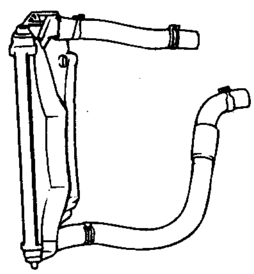
ECBB444B

INSTALLATION EDMB0350

Installation is the reverse of removal.

NOTE

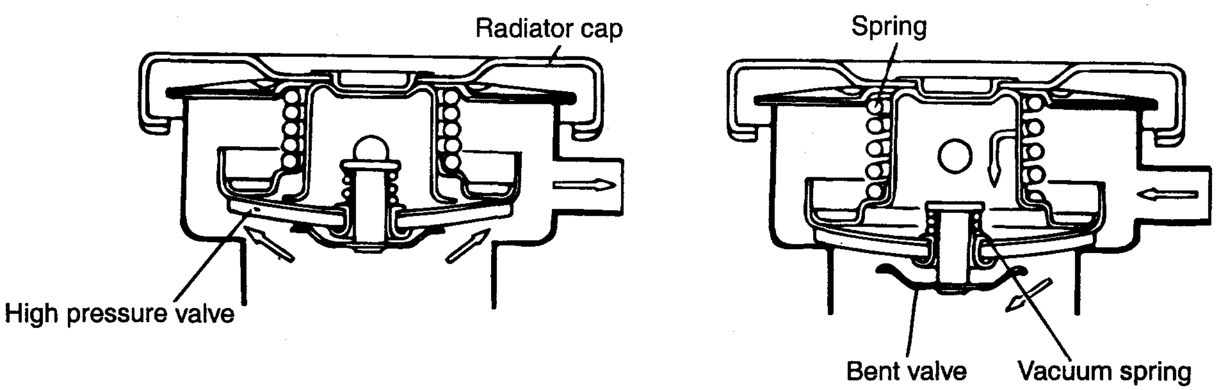
1. *Make sure the cooling fan does not come into contact with the shroud when installed.*
2. *After installation, make sure there is no unusual noise or vibration when the fan is rotating.*



ECA9061A

RADIATOR CAP

COMPONENTS ECBB6800



Pressure : 107.9±14.7 (1.1±0.15, 15.64±2.13)

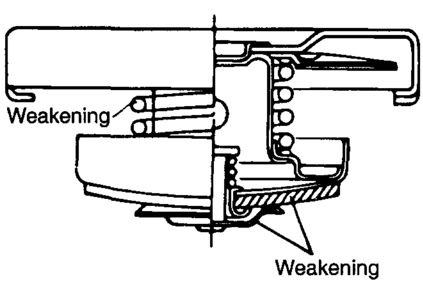
Pressure : 83.4 (0.85, 12.1)

PRESSURE : Kpa (kg/cm², psi)

HCT25012

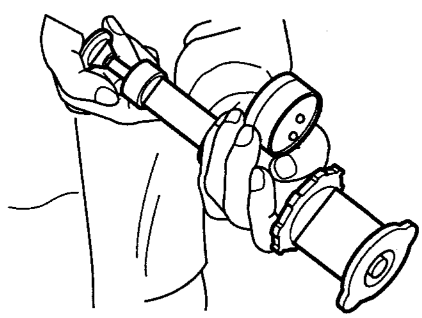
INSPECTION EDHA8300

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



HCT25013

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



KFW3203A

THERMOSTAT

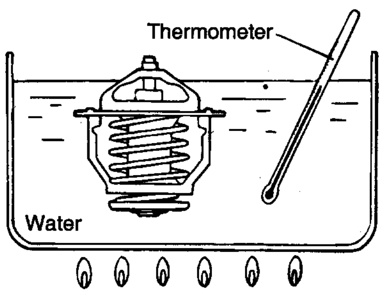
REMOVAL EDHA9100

1. Drain the coolant to thermostat level or below.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.

INSPECTION EDHA9200

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°C)



ECA9600A

INSTALLATION ECBB7300

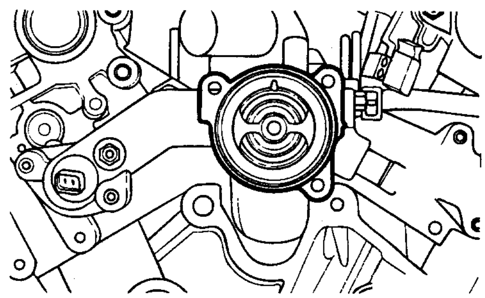
1. Check that the flange of the thermostat is correctly placed in the socket of the thermostat housing.
2. Install the inlet fitting.

Tightening torque

Engine coolant inlet fitting bolt :

17-20 Nm (170-200 kg.cm, 12-14 lb.ft)

3. Refill the coolant.

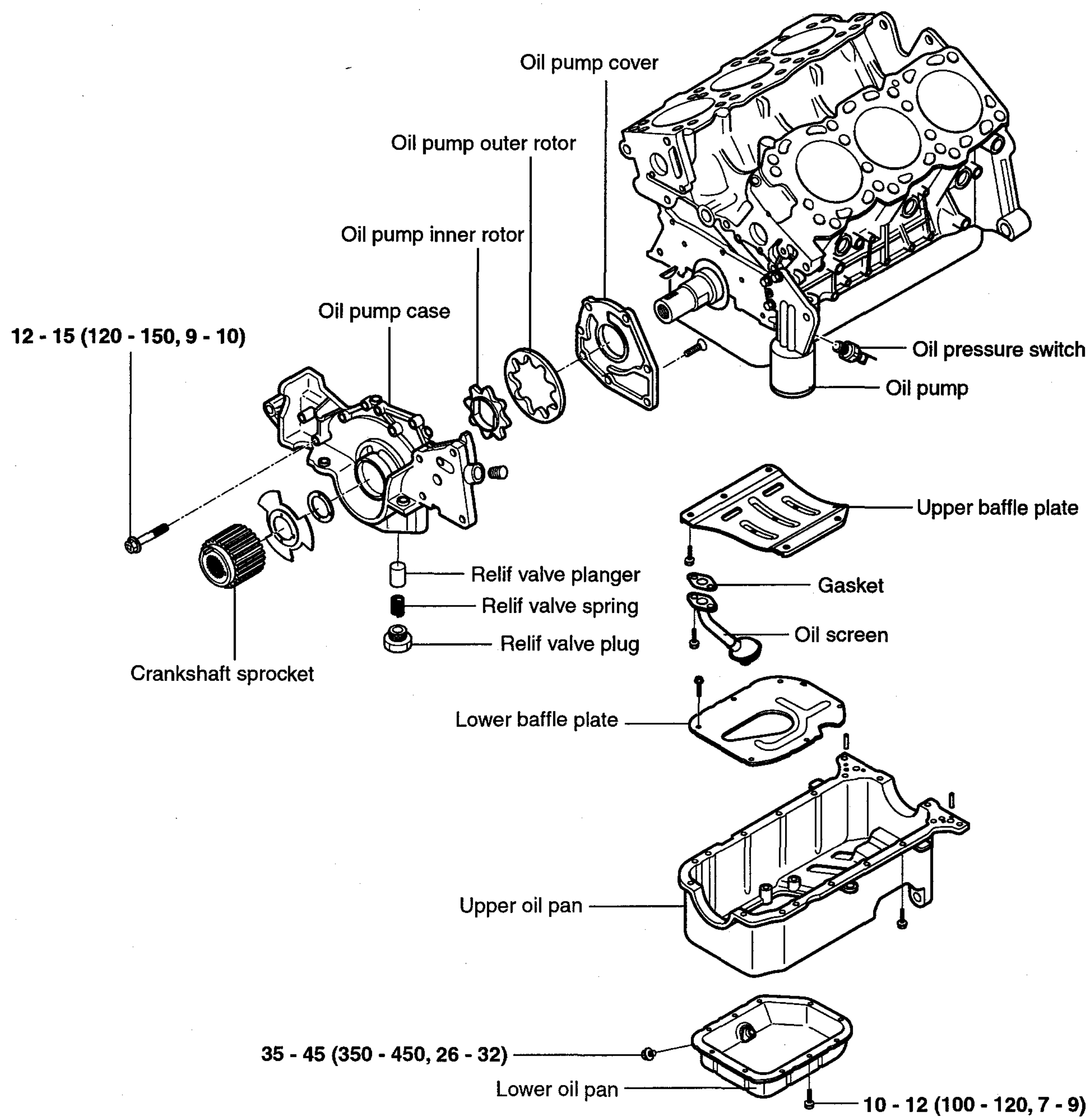


ECB9500O

LUBRICATION SYSTEM

OIL PUMP

COMPONENTS EDMB0400



TORQUE : Nm (kg·cm, lb.ft)

EDMB040A

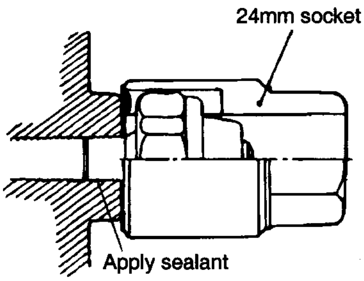
DISASSEMBLY EDHA9500

1. Remove the oil pressure switch, using 24 mm deep socket.

   NOTE

   Since a sealant is used on the threaded area, be careful not to damage the oil pressure switch.

2. Remove the oil filter and the oil pan.
3. Remove the oil screen and gasket.
4. Remove the three bracket securing bolts and remove the oil filter bracket and gasket.
5. Remove the oil relief valve plug from the oil pump case.
6. Remove the oil pump case.



HFR20A33

INSPECTION ECBB8200

OIL PUMP

1. Visually check the parts of the oil pump case for cracks and damage.
2. Assemble the rotor on the oil pump and then check the clearance with a thickness gauge.

Oil pump side clearance

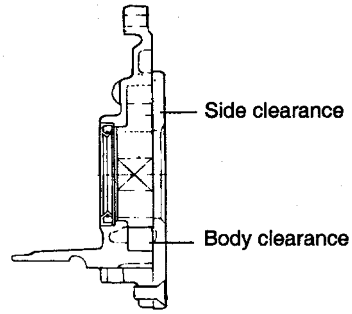
Standard value

Body clearance:0.100-0.181mm (0.0039-0.0071 in.)

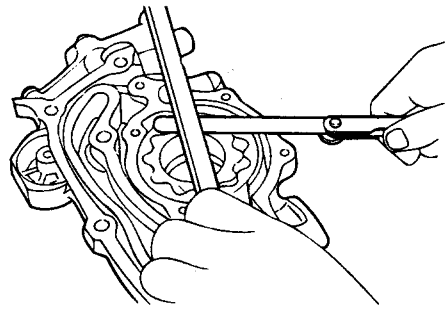
Side clearance:0.040-0.095mm (0.0016-0.0037 in.)

Oil pump Tip clearance :

0.06 - 0.18 mm (0.0024 - 0.0071 in.)



EDA9041A



EDA9340B

RELIEF PLUNGER AND SPRING

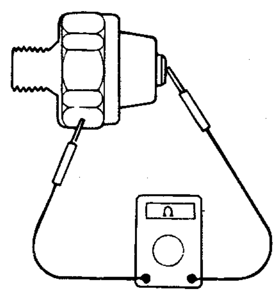
1. Check the relief plunger for smooth operation.
2. Check the relief spring for deformation or breaks.

OIL FILTER BRACKET

1. Make sure that there is no damage on the surface that mates with the oil filter.
2. Check the oil filter bracket for oil leaks or cracks.

OIL PRESSURE SWITCH

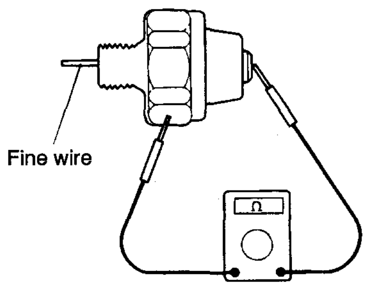
1. Check the continuity between the terminal and the body with an ohmmeter.
   If there is no continuity, replace the oil pressure switch.



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 air leakage. If air leaks, the diaphragm is broken Replace it.



ECA9320E

Operation Pressure

Oil pressure switch :

80 kpa (0.8 kg/cm². 11.4 psi)or more

REASSEMBLY ECBB8300

1. Install the oil pump case with the gasket.

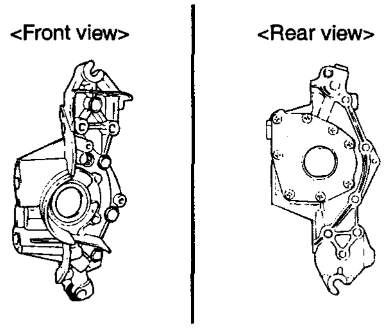
Tightening torque

Oil pump case bolt :

12-15 Nm (120-150 kg.cm, 9-11 lb.ft)

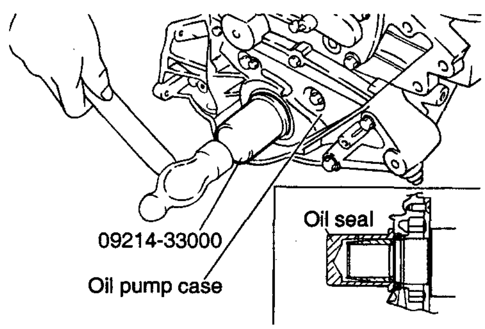
Oil pump cover screw :

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



EDA9042A

2. Install the oil seal into the oil pump case as tightly as possible, using the special tool (09214-33000).



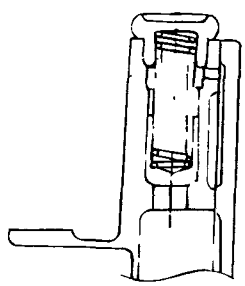
EDA9350B

3. Install the relief plunger and spring, and tighten the oil relief valve plug to the specified torque.

Tightening torque

Oil relief valve plug :

40-50 Nm (400-500 kg.cm, 29-36 lb.ft)



EDA9044A

4. Install the oil screen and a new gasket.

Tightening torque

Oil screen bolt :

15-22 Nm (150-220 kg.cm, 11-15 lb.ft)

5. Clean the gasket surfaces of the cylinder block and the oil pan.

6. Apply sealant to the groove of the oil pan flange.

NOTE

1. Make the first cut approx. 4 mm from the end of the nozzle furnished with the sealant. After application of the sealant, do not exceed 15 minutes before installing the oil pan.

2. Make sure that the sealant doesn't enter the inside of the oil pan.

7. Install the oil pan and tighten the bolts to the specified torque.

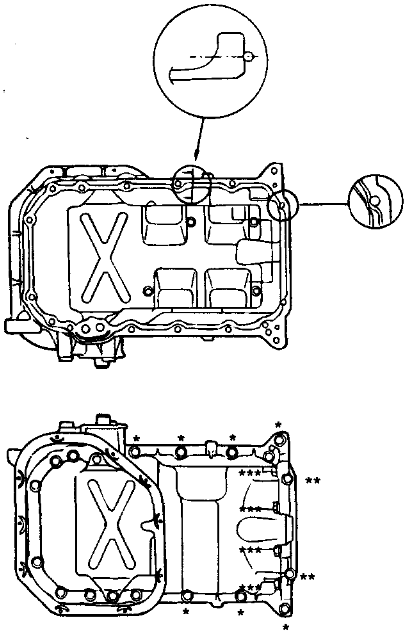
Tightening torque

Oil pan bolt :

* : 19-28 Nm (190-280 kg.cm, 14-20 lb.ft)

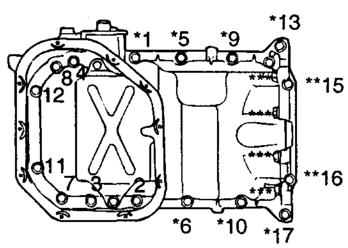
** : 5-7 Nm (50-70 kg.cm, 4-5 lb.ft)

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



EDA9045A

8. Tighten the oil pan bolts as shown in the illustration.



EDA9045B

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

Sealant : Three bond No.1104E or equivalent

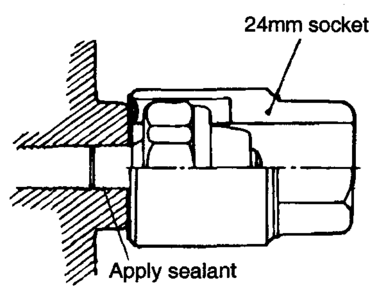
NOTE

Do not torque the oil pressure switch too much.

Tightening torque

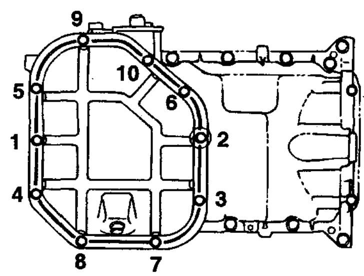
Oil pressure switch :

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



HFR20A33

10. Tighten the lower oil pan bolts as shown in figure.

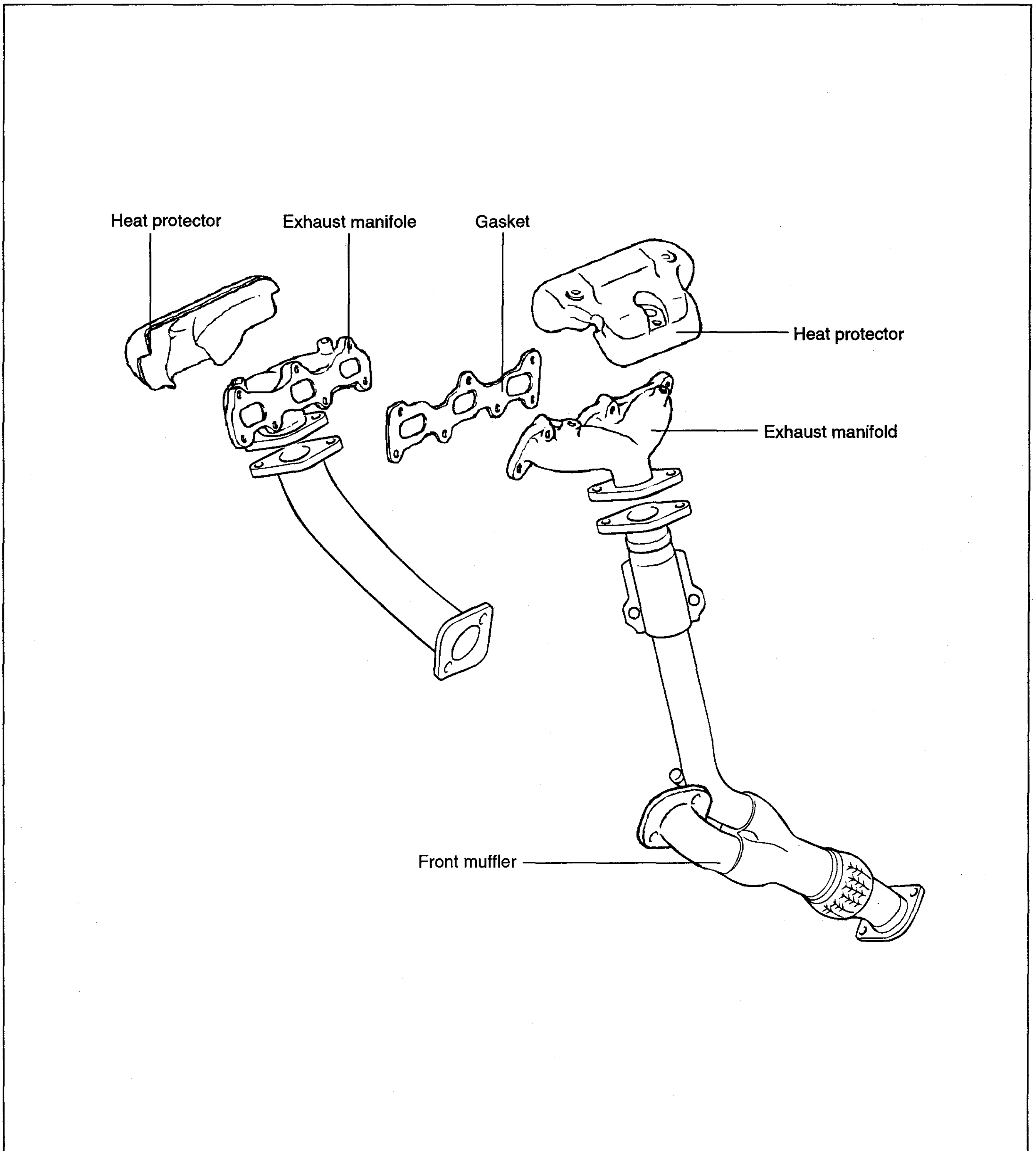


EDJA970A

INTAKE AND EXHAUST SYSTEM

EXHAUST MANIFOLD

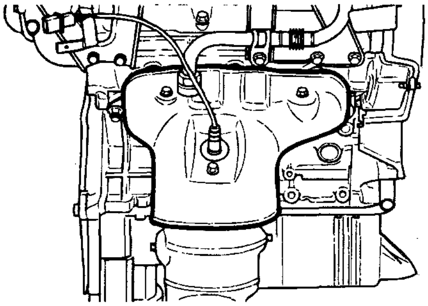
COMPONENTS EDMB0450



EDMB045A

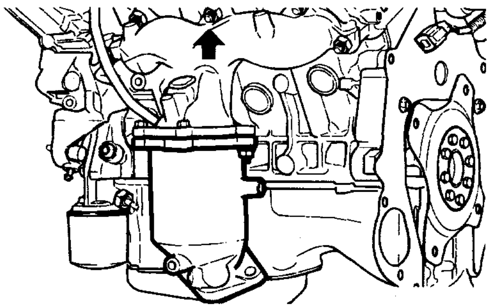
REMOVAL ECBB9100

1. Remove the heat protector.



ECB9510B

2. Remove the exhaust manifold.



ECB9510C

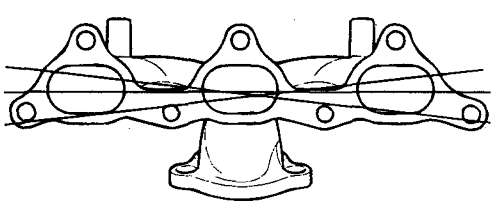
3. Remove the exhaust manifold gasket.

INSPECTION ECBB9200

1. Check for damage or cracks.
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.) or less

Service limit : 0.3 mm (0.012 in.) or less



ECB9510D

3. Check the exhaust manifold for damage and cracks.

INSTALLATION ECBB9300

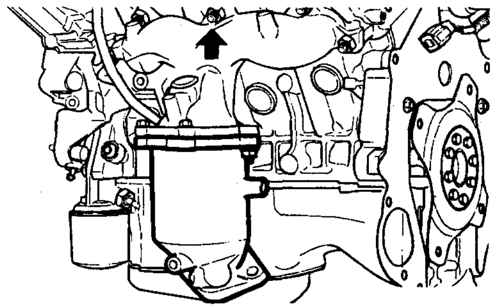
1. Install the exhaust manifold with gasket.

Tightening torque

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

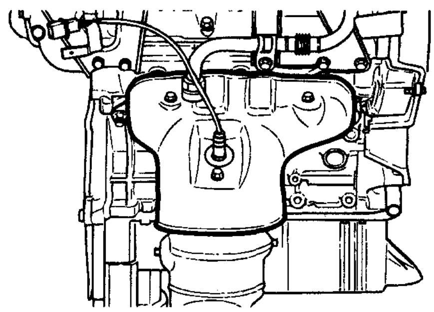
NOTE

Do not re - use an exhaust manifold gasket.



ECB9510C

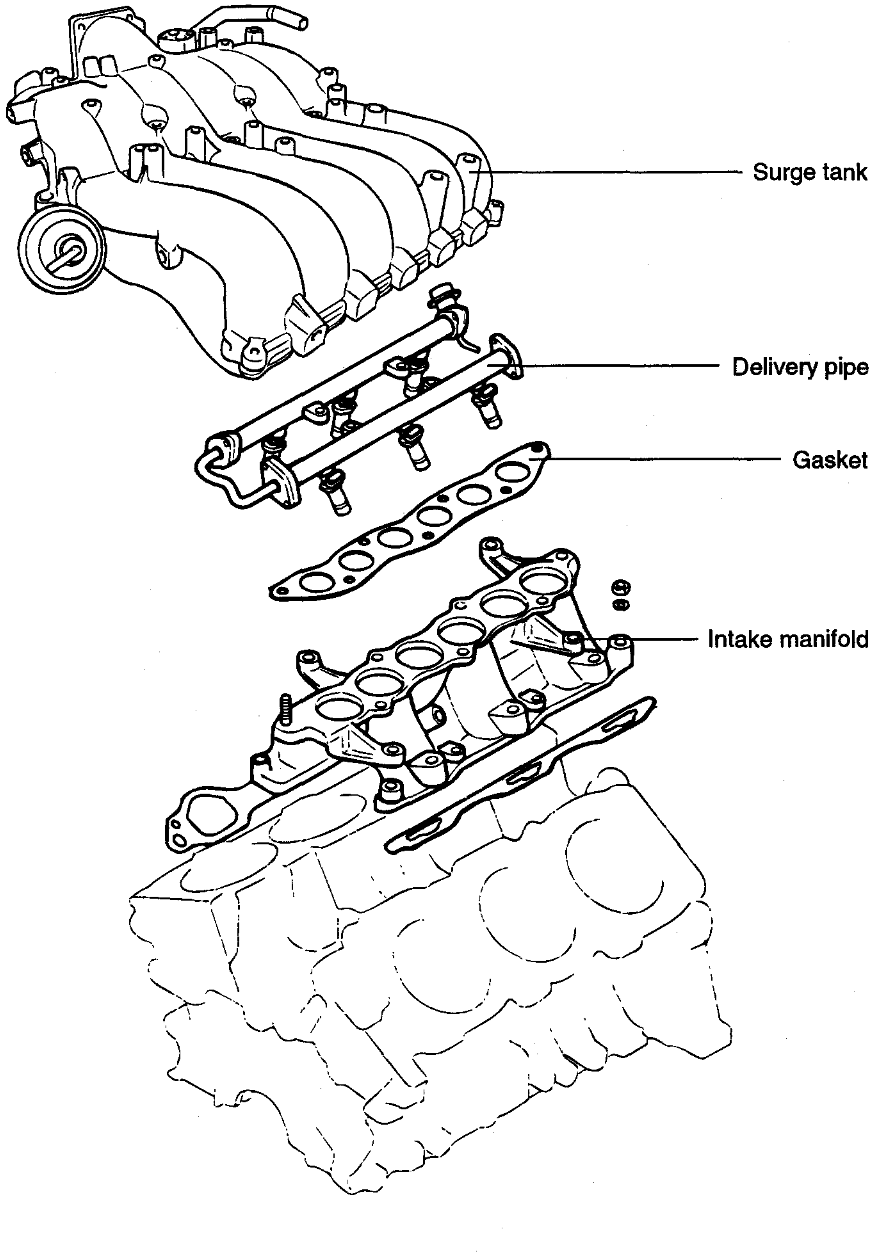
2. Install the heat protector.



ECB9510B

INTAKE MANIFOLD

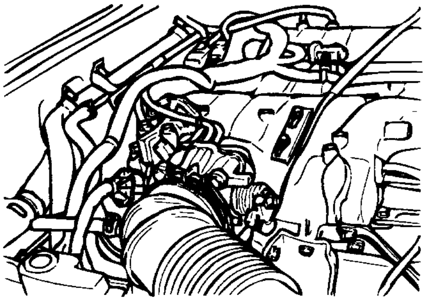
COMPONENTS EDMB0500



EDMB050A

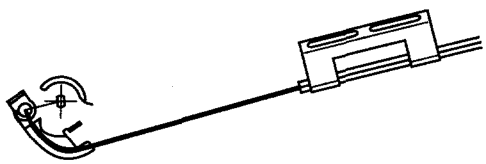
REMOVAL EDMB0510

1. Remove the air intake hose connected to the throttle body.



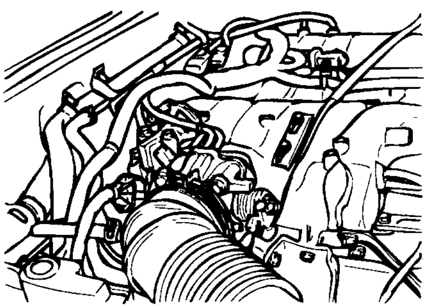
KDMB003B

2. Remove the accelerator and cruise control cables.
3. Remove the engine coolant hose and throttle body.



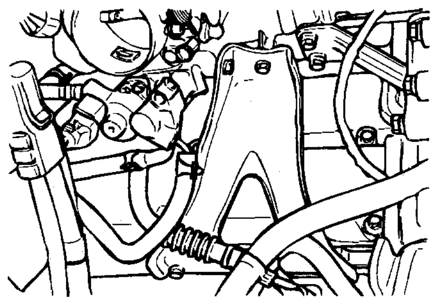
KFW3231A

4. Remove the P.C.V. hose and brake booster vacuum hoses.
5. Disconnect the vacuum hose connections.

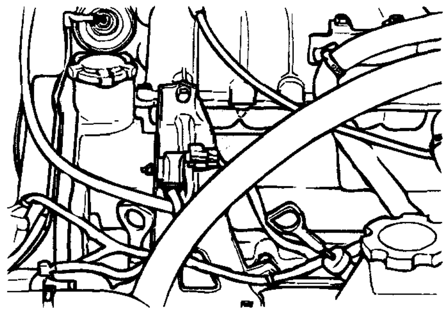


KDMB003B

6. Remove the surge tank stay.

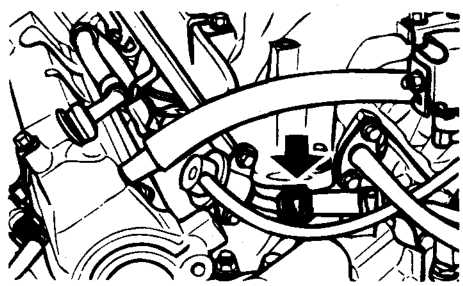


KDMB003C



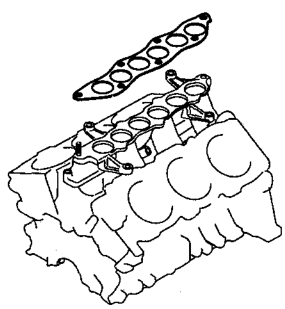
KDMB003D

7. Bleed off the pressure in the fuel pipe line to prevent the fuel from spilling.
8. Disconnect the connector from high pressure hose.



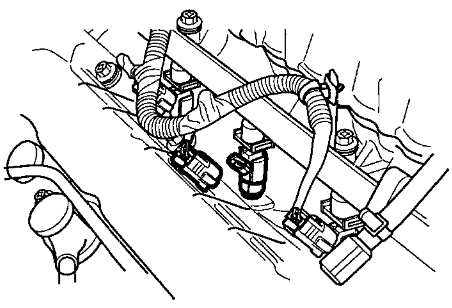
ECBB444F

9. Remove the surge tank and gasket.



KFW3236A

10. Disconnect the fuel injector harness connector.

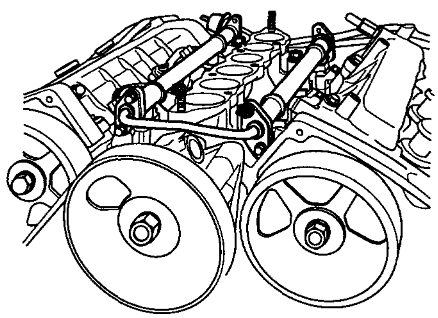


KFW3237A

11. Remove the delivery pipe with the fuel injector and the pressure regulator.

NOTE

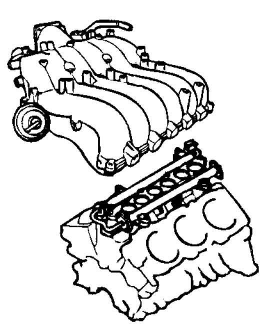
When the delivery pipe is removed, be careful not to drop an injector.



KFW3238A

12. Disconnect the wiring harness of the coolant sensor assembly.

13. Remove the surge tank.



KDMB009B

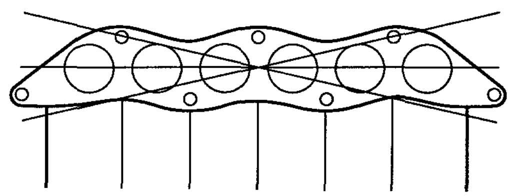
INSPECTION EDMB0520

SURGE TANK AND INTAKE MANIFOLD

1. Check the surge tank and intake manifold for damage, cracking or restriction of the vacuum outlet port, water or gas passages.

2. Check for distortion on the surface using a straight edge and feeler gauge.

Standard value : 0.15 mm (0.006 in.) or less	
Service limit : 0.2 mm (0.0078 in.)	



KDMB087A

INSTALLATION EDMB0530

1. Install the intake manifold and delivery pipe reversing the order of the removal procedure.

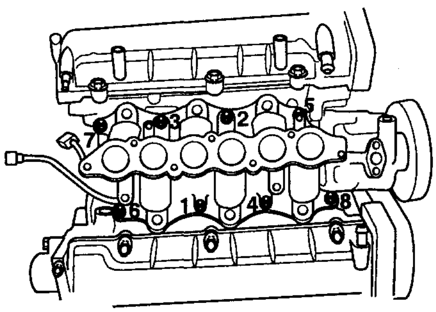
Tightening torque

Intake manifold :

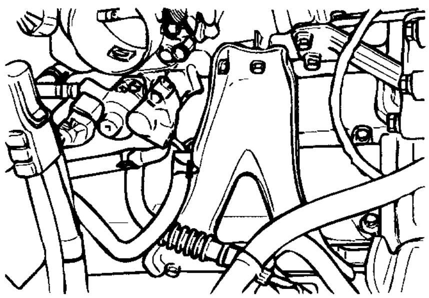
12 - 15 N.m (120 - 150 kg.cm, 9 - 11 lb.ft)

Surge tankstay :

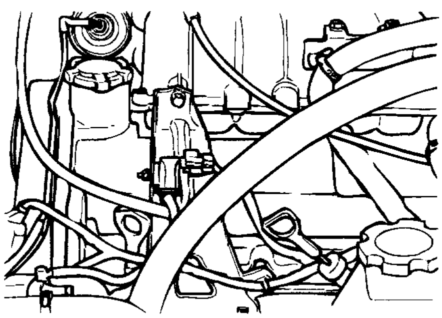
15-20 N.m (150-200 kg.cm, 11-14lb.ft)



KFW3241A



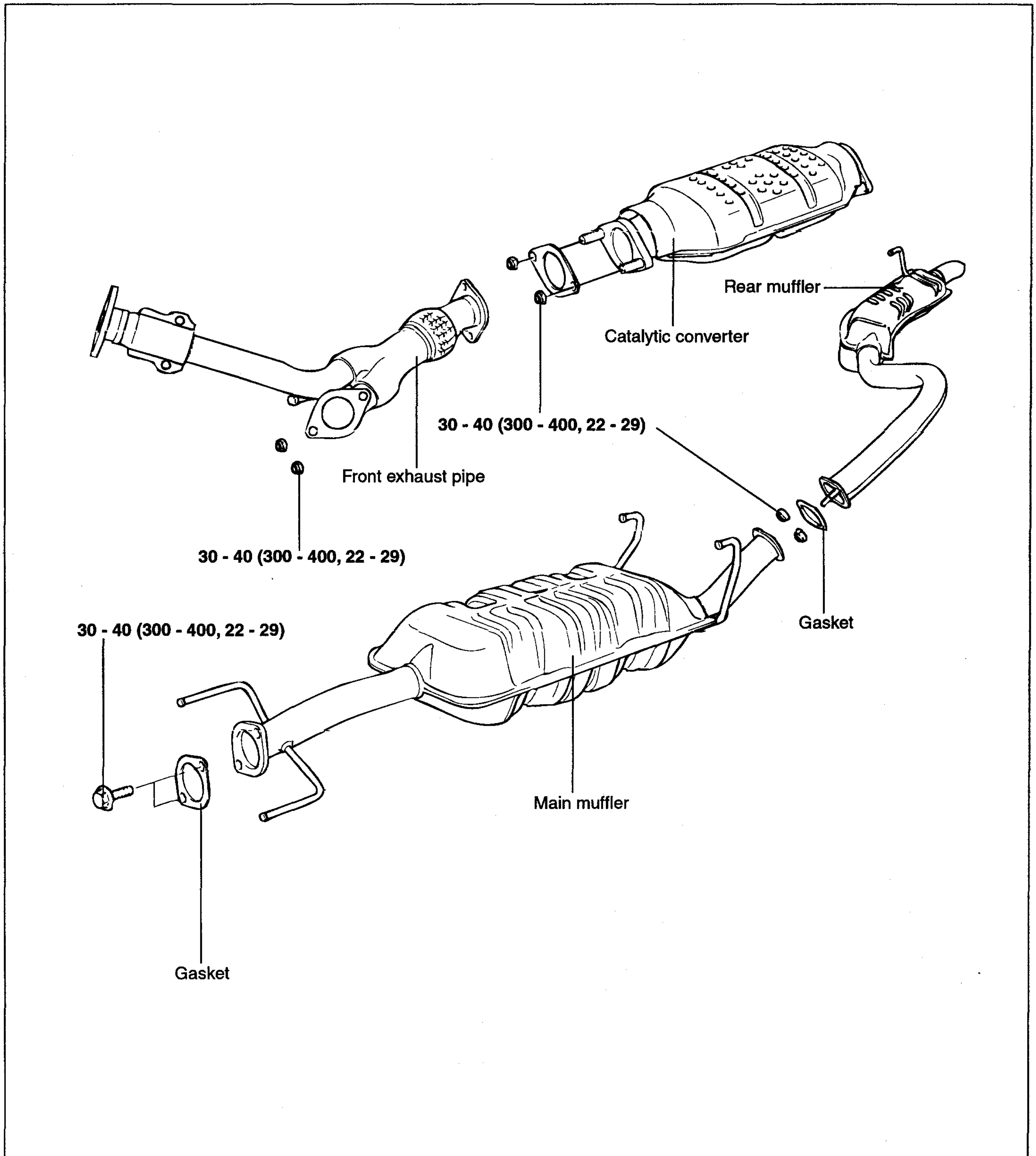
KDMB003C



KDMB003D

MUFFLER

COMPONENTS EDMB0600



EDMB060A

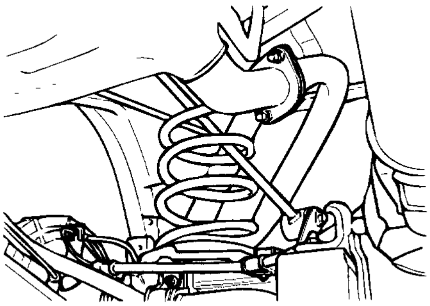
REMOVAL EDMB0610

REAR MUFFLER

CAUTION

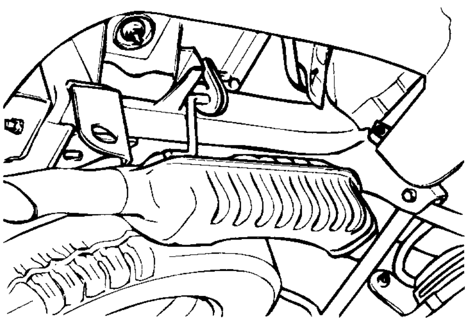
Before removing or inspecting the exhaust system, ensure that the exhaust system is cool.

1. Disconnect the rear muffler from the center exhaust pipe.



KDMB001B

2. Remove the rubber hangers and the rear muffler.

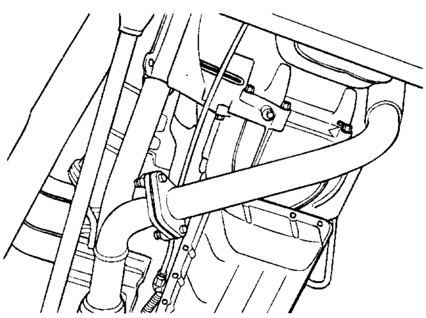


KDMB001C

FRONT EXHAUST PIPE (INCLUDING CATALYTIC CONVERTER)

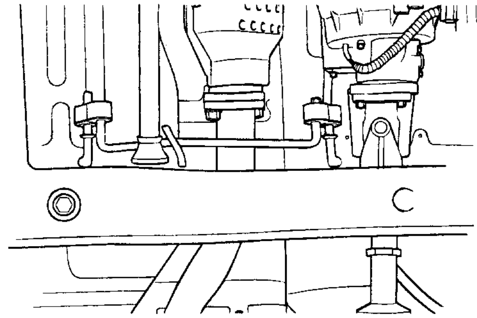
1. Remove the front exhaust pipe from the center exhaust pipe.

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

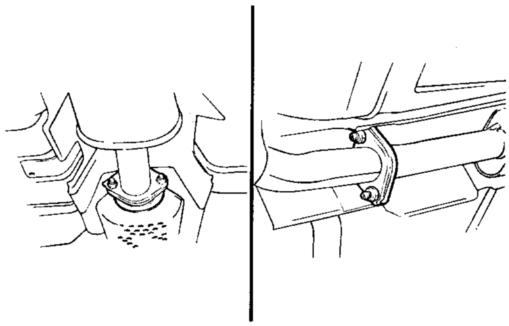


KDMB001D

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



KDMB001E



ECA9078A

INSPECTION EDHAB200

1. Check the mufflers and pipes for leaks, corrosion and damage.

2. Check the rubber hangers for deterioration and cracks.

INSTALLATION EDHAB300

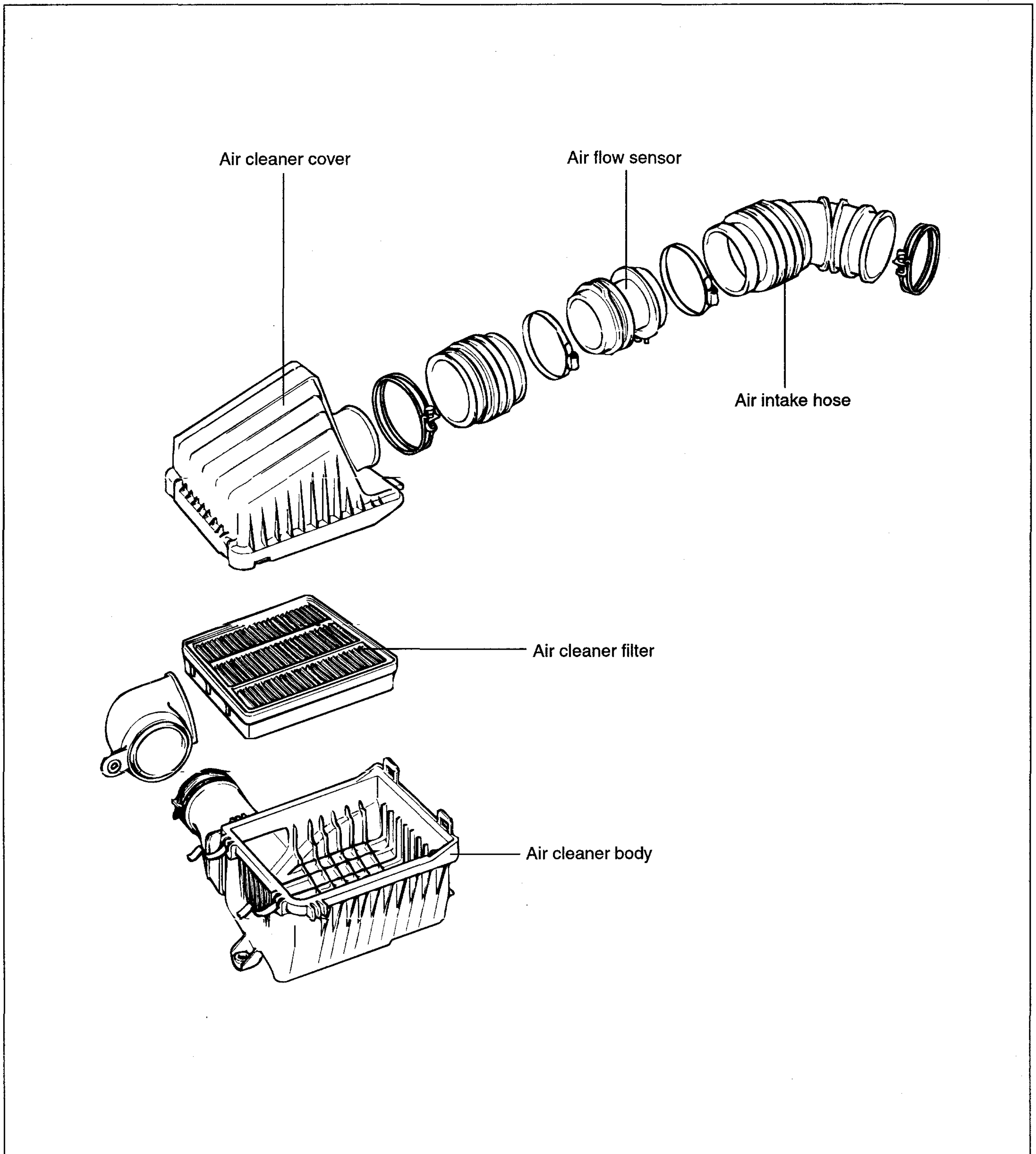
1. Temporarily install the front exhaust pipe, the catalytic converter assembly, the center exhaust pipe and the main muffler, in this order.

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 components.

AIR CLEANER (ACL)

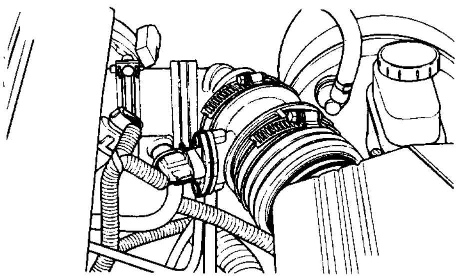
COMPONENTS EDMB0650



EDMB065A

REMOVAL ECBBA300

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. Detach the air cleaner.



ECB9505C

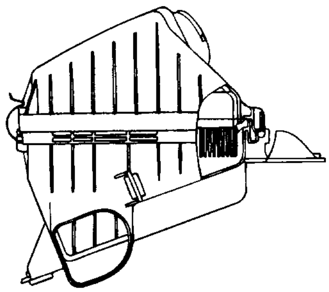
5. Remove the air flow sensor from the air intake hose.

⚠ ***CAUTION***

Do not pull on the air flow sensor wires.

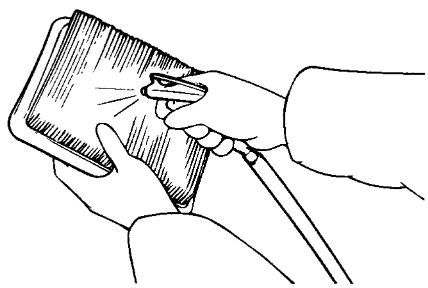
INSPECTION ECBBA400

1. Check the air intake hose, air cleaner cover for damage.
2. Check the air duct for damage.



ECB9505D

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. Replace the element if it cannot be cleaned.



ECA9066A

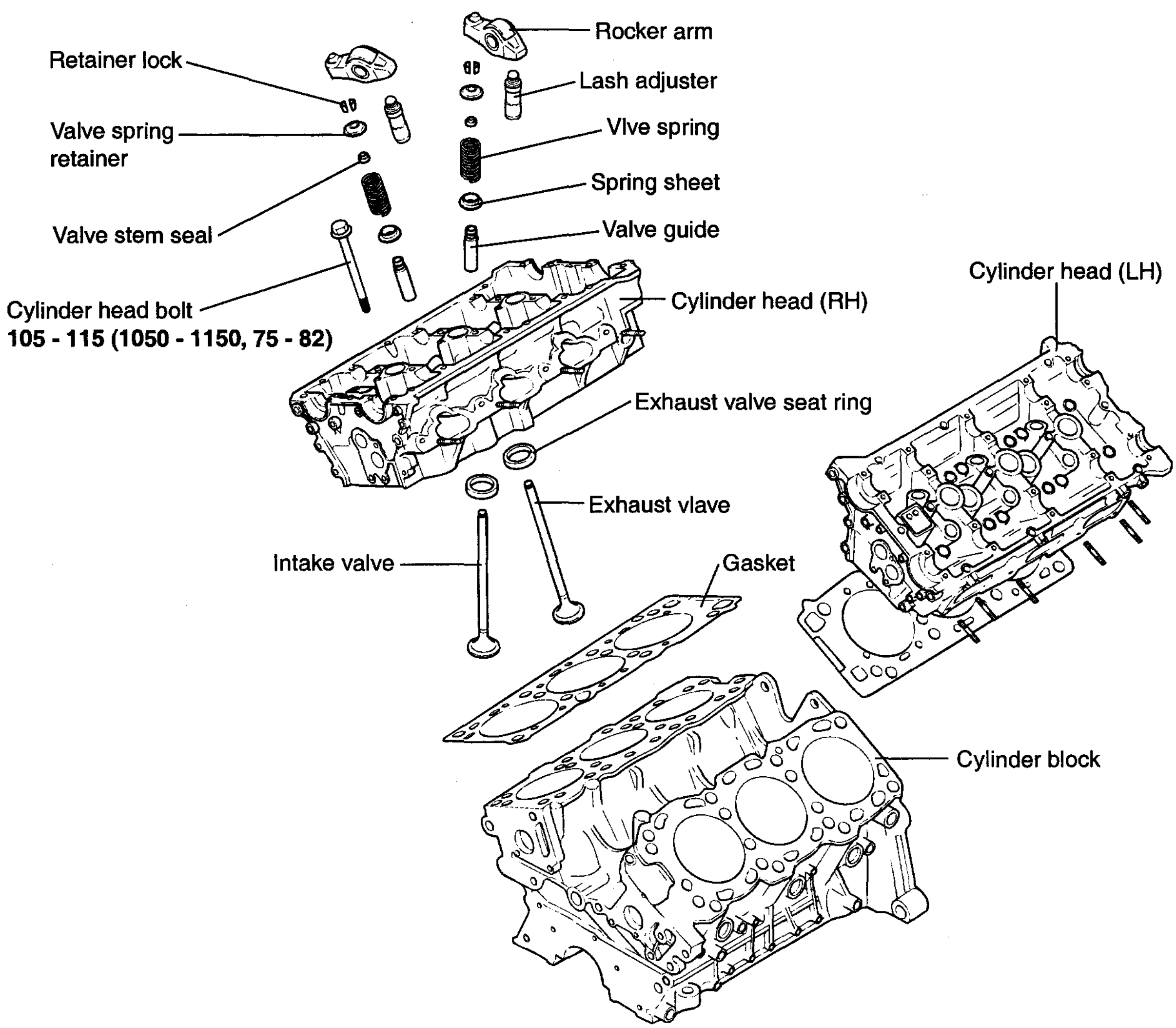
INSTALLATION EDHAB800

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

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS ECBBB000

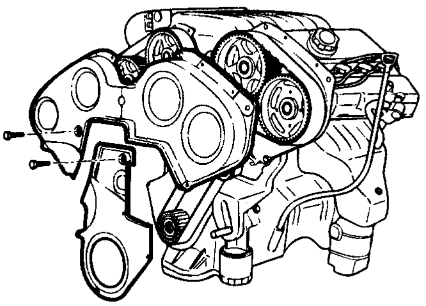


TORQUE : Nm (kg.cm, lb.ft)

EDB9031A

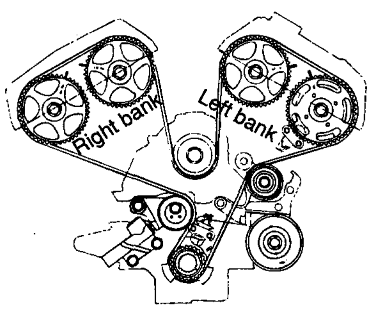
DISASSEMBLY ECBBB100

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose and air-intake hose.
3. Remove the vacuum hose, fuel hose and coolant hose.
4. Remove the intake manifold.
5. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
6. Remove the ignition coil.
7. Remove the upper and lower timing belt cover.



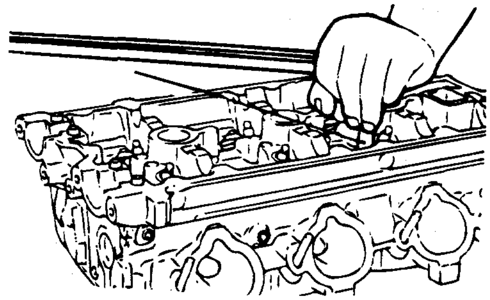
EDB9025C

8. Remove the timing belt and camshaft sprockets.

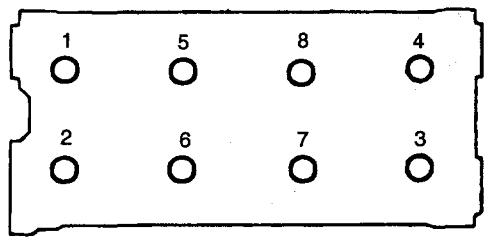


EDB9027G

9. Remove the heat protector and exhaust manifold assembly.
10. Remove the coolant pump pulley and head cover.
11. Remove the intake and exhaust camshaft.
12. Remove the cylinder head assembly. The cylinder head bolts should be removed using the 12 mm socket, in two or three steps.



EDB9032C



EDB9035B

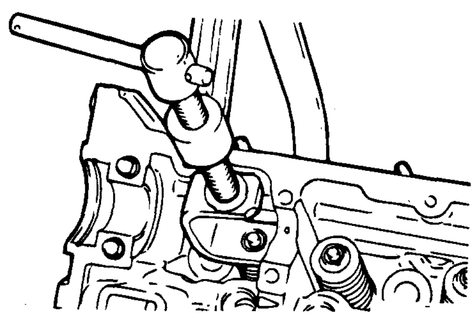
13. Clean the gasket pieces from the cylinder block top surface and cylinder head bottom surface.

NOTE

Make sure that fragments from the gasket do not fall in the engine.

RETAINER LOCK

1. Compress the valve spring using special tool. (09222 - 28000, 09222 - 28100)
2. Remove the retainer lock.



EDB9032D

INSPECTION EDMB0700

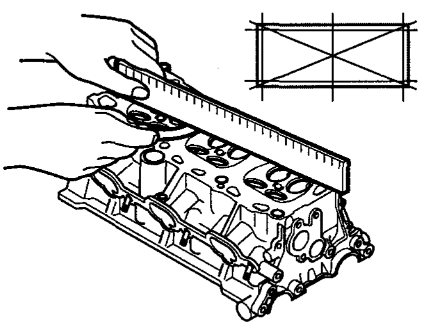
CYLINDER HEAD

1. Remove scale, sealing compound and carbon deposits. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.

2. Visually check the cylinder head for cracks, damage or water leakage.

3. Check the cylinder head surface for flatness with a straight edge and feeler gauge as shown in the illustration.

Cylinder head flatness:
Standard dimensions : Max. 0.03mm(0.0059 in.)
Service limit : 0.05mm(0.0020 in.)

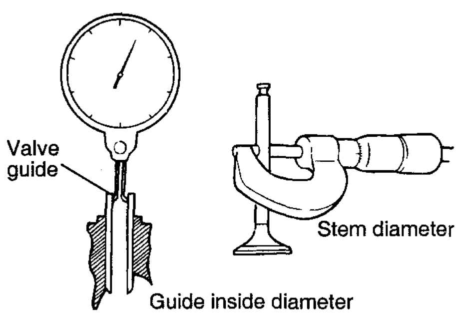


KFW3047A

VALVE GUIDES

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

Valve stem-to-guide clearance
Standard value
Intake : 0.02 - 0.05 mm (0.0009 - 0.0020 in.)
Exhaust : 0.050 - 0.085 mm (0.0020 - 0.0033 in.)

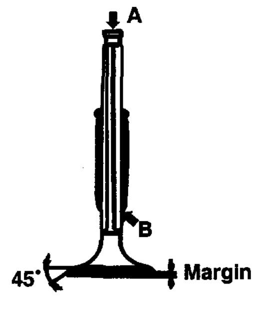


ECA9281D

VALVE

1. Replace the valve if its stem is bent, worn or damaged. Also replace it if the stem end (the surface contacting the hydraulic-lash adjuster) is hollowed out.

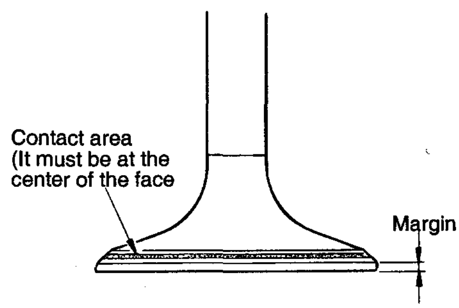
2. Check the valve face contact area, and recondition or replace as necessary.



ECA9281B

3. Replace the valve if the width of the margin (thickness of the valve head) is less than the minimum specified.

Valve margin
Standard value
Intake : 1.0mm (0.0394 in.)
Exhaust : 1.3mm (0.0512 in.)



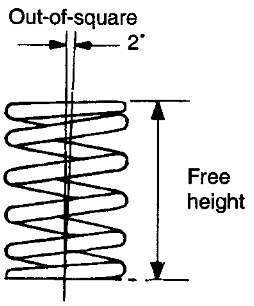
EDA9300D

VALVE SPRING

1. Check the free height of each valve spring and replace if necessary.

2. Using a square, test the squareness of each valve spring. If the spring is excessively out-of-square, replace it.

Valve spring
Standard value
Free height : 46.4 mm (1.8268 in.)
Load : 24 kg / 37.9 mm (53 lb / 1.492 in.)
Out - of - square : Max. 2°
Service limit
Free height : .41.5 mm (1.6339 in.)
Load : 55.8 kg / 28.9 mm (123 lb / 1.1378 in.)



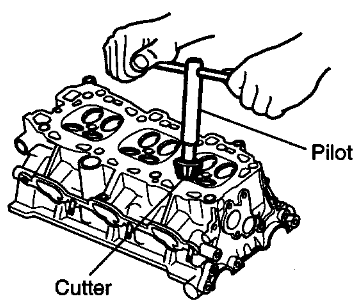
ECA9281C

RECONDITIONING VALVE SEAT

1. Before reconditioning, check the valve guide for wear. Replace worn guides if necessary and then recondition the valve seats.

2. Recondition the valve seat using the Valve Seat Cutter and Pilot.

3. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.



KFW3048A

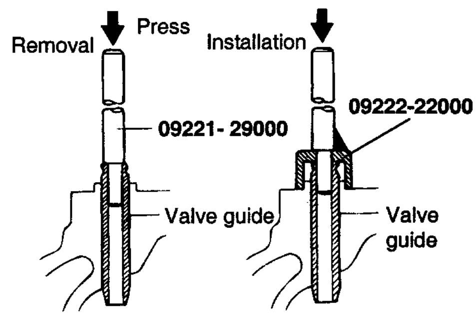
REPLACING VALVE GUIDE

1. Using the special tool (09222 - 22000 B), withdraw the old valve guide out the bottom of the cylinder head.

2. Recondition the valve guide hole so that it can receive the newly press-fitted oversize valve guide.

VALVE GUIDE OVERSIZES

Size mm (in.)	Size Mark	Oversize valve guide hole size mm (in.)
0.05 (0.002) O.S.	5	12.05 - 12.068 (0.474 - 0.475)
0.25 (0.010) O.S.	25	12.25 - 12.268 (0.482 - 0.483)
0.50 (0.020) O.S.	50	12.50 - 12.518 (0.492 - 0.493)



EDA9300G

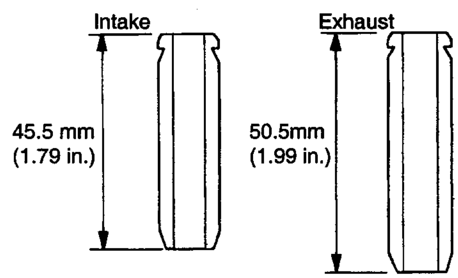
3. Using the special tool (09221-29000, 09222-22000) press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.

4. After the valve guide is press-fitted, insert a new valve and check for proper clearance.

5. After the valve guide is replaced, check that the valve is fully seated. Recondition the valve seats as necessary.

NOTE

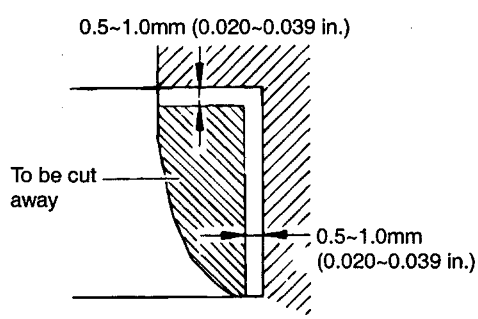
Do not install a valve guide unless it is oversize.



EOY168A

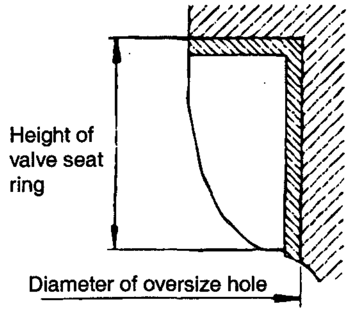
REPLACING VALVE SEAT RING

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



EOYR3940

2. Enlarge the diameter of the valve seat so that it matches the specified hole diameter of the new valve seat ring.



EOY167A

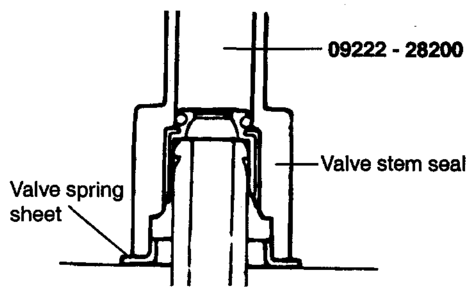
VALVE SEAT RING OVERSIZES

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.	30	7.9 - 8.1 (0.311 - 0.319)	36.300 - 36.325 (1.429 - 1.430)
	0.6 (0.024) O.S.	60	8.2 - 8.4 (0.323 - 0.331)	36.600 - 36.625 (1.441 - 1.442)
Exhaust valve seat ring	0.3 (0.012) O.S.	30	7.9 - 8.1 (0.311 - 0.319)	33.30 - 33.325 (1.311 - 1.312)
	0.6 (0.024) O.S.	60	8.2 - 8.4 (0.323 - 0.331)	33.600 - 33.625 (1.323 - 1.324)

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
Intake : 0.9 - 1.3 mm (0.035 - 0.051 in.)
Exhaust : 0.9 - 1.3 mm(0.035 - 0.051 in.)



EDB9037A

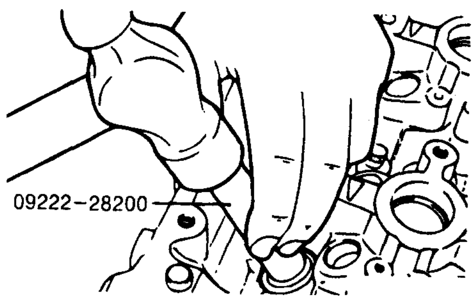
REASSEMBLY ECBBB300

1. Install the spring seats.

2. Using special tool (09222 - 28200), lightly tap the seal in position.

   NOTE

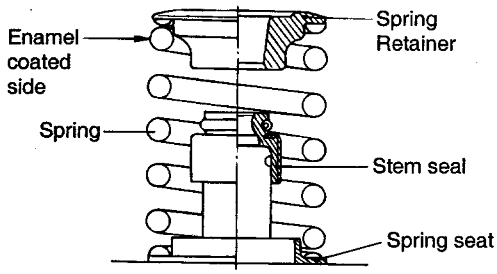
   - *Do not reuse old valve stem seals.*
   - *Incorrect installation of the seal could result in oil leakage of from the valve guides.*



EDB9037B

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

4. Place valve springs so that the side coated with enamel faces toward the valve spring retainer.

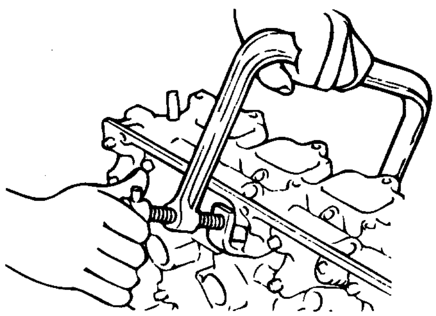


ECA9290B

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.

NOTE

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

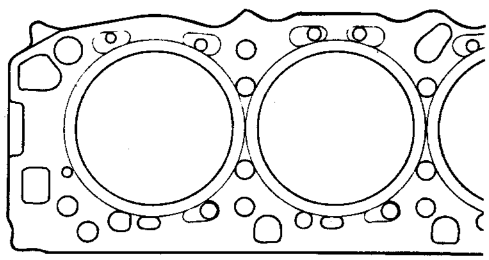


EDAA040B

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

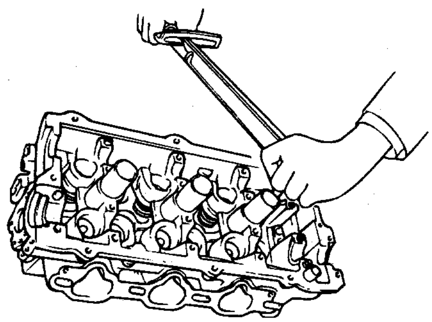
NOTE

Do not apply sealant to these surfaces.



EDB9032B

9. Tighten the cylinder head bolts in the sequence shown in the illustration with a torque wrench.



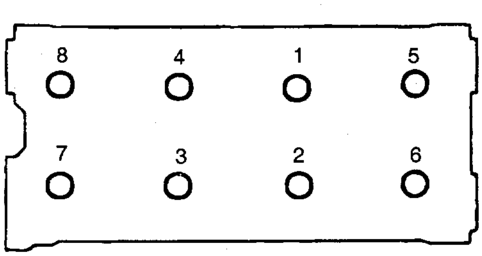
EDA9010A

10. Tighten the cylinder head bolts using the torque - angle method. Starting at top center, tighten all cylinder head bolts in sequence as shown in the illustration, using the 12 mm socket.

Tightening procedure

Cylinder head bolt :

105 - 115 Nm (1050 - 1150 kg.cm, 75 - 82 lb.ft)

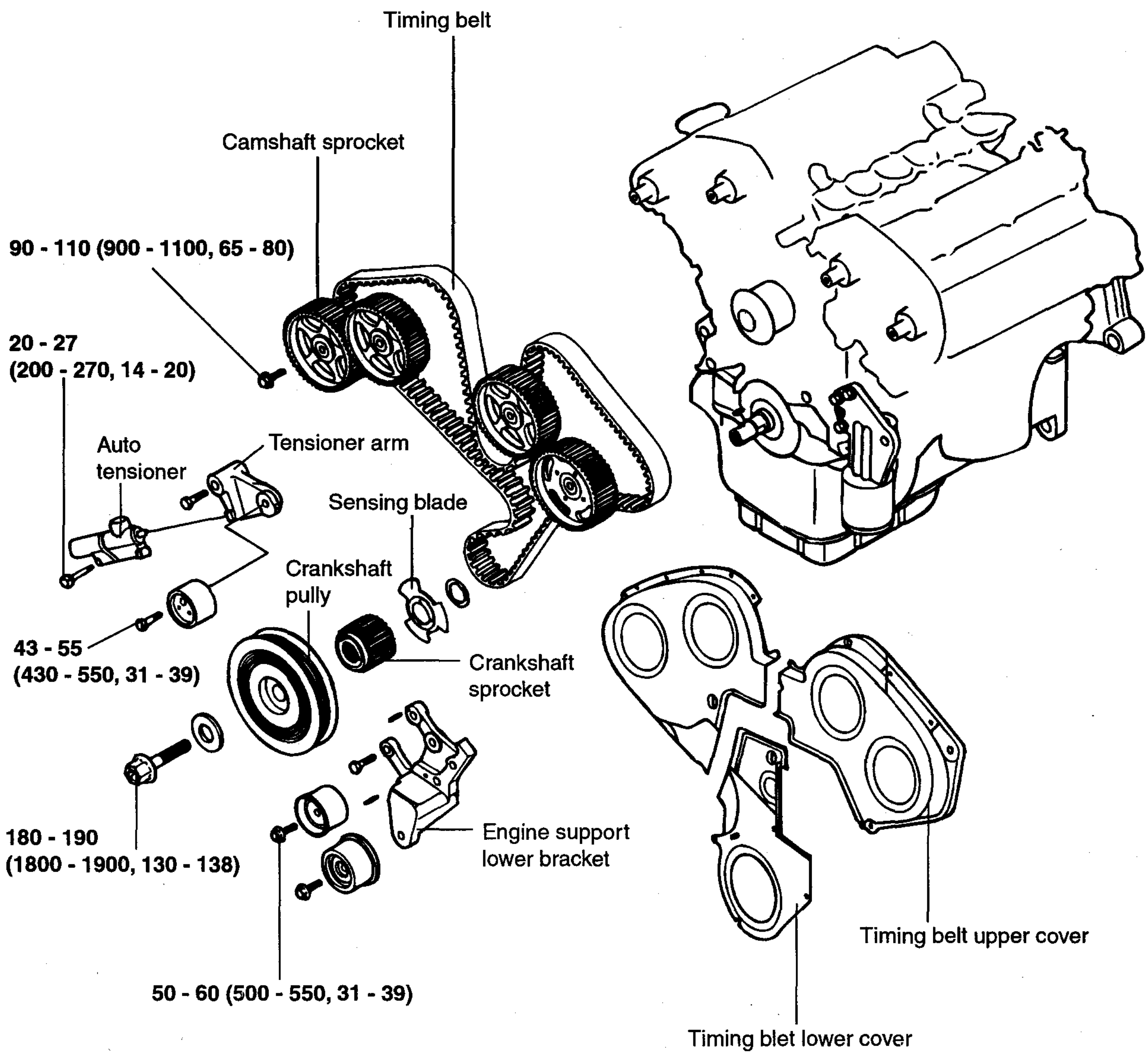


ECBB003A

TIMING SYSTEM

TIMING BELT

COMPONENTS EDMB0800

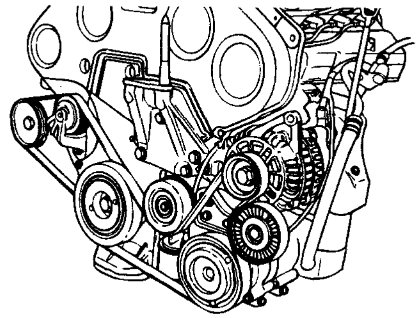


TORQUE : Nm (kg·cm, lb.ft)

EDMB080A

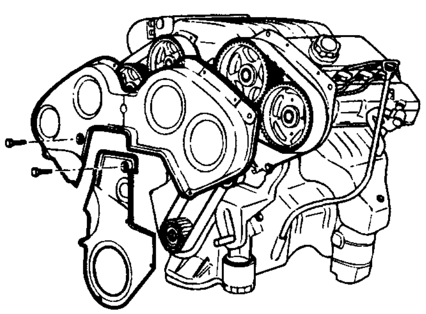
REMOVAL EDMB0810

1. Using a [16 mm], rotate the tensioner arm clockwise (about 14°)and remove the belt from the pulley.
2. Remove the power steering pump pulley, idler pulley, tensioner pulley and crankshaft pulley.



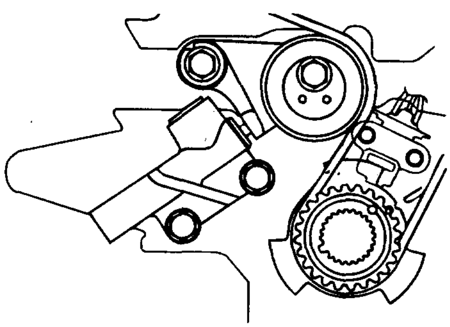
EDB9025B

3. Remove the upper and lower timing belt covers.



EDB9025C

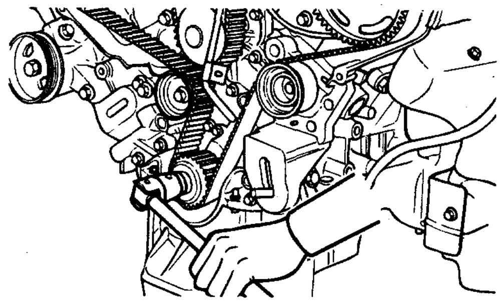
4. Remove the auto tensioner.



EDB9025D

NOTE

Rotate the crankshaft clockwise and align the timing mark to set the No.1 cylinder's piston to TDC (compression stroke).
At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with each other.



EDB9025E

5. Unbolt the tensioner to remove the timing belt.

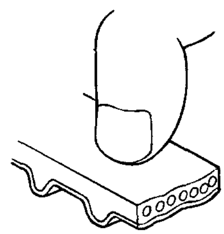
NOTE

If you plan to use the timing belt again, mark the rotation direction on the belt so you reinstall it correctly.

INSPECTION EDHAD200

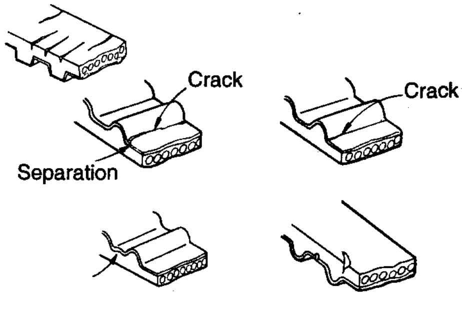
1. Inspect the belt closely. If the following problems are evident, replace the belt with a new one.

   1) Hardened back surface of rubber
   Back surface is glossn, non-elastic and so hard that when the nail of your finger is pressed into it, no mark is produced.



ECA9200B

   2) Cracked back surface of rubber.

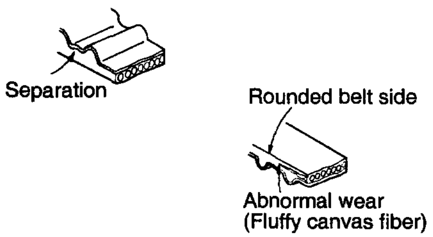


EDA9220B

3) Side of belt is badly worn.

NOTE

A belt in good condition should have clear-cut sides as if it were cut with a sharp knife.



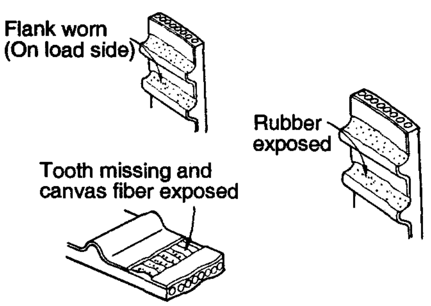
EDA9220C

4) Teeth are badly worn out.

Initial stage : Canvas on load side of the tooth flank worn (fluffy canvas fibers, rubber gone, color changed to white, and unclear canvas texture)

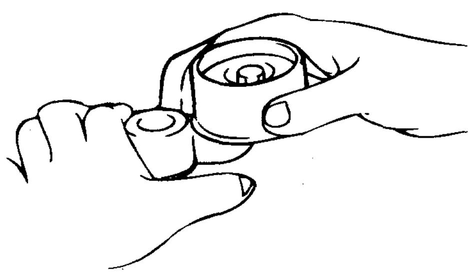
Last stage : Canvas on the load side of the tooth flank worn down and rubber exposed (tooth width reduced).

5) Missing tooth



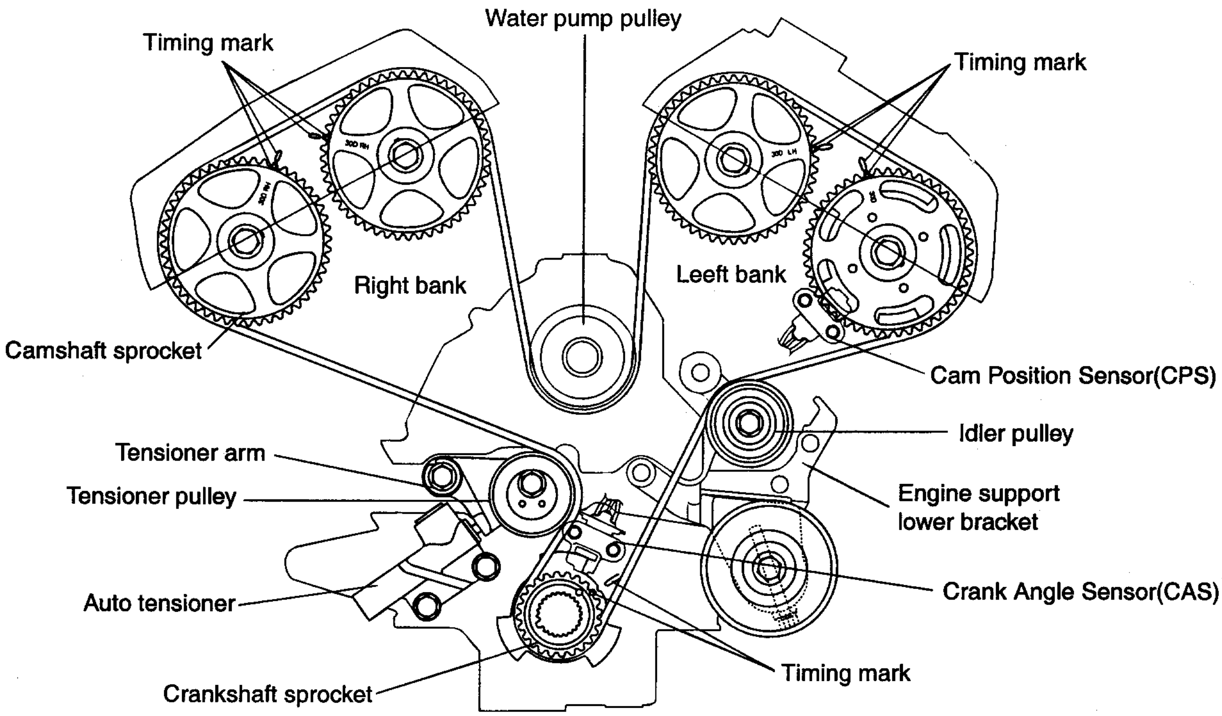
EDA9220D

2. If backlash or an irregular noise is observed when rotating the pulley, replace the timing belt tensioner and idler pulley.



EDA9025A

TIMING BELT ECBBC300

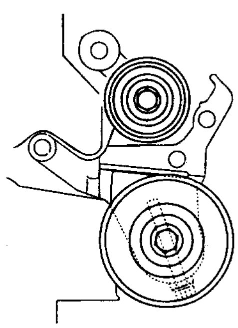


EDB9026A

INSTALLATION EDMB0820

The methed of installing timing belt and auto tensioner.

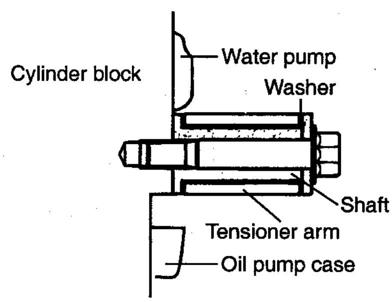
1. Install idler pulley to engine support lower bracket.



EDB9027A

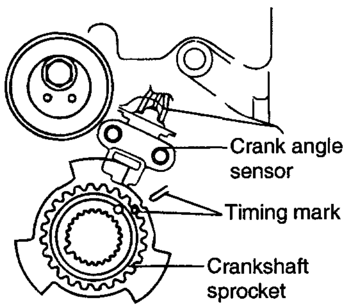
2. Install tensioner arm, shaft and plane washer to cylinder block.

Tightening torque : 35 - 55 Nm (350 - 550 kg.cm)



EDB9027B

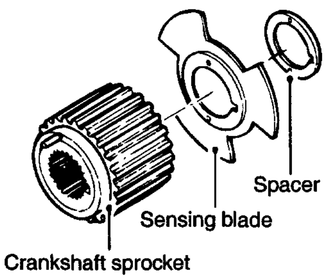
3. Install crankshaft sprocket and align the timing mark.



EDB9027C

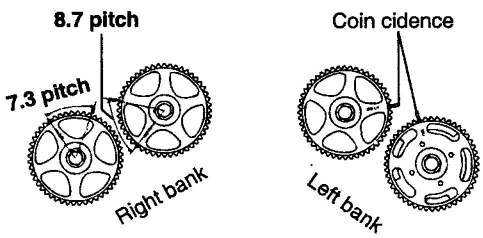
⚠ *CAUTION*

Be careful not to bend crankshaft sensing blade.



EDB9027D

4. Install camshaft sprocket and adjust initial installation state as illustration.

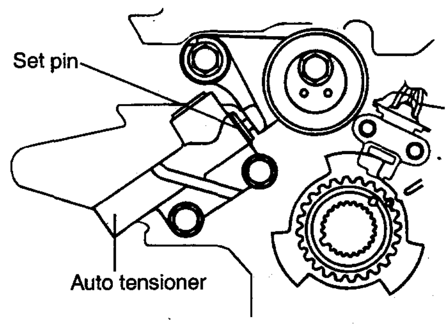


EDB9027E

5. Install auto tensioner to oil pump case.

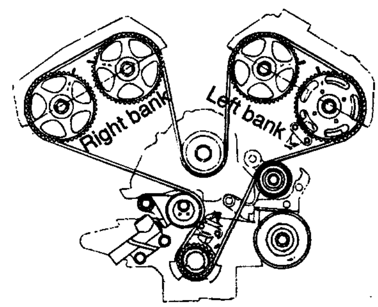
NOTE

At this time auto tensioner's set pin should be assembled completely.



EDB9027F

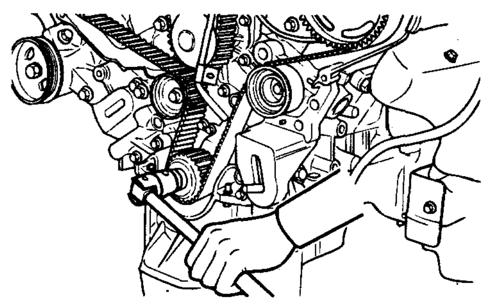
6. Aligh the timing marks of each sprocket and install the timing belt in this order.
   Crankshaft sprocket → Idler pulley → Exhaust camshaft sprocket (LH) → Intake camshaft sprocket (LH) → Water pump pulley → Intake camshaft sprocket (RH) → Exhauft camshaft sprocket (RH) → Tensioner pulley



EDB9027G

NOTE

- *In this step, No. 1 is in TDC (Compression stroke)*
- *Do not insert fingers.*



EDB9027H

7. After installating the timing belt, recontirm the timing mark.

8. Install the tensioner pulley.

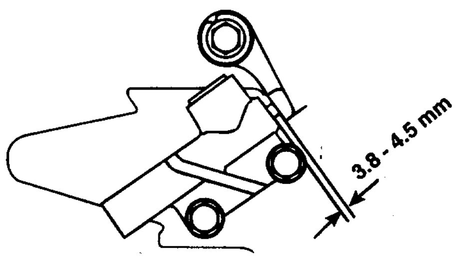
9. Pull out the set pin of auto tensioner.

THE METHOD TO ADJUST THE TENJSION OF TIMING BELT.

1. Rotate the crankshaft 2 rotation clockwise and measure the projected load of auto tensioner in the TDC (# 1 Compression stroke) after 5 minutes.
2. Check the projectde length is 3.8 - 4.5 mm.
3. Check again if the timing marks of each sprocket is with in specified position.

NOTE

If not within specified position, do again from procedure 6 in the method of installing timing belt and auto tensioner.



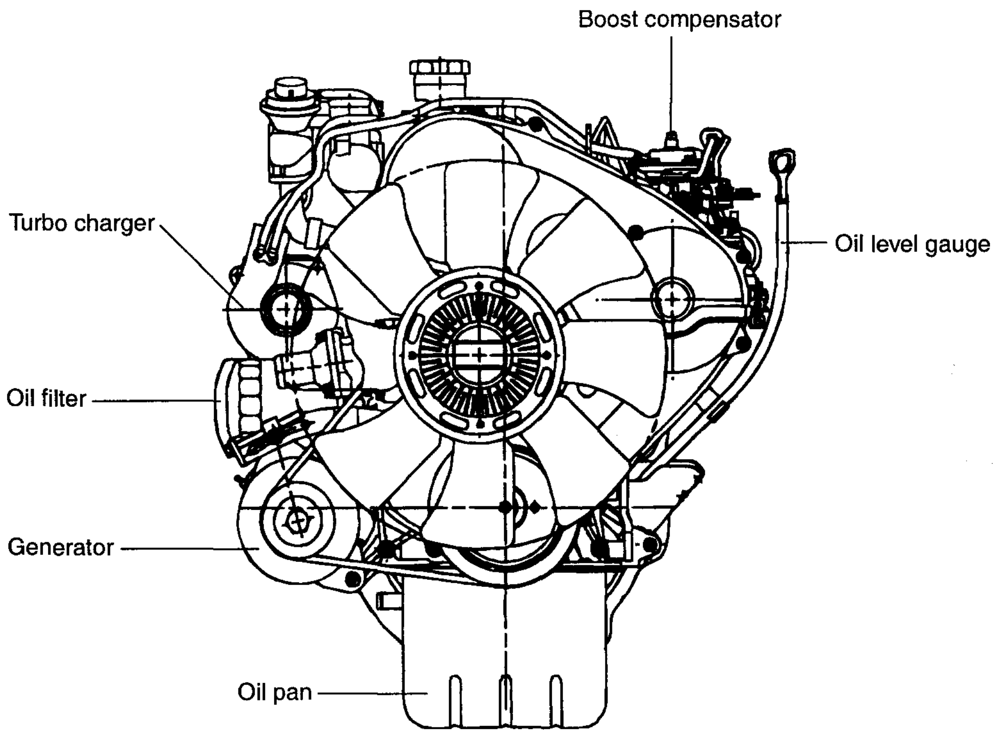
EDB9028A

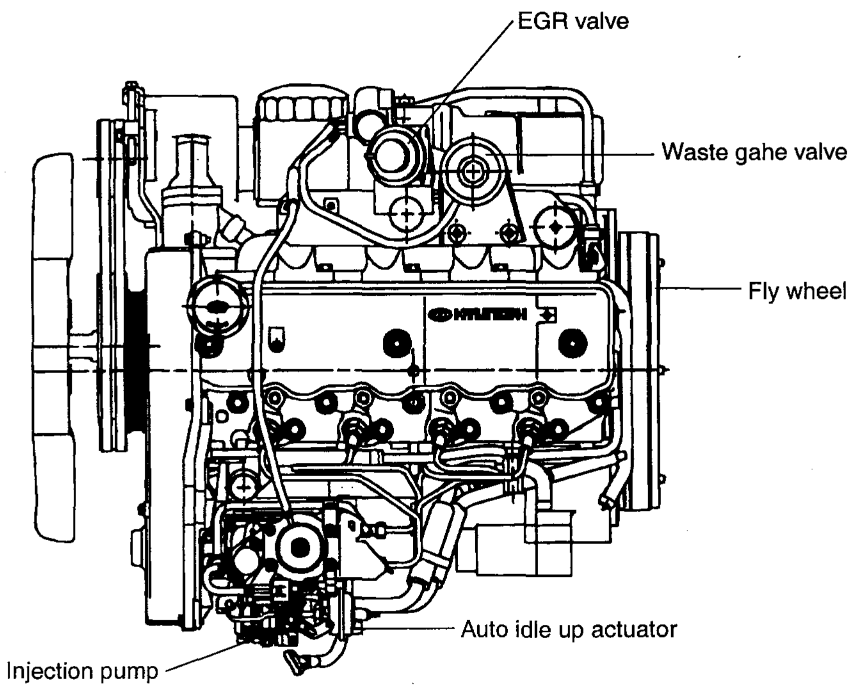
Engine Mechanical System [2.5 TCI]

GENERAL

GENERAL ELCB0010

[2.5 TCI]





ECLA001B

SPECIFICATIONS ELCB0020

	Standard	Limit
Engine model	D4BH (2.5 TCI)	
Type	Diesel engine	
No. of cylinders	4 in - line	
Valve mechanism	OHC	
Total displacement	2,467 cc	
Bor x stroke	91.1 × 95 mm	
Compression ratio	21	
Valve timing		
Intake valve		
Opens (BTDC)	20°	
Closes (ABDC)	48°	
Exhaust valve		
Opens (BBDC)	54°	
Closes (ATDC)	22°	
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.)	
Rocker shaft		
O.D.	18.878 - 18.898 mm (0.7432 - 0.7440 in.)	

	Standard	Limit
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 stat		
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 - 79.2 mm (3.1102 - 3.1181 in.)	
Piston - to cylinder clearance	0.04 - 0.08 mm (0.0016 - 0.0031 in.)	
Ring groove width		
No. 1 ring	2.601 - 2.603 mm (0.1024 - 0.1025 in.)	
No. 2 ring	2.100 - 2.102 mm (0.0827 - 0.0828 in.)	
Oil ring	4.010 - 4.035 mm (0.1579 - 0.1589 in.)	
Service size	0.25, 0.50, 0.75, 1.00 oversize	

	Standard	Limit
Piston ring		
End gap		
No. 1 ring	0.35 - 0.50 mm (0.0138 - 0.0197 in.)	0.8 mm (0.0315 in.)
No. 2 ring	0.25 - 0.40 mm (0.0098 - 0.0157 in.)	0.8 mm (0.0315 in.)
Oil ring	0.25 - 0.45 mm (0.0098 - 0.0177 in.)	0.8 mm (0.0315 in.)
Ring - to - ring froove clearance		
No. 1 ring	0.056 - 0.076 mm (0.0022 - 0.0030 in.)	0.15 mm (0.0059)
No. 2 ring	0.046 - 0.066 mm (0.0018 - 0.0026 in.)	0.15 mm (0.0059)
Oil ring	0.02 - 0.065 mm (0.0008 - 0.0026 in.)	0.1 mm (0.0039)
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.)	
Oil clearance of pin	0.02 - 0.05 mm (0.0008 - 0.0020 in.)	0.1 mm (0.0039 in.)
Journal		0.1 mm (0.0039 in.)
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.)	
Cylinder block		
I.D.	91.10 - 91.13 mm (3.5866 - 3.5878 in.)	
Flatness of gasket surface	0.05 mm (0.0020 in.)	0.1 mm (0.0039 in.)
Overall height	318.45 - 318.55 mm (12.537 - 12.541 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/cm^2) 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	

	Standard	Limit
Thermostat type Type	 Wax type with by - pass valve	
Coolant temperature gauge unit Type	 Thermister type (2 elements)	
Thermostat Valve opening temperature (°C) Fully opening temperature (°C)	 82 95	
Coolant temperature gauge unit Resistance Coolant temperature gauge element (Ω/°C) Glow control element (Ω/°C)	 90.5 - 117.5 / 70, 21.3 - 26.3 / 115 22.3 - 27.3 / -20, 2.92 - 3.58 / 20	
Air cleaner	Paper filter type	
Muffler	Expansion resonance type	

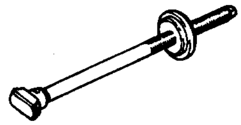
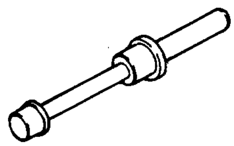
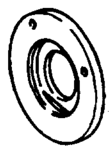
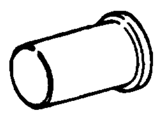
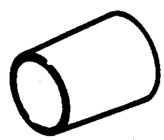
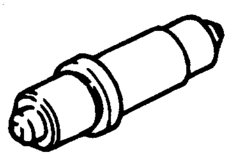
NOTE

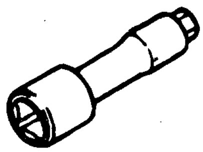
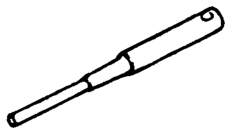
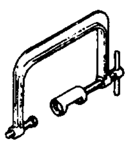
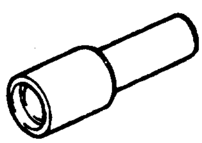
- *O.D. : Outer Diameter*
- *I.D. : Inner Diameter*
- *U.S. : Undersize Diameter*
- *O.S. : Oversize Diameter*

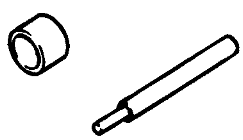
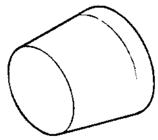
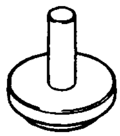
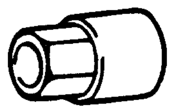
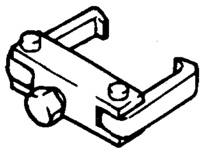
TORQUE SPECIFICATIONSSS ELCB0030

	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 ELCB0040

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
Camshaft oil seal installer (09221 - 21000)	 ECLA002I	Installation of the camshaft oil seal

Tool (Number and name)	Illustration	Use
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
Valve spring compressor (09222 - 21000)	 ECLA002G	Compression of valve spring
Valve stem seal installer (09222 - 32100)	 ECLA002H	Installation of valve stem seal

Tool (Number and name)	Illustration	Use
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
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 ELCB0050

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

Symptom	Probable cause	Remedy
Oil pressure drop	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
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

Symptom	Probable cause	Remedy
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
	c. Broken rubber hangers	c. Replace
	d. Interference of pipe or muffler with vehicle body	d. Correct

CHECKING ENGINE OIL ECJA0500

1. Position a vehicle on a level surface.

2. Turn off the engine.

   NOTE

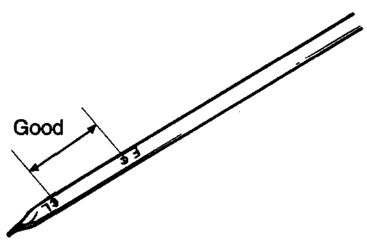
   If a vehicle that has not been used for a prolonged period, run the engine for several minutes.
   Turn off the engine and wait for 5 minutes at least, and then check the oil level.

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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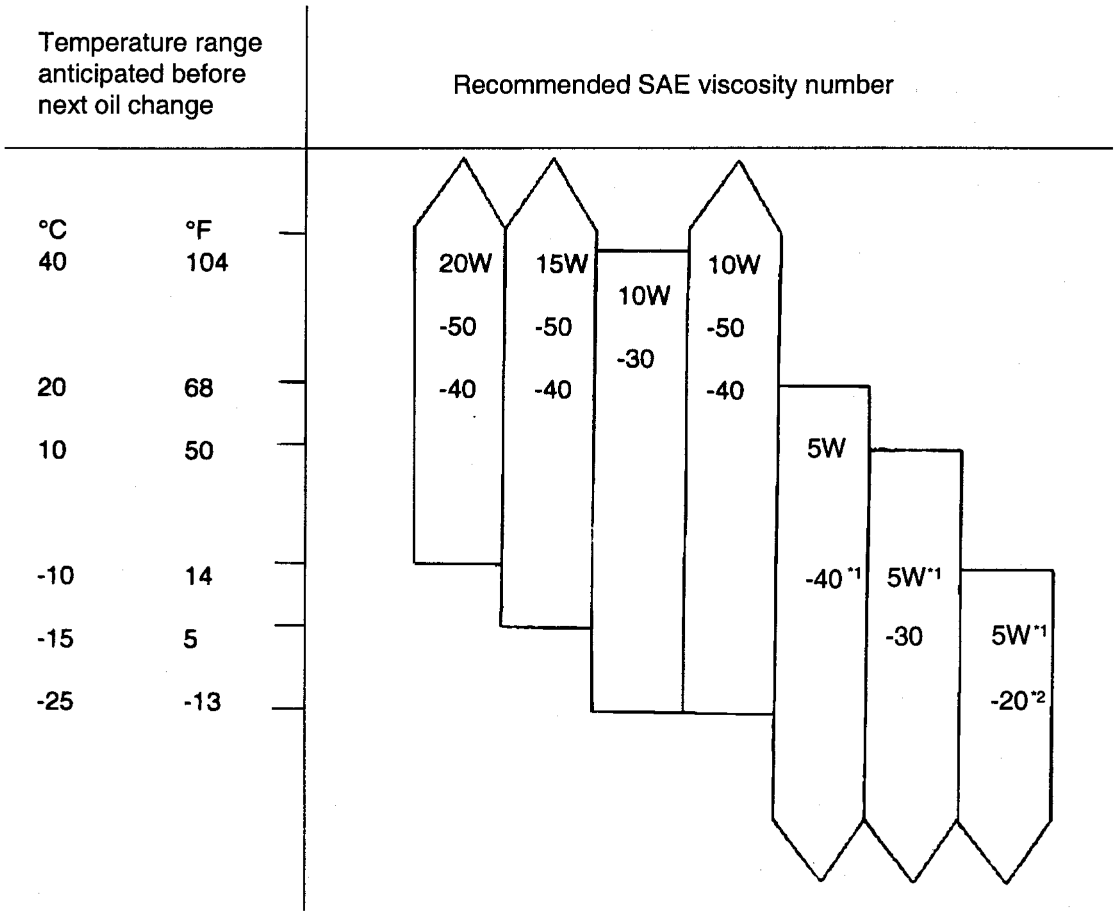
SELECTION OF ENGINE OIL ELCB0070

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 ECMB0100

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 : 6.5 lit (6.87 U.S.qts., 5.72 Imp.qts.)

NOTE

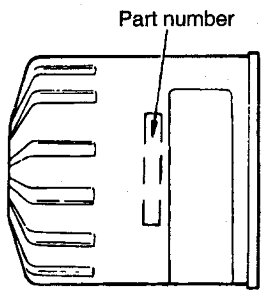
Do not overfill. This will cause oil aeration and loss of oil pressure.

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.



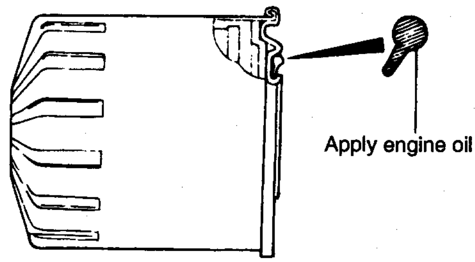
ECA9970A

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

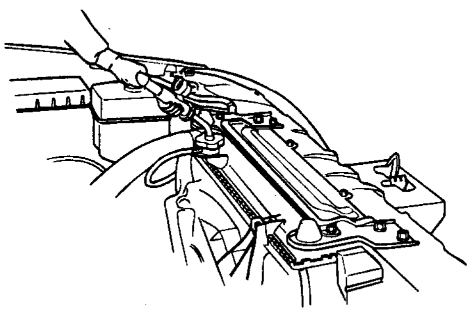
CHECKING COOLANT LEAK ECMB0110

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.



KDMB002A

RADIATOR CAP PRESSURE TEST ELCB0110

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)

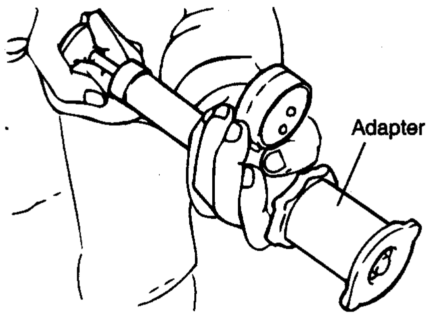
Main valve closing pressure :

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.



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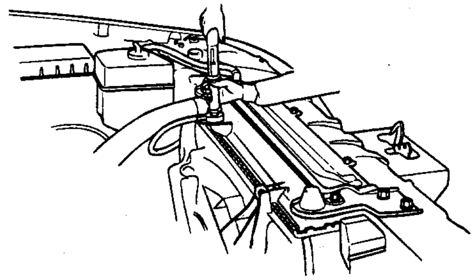
SPECIFIC GRAVITY TEST ECMB0120



KDMB002B

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.

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]

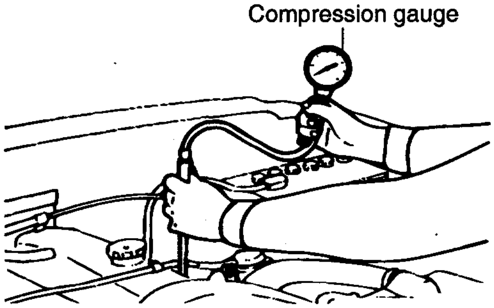
CHECKING ENGINE COMPRESSION PRESSURE ELCB0130

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

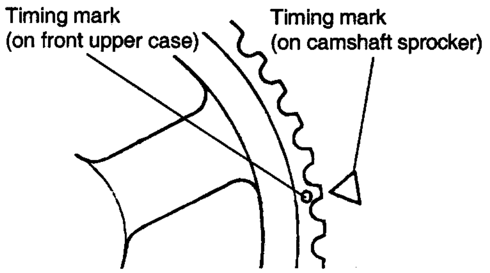
7. Crank the engine with the throttle valve fully open, and measure the compression at the place where the compression gauge indicator shows a stabilized reading.

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 glow 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 ELCB0140

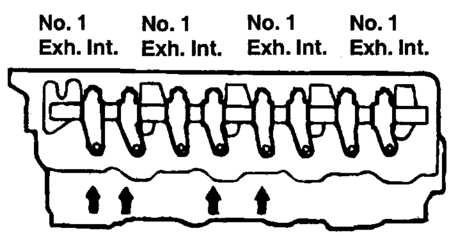
1. Start the engine and allow it to warm up until the temperature of the coolant reaches 80°C to 90°C (176°F to 194°F)
2. Check the infection timing and the idling speed, and adjust if necessary.
3. Remove the upper timing belt cover.
4. Remove the rocker cover.
5. Turn the crankshaft clockwise and align 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.

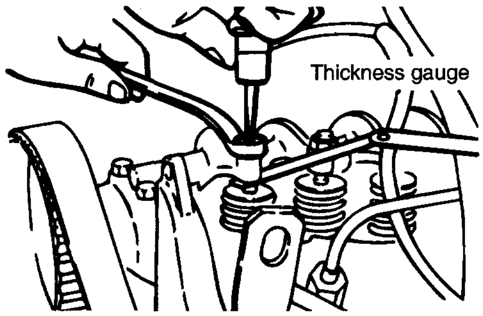
[A]



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 :

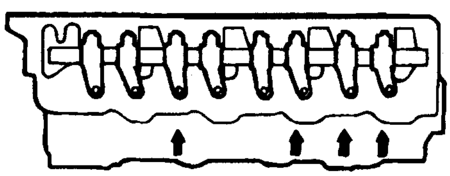
12 - 18 Nm (120 - 180 kg.cm, 9 - 13 lb,.ft)

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.

[B]

No. 1 Exh. Int. No. 2 Exh. Int. No. 3 Exh. Int. No. 4 Exh. Int.



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 :

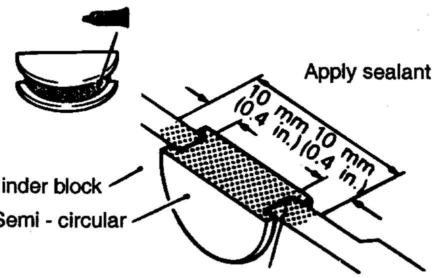
3M ART Part No. 8660 or equivalent

Tightening torque :

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

⚠ *CAUTION*

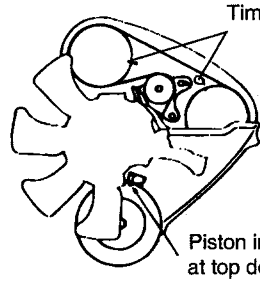
If they are overtorqued, a deformed rocker cover or oil leakage could result.



ECLA003F

ADJUSTMENT OF THE TIMING BELT TENSION ELCB0150

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.

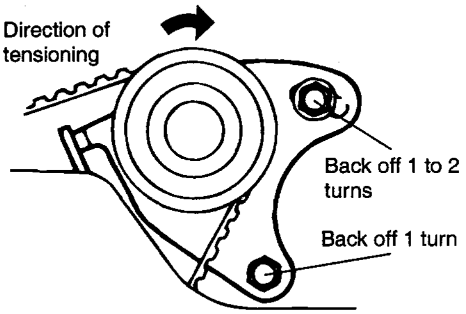


ECLA005B

2. Loosen the timing belt tensioner mounting bolts.

⚠ *CAUTION*

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



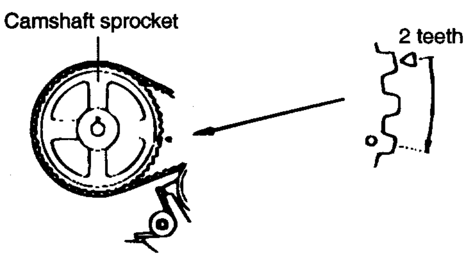
ECLA005C

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

4. Tighten the tensioner mounting bolts.

NOTE

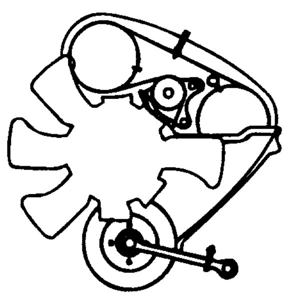
Tighten the upper bolts first and then the lower ones.



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.)

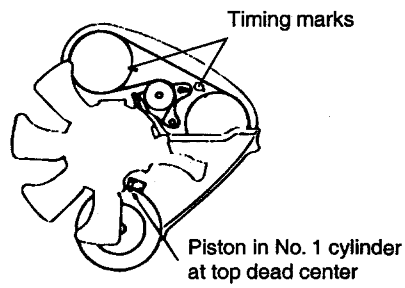


ECLA005E

6. Mount the timing belt upper cover.

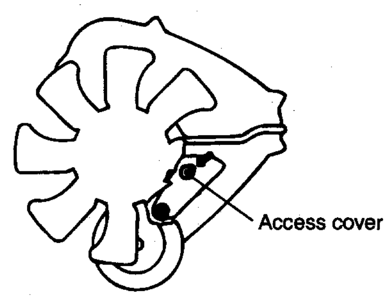
ADJUSTMENT OF THE TIMING BELT "B" TENSION

1. Remove the timing belt upper cover and bring the piston 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.

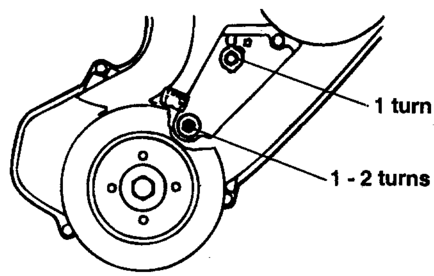
NOTE

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 ECMB0140

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 :

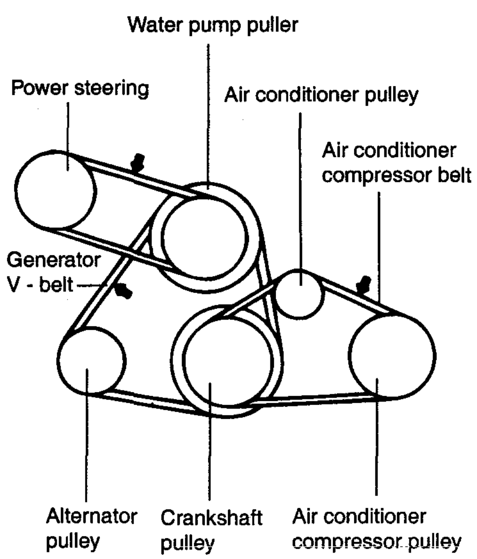
7 - 10 mm (0.28 - 0.39 in.)

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

Power steering : 8 - 11 mm (0.31 - 0.43 in.)

CAUTION

Measure the blet flex between specified pulleys (→).

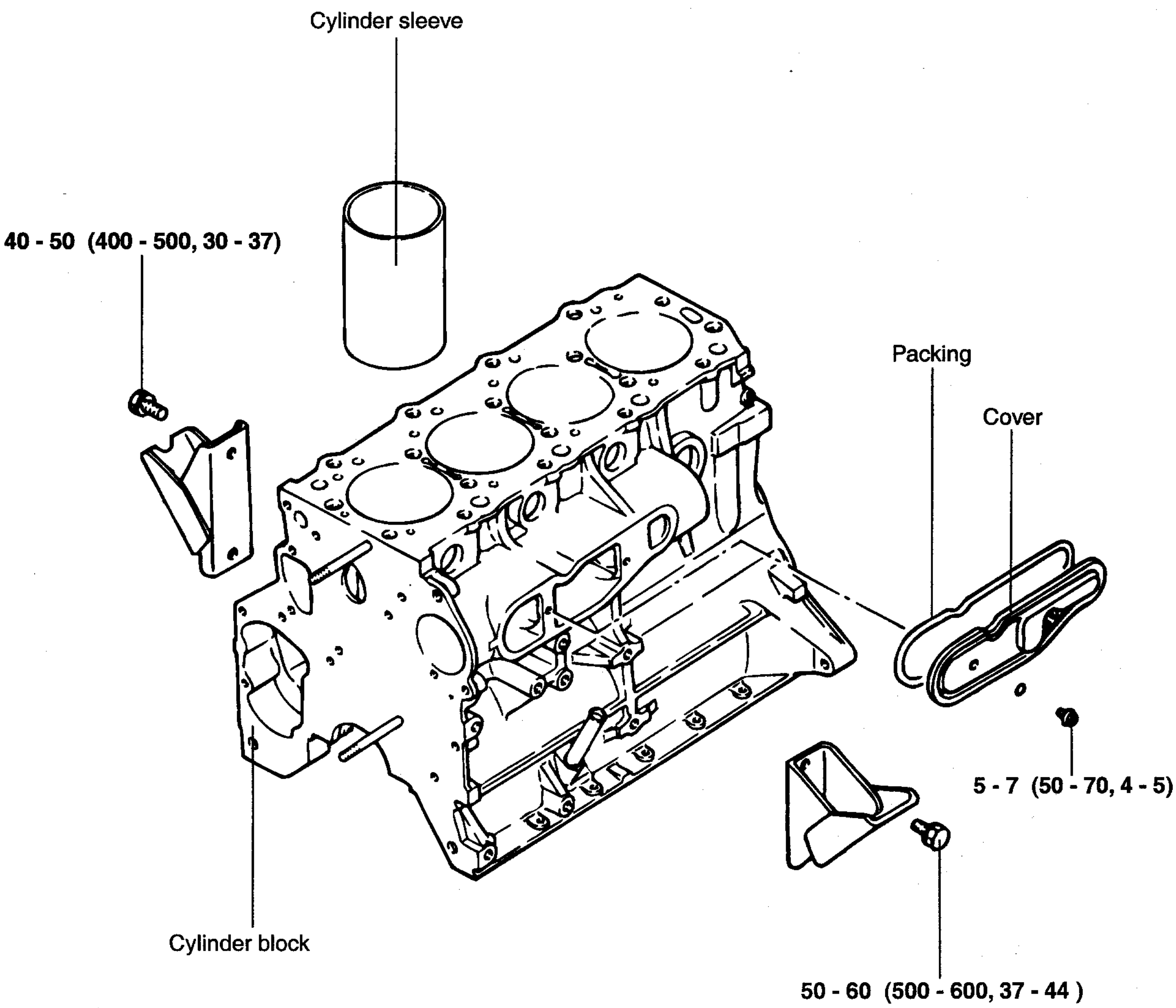


ECLA003A

ENGINE BLOCK

ENGINE BLOCK

COMPONENTS ELCB0200



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

ECLA007A

INSPECTION ELCB0210

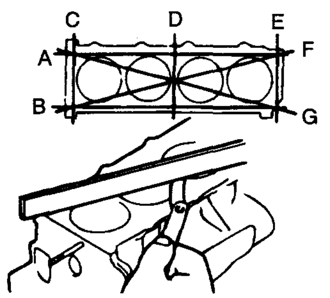
NOTE

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.

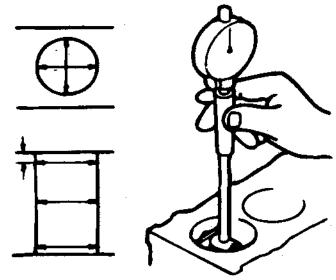


ECLA007B

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

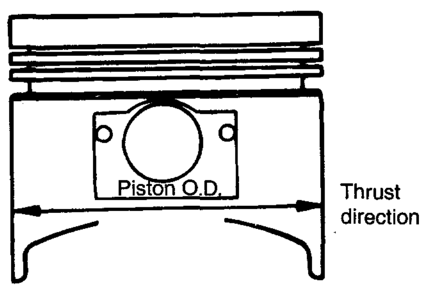
1. Using the maximum cylinder bore as a basis, determine the oversize piston to be used.

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

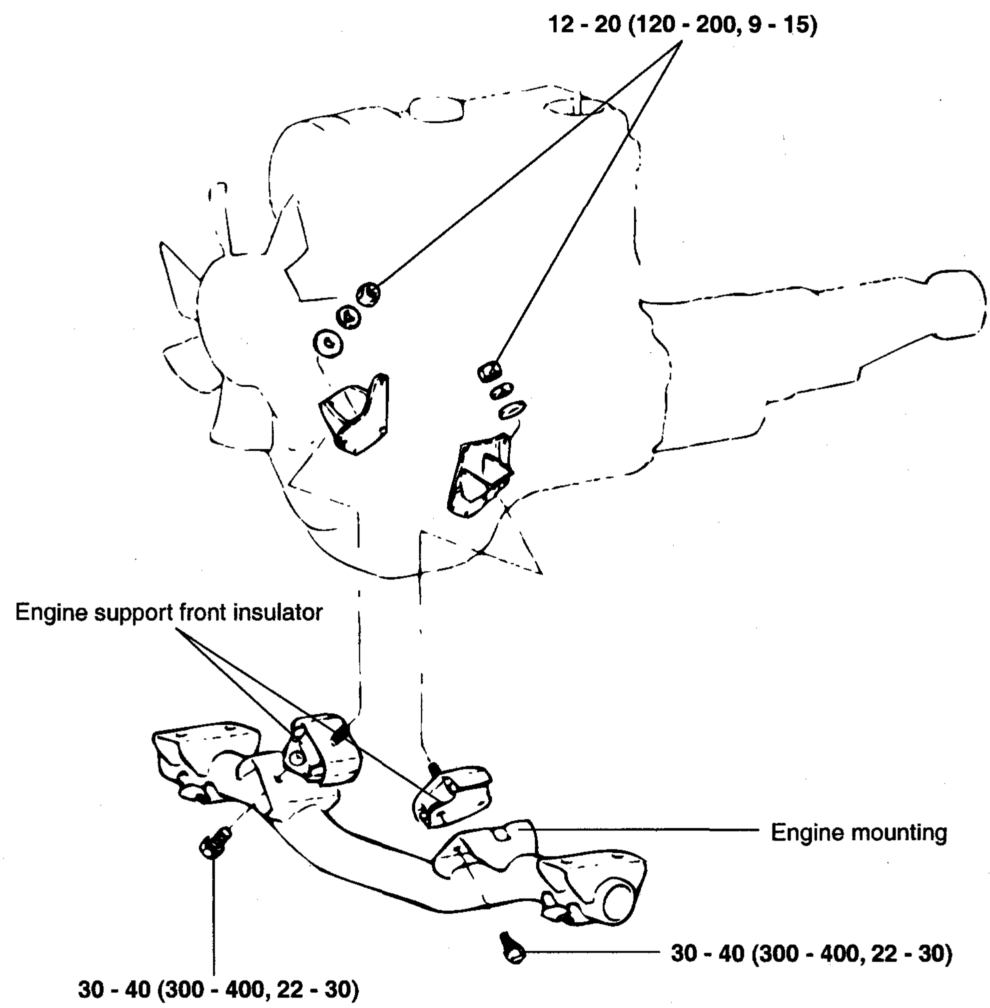
1. *When boring cylinders, finish all of four cylinders to the same oversize.*
2. *Don't bore only one cylinder to oversize.*

ENGINE MOUNTS

ENGINE MOUNTING ECMB0150

COMPONENTS

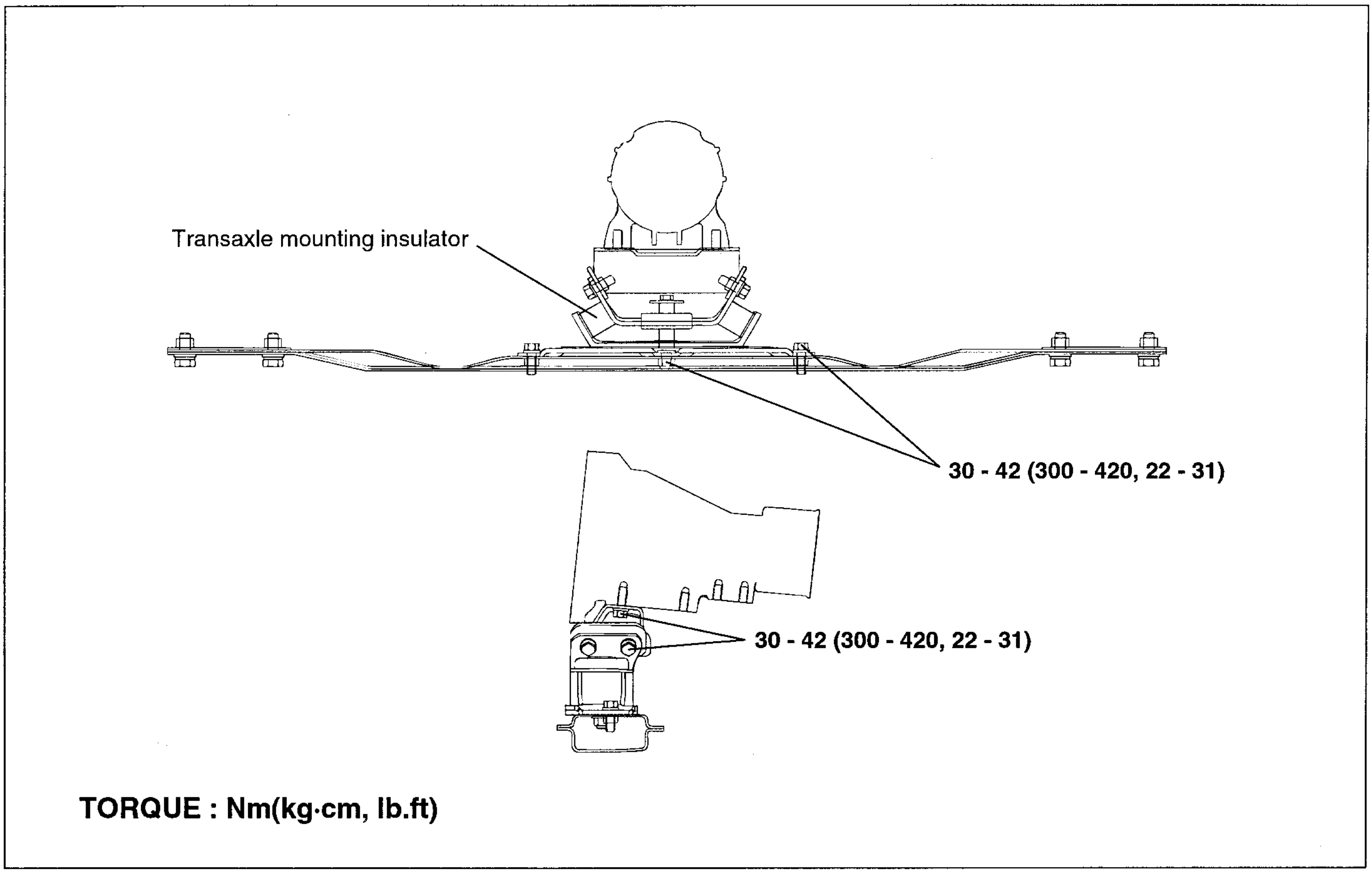
FRONT ENGINE MOUNTING



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

ECMB015A

T/M MOUNTING ECMB0160



ECMB004A

INSPECTION ELCB0240

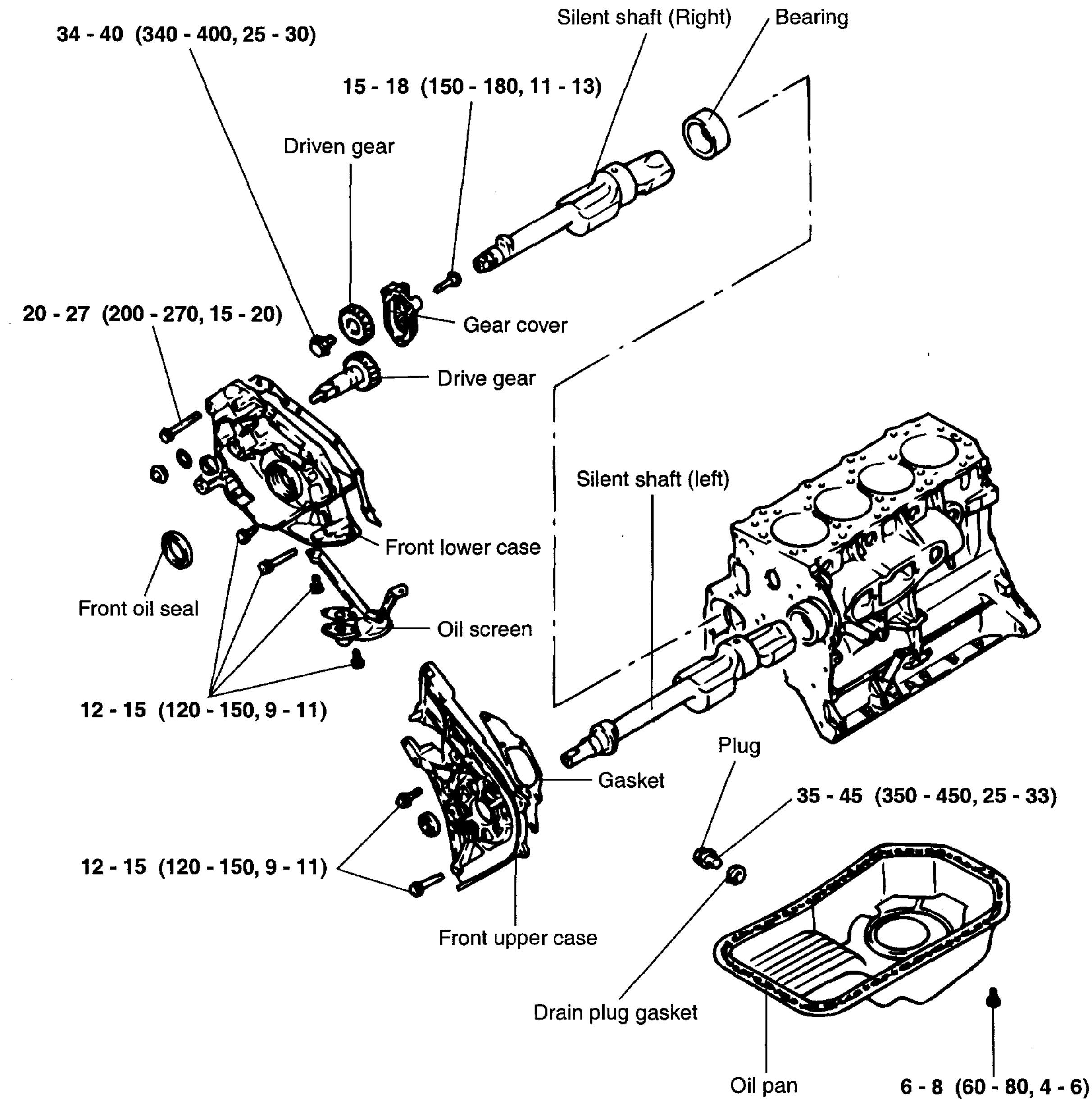
1. Check the insulator for damage, crack and deformation.
2. Check the insulator stopper plate for damage, crack and deformation.

NOTE

Be careful not to apply oil to the insulator.

FRONT CASE

COMPONENTS ELCB0250



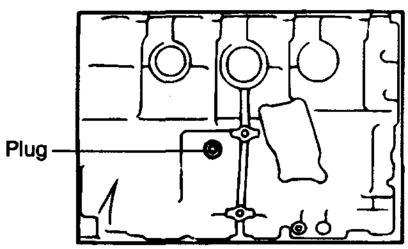
TORQUE : Nm (kg.cm, lb.ft)

ECLA007G

REMOVAL ELCB0260

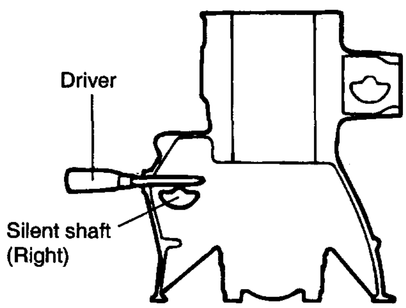
SILENT SHAFT

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

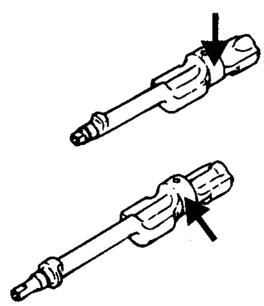
1. Turn the crankshaft to bring the piston in No. 1 cylinder to the top dead center on the compression stroke. (The piston in cylinder is at the top dead center on the compression stroke when the dowel pin is at the topmost.)
2. Remove the timing belt upper cover. With the timing belt as installed, remove 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 ELCB0270

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.

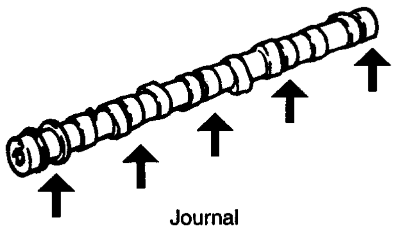
Oil clearance standard value
Front : 0.02 - 0.06 mm (0.0008 - 0.0024 in.)
Rear : 0.05 - 0.09 mm (0.0020 - 0.0035 in.)



ECLA007K

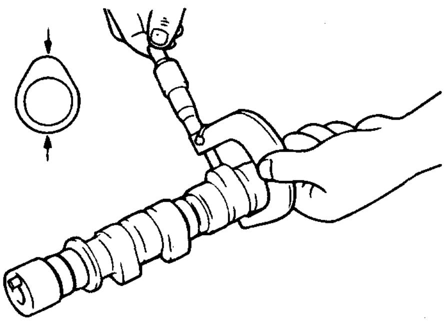
CAMSHAFT

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 :

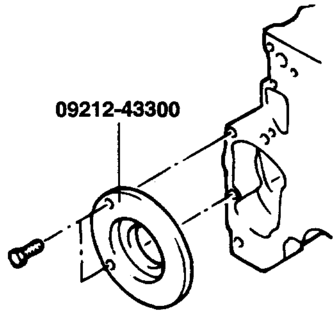
Intake and exhaust : 36.55 mm (1.4389 in.)

REPLACEMENT ELCB0280

SILENT SHAFT

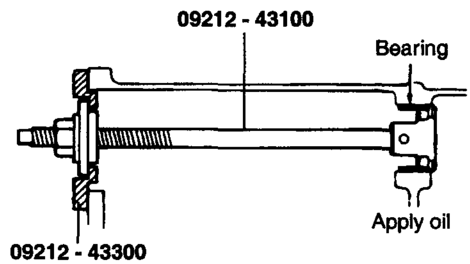
NOTE

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



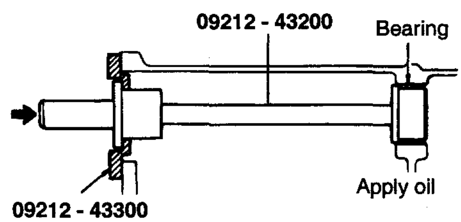
ECLA008A

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



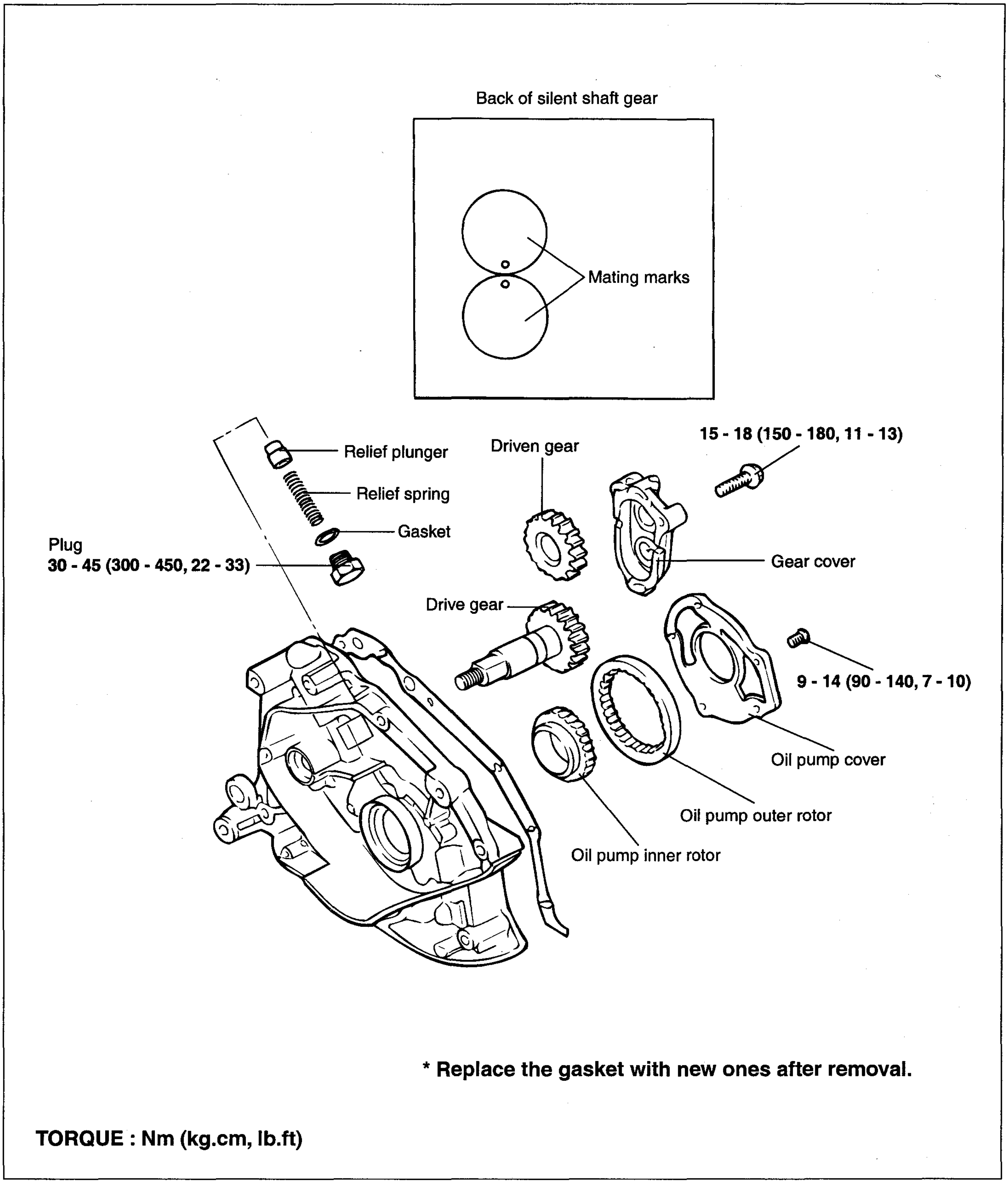
ECLA008B

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



ECLA008C

INSTALLATION ELCB0290



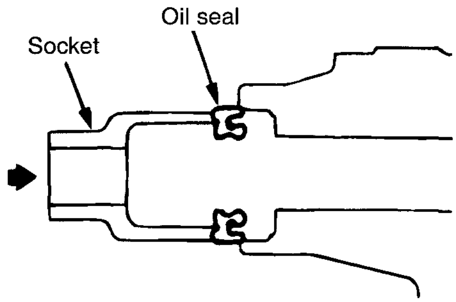
H7EM062A

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.



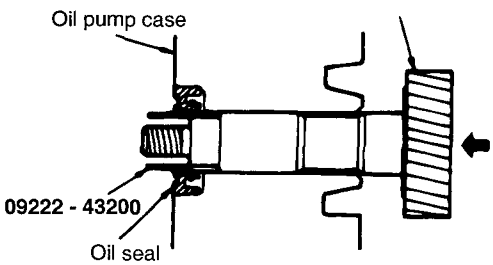
ECLA008E

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

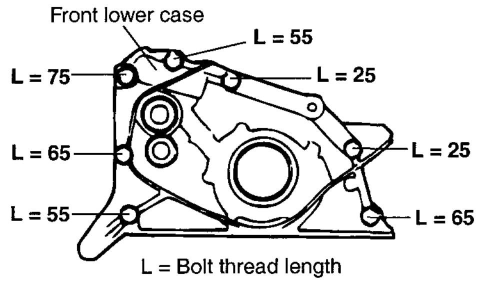
Apply oil to outer surfaces of Oil Seal Guide.



ECLA008G

FRONT LOWER CASE

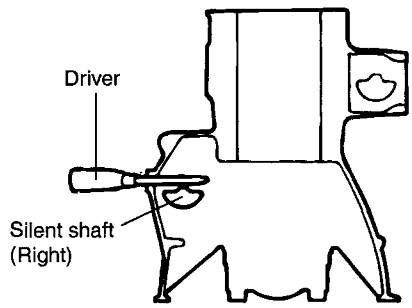
Tighten seven flange bolts to specification.



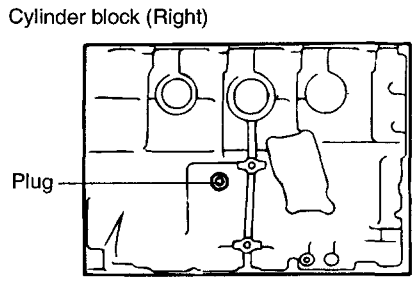
ECLA008H

FLANGE BOLT

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



ECLA007J



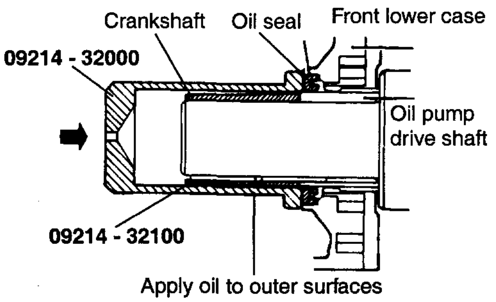
ECLA007I

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.

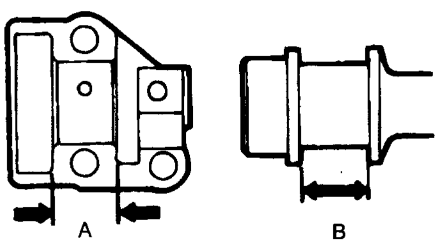


ECLA008I

CAMSHAFT

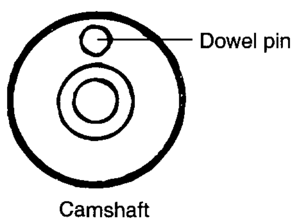
1. To obtain the end play, measure A and B. Replace parts if the limit is exceeded.
   End play = B - A

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.



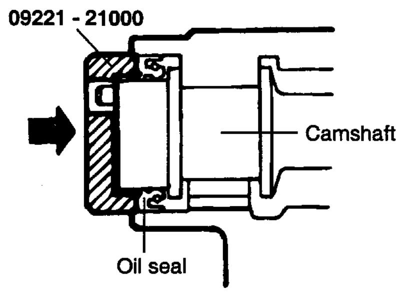
ECLA019D

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.

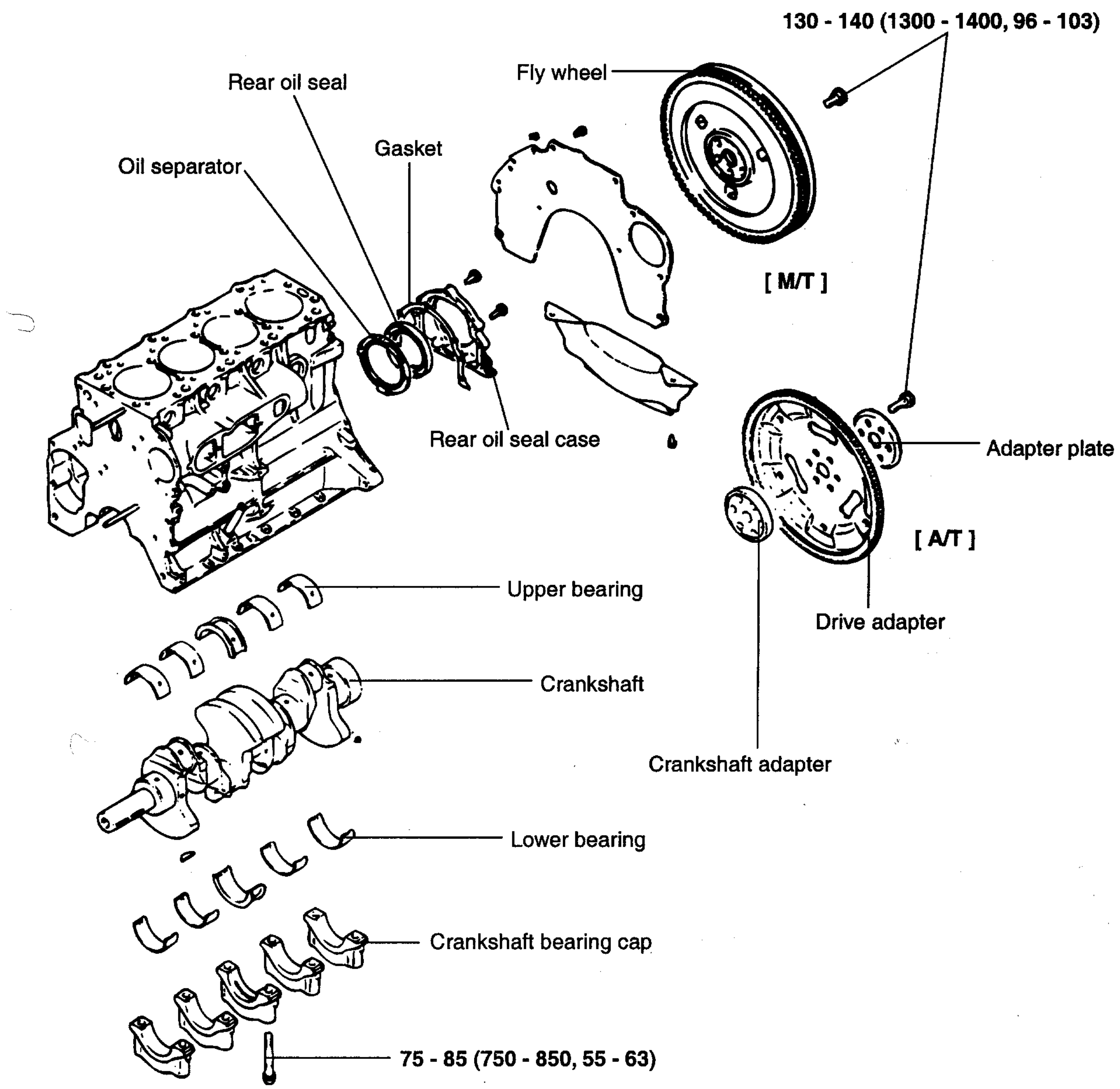


ECLA019E

MAIN MOVING SYSTEM

CRANK SHAFT

ELCB0300



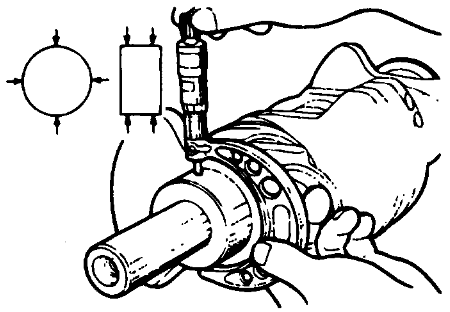
TORQUE : Nm (kg.cm, lb.ft)

ECLA009A

INSPECTION ELCB0310

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.



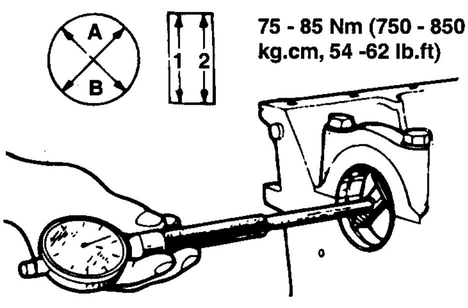
ECLA009B

Standard value
Journal O.D. : 66 mm (2.598 in.)
Pin O.D. : 53 mm (2.087 in.)

CRANKSHAFT OIL CLEARANCE

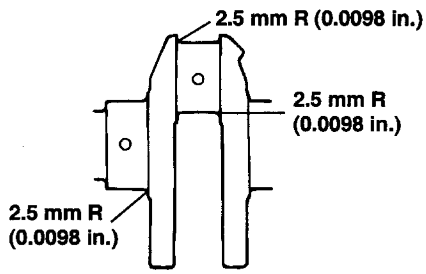
1. Determine the clearance from the diference between the O.D. of journal as well as pin O.D. and the I.D. of each bearing as assembled to the crankshaft. Measure the bearing I.D. in directions A and B at front and rear (1 and 2) positions.

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.

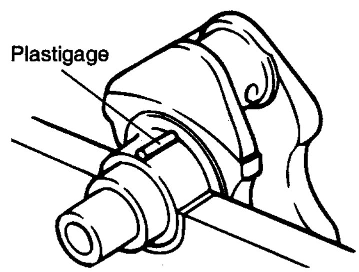


ECLA009D

CRANKSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)

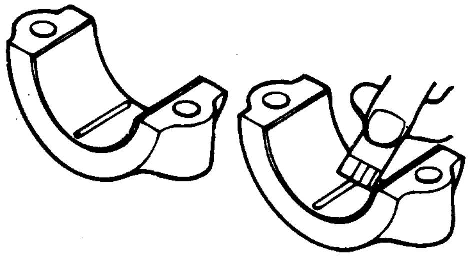
A Plastigage can be used to simplify the measurement of oil clearance. use the following procedure to check the oil clearance with a Plastigage (for journals).

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).



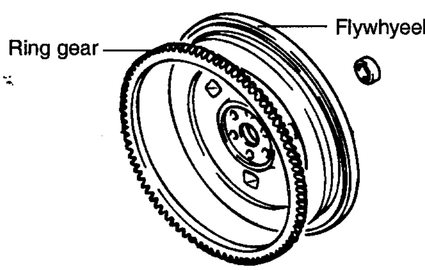
ECLA009F

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

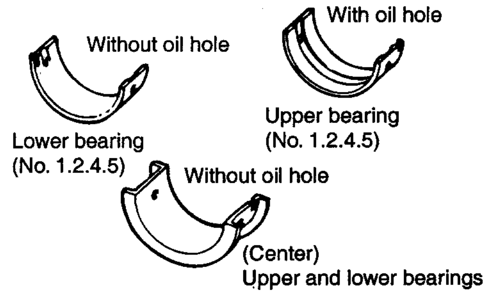
1. Check the flywheel clutch disc surface visually.
2. If ridge wear, streak, or seizure is evident, replace.
3. If the clutch disc surface runs out exceeding the limit, replace.

Limit : 0.13 mm (0.0051 in.)

INSTALLATION ELCB0320

CRANKSHAFT BEARING

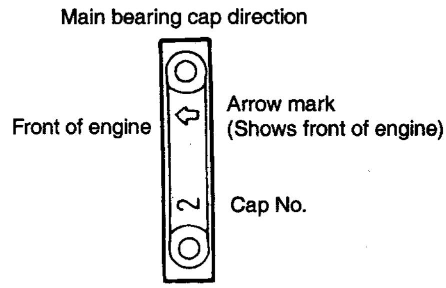
The upper main bearing is provided with an oil hole, whereas the lower bearing has no oil hole, There is no difference in center bearing (with flange) between upper and lower.



ECLA009H

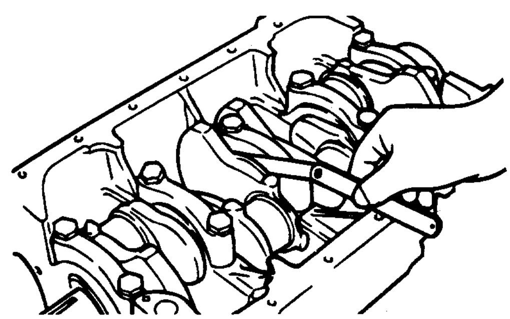
BEARING CAP

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.

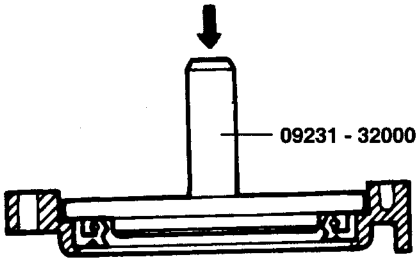


ECLA009J

Standard value : 0.05 - 0.18 mm (0.0020 - 0.0071 in.)
Limit : 0.25 mm (0.010 in.)

OIL SEAL CASE

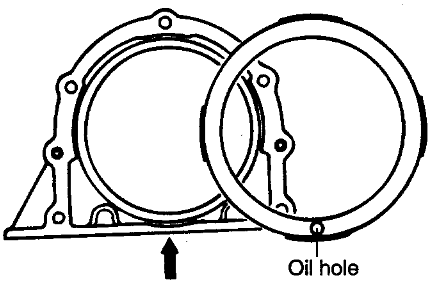
Using special tool, press-fit a new crankshaft rear oil seal into the oil seal case.



ECLA009K

OIL SEPARATOR

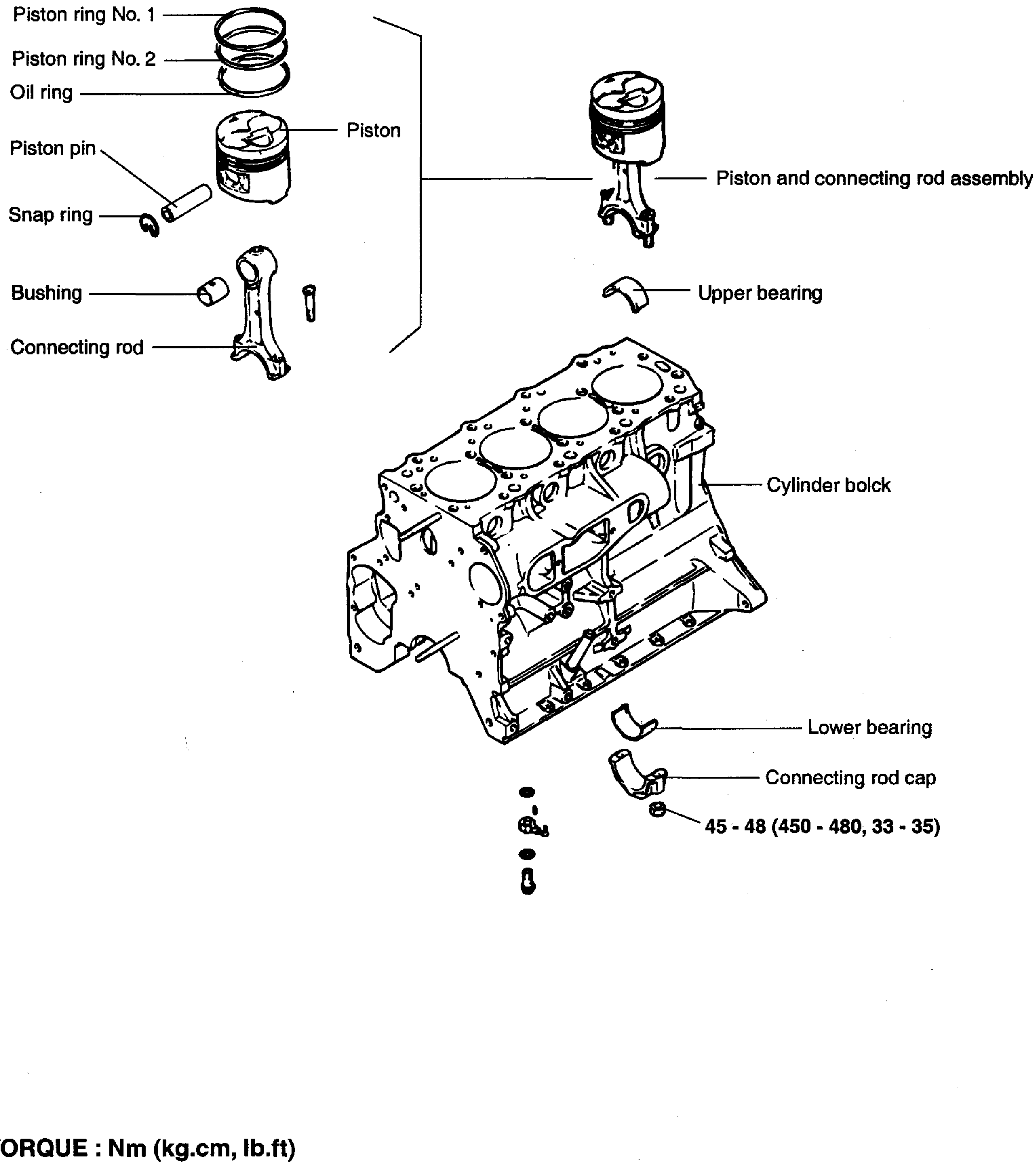
1. Push oil separator into the oil seal case.
2. Make sure that the oil hole in the separator comes at the bottom (indicated by an arrow in illustration.)



ECLA009L

PISTON

COMPONENTS ELCB0330



ECLA010A

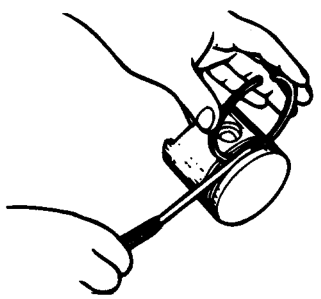
INSPECTION ELCB0340

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

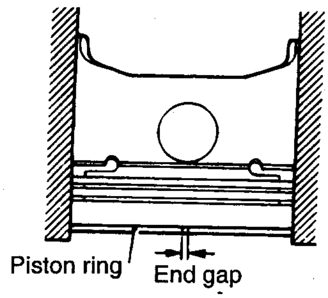
1. Check each piston ring for breakage, damage and abnormal wear.
   Replace the defective rings.
2. When the piston requires replacement, its ring should also be replaced.
3. Measure the clearance between piston ring and ring home.



ECLA010B

Standard Value : Ring - to - ring groove clearance
No. 1 : 0.056 - 0.076 mm (0.0022 - 0.0030 in.)
No. 2: 0.046 - 0.066 mm (0.0018 - 0.0026 in.)
Oil ring : 0.02 - 0.065 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.

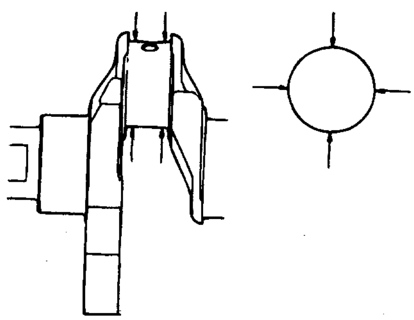


ECLA010D

Standard Value : End gap
No. 1 : 0.35 - 0.50 mm (0.0138 - 0.0197 in.)
No. 2 : 0.25 - 0.40 mm (0.0098 - 0.0157 in.)
Oil ring : 0.25 - 0.45 mm (0.0098 - 0.0177 in.)
Limit : 0.8 mm (0.0315 in.)

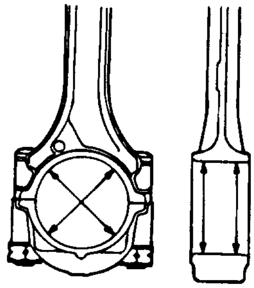
CONNECTING ROD BEARING

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.



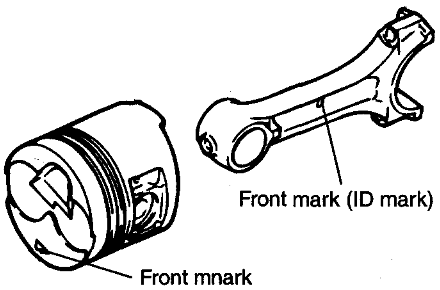
ECLA010F

Standard value : 0.02 - 0.05 mm (0.0008 - 0.0020 in.)
Limit : 0.10 mm (0.0039 in.)

INSTALLATION ELCB0350

CONNECTING ROD, PISTION PIN AND PISTON

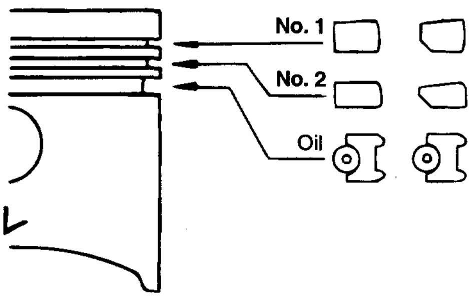
1. Match the piston with the connecting rod.
2. Line up the front marks and insert the piston pin. The piston pin must be smoothly pressed by hand into position. Replace the piston pin if there is excessive play.



ECLA010J

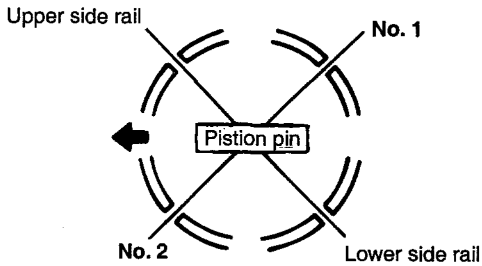
PISTON RING

1. Install the oil ring expander and oil ring to the piston.



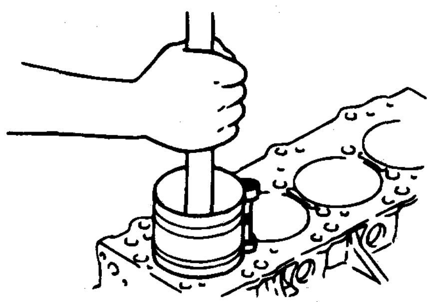
ECLA010L

2. 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.
3. Position ends of piston and oil (side rail, spacer) rings as illustrated.



ECLA010M

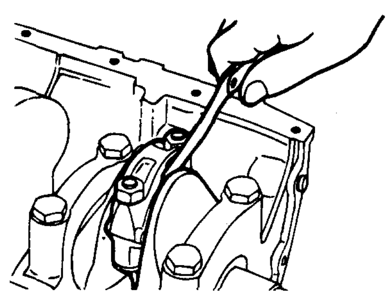
4. Insert the piston and connecting rod assembly from above the top of cylinder. Ensure that the front mark on piston crown and that (ID mark) on the connecting rod face toward the front of engine (to the crank pulley side).
5. Clamp firm the piston rings with the ring band and install the piston assembly into cylinder. Do not strike it hard into the piston, as broken piston ring or damaged crank pin could result.



ECLA010N

6. 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.)

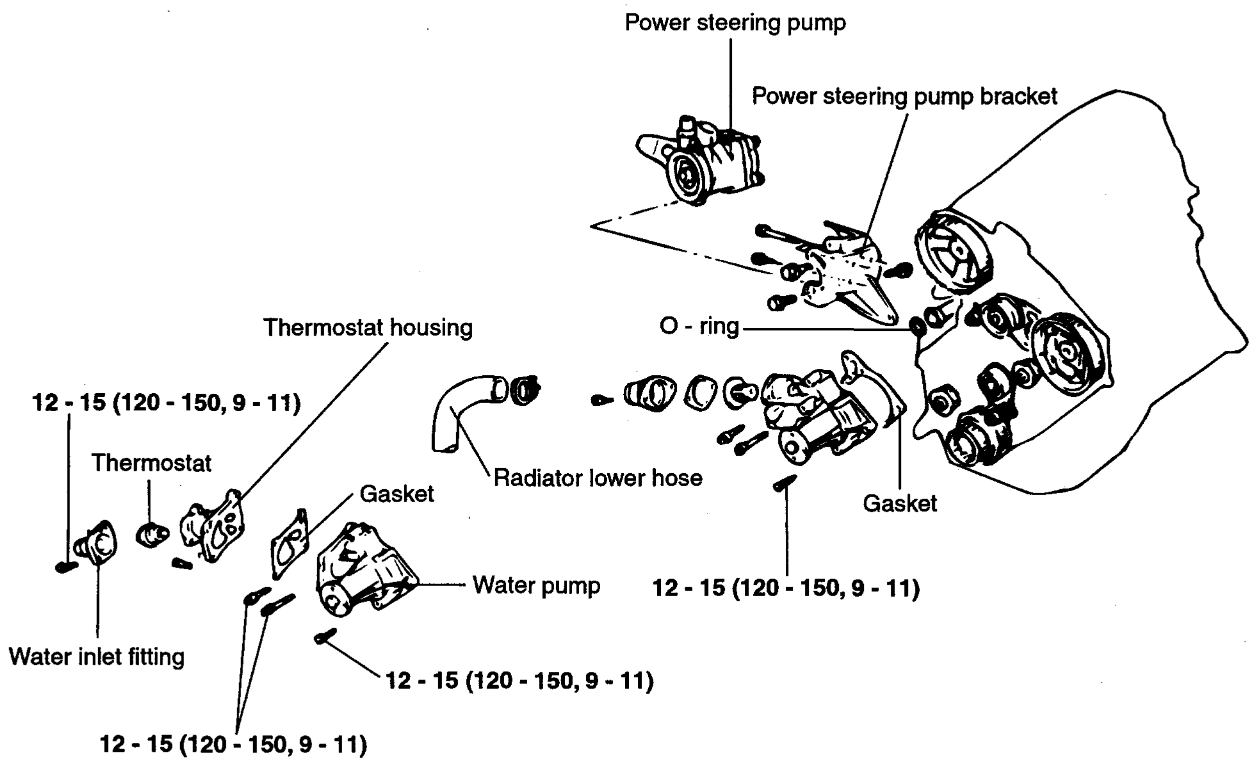


ECLA010O

COOLING SYSTEM

ENGINE COOLANT PUMP

COMPONENTS ELCB0400



*** Replace the gasket and O - ring with new ones after removal**

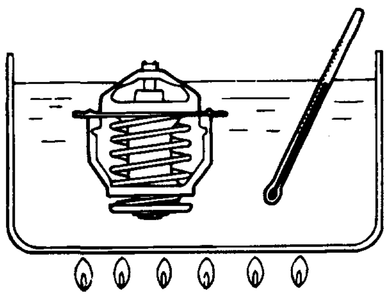
TORQUE : Nm (kg.cm, lb.ft)

ECLA011F

INSPECTION ELCB0410

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

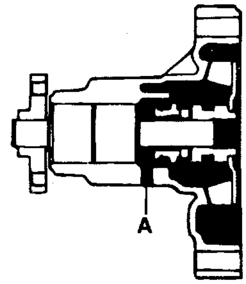
Measure valve heifht when fully close. Calculate lift by measuring the height when fully open.

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.

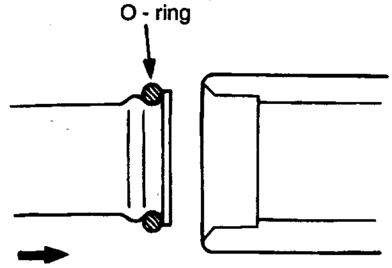


ECLA011B

INSTALLATION ELCB0420

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

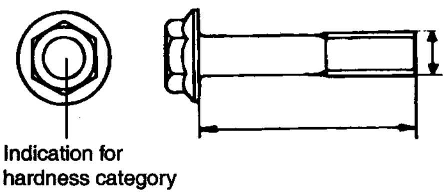
CAUTION

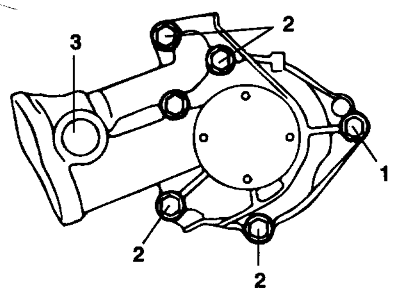
1. Do not apply oil and grease to water pipe O-ring.
2. Keep the water pipe connections free of sand, dust, etc.
3. Insert water pipe until its end bottoms.

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)

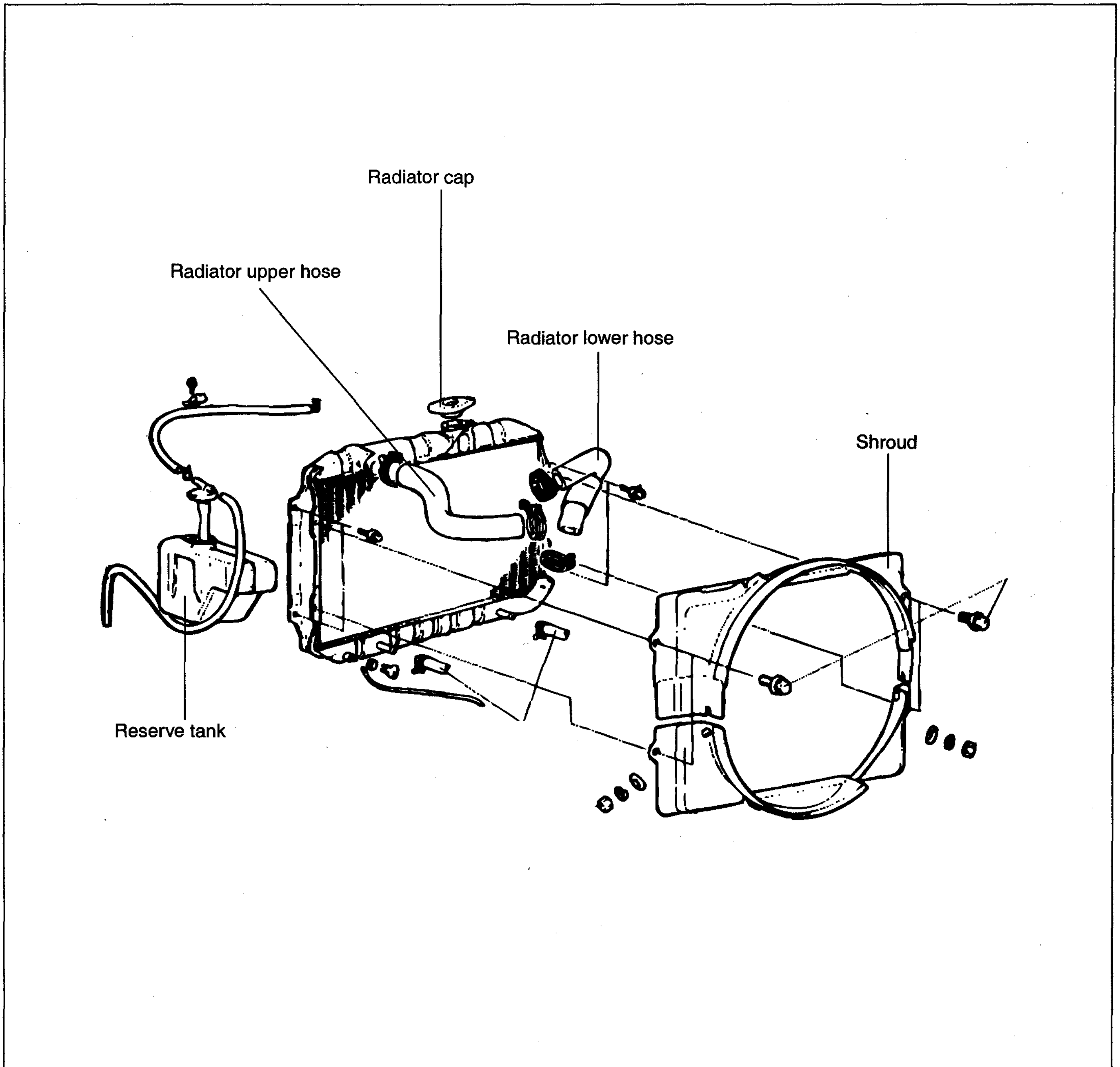




ECLA011D

RADIATOR

ELCB0430

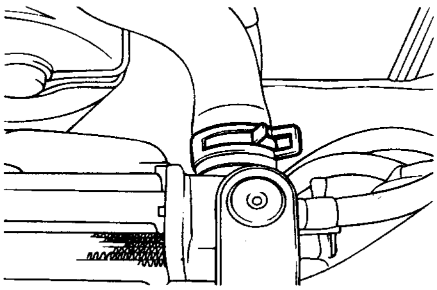


ECLA012A

REMOVAL ELCB0440

RADIATOR

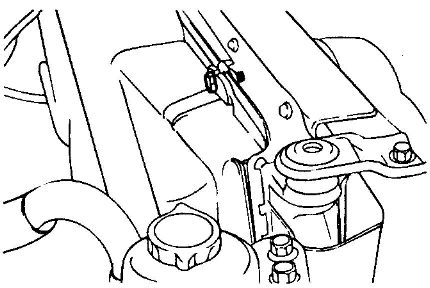
1. Loosen the radiator drain plug to drain the coolant.
2. Disconnect the radiator hoses from the following parts.
   Upper hose ... from the radiator
   Lower hose ... from the engine.
3. Disconnect the overflow tube from the radiator.



H7EM913A

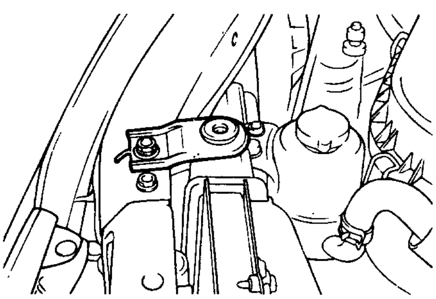
4. Remove the radiator shroud bolts from the radiator.

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



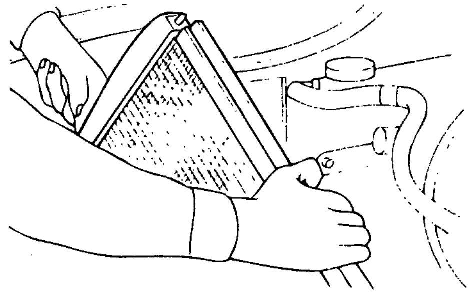
H7EM913B

5. Remove the radiator mounting bolts.



H7EM914A

6. Tilt radiator and take out obliquely upward.



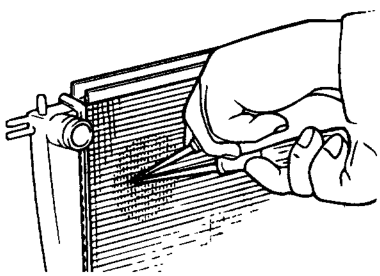
H7EM003A

   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

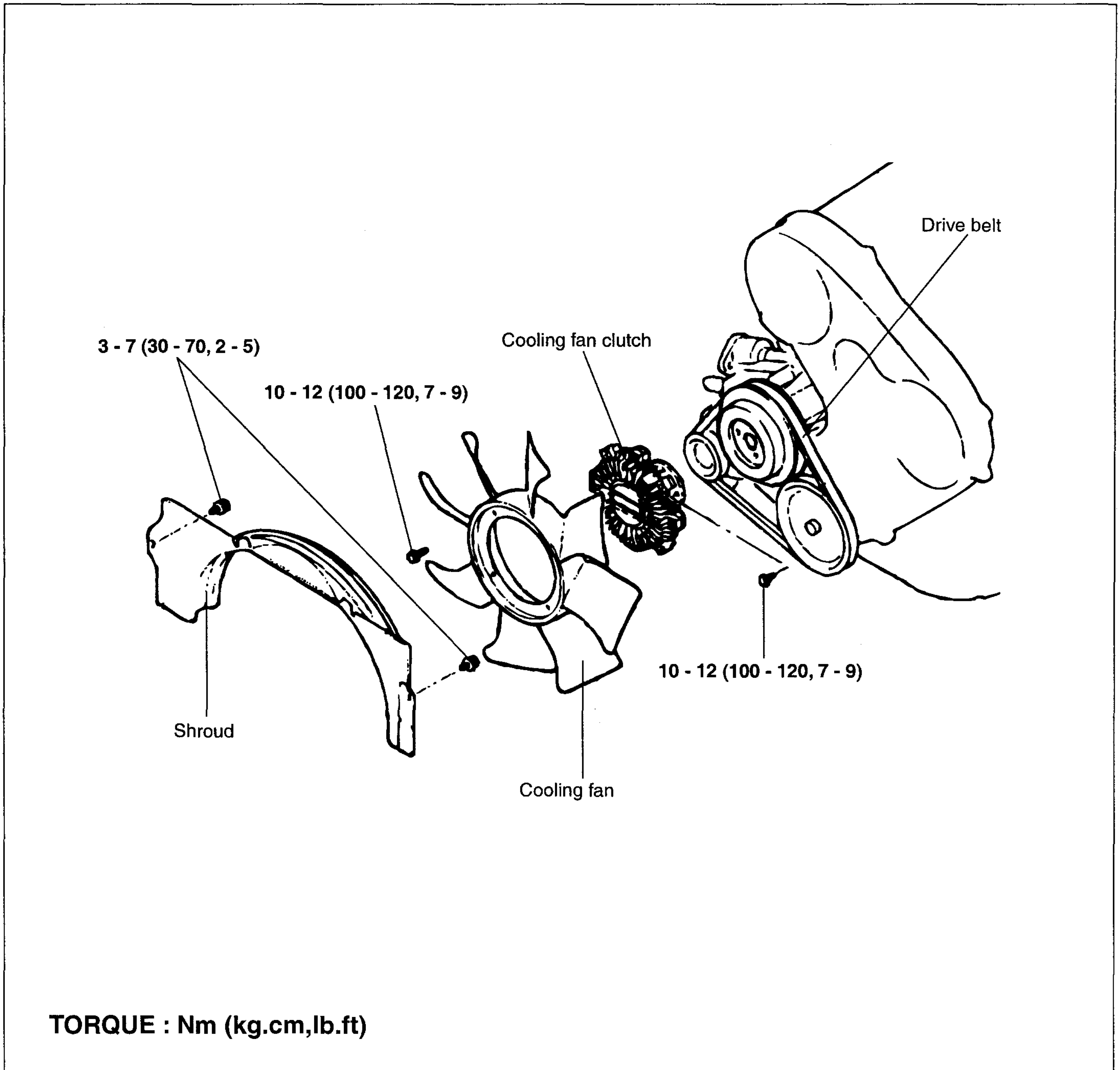
A bent or crushed portion shoude be corrected as shown.



H7EM003B

RADIATOR PAN MOTOR

COMPONENTS ELCB0450



ECLA012B

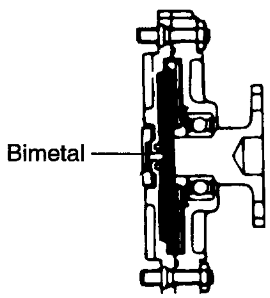
INSPECTION ELCB0460

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.



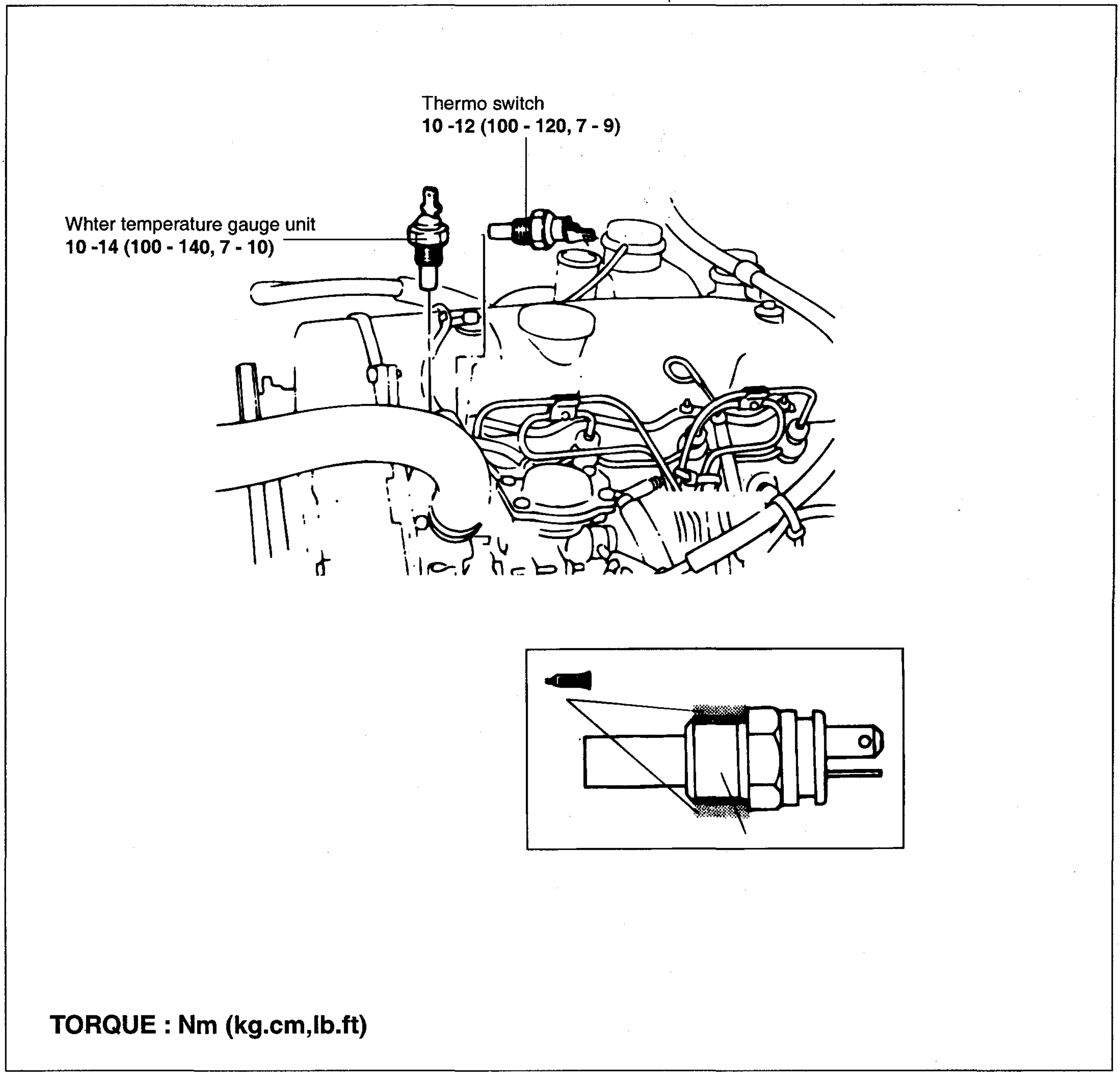
ECLA012C

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 ELCB0470

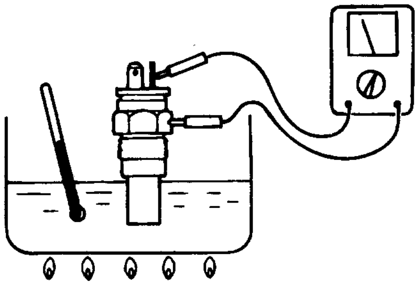


ECLA012D

INSPECTION ELCB0480

WATER TEMPERATURE GAUGE UNIT

1. Put the sensor in water and increase the water temperature to measure the nesistance.

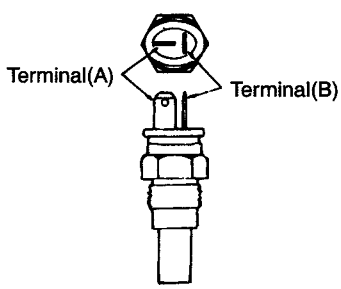


ECLA012E

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

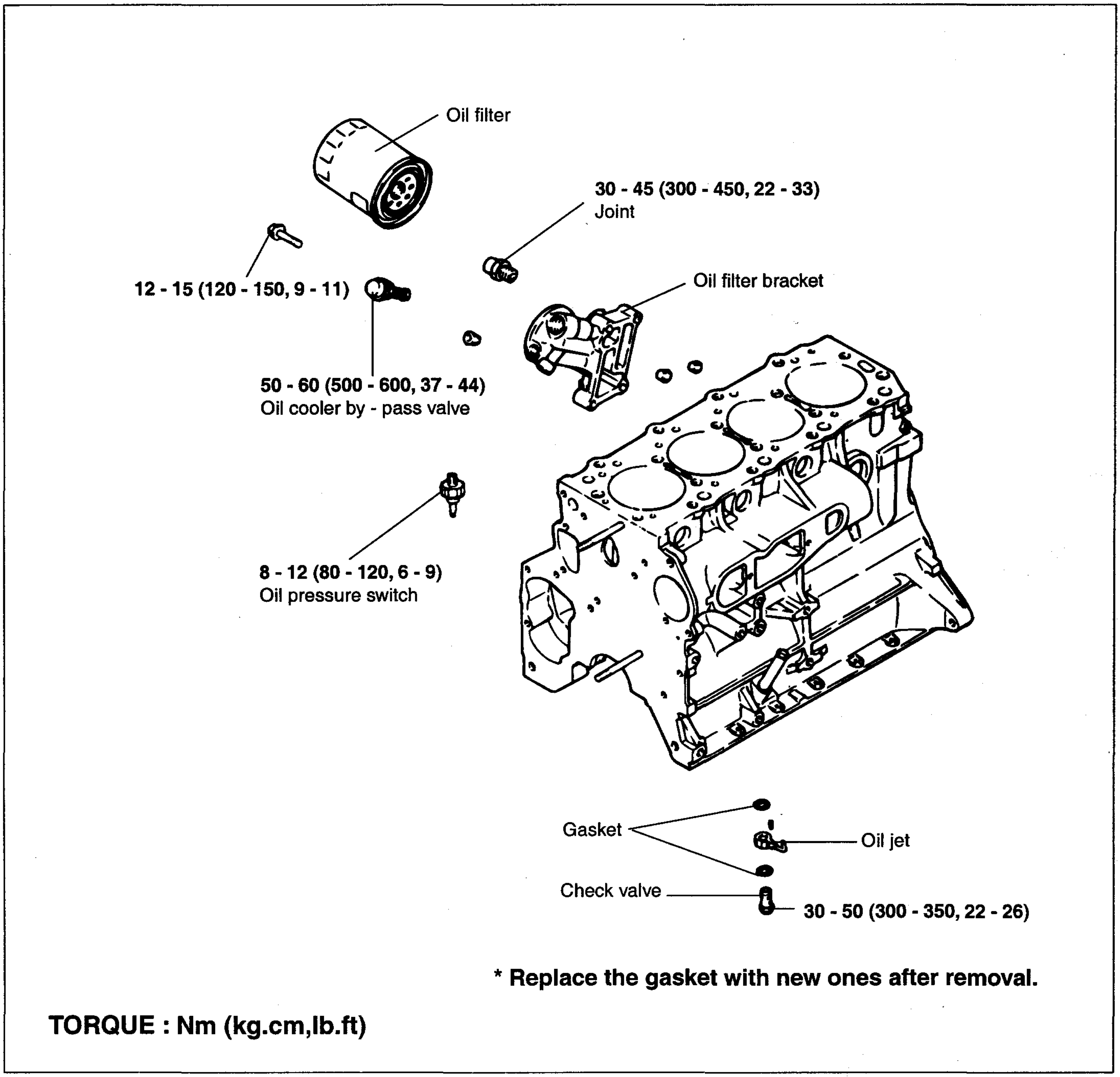


ECLA012F

LUBRICATION SYSTEM

OIL FILTER

ELCB0500



ECLA013A

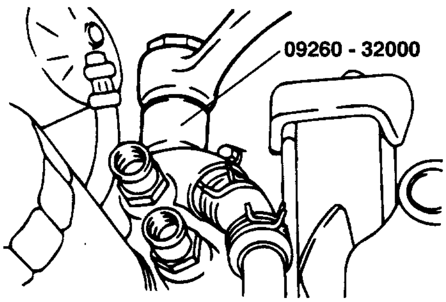
REMOVAL ELCB0510

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

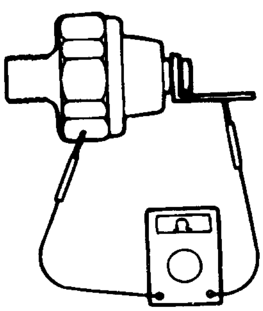
INSPECTION ELCB0520

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.

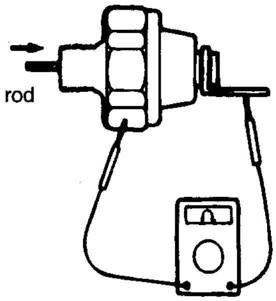
OIL PRESSURE SWITCH

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.

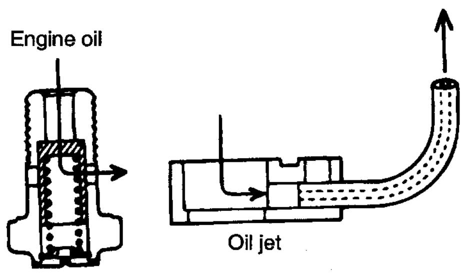


ECLA013D

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

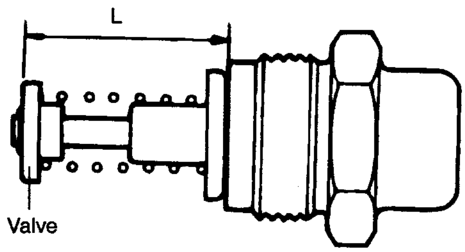
OIL COOLER BYPASS VALVE

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

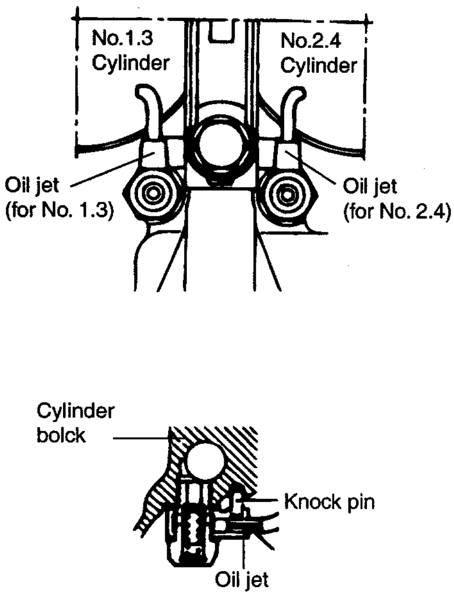


ECLA013F

INSTALLATION ELCB0530

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

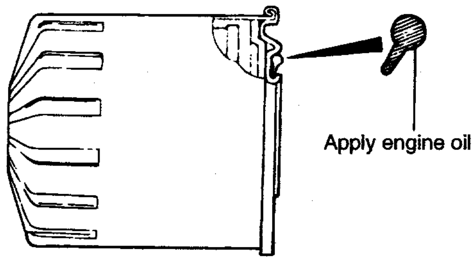
The sealant must not get into the thread top surface. Use care not to torque excessively.

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

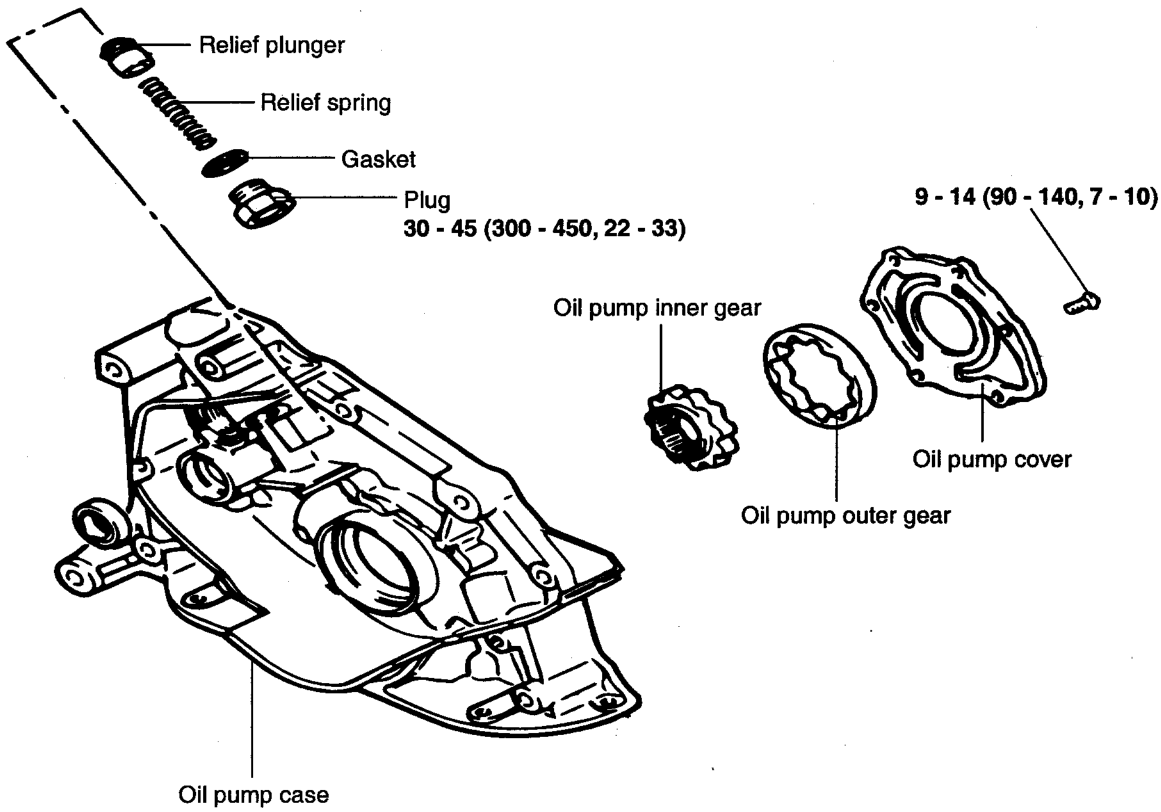
Never use a wrench to tighten the oil filter.



ECA9970B

OIL PUMP

COMPONENTS ELCB0540



*** Replace the gasket with new ones after removal.**

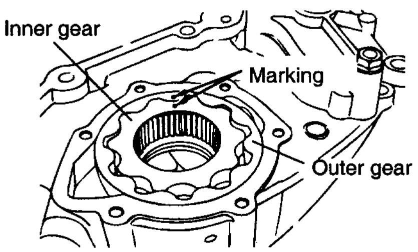
TORQUE : Nm (kg.cm,lb.ft)

ECLA014A

DISASSEMBLY ELCB0550

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.

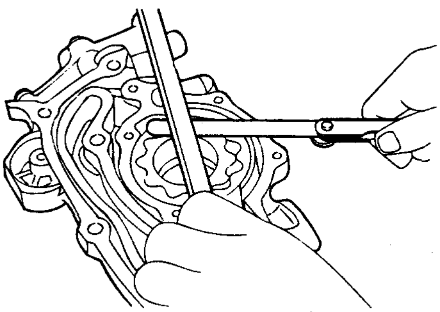


ECLA014B

INSPECTION ELCB0560

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.

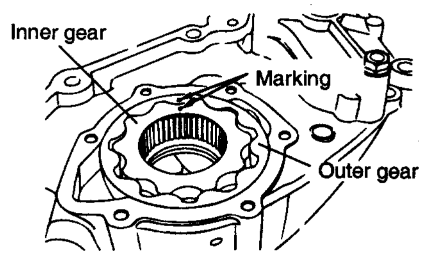
[Standard]
Drive gear : 0.03 - 0.09 mm (0.0012 - 0.0035 in.)
Driven gear : 0.12 - 0.22 mm (0.0047 - 0.0087 in.)
[Limit]
Drive gear : 0.5 mm (0.0197 in.)
Driven gear : 0.4 mm (0.0157 in.)

INSTALLATION ELCB0570

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.

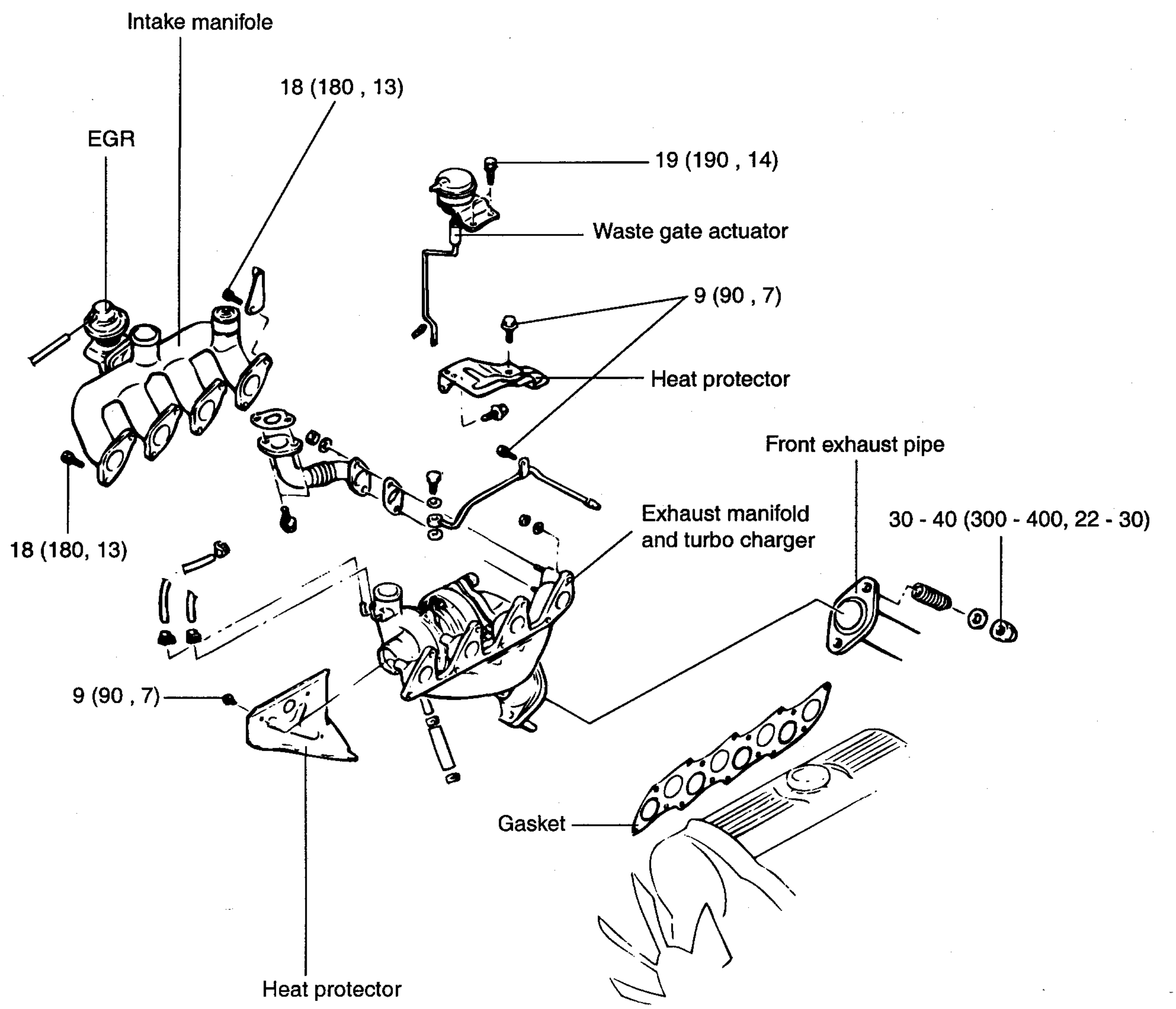


ECLA014B

INTAKE AND EXHAUST SYSTEM

EXHAUST MANIFOLD

COMPONENTS ELCB0600



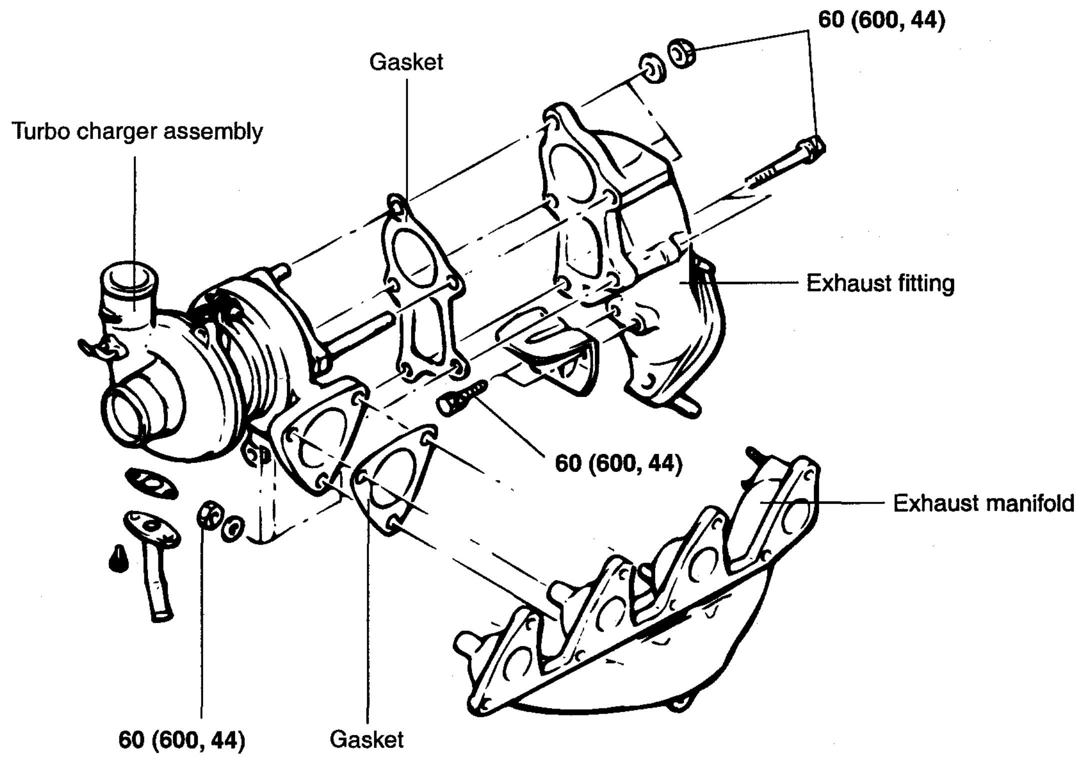
***Replace the gasket with new ones after removal.**

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

ECLA015A

COMPONENTS ELCB0610

[TCI]



*** Replace the gasket with new ones after removal.**

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

ECLA015B

INSPECTION ELCB0620

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.

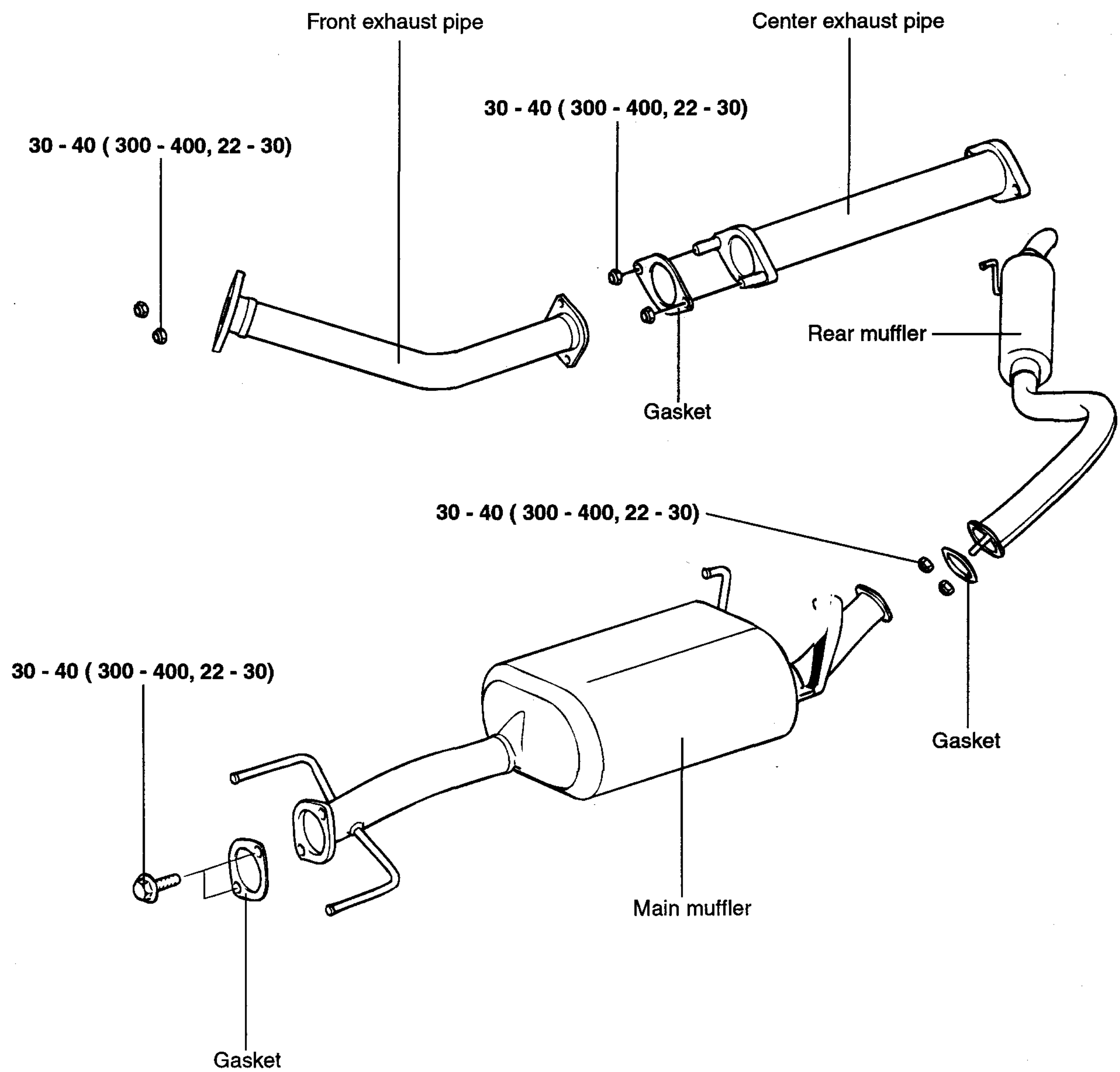
Limit : 0.3 mm

EXHAUST MANIFOLD GASKET

The gasket may be reused if they are free from peeled or damaged surface.

MUFFLER

COMPONENTS ECMB0250



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

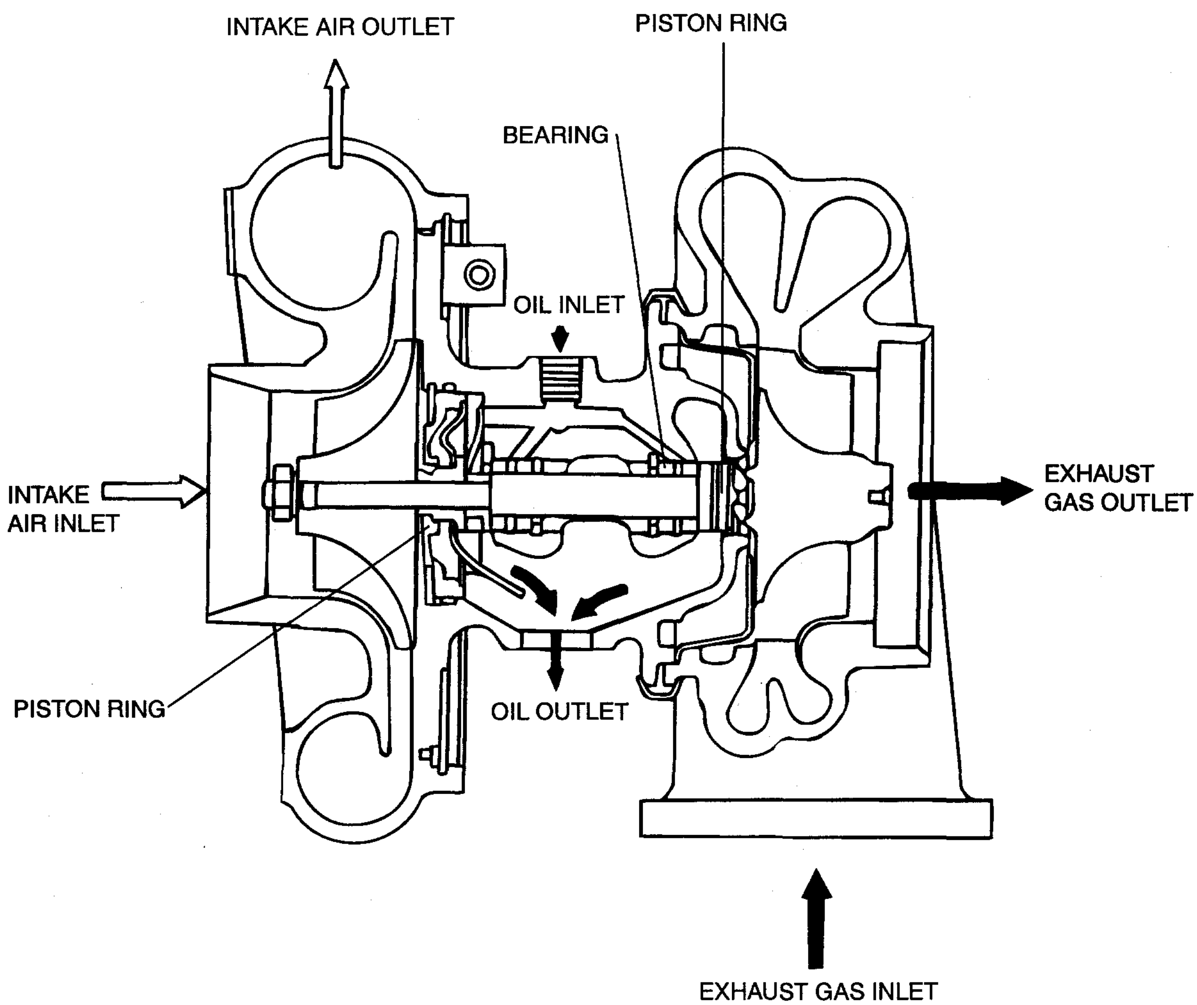
ECMB001A

INSPECTION ELCB0640

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

TURBO CHARGER (TC)

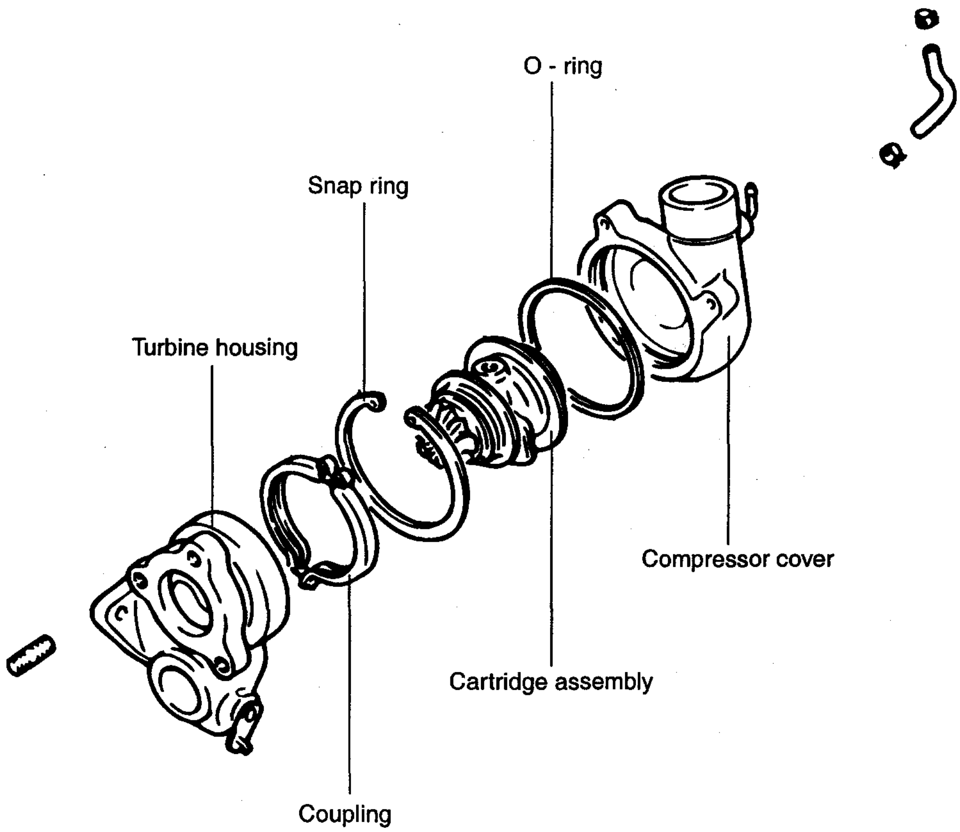
COMPONENTS ELCB0650



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

ECLB002A

COMPONENTS ELCB0660



*** Replace the gasket with new ones after removal.**

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

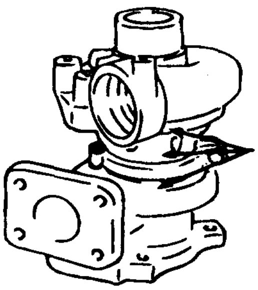
ECLA016A

DISASSEMBLY ELCB0670

1. Before removal, make the matching mark on compressor cover bearing housing and turbine housing.

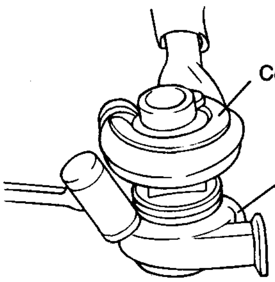
⚠ ***CAUTION***

Be sure not to damage the compressor and turbine wheel blade.



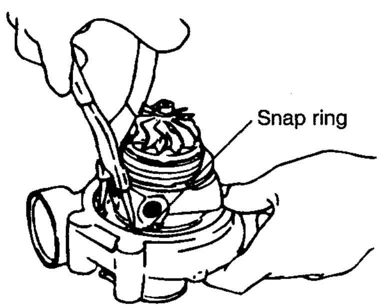
ECLA016B

2. Loosen the assembly and tap the housing by plastic hammer when removing the housing.



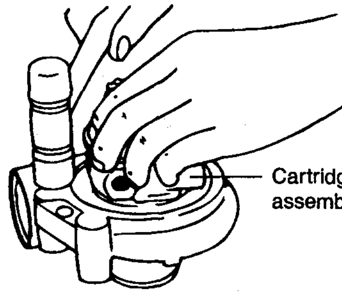
H7ET008B

3. Remove the snap ring using snap ring filler.



ECLA016C

4. Remove by tapping the compressor cover of cartridge assembly with plastic hammer.



ECLA016D

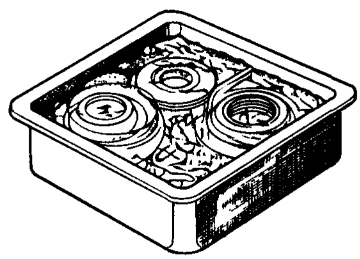
CLEANING

1. Use a heavy duty carbon solvent to loosen the carbon from the parts.

⚠ ***CAUTION***

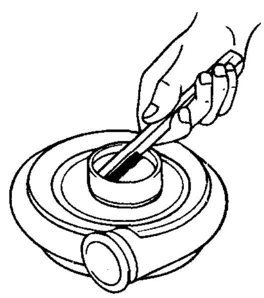
Do not use caustic solutions, wire brushes, or wire wheels to remove carbon deposits from any turbo charger part.

2. A small, closed, agitated cleaning tank and solvent will give the best results.



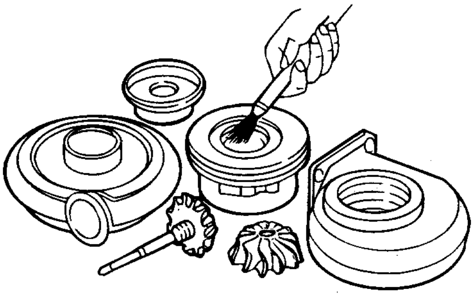
H7ET009A

3. After the carbon is loosened, use a hard, bristle type brush and remove all dirt particles.



H7ET009B

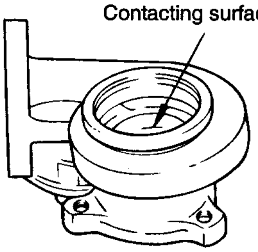
4. Clean all drilled passages with air under pressure and put oil on cleaned parts to prevent corrosion.



H7ET009C

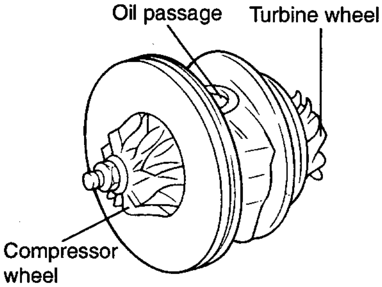
INSPECTION ELCB0680

1. Check the inner housing contacting turbine wheel for crack, pitching and other damages caused by over-heat.
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.



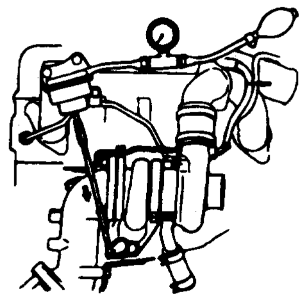
ECLA016F

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.

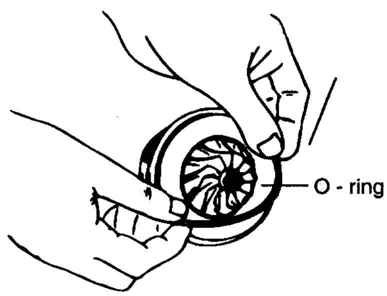
Nominal Value : 77.5 kPa (0.79 kgf / cm²)



ECLA016J

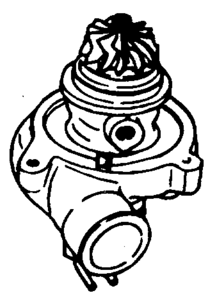
REASSEMBLY ELCB0690

1. Apply engine oil to new O-ring and insert the O-ring to the groove of cartridge assembly.



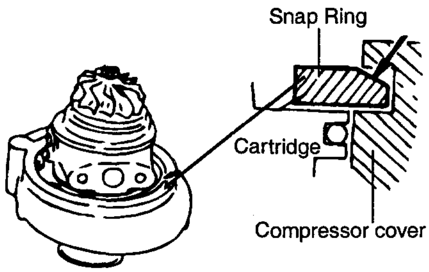
ECLA016G

2. Assemble cartridge assembly and compressor cover matching the mark.



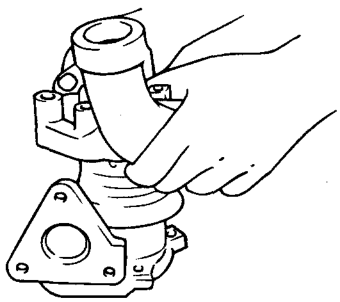
ECLA016H

3. Install the snap ring as shown in the figure.



ECLA016I

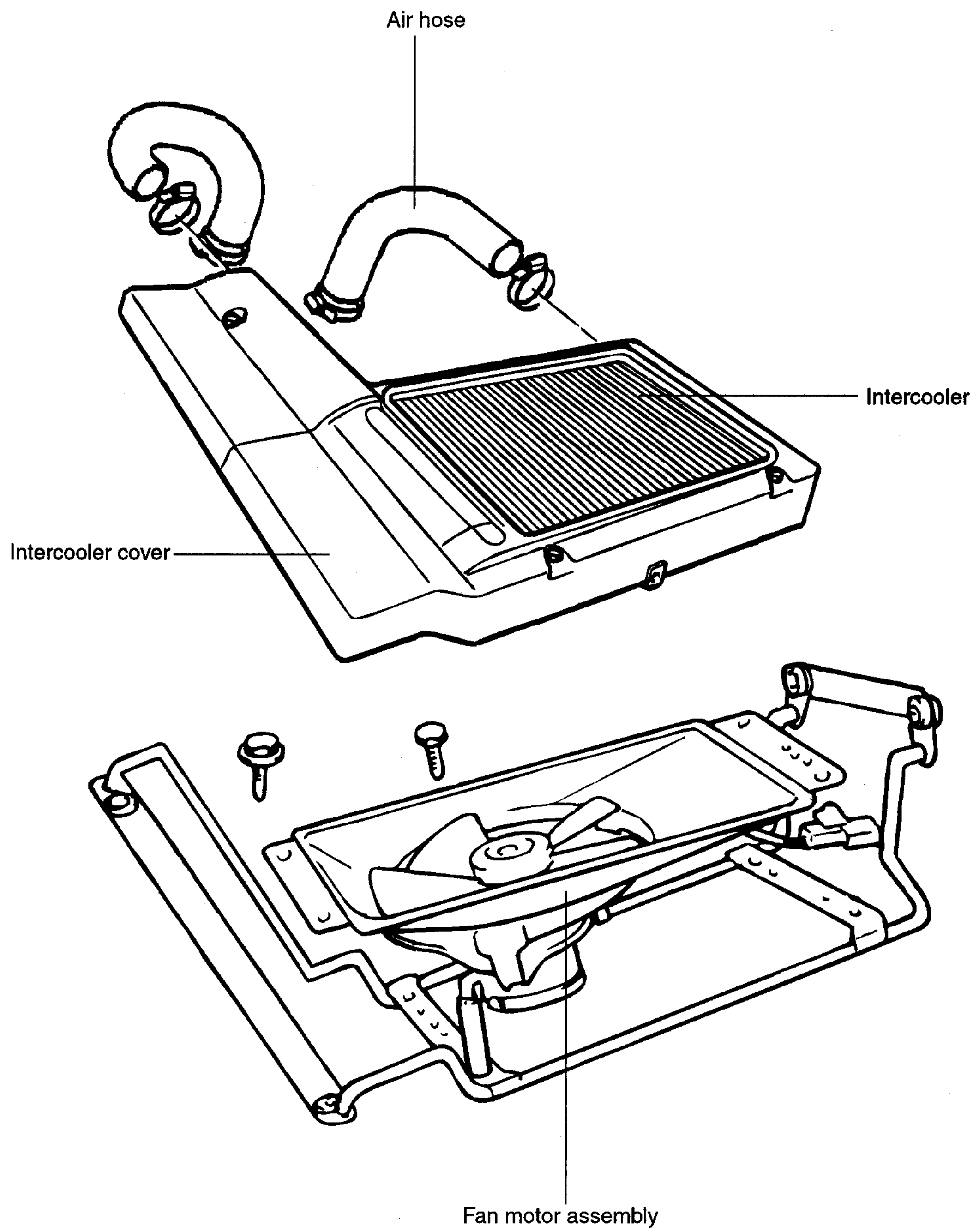
4. Before reassembly, make sure that the turbine housing matching mark is matched with compressor cover and cartridge assembly.



H7ET010D

INTERCOOLER

COMPONENTS ELCB0700



ECMB700A

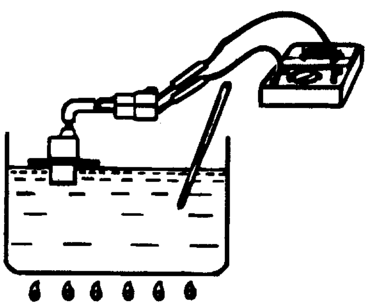
REMOVAL ELCB0710

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 ELCB0720

AIR TEMPERATURE SWITCH

1. Place the sensing part of sensor into the water.
2. Check the continnity according as the temperature increase.



ECLA017B

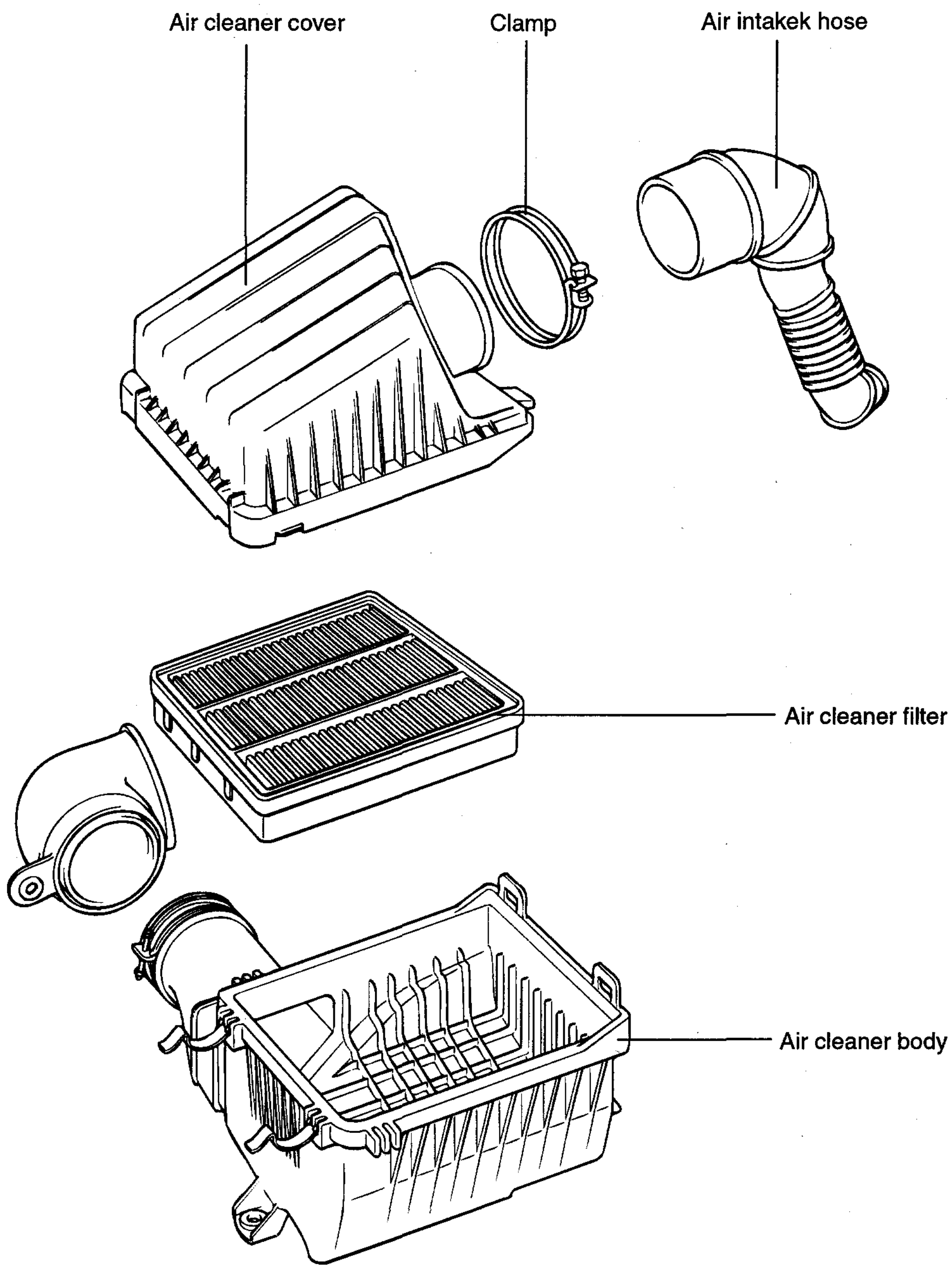
Temperature	Normal Condition
50°C or less	No - Continuity
60°C or more	Continuity

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 ECMB0400

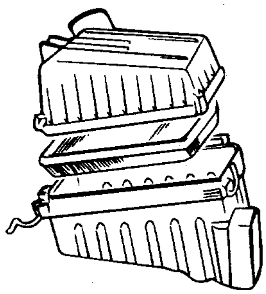


ECMB005A

INSPECTION ECMB0410

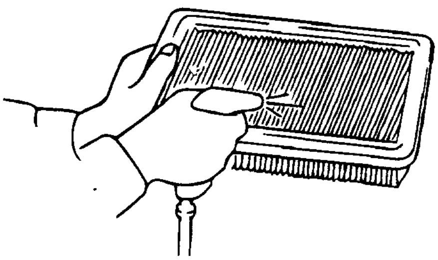
1. Check the air cleaner body, cover, or filter for distortion, corrosion or damage.

2. Check the air duct for damage.



ECKA060B

3. Check the air cleaner filter for restriction, contamination or damage. If the filter is slightly restricted, remove the dust and other contaminants by blowing compressed air from the upper side through the filter.



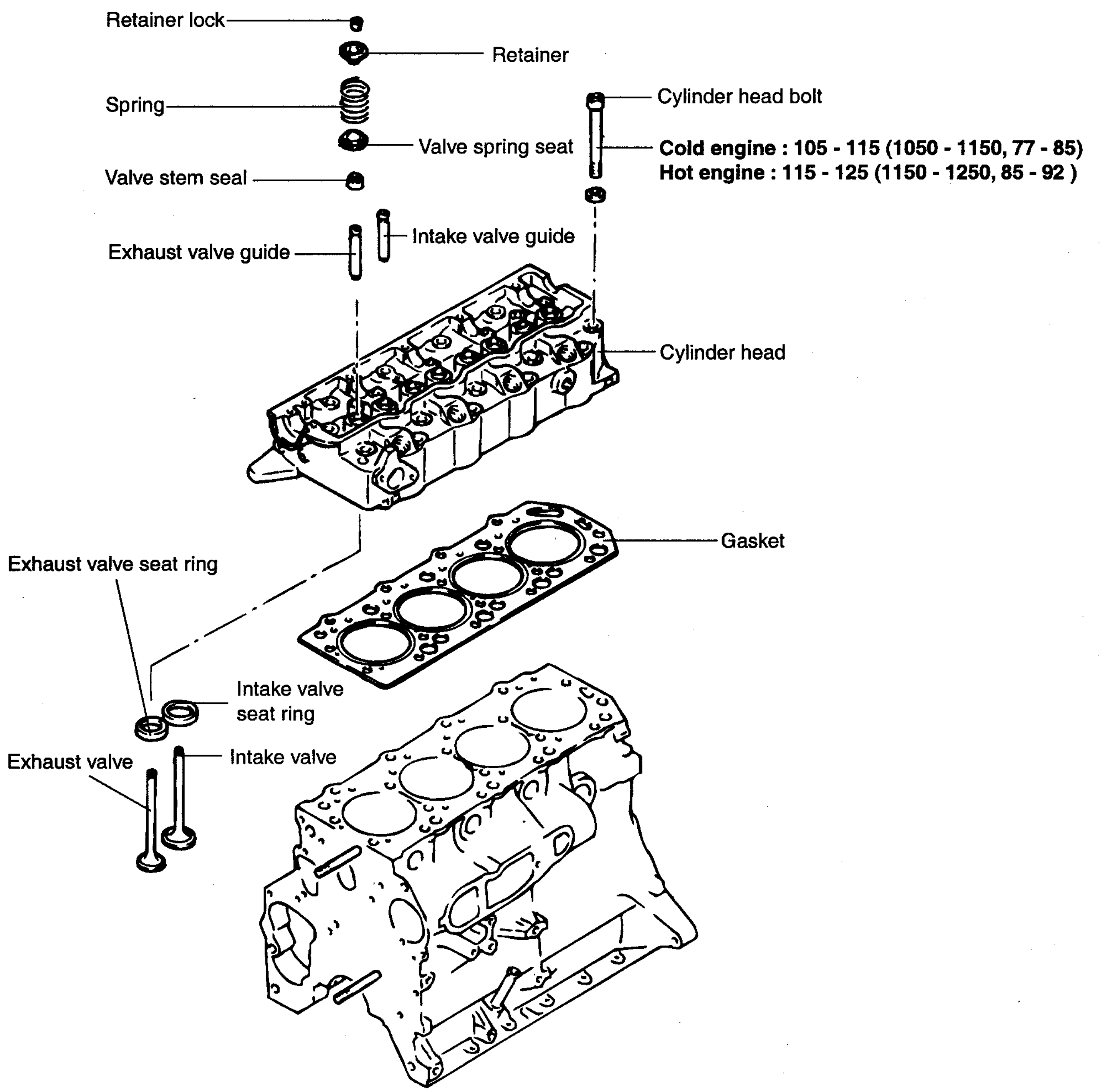
EDDA080B

4. Check the air cleaner housing for restrictions, contamination or damage.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS ELCB0800



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

*** Replace the gasket with new ones after removal**

ECLA018A

DISASSEMBLY ELCB0810

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

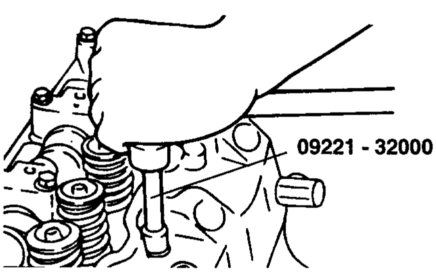
After the injection pipe is removed, put a cap on the nozzle holder and the delivery valve holder to prevent ingress of dust and foreign matter.

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.

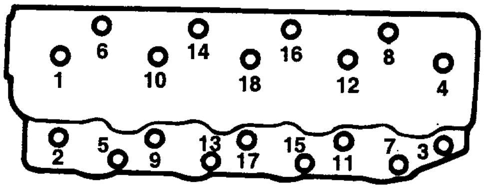
CAUTION

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

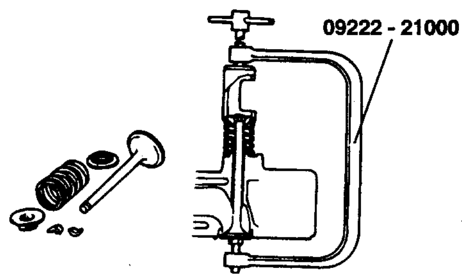


ECLA018C

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.

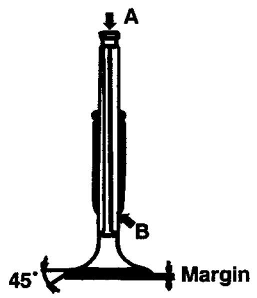


ECLA018D

INSPECTION ELCB0820

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.

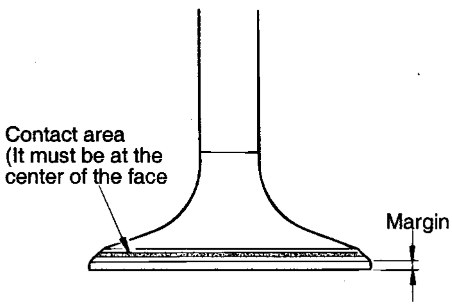


ECA9281B

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.)



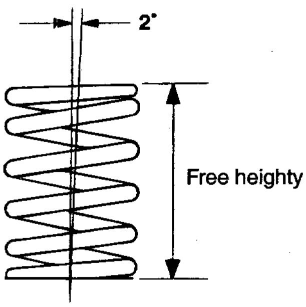
EDA9300D

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 : 48.1 mm (1.894 in.)

2. Measure the squareness of the spring and, if the limit is exceeded, replace.



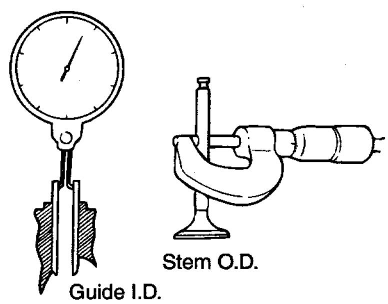
B0Y041D

Standard value : 2° or less Limit : 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.

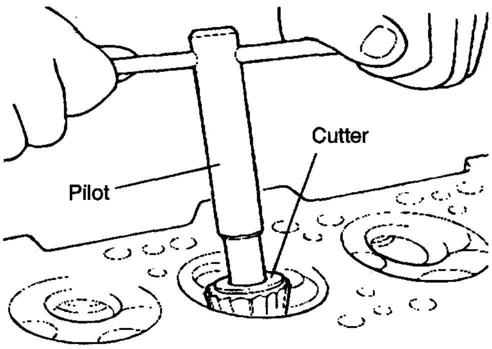
3. If there is gas leak from the cylinder head gasket surface, measure the surface flatness. If distortion exceeds the limit, replace the cylinder head.

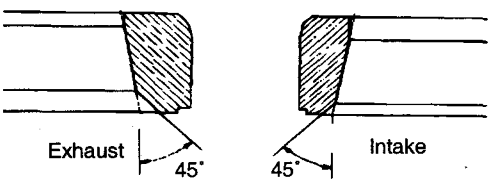
Standard value : 0.05 mm (0.002 in.) Limit : 0.2 mm (0.008 in.)

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. Before 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.



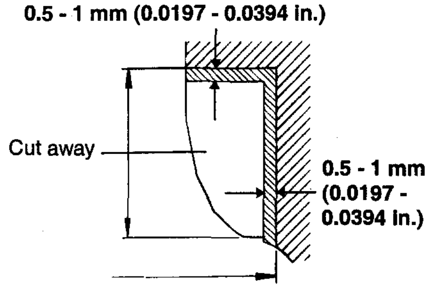


ECHA920B

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.



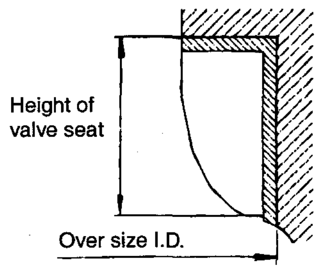
B0YR3940

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.

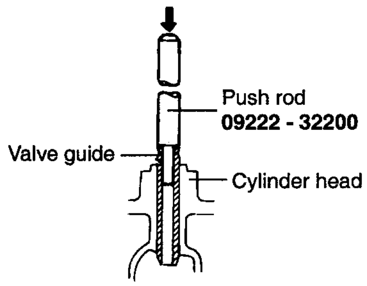
4. After installation, recondition the valve seat.



B0YR167A

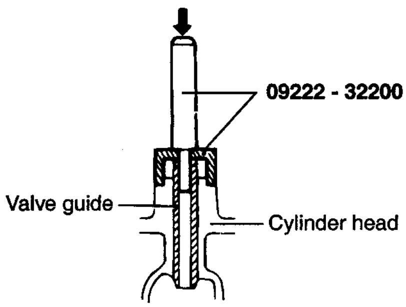
VALVE GUIDE REPLACEMENT PROCEDURE

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.)

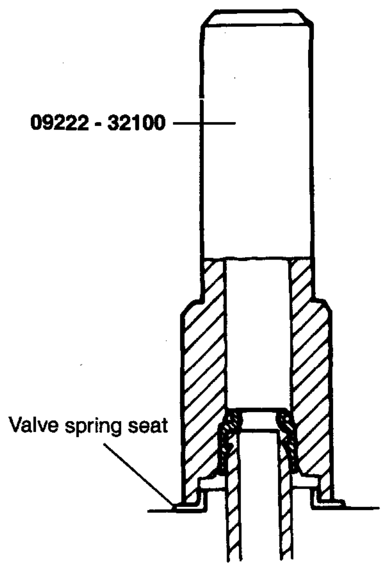
INSTALLATION ELCB0830

VALVE STEM SEAL

1. Using Valve Stem Seal Installer (09222 - 32100), install the valve stem seal into the valve guide.

NOTE

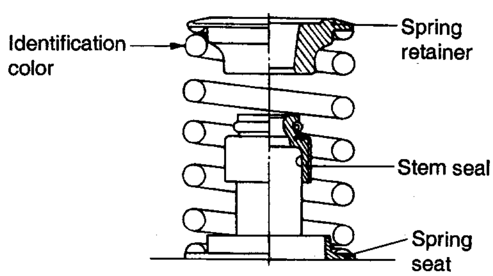
1. *The valve stem seal must be not reused.*
2. *The special tool must be used for the installation of the valve stem seal. Improper installation could result in oil consumption through valve guide.*



ECLA018I

VALVE SPRING

Direct the valve spring end with identification color to the rocker arm.



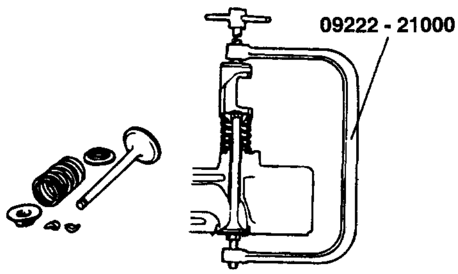
B0Y044B

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

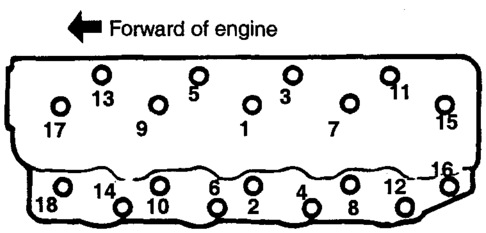
CYLINDER HEAD

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 :

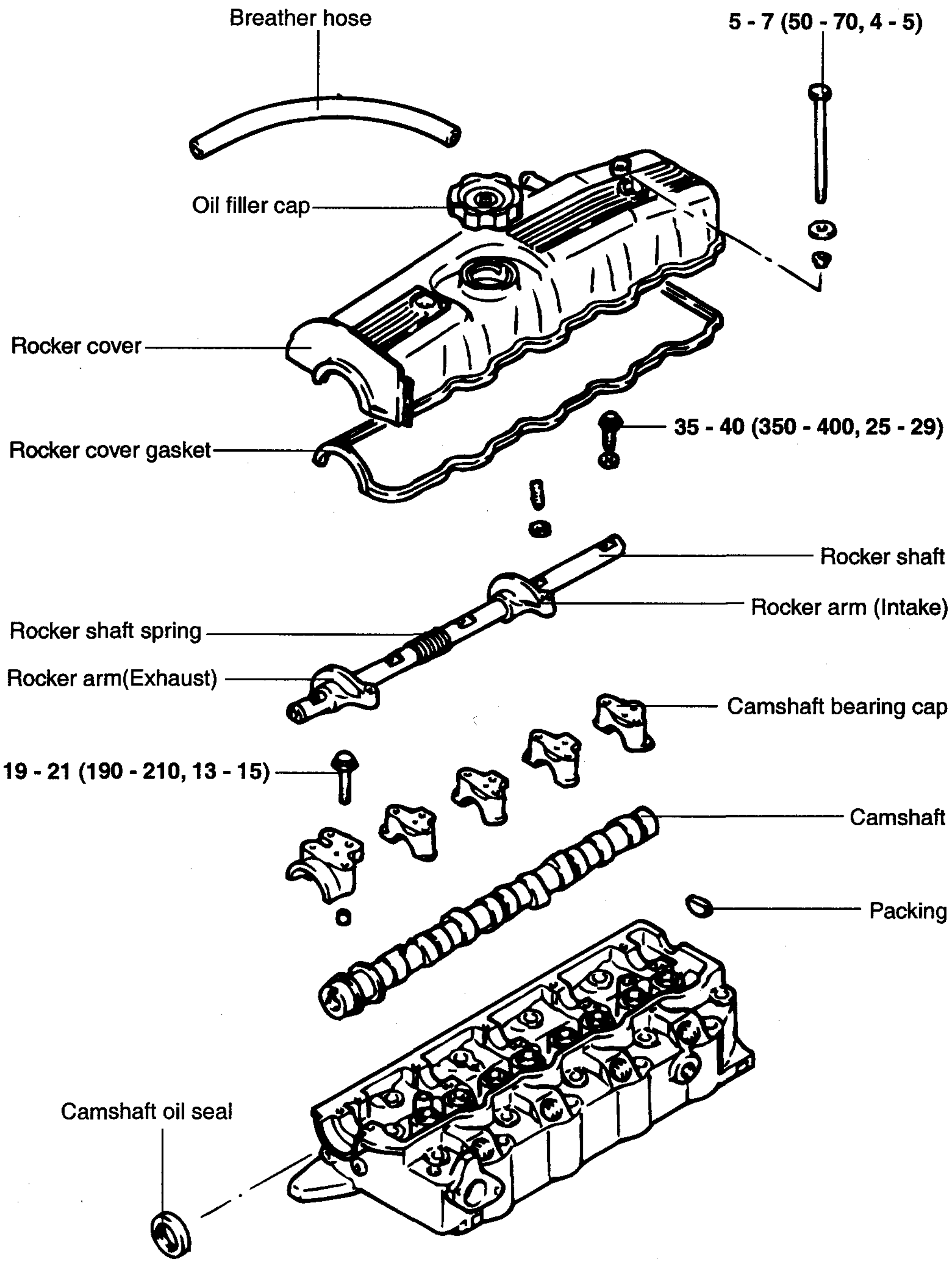
105 - 115 Nm (1050 - 1150 kg.cm, 77 - 85 lb.ft)

Hot engine :

115 - 125 Nm (1150 - 1250 kg.cm, 85 - 92 lb.ft)

ROCKER ARM

COMPONENTS ELCB0840



***Replace the gasket with new ones after removal.**

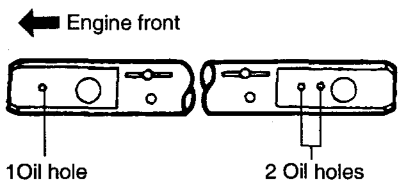
TORQUE : Nm (kg.cm, lb.ft)

ECLA019A

INSPECTION ELCB0845

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.

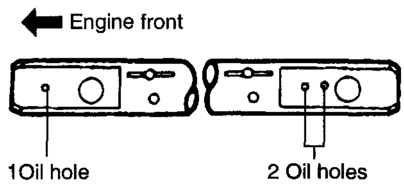
INSTALLATION ELCB0850

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.

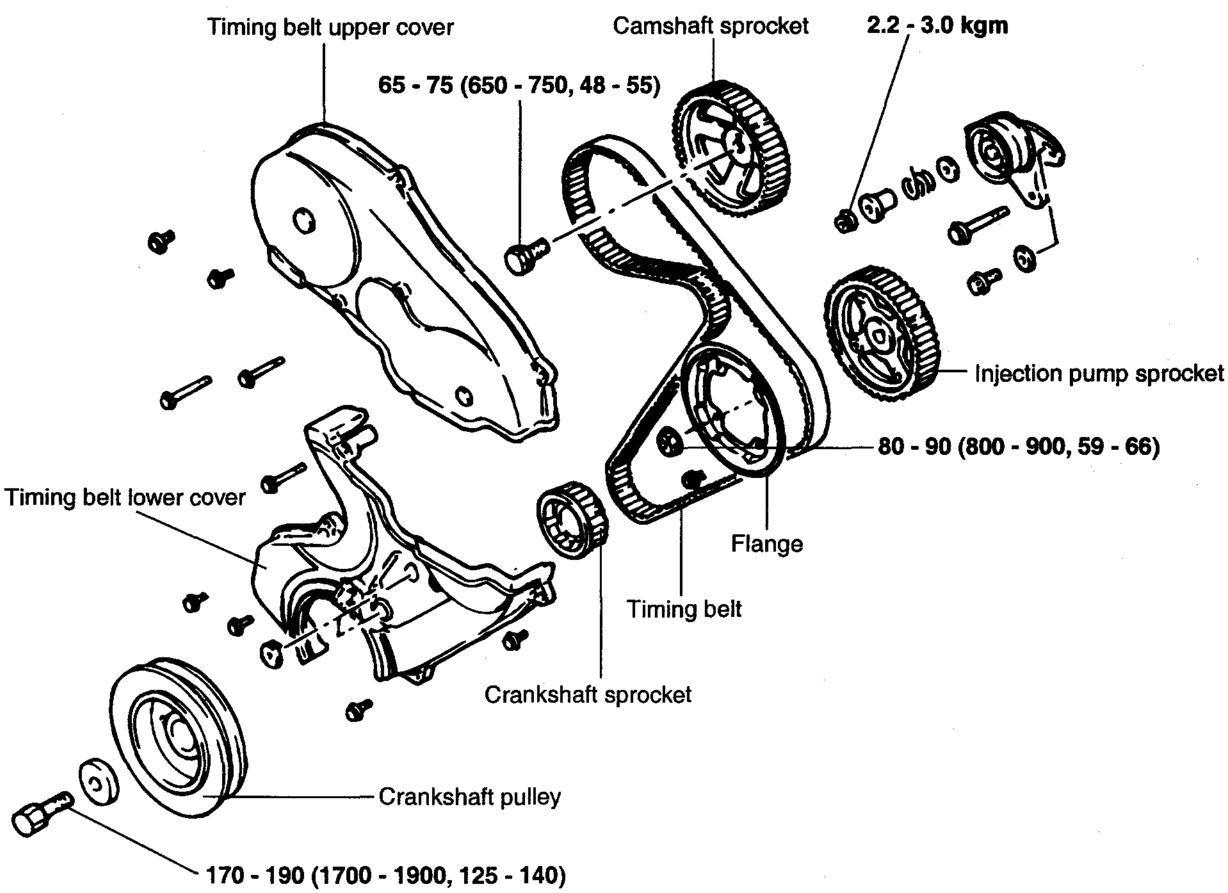
Specified sealant : 3M part No 8660 or equivalent

ECLA019G

TIMING SYSTEM

TIMING BELT

COMPONENTS ELCB0900



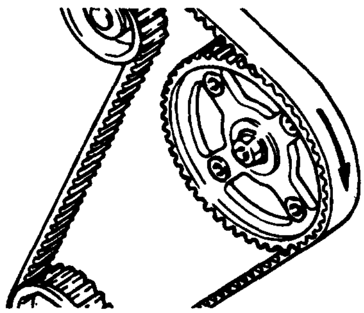
TORQUE : Nm (kg.cm, lb.ft)

ECLA020A

REMOVAL ELCB0910

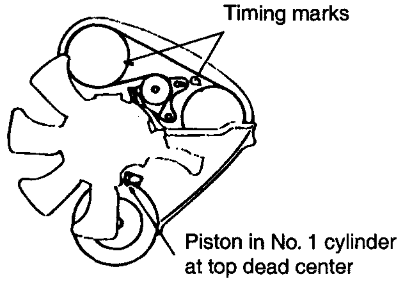
TIMING BELT

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.



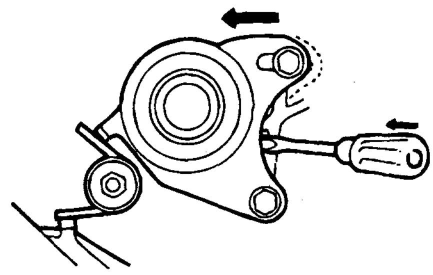
ECLA020B

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

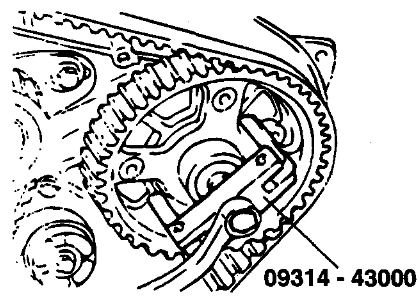
CAMSHAFT SPROCKET

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.



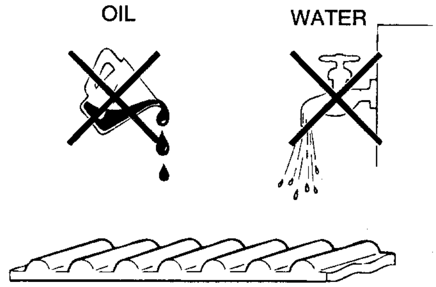
ECLA020D

INSPECTION ELCB0920

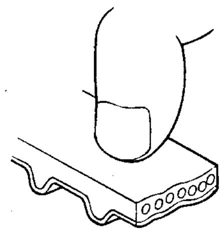
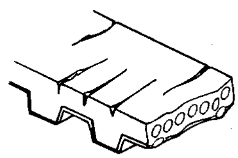
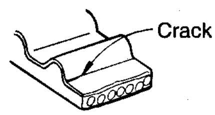
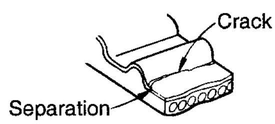
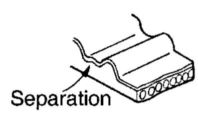
TIMING BELT

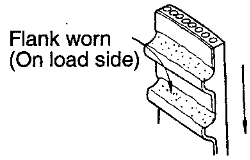
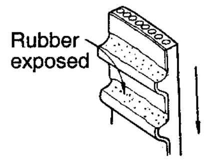
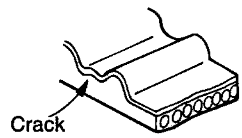
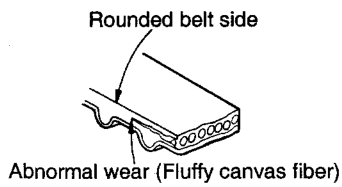
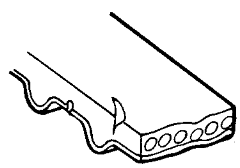
1. Check the belt for oil or dust deposits. Replace if necessary. Small deposits should be wipe away with a dry cloth or paper. Do not clean with solvent.

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

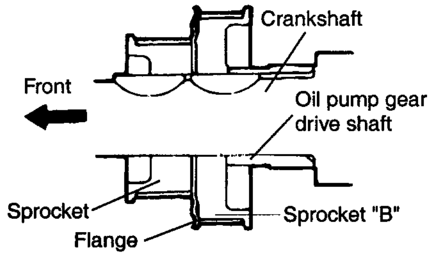
Description	Flaw conditions
1. Hardened back surface of rubber	Back surface is glossy, Non-elastic and so hard that, when your fingernail is pressed into it, no mark is produced.  ECA9200B
2. Cracked back surface of rubber	 ECA9200Y
3. Cracked or separating canvas	 ECA9200I  ECA9200J  ECA9200K
4. Badly 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 ELCB0930

CRANKSHAFT SPROCKET

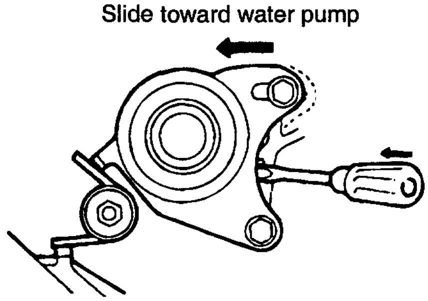
1. Mount the crankshaft sprocket to the crankshaft noting the direction of the sprocket as well as the flange.
2. Mount the camshaft sprocket and tighten the flange bolts to specified torque.



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.



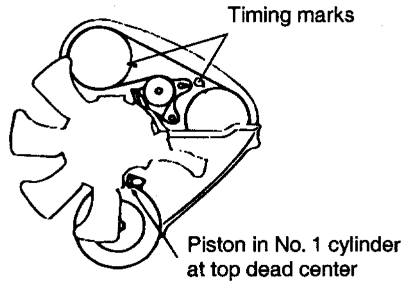
ECLA020C

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.

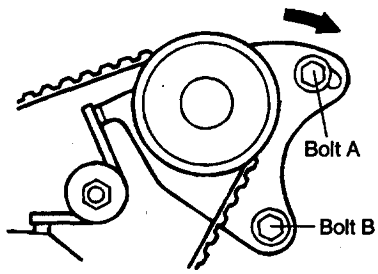
NOTE

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.

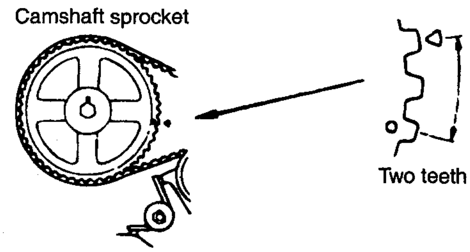


ECLA020F

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

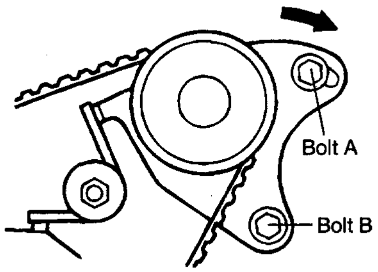
Never turn the crankshaft counterclockwise.



ECLA020G

7. Tighten the bolt A.

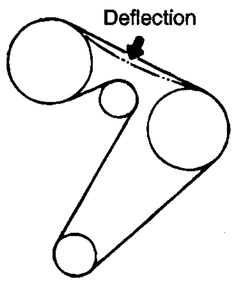
8. Tighten the bolt B.
   If the bolt B is tightened first, the tensioner should be turned together, causing an undue tension to be applied to the timing belt.



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.

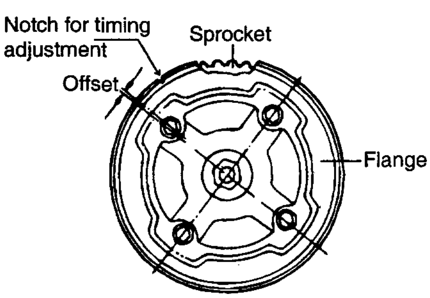
Standard : 4 - 5 mm (0.1575 - 0.1969 in.)



ECLA020H

FLANGE

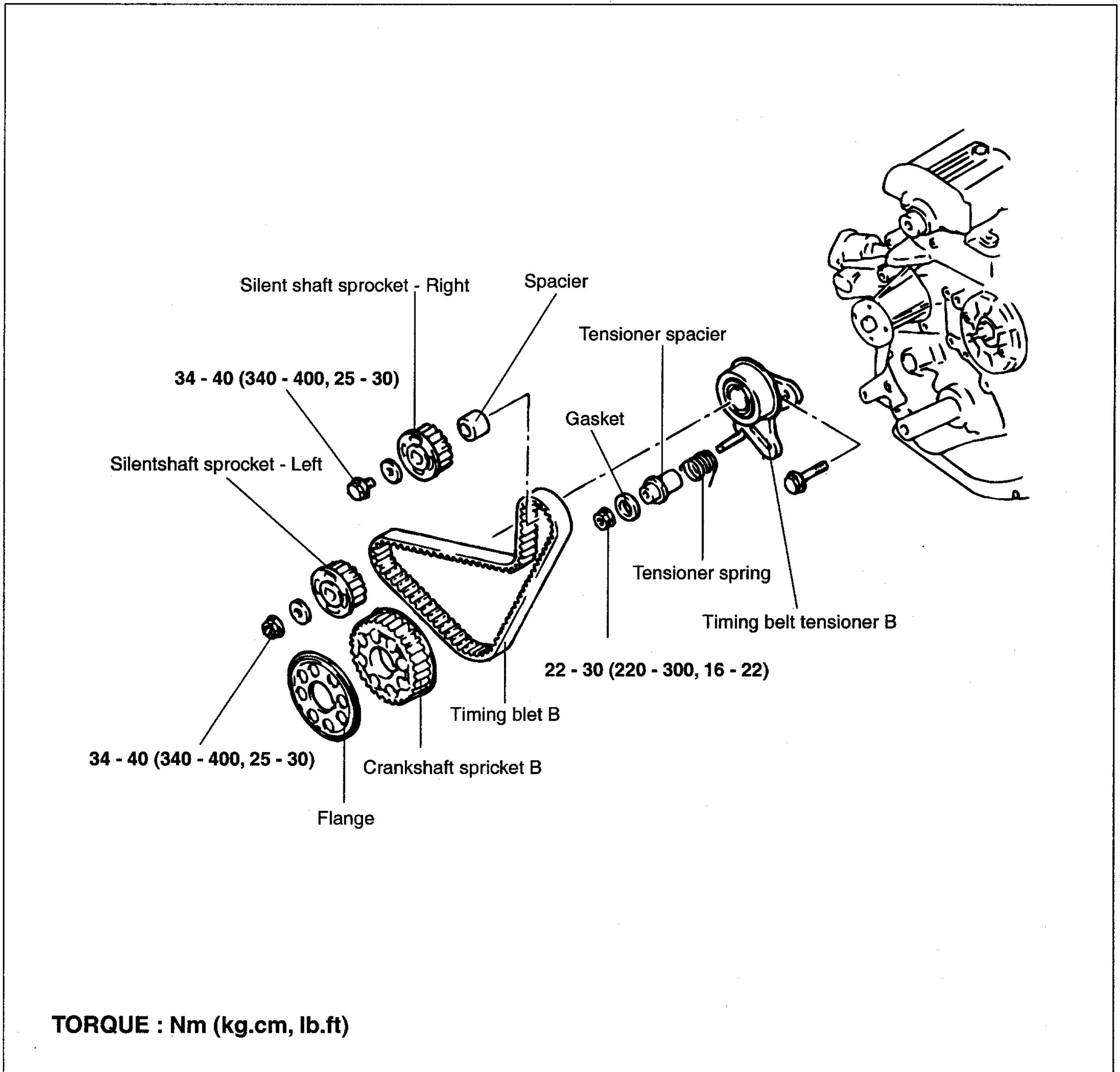
Note that bolt holes in the flange and those in the injection pump sprocket are offset positioned at one place. When assembling, position the jlange and sprocket as shown.



ECLA020I

TIMING BELT ELCB0940

COMPONENT

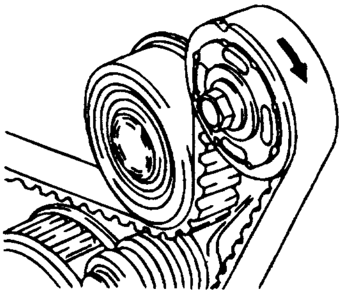


ECLA021A

REMOVAL ELCB0950

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

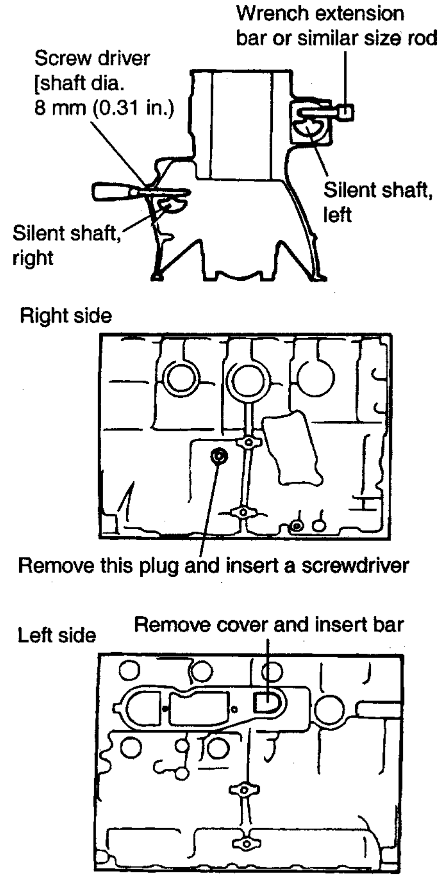
3. Slightly loosen the bolts and nuts securing the tensioner.
   Then, slide the tensioner toward the water pump and tighten the nuts to secure the tensioner in place temporarily.
4. Remove the timing belt " B"
5. Remove the crankshaft sprocket "B"
6. Remove the two silent shaft sprockets.
7. When loosening 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.

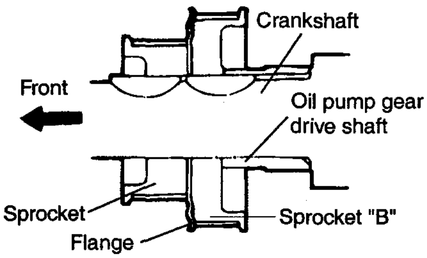


ECLA021C

INSTALLATION ELCB0960

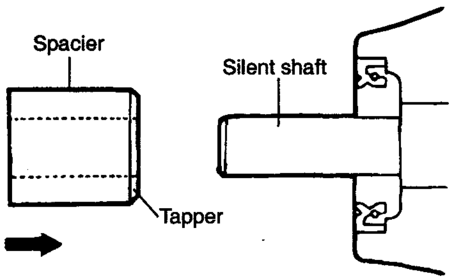
CRANKSHAFT SPROCKET "B"

1. Mount the crankshaft sprocket "B" to the crankshaft, noting the direction of the sprocket "B".



ECLA020E

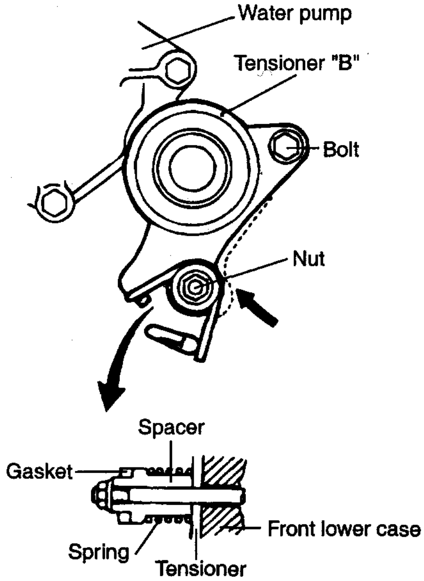
2. The spacer must be installed with its chamfered end facing toward the silent shaft. If the spacer is installed in the wrong direction, damage to oil seal will result.



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

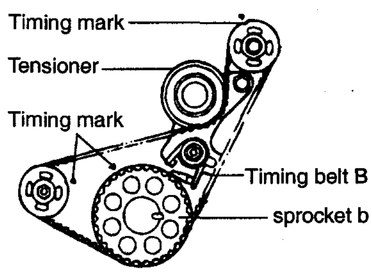
TIMING BELT "B"

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.

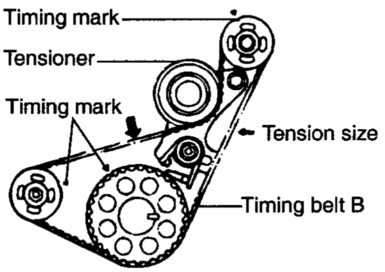
NOTE

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

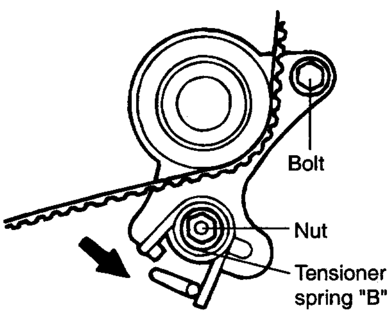
4. Back off tensioner B nut, that have previously been secured to the water pump side, one to two turns to give tension to the belt using tensioner spring tension.

5. Tighten the tensioner B attaching nut.

6. Tighten the tensioner B attaching bolt.

NOTE

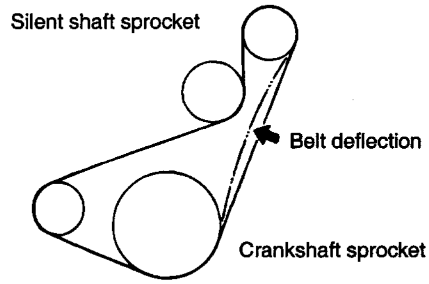
If the bolt is tightened first, the tension B should be turned together, resulting in reduced timing belt B tension.



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

Engine Electrical System

GENERAL

SPECIFICATIONS EBMB0010

IGNITION

	3.5L V6 Engine
Type Primary coil resistance Secondary coil resistance	 0.74 ± 10% (Ω) 13.3 ± 15% (KΩ)

SPARK PLUG

	3.5L V6
Type Champion NGK Plug gap	 RC10PYP4 PFR5N-11 1.0-1.1 mm (0.039-0.043 in.)

STARTER MOTOR

	3.5L V6	Diesel
Type Voltage Output	Reduction drive (with planetary gear) 12V 1.2KW	Reduction drive (with planetary gear) 12V 200KW
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	8
Pinion gap	0.5-2.0 mm (0.0197-0.079 in.)	0.5-2.0 mm (0.0197-0.079 in.)

GENERATOR

	3.5L V6	Diesel
Type Rated output Voltage regulator type Regulator setting voltage Temperature compensated	Battery voltage sensing 13.5V / 120A 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, MF 100 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).

CRUISE CONTROL SYSTEM

Speed control module Operating voltage range Operating temperature Voltage drop between unit and actuator Operating speed range	 DC 10 - 16V -30 ± 75°C (-22 ± 167°F) 0.4V Low speed limit : 40 ± 3 km/h (25 ± 2 mph) High speed limit : 145 ± 5 km/h (90 ± 3 mph)
Actuator Rated voltage Operating temperature Operating consumption Insulating resistance	 DC 12V -30 ± 90°C (-22 ± 194°F) 3A or less (at 12V 20°C) 1MΩ or less (at 500V megger)
Cruise main switch Rated voltage Operating force Voltage drop	 DC 12V 0.3 - 1.0 kg 0.15 V or less
Stop lamp switch Rated voltage Rated load Stop lamp Cruise control Insulating resistance	 DC 12V 27 x 5W (lamp load) 0.1 - 0.5A (relay load) Min 3 MΩ (by 500V megger)

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 EBMB0030

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

CRUISE CONTROL SYSTEM PRE-TROUBLESHOOTING

PRE-TROUBLESHOOTING

Before starting troubleshooting, inspect each of the following sections, and if there is an abnormality, carry out a repair.

1. Check if the installation and connection routes of the cables and vacuum hoses of the cruise vacuum pump assembly, actuator and pulley assembly are all normal.
2. Check if the pulley assembly and the movement of cables are working smoothly.
3. Check if there is no excessive play or tension in each cable.

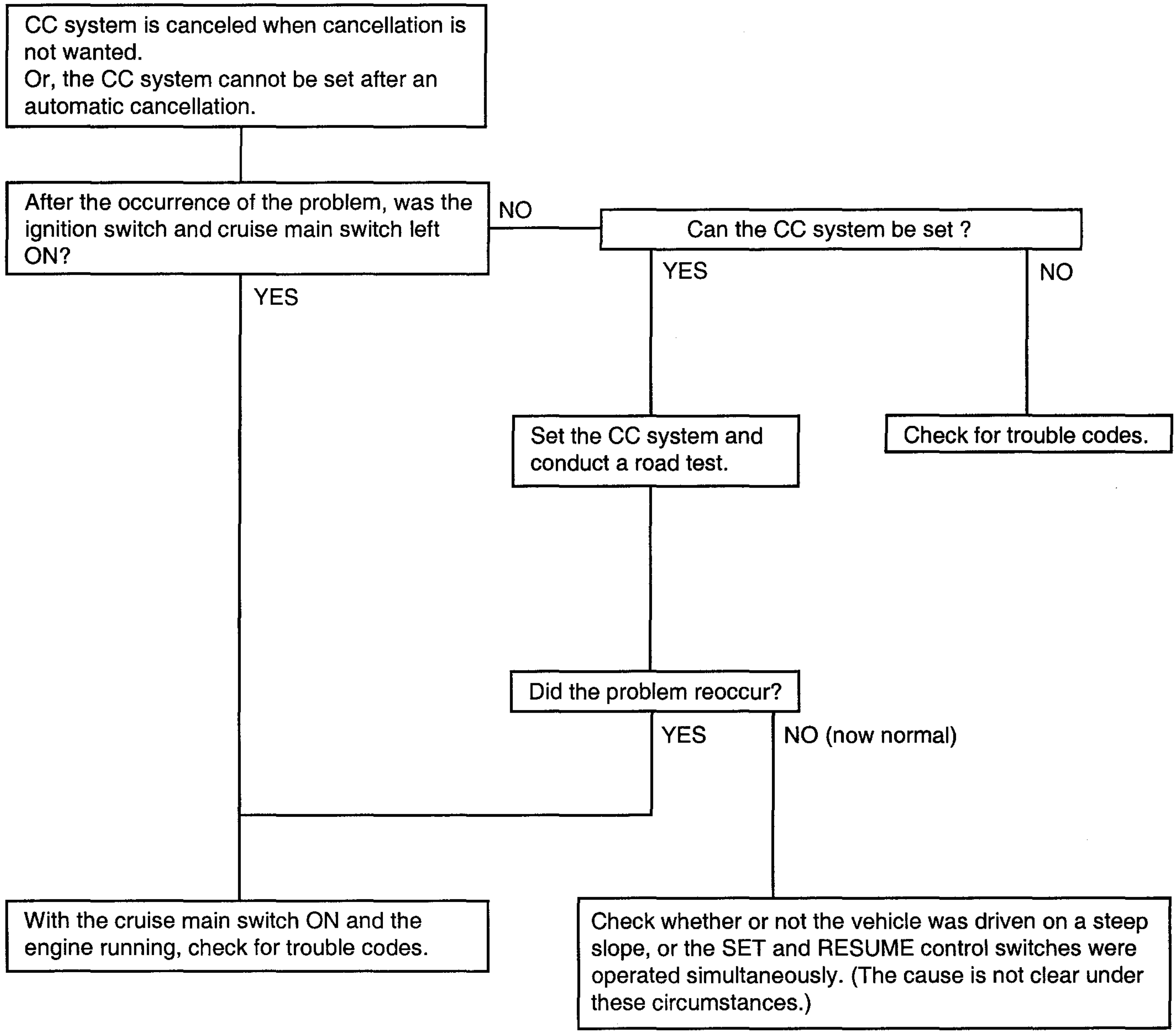
TROUBLESHOOTING PROCEDURES

First, select the applicable malfunction symptom from the "TROUBLE SYMPTOM CHARTS" shown on next pages. Determine the condition of all function circuits.

1. Make the following preliminary inspections.
   - Check that the installation of the actuator, accelerator cable are correct, and that the cables and links are securely connected.
   - Check that the accelerator pedal moves smoothly.
   - Adjust the cable so there is not excessive tension or excessive play on the accelerator cable.
   - Check that the actuator and unit assembly, cruise main, control switch and the connector of each cancel switch are connected securely.
2. Check in the sequence indicated in the "TROUBLE SYMPTOM CHARTS".
3. If a normal condition is indicated, replace the cruise control module.

TROUBLE SYMPTOM CHARTS

TROUBLE SYMPTOM 1



CC : Cruise Control

EBA9003A

TROUBLE SYMPTOM 2

Trouble symptom	Probable cause	Remedy
The set vehicle speed varies greatly upward or downward "Surging" (repeated alternating acceleration and deceleration) occurs after setting	Malfunction of the vehicle speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the speedometer cable or speedometer drive gear	
	Cruise vacuum pump circuit poor contact	Repair the actuator system, or replace the part
	Malfunction of the acutator and unit	Replace the actuator and unit

TROUBLE SYMPTOM 3

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the brake pedal is depressed	Damaged or disconnected wiring of the stop lamp switch	Repair the harness or replace the stop lamp switch
	Cruise vacuum pump drive circuit short-circuit	Repair the harness or replace the vacuum pump
	Malfunction of the actuator and unit	Replace the actuator and unit

TROUBLE SYMPTOM 4

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the shift lever is moved to the "N" position (It is canceled, however, when the brake pedal is depressed	Damaged or disconnected wiring of inhibitor switch input circuit	Repair the harness or repair or replace the inhibitor switch
	Improper adjustment of inhibitor switch	
	Malfunction of the actuator and unit	Replace the actuator and unit

TROUBLE SYMPTOM 5

Trouble symptom	Probable cause	Remedy
Cannot decelerate (coast) by using the SET switch	Temporary damaged or disconnected wiring of SET switch input circuit	Repair the harness or replace the SET switch
	Actuator circuit poor contact	Repair the harness or replace the actuator
	Malfunction of the actuator	
	Malfunction of the actuator and unit	Replace the actuator and unit

TROUBLE SYMPTOM 6

Trouble symptom	Probable cause	Remedy
Cannot accelerate or resume speed by using the RESUME switch	Damaged or disconnected wiring, or short circuit, or RESUME switch input circuit	Repair the harness or replace the RESUME switch
	Actuator circuit poor contact	Repair the harness or replace the actuator
	Malfunction of the actuator	
	Malfunction of the actuator and unit	Replace the actuator and unit

TROUBLE SYMPTOM 7

Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the speedometer cable or the speedometer drive gear	
	Malfunction of the actuator and unit	Replace the actuator and unit

TROUBLE SYMPTOM 8

Trouble symptom	Probable cause	Remedy
The cruise main switch indicator lamp does not illuminate (But CC system is normal)	Damaged or disconnected bulb of cruise main switch indicator lamp	Repair the harness or replace the part.
	Harness damaged or disconnected	

TROUBLE SYMPTOM 9

Trouble symptom	Probable cause	Remedy
Malfunction of control function by ON/OFF switching of idle switch	Malfunction of circuit related to idle switch function	Repair the harness or replace the part
	Malfunction of the actuator and unit	

TROUBLE SYMPTOM 10

Trouble symptom	Probable cause	Remedy
Overdrive is not canceled during fixed speed driving	Malfunction of circuit related to overdrive cancelation, or malfunction of actuator and unit	Repair the harness or replace the part
No shift to overdrive during manual driving		

IGNITION SYSTEM

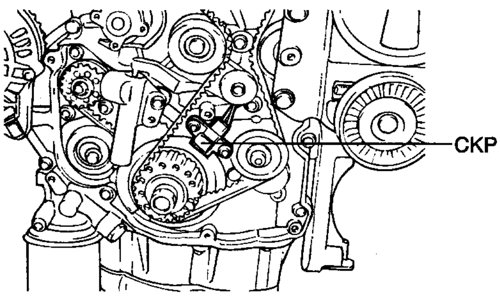
GENERAL INFORMATION EBBB0040

Ignition timing is controlled by the electric control ignition timing system. The ignition timing data for the engine operating conditions are programmed in the memory of the power train control module (PCM).

The engine conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based upon these sensor signals and the ignition timing data, 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 Sensor

*CMP : Camshaft Position Sensor



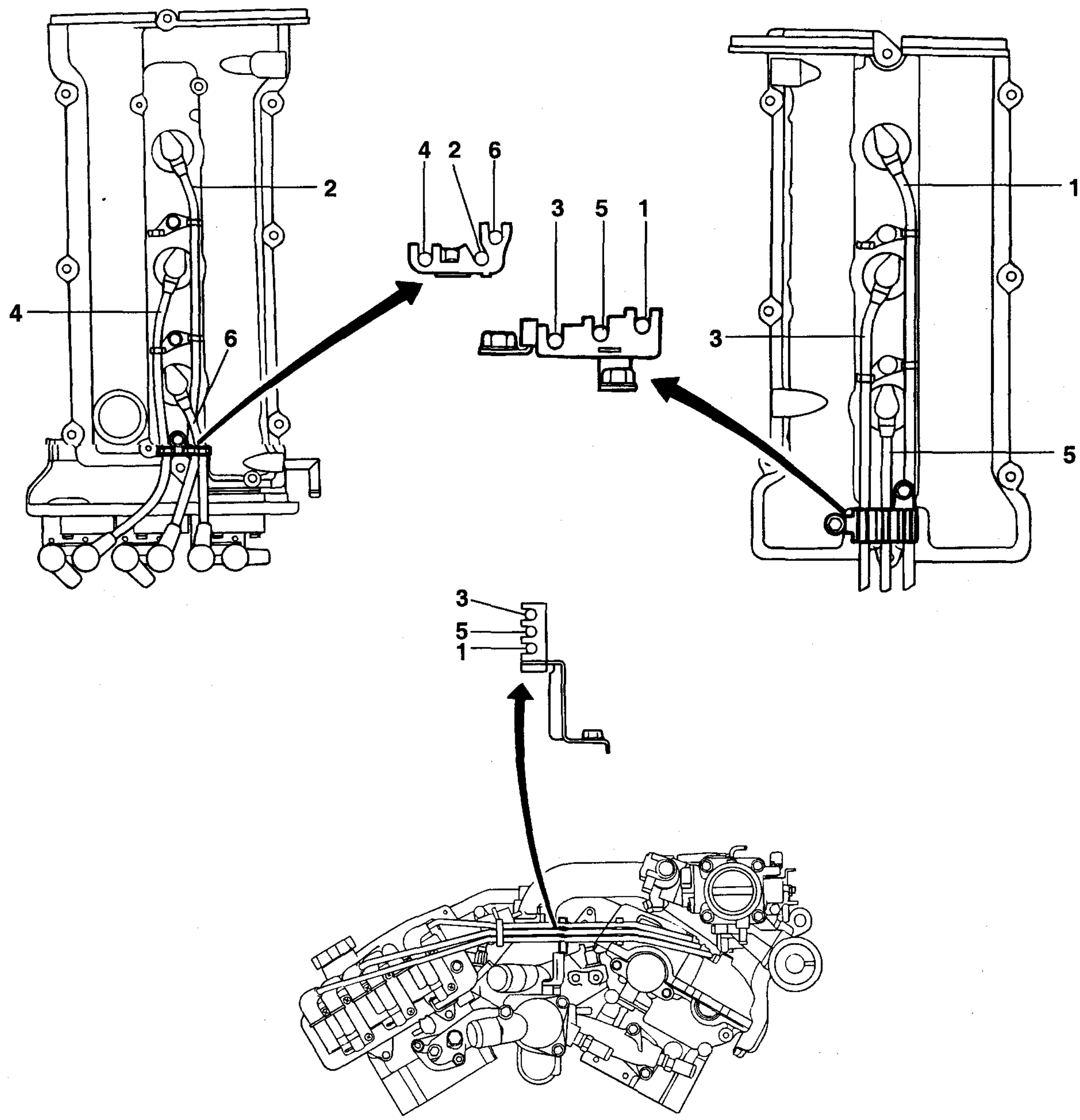
EFA9401D

IGNITION SYSTEM (V6)

INSTALLATION OF SPARK PLUG CABLE

EBBB0100

Improper arrangement of spark plug cables will induce flashover between the cables, causing misfiring and surging at acceleration in high-speed operations. Therefore, be careful to arrange the spark plug cables properly as shown in the illustration.

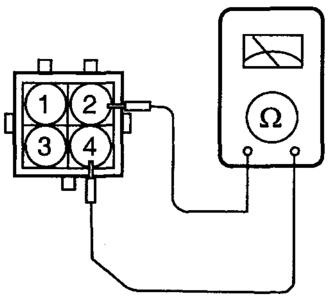


EBA9010E

IGNITION COIL EBBB0060

1. **Measurement of the primary coil resistance**
   Measure the resistance between connector terminals 1 and 2 (the coils at the No. 3 and No. 6 cylinder sides) of the ignition coil, and between terminals 2 and 4 (the coils at the No. 1 and No. 4 cylinder sides), and between terminals 2 and 3 (the coils at the No.2 and No.5 cylinder sides).

   Standard value : 0.74 ± 10% (Ω)



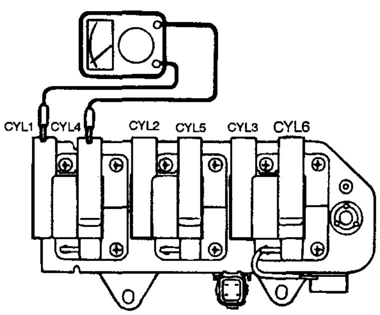
EBHA006A

2. **Measurement of the secondary coil resistance**
   Measure the resistance between the high-voltage terminal for the No. 3 and No. 6 cylinders, between the high-voltage terminals for the No. 1 and No. 4 cylinders and between the high-voltage terminals for the No.2 and No.5 cylinders.

   Standard value : 13.3 ± 15% (KΩ)

   CAUTION

   When measuring the resistance of the secondary coil, be sure to disconnect the connector of the ignition coil.



EBA9009B

INSPECTION AND CLEANING EBHA0110

1. Disconnect the spark plug cable from the spark plug.

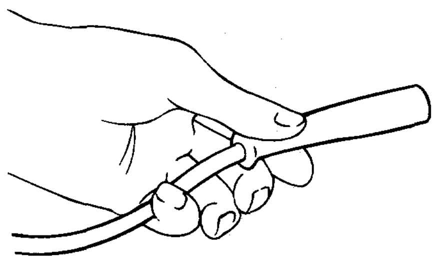
NOTE

Pull on the spark plug cable boot when removing the spark plug cable, not the cable, as it may be damaged.

2. Using the spark plug wrench, remove all of the spark plugs from the cylinder head.

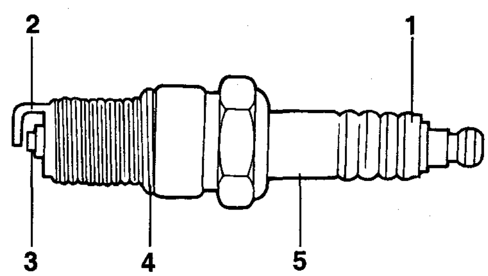
NOTE

Take care not to allow contaminants to enter through the spark plug holes.



EBA9015A

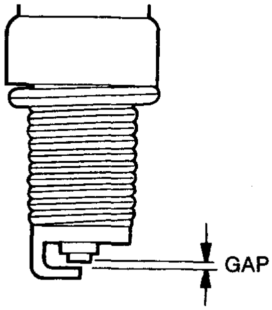
3. Check the spark plugs for the following:
   1) Broken insulator
   2) Worn electrode
   3) Carbon deposits
   4) Damaged or broken gasket
   5) Condition of the porcelain insulator at the tip of the spark plug (carbon tracking)



EBA9015B

4. Check the spark plug gap using a wire gap gauge, and adjust if necessary.

Standard value
Spark plug gap : 1.0-1.1 mm (0.039-0.043 in.)



EBA9015C

5. Re-insert the spark plug and tighten to the specified torque. If it is overtorqued, damage to the threaded portion of cylinder head may result.

Tightening torque
Spark plug : 20-30Nm (200-300kg·cm, 15-22 lb·ft)

NOTE

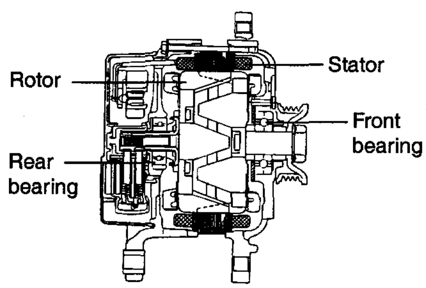
When replacing the spark plug, use resistance plugs.

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

INSPECTIONA 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.

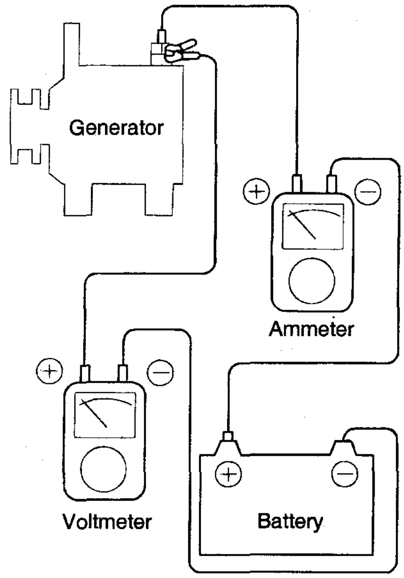
PREPARATION

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 voltmeter between the generator "B" terminal and battery (+) lead wire to the battery (+) terminal. 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 de scribed 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.

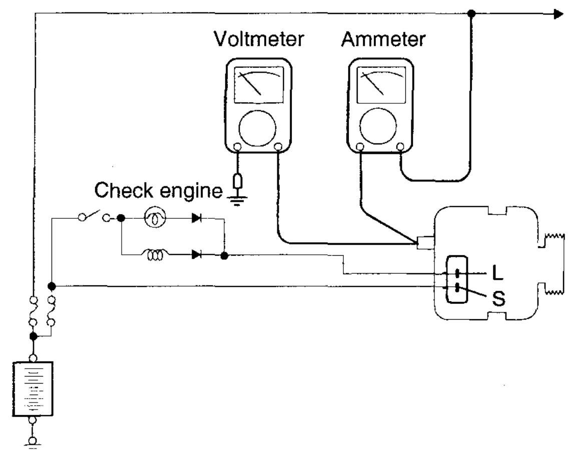
2) Check the tension of the generator drive belt. The belt tension check method is described in the section "COOLING".

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.

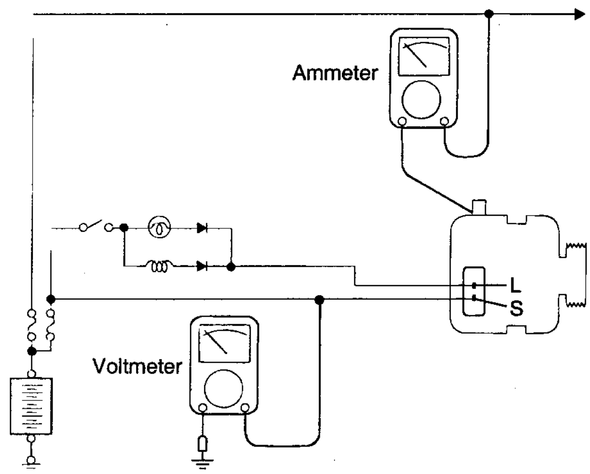
2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the generator output wire to the generator "B" terminal.
6. Connect the battery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

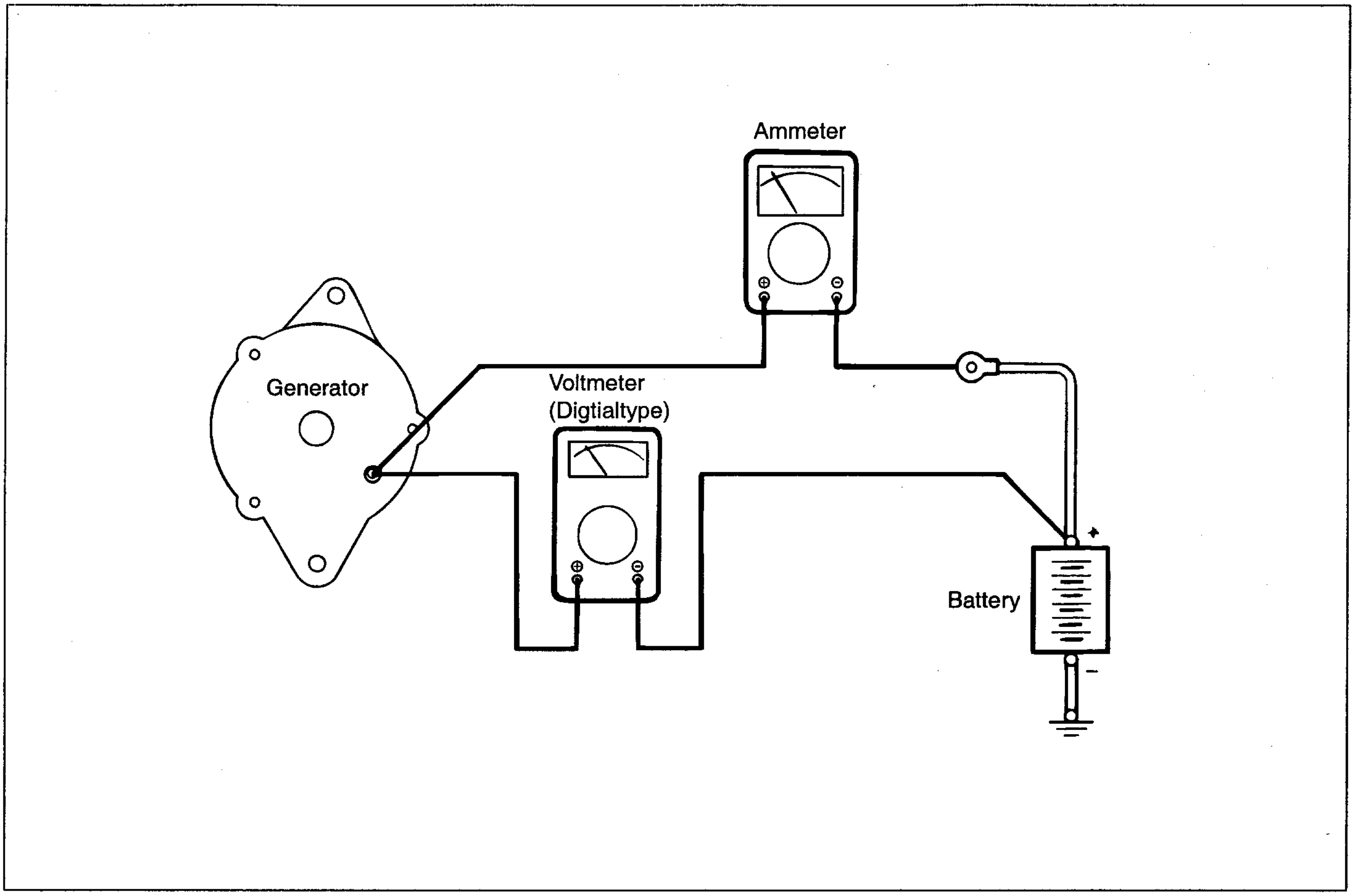
   NOTE

   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

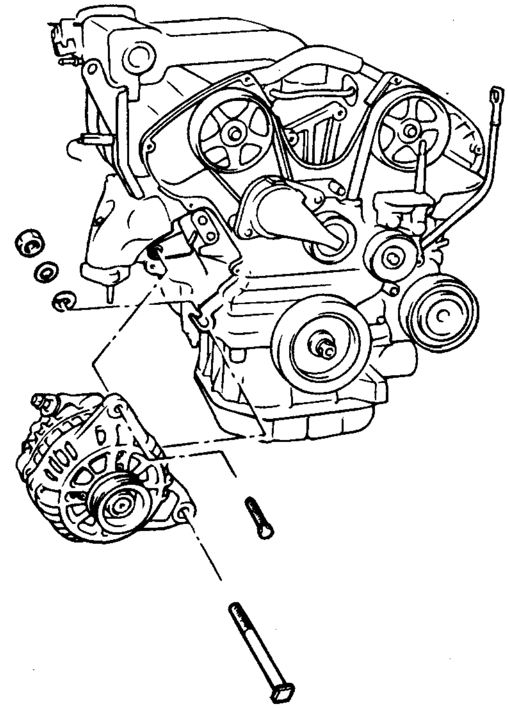
   NOTE

   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 EBBB0150



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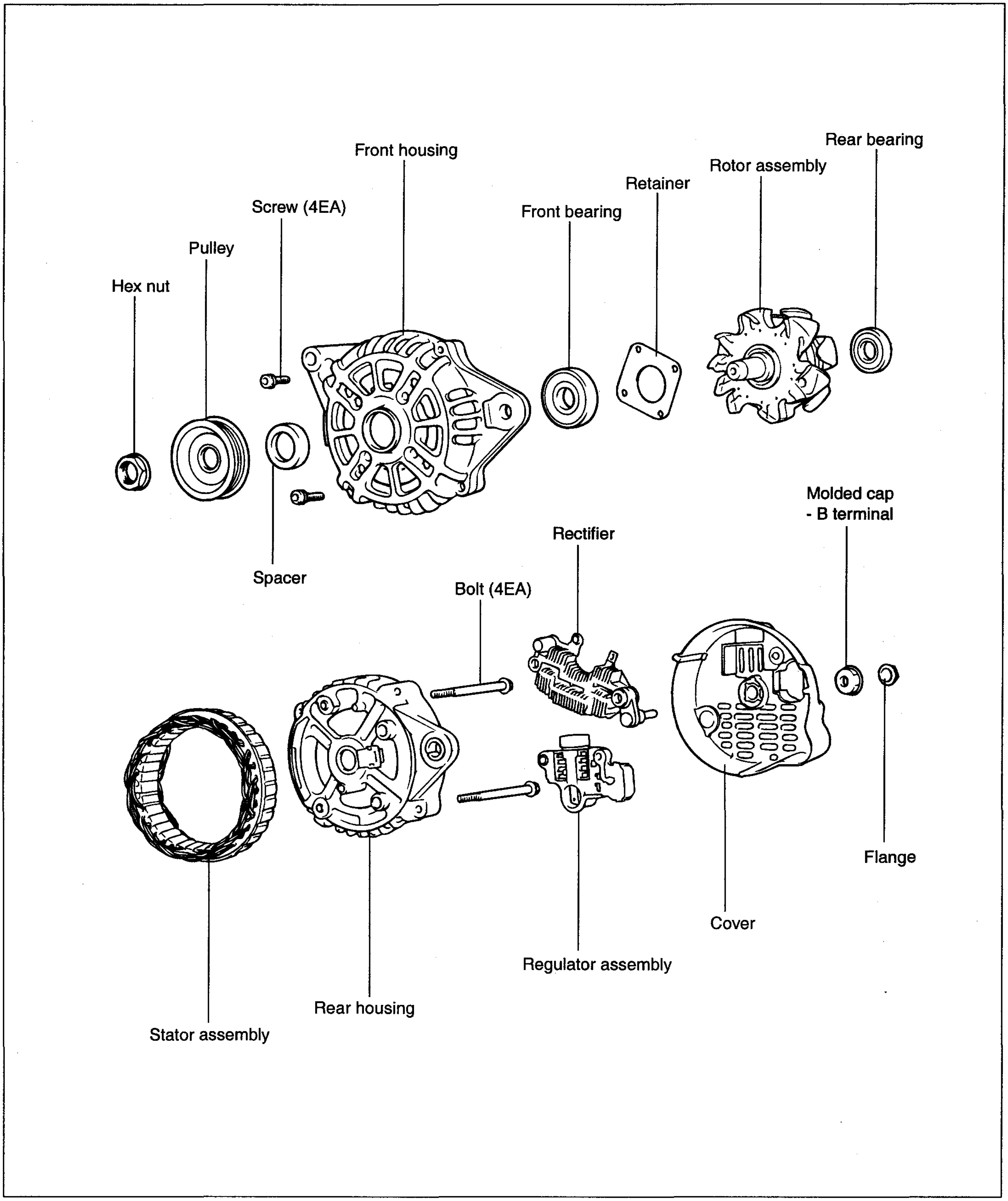
DISASSEMBLY AND REASSEMBLY EBBB0160



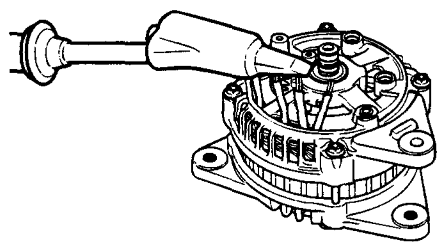
EBA9030A

DISASSEMBLY EBBB0180

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.



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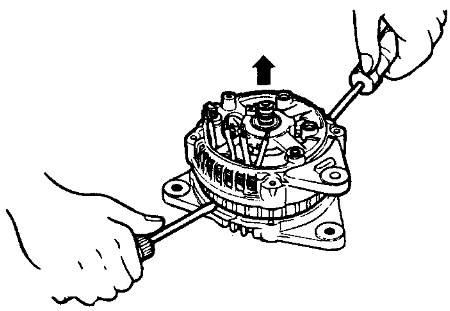

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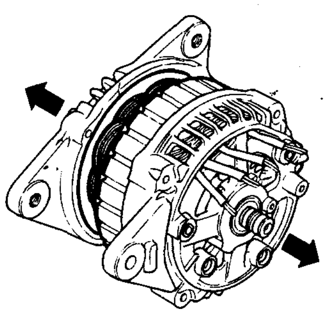

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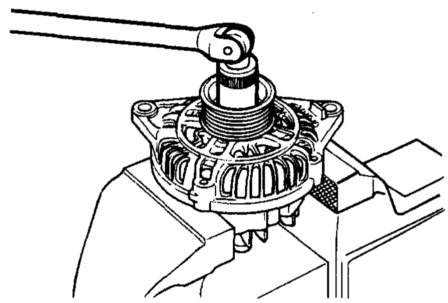
3. Secure the rotor in a soft-jaw vise with the pulley side up.

⚠ CAUTION

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



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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.

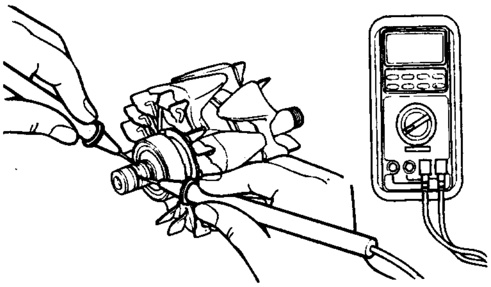
INSPECTION

ROTOR

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

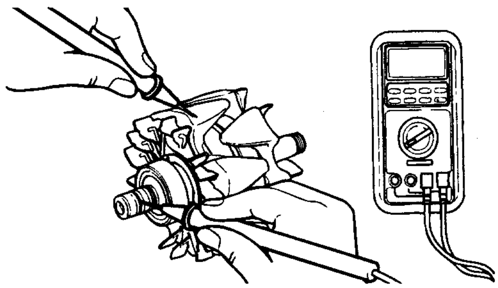
   If resistance is extremely low, there is a short. If there is no continuity or if there is a short circuit, replace the rotor assembly.

   Resistance value : Approx. 3.1Ω



KFW2021A

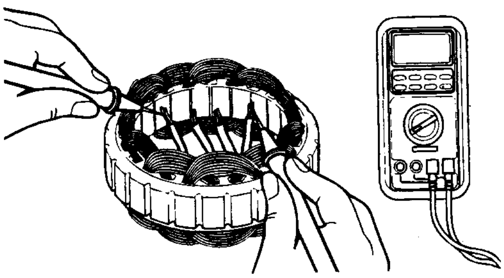
2. Check the rotor coil for a ground. Check that there is no continuity between the slip ring and the core. If there is continuity, replace the rotor assembly.



KFW2022A

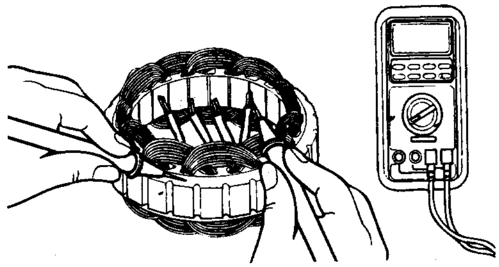
STATOR

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.

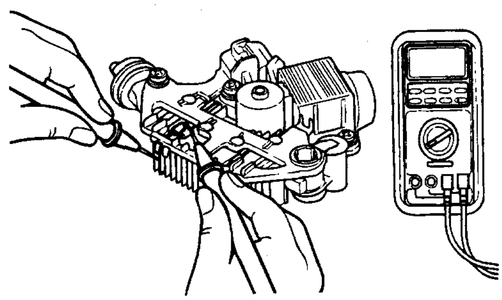


KFW2024A

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.

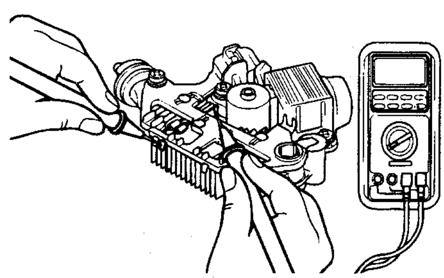


KFW2025A

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.

[V6]



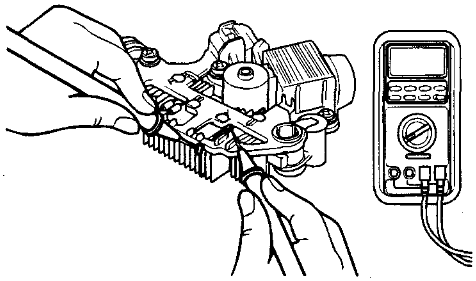
KFW2026A

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.

[V6]



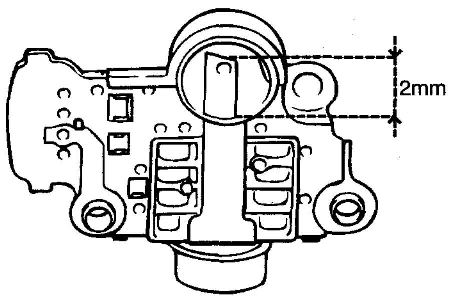
KFW2027A

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.

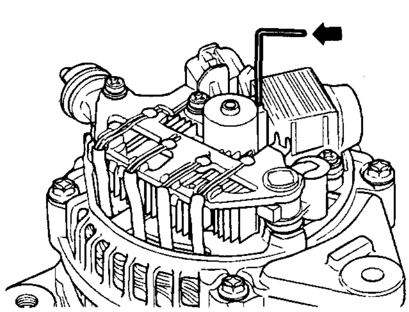
Limit : 2mm (0.8 in.) or less

[V6]



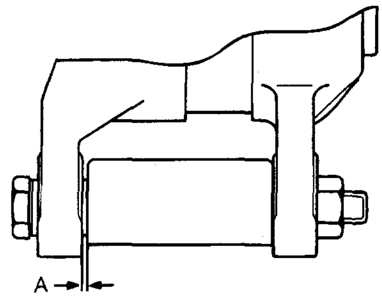
EBA9030E

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.



KFW2009A

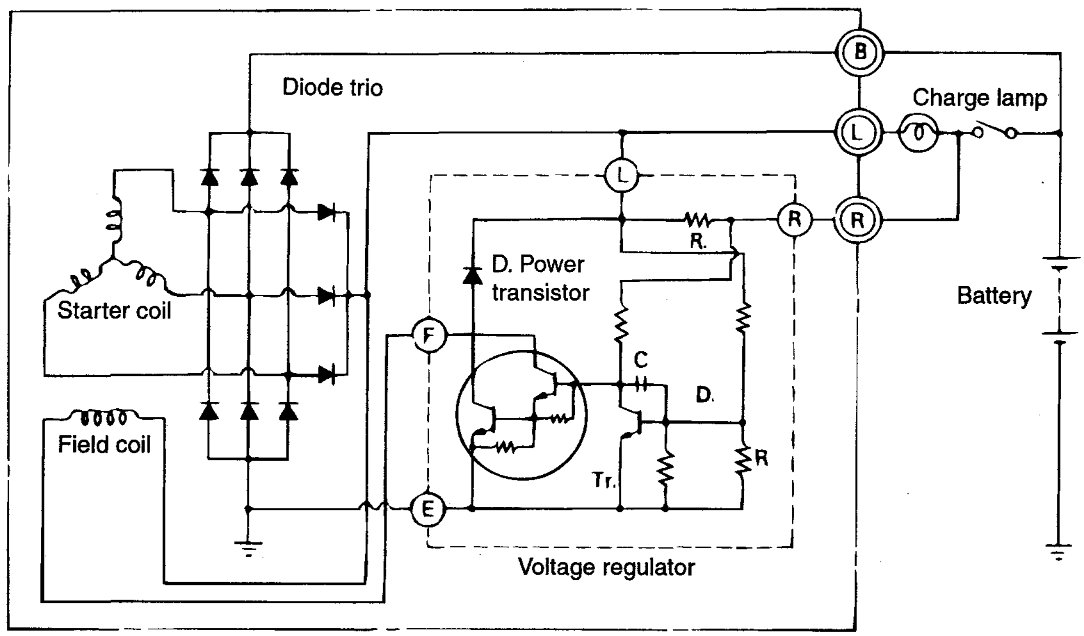
REASSEMBLY EBBB0190

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

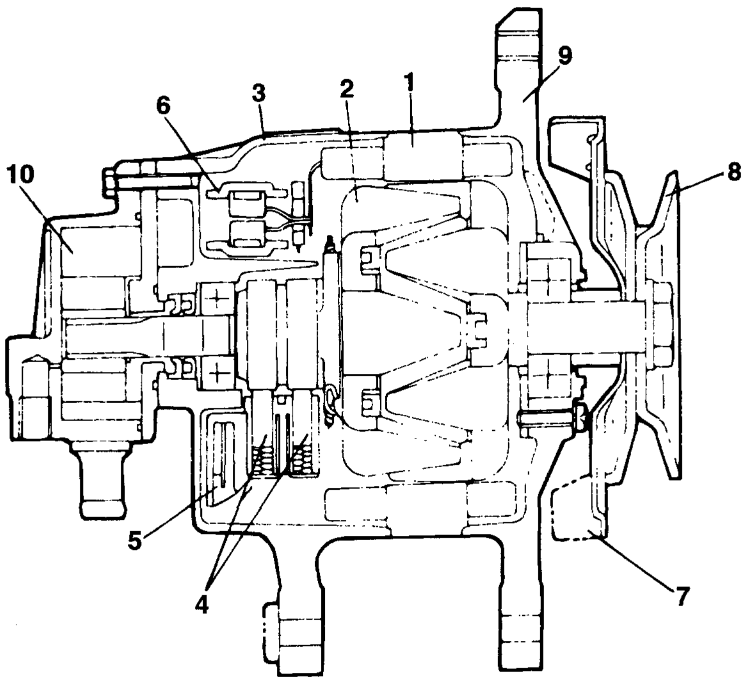
Before the rotor is attached to the rear bracket, insert a wire through the small hole in the rear bracket to hold the brush. After the rotor has been installed, the wire can be removed.

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.



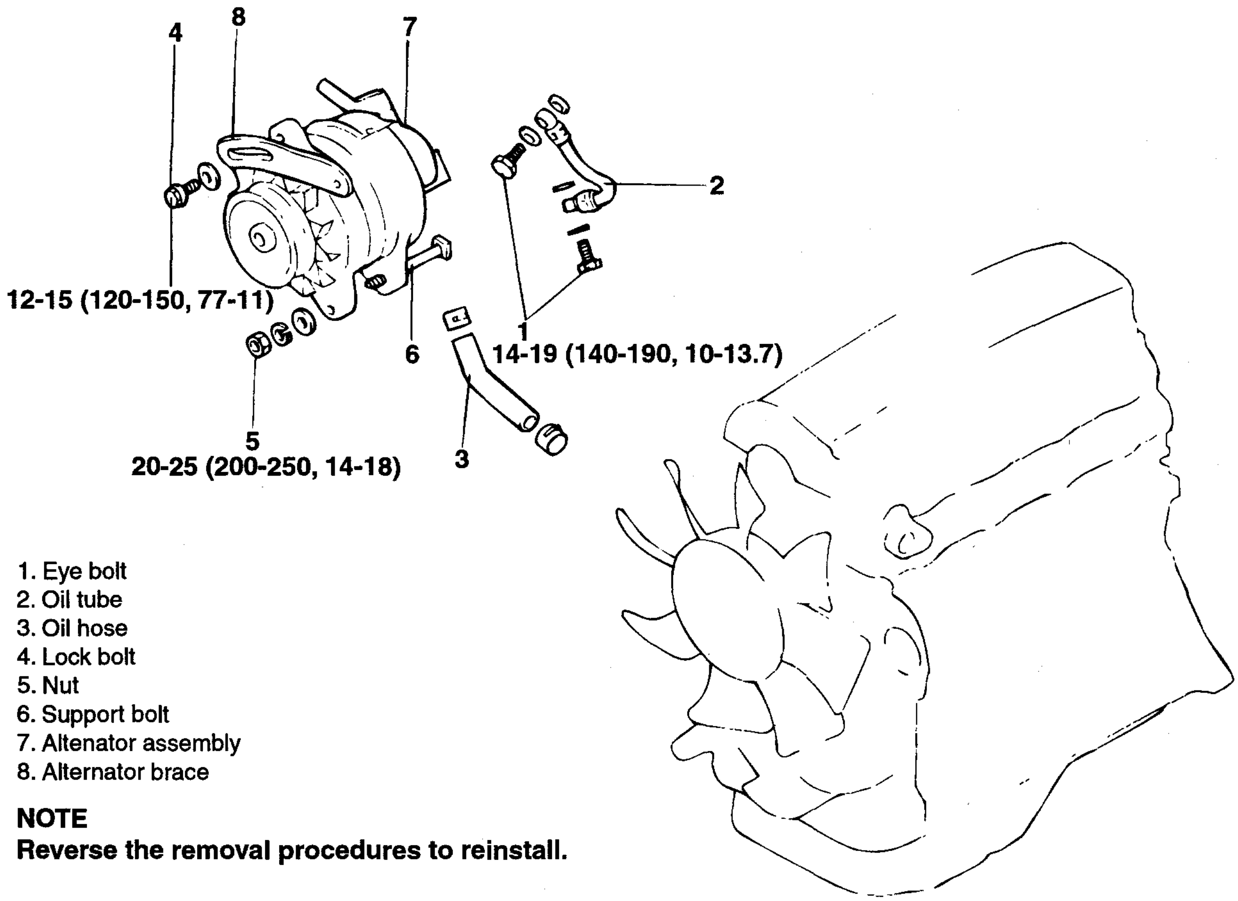
B7AD7415



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. Altenator assembly
8. Alternator brace

NOTE
Reverse the removal procedures to reinstall.

TORQUE : Nm (Kg·cm, lb·ft)

B7AD7395

INSTALLATION EBMB0220

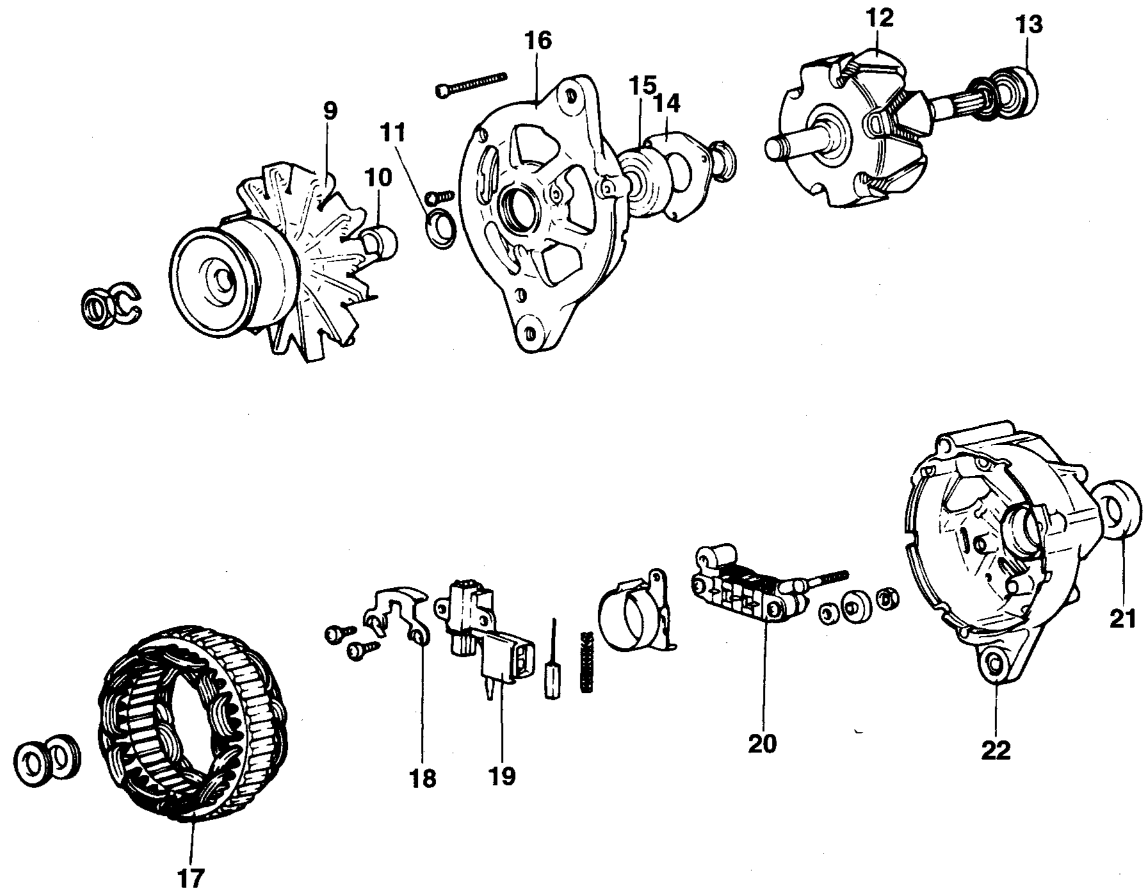
ALTERNATIOR ASSEMBLY

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

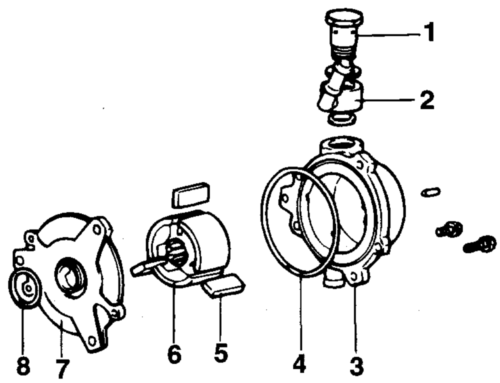
CAUTION

- ***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

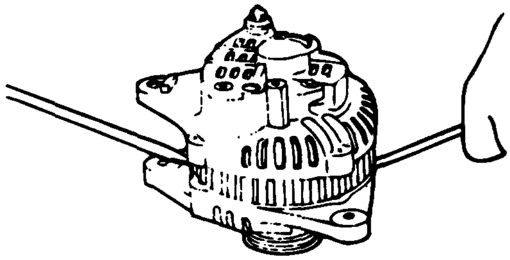
DISASSEMBLY EBMB0240

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.



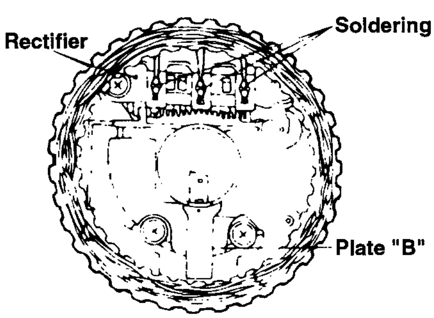
EBMB024A

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.***

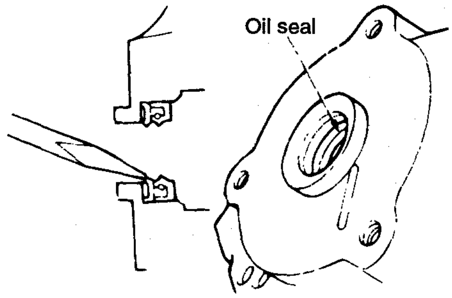
1. When removing the stator, unsolder the three stator leads from the main diodes.
2. When removing the rectifier from the brush holder, unsolder two soldered points.



B7AD7430

OIL SEAL

Push out and remove the oil seal using a screwdriver.



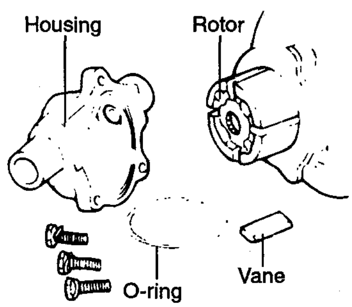
B7AD7435

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.

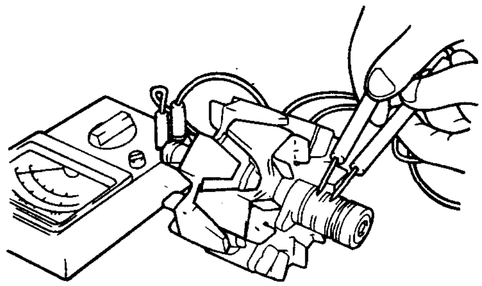


B7AD7440

ROTOR

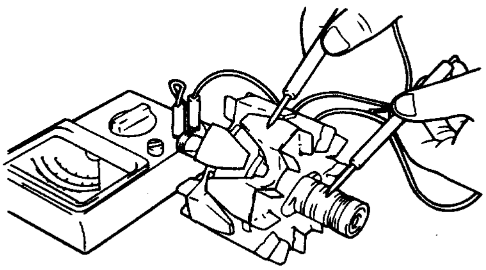
1. Check the rotor coil continuity. Make sure that there is continuity between slip rings.
   Measure the rotor resistance. If it is excessively small, it indicates a shorted rotor, If without continuity or shorted, replace the rotor assembly.

   Standard value : 3 - 5 ohms



B7ZN0440

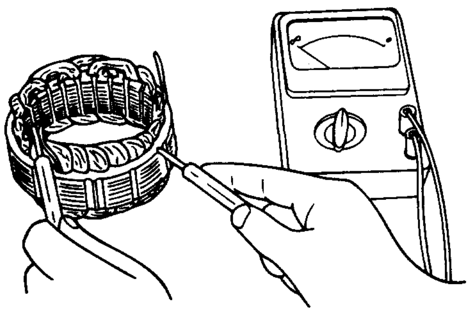
2. Check the rotor coil grounding. Make sure that there is no continuity between the slip ring and core. Replace the rotor assembly if there is continuity.



B7ZN0450

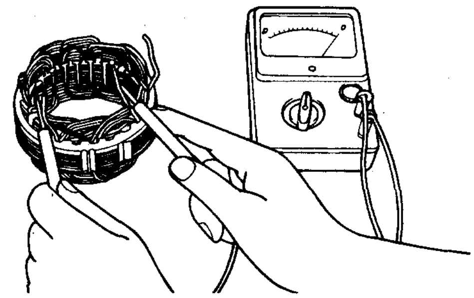
STATOR

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



B7ZN0470

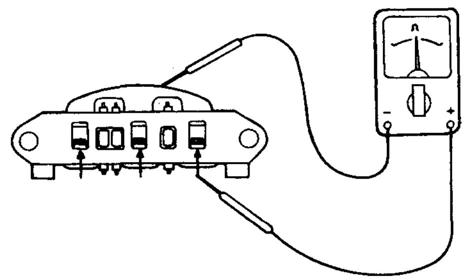
2. Check the coil grounding. Make sure that there is no continuity between the coil and core. Replace the stator assembly if there is continuity.



B7ZN0460

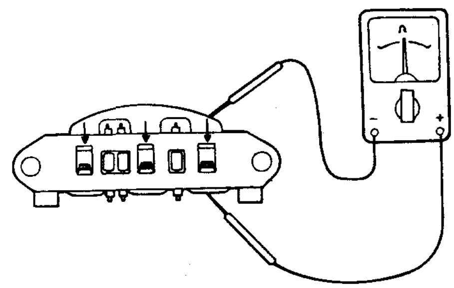
RECTIFIER

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.



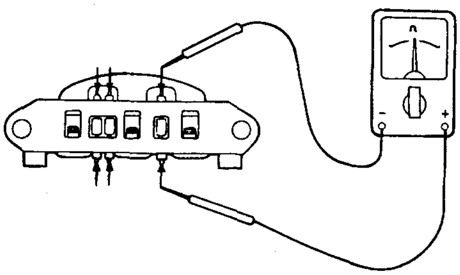
B7ZN0480

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

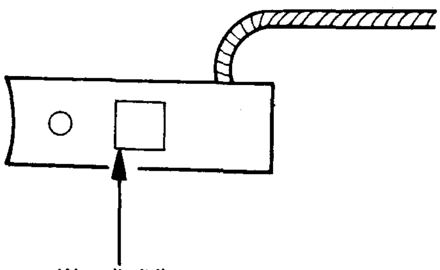
3. Inspection of Diode Trio
   With a circuit tester connected to both ends of each diode, check continuity of the three diodes. If there is continuity or no continuity in both directions, the diode is damaged. Then, replace the rectifier assembly.



B7ZN0500

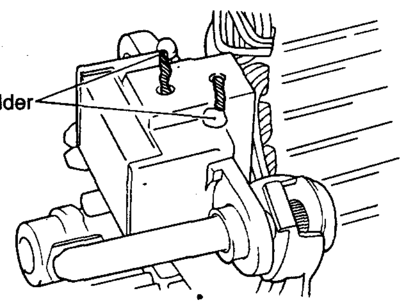
BRUSH

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



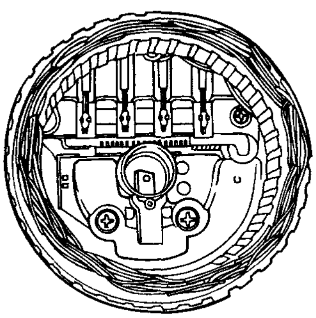
B7ZN0510

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.

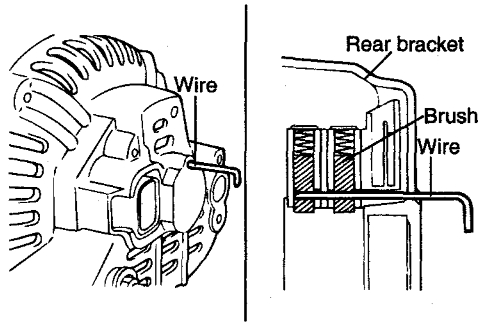


EBMB025A

REASSEMBLY EBMB0260

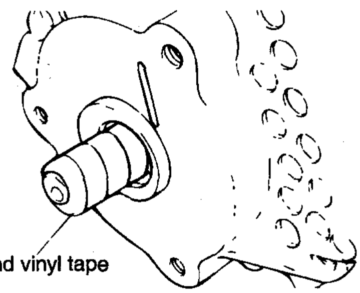
ROTOR ASSEMBLY

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

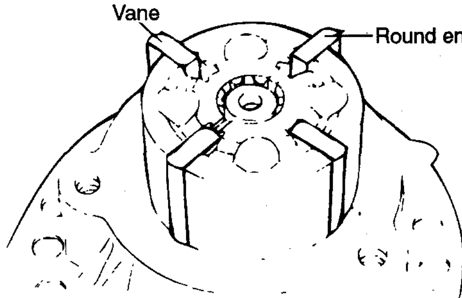
2. When installing the rotor on the alternator rear bracket, wind vinyl tape round the splined shaft to prevent damage to the oil seal



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.



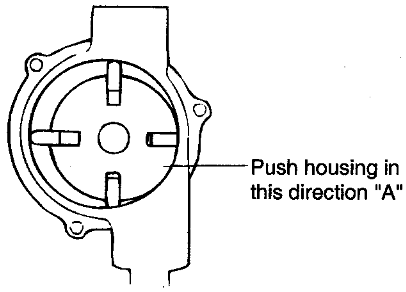
B7AD7505

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.

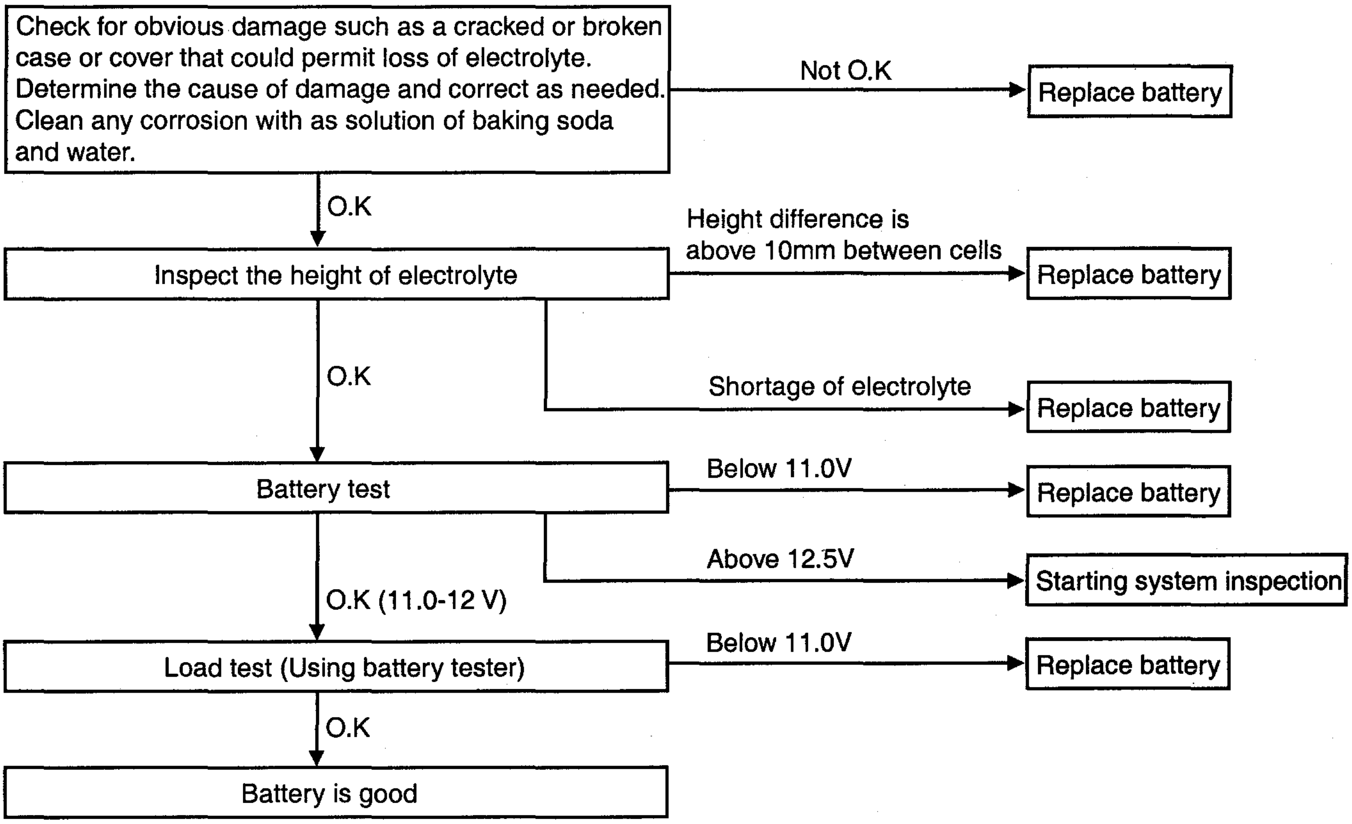
Standard value of ultimate vacuum :
600 mmHg or better at 3,000 rpm



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 - Cover leakage	 * Carelessness * Bad cover seal	 Replace Replace	 O 	 O
2. Electrolyte height inspection	* Electrolyte height between cells is over 10mm	* Cell shorted electrically * Vaporization caused by excessive temperature	Replace Replace	 O	O
	* Shortage of electrolyte	* Electrolyte loss caused by over-charge	Replace	O	

Item	Trouble	Cause	Remedy	Responsibility	
				User	Manufacturer
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.

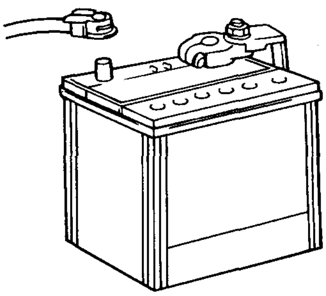
3. If the battery is left alone for 2 hours after re-charging and its output is over 12.5V, and the voltage after a load test is over the standard value, the battery can be used.

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.

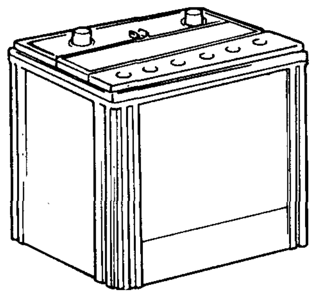


EBA9018C

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

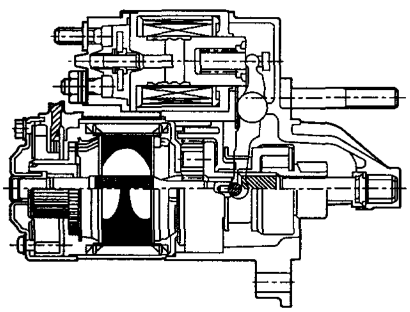
STARTING SYSTEM

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.

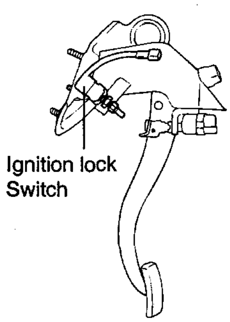


EBBB029A

EBHA0200

CHECK CLUTCH PEDAL (M/T)

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



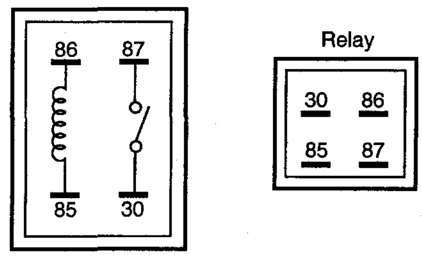
EBA9020D

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	O—	—O		
When energized	O—	—O	O—	—O

EBA9020E



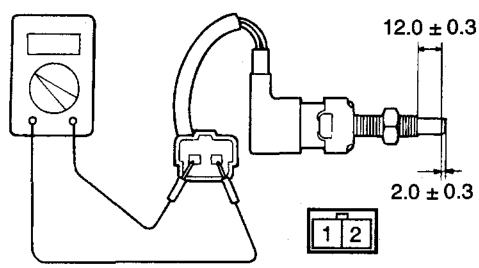
EBA9020F

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.

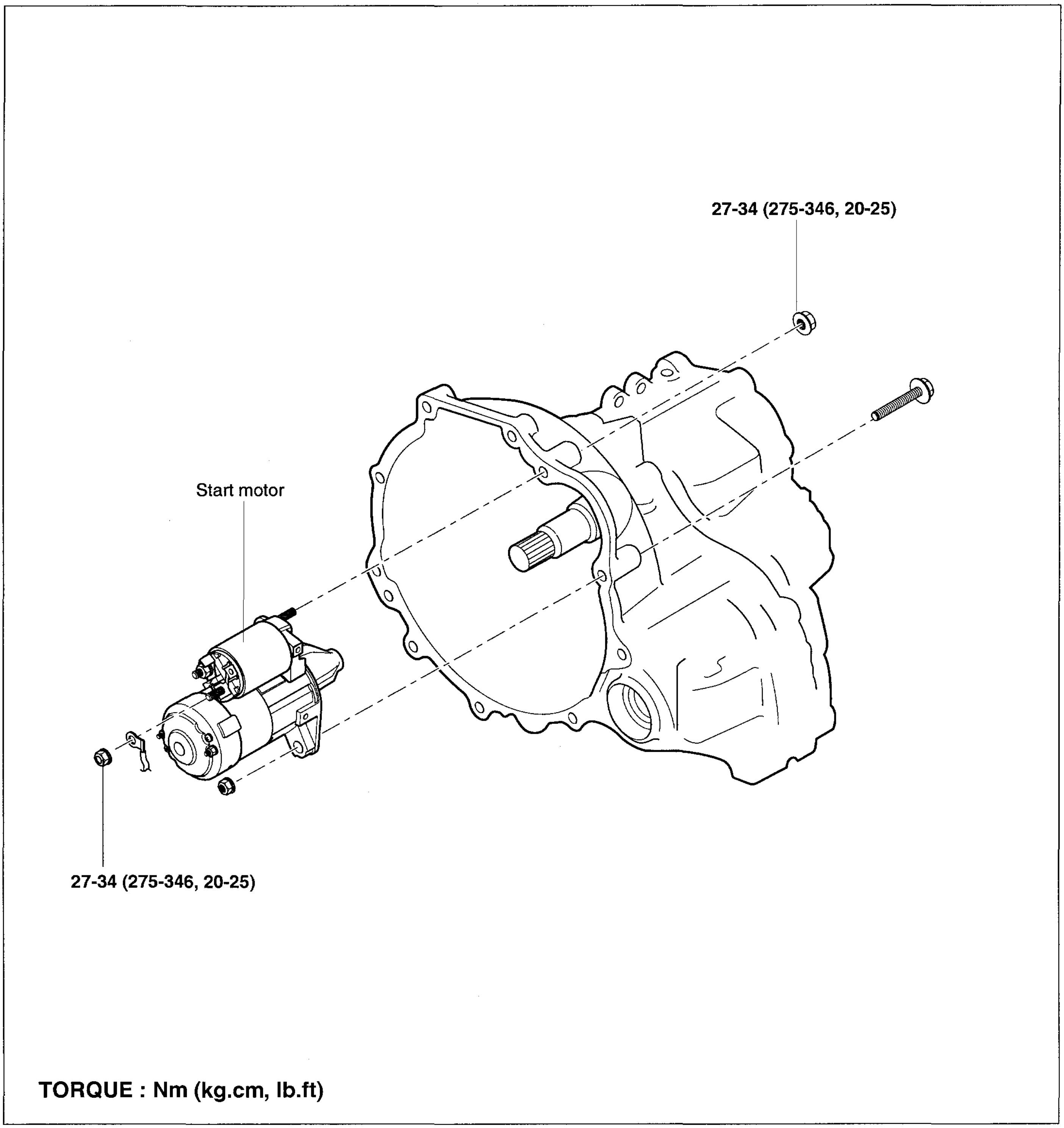
Condition \ Terminal	1	2
Pushed	O—	—O
Free		

EBA9020G



EBHA020A

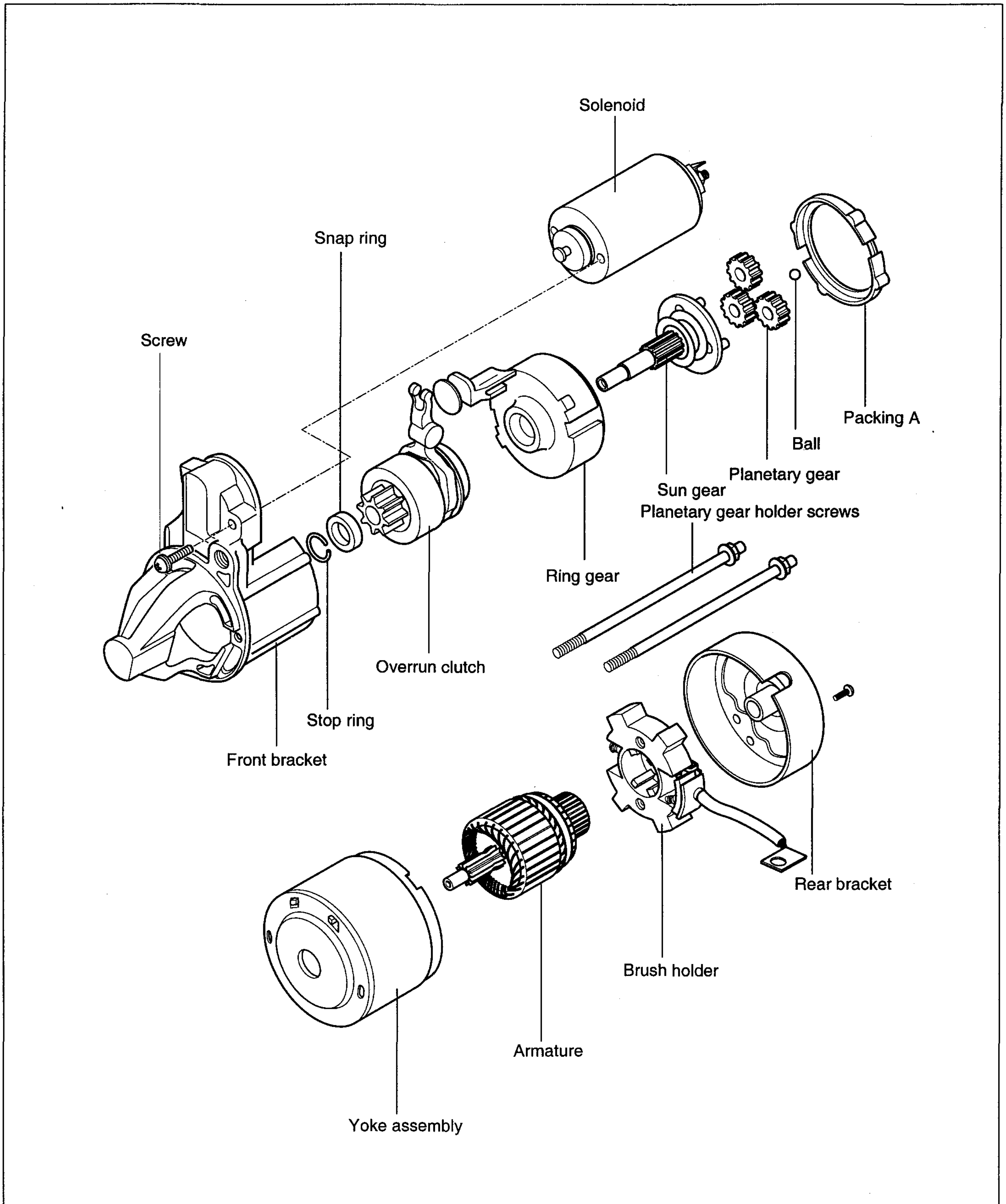
REMOVAL AND INSTALLATION EBHA0210



KFW2011A

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

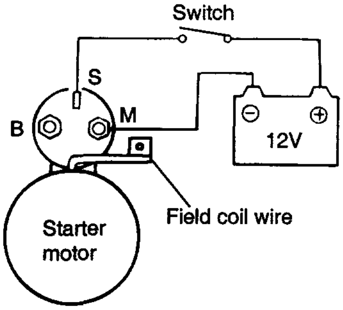
CHECKING FOR OPERATION EBHA0230

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

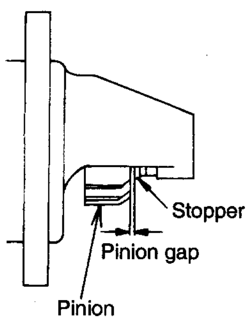
This test must be performed quickly (in less than 10 seconds) to prevent the coil from overheating.



EBA9023A

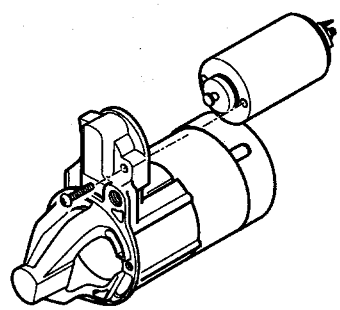
4. Check the pinion for stopper clearance (pinion gap) with a feeler gauge.

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

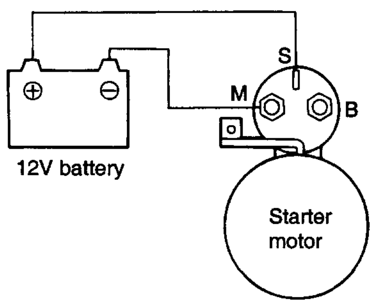
MAGNETIC SWITCH PULL-IN TEST

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

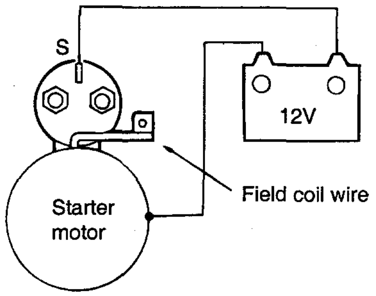
MAGNETIC SWITCH HOLD-IN TEST

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.

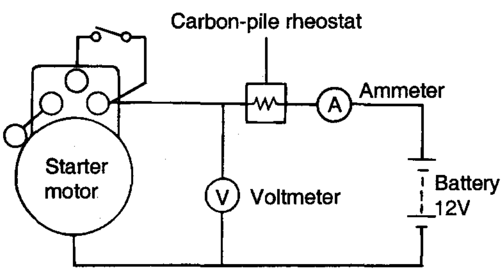
3. If the pinion moves out, everything is in order. If the pinion moves back and forth repeatedly, the hold-in circuit is open. If it is open, replace the magnetic switch.



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

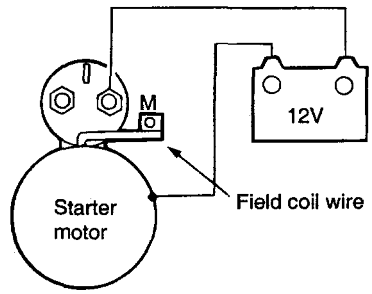
MAGNETIC SWITCH RETURN TEST

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

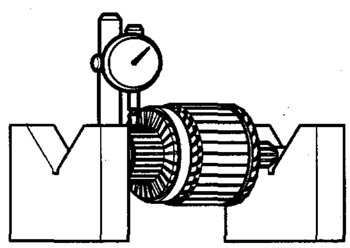
1. Place the armature on a pair of V-blocks, and check the run - out by using a dial gauge.

Standard value

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

Limit

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



KFW2033A

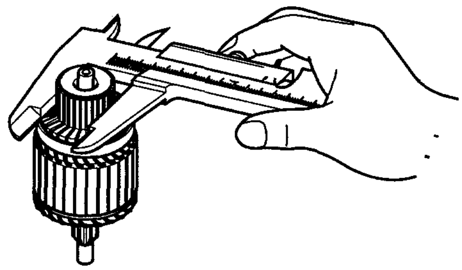
2. Check the outer diameter of the commutator.

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

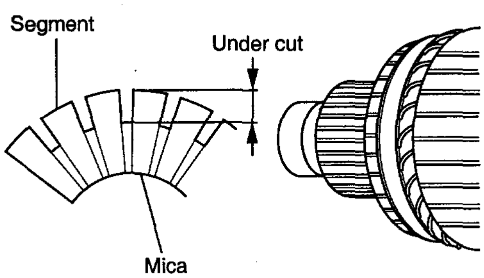
3. Check the depth of the undercut between segments.

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.)

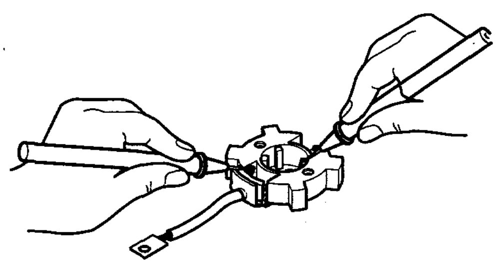


KFW2035A

BRUSH HOLDER

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

The normal condition is no continuity.

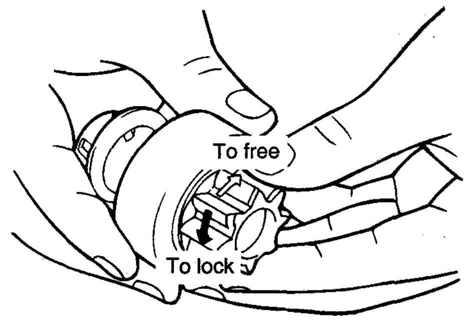


KFW2036A

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.



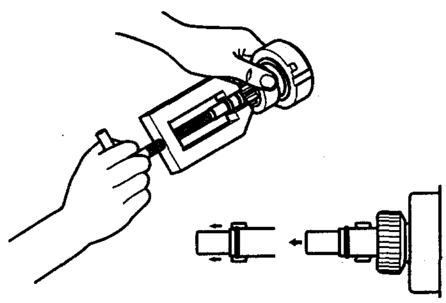
EBA9024E

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.



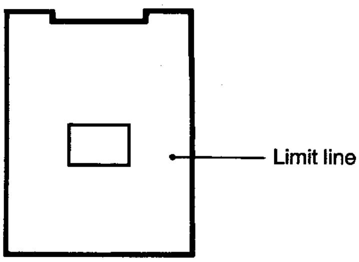
KFW2043A

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.

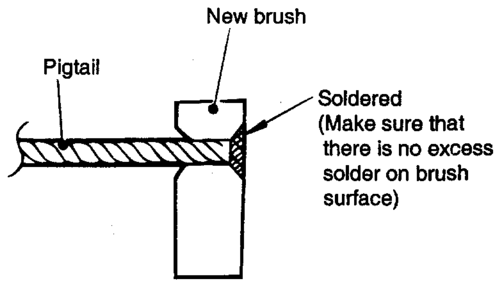
REPLACEMENT OF BRUSHES AND SPRINGS EBA90270

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.

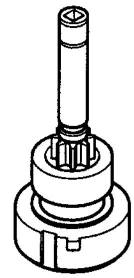


EBA9027B

DISASSEMBLY EBHA0280

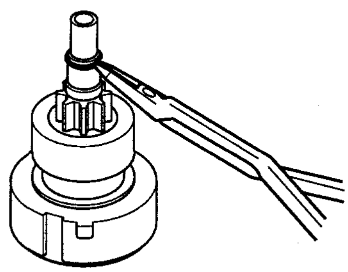
REMOVAL OF THE SNAP RING AND STOP RING

1. Press the stop ring using a socket.



KFW2031A

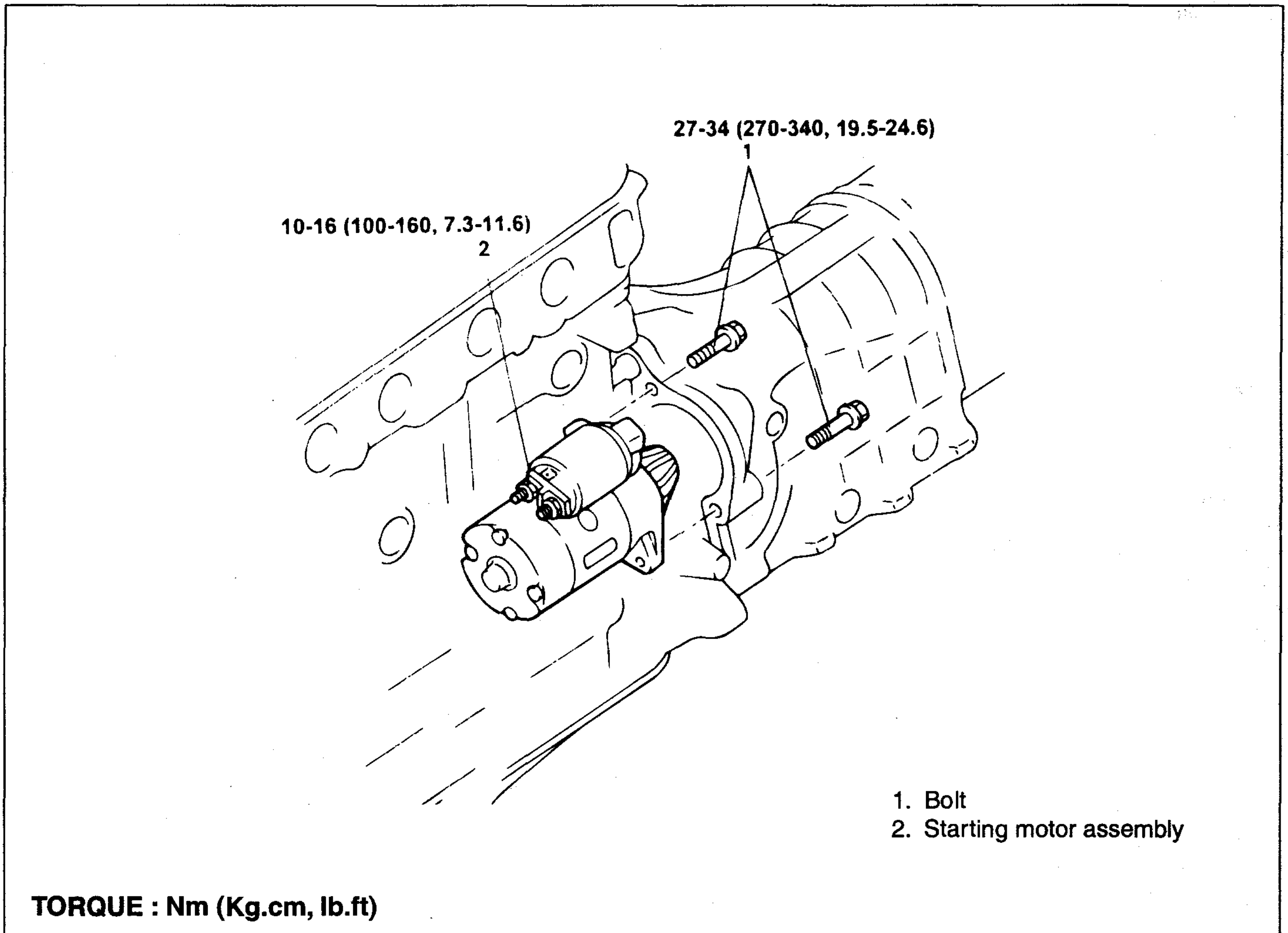
2. After removing the snap ring (using snap-ring pliers), remove the stop ring and the overrunning clutch.



KFW2032A

REMOVAL AND INSTALLATLON (DIESEL) EBMB0290

COMPONENTS



B7AD7520

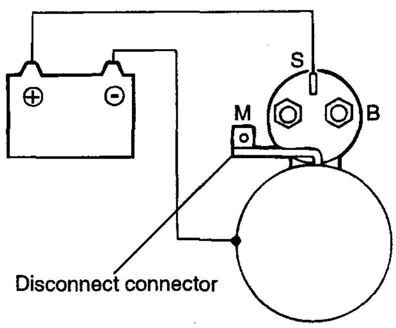
EBMB0300

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

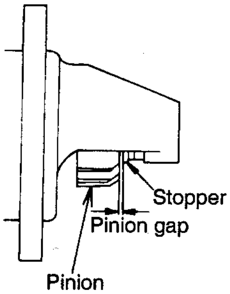
This test must be performed quickly within 10 seconds to prevent the switch coil from burning.



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

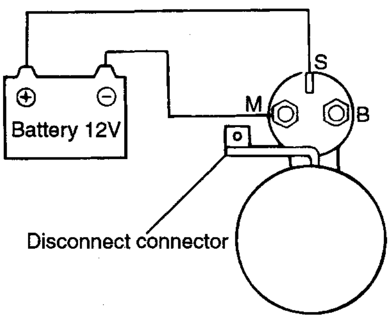
EBMB0310

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.



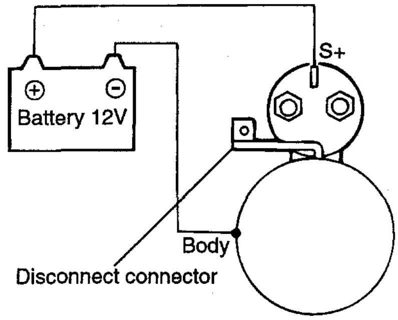
EBMB031A

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.



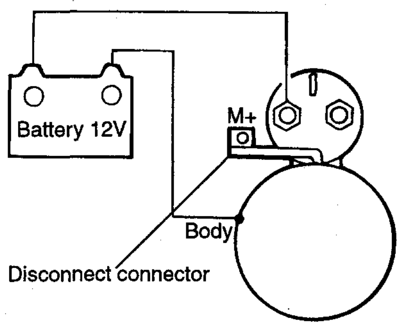
EBMB031B

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.

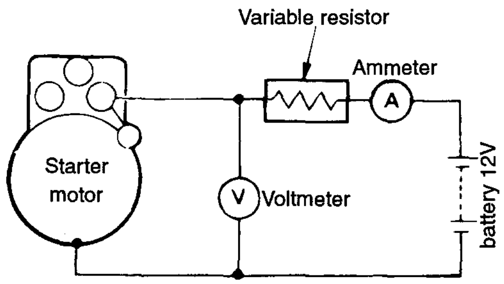


EBMB031C

NO-LOAD TEST

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

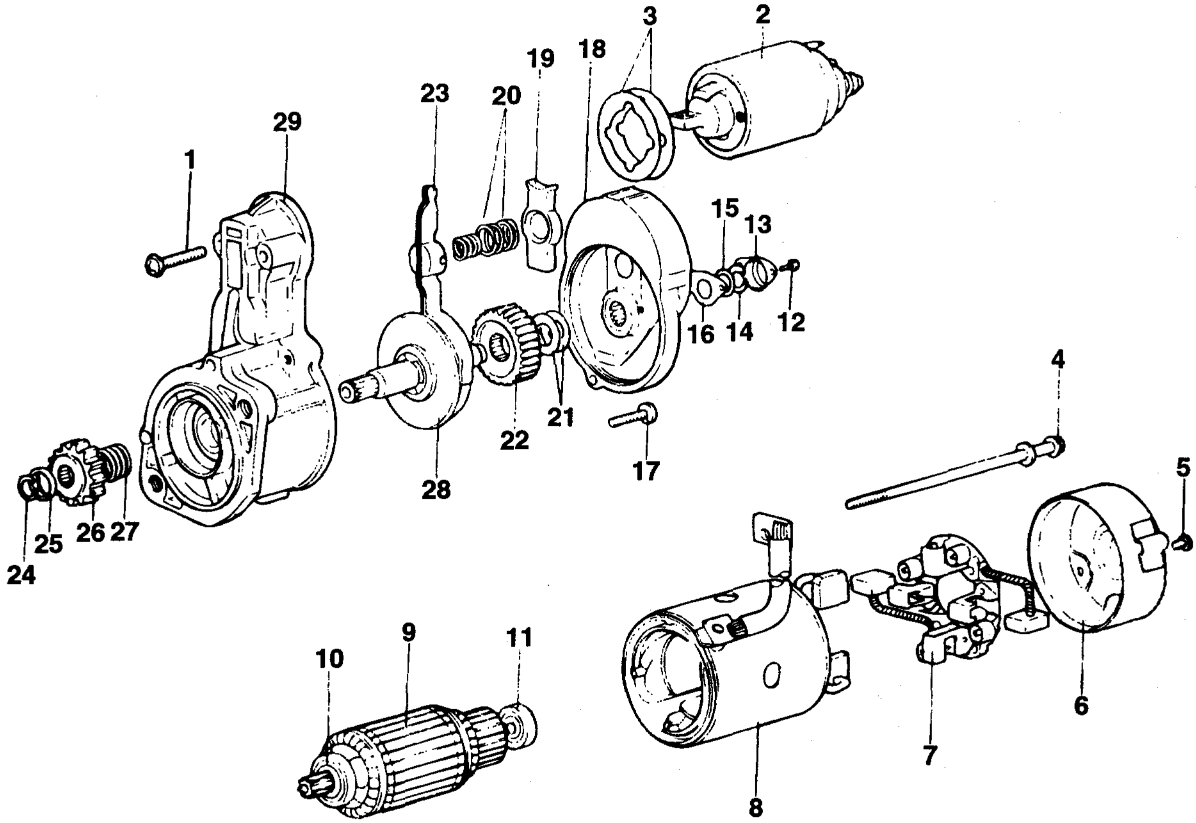
2. The starting motor should be in good condition if it turns smoothly and steadily when the switch is turned ON with a maximum variable resistance value. Adjust the variable resistor so that the voltmeter reads 11.5V. If the current and rpm are out of specification after this adjustment, troubleshoot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

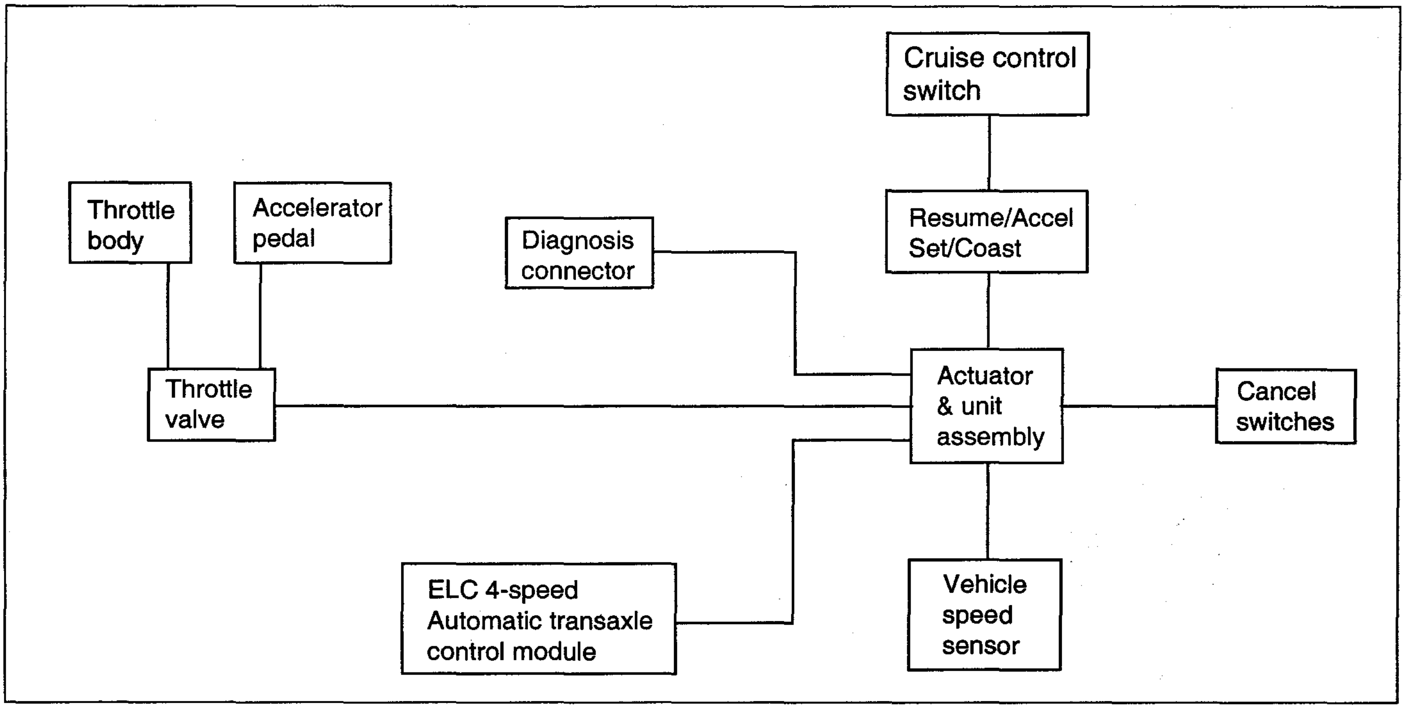
NOTE

Reverse the disassembly procedures to reassemble

B7AD7555

CRUISE CONTROL SYSTEM

SYSTEM BLOCK DIAGRAM EBA90290



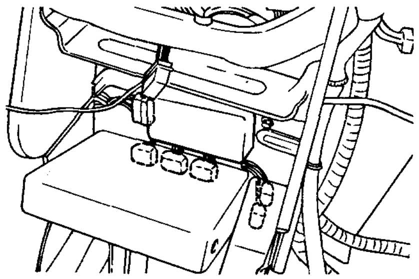
EBA9029A

COMPONENT PARTS AND FUNCTION OUTLINE

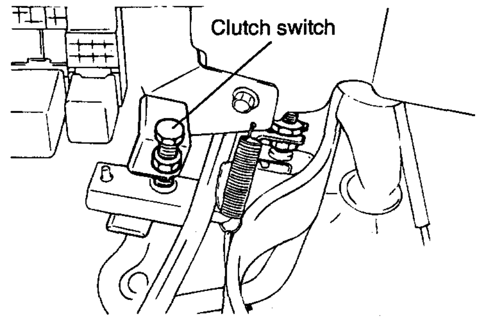
COMPONENT PART	FUNCTION
Vehicle speed sensor	Converts vehicle speed to pulses.
Cruise control module (CCM)	Receives signals from sensor and control switch; CCM controls all automatic speed control function.
Actuator	Regulates the throttle valve to the set opening by signals from the CCM.
Control switch	
CRUISE main switch	Switch for automatic speed control power supply.
SET/RESUME switch	Controls automatic speed control functions by SET (COAST) and RESUME (ACCEL).
CRUISE main switch indicator	Illuminates when CRUISE main switch is ON (Built into cluster).
Cancel switch	Sends cancel signals to the CCM
Stop lamp switch/Clutch switch (M/T)	Cancels cruise
Transaxle range switch	Controls the overdrive ON and OFF, based on signals from the CCM for the CC.
Data link connector	By connecting the voltmeter or scan tool, control module diagnostic codes may be read.

*CC : Cruise Control

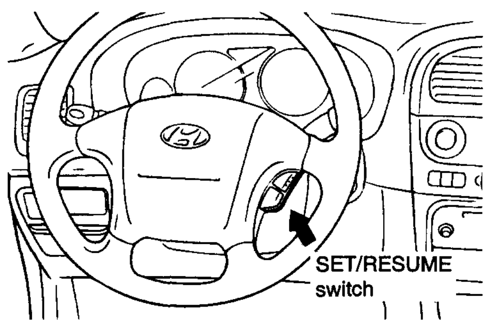
COMPONENTS LOCATION EBBB0310



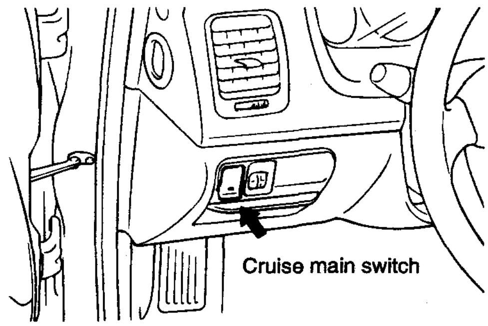
S5EE490E



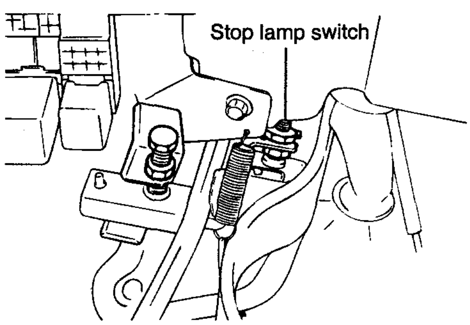
EBBB031A



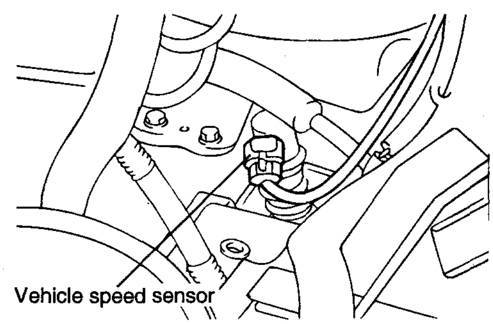
EBAA030B



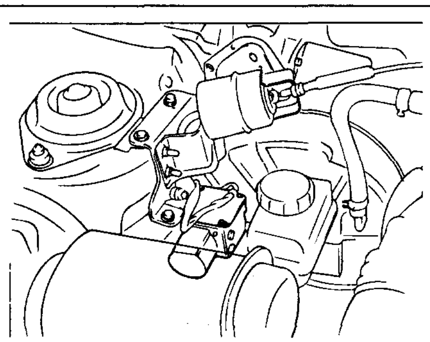
EBAA030C



EBA9030L

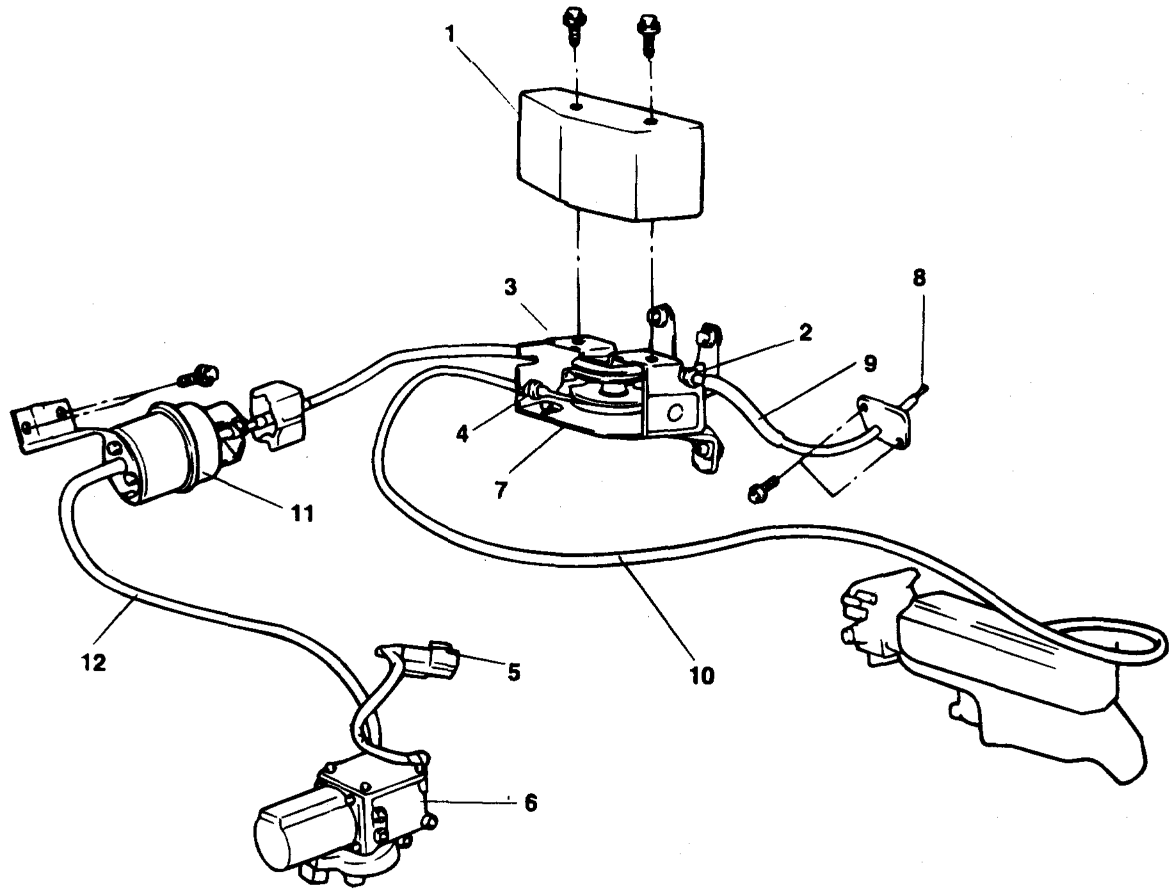


EBA9030N



EBBB031B

COMPONENTS EBBB0320

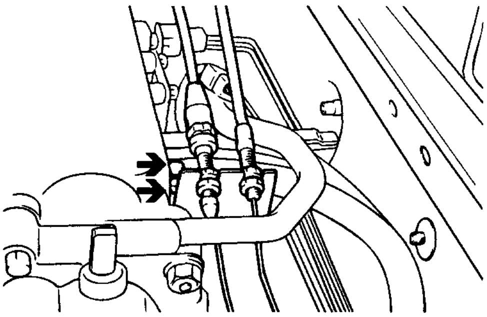


1. Pulley protector
2. Accelerator cable and pulley assembly connection
3. Cruise control cable and pulley assembly connection
4. Throttle cable and pulley assembly connection
5. Vacuum pump connector
6. Pump assembly
7. Pulley assembly
8. Accelerator cable and pedal connection
9. Accelerator cable
10. Throttle cable
11. Actuator
12. Vacuum hose

S6EE510A

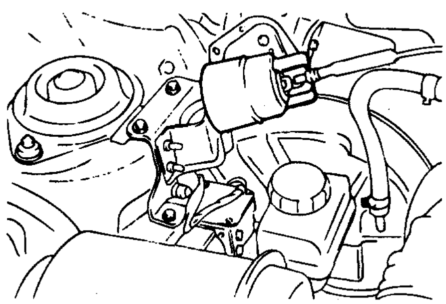
REMOVAL AND INSTALLATION EBBB0330

1. Remove the battery negative terminal.
2. Disconnect the accelerator cable and cruise control cable from throttle assembly by turing throttle lever to full open position.
3. Disconnect the accelerator cable from accelerator pedal connection.
4. Remove the accelerator cable mounting bolts.



EBAA031B

5. Remove the actuator and unit assembly mounting bolt.
6. Installation is the reverse order of removal.



Y27-059C

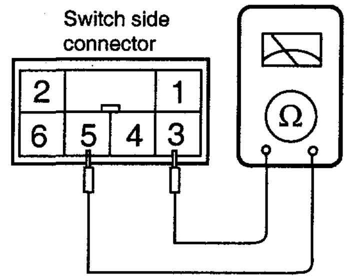
PARTS INSPECTION EBAA0320

CRUISE CONTROL MAIN SWITCH

1. Operate the switch and check for continuity between the terminals.
2. If continuity is not as specified, replace the switch.

Terminal / Position	1	2	3	4	5	6
ON	○	—	○ —	— ○	○	
OFF	○	—	—	○		

EBAA032A



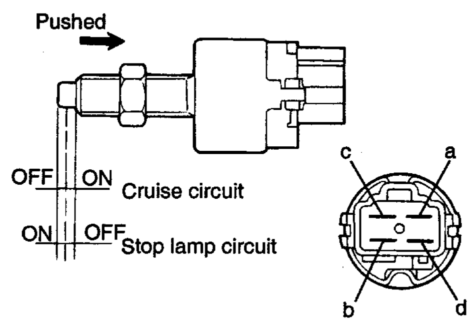
EBAA032B

STOP LAMP SWITCH

After operating the stop lamp switch, check for continuity between the terminals.

Terminal / Position	1	2	3	4
Not pushed			○	○
Pushed	○	○		

EBAA032C



EBA9032C

INSPECTION EBAA0330

CONDITION

- Turn A/C and all lights OFF. Inspect and adjust at no load.
- Warm the engine until idle is stabilized. Confirm that the idle speed is at the specified RPM.
- Turn the ignition switch OFF.

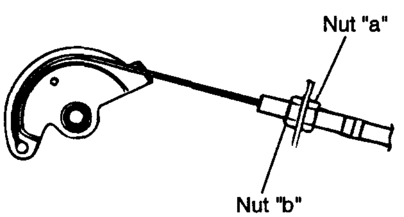
1. Confirm there are no sharp bends in the cables.
2. Depress the accelerator pedal and check if the throttle lever moves smoothly from fully closed to fully open.
3. Check the inner cables for correct slack.
4. If there is too much slack or no slack, adjust the play by the following procedures :

SERVICE HINT

1. If the cable is very loose, the loss of speed going uphill will be large.
2. If the cable is too tight, idle RPM will be high.

CABLE ADJUSTMENT

1. Assemble the cable to actuator and unit assembly.
2. Tighten nut "b" after pulling the cable tightly.
3. Back nut "b" off one turn.
4. Tighten nut "a".
5. Cable should have approximately 1mm of slack with the actuator and unit against the stop.



EBAA033A

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

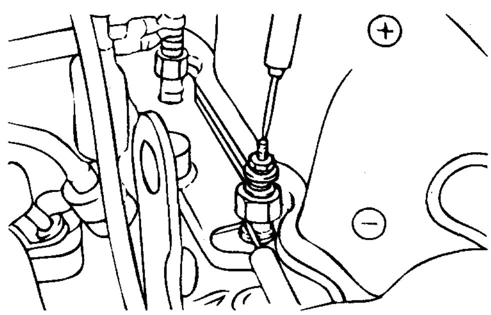
Conditions before inspection :
Battery voltage : 12V

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.

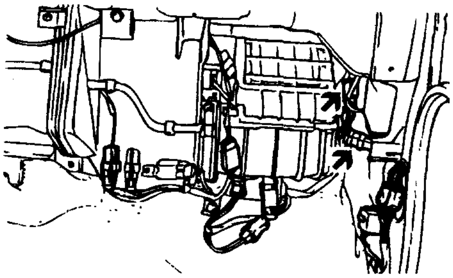
4. After checking 3, set ignition switch at START position.
5. The system is normal if battery voltage (about 9V or over) is generated for about 6 seconds during engine cranking and after start operation. [at cooling water temperature 20°C (68°F)]
6. When the voltage or continuity time is not normal,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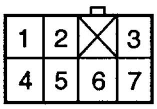

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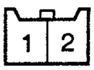


C002F003

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

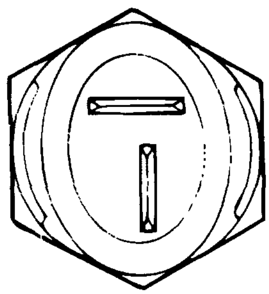
2. Remove glow control unit connector. Check with harness side connector. (M13)

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.

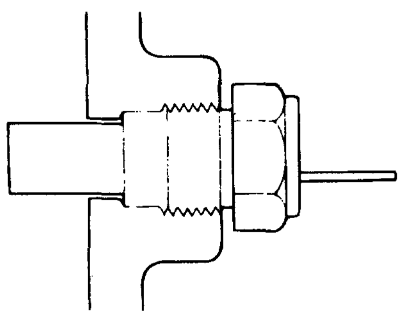
   Standard value : 3.25kΩ [at 20°C (68°F)]



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

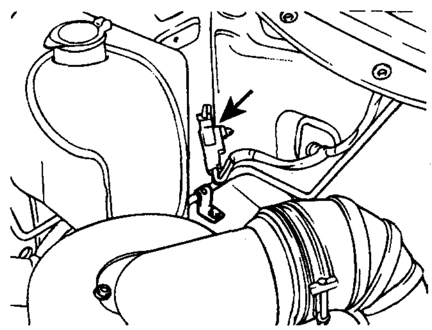


B7AD7660

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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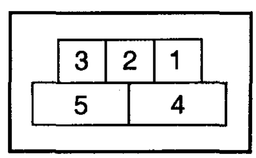
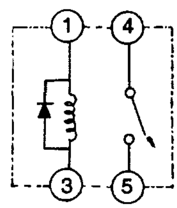


(M41)

G6CL001T



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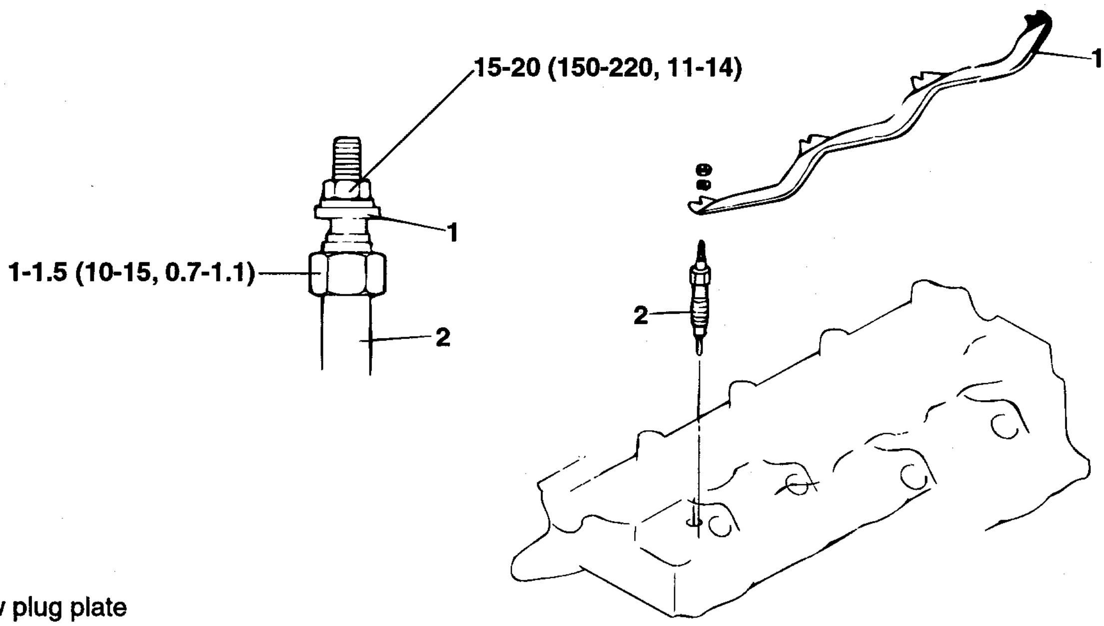
EBLB041A

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

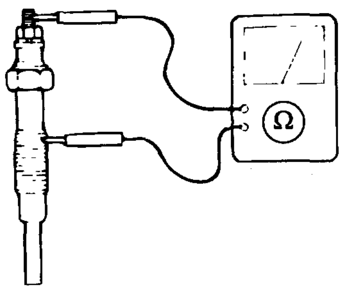
GLOW PLUG

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.



EBMB038A

Emissions Control System

GENERAL

SPECIFICATIONS EEMB0010

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 Coil resistance	 0.45A or below (at 12V) 24.5 - 27.5 Ω [at 20°C (68°F)]
EVAP Canister Purge Solenoid Valve Coil resistance	 36 - 44 Ω [at 20°C (68°F)]

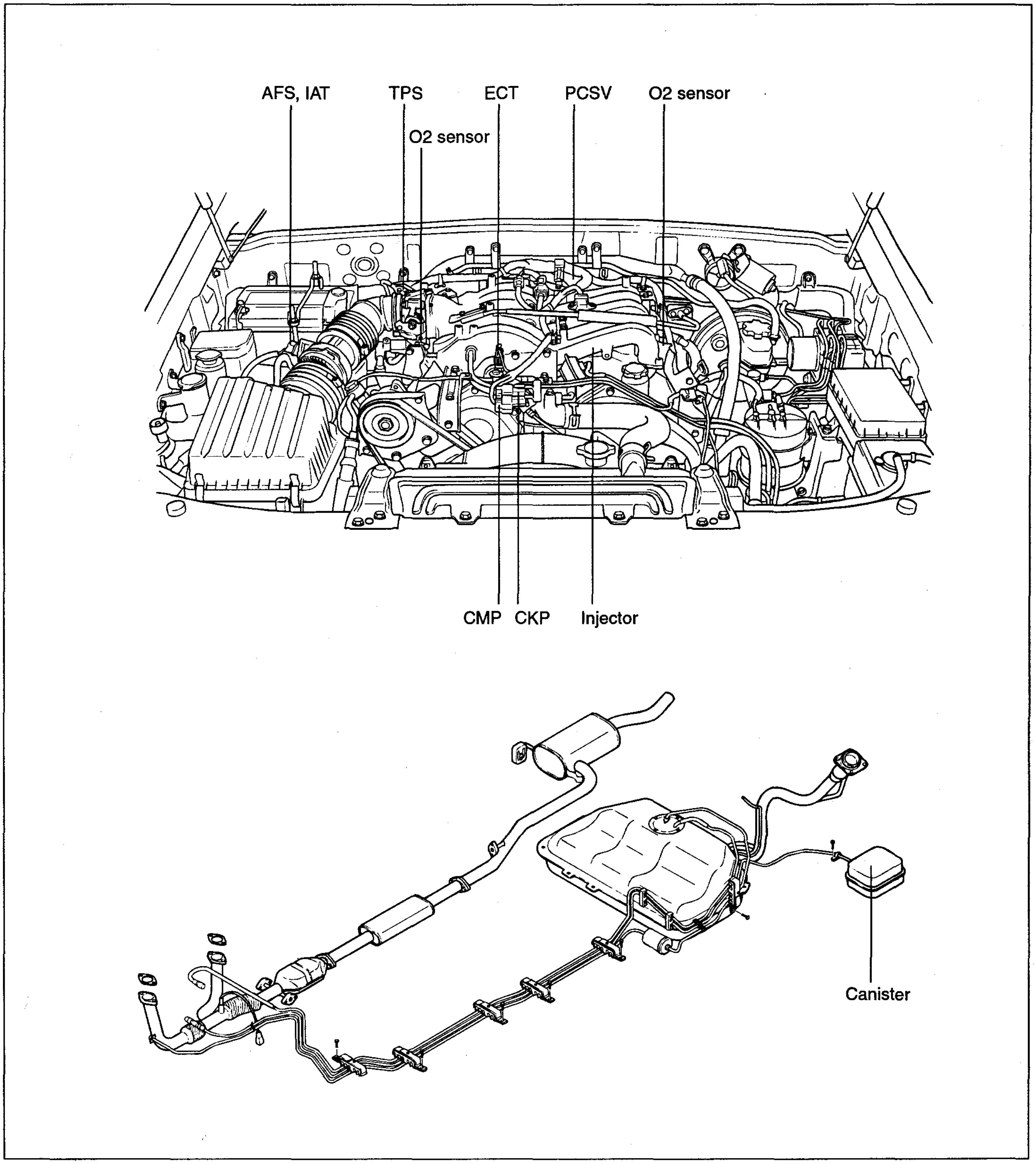
SEALANT

Engine coolant temperature sensor threaded portion	THREE BOND 2403 or equivalent

TROUBLESHOOTING

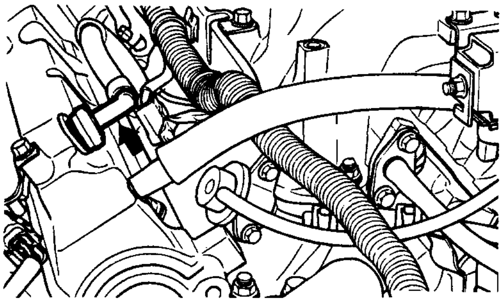
Symptom	Probable cause	Remedy
Engine will not start or hard to start	Vacuum hose disconnected or damaged Malfunction of the EVAP Canister Purge Solenoid Valve	Repair or replace Repair or replace
Rough idle or engine stalls	Vacuum hose disconnected or damaged Malfunction of the PCV valve Malfunction of the EVAP Canister Purge System	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

EMISSION CONTROLS LOCATION EEMB0030



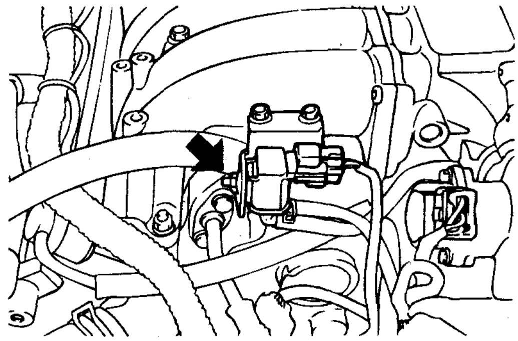
EEMB003A

A. PCV valve



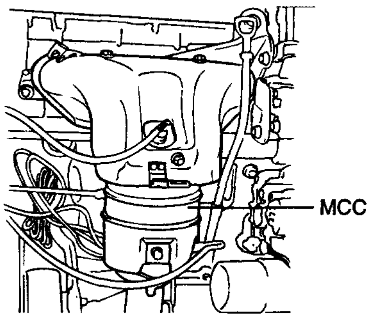
KFW5215A

B. EVAP Canister Purge Solenoid Valve



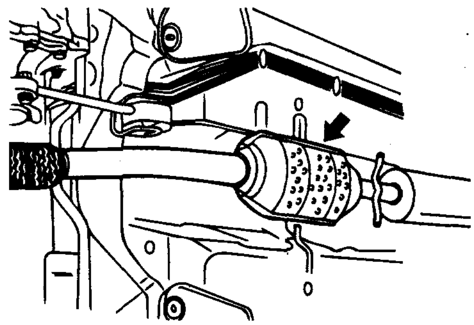
EFB9007A

C. Catalytic Converter (MCC)



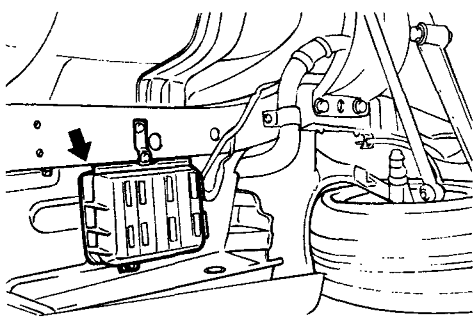
EEA9005G

D. Catalytic Converter (UCC)



EEBB003B

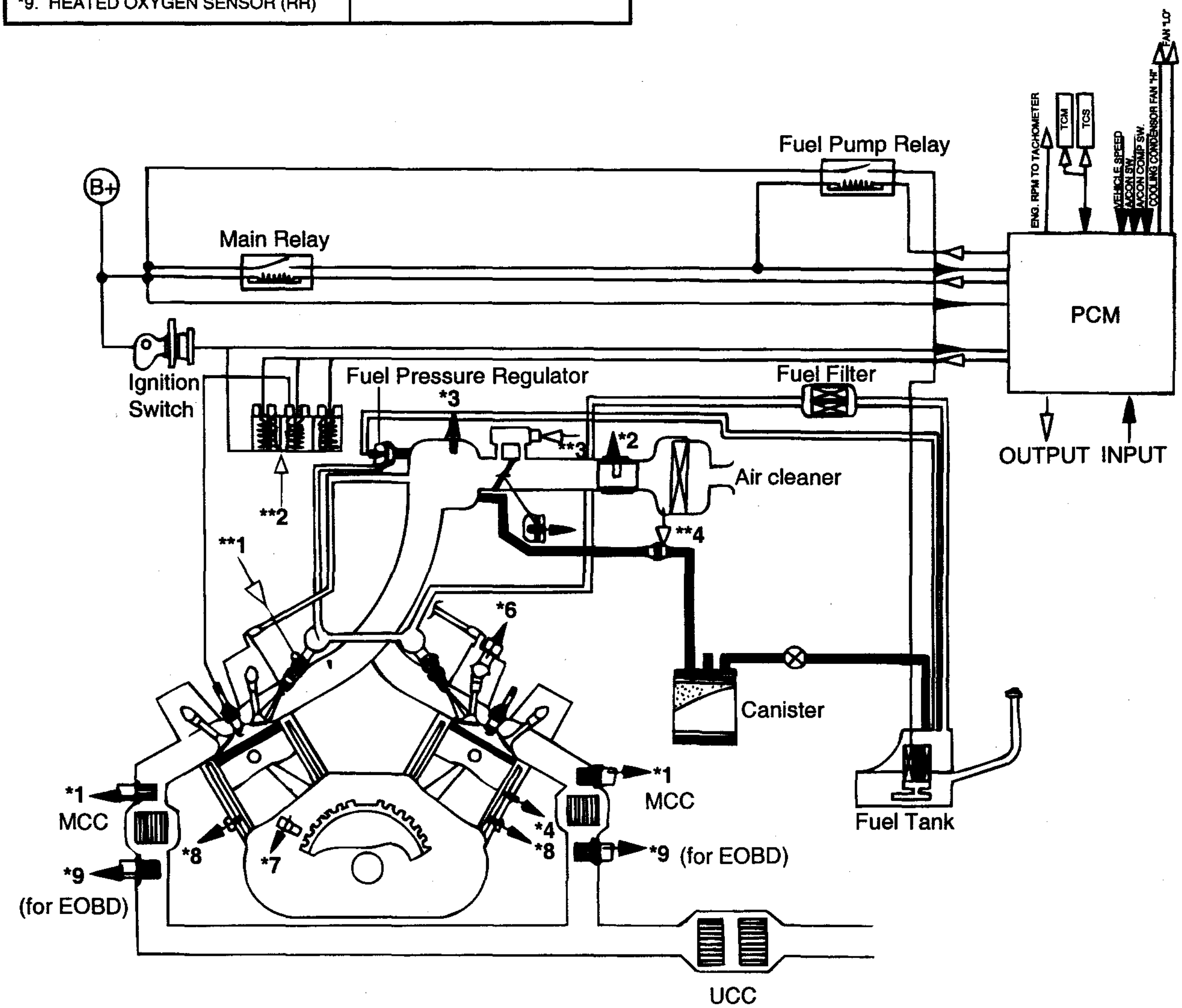
E. EVAP. canister



EEA9005E

SCHEMATIC DRAWING EEMB0050

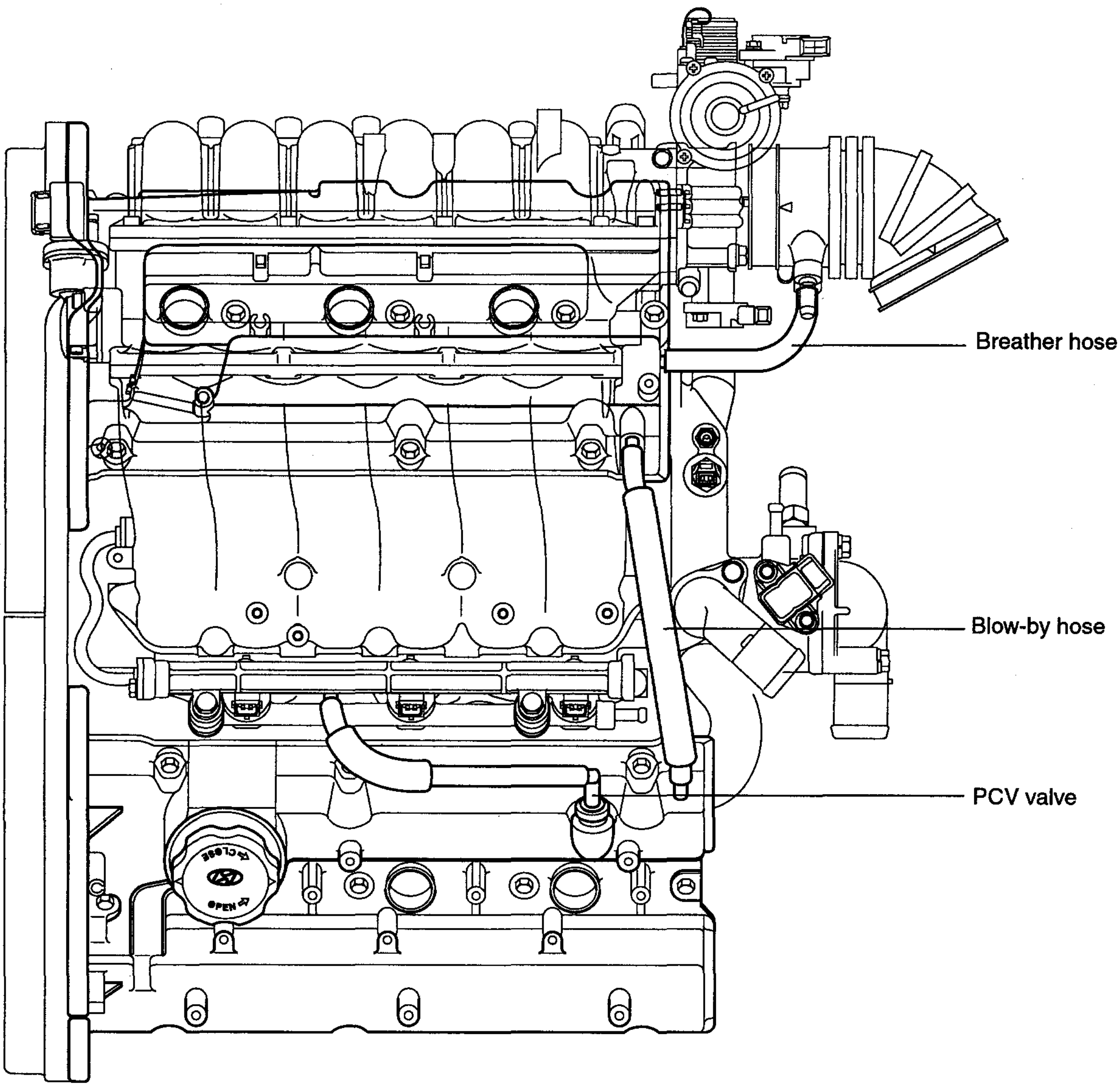
*1. HEATED OXYGEN SENSOR (H02S) *2. HOT FILM SENSOR *3. INTAKE AIR TEMP. SENSOR (IAT SENSOR) *4. ENGINE COOLANT TEMP. SENSOR (ECT SENSOR) *5. THROTTLE POSITION SENSOR (TP SENSOR) *6. CAMSHAFT POSITION SENSOR (CMP SENSOR) *7. CRANKSHAFT POSITION SENSOR (CKP SENSOR) *8. KNOCK SENSOR *9. HEATED OXYGEN SENSOR (RR)	o IGNITION SWITCH o BATTERY VOLTAGE o VEHICLE SPEED SENSOR o A/C LOAD SIGNAL o "PNP" SWITCH (A/T ONLY) o FUEL PUMP RELAY SIGNAL	INPUT → PCM → 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 A/C RELAY o IGNITION TIMING CONTROL o DIAGNOSIS



PCM : Powertrain Control Module
EVAP : Evaporative Emission
UCC : Underbody Catalytic Converter
MCC : Manifold Catalytic Converter

EEMB005A

VACUUM HOSES LAYOUT EEMB0110

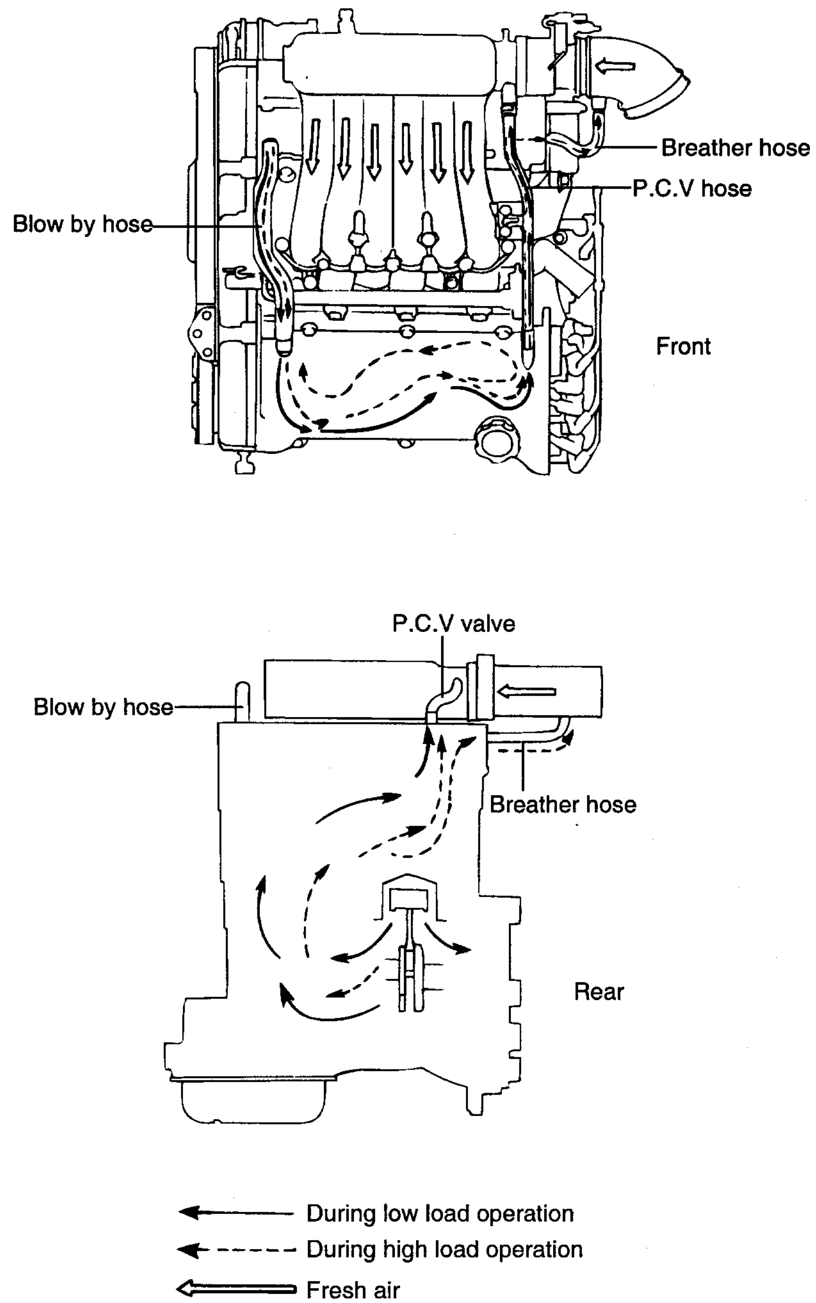


EEMB011A

CRANKCASE EMISSION CONTROL SYSTEM

POSITIVE CRANKCASE VENTILATION (PCV) VALVE EEBB0070

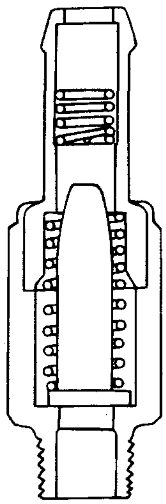
COMPONENTS



EEHA013A

PCV VALVE OPERATING EEA90140

Intake manifold side (No vacuum)

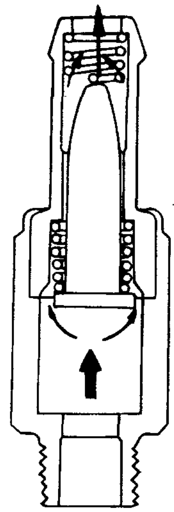


EEA9014A

Rocker cover side

Engine condition	Not running
PCV valve	Not operating
Vacuum passage	Restricted

Intake manifold side (High vacuum)

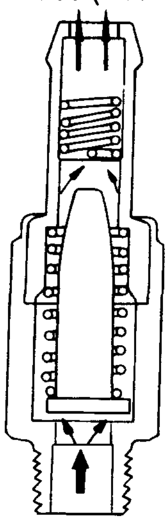


EEA9014B

Rocker cover side

Engine condition	Idling or decelerating
PCV valve	Fully operating
Vacuum passage	Small

Intake manifold side (Moderate vacuum)

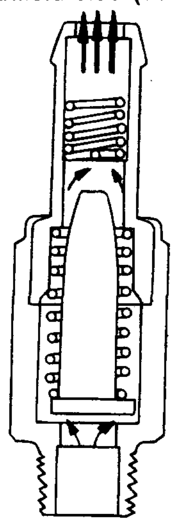


EEA9014C

Rocker cover side

Engine condition	Normal operation
PCV valve	Properly operating
Vacuum passage	Large

Intake manifold side (Low vacuum)



EEA9014D

Rocker cover side

Engine condition	Accelerating and high load
PCV valve	Slightly operating
Vacuum passage	Much large

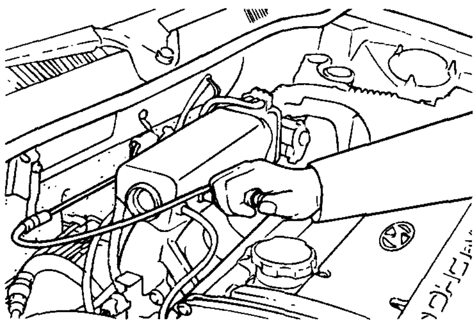
DISASSEMBLY EEA90150

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.

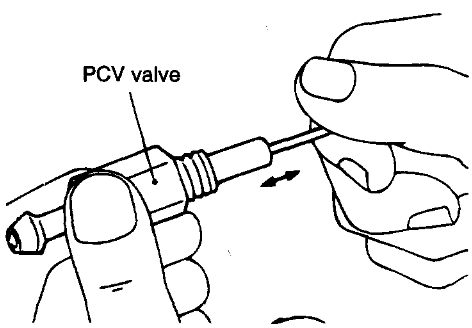
3. If vacuum is not felt, clean the PCV valve and ventilation hose in cleaning solvent, or replace if necessary.



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

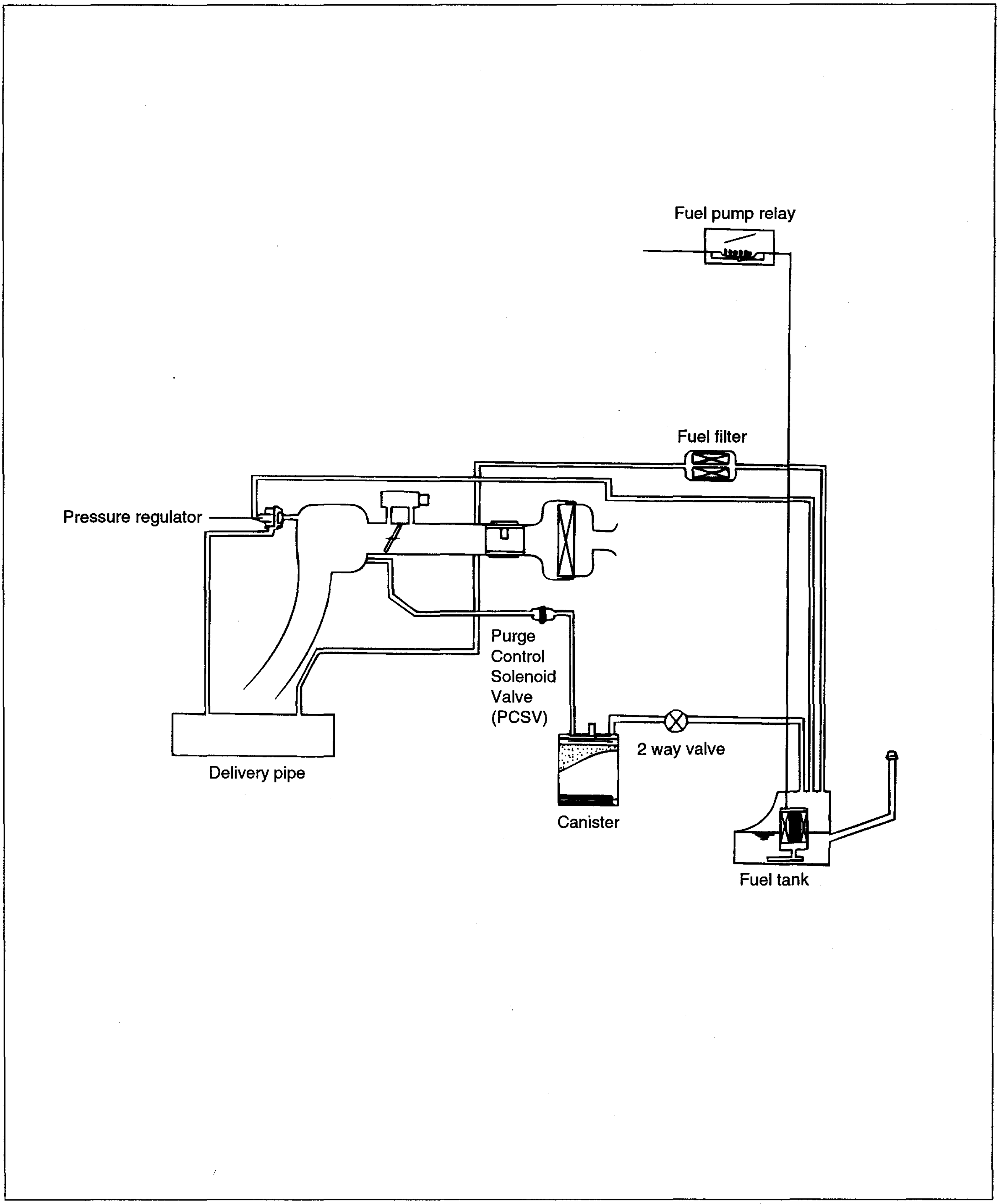
INSTALLATION

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)

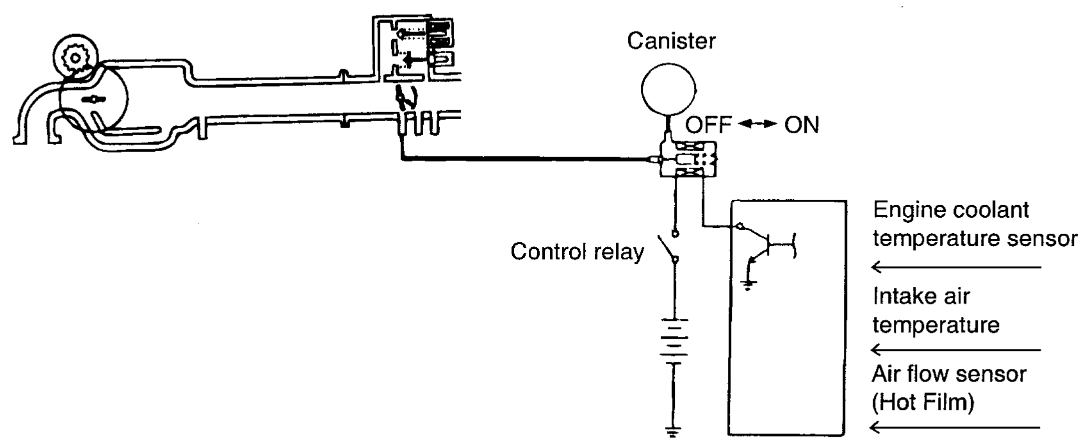
EVAPORATIVE EMISSION CONTROL SYSTEM

COMPONENTS EEMB0100



EEMB010A

EVAPORATIVE (EVAP) CANISTER PURGE SOLENOID VALVE EEBB0120

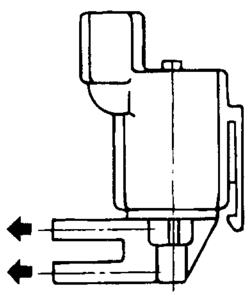


EEBB012A

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 the warm-up of the engine during ordinary driving, valve opens to let the stored vapors flow into the surge tank.

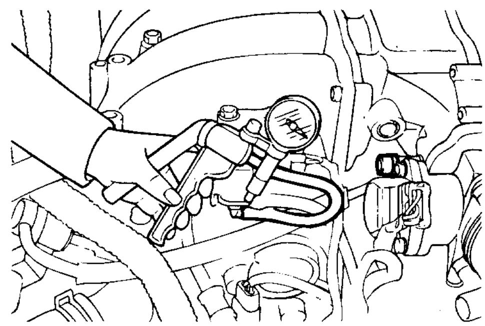


EEBB012B

INSPECTION

NOTE

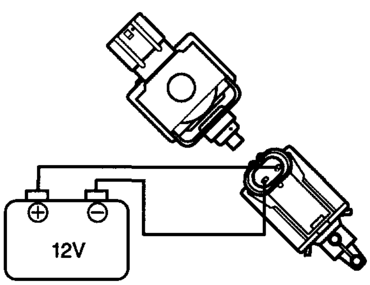
When disconnecting the vacuum hose, make an identification mark on it so that it can be reconnected to its original position.



EEB9007A

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.

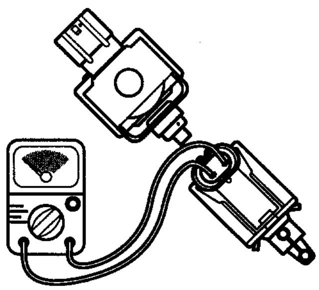
Battery voltage	Normal condition
When applied	Vacuum is released
When discontinued	Vacuum is maintained



KFW4011A

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 : 24.5 - 27.5 Ω [at 20°C (68°F)]

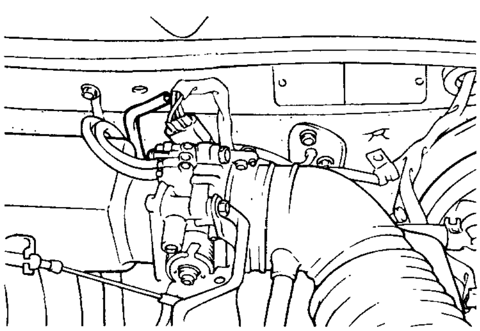


KFW4012A

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.

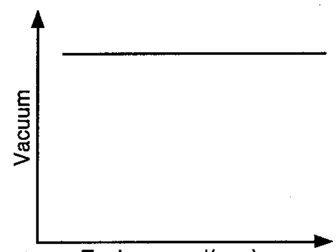


EEA9023A

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.



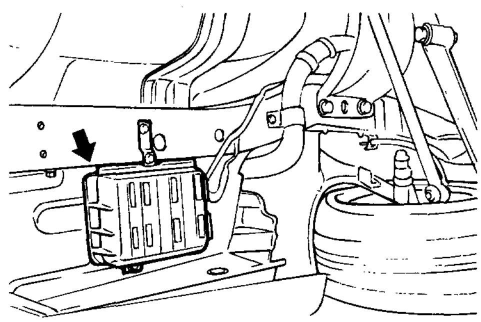
EEA9023B

EVAPORATIVE (EVAP) CANISTER EEJB0240

CANISTER

Inspect the Canisfer Close Valve (CCV) and its air filter as shown in the illustration.

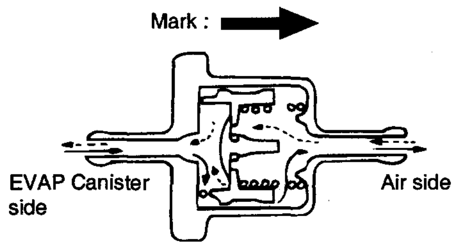
1. Look for loose connections, and sharp bends or damage to the fuel vapor lines.
2. Look for distortion, cracks or fuel leakage.
3. After removing the EVAP Canister, inspect for cracks or damage.



EEA9005E

TWO-WAY VALVE

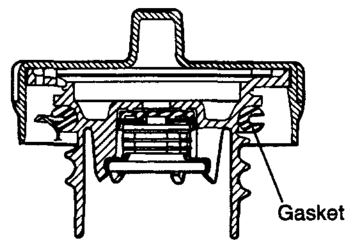
1. Inspect that air flows as shown.
2. Check that the valve is connected correctly noting the arrow mark on the valve.



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

EXHAUST EMISSION CONTROL SYSTEM

VEHICLES WITH CATALYTIC CONVERTER EEA90270

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components in the fuel.

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 richness.

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.