SUZUKI

TECHNICAL DEPT

VITARA

SUPPLEMENTARY SERVICE MANUAL
FOR ELECTRONIC FUEL INJECTION WITH CATALYTIC CONVERTER MODELS

USE THIS MANUAL WITH.
VITARA SERVICE MANUAL (00000A00698 IN)

SUZUKI
Caring for Customers

Pub. 00000A00 910 IN

FOREWORD

This SUPPLEMENTARY SERVICE MANUAL is a supplement to VITARA SERVICE MANUAL 00000A00698 IN and has been prepared for Electronic Fuel Injection with catalytic converter model.

When servicing Electronic Fuel Injection with catalytic converter model, consult this manual first. And for any item or description not contained in this manual, refer to the above mentioned SERVICE MANUAL.

When replacing parts or servicing by disassembling, it is recommended to use SUZUKI genuine parts, tools and service materials (lubricants, sealants, etc.) as specified in each description.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

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WIRING DIAGRAM

SANTANA - MOTOR, S.A.

SECTION 0B

MAINTENANCE AND LUBRICATION

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MAINTENANCE SCHEDULE

NOTE:
This table includes services as scheduled up to 80,000 km (48,000 miles) mileage. Beyond 80,000 km (48,000 miles), carry out the same services at the same intervals respectively.

Interval: This interval should be judged by odometer reading or months, whichever comes first.									
	km	(x 1,000)	10	20	30	40	50	60	70	80
	miles	(x 1,000)	6	12	18	24	30	36	42	48
	months		6	12	18	24	30	36	42	48
ENGINE & EMISSION CONTROL										
1-1. Fan (Water pump) drive belt			–	–	–	I	–	–	–	R
1-2. Camshaft timing belt			–	–	–	–	–	–	–	I
1-3. Valve lash (clearance)			–	I	–	I	–	I	–	I
1-4. Engine oil and oil filter			R	R	R	R	R	R	R	R
1-5. Cooling system hoses and connections			–	–	–	I	–	–	–	I
1-6. Engine coolant			–	–	–	R	–	–	–	R
1-7. Exhaust pipes and mountings			–	–	–	I	–	–	–	I&(R)
EMISSION CONTROL										
2-1. PCV valve			–	–	–	–	–	–	–	I
2-2. Oxygen sensor			–	–	–	–	–	–	–	R
2-3. Charcoal canister			–	–	–	–	–	–	–	I
ELECTRICAL SYSTEM										
3-1. Wiring harness and connections			–	–	–	I	–	–	–	I
IGNITION SYSTEM										
4-1. Spark plugs			–	–	–	–	R	–	–	–
4-2. Distributor cap and rotor			–	–	–	I	–	–	–	I
4-3. Ignition wiring			–	–	–	–	–	–	–	R
4-4. Ignition timing			–	–	–	I	–	–	–	I
4-5. Distributor advance			–	–	–	I	–	–	–	I
FUEL										
5-1. Fuel tank cap			–	–	–	I	–	–	–	R
5-2. Air cleaner filter element			I	I	I	R	I	I	I	R
5-3. Fuel filter			–	–	–	**R	–	–	–	R
5-4. Fuel lines and connections			–	–	–	I	–	–	–	I
5-5. Idle speed			–	I	–	I	–	I	–	I
CHASSIS AND BODY										
6- 1. Clutch			–	I	–	I	–	I	–	I
6- 2. Brake discs and pads (front) Brake drums and shoes (rear)			–	I	–	I	–	I	–	I
6- 3. Brake hoses and pipes			–	I	–	I	–	I	–	I
6- 4. Brake fluid			–	I	–	R	–	I	–	R
6- 5. Brake pedal			–	I	–	I	–	I	–	I
6- 6. Brake lever and cable			–	I	–	I	–	I	–	I
6- 7. Tires			I	I	I	I	I	I	I	I
6- 8. Wheel discs and free wheeling hubs (if equipped)			I	I	I	I	I	I	I	I
6- 9. Wheel bearings			–	I	–	*I	–	I	–	*I
6-10. Suspension system			I	I	–	I	–	I	–	I
6-11. Propeller shafts			–	I	–	I	–	I	–	I
6-12. Transmission oil (Manual)			R	I	I	R	I	I	I	R
6-13. Transfer and differential oil			R	I	I	R	I	I	I	R
6-14. Steering system			I	I	I	I	I	I	I	I
6-15. Power steering (if equipped)			I	I	I	I	I	I	I	I
6-16. Door hinges			L	L	L	L	L	L	L	L

NOTE:
"R" : Replace or change *"L" : Lubricate*
"I" : Inspect and correct or replace if necessary *"T" : Tighten to the specified torque*

- *Item 1-7 (R) is applicable to exhaust mounting rubber only.*
- *Item 5-3 **R is recommended maintenance item.*
- *Item 5-5 is recommended maintenance item.*
- *Item 6-9 *I is applicable to "wear" and "grease condition".*

MAINTENANCE RECOMMENDED UNDER SEVERE DRIVING CONDITIONS

If the vehicle is usually used under the conditions corresponding to any severe condition code given below, it is recommended that applicable maintenance operation be performed at the particular interval as given in the below chart.

Severe condition code

A — Towing a trailer
B — Repeated short trips
C — Driving on rough and/or muddy roads
D — Driving on dusty roads
E — Driving in extremely cold weather and/or salted roads
F — Repeated short trips in extremely cold weather

Severe Condition Code	Maintenance	Maintenance Operation	Maintenance Interval
– – C D – –	Water pump (fan) drive belt	I	Every 12,000 miles (20,000 km) or 12 months
		R	Every 24,000 miles (40,000 km) or 24 months
A – – D E F	Engine oil and oil filter	R	Every 3,000 miles (5,000 km) or 3 months
A B C – E –	Exhaust pipes and mountings	I	Every 6,000 miles (10,000 km) or 6 months
– – – D – –	Air cleaner filter element *1	I	Every 1,500 miles (2,500 km)
		R	Every 12,000 miles (20,000 km) or 12 months
A B C D – –	Brake discs and pads (Front) Brake drums and shoes (Rear)	I	Every 6,000 miles (10,000 km) or 6 months
A B C – – –	Propeller shafts	I	Every 6,000 miles (10,000 km) or 6 months
A – C – – –	Transmission, transfer and differential oil	R	Every 12,000 miles (20,000 km) or 12 months
– – C – – –	Drive axle shaft boots	I	Every 6,000 miles (10,000 km) or 6 months
– – C – – –	Bolts and nuts on chassis	T	Every 6,000 miles (10,000 km) or 6 months

NOTE:
I — Inspect and correct or replace if necessary *T — Tighten to the specified torque*
R — Replace or change

**1 Inspect or replace more frequently if the vehicle is used under dusty conditions.*

MAINTENANCE SERVICE

ENGINE AND EMISSION CONTROL

ITEM 1-1

Water Pump Belt Inspection and Replacement

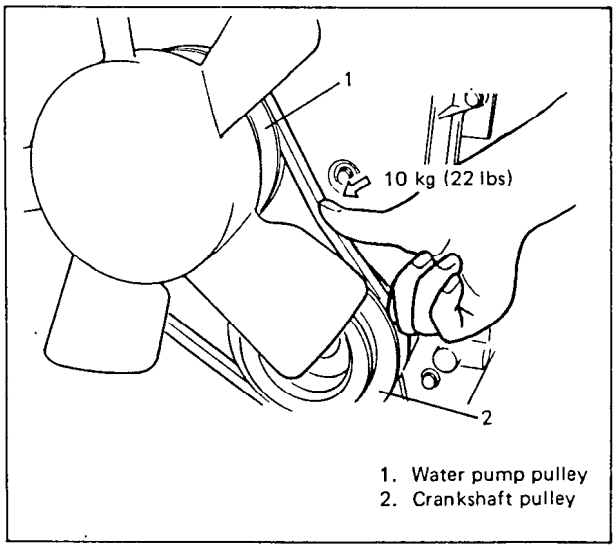
WARNING:
All inspection and replacement are to be performed with ENGINE NOT RUNNING.

[Inspection]

1) Disconnect negative battery lead at battery.
2) Inspect belt for craks, cuts, deformation, wear and cleanliness. If any defect exists, replace. Check belt for tension. The belt is in proper tension if it deflects 6 to 8 mm (0.24 – 0.32 in.) under thumb pressure (about 10 kg or 22 lb.).

Belt tension specification	6 – 8 mm (0.24 – 0.32 in.) as deflection

NOTE:
When replacing belt with a new one, adjust belt tension to 5 – 7 mm (0.20 – 0.27 in.).



1. Water pump pulley
2. Crankshaft pulley

Fig. 0B-1

3) If the belt is too tight or too loose, adjust it to specification by adjusting alternator position.

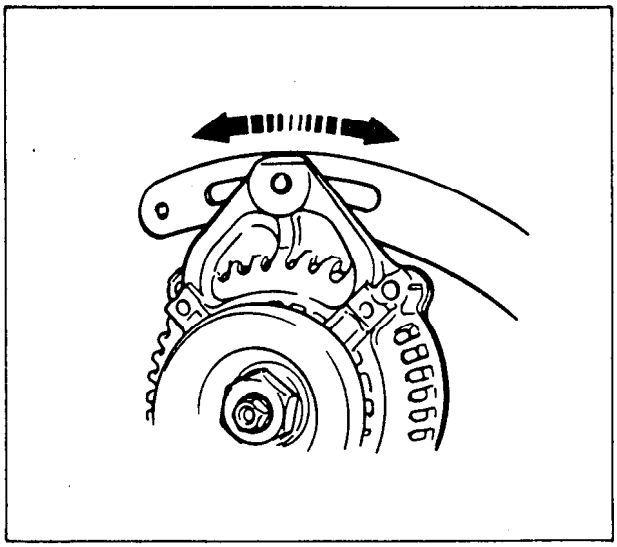


Fig. 0B-2

4) Tighten alternator adjusting bolt and pivot bolts.
5) Connect negative battery lead to battery.

[Replacement]

1) Disconnect negative battery lead at battery.
2) Loosen alternator adjusting bolt and pivot bolts.
3) Replace water pump belt.
4) Adjust belt tension to specification and tighten alternator adjusting bolt and pivot bolts.
5) Connect negative battery lead to battery.

ITEM 1-2

Camshaft Timing Belt Inspection

1) Disconnect negative battery lead at battery.
2) Loosen fan drive belt, and remove radiator shroud and cooling fan & clutch at the same time.

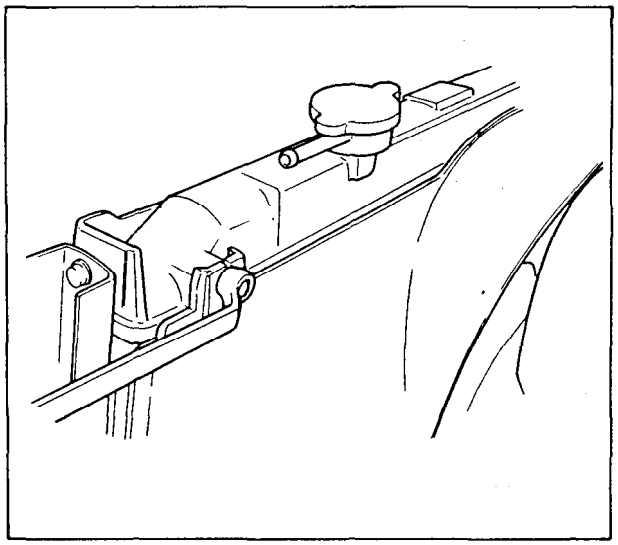
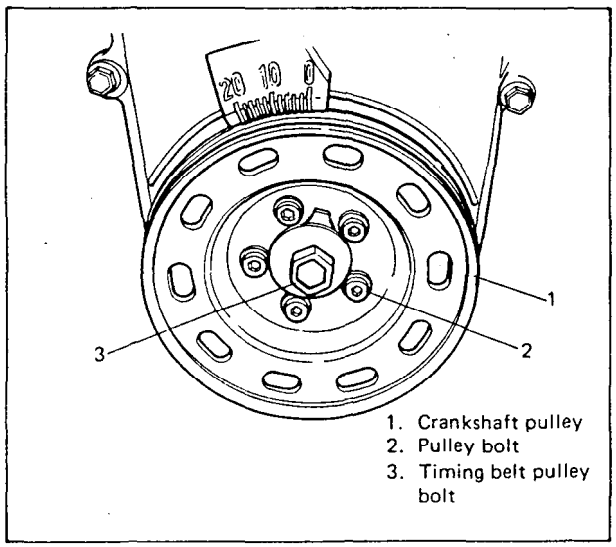


Fig. 0B-3

3) Remove water pump belt and pump pulley.
4) Remove crankshaft pulley by removing 5 pulley bolts. The crankshaft timing belt pulley bolt at the center needs not be loosened.



1. Crankshaft pulley
2. Pulley bolt
3. Timing belt pulley bolt

Fig. 0B-4

5) Remove timing belt outside cover. Inspect the belt for damage or wear. When any damage or wear is found on the belt, replace it.
6) Install timing belt outside cover and torque bolts and nut to specification.
7) Install crankshaft pulley and torque bolts to specification.
8) Install water pump pulley and belt.
9) Install radiator shroud and cooling fan & clutch
10) Adjust water pump belt tension to specification.
11) Connect negative battery lead to battery.

ITEM 1-3

Valve Lash Inspection

1) Remove cylinder head cover.
2) Inspect intake and exhaust valve lash and adjust as necessary.

		When cold (Coolant temperature is 15 – 25°C or 59 – 77°F)	When hot (Coolant temperature is 60 – 68°C or 140 – 154°F)
Valve lash (gap A) specification	Intake	0.13 – 0.17 mm (0.0051 – 0.0067 in.)	0.23 – 0.27 mm (0.009 – 0.011 in.)
	Exhaust	0.16 – 0.20 mm (0.0063 – 0.0079 in.)	0.26 – 0.30 mm (0.0102 – 0.0118 in.)

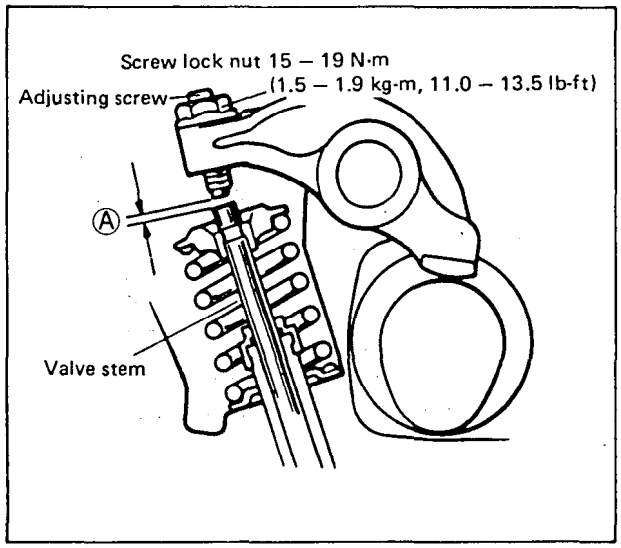


Fig. 0B-5

3) Refer to the SECTION 6A of the Service Manual shown in the FOREWORD of this manual for valve lash inspection and adjustment procedures.
4) Install cylinder head cover and tighten bolts to specification.

ITEM 1-4

Engine Oil and Filter Change

Before draining engine oil, check engine for oil leakage. If any evidence of leakage is found, make sure to correct defective part before proceeding to the following work.

1) Drain engine oil by removing drain plug.

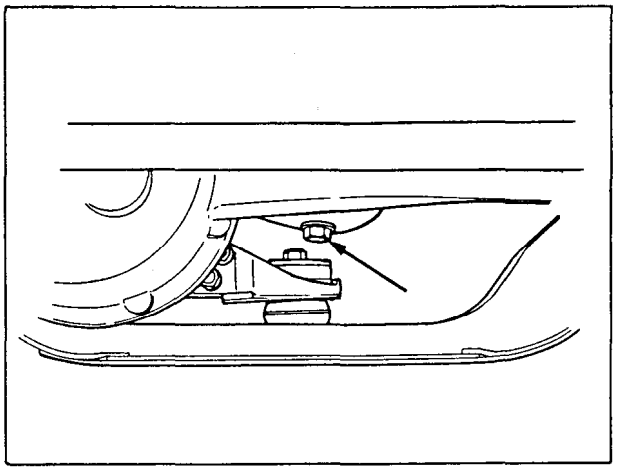


Fig. 0B-6

2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified below.

Tightening torque for oil drain plug	N·m	kg-m	lb-ft
	30 – 40	3.0 – 4.0	22.0 – 28.5

3) Loosen oil filter by using oil filter wrench (special tool).

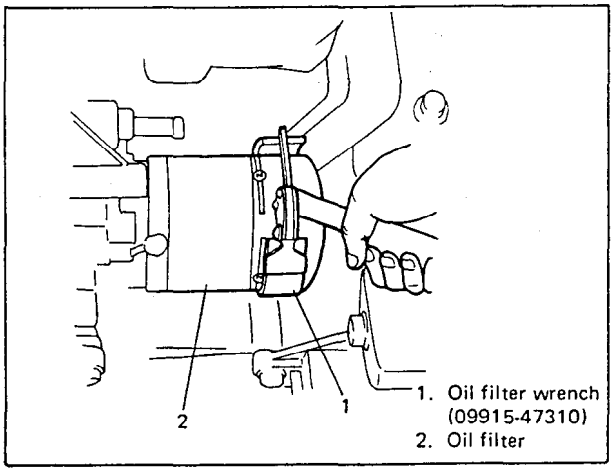


Fig. 0B-7

NOTE:
Before fitting new oil filter, be sure to oil its "O" ring. Use engine oil for this purpose.

4) Screw new filter on oil filter stand by hand until the filter "O" ring contacts the mounting surface.

CAUTION:
To tighten oil filter properly, it is important to accurately identify the position at which the filter "O" ring first contacts the mounting surface.

5) Tighten the filter 3/4 turn from the point of contact with the mounting surface using an oil filter wrench.

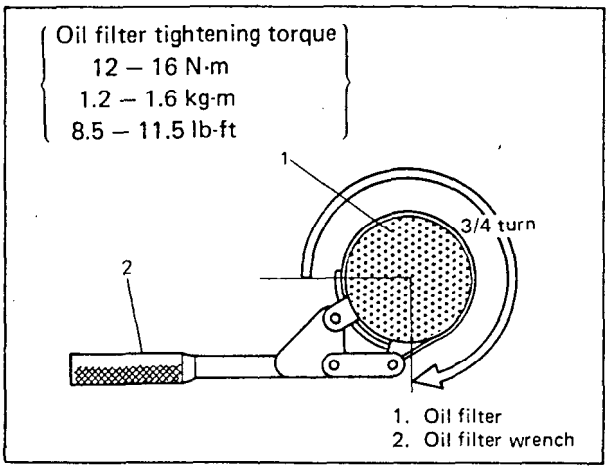


Fig. 0B-8

6) Replenish oil until oil level is brought to FULL level mark on dipstick. (about 4.2 liters or 8.9/7.4 US/Imp pt.). The filler inlet is atop the cylinder head cover.
7) Start engine and run it for three minutes. Stop it and wait another three minutes before checking oil level. Add oil, as necessary, to bring oil level to FULL level mark on dip stick.

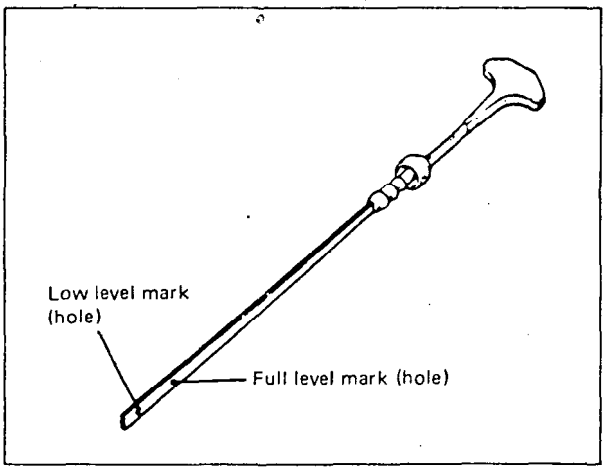


Fig. 0B-9

NOTE:
Steps 1) – 6) outlined above must be performed with ENGINE NOT RUNNING. For step 7), be sure to have adequate ventilation while engine is running.

It is recommended to use engine oil of SE, SF or SF/CC class.

NOTE:
For temperature below 32°F (0°C), it is highly recommended to use SAE 5W –30 oil.

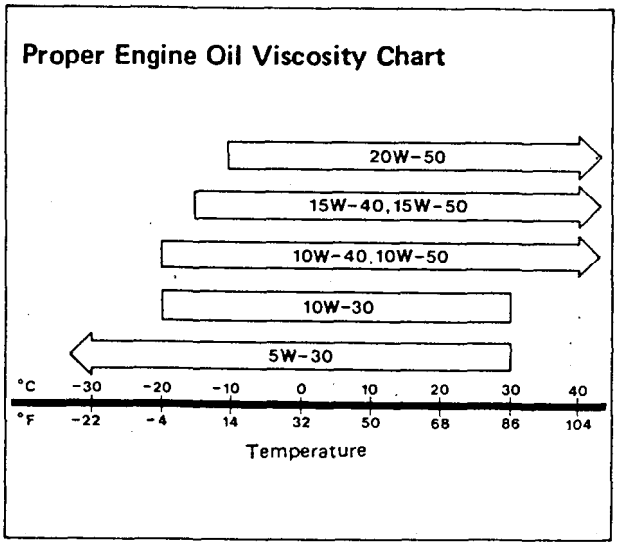


Fig. 0B-10 Engine Oil Viscosity Chart

Engine oil capacity

Oil pan capacity	about 4.0 liters (8.4/7.0 US/Imp pt.)
Oil filter capacity	about 0.2 liters (0.4/0.3 US/Imp pt.)
Others	about 0.3 liters (0.6/0.5 US/Imp pt.)
Total	about 4.5 liters (9.5/7.9 US/Imp pt.)

NOTE:
Engine oil capacity is specified as above. However, note that the amount of oil required when actually changing oil may somewhat differ from the data in the above table depending on various conditions (temperature, viscosity, etc.).

8) Check oil filter and drain plug for oil leakage.

ITEM 1-5

Cooling System Hoses and Connections Inspection

1) Visually inspect cooling system hoses for any evidence of leakage and cracks. Examine them for damage, and check connection clamps for tightness.

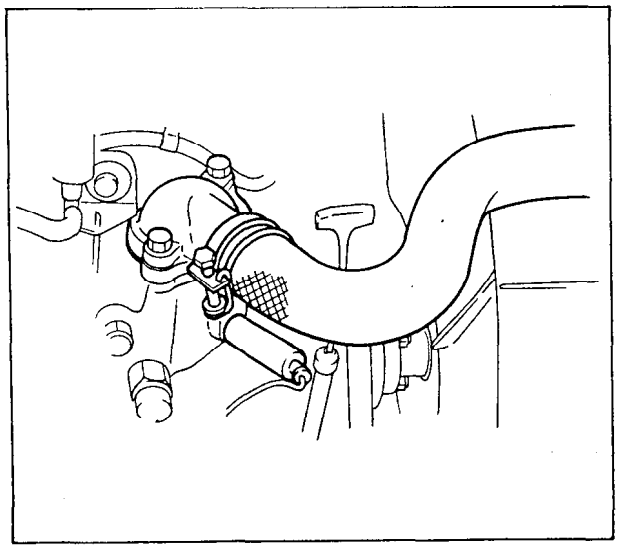


Fig. 0B-11

2) Replace all hoses which show evidence of leakage, cracks or other damage. Replace all clamps which cannot maintain proper tightness.

ITEM 1-6

Engine Coolant Change

WARNING:
To help avoid danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if cap is taken off too soon.

1) Remove radiator cap when engine is cool.
2) Loosen radiator drain plug to drain coolant.
3) Remove reservoir tank, which is on the side of radiator, and drain.
4) Tighten plug securely. Also reinstall reservoir tank.

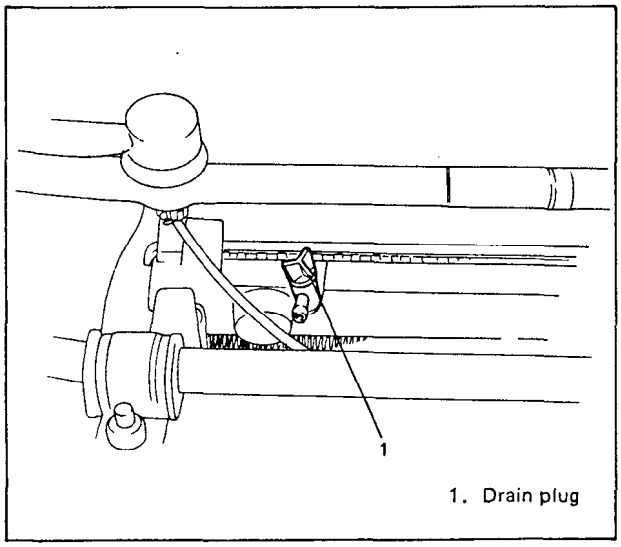


Fig. 0B-12

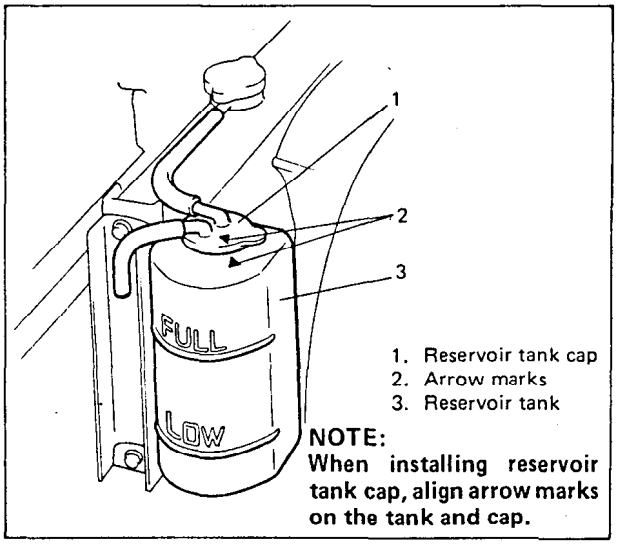


Fig. 0B-13

5) Fill radiator with specified amount of coolant, and run engine for 2 or 3 minutes at idle. This drives out any air which may still be trapped within cooling system. STOP ENGINE. Add coolant as necessary until coolant level reaches the filler throat of radiator. Reinstall radiator cap.
6) Add coolant to reservoir tank so that its level aligns with Full mark. Then, reinstall cap aligning arrow marks on the tank and cap.

CAUTION:
When changing engine coolant, use mixture of 50% water and 50% ANTIFREEZE/ ANTICORROSION COOLANT for the market where ambient temperature falls lower than −16° C (3° F) in winter and mixture of 70% water and 30% ANTIFREEZE/ ANTICORROSION COOLANT for the market where ambient temperature doesn't fall lower than −16° C (3° F).
Even in a market where no freezing temperature is anticipated, mixture of 70% water and 30% ANTIFREEZE/ANTICORROSION COOLANT should be used for the purpose of corrosion protection and lubrication.

ITEM 1-7

Exhaust Pipes and Mountings Inspection

WARNING:
To avoid danger of being burned, do not touch exhaust system when it is still hot. Any service on exhaust system should be performed when it is cool.

When carrying out periodic maintenance, or the vehicle is raised for other service, check exhaust system as follows:

- Check rubber mountings for damage, deterioration, and out of position.
- Check exhaust system for leakage, loose connections, dents, and damages.
  If bolts or nuts are loose, tighten them to specification. Refer to SECTION 6K (page 6K-2) for torque specification of bolts and nuts.
- Check nearby body areas for damaged, missing, or mispositioned parts, open seams, holes, loose connections or other defects which could permit exhaust fumes to seep into the vehicle.
- Make sure that exhaust system components have enough clearance from the underbody to avoid overheating and possible damage to the floor carpet.
- Any defects should be fixed at once.

Replace muffler rubber mountings with new ones periodically.

EMISSION CONTROL

ITEM 2-1

PCV Valve Inspection

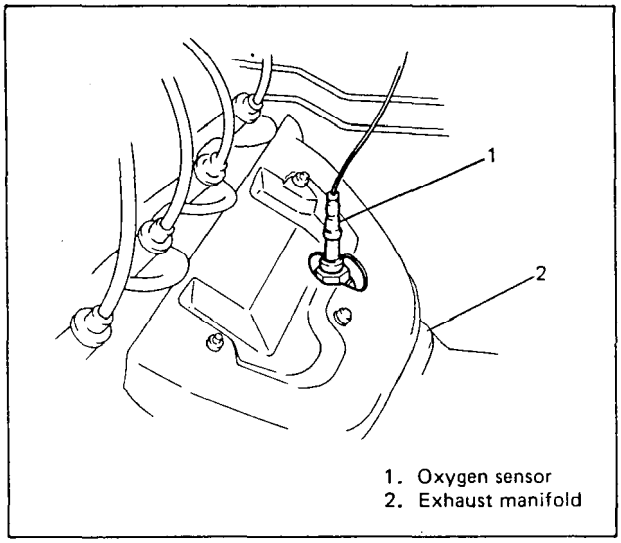
Check PCV valve. Refer to ON VEHICLE SERVICE of SECTION 6J for procedures to check PCV valve.

ITEM 2-2

Oxygen Sensor Replacement

WARNING:
To avoid danger of being burned, do not touch exhaust system when it is still hot. This work should be performed when it is cool.

1) Disconnect battery negative cable from battery and disconnect oxygen sensor wire at its coupler.
2) Remove oxygen sensor from exhaust manifold.



1. Oxygen sensor
2. Exhaust manifold

Fig. 0B-14

3) Install new gasket and oxygen sensor, and tighten it to specification.

Tightening torque for oxygen sensor	N·m	kg-m	lb-ft
	45 – 55	4.5 – 5.5	33.0 – 39.5

4) Connect oxygen sensor wire at the coupler securely and clamp its wire.
5) Connect negative cable to battery.
6) Start engine and check for gas leak.

ITEM 2-3

Charcoal Canister Inspection

Check charcoal canister. Refer to ON VEHICLE SERVICE of SECTION 6J for procedures to check charcoal canister.

ELECTRICAL SYSTEM

ITEM 3-1

Wiring Harness and Connections Inspection

1) Visually inspect all wires in engine compartment for evidence of breakage.
   Inspect the condition of insulation (cracks). All clips and clamps should have solid connections to wires.
2) Replace any wires in a deteriorated or otherwise defective condition.

IGNITION SYSTEM

ITEM 4-1

Spark plugs Replacement

1) Disconnect high-tension cords from spark plugs. Make sure to pull only on spark plug caps.

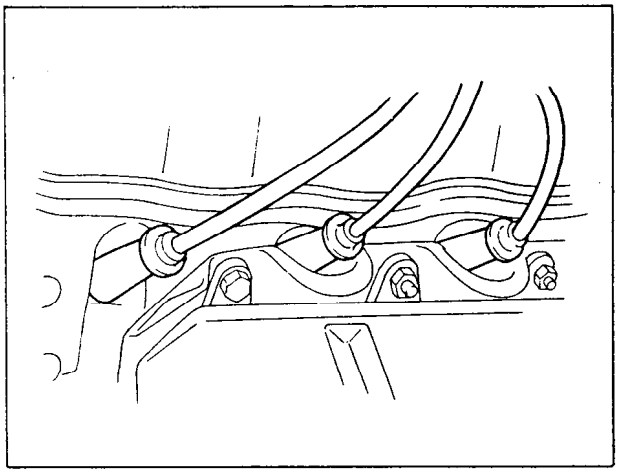


Fig. 0B-15

2) Using a spark plug wrench, loosen and remove plugs.

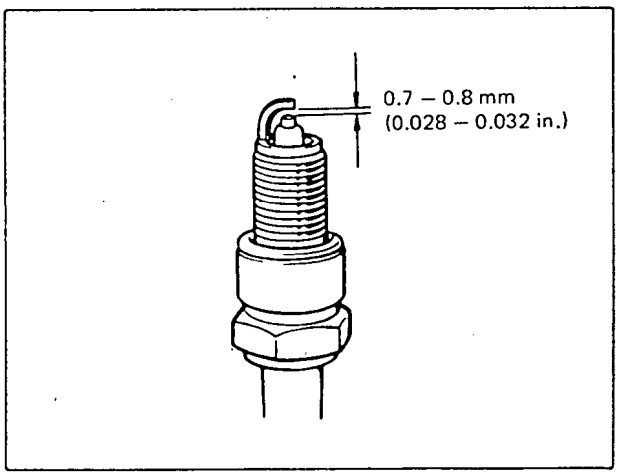


Fig. 0B-16

NOTE:
When replacing plugs, make sure to use new plugs of specified heat range and size.

PLUG SPECIFICATION

Maker	Heat range Standard type
NGK	BPR5ES
Nippon Denso	W16EXR-U

3) Install new spark plugs. Tighten plugs to specification.
4) Connect high tension cords to spark plugs. DO NOT push cords for connection. Push boots.

Tightening torque for spark plug	N-m	kg-m	lb-ft
	20 – 30	2.0 – 3.0	14.5 – 21.5

ITEM 4-2

Distributor Cap and Rotor Inspection

1) Inspect distributor cap and rubber caps for cracks.
2) Inspect center electrode and terminals for wear.

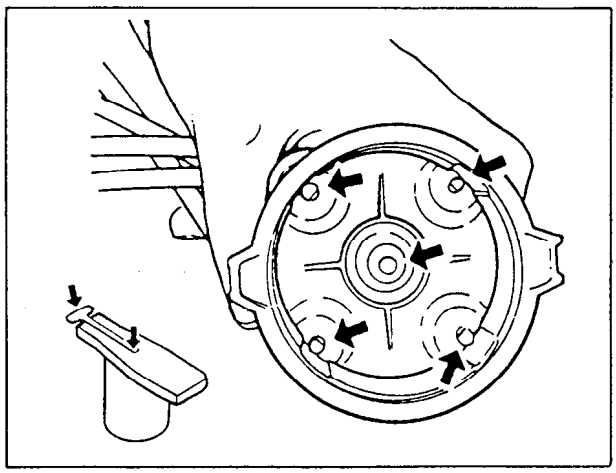


Fig. 0B-17

3) Inspect rotor for cracks, and its electrode for wear.
4) Repair or replace as necessary any component which is found to be in malcondition as described above.

NOTE:
Dust and stains found within distributor can be cleaned by using a dry, soft cloth.

ITEM 4-3

Ignition Wiring Replacement

1) Disconnect high tension cords from spark plugs, ignition coil and distributor.
2) Connect new high tension cords and clamp them securely. DO NOT push cords for connection. Push boots.

ITEM 4-4

Ignition Timing Inspection

Check to make sure that ignition timing is set properly. If out of specification, adjust it.
Refer to the SECTION 6F of the Service Manual shown in the FOREWORD of this manual for inspection and adjustment procedure.

ITEM 4-5

Distributor Advancer Inspection

Check advancer for proper operation. Refer to the SECTION 6F of the Service Manual shown in the FOREWORD of this manual for checking procedure.
Check vacuum hose for pinhole, crack or breakage. Correct or replace if necessary.

FUEL

ITEM 5-1

Fuel Tank Cap Gasket Inspection and Replacement

Visually inspect gasket of fuel tank cap. If it is damaged or deteriorated, replace it with new one.

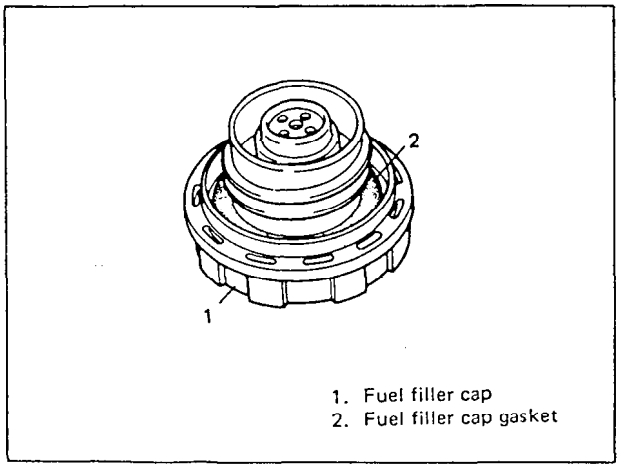


Fig. 0B-18

ITEM 5-2

Air Cleaner Element Inspection and Replacement

Inspection and Cleaning

1) Remove air cleaner cap.
2) Take cleaner element out of air cleaner case.
3) Blow off dust by blowing compressed air from air outlet side of element (i.e., the side facing up when installed in air cleaner case).

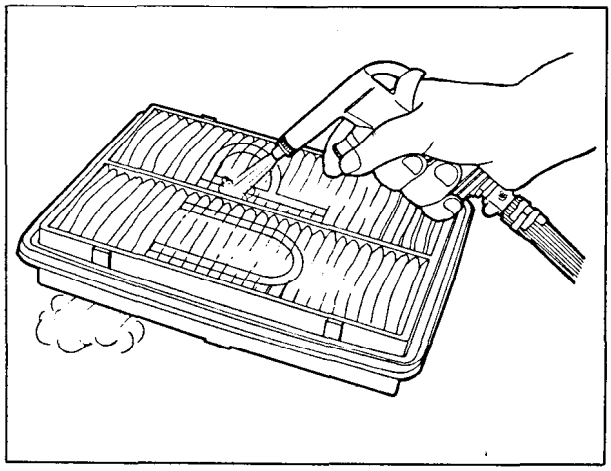


Fig. 0B-19 Cleaning Air Cleaner Element

4) Install element to air cleaner.
5) Install air cleaner cap securely.

Replacement

1) Remove air cleaner cap.
2) Take cleaner element out of air cleaner case.
3) Install new cleaner element into cleaner case.

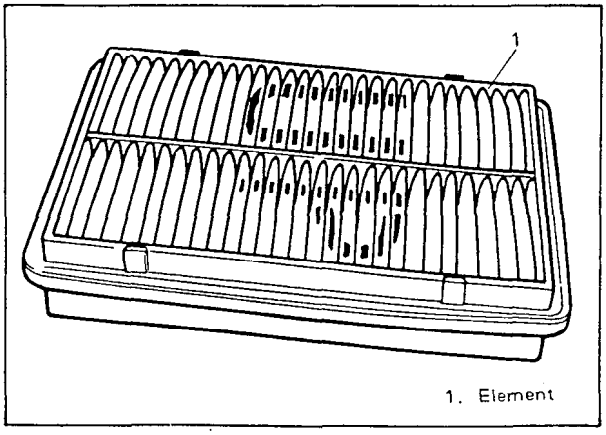


Fig. 0B-20

4) Install air cleaner cap securely.

ITEM 5-3

Fuel Filter Replacement

WARNING:
This work must be performed in a well ventilated area and away from any open flames (such as gas hot water heaters).

Fuel filter is located at the front part of fuel tank, inside the right-hand side of chassis.

1) Disconnect negative cable from battery.
2) Replace fuel filter. Be sure to refer to description under FUEL FILTER, REMOVAL and INSTALLATION in SECTION 6C (page 6C-3 and 6C-4) for proper procedure.

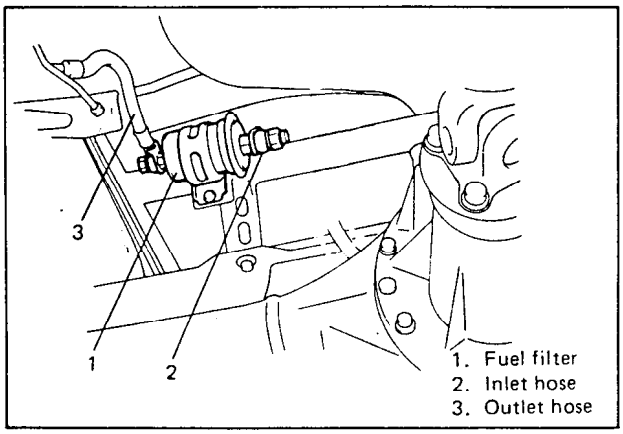


Fig. 0B-21

NOTE:
Torque hose fastening bolts to specification.

3) Connect negative cable to battery.
4) After installation, start engine and check it for leaks.

ITEM 5-4

Fuel Lines and Connections Inspection

[Inspection]

Visually inspect fuel lines and connections for evidence of fuel leakage, hose cracking, and damage. Make sure all clamps are secure.

Repair leaky joints, if any.

Replace hoses that are suspected of being cracked.

ITEM 5-5

Idle Speed Inspection

Check idle speed, and adjust it as necessary.

Refer to ON-VEHICLE SERVICE (page 6E-68) of SECTION 6E for procedures to check and adjust idle speed.

CHASSIS AND BODY

For CHASSIS AND BODY items, refer to Service Manual 99500-60A00 (page 0B-13 – 0B-17).

FINAL INSPECTION

Carry out road test in safe place.

> **WARNING:**
> **When carrying out the following road tests, select a safe place where no man or no running vehicle is seen so as to prevent any accident.**

1) Engine start
Check engine start for readiness.

NOTE:
In the cold weather, start to operate engine by pulling choke control knob (if equipped).

2) Clutch
Check the following:
- that clutch is completely released when depressing clutch pedal,
- that no slipping clutch occurs when releasing pedal and accelerating,
- and that clutch itself is free from any abnormal condition.

3) Gearshift Lever (Transmission and Transfer)
Check gearshift lever for smooth shifting to all positions and for good performance of transmission and transfer in any position.
With automatic transmission equipped vehicle, also check that shift indicator indicates properly according to which position shift lever is shifted to.

4) Brake
[Foot brake]
Check the following when depressing brake pedal while driving;
- that brake works properly,
- that it is free from noise,
- and that braking force is applied equally on all wheels.

[Parking brake]
Check to ensure that parking brake is fully effective when the vehicle is stopped on the slope and brake lever is pulled all the way.

5) Steering
Check to ensure that steering wheel is free from instability, or abnormally heavy feeling while driving.

6) Engine
- Check that engine responds readily at all speeds.
- Check that engine is free from abnormal noise and abnormal vibration.

7) Body, Wheels and Power Transmitting System
Check that body, wheels and power transmitting system are free from abnormal noise and abnormal vibration or any other abnormal condition.

8) Meters and Gauge
Check that speedometer, odometer, fuel meter, temperature gauge, etc. are operating accurately.

9) Oil Pressure and Charging Indicator Lights
Make sure that these lights stay off while engine is operating. If either of them comes on during engine operation, it means that something is wrong with engine lubrication system or charging system, and therefore immediate inspection is necessary.

10) Seat Belt
Inspect belt system, including webbing, buckles, latch plates, retractors and anchors.
Check that seat belt is securely locked.

> **WARNING:**
> **For this test, select a safe place without any running vehicle so as to prevent any accident. And again make sure that no man or no other vehicle is seen in front or behind and use great care to the surroundings when carrying out the test.**

RECOMMENDED FLUIDS AND LUBRICANTS

Engine oil	SE, SF or SF/CC, SAE 5W-30
Engine coolant (Ethylene glycol base coolant)	GOLDEN CRUISER 1200 "Antifreeze/Anticorrosion coolant"
Brake fluid	DOT3, or SAE J1703
Manual transmission oil	API GL-4 or SAE 75W-90
Transfer oil	
Differential oil (front & rear)	API GL-5 or SAE 75W-90 Hypoid gear oil
Power steering fluid	Automatic transmission fluid DEXRON-II
Clutch linkage pivot points	Water resistance chassis grease (SUZUKI SUPER GREASE A 99000-25010)
Gear shift control lever and shaft	Water resistance chassis grease (SUZUKI SUPER GREASE A 99000-25010)
Door hinges	Engine oil
Hood latch assembly	Engine oil
Key lock cylinder	Spray lubricant

Fig. 0B-22

SECTION 6

ENGINE

CONTENTS

GENERAL INFORMATION 6-1
ENGINE DIAGNOSIS 6-4
ENGINE MECHANICAL 6A-1
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ENGINE EMISSION CONTROLS 6J-1
ENGINE EXHAUST 6K-1

GENERAL INFORMATION

STATEMENT ON CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousands of an millimeter (ten thousands of inch). Accordingly, when any internal engine parts are serviced, care and cleanliness are important. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- Throughout this manual, the four cylinders of the engine are identified by numbers; No. 1, No. 2, No. 3 and No. 4 as counted from crankshaft pulley side to flywheel side. Refer to Fig. 6-1.

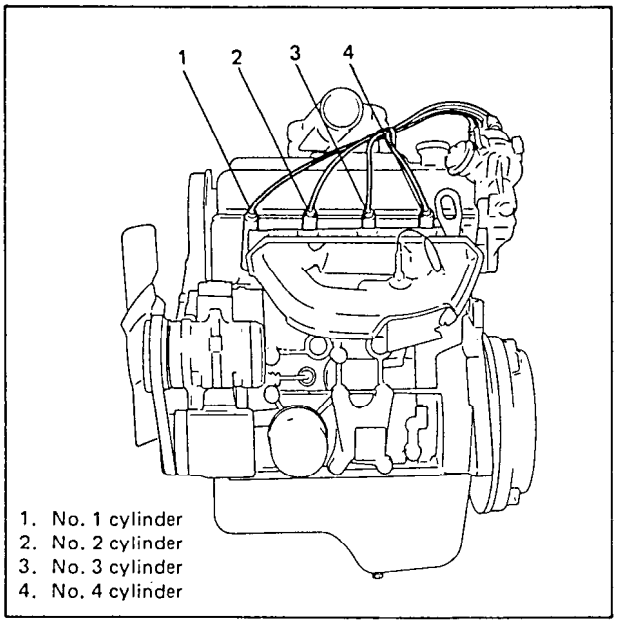


Fig. 6-1 Cylinder Numbers

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE, AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

- When raising or supporting engine for any reason, do not use a jack under oil pan. Due to small clearance between oil pan and oil pump strainer, jacking against oil pan may cause it to be bent against strainer resulting in damaged oil pick-up unit.
- It should be kept in mind, while working on engine, that 12-volt electrical system is capable of violent and damaging short circuits. When performing any work where electrical terminals could possibly be grounded, ground cable of the battery should be disconnected at battery.
- Any time the air cleaner, air intake case throttle body or intake manifold is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material which could follow intake passage into cylinder and cause extensive damage when engine is started.
- When disconnecting couplers, don't pull wire harness but make sure to hold coupler itself. With lock type coupler, be sure to unlock the lock before disconnection. With spring lock type coupler as shown in Fig. 6-2, push out spring before disconnection, but only within the extent that spring is not deformed. Attempt to disconnect coupler without unlocking may result in damage to coupler.
  When connecting lock type coupler, insert it till clicking sound is heard and connect it securely.

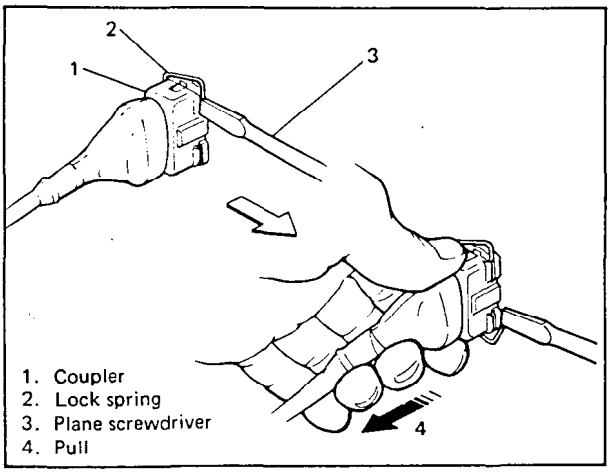


Fig. 6-2 Disconnection of Spring Lock Type Coupler

PRECAUTION ON FUEL SYSTEM SERVICE

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- **Releasing fuel pressure in fuel feed line.**
  As fuel feed line (between fuel pump and fuel pressure regulator) is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected.
  Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to following procedure.

> CAUTION:
> **This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst.**

1. Place transmission gear shift lever in "Neutral", set parking brake, and block drive wheels.
2. Disconnect coupler "A" from control relay.
3. Remove fuel filler cap to release fuel vapor pressure in fuel tank and then reinstall it.
4. Start engine and run it till it stops for lack of fuel. Repeat cranking engine 2 — 3 times of about 3 seconds each time to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
5. Upon completion of servicing, connect coupler "A" to control relay.

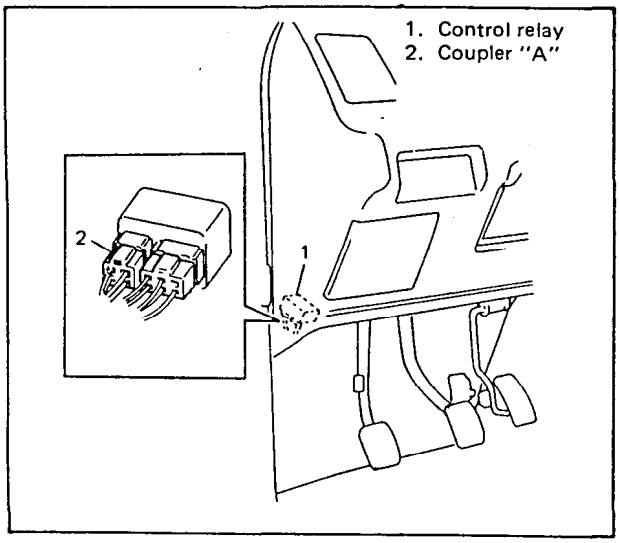
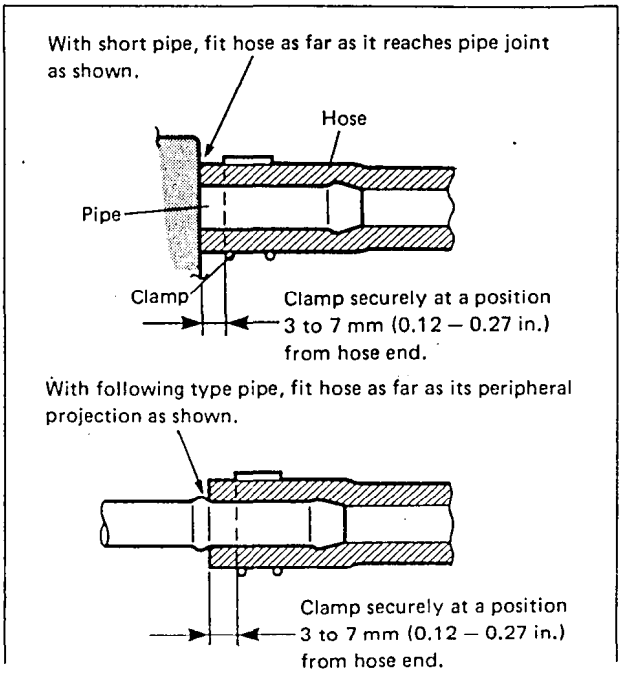


Fig. 6-3 Releasing Fuel Pressure

- When installing fuel filter union bolt or plug bolt on union bolt, always use new gasket and tighten it to specified torque. See Section 6C for specified torque.
- When installing injector, fuel feed pipe or fuel pressure regulator, lubricate its O ring with spindle oil or gasoline.
- When connecting fuel pipe flare nut, first tighten flare nut by hand and then tighten it to specified torque.
- Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly referring to the following.



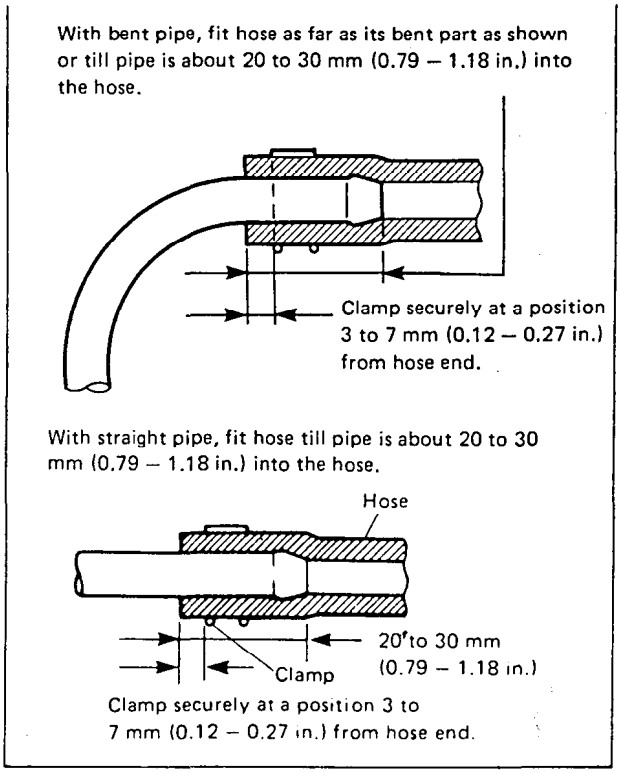


Fig. 6-4 Hose Connection

- **Fuel leakage check**
  After performing any service on fuel system, apply fuel pressure to fuel system as follows and check to make sure that there are no fuel leakages.

1. Operate fuel pump according to procedure described in item "Fuel Pump on Vehicle Inspection" (p. 6E-70) and apply fuel pressure to fuel system.
2. In this state, check to see that there are no fuel leakages from any part of fuel system.

ENGINE DIAGNOSIS

Condition	Possible Cause	Correction
Hard Starting (Engine cranks OK)	**Ignition system out of order.**	
	• Blown fuse	Repair or replace.
	• Faulty spark plug	Clean and adjust plug gap or replace.
	• Leaky high-tension cord	Replace.
	• Loose connection or disconnection of high-tension cords or lead wires	Repair or replace.
	• Maladjusted signal rotor air gap	Adjust.
	• Defective generator assembly in distributor	Replace.
	• Improper ignition timing	Adjust.
	• Faulty ignition coil	Replace.
	• Cracked rotor or cap in distributor	Replace.
	Fuel system out of order.	
	• Lack of fuel in fuel tank	Refill.
	• Dirty fuel filter	Replace.
	• Dirty or clogged fuel hose or pipe	Clean.
	• Malfunctioning fuel pump	Replace.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Low compression.	
	• Incorrect spark plug tightening or faulty gasket	Tighten to specified torque.or replace gasket.
	• Incorrect valve lash	Adjust.
	• Compression leak from valve seat	Remove cylinder head and lap valves.
	• Sticky valve stem	Correct or replace valve and valve guide.
	• Weak or damaged valve springs	Replace valve springs.
	• Compression leak at cylinder head gasket	Repair or replace.
	• Sticking or damaged piston ring	Replace piston rings.
	• Worn piston, ring or cylinder	Replace ring and piston. Rebore or replace cylinder.
	Others	
	• Broken valve timing belt	Replace.
	• Malfunctioning PCV valve	Replace.
	• Loose connection or disconnection of vacuum hoses	Connect securely.

Condition	Possible Cause	Correction
Engine has no power.	**Low compression.**	Previously outlined.
	Ignition system out of order.	
	• Incorrect ignition timing	Adjust.
	• Defective spark plug	Adjust or replace.
	• Worn distributor terminals	Dress or replace. Also check rotor.
	• Leaks, loose connection or disconnection of high tension cord	Connect or replace as necessary.
	• Malfunctioning ignition timing advancers	Replace.
	Fuel system out of order.	
	• Clogged fuel hose or pipe	Clean.
	• Dirty or clogged fuel filter	Replace.
	• Clogged air cleaner element	Clean or replace.
	• Air inhaling from intake manifold gasket or throttle body gasket	Replace gasket.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Others	
	• Malfunctioning EGR valve	Check and replace as necessary.
	• Dragging brakes	Repair or replace.
	• Slipping clutch	Adjust or replace.
Improper engine idling.	**Fuel system out of order.**	
	• Clogged air cleaner element	Clean or replace.
	• Leaky manifold, throttle body, or cylinder head gasket	Replace.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Ignition system out of order.	
	• Defective spark plug	Adjust or replace.
	• Leaky or disconnected high tension cord	Connect or replace.
	• Worn distributor terminals	Replace.
	• Improper ignition timing	Adjust.
	• Cracked cap in distributor, there being leakage inside	Replace.
	Low compression	Previously outlined.
	Others	
	• Loose connection or disconnection of vacuum hoses	Connect.
	• Malfunctioning EGR valve	Check and replace as necessary.
	• Malfunctioning PCV valve	Check and replace as necessary.

Condition	Possible Cause	Correction
Engine hesitates (Momentary lack of response as the accelerator is depressed. Can occur at all vehicle speeds. Usually most severe when first trying to make the vehicle move, as from a stop sign.)	**Ignition system out of order.**	
	• Improper ignition timing	Adjust.
	• Defective spark plug or plug gap out adjustment	Replace or adjust gap.
	• Leaky high tension cord	Replace.
	Fuel system out of order.	
	• Clogged air cleaner element	Clean or replace.
	• Leaky manifold or throttle body gasket	Replace.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Low compression	Previously outlined.
	Others	
	• Malfunctioning EGR valve	Check and replace as necessary.
Surges (Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and down with no change in the accelerator pedal.)	**Fuel system out of order.**	
	• Clogged fuel filter	Replace.
	• Kinky or damaged fuel hose and lines	Check and replace as necessary.
	• Leaky manifold or throttle body gasket	Replace.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Ignition system out of order.	
	• Improper ignition timing	Adjust.
	• Malfunctioning ignition timing advancers (mechanical and vacuum)	Check or replace.
	• Leaky or loosely connected high tension cord.	Check and repair or replace.
	• Defective spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	Check and clean, adjust or replace.
	• Cracked rotor or cap in distributor	Replace.
	Others	
	• Leaky vacuum hoses	Repair or replace.
	• Malfunctioning EGR valve	Check and replace as necessary.
Excessive detonation (The engine makes sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	**Engine overheating**	Refer to the section "Overheating".
	Ignition system out of order.	
	• Defective spark plug	Replace.
	• Improper ignition timing	Adjust.
	• Loose connection of high tension cord	Connect securely.

Condition	Possible Cause	Correction
	Fuel system out of order.	
	• Clogged fuel filter and fuel lines	Replace or clean.
	• Air inhaling from intake manifold or throttle body gasket	Replace.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Others	
	• Excessive combustion chamber deposits	Remove carbon.
	• Malfunctioning EGR valve	Check and replace as necessary.
Overheating	• Insufficient coolant	Replenish.
	• Loose water pump belt	Adjust.
	• Inoperative thermostat	Replace.
	• Poor water pump performance	Replace.
	• Improper ignition timing	Adjust.
	• Clogged or leaky radiator	Flush, repair or replace.
	• Improper engine oil grade	Replace with proper grade oil.
	• Clogged oil filter or oil strainer	Replace or clean (oil strainer).
	• Not enough oil	Replenish.
	• Poor oil pump performance	Repair or replace.
	• Oil leakage	Repair.
	• Dragging brakes	Repair or replace.
	• Slipping clutch	Adjust or repair.
	• Blown cylinder head gasket	Replace.
Poor gasoline mileage.	**Fuel system out of order.**	
	• Fuel leakage from fuel tank and lines	Repair or replace.
	• Clogged air cleaner element	Clean or replace.
	Electronic Fuel Injection system out of order.	Refer to SECTION 6E.
	Ignition system out of order.	
	• Improper ignition timing	Adjust.
	• Leaks or loose connection of high tension cord	Repair or replace.
	• Defective spark plug (improper gap, heavy deposits, and burned electrodes, etc..)	Clean, adjust or replace.
	• Malfunctioning mechanical and vacuum advencers in distributor	Check and repair or replace.

Condition	Possible Cause	Correction
	Low compression	Previously outlined.
	Others	
	• Poor valve seating	Repair or replace.
	• Dragging brakes	Repair or replace.
	• Slipping clutch	Adjust or replace.
	• Thermostat out of order	Replace.
	• Improper tire pressure	Adjust.
	• Malfunctioning EGR valve	Check and replace as necessary.
Excessive engine oil consumption	**Oil leakage**	
	• Loose oil drain plug	Tighten.
	• Loose oil pan bolts	Tighten.
	• Deteriorated or broken oil pan sealant	Replace sealant.
	• Leaky crankshaft oil seals	Replace.
	• Leaky cylinder head cover gasket	Replace.
	• Improper tightening of oil filter	Tighten.
	• Loose oil pressure switch	Tighten.
	• Blown cylinder head gasket	Replace.
	• Leaky camshaft oil seals	Replace.
	Oil entering combustion chamber	
	• Sticky piston ring	Remove carbon and replace rings.
	• Worn piston and cylinder	Replace or rebore cylinder, and replace piston.
	• Worn piston ring groove and ring	Replace piston and ring.
	• Improper location of piston ring gap	Reposition ring gap.
	• Worn or damaged valve stem seal	Replace.
	• Worn valve stem	Replace.
Low oil pressure	• Improper oil viscosity	Use oil of proper viscosity.
	• Malfunctioning oil pressure switch	Replace.
	• Not enough oil	Replenish.
	• Clogged oil strainer	Clean.
	• Functional deterioration of oil pump	Replace.
	• Worn oil pump relief valve	Replace.
	• Excessive clearance in various sliding parts	Replace worn parts.

Condition	Possible Cause	Correction
Engine noise Note: Before checking the mechanical noise, make sure that: • Ignition timing is properly adjusted. • Specified spark plug is used. • Specified fuel is used.	**Valve noise**	
	• Improper valve lash	Adjust.
	• Worn valve stem and guide	Replace.
	• Weak or broken valve spring	Replace.
	• Warped or bent valve	Replace.
	Piston, ring and cylinder noise	
	• Worn piston, ring and cylinder bore	Rebore or replace cylinder. Replace piston and ring.
	Connecting rod noise	
	• Worn rod bearing	Replace.
	• Worn crank pin	Repair by grinding or replace crankshaft.
	• Loose connecting rod nuts	Tighten nuts to specification.
	• Low oil pressure	Previously outlined.
	Crankshaft noise	
	• Low oil pressure	Previously outlined.
	• Worn bearing	Replace.
	• Worn crankshaft journal	Repair by grinding, or replace crankshaft.
	• Loose bearing cap bolts	Tighten bolts to specification.
	• Excessive crankshaft thrust play	Replace thrust bearing.

SECTION 6A

ENGINE MECHANICAL

NOTE:
For the items not found in this section of this manual, refer to the SECTION 6A of the Service Manual shown in the FOREWORD of this manual.

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- Air Intake Case 6A- 5
- Throttle Body and Intake Manifold .. 6A- 6
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RECOMMENDED TORQUE SPECIFICATIONS 6A-14

GENERAL DESCRIPTION

ENGINE

The engine is a water-cooled, in line 4 cylinders, 4 stroke cycle gasoline unit with its S.O.H.C. (Single overhead camshaft) valve mechanism arranged for "V"-type valve configuration.

The single overhead camshaft is mounted over the cylinder head; it is driven from crankshaft through timing belt, and no push rods are provided in the valve train system.

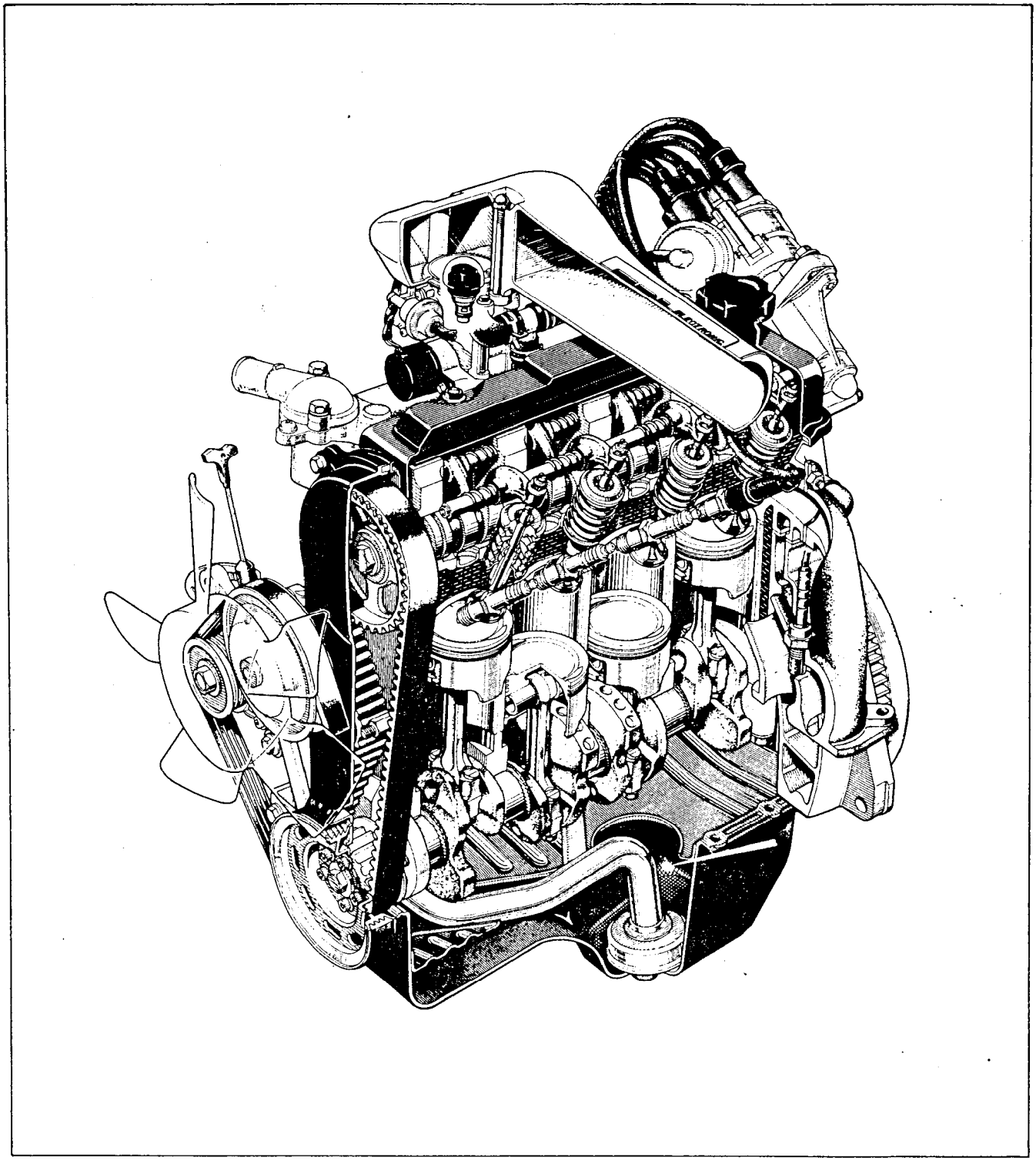


Fig. 6A-1 Engine Construction

CYLINDER HEAD AND VALVE TRAIN

The cylinder head is made of cast aluminum alloy and has four combustion chambers arranged in-line. Each combustion chamber has an intake and an exhaust ports.

Moreover, as shown in Fig. 6A-2, the air induction nozzle is provided near each intake valve. During intake stroke of the engine, air/fuel mixture enters into the combustion chamber from throttle body through intake manifold and intake valve. At the same time, air flows to the air induction nozzle through throttle body and air induction passage in the intake manifold, and jets into the combustion chamber.

The air jetted into the combustion chamber accelerates the mixture swirl to improve the combustion efficiency.

A single overhead camshaft driven by the crankshaft through the timing belt is mounted on the cylinder head.

The camshaft has eight cams, and each cam operates the intake or exhaust valve through rocker arm. The valve lash can be adjusted by turning the adjusting screw on the rocker arm after loosening the lock nut.

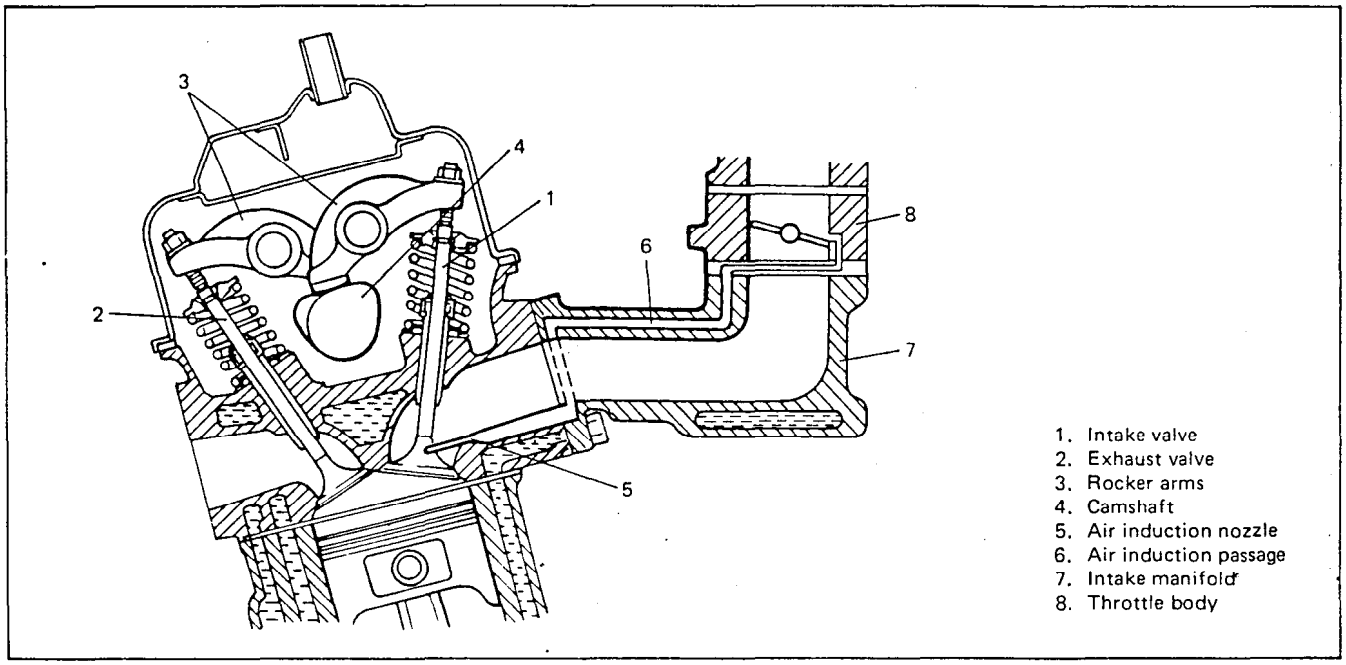


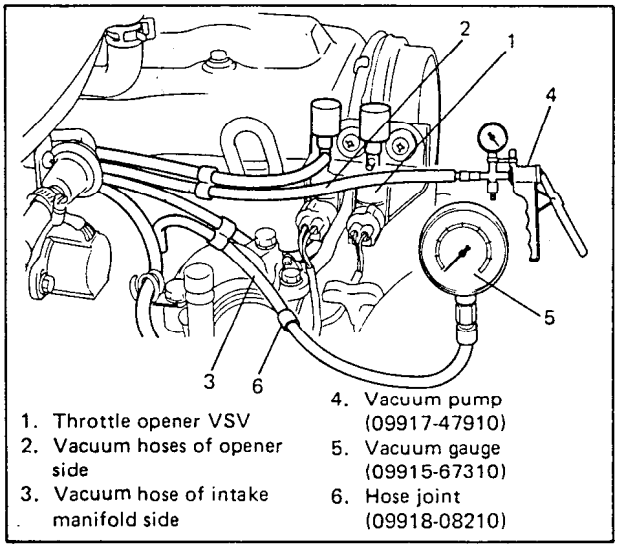
Fig. 6A-2 Cylinder Head and Valve Train

ON VEHICLE SERVICE

ENGINE VACUUM CHECK

The engine vacuum that develops in the intake line is a good indicator of the condition of the engine. The vacuum checking procedure is as follows:

1. Warm up engine to normal operating temperature and make sure that engine idle speed is within specification.
2. Stop engine and disconnect vacuum hoses from throttle opener VSV.
3. Connect vacuum pump to vacuum hose of opener side.
4. Connect special tools (vacuum gauge and hose joint) to vacuum hose of intake manifold side.



1. Throttle opener VSV
2. Vacuum hoses of opener side
3. Vacuum hose of intake manifold side
4. Vacuum pump (09917-47910)
5. Vacuum gauge (09915-67310)
6. Hose joint (09918-08210)

Fig. 6A-3 Installing Vacuum Gauge

5. Start engine and apply −40 cmHg vacuum to throttle opener to run engine at specified idle speed, and read vacuum gauge. Vacuum should be within specification.

Vacuum specification (sea level)	40 – 50 cm Hg (15.7 – 19.7 in. Hg) at 800 r/min

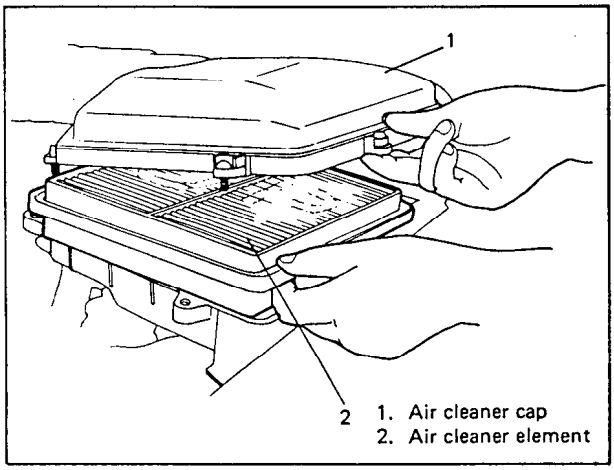
6. After checking, remove vacuum pump, vacuum gauge and hose joint.
7. Connect vacuum hoses to throttle opener VSV.

AIR CLEANER ELEMENT

This air cleaner element is of dry type. Note that it needs cleaning according to the following method.

REMOVE

1. Air cleaner cap securing screws.
2. Air cleaner element.



1. Air cleaner cap
2. Air cleaner element

Fig. 6A-4 Removing Air Cleaner Element

INSPECT

Check element for dirt.

CLEAN

Blow off dust by blowing compressed air from air outlet side of element (i.e., the side facing up when installed in air cleaner case).

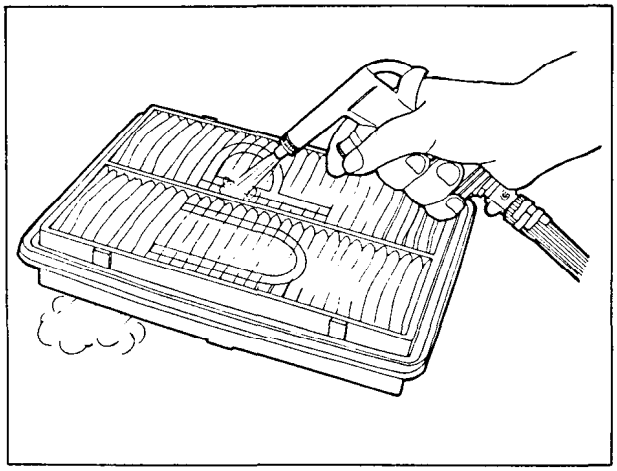


Fig. 6A-5 Cleaning Air Cleaner Element

INSTALL OR CONNECT

1. Element to air cleaner.
2. Air cleaner cap.

AIR INTAKE CASE

REMOVE OR DISCONNECT

1. Negative cable at battery.
2. Air intake hose and air intake case bracket from intake case.
3. PCV hose from intake case.
4. Intake case from throttle body.

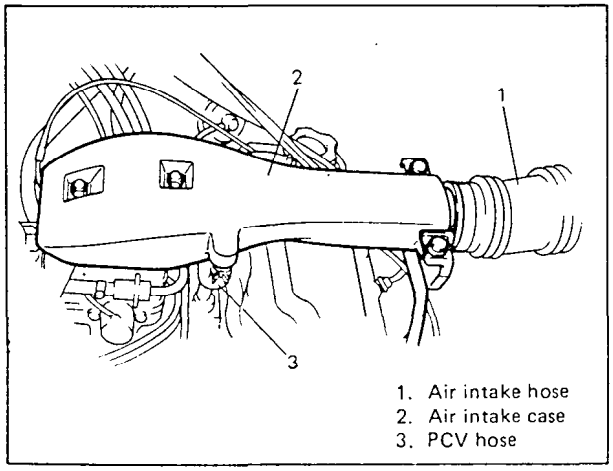


Fig. 6A-6 Air Intake Case

INSTALL OR CONNECT

1. Make sure that air intake case seal is installed on throttle body.

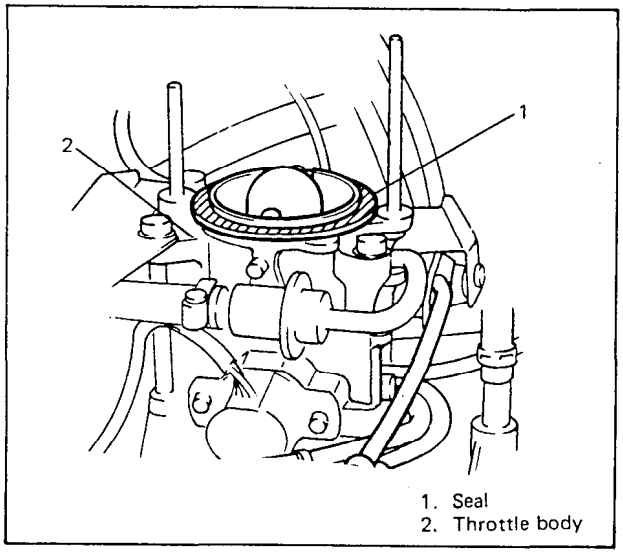
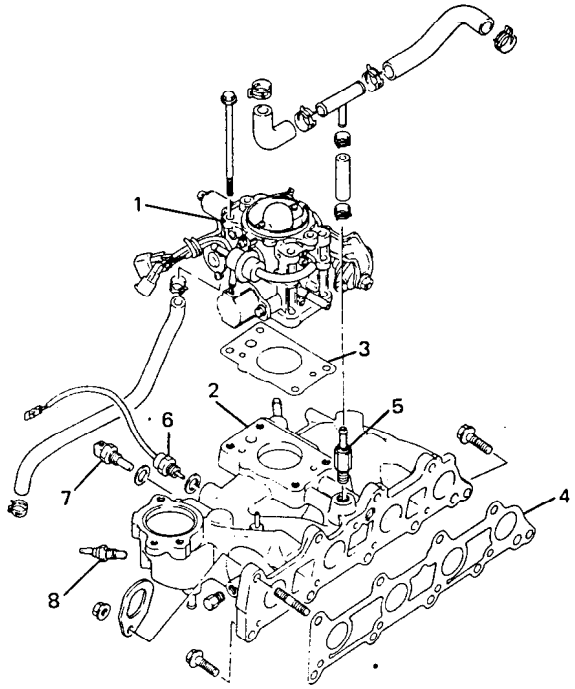


Fig. 6A-7 Air Intake Case Seal

2. Install in reverse order of removal.

THROTTLE BODY AND INTAKE MANIFOLD



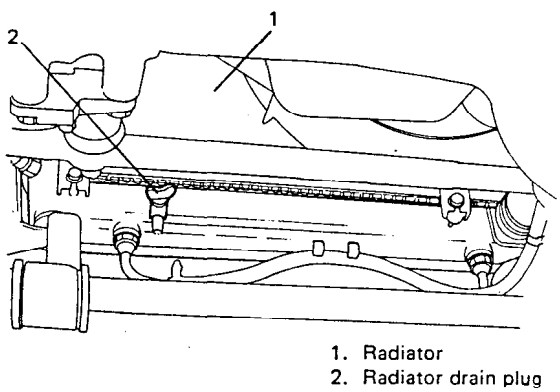
1. Throttle body
2. Intake manifold
3. Throttle body gasket
4. Intake manifold gasket
5. PCV valve
6. Air temp. sensor
7. Water temp. sensor
8. Water temp. gauge

Fig. 6A-8 Throttle Body and Intake Manifold

REMOVE OR DISCONNECT

1. Negative cable at battery.
2. Drain coolant.

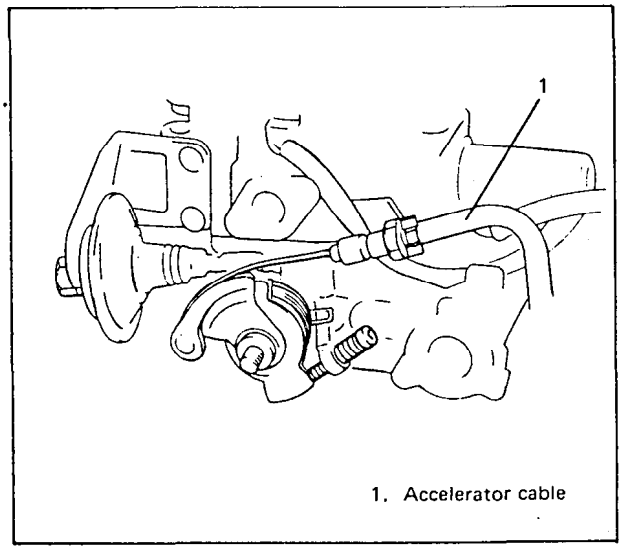
WARNING:
To help avoid danger of being burned, do not remove drain plug and radiator cap while engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if plug and cap are taken off too soon.



1. Radiator
2. Radiator drain plug

Fig. 6A-9 Radiator Drain Plug

3. Air intake case as previously outlined.
4. Accelerator cable from throttle body.
   Disconnect cable joint from lever by sliding joint.



1. Accelerator cable

Fig. 6A-10 Disconnecting Cable

5. Couplers of injector, throttle position sensor and idle speed control solenoid valve lead wires.

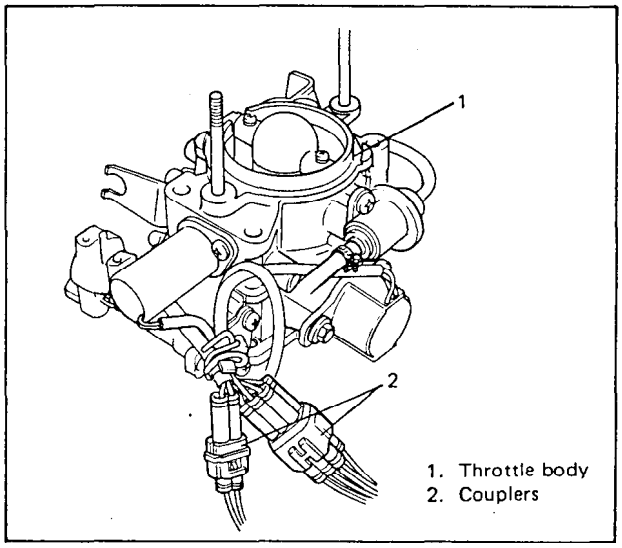


Fig. 6A-11 Disconnecting Couplers

6. Vacuum hoses from throttle body and throttle opener.

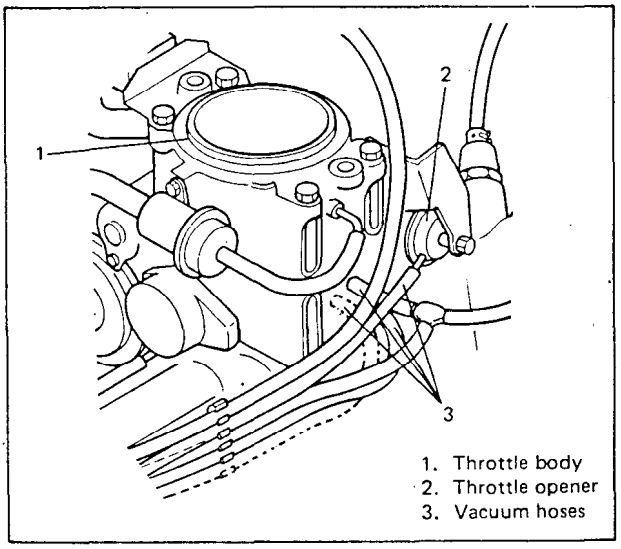


Fig. 6A-12 Disconnecting Vacuum Hoses

7. Water hose from air valve.
8. Fuel filler cap to release fuel vapor pressure in fuel tank. After releasing, reinstall cap.
9. Release fuel pressure in fuel feed line by referring to p. 6-2.
10. Fuel feed pipe from throttle body and intake manifold.
11. Fuel return hose from fuel pressure regulator.

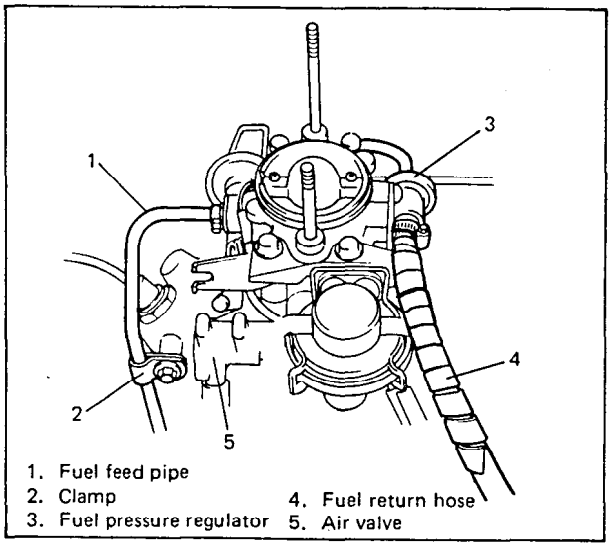


Fig. 6A-13 Disconnecting Fuel Pipe and Hose

12. Throttle body from intake manifold.
13. PCV hose from cylinder head cover.
14. Pressure sensor hose from gas filter.
15. Brake booster hose from intake manifold.
16. VSV (for throttle opener) hose from intake manifold.
17. Water hose from thermostat cap, heater inlet hose and water bypass hose from intake manifold.

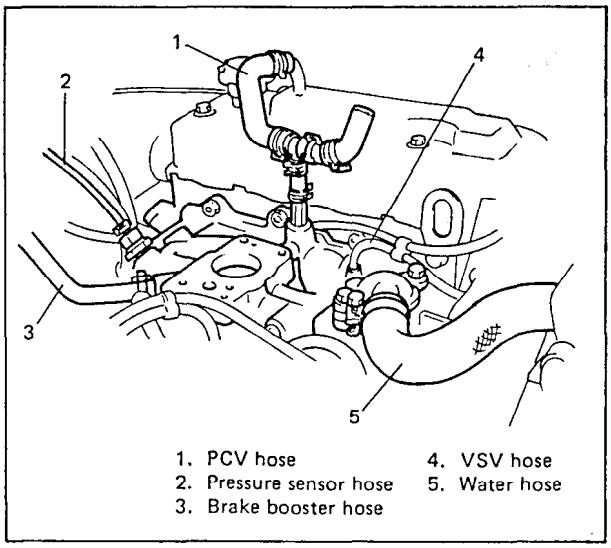
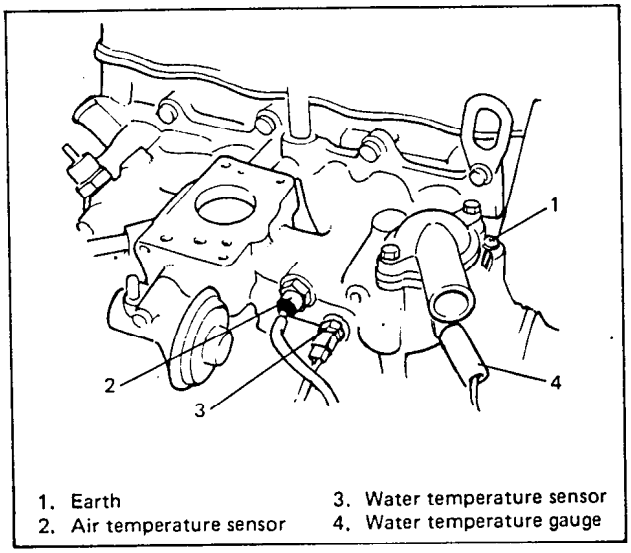


Fig. 6A-14 Disconnecting Hoses

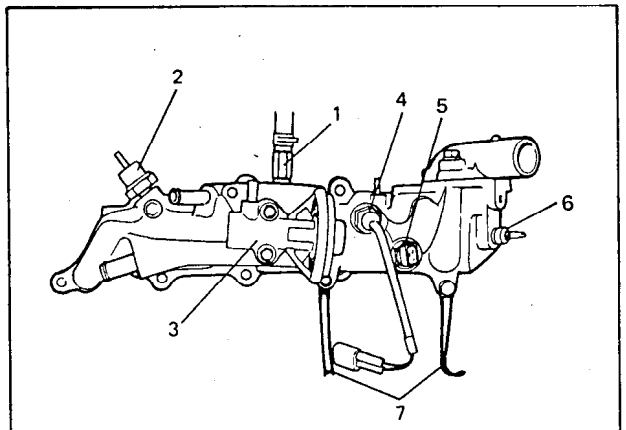
18. EGR valve hoses from EGR valve.
19. Earth wires from intake manifold and couplers from air temperature sensor, water (coolant) temperature sensor, water temperature gauge, etc..



1. Earth
2. Air temperature sensor
3. Water temperature sensor
4. Water temperature gauge

Fig. 6A-15 Disconnecting Wire Harnesses

20. Release wire harnesses from their clamps.
21. Other jointed parts from intake manifold, if any.
22. Intake manifold with PCV valve, EGR valve, sensors, switch and gauge from cylinder head.



1. PCV valve
2. Gas filter
3. EGR valve
4. Air temperature sensor
5. Water temperature sensor
6. Water temperature gauge
7. Clamp

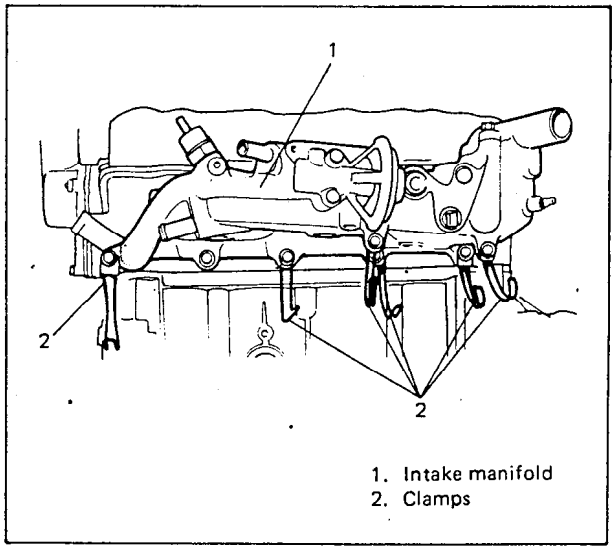
Fig. 6A-16 Intake Manifold

23. PCV valve, EGR valve, gas filter, thermostat, sensors, switch and gauge from intake manifold.

INSTALL OR CONNECT

1. PCV valve, EGR valve, gas filter, thermostat, sensors, switch, gauge, etc. to intake manifold.
   - Use new gasket, if equipped.
   - If gasket was not used, apply sealant to thread.
   - Tighten them to specified torque. Refer to Section 6E.
2. Intake manifold gasket to cylinder head.
   Before installing gasket, check it for deterioration or damage, and replace as necessary.
3. Intake manifold to cylinder head.
   - Install clamps as shown in figure and tighten bolts and nuts to specification.

Tightening torque for intake manifold bolts and nuts	N·m	kg-m	lb-ft
	18 – 28	1.8 – 2.8	13.5 – 20.0



1. Intake manifold
2. Clamps

Fig. 6A-17 Intake Manifold Installation

4. Earth wires to intake manifold, and couplers of air temperature sensor, water temperature sensor, water temperature gauge, etc..
5. Fix wire harness with clamps. Refer to wire harness routing in Section 8.

6. Water hose, bypass hose, heater inlet hose, pressure sensor hose, VSV hose (for throttle opener), brake booster hose, EGR valve hose and PCV hose.
7. Throttle body gasket to intake manifold.

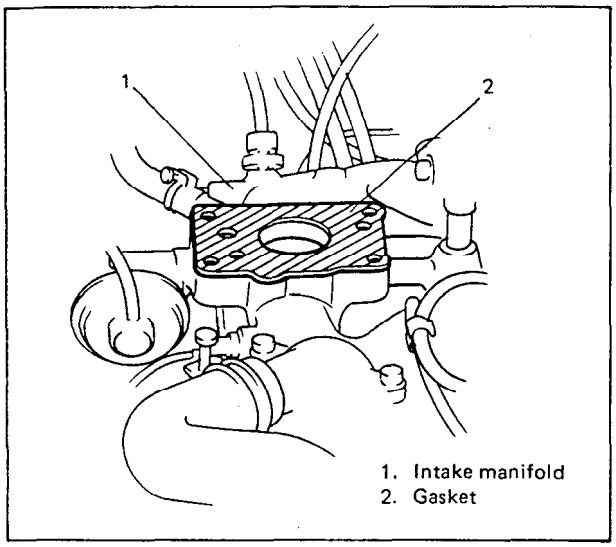


Fig. 6A-18 Gasket Installation

8. Throttle body to intake manifold and EGR modulator bracket to throttle body.
   Tighten 4 throttle body bolts to specified torque.

Tightening torque for throttle body bolts	N·m	kg-m	lb-ft
	18 – 28	1.8 – 2.8	13.5 – 20.0

9. Water hose to air valve.
10. Fuel return hose to fuel pressure regulator.
11. Fuel feed pipe to throttle body after applying thin coat of spindle oil or gasoline to O ring. Use a new O ring.
    Tighten pipe bolts to specified torque and pipe clamp bolt.

Tightening torque for fuel feed pipe bolts	N·m	kg-m	lb-ft
	8 – 12	0.8 – 1.2	6.0 – 8.5

12. Couplers of injector, throttle position sensor and idle speed control solenoid valve lead wires.
13. Vacuum hoses to throttle body and throttle opener.

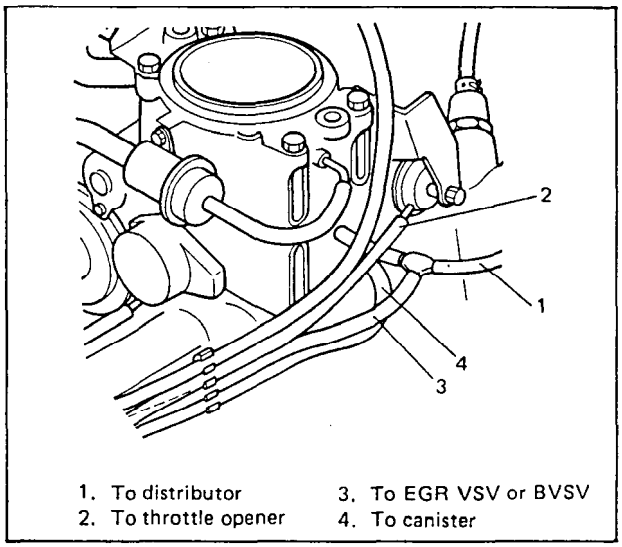


Fig. 6A-19 Connecting Vacuum Hoses

14. Accelerator cable to throttle valve lever.
    Adjust the cable play to specification according to procedure described in p. 6E-68.

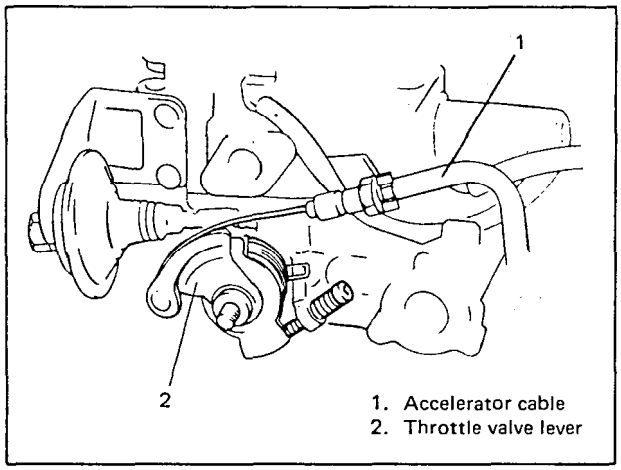
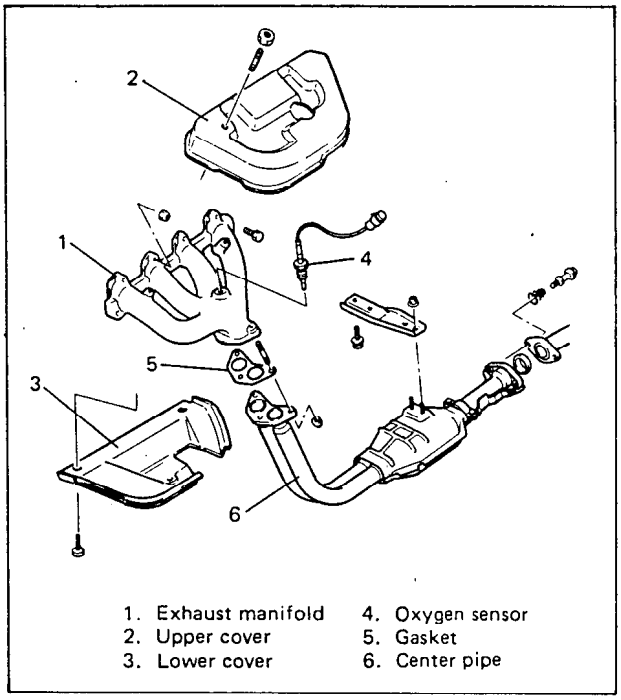


Fig. 6A-20 Accelerator Cable

15. Air intake case as previously outlined.
16. Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
17. Refill cooling system, referring to Section 6B.
18. Negative cable at battery.
19. Upon completion of installation, verify that there is no fuel leakage at each connection according to procedure described in p. 6-3.

EXHAUST MANIFOLD

WARNING:
To avoid danger of being burned, do not service exhaust system while it is still hot. Service should be performed after system cools down.

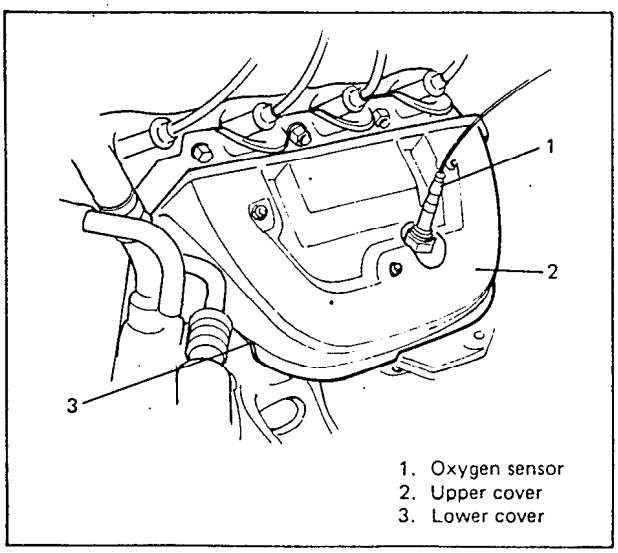


1. Exhaust manifold
2. Upper cover
3. Lower cover
4. Oxygen sensor
5. Gasket
6. Center pipe

Fig. 6A-21 Exhaust Manifold, Center Pipe, etc.

REMOVE OR DISCONNECT

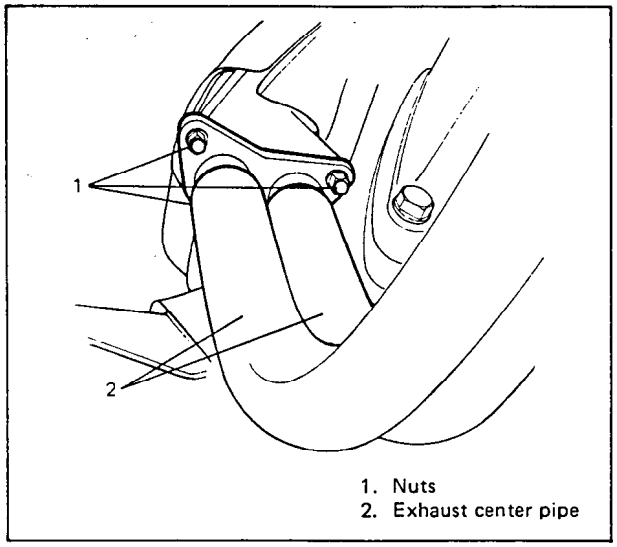
1. Negative cable at battery.
2. Oxygen sensor lead wire at coupler.
3. Air intake case bracket.
4. Exhaust manifold upper and lower covers from exhaust manifold.



1. Oxygen sensor
2. Upper cover
3. Lower cover

Fig. 6A-22 Exhaust Manifold Cover

5. Exhaust center pipe nuts.



1. Nuts
2. Exhaust center pipe

Fig. 6A-23 Exhaust Center Pipe

6. Exhaust manifold and its gasket from cylinder head.

INSTALL OR CONNECT

1. Manifold gasket to cylinder head.
   Before installing gasket, check it for deterioration or damage, and replace as necessary.
2. Exhaust manifold and air intake case bracket.
   Tighten manifold bolts and nuts to specified torque.

Tightening torque for exhaust manifold bolts and nuts	N·m	kg-m	lb-ft
	18 – 28	1.8 – 2.8	13.5 – 20.0

3. Pipe gasket and exhaust center pipe.
   Before installing gasket, check it for deterioration or damage. Replace as necessary.
   Tighten pipe nuts to specified torques.

Tightening torque for center pipe nuts	N·m	kg-m	lb-ft
	40 – 60	4.0 – 6.0	29.0 – 43.0

4. Exhaust manifold upper and lower covers.
5. Oxygen sensor lead wire coupler.
   Be sure to clamp its lead wire.
6. Negative cable to battery.
7. Upon completion of installation, start engine and check that no exhaust gas leakage exists.

UNIT REPAIR OVERHAUL

ENGINE ASSEMBLY

REMOVE OR DISCONNECT

1. Battery cable at battery.
2. Engine hood.
3. Drain cooling system.
4. Radiator reservoir tank, radiator fan shround and radiator. Refer to Section 6B for radiator removal. If vehicle has air conditioner, remove air conditioner condensor.
5. Air cleaner outlet hose.
6. Accelerator cable from throttle body.
7. Following electric lead wires:
   - Throttle opener VSV wire.
   - EGR VSV wire.
   - Earth wire from intake manifold.
   - Oil pressure gauge wire.
   - Water temperature gauge wire.
   - Water temperature sensor wire.
   - Air temperature sensor wire.
   - Injector, throttle position sensor and idle speed control solenoid valve wires at their couplers.
   - Alternator wires.
   - Starter motor wires.

   and release above wire harnesses from clamps.
   - Oxygen sensor wire.
   - Distributor wires at coupler and high-tension cord from ignition coil.
   - Earth wires from distributor gear case.
8. Starter motor.
9. Fuel filler cap to release fuel vapor pressure in fuel tank. After releasing, reinstall the cap.
10. Release fuel pressure in fuel feed line by referring to p. 6-2.
11. Following hoses:
    - Fuel feed pipe from throttle body.
    - Fuel return hose from fuel pressure regulator.
    - Canister purge hose from canister.
    - Pressure sensor hose from gas filter.
    - Brake booster hose from intake manifold.
    - Water inlet hose from water inlet pipe.
    - Heater outlet hose from water inlet pipe.
    - Heater inlet hose from intake manifold.

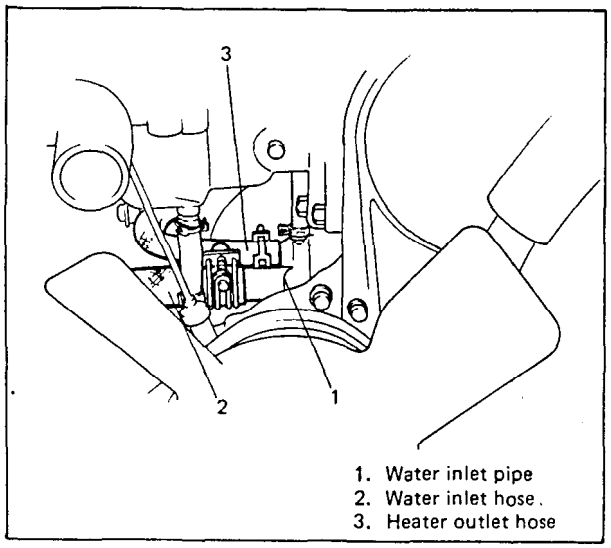


Fig. 6A-24 Disconnecting Water Hoses

12. Raise vehicle.
13. Drain engine oil.
14. Exhaust center pipe from exhaust manifold and muffler.

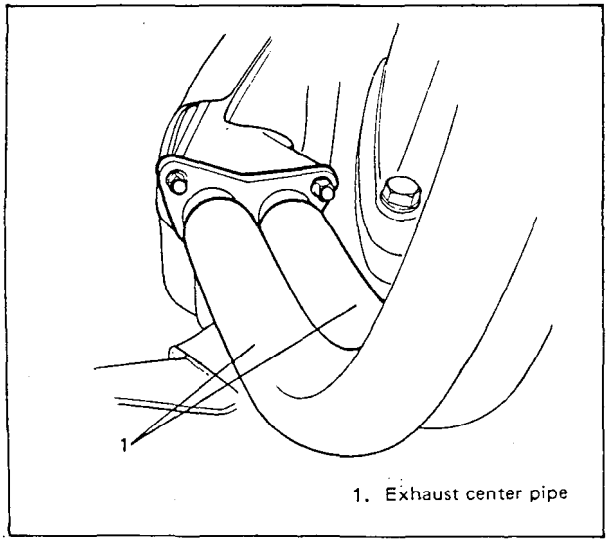


Fig. 6A-25 Exhaust Center Pipe

15. Clutch cable from release arm and bracket.

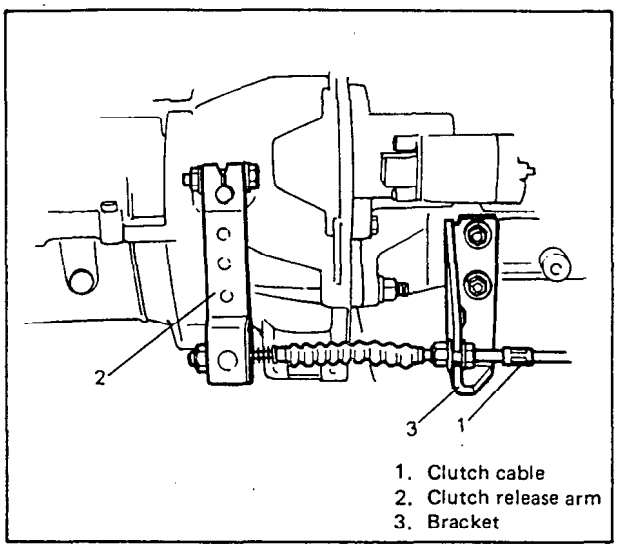


Fig. 6A-26 Clutch Cable

16. Clutch housing lower plate.
17. Lower vehicle.
18. Bolts and nuts fastening cylinder block and transmission.
19. Support transmission.
20. Install lifting device.
21. Engine mountings (left & right) with chassis side mounting brackets.
22. Before lifting engine, check to ensure all hoses, electric wires and cables are disconnected from engine.
23. Engine assembly from chassis and transmission by sliding towards the front side, and then, carefully hoist engine assembly.

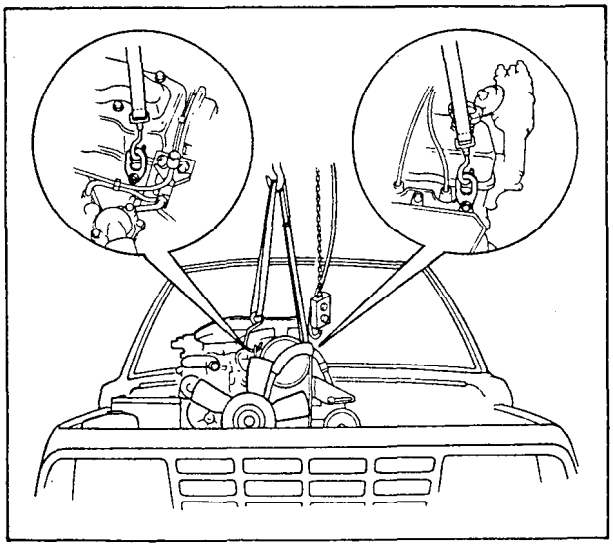
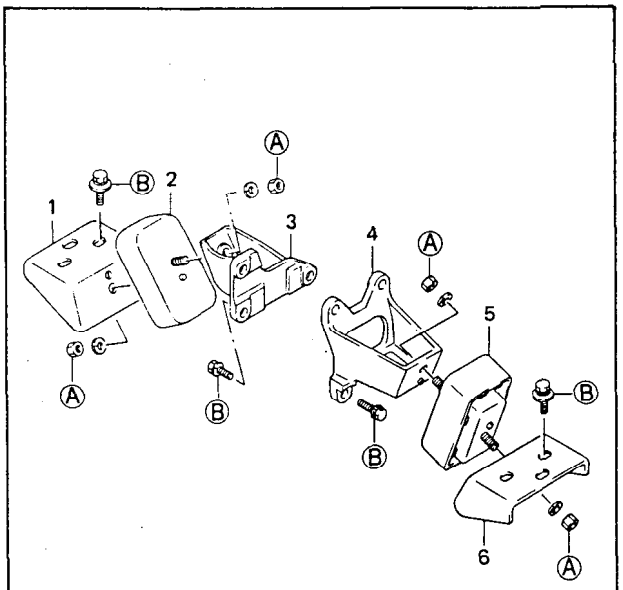


Fig. 6A-27 Hoisting Engine Assembly

INSTALL OR CONNECT

1. Lower engine assembly into engine compartment and connect engine to transmission.
2. Engine mountings (left & right) with chassis side mounting brackets. Tighten mounting nuts and bracket bolts to specified torque.



1. Chassis side mounting bracket (Right side)
2. Mounting (Right side)
3. Engine side mounting bracket (Right side)
4. Engine side mounting bracket (Left side)
5. Mounting (Left side)
6. Chassis side mounting bracket (Left side)

Tightening torque:
Ⓐ : 40 – 50 N·m
4.0 – 5.0 kg-m
29.0 – 36.0 lb-ft
Ⓑ : 50 – 60 N·m
5.0 – 6.0 kg-m
36.5 – 43.0 lb-ft

Fig. 6A-28 Engine Mounting

3. Remove lifting device.
4. Reverse removal procedures for installation of remainder.
5. Adjust clutch pedal free travel. Refer to Section 7C for adjustment.
6. Adjust accelerator cable according to procedure described in Section 6E.
7. Refill engine with engine oil referring to item "ENGINE OIL CHANGE" in Section 0B.

8. Refill cooling system.
9. Check to ensure all fasteners and clamps are tightened.
10. Upon completion of installation, verify that there is no fuel leakage, water leakage or exhaust gas leakage at each connection.
11. If vehicle has air conditioner, charge refrigerant.

RECOMMENDED TORQUE SPECIFICATIONS

System	Fastening parts	Tightening torque		
		N·m	kg-m	lb-ft
Engine	Cylinder head bolt	70 – 75	7.0 – 7.5	51.0 – 54.0
	Spark plug	20 – 30	2.0 – 3.0	14.5 – 21.5
	Intake & exhaust manifold bolt and nut	18 – 28	1.8 –2.8	13.5 – 20.0
	Camshaft timing pulley bolt	56 – 64	5.6 – 6.4	41.0 – 46.0
	Valve adjusting screw lock nut	15 – 19	1.5 – 1.9	11.0 – 13.5
	Timing belt cover bolt and nut	9 – 12	0.9 – 1.2	7.0 – 8.5
	Crankshaft pully bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
	Connecting rod bearing cap nut	33 – 37	3.3 – 3.7	24.0 – 26.5
	Crankshaft main bearing cap bolt	50 – 57	5.0 – 5.7	36.5 – 41.0
	Oil pressure switch	12 – 15	1.2 – 1.5	9.0 – 10.5
	Oil filter Ass'y	12 – 16	1.2 – 1.6	9.0 – 11.5
	Oil filter stand	20 – 25	2.0 – 2.5	14.5 – 18.0
	Oil pan bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
	Oil drain plug	30 – 40	3.0 – 4.0	22.0 – 28.5
	Cylinder head cover bolt	4 – 5	0.4 – 0.5	3.0 – 3.5
	Rocker arm shaft screw	9 – 12	0.9 – 1.2	7.0 – 8.5
	Throttle body bolt	18 – 28	1.8 – 2.8	13.5 – 20.0
	Exhaust center pipe nut	40 – 60	4.0 – 6.0	29.0 – 43.0
	Oil pump strainer and bracket bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
	Oil pump case bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
	Oil pump rotor plate screw	9 – 12	0.9 – 1.2	7.0 – 8.5
	Crankshaft timing belt pulley bolt	105 – 115	10.5 – 11.5	76.0 – 83.0
	Timing belt tensioner bolt	24 – 30	2.4 – 3.0	17.5 – 21.5
	Timing belt tensioner stud	9 – 12	0.9 – 1.2	7.0 – 8.5
	Water pump bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
	Cooling fan nut	9 – 12	0.9 – 1.2	7.0 – 8.5
	Crankshaft oil seal housing bolt	9 – 12	0.9 – 1.2	7.0 – 8.5
	Engine mounting nut (Right & Left)	40 – 50	4.0 – 5.0	29.0 – 36.0
	Engine mounting chassis side bracket bolt (Right & Left)	50 – 60	5.0 – 6.0	36.5 – 43.0
	Engine mounting engine side bracket bolt (Right & Left)	50 – 60	5.0 – 6.0	36.5 – 43.0
	Flywheel bolt	75 – 80	7.5 – 8.0	54.5 – 57.5

SECTION 6C

ENGINE FUEL

CONTENTS

GENERAL DESCRIPTION 6C-1
- Fuel System 6C-1
- Fuel Tank 6C-2
- Fuel Pump ..... Refer to SECTION 6E
- Fuel Filter 6C-2
- Fuel Filler Cap 6C-2

ON VEHICLE SERVICE 6C-3
- Fuel Pump ..... Refer to SECTION 6E
- Fuel Filter 6C-3
- Fuel Lines 6C-4
- Fuel Filler Cap 6C-4
- Fuel Tank 6C-5

RECOMMENDED TORQUE SPECIFICATIONS 6C-6

CAUTION:
THE ENGINE OF THIS VEHICLE REQUIRES THE USE OF UNLEADED FUEL ONLY. USE OF LEADED AND/OR LOW LEAD FUEL CAN RESULT IN ENGINE DAMAGE AND REDUCE THE EFFECTIVENESS OF THE EMISSION CONTROL SYSTEMS.

GENERAL DESCRIPTION

FUEL SYSTEM

The main components of the fuel system are fuel tank, fuel pump, fuel filter and fuel level gauge and it includes three lines; fuel feed line, fuel return line and fuel vapor line.
For the details of fuel flow and fuel vapor flow, refer to SECTION 6E "ELECTRONIC FUEL INJECTION SYSTEM" and SECTION 6J "ENGINE EMISSION CONTROL" respectively.

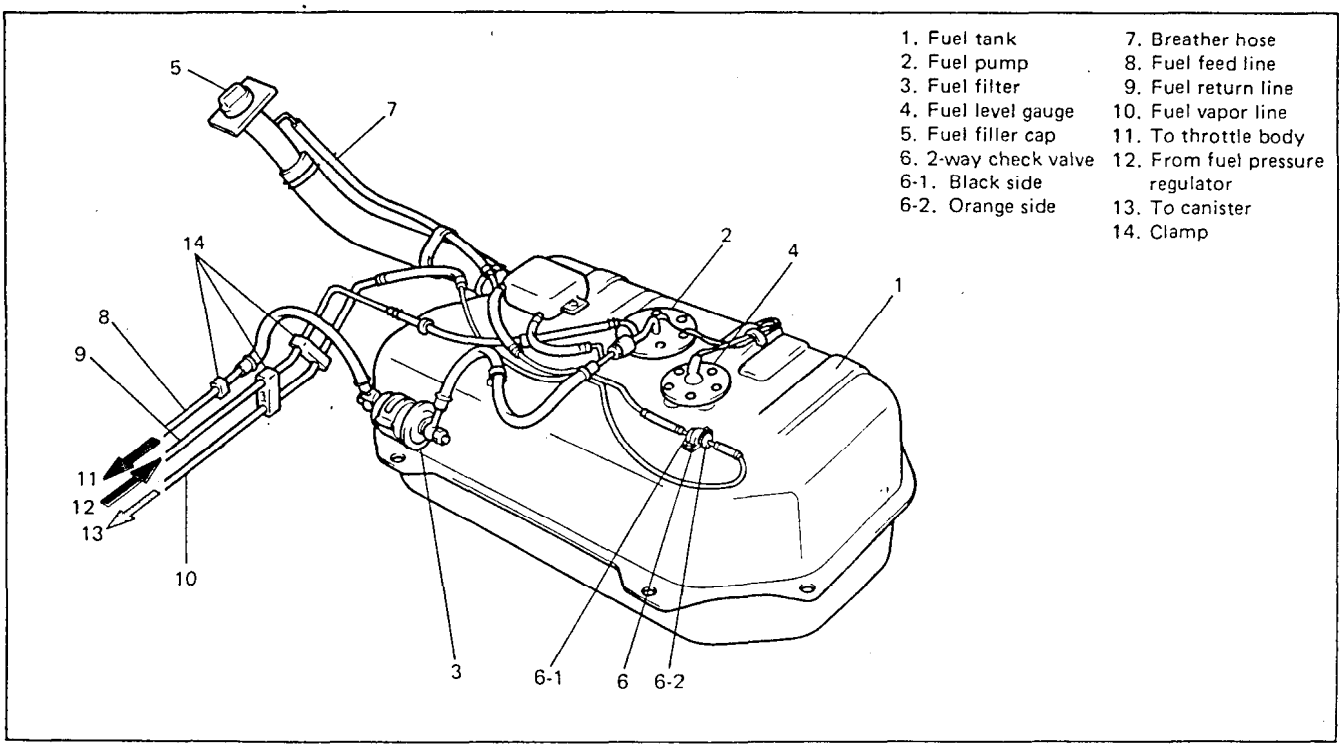


Fig. 6C-1 Fuel System

FUEL TANK

The fuel tank is located under the rear of the vehicle. The fuel pump and fuel level gauge are installed on the upper part of the fuel tank.
Also, the fuel tank has the inlet valve at the inlet port.

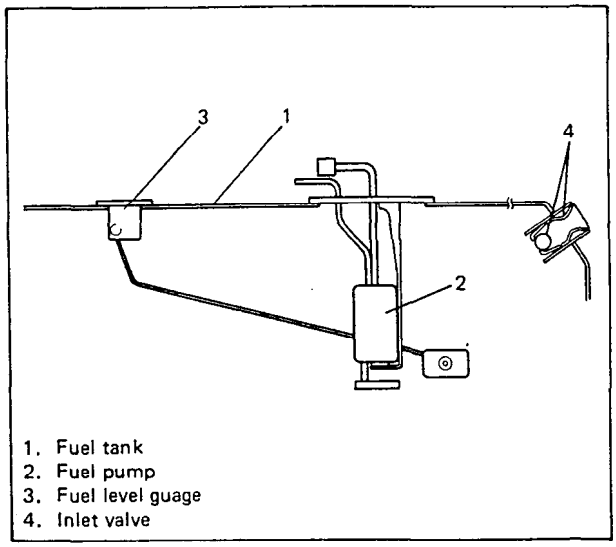


Fig. 6C-2 Fuel Pump, Level Gauge and Inlet Valve

FUEL FILTER

The fuel filter is installed on the chassis frame and filters the fuel sent under pressure from the fuel pump.
As it can't be disassembled, it should be replaced as an assembly. Note that letters indicating the fuel inlet and outlet ports are stamped on the fuel filter. Refer to them for proper hose connection.

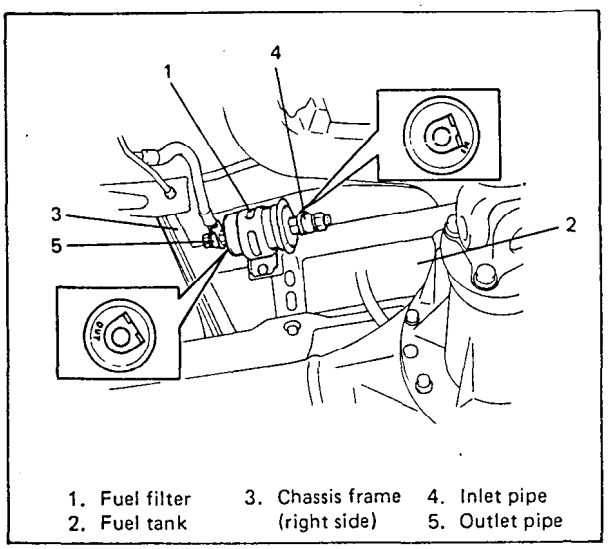


Fig. 6C-3 Fuel Filter

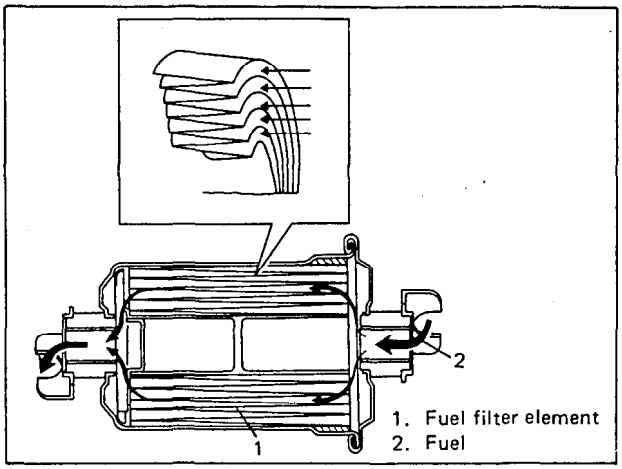


Fig. 6C-4 Fuel Flow

FUEL FILLER CAP

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would prevent sealing fuel vapors.
After the gasket on fuel filler cap and the filler neck flange contact, the ratchet produces a loud clicking noise, indicating the seal has been set.
This cap has a vacuum relief valve inside.

When the pressure in the fuel tank becomes negative (vacuum), the vacuum is usually relieved by the two-way check valve which is included in the fuel vapor line. Only when the vacuum becomes high especially the vacuum relief valve opens.

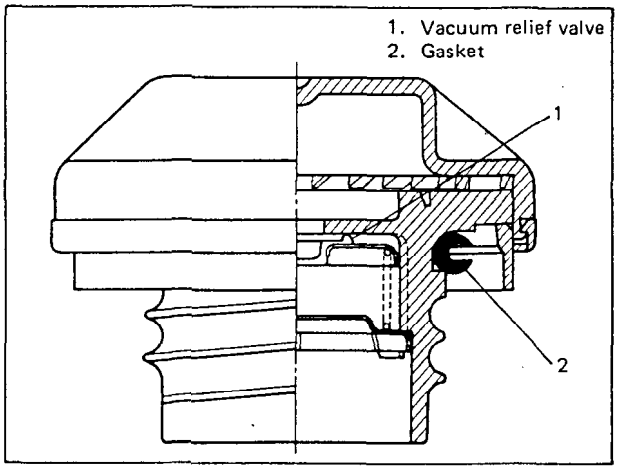


Fig. 6C-5 Fuel Filler Cap Cross-Section

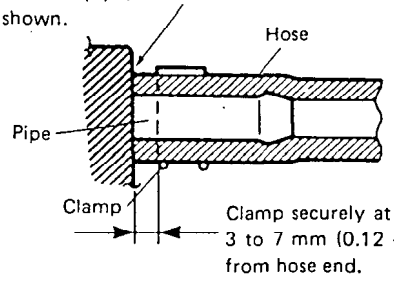
ON VEHICLE SERVICE

WARNING:

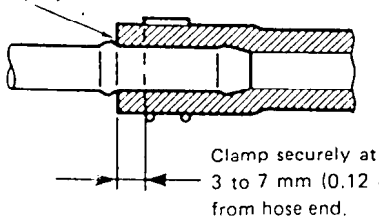
Before attempting service of any type on fuel system, following cautions should be always observed.

- **Disconnect negative cable at battery.**
- **DO NOT smoke, and place "NO SMOKING" signs near work area.**
- **Be sure to have CO_2 fire extinguisher handy.**
- **Be sure to perform work in a well-ventilated area and away from any open flames (such as gas hot heater).**
- **Wear safety glasses.**
- **To release fuel vapor pressure in fuel tank, remove fuel filler cap from fuel filler neck and then reinstall it.**
- **As fuel feed line is still under high fuel pressure even after engine was stopped, loosening or disconnecting fuel feed line directly may cause dangerous spout of fuel to occur where loosened or disconnected. Before loosening or disconnecting fuel feed line, make sure to release fuel pressure according to procedure described on p. 6-2.**
- **Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly referring to the following.**

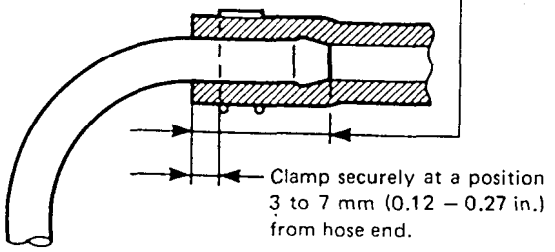
With short pipe, fit hose as far as it reaches pipe joint as shown.



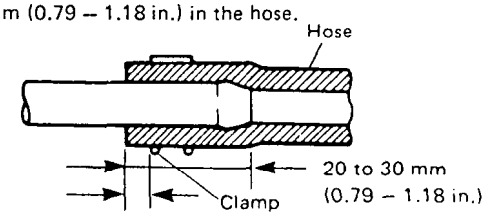
With following type pipe, fit hose as far as its peripheral projection as shown.



With bent pipe, fit hose as far as its bent part as shown or till pipe is about 20 to 30 mm (0.79 – 1.18 in.) into the hose.



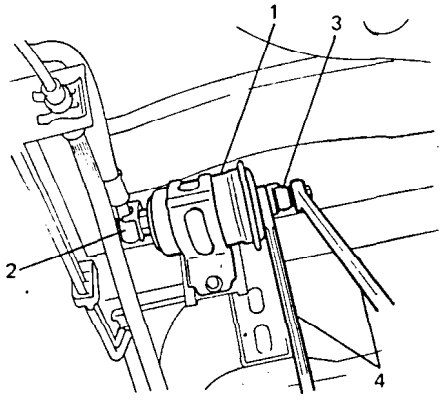
With straight pipe, fit hose till pipe is about 20 to 30 mm (0.79 – 1.18 in.) in the hose.



FUEL FILTER

REMOVE OR DISCONNECT

1. Negative cable at battery.
2. Fuel filler cap from fuel filler neck to release fuel vapor pressure in fuel tank. After releasing, reinstall cap.
3. Hoist vehicle.
4. Place fuel container under fuel filter.
5. Release fuel pressure in fuel feed line referring to P. 6-2.
6. Inlet and outlet pipes from fuel filter by using two wrenches.



1. Fuel filter
2. Outlet pipe
3. Inlet pipe
4. Wrenches

Fig. 6C-6 Fuel Filter Removal

7. Fuel filter from chassis frame.

INSTALL OR CONNECT

Reverse removal procedure noting the following.

- Use new gaskets.
- Make sure that gasketed surfaces are free from any damage.
- Inlet and outlet pipes should come into recess of plate as shown below.

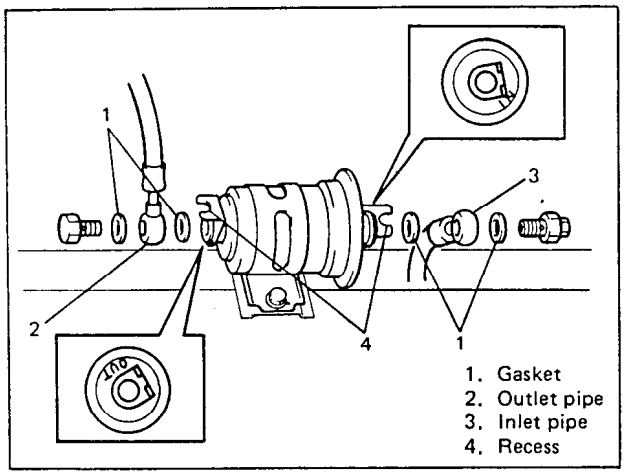


Fig. 6C-7 Fuel Filter Installation

- Tighten union bolts to specified torque.

Tightening torque of fuel filter union bolts	N·m	kg-m	lb-ft
	30 – 40	3.0 – 4.0	22.0 – 28.5

- Upon completion of installation, verify that there is no fuel leakage at each connection according to procedure described in P. 6-3.

FUEL LINES

Due to the fact that fuel feed line is under high pressure, this system requires special consideration for service.

The feed pipe uses screw couplings.

Any time these fittings are loosened to service or replace components, ensure that:

- Backup wrench is used while loosening and tightening fitting.
- Tighten fittings (flare nut) to specified torque.

Tightening torque for pipe fitting (flare nut)	N·m	kg-m	lb-ft
	40 – 50	4.0 – 5.0	29.0 – 36.0

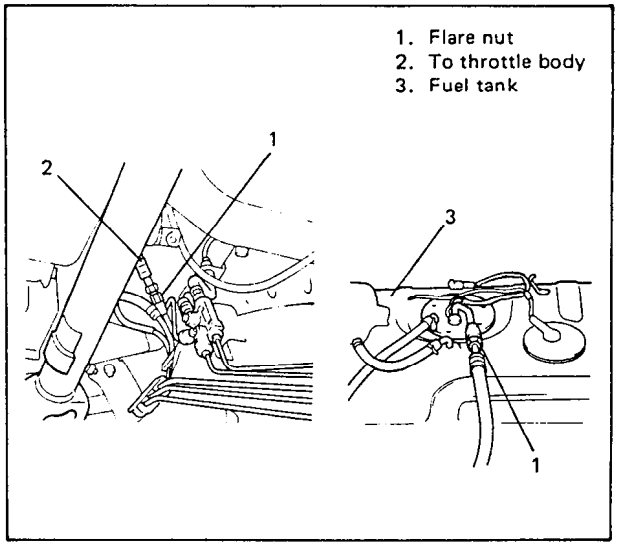


Fig. 6C-8 Fuel Pipe Screw Couplings

INSPECT

Visually inspect fuel lines for evidence of fuel leakage, hose cracking and deterioration, or damage. Make sure all clamps are secure.

Replace parts as needed.

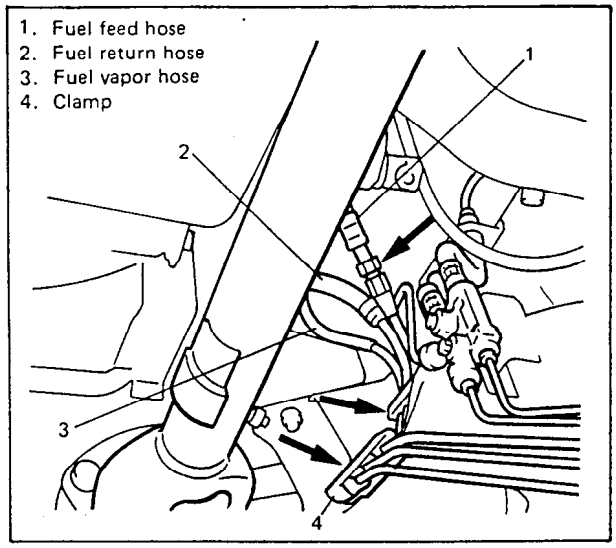


Fig. 6C-9 Fuel Lines Inspection

FUEL FILLER CAP

Remove cap, and check gasket for even filler neck imprint, and deterioration or any damage. If gasket is in malcondition, replace cap.

NOTE:

If cap requires replacement, only a cap with the same features should be used. Failure to use correct cap can result in serious malfunction of the system.

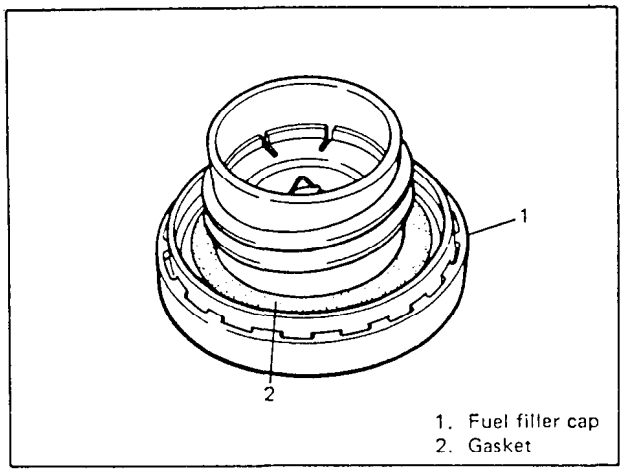


Fig. 6C-10 Fuel Filler Cap

FUEL TANK

REMOVE OR DISCONNECT

1. Negative cable at battery.
2. Fuel level gauge and fuel pump lead wire couplers after removing rear bumper cover.

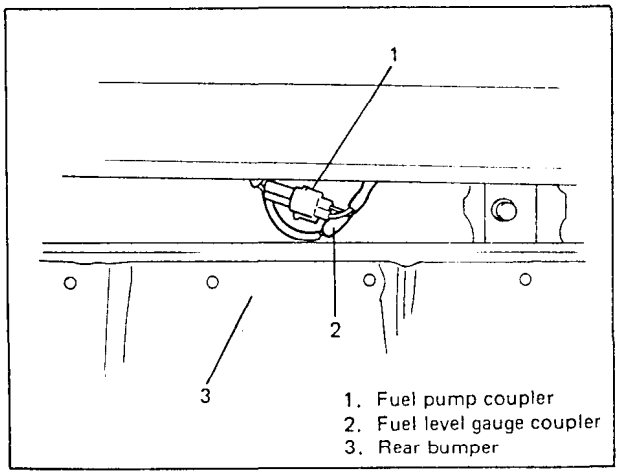


Fig. 6C-11 Fuel Pump and Level Gauge Couplers

3. To release pressure in fuel tank, remove fuel filler cap and then, reinstall it.
4. Fuel tank filler hose cover, filler hose and fuel tank inlet valve.
5. Due to absence of fuel tank drain plug, drain fuel tank by pumping fuel out through fuel tank filler.
   Use hand operated pump device to drain fuel tank.

> CAUTION:
> Never drain or store fuel in an open container due to possibility of fire or explosion.

6. Release fuel pressure in fuel feed line referring to p. 6-2.
7. Fuel filter inlet pipe from filter.

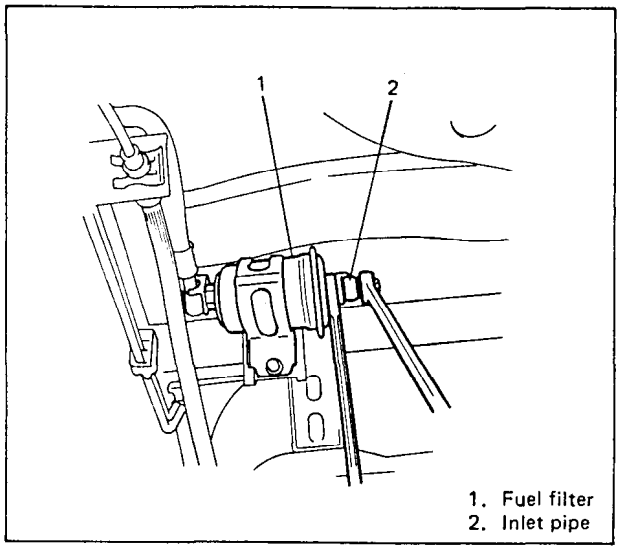


Fig. 6C-12 Disconnecting Fuel Filter Inlet Pipe

8. Fuel vapor hose and return hose from pipes.

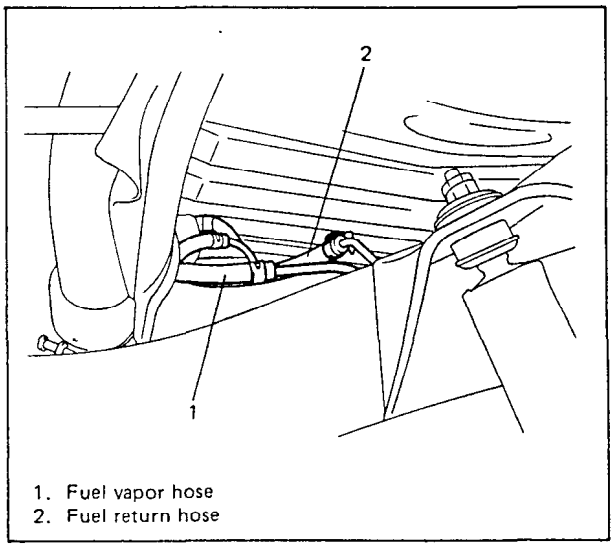


Fig. 6C-13 Disconnecting Hoses

9. Fuel tank protector.
10. Fuel tank and cover from vehicle.

INSPECT

After removing fuel tank, check hoses and pipes connected to fuel tank for leaks, loose connections, deterioration or damage. Also check fuel pump and level gauge gaskets for leaks, visually inspect fuel tank for leaks and damage.
Replace any damaged or malconditioned parts.

FUEL TANK PURGING PROCEDURE

> CAUTION:
> **This purging procedure will NOT remove all fuel vapor. Do not attempt any repair on tank where heat or flame is required, as an explosion resulting in personal injury could occur.**

The following procedure is used for purging the fuel tank.

1. After removing fuel tank, remove all hoses, 2-way check valve, fuel separator, fuel pump and fuel level gauge from fuel tank.
2. Drain all remaining fuel from tank.
3. Move tank to flushing area.
4. Fill tank with warm water or tap water, and agitate vigorously and drain. Repeat this washing until inside of tank is clean.
   Replace tank if its inside is rusty.
5. Completely flush out remaining water after washing.

INSTALL OR CONNECT

1. Fuel pump and fuel level gauge to fuel tank. Use new gaskets.
2. Fuel separator, inlet valve and 2-way check valve to fuel tank directing 2-way check valve black nozzle toward fuel separator. Refer to Fig. 6C-1.
3. Fuel hoses to fuel tank, fuel pump, 2-way check valve and separator.
   After connecting, clamp hoses securely. Refer to Fig. 6C-1.
4. Fuel tank and cover to vehicle.
5. Fuel filler hose and breather hose to fuel filler neck. Clamp them securely.
6. Fuel vapor hose and return hose to fuel pipe. Clamp them securely.
7. Fuel filter inlet pipe to fuel filter.
   Use new gaskets and tighen union bolt to specification.
8. Fuel filler hose cover.
9. Fuel pump and level gauge couplers.
10. Rear bumper cover.
11. Negative cable to battery.
12. Upon completion of installation, check fuel system for leakage referring to p. 6-3.

RECOMMENDED TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Fuel filter union bolt	30 – 40	3.0 – 4.0	22.0 – 28.5
Blind plug of fuel filter union bolt	9 – 11	0.9 – 1.1	7.0 – 7.5
Flare nut of fuel pipe	40 – 50	4.0 – 5.0	29.0 – 36.0

SECTION 6E

ELECTRONIC FUEL INJECTION SYSTEM

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GENERAL DESCRIPTION

The Electronic Fuel Injection system in this vehicle supplies the combustion chambers with air/fuel mixture of optimized ratio under widely varying driving conditions. It uses the single-point throttle body fuel injection system which injects fuel into the throttle body through one injector and ECM in it also controls the VSV for EGR system.

This system has 2 major sub-systems: fuel delivery system and electronic control system. Fuel delivery system includes fuel pump, throttle body, etc.. Electronic control system includes ECM, various sensors and various controlled devices.

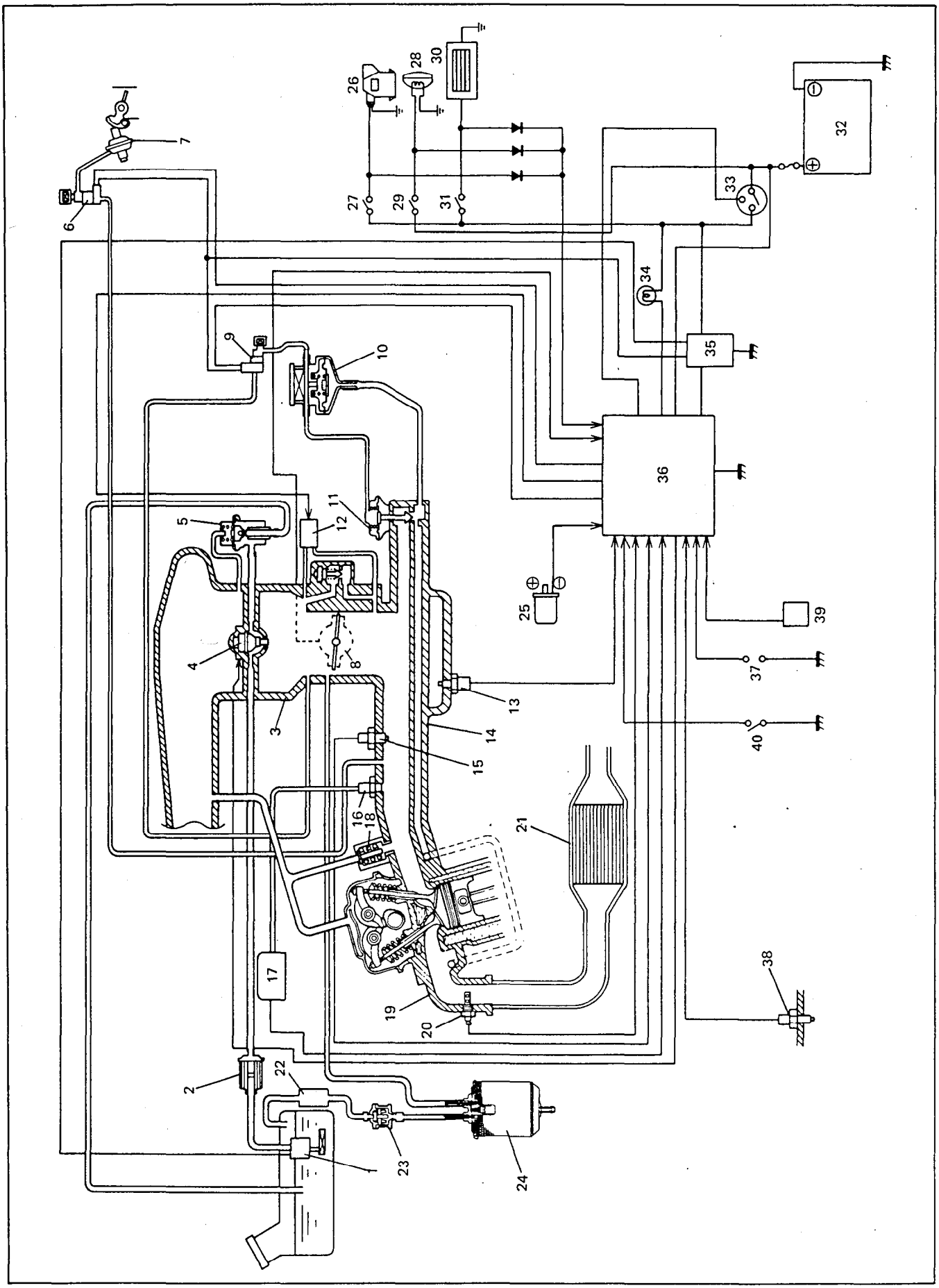


Fig. 6E-1 Electronic Fuel Injection System

1. Fuel pump
2. Fuel filter
3. Throttle body
4. Injector
5. Fuel pressure regulator
6. Throttle opener VSV (Vacuum Switching Valve)
7. Throttle opener
8. Throttle position sensor
9. EGR VSV
10. EGR modulator
11. EGR valve
12. ISC (Idle Speed Control) solenoid valve
13. Water temperature sensor
14. Intake manifold
15. Air temperature sensor
16. Gas filter
17. Pressure sensor
18. PCV valve
19. Exhaust manifold
20. Oxygen sensor
21. Three-way catalyst
22. Fuel vapor separator
23. 2-way check valve
24. Charcoal canister
25. Ignition coil
26. Heater fan motor
27. Heater fan switch
28. Small, tail, side marker & licence lights
29. Small, tail, side marker & license lights switch
30. Rear defogger
31. Rear defogger switch
32. Battery
33. Main switch
34. "CHECK ENGINE" light
35. Control relay
36. ECM (Electronic Control Module)
37. Diagnosis terminal
38. 5th switch
39. Air-conditioner amplifier (For vehicle with air-conditioner)
40. Power steering pump pressure switch (For vehicle with power steering system)

FUEL DELIVERY SYSTEM

The main components of the fuel delivery system are fuel tank, fuel pump, fuel filter, throttle body (including injector, fuel pressure regulator, air valve and ISC solenoid valve), fuel feed line and fuel return line.

The fuel in the fuel tank is pumped up by the fuel pump, filtered by the fuel filter and fed under pressure to injector installed in throttle body. As the fuel pressure applied to the fuel injector (the fuel pressure in the fuel feed line) is always kept a certain amount higher than the pressure in the throttle body (the pressure around the injector) by the fuel pressure regulator, the fuel is injected into the throttle body as injector valve opens and closes according to the injection signal from ECM. The fuel relieved by the fuel pressure regulator returns through the fuel return pipe to the fuel tank.

For the structure and operation of the fuel tank and fuel filter, refer to SECTION 6C "ENGINE FUEL".

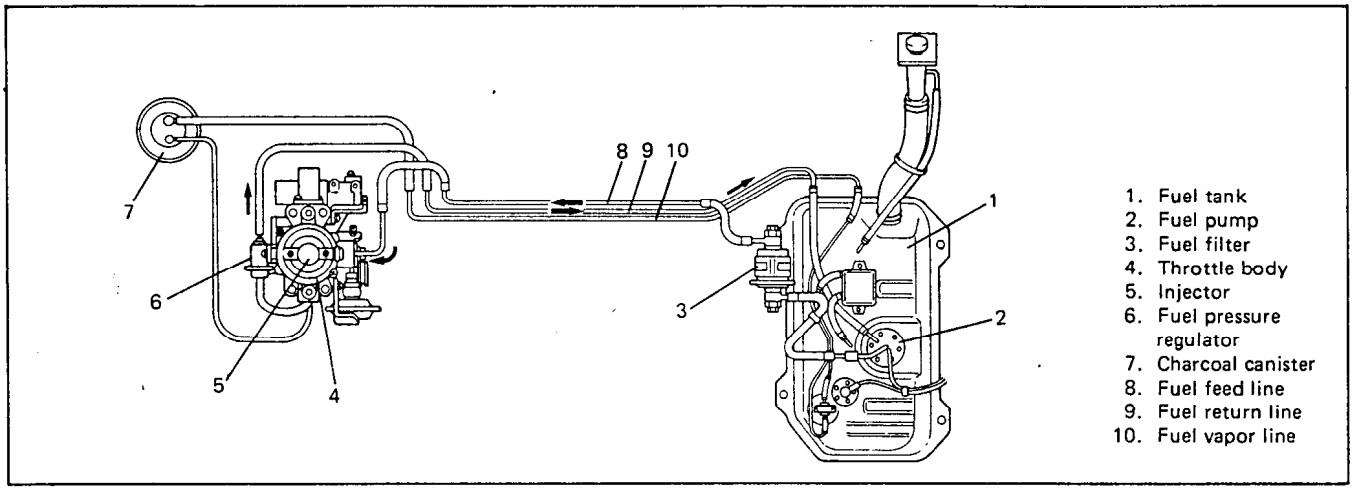


Fig. 6E-2 Fuel Delivery System

Fuel Pump

The electric fuel pump located in the fuel tank consists of armature, magnet, impeller, brush, check valve, relief valve, etc.. The control relay and ECM control its ON/OFF operation as described in item "Fuel Pump Control System".

Operation

When power is supplied to the fuel pump, the motor in the pump runs and so does the impeller. This causes a pressure difference to occur between both sides of the impeller as there are many grooves around it. Then the fuel is drawn through the inlet port, and with its pressure increased it is discharged through the outlet port.

The fuel pump also has a relief valve to prevent excessive rise of the discharge pressure and a check valve to keep some pressure in the fuel feed line even when the fuel pump is stopped.

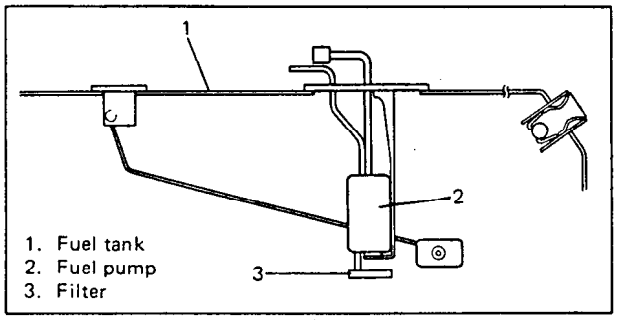


Fig. 6E-3 Fuel Pump Mounting

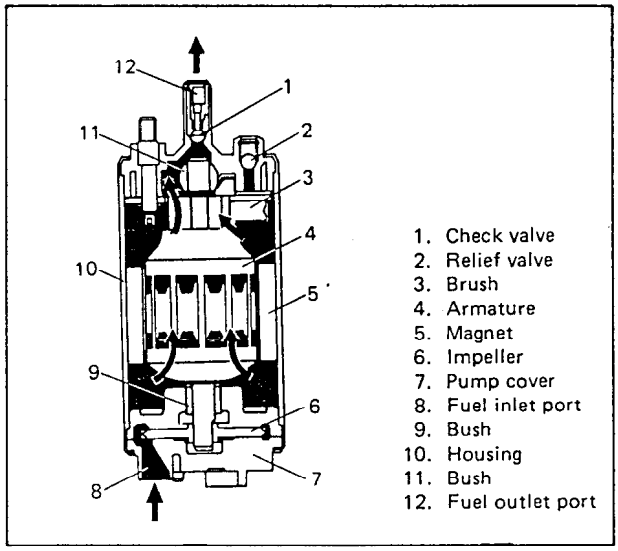


Fig. 6E-4 Fuel Pump Cross-Section

Throttle Body

The throttle body consists of the main bore, air bypass passage, fuel passage, vacuum passage (for ignition timing vacuum advancer, EGR system and canister purge system) and the following parts.

- Injector which injects fuel according to the signal from ECM
- Fuel pressure regulator which maintains the fuel pressure to the injector a certain amount higher than the pressure of the throttle body main bore (around the injector)
- Throttle valve which is interlocked with the accelerator pedal and controls the amount of the air fuel mixture drawn into the combustion chamber
- Throttle opener which controls the throttle valve opening so that it is a little wider when the engine is starting than when the engine is idling
- Throttle position sensor which detects the throttle valve opening and sends a signal to ECM
- Air valve which supplies the bypass air when the engine is cold
- Idle speed control solenoid valve which supplies the bypass air according to the signal from ECM

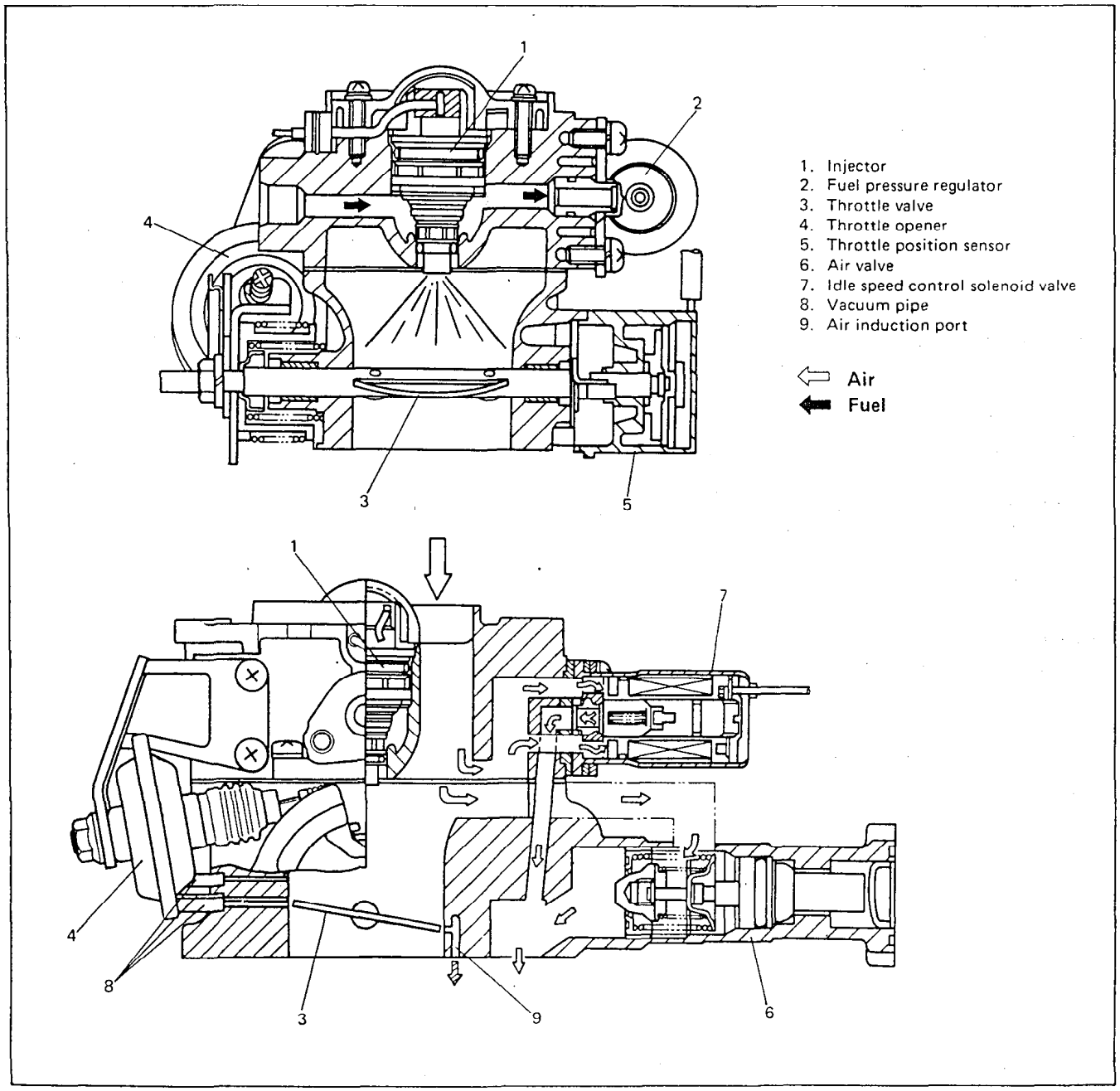
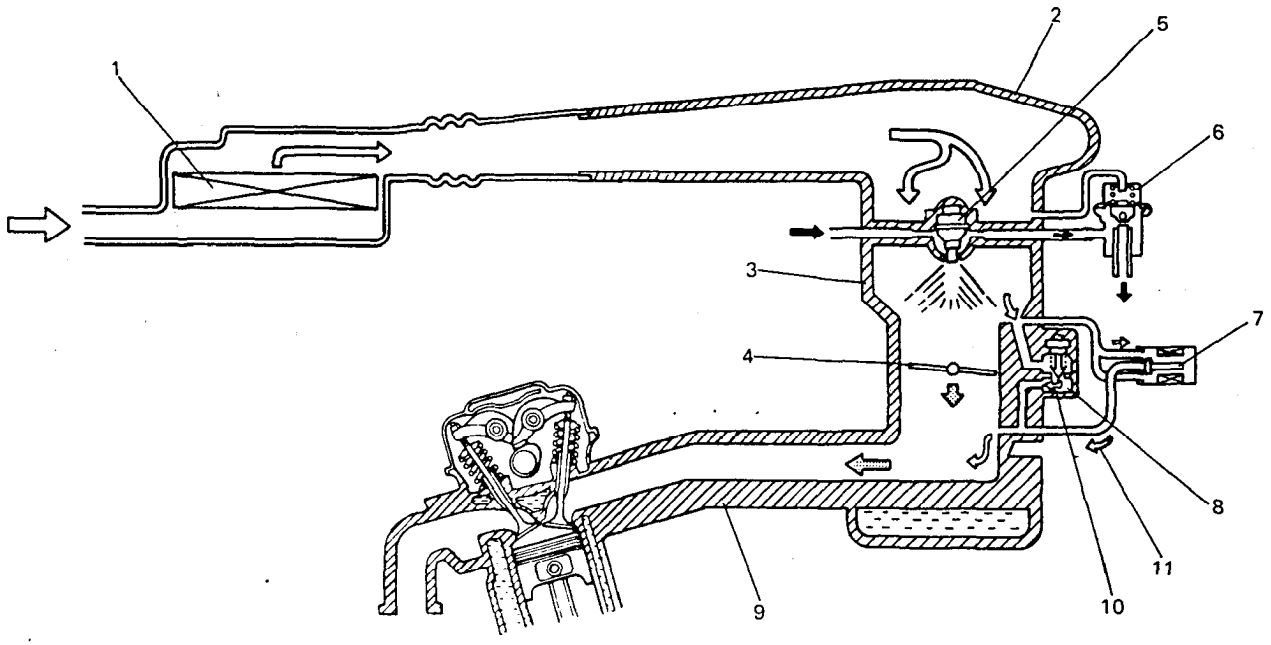


Fig. 6E-5 Throttle Body Cross-Section

Air and fuel flow

The fuel pressure regulator controls the pressure of the fuel supplied to the injector so that it is always a certain amount higher than the pressure in the throttle body bore. Therefore, when the injector opens according to the signal from ECM, the fuel is injected out into the throttle body bore in conic dispersion. The injected fuel is mixed with the air which has been filtered through the air cleaner and drawn through the air intake case into the throttle body. Then the intake manifold distributes the air/fuel mixture suitable for the throttle valve opening and the engine speed to each combustion chamber.

When the engine is cold and when the ISC (Idle Speed Control) solenoid valve opens according to the signal from ECM, the air is drawn through each passage bypassing the throttle valve into the intake manifold.



Air
Fuel
Air/fuel mixture

1. Air cleaner
2. Air intake case
3. Throttle body
4. Throttle valve
5. Injector
6. Fuel pressure regulator
7. Idle speed control solenoid valve
8. Air valve
9. Intake manifold
10. Air flow when engine cold
11. Air flow when ISC solenoid valve opening

Fig. 6E-6 Air and Fuel Flow

Fuel Injector

It is an electromagnetic type injection nozzle which injects fuel in the throttle body bore according to the signal from ECM.

Operation

When the solenoid coil of the injector is energized by ECM, it becomes an electromagnet and attracts the plunger. At the same time, the needle valve which is incorporated with the plunger opens and the injector which is under the fuel pressure injects fuel in conic dispersion.
As the lift stroke of the needle valve of the injector is set constant, the amount of fuel injected at one time is determined by the length of time during which the solenoid coil is energized (injection time).

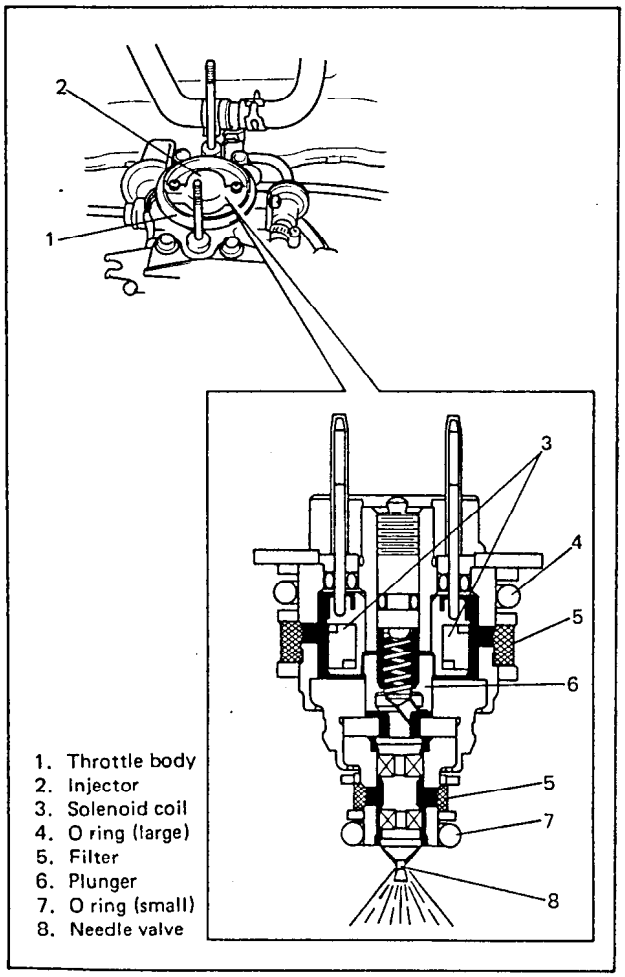


Fig. 6E-7 Injector Cross-Section

Fuel Pressure Regulator

The fuel pressure regulator keeps the fuel pressure applied to the injector 2.65 kg/cm² (265 kPa) higher than that in the throttle body (around injector) at all times.
The pressure applied to the chamber "A" of fuel pressure regulator is the pressure in throttle body and that to the chamber "B" is fuel pressure. When the fuel pressure rises more than 2.65 kg/cm² (265 kPa) higher than the pressure in the throttle body, the fuel pushes the valve in the regulator open and excess fuel returns to the fuel tank via the return pipe.

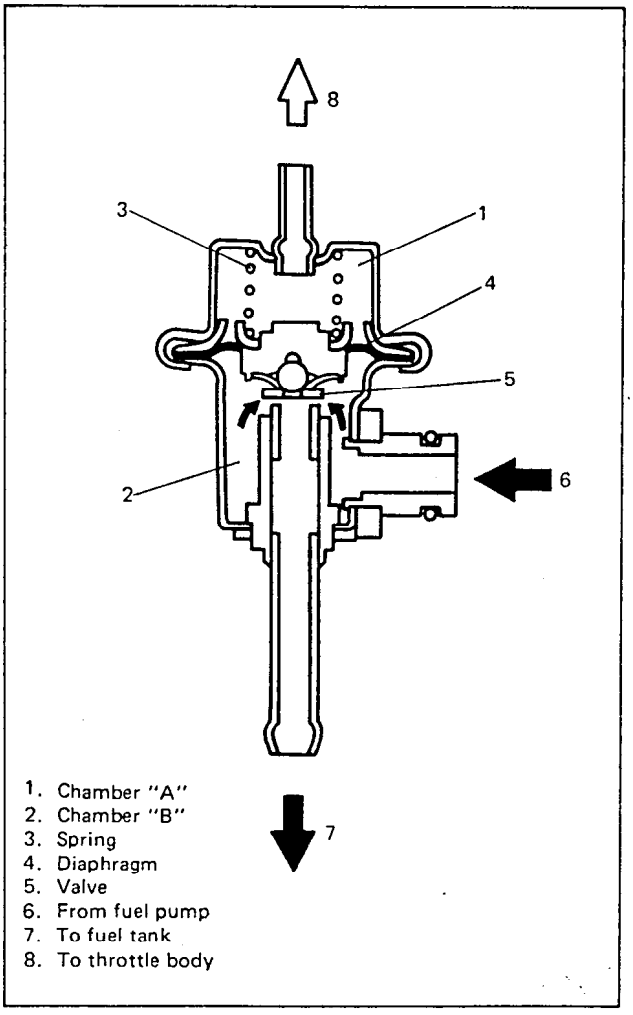


Fig. 6E-8 Pressure Regulator Cross-Section

Air Valve

The air valve consists of thermo-wax, springs and valve.

When the engine is cold, it sends the air from the air cleaner to the intake manifold without letting it pass through the throttle valve to increase the engine speed, and thus the engine is warmed up.

Operation

When the engine is cold (or engine cooling water is lower than about 60°C (140°F)), the thermo-wax contracts.

In this state, the valve is pushed to the left by the spring force and opens the air passage, allowing the air from the air cleaner to be drawn into the intake manifold. Thus the amount of intake air increases even when the throttle valve is at the idle position and the engine speed rises to the fast idle state which is higher than the idle speed.

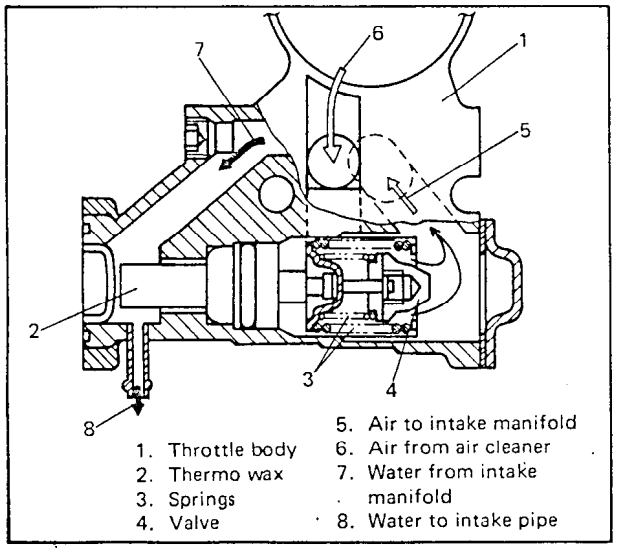


Fig. 6E-9 Air Valve Open

As the engine is warmed up, the thermo-wax expands gradually, then the piston is pushed to move the valve to the right gradually, and the amount of air passing through the air passage decreases and so does the engine speed. When the engine cooling water temperature reaches about 60°C (140°F), the valve is fully closed and the engine speed is back to the normal idle speed.

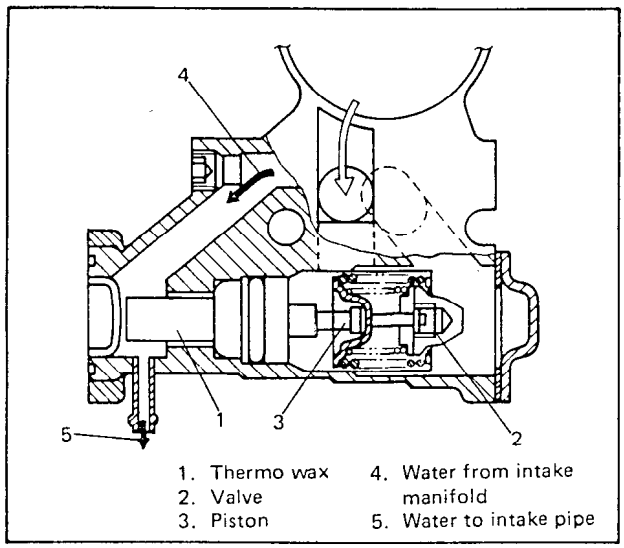


Fig. 6E-10 Air Valve Close

ISC (Idle Speed Control) Solenoid Valve

The ISC solenoid valve opens and closes air by-pass passage in the throttle body according to the signal from ECM.

When it opens, the air is supplied to the intake manifold.

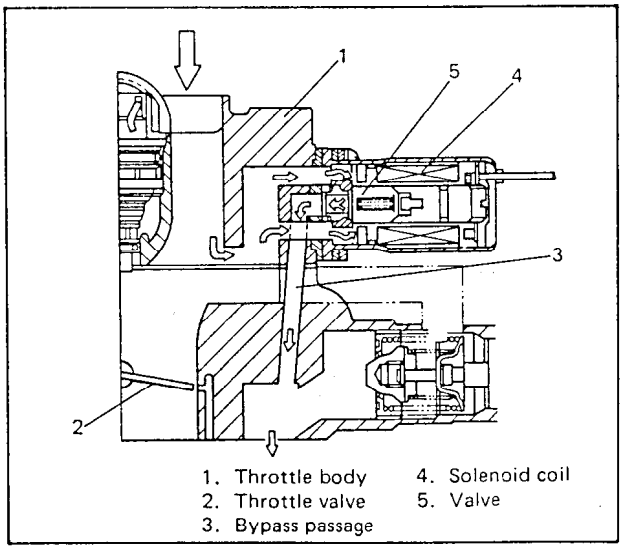
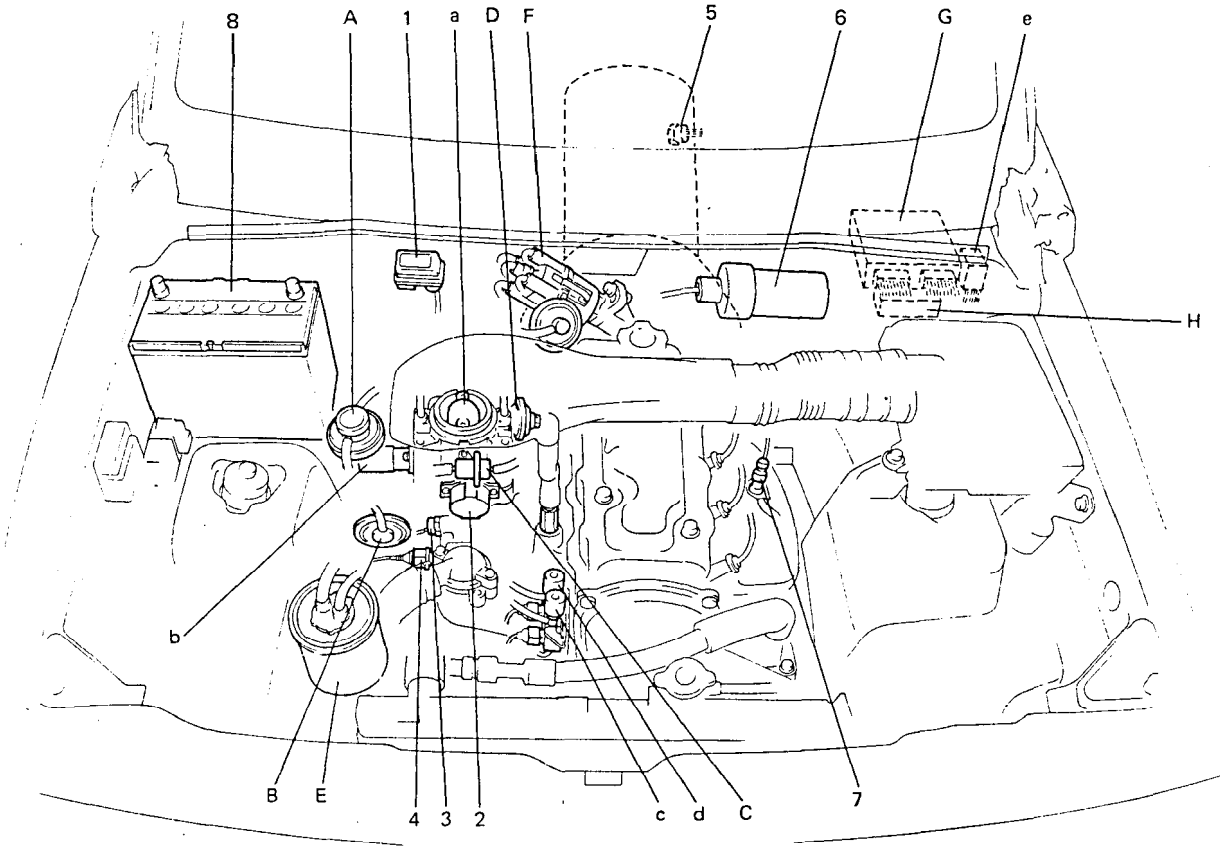


Fig. 6E-11 ISC Solenoid Valve

ELECTRONIC CONTROL SYSTEM

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions and send signals to ECM, 2) ECM which controls the fuel injector, ISC (Idle Speed Control) solenoid valve, control relay, throttle opener VSV (Vacuum Switching Valve), EGR (Exhaust Gas Recirculation) VSV, 3) fuel injector, 4) ISC solenoid valve, 5) control relay, 6) throttle opener VSV, 7) EGR VSV. Functionally, it is divided into seven sub-systems: fuel injection control system, fuel pump control system, ISC solenoid valve control system, throttle opener control system and EGR control system.



INFORMATION SENSORS
1. Pressure sensor
2. Throttle position sensor
3. Air temp. sensor
4. Water temp. sensor
5. 5th switch for MT vehicle
6. Ignition coil
7. Oxygen sensor
8. Battery

CONTROLLED DEVICES
a : Injector
b : ISC solenoid valve
c : Throttle opener VSV (Brown)
d : EGR VSV (Blue)
e : Control relay

OTHERS
A : EGR modulater
B : EGR valve
C : Fuel pressure regulator
D : Throttle opener
E : Canister
F : Distributor
G : ECM
H : Fuse box (Diagnosis terminal)

Fig. 6E-12 Component Parts Location

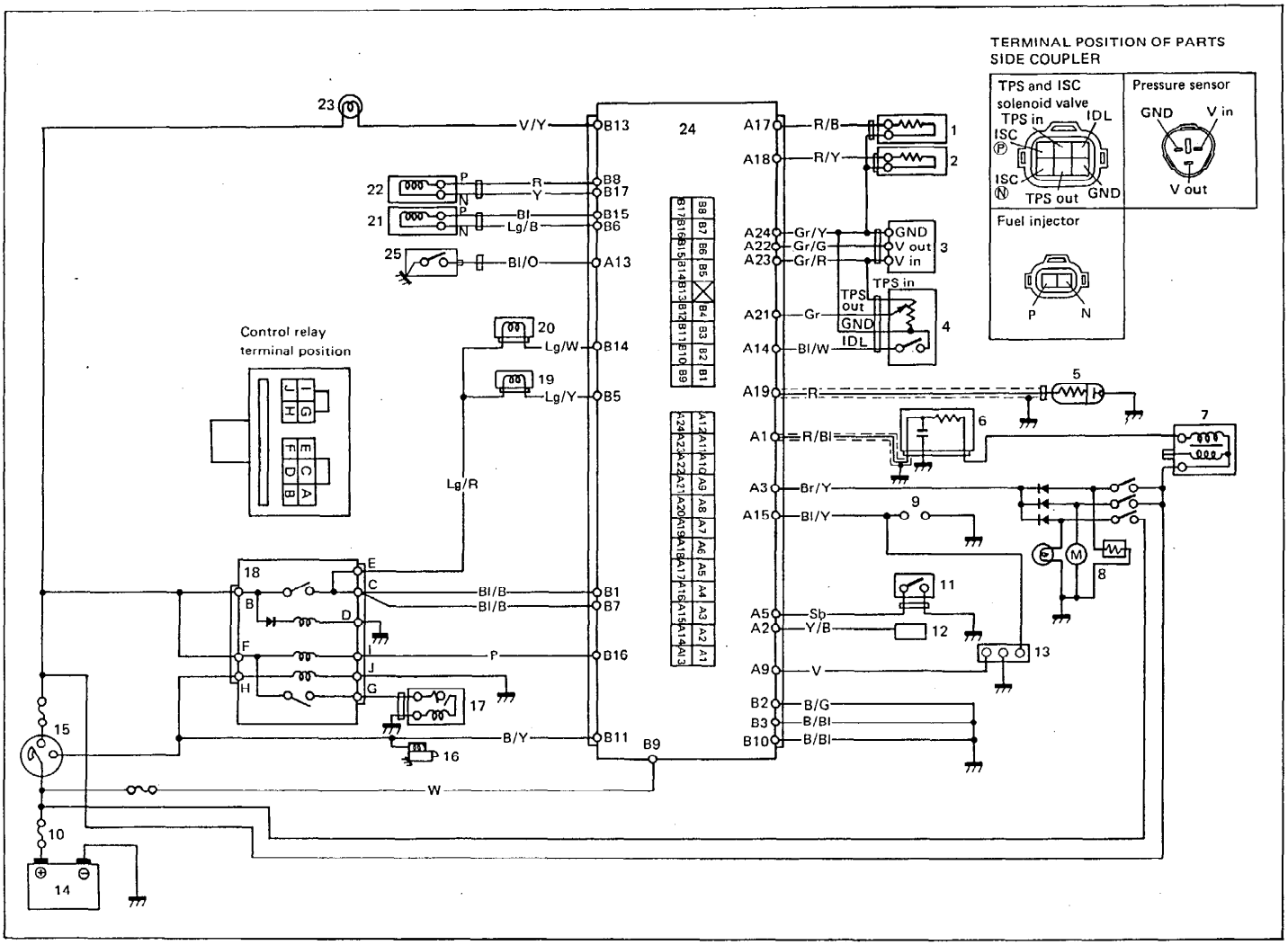


Fig. 6E-13 System Wiring Diagram

1. Air temperature sensor
2. Water temperature sensor
3. Pressure sensor
4. Throttle position sensor
5. Oxygen sensor
6. Noise suppressor
7. Ignition coil
8. Electric load
9. Diagnosis terminal
10. Main fuse
11. 5th switch
12. Air conditioner amplifier (If equipped)
13. Duty check coupler
14. Battery
15. Main switch
16. Starter magnetic switch
17. Fuel pump
18. Control relay
19. EGR VSV
20. Throttle opener VSV
21. ISC solenoid valve
22. Fuel injector
23. "CHECK ENGINE" light
24. ECM
25. Power steering pump pressure switch (If equipped)

Wire color

B/Bl . . . . Black/Blue
B/G . . . . Black/Green
B/Y . . . . Balck/Yellow
Bl . . . . . Blue
Bl/B . . . . Blue/Black
Bl/R . . . . Blue/Red
Bl/W . . . . Blue/White
Bl/Y . . . . Blue/Yellow
Bl/O . . . . Blue/Orange
Br/B . . . . Brown/Black
Br/Y . . . . Brown/Yellow
Gr . . . . . Gray
Gr/G . . . . Gray/Green
Gr/R . . . . Gray/Red
Gr/Y . . . . Gray/Yellow
Lg . . . . . Lightgreen
Lg/B . . . . Lightgreen/Black
Lg/W . . . Lightgreen/White
Lg/Y . . . . Lightgreen/Yellow
P . . . . . Pink
R . . . . . Red
R/B . . . . Red/Black
R/G . . . . Red/Green
R/Y . . . . Red/Yellow
Sb . . . . . Skyblue
V . . . . . Violet
V/Y . . . . Violet/Yellow
W . . . . . White
Y . . . . . Yellow
Y/B . . . . Yellow/Black
R/Bl . . . . Red/Blue

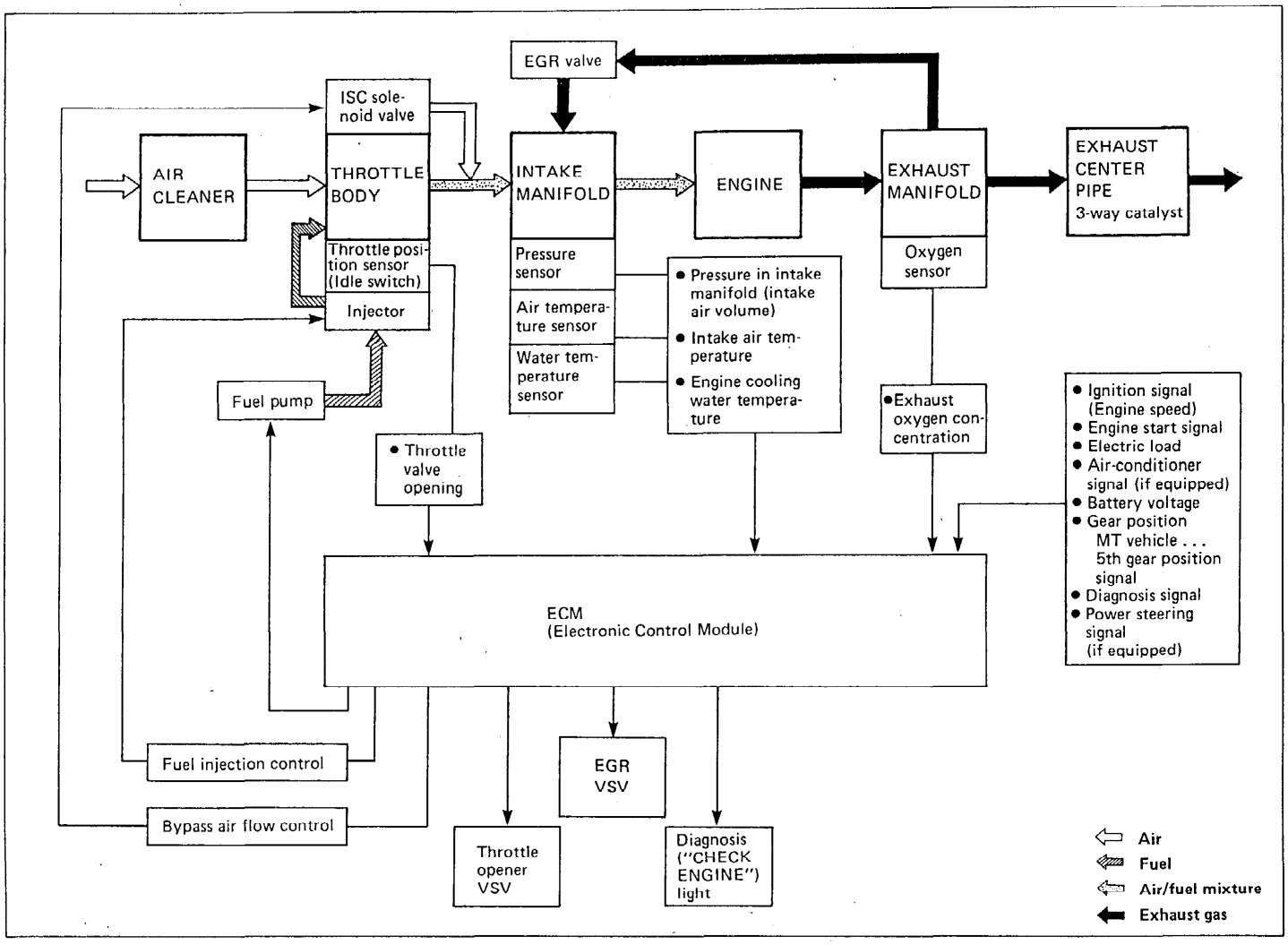


Fig. 6E-14 System Schematic

Electronic Control Module (ECM)

ECM is installed to the underside of the instrument panel at the driver's seat side.

ECM is a precision unit consisting of one chip microcomputer, A/D (Analog/Digital) converter, I/O (Input/Output) unit and etc..

It is an essential part of the electronic control system, for its functions include not only such a major function as to control fuel injector, ISC solenoid valve, control relay, throttle opener VSV and EGR VSV but also self-diagnosis function, fail safe function and back-up function as described in the following section.

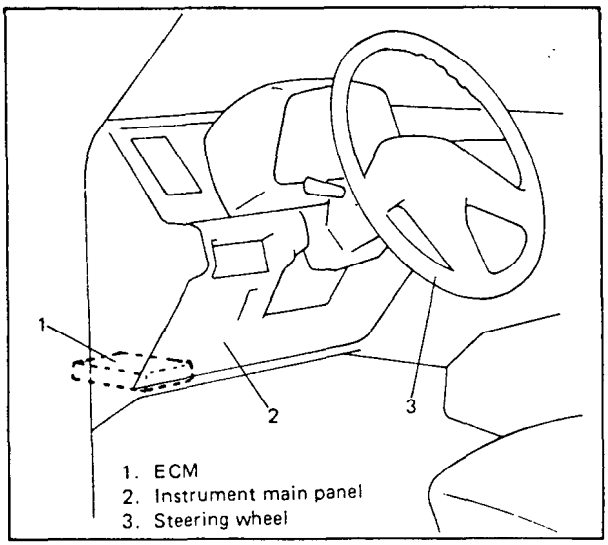


Fig. 6E-15 ECM Location

Self-diagnosis function

When any of such troubles as listed below occurs in Electronic Fuel Injection system, ECM stores the data on the defective area (where trouble occurred) in its back-up memory. (The memory is not erased even when ignition switch is turned OFF and it is retained as it is until either normal signal is inputted to ECM or power to ECM is shut off for 20 seconds or longer). Then it indicates defective area in memory by means of flashing of "CHECK ENGINE" light at the time of inspection (i.e. when diagnosis terminal is grounded and ignition switch is turned ON).

- When ECM receives defect informing signal from any one of the following sensors and circuits or no signal whatever.
  - *Oxygen sensor
  - *Air temperature sensor
  - *Pressure sensor
  - *Water temperature sensor
  - *Throttle position sensor
  - *Idle switch circuit
  - *5th switch circuit
  - *Ignition circuit
- When CPU (Central Processing Unit) of ECM fails to operate.

["CHECK ENGINE" light]

"CHECK ENGINE" light is located among the instrument cluster. It indicates defective area identified by self-diagnosis function of ECM as described previously.

It also lights when either of following conditions applies.

- When ignition switch is turned ON, engine is at a stop (When engine speed is lower than 500 r/min.) and diagnosis terminal is ungrounded, "CHECK ENGINE" light turns ON for the purpose of light and its circuit check but turns OFF once engine is started (When engine speed is higher than 500 r/min.) regardless of Electronic Fuel Injection system condition.

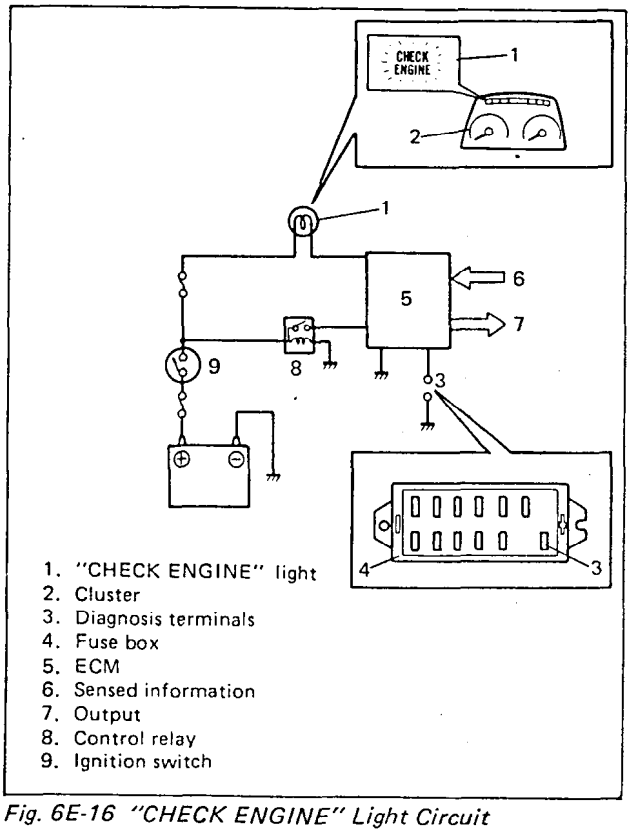


Fig. 6E-16 "CHECK ENGINE" Light Circuit

NOTE:
For West Germany specification car, a diagnosis couplers are provided under the instrument panel instead of the diagnosis terminal in fuse box. When checking diagnostic code, connect couplers ("A" and "B").

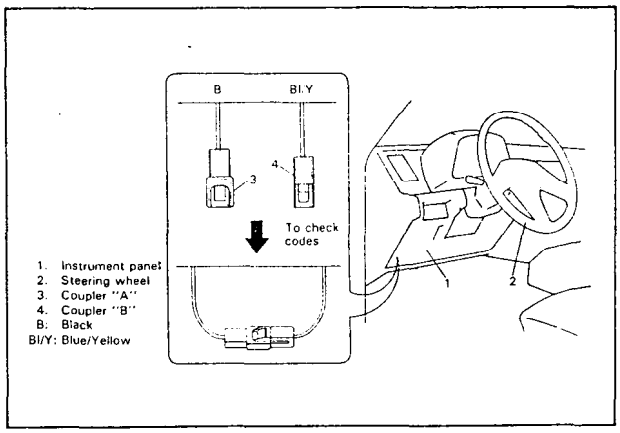


Fig. 6E-15-1

After checking diagnosis codes, be sure to disconnect couplers ("A" and "B").

Fail-safe function

When a failure occurs in any of the sensors listed below and their circuits, a signal indicating such failure is fed to ECM, which judges that signal as such.
Even then, however, control over the injector, ISC solenoid valve and others is maintained on the basis of the standard signals prestored in the memory of ECM while ignoring that failure signal. This function is called "fail-safe function". Thus, with this function, a certain level of engine performance is available even when some failure occurs in these sensors or their circuits and disability in running is avoided.

- Water temperature sensor
- Throttle position sensor
- Air temperature sensor
- Pressure sensor

Back-up function

Even when microcomputer in ECM fails to operate properly, the back-up circuit in ECM controls operation of the injector on the basis of the signals from pressure sensor so as to least impair driving performance.

Pressure (Intake manifold absolute pressure) Sensor (PS)

This sensor senses pressure change in the intake manifold and converts it into voltage change. It consists of a semi-conductor type pressure converting element which converts a pressure change into an electrical change and an electronic circuit which amplifies and corrects the electric change. The ECM sends a 5-volt reference voltage to the pressure sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By monitoring the sensor output voltage, ECM knows the manifold pressure (intake air volume).

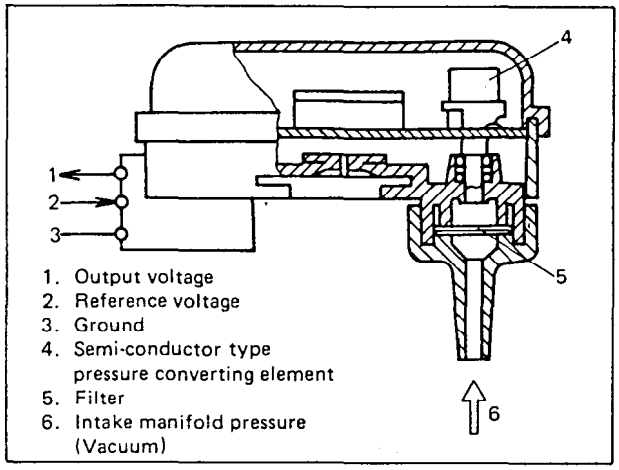


Fig. 6E-17 Pressure Sensor

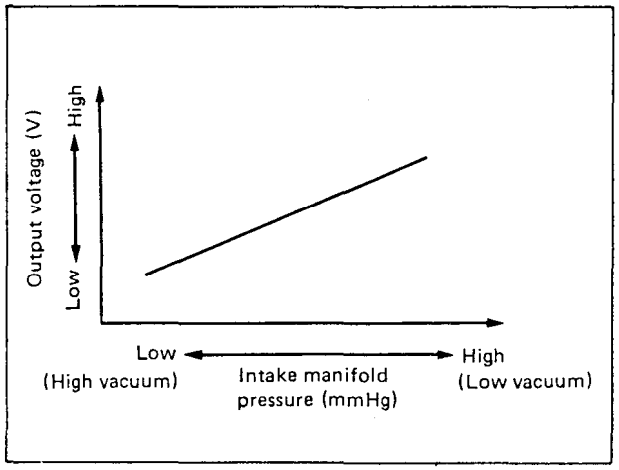


Fig. 6E-18 Output Characteristic

ECM uses the voltage signal from the pressure sensor as one of the signals to control fuel injection time, ISC solenoid valve operation and EGR VSV operation.

Throttle Position Sensor (TPS)

The throttle position sensor consisting of a contact point (idle switch) and a potentiometer is connected to the throttle valve shaft on the throttle body, and detects the throttle valve opening.

The throttle opening in the idle state is detected by means of the contact point which turns ON in that state.

But beyond that the full opening is detected by the potentiometer as follows.

A 5-volt reference voltage is applied to the sensor from ECM and as its brush moves over the print resistance according to the throttle valve opening, the output voltage varies accordingly.

By monitoring the sensor output voltage, ECM detects the throttle valve opening and its change.

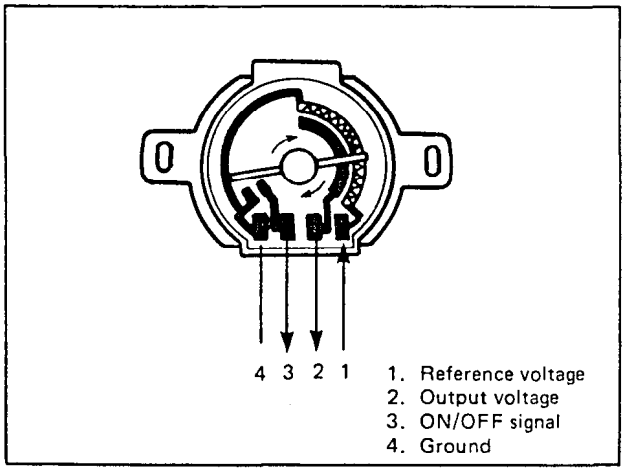


Fig. 6E-19 Throttle Position Sensor

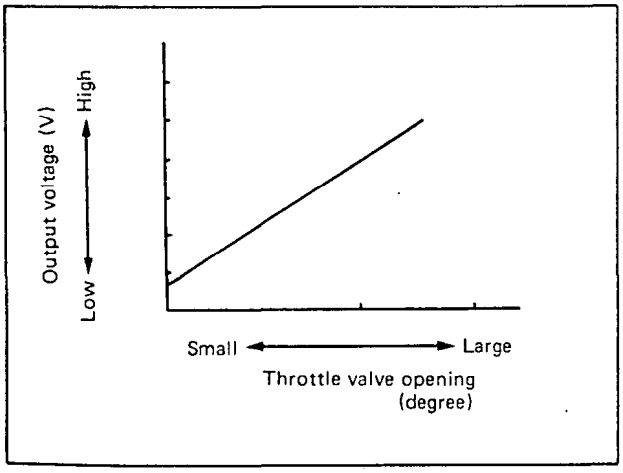


Fig. 6E-20 Output Characteristic

Air Temperature Sensor (ATS)

Located at the side of intake manifold, this sensor constantly measures the temperature of the air entering there and converts a change in the air temperature into that in resistance through its thermister. That is, as air temperature lowers, resistance increases and as it rises, resistance decreases. As air density of the intake air varies with variation in temperature, ECM, by monitoring the resistance, adjusts the amount of fuel injection according to the air temperature.

Water Temperature Sensor (WTS)

Located at the side of intake manifold, this sensor measures the temperature of the engine cooling water and converts its change into that in resistance through the thermister like the air temperature sensor.

That is, as cooling water temperature lowers, resistance increases and as it rises, resistance decreases.

By monitoring the resistance of the water temperature sensor, ECM detects the engine cooling water temperature and that affects most systems under the control of ECM.

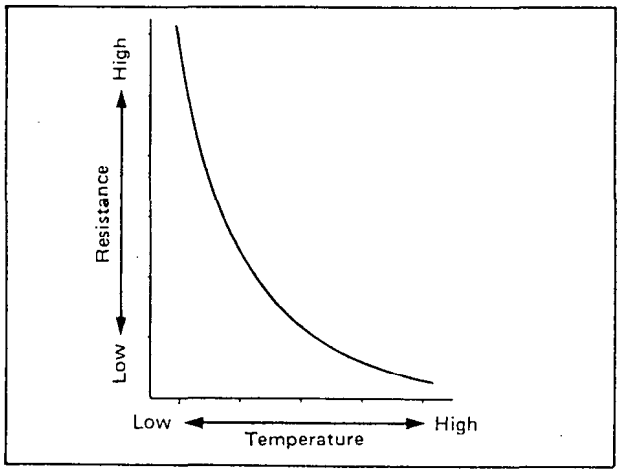


Fig. 6E-21 Air/Water Temperature Sensor Characteristic

Oxygen Sensor

The oxygen sensor is located on the exhaust manifold to detect the concentration of oxygen in the exhaust gases. It consists of the zirconia element (with thin platinum surface coating) which generates electromotive force, lead wire which draws out the electromotive force and cover and housing which protect the zirconia element from damage.

The zirconia element, by its property, generates the electromotive force when a difference in oxygen concentration exists between its faces. As its temperature rises, the change of the electromotive force is amplified by catalytic reaction of the platinum. The oxygen sensor makes use of this property. As atmosphere is introduced into the oxygen sensor, the inside of the zirconia element is exposed to the atmosphere and outside to exhaust gases. Thus the difference in concentration between the inside and the outside of the zirconia element varies with the oxygen concentration in the exhaust gases.

The large concentration difference results in about 1V of the electromotive force and small difference results in about 0V. To put in other words, if the amount of oxygen in the exhaust gases is less (air-fuel mixture is richer than the stoichiometric mixture), about 1V of electromotive force is generated and if more (air-fuel mixture is leaner than the stoichiometric mixture), almost none is generated.

In this way, the oxygen sensor detects whether the oxygen concentration is high or low (or the mixture is leaner or richer than the stoichiometric mixture).

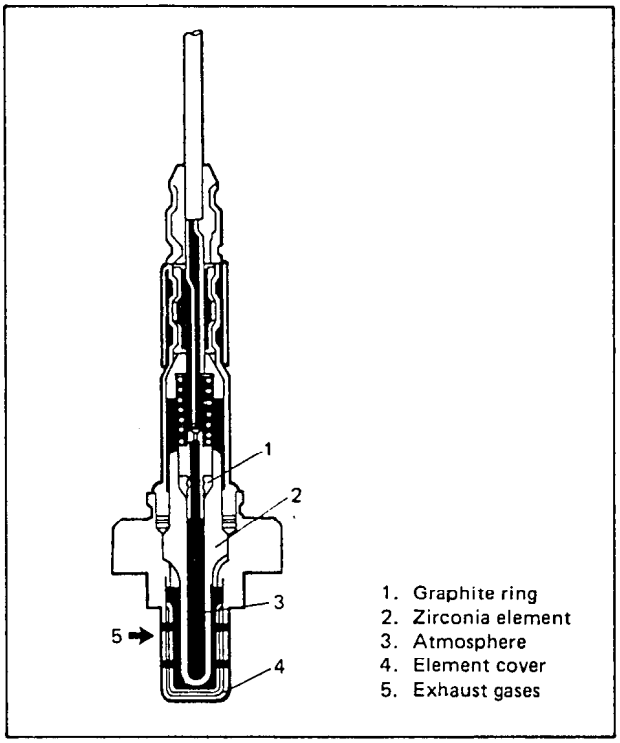


Fig. 6E-22 Oxygen Sensor

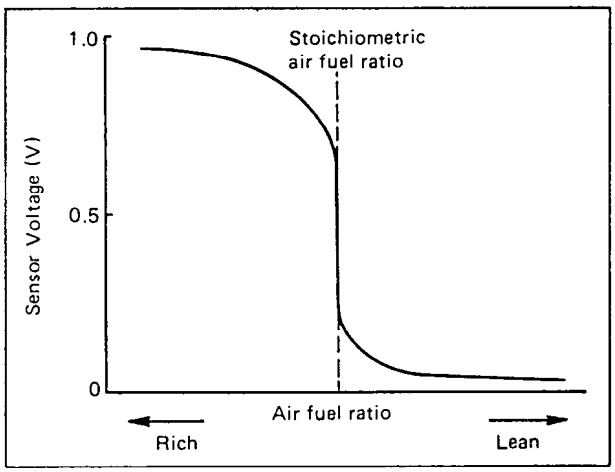


Fig. 6E-23 Output Characteristic

Ignition Signal
This signal is sent from the ignition system circuit. ECM detects the engine speed through this signal and uses it as one of the factors for controlling various actuators.

Engine Start Signal
This signal is sent from the engine starter circuit. Receiving it, ECM judges whether the engine is cranking or not and uses it as one of the signals to control fuel injection timing, injection time, ISC solenoid valve operation and throttle opener VSV operation.

Electric Load Signal
This signal is sent from each circuit of head & small lights, heater fan and rear window deffogger, if equipped.
ECM uses it as one of the factors for controlling ISC solenoid valve operation.

5th Switch
Located on the tansmission, it turns ON when the gear shift lever is shifted to the 5th gear position and OFF when it is at any other position. The ON/OFF signal from this switch is one of the signals that ECM uses to control EGR VSV.

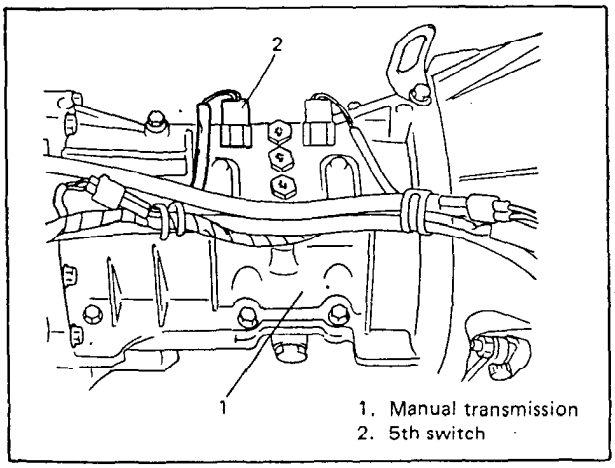


Fig. 6E-24 5th Switch Position

Air-Conditioner Signal (For vehicle with air conditioner)
This signal is sent from the air-conditioner circuit. ECM detects whether the air-conditioner is operating or not through the signal and uses it as one of the signals for controlling ISC solenoid valve operation.

Power Steering Signal (For vehicle with power steering system)
This ON/OFF signal is sent from the P/S pump pressure switch. ECM uses it as one of the signals for controlling ISC solenoid valve operation.

FUEL INJECTION CONTROL SYSTEM

In this system, ECM controls the time (amount) and timing of the fuel injection from the fuel injector into the throttle body according to the signals from the various sensors so that suitable air/fuel mixture is supplied to the engine in each driving condition.

Injection Timing

- At start

Fuel is injected at a certain cycle starting immediately after the initial ignition signal is inputted till the engine starts.

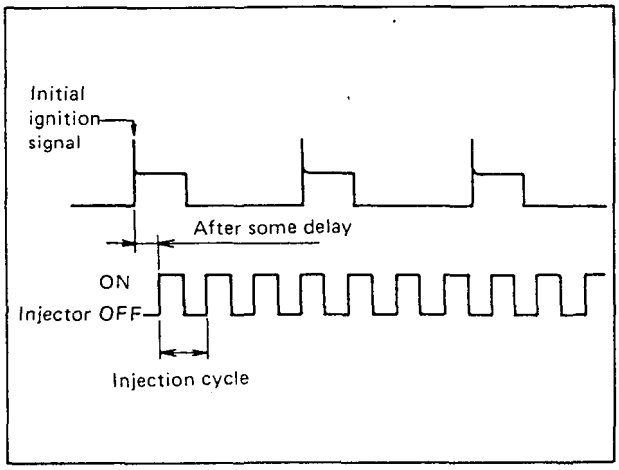


Fig. 6E-25 Injection Timing at Start

- In normal driving (Standard injection timing)

Fuel is injected at every ignition signal synchronously.

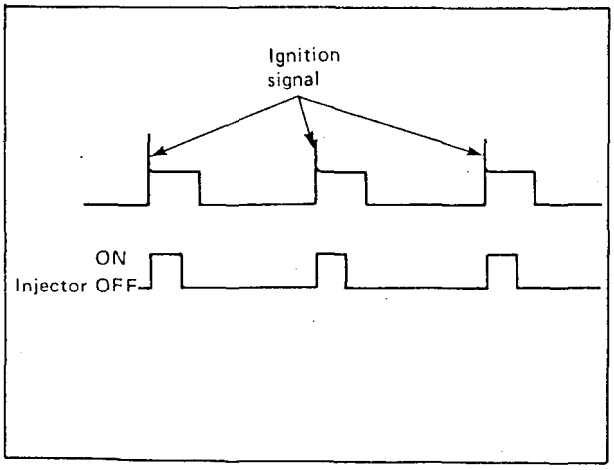


Fig. 6E-26 Injection Timing in Normal Driving

- When accelerating (Additional injection timing)

Fuel is injected in addition to the above standard injection timing whenever the throttle valve opening exceeds the specified opening.

Injection Time (amount of injection)

The factors to determine the injection time are the basic injection time which is calculated on the basis of the engine speed and the intake manifold pressure (amount of the intake air) and various compensations which are determined according to the signals from various sensors that detect the state of the engine and driving conditions.

NOTE:

The amount of fuel drawn into the engine is determined by the injection frequency as well as injection time.

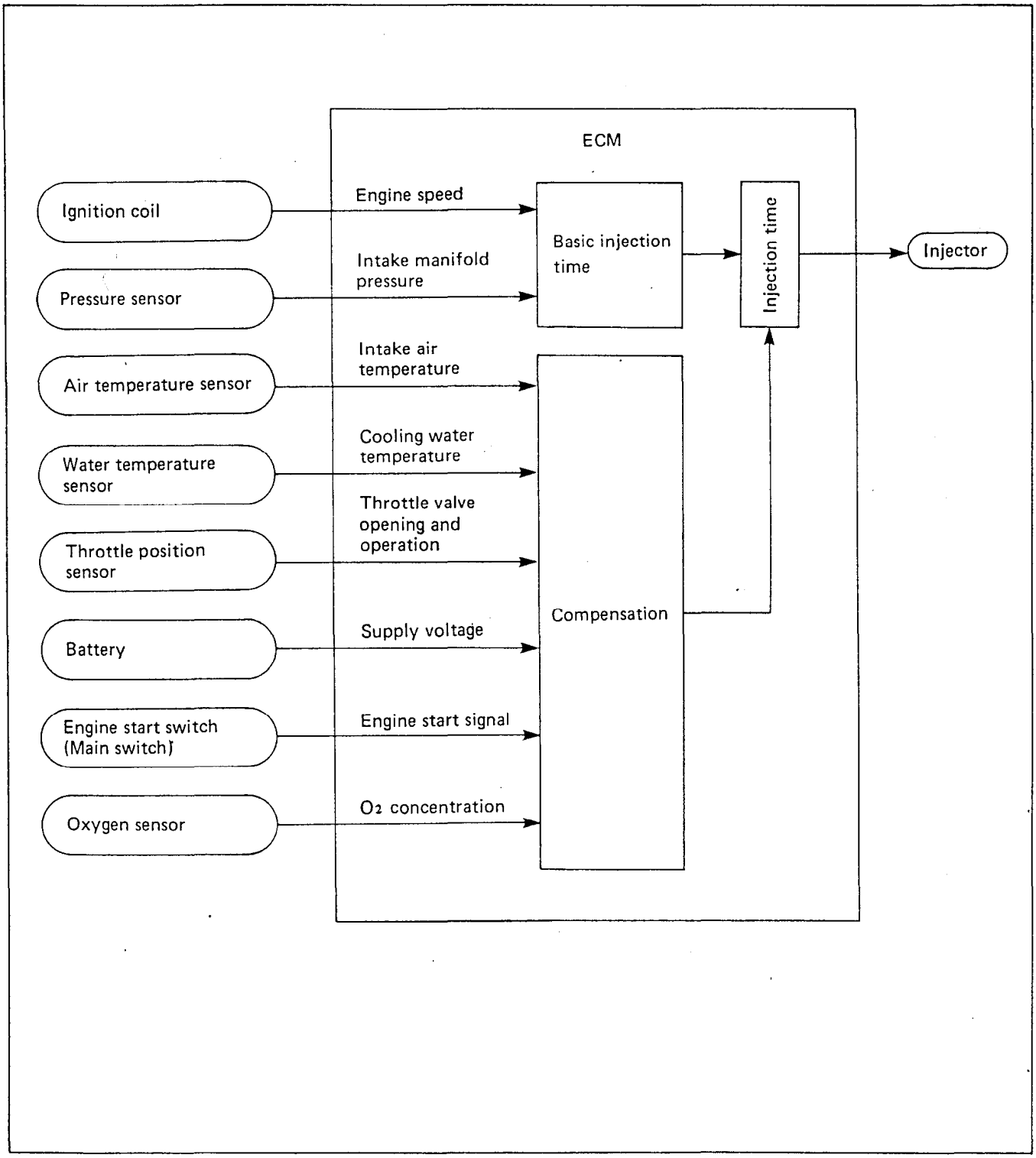


Fig. 6E-27 Parameter Diagram

Barometric pressure compensation
At a higher altitude where the barometric pressure is lower than at a lower altitude, compensation is made so as to adjust the air/fuel mixture ratio to such environment.

Intake air temperature compensation
As the intake air volume varies with the temperature, it is compensated for its temperature.

Enriching compensation while warming up
When the engine is cold, enriching compensation is made to ensure good driveability till the engine cooling water temperature reaches the specified level. The amount to enrich the air/fuel mixture is decreased as the temperature rises.

Enriching compensation after engine start
For a certain time after the engine is started, air/fuel mixture enriching compensation is made so as to stabilize the engine speed. As the amount of compensation depends on the engine cooling water temperature, it is the largest immediately after the engine start and after that, it reduces gradually.

Enriching compensation while loaded high
Enriching compensation is made to make the air/fuel mixture ratio richer than the theoretical air/fuel mixture ratio to ensure good driveability under highly loaded driving condition.

Enriching compensation when accelerating
To attain smooth acceleration, enriching compensation is provided for a certain time according to each accelerating condition, which is obtained through operation using the signal from the pressure sensor (representing variation of pressure in the intake manifold).

Leaning compensation when decelerating
To obtain a proper air/fuel mixture ratio during moderate deceleration, compensation is made for a certain time so that the air/fuel mixture leans out to a proper ratio for each decelerating condition, which is obtained through operation using the signal from the throttle position sensor (representing variation of throttle valve opening).

Compensation while idling
To stabilize the idle speed, the amount of fuel injection is adjusted according to the varying engine idle speed.

Battery voltage compensation
A power voltage drop delays the mechanical operation of the injector. Then the actual injection time becomes shorter for the time that electricity is supplied to the injector. To compensate this, the electricity supply time is made longer when the voltage is lower.

Base air/fuel ratio compensation
The air/fuel ratio may vary due to such factors as variation in each engine itself and aging. To compensate such variation, feed back compensation is used and base air/fuel mixture ratio is adjusted to a proper level.

Fuel cut
When decelerating quickly, the fuel supply is cut or decreased to prevent unburned gas from being emitted by making the injector operating time as ineffective injection time.
Also, when the engine speed exceeds 7,200 r/min, the fuel supply is cut to protect the engine by making the injector operating time as ineffective injection time. The normal injection is restored when the engine speed is 6,800 r/min or lower.

Fuel feed back compensation (Air/fuel ratio compensation)

It is necessary to keep the air/fuel mixture close to the theoretical air/fuel ratio (14.7) to obtain efficient performance of the 3-way catalyst and high clarification rate of CO, HC and NOx in the exhaust gas. For that purpose, ECM operates as follows. It first compares the signal from the oxygen sensor with a specified reference voltage and if the signal is higher, it detects that the air/fuel ratio is richer than the theoretical air/fuel ratio and reduces fuel. On the other hand, if the signal is lower, it detects that the air/fuel ratio is leaner and increases fuel. By repeating these operations, it adjusts the air/fuel ratio closer to the theoretical air/fuel ratio.

1) When oxygen concentration in the exhaust gas is low, that is, when the air/fuel ratio is smaller than the theoretical air/fuel ratio (fuel is richer), electromotive force of the oxygen sensor increases and a rich signal is sent to ECM.
2) Upon receipt of the rich signal, ECM decreases the amount of fuel injection, which causes oxygen concentration in the exhaust gas to increase and electromotive force of the oxygen sensor to decrease. Then a lean signal is sent to ECM.
3) As ECM increases the amount of fuel injection according to the lean signal, oxygen concentration in the exhaust gas decreases and the situation is back to above 1).

This control process, however, will not take place under any of the following conditions.

- At engine start and when fuel injection is increased after engine start
- When engine cooling water temperature is low
- When highly loaded and fuel injection is increased
- At fuel cut
- When oxygen sensor is cold

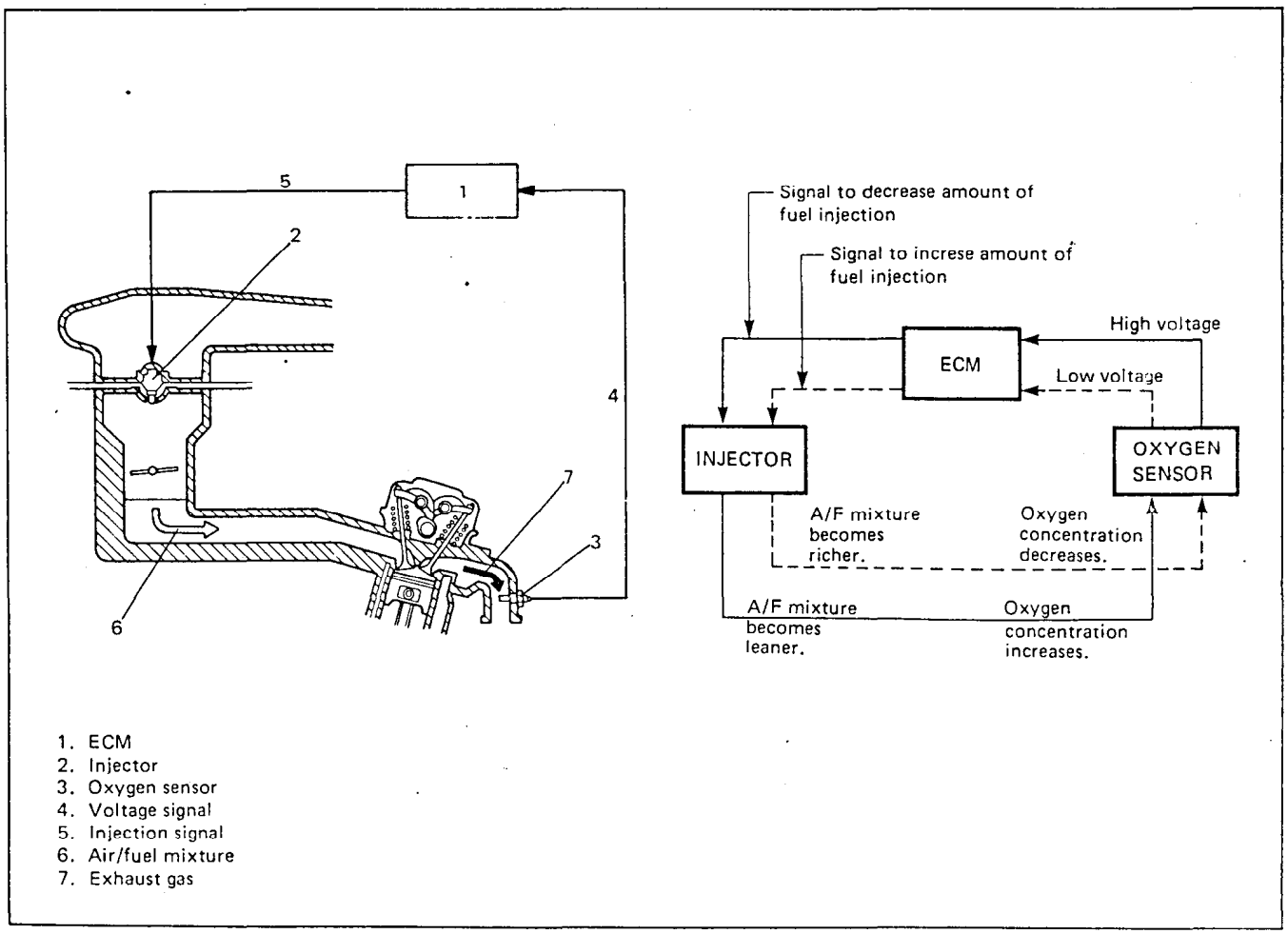


Fig. 6E-28 Fuel Feed Back Compensation

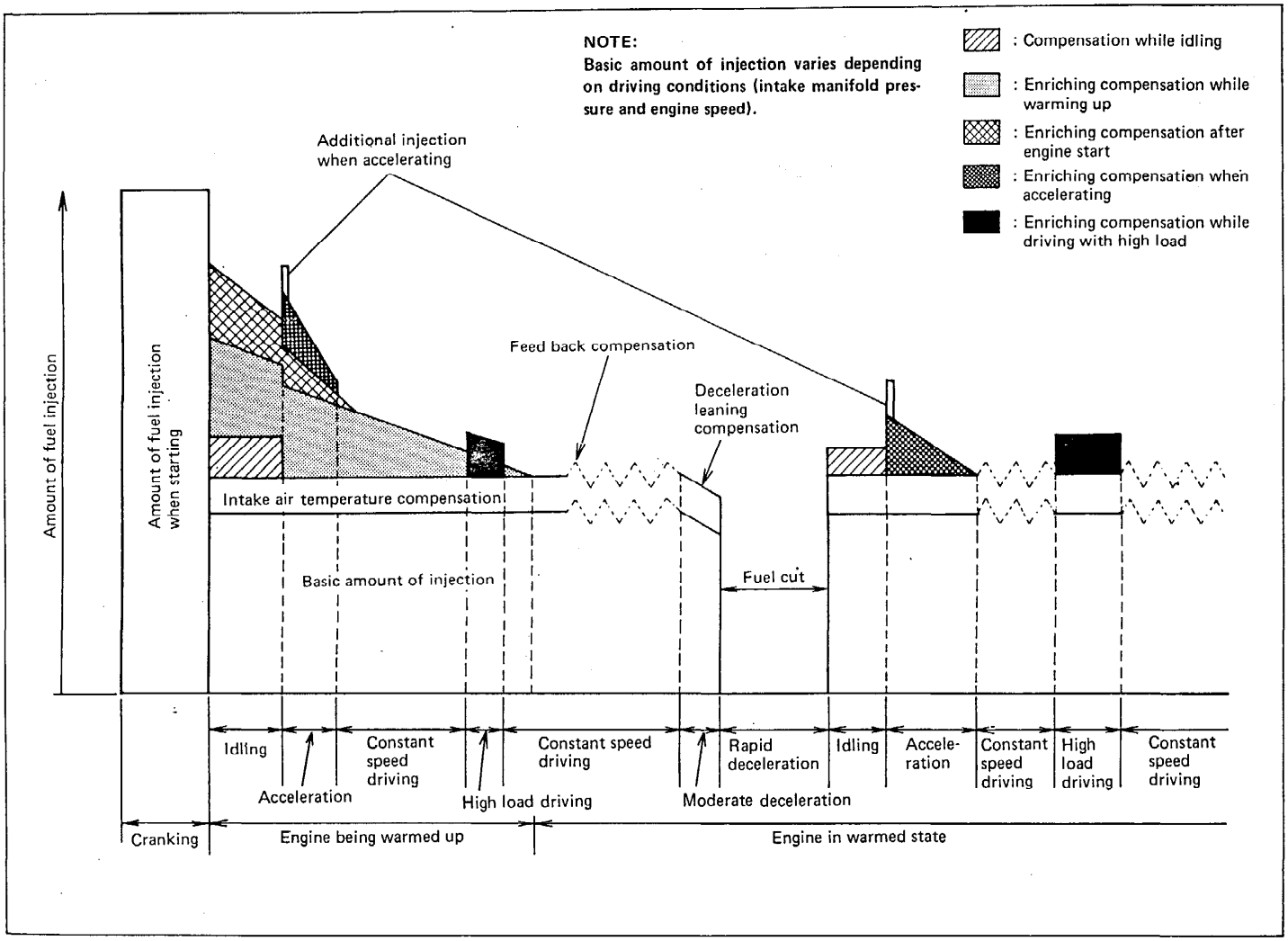


Fig. 6E-29 Driving Condition and Amount of Fuel Injection

ISC SOLENOID VALVE CONTROL SYSTEM

In this system, ECM controls ISC solenoid valve according to the signals from various sensors and switches to control the bypass air flow which plays the following three roles as required by the circumstances.

- Idle-up air flow to stabilize engine idle speed
  When head lights & small lights, heater fan, rear defogger (if equipped) or air conditioner (if equipped) and/or power steering system (if equipped) is operating (that is, when electric load and/or engine load is applied) and/or vehicle is at a high altitude, higher than 8,200 ft or 2,500 m (barometric pressure is lower than 550 mmHg), the bypass air is supplied to stabilize the engine idle speed. How much bypass air is supplied varies depending on the load.
  When only head lights and small lights are ON, the idle speed rises only a little higher than the normal specified idle speed (920 r/min).
- After start air flow to improve engine start
  When and after the engine is started, the bypass air is supplied to prevent the engine from stopping when the throttle opener is OFF and to improve the engine performance at its start. How much bypass air is supplied varies depending on the engine cooling water temperature and it decreases at time passes when engine is cool. When engine is hot and 15 seconds have passed after engine start, a given amount of bypass air is supplied till either the idle switch is once turned OFF from ON or engine speed exceeds 1,500 r/min. once.
- Dashpot air flow to correct air/fuel mixture ratio
  A sudden change in the throttle valve opening (especially when decelerating) causes the air/fuel mixture ratio to change also suddenly. To correct it, the bypass air flow is increased or decreased. (That is, by increasing or decreasing the air, the air/fuel mixture ratio is changed gradually and dashpot effect is thus obtained.) The air is increased when the throttle valve is opened, and decreased gradually when closed.

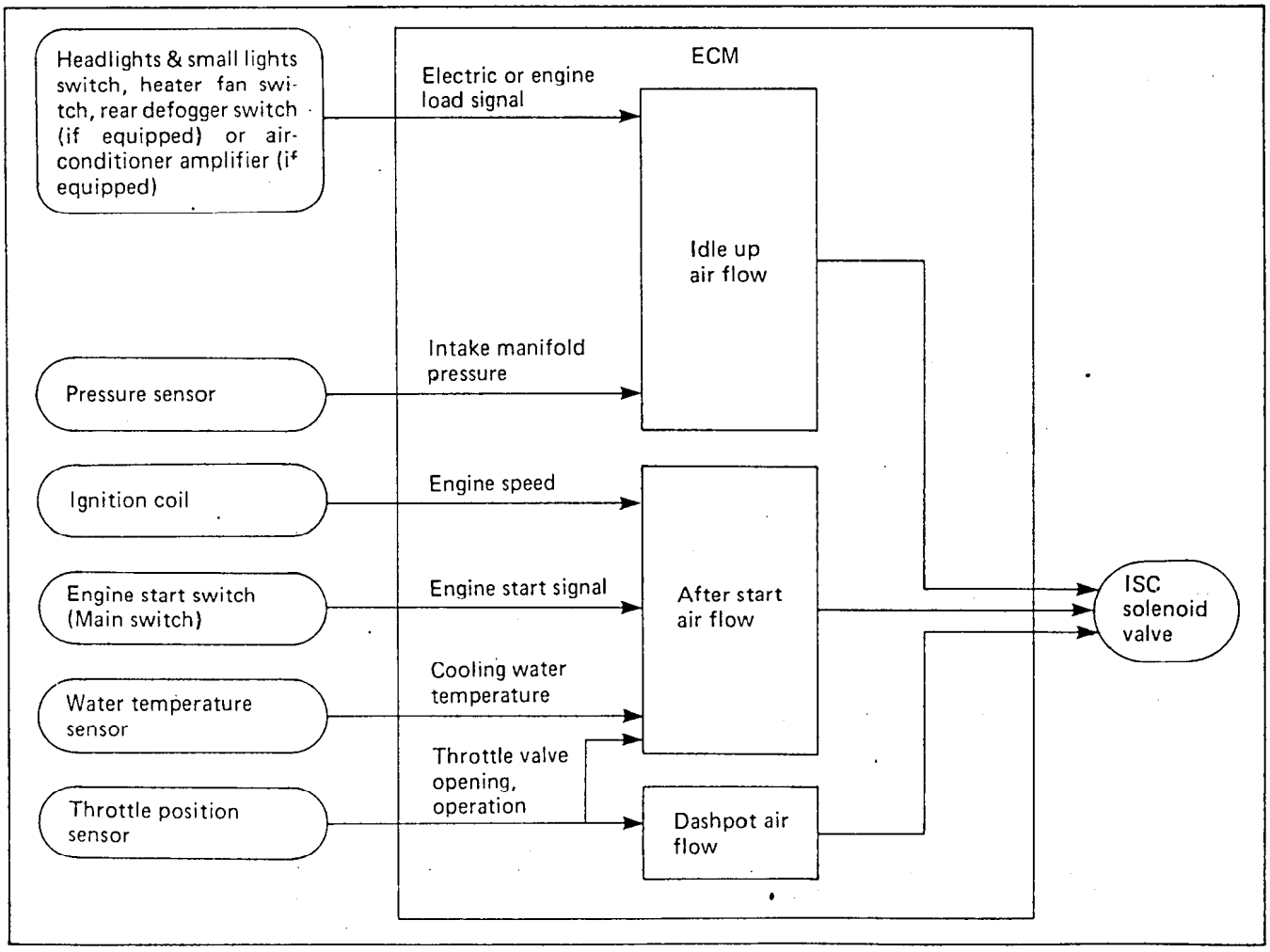


Fig. 6E-30 Parameter Diagram

Operation

Located on the throttle body, ISC solenoid valve opens the air bypass passage when it is ON and closes it when OFF. When the conditions as described in the previous page for each different type of flow apply, ECM turns ISC solenoid valve ON and OFF at a constant cycle (20 times per second) and by making ON time within one cycle longer or shorter, it controls the bypass air flow.

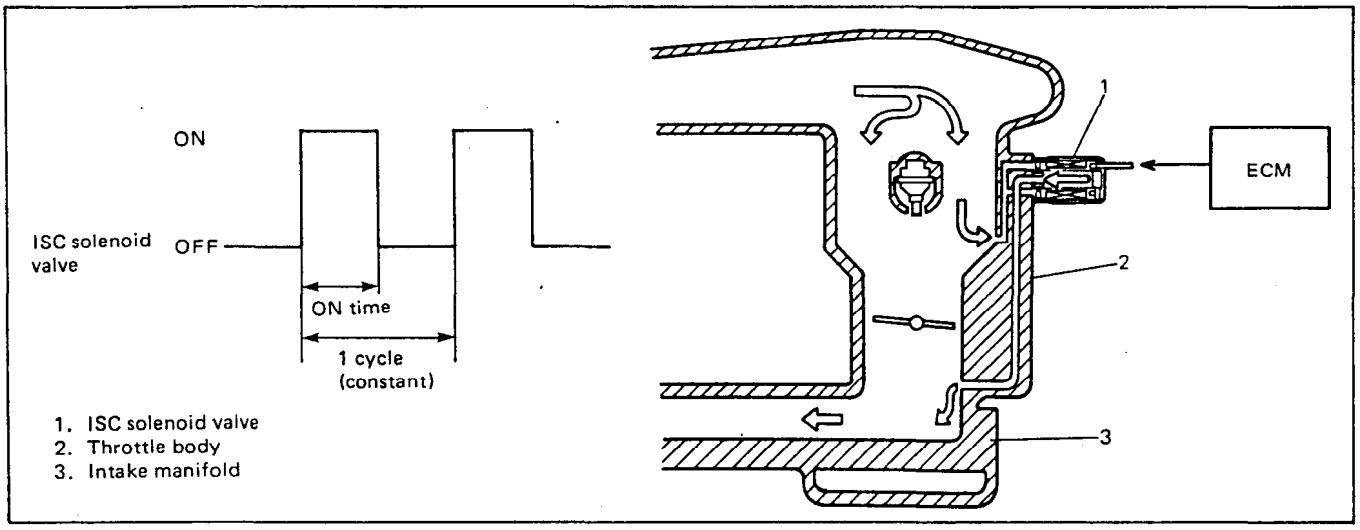


Fig. 6E-31 ISC Solenoid Valve Operation

FUEL PUMP CONTROL SYSTEM

The fuel pump ON/OFF operation is controlled by the control relay and ECM. It turns ON in the following conditions.

- When the engine is cranking, the control relay turns ON the fuel pump circuit.
- When the ignition signal is inputted to ECM (from engine cranking and while the engine is running), ECM turns ON the control relay, whereby the fuel pump circuit turns ON.
- When the engine cooling water temperature is low (lower than −10°C or 14°F) and the ignition switch is turned ON, ECM turns ON the control relay circuit (although for 3 seconds only) to operate the fuel pump even if it received no ignition signal.

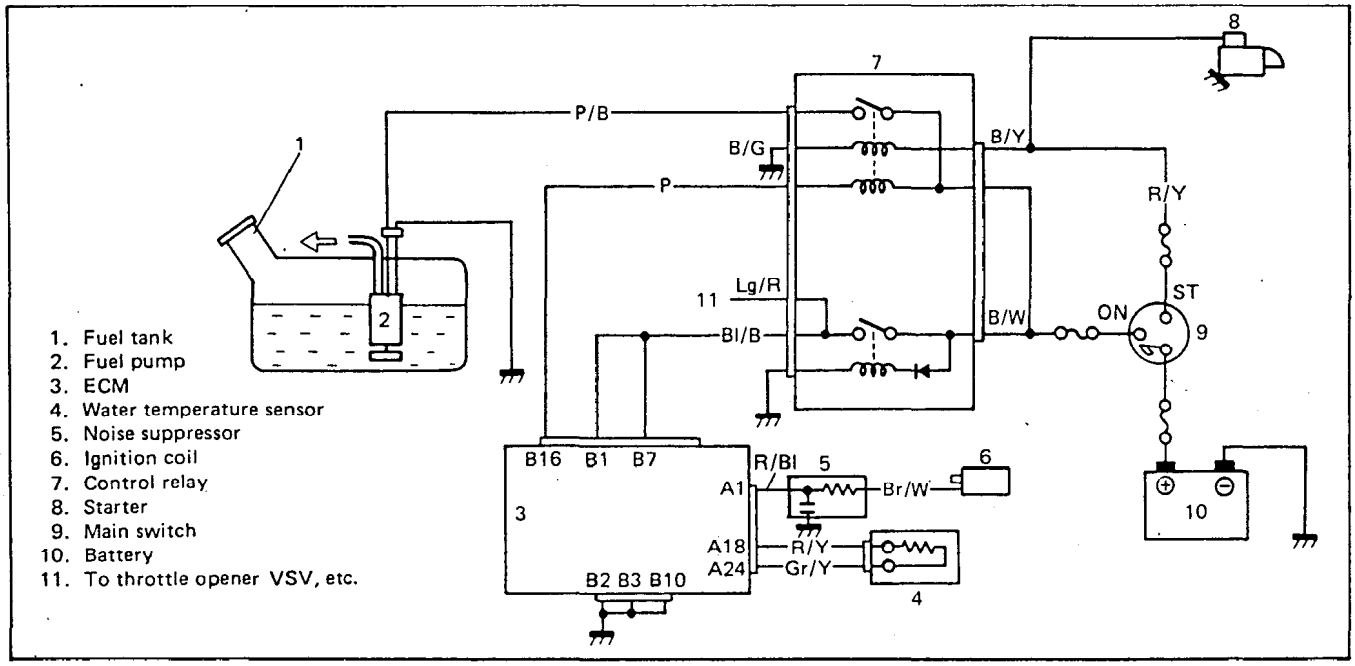


Fig. 6E-32 Fuel Pump Circuit

THROTTLE OPENER CONTROL SYSTEM

In this system, the throttle valve is opened a little wider than the idle position to improve the engine performance at its start.

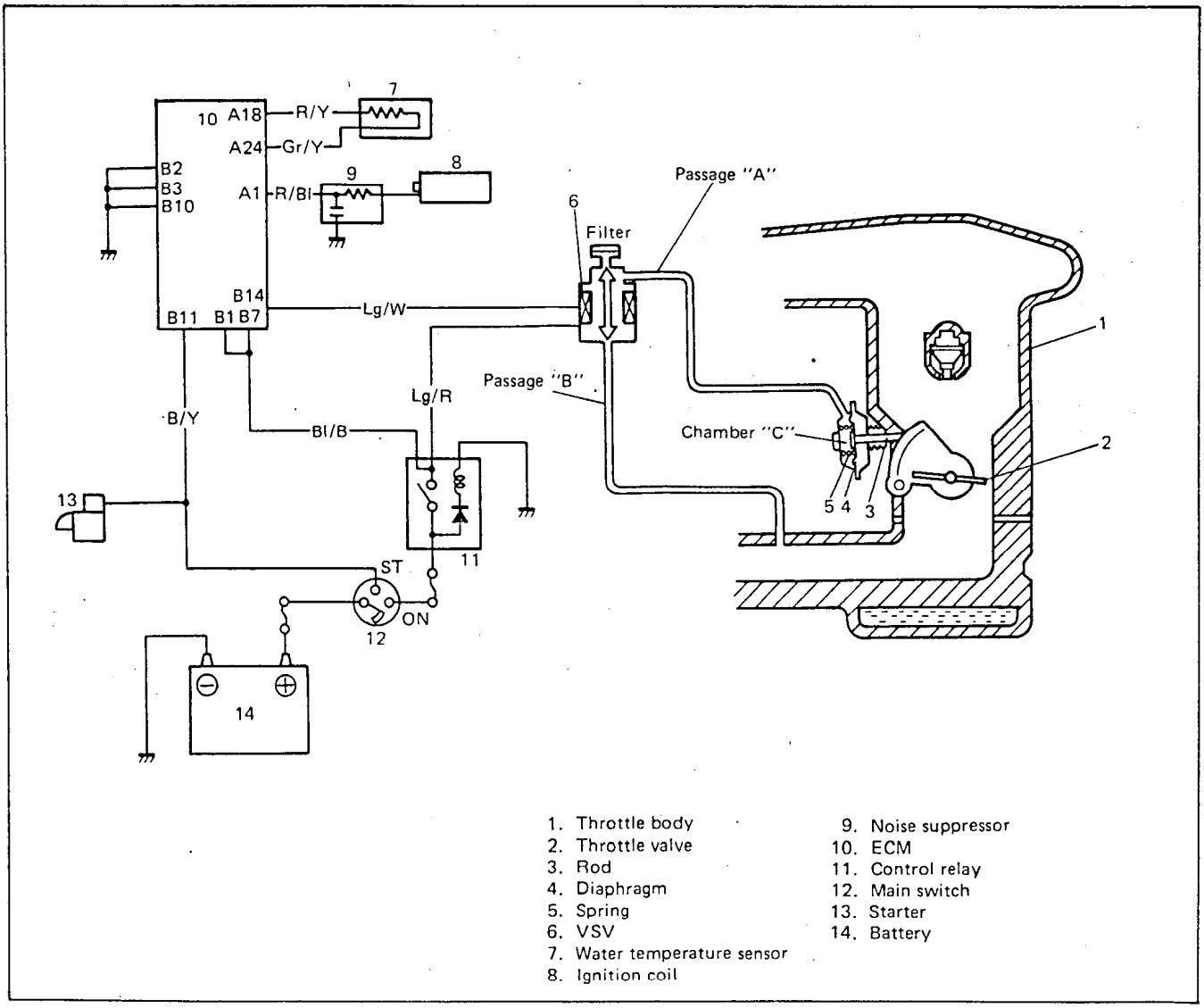
The throttle opener is controlled by VSV (Vacuum Switching Valve) which opens and closes the vacuum passage to the throttle opener.

ECM controls VSV according to the ignition signal, starter signal and signal from the engine cooling water temperature sensor and turns ON the electric circuit of VSV when;

- the engine is cranking
- the engine speed is less than 4,000 r/min, for 0 to some ten seconds after the engine start (duration time depends on the cooling water temperature, e.g. shorter for higher cooling water temperature.)

In either of the above conditions, VSV opens between the filter and passage "A" and closes between passages "A" and "B". In this state, like when the engine is at a stop, the chamber "C" of the throttle opener is under the atmospheric pressure. It means that the spring force pushes the rod to open the throttle valve.

Once the engine starts to run, ECM turns OFF the electric circuit of VSV which then opens between passages "A" and "B" and closes between the filter and passage "A". Consequently, the vacuum in the intake manifold is applied to the chamber "C" of the throttle opener and the diaphragm and rod are pulled. In this way, the throttle valve moves back to its idle position.



1. Throttle body
2. Throttle valve
3. Rod
4. Diaphragm
5. Spring
6. VSV
7. Water temperature sensor
8. Ignition coil
9. Noise suppressor
10. ECM
11. Control relay
12. Main switch
13. Starter
14. Battery

Fig. 6E-33 Throttle Opener Control System

EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM

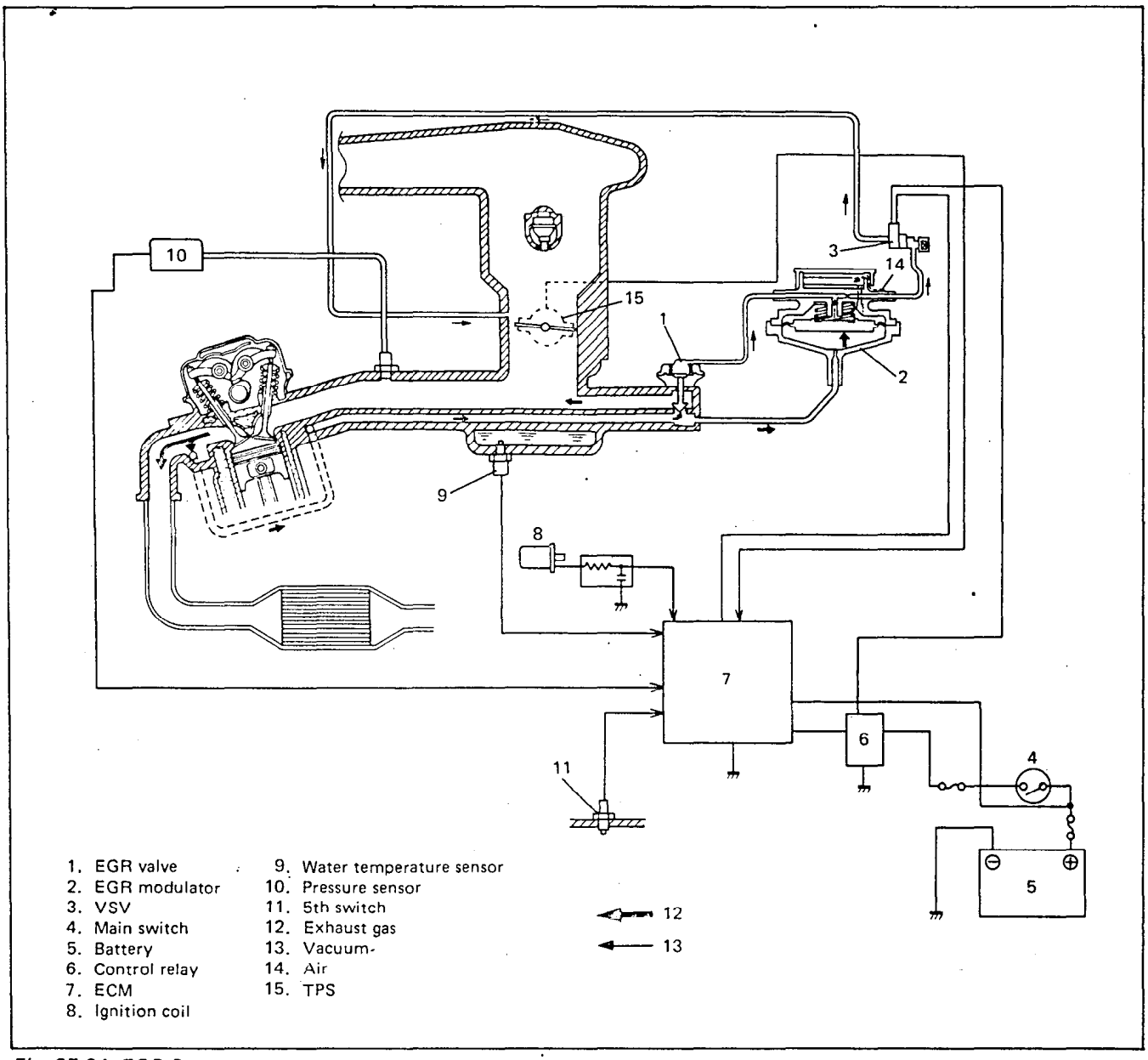
This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifold.
The EGR valve is controlled by EGR modulator and VSV controlled by ECM according to signals from various sensors.
The diaphragm mounted in the EGR modulator is operated by back pressure of the exhaust gas to open and close the valve. By this opening and closing action of the valve, the EGR modulator controls the vacuum transmitted to the EGR valve.

Under a low load condition such as low speed driving, the exhaust pressure is low. In this state, the diaphragm in the EGR modulator is pushed down by the spring force and the modulator valve opens to allow the air into the vacuum passage from the outside.
As a result, the vacuum transmitted to the EGR valve becomes smaller and so does the opening of the EGR valve.
Thus, less amount of exhaust gas is recirculated to the intake manifold.

Under a high load condition such as high speed driving, on the other hand, the exhaust pressure is high. By the high exhaust pressure, the diaphragm in the modulator is pushed up and closes its valve. As the air does not enter the vacuum passage in this state, the vacuum transmitted to the EGR valve grows larger and so does the opening of the EGR valve.
Thus, larger amount of exhaust gas is recirculated to the intake manifold.
Under any one of the following condition, ECM closes the vacuum passage of VSV. In this state, as the vacuum is not transmitted to the EGR valve, it remains closed.

- When engine cooling water temperature is low
- When barometric pressure is low (at high altitude)
- When engine is running at high load
- When transmission is in 5th gear condition.

Other than the above, EGR valve opens and closes in accordance with the EGR modulator operation.



1. EGR valve
2. EGR modulator
3. VSV
4. Main switch
5. Battery
6. Control relay
7. ECM
8. Ignition coil
9. Water temperature sensor
10. Pressure sensor
11. 5th switch
12. Exhaust gas
13. Vacuum
14. Air
15. TPS

Fig. 6E-34 EGR System

DIAGNOSIS

ECM has a system self-diagnosis function as described previously (p. 6E-15).
Investigate where the trouble is by referring to the following "Diagnostic Flow Chart" and "Diagnostic Code".

PRECAUTIONS IN DIAGNOSING TROUBLES

[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC CODE]

- Before identifying diagnostic code indicated by "CHECK ENGINE" light, don't disconnect couplers from ECM, battery cable from battery, ECM ground wire harness from engine or 15A fuse for tail light circuit. Such disconnection will erase memorized trouble in ECM memory.
- If abnormality or malfunction lies in two or more areas, "CHECK ENGINE" light indicates applicable codes three times each.
  And flashing of these codes is repeated as long as diagnosis terminal is grounded (spare fuse is connected) and ignition switch is held at ON position.

[NOTES ON SYSTEM CIRCUIT INSPECTION]

- Intermittent troubles
  Most intermittent problems are caused by faulty electrical connections or wiring.
  Perform careful check of suspect circuits for:
  - Poor mating of the coupler halves, or terminals not fully seated in the coupler body (backed out).
  - Improperly formed or damaged terminals. All coupler terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection.
- Never connect any tester (voltmeter, ohmmeter, or whatever) to ECM when its coupler is disconnected. Attempt to do it may cause damage to ECM.
- Never connect an ohmmeter to ECM with its coupler connected to it. Attempt to do it may cause damage to ECM and sensors.
- Use a digital type voltmeter for accurate measurement and be sure to connect negative probe of voltmeter to body or engine ground.
- When checking voltage at each terminal of the coupler which is connected to ECM, be sure to do as shown in Fig. 6E-35. Any other way is prohibited even by accident.
  Applying it improperly may cause the sensor or ECM to be shorted and damaged.

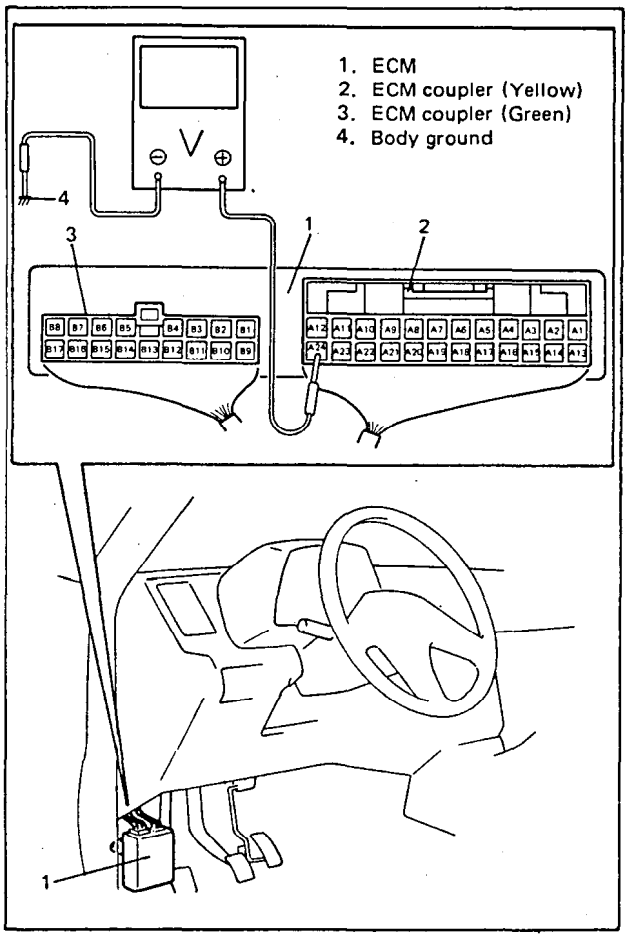


Fig. 6E-35 Checking Voltage and Terminal Position

- For ECM coupler terminal positions (A1, A2 . . . to A24 and B1, B2 . . . to B17), refer to Fig. 6E-35.
- When disconnecting and connecting coupler, make sure to turn ignition switch OFF.

- When there is a question "Are couplers connected properly? " in FLOW CHART, check male half of terminal for bend and female half for excessive opening, terminal for poor locking (looseness), corrosion, dust, etc.
- When connecting a probe of ohmmeter, voltmeter, etc. to coupler terminal, be sure to connect it from wire harness side of coupler.

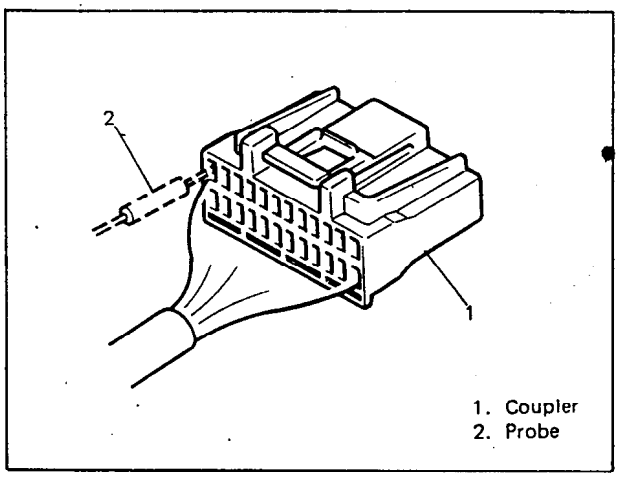


Fig. 6E-36 Connecting Meter Probe

- When connecting meter probe from terminal side of coupler because it can't be connected from harness side, use extra care not to bend male terminal of coupler or force its female terminal open for connection.
  In case of such coupler as shown below, connect probe as shown below to avoid opening female terminal.
  Never connect probe where male terminal is supposed to fit.

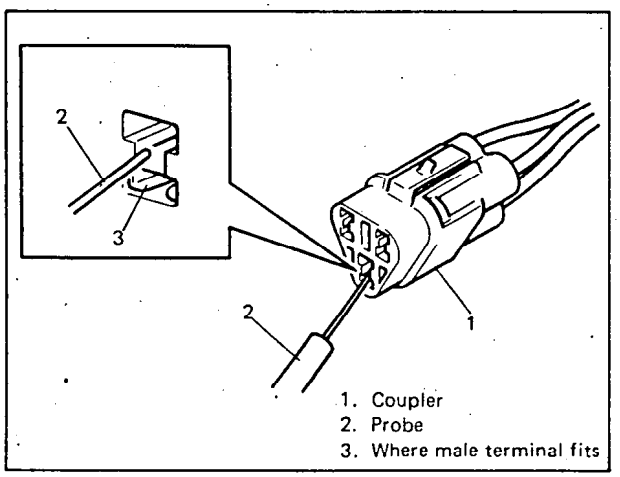


Fig. 6E-37 Connecting Meter Probe

- Before measuring voltage at each terminal, check to make sure that battery voltage is 11V or higher. Such terminal voltage check at low battery voltage will lead to erroneous diagnosis.

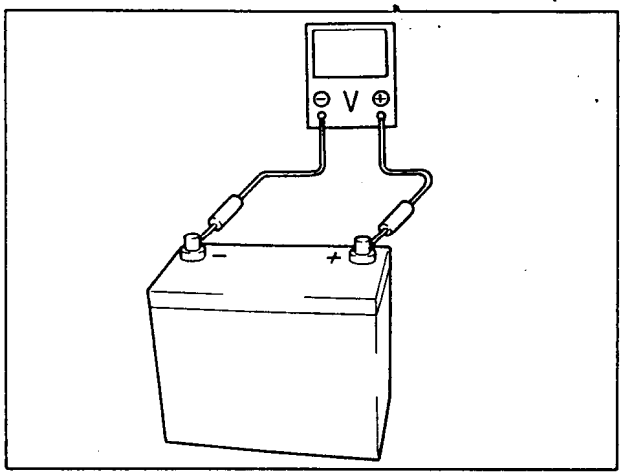


Fig. 6E-38 Checking Battery Voltage

CAUTION:
When substituting a known-good ECM for existing one, be sure to check each resistance between terminals of disconnected ECM coupler as listed below (representing resistance of each actuator) with ignition switch turned OFF before connecting it to good ECM.
Resistance in each check should satisfy corresponding specification. If there is an actuator whose coil or circuit is shorted, connection to such affected ECM coupler may cause damage to known-good ECM, too.

ACTUATOR	TERMINALS OF ECM COUPLER DISCONNECTED	RESISTANCE
Fuel injector	Between B8 and B17	1 – 2 Ω
ISC solenoid valve	Between B6 and B15	5 – 7 Ω
EGR VSV and throttle opener VSV	Between B5 and B14	70 – 80 Ω
Control relay	Between ECM coupler terminal B16 and terminal "F" of control relay coupler connected	114 – 140 Ω

DIAGNOSTIC FLOW CHART

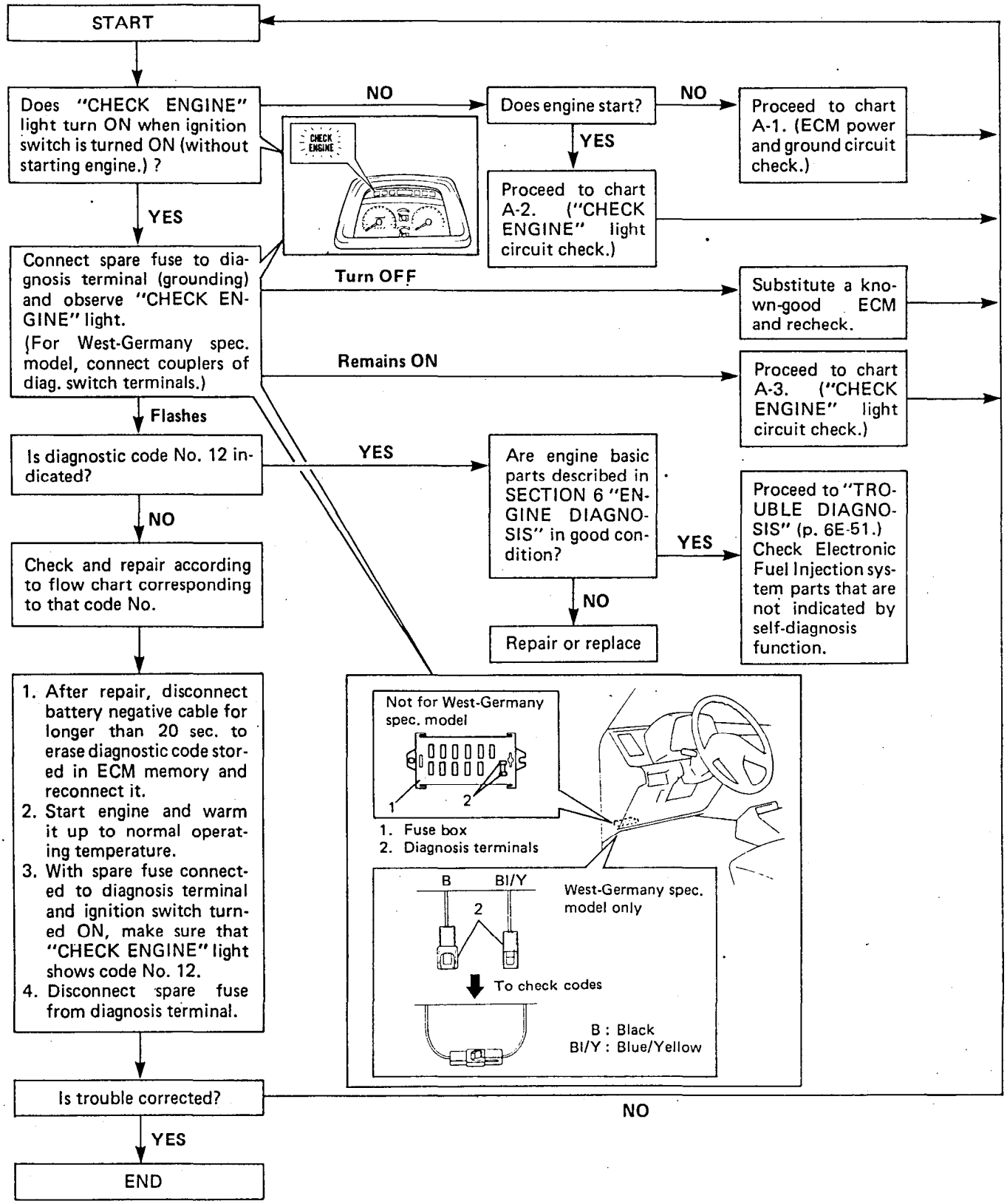
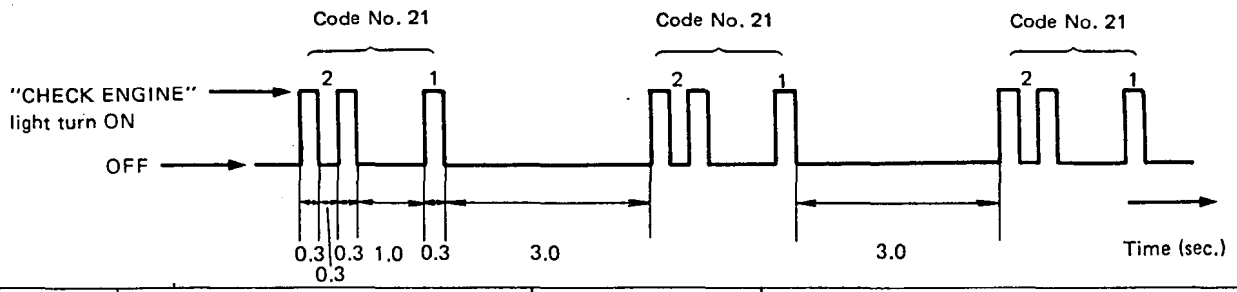


Fig. 6E-39 Diagnostic Flow Chart For Electronic Fuel Injection System

DIAGNOSIS CODE TABLE

EXAMPLE: When throttle position sensor is defective (Code No. 21)



DIAGNOSTIC CODE NO.	"CHECK ENGINE" LIGHT FLASHING PATTERN	DIAGNOSTIC ITEM	DIAGNOSIS
13	1 3	Oxygen sensor	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
14	1 4	Water temperature sensor	
15	1 5		
21	2 1	Throttle position sensor	
22	2 2		
23	2 3	Air temperature sensor	
25	2 5		
31	3 1	Pressure sensor	
32	3 2		
41	4 1	Ignition signal	
42	4 2	5th switch	
44	4 4	Idle switch of throttle position sensor	
45	4 5		
ON		ECM	ECM failure.
12	1 2	Normal	This code appears when none of the other codes (Above codes) are identified.

Fig. 6E-40 Diagnostic Code Table

A-1 ECM POWER AND GROUND CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T LIGHT AT IGNITION SWITCH ON AND ENGINE DOESN'T START THOUGH IT IS CRANKED UP.)

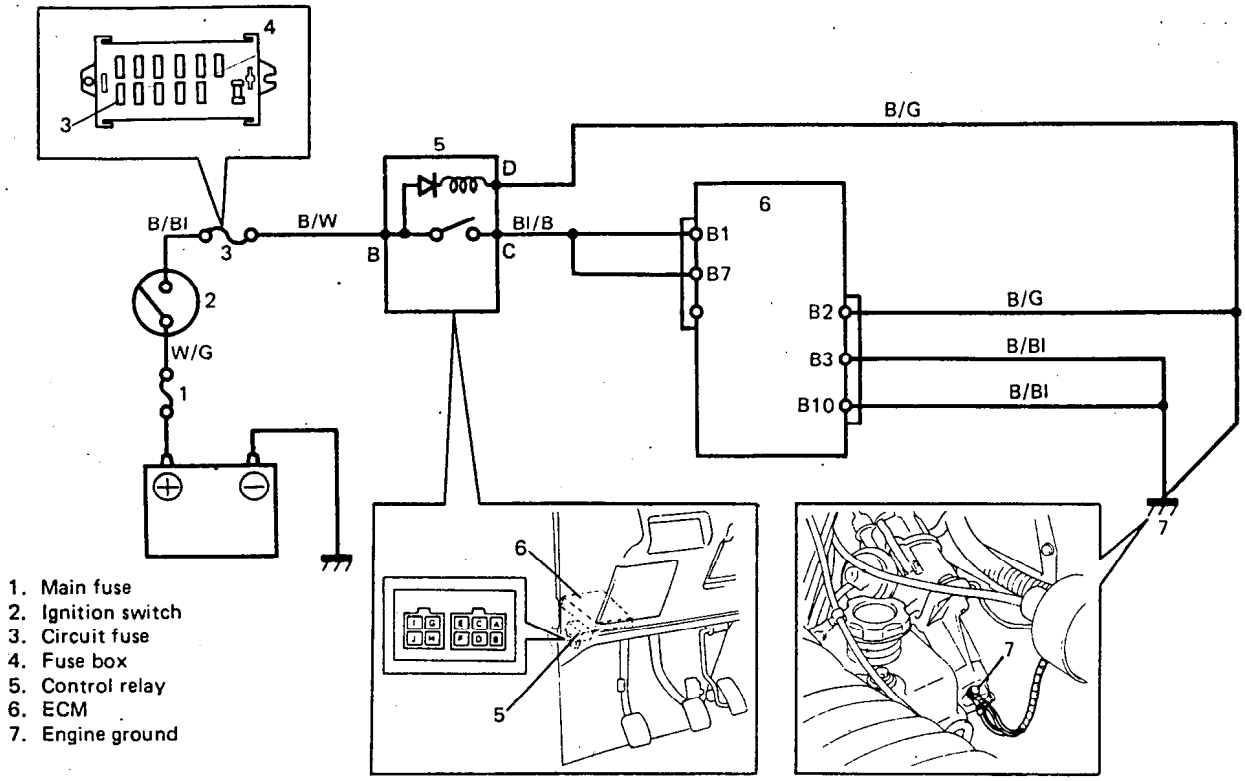
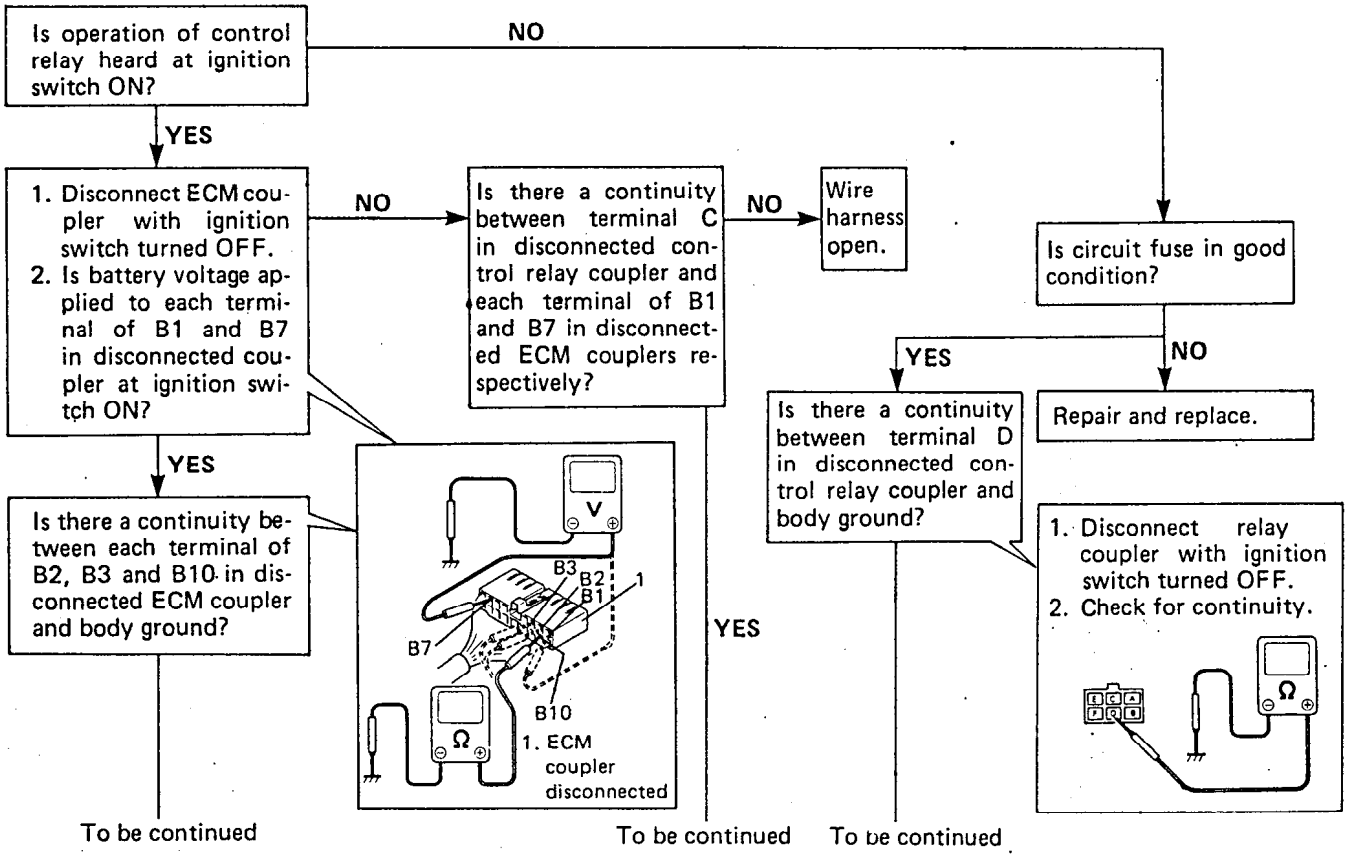


Fig. 6E-41 ECM Power and Ground Circuit



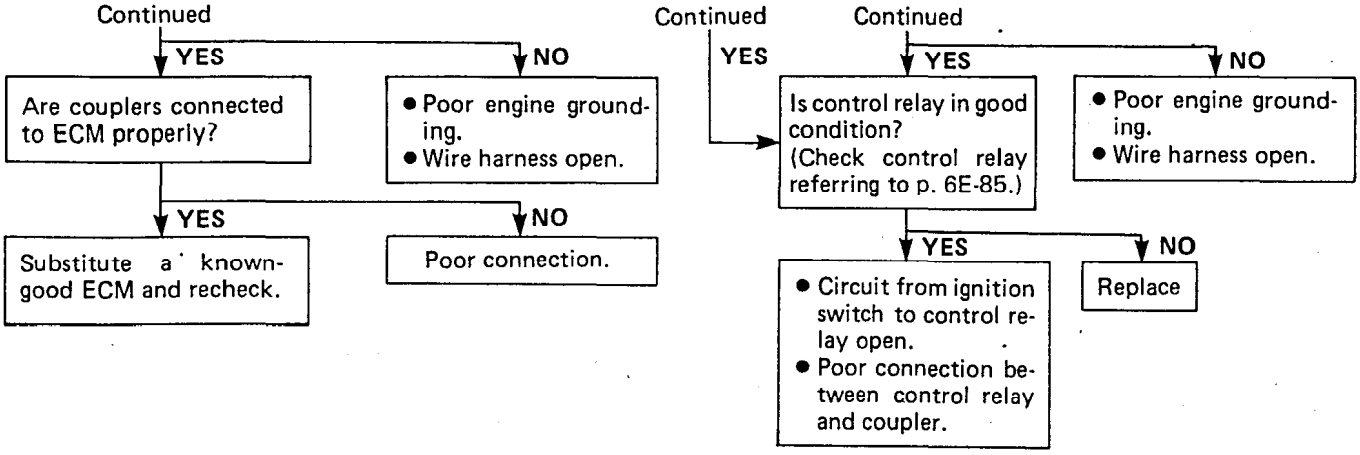


Fig. 6E-42 Diagnostic Flow Chart A-1 For ECM Power and Ground Circuit

A-2 "CHECK ENGINE" LIGHT CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T LIGHT AT IGNITION SWITCH ON THOUGH ENGINE STARTS.)

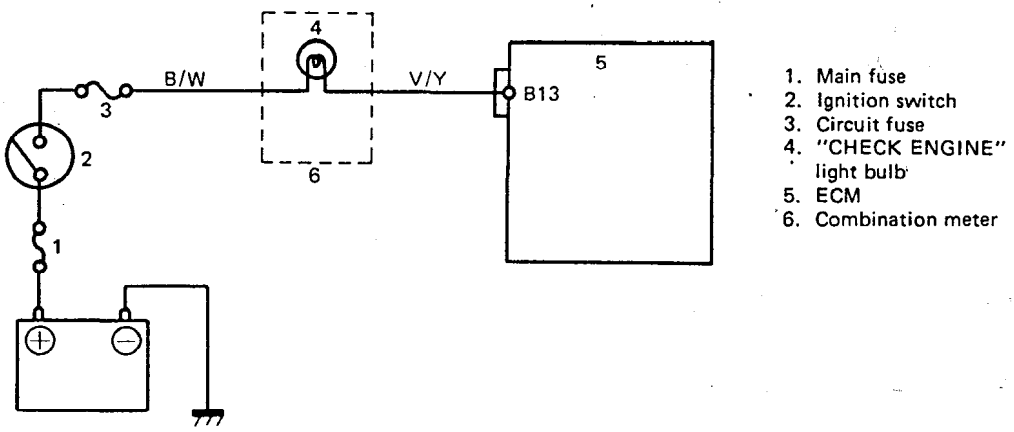


Fig. 6E-43 "CHECK ENGINE" Light Circuit

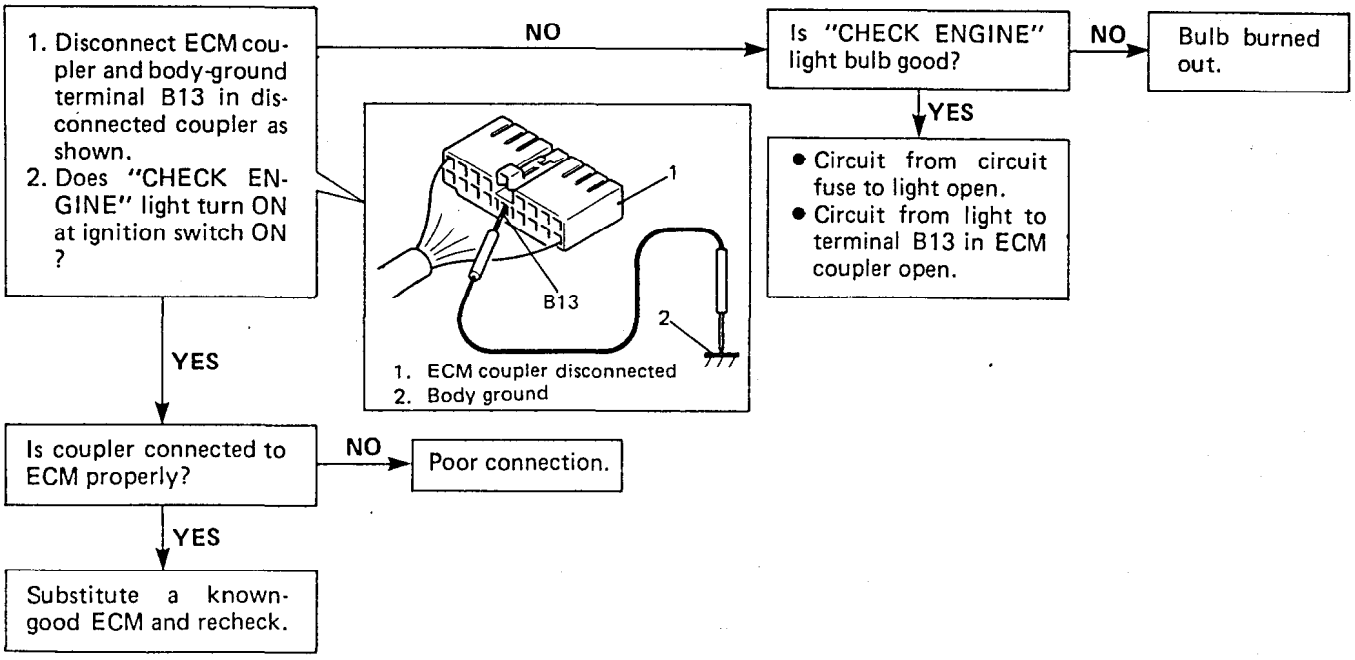
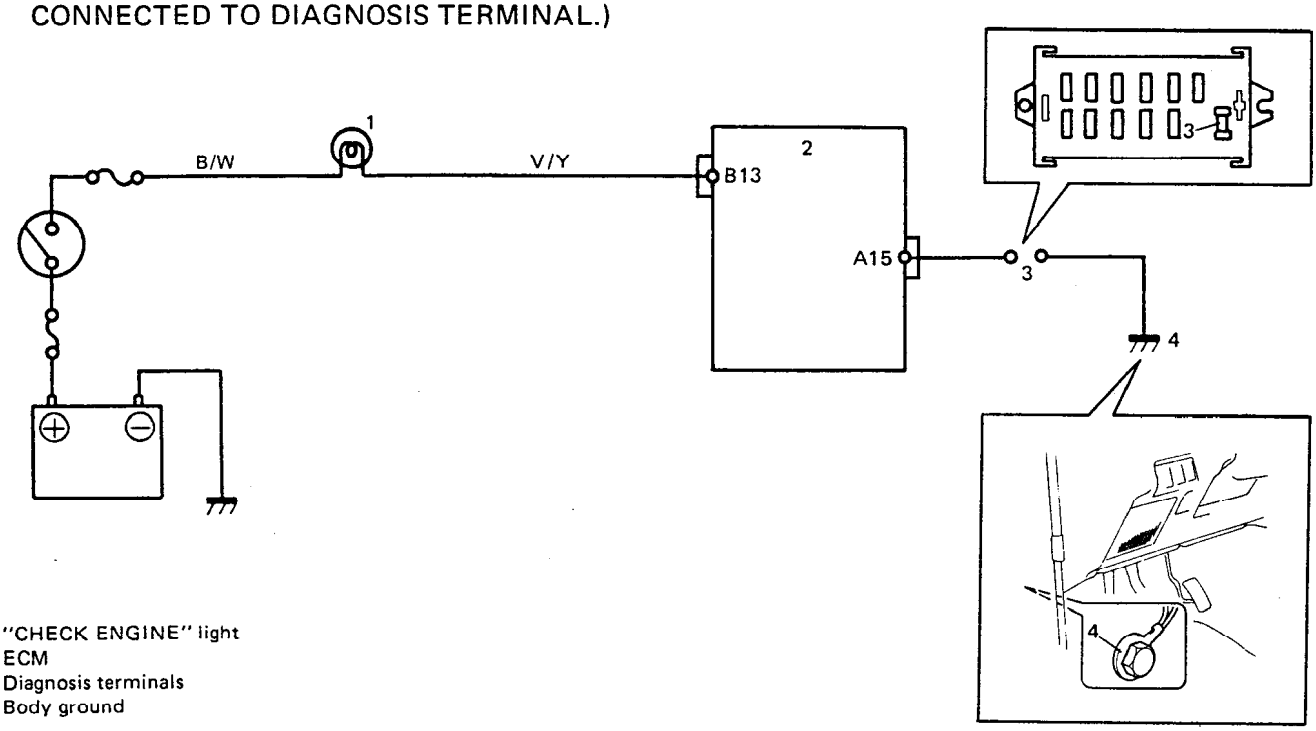


Fig. 6E-44 Diagnostic Flow Chart A-2 For "CHECK ENGINE" Light Circuit

A-3 "CHECK ENGINE" LIGHT CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T FLASH OR JUST REMAINS ON EVEN WITH SPARE FUSE CONNECTED TO DIAGNOSIS TERMINAL.)



1. "CHECK ENGINE" light
2. ECM
3. Diagnosis terminals
4. Body ground

Fig. 6E-45 "CHECK ENGINE" Light Circuit

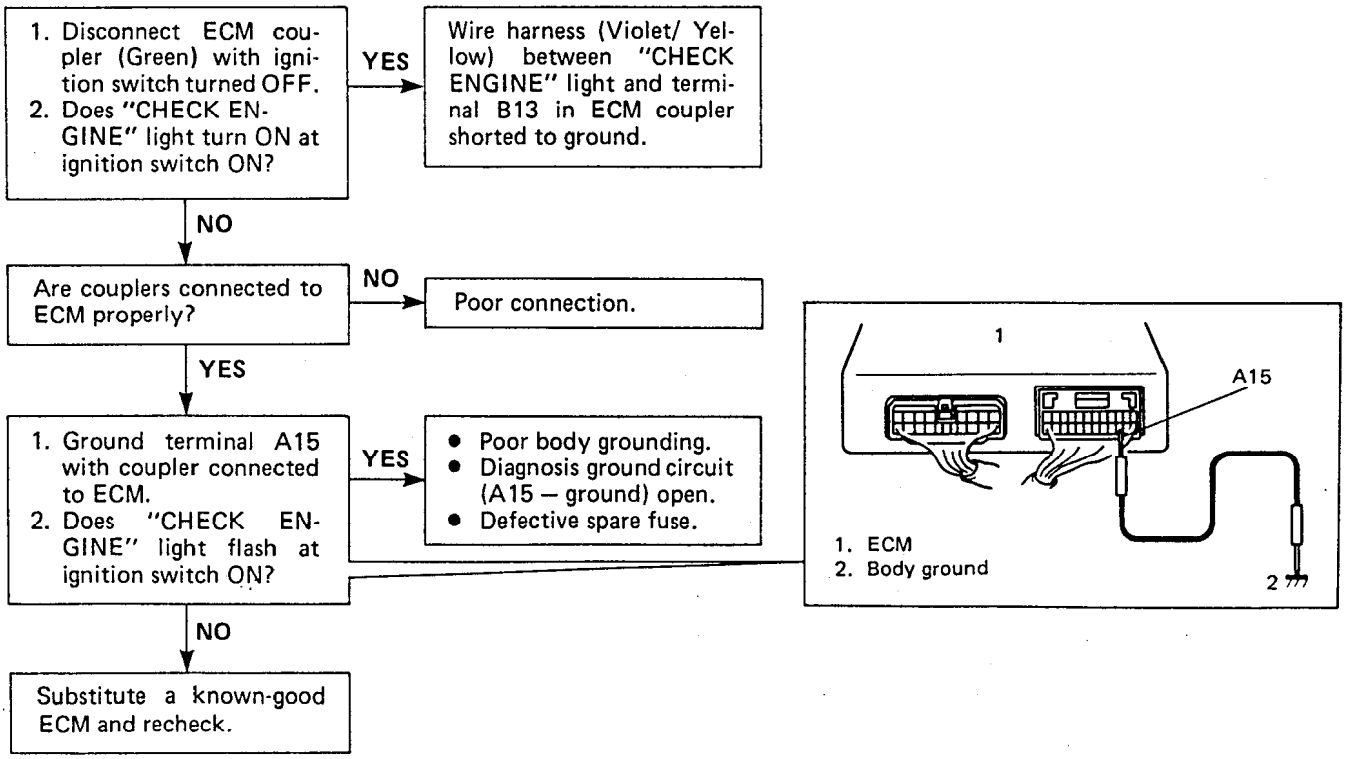


Fig. 6E-46 Diagnostic Flow Chart A-3 For "CHECK ENGINE" Light Circuit

CODE NO. 13 OXYGEN SENSOR CIRCUIT (SIGNAL VOLTAGE LOW AND DOESN'T CHANGE)

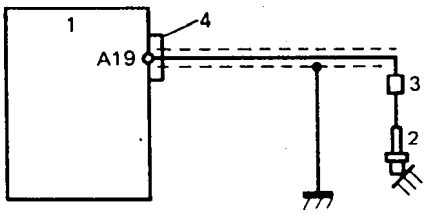
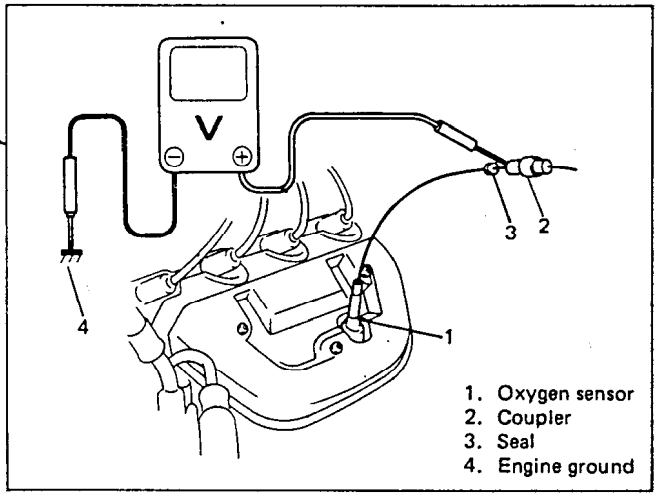


Fig. 6E-47 Oxygen Sensor Circuit

NOTE:

- **Before diagnosing trouble according to flow chart given below, check to make sure that following system and parts other than Electronic Fuel Injection system are in good condition.**
  - **Air cleaner (clogged)**
  - **Vacuum leaks (air inhaling)**
  - **Spark plugs (contamination, gap)**
  - **High tension cords (crack, deterioration)**
  - **Distributor rotor or cap (wear, crack)**
  - **Ignition timing**
  - **Engine compression**
  - **Any other system and parts which might affect A/F mixture or combustion.**
- **If code No. 13 and another code No. are indicated together, the latter has priority. Therefore, check and correct what is represented by that code No. first and then proceed to the following check.**

1. Warm up engine to normal operating temperature.
2. Remove seal from oxygen sensor coupler.
3. Connect voltmeter between oxygen sensor terminal and engine ground.
4. Maintain engine speed at 2000 r/min. After 60 seconds, check voltmeter.



0V	Remains unchanged at below 0.45V.	Remains unchanged at above 0.45V.	Deflects between above and below 0.45V repeatedly.
Replace oxygen sensor and recheck.	To ① on next page.	To ② on next page.	Oxygen sensor and its circuit (A/F ratio feed back system) are in good condition. ● Intermittent trouble or faulty ECM. Recheck referring to item "Intermittent troubles" on p. 6E-30.

CODE NO. 13 OXYGEN SENSOR CIRCUIT (Continued)

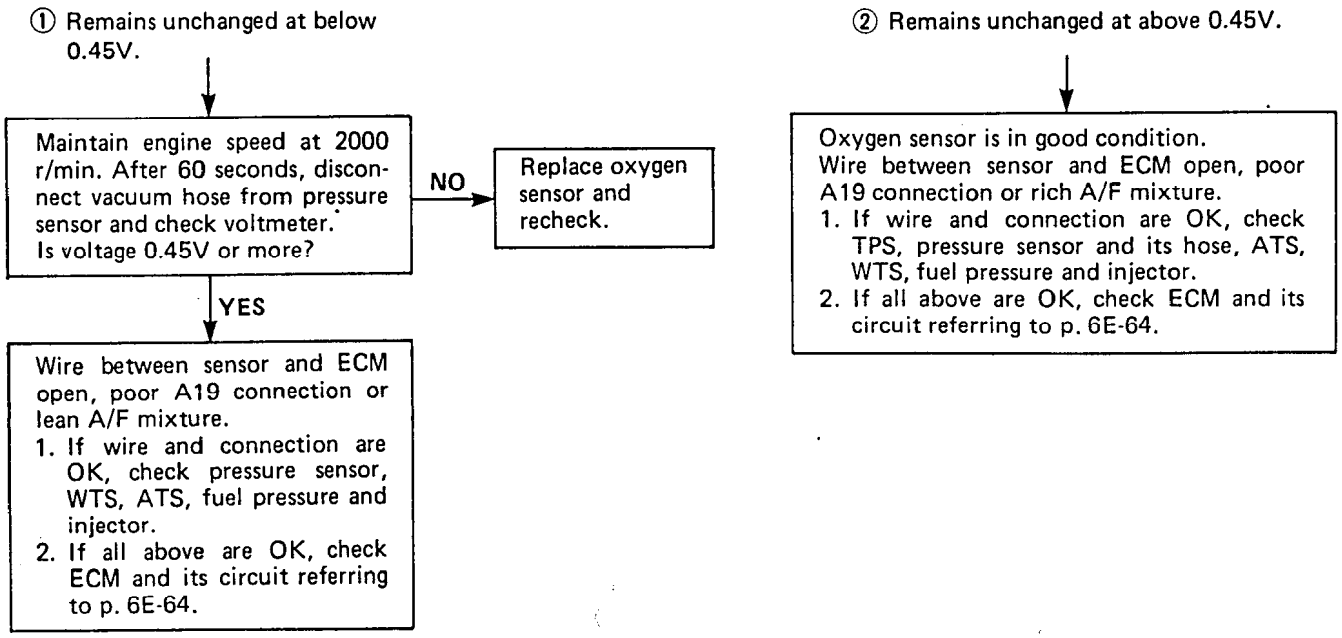


Fig. 6E-48 Diagnostic Flow Chart For Code No. 13

CODE NO. 14 WTS (WATER TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED)

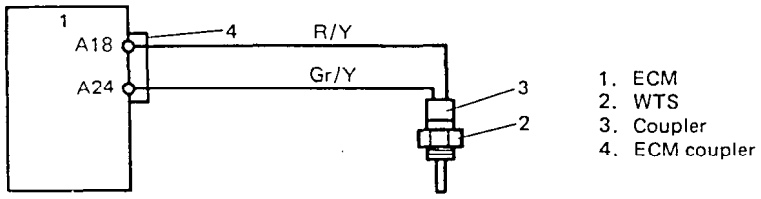


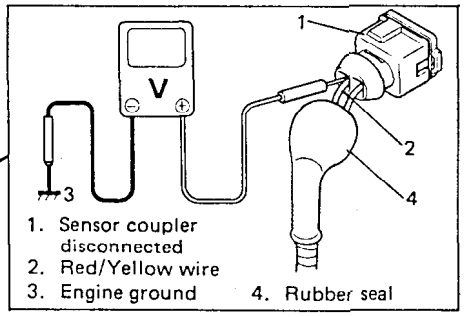
Fig. 6E-49 WTS Circuit

Check ECM-to-ECM coupler and WTS-to-WTS coupler connection respectively. Is it in good condition?

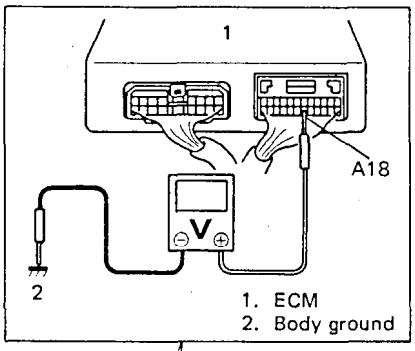
NO → Poor connection.

YES ↓

Check voltage at Red/Yellow wire terminal of disconnected sensor coupler with ignition switch ON. Is it about 4 – 5V?



NO →



With ECM couplers connected to ECM, sensor coupler disconnected and ignition switch ON, check voltage at ECM coupler terminal A18. Is it about 4V or more?

NO →

- Red/Yellow wire harness open.
- If battery voltage is indicated, Red/Yellow wire shorted to power circuit.

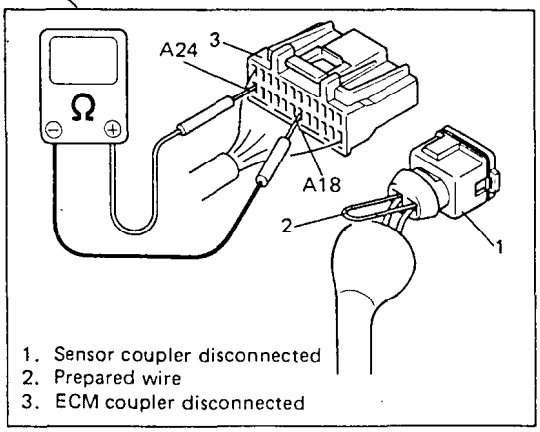
YES ↓

YES ↓

1. Disconnect ECM coupler with ignition switch OFF.
2. Using separately prepared wire, connect WTS coupler terminals.
3. Is there continuity between terminals A18 and A24 in ECM coupler?

NO → Gray/Yellow wire harness open.

YES ↓



Check WTS referring to p. 6E-83. Is it in good condition?

NO → Defective WTS.

YES ↓

Substitute a known-good ECM and recheck.

Fig. 6E-50 Diagnostic Flow Chart For Code No. 14

CODE NO. 15 WTS (WATER TEMPERATURE SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED)

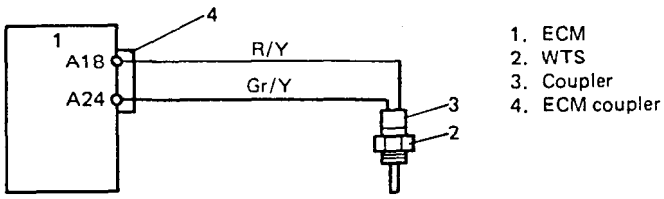


Fig. 6E-51 WTS Circuit

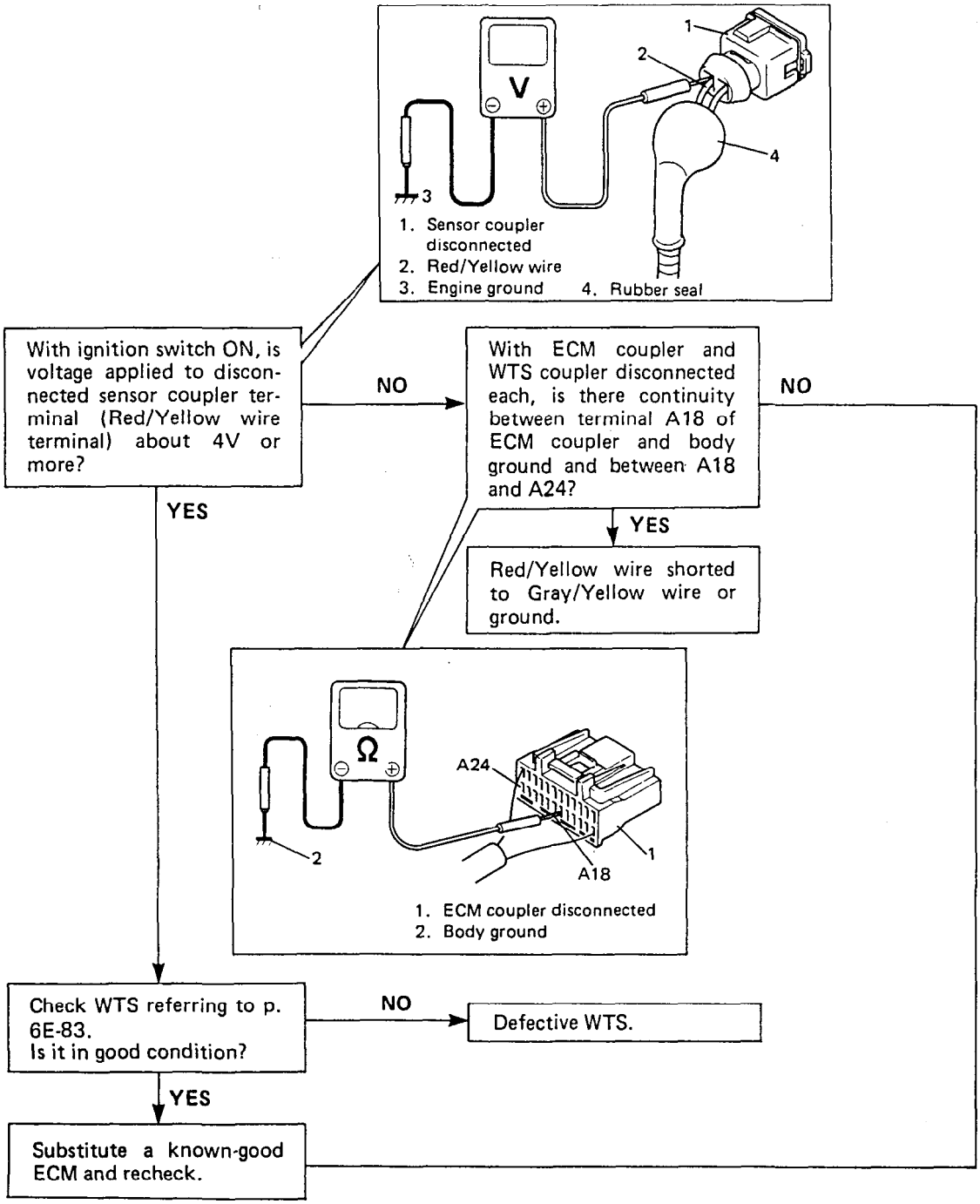


Fig. 6E-52 Diagnostic Flow Chart For Code No. 15

CODE NO. 21 TPS (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH)

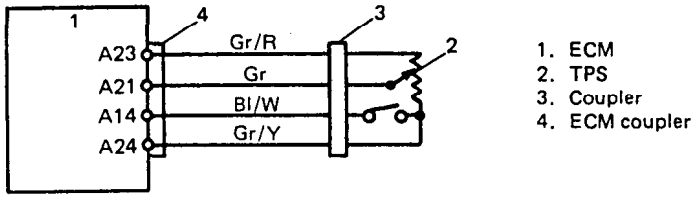


Fig. 6E-53 TPS Circuit

Check ECM-to-ECM coupler and TPS' coupler-to-coupler connection respectively.
Is it in good condition?

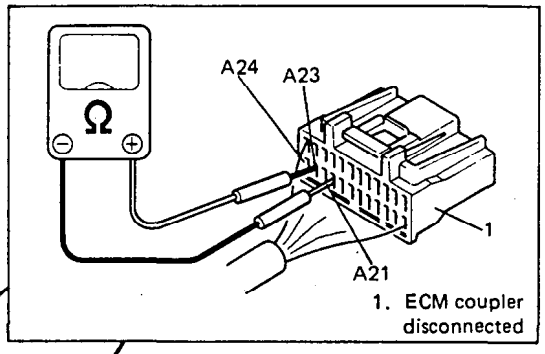
NO → Poor connection.

YES ↓

Check TPS referring to p. 6E-80.
Is it in good condition?

NO → Defective TPS.

YES ↓



1. Disconnect ECM coupler with ignition switch OFF.
2. With TPS coupler disconnected, is there continuity between ECM coupler terminals A23 and A21?

YES → Gray/Red wire shorted to Gray wire.

NO ↓

1. Disconnect PS coupler.
2. Connect TPS coupler.
3. Is resistance between ECM coupler terminals A23 and A24 3.5 – 6.5 kΩ?

NO → Gray/Yellow wire open.

YES ↓

Substitute a known-good ECM and recheck.

Fig. 6E-54 Diagnostic Flow Chart For Code No. 21

CODE NO. 22 TPS (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW)

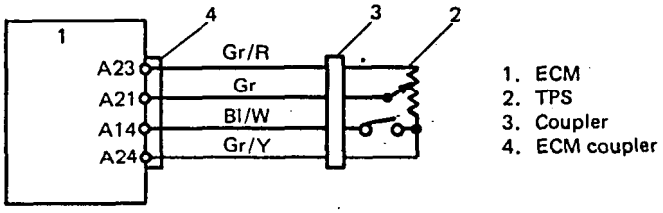


Fig. 6E-55 TPS Circuit

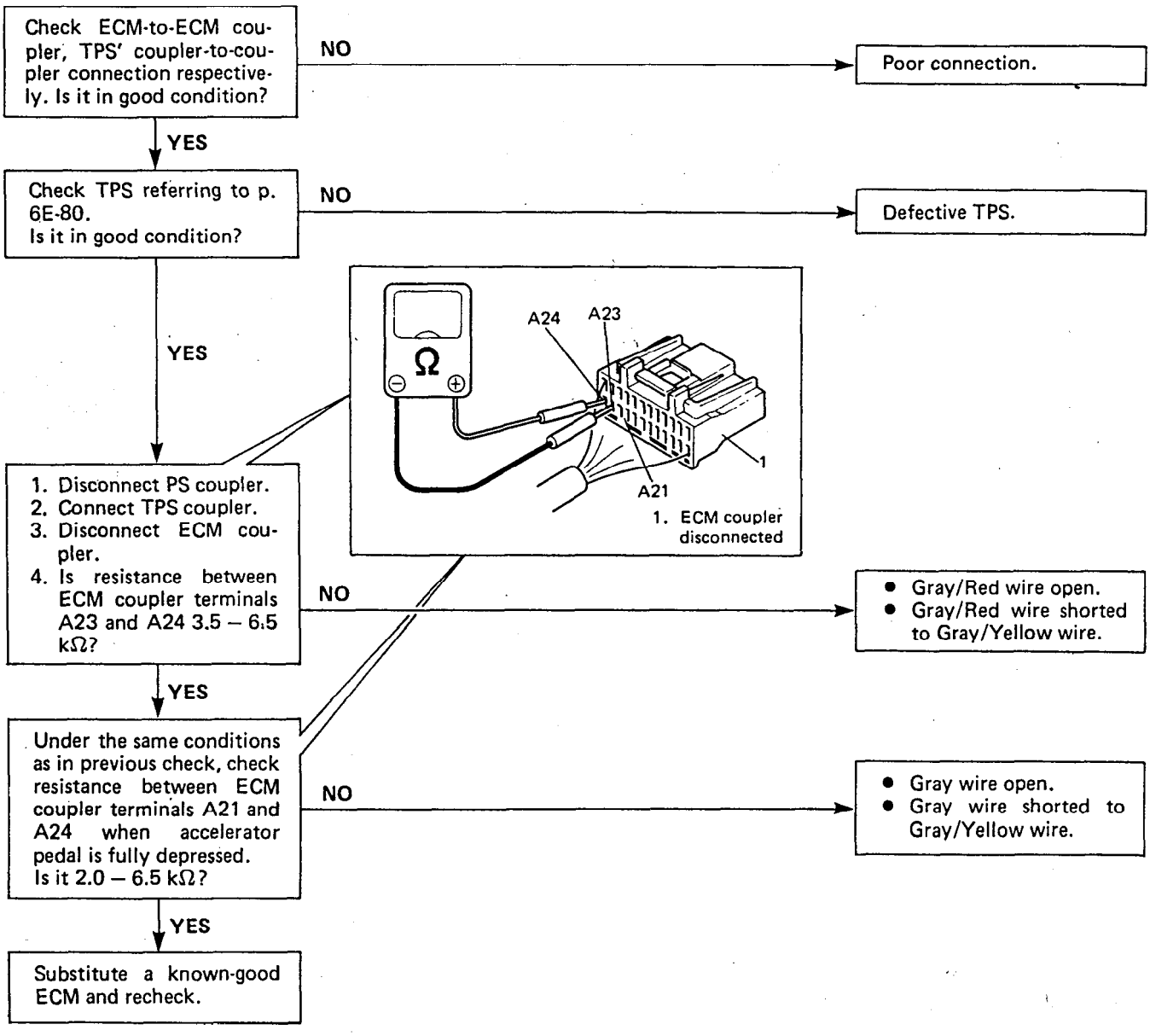
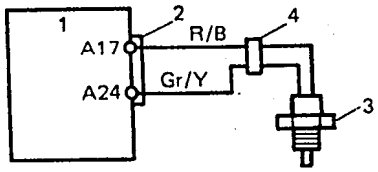


Fig. 6E-56 Diagnostic Flow Chart For Code No. 22

CODE NO. 23 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED)



1. ECM
2. ECM coupler
3. ATS
4. ATS coupler

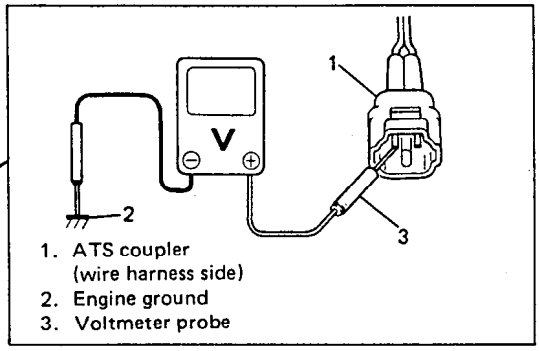
Fig. 6E-57 ATS Circuit

Check ECM-to-ECM coupler and ATS' coupler-to-coupler connection respectively.
Is it in good condition?

NO → Poor connection.

YES ↓

Check voltage at Red/Black wire terminal on wire harness side of disconnected sensor coupler with ignition switch ON.
Is it about 4 — 5V?

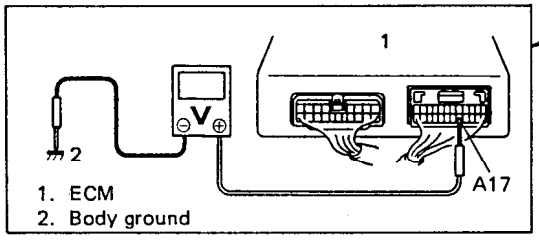


1. ATS coupler (wire harness side)
2. Engine ground
3. Voltmeter probe

NO → With ATS couplers disconnected, ECM coupler connected to ECM and ignition switch ON, is voltage at ECM coupler terminal A17 about 4V or more ?

NO → (to Substitute a known-good ECM and recheck.)

YES ↓



1. ECM
2. Body ground

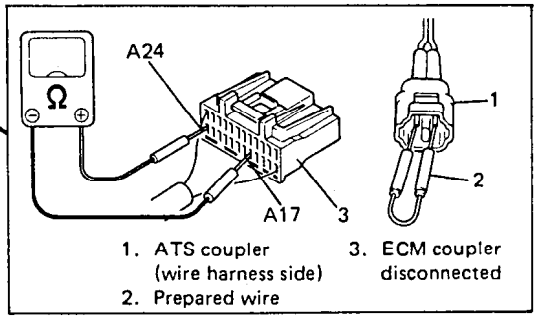
YES ↓

- Red/Black wire open.
- If battery voltage is indicated, Red/Black wire shorted to power circuit.

1. Disconnect ECM coupler with ignition switch OFF.
2. Using separately prepared wire, connect ATS coupler terminals.
3. Is there continuity between ECM coupler terminals A17 and A24?

NO → Gray/Yellow wire open.

YES ↓



1. ATS coupler (wire harness side)
2. Prepared wire
3. ECM coupler disconnected

Check ATS referring to p. 6E-82.
Is it in good condition?

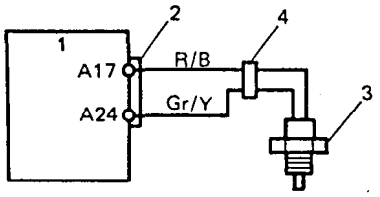
NO → Defective ATS.

YES ↓

Substitute a known-good ECM and recheck.

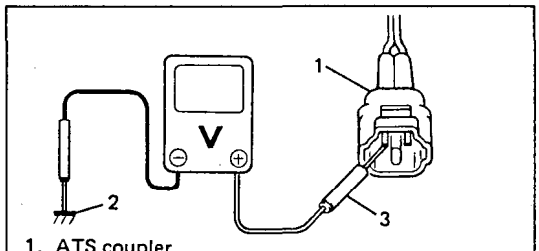
Fig. 6E-58 Diagnostic Flow Chart For Code No. 23

CODE NO. 25 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED)



1. ECM
2. ECM coupler
3. ATS
4. ATS coupler

Fig. 6E-59 ATS Circuit



1. ATS coupler (wire harness side)
2. Engine ground
3. Where male terminal fits

With ignition switch ON, is voltage applied to Red/Black wire terminal on wire harness side of disconnected ATS coupler 4 — 5V?

NO

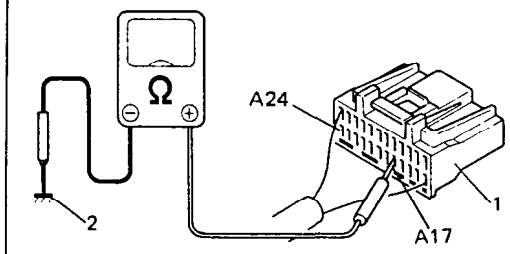
With ECM coupler and ATS coupler disconnected each, is there continuity between ECM coupler terminal A17 and body ground and between A17 and A24?

NO

YES

Red/Black wire shorted to Gray/Yellow wire or ground.

YES



1. ECM coupler disconnected
2. Body ground

Check ATS referring to p. 6E-82. Is it in good condition?

NO

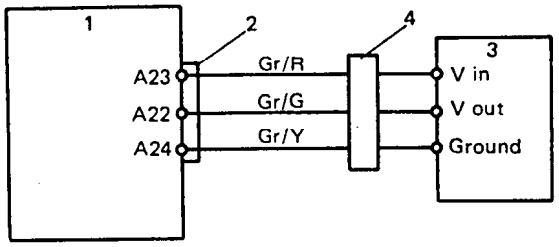
Defective ATS.

YES

Substitute a known-good ECM and recheck.

Fig. 6E-60 Diagnostic Flow Chart For Code No. 25

CODE NO. 31 PS (PRESSURE SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH–LOW VACUUM)



1. ECM
2. ECM coupler
3. PS
4. PS coupler

Fig. 6E-61 PS Circuit

Check output voltage of PS referring to p. 6E-79. Is proper voltage obtained ?

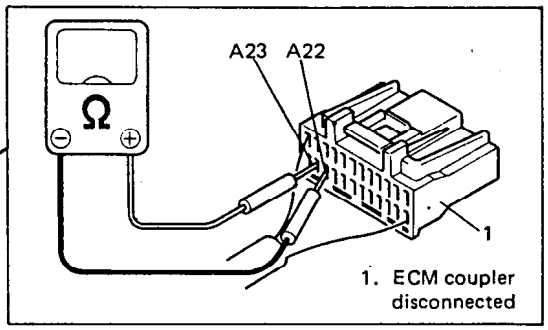
YES

NO

Check ECM-to-ECM coupler and PS' coupler-to-coupler connection respectively. Is it in good condition?

NO → Poor connection.

YES

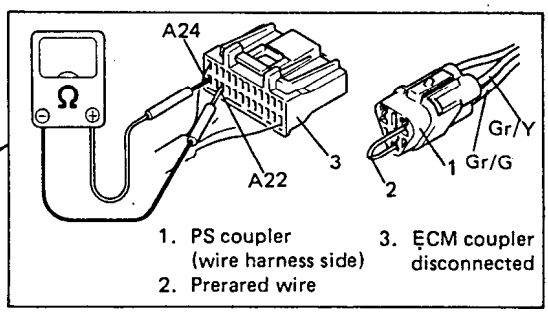


1. ECM coupler disconnected

1. Disconnect ECM coupler with ignition switch OFF.
2. With PS coupler disconnected, is there continuity between ECM coupler terminals A22 and A23?

YES → Gray/Green wire shorted to Gray/Red wire.

NO



1. PS coupler (wire harness side)
2. Prerared wire
3. ECM coupler disconnected

1. Under the same conditions as in previous check, connect Gray/Green and Gray/Yellow wire terminals by using separately prepared wire.
2. Is there continuity between ECM coupler terminals A22 and A24?

YES → Gray/Yellow wire open.

NO

Check PS individually referring to p. 6E-79. Is it in good condition?

NO → Defective PS.

YES

Substitute a known-good ECM and recheck.

Fig. 6E-62 Diagnostic Flow Chart For Code No. 31

CODE NO. 32 PS (PRESSURE SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW–HIGH VACCUM)

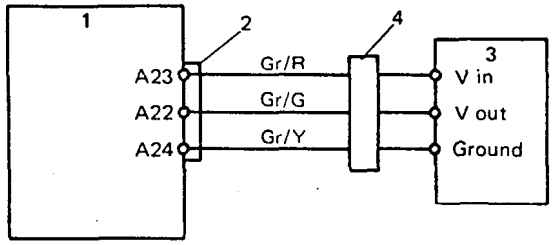
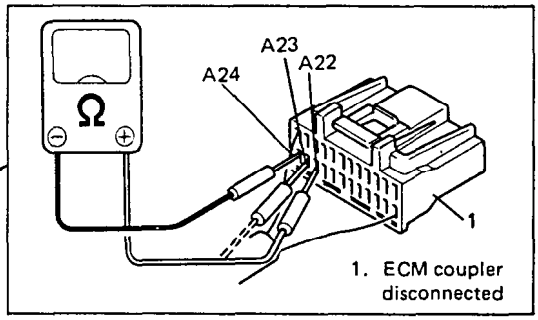


Fig. 6E-63 PS Circuit

Check output voltage of PS referring to p. 6E-79. Is proper voltage obtained?
- YES → (end)
- NO ↓

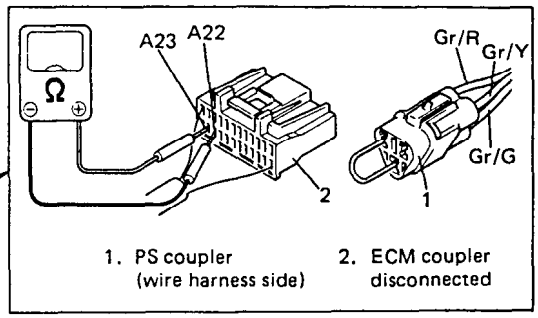
Check ECM-to-ECM coupler and PS' coupler-to-coupler connection respectively. Is it in good condition?
- NO → Poor connection.
- YES ↓

1. Disconnect ECM coupler with ignition switch OFF.
2. With PS coupler disconnected, is there continuity between ECM coupler terminals A22 and A24 and between A23 and A24?



- YES → Gray/Green or Gray/Red wire shorted to Gray/Yellow wire.
- NO ↓

1. Under the same conditions as in previous check, connect Gray/Red and Gray/Green wire terminals on PS coupler (wire harness side) by using separately prepared wire.
2. Is there continuity between ECM coupler terminals A22 and A23?



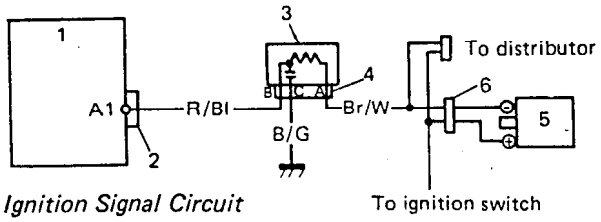
- NO → Gray/Green or Gray/Red wire open.
- YES ↓

Check PS individually referring to p. 6E-79. Is it in good condition?
- NO → Defective PS.
- YES ↓

Substitute a known-good ECM and recheck.

Fig. 6E-64 Diagnostic Flow Chart For Code No. 32

CODE NO. 41 IGNITION SIGNAL CIRCUIT (NO SIGNAL)



1. ECM
2. ECM coupler
3. Noise suppressor
4. Suppressor coupler
5. Ignition coil
6. Ignition coil coupler

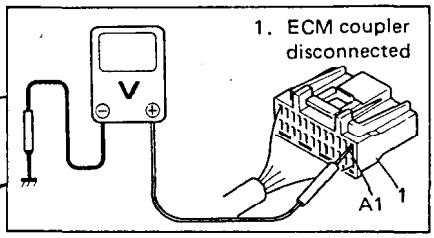
Fig. 6E-65 Ignition Signal Circuit

Check ignition system referrring to SECTION 6 Is it in good condition?
NO → Defective ignition system.
YES

1. Disconnect ECM coupler with ignition switch OFF.
2. Is battery voltage applied to ECM coupler terminal A1 at ignition switch ON?

YES →
1. With ECM coupler disconnected, disconnect ignition coil coupler.
2. Is battery voltage applied to ECM coupler terminal A1 at ignition switch ON?

YES → Brown/White or Red/Blue wire shorted to power circuit.



NO

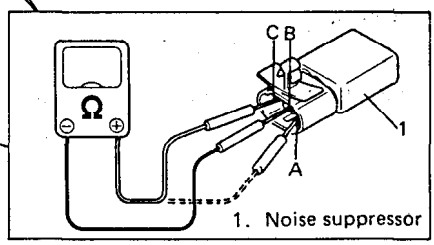
1. Remove noise suppressor.
2. Is resistance between suppressor terminals B and C ∞ (infinity)?

YES → Is ECM coupler connected to ECM properly?
YES → (to Substitute a known-good ECM and recheck.)
NO → Poor ECM-to-ECM coupler connection.

NO → Defective noise suppressor.

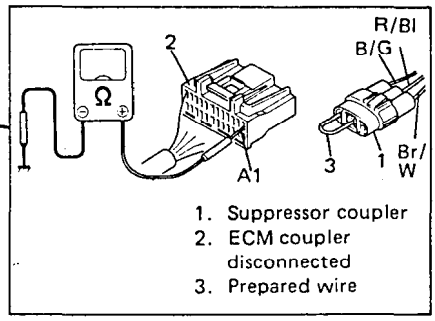
1. Remove noise suppressor.
2. Is there continuity between suppressor terminals A and B?

NO → Defective noise suppressor.
YES



1. Connect Black/Green and Red/Blue terminals of suppressor coupler with separately prepared wire.
2. Is there continuity between ECM coupler terminal A1 and body ground?

NO → Blue or Brown wire open.
YES



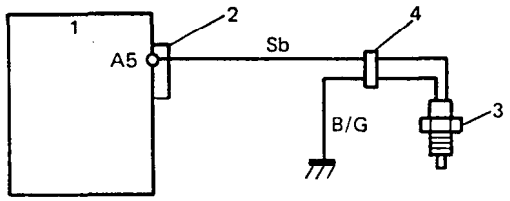
Is there continuity in Brown/White wire between suppressor coupler and ignition coil coupler?
NO → Brown/White wire open.
YES

Is each coupler of ignition coil and suppressor connected properly?
NO → Poor connection.
YES

Substitute a known-good ECM and recheck.

Fig. 6E-66 Diagnostic Flow Chart For Code No. 41

CODE NO. 42 5TH SWITCH CIRCUIT (A5 TERMINAL GROUNDED CONSTANTLY)



1. ECM
2. ECM coupler
3. 5th switch
4. 5th switch coupler

Fig. 6E-67 5th Switch Circuit

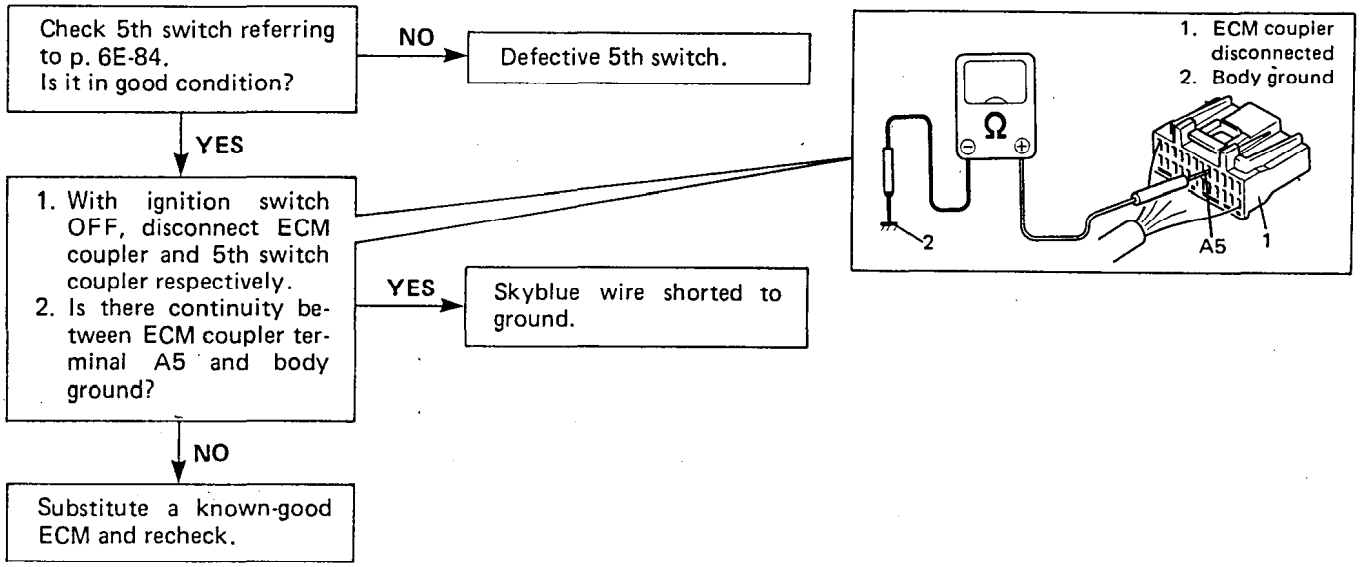
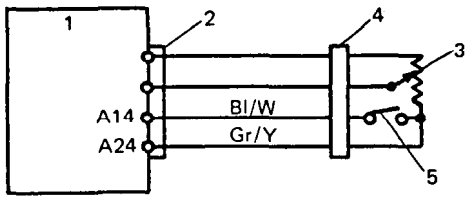


Fig. 6E-68 Diagnostic Flow Chart For Code No. 42

CODE NO. 44 IDLE SWITCH CIRCUIT (CIRCUIT OPEN OR TPS INSTALLATION ANGLE MALADJUSTED)



1. ECM
2. ECM coupler
3. TPS
4. TPS coupler
5. Idle switch in TPS

Fig. 6E-69 Idle Switch Circuit

Check ECM-to-ECM coupler and TPS' coupler-to-coupler connection respectively.
Is it in good condition?

NO → Poor connection.

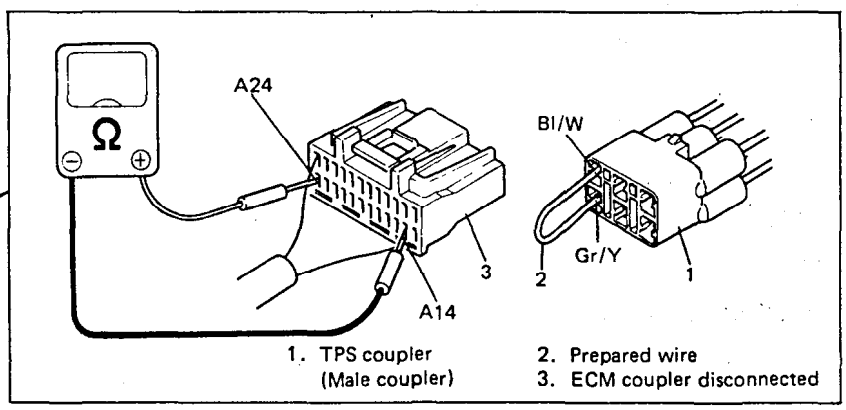
YES

Check idle switch in TPS referring to p. 6E-80.
Is it in good condition?

NO → Defective idle switch or TPS installation angle maladjusted.

YES

1. Disconnect ECM coupler with ignition switch OFF.
2. Using separately prepared wire, connect Blue/White wire and Gray/Yellow wire terminals on TPS male coupler.
3. In this state, is there continuity between ECM coupler terminals A14 and A24?



1. TPS coupler (Male coupler)
2. Prepared wire
3. ECM coupler disconnected

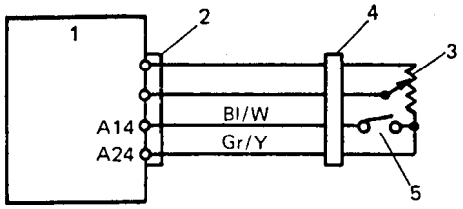
NO → Blue/White or Gray/Yellow wire open.

YES

Substitute a known-good ECM and recheck.

Fig. 6E-70 Diagnostic Flow Chart For Code No. 44

CODE NO. 45 IDLE SWITCH CIRCUIT (CIRCUIT SHORT OR TPS INSTALLATION ANGLE MALADJUSTED)



1. ECM
2. ECM coupler
3. TPS
4. TPS coupler
5. Idle switch in TPS

Fig. 6E-71 Idle Switch Circuit

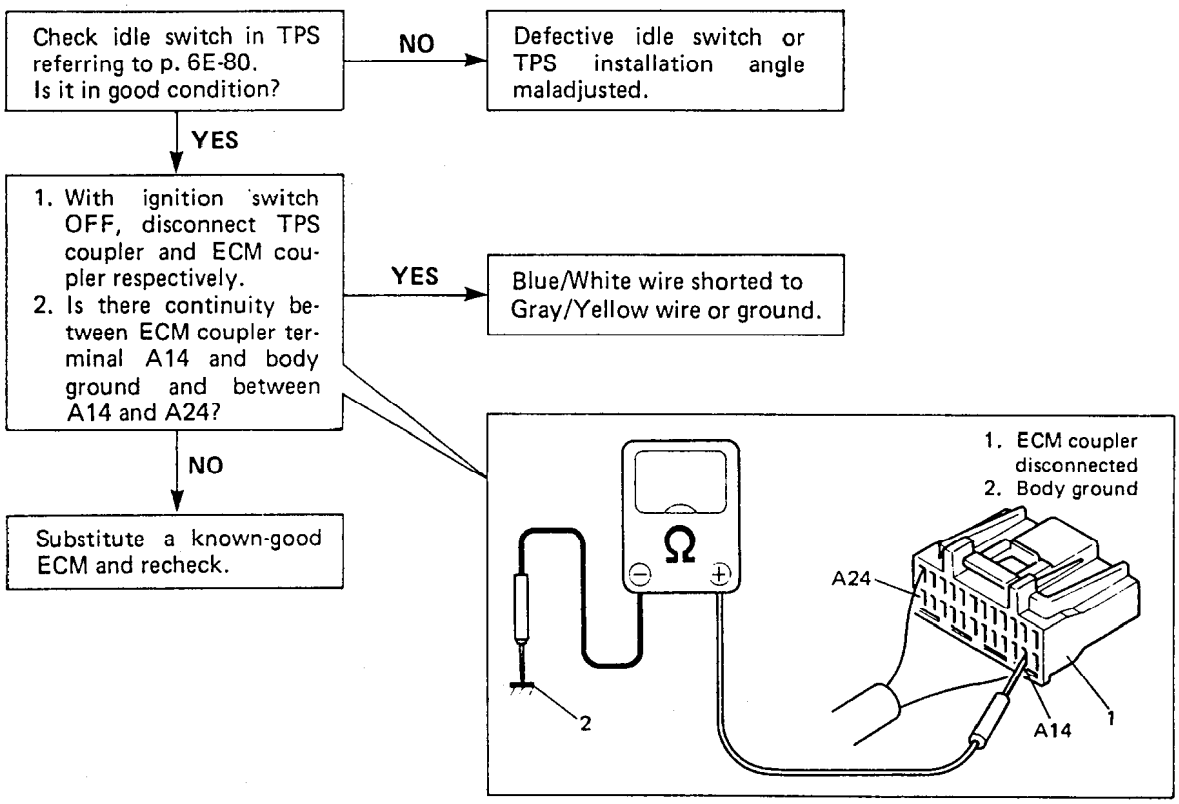


Fig. 6E-72 Diagnostic Flow Chart For Code No. 45

TROUBLE DIAGNOSIS

This section describes trouble diagnosis of Electronic Fuel Injection system parts whose trouble is not indicated by the self-diagnosis function.

When diagnostic code No. 12 is indicated by the self-diagnosis function and assuredly those engine basic parts as described in "ENGINE DIAGNOSIS" are all in good condition, check below Electronic Fuel Injection system parts which may be a possible cause for each symptom of the engine.

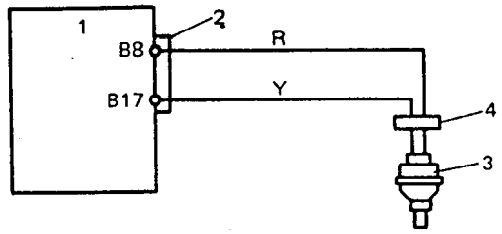
SYMPTOM	POSSIBLE CAUSE	INSPECTION
Hard or no starting (Engine cranks OK)	• Injector or its circuit defective	Diagnostic flow chart B-1
	• Defective fuel pump or its circuit open	Diagnostic flow chart B-2
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Defective air valve	See p. 6E-72
	• Open starter signal circuit	Check voltage at ECM coupler terminal B11 (refer to p. 6E-66)
	• Defective throttle opener system	Diagnostic flow chart B-4
	• Poor performance of water temperature sensor, air temperature sensor or pressure sensor	See p. 6E-83, 6E-82 or 6E-79
	• Faulty ECM	See p. 6E-64
NOTE: • **If engine doesn't start at all, perform fuel injector and its circuit check first. (Advance to Diagnostic flow chart B-1.)** • **If engine is hard to start only when it is cold, check air valve first.** • **If engine starts easily with help of accelerator pedal operation, check throttle opener system first. (Advance to Diagnostic flow chart B-4.)**		
Improper engine idling or engine fails to idle	• Clogged pressure sensor vacuum passage	Check vacuum hose and gas filter
	• Defective throttle opener system	Diagnostic flow chart B-4
	• Maladjusted idle speed adjusting screw	See p. 6E-68
	• Defective air valve	See p. 6E-72
	• ISC solenoid valve or its circuit defective	Diagnostic flow chart B-5
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-74)
	• Poor performance of water temperature sensor, throttle position sensor, air temperature sensor or pressure sensor	See p. 6E-83, 6E-80, 6E-82 or 6E-79
	• Faulty ECM	See p. 6E-64

SYMPTOM	POSSIBLE CAUSE	INSPECTION
NOTE: • **If engine fails to idle when it is cold, check air valve first.** • **If engine stops immediately after it started (i.e. when throttle opener moves throttle valve back to idle position) although it doesn't if accelerator pedal is used, check idle speed first and check ISC solenoid valve. (Advance to Diagnostic flow chart B-5.)** • **If idling speed is too high after engine is warmed up, first check if throttle opener has opened throttle valve when not supposed to. If it is still too high even after it was made sure that throttle opener system is in good condition and idle speed adjusting screw was loosened fully, check if air valve stays open or ISC solenoid valve fails to operate properly.**		
Engine has no or poor power	• Clogged pressure sensor vacuum passage	Check vacuum hose and gas filter
	• Maladjusted accelerator cable play	See p. 6E-68
	• Maladjusted installation angle of throttle position sensor	See p. 6E-80
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage. (Refer to p. 6E-74)
	• Poor performance of throttle position sensor, water temperature sensor, air temperature sensor or pressure sensor	See p. 6E-80, 6E-83, 6E-82 or 6E-79
	• Faulty ECM	See p. 6E-64
Engine hesitates when acceleration	• Defective throttle valve operation	Check throttle valve for smooth operation
	• Poor performance throttle position sensor	See p. 6E-80
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-74)
	• Poor performance of water temperature sensor or pressure sensor	See p. 6E-83 or 6E-79
	• Faulty ECM	See p. 6E-64

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Surges (Variation in vehicle speed is felt although accelerator pedal is not operated)	• Variable fuel pressure (Clogged fuel filter, defective fuel pressure regulator etc.)	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-74)
	• Poor performance of throttle position sensor, water temperature sensor or pressure sensor	See p. 6E-80, 6E-83 or 6E-79
	• Faulty ECM	See p. 6E-64
Excessive detonation (Engine makes sharp metallic knocks that change with throttle opening)	• Low fuel pressure	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-74)
	• Poor performance of throttle position sensor, water temperature sensor or pressure sensor	See p. 6E-80, 6E-83 or 6E-79
	• Faulty ECM	See p. 6E-64
Poor gasoline mileage	• High idle speed (Malfunctioning air valve or abnormal ISC solenoid valve operation)	See p. 6E-72 for air valve Diagnostic flow chart B-5 for ISC solenoid valve
	• High fuel pressure	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for fuel leakage (See p. 6E-74)
	• Poor performance of throttle position sensor, water temperature sensor or pressure sensor	See p. 6E-80, 6E-83 or 6E-79
	• Faulty ECM	See p. 6E-64
Excessive hydrocarbons (HC) emission (Rich or lean fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc..)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Fuel leakage from injector	See p. 6E-74
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Poor performance of water temperature sensor, pressure sensor or air temperature sensor	See p. 6E-83, 6E-79 or 6E-82
	• Faulty ECM	See p. 6E-64

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Excessive carbon monoxide (CO) emission (Righ fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc..)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Fuel leakage from injector	See p. 6E-74
	• Fuel pressure out of specification (High fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of water temperature sensor, pressure sensor or air temperature sensor	See p. 6E-83, 6E-79 or 6E-82
	• Faulty ECM	See p. 6E-64
Excessive nitrogen oxides (NOx) emission (Lean fuel mixture)	• Improper ignition timing	See section 6F
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Misrouted vacuum hoses	
	• Defective EGR system	Diagnostic flow chart B-6
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of water temperature sensor, pressure sensor or air temperature sensor	See p. 6E-83, 6E-79 or 6E-82
	• Faulty ECM	See p. 6E-64

B-1 FUEL INJECTOR AND ITS CIRCUIT CHECK (ENGINE NO STARTING)



1. ECM
2. ECM coupler
3. Injector
4. Injector coupler

Fig. 6E-73 Injector Circuit

Using sound scope, check injector for operating sound at engine cranking. Is it detected?

YES

Is fuel injected from injector at engine cranking? (Refer to p. 6E-74 for checking procedure.)

NO

Check fuel pump and fuel pressure. (Proceed to DIAGNOSTIC FLOW CHARTS B-2 and B-3.)

YES

Does injector inject fuel properly? (Refer to p. 6E-74 for checking procedure.)

NO

YES

Does fuel leak from injector after injection at a rate of higher than 1 drop/min.?

YES

NO

Injector and its circuit in good condition.

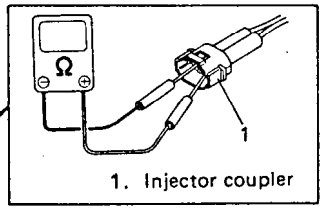
NO

Defective injector.

NO

1. Disconnect injector coupler.
2. Is resistance of injector 1.0 – 2.0 Ω (at 20°C, 68°F)?

YES



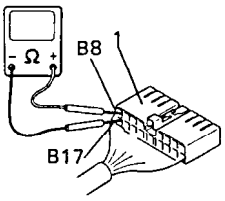
1. Injector coupler

1. Connect injector coupler.
2. Disconnect ECM coupler from ECM with ignition switch turned OFF.
3. Is resistance between B8 and B17 terminals of disconnected ECM coupler 1.0 – 2.0 Ω (at 20°C, 68°F) ?

NO

- Red or Yellow wire open.
- Red wire shorted to Yellow wire or ground.
- Poor connection of injector coupler.

YES



1. Disconnected ECM coupler

Is ECM coupler connected to ECM properly?

NO

Poor connection.

YES

Substitute a known-good ECM and recheck.

Fig. 6E-74 Diagnostic Flow Chart B-1 For Injector and Its Circuit

B-2 FUEL PUMP AND ITS CIRCUIT CHECK

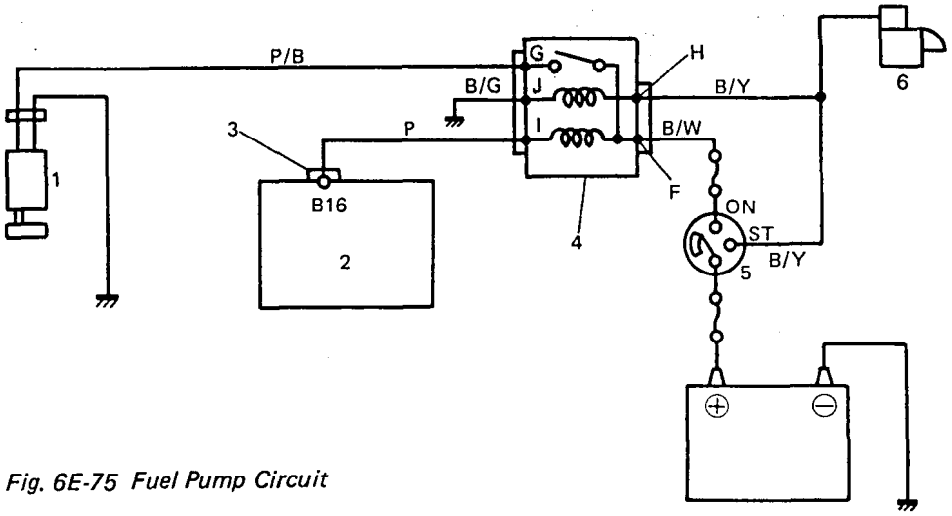


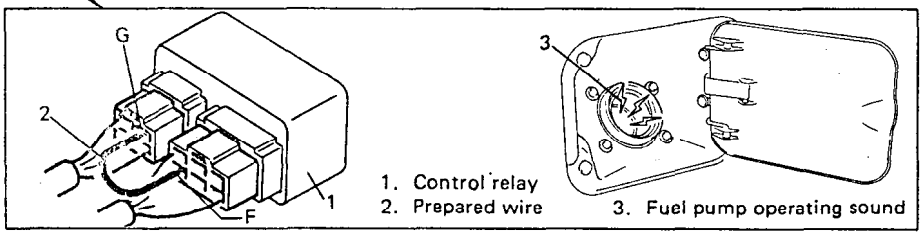
Fig. 6E-75 Fuel Pump Circuit

CAUTION:
Before substituting a known-good ECM for existing one, be sure to confirm that actuator circuits are all in good condition, referring to "CAUTION" on p. 6E-31.

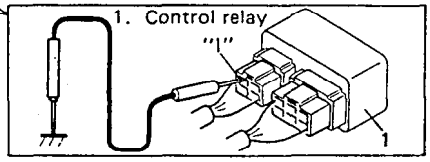
Is fuel pump heard to operate while engine cranking ?
YES
NO
1. Using separately prepared wire, connect control relay coupler terminals "F" and "G".
2. Is fuel pump heard to operate at ignition switch ON?
NO
Is battery voltage applied to relay coupler terminal "F" at ignition switch ON?
YES
- Pink/Black wire open.
- Defective fuel pump.

NO
Black/White wire open.

YES



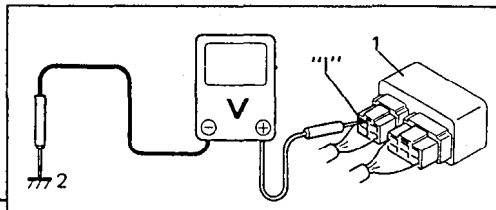
1. Using separately prepared wire, ground relay coupler terminal "I".
2. Is fuel pump heard to operate at ignition switch ON?
NO
Defective control relay.



YES

1. Connect voltmeter between relay coupler terminal "I" and body ground.
2. Is battery voltage indicated at ignition switch ON and 0V at engine cranking?
NO
- Pink wire open.
- Poor ECM-to-ECM coupler connection.
- Defective ECM (substitute a good known ECM and recheck.)

YES
Fuel pump circuit in good condition.



NOTE:
When engine cooling water temperature is −10°C (14°F) or lower, 0V is indicated for 3 seconds after ignition switch ON even without engine cranking.

Fig. 6E-76 Diagnostic Flow Chart B-2 For Fuel Pump Circuit

B-3 FUEL PRESSURE CHECK

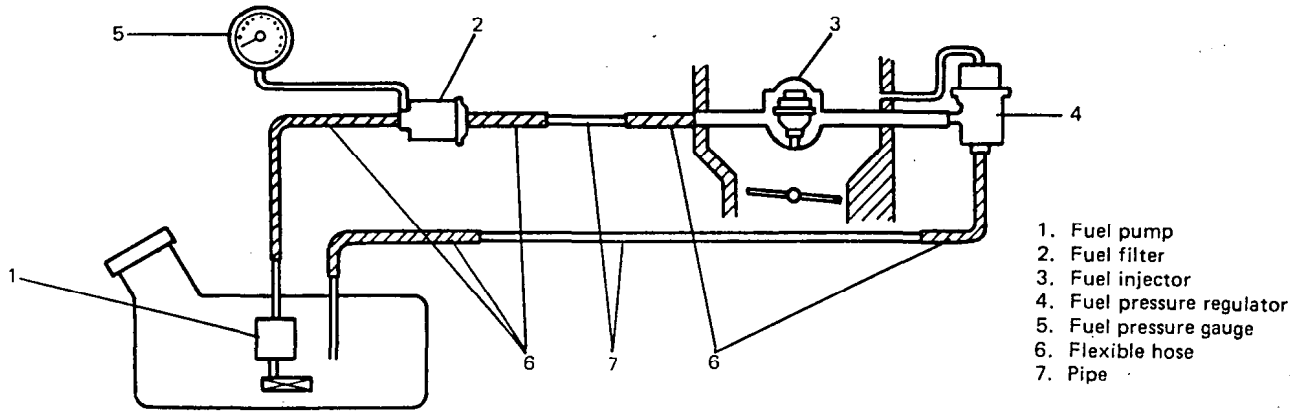


Fig. 6E-77 Fuel Pressure Check

1. Install fuel pressure gauge referring to p. 6E-70.
2. Operate fuel pump for 10 sec. according to precedure described in p. 6E-70. Is fuel pressure then 2.4 – 2.8 kg/cm^2 (240 – 280 kPa, 34.1 – 39.8 psi)?
   Also, is 1.5 kg/cm^2 (150 kPa, 21.3 psi) or higher fuel pressure retained for 1 minute after fuel pump is stopped?

YES → Normal fuel pressure.

NO

Pressure within spec. but not retained.

NO

Is there fuel leakage from fuel feed line hose, pipe or their joint?

YES → Fuel leakage

NO

Check again if specified pressure is retained.
While doing so, disconnect fuel return hose from fuel return pipe. Does fuel come out of return hose then?

YES → Faulty fuel pressure regulator

NO → To be continued

Low pressure.

NO

1. Operate fuel pump.
2. With fuel return hose blocked by pinching it, check fuel pressure. Is it 4.0 kg/cm^2 (400 kPa, 56.9 psi) or more?

YES → Faulty fuel pressure regulator

NO → To be continued

High pressure.

1. Disconnect fuel return hose from fuel pressure regulator and connect new return hose to it.
2. Insert the other end of new return hose into approved gasoline container.
3. Operate fuel pump.
   Is specified fuel pressure obtained then?

YES → Restricted fuel return line.

NO → To be continued

No pressure.

- Shortage of gasoline.
- Fuel pump or its circuit defective (Refer to Diagnostic Flow Chart B-2.)

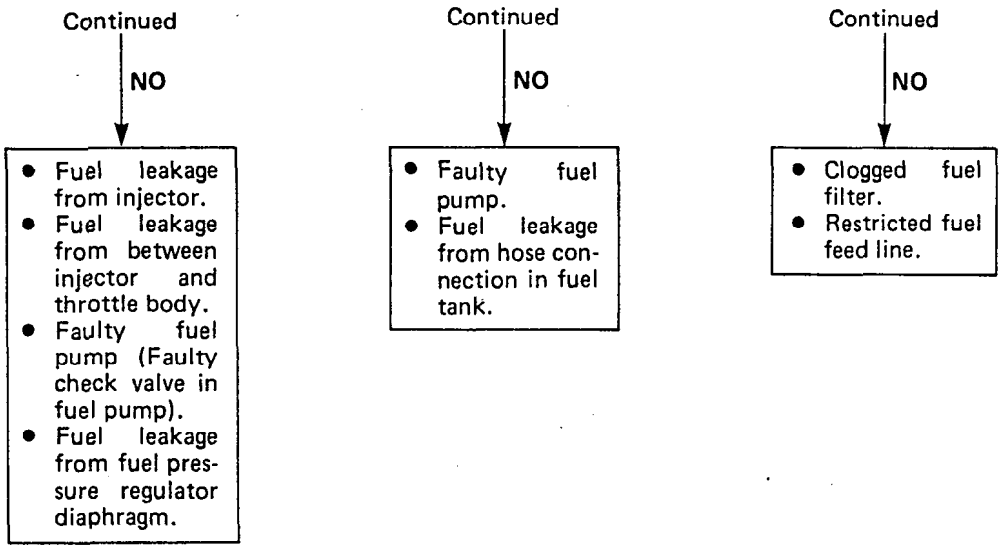
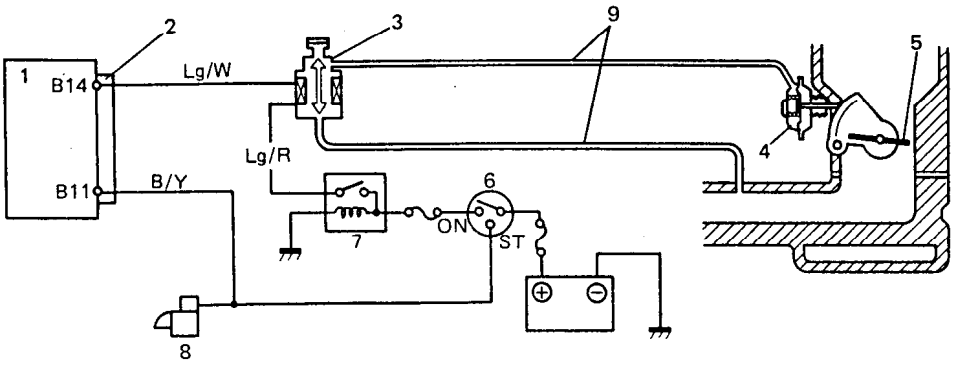


Fig. 6E-78 Diagnostic Flow Chart B-3 For Fuel Pressure

B-4 THROTTLE OPENER SYSTEM CHECK



1. ECM
2. ECM coupler
3. VSV
4. Throttle opener
5. Throttle valve
6. Main switch
7. Control relay
8. Starter
9. Vacuum hose

Fig. 6E-79 Throttle Opener System

1. Warm up engine to normal operating temperature.
2. Is throttle valve opened by throttle opener at both engine stop and cranking?

NO → Check throttle opener for operation referring to p. 6E-86. Is it in good condition?

YES → Adjust throttle valve opening by throttle opener referring to p. 6E-69.

NO → Defective opener

YES → Does throttle opener rod retract 0.2 – 1 second after engine start?

YES → Check throttle valve opening by throttle opener referring to p. 6E-69.

YES → Throttle opener system in good condition.

NO → Adjust throttle valve opening by throttle opener referring to p. 6E-69.

NO → Check vacuum hose and opener referring to p. 6E-86. Are they in good condition?

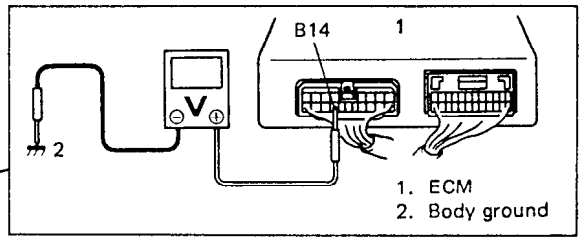
NO →
- Vaccum hose misconnection, leakage, clog or deterioration.
- Defective opener.

YES → Check VSV and its circuit referring to p. 6E-87. Are they both in good condition?

NO →
- Lightgreen/Red wire open.
- Defective VSV.
- Lightgreen/White wire shorted.
- Lightgreen/White wire open.

YES →
1. Connect ECM coupler.
2. Is battery voltage applied to ECM coupler terminal B14 at ignition switch ON?

NO →



1. ECM
2. Body ground

YES → To be continued

To be continued

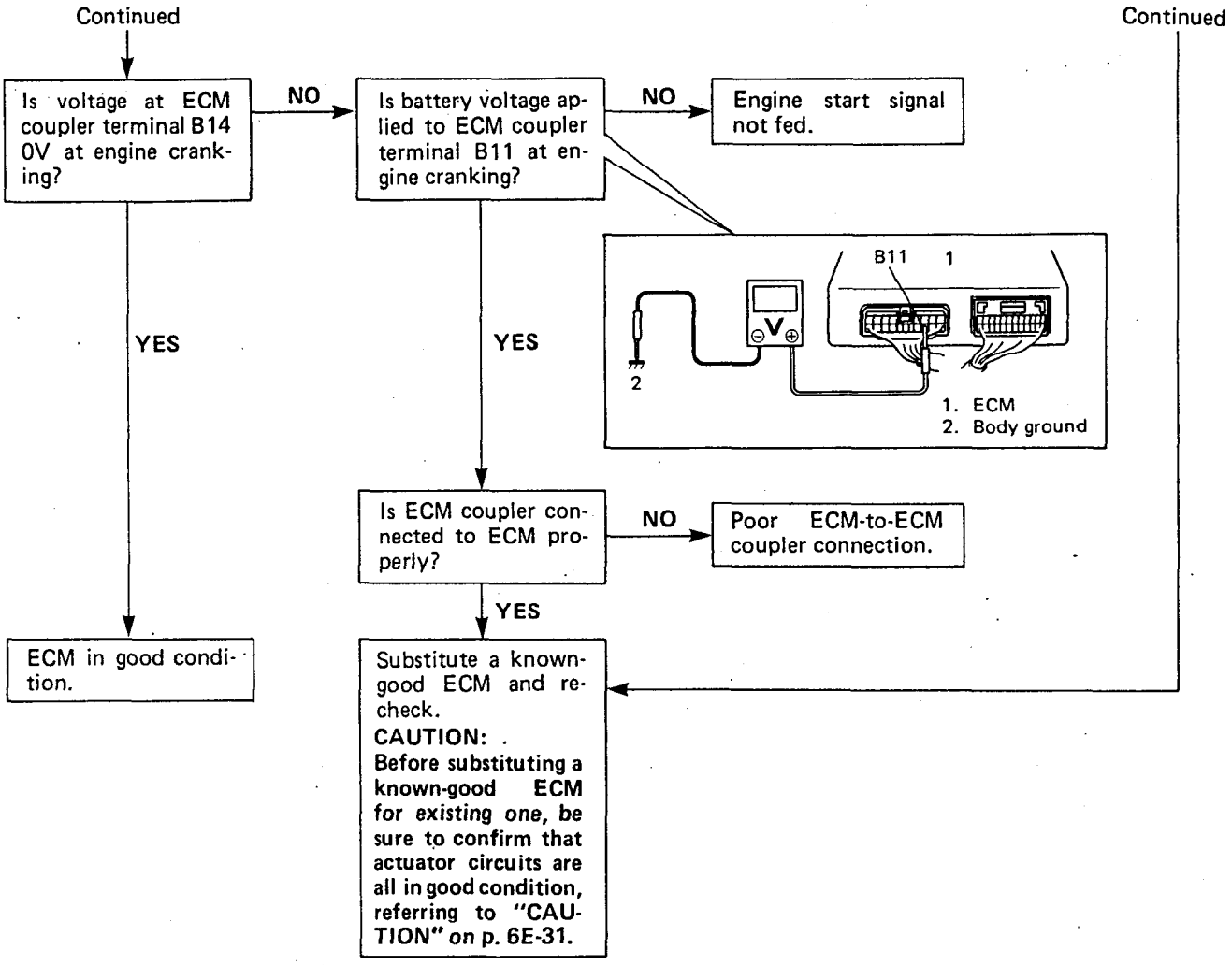
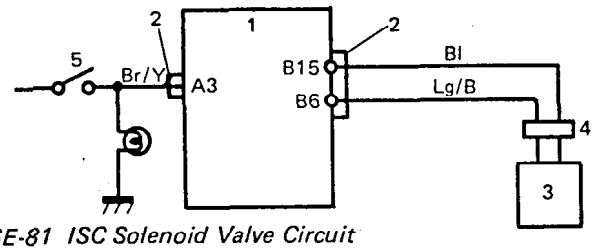


Fig. 6E-80 Diagnostic Flow Chart B-4 For Throttle Opener System

B-5 ISC SOLENOID VALVE CIRCUIT CHECK



1. ECM
2. ECM coupler
3. ISC solenoid valve
4. ISC solenoid valve coupler
5. Electric load switch

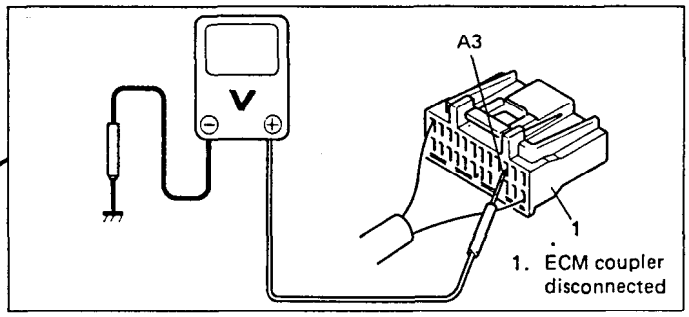
Fig. 6E-81 ISC Solenoid Valve Circuit

1. Warm up engine to normal operating temperature and keep it at idle speed.
2. Does idle speed increase at headlight switch ON?

YES → ISC solenoid valve and its circuit in good condition.

NO

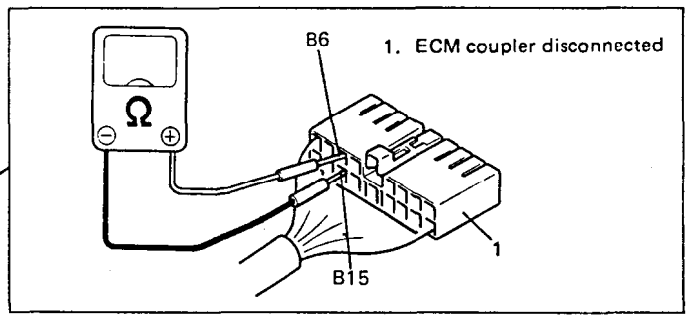
1. Stop engine.
2. Disconnect ECM coupler.
3. With ignition switch ON, is battery voltage applied to ECM coupler terminal A3 at headlight switch ON and 0V at OFF?



NO → Brown/Yellow wire open or short.

YES

Is resistance between disconnected ECM coupler terminals B6 and B15 5.4 – 6.6 Ω at 20°C (68°F)?



NO → 1. Disconnect ISC solenoid coupler.
2. Is resistance of solenoid 5.4 – 6.6 Ω at 20°C (68°F)?

YES → ● Blue wire or Light-green/Black wire open.
● Blue wire shorted to Lightgreen/Black wire.
● Poor connection of ISC solenoid valve coupler.

NO → Defective ISC solenoid valve.

YES

Does ISC solenoid valve operate? (For checking procedure, refer to p. 6E-77.)

NO → Defective ISC solenoid valve.

YES

Are ECM couplers connected properly?

NO → Poor connection.

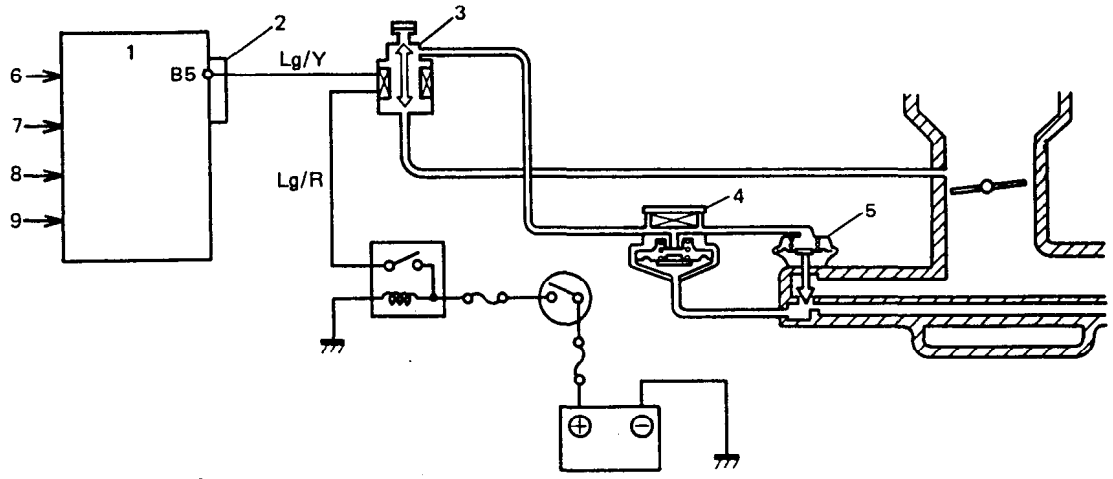
YES

Substitute a known-good ECM and recheck.

CAUTION:
Before substituting a known-good ECM for existing one, be sure to confirm that actuator circuits are all in good condition, referring to "CAUTION" on p. 6E-31.

Fig. 6E-82 Diagnostic Flow Chart B-5 For ISC Solenoid Valve Circuit

B-6 EGR SYSTEM CHECK



1. ECM
2. ECM coupler
3. VSV
4. EGR modulator
5. EGR valve
6. Pressure sensor signal
7. Water temperature sensor signal
8. Throttle position sensor signal
9. 5th switch signal

Fig. 6E-83 EGR System

Check EGR system referring to p. 6E-88.
Is it in good condition?

YES → EGR system in good condition.

NO

Check vacuum hose, EGR valve and EGR modulator referring to p. 6E-88.
Are they in good condition?

NO →
- Vacuum hose misconnection, leakage clog or deterioration.
- Defective EGR valve.
- Defective EGR modulator.

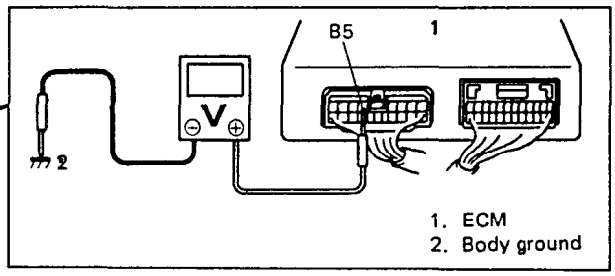
YES

Check VSV and its circuit referring to p. 6E-90.
Are they in good condition?

NO →
- Lightgreen/Red wire open.
- Defective VSV.
- Lightgreen/Yellow wire shorted to ground.
- Lightgreen/Yellow wire open.

YES

With coupler connected to ECM, is battery voltage applied to ECM coupler terminal B5 at ignition switch ON?



1. ECM
2. Body ground

YES → To be continued

NO → To be continued

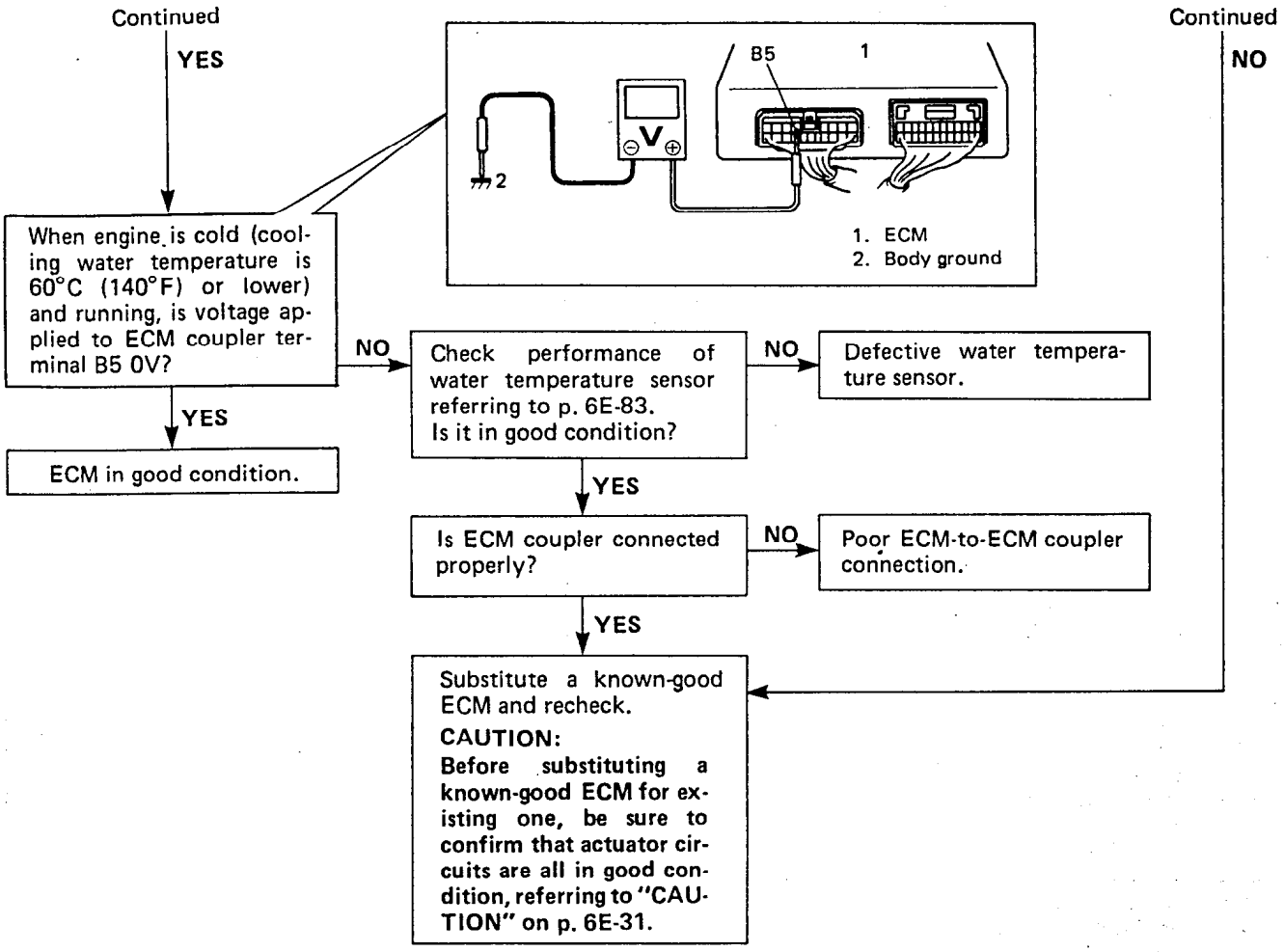


Fig. 6E-84 Diagnostic Flow Chart B-6 For EGR System

ECM AND ITS CIRCUIT CHECK

ECM and its circuits can be checked by measuring voltage at ECM coupler terminals.

CAUTION:
ECM cannot be checked by itself. It is strictly prohibited to connect voltmeter or ohmmeter to ECM with couplers disconnected from it.

1. Remove ECM from body.
2. Connect ECM couplers to ECM.
3. Check voltage at each terminal of couplers connected.

NOTE:
As each terminal voltage is affected by the battery voltage, confirm that it is 11V or more when ignition switch is ON.

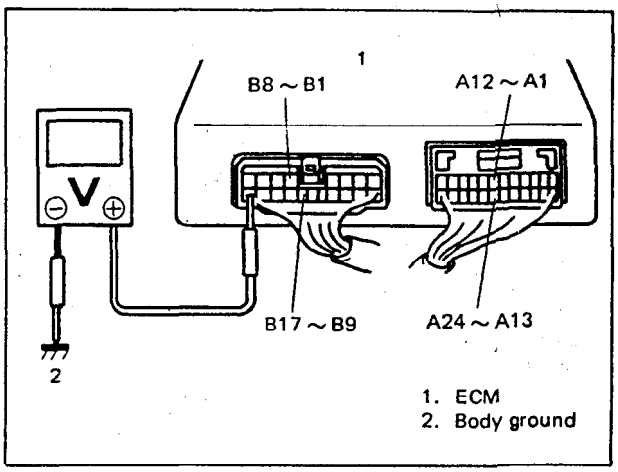


Fig. 6E-85 Checking Voltage

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A1	Ignition coil ⊖ (Ignition signal)	10 – 14V	Ignition switch ON
A2	Air-conditioner circuit (if equipped)	10 – 14V	Ignition switch ON
		0 – 1V	Ignition switch ON Air-conditioner switch ON
A3	Electric load switch	0V	Ignition switch ON Headlight, small light, heater fan and rear window defogger all turned OFF
		10 – 14V	Ignition switch ON Headlight, small light, heater fan or rear window defogger turned ON
A4	Blank	——	——
A5	5th switch	10 – 14V	Ignition switch ON Gear shift lever at any other position than 5th gear position
		0V	Ignition switch ON Gear shift lever at 5th gear position
A6	Blank	——	——
A7, A8	Blank	——	——
A9	Duty check terminal	——	——
A10	Blank	——	——

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A11	Blank	———	———
A12	Blank	———	———
A13	Power steering pump pressure switch (if equipped)	10 – 14V	Ignition switch ON
		0V	With engine running at idling speed, turning steering wheel to the right and left as far as it stops, repeating it a few times.
A14	Idle switch of throttle position sensor	0 – 1V	Ignition switch ON Throttle valve is at idle position (with throttle opener rod drawn in by vacuum pump gauge)
		10 – 14V	Ignition switch ON Throttle valve opens larger than idle position
A15	Diagnosis terminal	10 – 14V	Ignition switch ON
		0V	Ignition switch ON Diagnosis terminal grounded (with spare fuse connected to diagnostic terminals)
A16	Blank	———	———
A17	Air temperature sensor	2.2 – 3.0V	Ignition switch ON Sensor ambinet temperature: 20° C (68° F)
A18	Water temperature sensor	0.5 – 0.9V	Ignition switch ON Cooling water temperature: 80° C (176° F)
A19	Oxygen sensor	Refer to Diagnostic Flow Chart for Code No. 13	
A20	Blank	———	———
A21	Throttle position sensor	0.5 – 1.2V	Ignition switch ON Throttle valve at idle position (with throttle opener rod drawn in by vacuum pump gauge)
		3.4 – 4.7V	Ignition switch ON Throttle valve at full open position
A22	Pressure sensor	Refer to p. 6E-79	
A23	Power source of sensors	4.75–5.25V	Ignition switch ON
A24	Ground of sensors	———	———
B1	Power source	10 – 14V	Ignition switch ON
B2	Ground	———	———
B3	Ground	———	———
B4	Blank	———	———
B5	EGR VSV	10 – 14V	Ignition switch ON

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
B6	ISC solenoid valve ⊖	———	———
B7	Power source	10 – 14V	Ignition switch ON
B8	Injector ⊕	———	———
B9	Power source for back-up circuit	10 – 14V	Ignition switch OFF and ON
B10	Ground	———	———
B11	Engine start switch (Engine start signal)	6 – 10V	While engine cranking
		0V	Other than above
B12	Blank	———	———
B13	"CHECK ENGINE" light	0 – 1V	Ignition switch ON
		10 – 14V	When engine running
B14	Throttle opener VSV	10 – 14V	Ignition switch ON
B15	ISC solenoid valve ⊕	———	———
B16	Fuel pump relay in control relay	10 – 14V	Ignition switch ON (3 seconds after ignition switch ON when cooling water temp. is lower than −10°C or 14°F)
B17	Injector ⊖	———	———

ON VEHICLE SERVICE

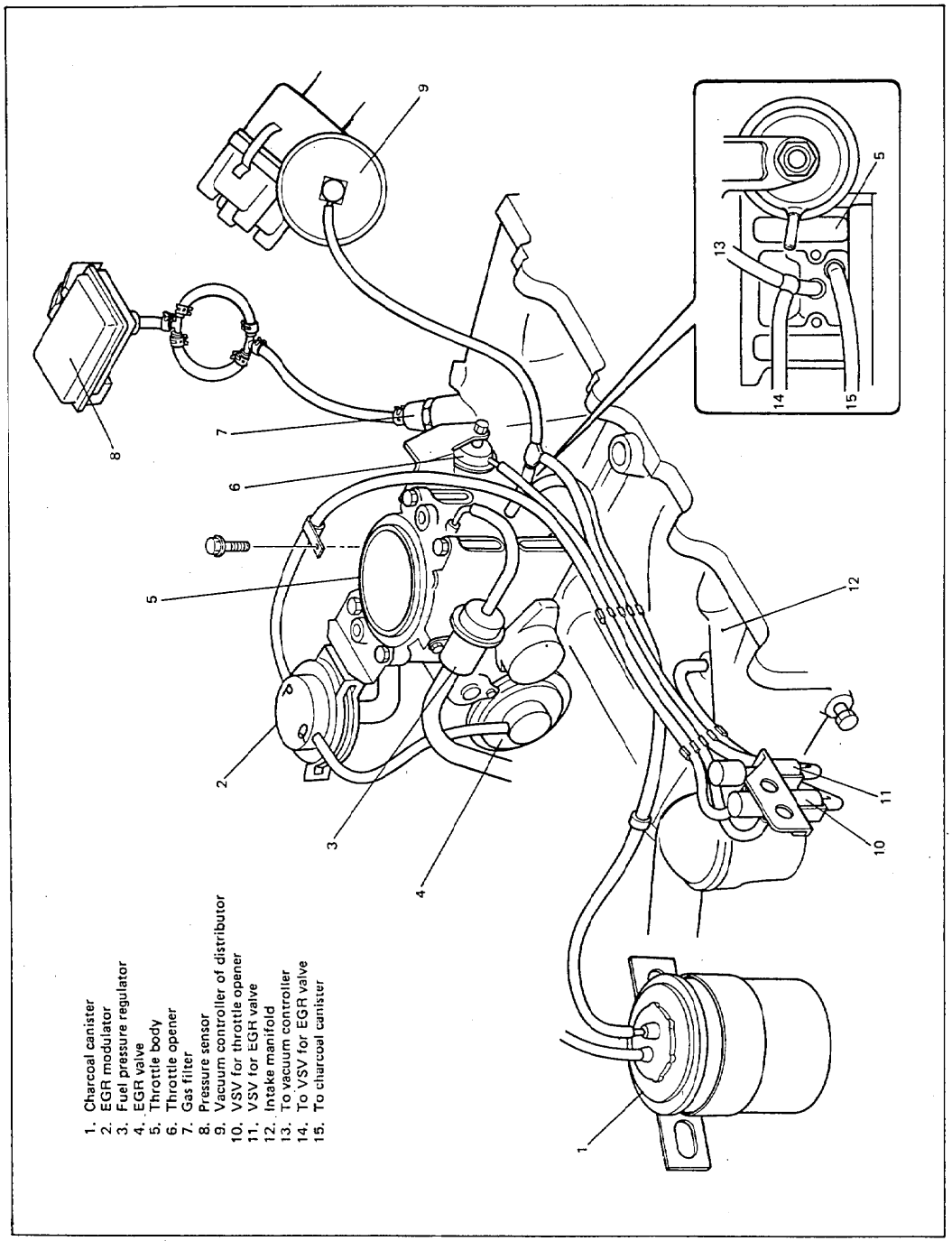


Fig. 6E-86 Vacuum Hose Routing

GENERAL

When hoses are disconnected and system's component is removed for service, reinstall component properly, and route and connect hoses correctly after service. Refer to Fig. 6E-86.

ACCELERATOR CABLE ADJUSTMENT

Check accelerator cable for play and adjust if necessary. Cable play should be within specification when accelerator pedal is released and engine is not running.

If not within specification, adjust by loosening lock nut. Be sure to tighten lock nut securely after adjustment.

Accelerator cable play	10 – 15 mm (0.4 – 0.6 in.)

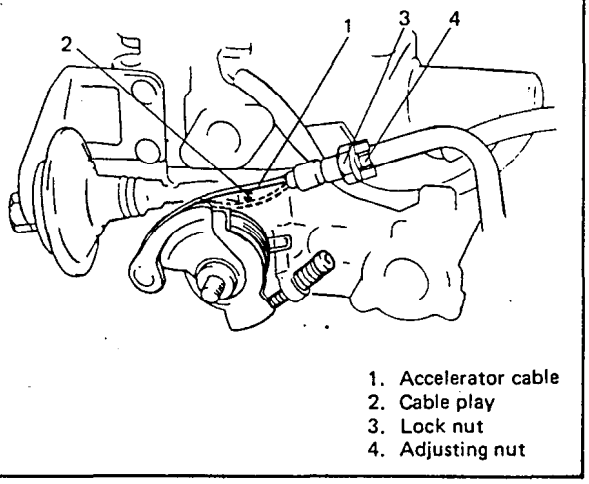


Fig. 6E-87 Accelerator Cable Play

Cable play should be 3 – 5 mm (0.12 – 0.20 in.) when throttle opener rod is pushed back by hand (i.e., throttle valve is at idle position).

IDLE SPEED ADJUSTMENT

Before idle speed check and adjustment, make sure of the following.

- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked and adjusted according to maintenance schedule.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, etc.) are out of service.
- Air cleaner has been properly installed and is in good condition.

After above items are all confirmed, adjust idle speed as follows.

NOTE:

- **Before starting engine, place transmission gear shift lever in "Neutral", and set parking brake and block drive wheels.**
- **In areas above 8,200 ft (2,500 m) elevation (barometric pressure is lower than 550 mmHg), ISC solenoid valve will be normally in operation. Do not attempt to adjust the idle speed.**

1. Warm up engine to normal operating temperature.
2. Race engine till engine speed exceeds 1,500 r/min. once and let it slow down to idle speed.
3. Check to ensure that idle speed is within below specification.

Engine idle speed	800 ± 50 r/min

4. If idle speed is not within specified range, adjust it by turning adjusting screw.

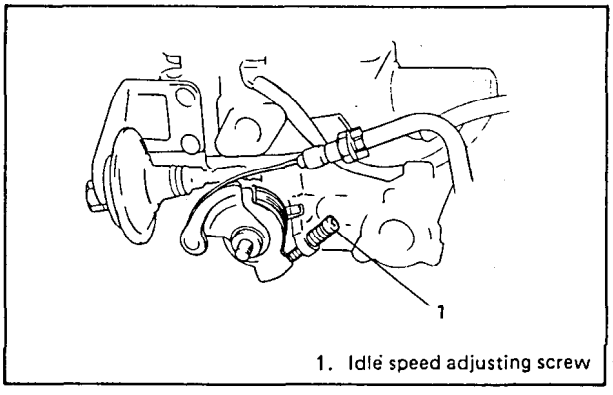


Fig. 6E-88 Idle Speed Adjustment

THROTTLE OPENER ADJUSTMENT

NOTE:
Before starting engine, place transmission gear shift lever in "Neutral", and set parking brake and block drive wheels.

1. Start engine and warm it up to normal operating temperature.
2. Check to make sure that no electric load is applied to engine.
3. Disconnect vacuum hose from throttle opener and put blind plug in disconnected vacuum hose.
   Check that engine speed is within specification then.

Engine speed while opener operating	1700 – 1800 r/min

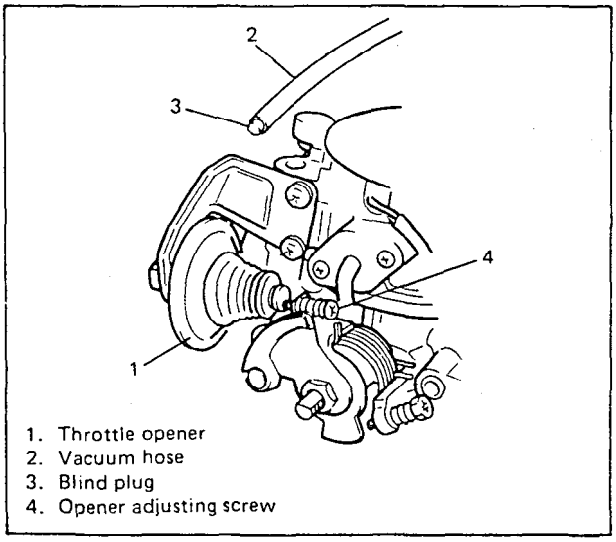


Fig. 6E-89 Checking and Adjusting Engine Speed for Opener

4. If engine speed is found out of specification in above check, adjust it to specification by turning throttle opener adjusting screw.
5. Upon completion of adjustment, connect vacuum hose to opener securely.

FUEL DELIVERY SYSTEM

FUEL PRESSURE INSPECTION

1. Remove fuel filler cap to release fuel vapor pressure in fuel tank and then reinstall it.
2. Release fuel pressure in fuel feed line referring to p. 6-2.
3. Remove plug bolt on fuel filter union bolt and connect special tool (fuel pressure gauge set) to fuel filter inlet union bolt.

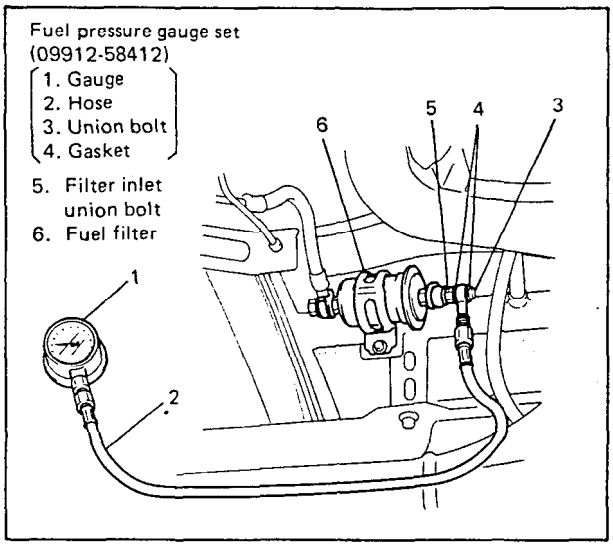


Fig. 6E-90 Connecting Fuel Pressure Gauge

4. Start engine and warm it up to normal operating temperature.

NOTE:
If engine doesn't start, operate fuel pump according to "Fuel Pump on Vehicle Inspection" described in p. 6E-70 and check fuel pressure.

5. Measure fuel pressure under each of the following conditions.

CONDITION	FUEL PRESSURE
At specified idle speed or with fuel pump operating and engine stopped	2.4 – 2.8 kg/cm² 240 – 280 kPa 34.1 – 39.8 psi
Within 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	over 1.5 kg/cm² 150 kPa 21.3 psi

If measured pressure doesn't satisfy specification, refer to "Diagnostic Flow Chart B-3" and check each possibly defective part. Replace if found defective.

6. After checking fuel pressure, remove fuel pressure gauge.

CAUTION:
As fuel feed line is still under high fuel pressure, make sure to release fuel pressure according to following procedures.
- **Place fuel container under fuel filter.**
- **Cover union bolt of gauge with rag and loosen union bolt slowly to release fuel pressure gradually.**

7. Install plug bolt to fuel filter inlet union bolt. Use new gasket.
   Tighten it to specified torque. Then check to make sure that no leakage exsists. Refer to p. 6-3 for leakage check.

FUEL PUMP

Fuel Pump on Vehicle Inspection

1. Make sure that ignition switch is at "OFF" position.
2. Using wire harness as thick as the one used for fuel pump circuit, connect Black/White (F) and Pink/Black (G) terminals.

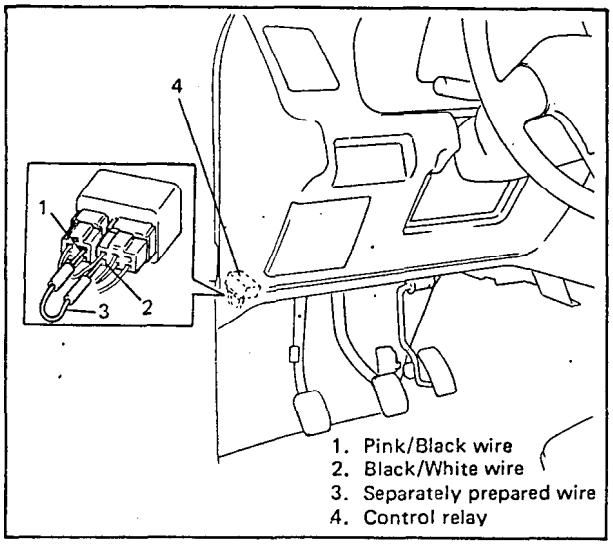


Fig. 6E-91 Connecting Fuel pump Circuit Terminals

3. Turn ignition switch to "ON" position. (Don't start engine).
4. Remove fuel filler cap and bring ear close to fuel filler so that it can be heard better.
   Check for fuel pump operation by sound.
   If operating sound can't be heard, possibility is defective wire harness or fuel pump.

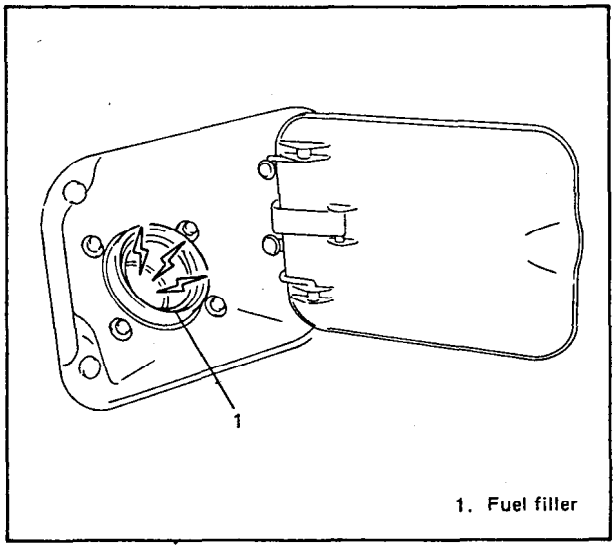


Fig. 6E-92 Checking Fuel Pump Operation Sound

Removal

Remove fuel tank according to procedure described in p. 6C-5 and remove fuel pump from fuel tank.

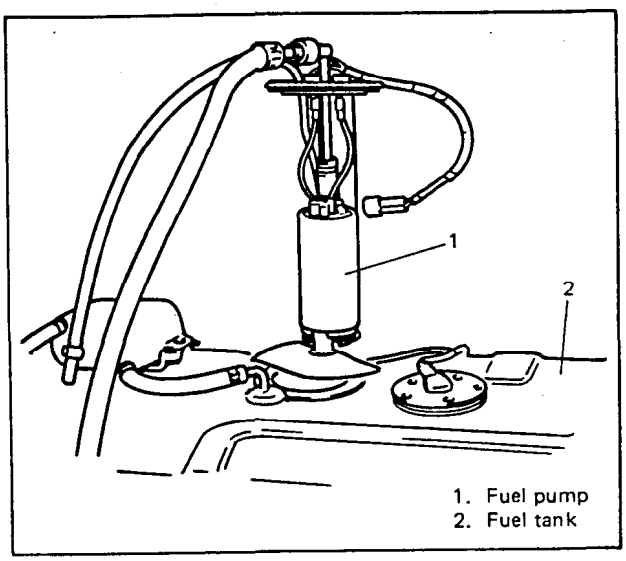


Fig. 6E-93 Removing Fuel Pump

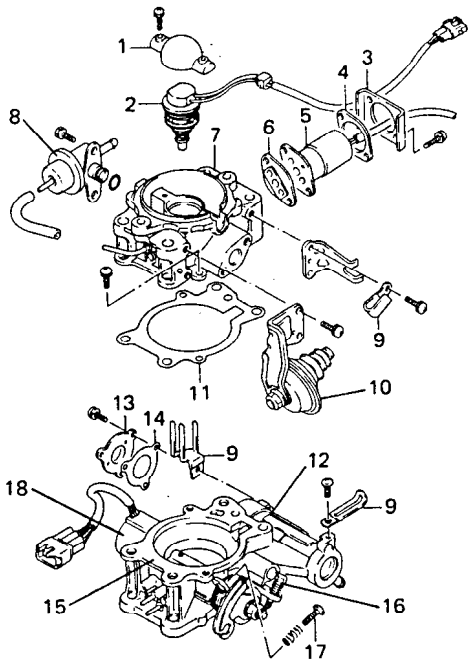
Inspection

Check fuel pump filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel tank.

Installation

Install fuel pump and install fuel tank to vehicle according to procedure described in p. 6C-6.

THROTTLE BODY



1. Injecter cover
2. Injecter
3. Plate
4. Rubber
5. ISC solenoid valve
6. Gasket
7. Upper body
8. Fuel pressure regulator
9. Clamp
10. Throttle opener
11. Gasket
12. Air valve
13. Air valve cap
14. Gasket
15. Lower body
16. Idle speed adjusting screw
17. Throttle opener adjusting screw
18. TPS

Fig. 6E-94 Throttle Body Parts Identification

On Vehicle Inspection

- Check that the throttle valve lever moves smoothly.
- Vacuum passage inspection
  With fingers placed against vacuum nozzles (2 pcs), increase engine speed a little and check that vacuum is applied.

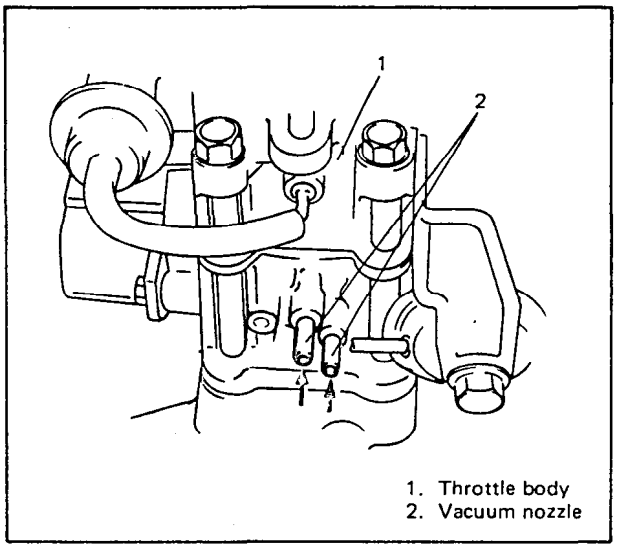


Fig. 6E-95 Checking Vacuum Passage

- Air valve inspection

This is an easy on-vehicle check. For further complete check, remove throttle body and use checking procedure described on p. 6E-72.

1. Remove air valve cap with engine stopped when engine is cold (engine cooling water temperature is 60°C, 140°F or lower) and check visually that air valve is open.
2. Reinstall air valve cap and warm up engine to its normal operating temperature (engine cooling water temperature is 70°C, 158°F or higher).
   Then remove air valve cap again with engine stopped and check visually that air valve is closed.

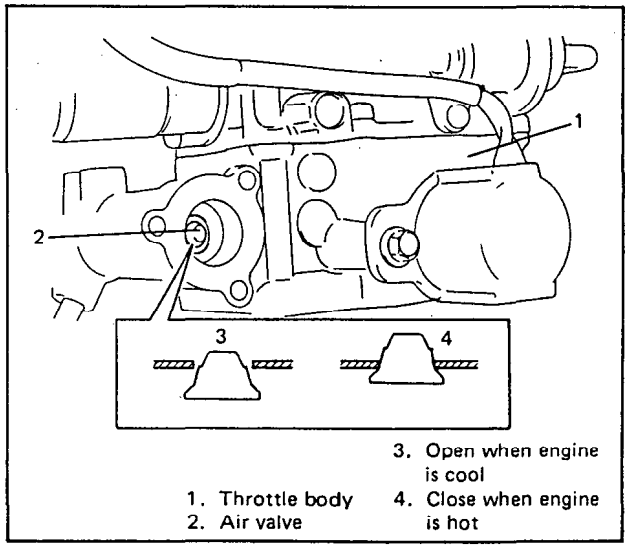


Fig. 6E-96 Inspecting Air Valve

3. Upon completion of checking, be sure to use new gasket when reinstalling air valve cap.

Removal

For removal of throttle body, refer to p. 6A-6.

Inspection

1. Remove air valve cap.
2. Immerse air valve of throttle body in water as shown below. Check visually that air valve closes gradually as water temperature rises and closes fully at higher than about 70°C, 158°F.

NOTE:

- **Be very careful to prevent water from entering throttle body bore.**
- **Be very careful never to put throttle body parts except air valve thermo wax in water or expose them to water splash.**

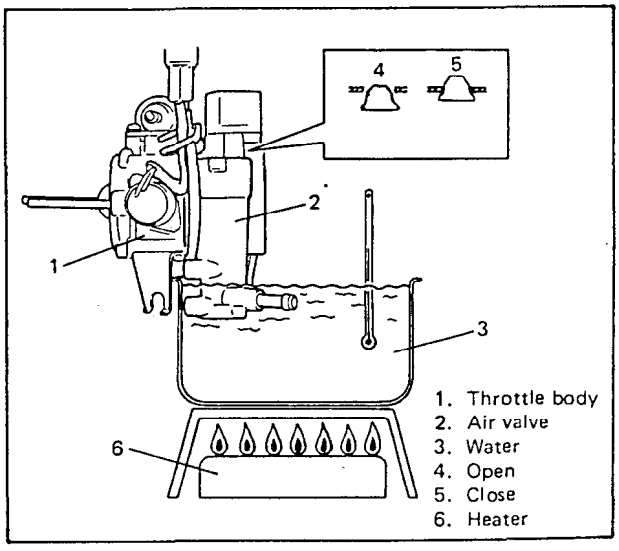


Fig. 6E-97 Inspecting Air Valve

Disassembly

NOTE:

- **Be sure to replace gaskets as well as worn or damaged parts.**
- **While disassembling and assembling throttle body, use special care not to deform levers on throttle valve shaft or cause damage to any other parts.**

1. Remove injector from throttle body according to procedure described in p. 6E-75.
2. Remove throttle position sensor.
3. Remove fuel pressure regulator and ISC solenoid valve from throttle body.
4. After removing screws, separate upper and lower bodies.

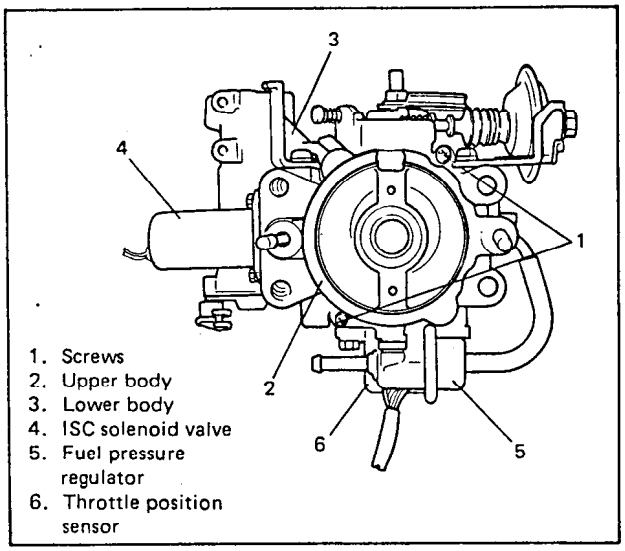


Fig. 6E-98 Disassembling Throttle Body

Cleaning

Clean below passages and fuel injector chamber by blowing compressed air.

NOTE:

- **The throttle position sensor, ISC solenoid valve, fuel pressure regulator, fuel injector, air valve, throttle opener or other components containing rubber must not be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or get distorted.**
- **Don't put drills or wires into passages for cleaning. It causes damages in passages.**

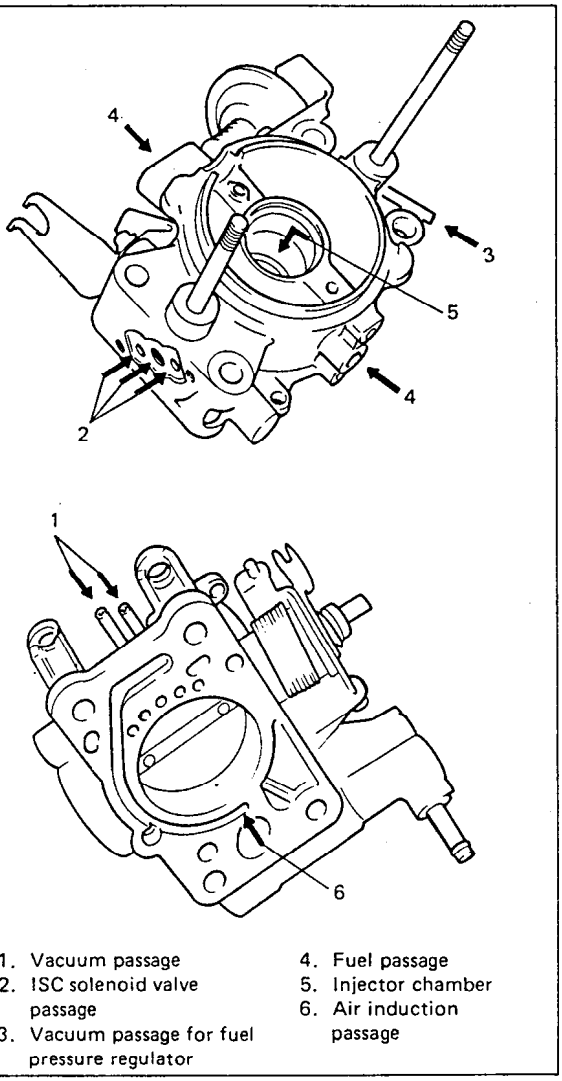


Fig. 6E-99 Cleaning Passage

Assembly

1. Install new gasket to lower body.

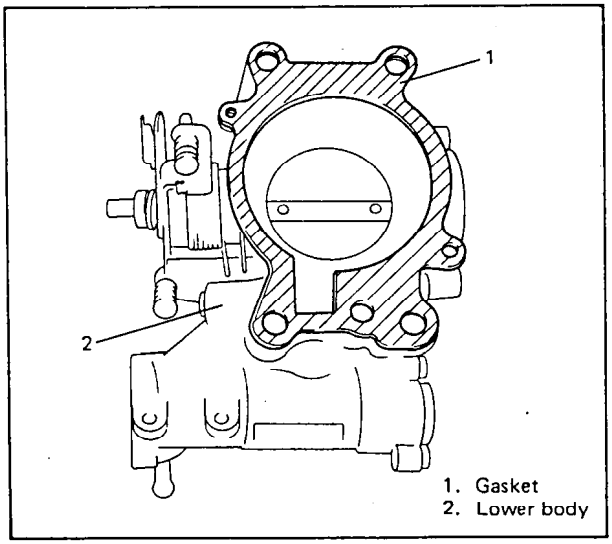


Fig. 6E-100 Installing Gasket

2. Install upper body on gasket, using care not to cause gasket to slip out of place.
3. Tighten screws indicated by "1" in Fig. 6E-98 to specified torque.

Tightening torque of screw	N·m	kg-m	lb-ft
	3.5	0.35	2.5

4. Install fuel pressure regulator according to procedure described in p. 6E-76.
5. Install ISC solenoid valve according to procedure described on p. 6E-78.
6. Install fuel injector according to procedure described on p. 6E-75.
7. Install throttle position sensor according to procedure described on p. 6E-82.
8. Clamp wire harness securely.

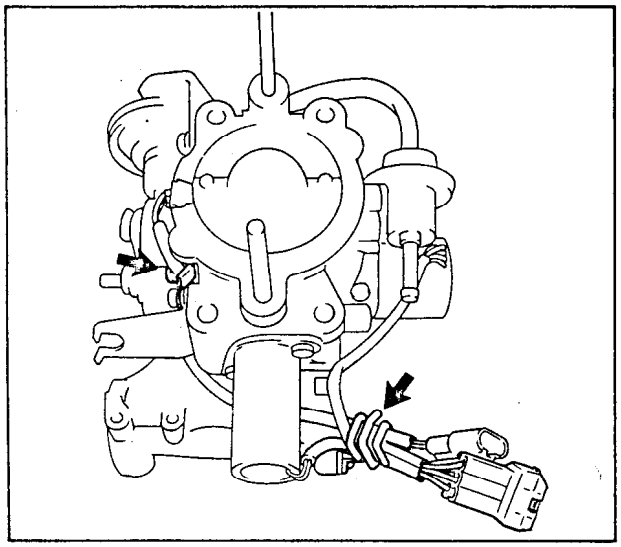


Fig. 6E-101 Clamping Wire Harness

Installation

For installation of throttle body, refer to p. 6A-8.

FUEL INJECTOR

On Vehicle Inspection

1. With battery negative cable disconnected, disconnect injector coupler.
2. Connect ohmmeter to each injector terminal and measure resistance.

Resistance of injector	1.0 – 2.0 Ω at 20°C (68°F)

If resistance is out of specification, replace fuel injector.

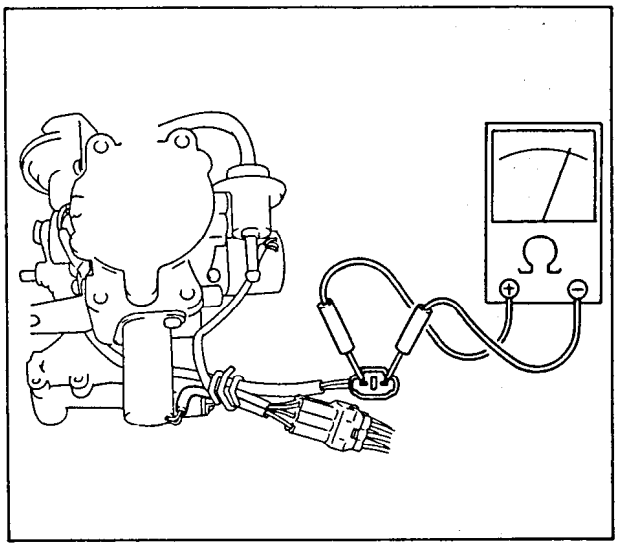


Fig. 6E-102 Checking Resistance of Fuel Injector

3. Connect injector coupler.
4. Remove air intake case referring to p. 6A-5.
5. Connect battery negative cable.
6. Referring to "Fuel Pressure Inspection" on p. 6E-69, check that fuel pressure is as specified.
7. Check that fuel is injected out in conical shape from fuel injector when cranking engine.

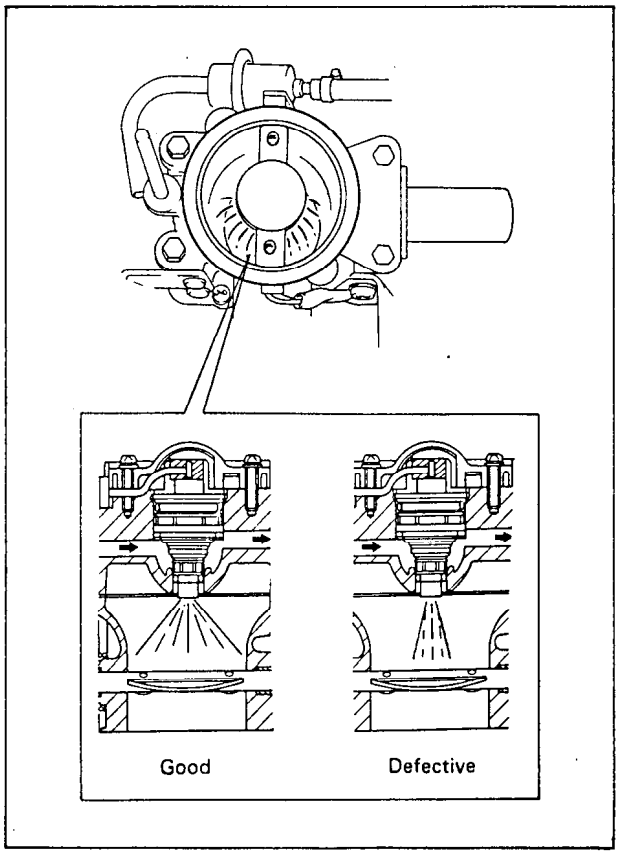


Fig. 6E-103 Checking Fuel Injection

If no fuel is injected, check wiring harness for continuity and couplers for proper connection referring to "Diagnostic Flow Chart B-1". If fuel is not injected out in conical shape, replace injector.

8. Check injector for fuel leakage after injection is stopped (i.e., after cranking or engine stop). Replace if leakage exists.

Fuel leakage	Less than 1 drop/min.

9. Install air intake case.

Removal

1. Disconnect battery negative cable at battery.
2. Release fuel pressure in fuel feed line referring to p. 6-2.
3. Remove air intake case.
4. Remove fuel feed pipe clamp from intake manifold and disconnect fuel feed pipe from throttle body.
5. Remove injector cover.
6. Disconnect injector coupler, release its wire harness from clamp and remove its grommet from throttle body.
7. Place some cloth over injector and hand on top of it. Using air gun, blow about 5 kg/cm² (500 kPa, 71.1 psi) or less compressed air into fuel inlet port of throttle body, and injector can be removed.

WARNING:
Be precise about pressure of compressed air. Blowing air under excessively high pressure may force injector jump out and cause damage not only to injector itself but also to other parts.

NOTE:
Use care when handling fuel injector especially not to damage injector-to-wire harness connection and its needle.
Also, because injector is an electrical component, it should not be immersed in any type of liquid solvent or cleaner, as damage may ocuur.

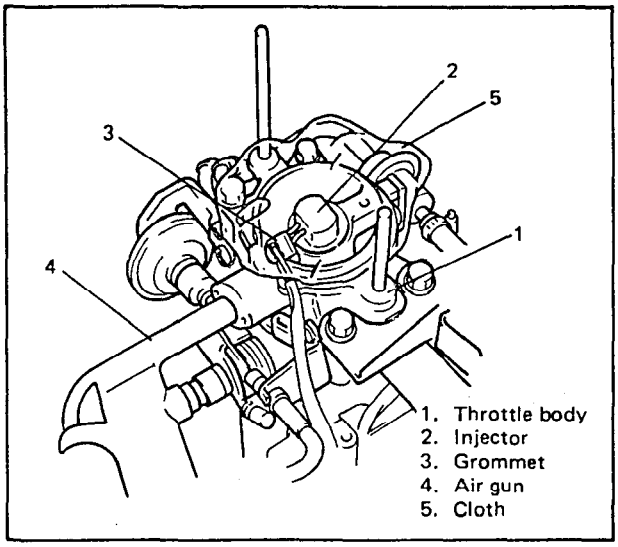


Fig. 6E-104 Removing Injector

Inspection

Check fuel injector filter for evidence of dirt and contamination. If present, clean and check for presence of dirt in fuel lines and fuel tank.

Installation

1. Make sure that injector O rings is free from any damage and deterioration.
2. Apply thin coat of spindle oil or gasoline to O rings and then install injector to throttle body.
   Make sure to fit injector wire harness into groove in throttle body securely.

NOTE:
Do not apply force to wire harness-to-injector connection.

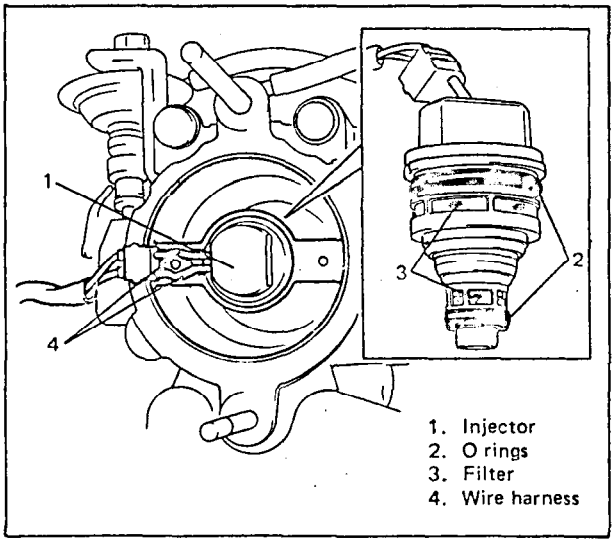


Fig. 6E-105 Installing Injector

3. Install injector cover.
   Apply thread locking cement (Thread lock 1322, 99000-32110) to the threads of cover screws and tighten screws to specified torque.

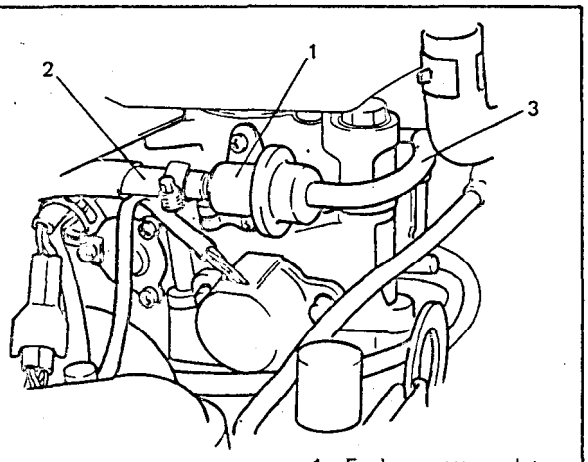
Tightening torque for injector cover screw	N·m	kg-m	lb-ft
	2	0.2	1.4

4. Connect fuel feed pipe to throttle body after applying thin coat of engine oil to O ring.
5. Referring to p. 6E-70, apply fuel pressure to fuel feed line and check that no fuel leaks from where fuel feed pipe is connected and where injector is installed.
6. Install air intake case.
7. Connect injector coupler and battery negative cable.

FUEL PRESSURE REGULATOR

Removal

1. Disconnect battery negative cable from battery.
2. Release fuel pressure in the fuel feed line referring to p. 6-2.
3. Disconnect fuel return hose and vacuum hose from fuel pressure regualtor.
4. Remove fuel pressure regulator from throttle body.



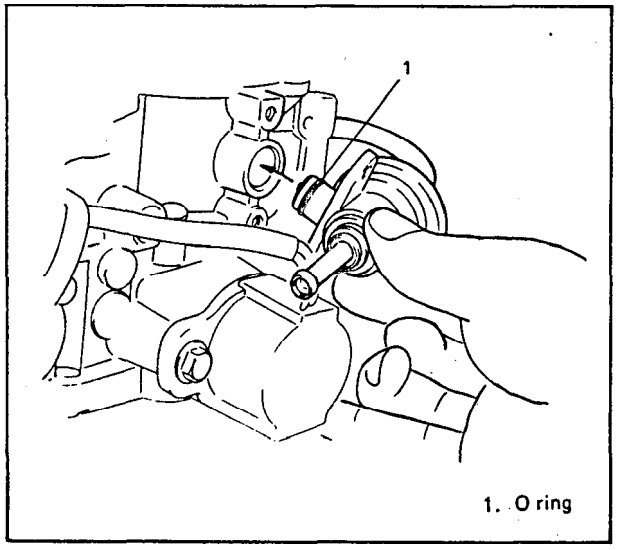
1. Fuel pressure regulator
2. Fuel return hose
3. Vacuum hose

Fig. 6E-106 Fuel Pressure Regulator Removal

Installation

For installation, reverse removal procedure and note following precautions.

- Use new O ring.
- Apply thin coat of spindle oil or gasoline to O ring to facilitate installation.



1. O ring

Fig. 6E-107 Installing Fuel Pressure Regulator

- Tighten fuel pressure regualtor screws securely to following specified torque.

Tightening torque for fuel pressure regulator screw	N·m	kg-m	lb-ft
	3.5	0.35	2.5

- Upon completion of installation, check that no fuel leakage exists with applying fuel pressure to fuel feed line.

ISC SOLENOID VALVE

On Vehicle Inspection

1. With ignition switch "OFF", disconnect ISC solenoid valve coupler.
2. Connect ohmmeter to each ISC solenoid valve terminal and measure resistance.

Resistance of ISC solenoid valve	5.4 – 6.6 Ω at 20°C (68°F)

If resistance is out of specification, replace.

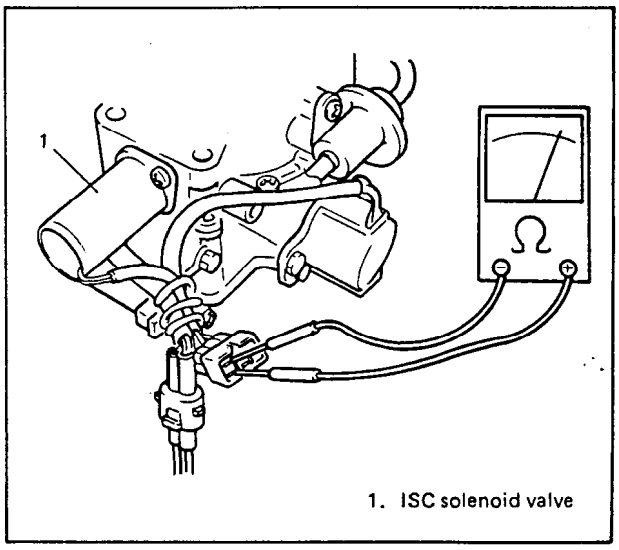


Fig. 6E-108 Checking Resistance of ISC Solenoid Valve

3. Connect ISC solenoid coupler securely.

Removal

1. Disconnect battery negative cable at battery.
2. Disconnect ISC solenoid valve coupler.
3. Pull out ISC solenoid valve wire harness terminals from coupler after unlocking terminal lock of coupler.

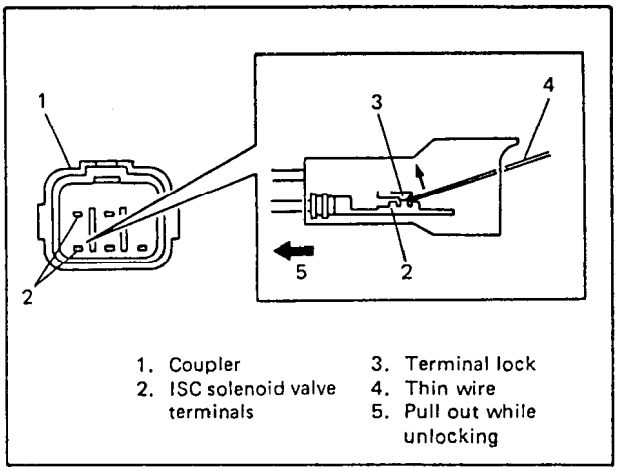


Fig. 6E-109 Removing Terminals

4. Remove ISC solenoid valve from throttle body.

NOTE:
ISC solenoid valve is an electrical component and must not be soaked in any liquid cleaner or solvent. Otherwise damage could result.

Inspection

CAUTION:
In this inspection, battery voltage is applied to ISC solenoid valve. But its application should be limited as follows. Continuous voltage application should not exceed 1 second and should be followed by 10 seconds without voltage application.
When repeated check is necessary, perform it at such interval as to apply voltage for one second and then wait for 10 seconds without applying it.
Neglecting this will damage ISC solenoid valve.

Connect battery to ISC solenoid valve termianls momentarily (within 1 second) and disconnect it immediately. While doing so, check valve for operation. When another check is necessary, wait for longer than 10 seconds before rechecking.

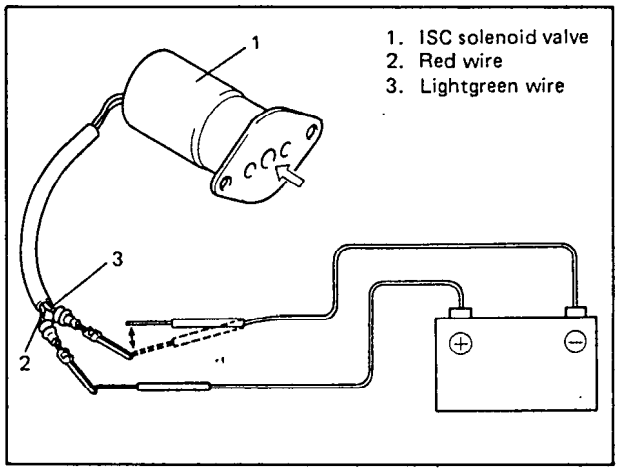
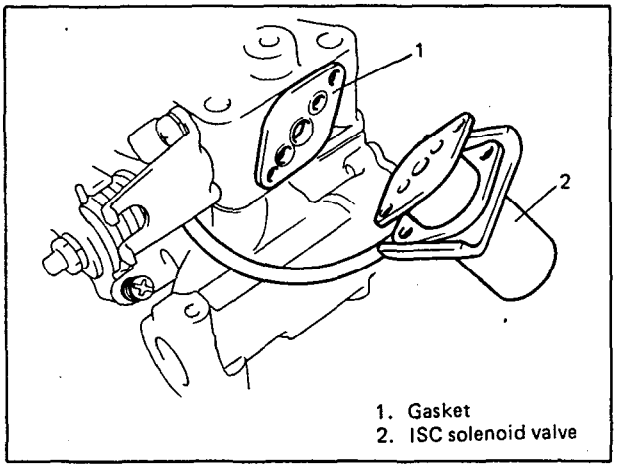


Fig. 6E-110 Checking ISC Solenoid Valve Operation

Installation

For installation, reverse removal procedure and note following precautions.

- Check gasket for deterioration and damage. Replace it if any defective.



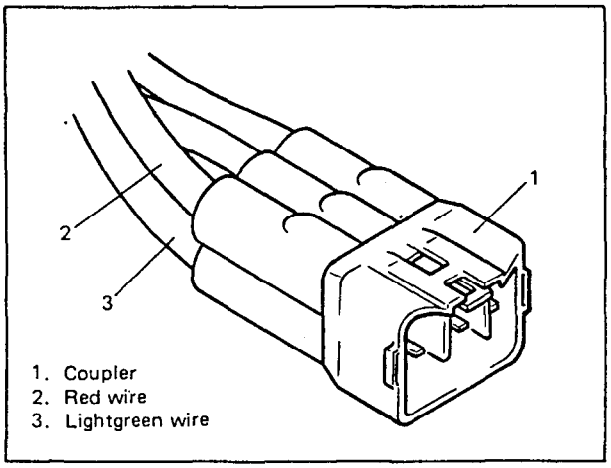
1. Gasket
2. ISC solenoid valve

Fig. 6E-111 Installing Gasket

- Tighten ISC solenoid valve screws to specified torque.

Tightening torque for ISC solenoid valve screws	N·m	kg-m	lb-ft
	3.5	0.35	2.5

- After installing ISC solenoid valve terminals into coupler, check to make sure that they are locked securely.



1. Coupler
2. Red wire
3. Lightgreen wire

Fig. 6E-112 Connecting ISC Solenoid Valve Wires

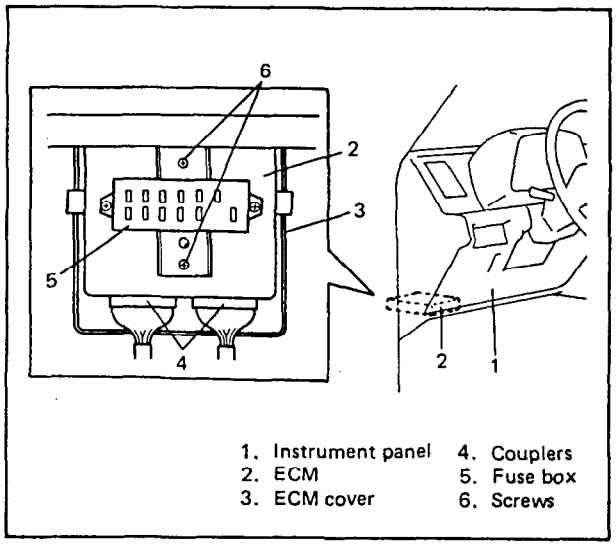
ELECTRONIC CONTROL SYSTEM

ELECTRONIC CONTROL MODULE (ECM)

CAUTION:
As ECM consists of precision parts, be careful not to expose it to excessive shock.

Removal

1. Disconnect battery negative cable from battery.
2. Disconnect couplers from ECM while releasing coupler lock.
3. Removing ECM with cover loosening two screws.



1. Instrument panel
2. ECM
3. ECM cover
4. Couplers
5. Fuse box
6. Screws

Fig. 6E-113 Removing ECM

Installation

1. Install ECM with cover.
2. Connect couplers to ECM securely.
3. Connect battery negative cable to battery.

PRESSURE SENSOR (PS)

Output Voltage Check

1. Remove ECM according to previously outline.
2. Connect couplers to ECM securely.
3. With coupler connected to ECM, connect digital type voltmeter as shown below and check that ECM supply voltage 4.75 – 5.25V is applied to coupler terminal A23.
4. Check output voltage at coupler terminal A22. Note that it varies with atmospheric pressure and altitude.
   Also, start engine, if it can, and check if output voltage varies.

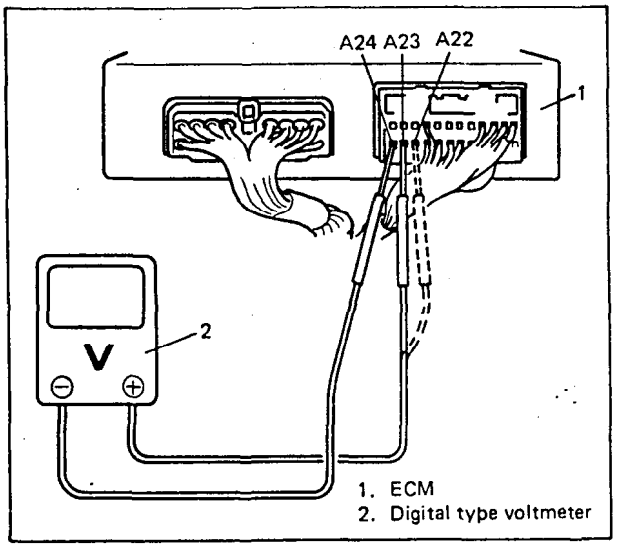


Fig. 6E-114 Checking Pressure Sensor

Output voltage (ECM supply voltage 4.75–5.25V)

ALTITUDE (ft)	ALTITUDE (m)	BAROMETRIC PRESSURE (mmHg)	OUTPUT VOLTAGE (V)
0	0	760	3.6 – 4.4
1 000	305	733	3.5 – 4.2
2 000	610	707	3.4 – 4.1
3 000	914	682	3.2 – 4.0
4 000	1 219	658	3.1 – 3.8
5 000	1 524	634	3.0 – 3.7
6 000	1 829	611	2.9 – 3.6
7 000	2 133	589	2.8 – 3.4
8 000	2 438	567	2.7 – 3.3
9 000	2 743	546	2.6 – 3.2
10 000	3 048	526	2.5 – 3.1

NOTE:

When the barometric pressure varies from above specified one while checking (When they don't coincide), output voltage of the pressure sensor, even when it is known good, may not fall within that corresponding range as given above.

If check result is not satisfactory in previous step 3 or 4, check pressure sensor and its circuit according to Code No. 31 Diagnostic Flow Chart.

NOTE:

If output voltage does not vary when engine is started, it is possible that vacuum hose and/or gas filter are clogged. Clean them.

Another possibility is that filter in pressure sensor is clogged from freezing. If it is suspected, leave it at room temperature (20°C, 68°F) for a while and recheck.

5. Upon completion of checking, install ECM and connect ECM coupler securely.

Pressure Sensor Individual Check

1. Disconnect pressure sensor vacuum hose from gas filter.
2. Disconnect pressure sensor coupler.
3. Remove pressure sensor.
4. Arrange 3 new 1.5V batteries in series and connect its positive terminal to "Vin" terminal of coupler and negative terminal to "Ground" terminal. Then check voltage between "Vout" and "Ground".
   Also, check if voltage reduces when vacuum is applied up to 40 cmHg by using vacuum pump.

CAUTION:

As connection to wrong terminal will cause damage to pressure sensor, make absolutely sure to connect properly as shown below.

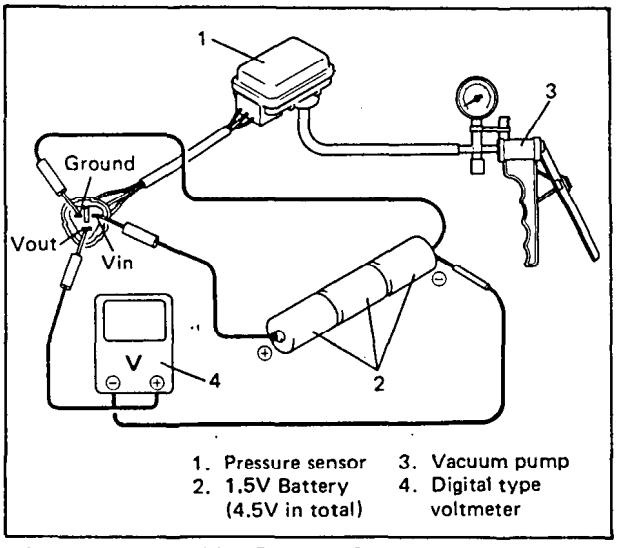


Fig. 6E-115 Checking Pressure Sensor

Output voltage (Vin voltage 4.5V)

ALTITUDE (ft)	ALTITUDE (m)	BAROMETRIC PRESSURE (mmHg)	OUTPUT VOLTAGE (V)
0	0	760	3.4 – 3.8
1 000	305	733	3.3 – 3.7
2 000	610	707	3.1 – 3.6
3 000	914	682	3.0 – 3.5
4 000	1 219	658	2.9 – 3.3
5 000	1 524	634	2.8 – 3.2
6 000	1 829	611	2.7 – 3.1
7 000	2 133	589	2.6 – 3.0
8 000	2 438	567	2.5 – 2.9
9 000	2 743	546	2.4 – 2.8
10 000	3 048	526	2.3 – 2.7

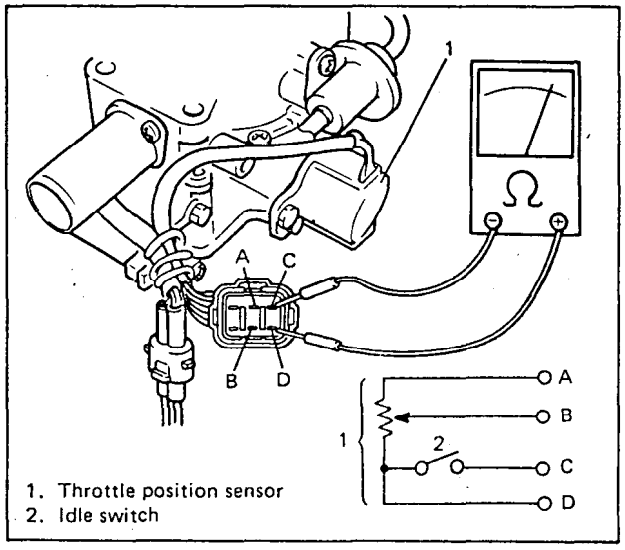
If check result is not satisfactory, replace pressure sensor.

5. Install pressure sensor and connect vacuum hose securely.
6. Connect pressure sensor coupler securely.

THROTTLE POSITION SENSOR (TPS)

Inspection

1. Disconnect negative cable at battery and throttle position sensor wires at the coupler.
2. Using ohmmeter, check the resistance between each two terminals.



1. Throttle position sensor
2. Idle switch

Fig. 6E-116 Checking Throttle Position Sensor

Resistance between C and D terminals (Idle switch)	When throttle valve is at idle position	0 – 500 Ω
	When throttle valve is fully open	∞ (Infinity)
Resistance between A and D terminals	———	3.5 – 6.5 kΩ
Reistance between B and D terminals	When throttle valve is at idle position	0 – 2 kΩ
	When throttle valve is fully open	2 – 6.5 kΩ

NOTE:

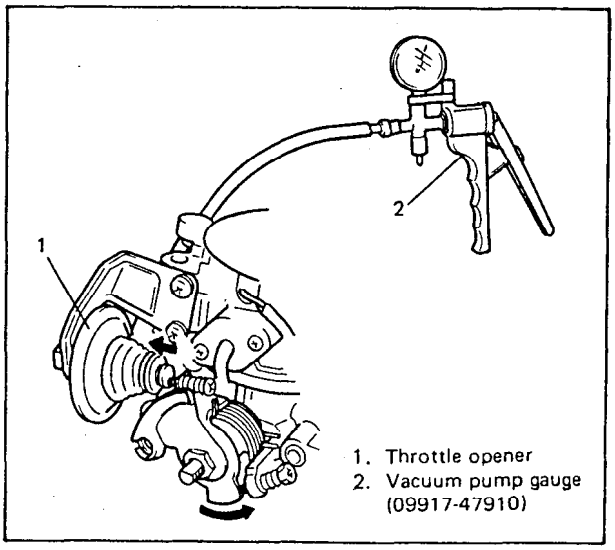
- **To move throttle valve to idle position, apply –50 cmHg vacuum to throttle opener.**
- **There should be more than 2 kΩ resistance difference between when throttle valve is at idle position and when it is fully open.**

If idle switch check result is not satisfactory, adjust installation angle of throttle position sensor and then check again.
If found defective in above check, replace.

3. Connect throttle position sensor coupler securely and battery negative cable to battery.

Adjustment

1. Disconnect battery negative cable at battery and throttle position sensor coupler.
2. Disconnect throttle opener vacuum hose from VSV and connect vacuum pump gauge to hose disconnected.
   Apply –50 cmHg vacuum to throttle opener to move throttle valve to idle position.

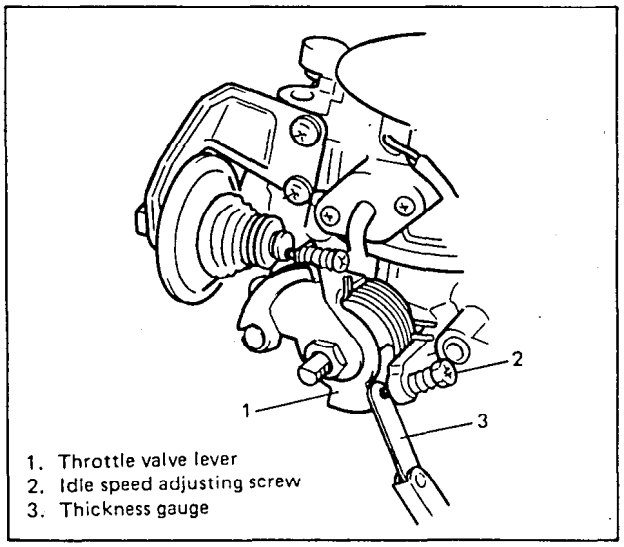


1. Throttle opener
2. Vacuum pump gauge (09917-47910)

Fig. 6E-117 Applying Vacuum to Throttle Opener

3. • To close throttle valve fully, loosen idle speed adjusting screw till there is clearance between throttle valve lever and idle speed adjusting screw, counting how many revolutions it is turned and note it down.
   • Next, tighten screw till it contacts lever, again counting how may revolutions it is turned, but be sure to avoid overtightening which will cause throttle valve to open.
   Subtract number of revolutions counted in tightening screw from that noted previously and note difference down.
   This difference represents number of revolutions by which idle speed adjusting screw was actually loosened from idle position. Use it as a guide when setting it back to idle position after adjustment.
4. In the above state, insert the below specified thickness guage between throttle valve lever and idle speed adjusting screw.

Clearance for adjusting installation angle of TPS	2.2 mm (0.086 in.)

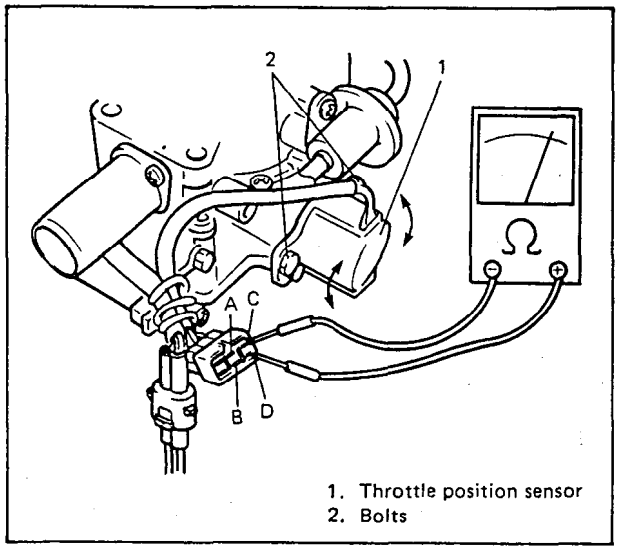


1. Throttle valve lever
2. Idle speed adjusting screw
3. Thickness gauge

Fig. 6E-118 Inserting Thickness Gauge

5. Loosen throttle position sensor mounting bolts.
6. Connect ohmmeter between C and D terminals of throttle position sensor coupler.
7. First, turn throttle position sensor clockwise fully and then counterclockwise gradually to find position where ohmmeter reading changes from ∞(infinity) to 0 (zero). Then fix throttle position sensor at that position by tightening bolts to specified torque.

Tightening torque of throttle position sensor bolt	N·m	kg-m	lb-ft
	3.5	0.35	2.5



1. Throttle position sensor
2. Bolts

Fig. 6E-119 Adjusting Installation Angle of Throttle Position Sensor

8. Connect throttle opener vacuum hose to VSV.
9. Connect throttle position sensor coupler securely.
10. Connect battery negative cable to battery.
11. Tighten idle speed adjusting screw by number of revolutions turned in loosening it in Step 3.
12. Adjust idle speed according to procedure described in item "IDLE SPEED ADJUSTMENT".
13. Recheck resistance between C and D terminals referring to previous item "Inspection".

Removal

1. Disconnect negative cable at battery.
2. Disconnect throttle position sensor coupler.
3. Pull out throttle position sensor wire harness terminals from coupler after unlocking terminal lock.

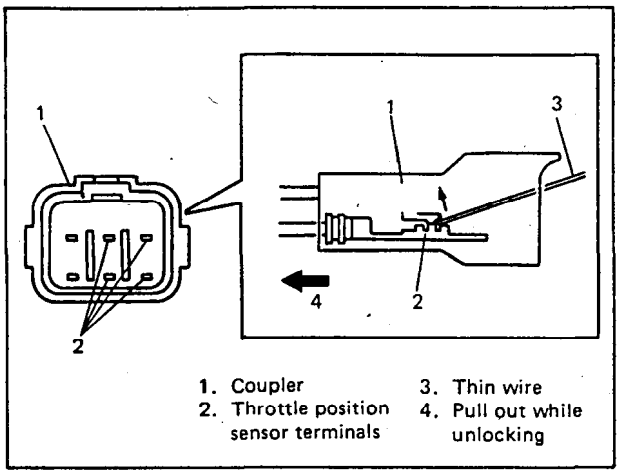


Fig. 6E-120 Removing Terminals

4. Remove throttle position sensor from throttle body.

Installation

1. Install throttle position sensor to throttle body.
   Fit sensor to throttle body in such way that its adjusting holes are a little away from sensor mounting bolt holes as shown in Fig. 6E-121 and turn sensor clockwise so that those holes align. Then hand-tighten sensor mounting bolts in aligned holes.

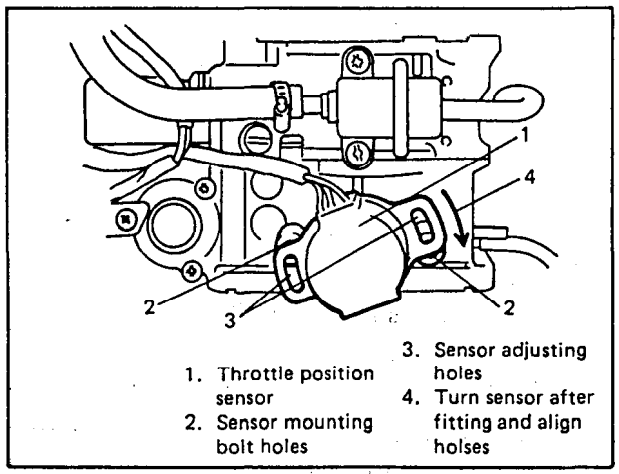


Fig. 6E-121 Installing Throttle Position Sensor

2. Insert throttle position sensor terminals into coupler and check to make sure that they are locked.

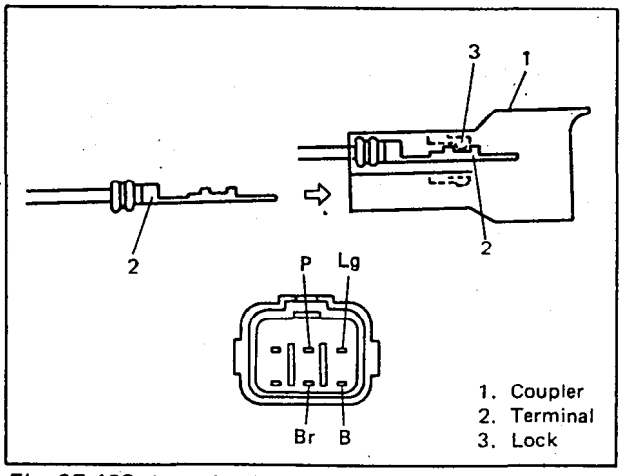


Fig. 6E-122 Inserting Terminals

3. Adjust installation angle of throttle position sensor according to procedure described in item "Adjustment".
4. Connect battery negative cable to battery.

AIR TEMPERATURE SENSOR (ATS)

Removal

1. Disconnect negative cable from battery.
2. Disconnect air temperature sensor coupler.
3. Remove air temperature sensor from intake manifold.

Inspection

Immerse temperature sensing part of air temperature sensor in water (or ice) and measure resistance between sensor terminals while heating water gradually.
If measured resistance doesn't show such characteristic as shown in Fig. 6E-124, replace air temperature sensor.

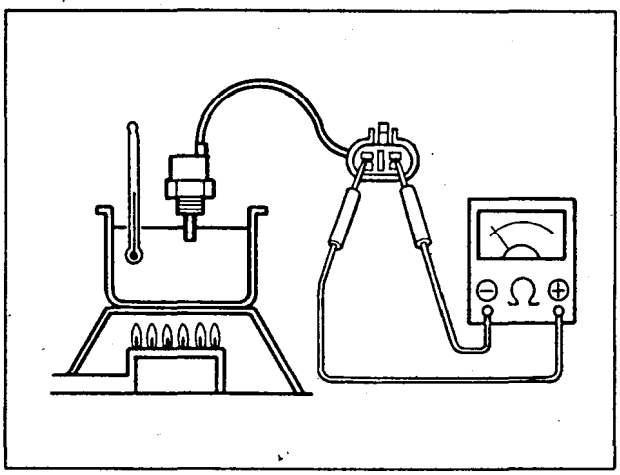


Fig. 6E-123 Checking ATS

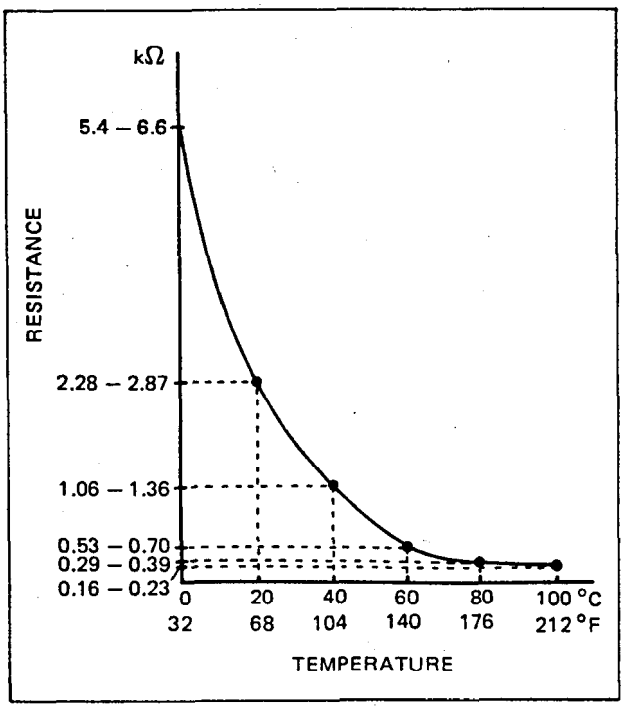


Fig. 6E-124 ATS Characteristic

Installation

Reverse removal procedure noting the following.

- Clean mating surface of sensor and intake manifold.
- Use new gasket.
- Tighten air temperature sensor to specified torque.

Tightening torque for air temperature sensor	N·m	kg-m	lb-ft
	10 – 20	1.0 – 2.0	7.5 – 14.0

- Connect sensor coupler securely.

WATER TEMPERATURE SENSOR (WTS)

Removal

1. Disconnect battery negative cable from battery.
2. Drain cooling system.
3. Disconnect coupler from water temperature sensor.
4. Remove water temperature sensor from intake manifold.

Inspection

Immerse temperature sensing part of water temperature sensor in water and measure resistance between sensor terminals while heating water gradually.

If measured resistance doesn't show such characteristic as shown below, replace water temperture sensor.

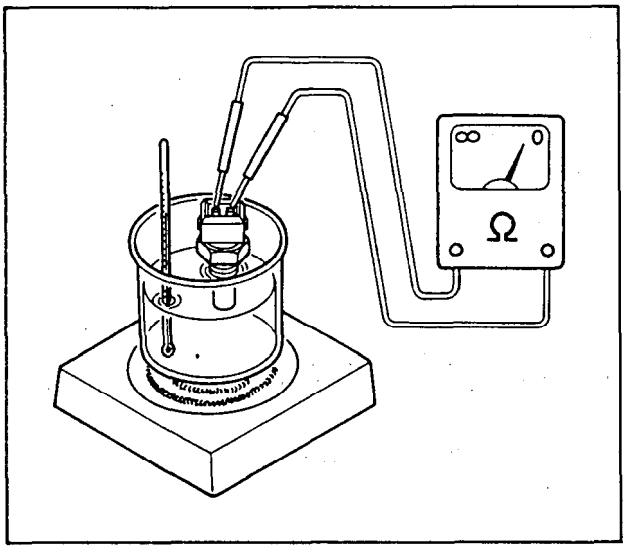


Fig. 6E-125 Checking WTS

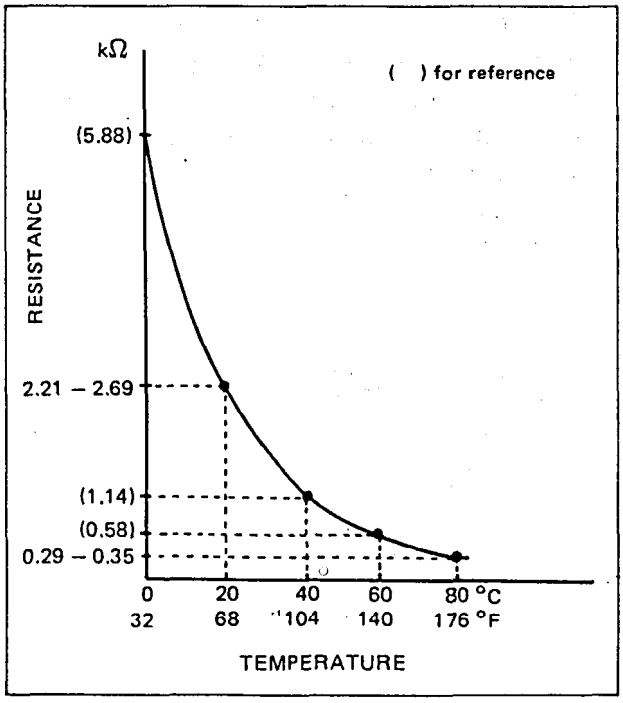


Fig. 6E-126 WTS Characteristic

Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of sensor and intake manifold.
- Use new gasket.
- Tighten water temperature sensor to specified torque.

Tightening torque for water temperature sensor	N·m	kg-m	lb-ft
	35 – 55	3.5 – 5.5	25.5 – 39.5

- Connect coupler to sensor securely.
- Refill cooling system.

OXYGEN SENSOR

Removal

WARNING:
To avoid danger of being burned, do not touch exhaust system when system is hot. Oxygen sensor removal should be performed when system is cool.

1. Disconnect negative cable from battery.
2. Disconnect coupler of oxygen sensor.
3. Remove exhaust manifold upper cover.
4. Remove oxygen sensor from exhaust manifold.

Installation

Reverse removal procedure noting the following.

- Tighten oxygen sensor to specified torque.

Tightening torque for oxygen sensor	N·m	kg-m	lb-ft
	45 – 55	4.5 – 5.5	33.0 – 39.5

- Connect coupler of oxygen sensor and clamp wire harness securely.
- After installing oxygen sensor, start engine and check that no exhaust gas leakage exists.

5TH SWITCH

Inspection

1. Disconnect negative cable from battery.
2. Disconnect 5th switch coupler.
   The coupler is located under intake manifold.

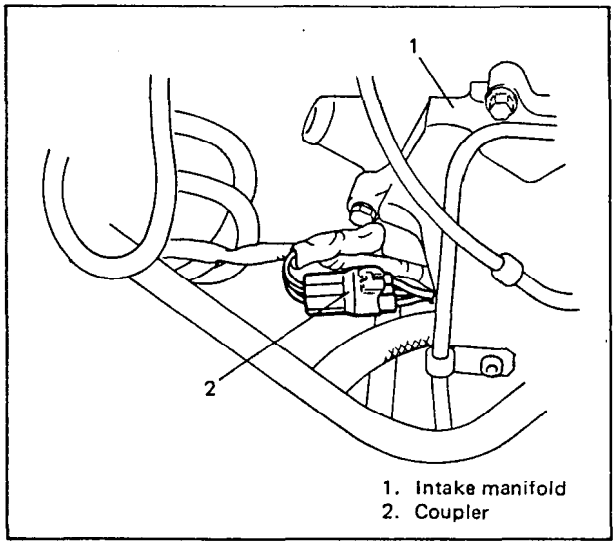


Fig. 6E-127 5th Switch Coupler Location

3. Connect ohmmeter to 5th switch terminals of disconnected coupler and check for continuity.

CONDITION	METER INDICATION
Shift lever in 5th gear position	0 (Zero)
Shift lever in any other position than 5th gear position	∞ (Infinity)

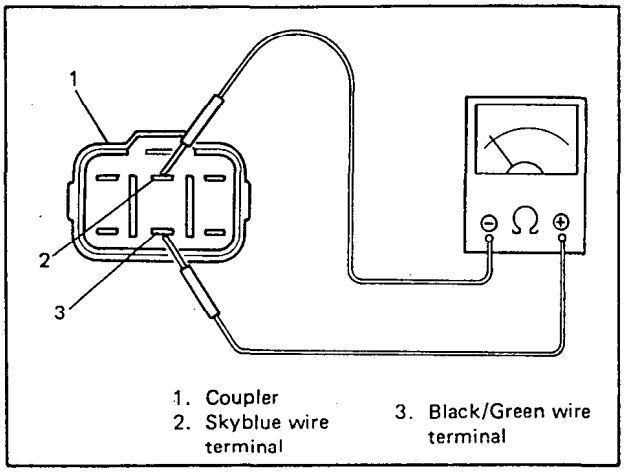


Fig. 6E-128 Checking 5th Switch

If check result is not satisfactory, replace 5th switch or repair wire harness.

4. Connect 5th switch coupler and battery negative cable.

Removal and Installation

Refer to the SECTION 7A of the Service Manual shown in the FOREWORD of this manual for removal and installation procedures.

CONTROL RELAY AND ITS CIRCUIT

Inspection

With ignition switch ON, check voltage at each of the following terminals.

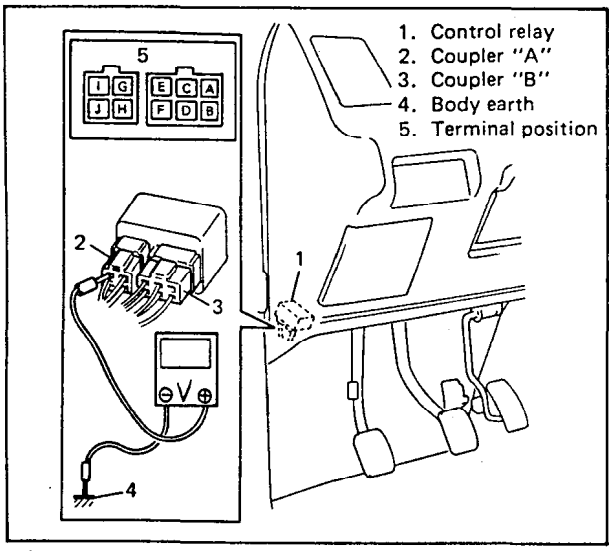


Fig. 6E-129 Checking Control Relay Voltage

TERMINALS	VOLTAGE
B	Battery voltage (approx. 12V)
F	Battery voltage (approx. 12V)
H: In this case, battery voltage (approx. 12V) is applied only at engine cranking.	

If no voltage is applied to terminals "B" and "F", check fuse, wiring harness or ignition switch.
Also, if no voltage is applied to terminal "H", check wire harness and starter switch. When checking wire harness, refer to system wiring diagram in Fig. 6E-13.

TERMINALS	VOLTAGE
C	Battery voltage (approx. 12V)
E	Battery voltage (approx. 12V)
I	Battery voltage (approx. 12V) but 0V after engine start
G: In this case, battery voltage (approx. 12V) is applied only at engine cranking and running.	

If check results are not as specified in above table, replace control relay. However, if voltage at terminal "I" is not 0V at engine cranking, it is possible that pink wire is open or ECM is defective.

THROTTLE OPENER SYSTEM

System Inspection

1. Warm up engine to normal operating temperature.
2. Check that there is clearance between idle speed adjusting screw and throttle lever at engine stop and cranking and that 0.2 — 1.0 second after engine start, throttle opener rod retracts and clearance disappears.

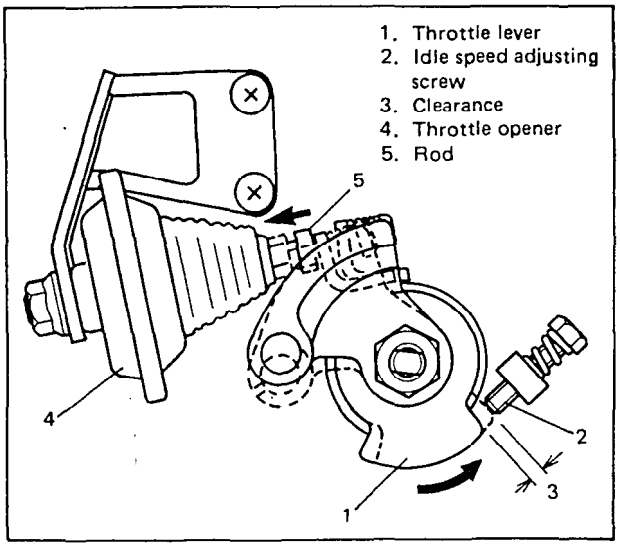


Fig. 6E-130 Checking Throttle Opener Operation

If check result is not satisfactory, check vacuum hoses, throttle opener, VSV and system electric circuit.

Vacuum Hoses

Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

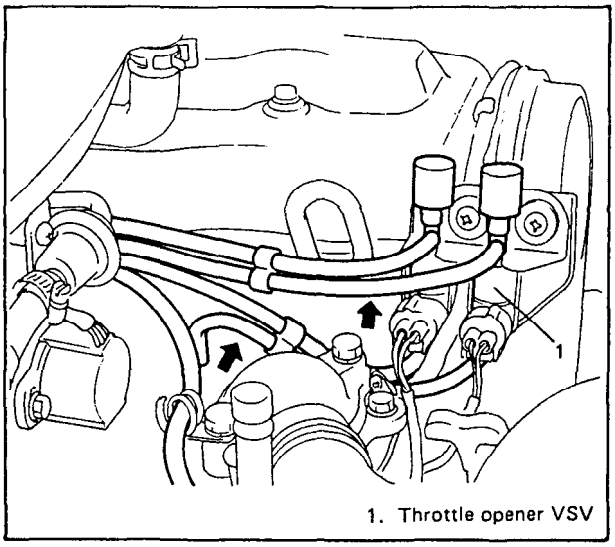


Fig. 6E-131 Checking Vacuum Hoses

Throttle Opener

1. Disconnect vacuum hose from VSV.
2. Connect vacuum pump gauge to hose disconnected in Step 1.
3. Check that opener rod moves smoothly and that it is held at the same position when 50 cmHg vacuum is applied to opener.

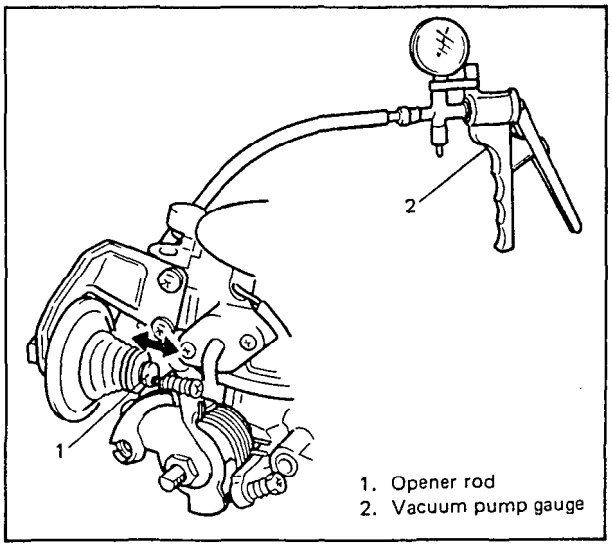
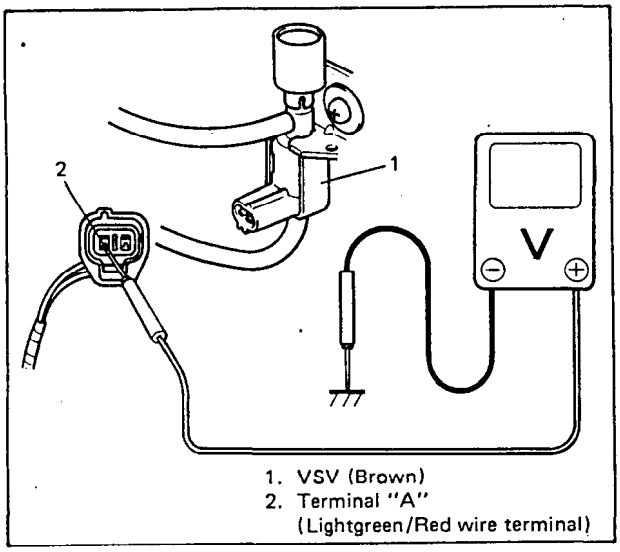


Fig. 6E-132 Checking Throttle Opener

If rod doesn't move smoothly, or it isn't held at the same position, replace.

VSV (Vacuum Switching Valve) and its Circuit

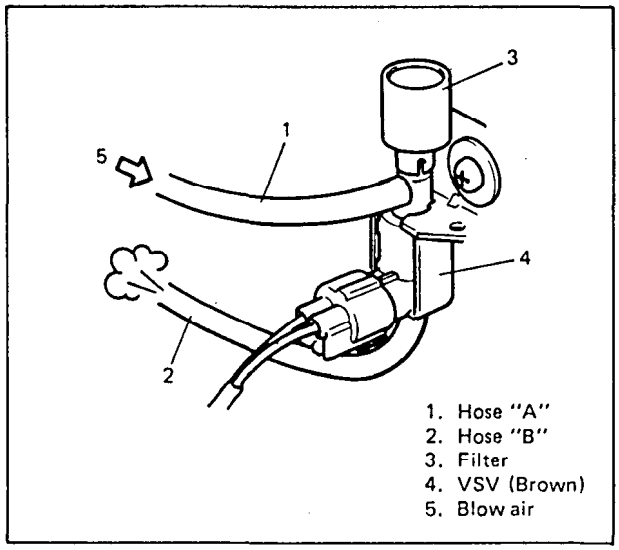
1. Disconnect ECM coupler (green) from ECM with ignition switch turned OFF.
2. Disconnect coupler from VSV.
3. Turn ignition switch ON and check if battery voltage is applied to coupler terminal "A". If not, check if wire harness (Lg/R) or control relay circuit is open.



1. VSV (Brown)
2. Terminal "A" (Lightgreen/Red wire terminal)

Fig. 6E-133 Checking Wire Harness

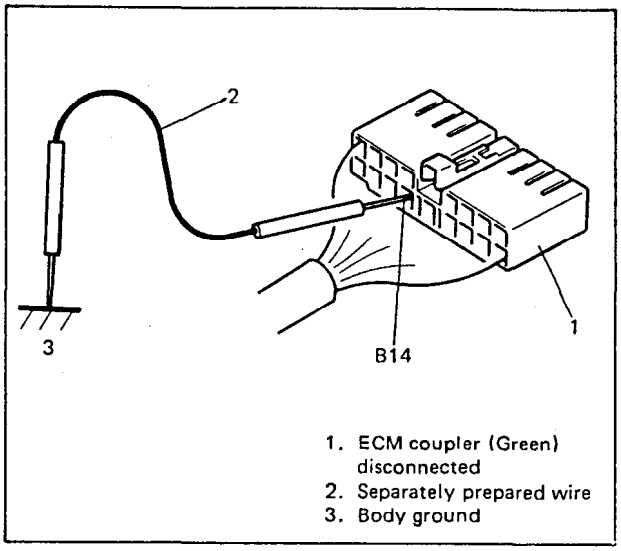
4. Reconnect VSV coupler.
5. Disconnect vacuum hoses from throttle opener and intake manifold.
6. With ignition switch turned ON, blow air into hose "A". Air should come out of hose "B" and not out of filter. If check result is not satisfactory, it is possible that VSV is defective or Lg/W wire harness is shorted to ground.



1. Hose "A"
2. Hose "B"
3. Filter
4. VSV (Brown)
5. Blow air

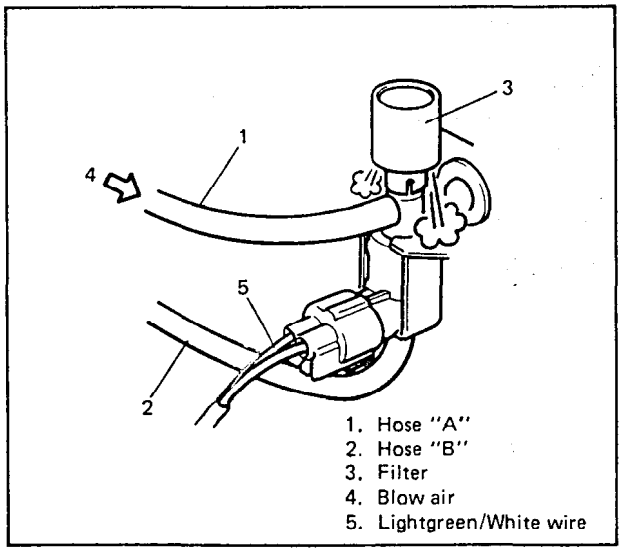
Fig. 6E-134 Checking Opener VSV (1)

7. Using wire harness as thick as the one used for VSV circuit, ground terminal B14 of ECM coupler. In this state, turn ignition switch ON and blow air into hose "A". Air should come out of filter and not out of hose "B".



1. ECM coupler (Green) disconnected
2. Separately prepared wire
3. Body ground

Fig. 6E-135 Grounding B14 Terminal



1. Hose "A"
2. Hose "B"
3. Filter
4. Blow air
5. Lightgreen/White wire

Fig. 6E-136 Checking Opener VSV (2)

If check result is not satisfactory, it is possible that VSV is defective or Lg/W wire harness is open.

8. Connect vacuum hoses securely.
9. Connect ECM coupler securely.

EGR SYSTEM

NOTE:
Before inspecting EGR system be sure to confirm the following.

- **Altitude is 3,870 ft, 1,180 m above sea level or lower and atmospheric pressure is 660 mmHg or higher.**
- **Pressure sensor is in good condition.**

If even one of the above conditions do not apply, they don't operate.

System Inspection

NOTE:
Before inspection, check to make sure that gear shift lever is in neutral position and that parking brake lever is pulled all the way up.

1. When engine is cool (cooling water temperature is below 48°C, 118°F), start engine and race it, and check that EGR valve diaphragm is not operating in this state, by touching diaphragm with finger.

CAUTION:
If EGR valve is hot, it may be necessary to wear gloves to avoid burning fingers.

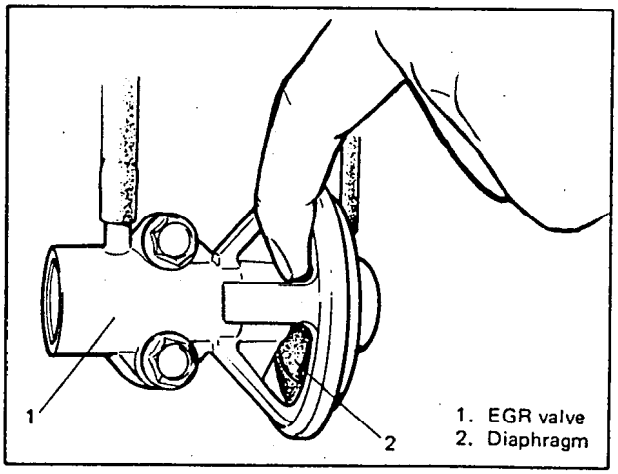


Fig. 6E-137 Checking EGR Valve Diaphragm

2. Warm up engine to normal operating temperature and race it after warming up. Then check to be sure that diaphragm (support) moves toward 1 in Fig. 6E-138 during acceleration and toward 2 during deceleration.

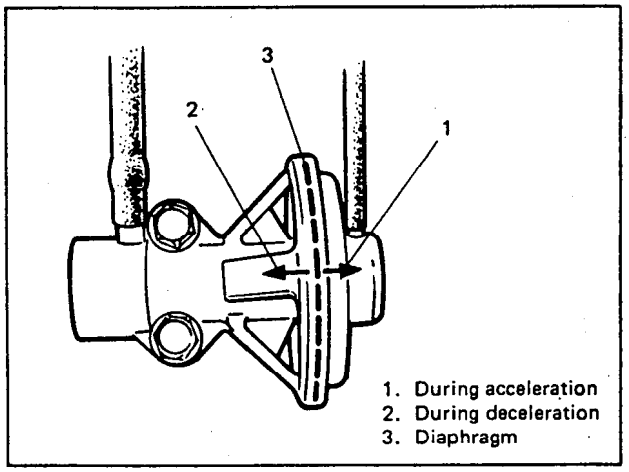


Fig. 6E-138 Movement of EGR Valve Diaphragm

If EGR valve fails to operate properly, check vacuum hoses, EGR valve, EGR modulator, VSV and 5th switch.

3. Keep engine running at idle speed and open EGR valve by hand, and engine should either stop or reduce its speed. If neither occurs, EGR passage is clogged. Clean it.

Vacuum Hoses
Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

EGR Valve

1. Disconnect vacuum hpse from EGR modulator or VSV.
2. Connect vacuum pump gauge to its hose.
3. Check that EGR valve diaphragm moves smoothly and that it is held at the same position when more than 20 cmHg vacuum is applied to EGR valve.
   If diaphragm doesn't move smoothly, or it isn't held at the same position, replace EGR valve.

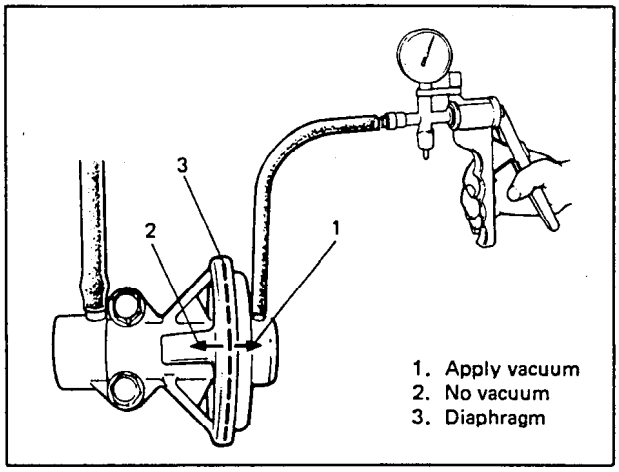


Fig. 6E-139 Checking EGR Valve

4. After checking, be sure to connect vacuum hose.

EGR Modulator

1. Check filter for contamination and damage.
   Using compressed air, clean filter.

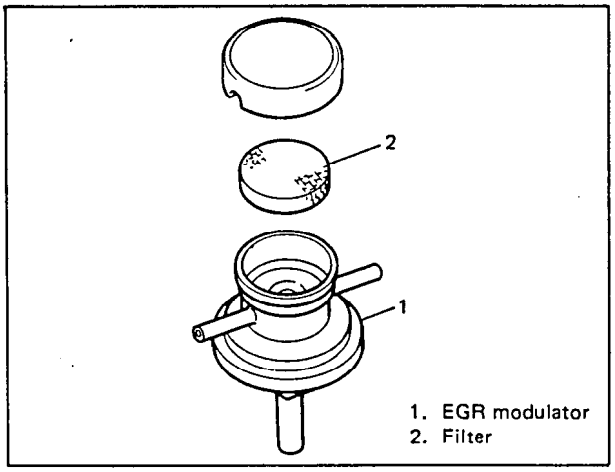


Fig. 6E-140 Filter of EGR Modulator

2. Remove EGR modulator and plug nozzle with your finger. Blow air into another nozzle and check that air passes through to air filter side freely.

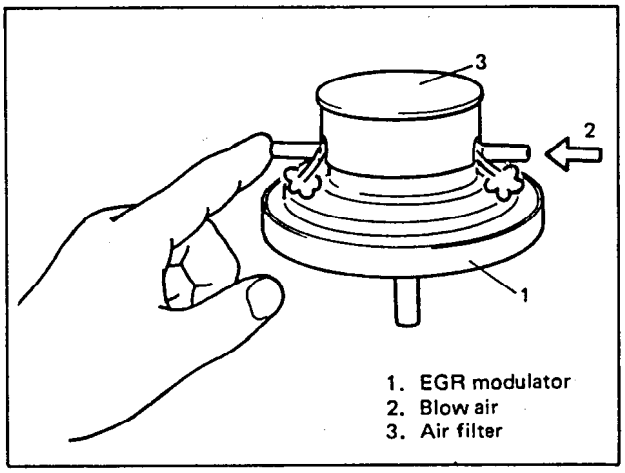


Fig. 6E-141 Checking EGR Modulator (1)

3. Connect vacuum pump gauge to nozzle "P" and plug nozzle "Q" with your finger.
   While blowing air into nozzle "A", operate vacuum pump gauge and check that vacuum is applied to modulator then.

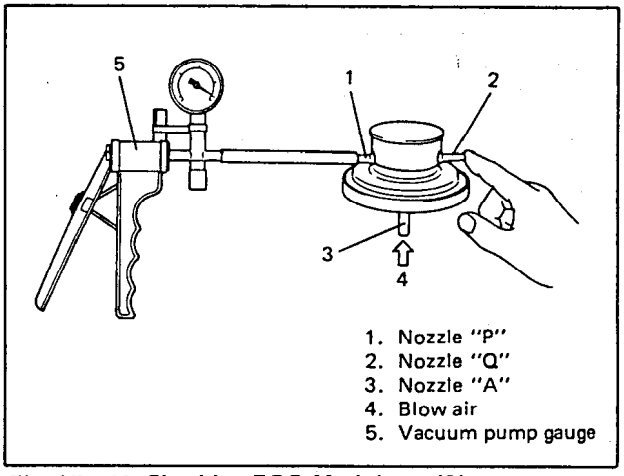


Fig. 6E-142 Checking EGR Modulator (2)

4. After checking, install modulator and connect hoses securely. Refer to Fig. 6E-86 for connection.

VSV (Vacuum Switching Valve) and Its Circuit

1. Disconnect ECM coupler (green) from ECM with ignition switch turned OFF.
2. Disconnect coupler from VSV.
3. Turn ignition switch ON and check that battery voltage is applied to coupler terminal "A". If not, check if wire harness (Lg/R) or control relay circuit is open.

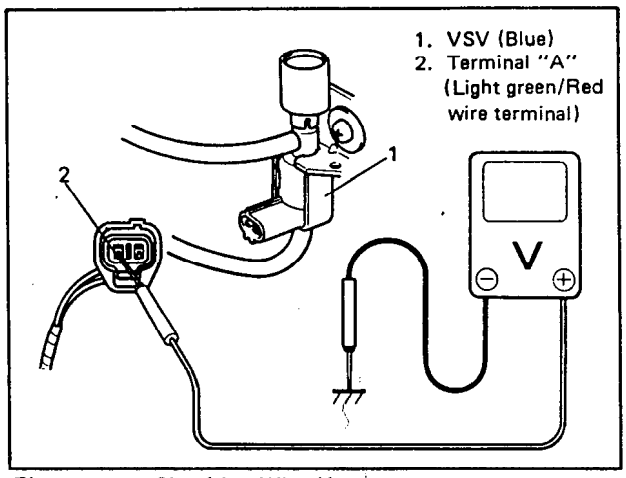


Fig. 6E-143 Checking Wire Harness

4. Reconnect VSV coupler.
5. Disconnect vacuum hoses from EGR valve (or EGR modulator) and throttle body.
6. With ignition switch ON, blow into hose "A". Air should come out of hose "B" and not out of filter.
   If otherwise, either VSV is defective or Lg/Y wire harness is shorted to ground.

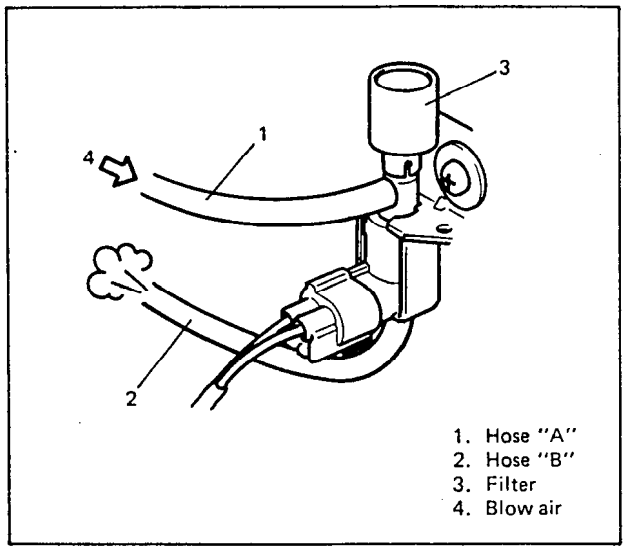


Fig. 6E-144 Checking EGR VSV (1)

7. Using wire harness as thick as the one used for VSV circuit, ground terminal B5 of ECM coupler. In this state, turn ignition switch ON and blow into hose "A". Air should come out of filter and not out of hose "B".

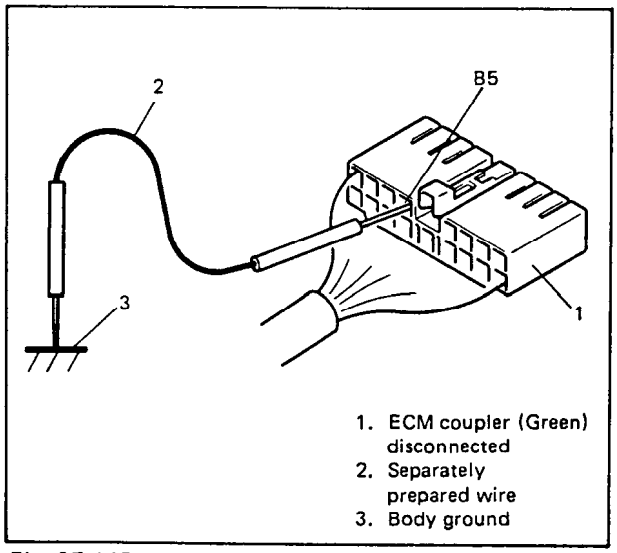


Fig. 6E-145 Grounding B5 Terminal

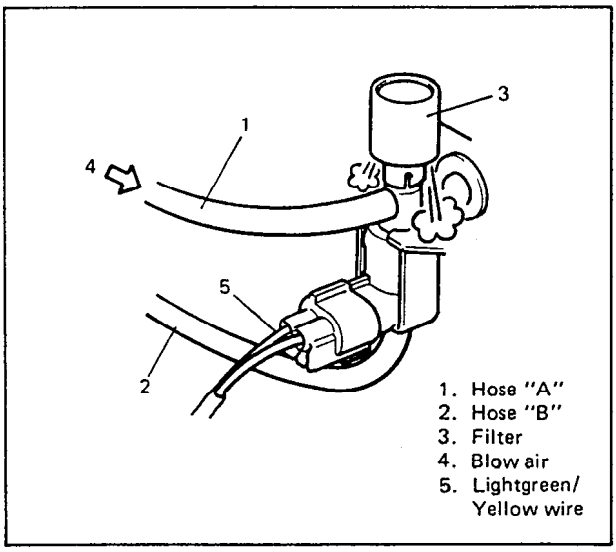
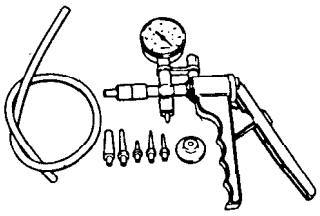


Fig. 6E-146 Checking EGR VSV (2)

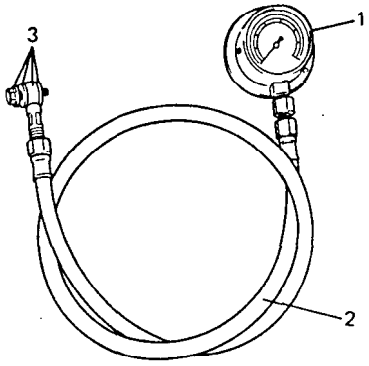
If check result is not as described above, either VSV is defective or Lg/Y wire harness is open.

8. Connect vacuum hoses securely.
9. Connect ECM coupler securely.

SPECIAL TOOLS



09917-47910
Vacuum pump gauge



09912-58412
Fuel pressure gauge set

1. Pressure gauge
   09912-58441
2. Pressure hose
   09912-58431
3. Gauge attachment
   09912-58450

RECOMMENDED TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Throttle body mounting bolt	18 – 28	1.8 – 2.8	13.5 – 20.0
Fuel inlet pipe bolt of throttle body	8 – 12	0.8 – 1.2	6.0 – 8.5
Throttle upper and lower body screw	3.5	0.35	2.5
Fuel pressure regulator screw	3.5	0.35	2.5
Injector cover screw	2.0	0.2	1.4
ISC solenoid valve screw	3.5	0.35	2.5
Throttle position sensor bolt	3.5	0.35	2.5
Air temperature sensor	35 – 55	3.5 – 5.5	25.5 – 39.5
Water temperature sensor	35 – 55	3.5 – 5.5	25.5 – 39.5
Oxygen sensor	45 – 55	4.5 – 5.5	33.0 – 39.5

SECTION 6F

IGNITION SYSTEM

NOTE:
For the items not found in this section of this manual, refer to the SECTION 6F of the Service Manual shown in the FOREWORD of this manual.

CONTENTS

ON VEHICLE SERVICE 6F- 1
Spark Plugs 6F- 1

ON VEHICLE SERVICE

SPARK PLUGS

Spark plug type		Standard
	NGK	BPR5ES
	NIPPON DENSO	W16EXR-U
Plug gap "A"	0.7 – 0.8 mm (0.027 – 0.031 in.)	

1. Disconnect high tension cords at spark plugs. DO NOT pull on the cord to remove it. Pull on the boot as previously outlined.
2. Using spark plug wrench, remove spark plugs.
3. Check following:
   - Electrode wear
   - Carbon deposits
   - Insulator damage.

   If any fault is found, replace the plugs.
4. Check the gap, and make sure that the gap is within the specification. If the gap is out of specification, adjust it by bending the ground (side) electrode.

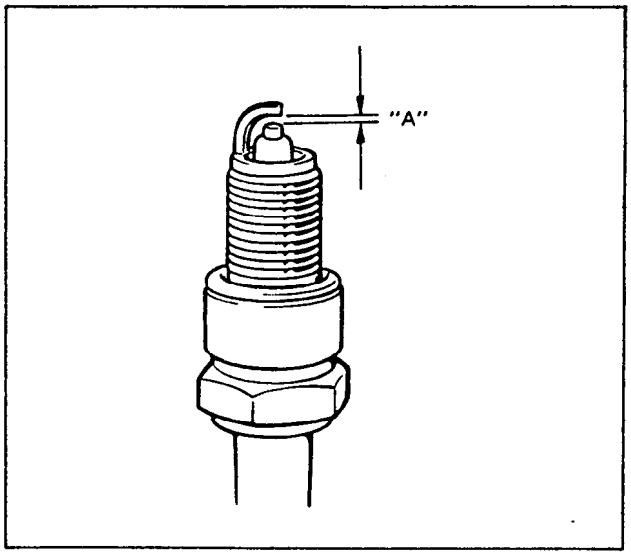


Fig. 6F-1 Plug Gap

5. Install spark plugs and tighten it to specified torque.

Tightening torque for spark plug	N·m	kg-m	lb-ft
	20 – 30	2.0 – 3.0	14.5 – 21.5

SECTION 6J

EMISSION CONTROLS

CONTENTS

GENERAL DESCRIPTION 6J-2
Positive Crankcase Ventilation (PCV) System 6J-2
Evaporative Emission Control System 6J-2
Three-Way Catalyst 6J-3
Exhaust Gas Recirculation (EGR) System ..... Refer to SECTION 6E "ELECTRONIC FUEL INJECTION SYSTEM"
Fuel Feed Back System (Compensation) ..... Refer to SECTION 6E "ELECTRONIC FUEL INJECTION SYSTEM"
DIAGNOSIS ..... Refer to SECTION 6 "ENGINE" and SECTION 6E "ELECTRONIC FUEL INJECTION SYSTEM"
ON VEHICLE SERVICE 6J-3
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PCV System 6J-3
Evaporative Emission Control System 6J-4
EGR System ..... Refer to SECTION 6E "ELECTRONIC FUEL INJECTION SYSTEM"
Fuel Feed Back System (Oxygen sensor) ..... Refer to SECTION 6E "ELECTRONIC FUEL INJECTION SYSTEM"

GENERAL DESCRIPTION

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

The term "blow-by gas" stands for the compressed gas and exploded gas which blow through cylinder-to-piston clearance, which contain a large amount of unburned gases such as CO and HC. The PCV (Positive Crankcase Ventilation) system is provided to prevent the blow-by gas from being emitted into atmosphere and it operates as follows.

When the vacuum in the intake manifold is low (throttle valve open), the PCV valve is wide open due to its spring force. Thus a large amount of the blow-by gas is drawn into the intake manifold.

On the other hand, when the vacuum in the manifold is high, the PCV valve opening is limited due to the high vacuum. Thus the amount of the blow-by gas drawn into the intake manifold is small.

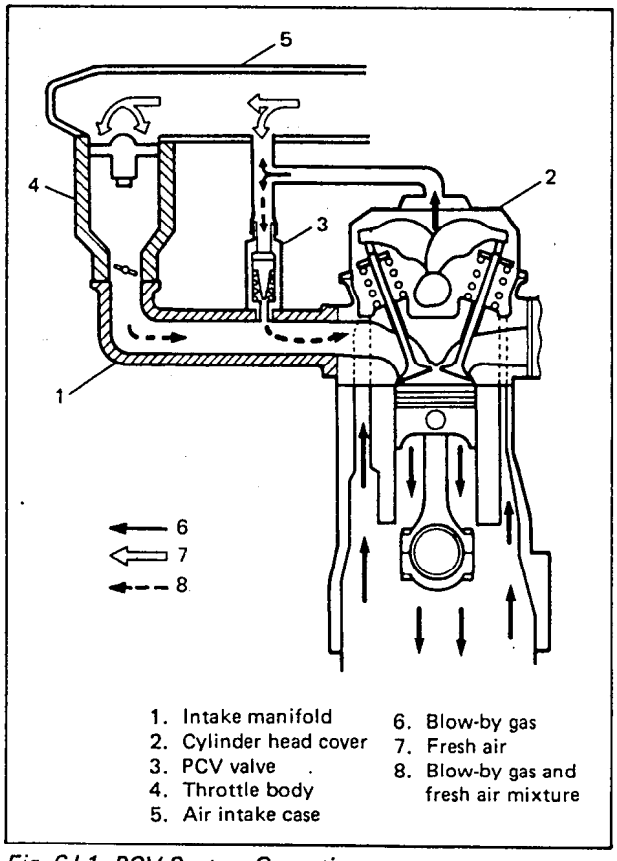


Fig. 6J-1 PCV System Operation

EVAPORATIVE EMISSION CONTROL SYSTEM

An evaporative emission control system is used to prevent emission of fuel vapor.

The vapor generated in the fuel tank while driving or the engine at a stop passes through a 2-way check valve and enters the charcoal canister where the charcoal absorbs and stores the fuel vapor.

While the engine is running, the fuel vapor stored in the canister is drawn into the intake manifold together with fresh air to be burned. While the engine is not running, the fuel vapor is stored in the canister.

The 2-way check valve is provided to keep the pressure in the fuel tank constant. When the pressure in the fuel tank becomes positive and reaches its specified value, it opens the valve to let the vapor flow into the charcoal canister. On the other hand, when the pressure in the fuel tank becomes negative and reaches its specified value, it opens the valve to let the air flow into the fuel tank.

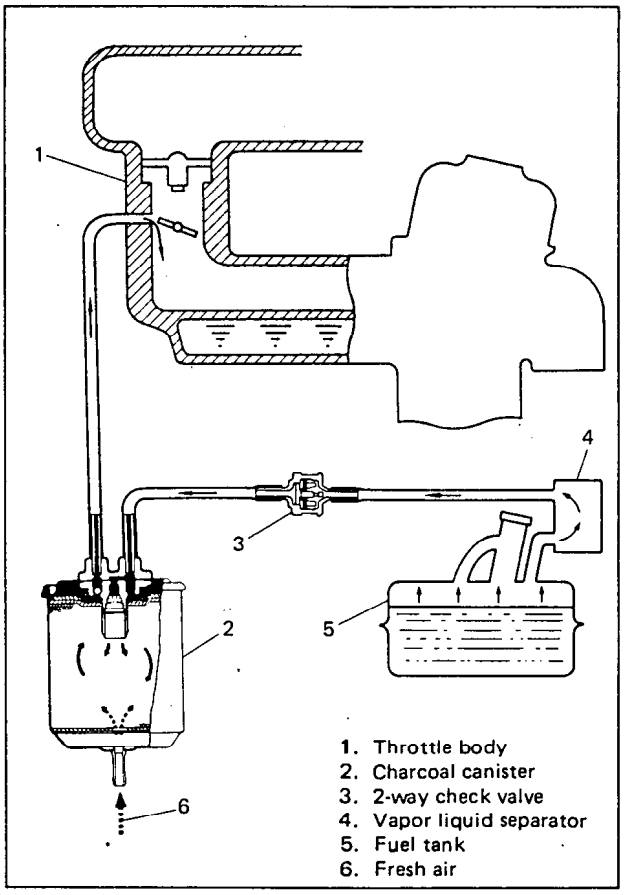


Fig. 6J-2 Evaporative Emission Control System

THREE-WAY CATALYST

The three-way catalyst is provided in the exhaust system (exhaust center pipe). The function of the catalyst is to reduce the emission of CO, HC and NOx in the exhaust gas by oxidizing or converting them into CO_2, H_2O and N_2 respectively.

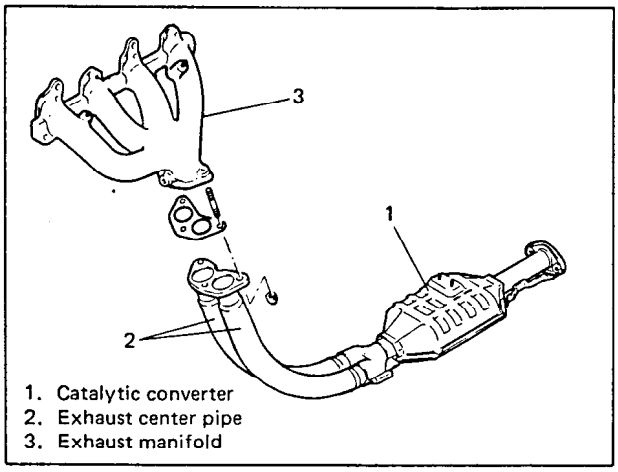


Fig. 6J-3 Catalytic Converter

ON VEHICLE SERVICE

GENERAL

When the emission control hoses are disconnected and the system's component is removed for service, reinstall the component properly, and route and connect hoses correctly after service. Refer to Fig. 6E-86 for proper routing of hoses.

PCV SYSTEM

NOTE:

If engine is idling rough, this may be caused by a clogged PCV valve or plugged hoses; therefore, never adjust idle speed without first checking PCV valve and hoses.

PCV HOSE

Check hoses for connection, leakage, clog, and deterioration. Replace as necessary.

PCV VALVE

1. Disconnect PCV hose from PCV valve.
2. Run engine at idle.
3. Place your finger over end of PCV valve to check for vacuum. If there is no vacuum, check for clogged valve. Replace as necessary.

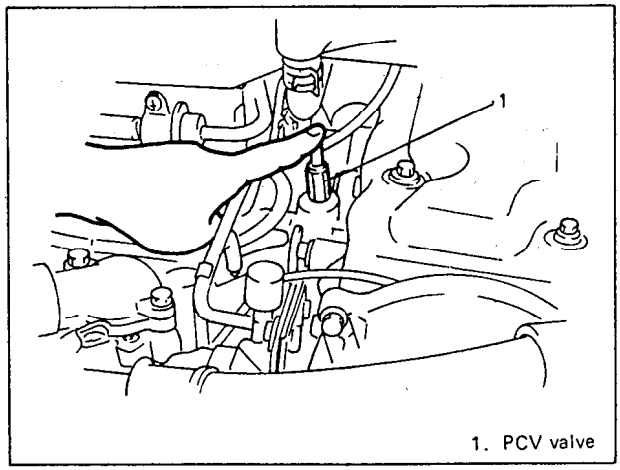


Fig. 6J-4 Checking Vacuum

4. After checking vacuum, stop engine and ckeck PCV valve for sticking.
   With engine stopped, connect a new hose to PCV valve.
   Blow air into new hose and check that air flows with difficulty from cylinder head side to intake manifold side. If air flows without difficulty, valve is stuck in "Open" position. Replace PCV valve.

WARNING:
Do not suck air through PCV valve. Petroleum substances inside the valve and fuel vapor inside the intake manifold are harmful.

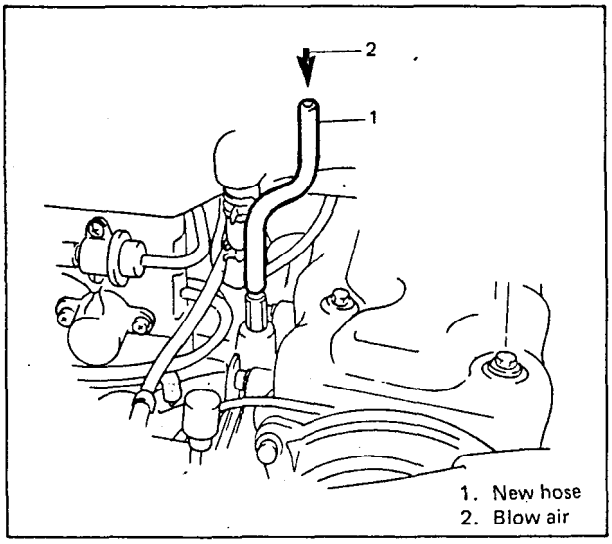


Fig. 6J-5 Checking PCV Valve for Sticking

5. Connect PCV hose and clamp securely.

EVAPORATIVE EMISSION CONTROL SYSTEM

VACUUM HOSES

Check hoses for connection, leakage, clog and deterioration. Replace as necessary.

CHARCOAL CANISTER

WARNING:
DO NOT SUCK nozzles on canister. Fuel vapor inside canister is harmful.

1. Disconnect hoses from canister.

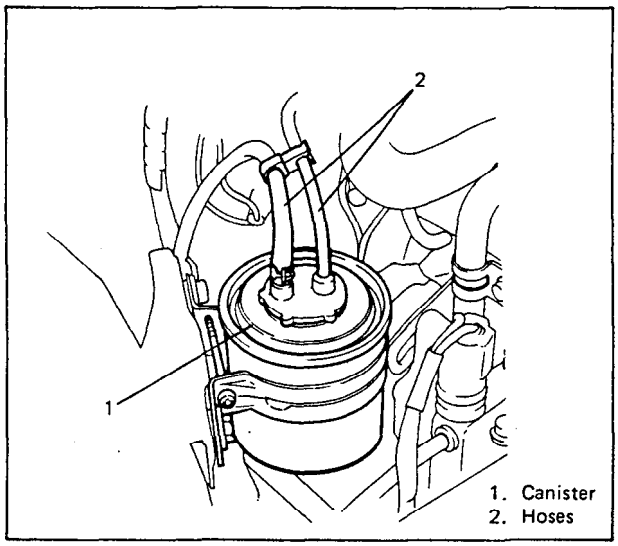


Fig. 6J-6 Canister Hoses

2. When air is blown into pipe "A", there should be no restriction of flow through pipes "B" and "C".

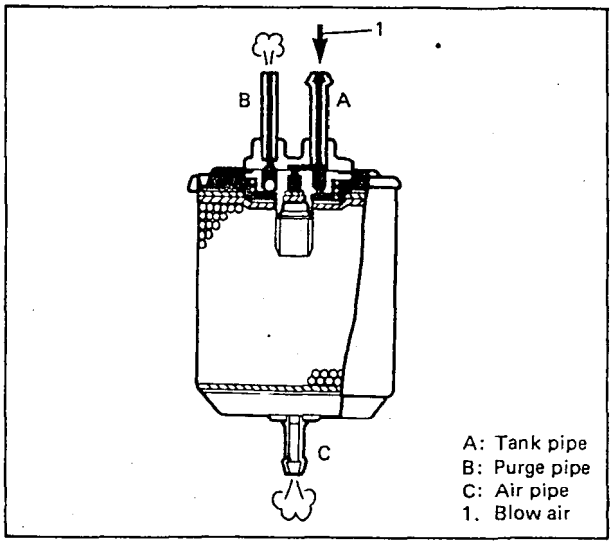


Fig. 6J-7 Checking Canister (1)

3. When air is blown into pipe "B", air should not pass through either pipe "A" or "C".

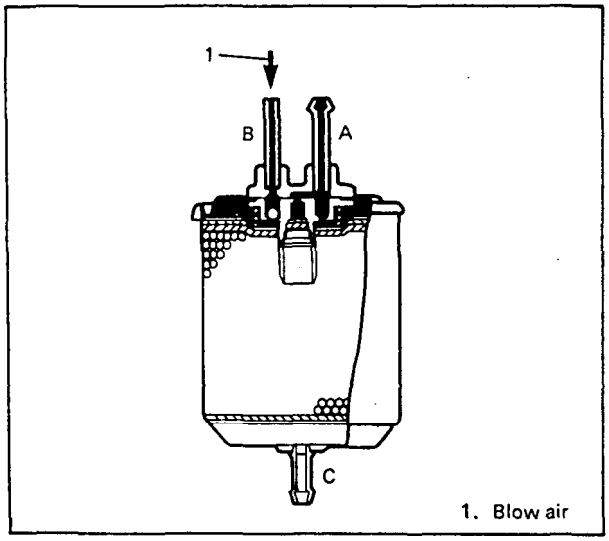


Fig. 6J-8 Checking Canister (2)

4. If operation differs from above description, charcoal canister must be replaced.
5. Connect hoses to canister.

2-WAY CHECK VALVE

1. Remove 2-way check valve.
2. Air should pass through valve smoothly from fuel tank side (black side of check valve) to orange side when blown hard.
3. From orange side, even when blown softly, air should come out of black side.
4. If air doesn't pass through valve in step 2 or hard blow is required in step 3, replace 2-way check valve.

WARNING:
DO NOT SUCK air through two way check valve. Fuel vapor inside the valve is harmful.

5. Install 2-way check valve.

NOTE:
When connecting check valve between hoses, refer to below figure for installing direction.

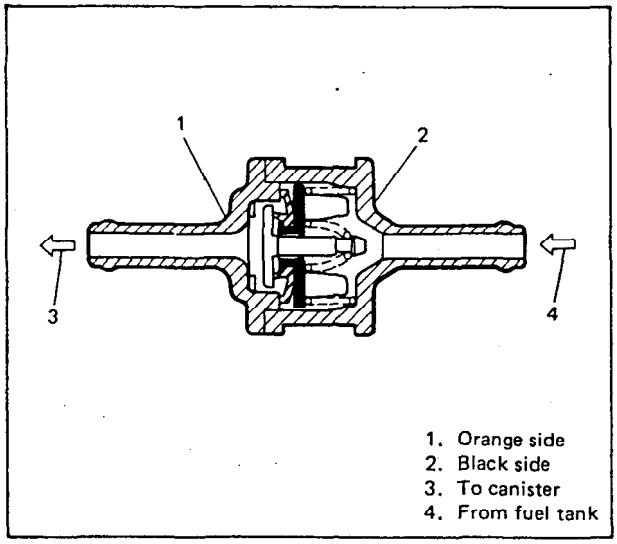


Fig. 6J-9 2-Way Check Valve

SECTION 6K

EXHAUST SYSTEM

CONTENTS

GENERAL DESCRIPTION 6K-1
MAINTENANCE 6K-2
ON VEHICLE SERVICE 6K-2

GENERAL DESCRIPTION

The exhaust system consists of an exhaust manifold, an exhaust center pipe, a muffler, a tail pipe, and seals and gaskets etc., and the exhaust center pipe has the catalytic converter.

The catalytic converter is an emission control device added to the exhaust system to lower the levels of Hydrocarbon (HC), Carbon Monoxide (CO), and Oxides of Nitrogen (NOX) pollutants in the exhaust gas.
The catalyst in the catalytic converter is of "Three-way" type.

THE CATALYTIC CONVERTER REQUIRES USE OF UNLEADED FUEL ONLY.

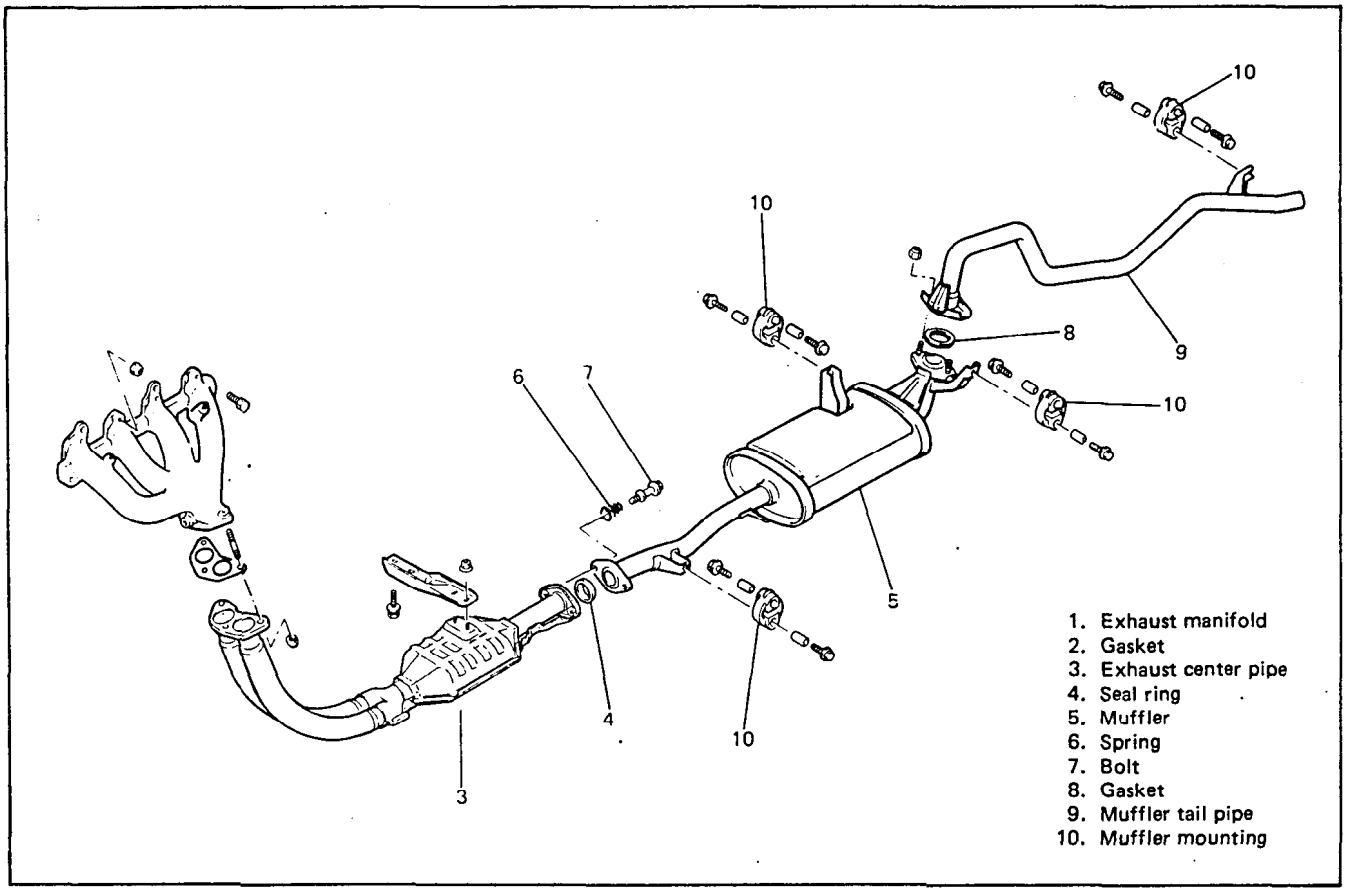


Fig. 6K-1 Exhaust System

MAINTENANCE

WARNING:
To avoid the danger of being burned, do not touch the exhaust system when the system is hot. Any service on the exhaust system should be performed when the system is cool.

At every interval of periodic maintenance service, and when vehicle is raised for other service, check exhaust system as follows:

- Check rubber mountings for damage, deterioration, and out of position.
- Check exhaust system for leakage, loose connection, dent and damage.
  If bolts or nuts are loosened, tighten them to specified torque. Refer to "ON VEHICLE SERVICE" for torque data.
- Check nearby body areas for damaged, missing, or mispositioned part, open seam, hole, loose connection or any other defect which could permit exhaust fumes to seep into vehicle.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to passenger compartment carpet.
- Any defect should be fixed at once.

ON VEHICLE SERVICE

- Refer to Section 6A for removal and installation procedures of exhaust manifold.
- For replacement of center pipe, muffler, tail pipe or any part used to mount or connect them, be sure to hoist vehicle and observe WARNING given at the left of this page.

CAUTION:
As muffler center pipe has catalytic converter in it, it should not be exposed to any impulse. Be careful not to drop it or hit it against something.

- When exhaust manifold is removed, check gaskets and seal for deterioration or damage. Replace them as necessary.
- Tighten bolts and nuts to specified torques when reassembling.
  Refer to Fig. 6K-2 for location of bolts and nuts.

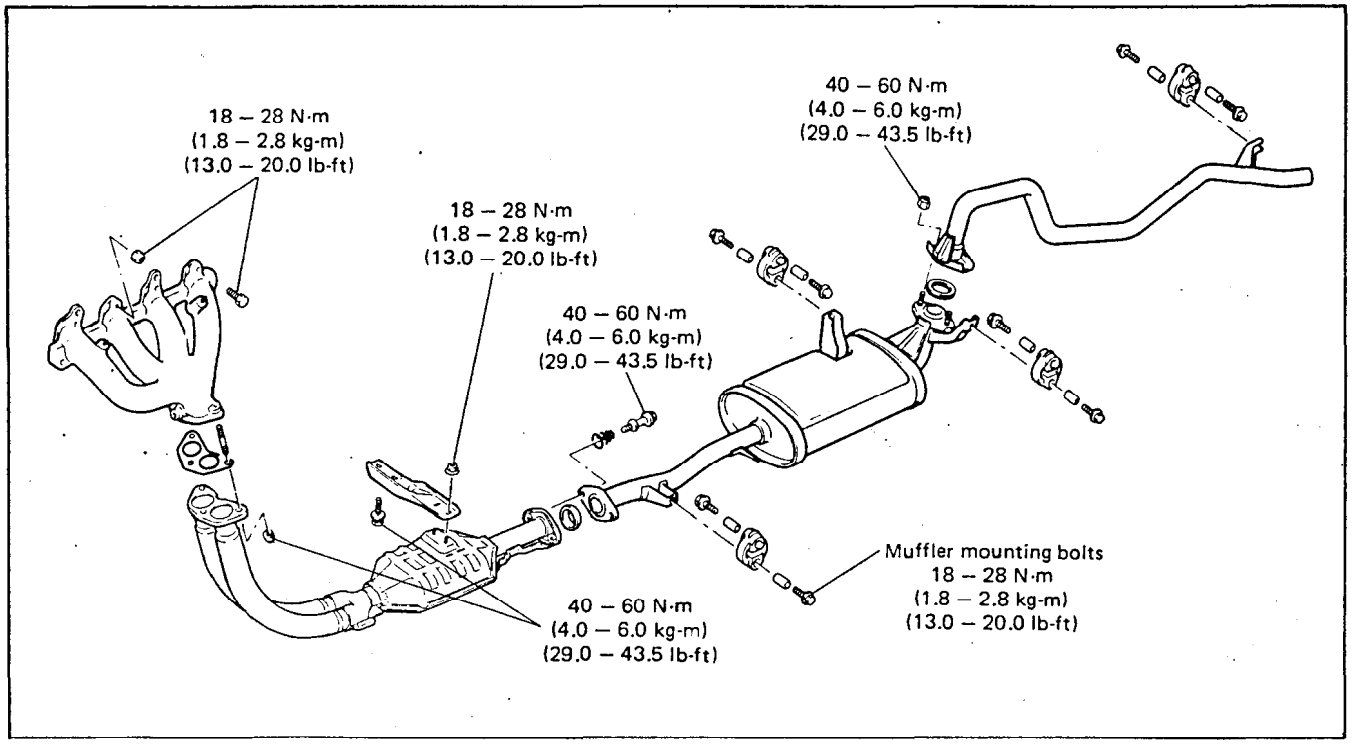


Fig. 6K-2 Recommended Torque Specification

SECTION 8

BODY ELECTRICAL SYSTEM

NOTE:
For the items not found in this section of this manual, refer to the SECTION 8 of the Service Manual shown in the FOREWORD of this manual.

CONTENTS

BODY ELECTRICAL SYSTEM 8-2
Fuses 8-2
Switches 8-3
INSTRUMENTS AND GAUGES 8-4
Combination Meter Wiring 8-4
ON VEHICLE SERVICE 8-5
Lighting Systems 8-5
WIRING HARNESS ROUTING 8-6

BODY ELECTRICAL SYSTEM

FUSES

FUSE BOX

[For West Germany market]

W/Y		W/Y			Y/B		
10A HEAD R	10A HEAD L	10A DOME	15A STOP HORN	15A HAZARD	15A REAR DEFG.	20A HEATER	IN
W/R	W/Bl	W	G	W/G	Y/G	Lg	OUT
R/B		Bl	B/Bl				IN
10A LICENSE	10A TAIL R	10A TAIL L	20A CIGER RADIO	15A IG. COIL METER	10A TURN BACK	15A WIPER WASHER	
R/Y	R/G	R/Bl	W/B	B/W	Y	Y/Bl	OUT
						W/Y	IN
						20A DOOR LOCK	
						R	OUT

[For Other markets]

W/Y		W/Y			Bl	Y/B	
10A HEAD R	10A HEAD L	15A TAIL DOME	15A STOP HORN	15A HAZARD	20A CIGER	15A ACC	IN
W/R	W/Bl	W	G	W/G	W/B	Lg/R	OUT
B/Bl		Y/B			W/Y	B	IN
15A IG. COIL METER	10A TURN BACK	15A WIPER WASHER	15A REAR DEFG.	20A HEATER	20A DOOR LOCK	DIAG	
B/W	Y	Y/Bl	Y/G	Lg	R	Bl/Y	OUT

W/R	: White/Red	W/Bl	: White/Blue	W	: White
G	: Green	W/G	: White/Green	W/B	: White/Black
B/W	: Black/White	Y/Bl	: Yellow/Blue	Y/G	: Yellow/Green
Y	: Yellow	Lg	: Light green	Bl/Y	: Blue/Yellow
W/Y	: White/Yellow	Bl	: Blue	B/Bl	: Black/Blue
Y/B	: Yellow/Black	B	: Black	R/B	: Red/Black
Lg/R	: Light green/Red	R	: Red	R/Y	: Red/Yellow
R/G	: Red/Green	R/Bl	: Red/Blue		

Fig. 8-1

SWITCHES

LIGHT TURN SIGNAL/DIMMER SWITCH

CONNECTOR									
R	G/R	Y/W	Bl/G	Bl	Bl/R	Bl/W	R/Y, R/B or R/Bl	Br/Y	W
R/W or R/G	G/Y	G			Bl/B	Y/Bl	W/G	Y	B

Y/Bl : Yellow/Blue
Y : Yellow
G/Y : Green/Yellow
W : White
Bl/G : Blue/Green
R/W : Red/White
Bl/R : Blue/Red
Y/W : Yellow/White
B : Black
R/G : Red/Green
W/G : White/Green
G : Green
G/R : Green/Red
R/Y : Red/Yellow
R : Red
Br/Y : Brown/Yellow
Bl : Blue
Bl/W : Blue/White
Bl/B : Blue/Black
R/Bl : Red/Blue
R/B : Red/Black

Fig. 8-2

CONTINUITY BETWEEN TERMINALS	
Switch Position	Terminal-to-Terminal Continuity
RH Turn Signal	G – G/Y
LH Turn Signal	G – G/R
Neutral	Y/W – Y
Hazard	Y/W – W/G
(RH – N – LH)	G/Y – G – G/R
Low Beam	R/G or R/W – B
High Beam	R – B
Passing	R/G or R/W – B, R – B
Bl/G, a horn lead wire, produces no continuity inside turn signal/dimmer switch.	

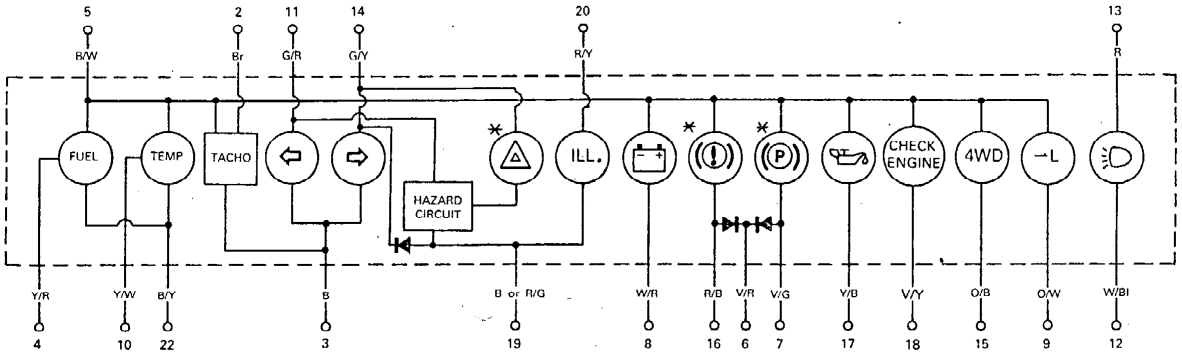
Fig. 8-3

CONTINUITY BETWEEN TERMINALS	
Switch Position	Terminal-to-Terminal Continuity
≡D	(Lo) R/W or R/G – B, (Hi) R – B
≡DO≡	W – R/Y, R/B or R/Bl
OFF	(Lo) Br/Y – R/W or R/G, (Hi) Br/Y – R

Fig. 8-4

INSTRUMENTS AND GAUGES

COMBINATION METER WIRING



2. To ignition ⊖
3. To earth
4. To fuel level gauge unit
5. To ignition ⊕ (Battery)
6. To main switch
7. To parking brake switch
8. To generator
9. To 4WD low switch
10. To water temperature gauge unit
11. To turn signal switch (Left)
12. To battery (Fuse box) ⊕
13. To dimmer & passing switch
14. To turn signal switch (Right)
15. To 4WD switch
16. To brake fluid level switch and parking brake switch
17. To oil pressure switch
18. To ECM
19. To earth
20. To lighting switch
22. To earth

NOTE:
Whether equipped with * marked parts or not depends on vehicle specifications.

NOTE:
Terminals position.

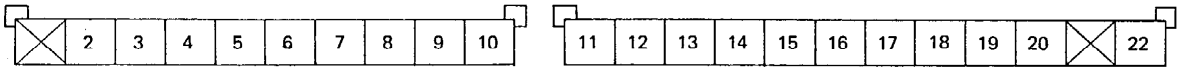
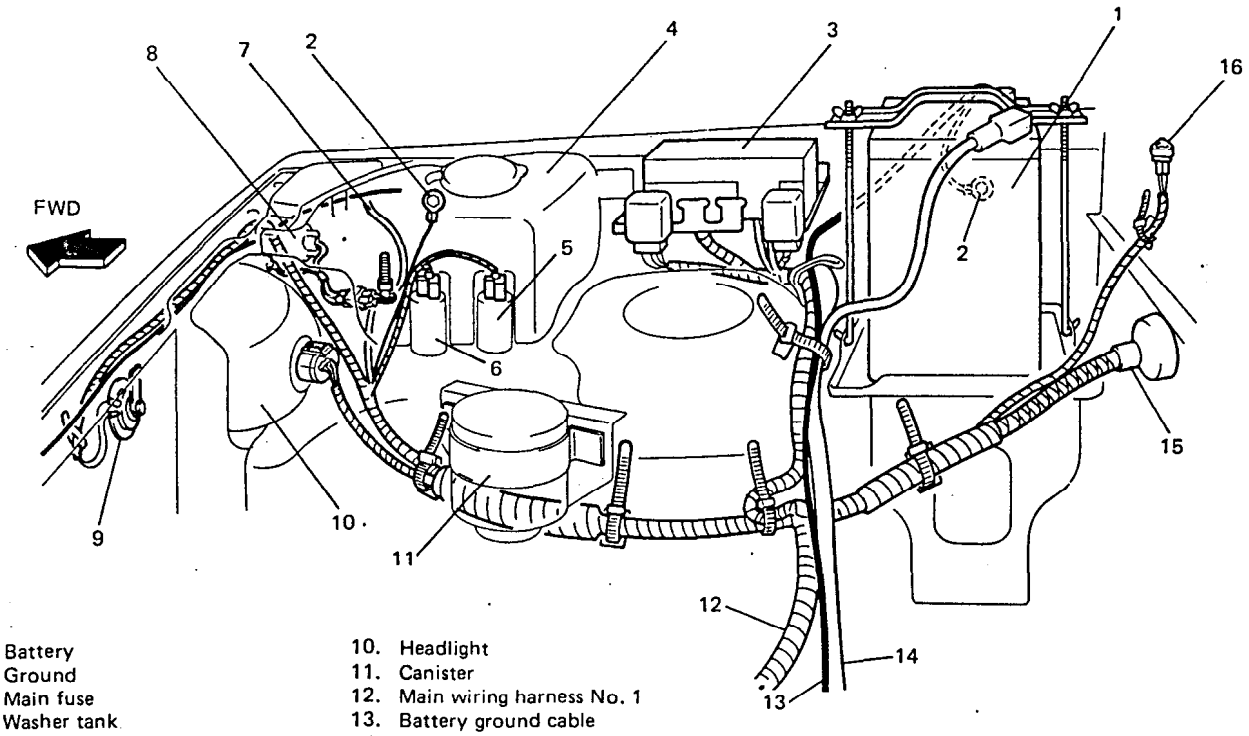


Fig. 8-5 Combination Meter Wiring

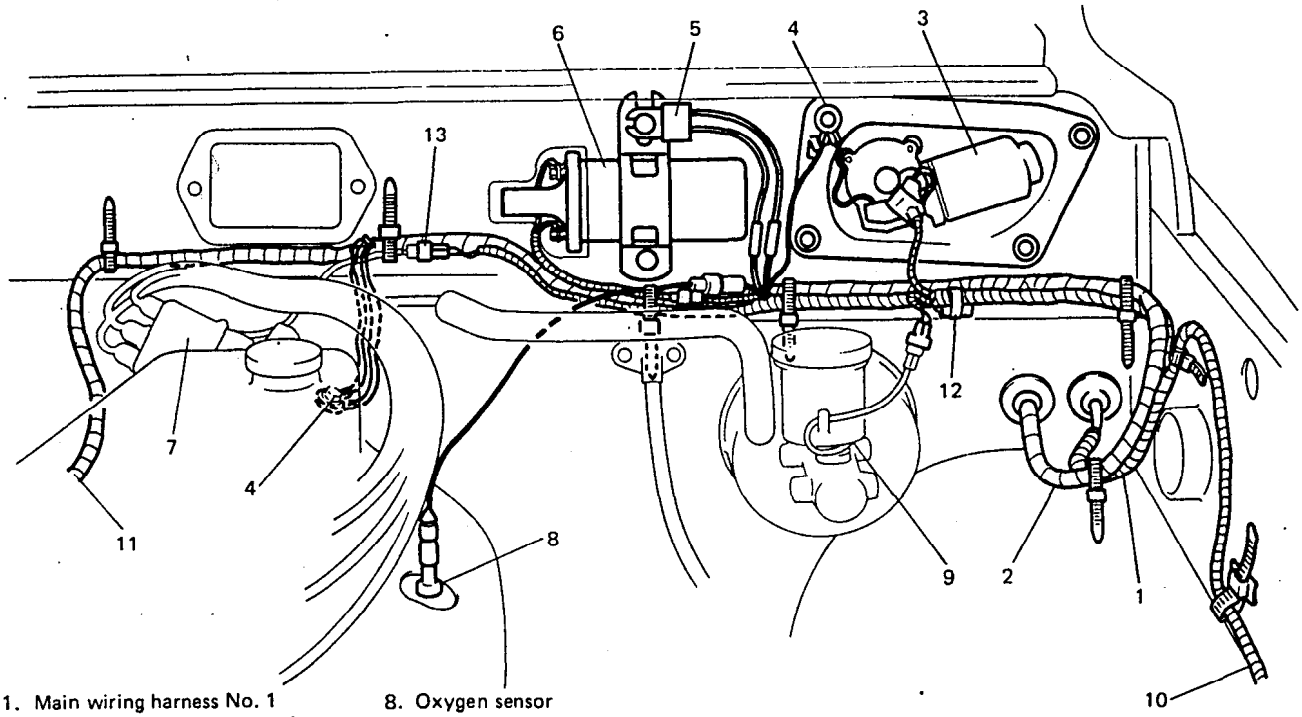
MEMO

WIRING HARNESS ROUTING



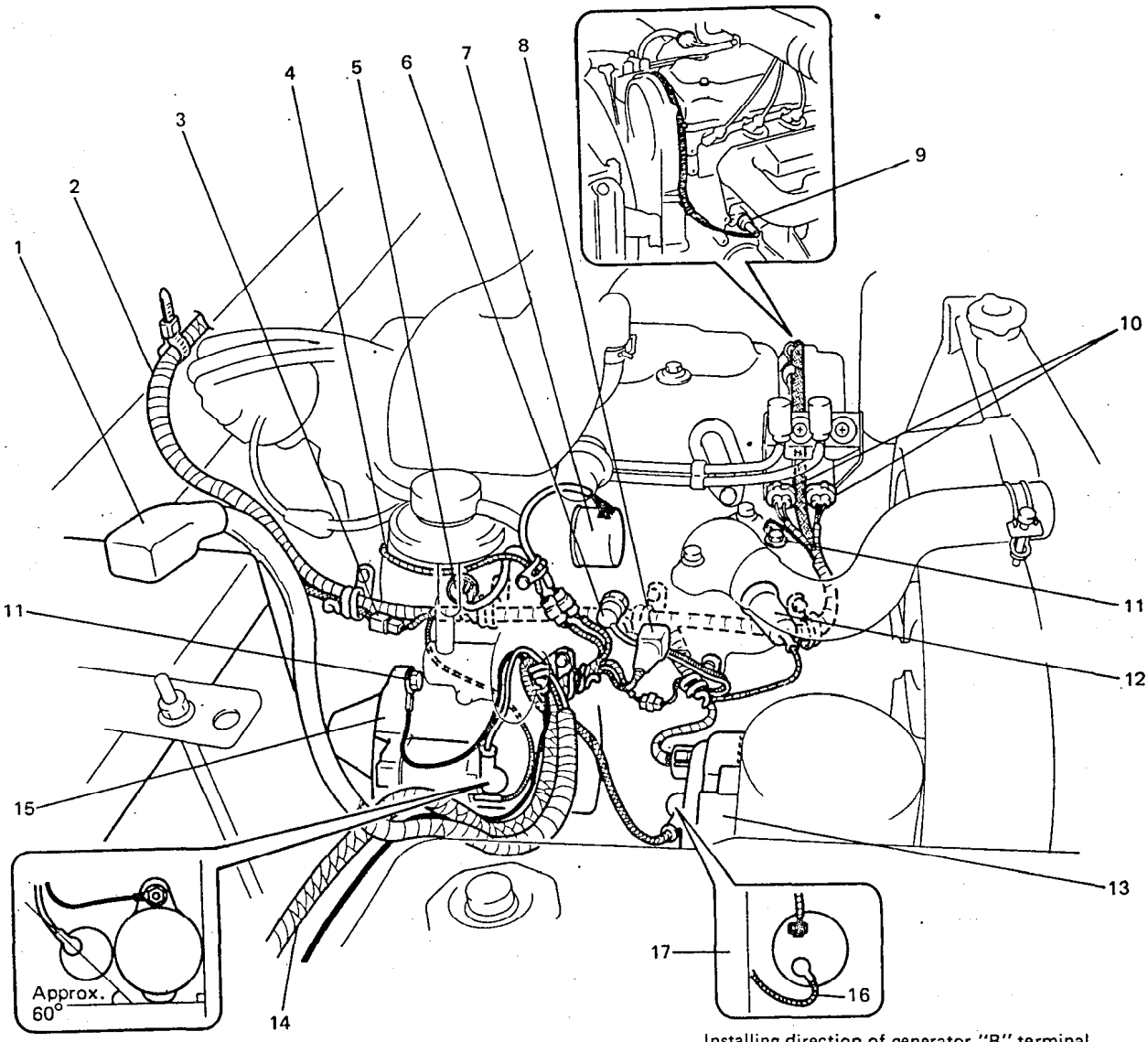
1. Battery
2. Ground
3. Main fuse
4. Washer tank
5. Front washer pump
6. Rear washer pump (Optional)
7. To right side turn signal
8. Turn signal and small light
9. Horn
10. Headlight
11. Canister
12. Main wiring harness No. 1
13. Battery ground cable
14. To generator and starter
15. To room side
16. To pressure sensor

Fig. 8-7 Right Side Inner Fender Wiring



1. Main wiring harness No. 1
2. Engine wiring harness No. 5
3. Front wiper motor
4. Ground
5. Condenser (Noise suppressor)
6. Ignition coil
7. Distributor
8. Oxygen sensor
9. To brake fluid level switch
10. To headlight, side turn signal
11. To generator and starter
12. Noise suppressor
13. To distributor

Fig. 8-8 Engine Room Wiring No. 1



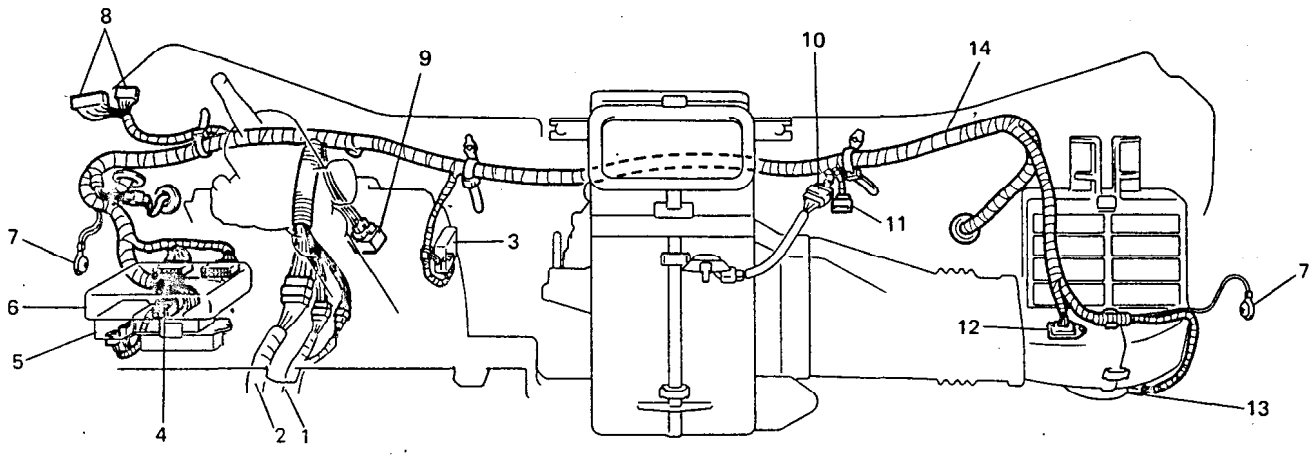
Installing direction of starter wire

Installing direction of generator "B" terminal

NOTE:
"B" terminal wire should not touch to cylinder block, water intake pipe or generator bracket.

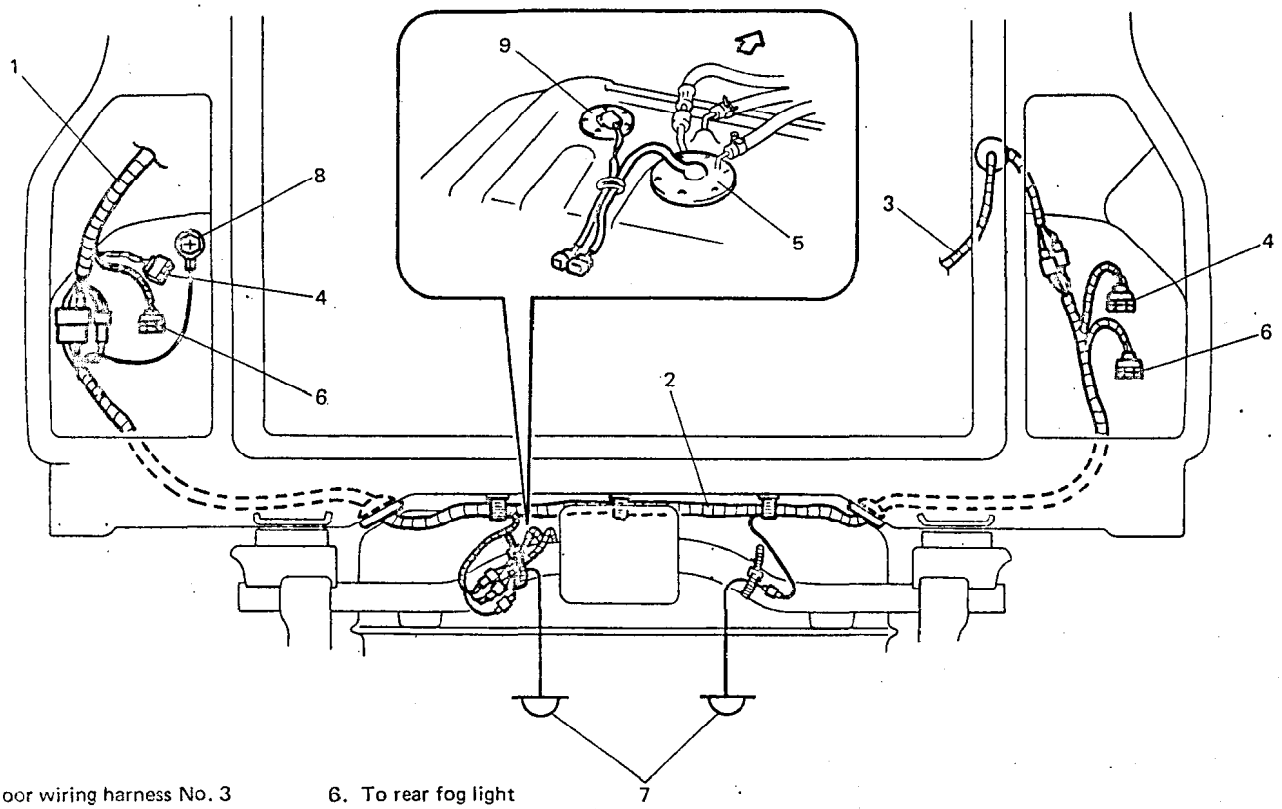
1. Battery positive (+) terminal
2. Engine wiring harness No. 5
3. To transmission wiring harness No. 6
4. To injector
5. Idle speed control solenoid valve
6. Air temperature sensor
7. Throttle position sensor
8. Water temperature sensor
9. Oil pressure switch
10. To V.S.V.
11. Ground
12. Water temperature gauge unit
13. Generator
14. Main wiring harness No. 1
15. Starter
16. Generator "B" terminal wire
17. Cylinder block

Fig. 8-9 Engine Room Wiring No. 2



1. To main switch
2. To turn signal/dimmer switch
3. Door lock controller (If equipped)
4. To turn signal relay
5. Control relay
6. Electric control module
7. Ground
8. To instrument panel wiring harness No. 2
9. To brake light switch
10. To blower motor speed selecting switch
11. To A/C wiring harness (Optional)
12. Blower resister
13. To blower motor
14. Main wiring harness No. 1

Fig. 8-10 Cowl Upper Wiring



1. Floor wiring harness No. 3
2. Rear wiring harness No. 4
3. Back door harness
4. To rear combination light
5. Fuel pump
6. To rear fog light
7. License light
8. Ground
9. Fuel level gauge

Fig. 8-11 Rear Wiring

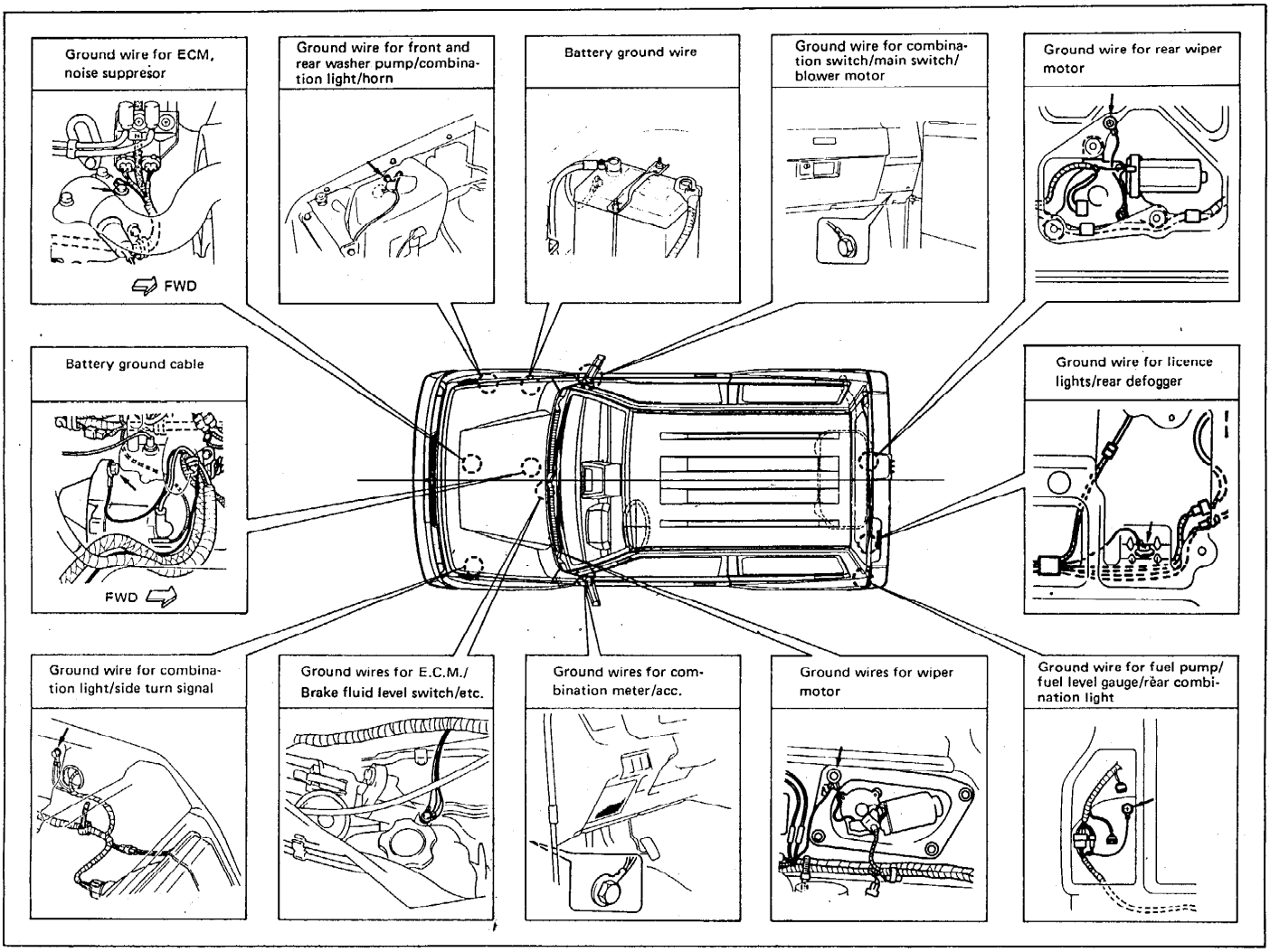
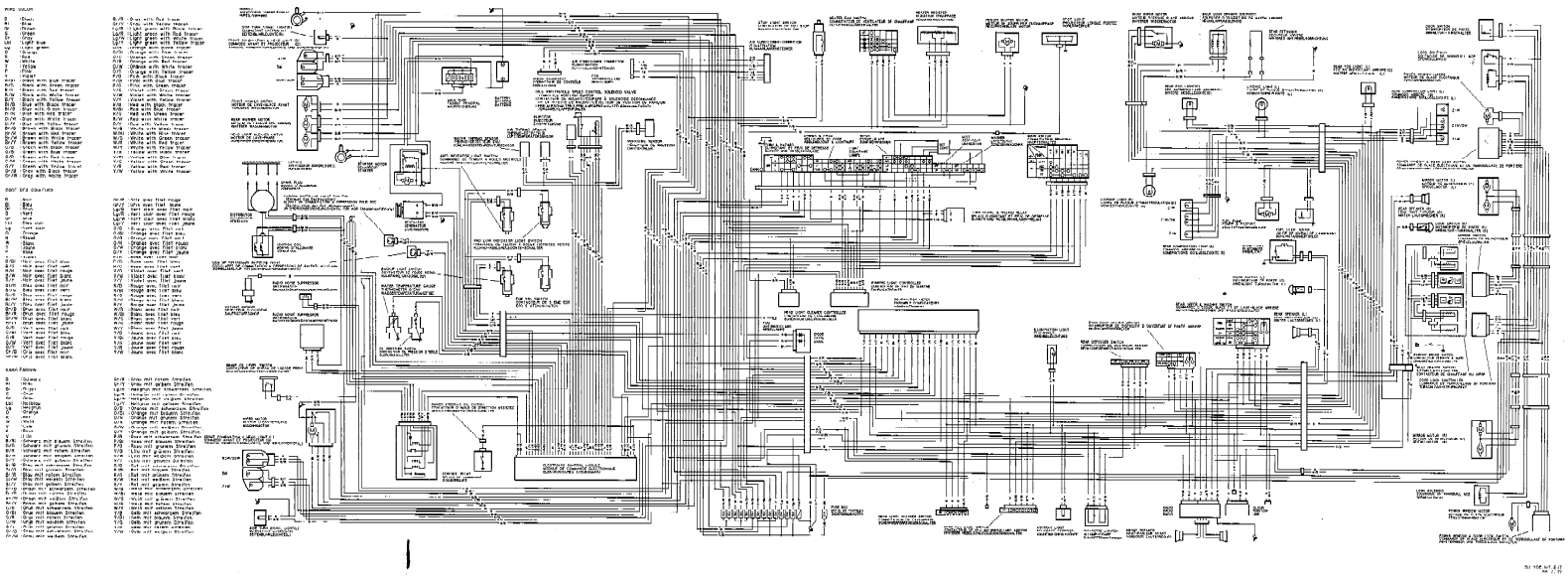


Fig. 8-12 Grounding Points

WIRING DIAGRAM



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