EMISSION CONTROL SYSTEM AND VACUUM FITTING 2-1

SUBARU

SVX

1992

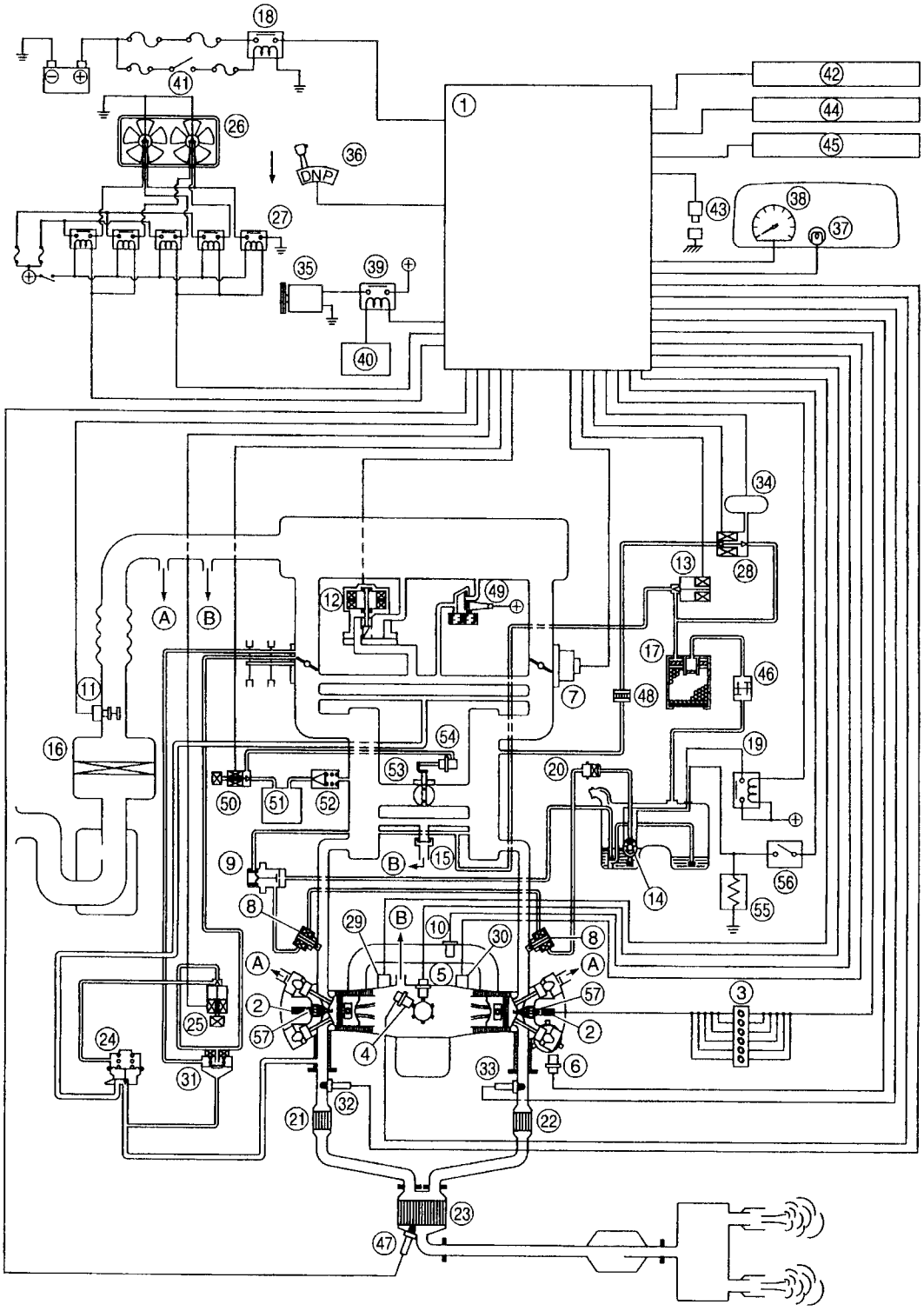
1. System Application

There are three emission control systems which are as follows:

1) Crankcase emission control system
2) Exhaust emission control system
   - Three-way catalyst system
   - A/F control system
   - Ignition control system
   - EGR system
3) Evaporative emission control system
4) Fuel pump discharge flow control system

Item			Main components	Function
Crankcase emission control system			PCV valve	Draws blow-by gas into intake manifold from crankcase and burns it together with air-fuel mixture. Amount of blow-by gas to be drawn in is controlled by intake manifold pressure.
Exhaust emission control system	Catalyst system	Front (LH & RH)	Three-way catalyst	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.
		Rear		
	A/F control system		ECU (Electric control unit)	Receives input signals from various sensors, compares signals with stored data, and emits a signal for optimal control of air-fuel mixture ratio.
			O_2 sensor 1 & 2	Detects density of oxygen contained exhaust gases.
			Air flow sensor	Detects amount of intake air.
			Throttle sensor	Detects throttle position.
	Ignition control system		ECU	Receives various signals, compares signals with basic data stored in memory, and emits a signal for optimal control of ignition timing.
			Crank angle sensor 1 & 2	Detects engine speed (Revolution).
			Cam angle sensor	Detects reference signal for combustion cylinder discrimination.
			Water temperature sensor	Detects coolant temperature.
			Knock sensor	Detects knocking in combustion chamber of each cylinder.
	EGR system		ECU	Receives various signals, compares signals with basic data stored in memory, and emits ON-OFF signal for EGR solenoid valve.
			EGR valve	Controls amount of exhaust gas to send to collector chamber.
			BPT	Controls quantity of recirculation gas depending upon engine operating conditions.
			EGR solenoid valve	Controls intake manifold pressure to transmit EGR valve for ON-OFF signal emitted from ECU.
Evaporative emission control system			Canister	Absorbs evaporative gas which occurs in fuel tank when engine stops, and sends it to combustion chambers for a complete burn when engine is started. This prevents HC from being discharged into atmosphere.
			Purge control solenoid valve	Receives a signal from ECU and controls purge of evaporative gas absorbed by canister.
Fuel pump discharge flow control system			ECU	Receives various signals, compares signals, and emits ON-OFF signal for fuel pump modulator.
			Fuel pump modulator	Receives a signal from ECU and controls the discharge flow of fuel pump.

2. Schematic Drawing



D2M0744A

① Engine control module (ECM)
② Ignition coil
③ Ignitor
④ Crankshaft position sensor 1
⑤ Crankshaft position sensor 2
⑥ Camshaft position sensor
⑦ Throttle position sensor
⑧ Fuel injectors
⑨ Pressure regulator
⑩ Engine coolant temperature sensor
⑪ Mass air flow sensor
⑫ Idle air control solenoid valve
⑬ Purge control solenoid valve
⑭ Fuel pump
⑮ PCV valve
⑯ Air cleaner
⑰ Canister
⑱ Main relay
⑲ Fuel pump relay
⑳ Fuel filter
㉑ Front catalytic converter (RH)
㉒ Front catalytic converter (LH)
㉓ Rear catalytic converter
㉔ EGR valve
㉕ EGR control solenoid valve
㉖ Radiator fan
㉗ Radiator fan relay
㉘ Pressure sources switching solenoid valve
㉙ Knock sensor 1
㉚ Knock sensor 2
㉛ Back-pressure transducer (BPT)
㉜ Front oxygen sensor 1 (RH)
㉝ Front oxygen sensor 2 (LH)
㉞ Pressure sensor
㉟ A/C compressor
㊱ Inhibitor switch
㊲ CHECK ENGINE malfunction indicator lamp (MIL)
㊳ Tachometer
㊴ A/C relay
㊵ A/C control module
㊶ Ignition switch
㊷ Transmission control module (TCM)
㊸ Vehicle speed sensor 2
㊹ Data link connector (For Subaru select monitor)
㊺ Data link connector (For Subaru select monitor and OBD-II general scan tool)
㊻ Two-way valve
㊼ Rear oxygen sensor
㊽ Filter
㊾ Auxiliary air control valve
㊿ Induction control solenoid valve
(51) Vacuum tank
(52) Check valve
(53) Induction control valve
(54) Induction valve diaphragm
(55) Resistor
(56) Fuel pump modulator
(57) Spark plug

3. General Precautions

1) Know the importance of periodic maintenance services.
   (1) Every service item in the periodic maintenance schedule must be performed.
   (2) Failing to do even one item can cause the engine to run poorly and increase exhaust emissions.
2) Determine if you have an engine or emission system problem.
   (1) Engine problems are usually not caused by the emission control systems.
   (2) When troubleshooting, always check the engine and the MPFI system first.
3) Check hose and wiring connections first.
The most frequent cause of problems is simply a bad connection in the wiring or vacuum hoses. Always make sure that connections are secure and correct.
4) Avoid coasting with the ignition turned off and prolonged engine braking.
5) Do not damage parts.
   (1) To disconnect vacuum hoses, pull on the end, not the middle of the hose.
   (2) To pull apart electrical connectors, pull on the connector itself, not the wire.
   (3) Be careful not to drop electrical parts, such as sensors, or relays.
   If they are dropped on a hard floor, they should be replaced and not reused.
   (4) When checking continuity at the wire connector, the test bar should be inserted carefully to prevent terminals from bending.
6) Use SUBARU genuine parts.
7) Record how hoses are connected before disconnecting.
   (1) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.
   (2) After completing a job, double check to see that the vacuum hoses are properly connected. See the "Vacuum connections label" under the hood.

4. Crankcase Emission Control System

A: DESCRIPTION

The positive crankcase ventilation (PCV) system is employed to prevent air pollution which will be caused by blow-by gas being emitted from the crankcase.
The system consists of a sealed oil filler cap, rocker covers with fresh air inlet, connecting hoses, PCV valve and an air intake duct.
At the part throttle, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose of crank case and PCV valve by the strong vacuum of the intake manifold. Under this condition, the fresh air is introduced into the crankcase through connecting hose of rocker cover.
At wide open throttle, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn to the throttle chamber, because under this condition, the intake manifold vacuum is not so strong as to introduce all blow-by gases increasing with engine speed directly through the PCV valve.

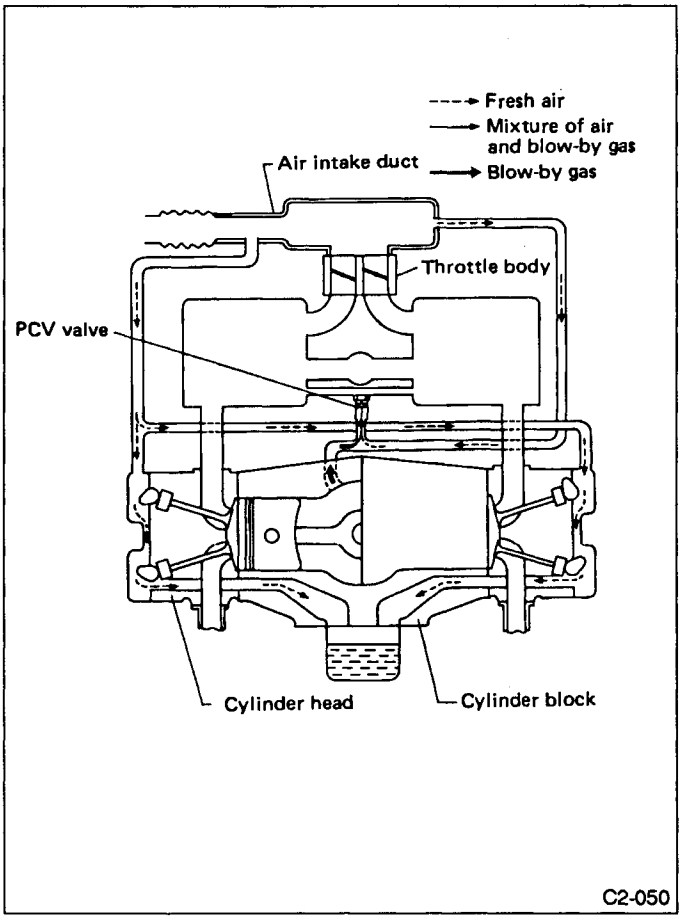


Fig. 2

B: INSPECTION

1) Check the positive crankcase ventilation hoses and connections for leaks and clogging. The hoses may be cleared with compressed air.
2) Check the oil filler cap to insure that the gasket is not damaged and the cap fits firmly on the filler cap end.
3) Check the PCV valve as the following procedure.
   (1) Disconnect the hose from the PCV valve.
   (2) With a finger attaching top of the valve, then lightly open and close the throttle valve (increase and decrease the engine speed a little).
   (3) The valve is in good condition if a vacuum is felt by the finger. If not, replace the valve.
   (4) The valve alone may be checked by shaking it. It is normal when you hear it move. Replace it if it fails to move.

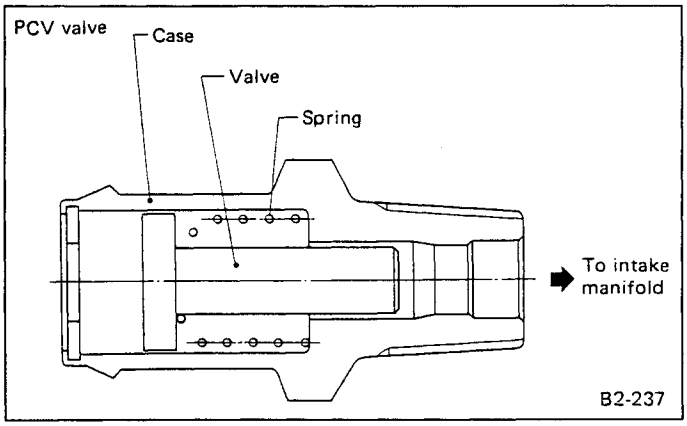


Fig. 3

5. Three-way Catalyst

The basic material of three-way catalyst is platinum (Pt) and rhodium (Rh), and a thin film of their mixture is applied onto honeycomb or porous ceramics of an oval shape (carrier). To avoid damaging the catalyst, only unleaded gasoline should be used.
The catalyst is used to reduce HC, CO and NOx in exhaust gases, and permits simultaneous oxidation and reduction. To obtain an excellent purification efficiency on all components HC, CO and NOx, a balance should be kept among the concentrations of the components. These concentrations vary with the air-fuel ratio.
The air-fuel ratio needs to be controlled to a value within the very narrow range covering around the theoretical (stoichiometric) air-fuel ratio to purify the components efficiently.
Refer to 2-9 "EXHAUST SYSTEM" as for removal and installation.

6. A/F Control System

The air/fuel control system compensates for the basic amount of fuel injection in response to a signal sent from the O_2 sensor to provide proper feedback control of the mixture. Thus, the theoretical air-fuel ratio is maintained to provide effective operation of the three-way catalyst. The basic amount of fuel injection is preset according to engine speed and loads, as well as the amount of intake air.
This system also has a "learning" control function which stores the corrected data in relation to the basic amount of fuel injection in the memory map. A new air-fuel ratio correction is automatically added for quick response to the deviation of the air-fuel ratio. Thus, the air-fuel ratio is optimally maintained under various conditions while stabilizing exhaust gases, improving driving performance and compensating for changes in sensors' performance quality with elapse of time.
Refer to 2-7 "FUEL INJECTION SYSTEM".

7. Ignition Control System

The ignition control system is controlled by the ECU. The ECU determines the optimal ignition timing according to signals sent from various sensors (which monitor the operating conditions of the engine), and sends a signal to the igniters.

The ECU has a "learning" control function which provides superb transient characteristics for responsive ignition timing control.

Refer to 2-7 "FUEL INJECTION SYSTEM".

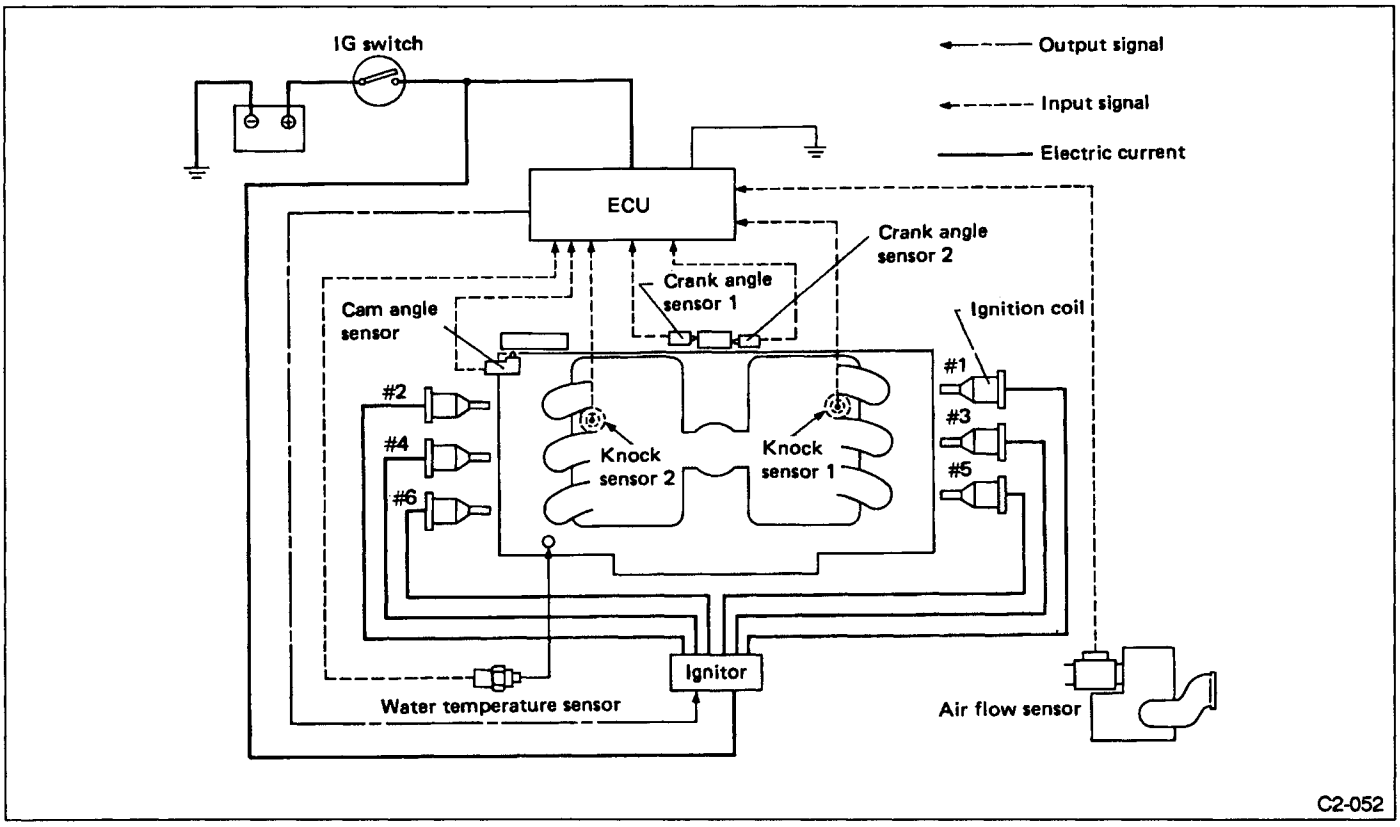


Fig. 4

8. EGR (Exhaust Gas Recirculation) System

A: DESCRIPTION

1. GENERAL

The EGR system recirculates a part of the exhaust gas into the throttle body from the exhaust manifold to decrease combustion temperature and thereby reduce NOx and improve fuel consumption.

The intake manifold pressure is transmitted to the EGR valve diaphragm when the EGR solenoid valve is opened by the signal from ECU, and the EGR valve is opened. As a result, the exhaust gas is sent into the collector chamber.

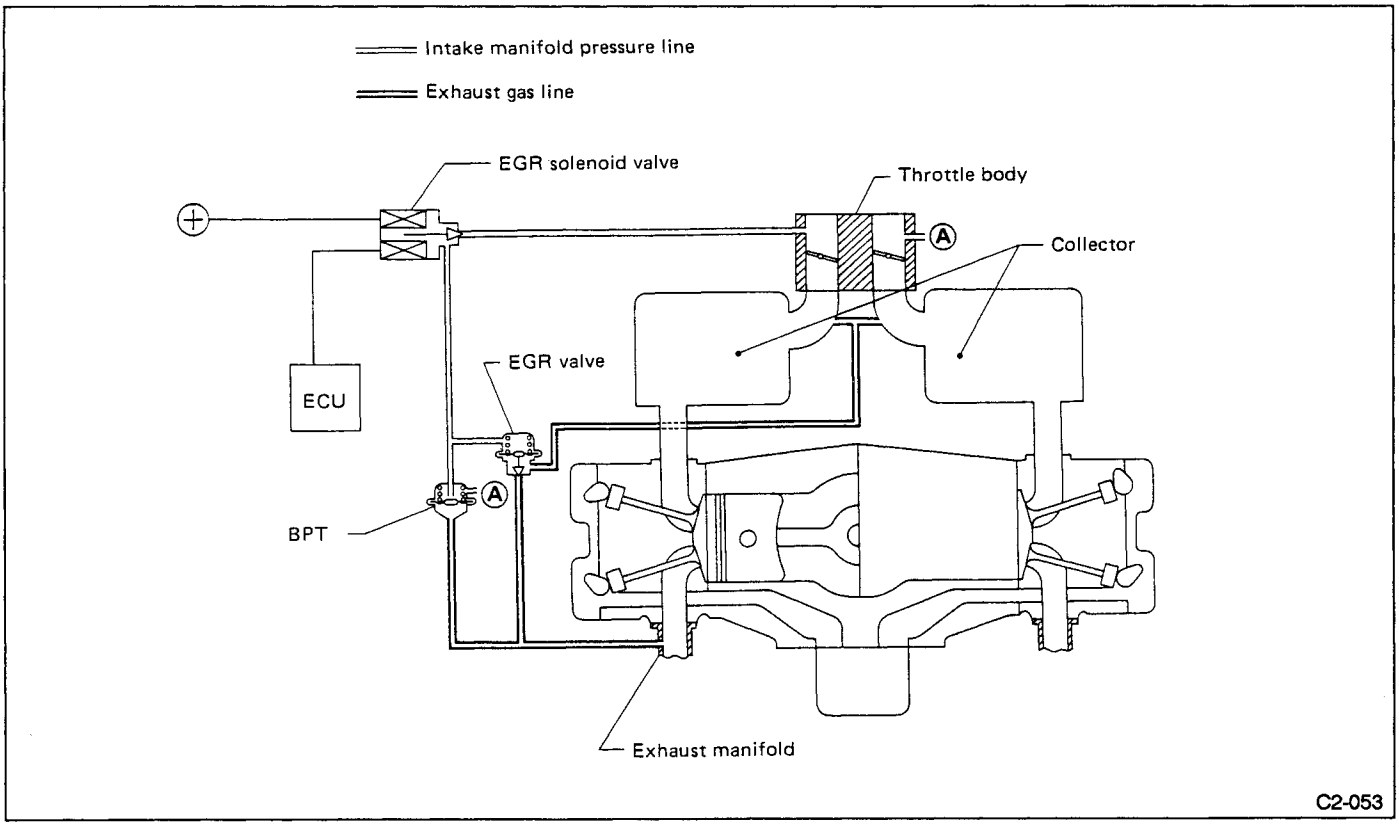


Fig. 5

2. EGR VALVE

The EGR valve is situated between the exhaust manifold and collector. After opening EGR solenoid valve, EGR valve is opened for receiving throttle port pressure on diaphragm. Then, part of the exhaust gas is recirculated into collector chamber.

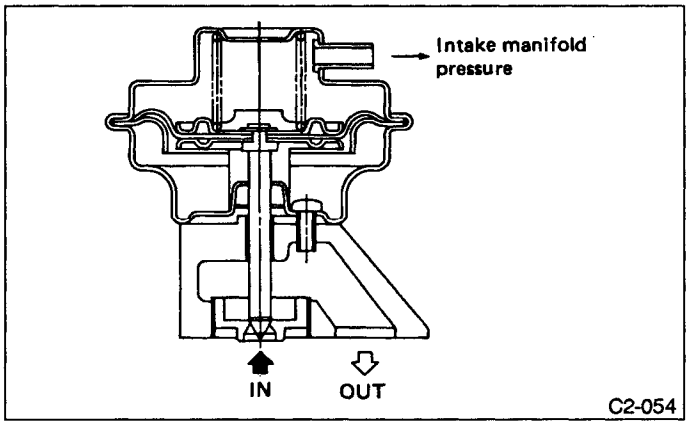


Fig. 6

3. EGR SOLENOID VALVE

The EGR solenoid valve is situated between the throttle body and EGR valve. EGR solenoid valve is opened by a signal emitted from the ECU. Therefore, throttle port pressure is transmitted to diaphragm of EGR valve.

4. BPT

The EGR solenoid valve is either ON or OFF. The EGR vacuum controller performs control corresponding to a change in the engine operating condition after the solenoid valve is opened.

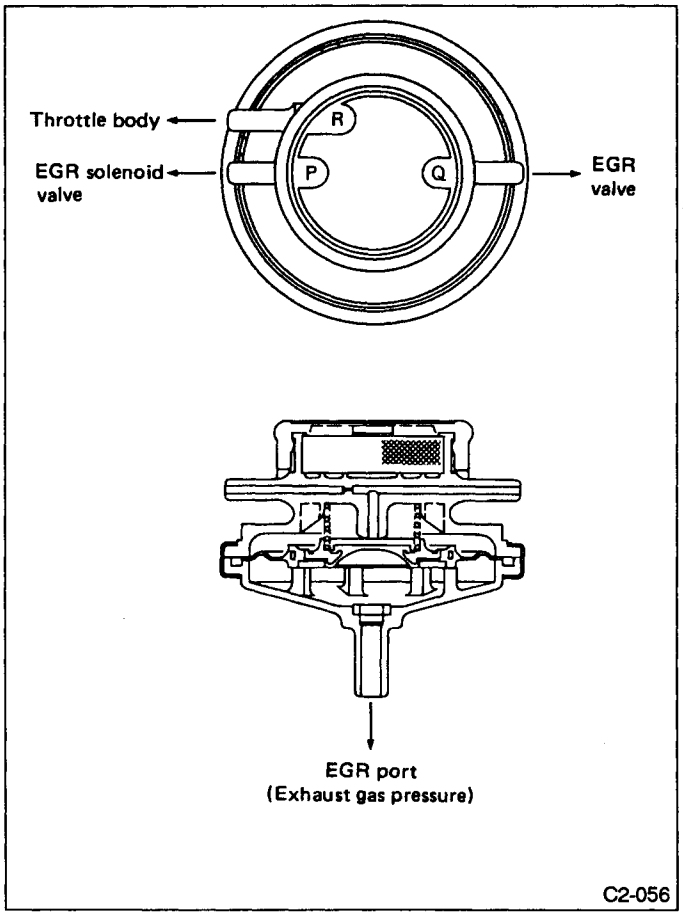


Fig. 7

9. Evaporative (EVAP) Emission Control System

A: DESCRIPTION

1. GENERAL

The evaporative emission control system is employed to prevent evaporative fuel from being discharged into ambient atmosphere. This system includes a canister, purge control solenoid valve, fuel cut valve, their connecting lines, etc.

Gasoline vapor evaporated from the fuel in the fuel tank is introduced into the canister located in the engine compartment through the evaporation line, and is absorbed on activated carbon in it. A fuel cut valve is also incorporated on the tank fuel line.

The purge control solenoid valve is controlled by the ECU and provides optimal purge control according to the coolant temperature, engine load and vehicle speed.

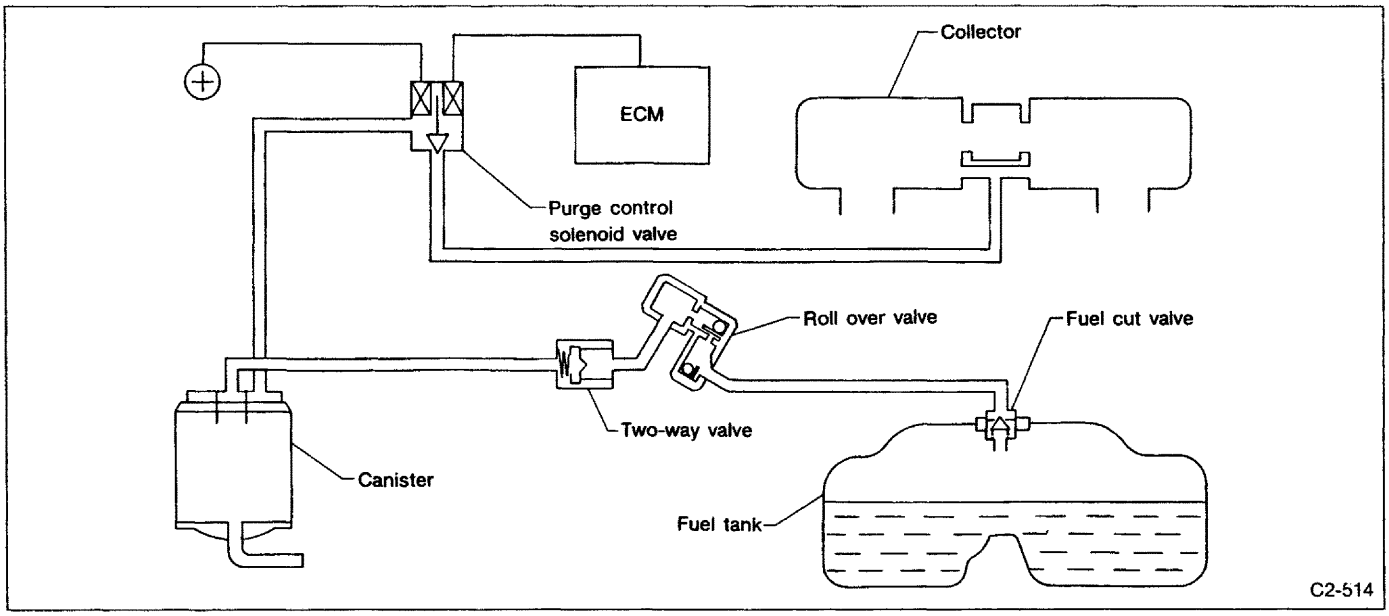


Fig. 2

2. FUEL CUT VALVE

The fuel cut valve is built onto the evaporation pipe of the fuel tank cap. The rising level of the fuel from the fuel tank causes the float to move up and close the cap hole so that no fuel can enter during evaporation line.

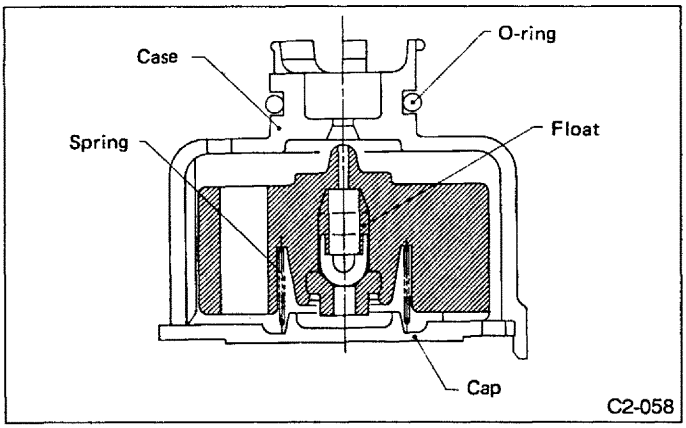


Fig. 9

3. FUEL CAP

The relief valve is adopted to prevent the development of vacuum in the fuel tank which may occur in case of trouble in the fuel vapor line.

In normal condition, the filler pipe is sealed at Ⓐ and at the packing pressed against the filler pipe end. As vacuum develops in the fuel tank, atmospheric pressure forces the spring down to open the valve; consequently air is led into the fuel tank controlling the inside pressure.

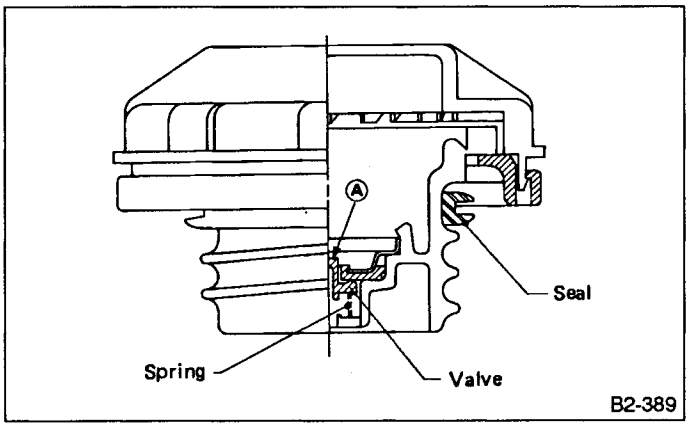


Fig. 10

4. CANISTER

The canister temporarily stores the evaporation gas. When the purge control solenoid valve is opened from a signal sent from the ECU, the evaporation gas is sent into the collector chamber after being mixed with fresh external air.

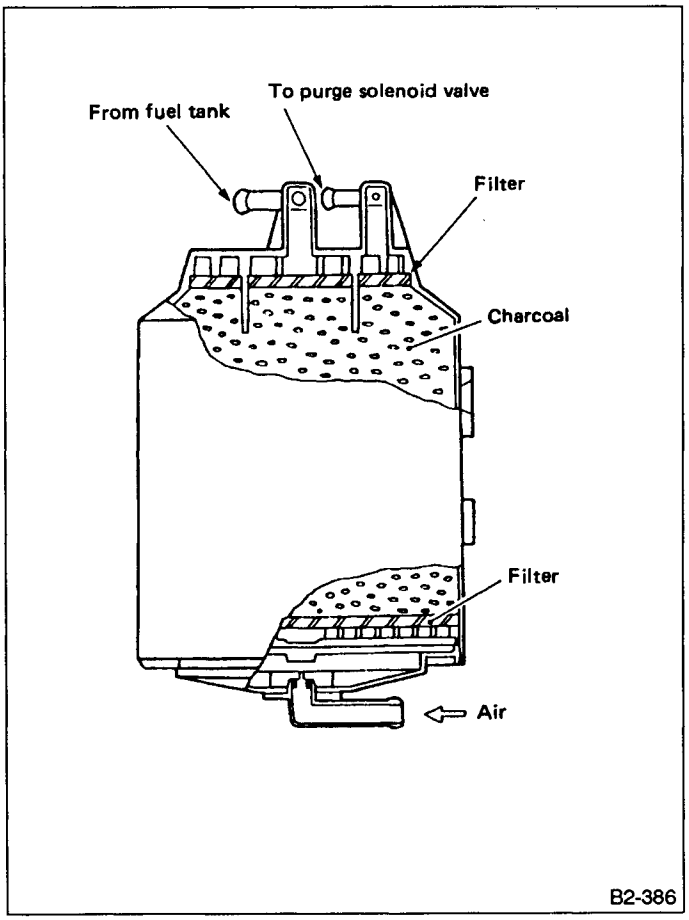


Fig. 11

Refer to 2-8 "Fuel System" as for removal procedure.

5. PURGE CONTROL SOLENOID VALVE

The purge control solenoid valve is on the evaporation line between canister and collector chamber. It is built on the inside of collector chamber.

B: INSPECTION

1) Remove fuel filler cap.
2) Disconnect evaporation hose from canister. Check for unobstructed evaporation line by blowing air into hose.
3) Disconnect purge hose from canister. Blow air through hose to ensure that air does not leak.
Be careful not to suck on the hose as this causes fuel evaporating gas to enter your mouth.
4) Check the exterior of the canister to ensure that it is not cracked or scratched.

10. Fuel Pump Discharge Flow Control System

A: GENERAL

If the fuel pump discharge is always constant, the injection amount from the jet pump increases at high engine speeds, and this leads to increased generation of evaporation gas.
This fuel pump discharge flow control system reduces the fuel pump discharge and return flow to reduce the injection quantity from the jet pump, thereby reducing the generation of evaporation gas at higher engine speeds.

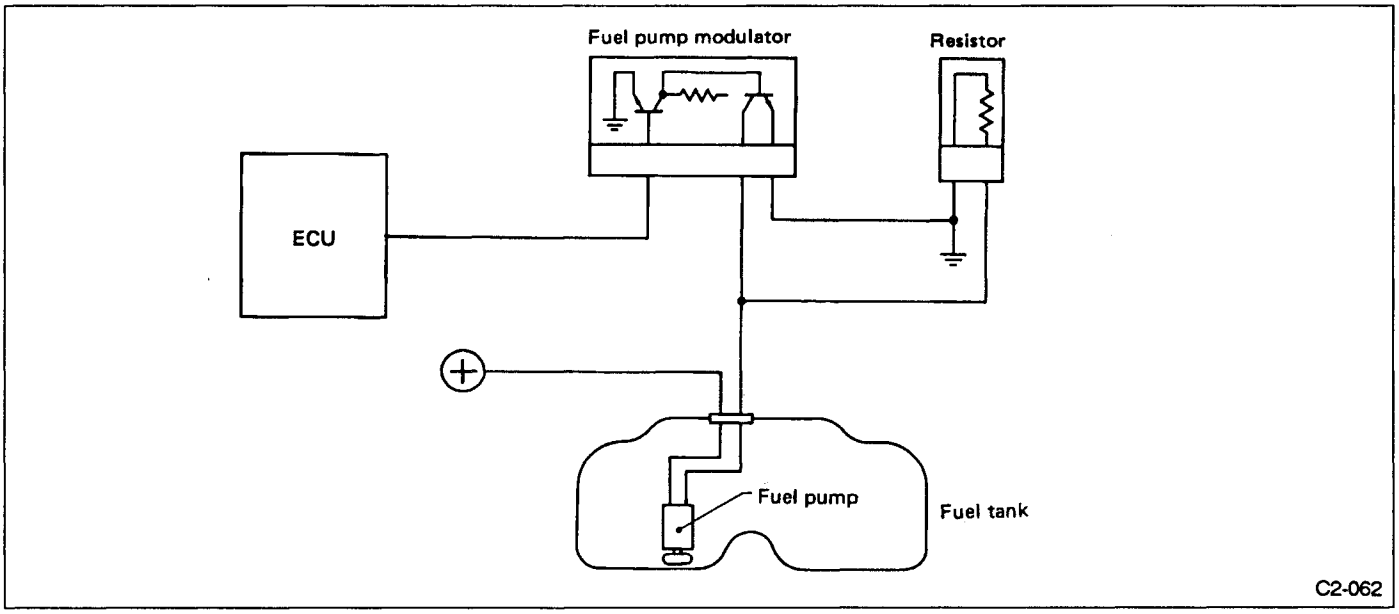


Fig. 12

B: FUNCTION

1) At low engine speeds, the source current flows directly through the fuel pump to the ground, and the fuel pump sends fuel at the specified discharge rate.
2) As the engine speed increases, the ECU sends a signal out to the fuel pump modulator to allow the source current to flow through the fuel pump modulator and resistor to ground.
3) In this way, the amount of current flowing through the fuel pump varies with engine speed, thus fuel pump discharge is controlled.

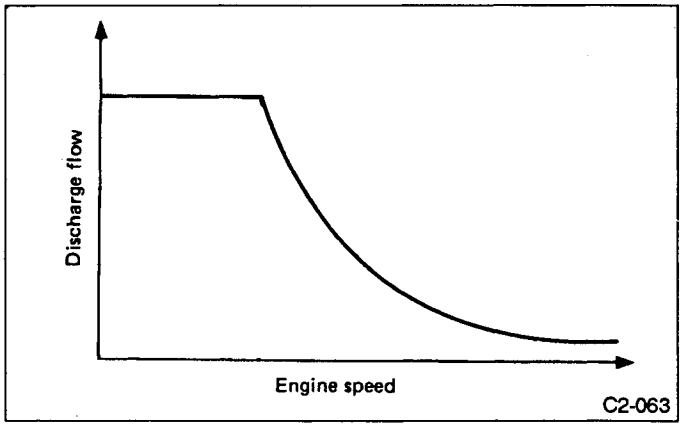


Fig. 13

C: INSPECTION

1) Warm up engine until radiator fan starts to operate.
2) Stop engine, and connect the voltage meter to fuel pump connector.

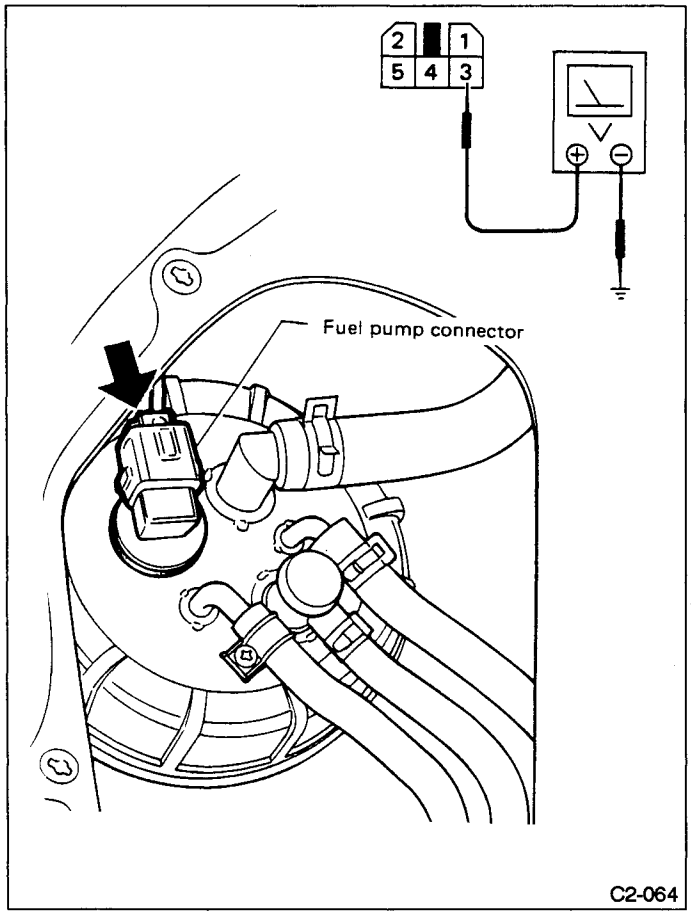


Fig. 14

3) Check voltage while engine is running.

Specified voltage:
No. 3 — Body / 10V, min.

4) Gradually higher1 engine speed, and see that voltage lowers.

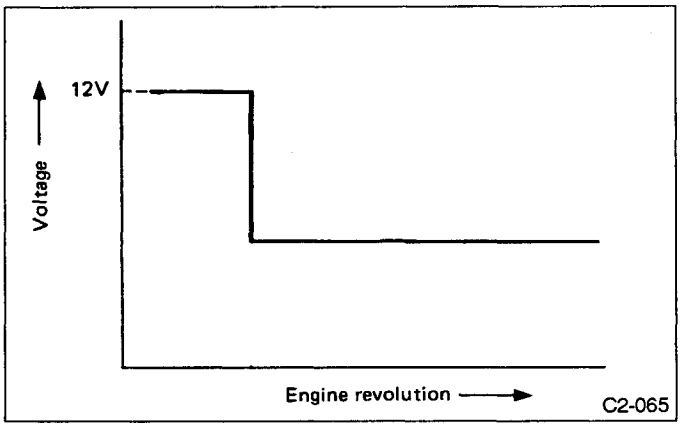


Fig. 15

5) If voltage did not change, check for following.
(1) Measure voltage between ECU and body.

Specified voltage:
(B61) No. 14 — Body / 5V, min.

(2) Remove fuel pump modulator, and measure resistance of harness connector between modulator and fuel pump.

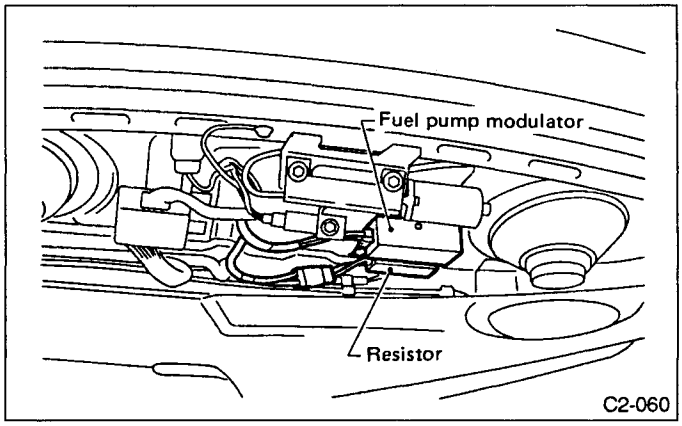


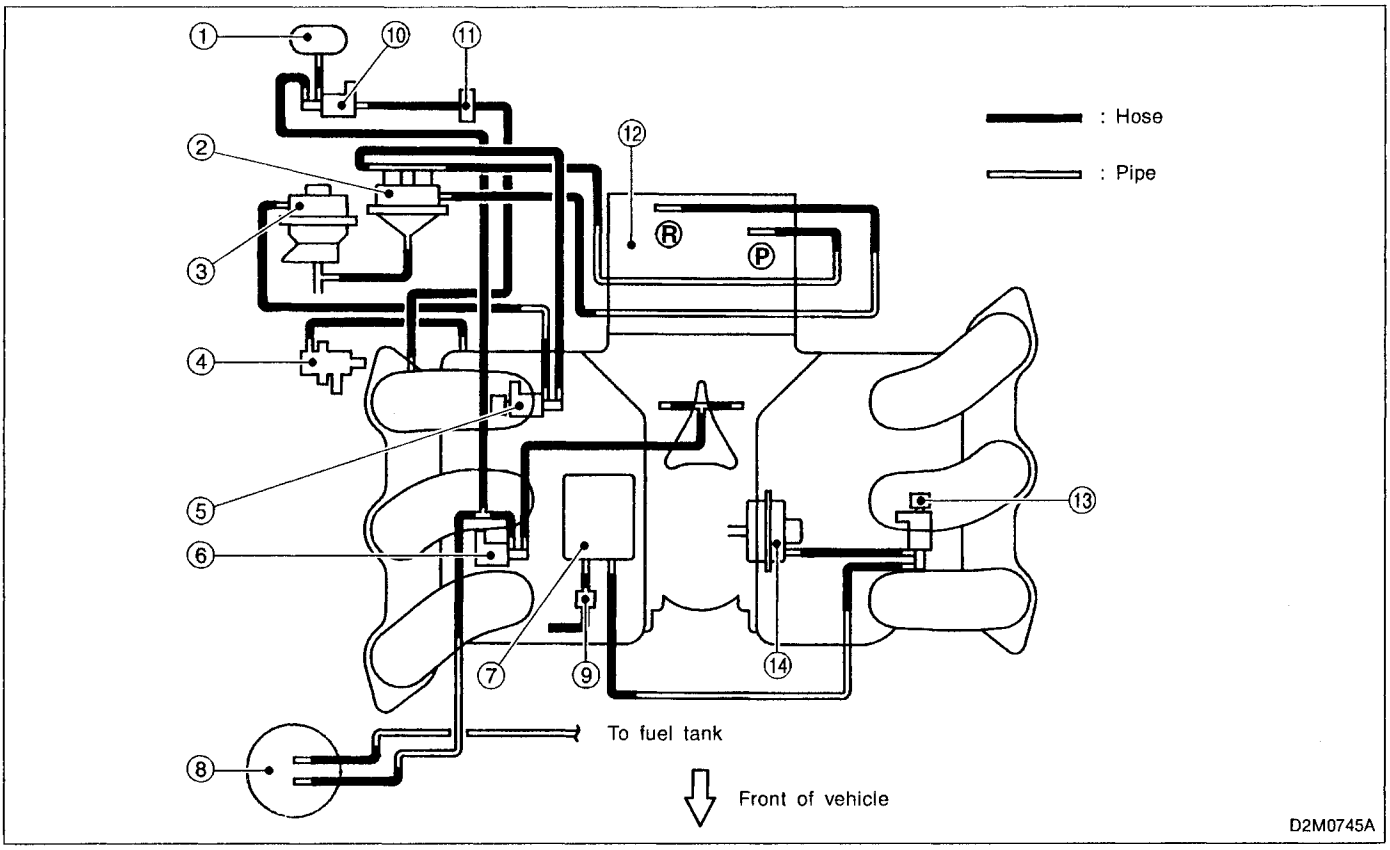
Fig. 16

Specified resistance:
(R33) No. 1 — (R23) No. 4 / 0 Ω
(R33) No. 3 — (R23) No. 1 / 0 Ω

(3) Measure resistance of harness connector between modulator and resistor.

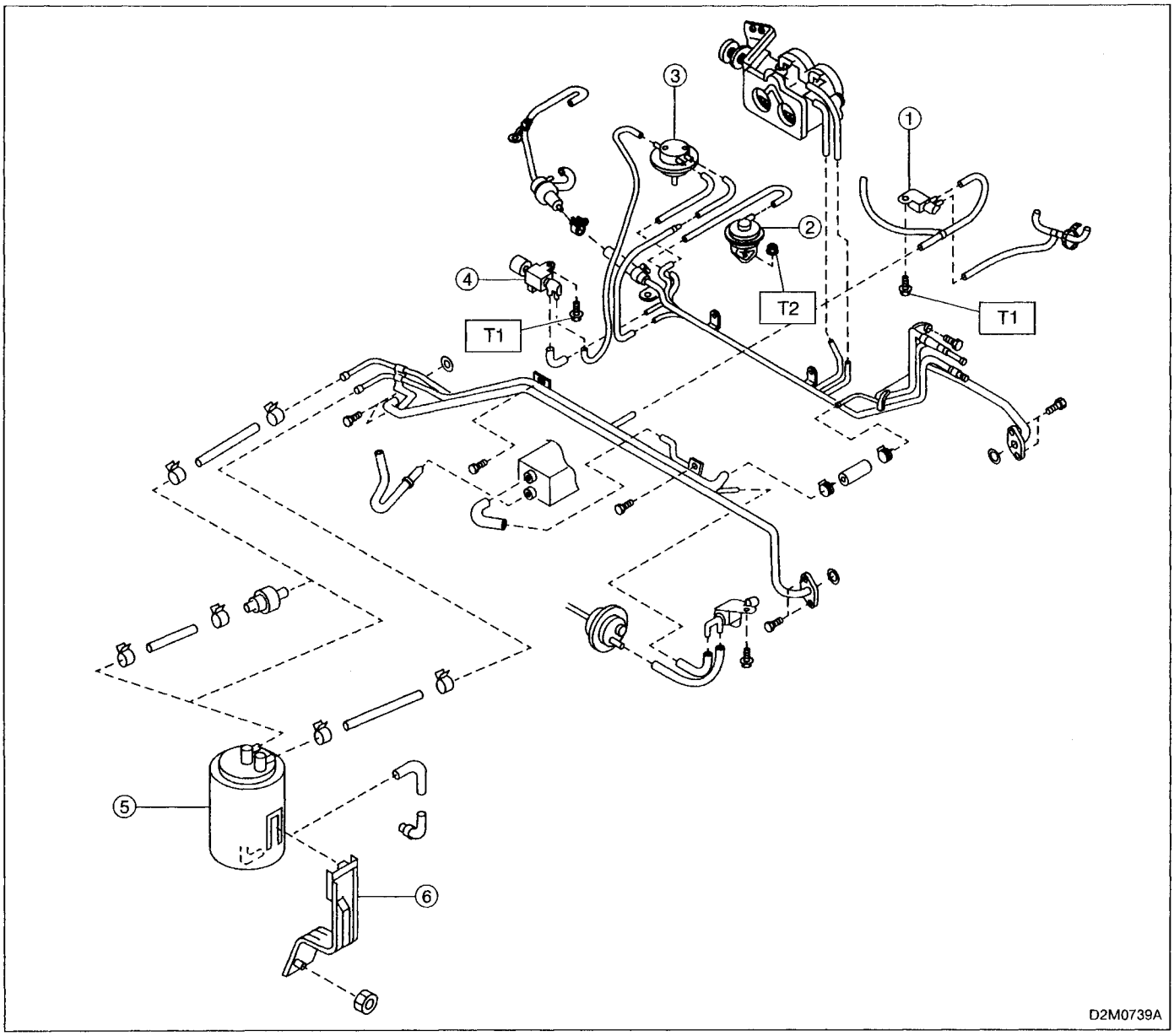
Specified resistance:
(R33) No. 1 — (R34) No. 2 / 0 Ω

11. Vacuum Fitting



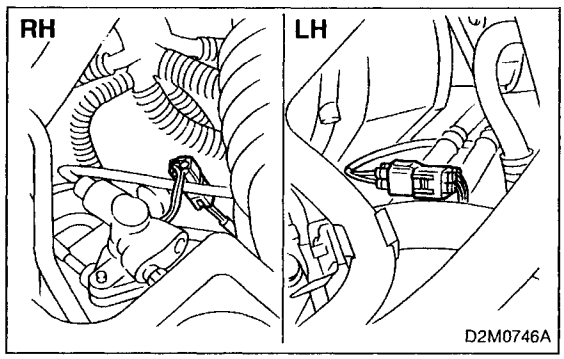
① Pressure sensor
② BPT
③ EGR valve
④ Pressure regulator
⑤ EGR control solenoid valve
⑥ Purge control solenoid valve
⑦ Vacuum tank
⑧ Canister
⑨ One-way valve
⑩ Pressure sources switching solenoid valve
⑪ Filter
⑫ Throttle body
⑬ Induction control solenoid valve
⑭ Diaphragm

1. Emission Control System



① Purge control solenoid valve
② EGR valve
③ Back-pressure transducer (BPT)
④ EGR control solenoid valve
⑤ Canister
⑥ Canister bracket

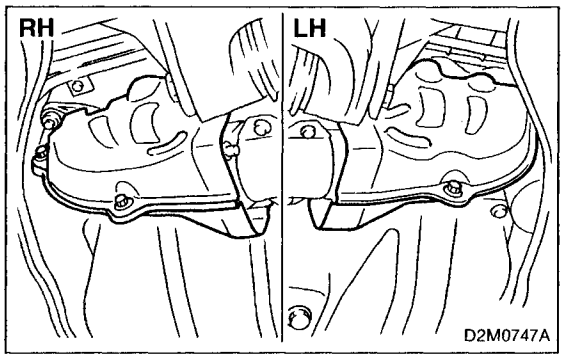
Tightening torque: N·m (kg-m, ft-lb)
T1: 16 ± 1.5 (1.6 ± 0.15, 11.6 ± 1.1)
T2: 19 ± 1.5 (1.9 ± 0.15, 13.7 ± 1.1)



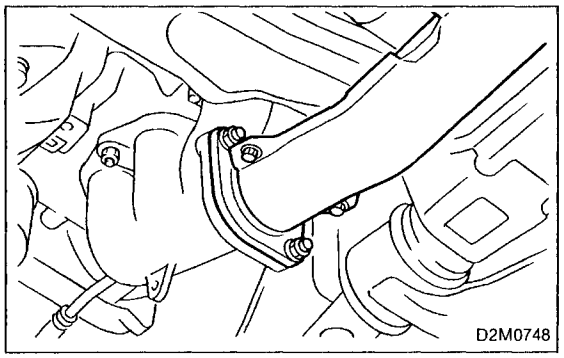
1. Front Catalytic Converter (RH & LH)

A: REMOVAL

1) Disconnect front oxygen sensor connectors (RH and LH).

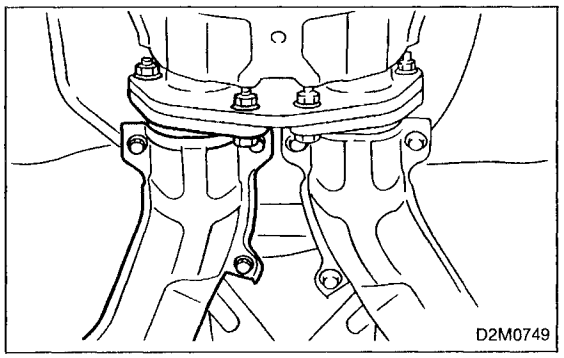


2) Lift-up the vehicle.
3) Remove exhaust manifold covers (RH and LH).

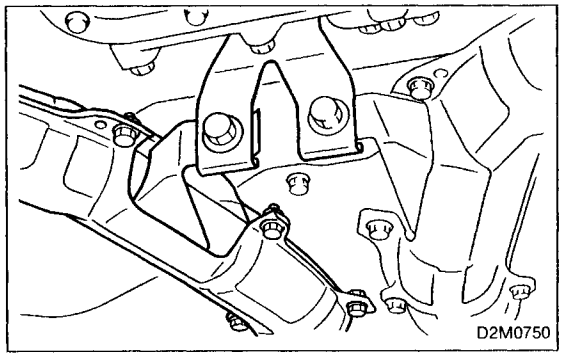


CAUTION:
To prevent front exhaust pipes from dropping, do not remove the right and left exhaust pipes at the same time; always remove one at a time.

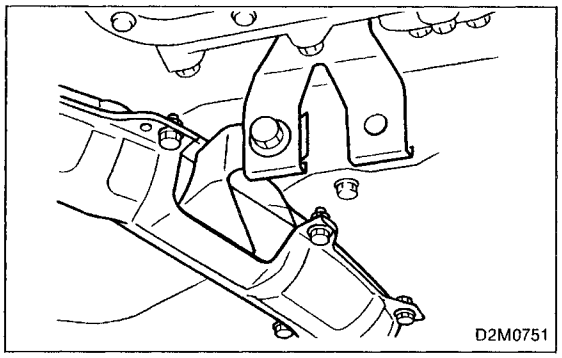
4) Separate one front exhaust pipe from exhaust manifold.



5) Separate front exhaust pipe from rear catalytic converter.



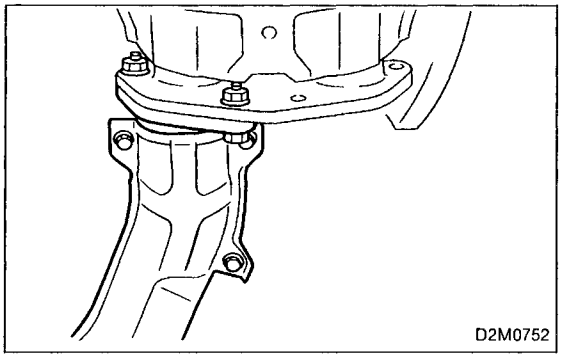
6) Remove front exhaust pipe from hanger bracket.
NOTE:
The front catalytic converter is a unit with the front exhaust pipe.
7) Similarly, remove the other front exhaust pipe.
8) If necessary, remove heat sealed covers and oxygen sensor from front exhaust pipe.



B: INSTALLATION

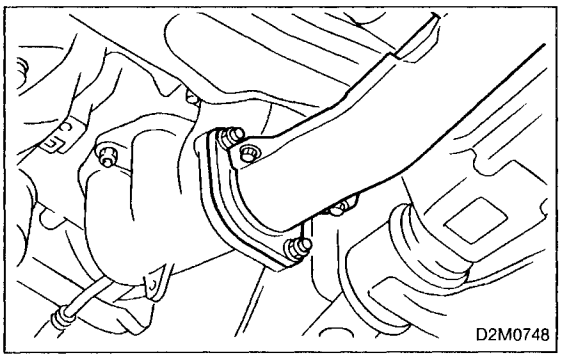
CAUTION:
Replace gaskets with new ones.

1) Install one front exhaust pipe to hanger bracket. And temporarily tighten nut which installs front exhaust pipe to hanger bracket.



2) Install front exhaust pipe to rear catalytic converter.

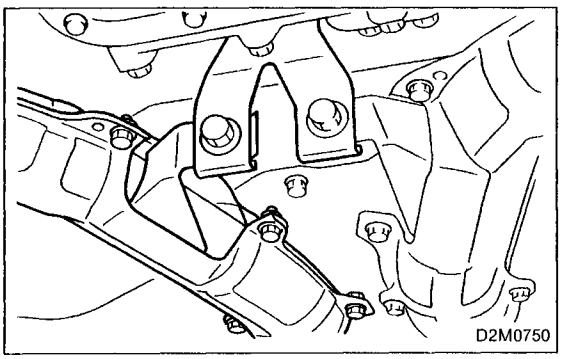
Tightening torque:
34 ± 5 N·m (3.5 ± 0.5 kg-m, 25.3 ± 3.6 ft-lb)



3) Install front exhaust pipe to exhaust manifold.

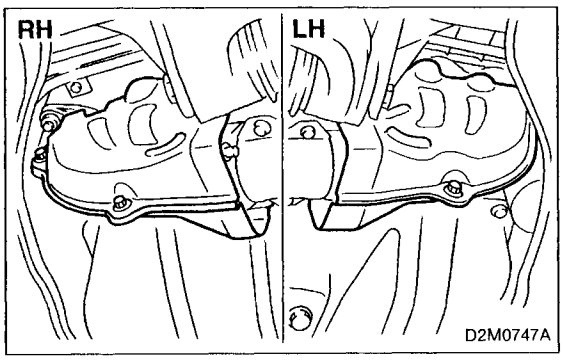
Tightening torque:
34 ± 5 N·m (3.5 ± 0.5 kg-m, 25.3 ± 3.6 ft-lb)

4) Similarly, install the other front exhaust pipe.



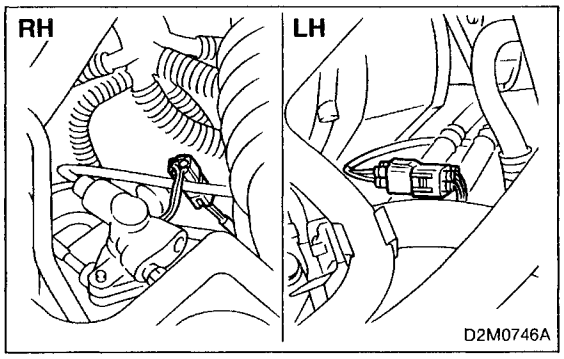
5) Tighten nuts which hold front exhaust pipes to hanger bracket.

Tightening torque:
34 ± 5 N·m (3.5 ± 0.5 kg-m, 25.3 ± 3.6 ft-lb)

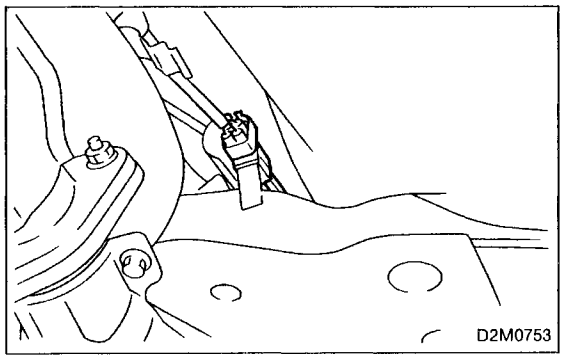


6) Install exhaust manifold covers (RH and LH).

Tightening torque:
19 ± 1.5 N·m (1.9 ± 0.15 kg-m, 13.7 ± 1.1 ft-lb)



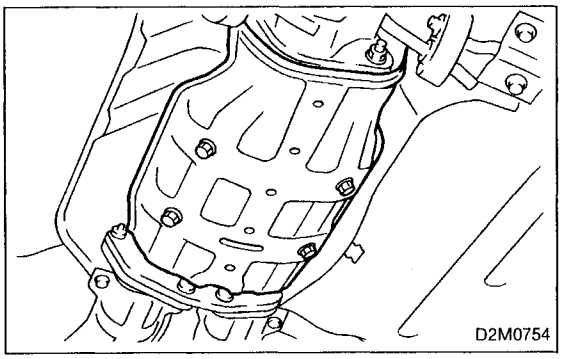
7) Lower the vehicle.
8) Connect front oxygen sensor connectors (RH and LH).



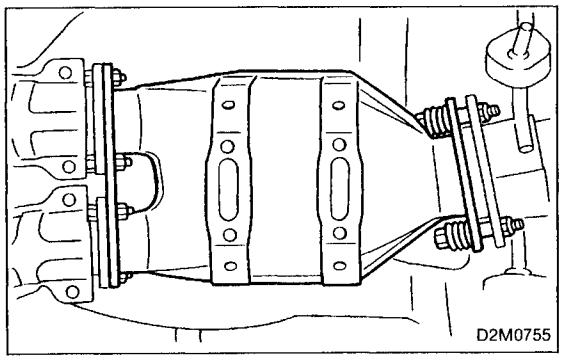
2. Rear Catalytic Converter

A: REMOVAL

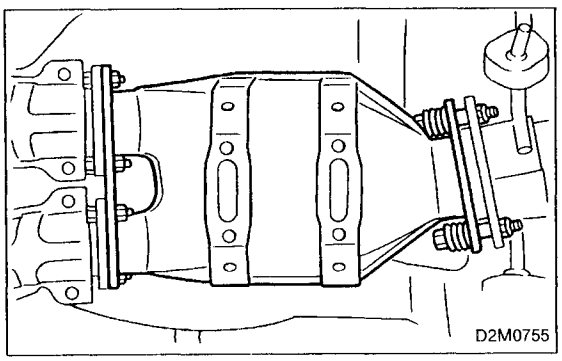
1) Lift-up the vehicle.
2) Disconnect rear oxygen sensor connector.



3) Remove rear catalytic converter protector.



4) Separate rear catalytic converter from front exhaust pipes.
5) Separate rear catalytic converter from rear exhaust pipe.
6) Remove rear catalytic converter.



B: INSTALLATION

CAUTION:
Replace gaskets with new ones.

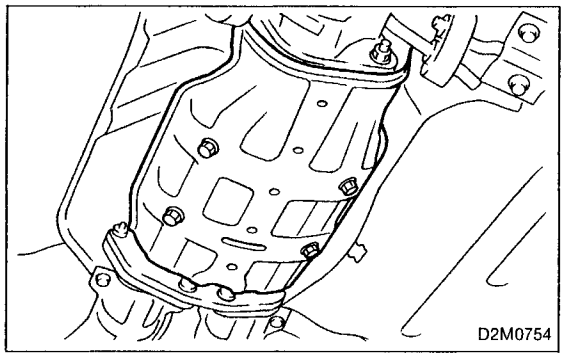
1) Install rear catalytic converter to rear exhaust pipe.

CAUTION:
Be sure to install bolts, springs, and nuts in the original order.

Tightening torque:
18 ± 5 N·m (1.8 ± 0.5 kg-m, 13.0 ± 3.6 ft-lb)

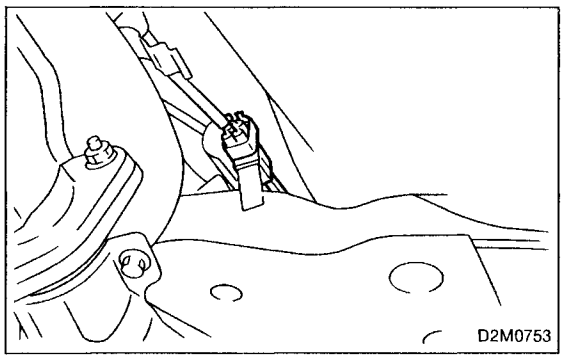
2) Install rear catalytic converter to front exhaust pipes.

Tightening torque:
34 ± 5 N·m (3.5 ± 0.5 kg-m, 25.3 ± 3.6 ft-lb)

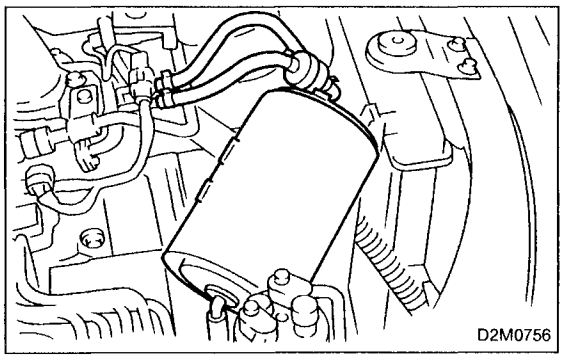


3) Install rear catalytic converter protector.

Tightening torque:
18 ± 5 N·m (1.8 ± 0.5 kg-m, 13.0 ± 3.6 ft-lb)



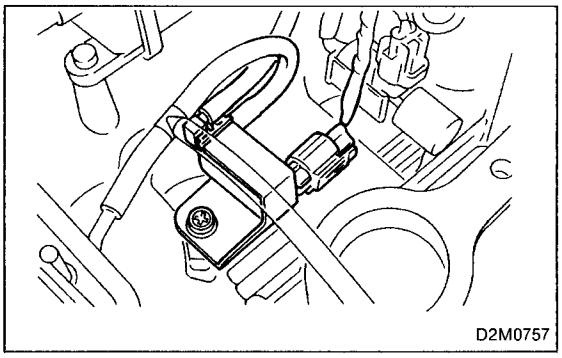
4) Connect rear oxygen sensor connector.



3. Canister

A: REMOVAL AND INSTALLATION

1) Disconnect canister hoses from evaporation pipes.
2) Remove canister from hanger, then disconnect hose from bottom position of canister.
3) Installation is in the reverse order of removal.


D2M0757

4. Purge Control Solenoid Valve

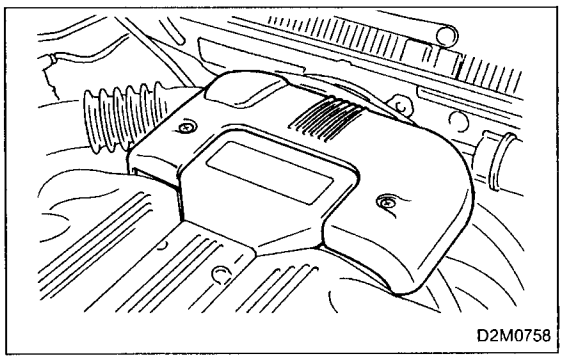
A: REMOVAL AND INSTALLATION

1) Remove collector chamber from intake manifold. <Ref. to 2-7 [W4A0].☆5>
2) Disconnect hoses from purge control solenoid valve.
3) Remove bolt which installs purge control solenoid valve onto collector chamber, then remove purge control solenoid valve.

NOTE:
This figure shows the rear side of collector chamber.

4) Installation is in the reverse order of removal.

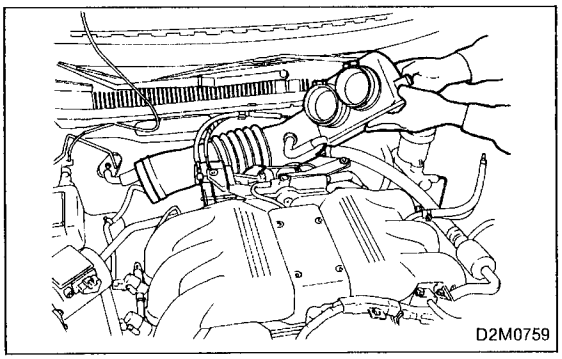
Tightening torque:
16 ± 1.5 N·m (1.6 ± 0.15 kg-m, 11.6 ± 1.1 ft-lb)


D2M0758

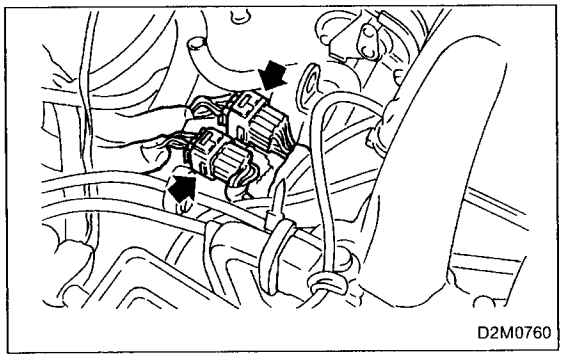
5. EGR Valve

A: REMOVAL AND INSTALLATION

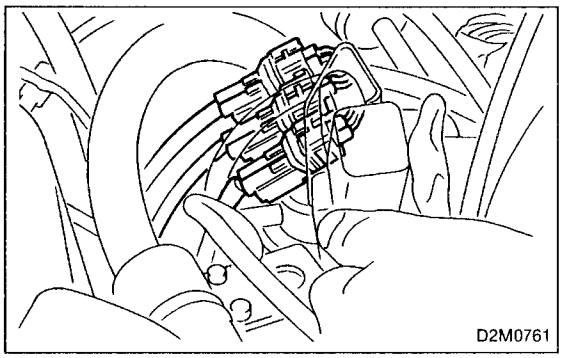
1) Remove collector cover.


D2M0759

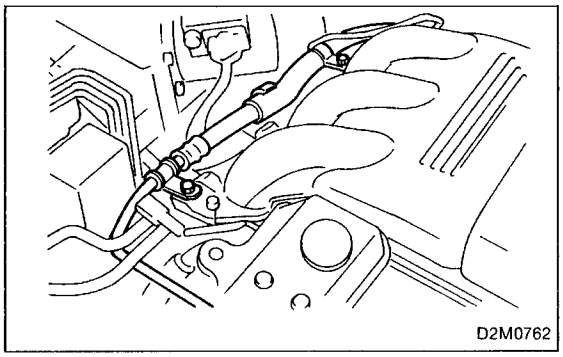
2) Remove air intake duct.


D2M0760

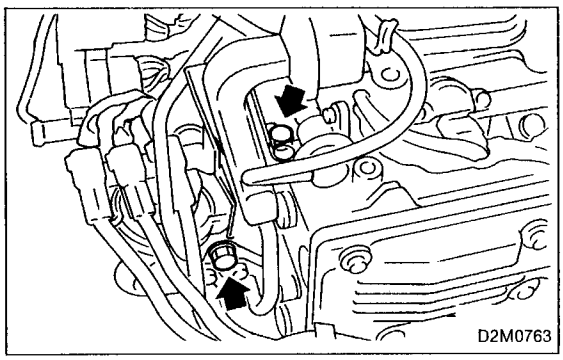
3) Disconnect engine harness connectors.
4) Remove bolt from engine harness connector bracket, then position the bracket away from its original position.


D2M0761

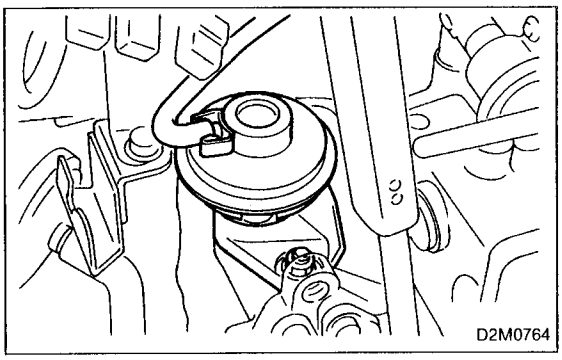
5) Disconnect ignition coil connectors (engine RH).


D2M0762

6) Remove bolts which install power steering hose bracket to engine, and position the hose away from engine.


D2M0763

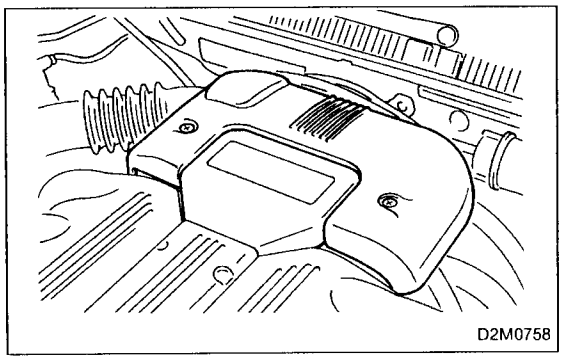
7) Remove bolts which install BPT bracket to cylinder block.


D2M0764

8) Disconnect vacuum hose from EGR valve.
9) Remove nuts which install EGR valve, then remove EGR valve and gasket.
10) Installation is in the reverse order of removal.

CAUTION:
Replace gasket with a new one.

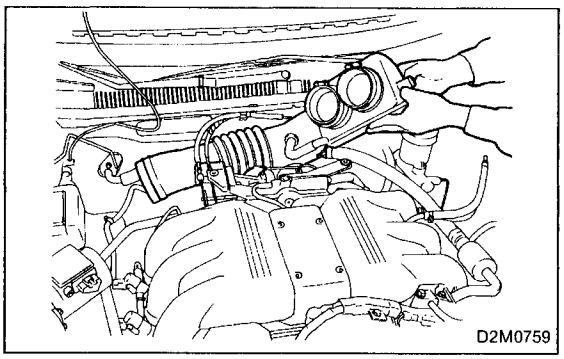
Tightening torque:
19 ± 1.5 N·m (1.9 ± 0.15 kg-m, 13.7 ± 1.1 ft-lb)


D2M0758

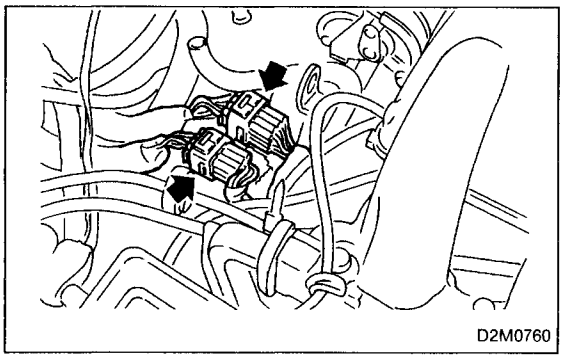
6. Back-Pressure Transducer (BPT)

A: REMOVAL AND INSTALLATION

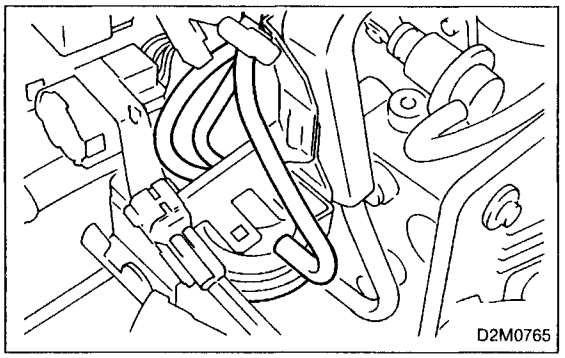
1) Remove collector cover.


D2M0759

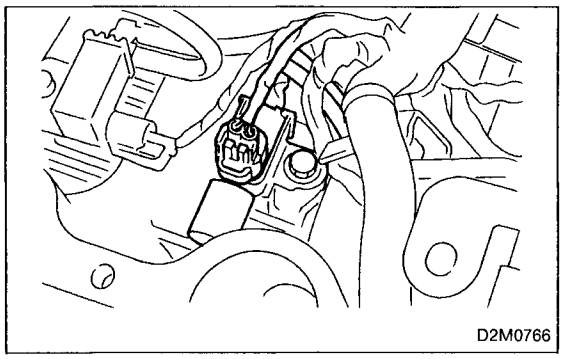
2) Remove air intake duct.


D2M0760

3) Disconnect engine harness connectors.
4) Remove bolt from engine harness connector bracket, then position the bracket away from its original position.


D2M0765

5) Disconnect vacuum hoses from BPT.
6) Remove BPT from bracket.
7) Installation is in the reverse order of removal.


D2M0766

7. EGR Control Solenoid Valve

A: REMOVAL AND INSTALLATION

1) Remove collector chamber from intake manifold.
<Ref. to 2-7 [W4A0].☆5>
2) Disconnect hoses from EGR control solenoid valve.
3) Remove bolt which installs EGR control solenoid valve onto collector chamber, then remove EGR control solenoid valve.
NOTE:
This figure shows the rear side of collector chamber.
4) Installation is in the reverse order of removal.

Tightening torque:
16 ± 1.5 N·m (1.6 ± 0.15 kg-m, 11.6 ± 1.1 ft-lb)