SUZUKI

SF413

SUPPLEMENTARY SERVICE MANUAL

GS/GL/GLX WITH ELECTRONIC FUEL INJECTION SYSTEM

USE THIS MANUAL WITH:
SF413 SERVICE MANUAL (99500-63B00)

SUZUKI
Caring for Customers
99501-63B01-18E
(英)

FOREWORD

This SUPPLEMENTARY SERVICE MANUAL is a supplement to "SF413 GA/GS/GL/GLX MODEL SERVICE MANUAL".
It has been prepared exclusively for "SF413 GS/GL/GLX MODEL WITH ELECTRONIC FUEL INJECTION SYSTEM."

It describes single point Electronic Fuel Injection system and different service information of "THOSE MODELS WITH ELECTRONIC FUEL INJECTION SYSTEM" as compared with "THOSE MODELS WITH CARBURETOR."

Therefore, whenever servicing "SF413 GS/GL/GLX MODEL WITH ELECTRONIC FUEL INJECTION SYSTEM", consult this supplement first. And for any section, item or description not found in this supplement, refer to "SF413 GA/GS/GL/GLX MODEL SERVICE MANUAL.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. And used as the main subject of description is the vehicle of standard specifications among others. Therefore, note that illustrations may differ from the vehicle being actually serviced. The right is reserved to make changes at any time without notice.

SUZUKI MOTOR CORPORATION
TECHNICAL DEPARTMENT
AUTOMOBILE SERVICE DIVISION

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SECTION 0B

MAINTENANCE AND LUBRICATION

CONTENTS

MAINTENANCE SCHEDULE

NORMAL CONDITION SCHEDULE

Interval: This interval should be judged by odometer reading or months, whichever comes first.	This table includes services as scheduled up to 48,000 miles (80,000 km) mileage. Beyond 48,000 miles (80,000 km), carry out the same services at the same intervals respectively.								
	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
1. ENGINE									
1-1. Water pump belt (tension, damage)		–	–	–	I	–	–	–	R
1-2. Valve lash (clearance)		–	I	–	I	–	I	–	I
1-3. Engine oil and Engine oil filter	API Grade SD, SE or SF	R	R	R	R	R	R	R	R
1-4. Cooling system, hoses and connections (leakage, damage)		–	I	–	I	–	I	–	I
1-5. Engine coolant		–	–	–	R	–	–	–	R
1-6. Exhaust pipes and mountings (leakage, damage, tightness)		–	I	–	I	–	I	–	I
1-7. Wiring harness and connections		–	–	–	I	–	–	–	I
2. IGNITION SYSTEM									
2-1. Spark plugs		–	–	–	R	–	–	–	R
2-2. Distributor cap and rotor (crack, wear)		–	–	–	I	–	–	–	I
2-3. Ignition wiring		–	–	–	–	–	–	–	R
2-4. Ignition timing		–	–	–	I	–	–	–	I
2-5. Distributor advancer		–	–	–	I	–	–	–	I
3. FUEL SYSTEM									
3-1. Air cleaner filter element	Paved-road	–	–	–	R	–	–	–	R
	Dusty condition	Refer to "Severe Driving Condition" schedule							
3-2. Fuel tank, cap & lines (Deterioration, leakage, damage)		–	–	–	I	–	–	–	I(R)
4. EMISSION CONTROL SYSTEM									
4-1. PCV (Positive Crankcase Ventilation)Valve		–	–	–	–	–	–	–	I
4-2. Charcoal canister		–	–	–	–	–	–	–	I
5. BRAKE									
5-1. Brake discs and pads (thickness, wear, damage) Brake drums and shoes (wear, damage)		I	–	I	–	I	–	I	–
5-2. Brake hoses and pipes (leakage, damage, clamp)		I	–	I	–	I	–	I	–
5-3. Brake fluid		–	I	–	I	–	I	–	R
5-4. Brake lever and cable (damage, stroke, operation)		I	–	I	–	I	–	I	–
5-5. Brake pedal		–	I	–	I	–	I	–	I

Interval: This interval should be judged by odometer reading or months, whichever comes first.	This table includes services as scheduled up to 48,000 miles (80,000 km) mileage. Beyond 48,000 miles (80,000 km), carry out the same services at the same intervals respectively.								
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	Miles (x 1,000)	6	12	18	24	30	36	42	48
	Months	6	12	18	24	30	36	42	48
6. CHASSIS AND BODY									
6-1. Clutch (For manual transmission) pedal free travel		I	I	I	I	I	I	I	I
6-2. Tires/wheel discs (wear, damage, rotation)		I	I	I	I	I	I	I	I
6-3. Drive axle boots (breakage, damage)		I	I	I	I	I	I	I	I
6-4. Suspension system (Tightness, damage, rattle, breakage)		I	I	I	I	I	I	I	I
6-5. Steering system (tightness, damage, breakage, rattle)		I	I	I	I	I	I	I	I
6-6. Manual transmission oil (leakage, level)		I	R	I	R	I	R	I	R
6-7. Automatic transmission	Fluid level	I	I	I	I	I	I	I	I
	Fluid change	Replace every 160,000 km (100,000 miles)							
	Fluid hose	—	—	—	—	—	R	—	—
6-8. Door hinges & Gear shift control lever/shaft		I	I	I	I	I	I	I	I

NOTES:
"R" : Replace or change
"I" : Inspect and correct or replace if necessary

Item 3-2 (R) is applicable only to the fuel tank cap.

MAINTENANCE RECOMMENDED UNDER SEVERE DRIVING CONDITIONS

If the car 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 — Repeated short trips
B — Driving on rough and/or muddy roads
C — Driving on dusty roads
D — Driving in extremely cold weather and/or salted roads
E — Repeated short trips in extremely cold weather

Severe Condition Code	Maintenance	Maintenance Operation	Maintenance Interval
— — C D E —	Engine oil and oil filter	R	Every 5,000 km (3,000 miles) or 3 months
— — C — — —	Air cleaner filter element *1	I	Every 2,500 km (1,500 miles)
		R	Every 40,000 km (24,000 miles) or 24 months
— — — D — —	Fuel tank, cap and lines	I	Every 20,000 km (12,000 miles) or 12 months
A B C — E —	Brake discs and pads Brake drums and shoes	I	Every 10,000 km (6,000 miles) or 6 months
A B — D E —	Brake hoses and pipes	I	Every 10,000 km (6,000 miles) or 6 months
A B — — E —	Automatic transmission fluid change	R	Every 20,000 km (12,000 miles) or 12 months
— B C D —	Wheel bearings	I	Every 20,000 km (12,000 miles) or 12 months

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

NOTES:

"R": Replace or change "I" : Inspect and correct or replace if necessary

MAINTENANCE SERVICE

ENGINE

1-1
Water Pump Belt Inspection and Replacement

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

[Inspection]

1) Inspect belt for cracks, cuts, deformation, wear and cleanliness. Replace, if necessary.
2) Check pump belt for tension and adjust it as necessary. Refer to SECTION 6B for its procedure.

[Replacement]

Replace belt. Refer to SECTION 6B for replacement procedure of pump belt.

1-2
Valve Lash Inspection

1) Remove cylinder head cover.
2) Inspect intake and exhaust valve lash and adjust as necessary.
   Refer to SECTION 6A for valve lash inspection and adjustment procedures.

		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.)

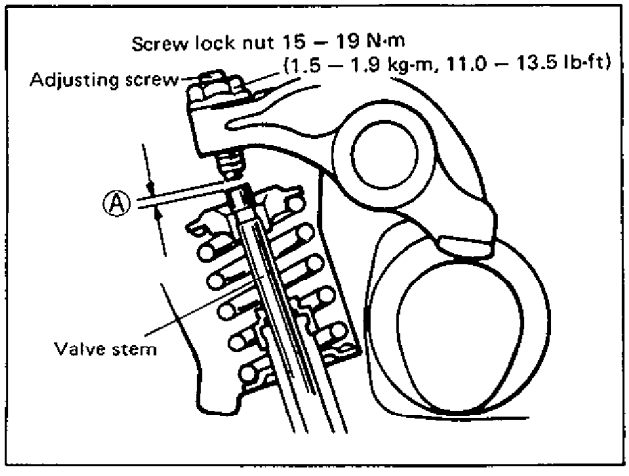


Fig. 0B-1-1

3) Install cylinder head cover and tighten bolts to specification.

1-3
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 following work.

1) Drain engine oil by removing drain plug.
2) After draining oil, wipe drain plug clean. Reinstall drain plug, and tighten it securely as specified in figure below.

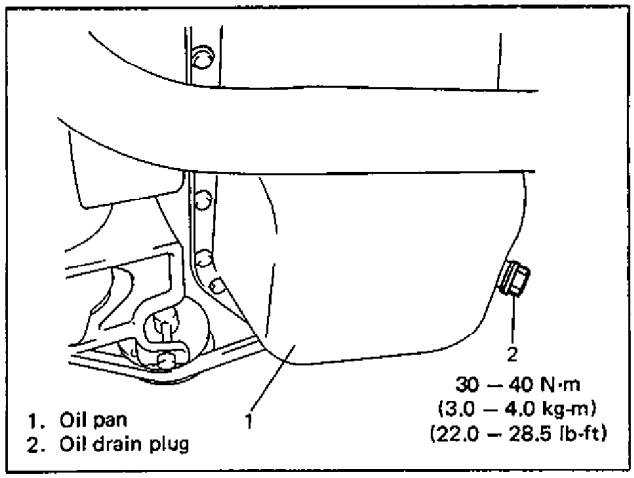


Fig. 0B-1-2

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

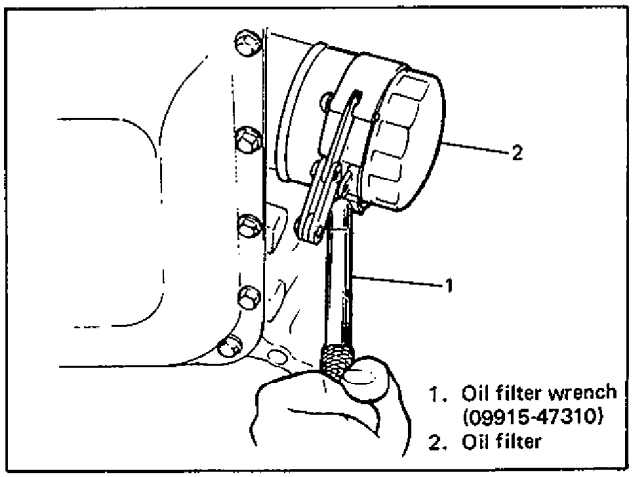


Fig. 0B-1-3

NOTE:
Before fitting new oil filter, be sure to apply engine oil to its "O" ring.

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

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

5) Using oil filter wrench, tighten filter 3/4 turn from contact point described above.

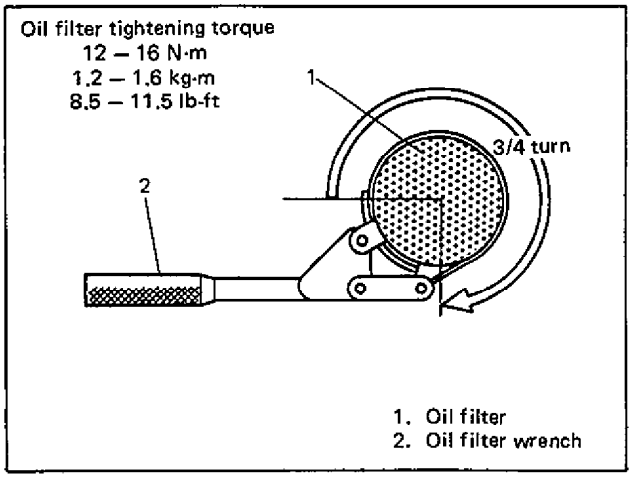


Fig. 0B-1-4

6) Replenish oil until oil level is brought to FULL level mark on dipstick. (about 3.3 liters or 6.9/5.8 US/Imp pt.). Filler inlet is at the top of cylinder head cover.
7) Start engine and run it for three minutes. Stop it and wait another 3 minutes before checking oil level. Add oil, as necessary, to bring oil level to FULL level mark on dipstick.

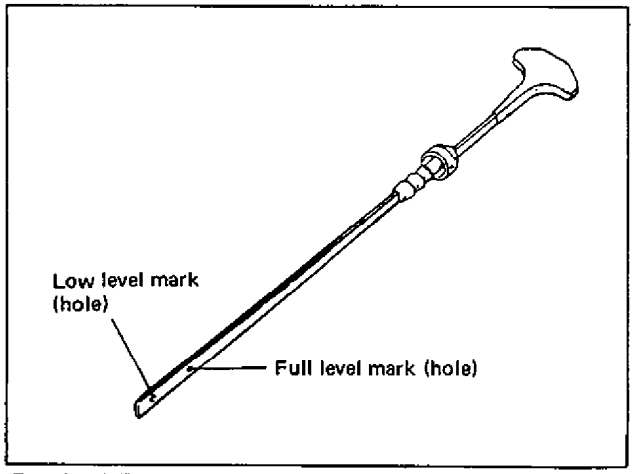


Fig. 0B-1-5

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.

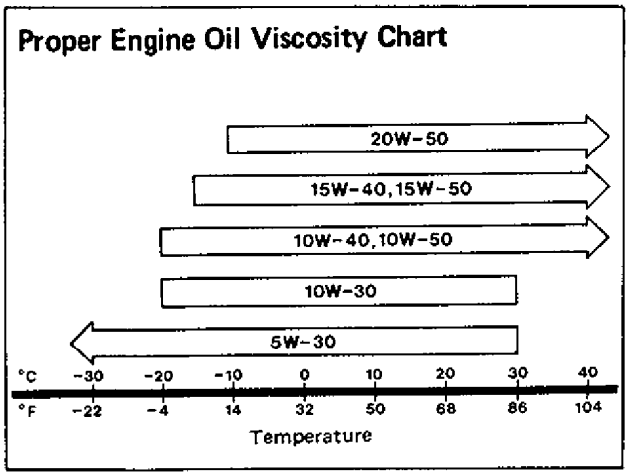


Fig. 0B-1-5-1

Engine oil capacity

Oil pan capacity	about 3.1 liters (6.5/5.5 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 3.6 liters (7.5/6.3 US/Imp pt.)

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

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

1-4
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.

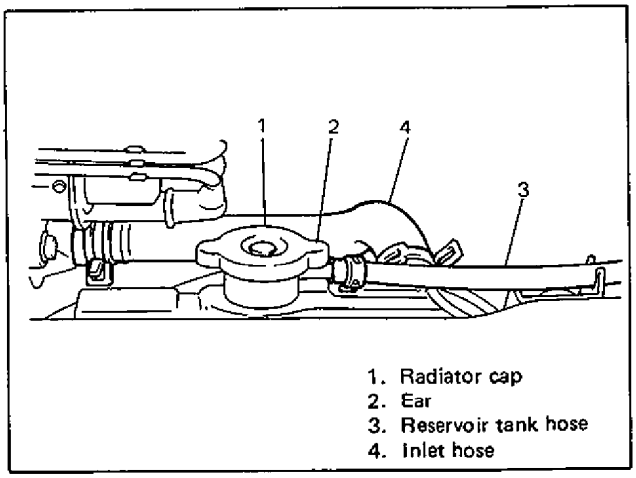


Fig. 0B-1-6

2) Replace all hoses which show evidence of leakage, cracks or other damage. Replace all clamps which cannot maintain proper tightness.
3) Clean frontal area of radiator core.
4) Test system and radiator cap for proper pressure holding capacity, 0.9 kg/cm² (12.8 psi). If replacement cap is needed, use a cap designed for cooling system of this car.
5) Check coolant level and concentration.
   Add if necessary.
   Refer to COOLANT LEVEL of SECTION 6B for procedure of level check.

1-5
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, and drain.
4) Tighten plug securely. Also reinstall reservoir tank.

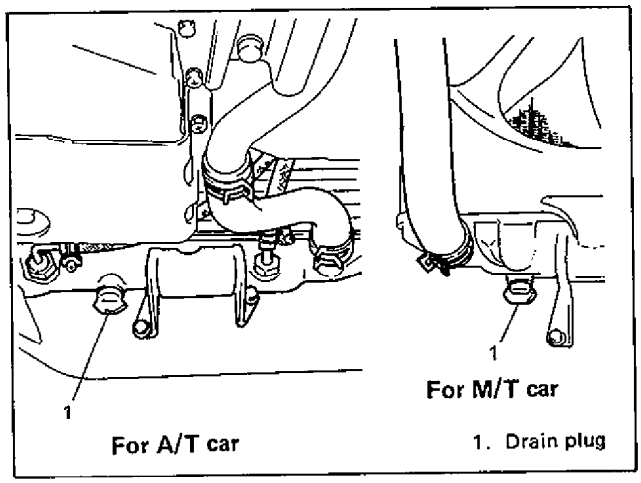


Fig. 0B-1-7

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 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 tank and cap.

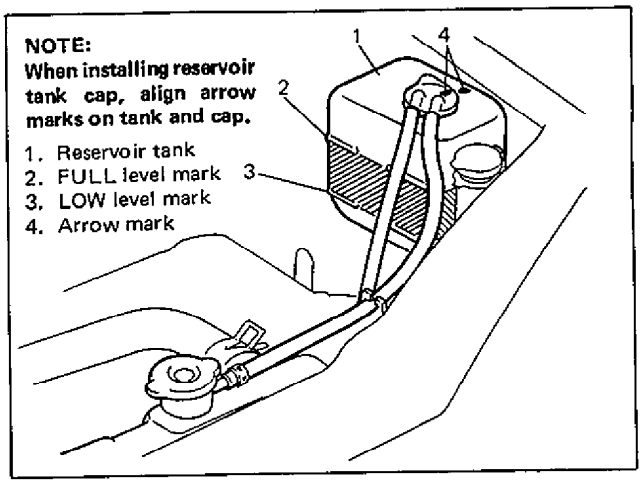


Fig. 0B-1-8

CAUTION:
When changing engine coolant, use mixture of 50% water and 50% ETHYLENE GLYCOL BASE COOLANT (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% ETHYLENE GLYCOL BASE COOLANT (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% ETHYLENE GLYCOL BASE COOLANT (ANTIFREEZE/ANTICORROSION COOLANT) should be used for the purpose of corrosion protection and lubrication.

Refer to SECTION 6B for COOLANT CAPACITY.

1-6
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 car is raised for other service, check exhaust system as follows:

- Check rubber mountings for damage and deterioration.
- Check muffler pipe for leakage, loose connections, dents, and damages.
  If bolts or nuts are loose, tighten them to specification. Refer to SECTION 6K 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 car.
- Make sure that exhaust system components have enough clearance from underbody to avoid overheating and possible damage to floor carpet.
- Any defects should be fixed at once.

1-7
Wiring Harness and Connections Inspection

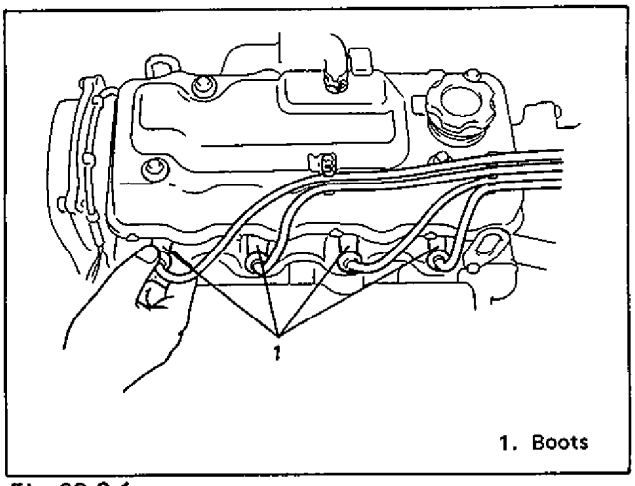
1) Visually inspect all wires in engine compartment for evidence of breakage.
   Inspect condition of insulation (cracks). All clips and clamps should have solid connections to wires.
2) Replace any wires in a deteriorated or otherwise defective condition.

IGNITION SYSTEM

2-1
Spark Plugs Replacement

Replace spark plugs as follows:

1) Dust off cylinder head around spark plugs.
2) Disconnect high tension cords at spark plugs.
   To avoid inside damage of cords, DO NOT pull on cords for disconnection. Pull on caps.



1. Boots

Fig. 0B-2-1

3) Using a spark plug wrench, remove spark plugs.
4) Check plug gaps of new spark plugs, and adjust them to specification as necessary.

Spark Plug Specifications	
Plug type	NGK BPR6ES DENSO W20EPR-U
Plug gap	0.7 – 0.8 mm (0.028 – 0.032 in)
Tightening torque	25 – 30 N·m (2.5 – 3.0 kg-m) (18.0 – 21.5 lb-ft)

5) Install new spark plugs. Tighten plugs to specification.
6) Connect high tension cords to spark plugs. DO NOT push cords for connection. Push caps.

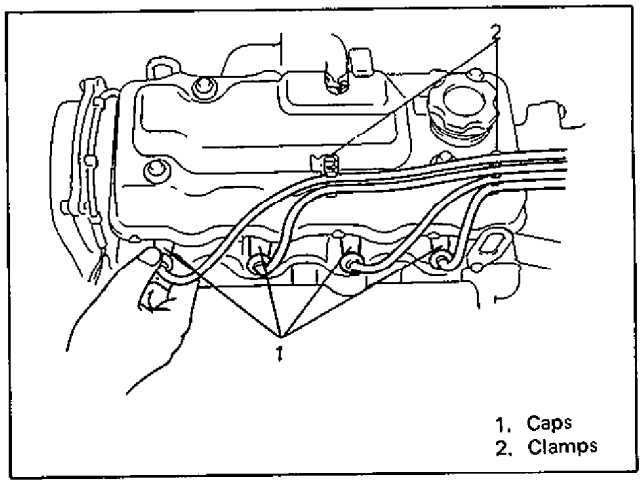
2-2
Distributor Cap and Rotor Inspection

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

2-3
Ignition Wiring (high-tension cord) 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 cap.



1. Caps
2. Clamps

Fig. 0B-2-2

2-4
Ignition Timing Inspection
Check to make sure that ignition timing is set properly. If out of specification, adjust it.
Refer to page 6F-7 of this supplement for inspection and adjustment procedure.

2-5
Distributor Advancer Inspection
Check centrifugal and vacuum advancers for proper operation. Refer to page 6F-6 of this supplement for checking procedure.
Check vacuum hose for pinhole, crack or breakage. Correct or replace if necessary.

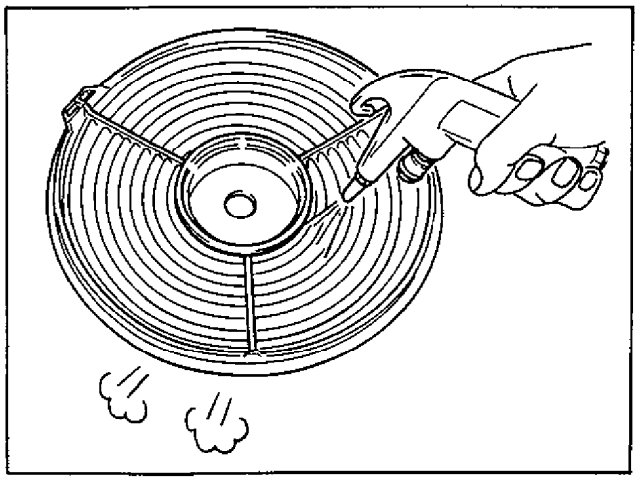


Fig. 0B-3-1

FUEL SYSTEM

3-1
Air Cleaner Element Replacement

NOTE:
Replace more often under dusty conditions. Ask your dealer for proper replacement interval for your driving conditions.

Replace air cleaner element with new one according to procedure described in p. 6A-6 of this supplement.

Air Cleaner Element Inspection
1) Visually check that air cleaner element is not excessively dirty, damaged or oily.
2) Clean element with compressed air from air outlet side of element (i.e., the side facing down when installed).

NOTE:
If car is used in dusty area, clean every 2,500 km (1,500 miles) or more frequently.

3-2
Fuel Tank, Cap Gasket and Fuel Lines Inspection
- Check fuel tank, fuel filler cap and fuel lines for loose connection, deterioration or damage which could cause leakage.
  Make sure all clamps are secure.
- Check fuel filler cap gasket for an even filler neck imprint or any damage.
- Replace any damaged or deteriorated parts.
  There should be no sign of fuel leakage or moisture at any fuel connection.

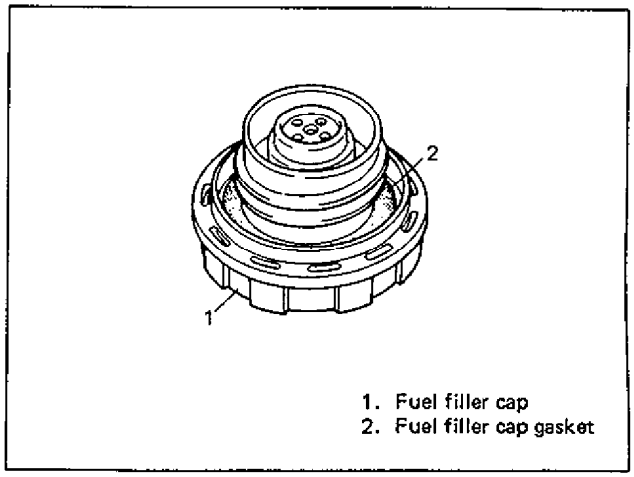


Fig. 0B-3-2

EMISSION CONTROL SYSTEM

4-1
PCV (Positive Crankcase Ventilation) Valve Inspection

Check PCV hose for leaks, cracks or clog, and PCV valve for stick or clog. Refer to SECTION 6J of this supplement for PCV valve checking procedure.

4-2
Charcoal Canister Inspection

Check charcoal canister. Refer to SECTION 6J of this supplement for procedures to check charcoal canister.

BRAKE

5-1
Brake Discs, Pads, Drums and Shoes Inspection

Brake discs and pads

1) Remove wheel and caliper but don't disconnect brake hose from caliper.
2) Check front disc brake pads and discs for excessive wear, damage and deflection. Replace parts as necessary. For the details, refer to SECTION 5.
   Be sure to torque caliper pin bolts to specification.

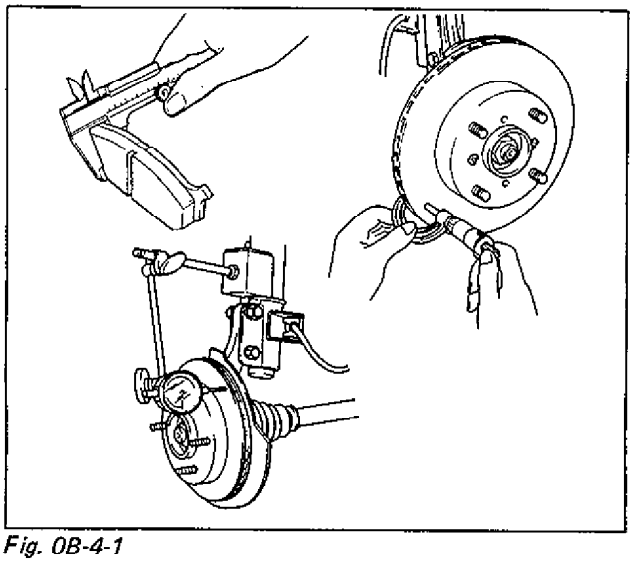


Fig. 0B-4-1

NOTE:
If noise is heard from front brake when brake pedal is depressed, check brake pad lining for wear. If it is worn, both right and left brake pads should be replaced with new ones.

CAUTION:
After replacing any brake pipe or hose, be sure to carry out air purge operation.

Brake drums and shoes

1) Remove wheel and brake drum.
2) Check rear brake drums and brake linings for excessive wear and damage, while wheels and drums are removed. At the same time, check wheel cylinders for leakage. Replace as necessary.
   For the details, refer to SECTION 5.

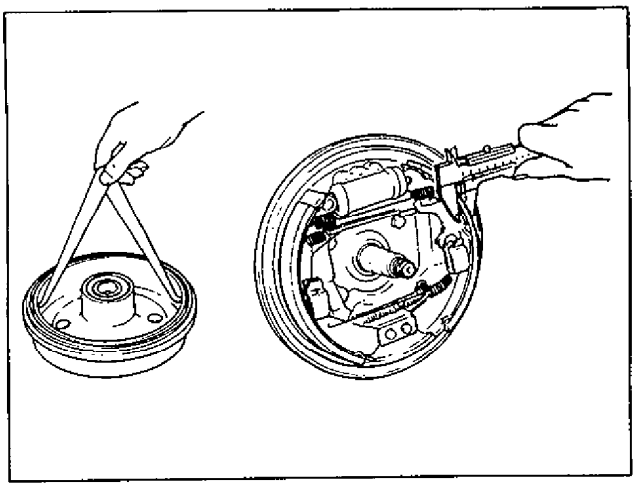


Fig. 0B-4-2

5-2

Brake Hoses and Pipes Inspection

Perform this inspection where there is enough light and use a mirror as necessary.

- Check brake hoses and pipes for proper hook-up, leaks, cracks, chafing, wear, corrosion bends, twists and other damage.
  Replace any of these parts as necessary.
- Check all clamps for tightness and connections for leakage.
- Check that hoses and pipes are clear of sharp edges, moving parts.

5-3

Brake Fluid Inspection and Change

[Inspection]

1) Check around master cylinder and reservoir for fluid leakage.
   If found leaky, correct.
2) Check fluid level
   If fluid level is lower than the minimum level of reservoir, refilling is necessary. Fill reservoir with specified brake fluid.

Brake fluid	Specification
	DOT3 or SAE J1703

For the details, refer to SECTION 5 "BRAKES".

CAUTION:
Since brake system of this car is factory-filled with glycol-base brake fluid, do not use or mix different type of fluid when refilling; otherwise serious damage will occur. Do not use old or used brake fluid, or unsealed container.

[Change]

Change brake fluid as follows.

Drain existing fluid from brake system completely, fill system with above recommended fluid and carry out air purge operation.

For air purging procedure, refer to SECTION 5 "BRAKES".

5-4

Brake Lever and Cable Inspection

Parking brake lever

- Check tooth tip of each notch for damage or wear. If any damage or wear is found, replace parking lever.
- Check parking brake lever for proper operation and stroke, and adjust it if necessary.
  For checking and adjusting procedures, refer to PARKING BRAKE INSPECTION AND ADJUSTMENT of SECTION 5 "BRAKES".

Parking brake cable

Inspect brake cable for damage and smooth movement. Replace cable if it is in deteriorated condition.

5-5

Brake Pedal Inspection

Check brake pedal travel.

For checking procedure, refer to PEDAL TRAVEL CHECK of SECTION 5 "BRAKES".

CHASSIS AND BODY

6-1
Clutch Pedal Free Travel Inspection

Check clutch pedal free travel. Refer to SECTION 7C for procedure to check and adjust it.

6-2
Tire and Wheel Disc Inspection

[Tire inspection]

- Check tire for uneven or excessive wear, or damage. If defective, replace.
- Check inflating pressure of each tire and adjust pressure to specification as necessary.

NOTE:

- **Tire inflation pressure should be checked when tires are cool.**
- **Specified tire inflation pressure should be found on tire placard or in owner's manual which came with car.**

[Wheel disc inspection]

Inspect each wheel disc for dents, distortion and cracks. A disc in badly damaged condition must be replaced.

[Tire rotation]

Rotate tires.

For details of above steps, refer to SECTION 3F.

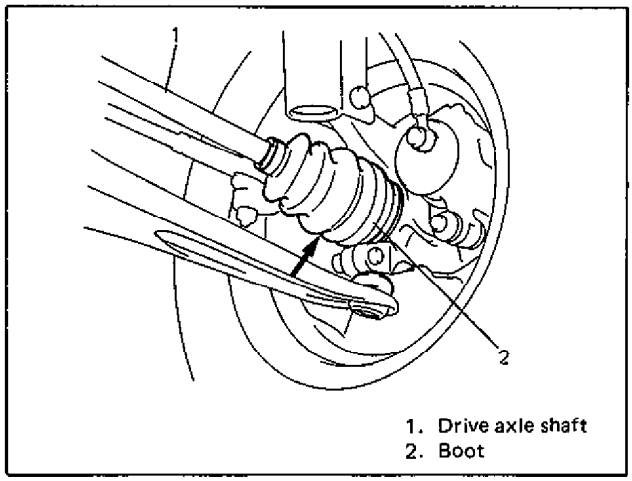
[Wheel Bearing Inspection]

1) Check front wheel bearing for wear, damage, abnormal noise or rattles. For details, refer to FRONT SUSPENTION INSPECTION of SECTION 3D.
2) Check rear wheel bearing for wear, damage abnormal noise or rattle. For details, refer to WHEEL BEARING INSPECTION of SECTION 3E.

6-3
Drive Axle Boot Inspection

Check drive axle boots (wheel side and differential side) for leakage, detachment, tear or any other damage.

Replace boot as necessary.

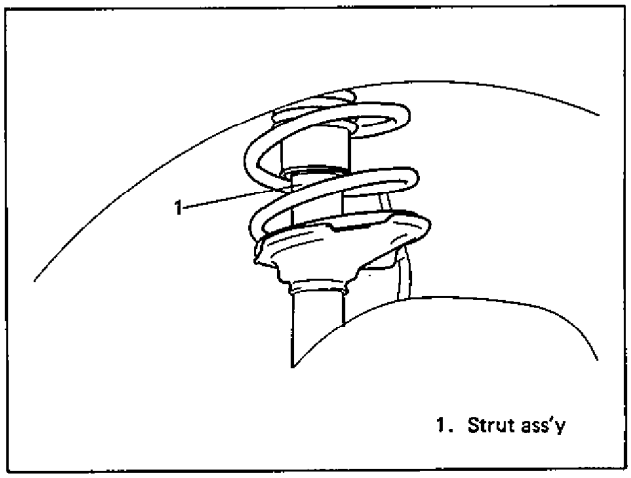


1. Drive axle shaft
2. Boot

Fig. 0B-5-1

6-4
Suspension System Inspection

- Inspect front & rear struts for evidence of oil leakage, dents or any other damage on sleeves; and inspect anchor ends for deterioration. Replace defective parts, if any.



1. Strut ass'y

Fig. 0B-5-2

- Check front and rear suspension systems for damaged, loose or missing parts; also for parts showing signs of wear or lack of lubrication.
  Repair or replace defective parts, if any.
- Check front suspension arm ball joint stud dust seals for leakage, detachment, tear, or any other damage.
  Replace defective boot, if any.

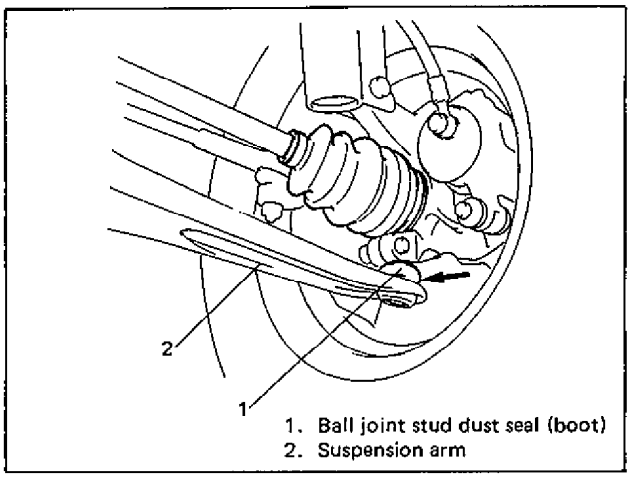


Fig. 0B-5-3

6-5
Steering System Inspection

1) Check steering wheel for play and rattle, holding car straight on ground.

Steering wheel play "A"	0 – 30 mm (0 – 1.2 in.)

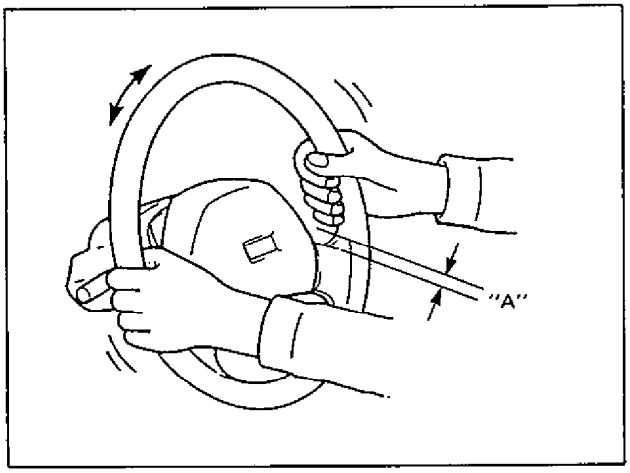


Fig. 0B-5-4

2) Check steering linkage for looseness and damage. Repair or replace defective parts, if any.
3) Check boots of steering linkage and steering gear case for damage (leaks, detachment, tear, etc.). If damage is found, replace defective boot with new one.
4) Check universal joints of steering shaft for rattle and damage. If rattle or damage is found, replace defective part with a new one.

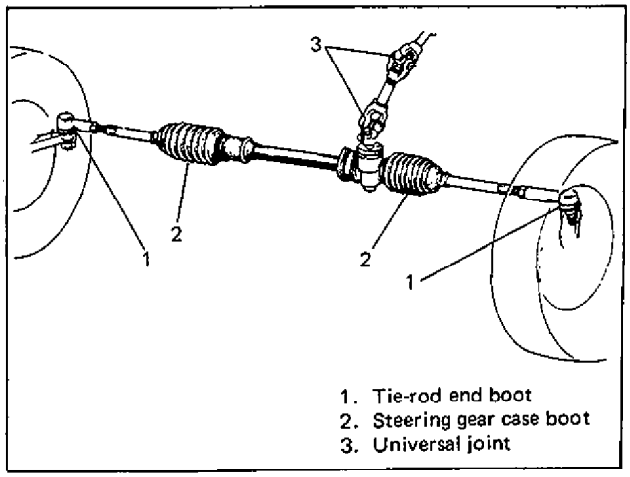


Fig. 0B-5-5

6-6
Manual Transmission Oil Inspection and Change

[Inspection]

1) Inspect transmission case for evidence of oil leakage.
   Repair leaky point if any.
2) Make sure that car is placed level for oil level check.
3) Remove level plug of transmission.
4) Check oil level.
   Oil level can be checked roughly by means of filler/level plug hole. That is, if oil flows out of level plug hole or if oil level is found up to hole when level plug is removed, oil is properly filled.
   If oil is found insufficient, pour specified oil up to level hole.
   For specified oil, refer to description of oil change under ON-CAR SERVICE in section 7A.

[Change]
1) Place the car level and drain oil by removing drain plug.
2) Apply sealant to drain plug and tighten drain plug to specified torque.
3) Pour specified oil up to level hole.
4) Tighten filler plug to specified torque.
For recommended oil, its amount and tightening torque data, refer to ON-CAR SERVICE of SECTION 7A.

6-7
Automatic Transmission
[Fluid level inspection]
1) Inspect transmission case for evidence of fluid leakage.
Repair leaky point, if any.
2) Make sure that car is placed level for fluid level check.
3) Check fluid level.
For fluid level checking procedure, refer to ON-CAR SERVICE in SECTION 7B and be sure to perform it under specified conditions.
If fluid level is low, replenish specified fluid.

[Fluid change]
1) Perform steps 1) and 2) of above Fluid Level inspection.
2) Change fluid. For its procedure, refer to ON-CAR SERVICE in SECTION 7B.

CAUTION:
Use of specified fluid is absolutely necessary.

[Fluid cooler hose change]
Replace inlet and outlet hoses of cooler hose and their clamps. For replacement procedure, refer to ON-CAR SERVICE in SECTION 7B.

6-8
Door Hinges, Gear Shift Control Lever and Shaft Lubrication
Check that doors and gear shift control lever move smoothly without abnormal noise.
If defective, lubricate as follows.
Wipe off dirt of door hinges and apply a thin coat of engine oil. Open and close door several times to insure that oil has worked in effectively.
Lubricate lever seat and shaft bushings with water resistant chassis grease.

FINAL INSPECTION

BODY PARTS OPERATION

Hood Latch
Check that hood opens and closes smoothly and properly. Also check that it locks securely when closed.

Doors
Check that each door opens and closes smoothly and locks securely when closed.

Seats
Check that seat slides smoothly and locks securely at any position. Also check that reclining mechanism of front seat back allows it to be locked at any angle.

ROAD TEST
Carry out road test in safe place.

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

Engine Start
Check engine start for readiness.

Clutch (For Manual transmission)
Check for the following.
- Clutch is completely released when depressing clutch pedal,
- No slipping clutch occurs when releasing pedal and accelerating,
- Clutch itself is free from any abnormal condition.

Gearshift or Selector Lever (Transmission)
Check gear shift or selector lever for smooth shifting to all positions and for good performance of transmission in any position.
With automatic transmission equipped car, also check that shift indicator indicates properly according to which position selector lever is shifted to.

CAUTION:
With automatic transmission equipped car, make sure that car is at complete stop when shifting selector lever to "P" range position.

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 car is stopped on the slope and brake lever is pulled all the way.

Steering
- Check to ensure that steering wheel is free from instability, or abnormally heavy feeling while driving.
- Check that the car does not wander or pull to one side.

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

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.

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

Lights
Check that all lights operate properly.

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 car so as to prevent any accident. And again make sure that no man or no other car is seen in front or behind and use great care to the surroundings when carrying out the test.

SECTION 6

ENGINE

CONTENTS

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 an 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 counted from crankshaft pulley side to flywheel side as shown in Fig. 6-1.

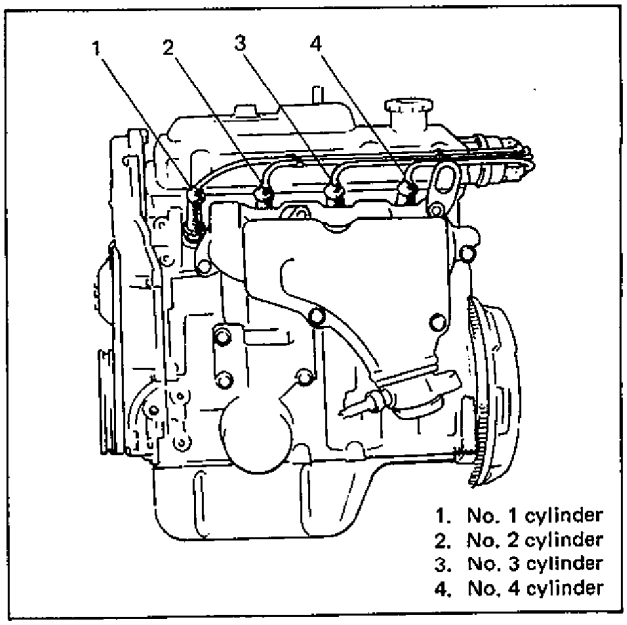


Fig. 6-1 Cylinder Numbers

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, 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.

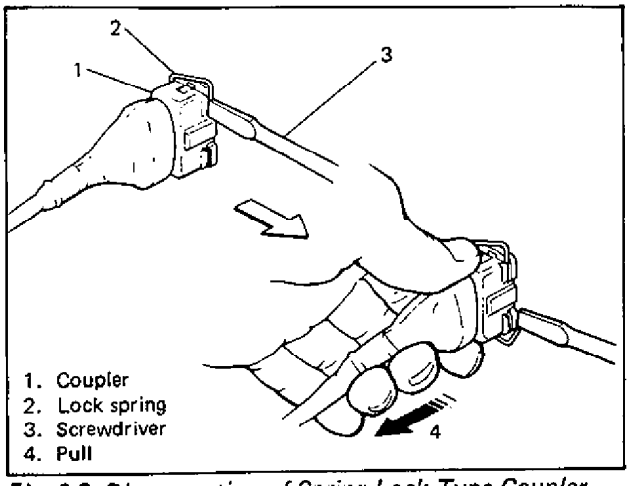


Fig. 6-2 Disconnection of Spring Lock Type Coupler

PRECAUTIONS ON FUEL LINE SERVICE

- Work must be done with no smoking, in a well-ventilated area and away from any open flames.
- 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 relieve fuel pressure according to "FUEL PRESSURE RELIEF PROCEDURE".
  A small amount of fuel may be released after the fuel line is disconnected.
  In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Put that cloth in an approved container when disconnection is completed.
- Fuel or fuel vapor hose connection varies with each type of pipe. When reconnecting fuel or fuel vapor hose, be sure to connect and clamp each hose correctly referring to Fig. 6-3 Hose Connection.
  After connecting, make sure that it has no twist or kink.

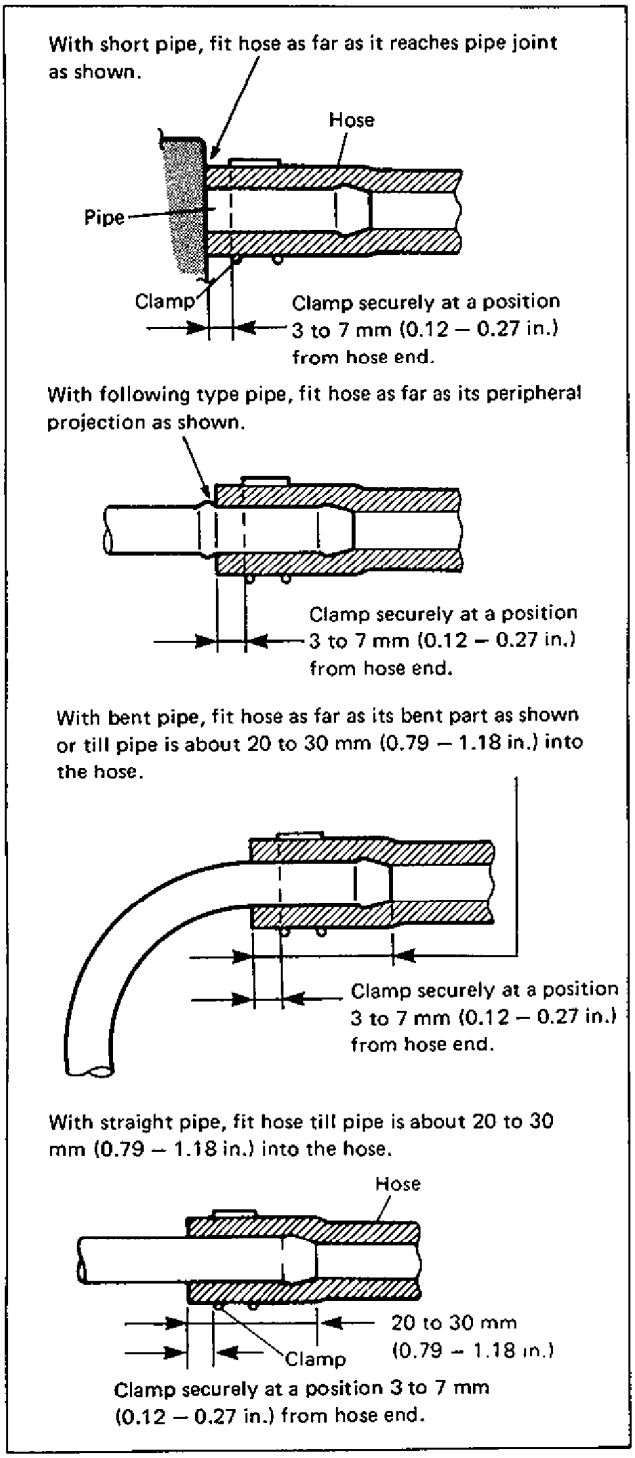


Fig. 6-3 Hose Connection

FUEL PRESSURE RELIEF PROCEDURE

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

After making sure that engine is cold, relief fuel pressure as follows.

1. Place transmission gear shift lever in "Neutral" (Shift selector lever to "P" range for A/T model), set parking brake, and block drive wheels.
2. Remove main fuse box cover and engine cooling water reservoir from its bracket.
3. Detach main fuse box from body and disconnect coupler from fuel pump relay.

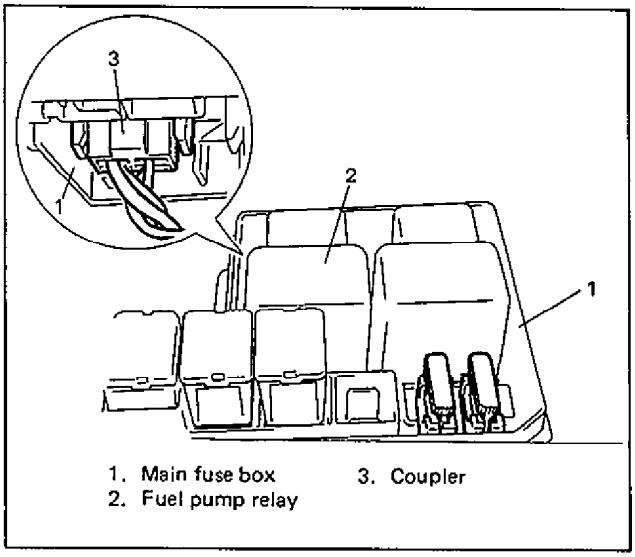


Fig. 6-4 Disconnecting Fuel Pump Relay Coupler

4. Remove fuel filler cap to release fuel vapor pressure in fuel tank and then reinstall it.
5. Start engine and run it till it stops for lack of fuel. Repeat cranking engine 2 – 3 times for about 3 seconds each time to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
6. Upon completion of servicing, connect coupler to fuel pump relay and fix main fuse box.

ABBREVIATIONS USED IN THIS SECTION

A/C	:	Air-Conditioner
A/T	:	Automatic Transmission
ATS	:	Air Temperature Sensor
BVSV	:	Bimetal Vacuum Switching Valve
ECM	:	Electronic Control Module
EGR	:	Exhaust Gas Recirculation
ISC	:	Idle Speed Control
M/T	:	Manual Transmission
PCV	:	Positive Crankcase Ventilation
TB	:	Throttle Body
TPS	:	Throttle Position Sensor
TS	:	Throttle Switch
VSV	:	Vacuum Switching Valve
WTG	:	Water Temperature Gauge

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
	• Faulty pickup coil or igniter	Replace
	• Improper ignition timing	Adjust
	• Faulty ignition coil	Replace
	• Cracked rotor or cap in distributor	Replace
	• Faulty noise suppressor	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
	• Air inhaling from intake manifold gasket or throttle body gasket	Replace
	Electronic Fuel Injection system out of order	Refer to SECTION 6E
	Low compression	
	• Poor spark plug tightening or faulty gasket	Tighten to specified torque or replace gasket
	• 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
	• Compression leak at cylinder head gasket	Repair or replace
	• Sticking or damaged piston ring	Replace
	• Worn piston, ring or cylinder	Replace ring and piston. Rebore or replace cylinder
	Others	
	• Broken valve timing belt	Replace
	• Malfunctioning PCV valve	Replace

Condition	Possible Cause	Correction
Engine has no power	**Ignition system out of order**	
	• Incorrect ignition timing	Adjust
	• Faulty 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
	Engine overheating	Refer to "Overheating" section
	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
	Electronic Fuel Injection system out of order	Refer to SECTION 6E
	Low compression	Previously outlined
	Others	
	• Loose connection or disconnection of vacuum hoses	Connect securely
	• Malfunctioning EGR valve (if equipped)	Check and replace as necessary
	• Dragging brakes	Repair or replace
	• Slipping clutch	Adjust or replace
Improper engine idling or engine fails to idle	**Ignition system out of order.**	
	• Faulty 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 with leakage inside	Replace
	• Malfunctioning ignition timing advancer	Replace

Condition	Possible Cause	Correction
	Fuel system out of order	
	• Shortage of fuel in fuel tank	Refill
	• 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
	Engine overheating	Refer to "Overheating" section
	Low compression	Previously outlined
	Others	
	• Loose connection or disconnection of vacuum hoses	Connect securely
	• Malfunctioning EGR valve (if equipped)	Check and replace as necessary
	• Malfunctioning PCV valve	Check and replace as necessary
Engine hesitates (Momentary lack of response as accelerator is depressed. Can occur at all car speeds. Usually most severe when first trying to make car move, as from a stop sign.)	**Ignition system out of order**	
	• Improper ignition timing	Adjust
	• Spark plug faulty or plug gap out of adjustment	Replace or adjust gap
	• Leaky high tension cord	Replace
	Fuel system out of order	
	• Clogged air cleaner element	Clean or replace
	• Clogged fuel filter, hose or pipe	Clean or replace
	Electronic Fuel Injection system out of order	Refer to SECTION 6E.
	Engine overheating	Refer to "Overheating" section
	Low compression	Previously outlined
	Others	
	• Malfunctioning EGR valve (if equipped)	Check and replace as necessary

Condition	Possible Cause	Correction
Surges (Engine power variation under steady throttle or cruise. Feels like car speeds up and down with no change in accelerator pedal.)	**Ignition system out of order**	
	• Improper ignition timing	Adjust
	• Malfunctioning ignition timing advancers	Replace
	• Leaky or loosely connected high-tension cord	Check and repair or replace
	• Faulty spark plug (excess carbon deposits, improper gap, and burned electrodes, etc.)	Check and clean, adjust or replace
	• Cracked rotor or cap in distributor	Replace
	Fuel system out of order	
	• Clogged fuel filter	Replace
	• Kinky or damaged fuel hose and lines	Check and replace as necessary
	Electronic Fuel Injection system out of order	Refer to SECTION 6E
	Others	
	• Malfunctioning EGR valve (if equipped)	Check and replace as necessary
Excessive detonation (Engine makes sharp metallic knocks that change with throttle opening. Sounds like pop corn popping.)	**Engine overheating**	Refer to "Overheating" section
	Ignition system out of order.	
	• Faulty spark plug	Replace
	• Improper ignition timing	Adjust
	• Loose connection of high tension cord	Connect securely
	Fuel system out of order.	
	• Clogged fuel filter or 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	
	• Loose connection or disconnection of vacuum hoses	Connect securely
	• Excessive combustion chamber deposits	Remove carbon
	• Malfunctioning EGR valve (if equipped)	Check and replace as necessary

Condition	Possible Cause	Correction
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
	Ignition system out of order	
	• Improper ignition timing	Adjust
	• Leaks or loose connection of high-tension cord	Repair or replace
	• Faulty spark plug (improper gap, heavy deposits, and burned electrodes, etc..)	Clean, adjust or replace
	• Malfunctioning mechanical and vacuum advancers in distributor	Check and repair or replace
	Electronic Fuel Injection system out of order	Refer to SECTION 6E
	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 (if equipped)	Check and replace as necessary

Condition	Possible Cause	Correction
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	• Not enough oil	Replenish
	• Improper oil viscosity	Use oil of proper viscosity
	• Malfunctioning oil pressure switch	Replace
	• 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
Engine noise Note: Before checking 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

Condition	Possible Cause	Correction
	Connecting rod noise	
	• Worn rod bearing	Replace
	• Worn crank pin	Repair by grinding or replace crankshaft
	• Loose connecting rod nuts	Tighten 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 to specification
	• Excessive crankshaft thrust play	Replace thrust bearing

SECTION 6A

ENGINE MECHANICAL

NOTE:
For the items not found in this section, refer to the same section of the SF413 Service Manual.

CONTENTS

NOTE:
In this section, the following system and parts appear in some description or illustrations, but whether they are installed in the particular car or not depends on specifications or models. Be sure to bear this in mind when performing inspection and service work.

- **EGR system (EGR valve, EGR modulator, VSV and vacuum hoses)**
  This system is installed in the California spec. model.

GENERAL DESCRIPTION

ENGINE

The component parts of the Electronic Fuel Injection system equipped engine are the same as those of the carburetor equipped one (described in SF413 Service Manual) except the intake manifold, exhaust manifold and distributor.

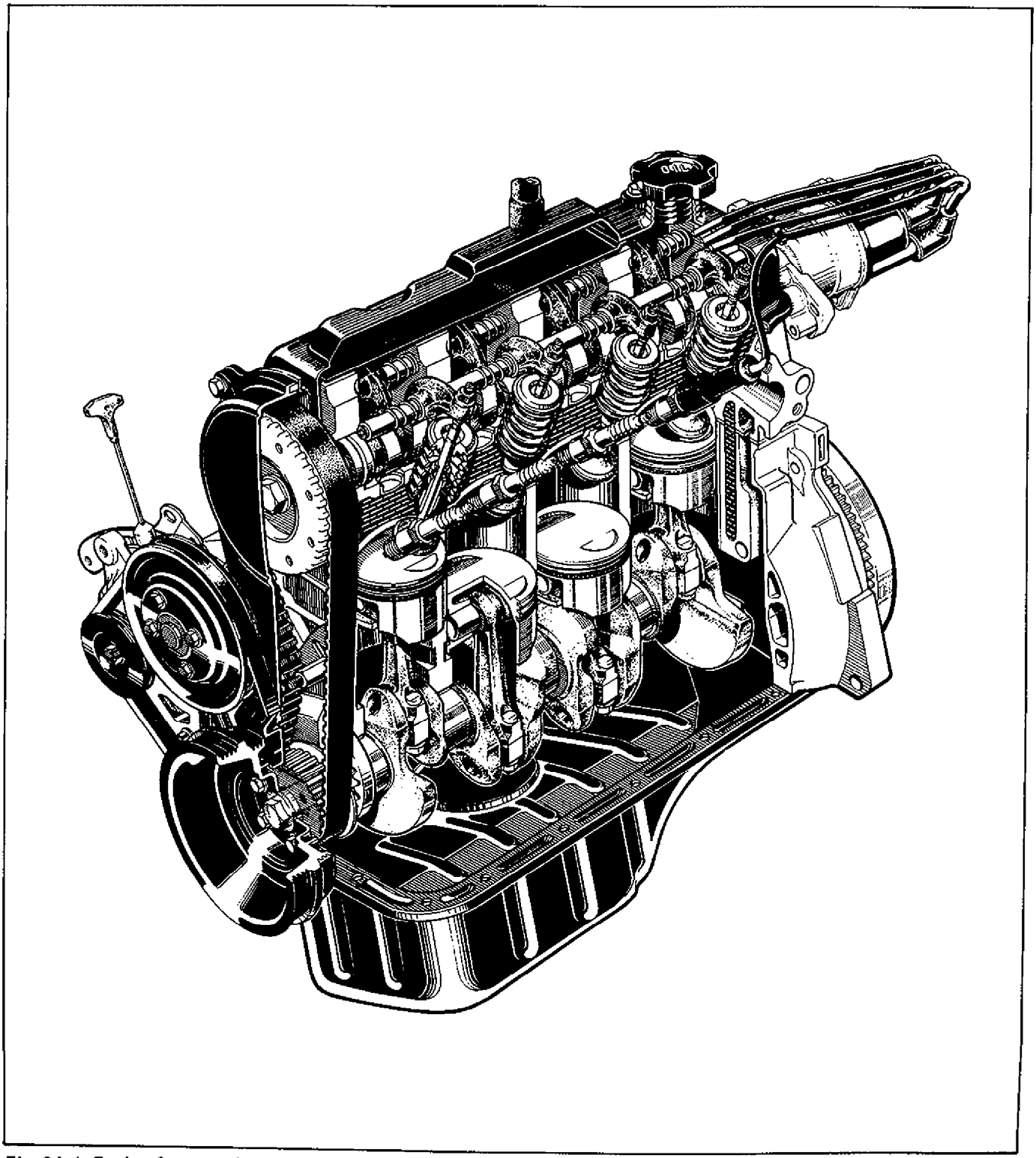


Fig. 6A-1 Engine Construction

Air induction passage of this engine is as follows.

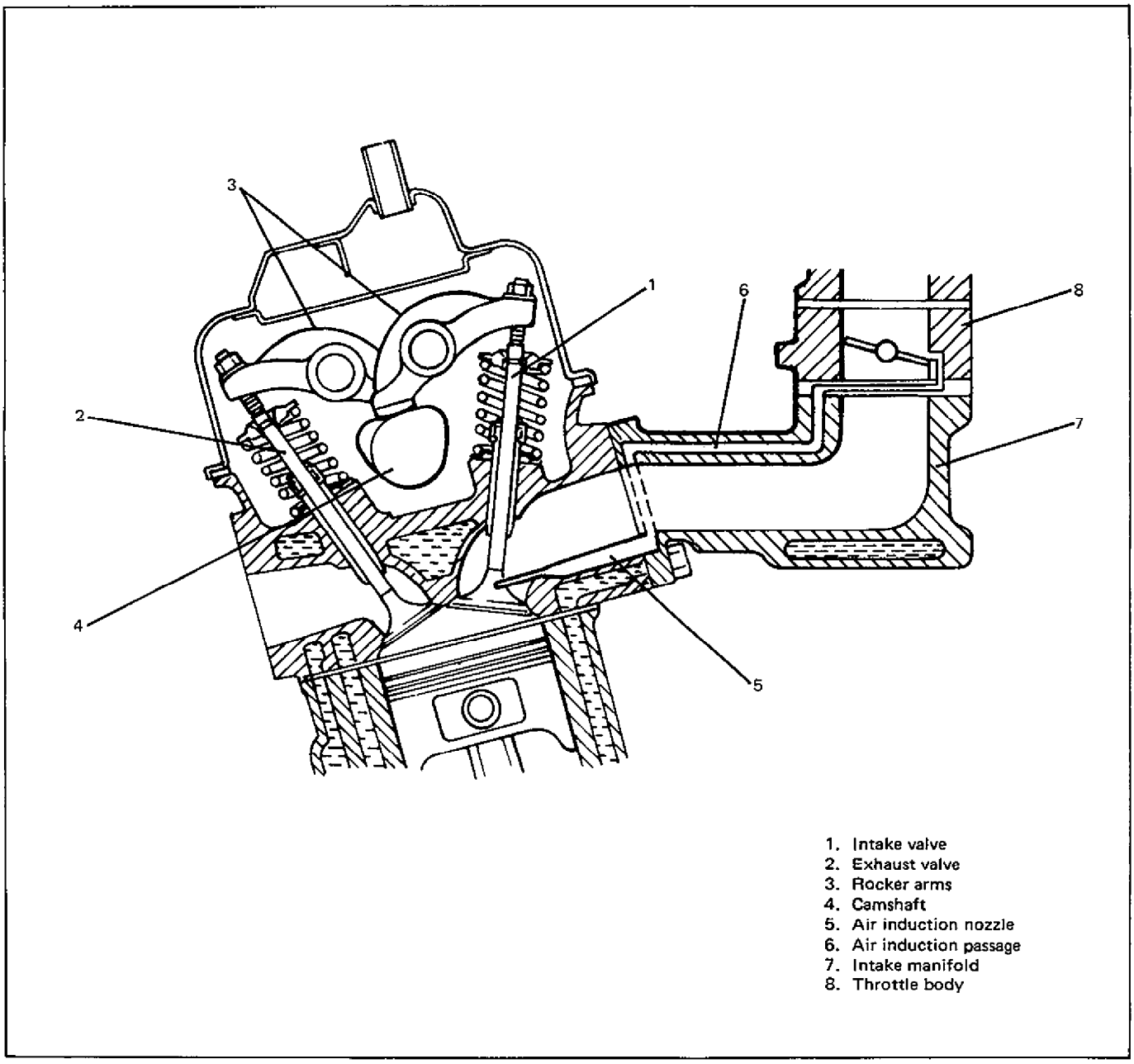


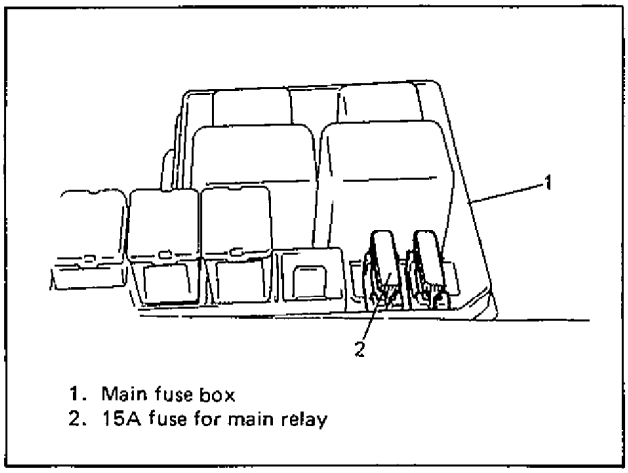
Fig. 6A-2 Cylinder Head and Valve Train

ON CAR SERVICE

COMPRESSION CHECK

Check compression pressure on all four cylinders as follows:

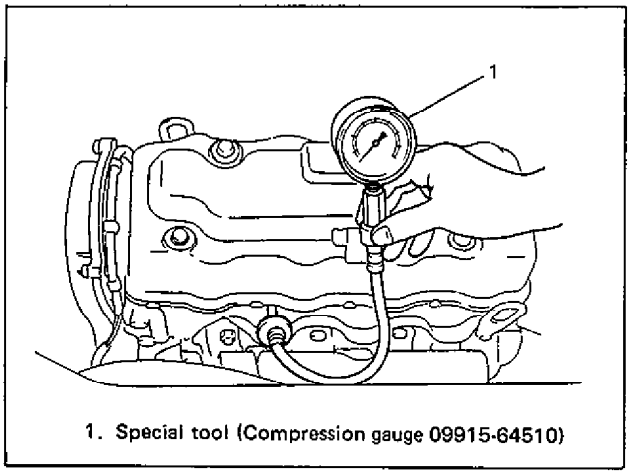
1. Warm up engine.
2. Stop engine after warming up.
3. Remove all spark plugs and disconnect distributor wire harness at coupler.
4. In this check, remove 15A fuse for main relay shown in below figure.
   This is to prevent diagnostic code No. 41 from being stored in ECM memory.



1. Main fuse box
2. 15A fuse for main relay

Fig. 6A-3 Removing 15A Fuse for Main Relay

5. Install special tool (Compression gauge) into spark plug hole.



1. Special tool (Compression gauge 09915-64510)

Fig. 6A-4 Installing Compression Gauge

6. Disengage clutch (to lighten starting load on engine) for M/T model, and depress accelerator pedal all the way to make throttle valve full-open.
7. Crank engine with fully charged battery, and read the highest pressure on compression gauge.

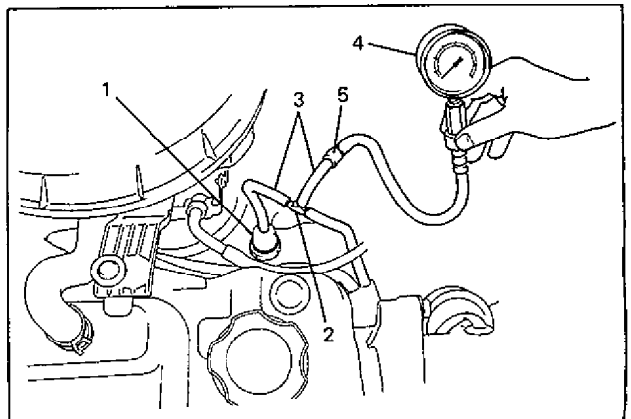
	Compression pressure
Standard	14.0 kg/cm² (199.0 psi, 1400 kPa)/400 r/min
Limit	11.0 kg/cm² (156.4 psi, 1100 kPa)/400 r/min
Max. difference between any two cylinders	1.0 kg/cm² (14.2 psi, 100 kPa)

8. Carry out steps 5 through 7 on each cylinder to obtain four readings.
9. After checking, install 15A fuse, connect coupler of distributor and install spark plugs.

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.
2. With engine stopped, disconnect vacuum hoses from gas filter and connect 3-way joint, hoses and the special tool (vacuum gauge and joint) between gas filter and vacuum hose disconnected.



1. Gas filter
2. 3-way joint (SUZUKI GENUINE PARTS 09367-04002)
3. Hoses (SUZUKI GENUINE PARTS 09343-03087)
4. Special tool (Vacuum gauge 09915-67310)
5. Special tool (Hose joint 09918-08210)

Fig. 6A-5 Installing Vacuum Gauge

3. Run engine at specified idle speed (see section 6E), and read vacuum gauge. Vacuum should be within following specification.

Vacuum specification	40 – 50 cmHg (15.7 – 19.7 in.Hg) at specified idling speed

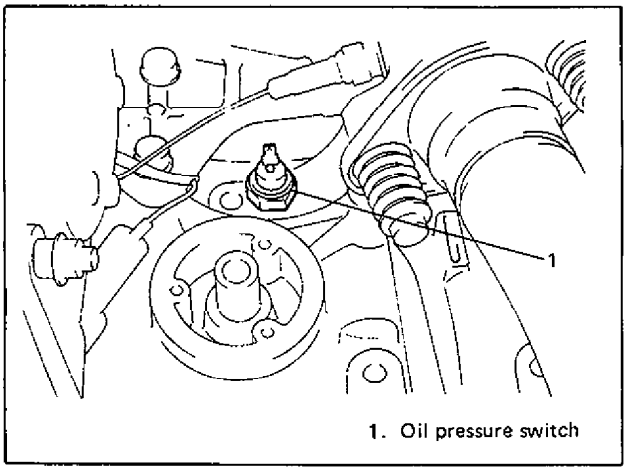
4. After checking, connect vacuum hose.

OIL PRESSURE CHECK

NOTE:
Prior to checking oil pressure, check the followings.

- **Oil level in oil pan.**
  If oil level is low, add oil up to Full level hole on oil level gauge.
- **Oil quality.**
  If oil is discolored, or deteriorated, change it. For particular oil to be used, refer to the table in Section 0B.
- **Oil leaks.**
  If leak is found, repair it.

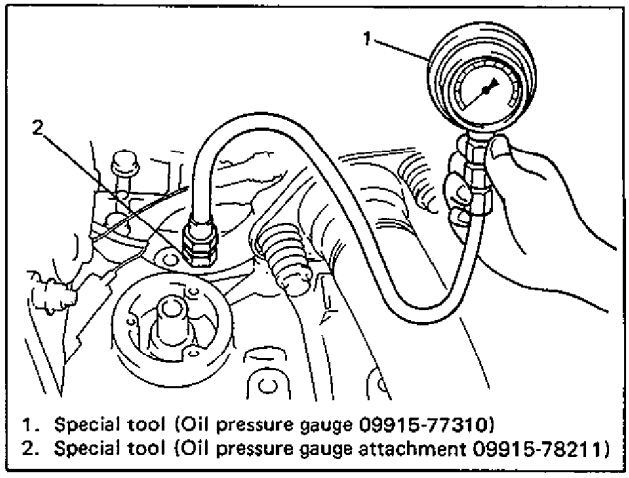
1. Using special tool (Oil filter wrench), remove oil filter.
2. After removing oil filter, remove oil pressure switch from cylinder block.



1. Oil pressure switch

Fig. 6A-6 Oil Pressure Switch

3. Install special tool (Oil pressure gauge) to vacated threaded hole.



1. Special tool (Oil pressure gauge 09915-77310)
2. Special tool (Oil pressure gauge attachment 09915-78211)

Fig. 6A-7 Oil Pressure Gauge Installation

4. Reinstall oil filter.
5. Start engine and warm it up to normal operating temperature.
6. After warming up, raise engine speed to 3,000 r/min and measure oil pressure.

Oil pressure specification	3.0 – 4.2 kg/cm² 42.7 – 59.7 psi at 3,000 r/min (rpm)

7. After checking oil pressure, stop engine and remove oil filter and oil pressure gauge.
8. Before reinstalling oil pressure switch, be sure to wrap its screw threads with a sealing tape and tighten switch to specified torque.

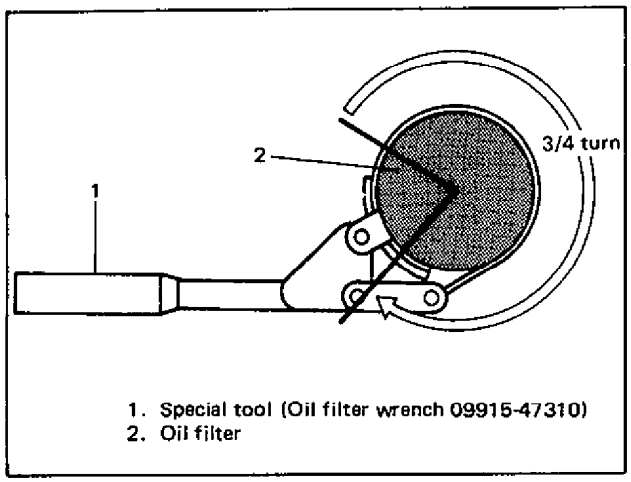
Tightening torque for oil pressure switch	N·m	kg-m	lb-ft
	12 – 15	1.2 – 1.5	9.0 – 10.5

NOTE:
If sealing tape edge is bulged out from screw threads of switch, cut it off.

9. After oiling oil filter "O" ring (rubber gasket), screw oil filter on oil filter stand by hand until filter "O" ring contacts mounting surface.

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

10. Tighten filter 3/4 (270°) turn from the point of contact with mounting surface using an oil filter wrench.



1. Special tool (Oil filter wrench 09915-47310)
2. Oil filter

Fig. 6A-8 Tightening Oil Filter

CAUTION:
To prevent oil leakage, make sure that oil filter is tight, but do not overtighten it.

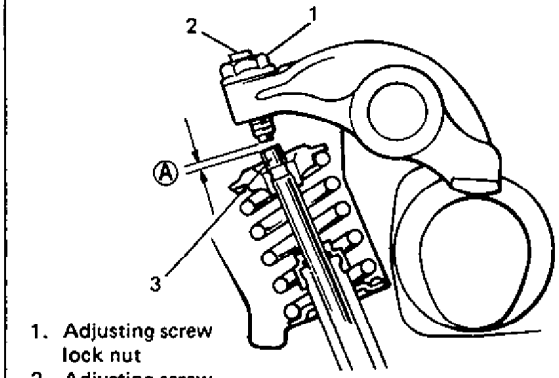
11. After installing oil filter, start engine and check oil filter for oil leakage.

VALVE LASH

VALVE LASH SPECIFICATIONS

Valve lash refers to the gap between the rocker arm adjusting screw and valve stem. Use a thickness gauge to measure this gap Ⓐ.

		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)

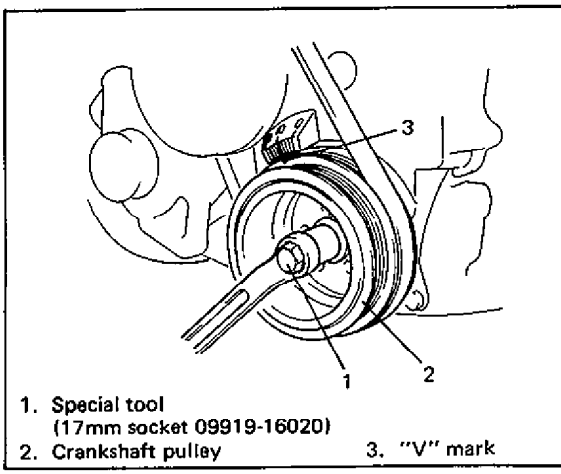


1. Adjusting screw lock nut
2. Adjusting screw
3. Valve stem

Fig. 6A-9 Valve Lash

CHECKING AND ADJUSTING PROCEDURES

1. Disconnect negative cable at battery.
2. Remove cylinder head cover, referring to item "Cylinder head cover" in this section.
3. Hoist car and remove fender apron extension on right side.
4. Using special tool (17 mm socket), turn crankshaft pully clockwise until "V" mark (in white paint) on pulley aligns with "0" (zero) calibrated on timing belt cover.



1. Special tool (17mm socket 09919-16020)
2. Crankshaft pulley
3. "V" mark

Fig. 6A-10 Aligning Marks

5. Remove distributor cap, and check if rotor is positioned as shown in figure. (i.e. No. 1 piston is at TDC of compression stroke). If rotor is out of place, turn crankshaft clockwise once (360°).
   In this state, check valve lashes at valves ①, ②, ⑤, and ⑦.

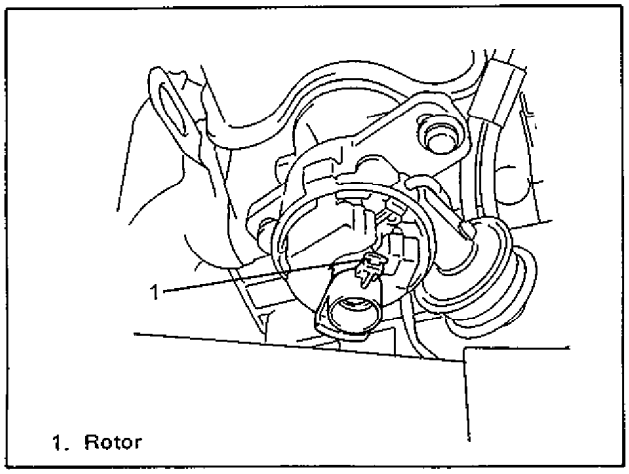


Fig. 6A-11 Checking Rotor Position

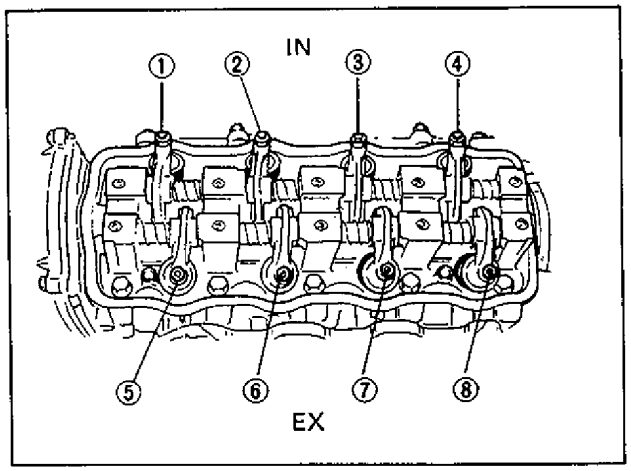


Fig. 6A-12 Valve Identification

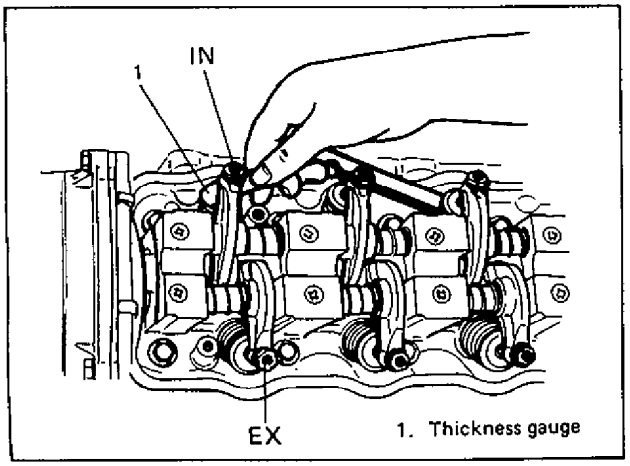


Fig. 6A-13 Checking Valve Lashes

6. If valve lash is out of specification, adjust it to specification by turning adjusting screw after loosening lock nut. After adjustment, tighten lock nut to specified torque while holding adjusting screw stationary with screwdriver, and then make sure again that valve lash is within specification.

Tightening torque for adjusting screw lock nut	N·m	kg-m	lb-ft
	15 – 19	1.5 – 1.9	11.0 – 13.5

7. After checking and adjusting valve lashes at valves ①, ②, ⑤ and ⑦, rotate crankshaft exactly one full turn (360°), and check the same at valves ③, ④, ⑥ and ⑧. Adjust them as necessary.
8. After checking and adjusting all valves, install cylinder head cover, distributor cap and air cleaner assembly.

AIR CLEANER ELEMENT

This air cleaner element is of dry type. Remember that it needs cleaning according to following procedure.

REMOVE OR DISCONNECT

1. Resonator hose from air cleaner nozzle.
2. Air cleaner upper case after removing case nut and clamps.

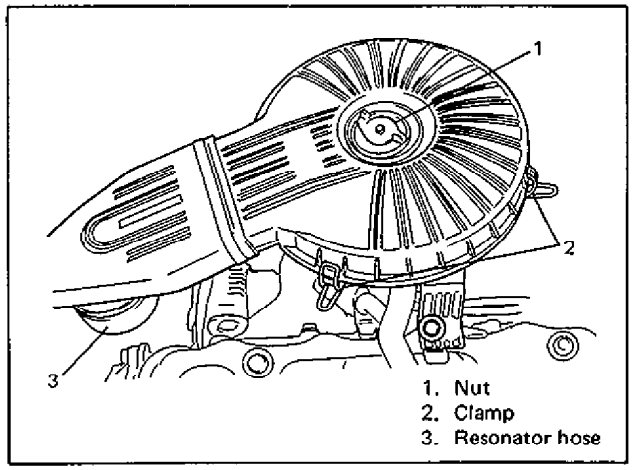


Fig. 6A-14 Removing Upper Case

3. Air cleaner element.

INSPECT
Check air cleaner element for dirt.

CLEAN
Blow off dust by compressed air from air outlet side of element.

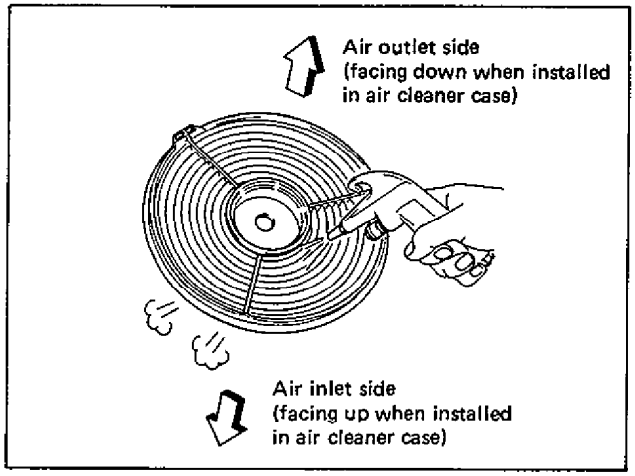


Fig. 6A-15 Cleaning Air Cleaner Element

INSTALL OR CONNECT
1. Air cleaner element to its lower case.
   Fit the lug of element to the recession of lower case as shwon in below figure.

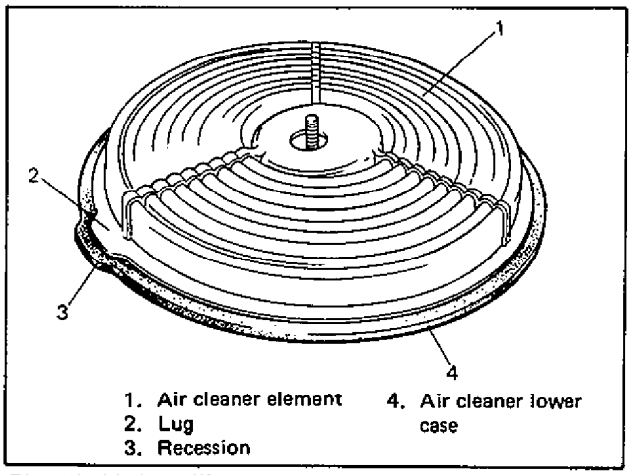


Fig. 6A-16 Installing Air Cleaner Element

2. Air cleaner upper case.
   Tighten case nut and clamps securely.
3. Resonator hose to air cleaner nozzle.

AIR CLEANER ASSEMBLY

REMOVE OR DISCONNECT
1. Negative cable at battery.
2. Coupler from ATS.
3. ISC solenoid valve hose from air cleaner lower case.
4. PCV valve hose from air cleaner lower case.
5. Air cleaner assembly with air cleaner hose from throttle body.
   Remove air cleaner case nut and bolt, and disconnect air cleaner hose from its pipe and resonator hose.

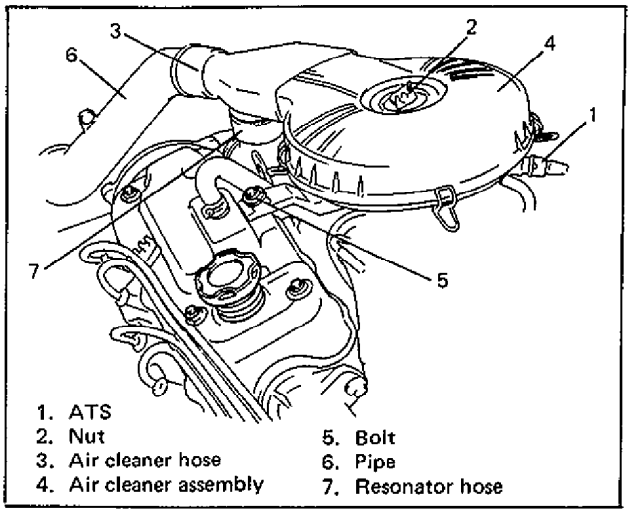


Fig. 6A-17 Removing Air Cleaner Assembly

INSTALL OR CONNECT
Reverse removal procedure for installation, noting following.

- Before installing, make sure that air cleaner case seal is installed to air cleaner case securely.

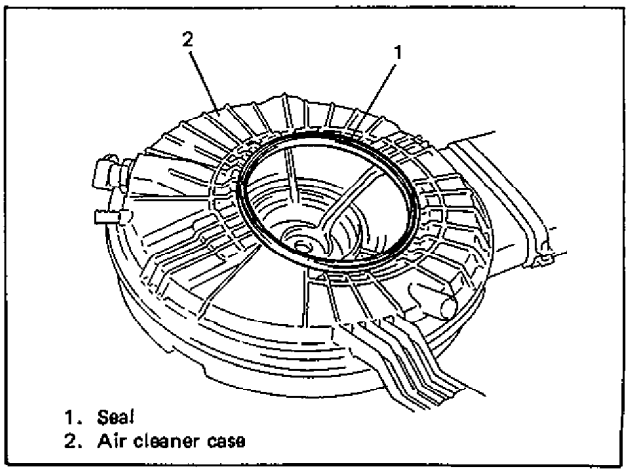


Fig. 6A-18 Air Cleaner Case Seal

- Clamp air cleaner hose and resonator hose securely.

CYLINDER HEAD COVER

REMOVE OR DISCONNECT

1. Negative cable at battery.
2. Air cleaner assembly as previously outlined.
3. High-tension cord clamps from cylinder head cover.
4. PCV hose from cylinder head cover.
5. Cylinder head cover from cylinder head.

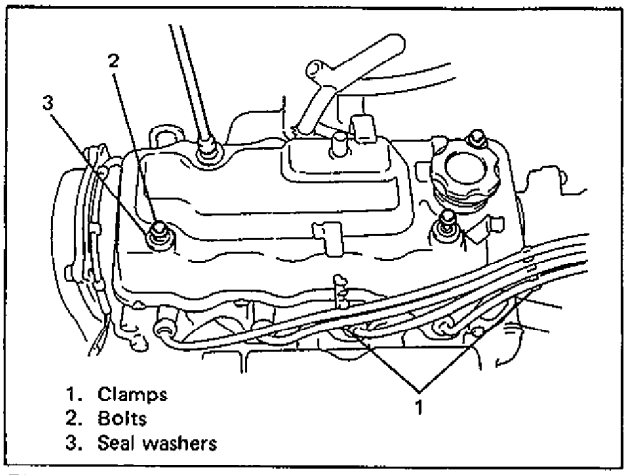


Fig. 6A-19 Removing Cylinder Head Cover

INSTALL OR CONNECT

1. Cylinder head cover gasket to head cover.
   Before installing gasket, check it for deterioration or damage, and replace as necessary.
2. Cylinder head cover.
   Before installing seal washers, check each one for deterioration or damage, and replace as necessary.
   Tighten cover bolts to specified torque.

Tightening torque for cover bolt	N·m	kg-m	lb-ft
	4 – 5	0.4 – 0.5	3.0 – 3.5

3. High-tension cord clamps to cylinder head cover.
4. PCV hose to cylinder head cover.
5. Air cleaner assembly as previously outlined.
6. Negative cable at battery.

THROTTLE BODY AND INTAKE MANIFOLD

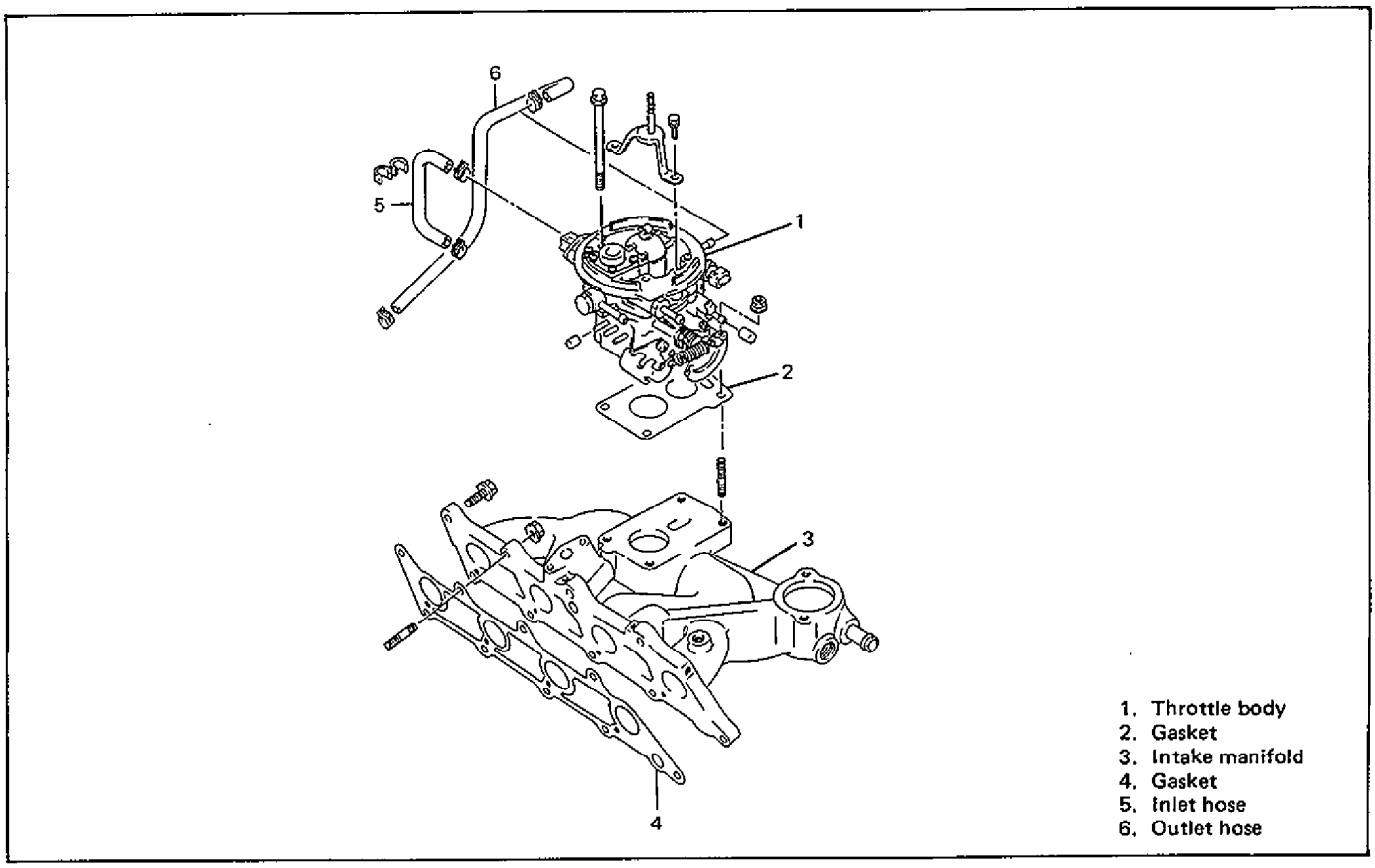


Fig. 6A-20 Throttle Body and Intake Manifold

REMOVE OR DISCONNECT

1. Relieve fuel pressure according to procedure described in p. 6-3.
2. Negative cable at battery.
3. Drain cooling water.

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.

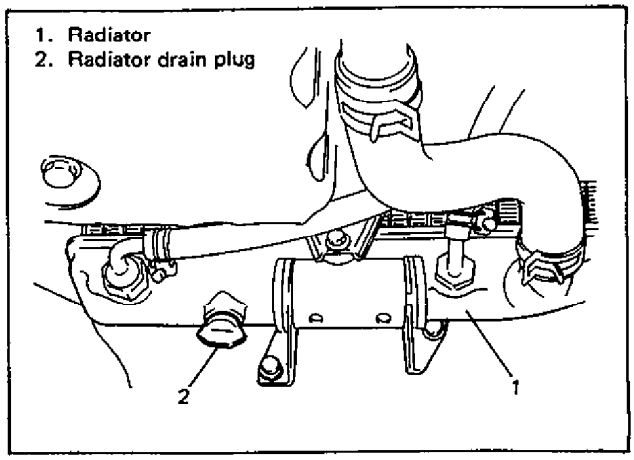


Fig. 6A-21 Radiator Drain Plug

4. Air cleaner assembly as previously outlined.
5. Following electric lead wires:
   - VSV for EGR valve (if equipped)
   - Radiator cooling fan thermo switch
   - WTS
   - WTG
   - ISC solenoid valve
   - Ground wires from intake manifold
   - Fuel injector
   - TS or TPS

6. Fuel return and feed hoses from throttle body.
7. Water hoses from throttle body and intake manifold.

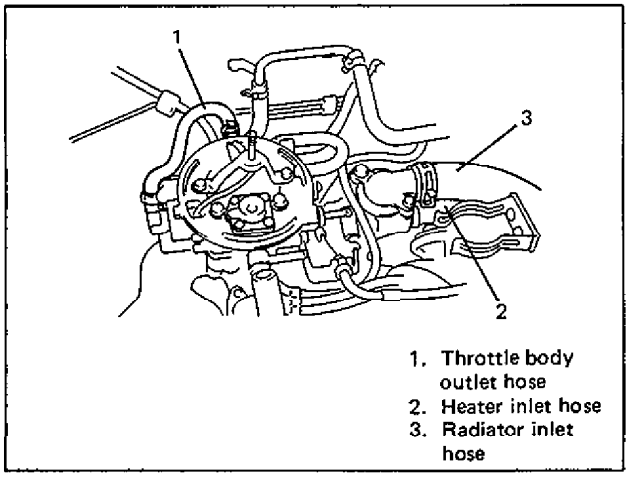


Fig. 6A-22 Water Hoses

8. Following vacuum hoses:
   - Distributor vacuum advancer hoses from advancer.
   - Canister purge hose from intake manifold.
   - Canister hose from its pipe.
   - EGR modulator hoses from EGR valve.
   - EGR VSV hose from VSV.
   - PS hose from intake manifold.
   - Brake booster hose from intake manifold.
9. PCV hose from PCV valve.
10. Accelerator cable from throttle body.
11. Other connected to throttle body and intake manifold, if any.
12. Intake manifold with throttle body from cylinder head.

INSTALL OR CONNECT

1. Intake manifold gasket to cylinder head. Use a new gasket.
2. Intake manifold with throttle body to cylinder head.
   - Install clamps as shown in Fig. 6A-23, and tighten bolts and nuts to specification.

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

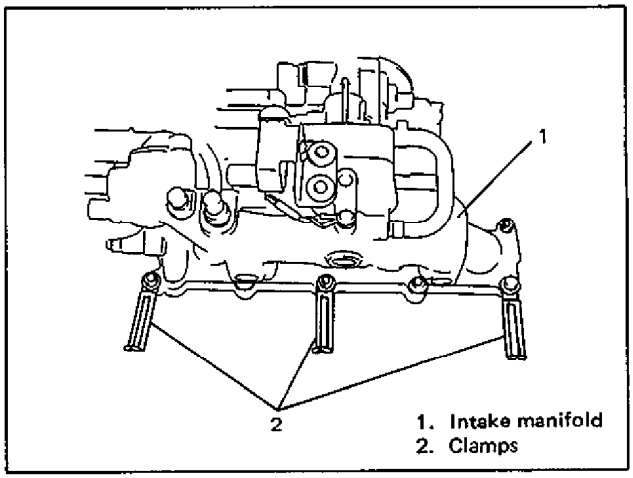


Fig. 6A-23 Clamps

3. PCV hose to PCV valve.
4. Vacuum hoses.
5. Water hoses.
6. Fuel return and feed hoses to throttle body.
7. Electric lead wires.

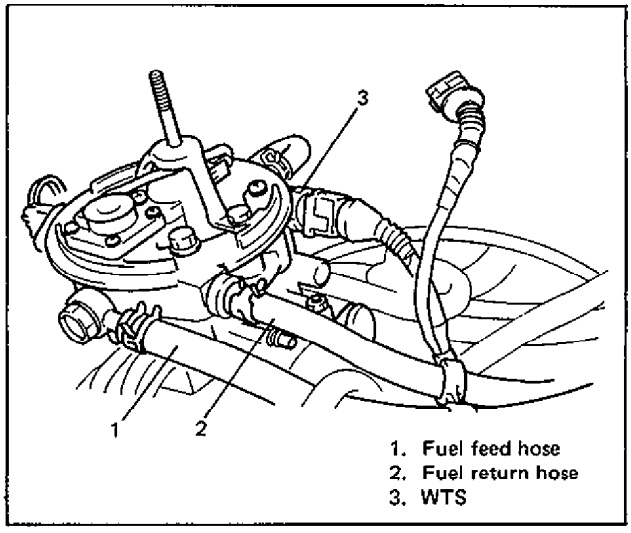
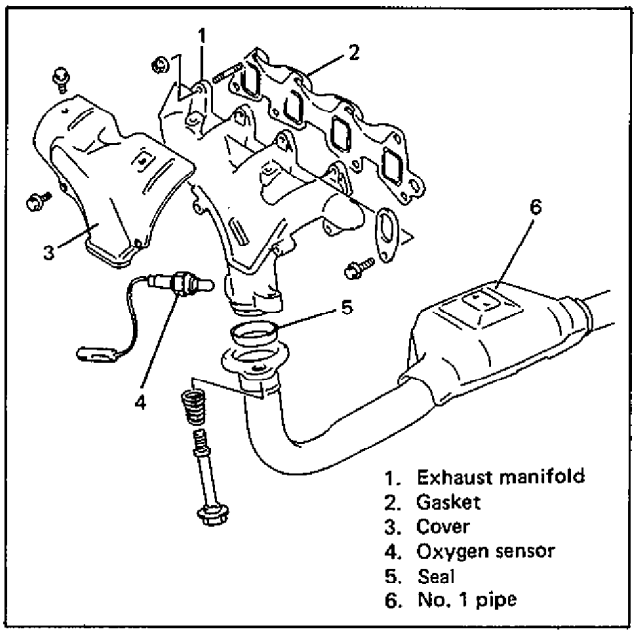


Fig. 6A-24 Connecting Hoses and Couplers

8. Accelerator cable to throttle body.
   Adjust accelerator cable play to specification according to description in section 6E.
9. Air cleaner assembly to throttle body as previously outlined.
10. Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
11. Refill cooling system.
12. Negative cable at battery.
13. Upon completion of installation, start engine and check for fuel leaks and engine cooling water leaks.

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.

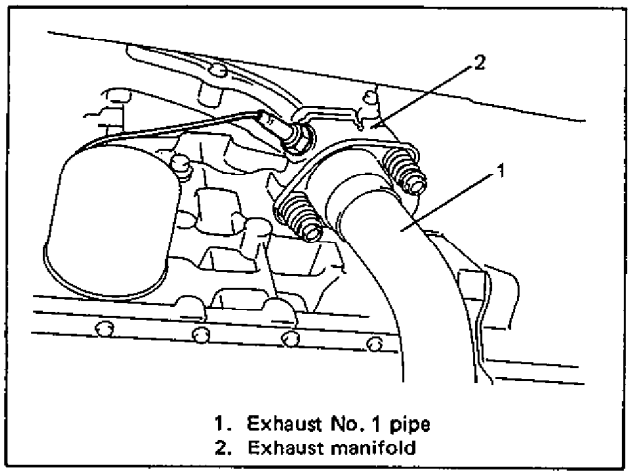


1. Exhaust manifold
2. Gasket
3. Cover
4. Oxygen sensor
5. Seal
6. No. 1 pipe

Fig. 6A-25 Exhaust Manifold, No. 1 Pipe, etc.

REMOVE OR DISCONNECT

1. Negative cable at battery.
2. Oxygen sensor coupler.
   Release its wire from clamps.
3. Exhaust No. 1 pipe from exhaust manifold.



1. Exhaust No. 1 pipe
2. Exhaust manifold

Fig. 6A-26 Exhaust No. 1 Pipe

4. Exhaust manifold cover.
5. Exhaust manifold and its gasket from cylinder head.

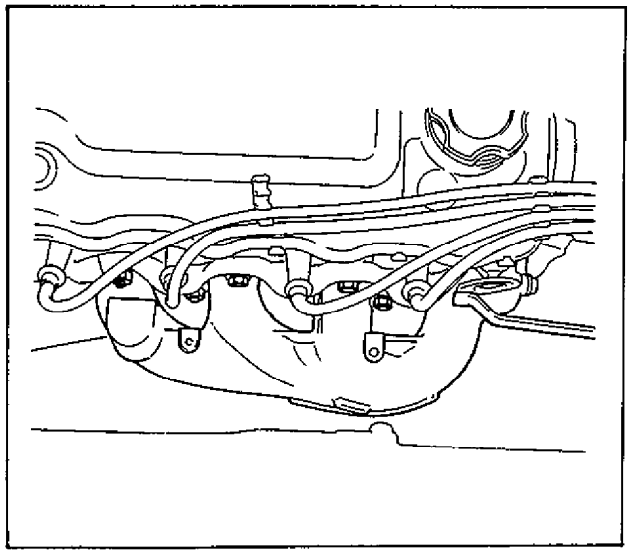


Fig. 6A-27 Removing Exhaust Manifold

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.
   Tighten manifold bolts and nuts to specified torque.

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

3. Exhaust manifold cover.
4. Pipe seal and exhaust No. 1 pipe.
   Before installing pipe seal, check it for deterioration or damage, and replace as necessary.
   Tighten pipe bolts to specified torque.

Tightening torque for No. 1 pipe bolts	N·m	kg-m	lb-ft
	35 – 50	3.5 – 5.0	25.5 – 36.0

5. Oxygen sensor coupler.
6. Clamp its wire securely.
7. Negative cable at battery.
8. Check exhaust system for exhaust gas leakage.

VALVES AND CYLINDER HEAD

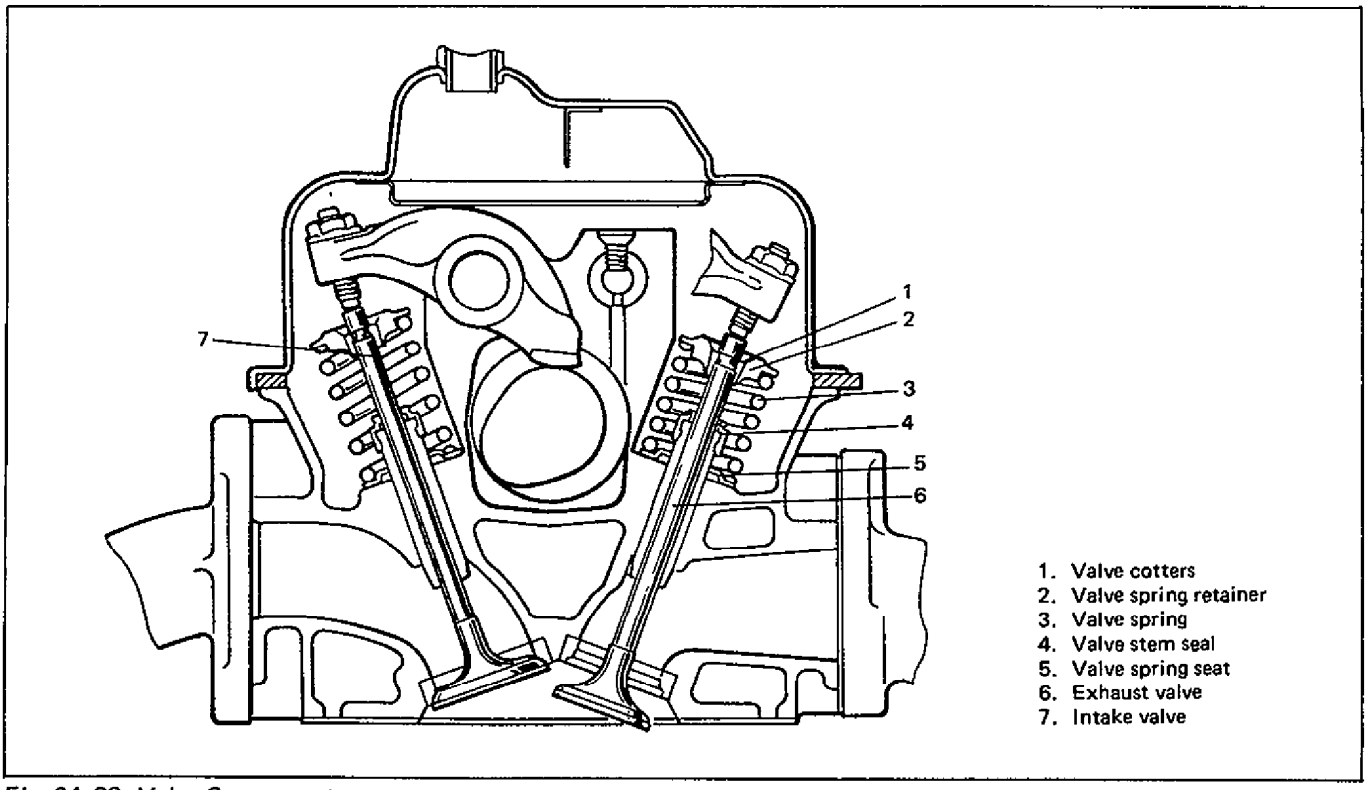


Fig. 6A-28 Valve Components

REMOVE OR DISCONNECT

1. Relieve fuel pressure according to procedure described in p. 6-3.
2. Negative cable at battery.
3. Drain cooling water.
4. Air cleaner assembly as previously outlined.
5. Following electric wire harness:
   - Center high-tension cord from distributor
   - Distributor
   - VSV for EGR valve (if equipped)
   - Radiator fan thermo switch
   - Water temp. gauge
   - WTS
   - ISC solenoid valve
   - TS or TPS
   - Fuel injector
   - Ground wires from intake manifold
   - Oxygen sensor

   and release above wire harness from clamps.
6. Cooling water hoses:
   - Radiator inlet hose from thermostat cap
   - Heater inlet hose from intake manifold
   - Throttle body outlet hose from throttle body
7. Following vacuum hoses:
   - Pressure sensor hose from intake manifold
   - Canister hose from its pipe
   - Canister purge hose from intake manifold
   - Brake booster hose from intake manifold
8. Fuel return hose and fuel feed hose from throttle body.
9. Accelerator cable from throttle body.
10. Water pump pulley, crankshaft pulley and timing belt as previously outlined.
11. Exhaust No. 1 pipe from exhaust manifold.
12. Cylinder head cover.
    After loosening all valve adjusting screw lock nuts, turn adjusting screws back all the way to allow all valves to close.
13. Cylinder head bolts.
14. Other jointed parts, hoses and electric wires, if any.
15. Cylinder head with distributor, intake manifold and exhaust manifold.

DISASSEMBLY
INSPECTION
ASSEMBLY

Use the disassembly, inspection and assembly procedures described for the cylinder head of the carburetor equipped engine in Section 6A of SF413 Service Manual.

INSTALL OR CONNECT

1. Cylinder head gasket.
   Install new head gasket as shown in Fig. 6A-29 in such a way that "TOP" mark provided on the gasket comes on top side (toward cylinder head) and on crankshaft pulley side.

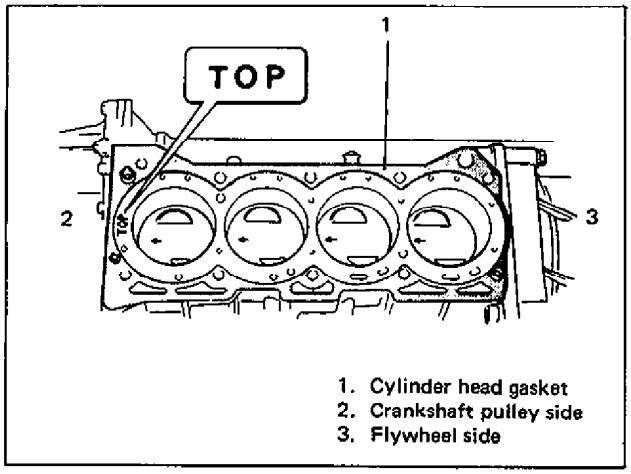


Fig. 6A-29 Cylinder Head Gasket Installation

2. Cylinder head:
   After applying engne oil to cylinder head bolts, tighten them gradually with a torque wrench, following sequence given in below figure. Finally tighten bolts to specified torque.

Tightening torque for cylinder head bolts	N·m	kg-m	lb-ft
	70 – 75	7.0 – 7.5	51.0 – 54.0

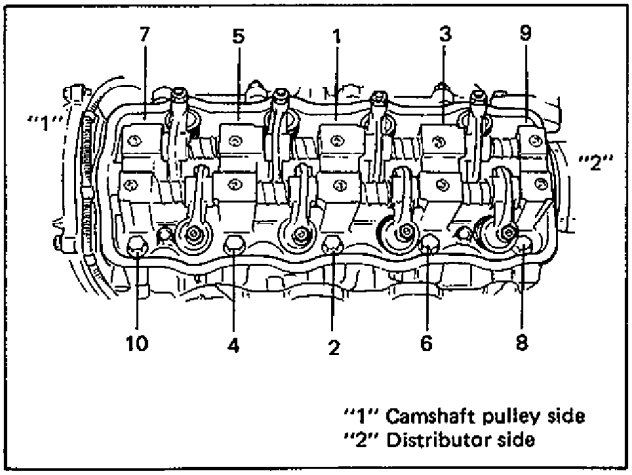


Fig. 6A-30 Tightening Sequence of Cylinder Head Bolts

3. Rubber seal between water pump and cylinder head.

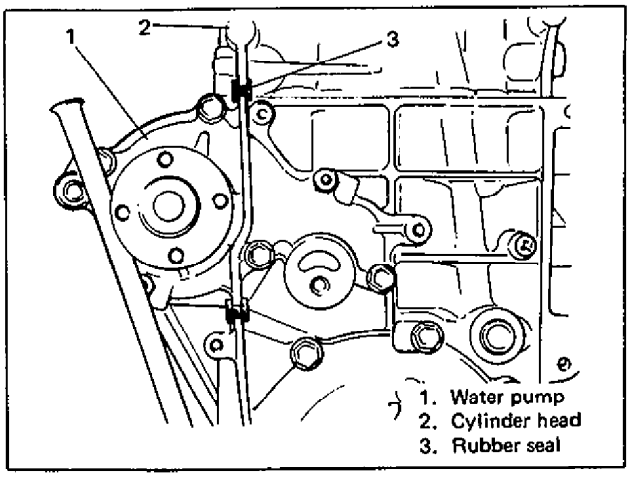


Fig. 6A-31 Installing Rubber Seal

4. Timing belt as previously outlined.
5. Distributor to cylinder head. See section 6F for installation.
6. Reverse removal procedure for installation of remainder.
7. Adjust intake and exhaust valve lashes as previously outlined.
8. Adjust water pump belt. Refer to section 6B for adjusting procedure.
9. Adjust accelerator cable play according to procedure described in section 6E.
10. Refill cooling system, referring to section 6B.
11. Negative cable at battery.
12. Adjust ignition timing. Refer to section 6F for adjustment.
13. Upon completion of installation, verify that there is no fuel leakage, water leakage or exhaust gas leakage at each connection.

UNIT REPAIR OVERHAUL

ENGINE ASSEMBLY

REMOVE OR DISCONNECT

1. Relieve fuel pressure according to procedure described in p. 6-3.
2. Engine hood after disconnecting front window washer hose.
3. Battery cables at battery.
   For A/T model, remove battery and its tray.
4. Drain cooling system.
5. Air cleaner assembly as previously outlined.
6. Radiator with cooling fan. Refer to section 6B for removal.
7. Following electric wire harness:
   - High-tension cord from ignition coil
   - Distributor
   - VSV for EGR valve (if equipped)
   - Radiator fan thermo switch
   - Water temp. gauge
   - WTS
   - ISC solenoid valve
   - Ground wire harness from intake manifold
   - TS or TPS
   - Fuel injector
   - Pressure sensor
   - Oil pressure gauge
   - Oxygen sensor
   - Generator
   - Starter
   - Back-up light switch (For M/T model)
   - Battery negative cable from transmission
   - Shift switch of A/T (For A/T model)
   - Direct clutch and 2nd brake solenoids of A/T (For A/T model)
   - Speed sensor on A/T (For A/T model)

   And release above wire harness from clamps.
8. Following vacuum hoses:
   - Brake booster hose from intake manifold.
   - Canister purge hose from intake manifold.
   - Canister hose from its pipe.
9. Fuel return hose and fuel feed hose from throttle body.
10. Heater inlet and outlet hoses.
11. Following cables:
    - Accelerator cable from throttle body.
    - Clutch cable from transmission. (For M/T model)
    - Gear select cable and oil pressure control cable from transmission (For A/T model)
    - Speedometer cable from transmission.
12. Chacoal canister from body.
13. Hoist car.
14. Exhaust No. 1 pipe from exhaust manifold.
15. Gear shift control shaft and extension rod from transmission. (For M/T model)
16. Drain engine oil and transmission oil.
17. Left side drive shaft joint from differential gear of transmission.
    Right side drive shaft joint from center bearing support.
    Refer to section 4 (DRIVE SHAFT) for procedure to disconnect drive shaft joints. For engine and transmission removal, it is not necessary to remove drive shaft from steering knuckle.
18. Engine rear torque rod bracket from transmission. (For A/T model)
19. Lower car.
20. Install lifting device.
21. Rear mounting from body. (For M/T model)
    Rear mounting nut. (For A/T model)
22. Left side engine mounting bracket bolts and mounting bolt.
23. Right side engine mounting from its bracket.
24. Before lifting engine with transmission, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transmission.
25. Engine with transmission from body.

INSTALL OR CONNECT

1. Lower engine with transmission into engine compartment, but do not remove lifting device.
2. Rear mounting to body. (For M/T model)
   Rear mounting nut. (For A/T model)
3. Left side engine mounting and its bracket.
4. Right side engine mounting to its bracket.
5. Tighten bolts and nuts of all parts installed in above steps 2, 3 and 4 to specified torque.

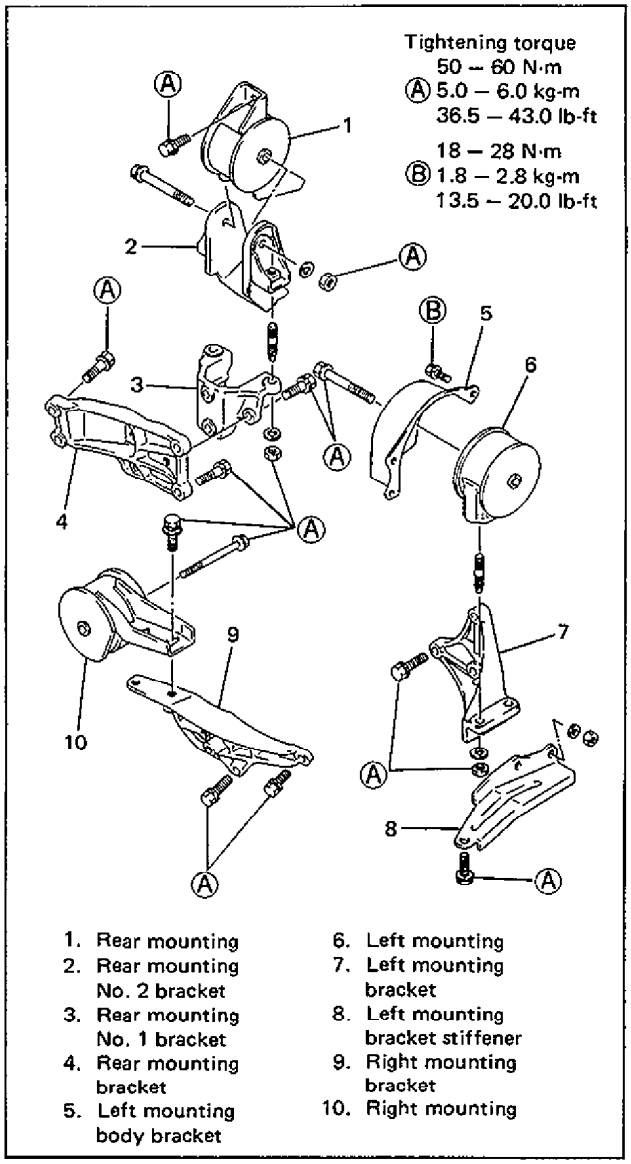


Fig. 6A-32 Engine Mounting (For M/T Model)

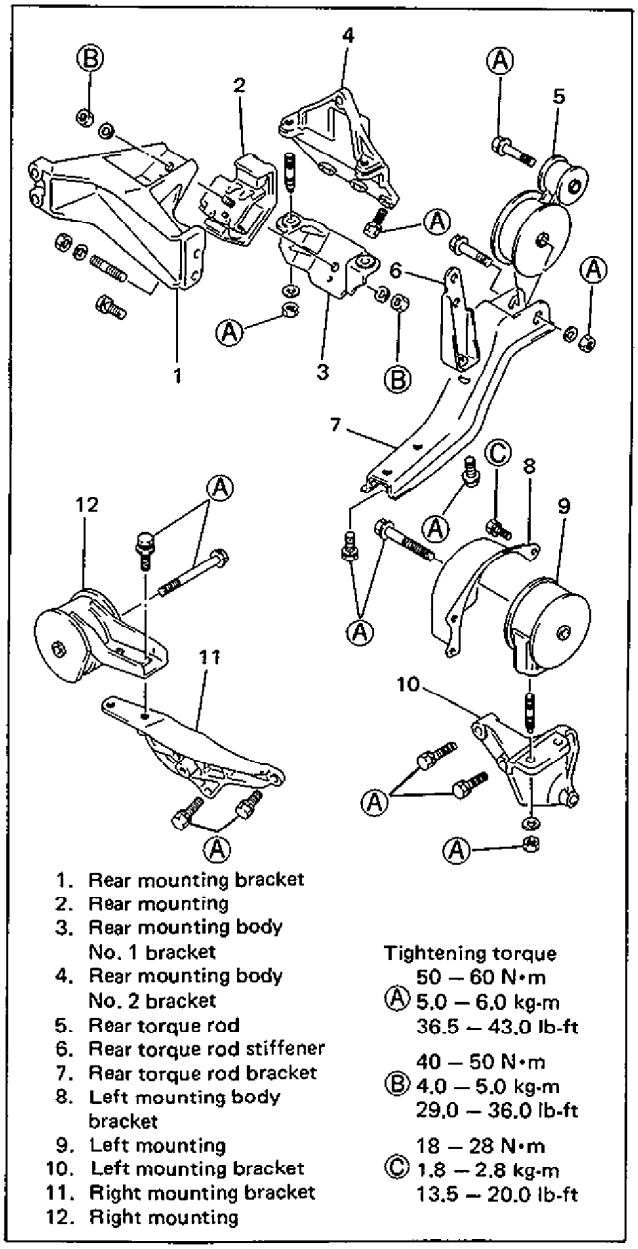


Fig. 6A-33 Engine Mounting (For A/T Model)

6. Remove lifting device.
7. Reverse removal procedures for installation of remainder.
   - Push in each drive shaft joint fully so that snap ring engages with differential gear or center bearing support. Use care not to damage oil seal lip when inserting.
   - Clamp electric wires securely.

8. Adjust clutch pedal free travel, referring to section 7C. (For M/T model)
   Adjust gear select cable and oil pressure control cable, referring to section 7B. (For A/T model)
9. Adjust accelerator cable play, referring to section 6E.
10. Refill transmission with gear oil. (A/T fluid for A/T model), referring to section 0B.
11. Refill engine with engine oil, referring to section 0B.
12. Refill cooling system, referring to section 6B.
13. Upon completion of installation, verify that there is no fuel leakage, water leakage, transmission oil leakage or exhaust gas leakage at each connection.

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 belt pulley bolt	56 – 64	5.6 – 6.4	41.0 – 46.0
	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
	Flywheel bolt	57 – 65	5.7 – 6.5	41.5 – 47.0
	Oil pressure switch	12 – 15	1.2 – 1.5	9.0 – 10.5
	Oil filter stand	20 – 25	2.0 – 2.5	14.5 – 18.0
	Oil pan bolt and nut	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
	Valve adjusting screw lock nut	15 – 19	1.5 – 1.9	11.0 – 13.5
	Exhaust No. 1 pipe bolt	35 – 50	3.5 – 5.0	25.5 – 36.0
	Oil pump strainer 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
	Crankshaft timing belt pulley bolt	125 – 135	12.5 – 13.5	90.5 – 92.5
	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
	Oil pump rotor plate screw	8 – 13	0.8 – 1.3	6.0 – 9.0
	Engine mounting & bracket bolt and nut	Refer to Fig. 6A-32 and 6A-33		

SECTION 6C

ENGINE FUEL

CONTENTS

CAUTION:
THE ENGINE OF THIS CAR 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 SYSTEM.

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.

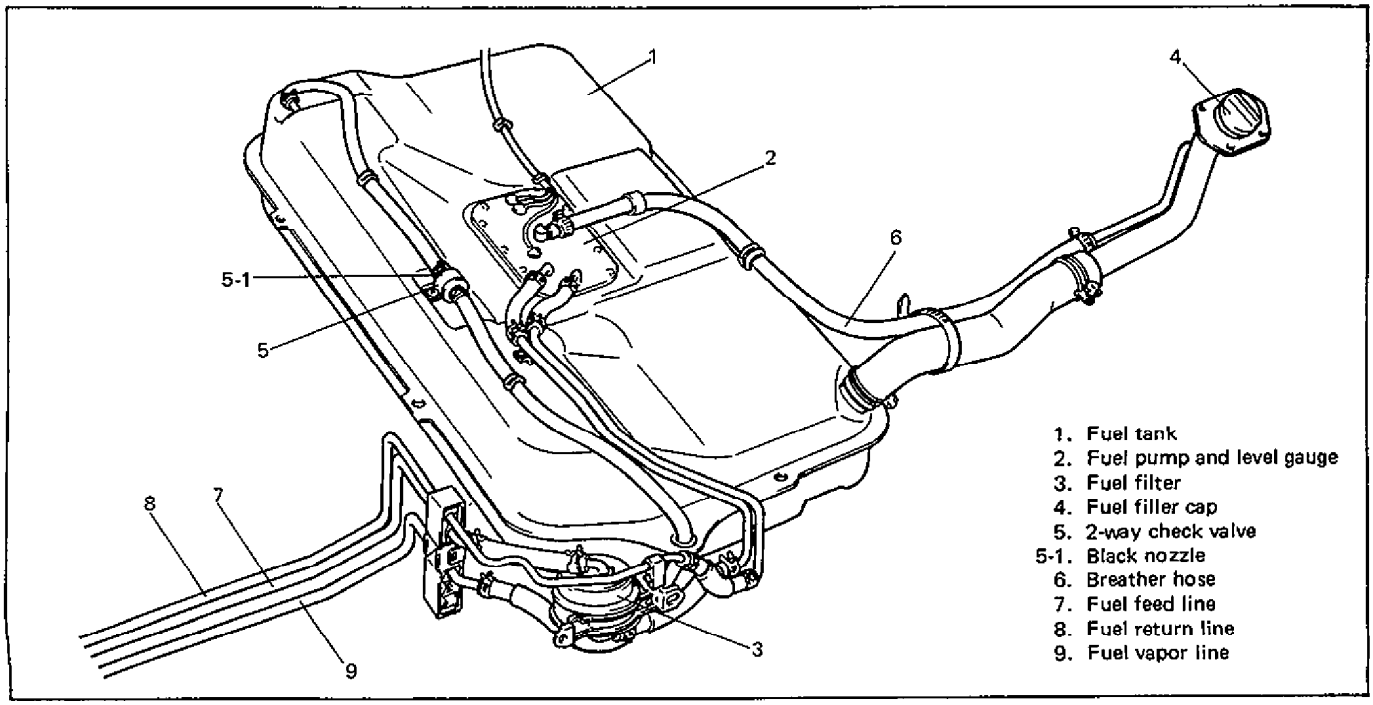


Fig. 6C-1 Fuel System

FUEL TANK

The fuel tank is located under the rear of the car. The fuel pump and fuel level gauge are installed on the upper part of fuel tank. Whenever servicing the fuel level gauge or the fuel pump, the fuel tank must be removed from the body.

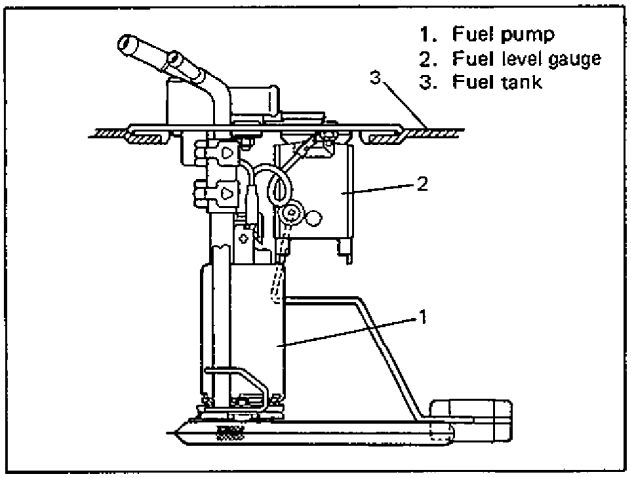


Fig. 6C-2 Fuel Pump and Level Gauge

FUEL FILTER

The fuel filter is located in front of fuel tank as shown in Fig. 6C-1 and filters the fuel sent under pressure from the fuel pump.

As it can't be disassembled, it must be replaced as an assembly.

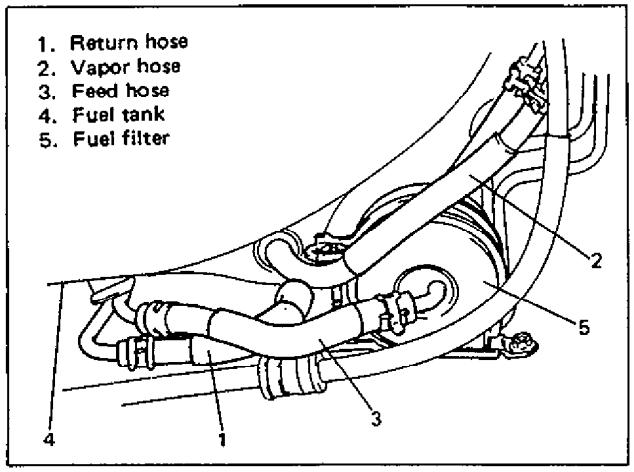


Fig. 6C-3 Fuel Filter

FUEL FILLER CAP

The fuel tank filler neck has a pressure-vaccum 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 pressure relief valve and a vacuum relief valve inside.

If the pressure of fuel vapor in the fuel tank should exceed that for which fuel system is designed, the pressure relief valve opens to relieve the pressure.

The vacuum relief valve opens to relieve the vacuum created in the fuel tank.

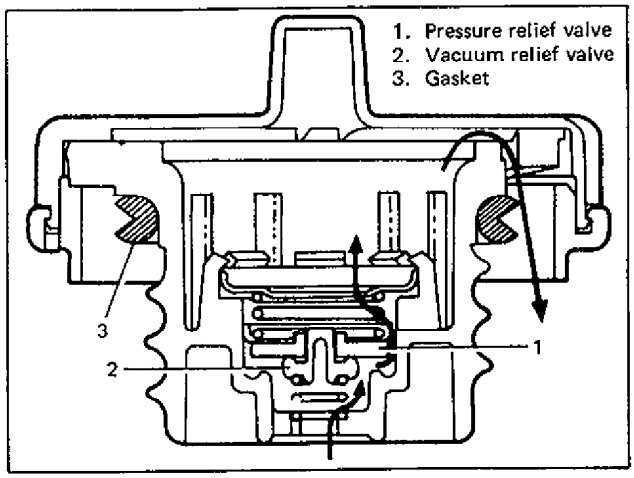


Fig. 6C-4 Fuel Filler Cap Cross-Section

ON-CAR SERVICE

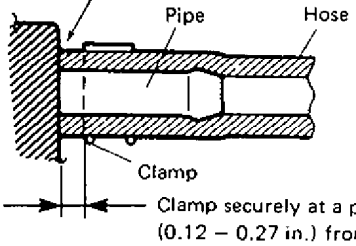
WARNING:

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

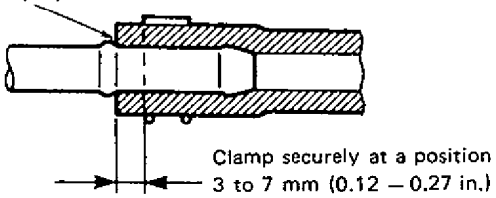
- **Disconnect negative cable at battery.**
- **DO NOT smoke, and place "NO SMOKING" signs near work area.**
- **Be sure to have CO_2 fire extinguisher handy.**
- **Be sure to perform work in a well-ventilated area and away from any open flames (such as gas hot heater).**
- **Wear safety glasses.**
- **To relieve 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 relieve fuel pressure according to procedure described on p. 6-3.**

  A small amount of fuel may be released after the fuel line is disconnected. In order to reduce the chance of personal injury, cover the fitting to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.
- **Note that fuel hose connection varies with each type of pipe. Be sure to connect and clamp each hose correctly referring to the following.**

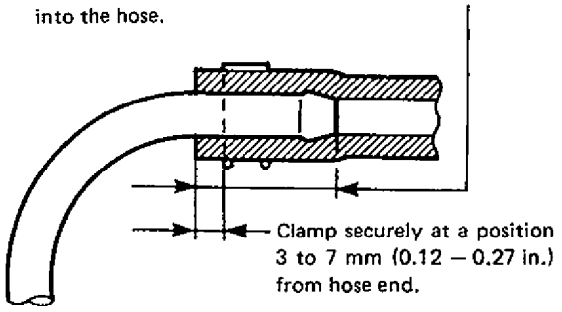
With short pipe, fit hose as far as it reaches pipe joint as shown.



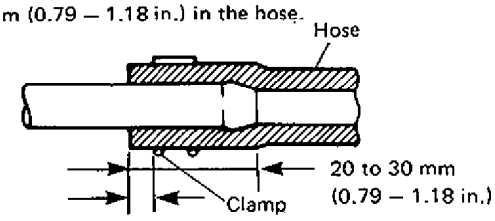
With following type pipe, fit hose as far as its peripheral projection as shown.



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 LINES

Due to the fact that fuel feed line is under high pressure, use special care when servicing it.

INSPECT

Visually inspect fuel lines for evidence of fuel leakage, hose crack and deterioration, or damage.
Make sure all clamps are secure.
Replace parts as needed.

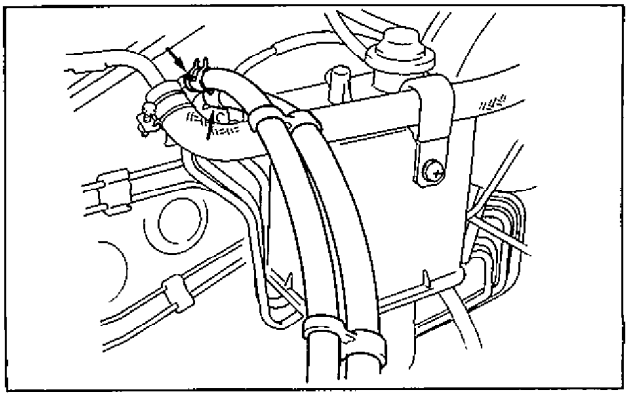


Fig. 6C-5 Fuel Lines Inspection

FUEL PIPE

REMOVE OR DISCONNECT

1. Relieve fuel pressure in fuel feed line according to procedure on p. 6-3.
2. Negative cable at battery.
3. Fuel hose from fuel pipe at the front and rear of each fuel pipe.

WARNING:
A small amount of fuel may be released after fuel hose is disconnected. In order to reduce the chance of personal injury, cover hose and pipe to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.

4. Brake pipe from pipe joint referring to SECTION 5.
5. Pipe cover from body.
6. Put clamp position mark on body and pipes so that clamps can be installed on original position.
7. Pipes with clamp from body.

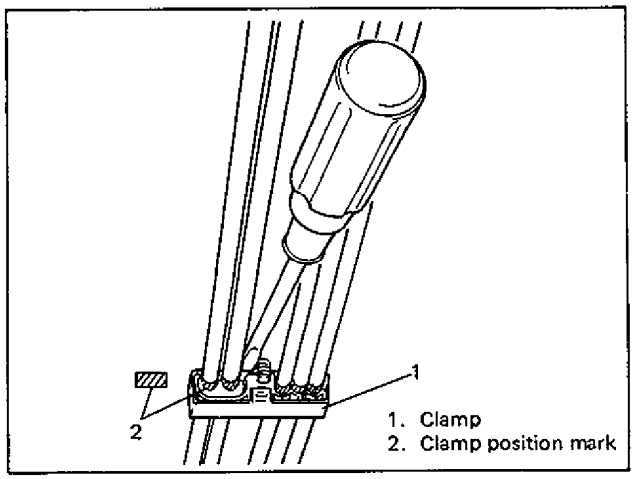


Fig. 6C-6 Detaching Clamp with Pipes

8. Clamp from pipes.

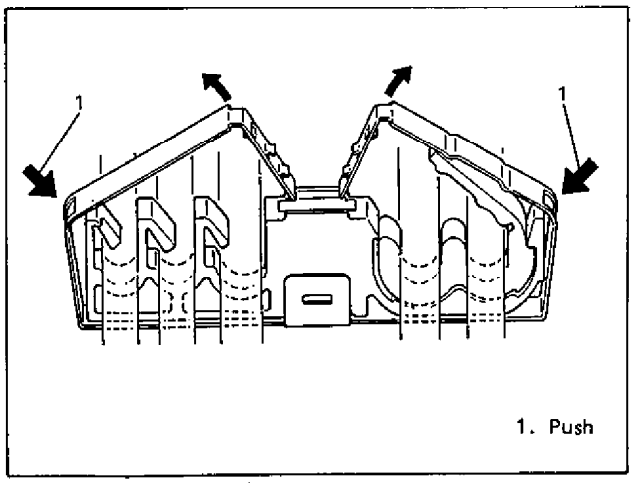


Fig. 6C-7 Removing Clamp

INSTALL OR CONNECT

1. Clamps to marked position on pipes.
   If clamp is deformed or its claw is bent or broken, replace it with new one.
2. Pipes with pipe clamp to body.

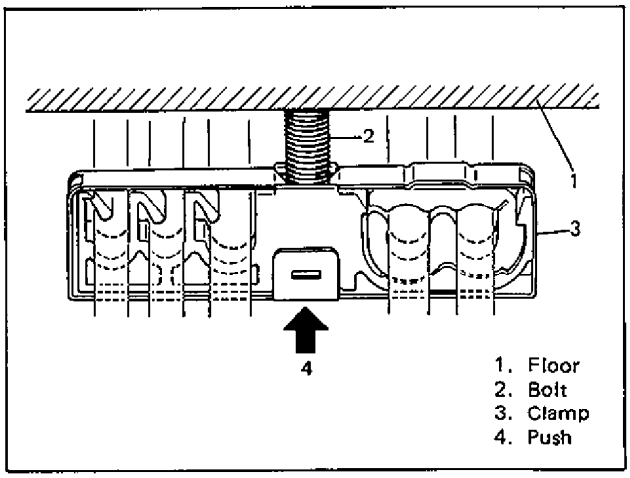


Fig. 6C-8 Installing Clamp

3. Pipe cover to body. Be sure to use new nuts.
4. Fuel hoses to fuel pipes.
5. Brake pipe joints referring to SECTION 5.
6. With engine "OFF" and ignition switch "ON", check for fuel leaks.
7. Bleed air in brake system referring to SECTION 5.

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 critical malfunction of system.

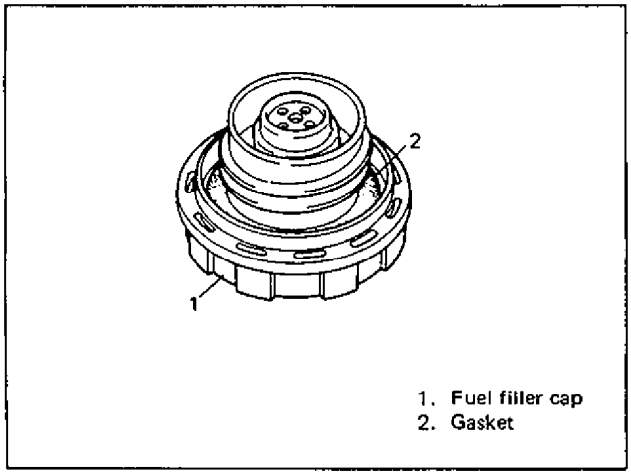


Fig. 6C-9 Fuel Filler Cap

FUEL FILTER

REMOVE OR DISCONNECT

1. Relieve fuel pressure in fuel feed line according to procedure described on p. 6-3.
2. Negative cable at battery.
3. Hoist car.
4. Place fuel container under fuel filter.
5. Inlet hose from fuel filter.

> **WARNING:**
> **A small amount of fuel may be released after fuel hose is disconnected. In order to reduce the chance of personal injury, cover hose and pipe to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.**

6. Fuel filter outlet hose from fuel feed pipe.

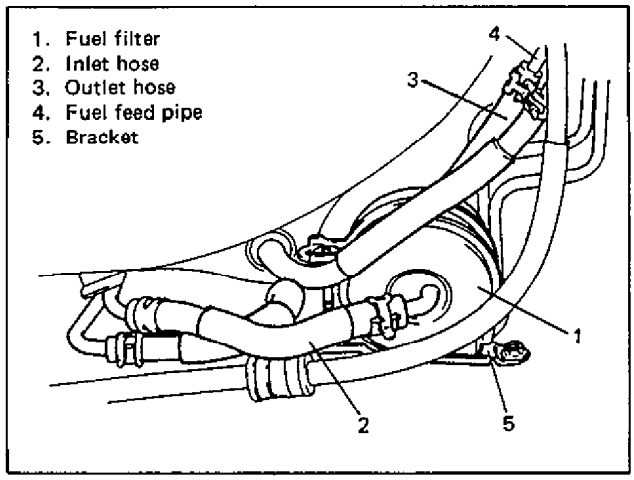


Fig. 6C-10 Disconnecting Hoses

7. Fuel filter with outlet hose from body.
8. Outlet hose and bracket from fuel filter.

INSTALL OR CONNECT

1. Filter bracket to filter.
   Be sure to align match marks on filter and bracket before tightening bracket bolt.

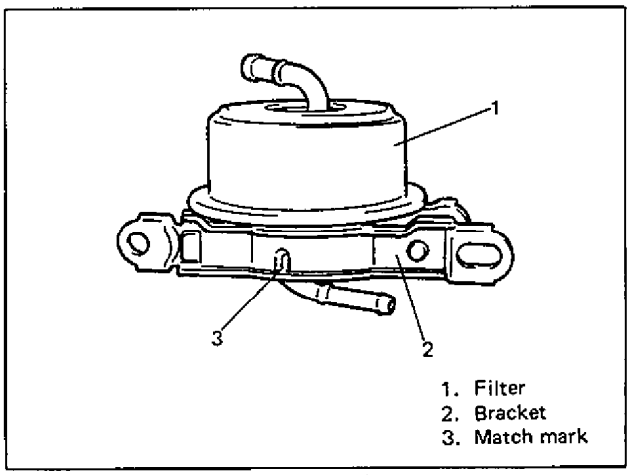


Fig. 6C-11 Installing Filter Bracket

2. Outlet hose to fuel filter outlet pipe.
3. Filter with outlet hose to body.
4. Outlet and inlet hoses.
   Clamp hoses securely.
5. Negative cable to battery.
6. With engine "OFF" and ignition switch "ON", check for fuel leaks.

FUEL TANK

REMOVE OR DISCONNECT

1. Relieve fuel pressure in fuel feed line according to procedure described on p. 6-3.
2. Negative cable at battery.
3. Rear seat cushion referring to SECTION 9.
4. Fuel level gauge and fuel pump lead wire couplers, and detach wire tape.

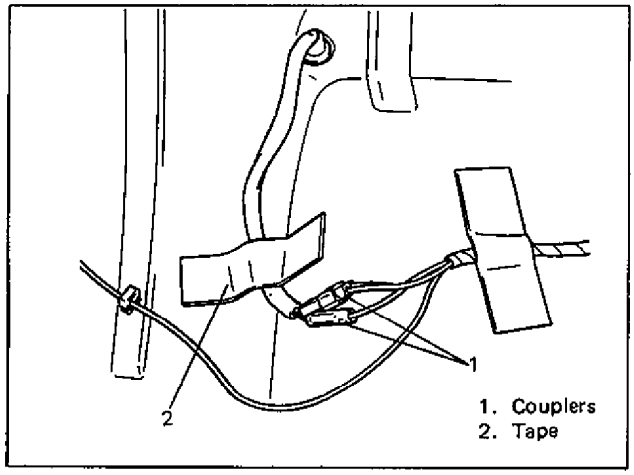


Fig. 6C-12 Disconnecting Couplers

5. Hoist car.
6. Fuel filler hose from fuel tank and breather hose from filler neck.

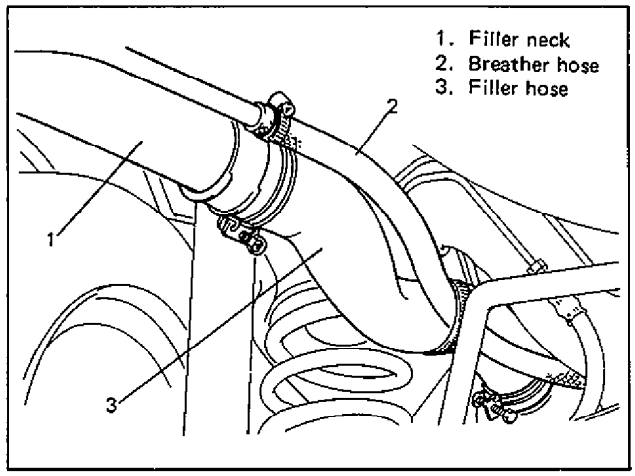


Fig. 6C-13 Breather and Filler Hoses

7. As fuel tank has no 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 to avoid possibility of fire or explosion.

8. Fuel hoses from filter and pipes.

WARNING:
A small amount of fuel may be released after the fuel hose is disconnected. In order reduce the chance of personal injury, cover the hose and pipe to be disconnected with a shop cloth. Be sure to put that cloth in an approved container when disconnection is completed.

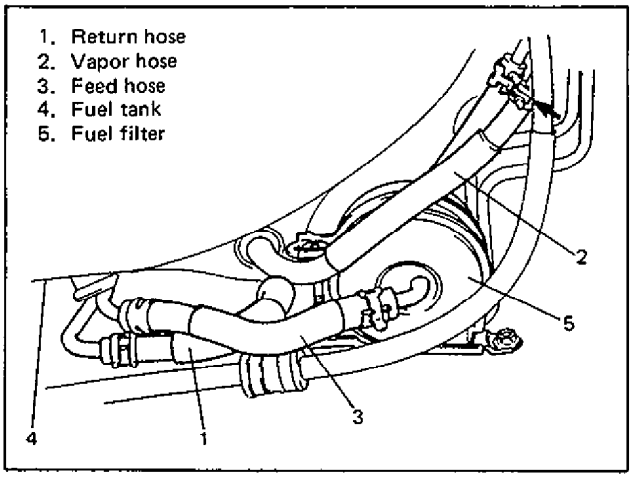


Fig. 6C-14 Disconnecting Hoses

9. Fuel tank from car.

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 gasket 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 using heat or flame as an explosion resulting in personal injury could occur.

Following procedure is used for purging fuel tank.

1. After removing fuel tank, remove all hoses, 2-way check valve, 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 gasket.
2. 2-way check valve to fuel tank directing its black nozzle toward fuel tank. Refer to Fig. 6C-1.
3. Fuel hoses and pipes to fuel tank as shown in Fig. 6C-1.
   Clamp hoses and wire harness securely.
4. Fuel breather hose to fuel tank.
5. Fuel tank to car.
6. Fuel filler hose to tank and breather hose to filler neck as shown in Fig. 6C-13 and clamp them securely.
7. Fuel hoses to filter and pipes as shown in Fig. 6C-14 and clamp them securely.
8. Fuel pump and level gauge couplers.
   Fix its wire with tape as shown in Fig. 6C-12.
9. Rear seat cushion referring to SECTION 9.
10. Negative cable to battery.
11. With engine "OFF" and ignition switch "ON", check for fuel leaks.

SECTION 6E

ELECTRONIC FUEL INJECTION SYSTEM

NOTE:
EGR system (EGR valve, EGR modulator, VSV and vacuum hoses) and shift-up indicator light control system are not installed in the European spec. model.

CONTENTS

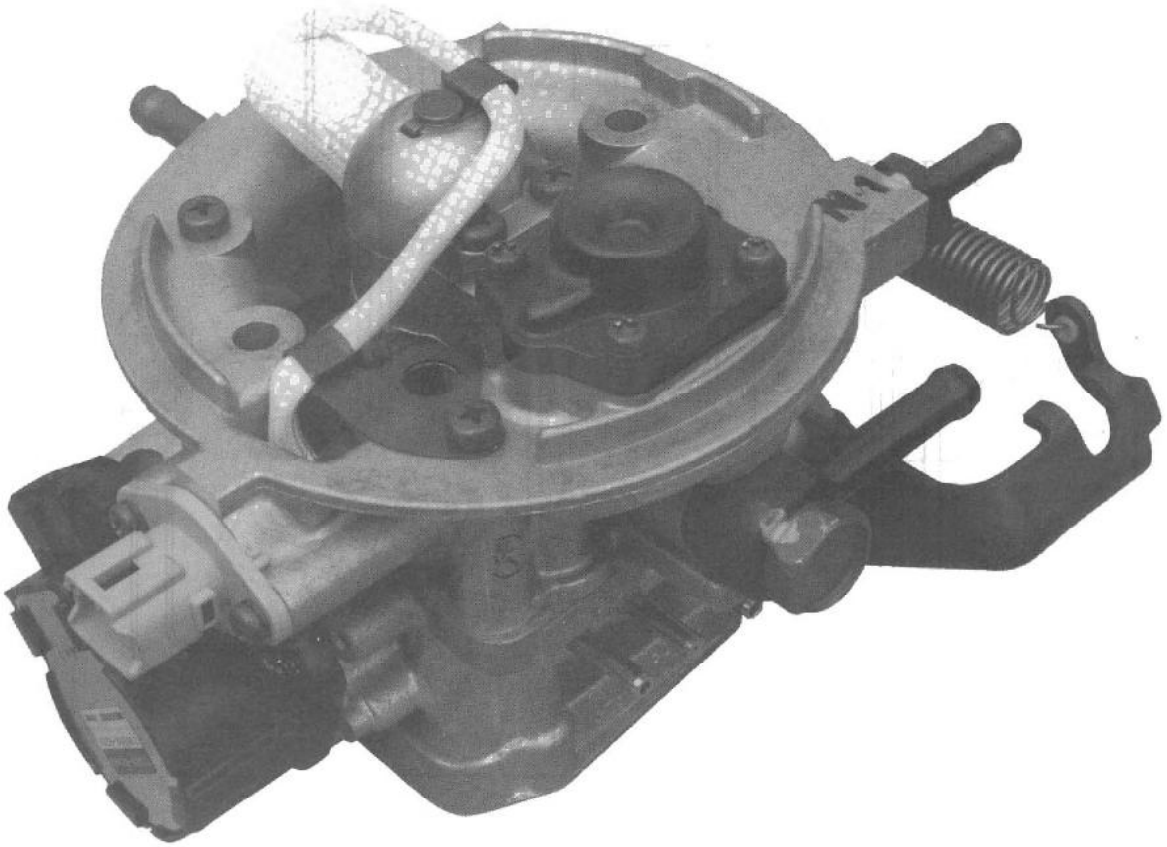
GENERAL DESCRIPTION

The Electronic Fuel Injection system in this car supplies the combustion chambers with air/fuel mixture of optimized ratio under widely varying driving conditions. It uses the single-point throttle body injection system which injects fuel into the throttle body through one injector.

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

This section explains the system related to the electronic fuel injection as well as such functions of ECM as listed below.

- EGR control system equipped in California spec. model only
- Shift-up indicator light control system (If equipped)
- Throttle valve opening signal output for A/T



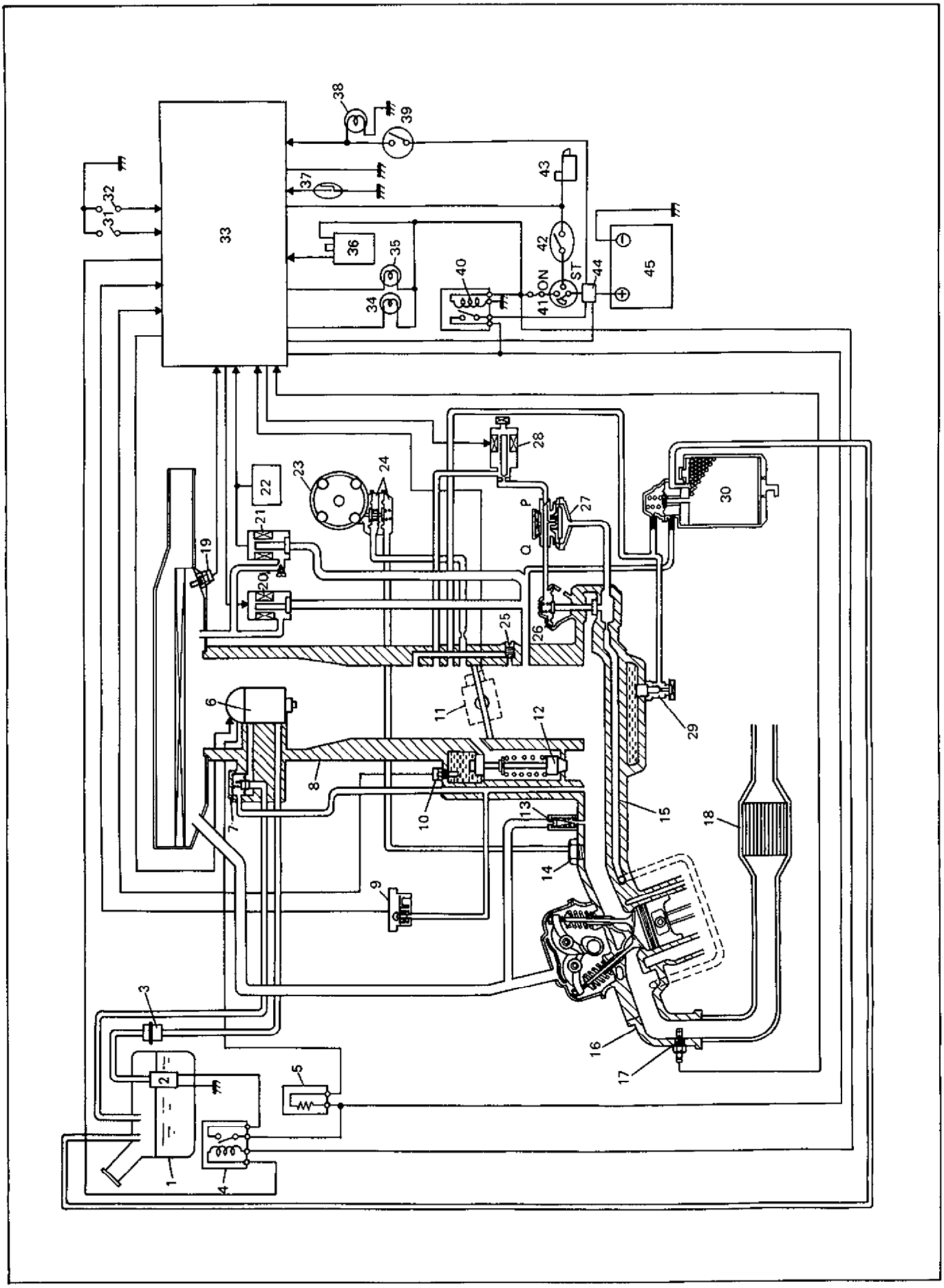


Fig. 6E-1 Electronic Fuel Injection System (M/T model)

1. Fuel tank
2. Fuel pump
3. Fuel filter
4. Fuel pump relay
5. Fuel injector resistor
6. Fuel injector
7. Fuel pressure regulator
8. Throttle body
9. Pressure sensor
10. WTS
11. TS
12. Air valve
13. PCV valve
14. Gas filter
15. Intake manifold
16. Exhaust manifold
17. Oxygen sensor
18. Three-way catalyst
19. ATS
20. ISC solenoid valve
21. Air-conditioner VSV (If equipped)
22. Air-conditioner amplifier (If equipped)
23. Distributor
24. Vacuum advancer
25. Idle speed adjusting screw
26. EGR valve (California spec. model only)
27. EGR modulator (California spec. model only)
28. EGR VSV (California spec. model only)
29. BVSV
30. Charcoal canister
31. Diagnosis switch terminal
32. Test switch terminal
33. ECM
34. "CHECK ENGINE" light
35. Shift-up indicator light (If equipped)
36. Ignition coil
37. Speed sensor
38. Illumination light
39. Lighting switch
40. Main relay
41. Main switch
42. Clutch switch
43. Starter magnetic switch
44. Main fuse
45. Battery

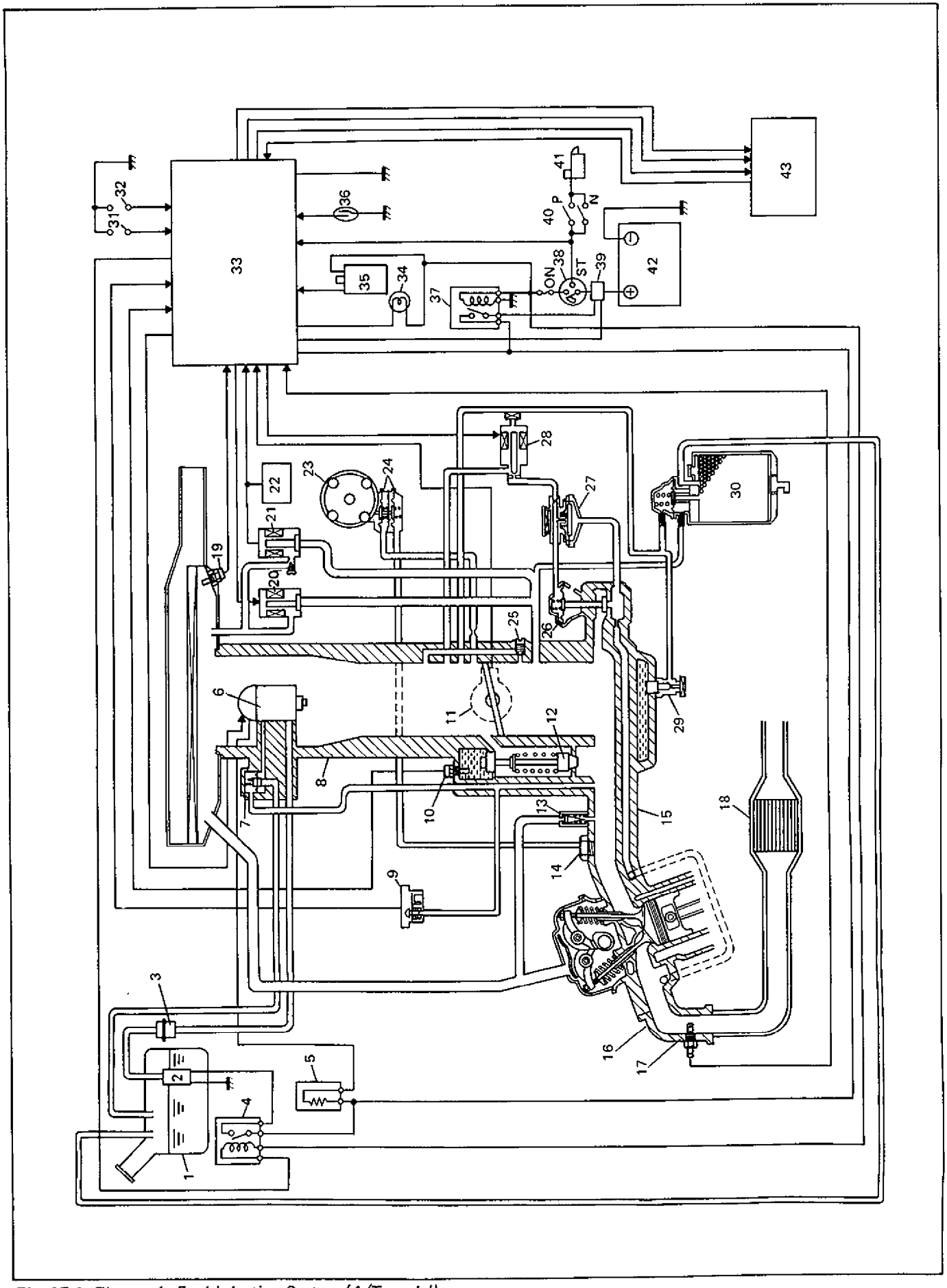


Fig. 6E-2 Electronic Fuel Injection System (A/T model)

1. Fuel tank
2. Fuel pump
3. Fuel filter
4. Fuel pump relay
5. Fuel injector resistor
6. Fuel injector
7. Fuel pressure regulator
8. Throttle body
9. Pressure sensor
10. WTS
11. TPS
12. Air valve
13. PCV valve
14. Gas filter
15. Intake manifold
16. Exhaust manifold
17. Oxygen sensor
18. Three-way catalyst
19. ATS
20. ISC solenoid valve
21. Air-conditioner VSV (If equipped)
22. Air-conditioner amplifier (If equipped)
23. Distributor
24. Vacuum advancer
25. Idle speed adjusting screw
26. EGR valve (California spec. model only)
27. EGR modulator (California spec. model only)
28. EGR VSV (California spec. model only)
29. BVSV
30. Charcoal canister
31. Diagnosis switch terminal
32. Test switch terminal
33. ECM
34. "CHECK ENGINE" light
35. Ignition coil
36. Speed sensor
37. Main relay
38. Main switch
39. Main fuse
40. Shift switch
41. Starter magnetic switch
42. Battery
43. A/T control module

AIR AND FUEL DELIVERY SYSTEM

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

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 intake manifold by the fuel pressure regulator, the fuel is injected into the throttle body in conic dispersion when the injector opens according to the injection signal from ECM. The fuel relieved by the fuel pressure regulator returns through the fuel return line to the fuel tank.

The injected fuel is mixed with the air which has been filtered through the air cleaner in the throttle body. The air/fuel mixture is drawn through clearance between throttle valve and bore and idle bypass passage into intake manifold. Then the intake manifold distributes the air/fuel mixture to each combustion chamber.

When the engine is cold, the air is drawn through air valve bypassing the throttle valve into the intake manifold.
When ISC solenoid valve opens according to the signal from ECM, the air is drawn through hose bypassing the throttle valve into the intake manifold.

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

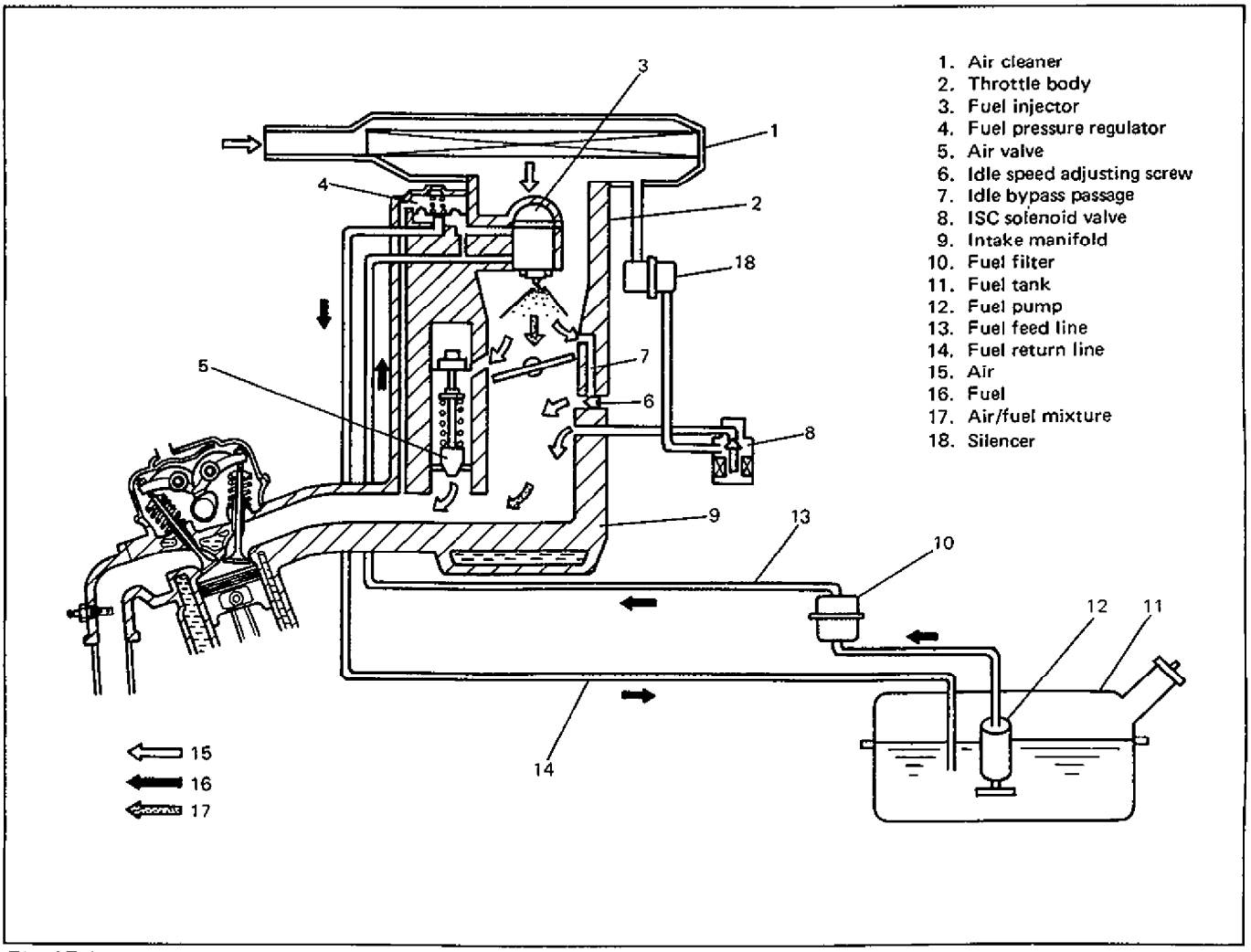


Fig. 6E-3 Air and Fuel Delivery System

FUEL PUMP

The electric fuel pump located in the fuel tank consists of armature, magnet, impeller, brush, check valve, etc.. The ECM controls its ON/OFF operation as described under "Fuel Pump Control System" included in later part of this section.

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 check valve to keep some pressure in the fuel feed line even when the fuel pump is stopped.

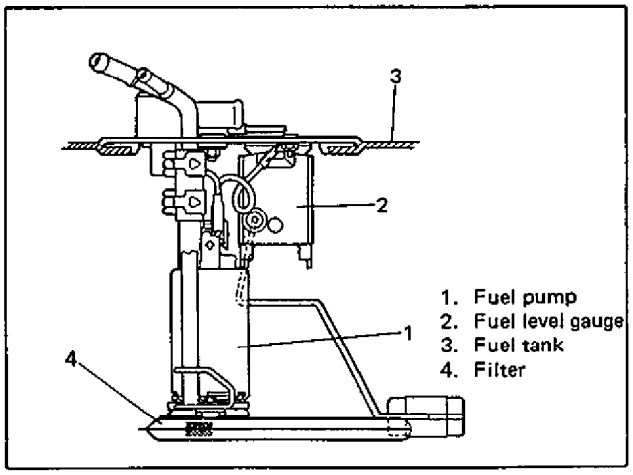


Fig. 6E-4 Fuel Pump Mounting

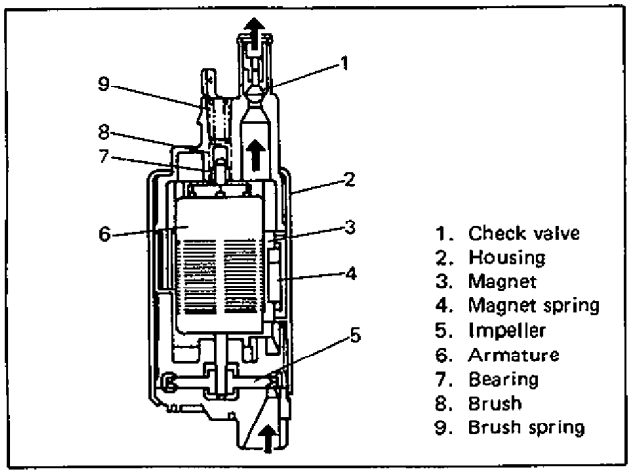


Fig. 6E-5 Fuel Pump Cross-Section

THROTTLE BODY

The throttle body consists of the main bore, air and/or fuel passage, vacuum passage (for pressure sensor, ignition timing vacuum advancer, evaporative emission control system and EGR system), air induction passage and the following parts.

- Fuel 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 in the intake manifold.
- Throttle valve which is interlocked with the accelerator pedal and controls the amount of the air/fuel mixture drawn into the combustion chamber.
- Air valve which supplies the bypass air when engine is cold.
- Idle speed adjusting screw which controls the amount of bypass air to adjust engine idle speed.
- TS (M/T model) or TPS (A/T model) which detects the throttle valve opening and sends a signal to ECM.

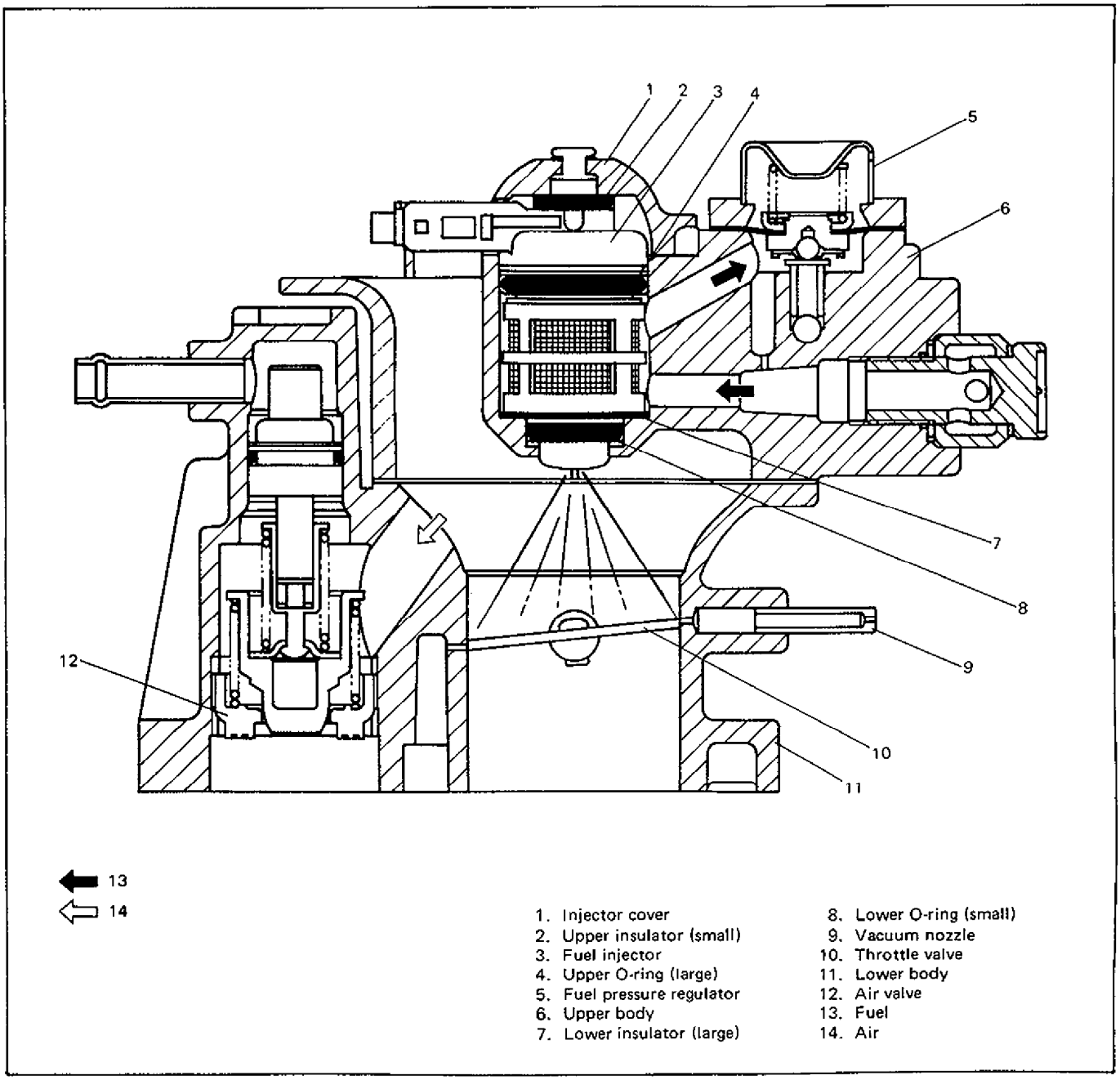


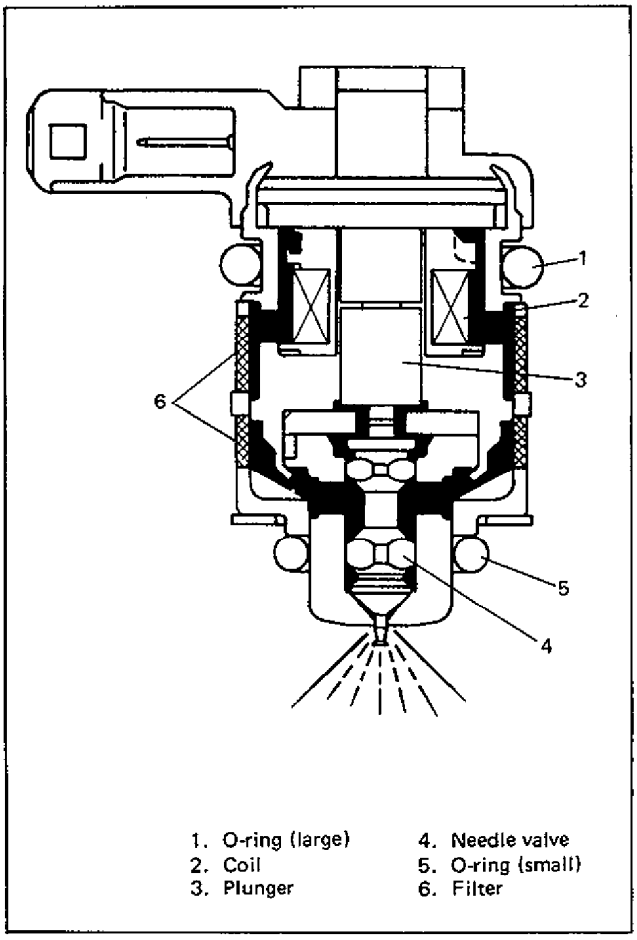
Fig. 6E-6 Throttle Body Cross-Section

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).



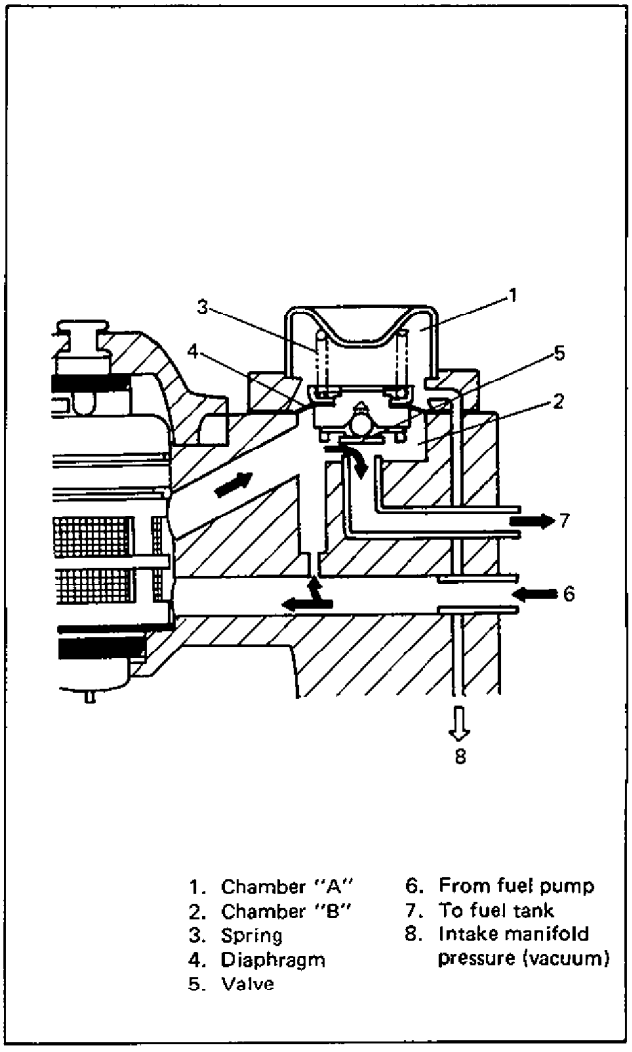
1. O-ring (large)
2. Coil
3. Plunger
4. Needle valve
5. O-ring (small)
6. Filter

Fig. 6E-7 Fuel Injector Cross-Section

FUEL PRESSURE REGULATOR

The fuel pressure regulator is diaphragm-operated relief valve consisting of diaphragm, spring and valve. It keeps the fuel pressure applied to the injector 1.8 kg/cm² (180 kPa, 25.6 psi) higher than that in the intake manifold at all times.

The pressure applied to the chamber "A" of fuel pressure regulator is intake manifold pressure and that to the chamber "B" is fuel pressure. When the fuel pressure rises more than 1.8 kg/cm² (180 kPa, 25.6 psi) higher than the intake manifold pressure, the fuel pushes the valve in the regulator open and excess fuel returns to the fuel tank via the return line.



1. Chamber "A"
2. Chamber "B"
3. Spring
4. Diaphragm
5. Valve
6. From fuel pump
7. To fuel tank
8. Intake manifold pressure (vacuum)

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 into 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 80°C (176°F)), the thermo-wax contracts.

In this state, the valve opens by the spring force, allowing the air 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.

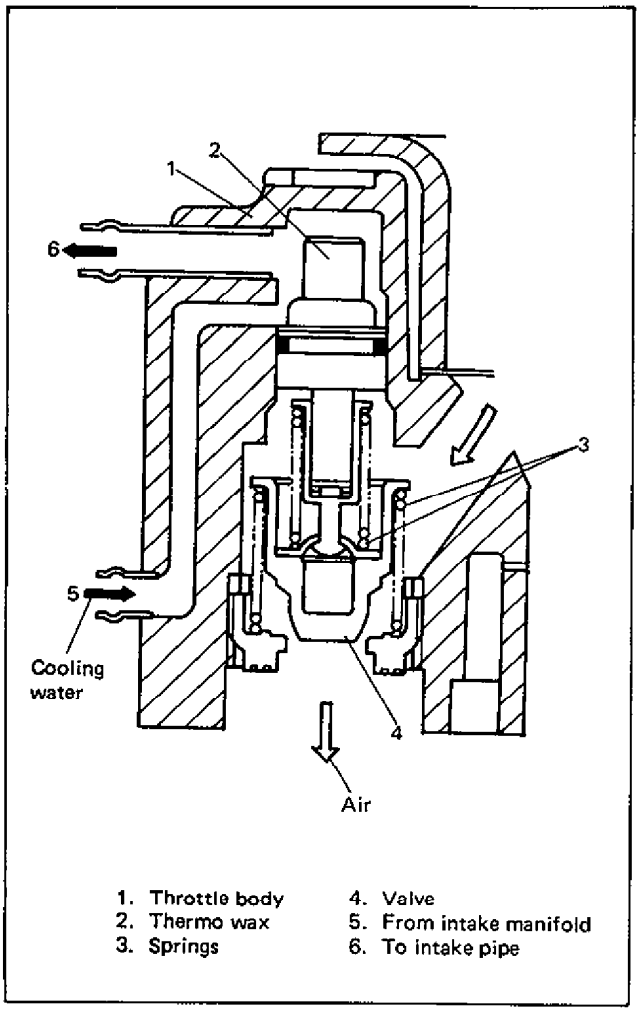


Fig. 6E-9 Opening Air Valve

As the engine is warmed up, the thermo-wax expands gradually, then the piston pushes down the valve gradually, and the amount of air passing through the air valve decreases and so does the engine speed. When the engine cooling water temperature reaches about 80°C (176°F), the valve is fully closed and the engine speed is back to the normal idle speed.

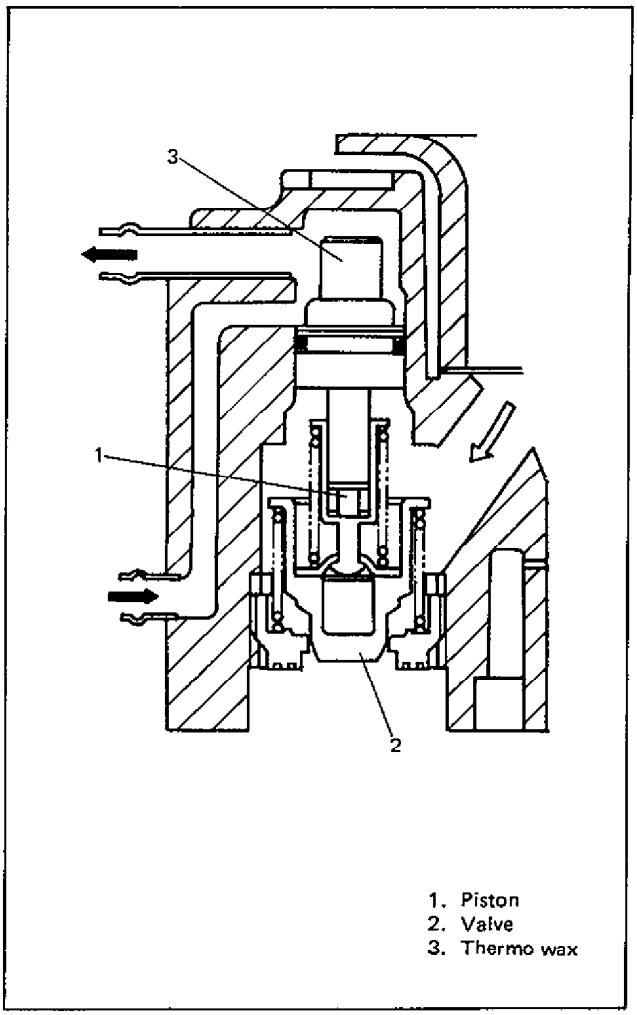


Fig. 6E-10 Closing Air Valve

ISC (Idle Speed Control) SOLENOID VALVE

The ISC solenoid valve opens and closes air by-pass passage according to the signal from ECM. When it opens, the air is supplied to the intake manifold.

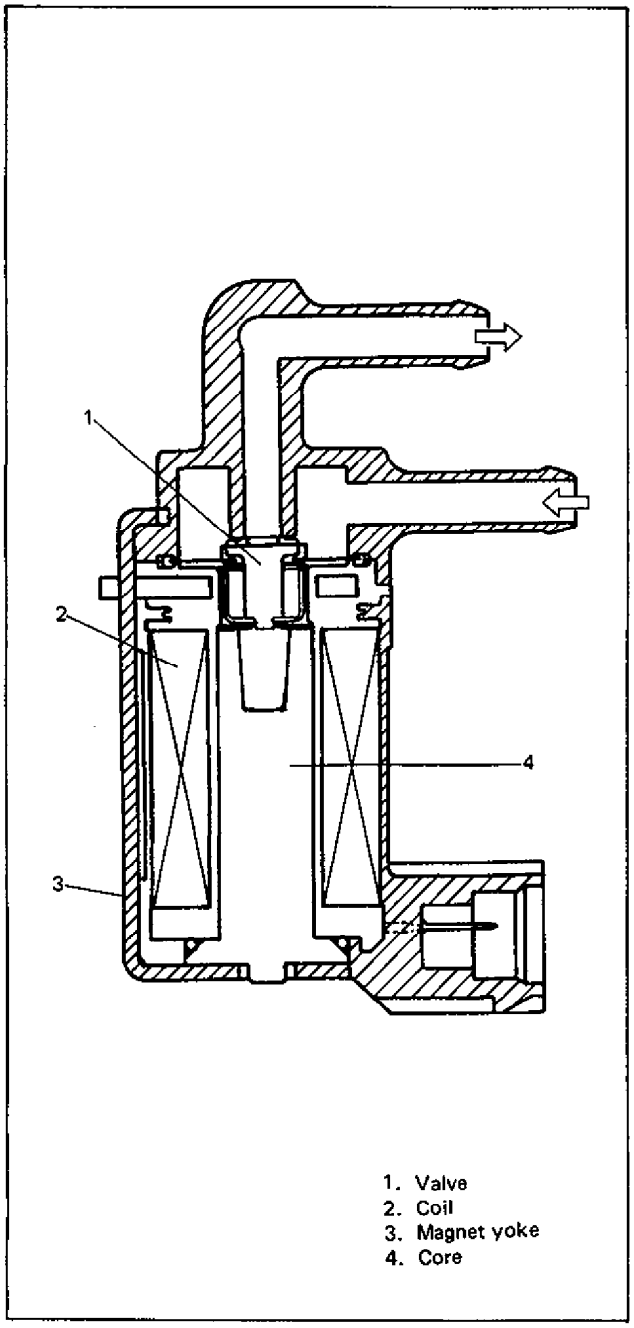


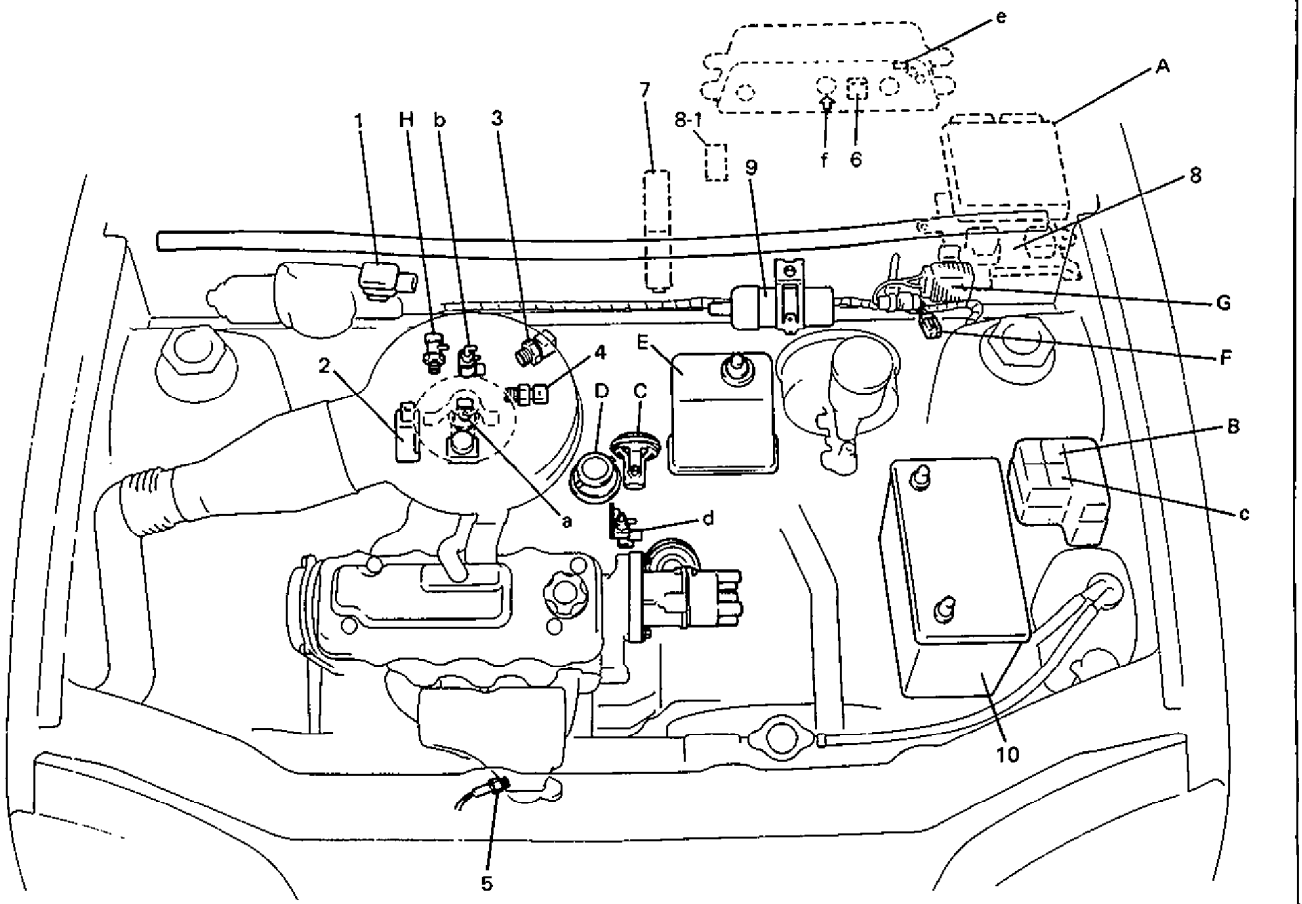
Fig. 6E-10-1 ISC Solenoid Valve Cross-Section

ELECTRONIC CONTROL SYSTEM

The electronic control system consists of 1) various sensors which detect the state of engine and driving conditions, 2) ECM which controls various devices according to the signals from the sensors and 3) various controlled devices.
Fanctionally, it is divided into five sub systems:

- Fuel injection control system
- ISC solenoid valve control system
- Fuel pump control system
- EGR control system (For California spec. model only)
- Shift-up indicator light control system (If equipped)

Also, with A/T model ECM sends throttle valve opening signal to A/T control module to control A/T.



INFORMATION SENSORS
1. Pressure sensor
2. TS or TPS
3. ATS
4. WTS
5. Oxygen sensor
6. Speed sensor
7. A/T control module (A/T model only)
8. Diagnosis switch terminal on junction/fuse block (Not for West Germany spec. model.)
8-1. Diagnosis switch (West Germany spec. model only.)
9. Ignition coil
10. Battery

CONTROLLED DEVICES
a : Fuel injector
b : ISC solenoid valve
c : Fuel pump relay
d : EGR VSV (California spec. model only)
e : "CHECK ENGINE" light
f : Shift-up indicator light (if equipped)

OTHERS
A : ECM
B : Main relay
C : EGR valve
D : EGR modulator
— California spec. model only
E : Canister
F : Monitor coupler
G : Injector resistor
H : BVSV

Fig. 6E-11 Parts Location

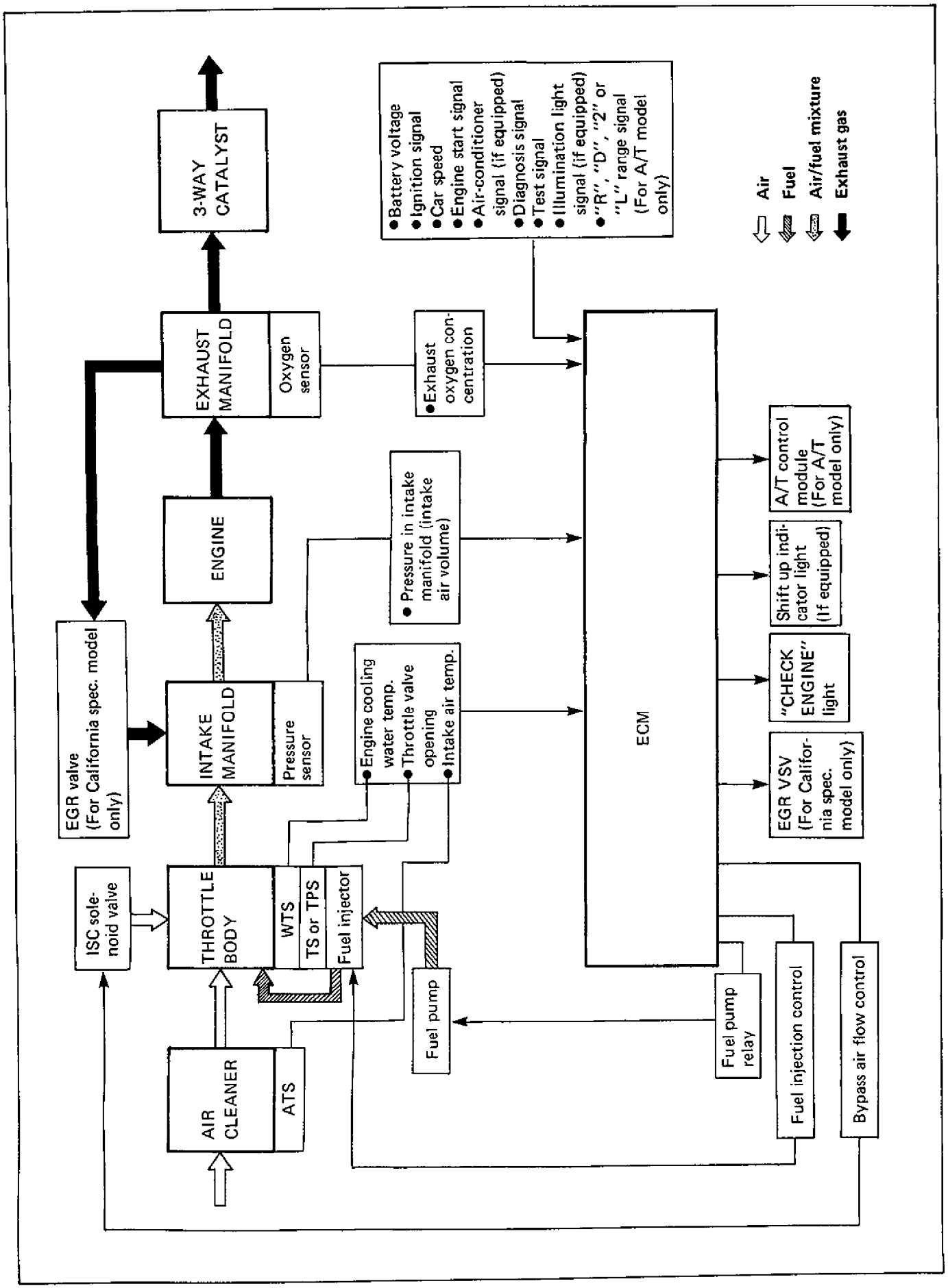


Fig. 6E-12 System Schematic

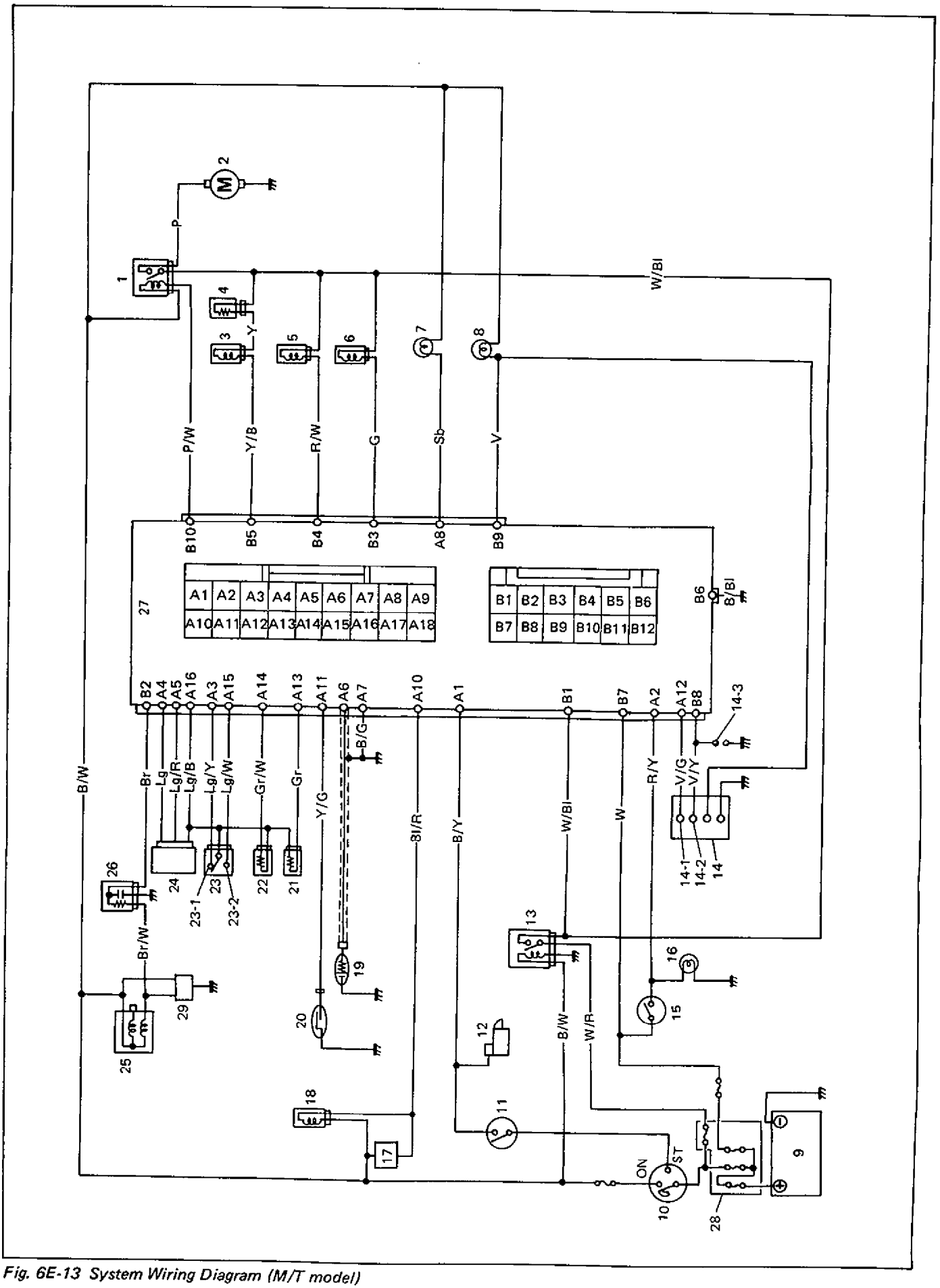


Fig. 6E-13 System Wiring Diagram (M/T model)

1. Fuel pump relay
2. Fuel pump
3. Fuel injector
4. Resistor
5. ISC solenoid valve
6. EGR VSV
   (For California spec. model only)
7. Shift-up indicator light
   (if equipped)
8. "CHECK ENGINE" light
9. Battery
10. Main switch
11. Clutch switch
12. Starter magnetic switch
13. Main relay
14. Monitor coupler
14-1. Test switch terminal
14-2. Diagnosis switch terminal
14-3. Diagnosis switch terminal
   (Not for West Germany spec. model)
   Diagnosis switch
   (West Germany spec. model only)
15. Lighting switch
16. Illumination light
17. Air-conditioner amplifier
   (If equipped)
18. Air-conditioner VSV
   (If equipped)
19. Oxygen sensor
20. Speed sensor
21. Air temp. sensor
22. Water temp. sensor
23. Throttle switch
23-1. Idle switch
23-2. Wide open switch
24. Pressure sensor
25. Ignition coil
26. Noise suppressor
27. ECM
28. Main fuse box
29. Ignitor

Wire color

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

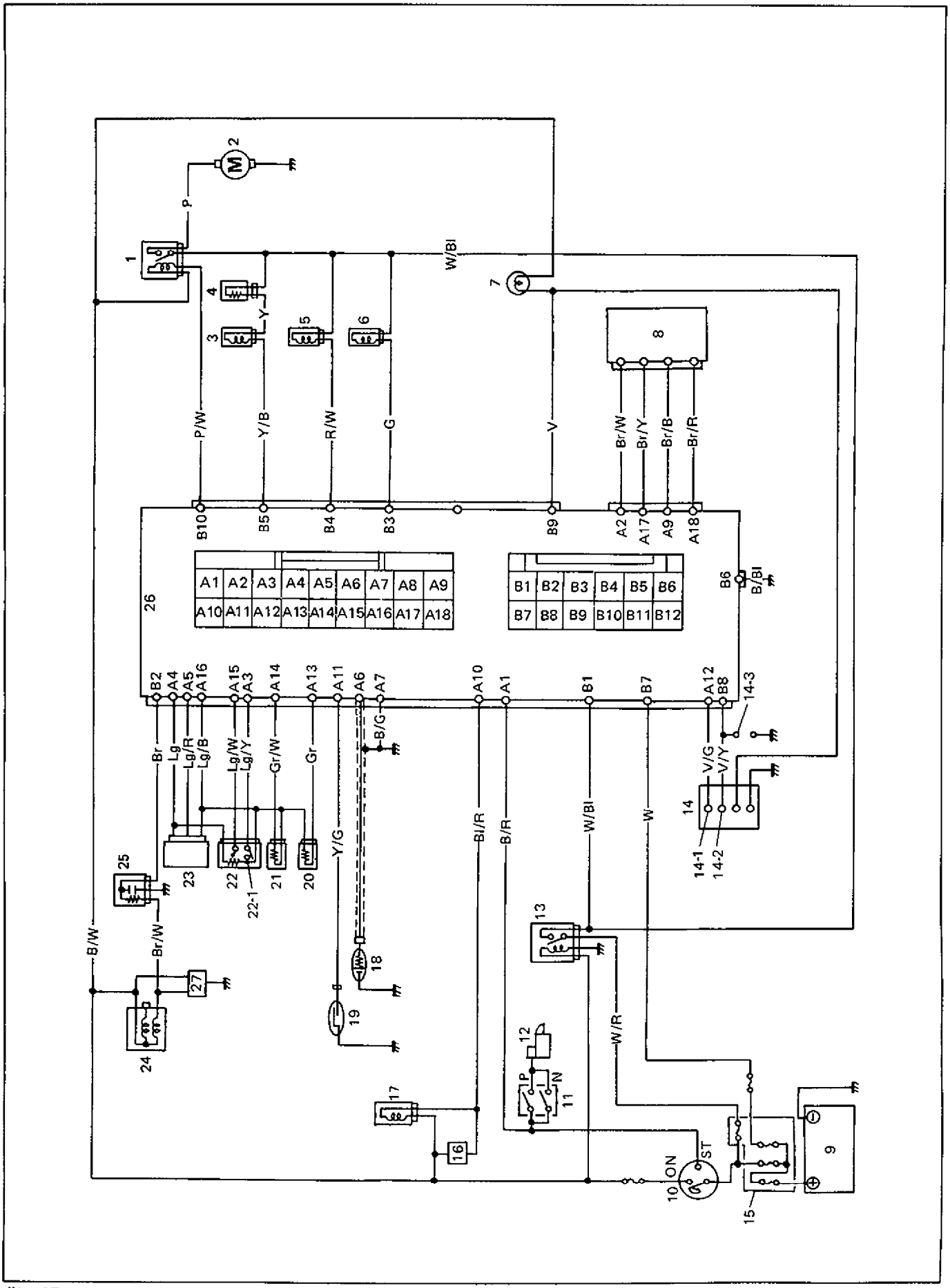


Fig. 6E-14 System Wiring Diagram (A/T model)

1. Fuel pump relay
2. Fuel pump
3. Fuel injector
4. Resistor
5. ISC solenoid valve
6. EGR VSV
   (For California spec. model only)
7. "CHECK ENGINE" light
8. A/T control module
9. Battery
10. Main switch
11. Shift switch
    ("P" and "N" range)
12. Starter magnetic switch
13. Main relay
14. Monitor coupler

14-1. Test switch terminal
14-2. Diagnosis switch terminal
14-3. Diagnosis switch terminal
    (Not for West Germany spec. model)
    Diagnosis switch
    (West Germany spec. model only)
15. Main fuse box
16. Air-conditioner amplifier
    (If equipped)
17. Air-conditioner VSV
    (If equipped)
18. Oxygen sensor
19. Speed sensor
20. Air temp. sensor
21. Water temp. sensor
22. Throttle position sensor

22-1. Idle switch
23. Pressure sensor
24. Ignition coil
25. Noise suppressor
26. ECM
27. Ignitor

Wire color

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

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 microcomputer, A/D (Analog/Digital) converter, I/O (Input/Output) unit, 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, fuel pump relay, etc. but also self-diagnosis function and fail-safe function as described in the following section.

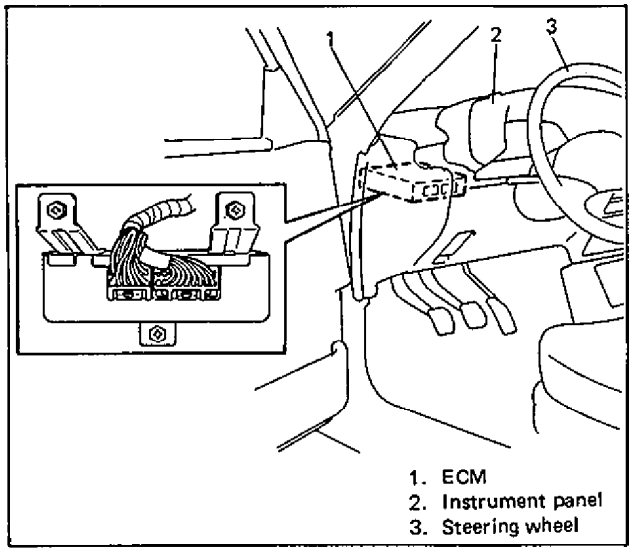


Fig. 6E-15 ECM Location

Self-diagnosis function

ECM diagnoses troubles which may occur in the area including the following parts when the ignition switch is ON and the engine is running, and indicates the result by turning on or flashing "CHECK ENGINE" light.

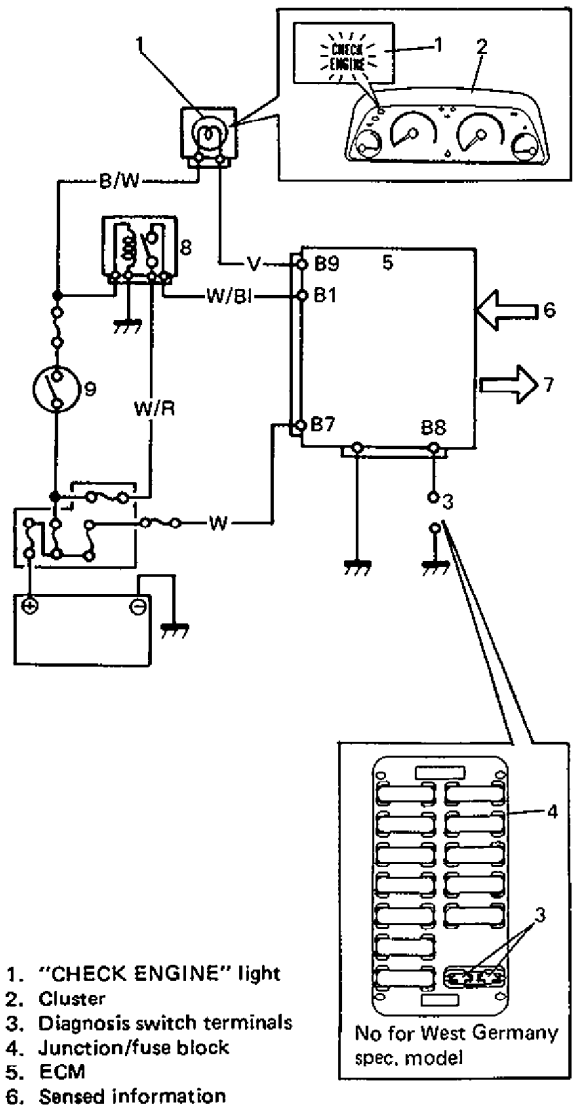
- Oxygen sensor
- Water temp. sensor
- Throttle switch (M/T model) or throttle position sensor (A/T model)
- Air temp. sensor
- Pressure sensor
- Ignition signal
- Speed sensor
- EGR system (California spec. model only)
- CPU (Central Processing Unit) of ECM

ECM and "CHECK ENGINE" light operate as follows.

- "CHECK ENGINE" light lights when the ignition switch is turned ON (but the engine at stop) with the diagnosis switch terminal ungrounded regardless of the condition of Electronic Fuel Injection system. This is only to check to the "CHECK ENGINE" light bulb and its circut.
- If the avove areas of Electronic Fuel Injection system is free from any trouble after the engine start (while engine is running), "CHECK ENGINE" light turns OFF.
- When ECM detects a trouble which has occurred in the above areas, it makes "CHECK ENGINE" light turn ON while the engine is running to warn the driver of such occurrence of trouble and at the same time it stores the trouble area in ECM back-up memory.
  (The memory is kept as it is even if the trouble was only temporary and disappeared immediately. And it is not erased unless the power to ECM is shut off for 60 seconds or longer.)
  ECM also indicates trouble area in memory by means of flashing of "CHECK ENGINE" light at the time of inspection (i.e. when diagnosis switch terminal is grounded and ignition switch is turned ON).

NOTE:

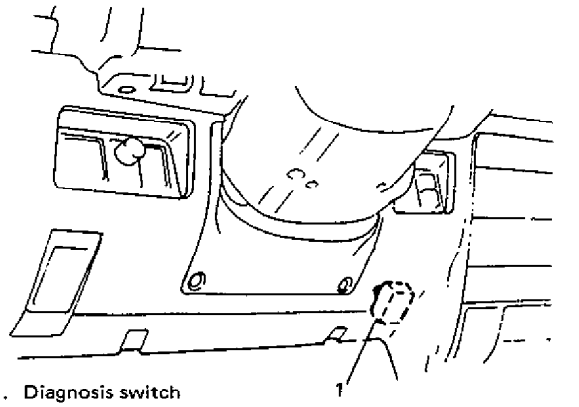
- **When a trouble occurs in the above areas except EGR system and disappears soon while the diagnosis switch terminal is ungrounded and the engine is running, "CHECK ENGINE" light lights and remains ON as long as the trouble exists but it turns OFF when the normal condition is restored.**
  When it is EGR system where a trouble occurs, even if it is only a temporary one and disappears soon, "CHECK ENGINE" light remains ON till the ignition switch is turned OFF.



1. "CHECK ENGINE" light
2. Cluster
3. Diagnosis switch terminals
4. Junction/fuse block
5. ECM
6. Sensed information
7. Output
8. Main relay
9. Ignition switch

NOTE:

West Germany spec. model is not provided with a diagnosis switch terminal in the fuse box but instead a diagnosis switch is installed to the underside of the instrument panel as shown below.



1. Diagnosis switch

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

Fail-safe function

Even when a trouble has occurred in such area of Electronic Fuel Injection system that includes the following parts and a failure signal is sent to ECM, control over the injector, ISC solenoid valve and others is maintained on the basis of the standard signals and/or back-up program prestored in the ECM while ignoring that failure signal and/or CPU. 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 such area and disability in running is avoided.

- Water temp. sensor
- Throttle switch (M/T model) or throttle position sensor (A/T model)
- Speed sensor
- Air temp. sensor
- Pressure sensor
- CPU in ECM

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).

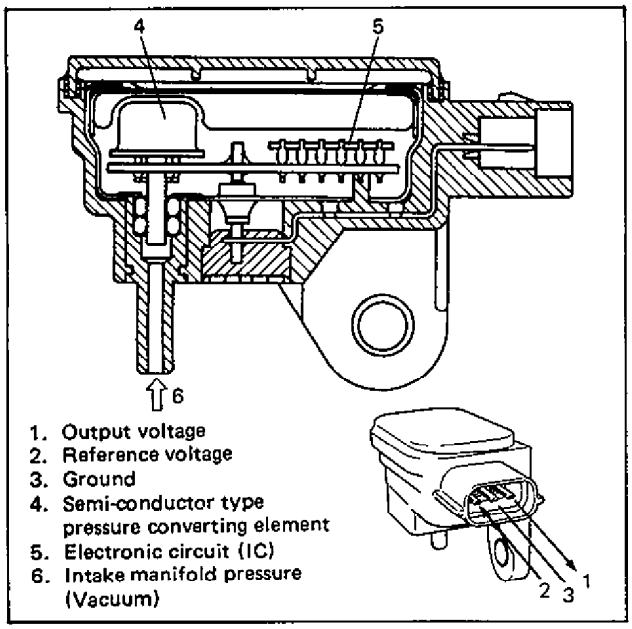


Fig. 6E-17 Pressure Sensor

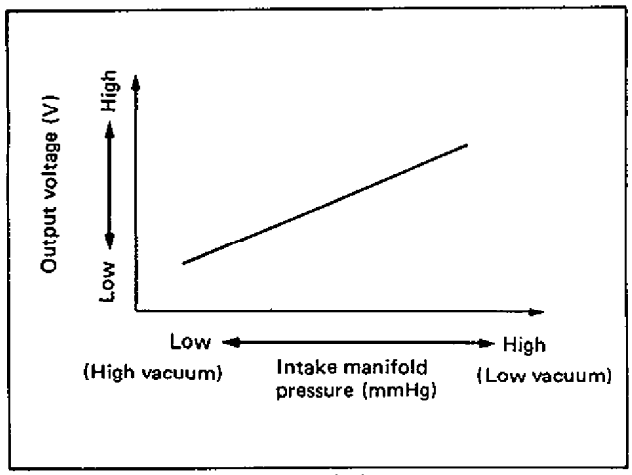


Fig. 6E-18 Output Characteristic

ECM uses the voltage signal from the pressure sensor as one of the signals to control fuel injector, ISC solenoid valve, shift-up indicator light and EGR VSV (if equipped).

Throttle Switch (M/T model only)

The throttle switch consisting of 2-contact points (idle switch and wide open switch) 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 idle switch which turns ON in that state.

The wide open state is detected by the wide open switch which turns ON in that state.

By monitoring thier ON/OFF signals, ECM detects the throttle valve opening.

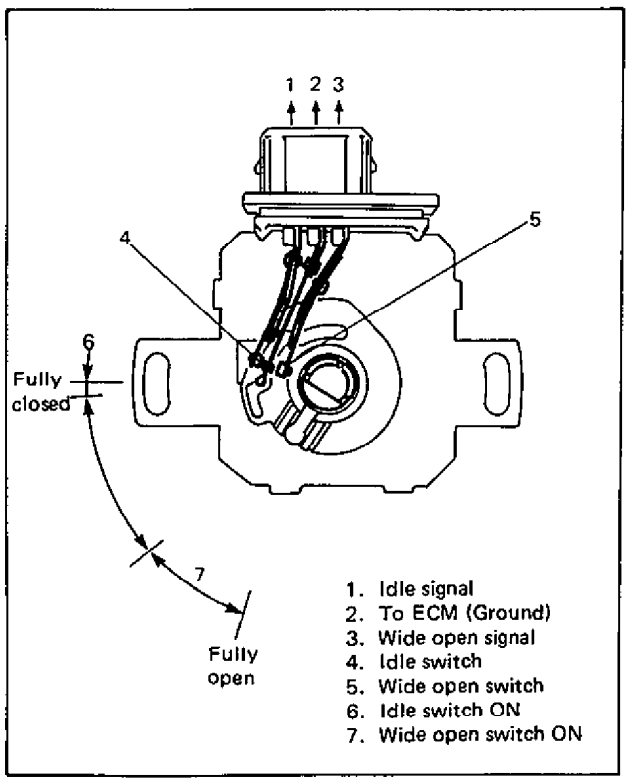


Fig. 6E-19 Throttle Switch

ECM uses the ON/OFF signals from throttle switch as one of the signals to control fuel injector, ISC solenoid valve, shift up indicator light and EGR VSV (if equipped).

Throttle Position Sensor (TPS) (A/T model only)

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 ON/OFF signal and sensor output voltage, ECM detects the throttle valve opening.

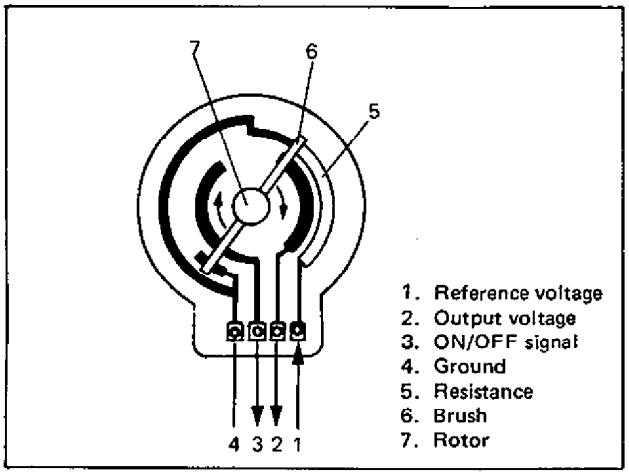


Fig. 6E-20 Throttle Position Sensor

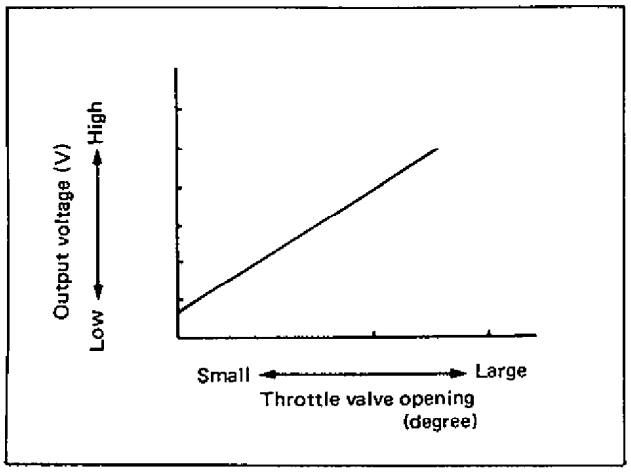


Fig. 6E-21 Output Characteristic

ECM uses the signal from TPS as one of the signals to control fuel injector, ISC solenoid valve and EGR VSV (if equipped).

Also, ECM converts the voltage signal from TPS into ON/OFF signal and sends it to A/T control module, where it is used as one of the signals to control the automatic transmission.

Air Temperature Sensor (ATS)

Located at the side of air cleaner case, 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 throttle body, 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.

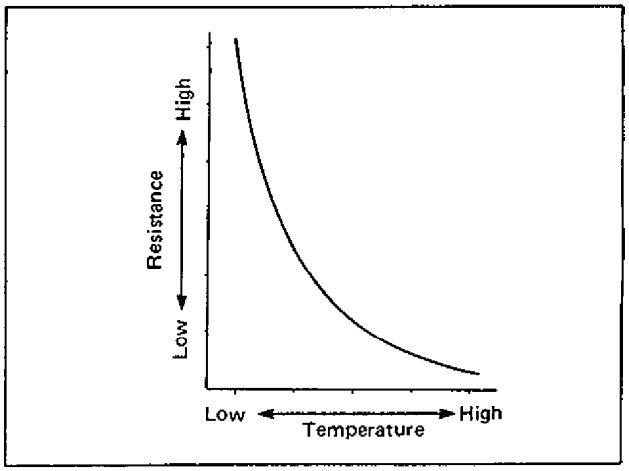


Fig. 6E-22 Air/Water Temperature Sensor Characteristic

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 sonsor detects whether the oxygen concentration is high or low (or the mixture is leancer or richer than the stoichiometric mixture).

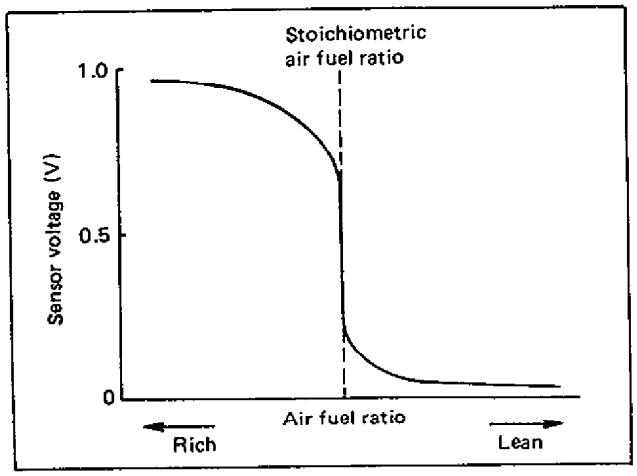


Fig. 6E-23 Output Characteristic

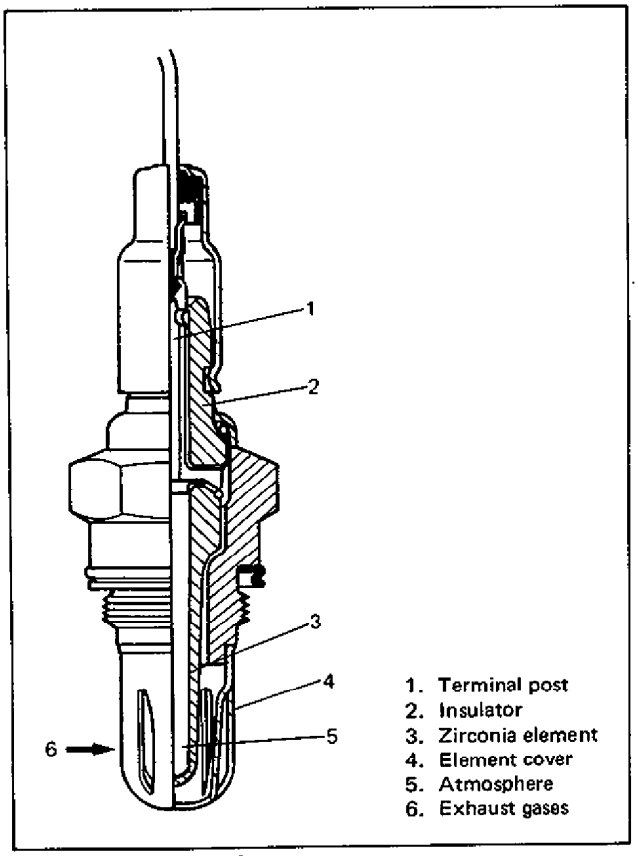


Fig. 6E-24 Oxygen Sensor

Speed Sensor

The speed sensor consisting of the lead switch and magnet is built in the speedometer. As the magnet turns with the speedometer cable, its magnetic force causes the lead switch to turn ON and OFF. Such ON/OFF frequency increases or decreases in proportion with the car speed and is sent to ECM as pulse signals.

ECM uses it as one of the signals to control the ISC solenoid valve and shift-up indicator light.

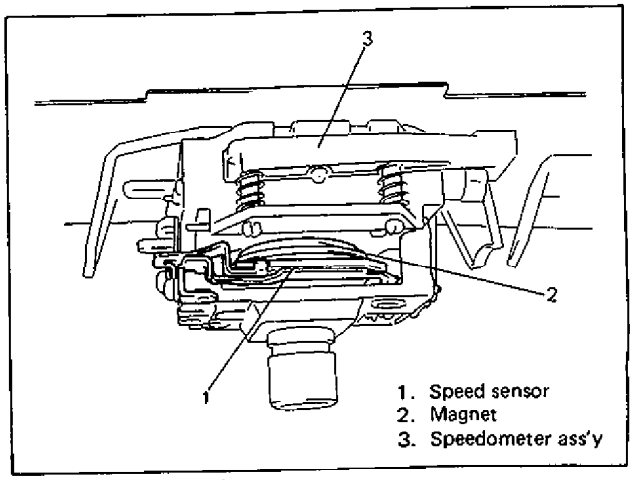


Fig. 6E-25 Speed Sensor

Ignition Signal

This signal is sent from the ignition coil primary circuit.

ECM detects the engine speed through this signal and uses it as one of the factors for controlling various devices.

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 the fuel injector and fuel pump relay.

"R", "D", "2" or "L" Range Signal (A/T model only)

This signal is sent from A/T control module as a battery voltage signal only when A/T is in "R", "D", "2" or "L" range. Thus, ECM judges whether A/T is in one of the above ranges or otherwise (i.e. in "P" or "N" range) and uses it as one of the signals to control the fuel injector and ISC solenoid valve.

Illumination Light Signal (If equipped)

This signal is sent from the illumination light circuit. It is used to reduce intensity of the shift-up indicator light when the illumination light is ON.

Air-Conditioner Signal (Car with air-conditioner only)

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.

Battery Voltage

The fuel injector is driven by its solenoid coil based upon the ECM output signal.

There is some delay called as "Ineffective injection time", which doesn't provide fuel, between ECM signal and valve action.

As the ineffective injection time depends on the battery voltage, ECM takes voltage information to compensate it in fuel injection time.

Diagnosis Switch Terminal

There are two diagnosis switch terminals; one included in the junction/fuse block and the other in the monitor coupler in the engine room. When either diagnosis switch terminal is grounded, a diagnosis signal is fed to ECM which then outputs self-diagnosis code and at the same time fix the ON time of ISC solenoid valve constant.

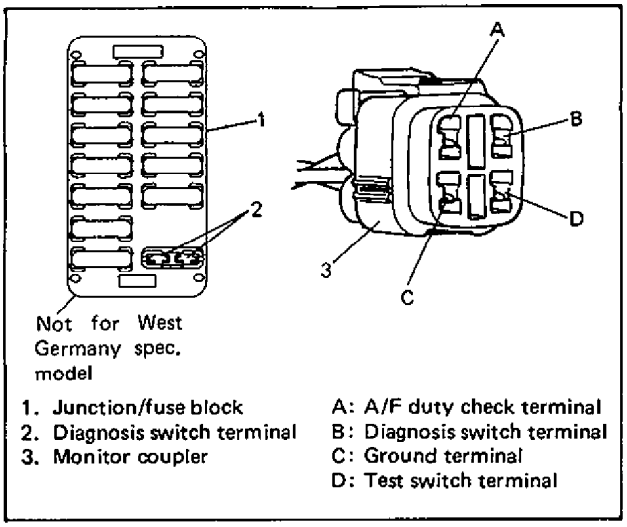


Fig. 6E-26 Diagnosis and Test Switch Terminals

NOTE:

West Germany spec. model is not provided with a diagnosis switch terminal in the fuse box but instead a diagnosis switch is installed to the underside of the instrument panel as shown below.

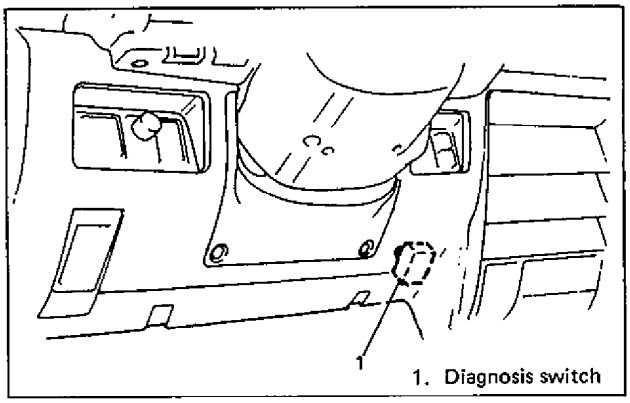


Fig. 6E-26-1 Diagnosis Switch (West Germany Spec. Model only)

Test Switch Terminal

The test switch terminal is included in the monitor coupler.

When both test switch terminal and diagnosis switch terminal are grounded, ECM outputs A/F duty through the A/F duty check terminal.

Also, "CHECK ENGINE" light stays ON at this time, but it is nothing abnormal.

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

Thre are two types of injection timing. One is "synchronous injection" in which injection is synchronous with the ignition signal and the other is "asynchronous injection" in which injection takes place independently of the ignition signal.

- **Synchronous injection**
  Normally, the injector injects fuel at every ignition signal. But when the engine cooling water temperature is low immediately after its start, the injection time for one ignition cycle is divided into some and injection takes place accordingly.

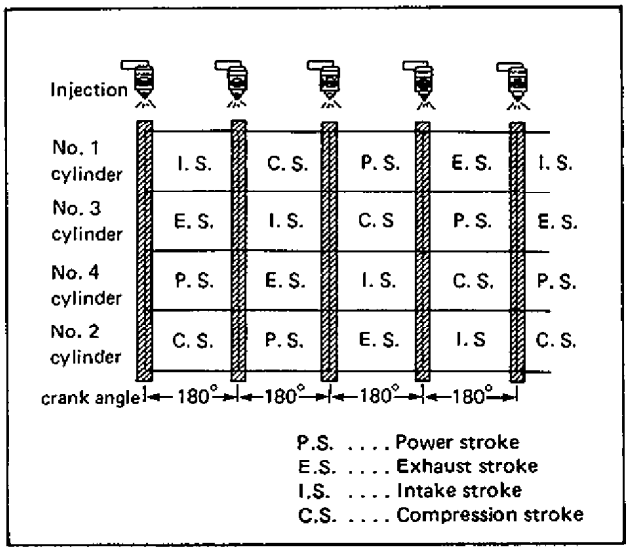


Fig. 6E-27 Synchronous Injection

- **Asynchronous injection**
  When the throttle valve is opened from its idle position, the injector injects fuel in addition to synchronous injection independently of the ignition signal.

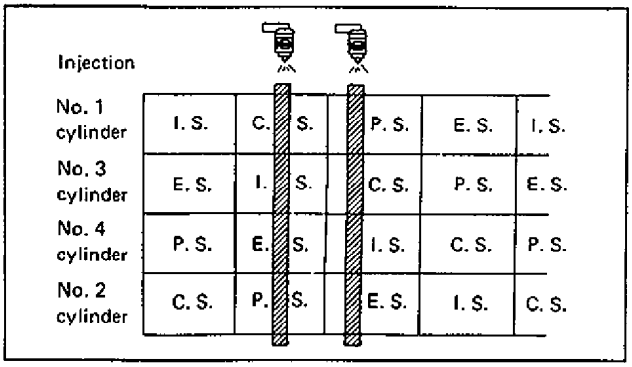


Fig. 6E-28 Asynchronous Injection

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.

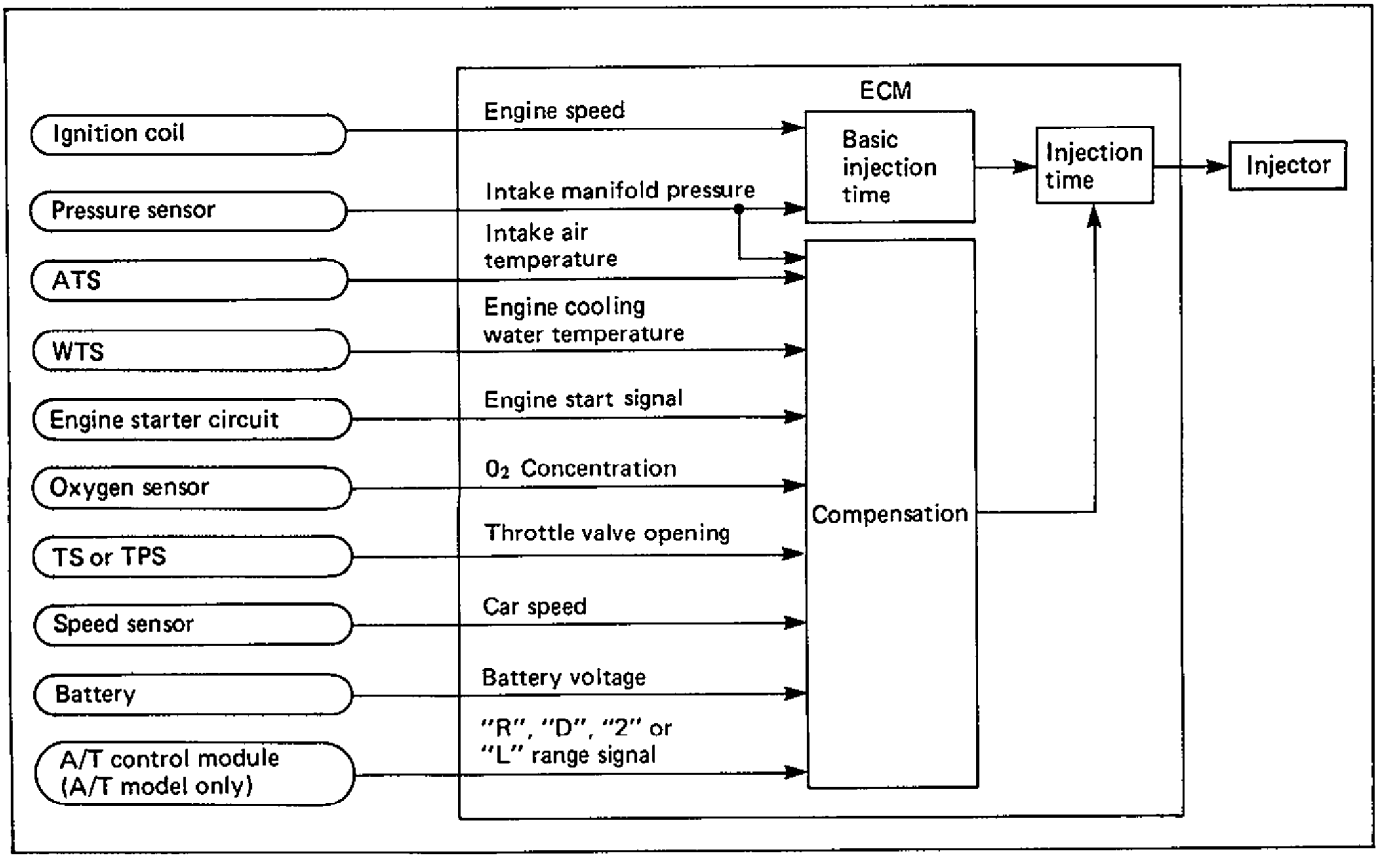


Fig. 6E-29 Parameter Diagram for Fuel Injection Control System

Intake air temperature compensation

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

Enriching compensation while engine starting

In order to improve starting performance, enriching compensation at start is carried out.

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. The amount of compensation varies depending on the engine cooling water temperature and it is the largest immediately after the engine start and after that, it reduces gradually.

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.

Power enriching compensation

To ensure smooth acceleration and good driveability under the high load driving condition, enriching compensation is carried out when the throttle valve opening is larger than specification.

Enriching compensation when accelerating
To ensure smooth acceleration, enriching compensation is carried out when the intake manifold pressure varies by more than a specified amount druring acceleration. The amount of compensation is determined according to the engine cooling water temperature and how much the intake manifold pressure varies.

Leaning compensation when decelerating
To obtain a proper air/fuel mixture ratio during deceleration, leaning compensation is carried out when the intake manifold pressure varies by more than a specified amount during deceleration.

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 for feed back compensation.

Fuel cut
Fuel injection stops (with operation of the injector prevented) when decelerating (i.e. when the throttle valve is at idle position and the engine speed is high), so that unburned gas will not be exhausted and it starts again when above conditions are not met.
The fuel injection also stops when the engine speed exceeds about 6,800 r/min to prevent overrun which affects the engine adversely and it starts again when the engine speed reduces to less than about 6,600 r/min.

Leaning compensation when EGR valve is operating (For California spec. model only)
To ensure proper air/fuel mixture ratio even while EGR valve is open, leaning compensation is carried out when EGR VSV is ON.

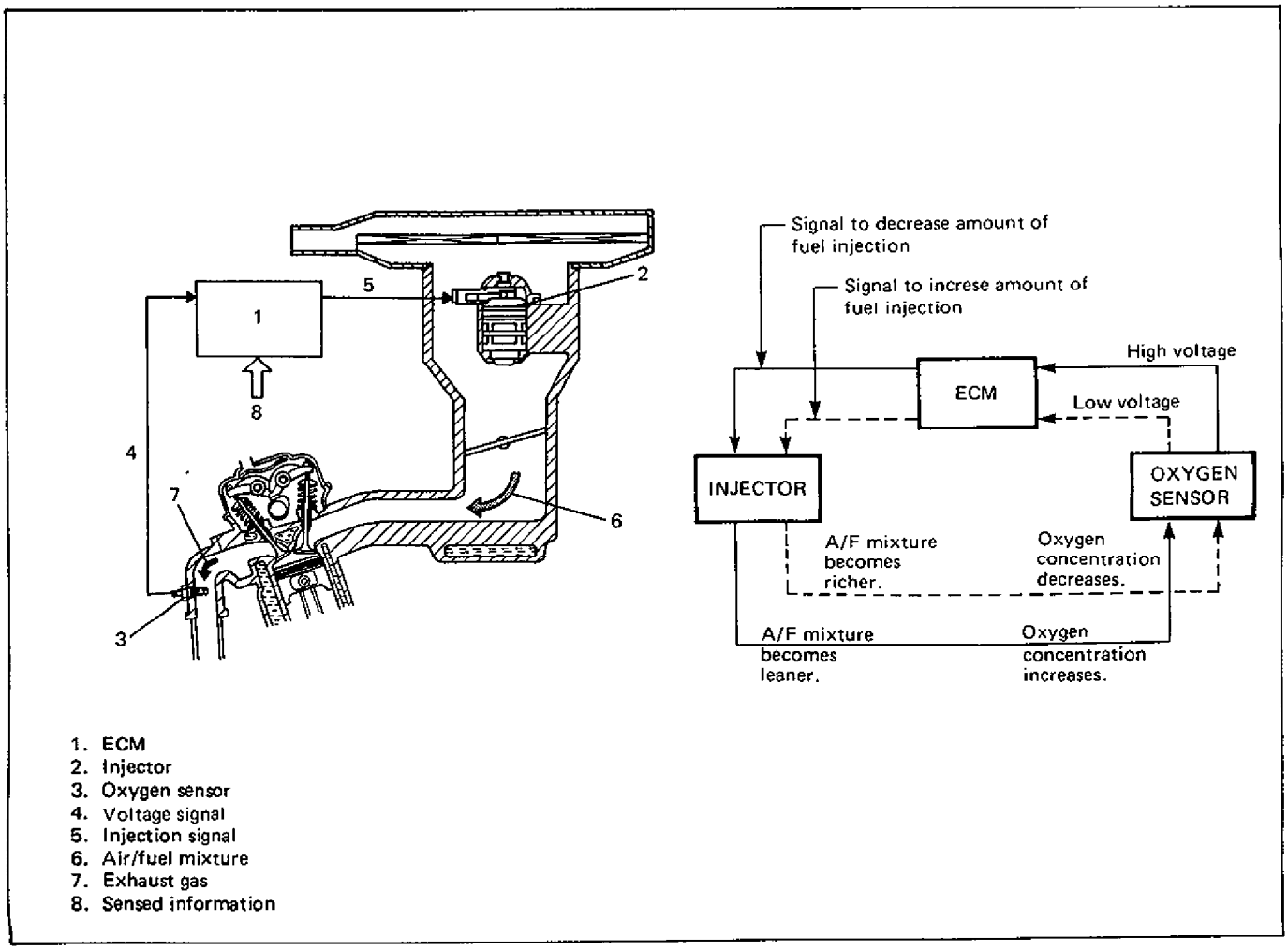
Air/fuel ratio feed back compensation

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
- When engine is running at high speed (higher than about 4000 r/min).



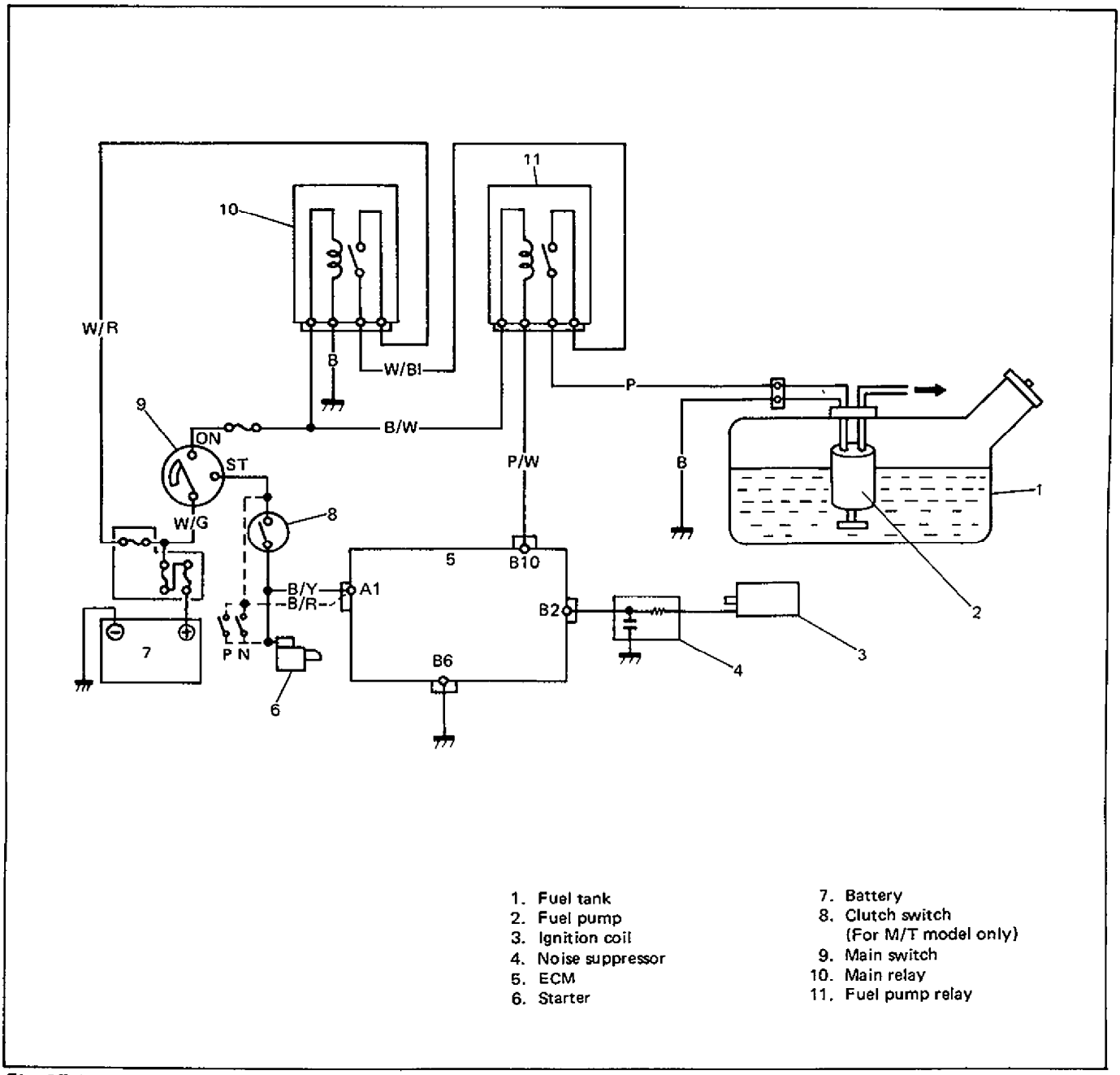
1. ECM
2. Injector
3. Oxygen sensor
4. Voltage signal
5. Injection signal
6. Air/fuel mixture
7. Exhaust gas
8. Sensed information

Fig. 6E-30 A/F Ratio Feed Back Compensation

FUEL PUMP CONTROL SYSTEM

ECM controls ON/OFF operation of the fuel pump by turning it ON via the fuel pump relay under any of the following conditions.

- For 2 seconds after ignition switch ON.
- While cranking engine (while engine start signal is inputted to ECM).
- While ignition signal is inputted to ECM



1. Fuel tank
2. Fuel pump
3. Ignition coil
4. Noise suppressor
5. ECM
6. Starter
7. Battery
8. Clutch switch (For M/T model only)
9. Main switch
10. Main relay
11. Fuel pump relay

Fig. 6E-31 Fuel Pump Circuit

ISC SOLENOID VALVE CONTROL SYSTEM

This system controls the bypass air flow by means of ECM and ISC solenoid valve for the following three purposes.

- To keep the engine idle speed as specified at all times
  The engine idle speed can vary due to following reasons.
  * Load applied to engine (when electric load is applied, automatic transmission is shifted to "R", "D" "2" or "L" range, air-conditioner is turned ON, etc.)
  * Variation in atmospheric pressure
  * Change in engine itself with passage of time
  * Other factors causing idle speed to change
- To improve starting performance of engine
- To compensate air/fuel mixture ratio when decelerating (Dash-pot effect)

Operation

ISC solenoid valve opens the bypass air passage when it is turned ON by ECM and closes it when turned OFF.
ECM detects the engine condition by using signals from various sensors and switches and while repeating ON and OFF cycle of ISC solenoid valve at a certain rate (12 times a second), it controls bypass air flow by increasing and decreasing its ON time within a cycle.

While the engine is cranking, ECM keeps ISC solenoid valve ON so as to obtain better start of the engine. After the engine has started, it reduces ON time gradually to maintain the idle speed as specified.

When the accelerator pedal is depressed (throttle valve is at other than idle position), ECM keeps ISC solenoid valve ON. When decelerating, on the other hand, it reduces its ON time gradually (thereby reducing the bypass air flow gradually) to adjust air/fuel mixture to an optimum ratio for combustion.

When the car is at a stop, the throttle valve is at the idle position and the engine is running, ECM controls the bypass air flow by increasing or decreasing ON time of ISC solenoid valve so that the engine speed is kept at a specified idle speed.

With an air-conditioner equipped car, when the air-conditioner is ON, a certain amount of the bypass air is supplied by the air-conditioner VSV independently of this system. The bypass air supplied by this system is used for fine control to keep the idle speed as specified.

NOTE:
This system automatically adjusts the engine idle speed to specification by means of ECM. If such specified idle speed is not available, it is necessary to adjust the basic idle speed with the idle speed adjusting screw as follows. With the diagnosis switch terminal grounded and ON time of ISC solenoid valve fixed constant, adjust the engine idle speed as specified.

Engine idle speed specifications at engine normal operating temperature are as follows.

(Unit: r/min)

		Air-conditioner OFF	Air-conditioner ON
M/T model		650 ± 50	900 ± 50
A/T model	At "P" or "N" range	750 ± 50	850 ± 50
	At "R", "D", "2" or "L" range	650 ± 50	750 ± 50

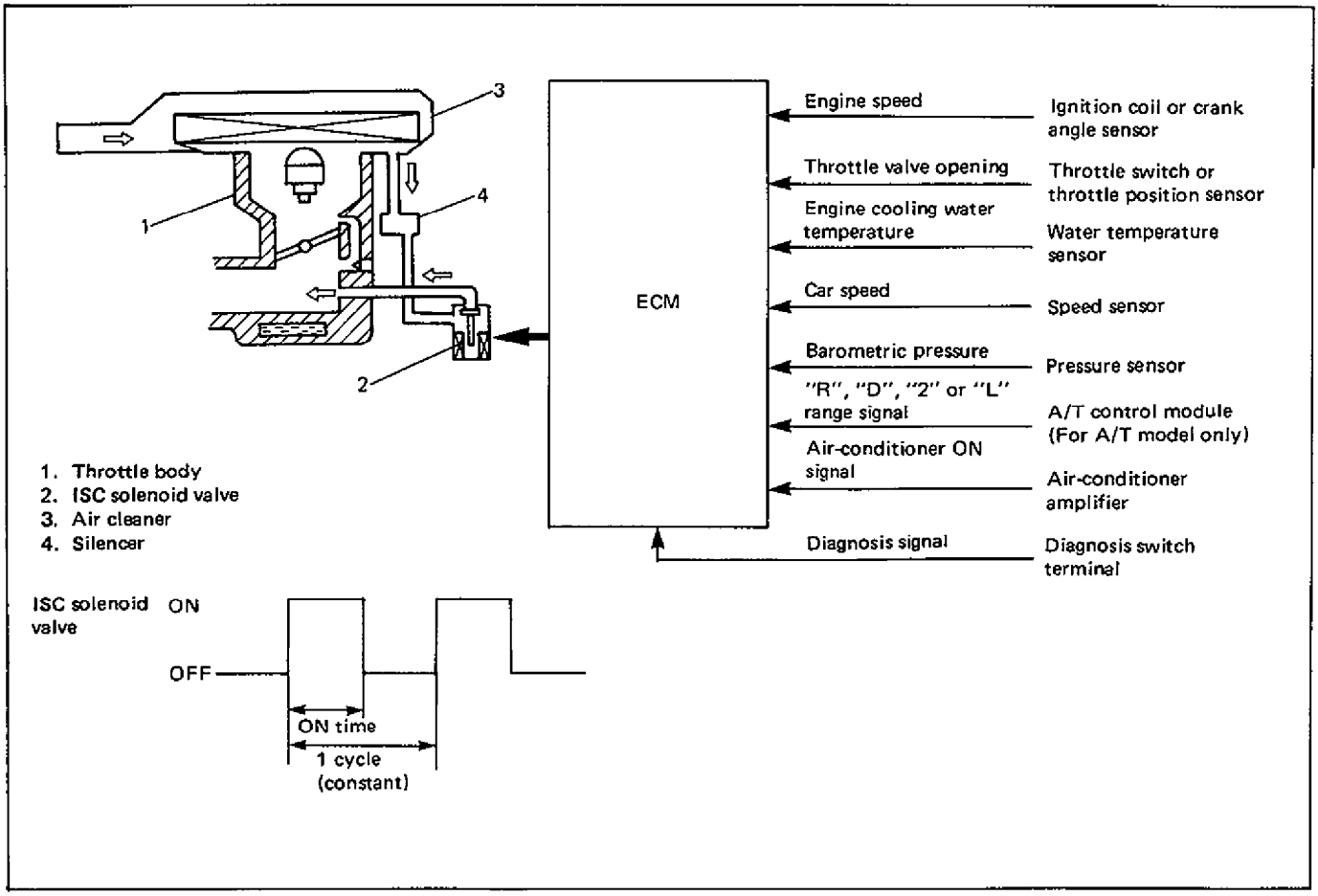


Fig. 6E-32 ISC Solenoid Valve Control System

EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM (For California specification model only)

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 conditions, 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 throttle valve is at idle position.
- When engine is running under high load.
- When intake manifold pressure is low.

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

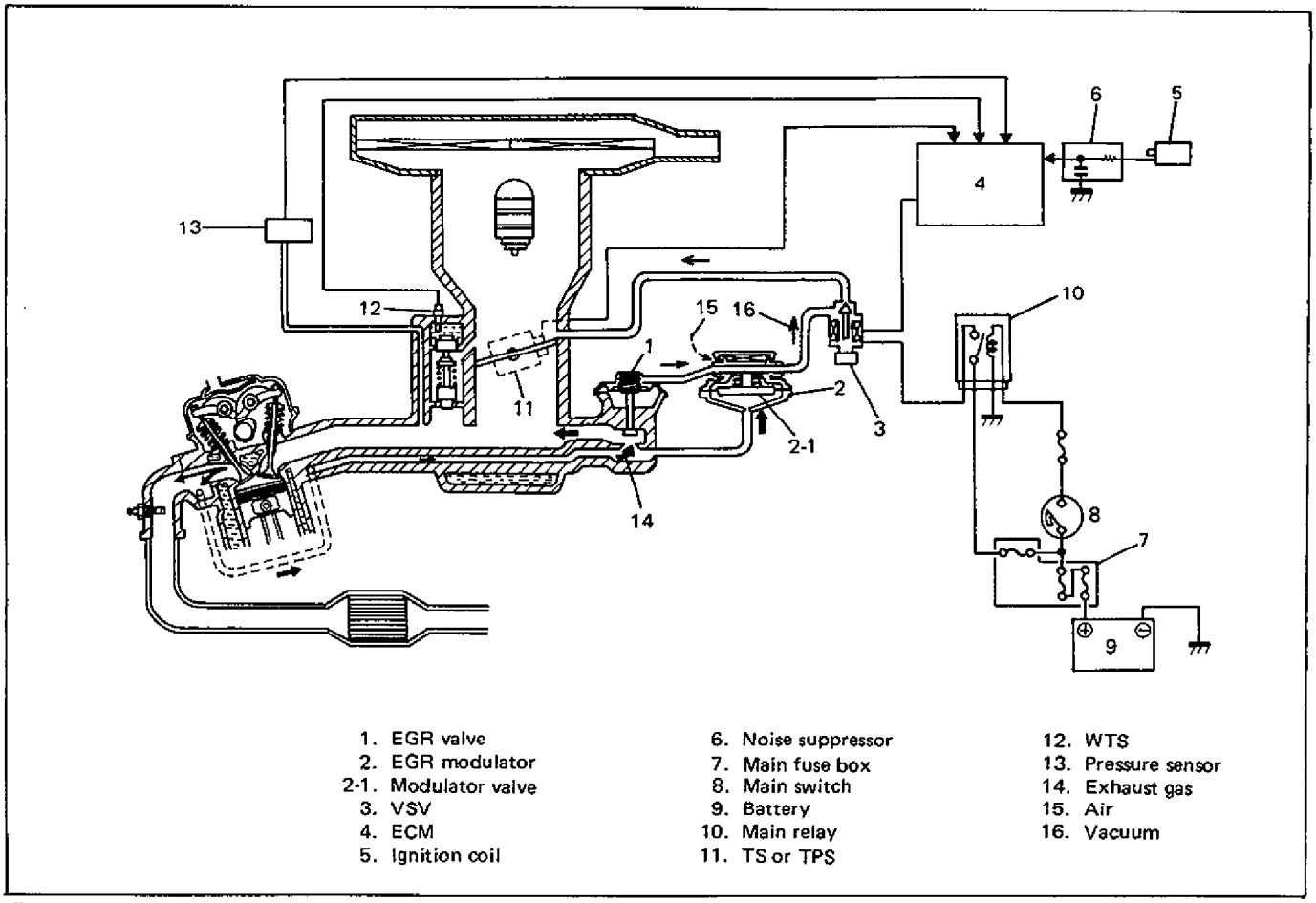


Fig. 6E-33 EGR System (For California spec. model only)

SHIFT-UP INDICATOR LIGHT CONTROL SYSTEM (If equipped)

This system is intended for economical driving by using proper gear positions. When the following conditions are all met, it turns ON the shift-up indicator light included in the meter cluster, but for 5 seconds at the longest, so as to urge the driver to shift up the gear.

- Car speed is higher than 5 km/h (3.1 mile/h)
- Both idle switch and wide open switch are OFF
- Engine speed is higher than a specified speed (The specified engine speed varies with the intake manifold pressure and engine cooling water temperature.)

To ensure better visibility of the shift-up indicator light, its intensity is reduced when the meter illumination light is turned ON.

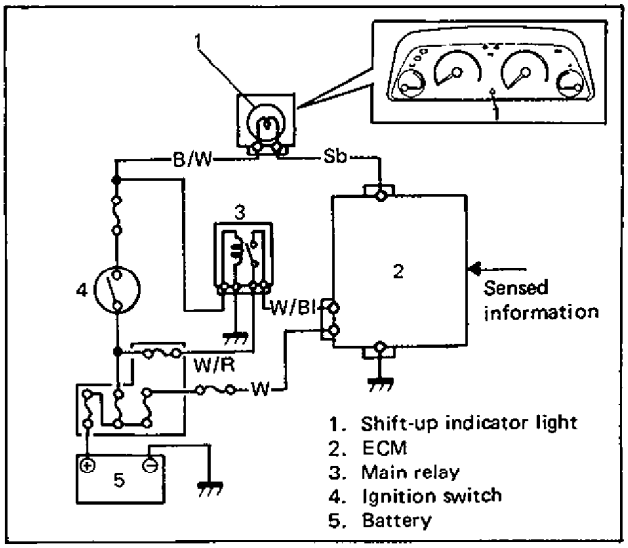


Fig. 6E-34 System Circuit

THROTTLE VALVE OPENING SIGNAL OUTPUT FOR A/T

Receiving the throttle valve opening signal from the throttle position sensor, ECM converts it into the three ON/OFF signals and sends their signals to A/T control module through A17, A9, and A18 terminals. Then A/T control module uses them as the signals to control the automatic transmission.

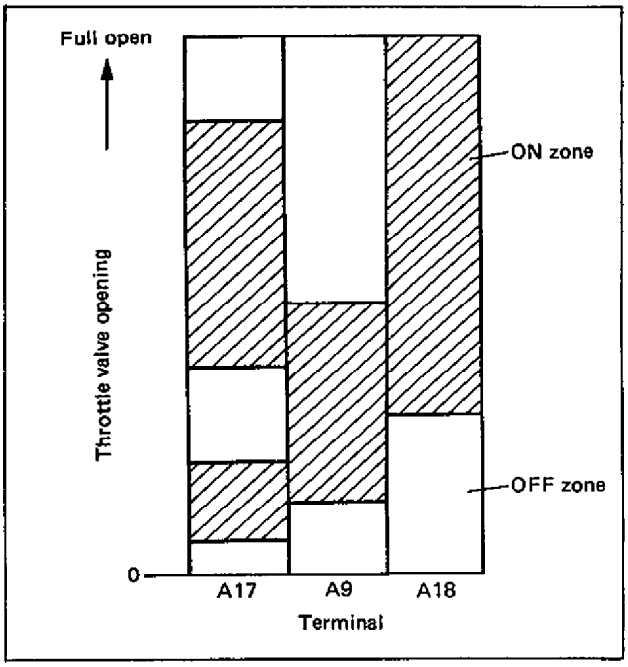


Fig. 6E-35 ON/OFF Signal Diagram

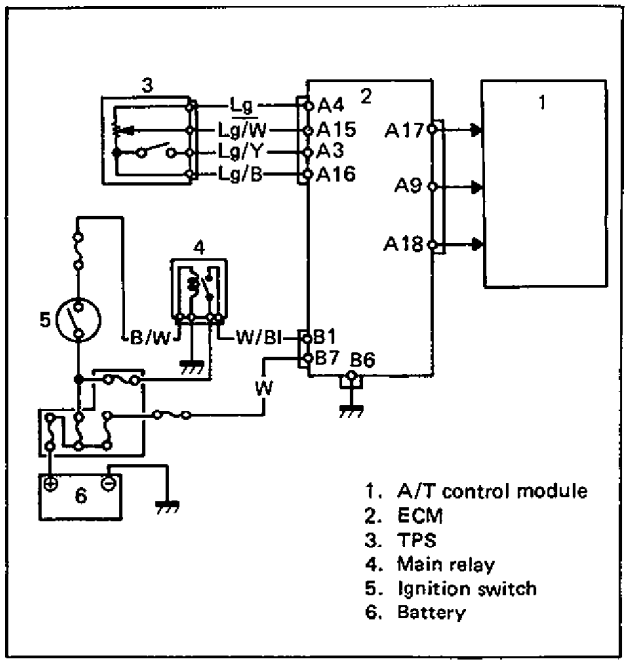


Fig. 6E-36 Signal Output Circuit

DIAGNOSIS

ECM has a system self-diagnosis function as described previously (p. 6E-20).
Investigate where the trouble is by referring to "Diagnostic Flow Chart" and "Diagnostic Code" in this section.

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 main fuse.
  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 switch terminal is grounded (spare fuse is connected or diagnosis switch turned ON) and ignition switch is held at ON position.
- Take a note of diagnostic code indicated first.

[INTERMITTENT TROUBLES]

- There are cases where "CHECK ENGINE" light indicates a diagnostic code representing a trouble which occurred only temporarily and has gone. In such case, it may occur that good parts are replaced unnecessarily. To prevent such an accident, be sure to follow instructions given below when checking by using "Diagnostic Flow Chart".
  * When trouble can be identified, that is, it is not an intermittent one:
    Check sensor (actuator), wires and each connection and if they are all in good condition, substitute a known-good ECM and recheck.
  * When trouble can not be identified but "CHECK ENGINE" light indicates a trouble code:
    Diagnose trouble by using that code No. and if sensor (actuator), wires and each connection are all in good condition, erase diagnostic code in ECM memory. Then conduct a test run and check what "CHECK ENGINE" light indicates. Only when it indicates trouble code again, substitute a known-good ECM and check again.
    If it indicates not trouble code but normal code No. 12, it means that an intermittent trouble did occur and has gone. In this case, check wires and connections carefully again.

[NOTES ON SYSTEM CIRCUIT INSPECTION]

- Intermittent trobles
  Most intermittent problems are caused by faulty electrical connections or wiring.
  Perform careful check of suspect circuits for:
  - Poor mating of coupler halves, or terminals not fully seated in 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.
- Be sure to use a voltmeter with high impedance (MΩ/V minimum) or a digital type voltmeter. Any other voltmeter should not be used because accurate measurements are not obtained.

- When checking voltage at each terminal of the coupler which is connected to ECM, be sure to connect negative probe to body ground and using service wire, connect ECM case to body ground as shown in Fig. 6E-37. Any other way is prohibited even by accident.
  Applying probes of voltmeter improperly may cause the sensor or ECM to be shorted and damaged.

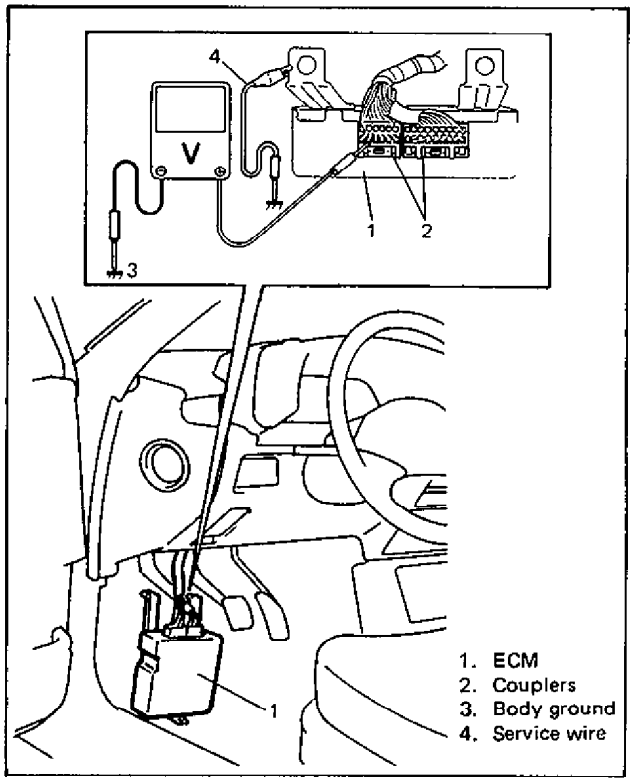


Fig. 6E-37 Checking Voltage

- For ECM coupler terminal positions (A1, A2 . . . to A18 and B1, B2 . . . to B12), refer to Fig. 6E-38.

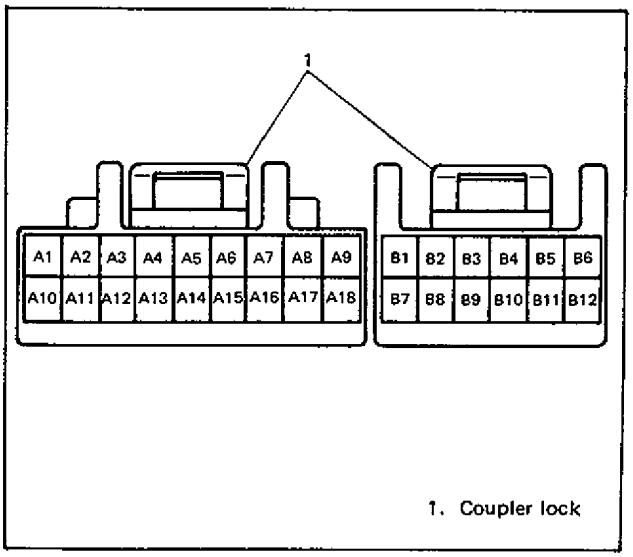


Fig. 6E-38 Coupler Terminal Position (Viewed from Wire Harness Side)

- When disconnecting and connecting coupler, make sure to turn ignition switch OFF.
- When checking connection of terminals, check its male half for bend and female half for excessive opening and both for 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.

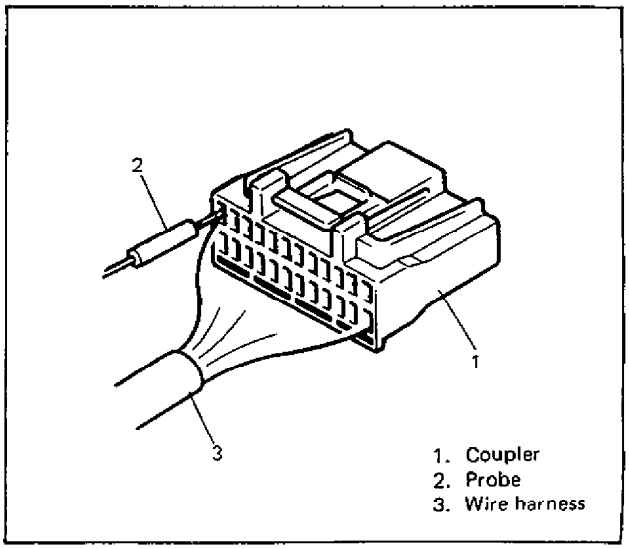


Fig. 6E-39 Connecting Meter Probe

- 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.

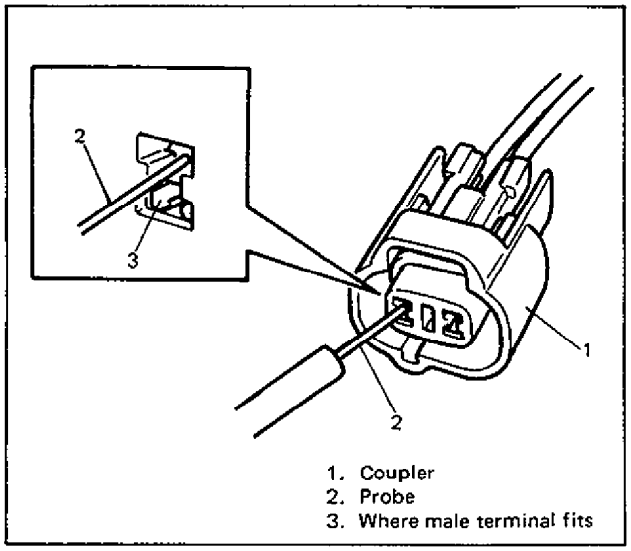


Fig. 6E-40 Connecting Meter Probe

- 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.

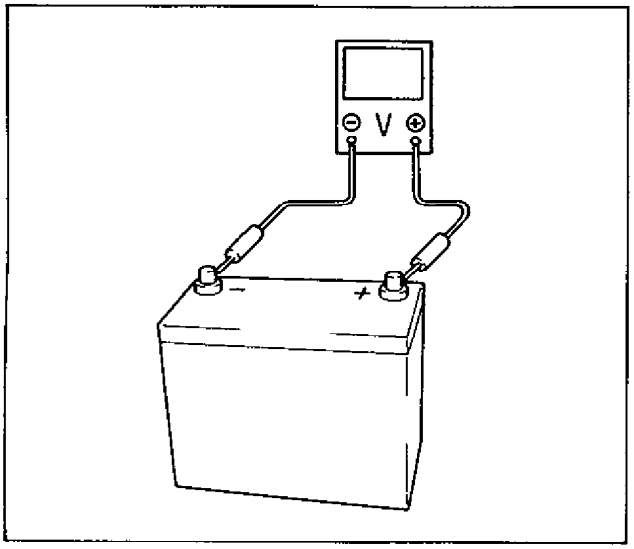


Fig. 6E-41 Checking Battery Voltage

DIAGNOSTIC FLOW CHART

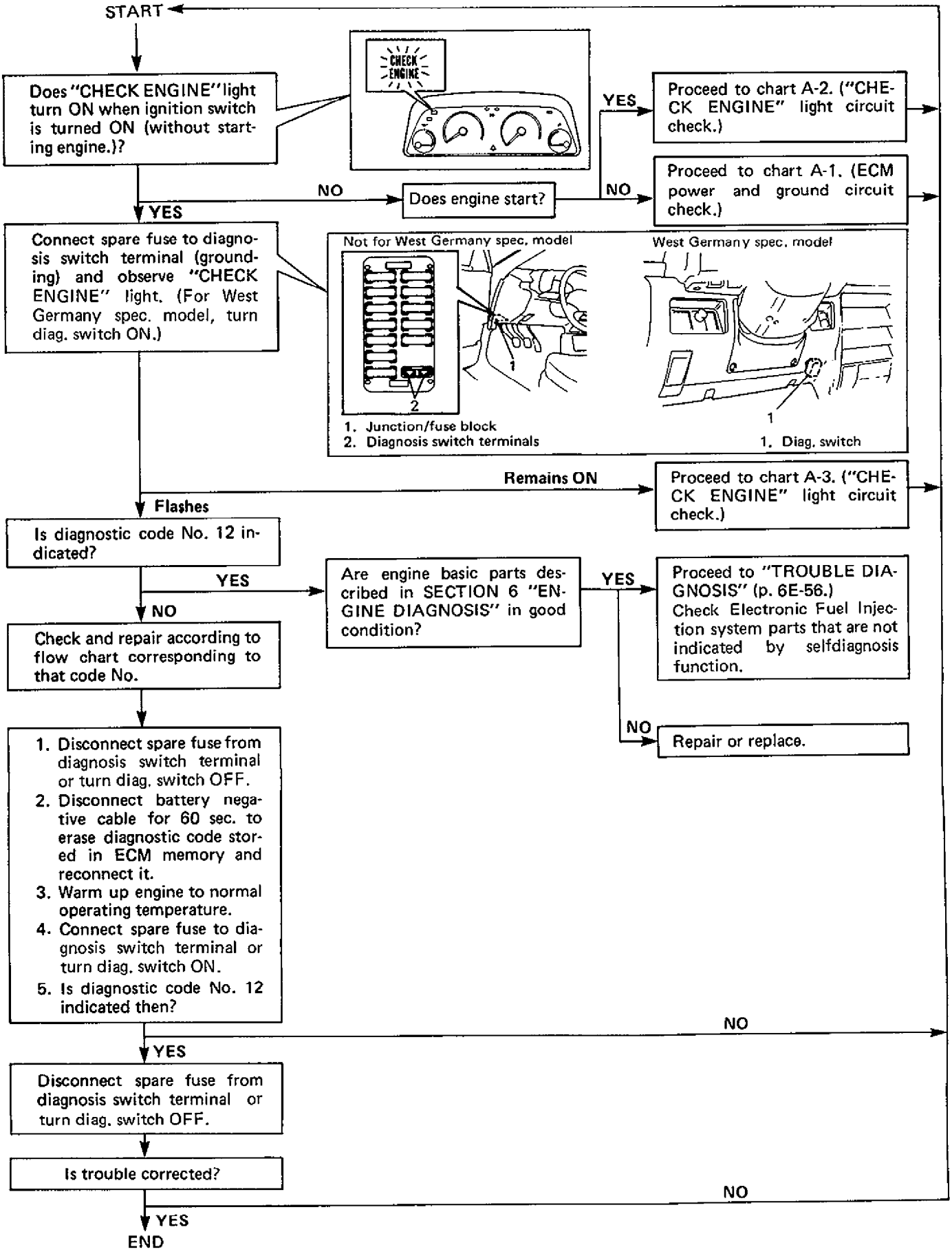
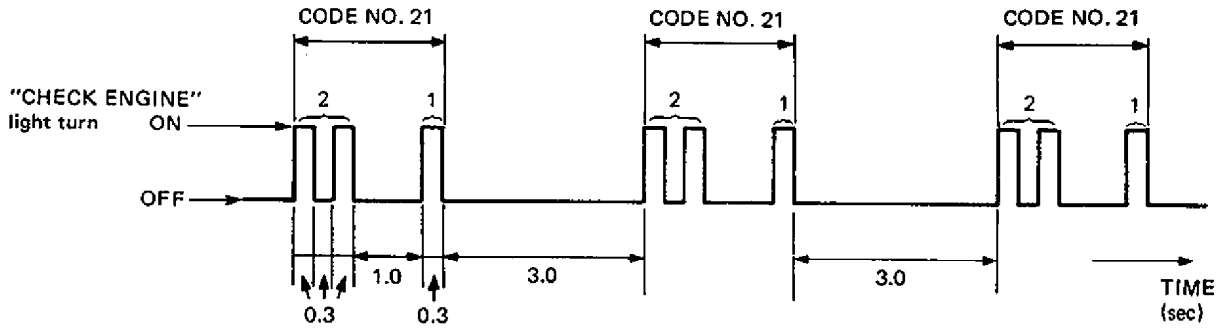


Fig. 6E-42 Diagnostic Flow Chart for Electronic Fuel Injection System

DIAGNOSTIC CODE TABLE

EXAMPLE: THROTTLE SWITCH (THROTTLE POSITION SENSOR FOR A/T) FAILURE (CODE NO. 21)



DIAGNOSTIC CODE		DIAGNOSTIC AREA	DIAGNOSIS
NO.	MODE		
12	1 2	Normal	This code appears when none of the other codes (Below codes) is identified.
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 switch (M/T model only)	
21	2 1	Throttle position sensor (A/T model only)	
22	2 2		
23	2 3	Air temperature sensor	
25	2 5		
24	2 4	Speed sensor	
31	3 1	Pressure sensor	
32	3 2		
41	4 1	Ignition signal	
51	5 1	EGR system (California spec. model only)	
ON		ECM	ECM failure

Fig. 6E-43 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.)

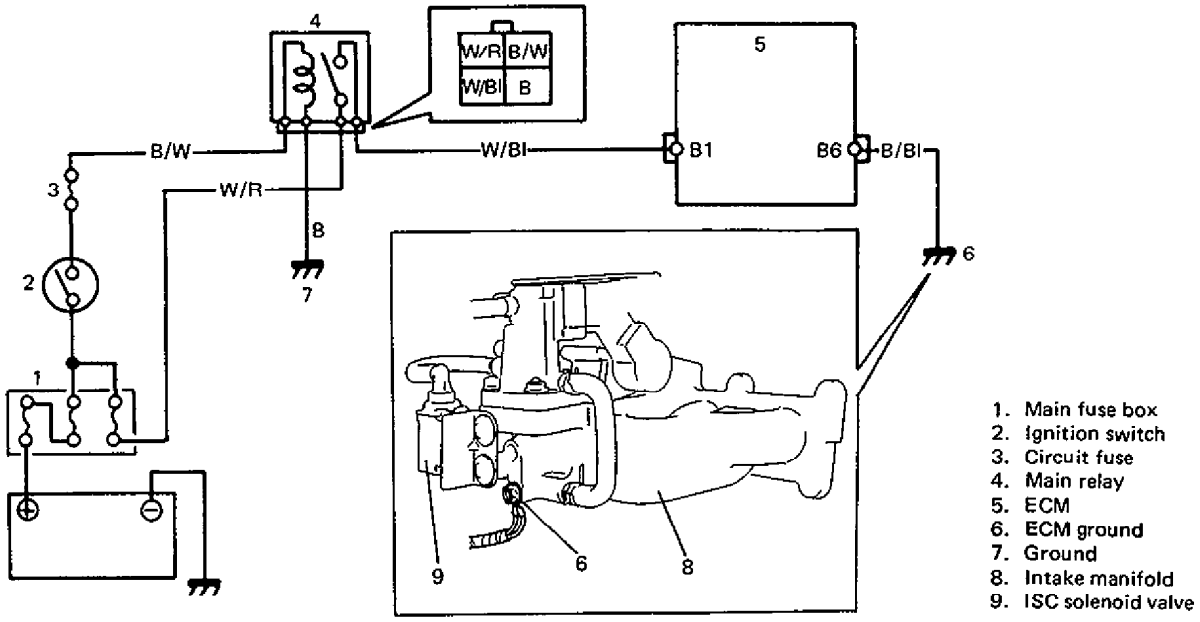
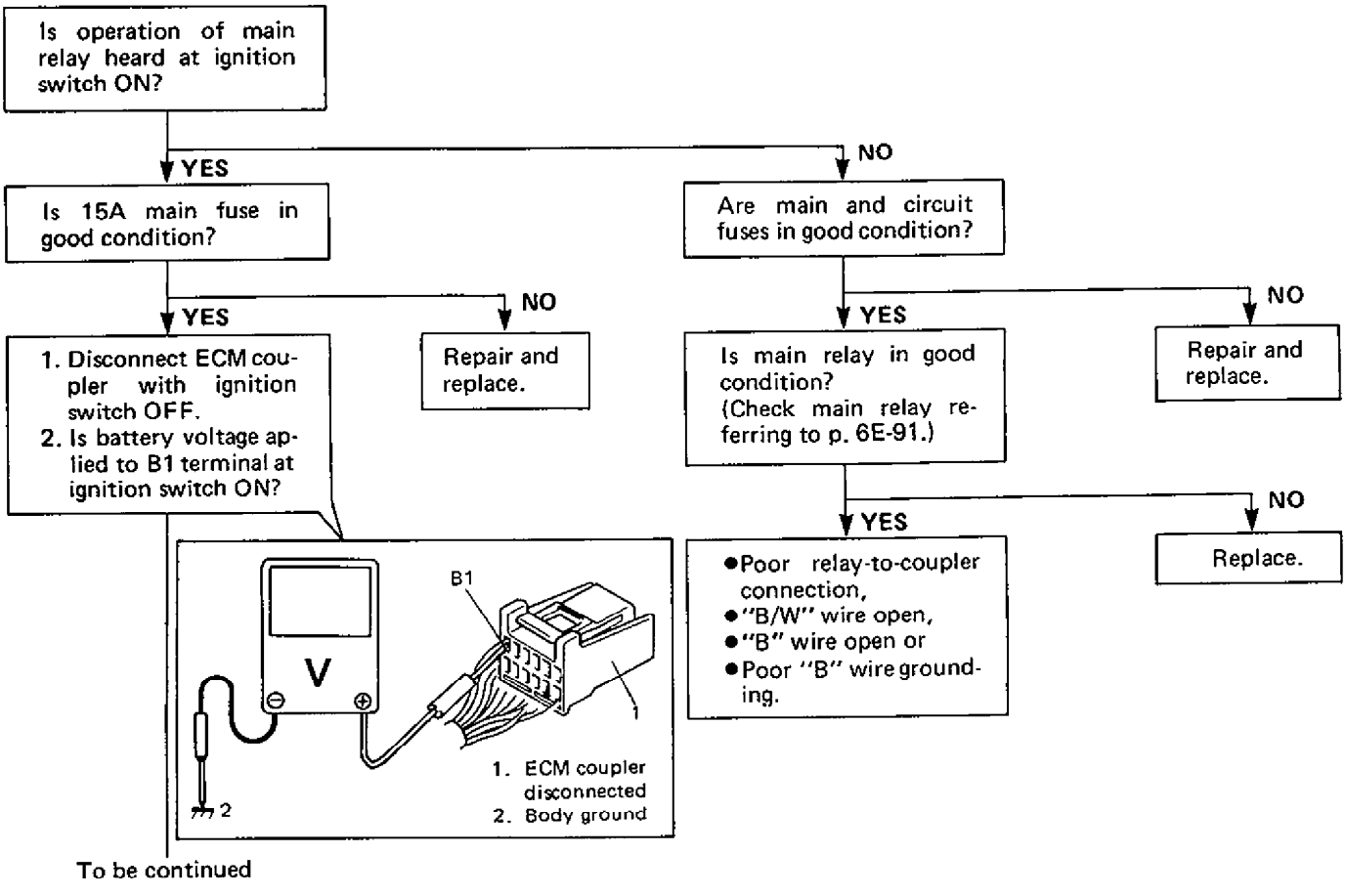


Fig. 6E-44 ECM Power and Ground Circuit



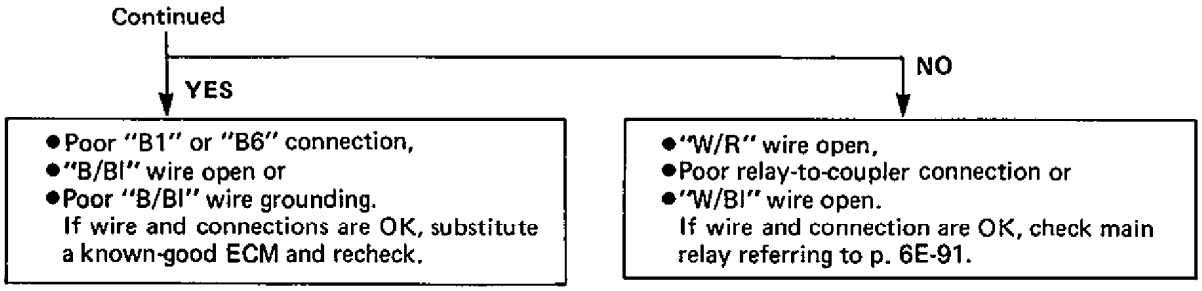
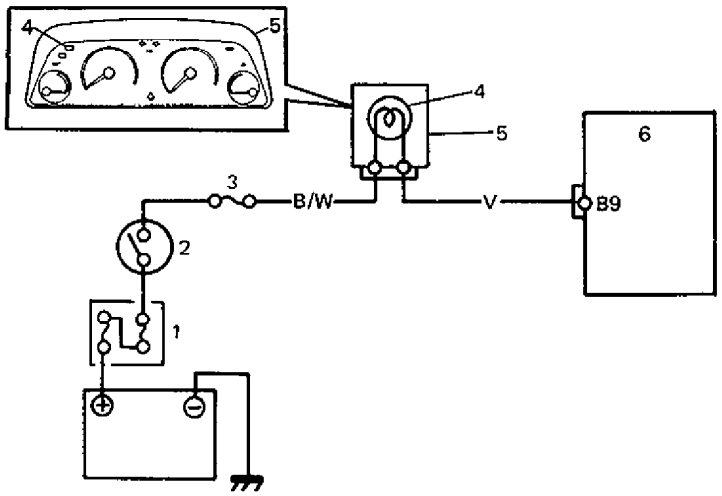


Fig. 6E-45 Diagnostic Flow Chart A-1 for ECM Power and Ground Circuit

A-2 "CHECK ENGINE" LIGHT CIRCUIT CHECK
("CHECK ENGINE" LIGHT DOES NOT LIGHT BUT ENGINE STARTS.)



1. Main fuse
2. Ignition switch
3. Circuit fuse
4. "CHECK ENGINE" light
5. Combination meter
6. ECM

Fig. 6E-46 "CHECK ENGINE" Light Circuit

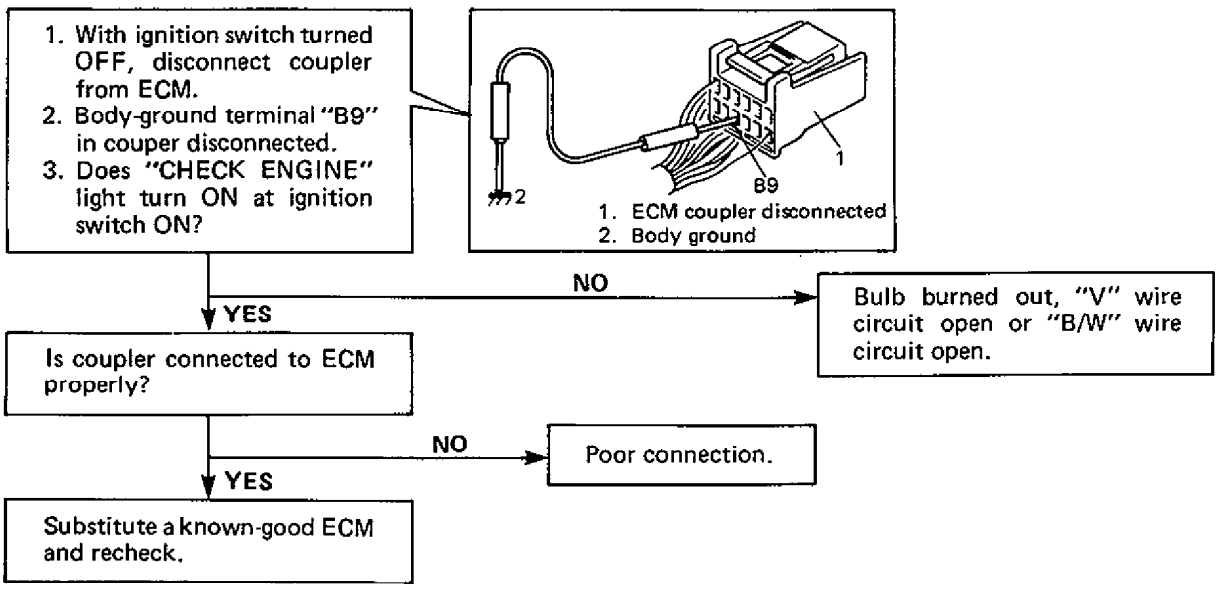
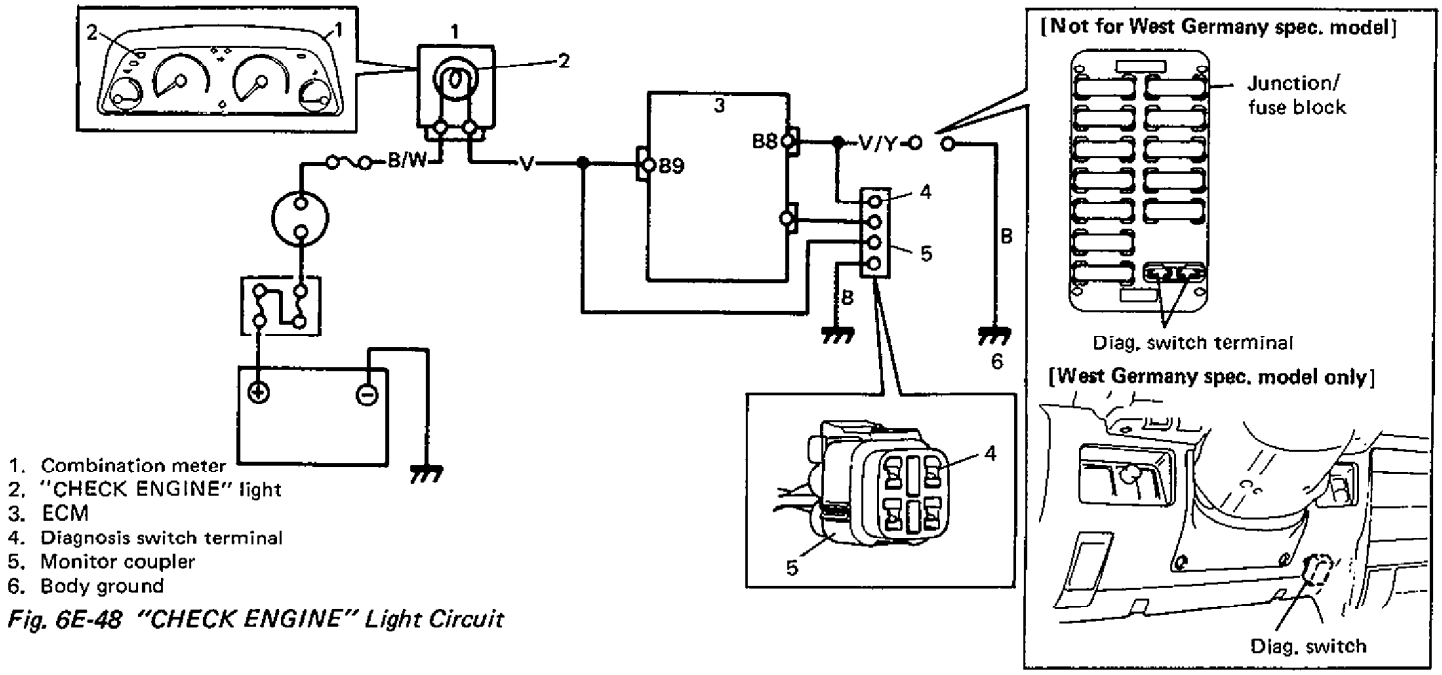


Fig. 6E-47 Diagnostic Flow Chart A-2 For "CHECK ENGINE" Light Circuit

A-3 "CHECK ENGINE" LIGHT CIRCUIT CHECK

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



1. Combination meter
2. "CHECK ENGINE" light
3. ECM
4. Diagnosis switch terminal
5. Monitor coupler
6. Body ground

Fig. 6E-48 "CHECK ENGINE" Light Circuit

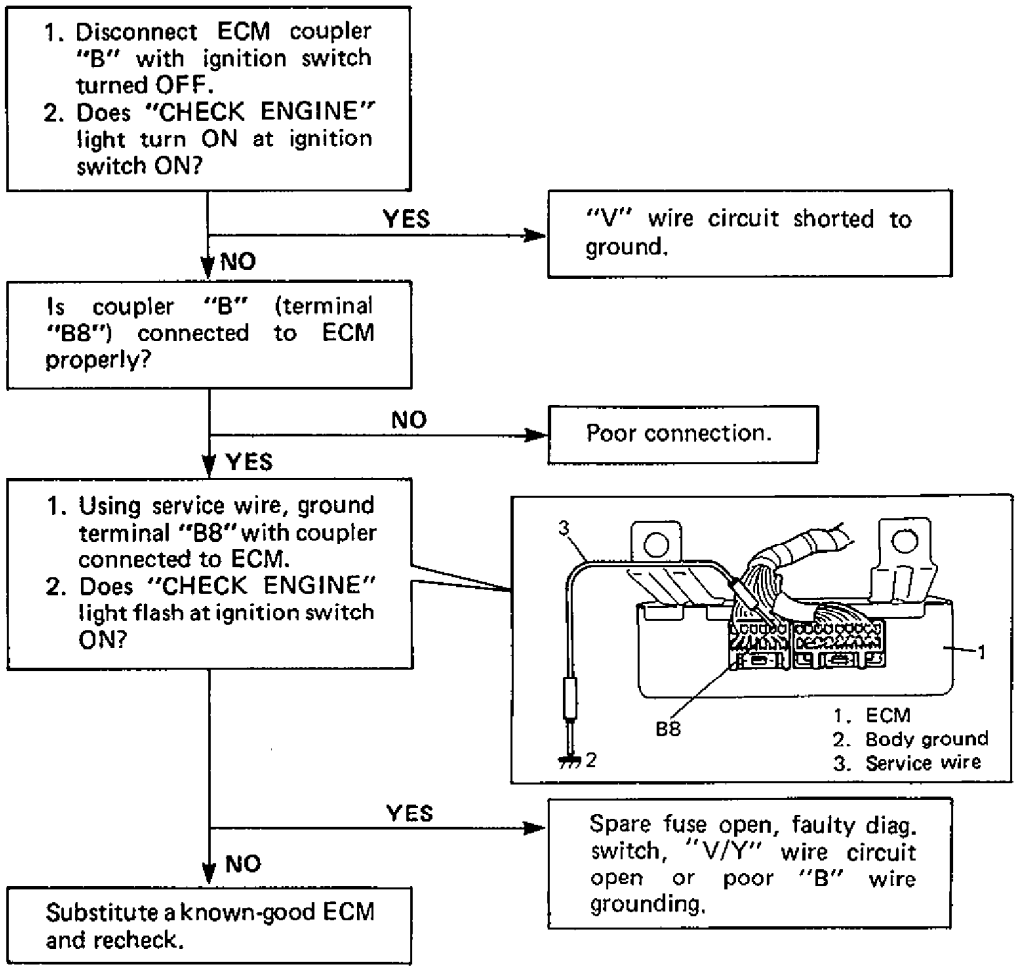


Fig. 6E-49 Diagnostic Flow Chart A-3 For "CHECK ENGINE" Light Circuit

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

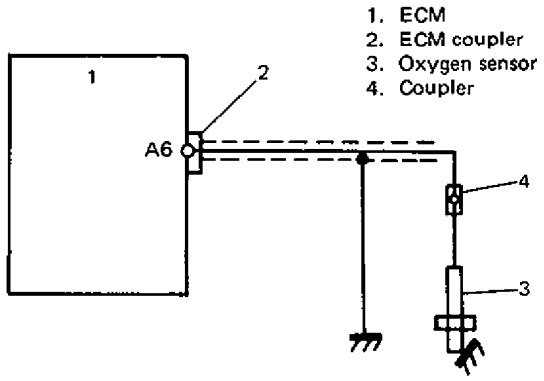
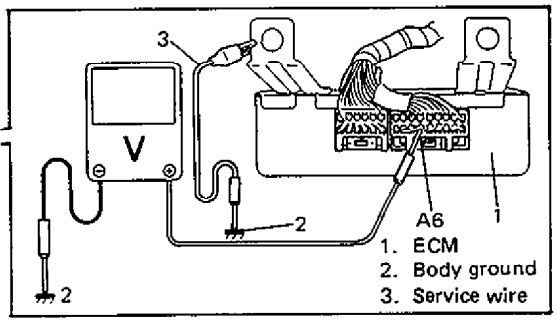


Fig. 6E-50 Oxygen Sensor Circuit

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.**
- **Be sure to use a voltmeter with high impedance (MΩ/V minimum) or digital type voltmeter for accurate measurement.**

1. Remove ECM and connect couplers to ECM.
2. Warm up engine to normal operating temperature.
3. Connect voltmeter between "A6" terminal of ECM coupler and body ground.
4. Maintain engine speed at 2000 r/min. After 60 seconds, check voltmeter.



0V

- Wire between sensor and ECM open or
- Poor connection.

If wire and connection are OK, replace oxygen sensor and recheck.

Remains unchanged at below 0.45V.

Maintain engine speed at 2000 r/min. After 60 sec., disconnect vacuum hose from pressure sensor and check voltmeter. Is voltage 0.45V or more?

NO

Faulty oxygen sensor.

YES

Poor A6 connection or lean A/F mixture.

- Check pressure sensor, WTS, ATS, fuel pressure and injector.

If all above are OK, check ECM and its circuit referring to p. 6E-67.

Remains unchanged at above 0.45V.

Poor A6 connection or rich A/F mixture.

- Check TS (TPS for A/T model), clogged pressure sensor hose, pressure sensor, ATS, WTS, fuel pressure and injector.

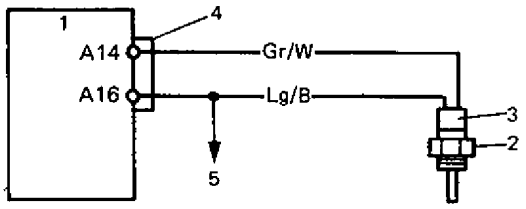
If all above are OK, check ECM and its circuit referring to P. 6E-67.

Deflects between above and below 0.45V repeatedly.

Oxygen sensor and its circuit (Air/fuel ratio feed back system) are in good condition.
Intermittent trouble or faulty ECM.
Recheck referring to "intermittent trouble" on p. 6E-35.

Fig. 6E-51 Diagnostic Flow Chart For Code No. 13

CODE NO. 14 WTS (WATER TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)

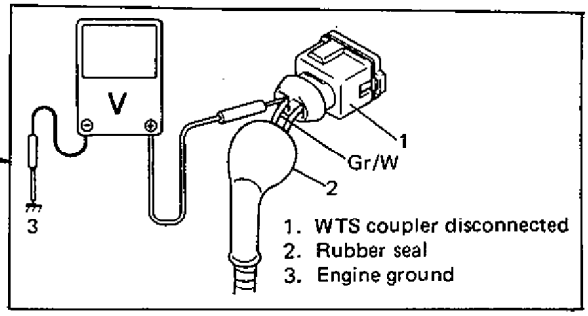


1. ECM
2. WTS
3. WTS coupler
4. ECM coupler
5. To other sensors

Fig. 6E-52 WTS Circuit

NOTE:
When Code Nos. 14, 23 and 32 are indicated together, it is possible that "Lg/B" wire is open or A16 terminal connection is poor.

1. Disconnect WTS coupler with ignition switch OFF.
2. With ignition switch ON, check voltage at "Gr/W" wire terminal of WTS coupler. Is it about 4 — 5V?



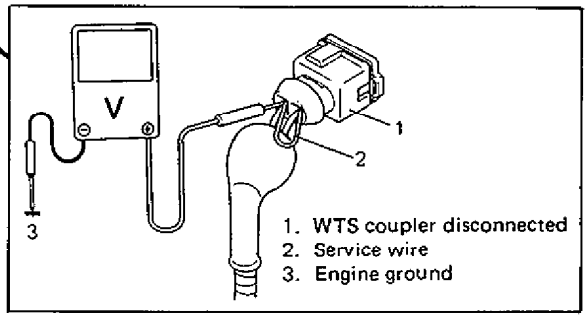
1. WTS coupler disconnected
2. Rubber seal
3. Engine ground

YES

NO

"Gr/W" wire open, poor A14 connection or "Gr/W" wire shorted to power circuit. If wire and connection are OK, substitute a known-good ECM and recheck.

1. Using service wire, connect WTS coupler terminals.
2. Check voltage at "Gr/W" wire terminal of WTS coupler with ignition switch ON. Is it below 0.15V?



1. WTS coupler disconnected
2. Service wire
3. Engine ground

NO

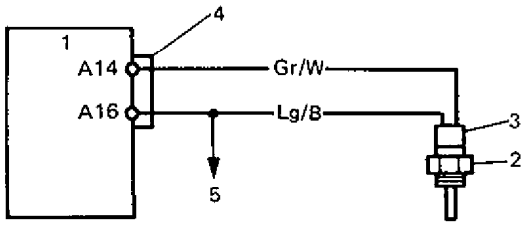
"Lg/B" wire open or poor A16 connection. If wire and connection are OK, substitute a known-good ECM and recheck.

YES

Poor WTS-to-WTS coupler connection or faulty WTS. If connection and WTS are OK, intermittent trouble or faulty ECM. Recheck referring to "Intermittent trouble" on Fig.6E-35.

Fig. 6E-53 Diagnostic Flow Chart For Code No. 14

CODE NO. 15 WTS (WATER TEMPERATURE SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED, SIGNAL VOLTAGE LOW)



1. ECM
2. WTS
3. Coupler
4. ECM coupler
5. To other sensors

Fig. 6E-54 WTS Circuit

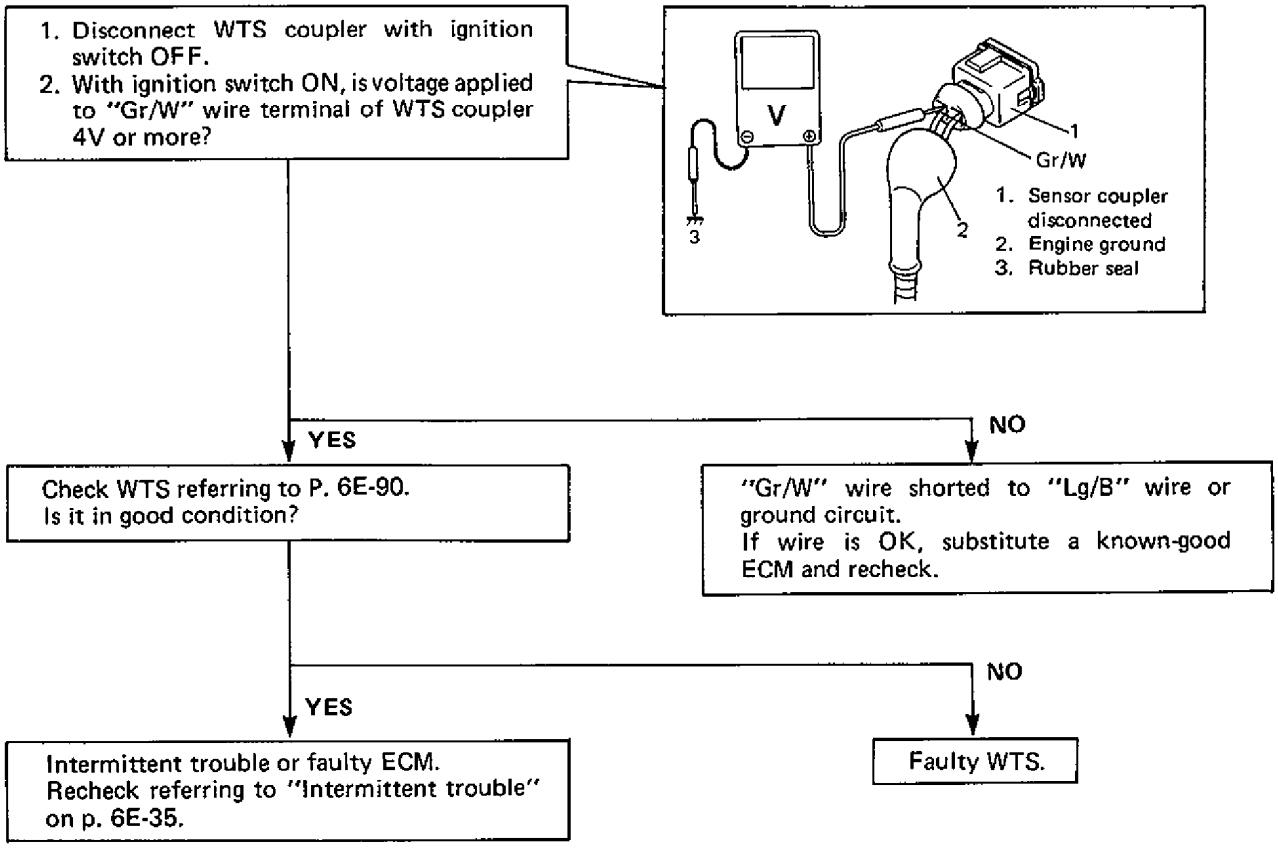


Fig. 6E-55 Diagnostic Flow Chart For Code No. 15

CODE NO. 21 TS (THROTTLE SWITCH) CIRCUIT FOR M/T MODEL (BOTH IDLE SWITCH AND WIDE OPEN SWITCH ON)

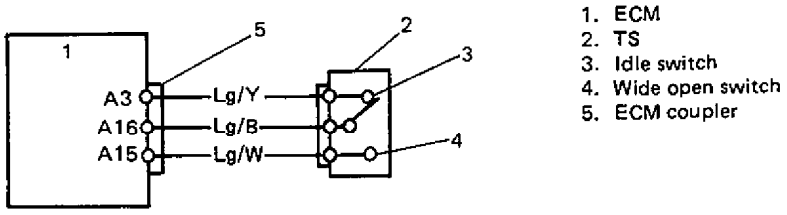


Fig. 6E-56 TS Circuit

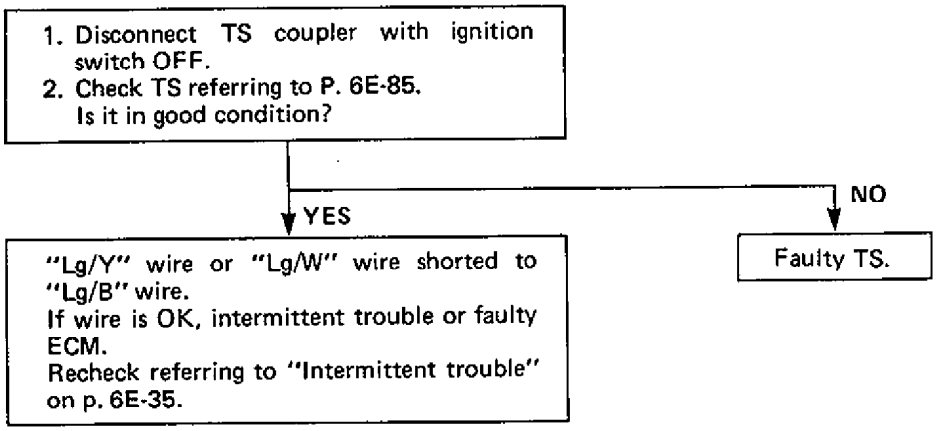
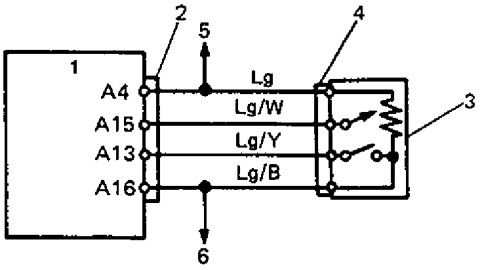


Fig. 6E-57 Diagnostic Flow Chart For Code No. 21 (M/T Model Only)

CODE NO. 21 TPS (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE HIGH) FOR A/T MODEL



1. ECM
2. ECM coupler
3. TPS
4. TPS coupler
5. To PS
6. To other sensors

NOTE:
Be sure to turn OFF ignition switch for this check.

Fig. 6E-58 TPS Circuit

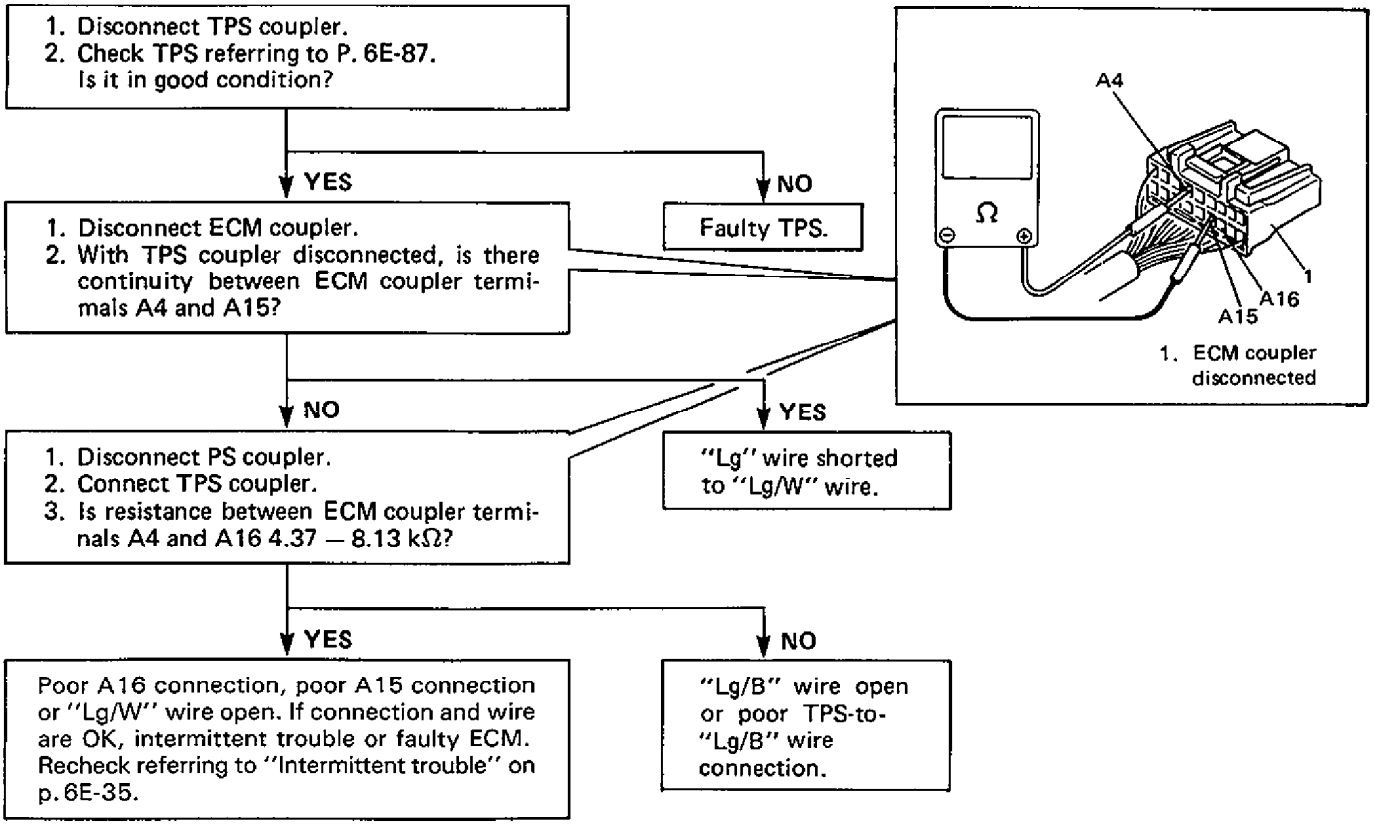
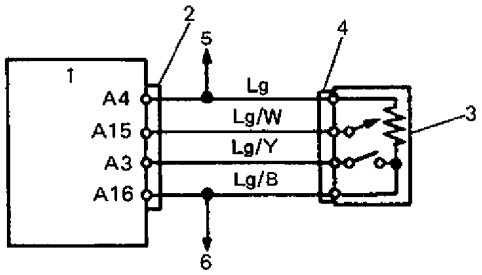


Fig. 6E-59 Diagnostic Flow Chart For Code No. 21 (A/T Model Only)

CODE NO. 22 TPS (THROTTLE POSITION SENSOR) CIRCUIT (SIGNAL VOLTAGE LOW) FOR A/T MODEL



1. ECM
2. ECM coupler
3. TPS
4. TPS coupler
5. To PS
6. To other sensors

Fig. 6E-60 TPS Circuit

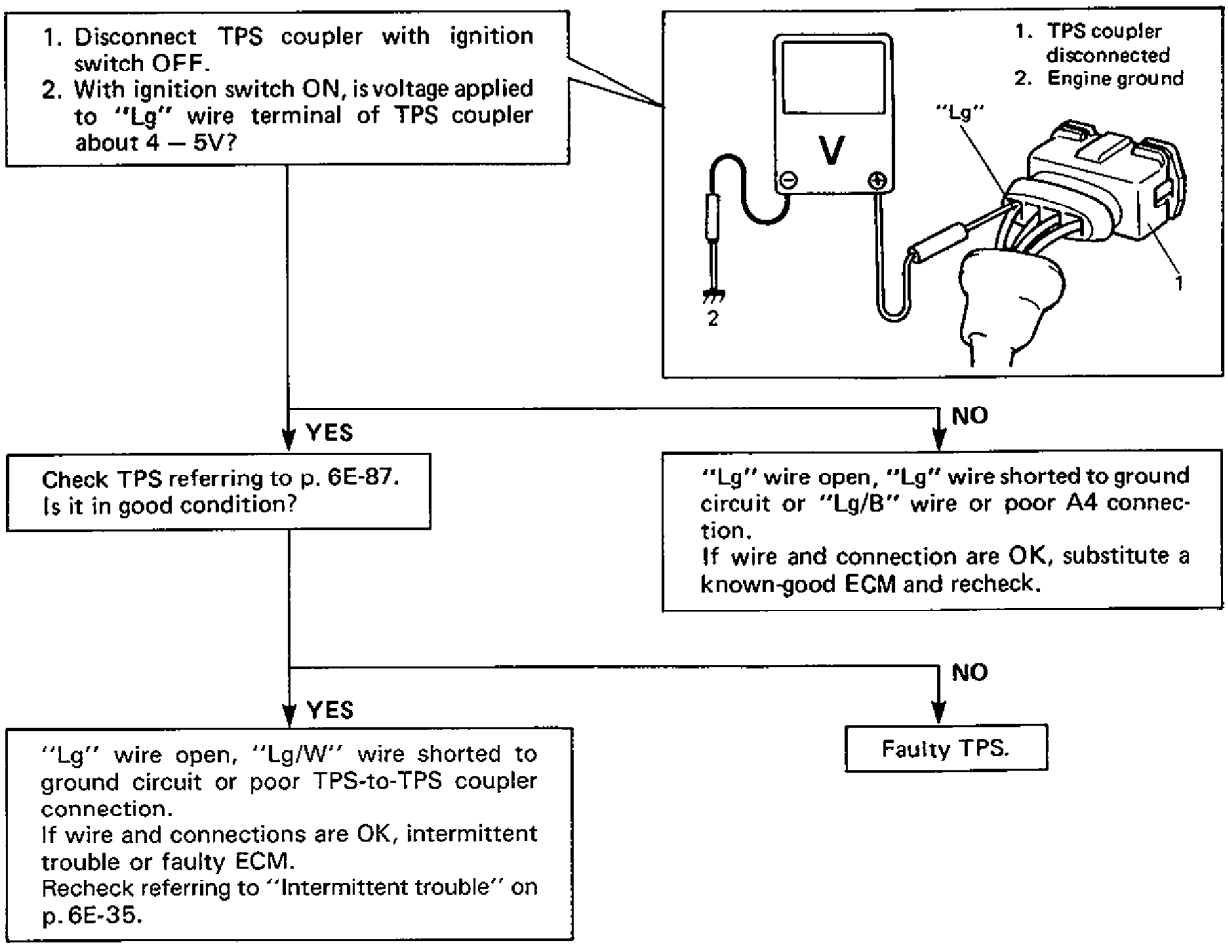
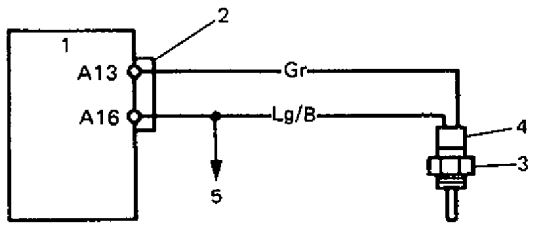


Fig. 6E-61 Diagnostic Flow Chart For Code No. 22 (A/T Model Only)

CODE NO. 23 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)



1. ECM
2. ECM coupler
3. ATS
4. ATS coupler
5. To ther sensors

Fig. 6E-62 ATS Circuit

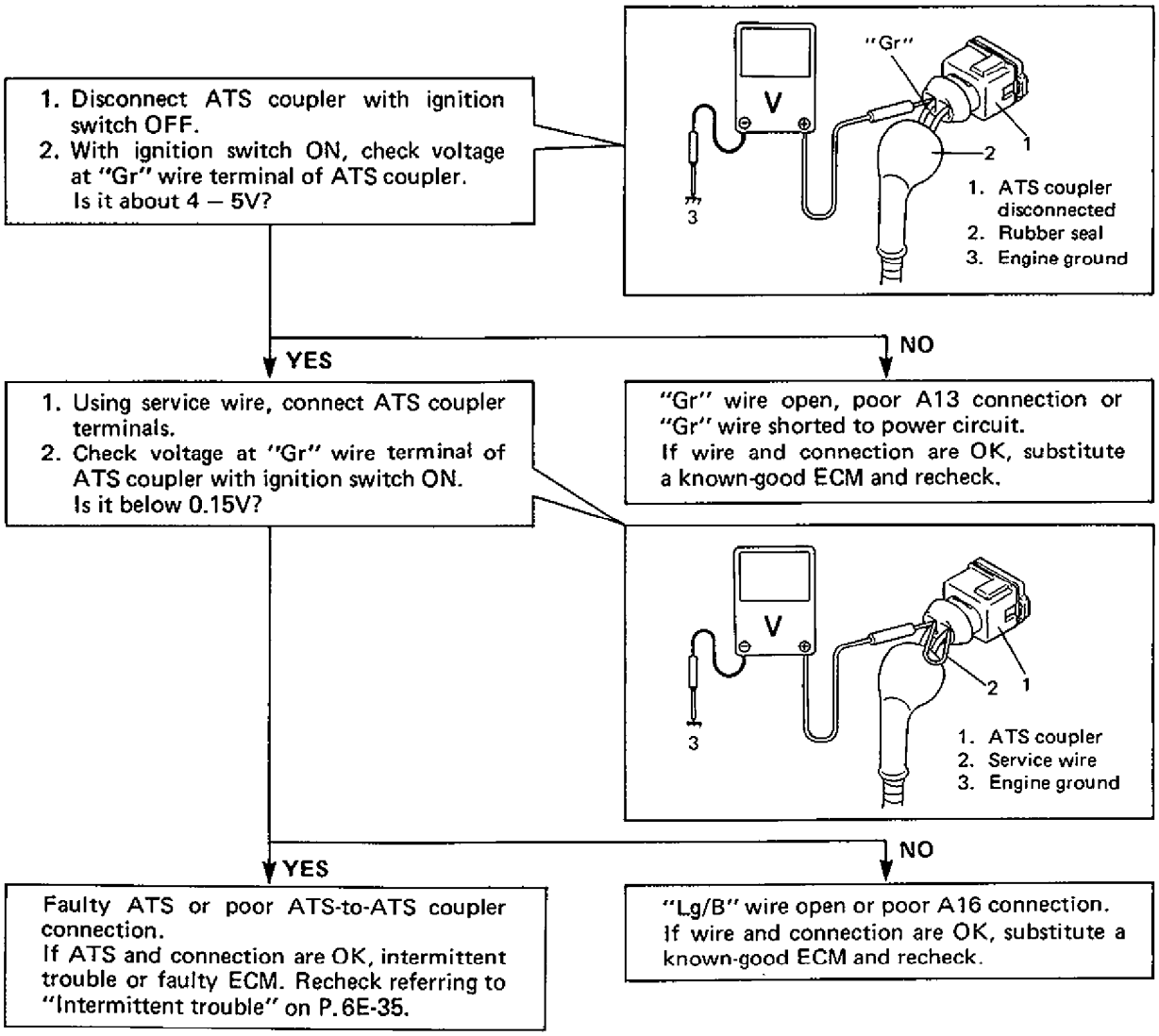
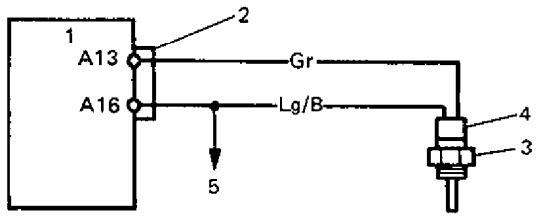


Fig. 6E-63 Diagnostic Flow Chart For Code No. 23

CODE NO. 25 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (HIGH TEMPERATURE INDICATED, SIGNAL VOLTAGE LOW)



1. ECM
2. ECM coupler
3. ATS
4. ATS coupler
5. To other sensors

Fig. 6E-64 ATS Circuit

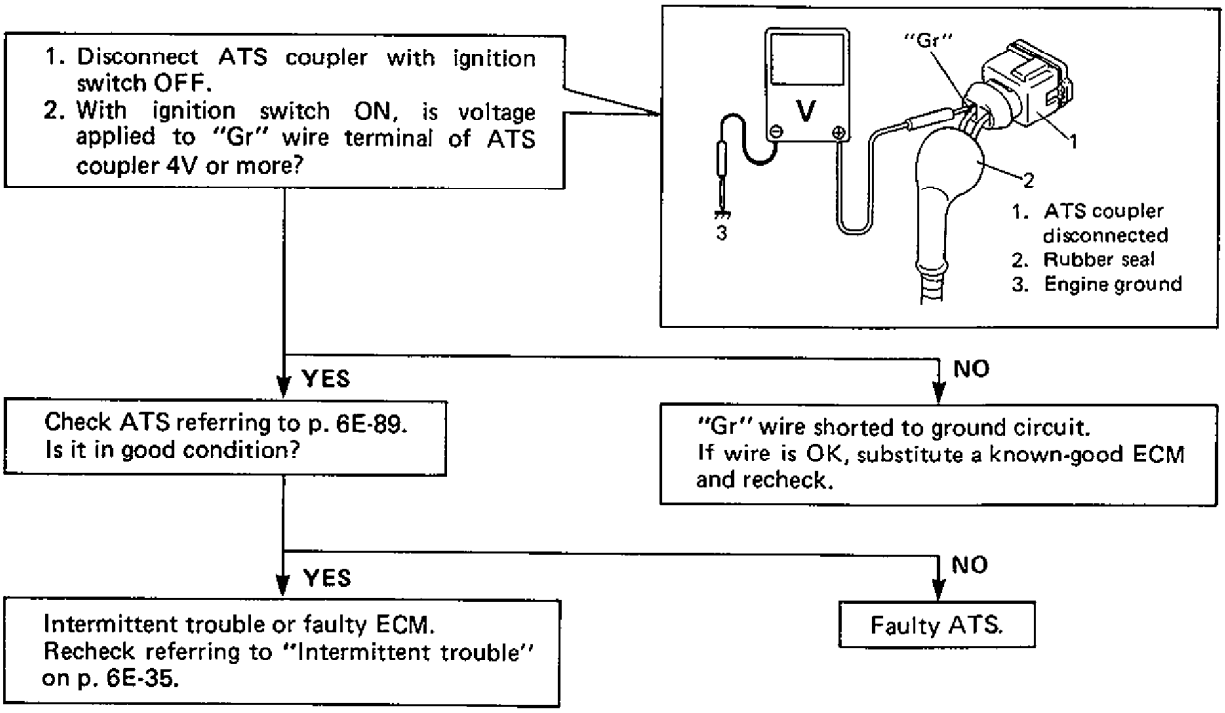
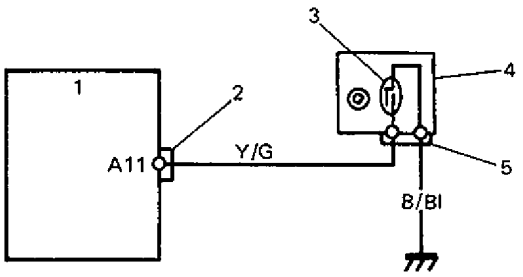


Fig. 6E-65 Diagnostic Flow Chart For Code No. 25

CODE NO. 24 SPEED SENSOR CIRCUIT (SPEED SENSOR SIGNAL NOT INPUTTED ALTHOUGH FUEL IS KEPT CUT AT LOWER THAN 4000 r/min FOR LONGER THAN 4 SECONDS)



1. ECM
2. ECM coupler
3. Speed sensor
4. Speedometer
5. Coupler

NOTE:
Be sure to turn OFF ignition switch for this check.

Fig. 6E-66 Speed Sensor Circuit

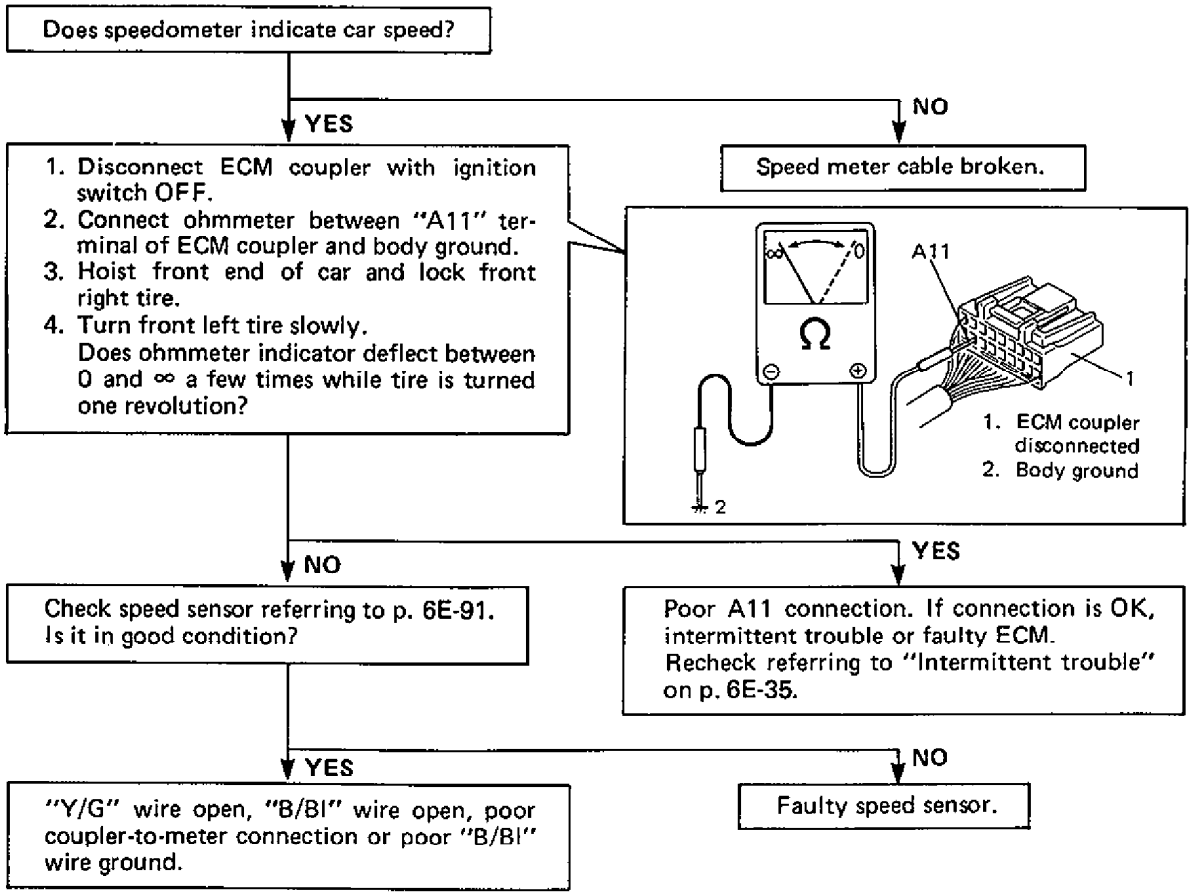
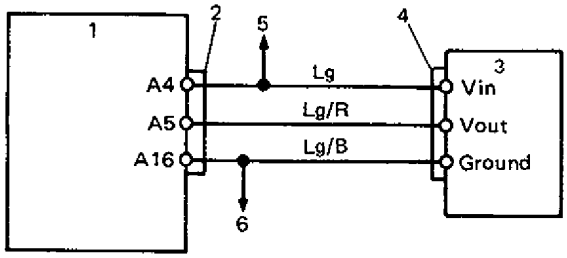


Fig. 6E-67 Diagnostic Flow Chart For Code No. 24

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



1. ECM
2. ECM coupler
3. PS
4. PS coupler
5. To TPS (A/T model only)
6. To other sensors

Fig. 6E-68 PS Circuit

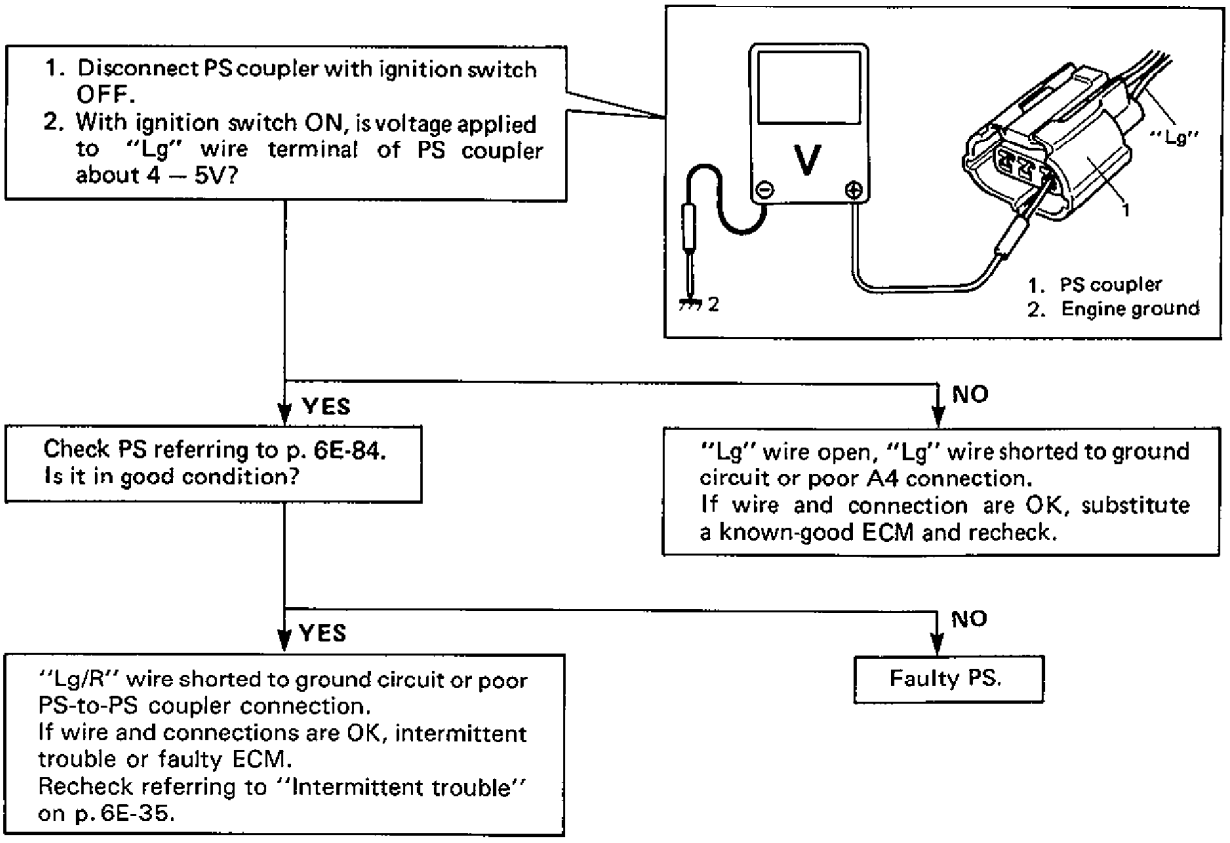
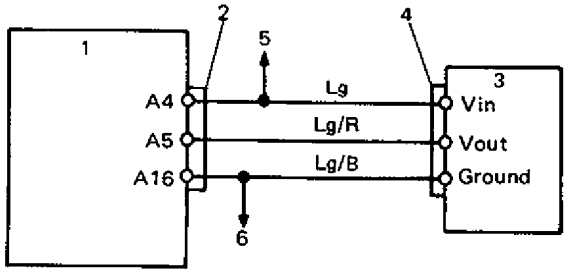


Fig. 6E-69 Diagnostic Flow Chart For Code No. 31

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



1. ECM
2. ECM coupler
3. PS
4. PS coupler
5. To TPS (A/T model only)
6. To other sensors

Fig. 6E-70 PS Circuit

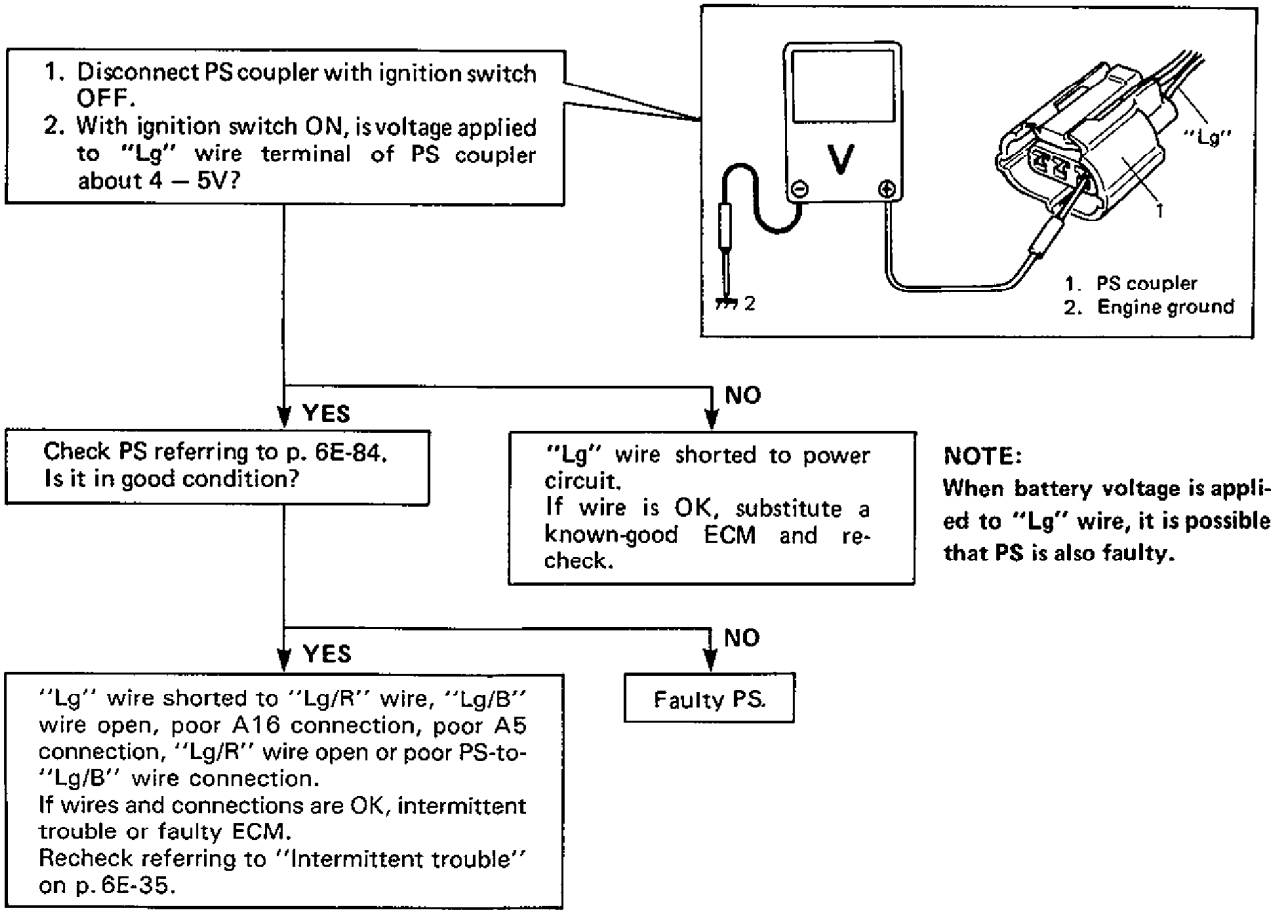


Fig. 6E-71 Diagnostic Flow Chart For Code No. 32

CODE NO. 41 IGNITION SIGNAL CIRCUIT (IGNITION SIGNAL NOT INPUTTED AT ENGINE CRANKING)

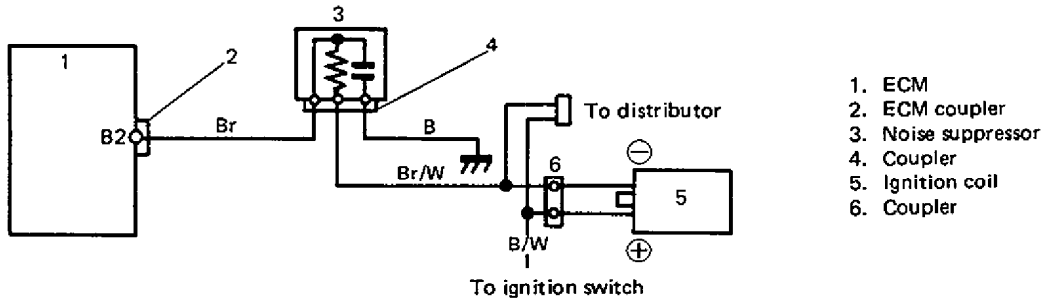


Fig. 6E-72 Ignition Signal Circuit

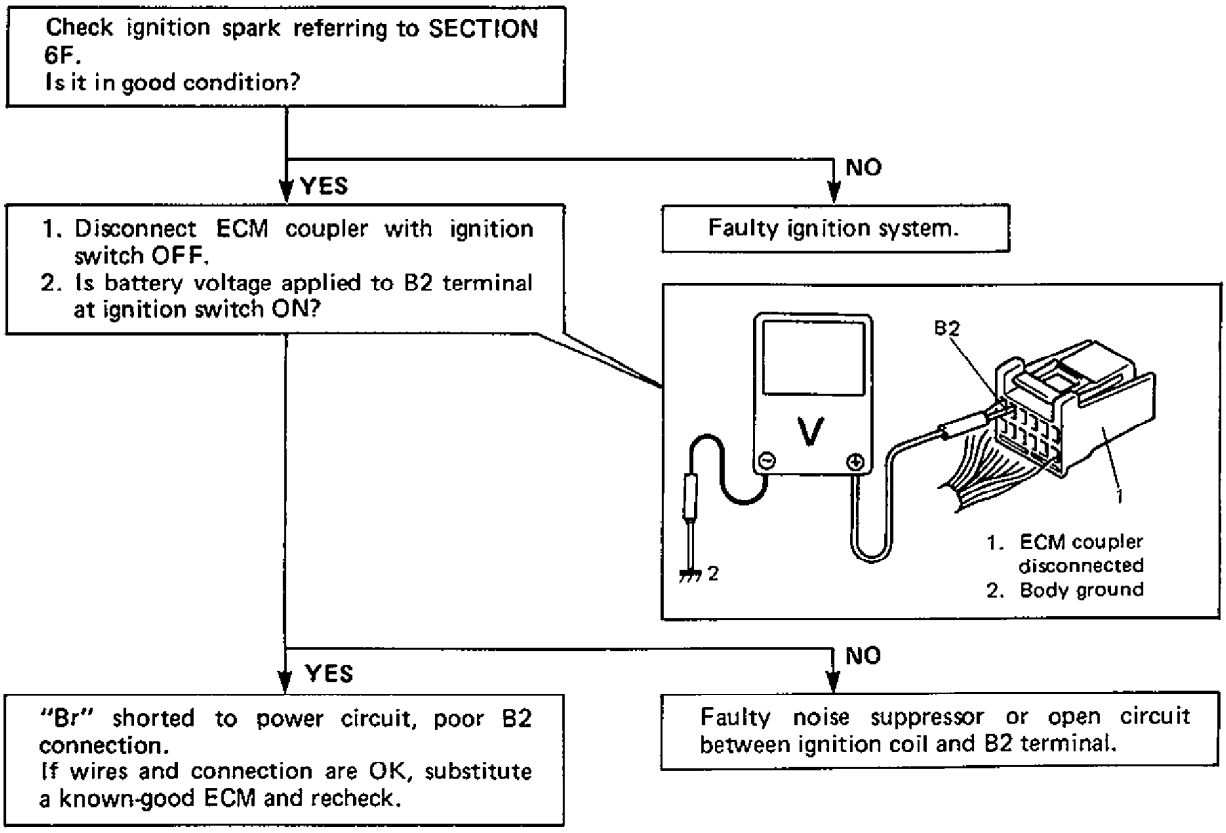


Fig. 6E-73 Diagnostic Flow Chart For Code No. 41

CODE NO. 51 EGR SYSTEM (FAULTY EGR SYSTEM)

For California spec. model only

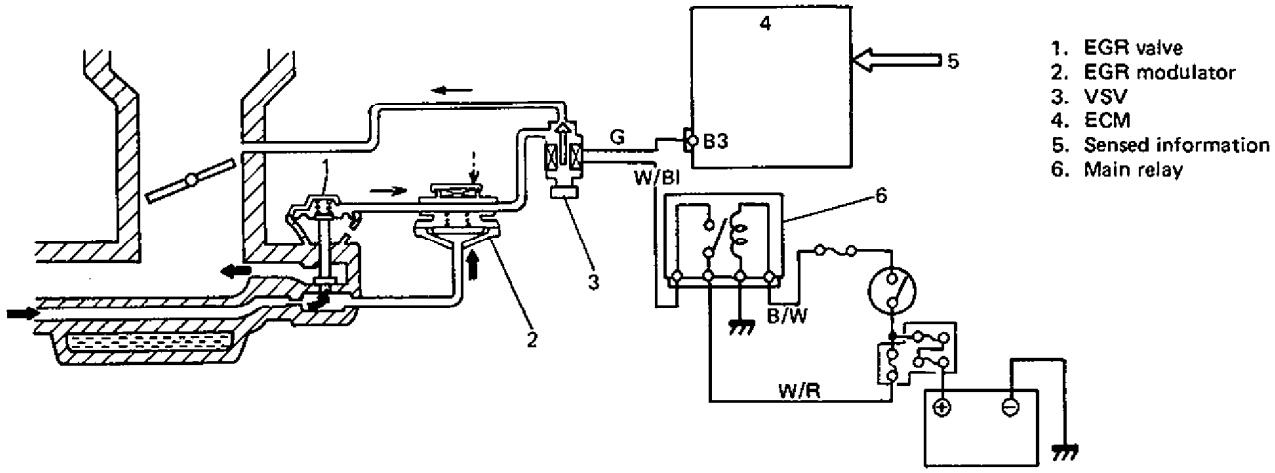


Fig. 6E-74 EGR System

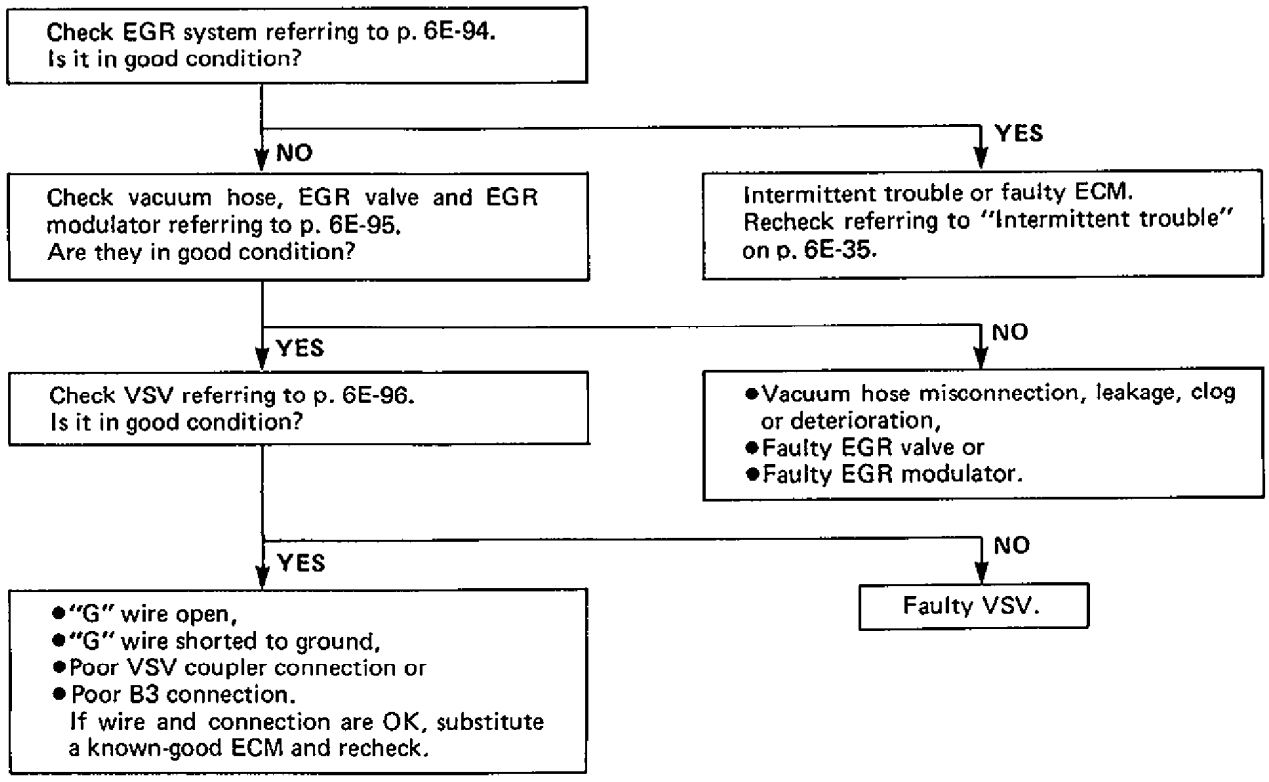


Fig. 6E-75 Diagnostic Flow Chart For Code No. 51 (California Spec. Model Only)

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)	• Shortage of fuel in fuel tank	
	• Injector or its circuit faulty	Diagnostic flow chart B-1
	• Faulty fuel pump or its circuit open	Diagnostic flow chart B-2
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty air valve	See p. 6E-80.
	• Engine start signal not to fed	Diagnostic flow chart B-5
	• Poor performance of ATS, WTS or pressure sensor	See p. 6E-89, 6E-90 or 6E-84
	• Faulty ECM	See p. 6E-67
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.**		
Engine fails to idle	• Shortage of fuel in fuel tank	
	• Faulty ISC solenoid valve control system	Diagnostic flow chart B-4
	• Maladjusted idle speed adjusting screw	See p. 6E-73
	• Faulty air valve	See p. 6E-80
	• Faulty EGR system (if equipped.)	See p. 6E-94
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty injector	Check injector for resistance and injection condition (Refer to p. 6E-81)
	• Poor performance of ATS, WTS or pressure sensor	See p. 6E-89, 6E-90, or 6E-84
	• Faulty ECM	See p. 6E-67
NOTE: **If engine fails to idle only when it is cold, check air valve.**		

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Improper engine idle speed	• Maladjusted accelerator cable play	See p. 6E-73
	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Faulty ISC solenoid valve control system	Diagnostic flow chart B-4
	• Faulty air-conditioner VSV control system (if equipped)	See section 1B
	• Faulty idle switch (in TS or TPS)	See p. 6E-85
	• Maladjusted idle speed adjusting screw	See p. 6E-73
	• Faulty air valve	See p. 6E-80
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Poor performance of ATS, WTS or pressure sensor	See p. 6E-89, 6E-90 or 6E-84
	• Faulty ECM	See p. 6E-67
NOTE: • **With engine warmed up, if engine idle speed is high and ISC solenoid valve is not heard to operate, check accelerator cable play, idle switch and ISC solenoid valve control system in that order.** • **If engine idle speed lowers below specification only when electric load is applied (e.g. headlight ON), check ISC solenoid valve control system first.** • **With A/T model, if engine idle speed lowers below specification only when shifted to "R", "D", "2" or "L" range, check if "R", "D", "2" or "L" signal is inputted to ECM first.**		
Engine has no or poor power	• Maladjusted accelerator cable play	See p. 6E-73
	• Faulty TS (wide open switch) for M/T model	See p. 6E-85
	• Faulty EGR system (if equipped.)	See p. 6E-94
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of TPS (For A/T model), ATS, WTS or pressure sensor	See p. 6E-87, 6E-89, 6E-90 or 6E-84
	• Faulty ECM	See p. 6E-67
Engine hesitates when accelerating	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Faulty EGR system (if equipped.)	See p. 6E-94
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of ATS, WTS or pressure sensor	See p. 6E-89, 6E-90 or 6E-84
	• Faulty ECM	See p. 6E-67
Surges (Variation in car speed is felt although accelerator pedal is not operated)	• Variable fuel pressure (Clogged fuel filter, faulty fuel pressure regulator, etc.)	Diagnostic flow chart B-3
	• Poor performance of pressure sensor	See p. 6E-84
	• Faulty ECM	See p. 6E-67

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Poor gasoline mileage	• High idle speed	Refer to item "Improper engine idle speed" previously outlined
	• Fuel pressure out of specification or fuel leakage	Diagnostic flow chart B-3
	• Faulty TS (M/T model) or TPS (A/T model)	See p. 6E-85 or 6E-87
	• Poor performance of ATS or WTS	See p. 6E-89 or 6E-90
	• Faulty ECM	See p. 6E-67
Excessive hydrocarbon (HC) emission	• Engine not at normal operating temperature	
	• Clogged air cleaner	
	• Faulty ignition system	See section 6F
	• Vacuum leaks	
	• Low compression	See section 6
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• A/F feed back compensation fails	
	– Faulty TS (M/T model) or TPS (A/T model)	See p. 6E-85 or 6E-87
	– Poor performance of WTS or pressure sensor	See p. 6E-90 or 6E-84
	• Poor performance of ATS	See p. 6E-89
	• Faulty injector	See p. 6E-81
	• Faulty ECM	See p. 6E-67
Excessive carbon monoxide (CO)	• Engine not at normal operating temperature	
	• Clogged air cleaner	
	• Faulty ignition system	See section 6F
	• Low compression	See section 6
	• Lead contamination of catalytic conveter	Check for absence of filler neck restrictor
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• A/F feed back compensation fails	
	– Faulty TS (M/T model) or TPS (A/T model)	See p. 6E-85 or 6E-87
	– Poor performance of WTS or pressure sensor	See p. 6E-90 or 6E-84
	• Poor performance of ATS	See p. 6E-89
	• Faulty injector	See p. 6E-81
	• Faulty ECM	See p. 6E-67

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Excessive nitrogen oxides (NOx) emission	• Improper ignition timing	See section 6F
	• Lead contamination of catalytic converter	Check for adsence of filler neck restrictor
	• Faulty EGR system (if equipped.)	See p. 6E-94
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• A/F feed back compensation fails	
	– Faulty TS (M/T model) or TPS (A/T model)	See p. 6E-85 or 6E-87
	– Poor performance of WTS or pressure sensor	See p. 6E-90 or 6E-84
	• Poor performance of ATS	See p. 6E-89
	• Faulty injector	See p. 6E-81
	• Faulty ECM	See p. 6E-67

B-1 FUEL INJECTOR AND ITS CIRCUIT CHECK (ENGINE NOT STARTING)

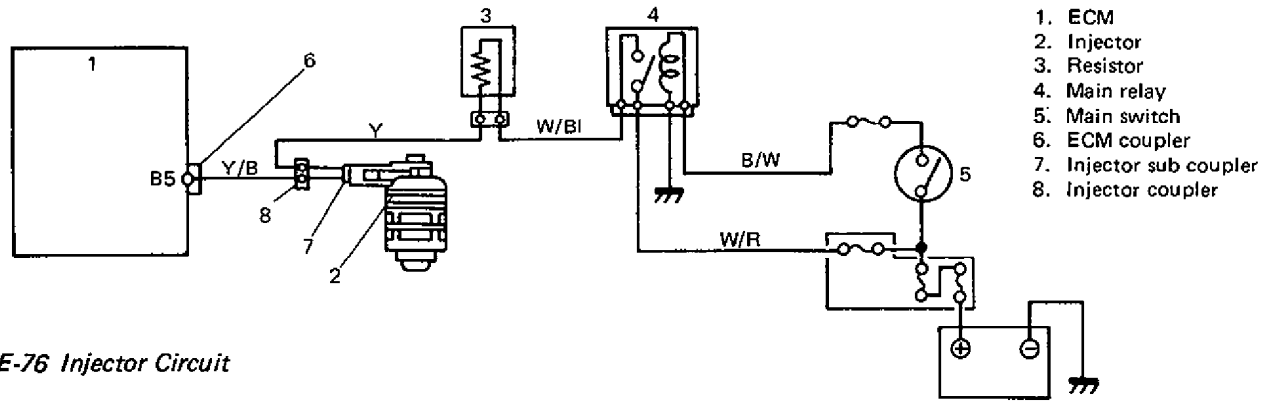


Fig. 6E-76 Injector Circuit

Is fuel injected from injector at ignition switch ON (not cranking)?

YES

"Y/B" wire shorted to ground or faulty injector.
If wire and injector are OK, check to make sure that resistance of resistor and injector is as specified respectively and then substitute a known-good ECM and recheck.

NO

Is fuel injected from injector at engine cranking?
(Refer to p. 6E-81 for checking).

YES

Check injector for leaks. (Refer to p. 6E-81 for checking).
Is it in good condition?

NO

Faulty fuel injector.

YES

Injector and its circuit in good condition.

NO

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

YES

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

NO

1. Desconnect injector coupler with ignition switch OFF.
2. Is resistance of injector 0.5 — 1.5 Ω (at 20°C, 68°F)?

To be continued

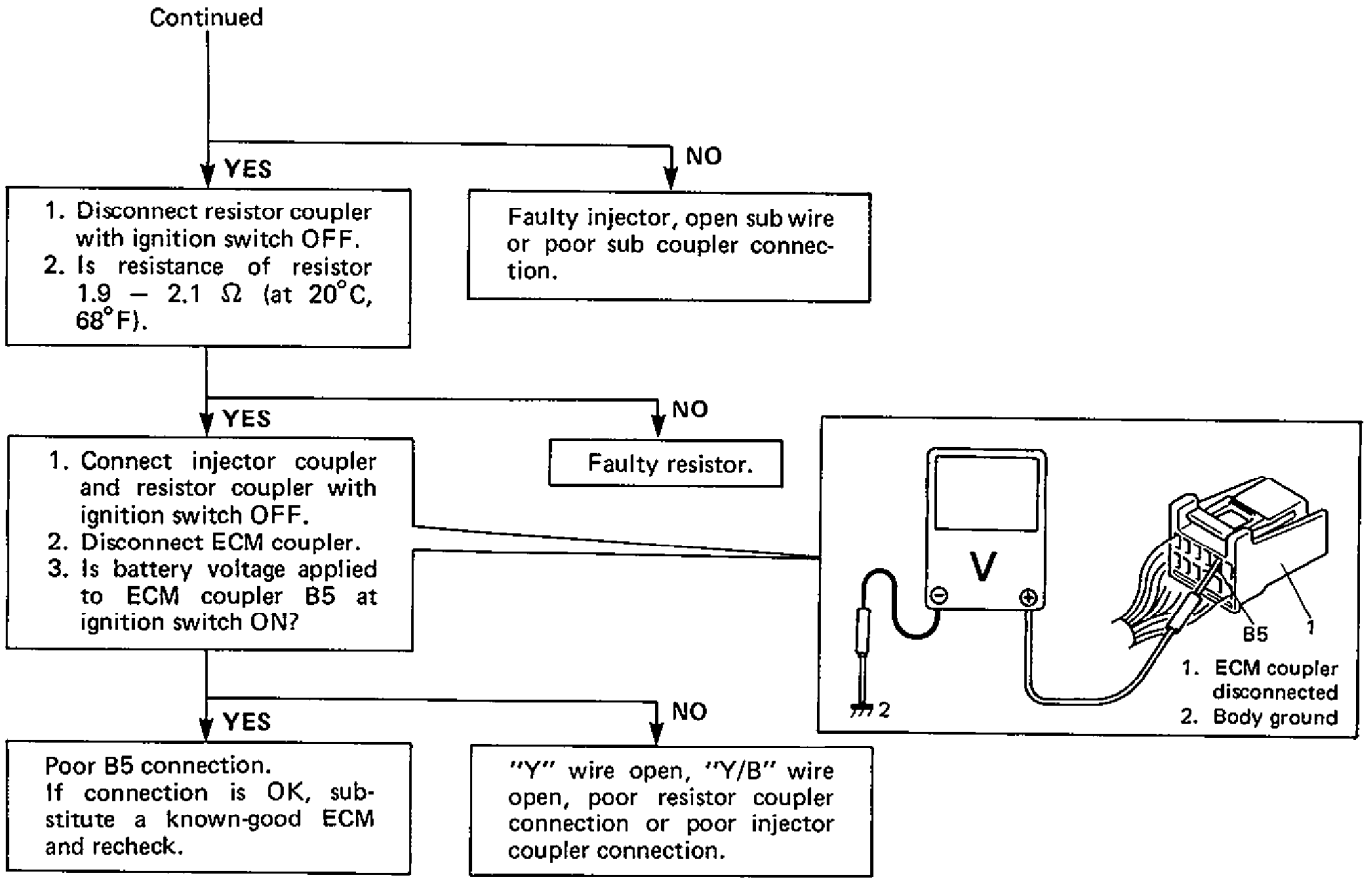


Fig. 6E-77 Diagnostic Flow Chart B-1 For Injector and Its Circuit

B-2 FUEL PUMP AND ITS CIRCUIT CHECK

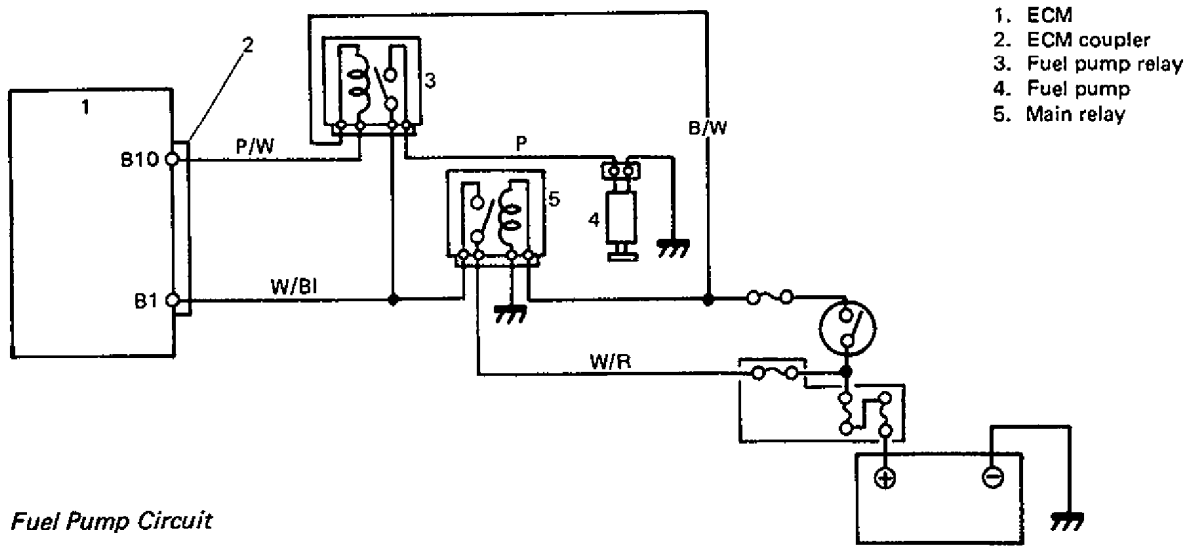


Fig. 6E-78 Fuel Pump Circuit

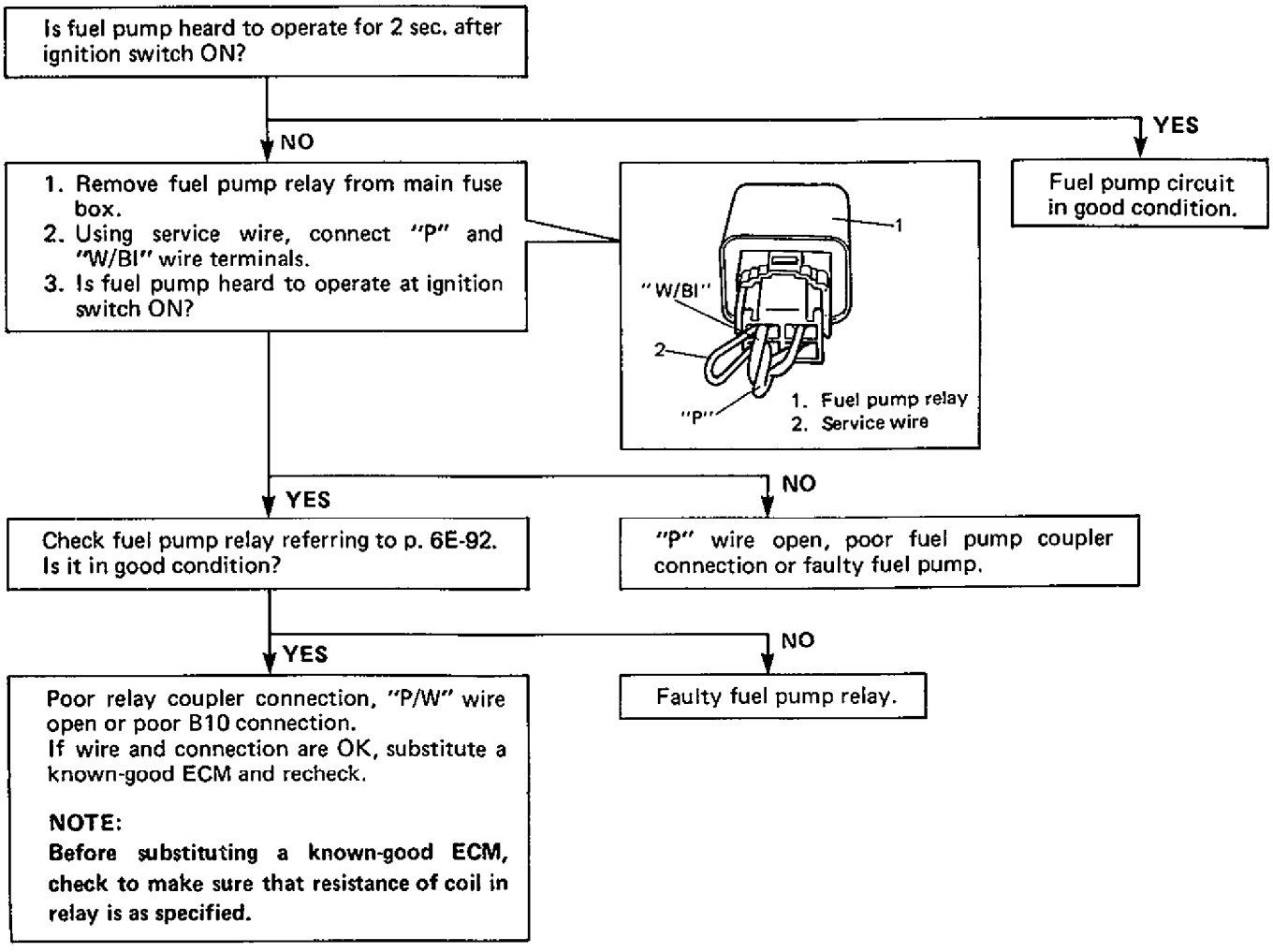


Fig. 6E-79 Diagnostic Flow Chart B-2 For Fuel Pump and Its Circuit Check

B-3 FUEL PRESSURE CHECK

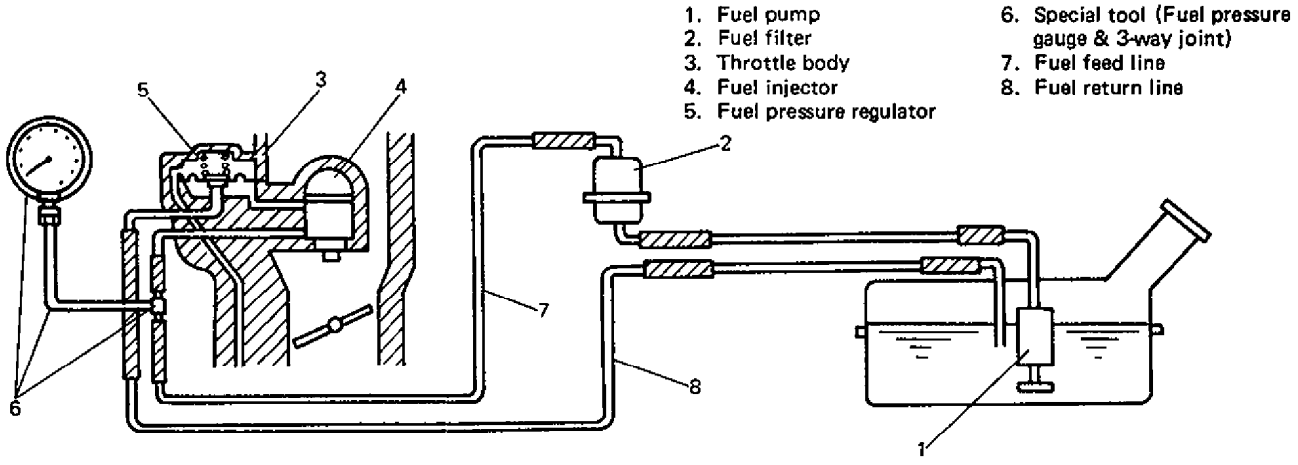


Fig. 6E-80 Fuel Pressure Check

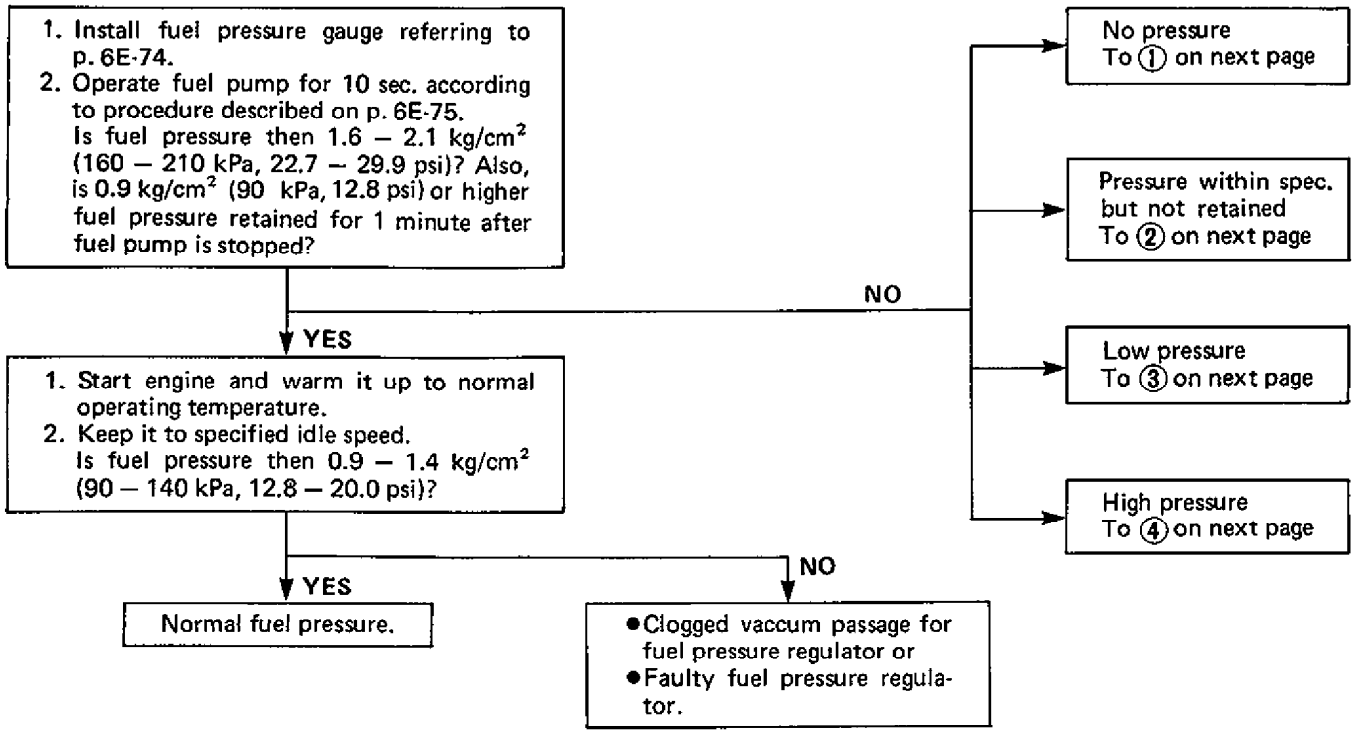


Fig. 6E-81 Diagnostic Flow Chart B-3 For Fuel Pressure (1)

B-3 FUEL PRESSURE CHECK (continued)

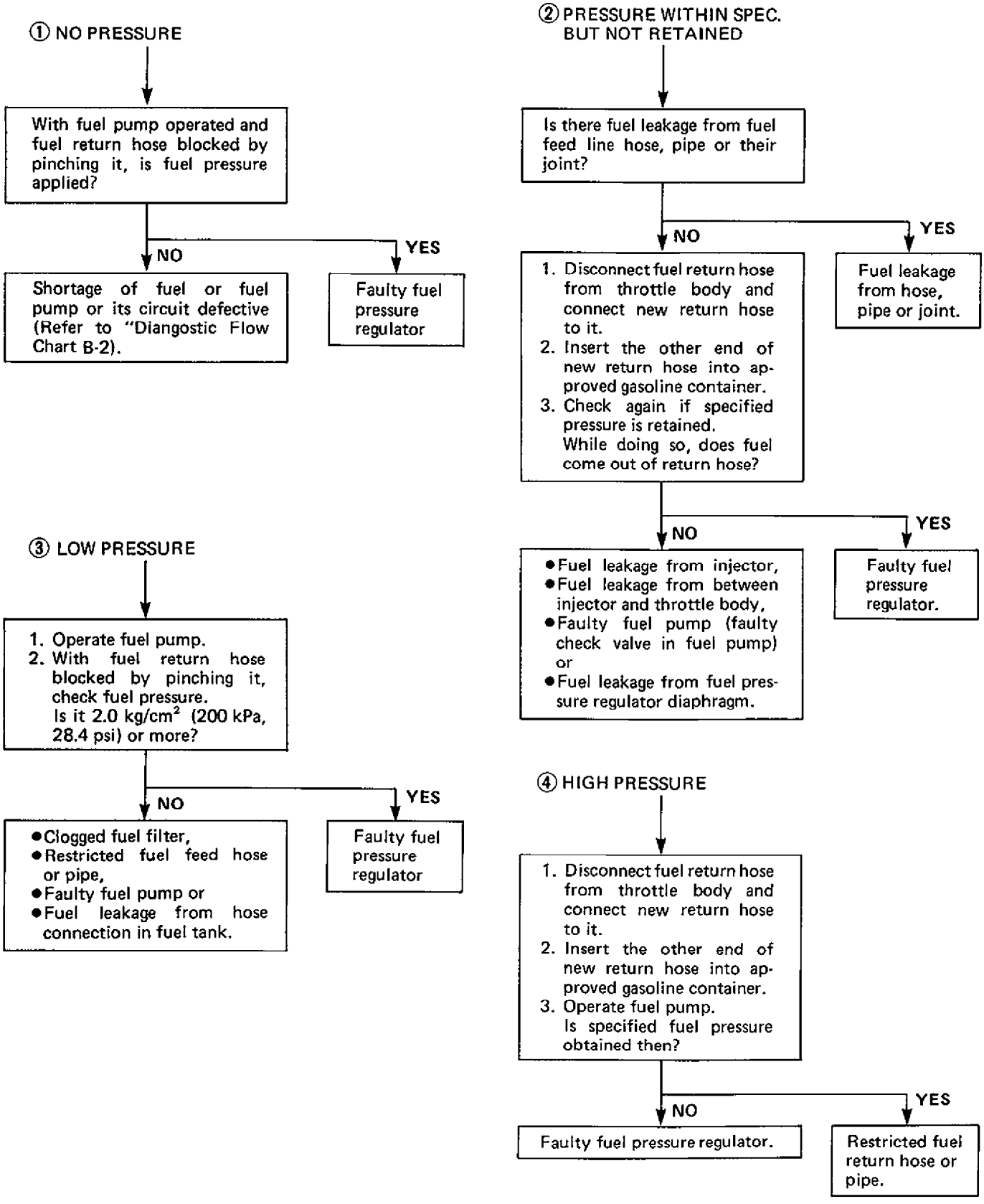


Fig. 6E-81-1 Diagnostic Flow Chart B-3 For Fuel Pressure (2)

B-4 ISC SOLENOID VALVE CONTROL SYSTEM CHECK

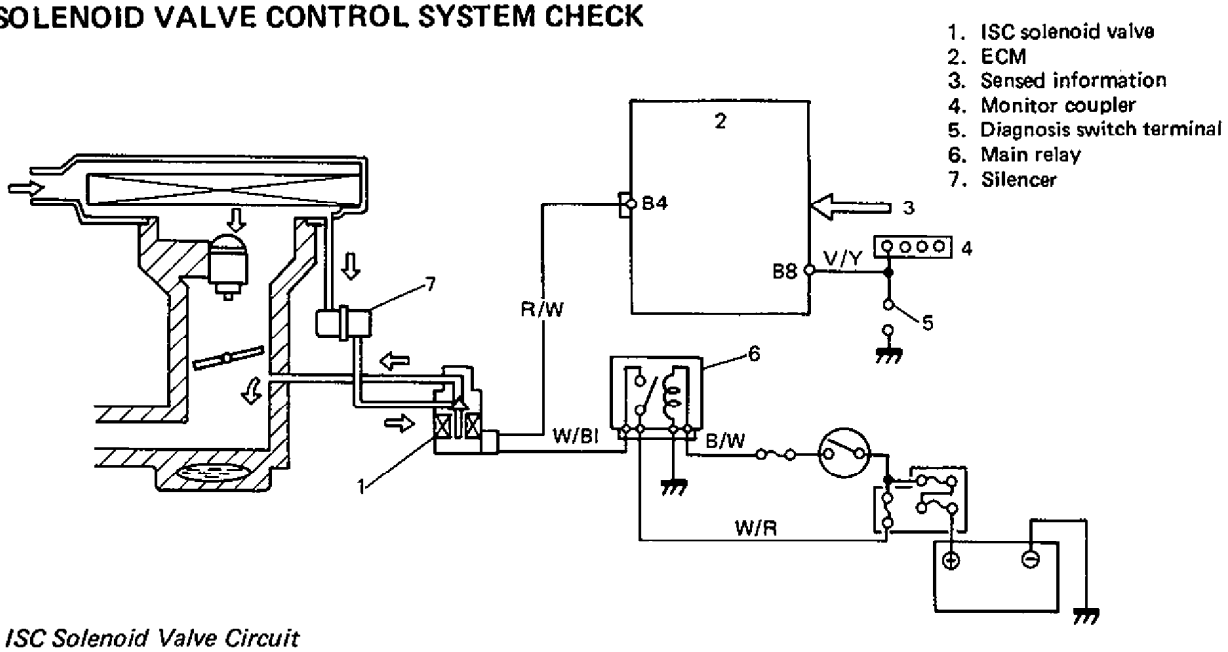


Fig. 6E-82 ISC Solenoid Valve Circuit

1. Connect spare fuse to diagnosis switch terminal (grounding).
2. Turn ignition switch ON.
3. Is diagnostic code No. 12 indicated?

YES → Is operation of ISC solenoid valve also heard then?

NO → Go back to "Diagnostic Flow Chart" on p. 6E-38.

YES → 1. Start engine and run it at idle speed.
2. Disconnect ISC solenoid valve hose from air cleaner case and check air flow.
Is it drawn into it?

NO → Check ISC solenoid valve referring to p. 6E-93.
Is it in good condition?

YES → System in good condition.

NO → Clogged air passage.

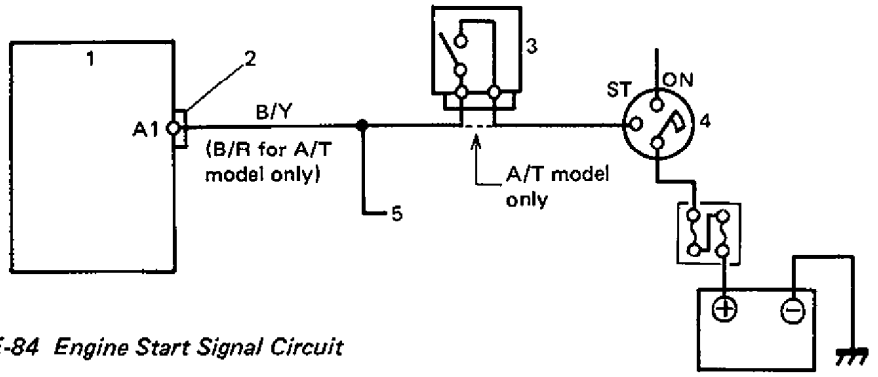
YES → ●"R/W" wire open,
●"R/W" wire shorted to ground circuit,
●Poor ISC solenoid coupler connection or
●Poor B4 connection.
If wire and connections are OK, substitute a known-good ECM and recheck.

NOTE:
Before substituting a known-good ECM, check to make sure that resistance of ISC solenoid valve is as specified.

NO → Faulty ISC solenoid valve.

Fig. 6E-83 Diagnostic Flow Chart B-4 For ISC Solenoid Valve Control System

B-5 ENGINE START SIGNAL CHECK



1. ECM
2. ECM coupler
3. Clutch switch (M/T model only)
4. Main switch
5. To starter motor

Fig. 6E-84 Engine Start Signal Circuit

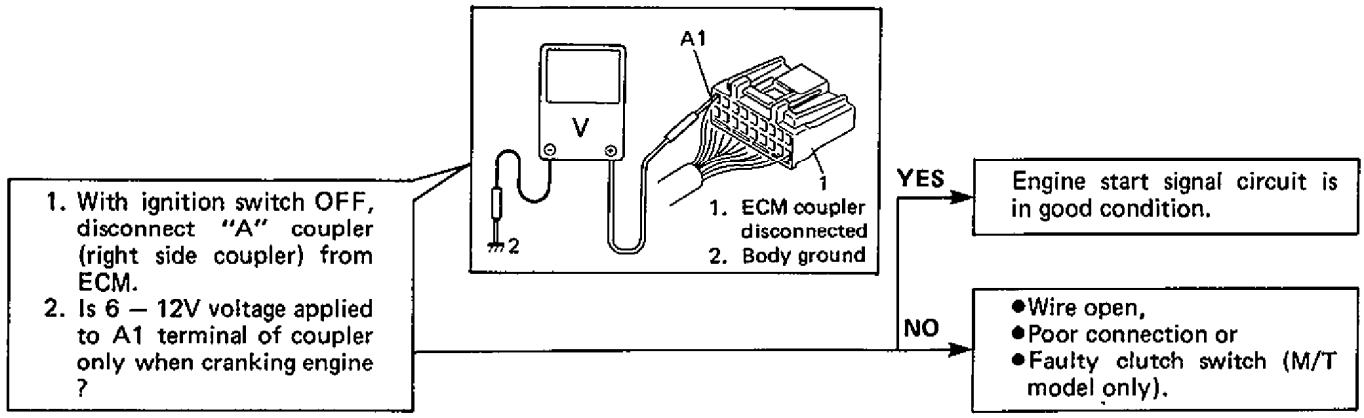
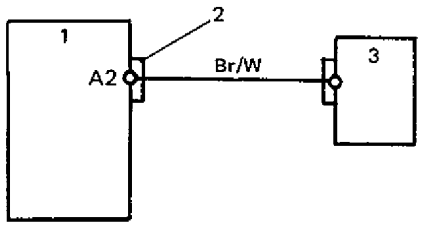


Fig. 6E-85 Engine Start Signal Check

B-6 "R", "D", "2" OR "L" RANGE SIGNAL CHECK (A/T MODEL ONLY)



1. ECM
2. ECM coupler
3. A/T control module

Fig. 6E-86 "R", "D", "2" or "L" Range Signal Circuit

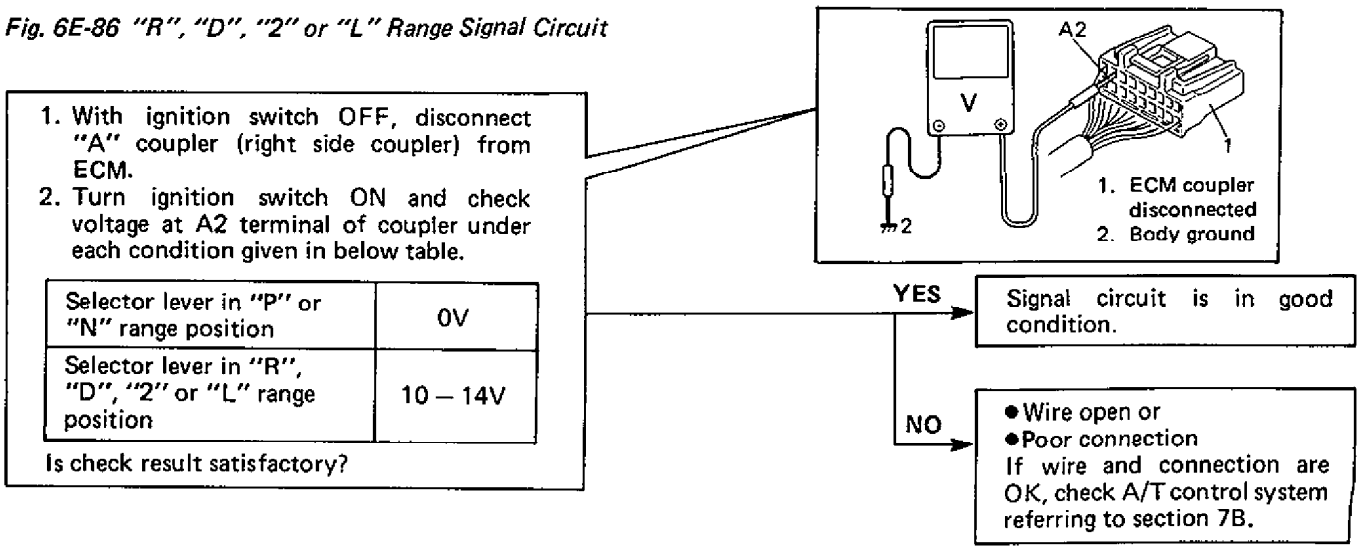


Fig. 6E-87 "R", "D", "2" or "L" Range Signal Check (A/T Model Only)

INSPECTION OF ECM AND ITS CIRCUITS

ECM and its circuits can be checked at ECM wiring couplers by measuring voltage and resistance.

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

Voltage Check

1. Remove ECM from body referring to p. 6E-83.
2. Connect ECM couplers to ECM.
3. Using service wire, ground ECM case.
4. 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.

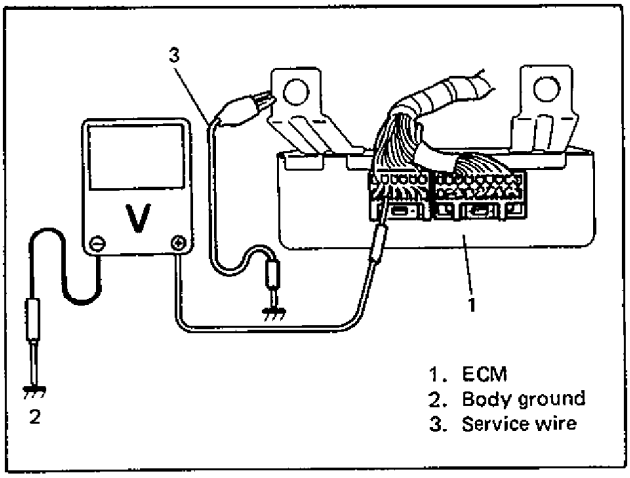


Fig. 6E-88 Checking Voltage

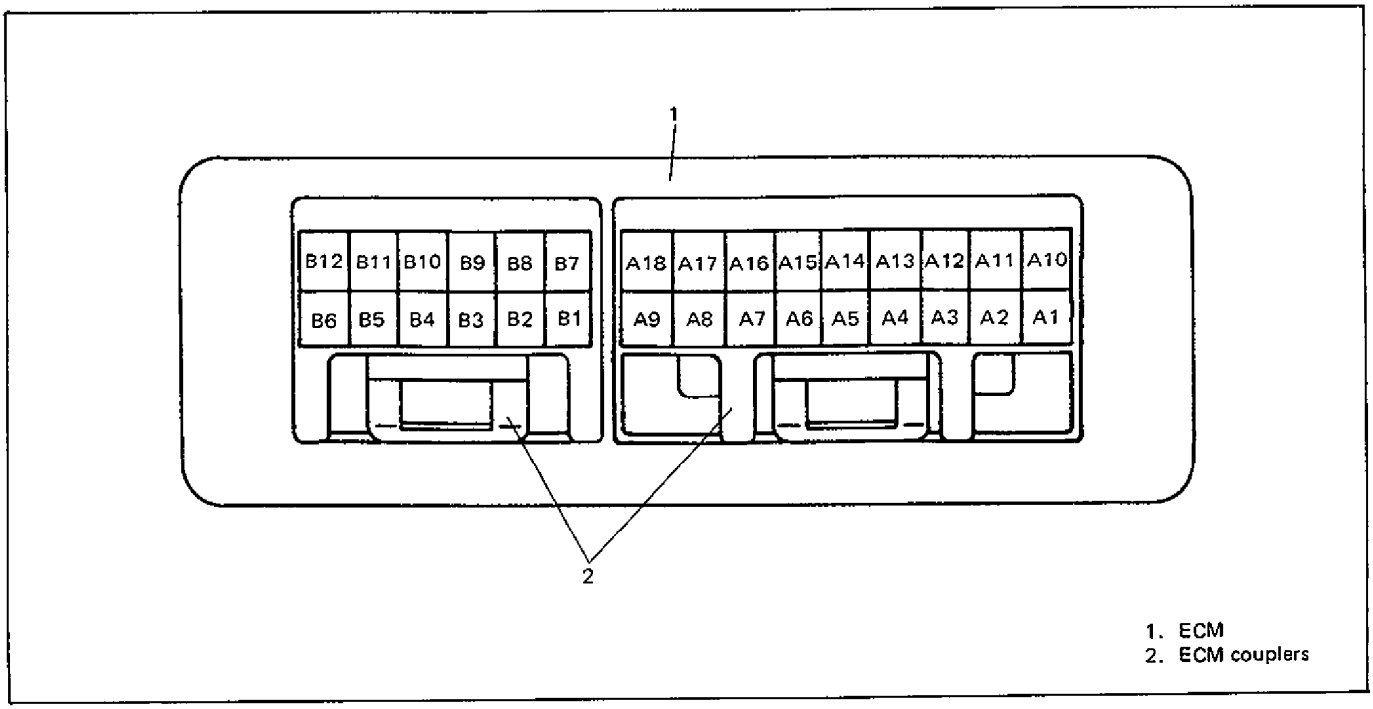


Fig. 6E-89 ECM Coupler Terminals

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A1	Engine start switch (Engine start signal)	6 – 12V	While engine cranking
		0V	Other than above
A2	———	———	———
A2 (A/T model only)	A/T control module ("R", "D", "2" or "L" range signal)	0V	Ignition switch ON, Selector lever in "P" or "N" range position
		10 – 14V	Ignition switch ON, Selector lever in "R", "D", "2" or "L" range position
A3	Idle switch (in TS or TPS)	0V	Ignition switch ON Throttle valve at idle position
		4 – 5V	Ignition switch ON Throttle valve opens larger than idle position
A4	Power source of sensor (PS and TPS)	4.75–5.25V	Ignition switch ON
A5	Pressure sensor	3.5 – 4.1V	Ignition switch ON Barometric pressure: 760 mmHg
A6	Oxygen sensor	Indicator deflection repeated between over and under 0.45V	While engine running at 2,000 r/min after warmed up and kept running at 2,000 r/min for 1 minute
A7	Circuit ground	0V	Ignition switch ON
A8	Shift-up indicator light (if equipped)	1 – 2V	Ignition switch ON
		10 – 14V	While engine running at idle speed
A8	———	———	———
A9 (A/T model only)	A/T control module (Throttle valve opening signal)	10 – 14V	Ignition switch ON, Throttle valve at idle position
		10 – 14V ↕ 0.2 – 0.4V	Ignition switch ON, Voltage varies as specified at the left while throttle valve is opened gradually. (Refer to Fig. 6E-157 for relations between opening and voltage)
A10	Air conditioner circuit (If equipped)	10 – 14V	Ignition switch ON
		0 – 0.6V	While engnie running at idle speed Air-conditioner ON

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A11	Speed sensor	Indicator deflection repeated between 0V and 4 – 5V	Ignition switch ON, front left tire turned slowly with front right tire locked.
A12	Test switch terminal	4 – 5V	Ignition switch ON
		0V	Ignition switch ON, Test switch terminal grounded
A13	ATS	2.0 – 2.7V	Ignition switch ON Sensor ambient temp (Intake air temp.): 20°C (68°F)
A14	WTS	0.45–0.80V	Ignition switch ON Engine cooling water temp.: 80°C (176°F)
A15 (M/T model only)	Wide open switch (in TS)	4 – 5V	Ignition switch ON Throttle valve at idle position
		0V	Ignition switch ON Throttle valve at full open position
A15 (A/T model only)	TPS	0.18–1.03V	Ignition switch ON Throttle valve at idle position
		3.27–4.58V	Ignition switch ON Throttle valve at full open position
A16	Ground of sensors	0V	Ignition switch ON
A17 (A/T model only)	A/T control module (Throttle valve opening signal)	10 – 14V	Ignition switch ON, Throttle valve at idle position
		10 – 14V ↕ 0.2 – 0.4V	Ignition switch ON Voltage varies as specified at the left while throttle valve is opened gradually. (Refer to Fig. 6E-157 for relations between opening and voltage.)
A17	———	———	———
A18 (A/T model only)	A/T control module (Throttle valve opening signal)	10 – 14V	Ignition switch ON, Throttle valve at idle position
		10 – 14V ↕ 0.2 – 0.4V	Ignition switch ON Voltage varies as specified at the left while throttle valve is opened gradually. (Refer to Fig. 6E-157 for relations between opening and voltage.)

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
B1	Power source	10 – 14V	Ignition switch ON
B2	Ignition coil (Ignition signal)	10 – 14V	Ignition switch ON
B3 (California spec. model only)	EGR VSV	10 – 14V	Ignition switch ON
B4	ISC solenoid valve	0.9 – 1.5V	Ignition switch ON Diagnosis switch terminal ungrounded
		10 – 13V	Ignition switch ON Diagnosis switch terminal grounded
B5	Injector	10 – 14V	Ignition switch ON
B6	Ground	0V	Ignition switch ON
B7	Power source for back-up circuit	10 – 14V	Ignition switch ON and OFF
B8	Diagnosis switch terminal	4 – 5V	Ignition switch ON
		0V	Ignition switch ON, Diagnosis switch terminal grounded
B9	"CHECK ENGINE" light	1.2 – 2.0 V	Ignition switch ON Diagnosis switch terminal ungrounded
		10 – 14V	When engine running Diagnosis switch terminal ungrounded
B10	Fuel pump relay	1.2 – 1.8V	For 2 seconds after ignition switch ON
		10 – 14V	When over 2 seconds after ignition switch ON
B11	———	———	———
B12	———	———	———

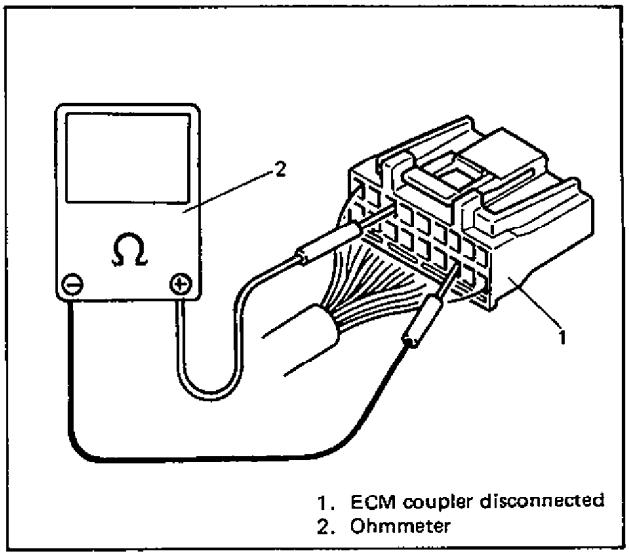
Resistance Check

1. Disconnect ECM couplers from ECM with ignition switch OFF.

CUATION:
Never touch terminals of ECM itselt or connect voltmeter or ohmmeter.

2. Check resistance between each terminal of couplers disconnected.

CAUTION:
- **Be sure to connect ohmmeter probe from wire harness side of coupler.**
- **Be sure to turn OFF ignition switch for this check.**
- **Resistance in below table represents that when ambient temperature is 20°C (68°F).**



1. ECM coupler disconnected
2. Ohmmeter

Fig. 6E-90 Checking Resistance

TERMINALS	CIRCUIT	NORMAL RESISTANCE	CONDITION
A3 – A16	Idle switch (in TS or TPS)	0 – 5kΩ	Throttle valve is at idle position
		∞ (Infinity)	Throttle valve opens larger than idle position
A11 – Body ground	Speed sensor	Ohmmeter indicator deflects between 0 and ∞	While front left tire turned slowly with front right tire locked
A12 – Body ground	Test switch terminal	0	Test switch terminal ground
		∞	Test switch terminal ungrounded
A13 – A16	ATS	2.21 – 2.69 kΩ	Intake air temp. 20°C (68°F)
A14 – A16	WTS	290 – 354 Ω	Engine cooling water temp. 80°C (176°F)
A15 – A16 (M/T model only)	Wide open switch (in TS)	∞ (Infinity)	Throttle valve at idle position
		0 (Zero)	Throttle valve at full open position
A15 – A16 (A/T model only)	TPS	0.20–11.42 kΩ	Throttle valve at idle position
		3.03–17.08 kΩ	Throttle valve at full open position

TERMINALS	CIRCUIT	NORMAL RESISTANCE	CONDITION
B3 – B1 (California spec. model only)	EGR VSV	33 – 39 Ω	———
B4 – B1	ISC solenoid valve	30 – 33 Ω	———
B5 – B1	Injector and resistor	2.4 – 3.6 Ω	———
B6 – Body ground	ECM ground	0 (Zero)	———

ON CAR SERVICE

GENERAL

When hoses have been disconnected and system's component removed for service, be sure to reinstall component properly, and route and connect hose correctly after service.

ACCELERATOR CABLE ADJUSTMENT

Check accelerator cable for play and adjust if necessary.

Cable play should be within specification. If out of specification, loosen accelerator cable lock nut and adjust by turning adjusting nut. Be sure to tighten lock nut securely after adjustment.

Accelerator cable play	3 – 5 mm (0.12 – 0.20 in.)

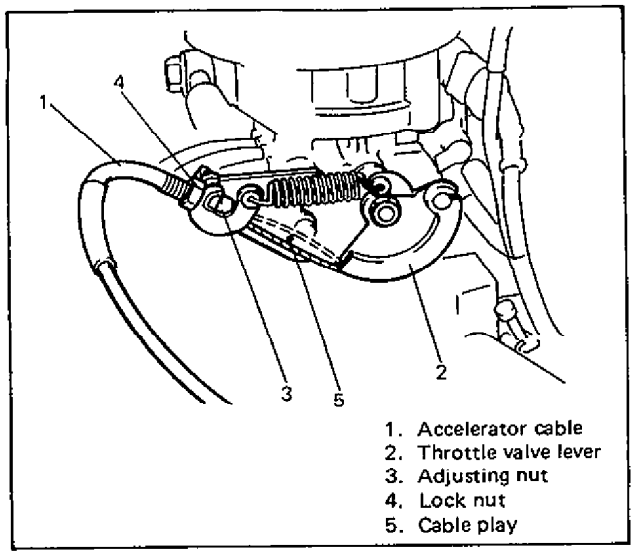


Fig. 6E-91 Accelerator Cable Play

IDLE SPEED ADJUSTMENT (INCLUDING AIR-CONDITIONER VSV 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.
- Ignition timing is within specification.
- All accessories (wipers, heater, lights, etc.) are out of service.
- Air-conditioner is OFF, if equipped.
- Air cleaner has been properly installed and is in good condition.

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

NOTE:

Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

1. Warm up engine to normal operating temperature.
2. Set tachometer
3. Connect spare fuse to diagnosis switch terminal in junction/fuse block, and amount of air supplied by ISC solenoid valve will be kept constant. (For West Germany spec. model, turn diagnosis switch ON.)

NOTE:

At this time, "CHECK ENGINE" light should indicate diagnostic code NO. 12 and also operation of ISC solenoid valve should be heard. If not, check and repair according to Diagnostic flow chart" on p. 6E-38 and "Diagnostic flow chart B-4" on p. 6E-65.

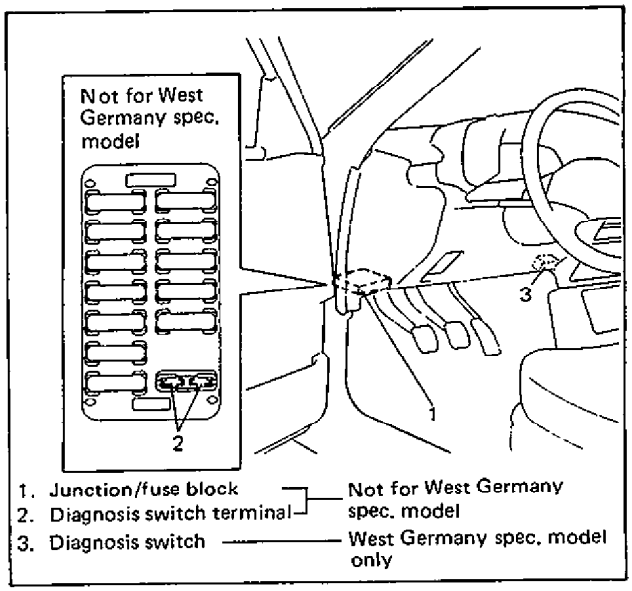
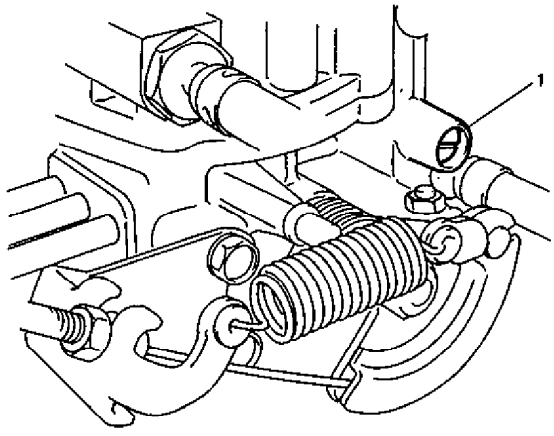


Fig. 6E-92

4. Check to ensure that idle speed is within below specification.

Engine idle speed	M/T model	650 ± 50 r/min.
	A/T model	750 ± 50 r/min.

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



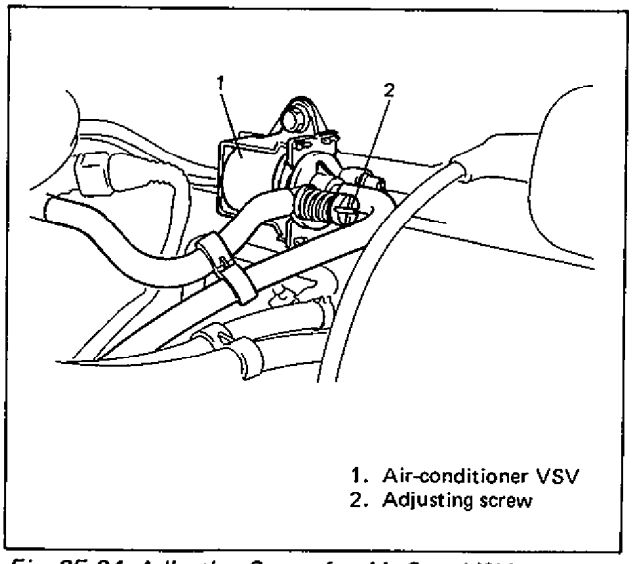
1. Idle speed adjusting screw

Fig. 6E-93 Idle Speed Adjsuting Screw

6. This step is for checking and/or adjusting engine idle speed when air-conditioner is working.
   With cars without air conditioner, advance to steps 7 and 8. With air-conditioner equipped ones, follow procedure described below.
   1) Turn air-conditioner switch ON and set heater blower switch to low speed position. Then check that air-conditioner is working.
   2) Check to ensure that idle speed is within below specification.

Engine idle speed with air-conditioner ON	M/T model	900 ± 50 r/min.
	A/T model	850 ± 50 r/min.

   3) If it is not within specified range, adjust it by turning adjusting screw of air-conditioner VSV.



1. Air-conditioner VSV
2. Adjusting screw

Fig. 6E-94 Adjusting Screw for Air-Con. VSV

7. Upon completion of adjustment, install adjusting screw cap to throttle body.
8. Disconnect spare fuse from diagnosis switch terminal or turn diagnosis switch OFF.

AIR AND FUEL DELIVERY SYSTEM

FUEL PRESSURE INSPECTION

1. Relieve fuel pressure according to procedure described on p. 6-3.
2. Separate air cleaner assembly from throttle body and shift its position.
3. Disconnect fuel feed hose from throttle body.

CAUTION:
A small amount of fuel may be released after fuel line is disconnected.
In order to reduce chance of personal injury, cover fitting to be disconnected with a shop cloth. Place that cloth in an approved container when disconnection is completed.

4. Connect special tool (fuel pressure gauge, hose & 3-way joint) between throttle body and fuel feed hose, and clamp hoses securely to ensure no leaks occur during checking.

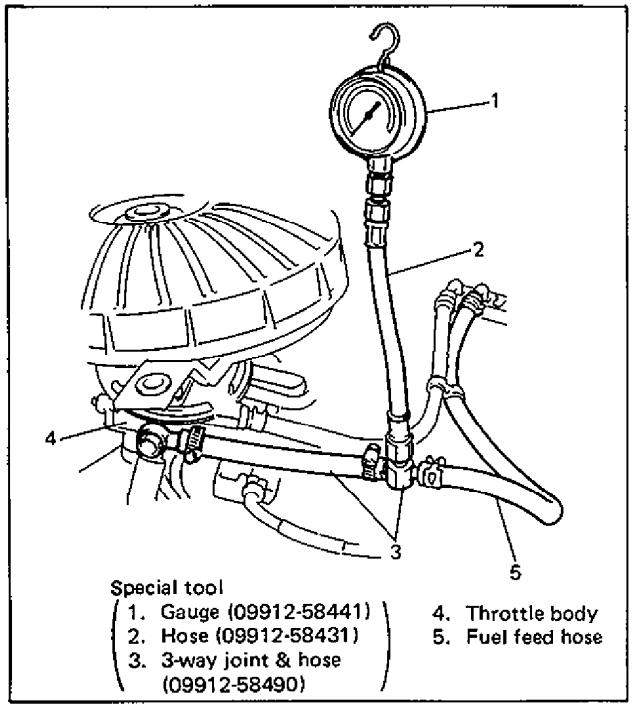


Fig. 6E-95 Connecting Fuel Pressure Gauge

5. Install air cleaner assembly to throttle body and cylinder head cover.
6. Start engine and warm it up to normal operating temperature.

   If engine doesn't start, operate fuel pump according to following procedure.

   1) Remove fuel pump relay from main fuse box after disconnecting its coupler and then reconnect coupler to fuel pump relay.

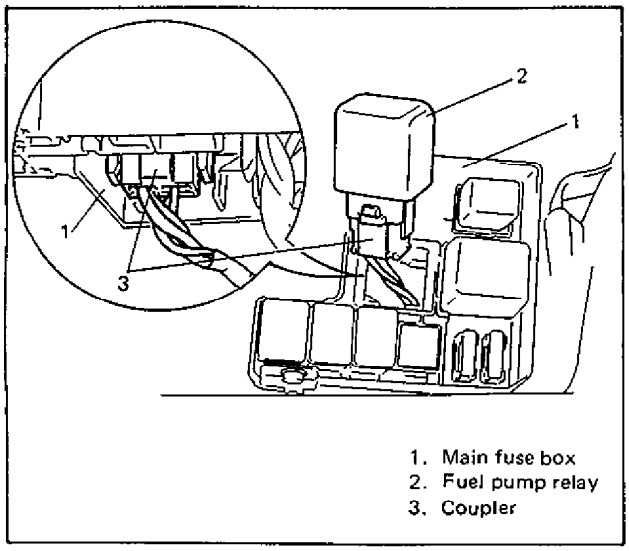


Fig. 6E-96 Removing Fuel Pump Relay

   2) To operate fuel pump, connect Pink and White/Blue wire terminals by using service wire and then turn ON ignition switch.

NOTE:
Check that battery voltage is 11V or more before operating fuel pump.

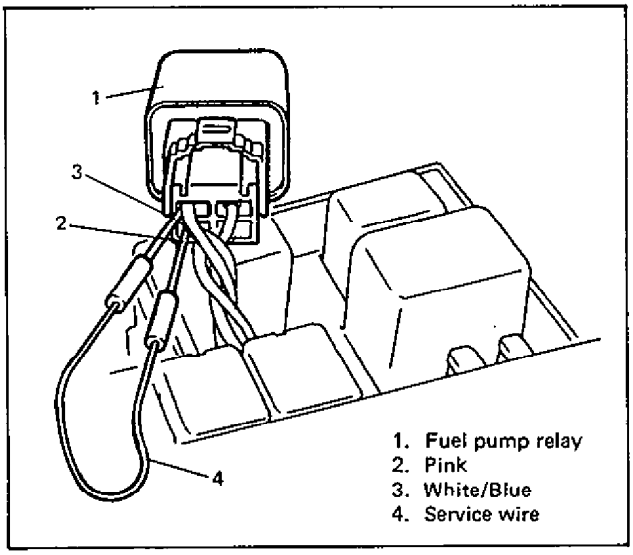


Fig. 6E-97 Operating Fuel Pump

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

CONDITION	FUEL PRESSURE
At specified idle speed	0.9 – 1.4 kg/cm² 90 – 140 kPa 12.8 – 20.0 psi
With fuel pump operating and engine at stop	1.6 – 2.1 kg/cm² 160 – 210 kPa 22.7 – 29.9 psi
Within 1 min. after engine (fuel pump) stop (Pressure reduces as time passes)	Over 0.9 kg/cm² 90 kPa 12.8 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.

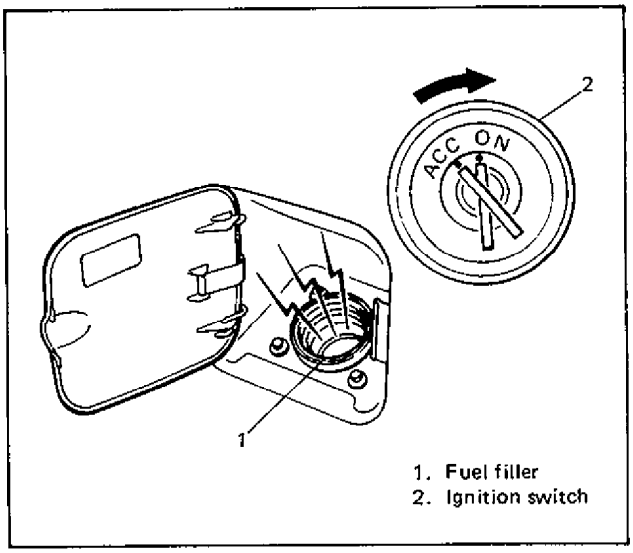
8. Relieve fuel pressure according to procedure described on p. 6-3.
9. Remove fuel pressure gauge, hose & 3-way joint after removing air cleaner assembly.
10. Connect fuel feed hose to throttle body and clamp it securely.
11. Install air cleaner assembly.
12. With engine "OFF" and ignition switch "ON", check for fuel leaks.

FUEL PUMP

Fuel Pump On-Car Inspection

WARNING:
When fuel filler cap is removed in any procedure, work must be done with no smoking, in a well-ventilated area and away from any open flames.

1. Remove filler cap and turn ON ignition switch. Then fuel pump operating sound should be heard from fuel filler for about 2 seconds and stop. Be sure to reinstall fuel filler cap after checking.



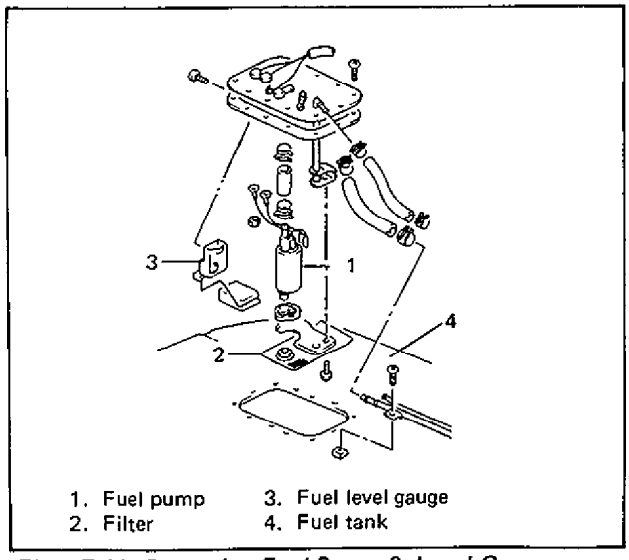
1. Fuel filler
2. Ignition switch

Fig. 6E-98 Checking Fuel Pump

If above check result is not satisfactory, advance to "Diagnostic Flow Chart B-2".

Removal

1. Remove fuel tank from body according to procedure described in section 6C and remove fuel pump & level gauge from fuel tank.



1. Fuel pump
2. Filter
3. Fuel level gauge
4. Fuel tank

Fig. 6E-99 Removing Fuel Pump & Level Gauge

2. Remove fuel pump from its bracket.

Inspection

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

Installation

1. Install fuel pump to its bracket.
2. Install fuel pump & level gauge to fuel tank and then install fuel tank to body according to procedure described in section 6C.

THROTTLE BODY

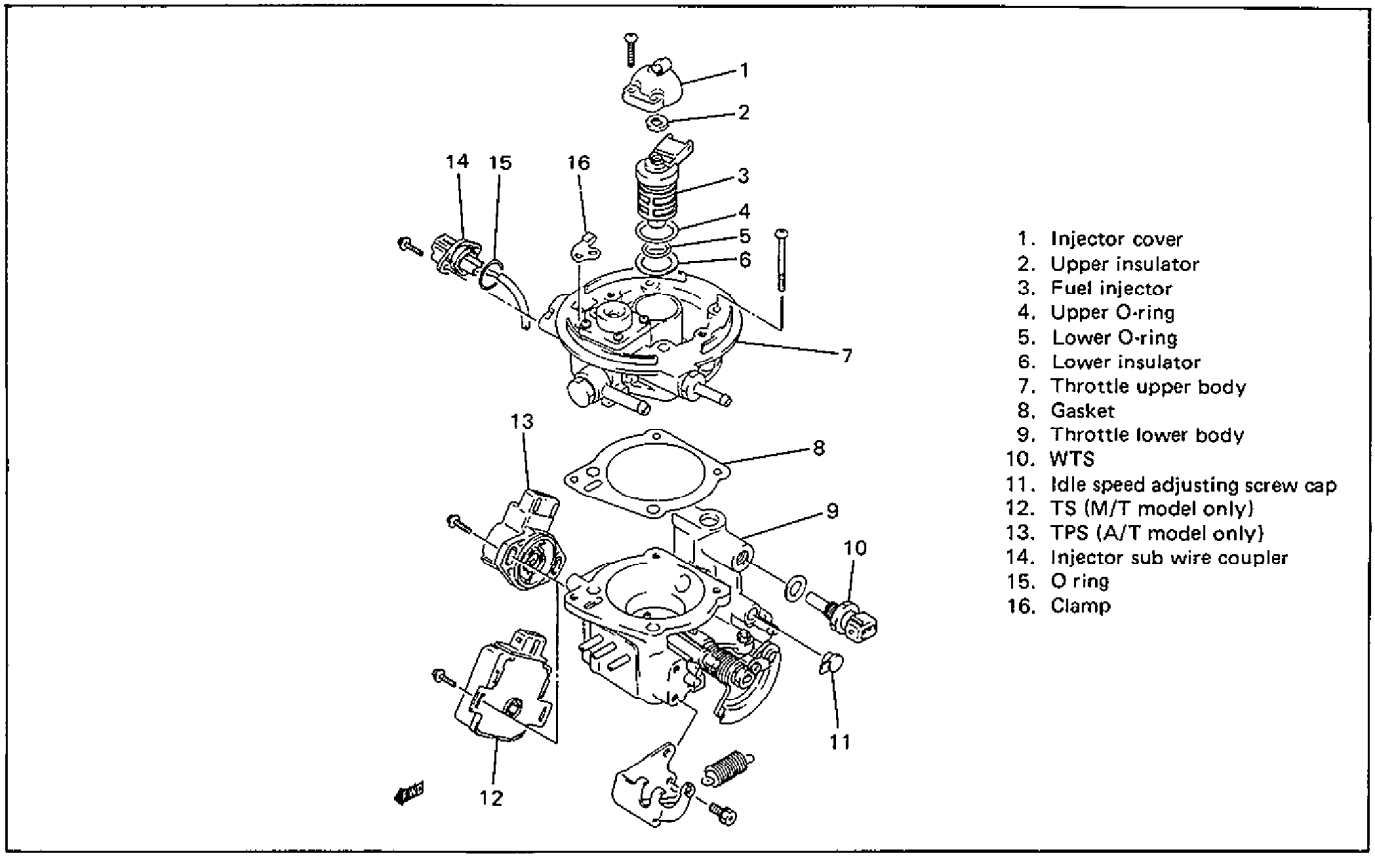


Fig. 6E-100 Throttle Body Parts Identification

On-Car Inspection

- Check that throttle valve lever moves smoothly.
- Vacuum passage inspection.
  With fingers placed against vacuum nozzles (2 or 3 pcs), increase engine speed a little and check that vacuum is applied.

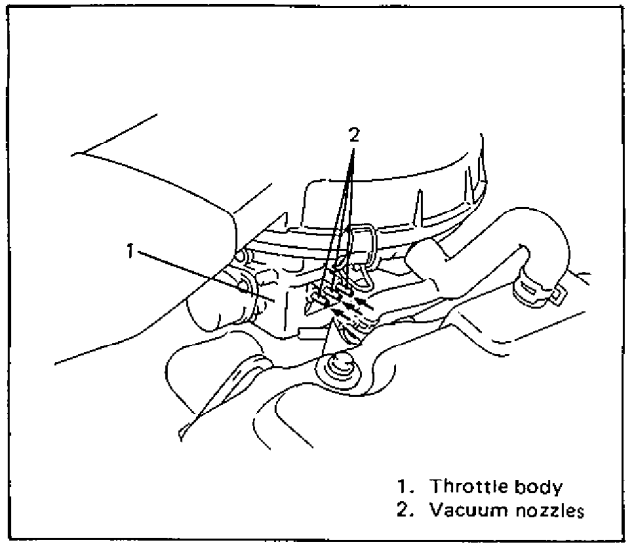


Fig. 6E-101 Checking Vacuum Passage

Removal

1. Relieve fuel pressure according to procedure described on p. 6-3.
2. Disconnect battery negative cable at battery.
3. Remove air cleaner assembly referring to section 6A.
4. Drain cooling system.
5. Disconnect following wire harness couplers:
   - TS or TPS
   - Fuel injector
   - WTS
6. Disconnect following hoses from throttle body.
   - Fuel feed and return hoses
   - Engine cooling water hoses
   - Vacuum hoses
7. Disconnect accelerator cable from throttle valve lever and cable bracket.

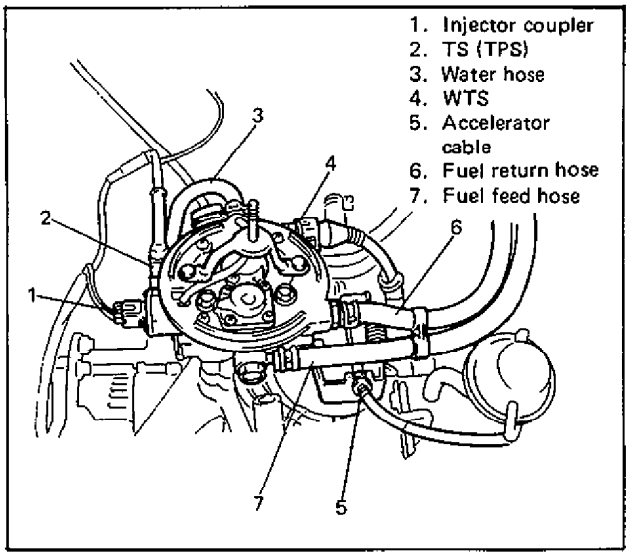


Fig. 6E-102 Disconnecting Couplers and Hoses

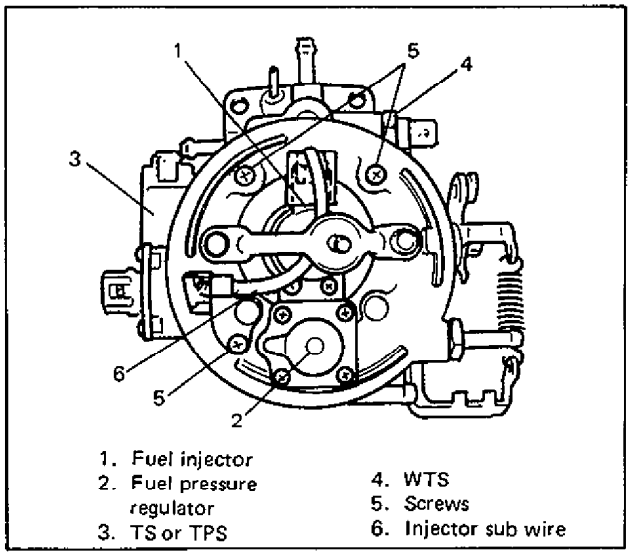


Fig. 6E-103 Disassembling Throttle Body

8. Remove throttle body from intake manifold.

Disassembly

NOTE:

- **Be sure not to remove either fuel pressure regulator or air valve from throttle body. They are factory adjusted precisely.**
- **Be sure to replace gaskets and O rings 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 fuel injector from throttle body according to procedure described on p. 6E-82.
3. Remove TS or TPS.
4. Remove WTS.
5. After removing screws, separate upper and lower bodies.

Cleaning

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

NOTE:

- **TS (TPS), fuel pressure regulator, fuel injector, air valve, WTS, other components containing rubber (resin) or throttle valve shaft seal must not be placed in a solvent or cleaner bath. Chemical reaction will cause these parts to swell, harden or get distorted.**
- **Don't put drills or wires into passages for cleaning. It causes damage in passages.**

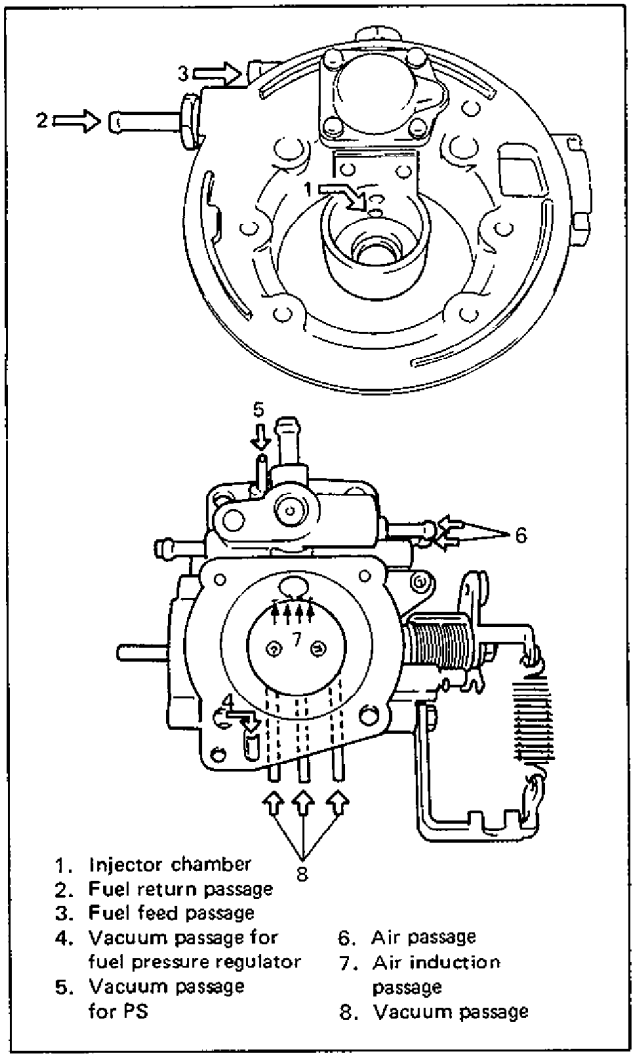


Fig. 6E-104 Cleaning Passage

Assembly

1. Install new gasket to lower body.

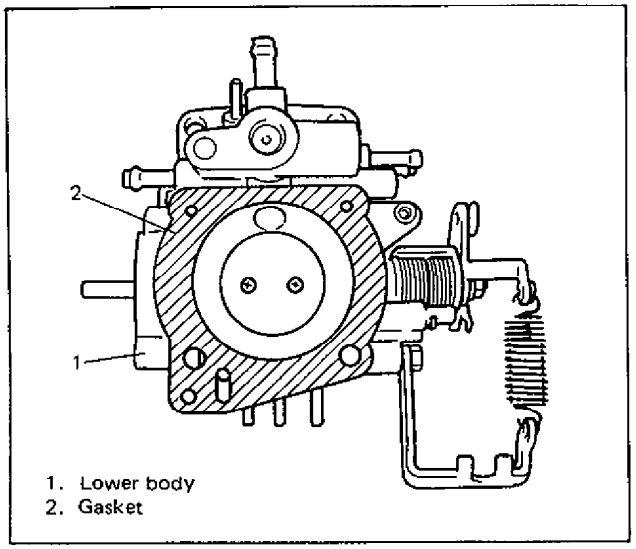


Fig. 6E-105 Installing Gasket

2. Install upper body on gasket, using care not to cause gasket to slip out of place.
3. Tighten screws indicated by "5" in Fig. 6E-103 to specified torque.

Tightening torque of screw	N·m	kg-m	lb-ft
	2.9–4.1	0.29–0.41	2.1 – 2.9

4. Install WTS according to procedure described on p. 6E-90.
5. Install TS or TPS according to procedure described on p. 6E-87.
6. Install fuel injector according to procedure described on p. 6E-82.
7. Install injector subwire to throttle body.
   Use new O ring.
   Tighten subwire coupler screw to specified torque.

Tightening torque of screw	N·m	kg-m	lb-ft
	1.6 – 2.4	0.16–0.24	1.2 – 1.7

Connect injector coupler to injector securely, cover injector coupler with coupler cover and with wire tube pushed against injector coupler, clamp sub wire.

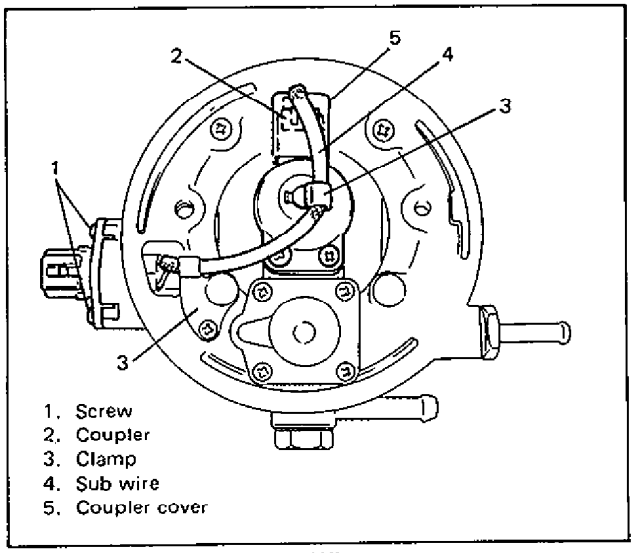


Fig. 6E-106 Clamping Sub Wire

Installation

1. Clean mating surfaces and install throttle body gasket to intake manifold. Use new gasket.

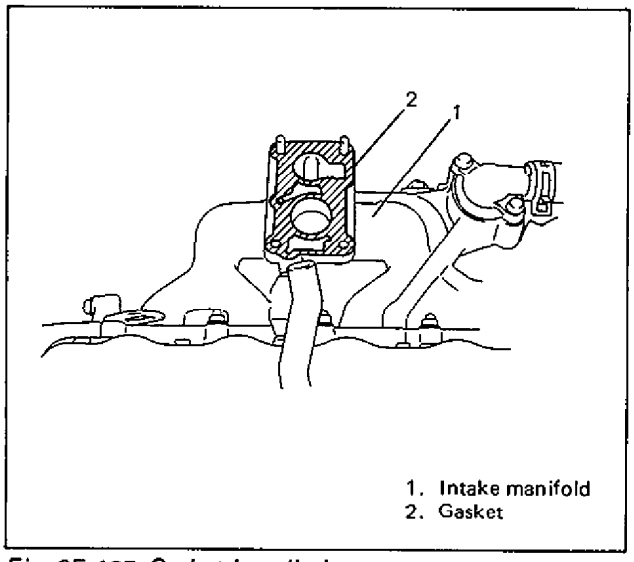


Fig. 6E-107 Gasket Installation

2. Install throttle body to intake manifold and tighten bolts and nuts to specified torque.

Tightening torque for throttle body bolts & nuts	N·m	kg-m	lb-ft
	18 – 28	1.8 – 2.8	13.0 – 20.0

3. Install accelerator cable to throttle valve lever and cable bracket.
   Adjust cable play to specification according to procedure described on p. 6E-73.
4. Connect fuel, cooling water and vacuum hoses to throttle body, and clamp securely.
5. Connect TS (TPS), injector and WTS coupler securely.
6. Refill cooling system referring to section 6B.
7. Connect negative cable at battery.
8. With engine "OFF" and ignition switch "ON", check for fuel leaks around fuel line connection.
9. Install air cleaner assembly referring to section 6A.
10. Upon completion of installation, start engine and check for fuel leaks and engine cooling water leaks.

AIR VALVE

Inspection

1. Remove throttle body assembly from intake manifold as previously outlined.
2. Separate upper and lower bodies.
3. Remove WTS from lower body.
4. 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 80°C, 176°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.**

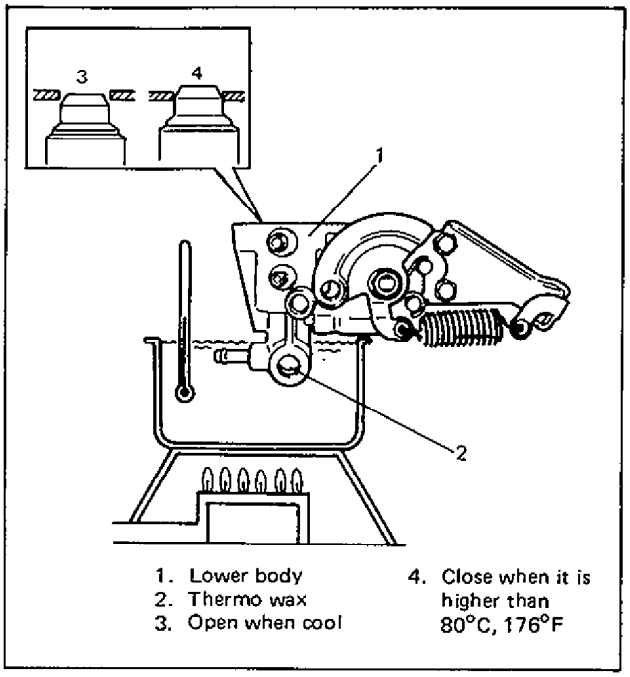


Fig. 6E-108 Inspecting Air Valve

If check result is not satisfactory, replace.

5. Install WTS according to procedure described on p. 6E-90.
6. Put upper and lower bodies together and tighten its screws to specified torque.
   Use new gasket between lower and upper bodies.
7. Install throttle body assembly to intake manifold as previously outlined.

FUEL INJECTOR

On-Car Inspection

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

Resistance of injector	0.5 – 1.5 Ω at 20°C (68°F)

If resistance is out of specification, replace fuel injector.

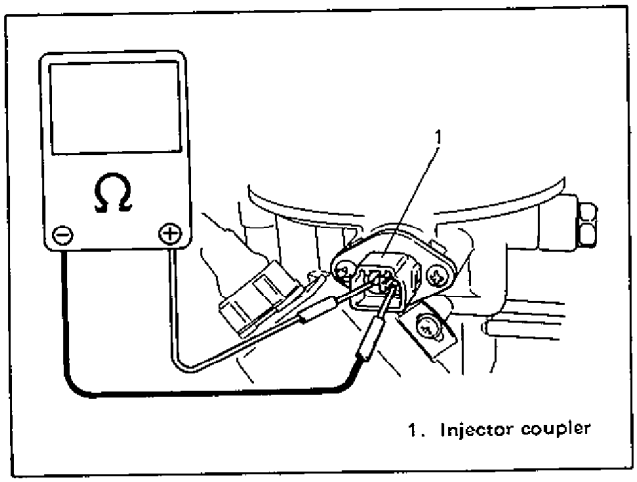


Fig. 6E-109 Checking Resistance of Fuel Injector

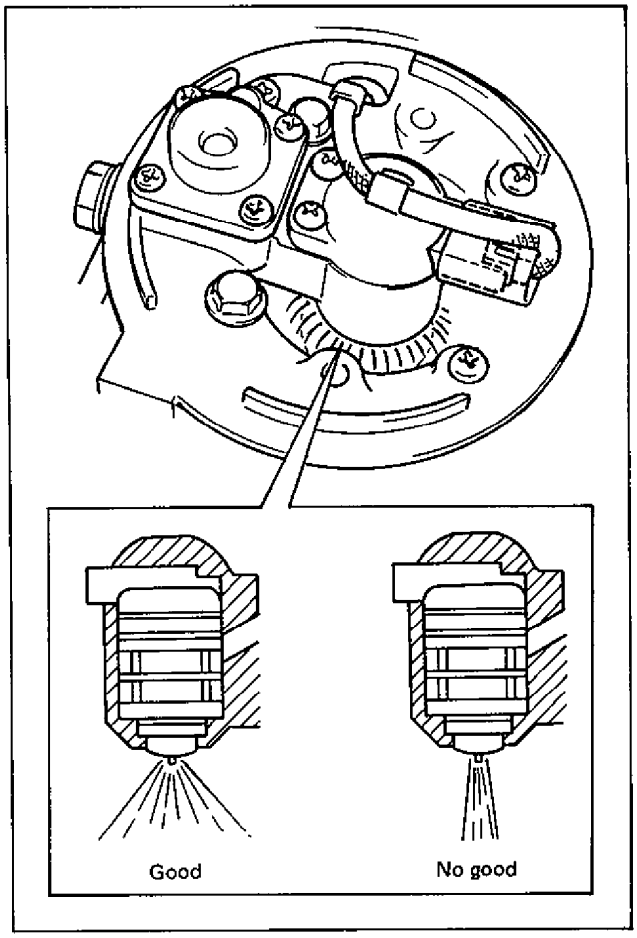


Fig. 6E-110 Checking Fuel Injection

3. Connect injector coupler.
4. Remove air cleaner assembly without disconnecting ATS coupler.
5. Check that fuel is injected out in conical shape from fuel injector when cranking or running engine.

   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.
6. 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.

7. Install air cleaner assembly.

Removal

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

1. Relieve fuel pressure according to procedure described on p. 6-3.
2. Disconnect battery negative cable at battery.
3. Remove air cleaner assembly referring to section 6A.
4. Remove air cleaner mounting stay for throttle body.
5. Remove injector cover and upper insulator. Then open claws of injector after removing coupler cover and disconnect coupler from it.

NOTE:
Use care not to break claws by opening them too far outward.

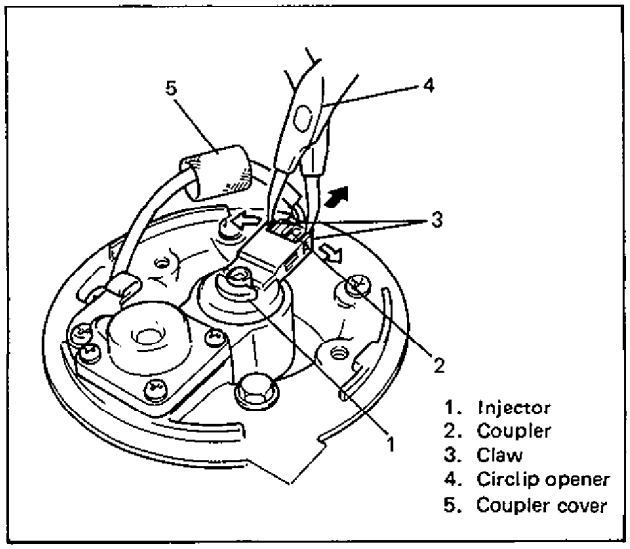


Fig. 6E-111 Disconnecting Coupler

6. Remove injector from throttle body.

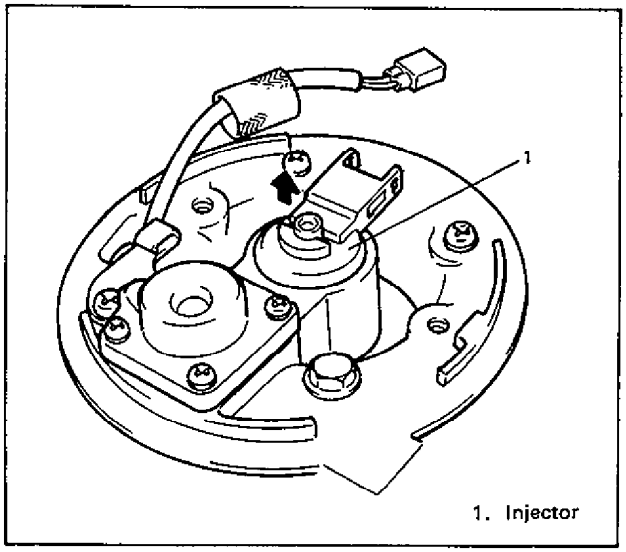


Fig. 6E-112 Removing Injector

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. Apply thin coat of spindle oil or gasoline to new upper and lower O-rings, install lower O-ring to injector cavity and upper O-ring to injector.
2. Install new lower insulator to injector cavity.

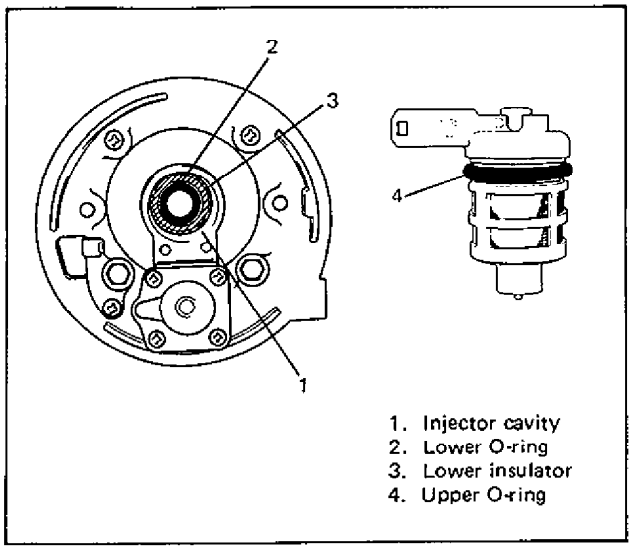


Fig. 6E-113 Installing O-rings and Insulator

3. Install injector by pushing it straight into fuel injector cavity.
   Never turn injector while pushing it.
4. Install new upper insulator and new injector cover, and tighten cover screw to specified torque.

Tightening torque for injector cover screw	N·m	kg-m	lb-ft
	2.9 – 4.1	0.29–0.41	2.1 – 2.9

5. Connect injector coupler to injector, facing its lug side upward and cover its coupler with coupler cover, and with wire tube pushed against injector coupler, clamp sub wire.

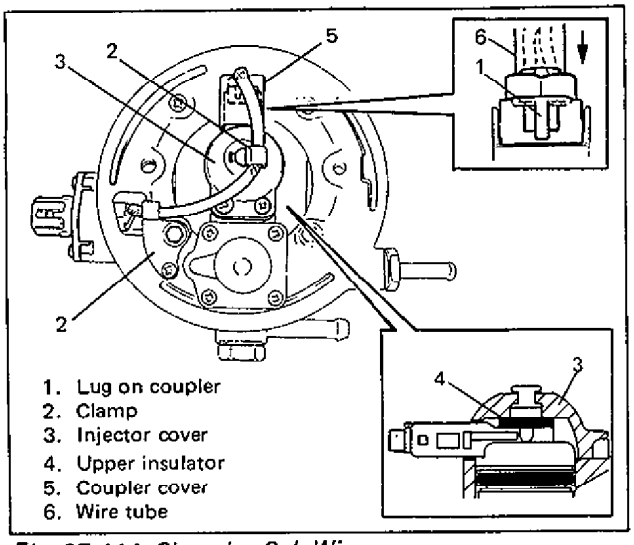


Fig. 6E-114 Clamping Sub Wire

6. Connect battery negative cable at battery.
7. With engine "OFF" and ignition switch "ON", check for fuel leaks.
8. Install air cleaner mounting stay as shown below.

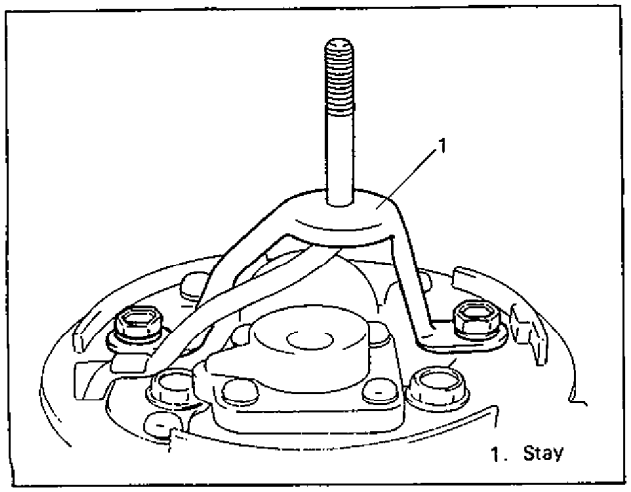


Fig. 6E-115 Installing Stay

9. Install air cleaner assembly referring to section 6A.

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 at battery.
2. Lower junction/fuse block after removing its bolts.
3. Disconnect couplers from ECM while releasing coupler lock.
4. Remove ECM from body.

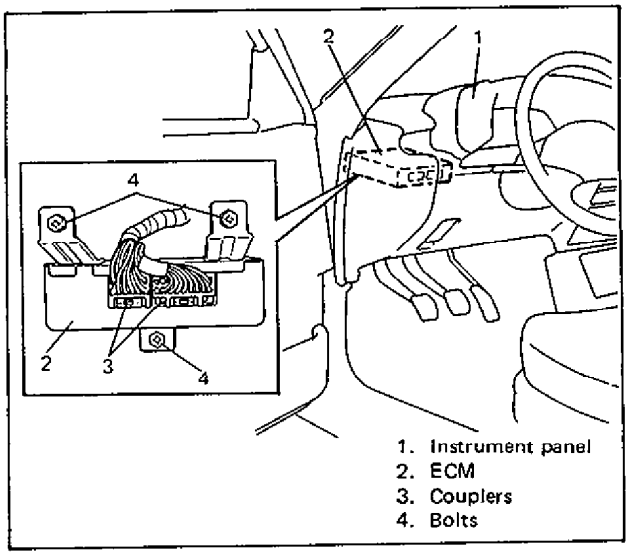


Fig. 6E-116 Removing ECM

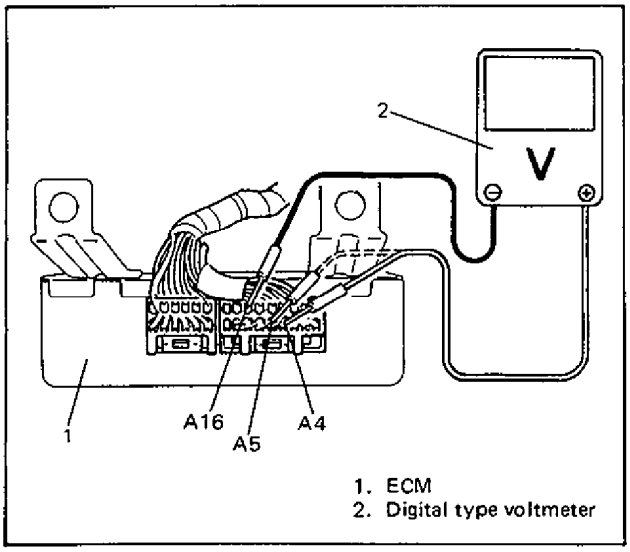
Installation

1. Install ECM to body.
2. Connect couplers to ECM securely.
3. Fix junction/fuse block with bolts.
4. Connect battery negative cable at battery.

PRESSURE SENSOR (PS)

Output Voltage Check

1. Remove ECM according to previously outlined.
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 A4.
4. Check output voltage at coupler terminal A5. Note that it varies with atmospheric pressure and altitude.
   Also, start engine, if it can, and check if output voltage varies.



1. ECM
2. Digital type voltmeter

Fig. 6E-117 Checking PS and Its Circuit

Output voltage (ECM supply voltage 4.75 – 5.25V, ambient temp. 10 – 40°C, 50 – 104°F)

ALTITUDE (Referance)		BAROMETRIC PRESSURE	OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(V)
0	0	760	3.5 – 4.1
1 000	305	733	3.4 – 4.0
2 000	610	707	3.2 – 3.8
3 000	914	682	3.1 – 3.7
4 000	1 219	658	3.0 – 3.6
5 000	1 524	634	2.9 – 3.5
6 000	1 829	611	2.8 – 3.3
7 000	2 133	589	2.7 – 3.2
8 000	2 438	567	2.6 – 3.1
9 000	2 743	546	2.5 – 3.0
10 000	3 048	526	2.4 – 2.9

NOTE:
Note that atmospheric pressure varies depending on weather conditions as well as altitude.
Take that into consideration when performing above check.

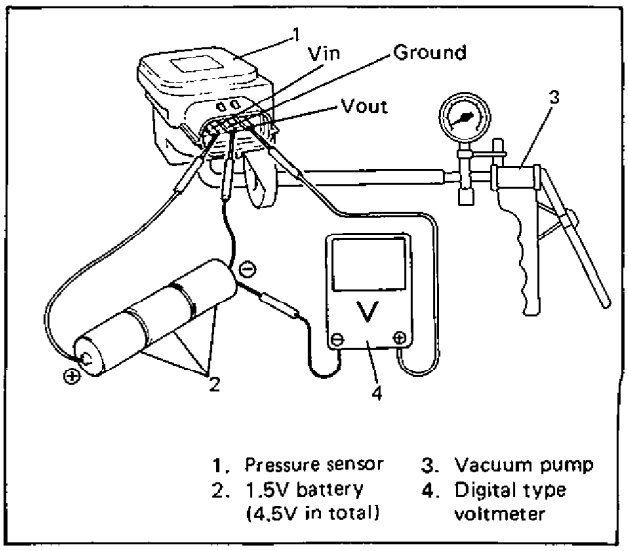
If check result is not satisfactory in previous step 3 or 4, check PS and its circuit according to Diagnostic Flow Chart for Code No. 31.

NOTE:
If output voltage does not vary when engine is started, it is possible that vacuum hose and/or filter are clogged. Clean them.
Another possibility is that filter in PS 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.

PS Individual Check

1. Disconnect PS vacuum hose from filter.
2. Disconnect coupler from PS.
3. Remove PS.
4. Arrange 3 new 1.5V batteries in series (check that total voltage is 4.5 – 5.0V) and connect its positive terminal to "Vin" terminal of sensor 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.



1. Pressure sensor
2. 1.5V battery (4.5V in total)
3. Vacuum pump
4. Digital type voltmeter

Fig. 6E-118 Checking PS

Output voltage (Vin voltage 4.5 – 5.0V, abmient temp. 20 – 30°C, 68 – 86°F)

ALTITUDE (Reference)		BAROMETRIC PRESSURE	OUTPUT VOLTAGE
(ft)	(m)	(mmHg)	(V)
0 – 2 000	0 – 610	760 – 707	2.9 – 4.2
2 001 – 5 000	611 – 1 524	Under 707 over 634	2.7 – 4.0
5 001 – 8 000	1 525 – 2 438	Under 634 over 567	2.5 – 3.8
8 001 – 10 000	2 439 – 3 048	Under 567 over 526	2.0 – 3.3

If check result is not satisfactory, replace PS.

5. Install PS and connect vacuum hose securely.
6. Connect PS coupler securely.

THROTTLE SWITCH (TS) FOR M/T MODEL

Inspection

1. Disconnect negative cable at battery.
2. Remove air cleaner assembly referring to section 6A.
3. Disconnect coupler from TS.
4. Insert thickness gauge between throttle stop screw and throttle lever.

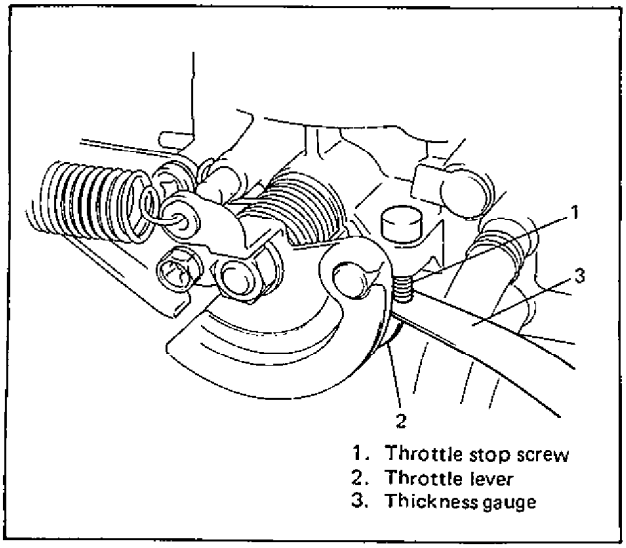


Fig. 6E-119 Inserting Thickness Gauge

5. Using ohmmeter, check continuity between terminals under each condition given in below table.

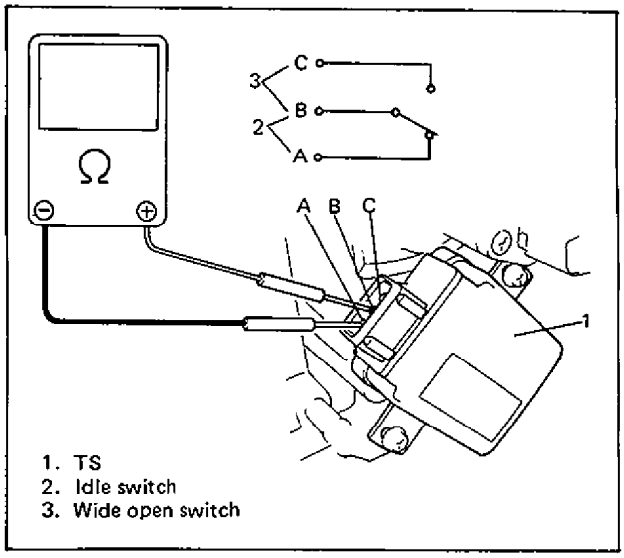


Fig. 6E-120 Checking TS

CLEARANCE BETWEEN STOP SCREW AND LEVER	CONTINUITY BETWEEN TERMINALS		
	A and B (Idle switch)	B and C (Wide open switch	A and C
0.3 mm 0.012 in.	Continuity	NO continuity	NO continuity
0.9 mm 0.035 in.	NO continuity	NO continuity	NO continuity
Throttle valve opened fully	NO continuity	Continuity	NO continuity

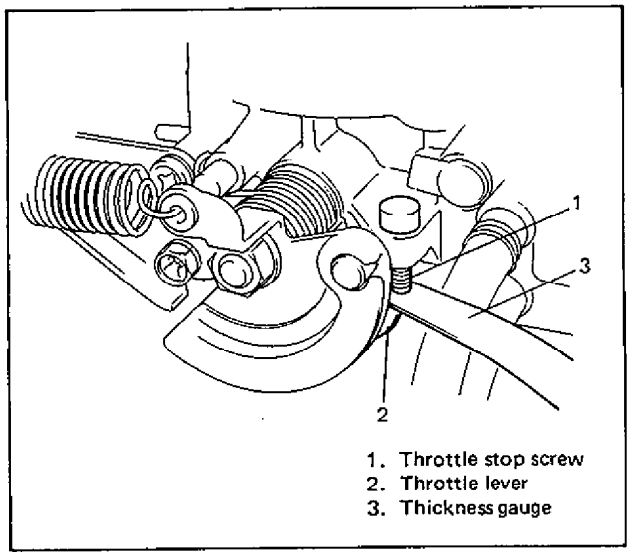
If check result is not satisfactory, replace TS. However, if only idle switch check is not satisfactory adjust installation angle of TS and recheck.

6. Connect TS coupler securely.
7. Install air cleaner assembly referring to section 6A.
8. Connect battery negative cable to battery.

Adjustment

1. Disconnect battery negative cable at battery.
2. Remove air cleaner assembly.
3. Disconnect coupler from TS.

4. Insert 0.6 mm (0.024 in) thickness gauge between throttle stop screw and throttle lever.



1. Throttle stop screw
2. Throttle lever
3. Thickness gauge

Fig. 6E-121 Inserting Thickness Gauge

5. Loosen TS screws.
6. Connect ohmmeter between A and B terminals.
7. First, turn TS counterclockwise fully and then clockwise gradually to find position where ohmmeter reading changes from 0 (zero, continuity) to ∞ (no continuity). Then fix TS at that position by tightening screws to specified torque.

Tightening torque of TS screw	N·m	kg-m	lb-ft
	1.6 – 2.4	0.16–0.24	1.2 – 1.7

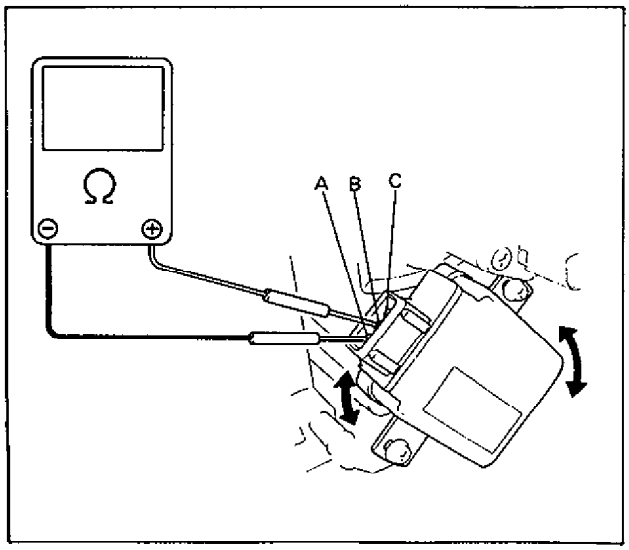


Fig. 6E-122 Adjusting Installation Angle

8. Check that there is no continuity between terminals A and B when 0.9 mm (0.035 in) thickness gauge is inserted.
9. Check that there is continuity between terminals A and B when 0.3 mm (0.012 in) thickness gauge is inserted.

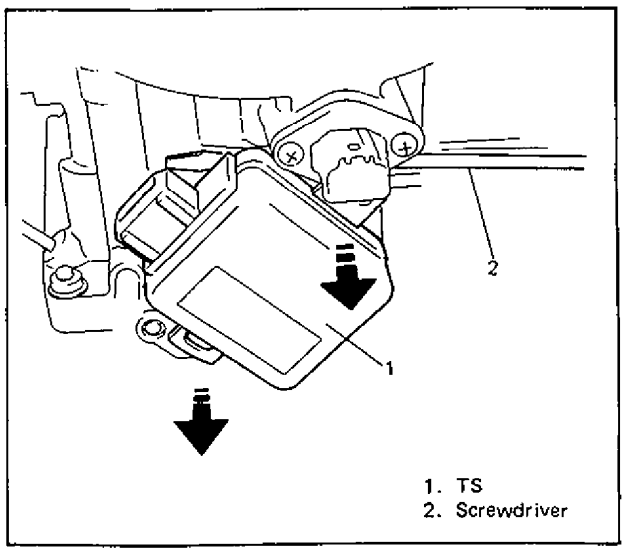
   If check result is unsatisfactory in steps 8 and 9, it means that installation angle of TS is not adjusted properly. Therefore, start all over again from step 1.

CAUTION:
As throttle stop screw is factory adjusted precisely, don't remove or adjust it.

10. Connect coupler to TS securely.
11. Install air cleaner assembly.
12. Connect negative cable to battery.

Removal

1. Disconnect battery negative cable at battery.
2. Remove air cleaner assembly referring to section 6A.
3. Disconnect coupler from TS.
4. Remove TS from throttle body. Using screwdriver, carefully pry TS to slide.



1. TS
2. Screwdriver

Fig. 6E-123 Removing TS

Installation

1. Install TS to throttle body. Before installation, check to make sure that flat part of TS rotor is positioned as shown in Figure. If not turn rotor with finger counterclockwise till it stops.

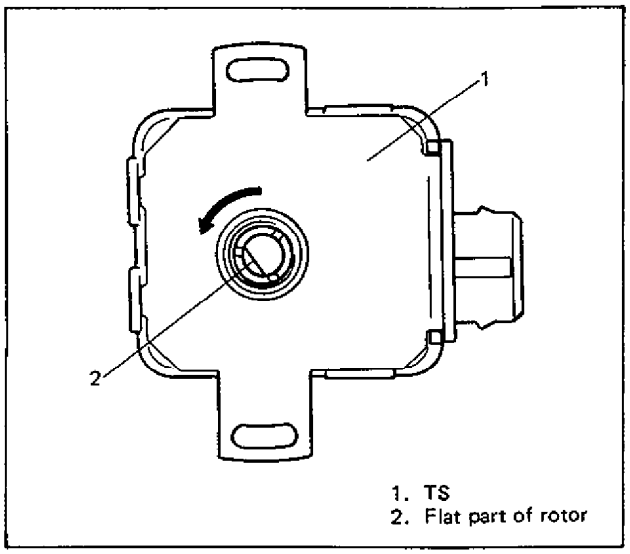


Fig. 6E-124 Rotor Position for Installing

2. Install TS to throttle valve shaft by aligning flat part of TS rotor with cut part of shaft and pushing TS till it becomes in full contact with throttle body.

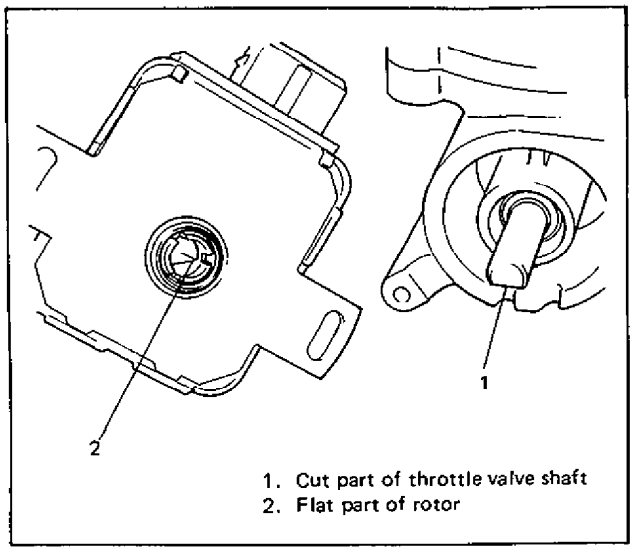


Fig. 6E-125 Installing TS

3. Hand-tighten TS screws.
   To position throttle valve in the center of bore, open it half and push throttle valve shaft from lever side.
4. Adjsut installation angle of TS according to procedure described in item "Adjustment".
5. Connect coupler to TS securely.
6. Install air cleaner assembly referring to section 6A.
7. Connect battery negative cable to battery.

THROTTLE POSITION SENSOR (TPS) FOR A/T MODEL

Inspection

1. Disconnect negative cable at battery.
2. Remove air cleaner assembly referring to section 6A.
3. Disconnect coupler from TPS.
4. Using ohmmeter, check resistance between terminals under each condition given in below table.

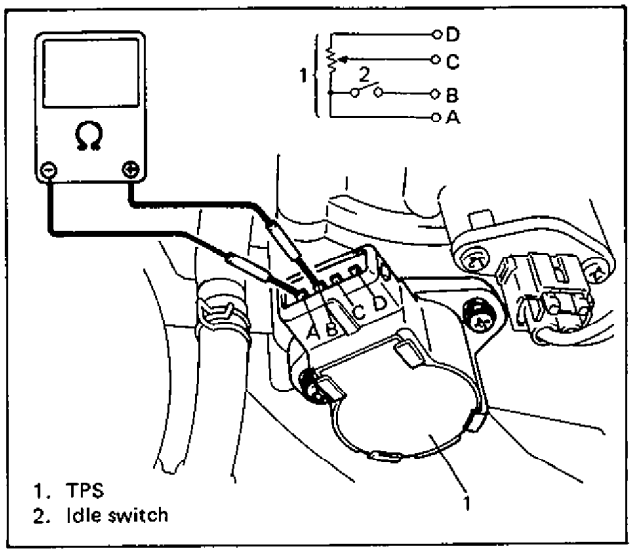


Fig. 6E-126 Checking TPS

TERMINALS	CONDITION	RESISTANCE
Between A and B terminals (Idle switch)	When throttle lever-to-stop screw clearance is 0.3 mm (0.012 in.)	0 – 5kΩ
	When throttle lever-to-stop screw clearance is 0.9 mm (0.035 in.)	∞
Between A and D terminals	———	4.37–8.13 kΩ
Between A and C terminals	Throttle valve is at idle position	0.20–11.42 kΩ
	Throttle valve is fully opened	3.03–17.08 kΩ
The resistance between A and C should increase as throttle valve opens larger.		

If idle switch check result is not satisfactory, adjust installation angle of TPS and if found defective in the other check, replace TPS.

5. Connect TPS coupler securely.
6. Install air cleaner assembly referring to section 6A.
7. Connect battery negative cable to battery.

Adjustment

1. Disconnect battery negative cable, remove air cleaner assembly and disconnect TPS coupler.
2. Insert 0.6 mm (0.024 in) thickness gauge between throttle stop screw and throttle lever.

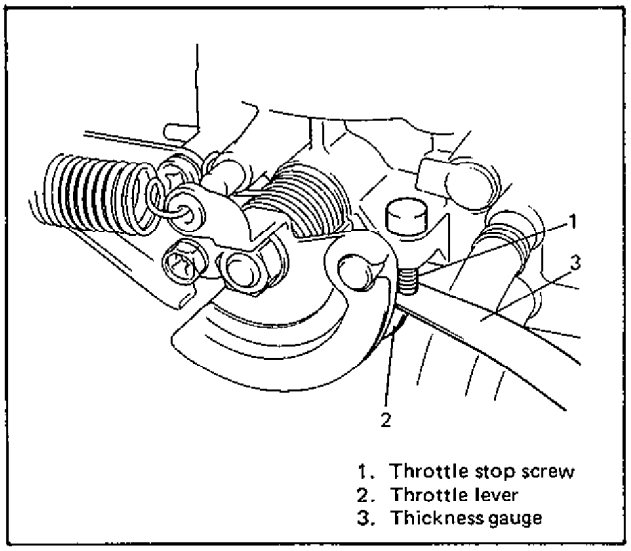


Fig. 6E-127 Inserting Thickness Gauge

3. Loosen TPS screws.
4. Connect ohmmeter between A and B terminals.
5. First, turn TPS counterclockwise fully and then clockwise gradually to find position where ohmmeter reading changes from 0 (zero, continuity) to ∞ (no continuity).
   Then fix TPS at that position by tightening screws to specified torque.

Tightening torque of TPS screw	N·m	kg-m	lb-ft
	1.6 – 2.4	0.16–0.24	1.2 – 1.7

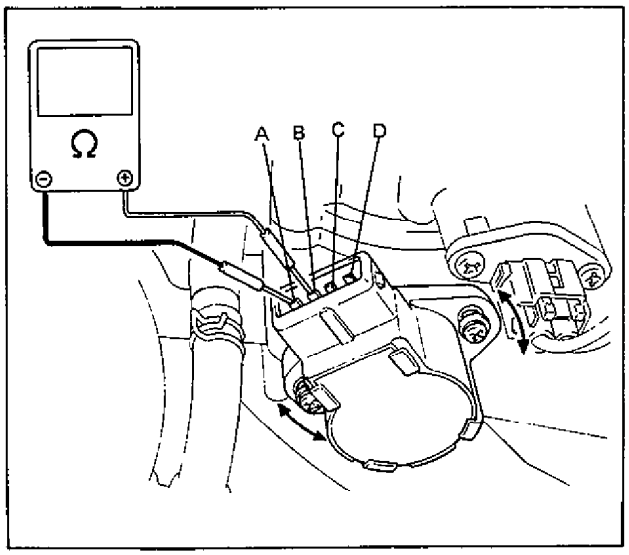


Fig. 6E-128 Adjusting Installation Angle

6. Check that there is no continuity between terminals A and B when 0.9 mm (0.035 in) thickness gauge is inserted.
7. Check that there is continuity between terminals A and B when 0.3 mm (0.012 in) thickness gauge is inserted.

   If check result is unsatisfactory in steps 6 and 7, it means that installation angle of TPS is not adjusted properly. Therefore, start all over again from step 1.

CAUTION:
As throttle stop screw is factory adjusted precisely, don't remove or adjust it.

8. Connect coupler to TPS securely, install air cleaner assembly and connect battery negative cable.

Removal

1. Disconnect battery negative cable at battery.
2. Remove air cleaner assembly referring to section 6A.
3. Disconnect coupler from TPS.
4. Remove TPS from throttle body.

Installation

1. Install TPS to throttle body.
   Fit TPS to throttle body in such way that its adjusting holes are a little away from TPS screw holes as shown in Fig. 6E-129 and turn TPS clockwise so that those holes align. Then hand-tighten TPS screws.

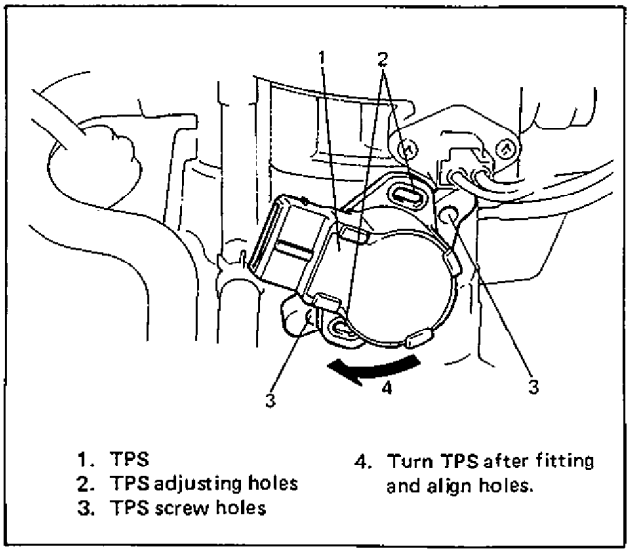


Fig. 6E-129 Installing TPS

2. Adjust installation angle of TPS according to procedure described in item "Adjustment".
3. Connect coupler to TPS securely.
4. Install air cleaner assembly referring to section 6A.
5. Connect battery negative cable to battery.

AIR TEMPERATURE SENSOR (ATS)

Removal

1. Disconnect battery negative cable at battery.
2. Disconnect coupler from ATS.
3. Remove ATS and gasket from air cleaner case.

Inspection

Immerse temperature sensing part of ATS 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-131, replace ATS.

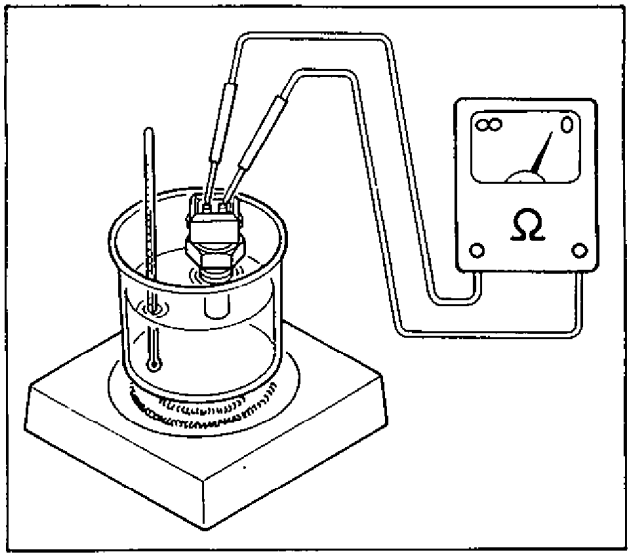


Fig. 6E-130 Checking ATS

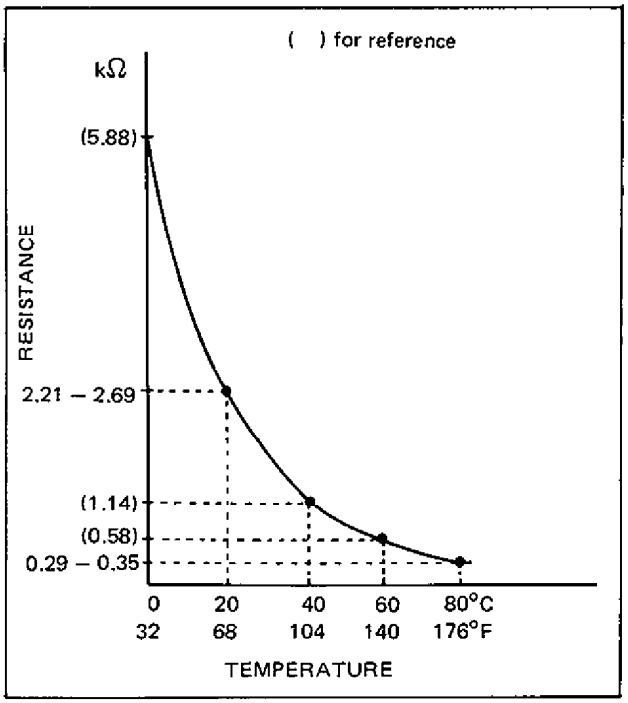


Fig. 6E-131 ATS and WTS Charactristic

Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of ATS and air cleaner case.
- Tighten ATS to specified torque.

Tightening torque for ATS	N·m	kg-m	lb-ft
	13 – 17	1.3 – 1.7	9.5 – 12.0

- Connect ATS coupler securely.

WATER TEMPERATURE SENSOR (WTS)

Removal

1. Disconnect battery negative cable at battery.
2. Remove air cleaner assembly referring to section 6A.
3. Remove radiator cap to relieve engine cooling water pressure and install it.

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.

4. Disconnect coupler from WTS.
5. Remove WTS and gasket from throttle body.

NOTE:
Cooling water, although small amount, may be released then. Cover WTS with shop cloth so that released water is absorbed on it.

Inspection

Check resistance of WTS variable with temperature by using the same checking method as ATS. For WTS characteristic, refer to Fig. 6E-131. If found defective, replace.

Installation

Reverse removal procedure noting the following.

- Clean mating surfaces of WTS and throttle body.
- Check gasket for damage and replace if necessary.
- Tighten WTS to specified torque.

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

- Connect coupler to WTS securely.

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 and release its wire harness from clamps.
3. Remove oxygen sensor from exhaust manifold.

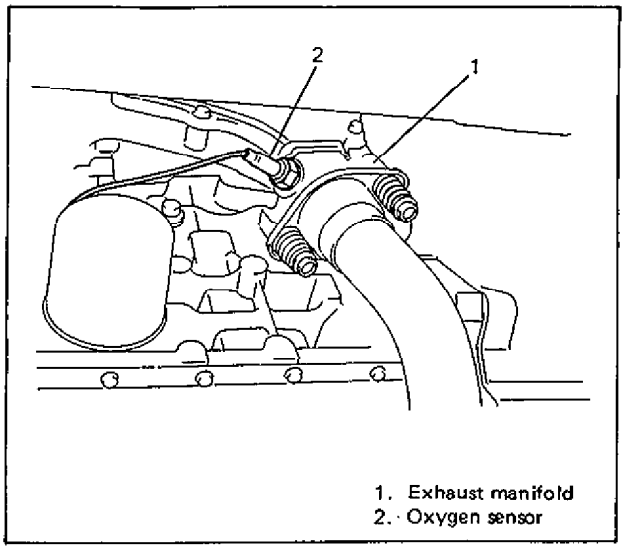


Fig. 6E-132 Removing Oxygen Sensor

Installtion

Reverse removal procedure noting the following.

- Tighten oxygen sensor to specified torque.

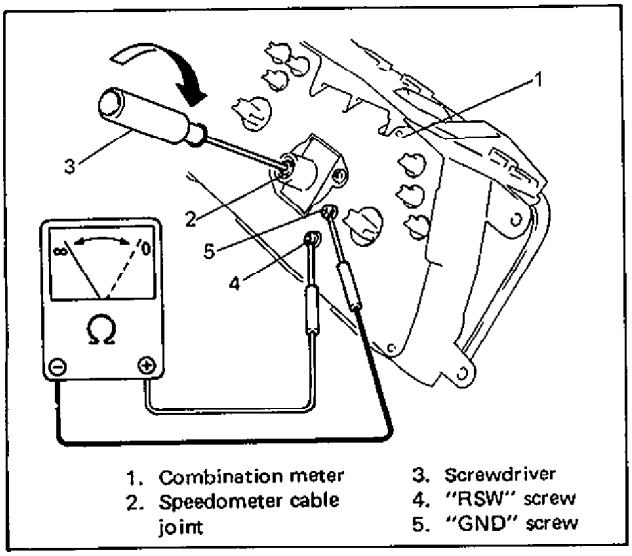
Tightening torque for oxygen sonsor	N·m	kg-m	lb-ft
	45 – 55	4.5 – 5.5	33.0 – 39.5

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

SPEED SENSOR

Inspection

1. Disconnect negative cable at battery.
2. Remove combination meter from instrument panel.
3. Connect ohmmeter between "GND" screw and "RSW" screw of combination meter and turn cable joint of speedometer with a screwdriver. Ohmmeter indicator should move back and forth between 0 (zero) and ∞ (infinity) 4 times while cable joint is turned one full revolution.



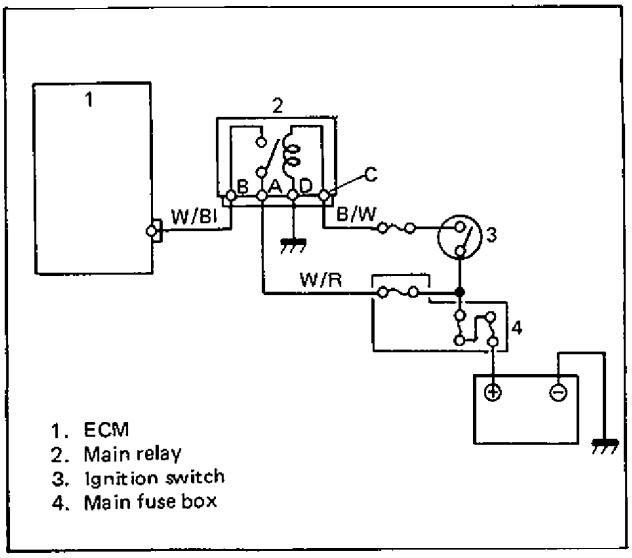
1. Combination meter
2. Speedometer cable joint
3. Screwdriver
4. "RSW" screw
5. "GND" screw

Fig. 6E-133 Checking Speed Sensor

Replace speedometer if check result is not satisfactory.

4. Install combination meter to instrument panel.
5. Connect negative cable to battery.

MAIN RELAY

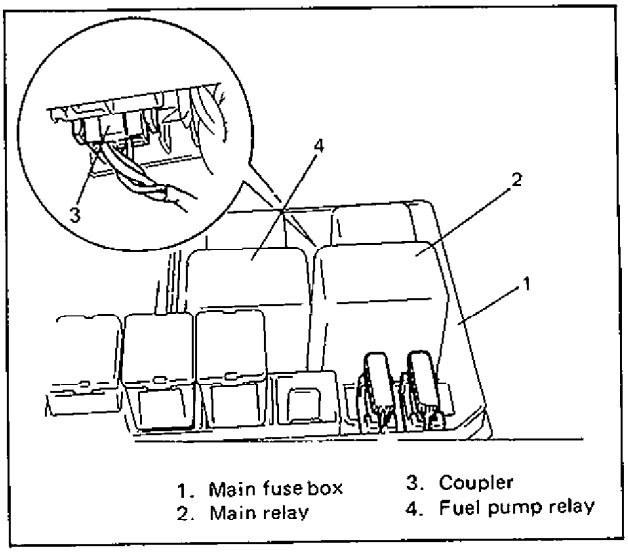


1. ECM
2. Main relay
3. Ignition switch
4. Main fuse box

Fig. 6E-134 Main Relay Circuit

Inspection

1. Disconnect negative cable at battery.
2. Remove main relay from main fuse box after disconnecting its coupler.



1. Main fuse box
2. Main relay
3. Coupler
4. Fuel pump relay

Fig. 6E-135 Removing Main Relay

3. Check resistance between each two terminals as in table below.
   If check results are as specified, proceed to next operation check. If not, replace.

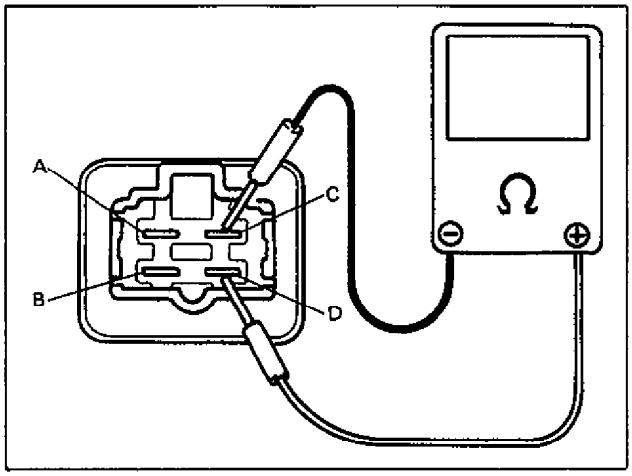


Fig. 6E-136 Checking Main Relay Resistance

TERMINALS	RESISTANCE
Between A and B	∞ (infinity)
Between C and D	56 – 84 Ω

4. Check that there is continuity between terminals "A" and "B" when battery is connected to terminals "C" and "D".

   If found defective, replace.

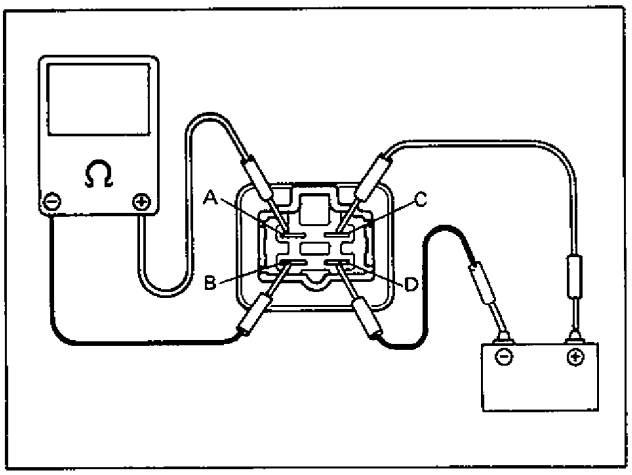


Fig. 6E-137 Checking Main Relay Operation

FUEL PUMP RELAY

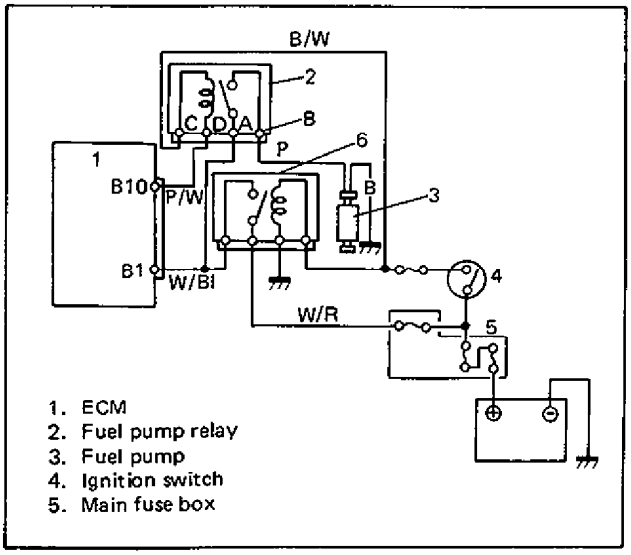


Fig. 6E-138 Fuel Pump Circuit

Inspection

1. Remove fuel pump relay in the same way as main relay.
2. Structure of fuel pump relay is the same as that of main relay. Check its resistance and operation using the same procedure as that for main relay.
   If found defective, replace.

FUEL INJECTOR RESISTOR

Inspection

1. With ignition switch OFF, disconnect resistor coupler.
2. Check resistor for resistance.

Resistance of fuel injector resistor	1.9 – 2.1 Ω

If check result is not satisfied, replace.

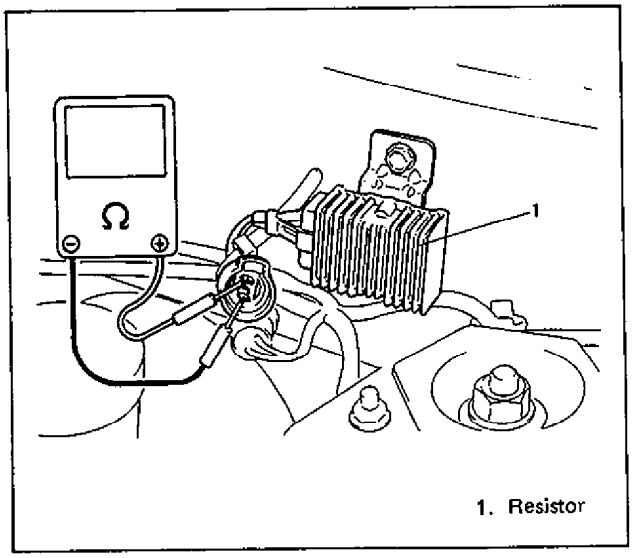


Fig. 6E-139 Checking Resistor

FUEL CUT OPERATION

Inspection

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range), A/C is OFF and that parking brake lever is pulled all the way up.

1. Warm up engine to normal operating temperature.
2. Remove rubber seal from TS or TPS.
3. Using service wire, connect "A" and "B" terminals (idle switch terminal) of coupler from wire side.

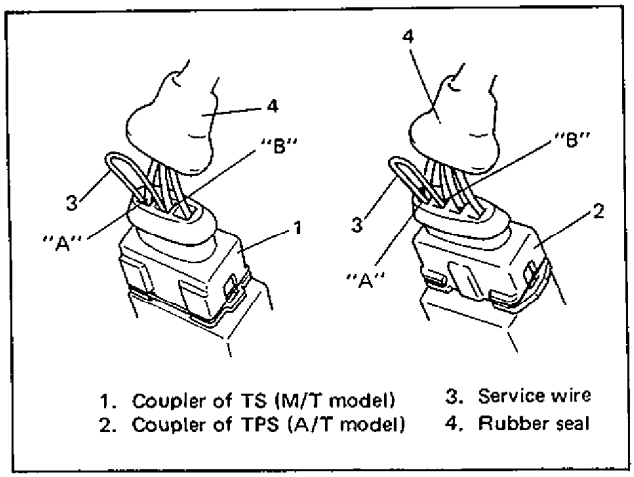


Fig. 6E-140 Short Idle Switch Circuit for Fuel Cut Inspection

4. Gradually raise engine speed. It should show variation (up and down) around 2,000 r/min.
5. After checking, disconnect service wire and install rubber seal to coupler.

ISC SOLENOID VALVE

Inspection

1. With ignition switch "OFF", disconnect ISC solenoid valve coupler.
2. Check resistance between each two terminals of ISC solenoid valve.

Resistance of ISC solenoid valve	30 – 33 Ω

If it is within specification, proceed to next operation check. If not, replace.

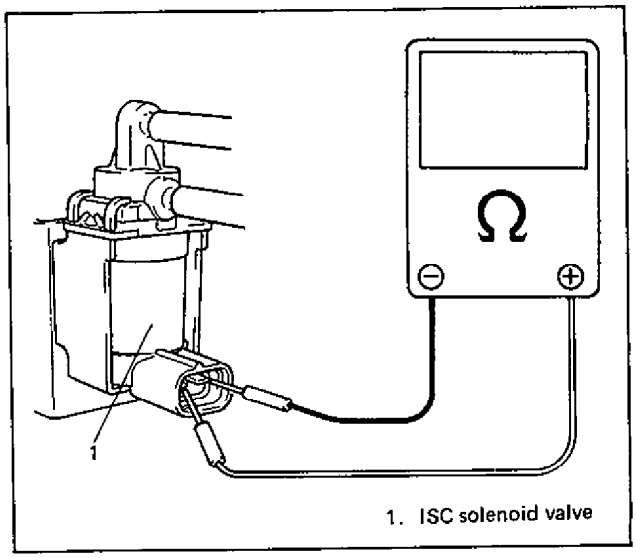


Fig. 6E-141 Checking Resistance

3. Warm up engine to normal operating temperature.
4. With engine running and ISC solenoid valve coupler disconnected, disconnect ISC solenoid valve hose of underside as shown below. In this state, check that air is not drawn into ISC solenoid valve.

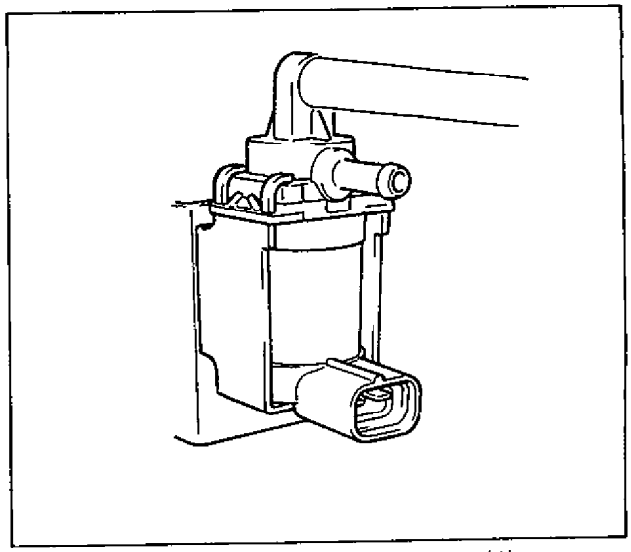


Fig. 6E-142 Checking ISC Solenoid Valve (1)

5. Under above condition, connect 12V-battery to ISC solenoid valve terminals and check that air is drawn into ISC solenoid valve.

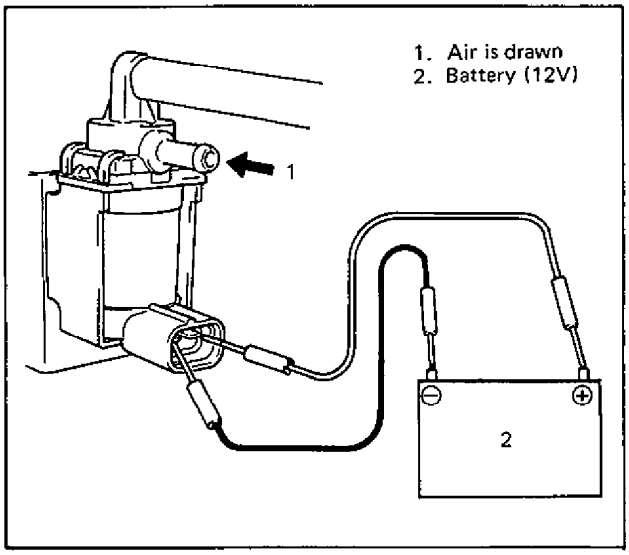


Fig. 6E-143 Checking ISC Solenoid Valve (2)

If check result is not satisfactory replace ISC solenoid valve.

6. Connect hose and coupler securely.

EGR CONTROL SYSTEM (For California spec. model only)

System Inspection

NOTE:

Before inspection, check to make sure that gear shift lever is in neutral position (with A/T model, selector lever in "P" range) and that parking brake lever is pulled all the way up.

1. When engine is cool (cooling water temperature is below 40°C, 104°F), start engine and race it, and check that EGR valve diaphragm is not operating in this state.

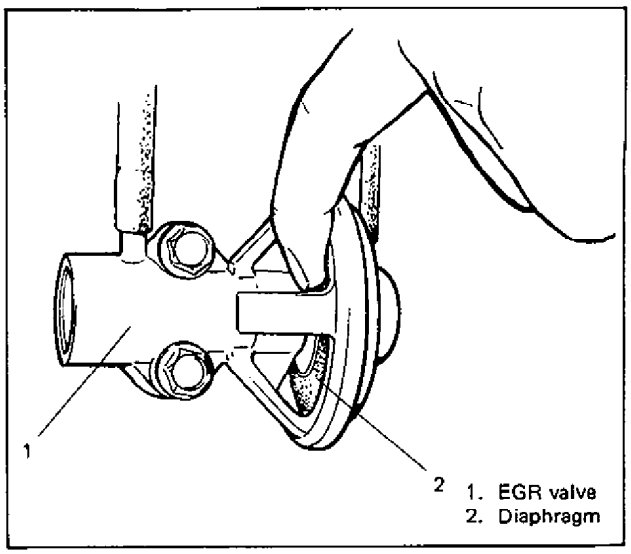


Fig. 6E-144 Checking EGR Valve Diaphragm

2. Warm up engine to normal operating temperature and race it after warming up. Then check to be sure that diaphragm moves toward 1 in Fig. 6E-145 during acceleration and toward 2 during deceleration.

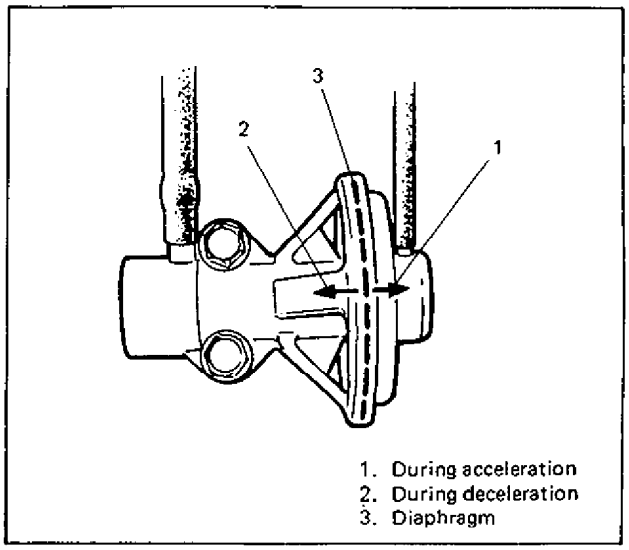


Fig. 6E-145 Movement of EGR Valve Diaphragm

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

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 Hose Inspection

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

EGR Valve Inspection

1. Disconnect vacuum hose from EGR modulator.
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 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.

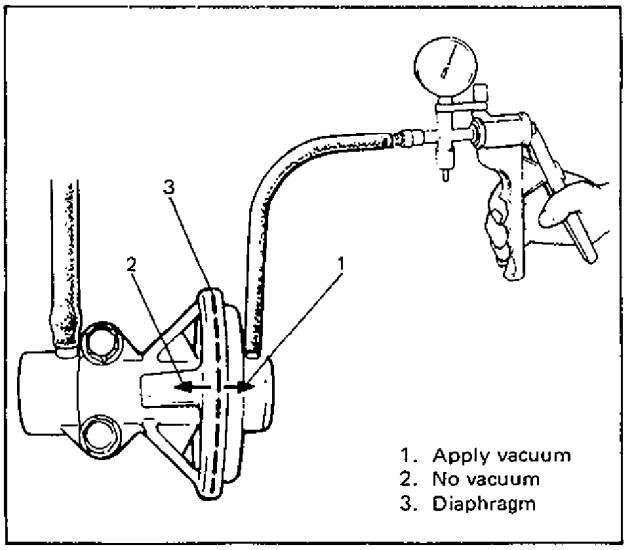


Fig. 6E-146 Checking EGR Valve

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

EGR Modulator Inspection

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

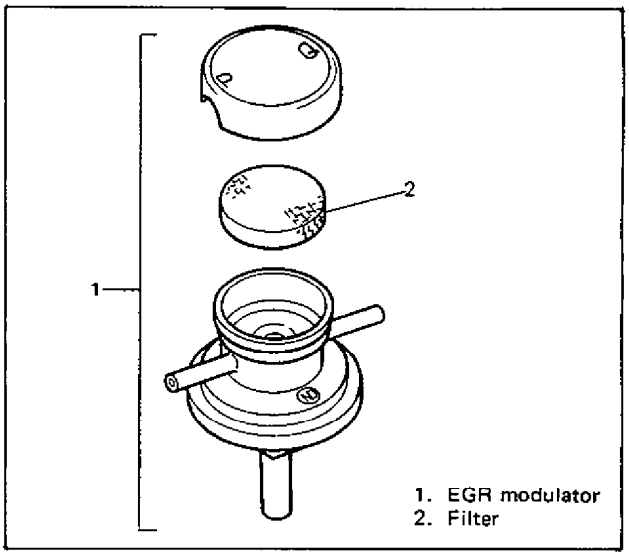


Fig. 6E-147 Filter of EGR Modulator

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

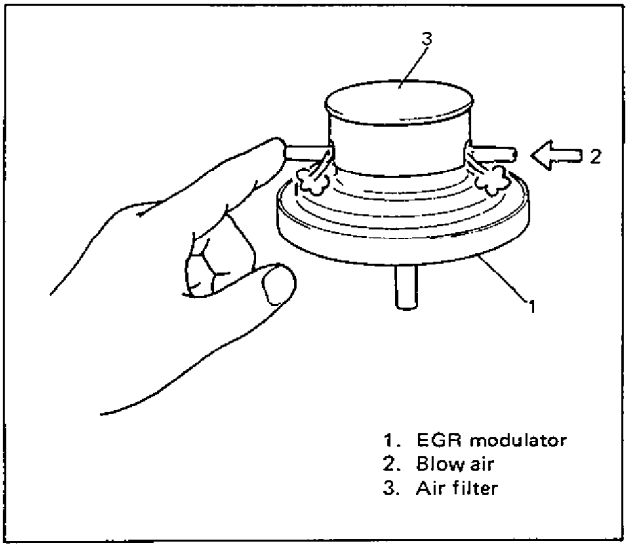


Fig. 6E-148 Checking EGR Modulator (1)

3. Connect vacuum pump gauge to nozzle "P" and plug nozzle "Q" with finger.
   While blowing air into nozzle "A", operate vacuum pump gauge and check that vacuum is applied to modulator.
   Then stop blowing nozzle "A" and check that vacuum pump gauge indicates "0" (zero).
   If check result is not satisfactory, replace EGR modulator.

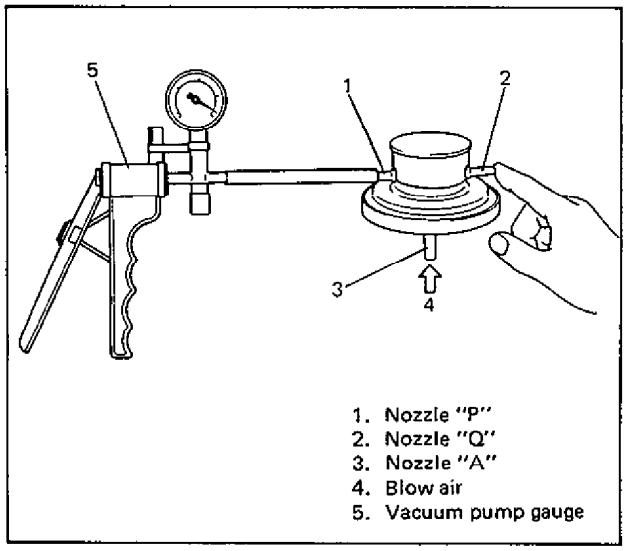


Fig. 6E-149 Checking EGR Modulator (2)

4. After checking, install modulator and connect hoses securely. Refer to emission control information label for connection.

VSV (Vacuum Switching Valve) Inspection

1. With ignition switch OFF, disconnect coupler from VSV.
2. Check resistance between two terminals of VSV.

Resistance of EGR VSV	33 – 39 Ω

If resistance is as specified, proceed to next operation check. If not, replace.

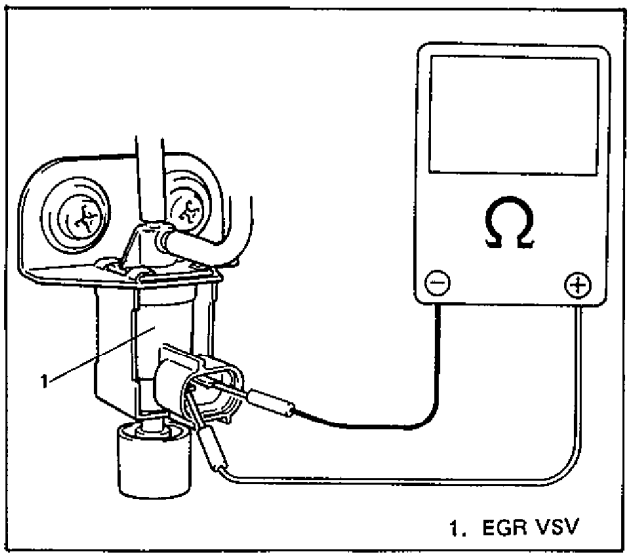


Fig. 6E-150 Checking Resistance

3. Disconnect vacuum hoses from EGR modulator and throttle body.
4. Blow into nozzle "A". Air should come out of filter and not out of nozzle "B".

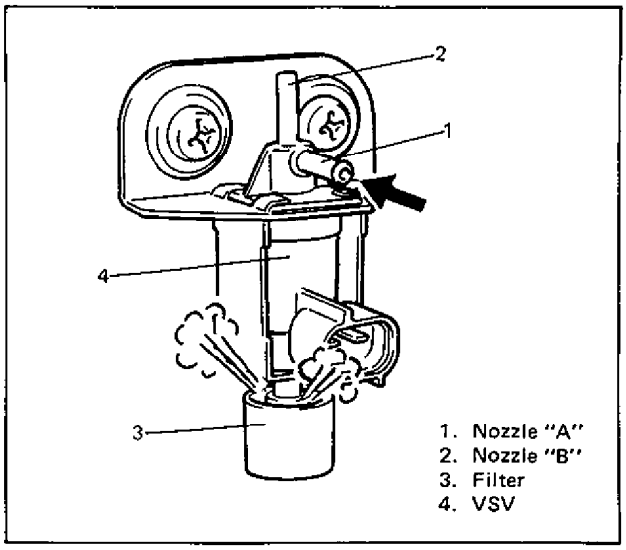


Fig. 6E-151 Checking VSV (1)

5. Connect 12V-battery to VSV terminals. In this state, blow nozzle "A".
   Air should come out of nozzle "B" and not out of filter.

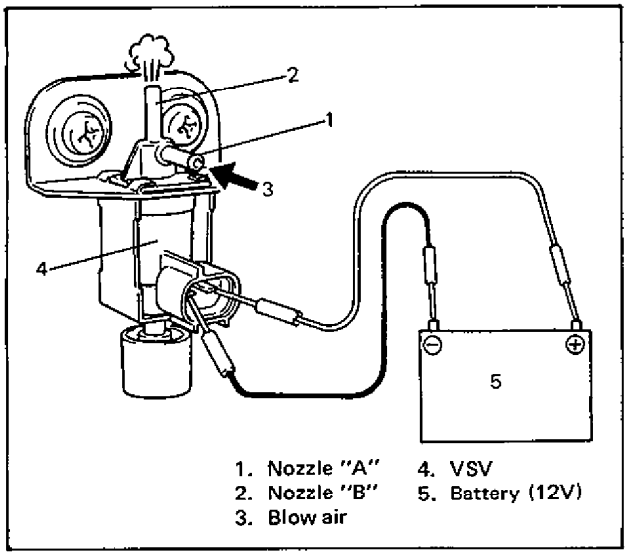


Fig. 6E-152 Checking VSV (2)

If check result is not as described above, replace VSV.

6. Connect VSV coupler securely.
7. Connect vacuum hose securely.

SHIFT-UP INDICATOR LIGHT CONTROL SYSTEM (If equipped)

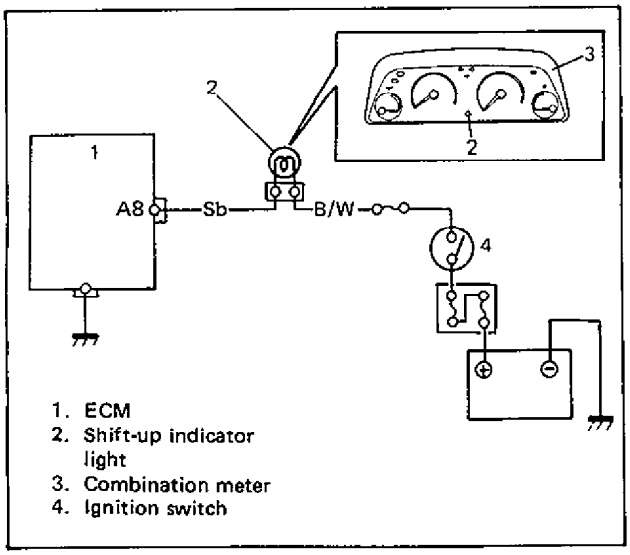


Fig. 6E-153 System Circuit

System Inspection

CAUTION:
This check requires test drive. Use special care for safety when driving.

1. Turn ignition switch ON, and shift-up indicator light should light.
   If not, cause may be burned bulb, open wire, poor connection or faulty ECM. Proceed to "Shift up indicator light and its circuit inspection".
2. Start engine, and shift-up indicator light should go off.
   If not, cause may be shorted wire to ground or faulty ECM.
3. Warm up engine to normal operating temperature.
4. With gear shift lever in low gear position, increase engine speed. When it exceeds 1,600 r/min. shift-up indicator light should light for 5 seconds at the longest.
   If it doesn't light, check speed sensor, WTS and pressure sensor. If they are all in good conditon, substitute a known good ECM for existing one.

Shift up Indicator Light and Its Circuit Inspection

1. With ignition switch OFF, disconnect ECM coupler from ECM.
2. Turn ignition switch ON, and shift-up indicator light should not light.
   If it light, wire is shorted to ground.
3. Ground A8 terminal of disconnected ECM coupler by using service wire.

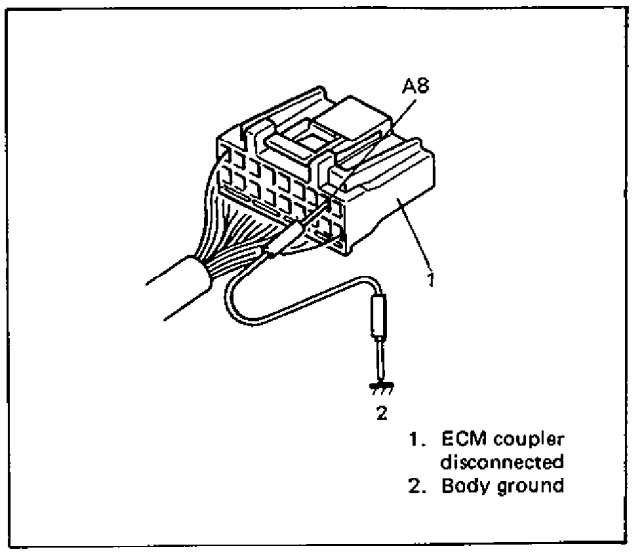


Fig. 6E-154 Checking Indicator Light

And then shift up indicator light should light. If not, cause may be burned bulb, open wire or poor connection. Repair or replace as necessary.

4. Connect coupler to ECM securely.

OUTPUT SIGNAL OF THROTTLE VALVE OPENING (A/T model only)

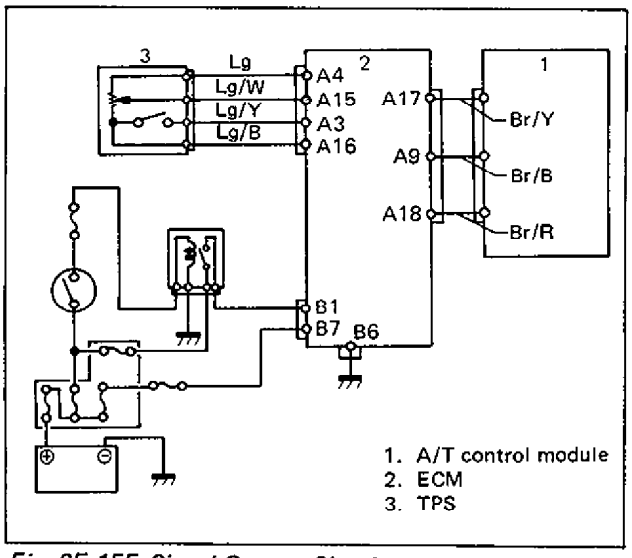


Fig. 6E-155 Signal Output Circuit

Inspection

1. Check voltage at each terminal for "Br/Y", "Br/B" and "Br/R" wires of A/T control module.

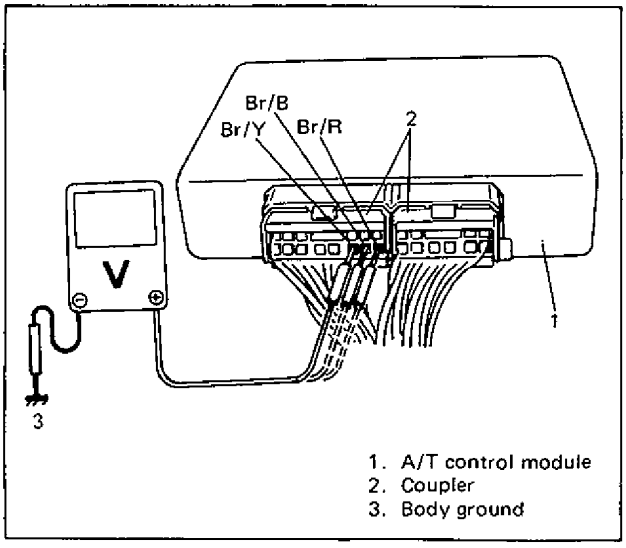


Fig. 6E-156 Checking Output Signal

Voltage at each terminal should vary as shown in following ON/OFF signal diagram.

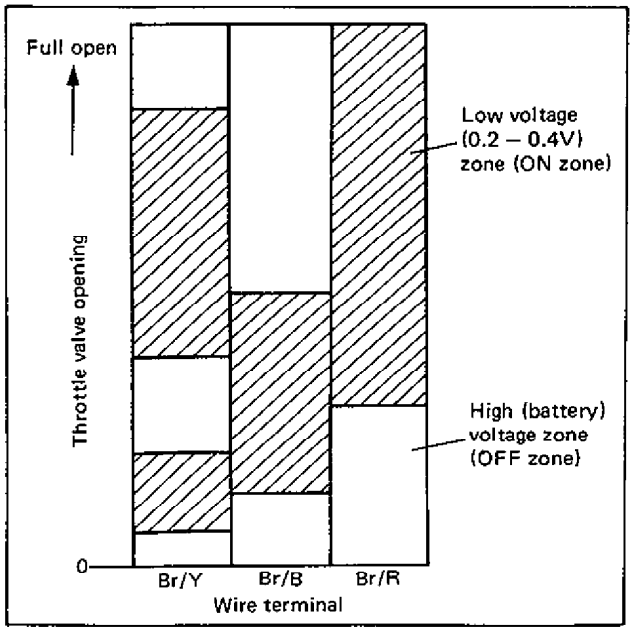
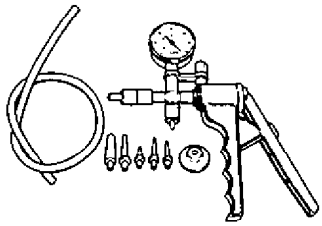


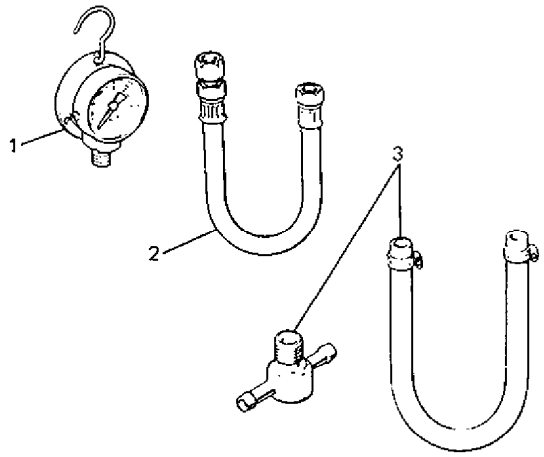
Fig. 6E-157 ON/OFF Siganl Diagram

If check result is not satisfactory, check each wire harness, circuit connections and TPS.

SPECIAL TOOLS



09917-47910
Vacuum pump gauge



1. Fuel pressure guage
   09912-58441
2. Pressure hose
   09912-58431
3. 3-way joint & hose
   09912-58490

RECOMMENDED TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Throttle body mounting bolt and nut	18 – 28	1.8 – 2.8	13.5 – 20.0
Throttle upper and lower body screw	2.9 – 4.1	0.29 – 0.41	2.1 – 2.9
Fuel injector sub wire coupler screw	1.6 – 2.4	0.16 – 0.24	1.2 – 1.7
Fuel injector cover screw	2.9 – 4.1	0.29 – 0.41	2.1 – 2.9
TS or TPS mounting screw	1.6 – 2.4	0.16 – 0.24	1.2 – 1.7
ATS	13 – 17	1.3 – 1.7	9.5 – 12.0
WTS	20 – 30	2.0 – 3.0	14.5 – 21.5
Oxygen sensor	45 – 55	4.5 – 5.5	33.0 – 39.5

SECTION 6F

IGNITION SYSTEM

CONTENTS

GENERAL DESCRIPTION

This car uses solid state ignition system.

The basic components of the ignition system are ignition coil, distributor and spark plugs and those of the distributor are signal generator (signal rotor and pickup coil), igniter, rotor, cap, vacuum advancer and centrifugal advancer.

When the distributor shaft rotates, the magnetic flux passing through the pickup coil varies due to the change in air gap between the pickup coil and the signal rotor. As a result, the alternating current voltage is induced in the pickup coil.

The voltage induced, turns on and off the igniter which switches off the ignition coil primary current. Thus, the high voltage is induced in the secondary winding of ignition coil and ignition sparks are generated at the spark plugs.

The spark advance is produced by the vacuum advancer which operates based on the engine vacuum and centrifugal advancer.

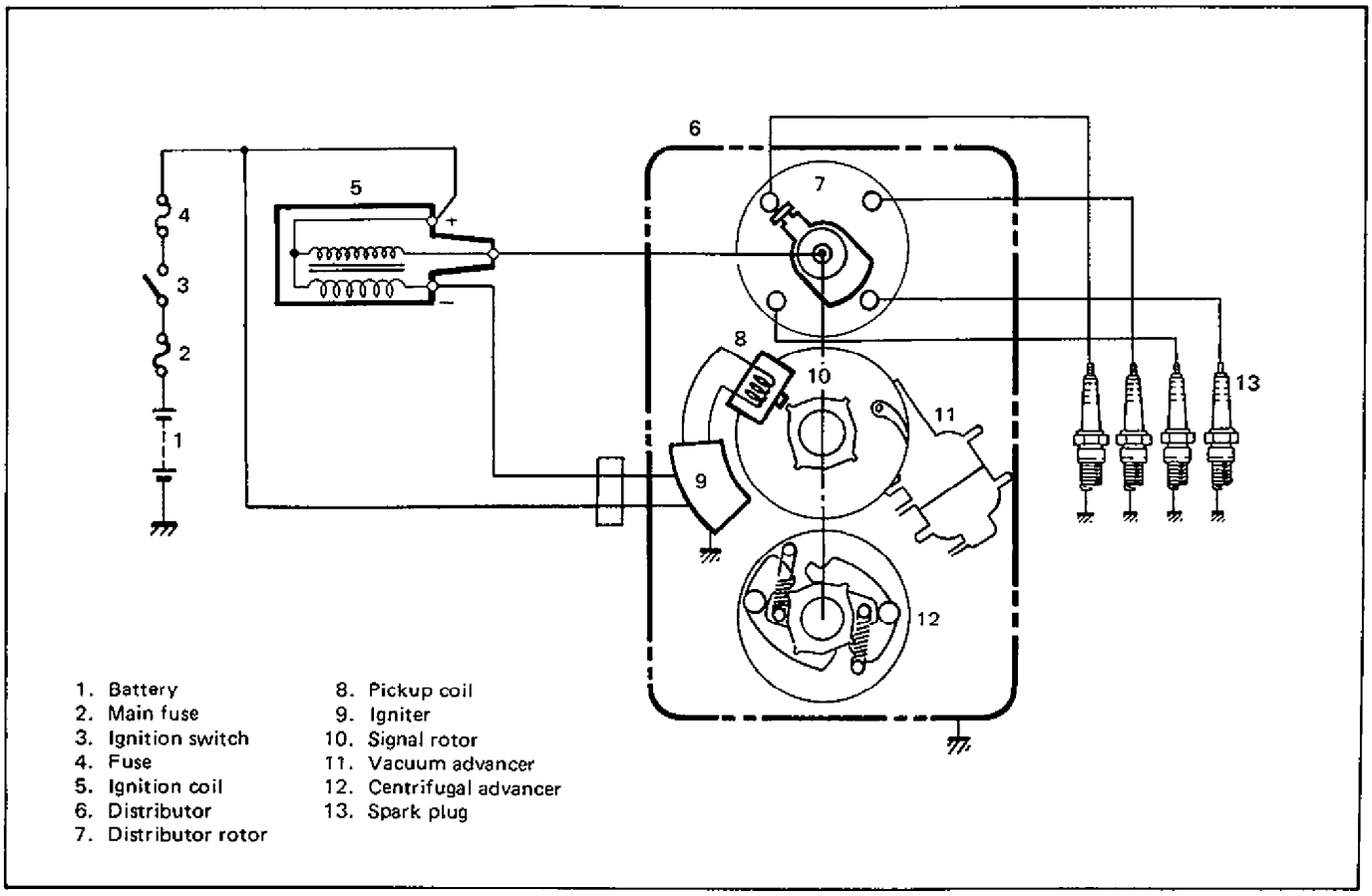
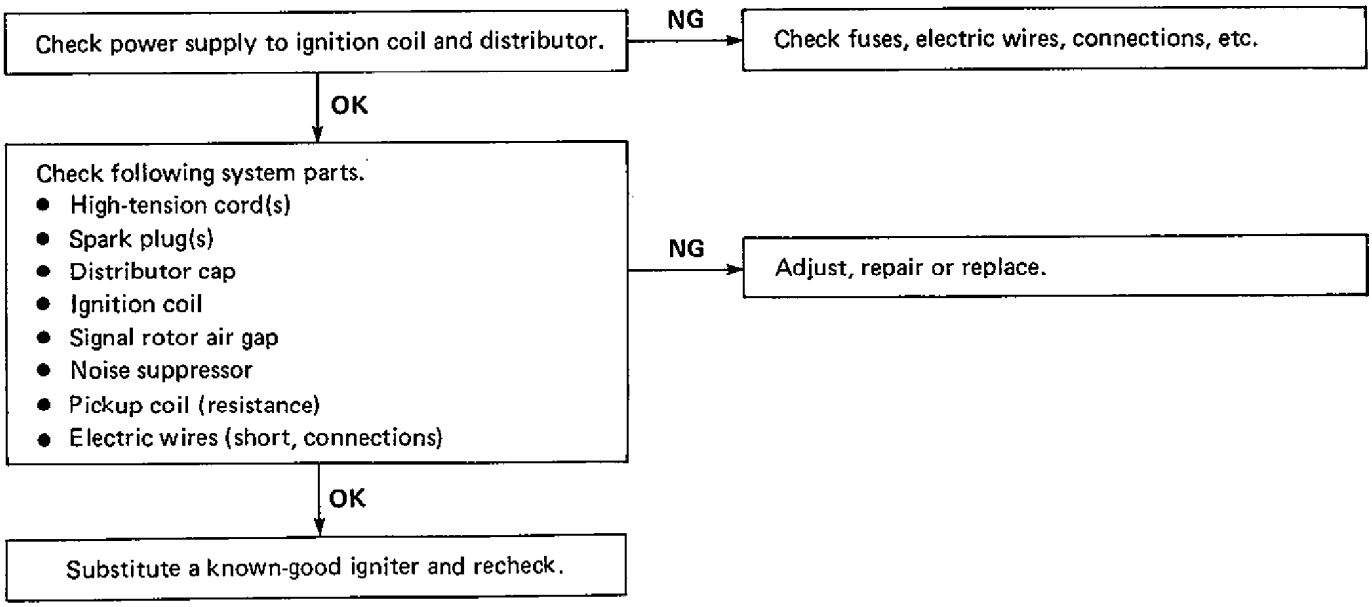


Fig. 6F-1 Ignition Circuit Diagram

DIAGNOSIS

Condition	Possible cause	Correction
Engine cranks, but will not start or hard to start	**No spark**	
	• Blown fuse for ignition coil	Replace
	• Loose connection or disconnection of lead wires or high-tension cord(s)	Connect securely
	• Faulty high-tension cord(s)	Replace
	• Faulty spark plug(s)	Adjust, clean or replace
	• Cracked rotor or cap	Replace
	• Maladjusted signal rotor air gap	Adjust
	• Faulty ignition coil	Replace
	• Faulty noise suppressor(s)	Replace
	• Faulty pickup coil or igniter	Replace
	Maladjusted ignition timing	Adjust
Poor fuel economy or engine performance	• Incorrect ignition timing	Adjust
	• Faulty spark plug(s)	Adjust, clean or replace

DIAGNOSTIC FLOW CHART (NO SPARK)



ON-CAR SERVICE

SPARK TEST

1. Disconnect injector coupler at throttle body side.

WARNING:
Without disconnection of injector coupler, combustible gas may come out from spark plug holes during this test and may get ignited in engine room.

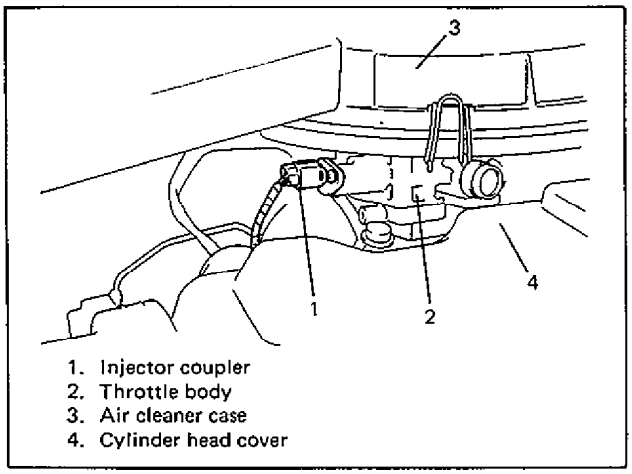


Fig. 6F-2 Disconnecting Injector Coupler

2. Remove spark plugs and connect them to high tension cords, and then ground spark plugs.
3. Depress clutch pedal fully, crank engine and check if each spark plug sparks.
4. If no spark, inspect high tension cords, spark plugs, ignition coil, distributor, etc..

POWER SUPPLY CHECK

For ignition coil

1. Remove ignition coil cap and check to make sure that coil terminals have battery voltage with ignition switch on.
2. If no voltage or low voltage is found, check fuse, couplers and wiring harness.

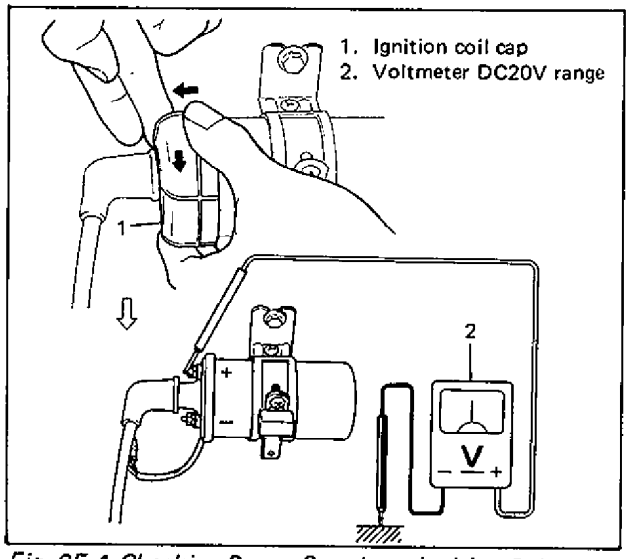


Fig. 6F-4 Checking Power Supply to Ignition Coil

For distributor

1. Disconnect distributor lead coupler, turn on ignition switch and check to make sure that coupler terminals have battery voltage.
2. If no voltage or low voltage is found, check wiring harness and coupler.

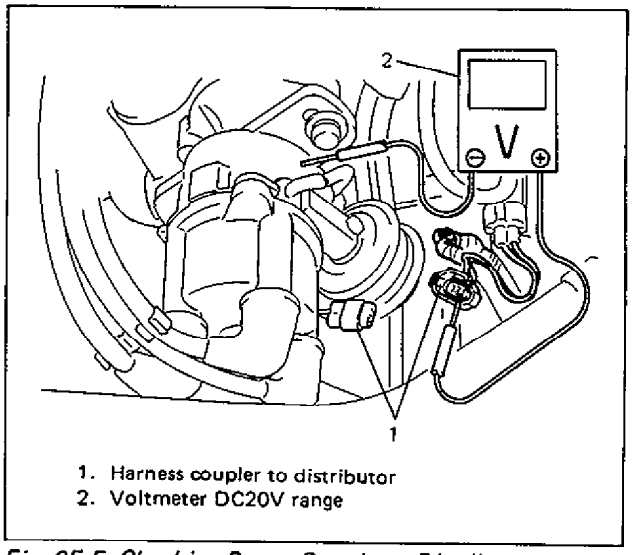


Fig. 6F-5 Checking Power Supply to Distributor

HIGH TENSION CORDS

1. Remove high tension cord at ignition coil while gripping its cap.
2. Remove distributor cap installed with high tension cords.
3. Remove high tension cord clamps from cylinder head cover.
4. Pull out high tension cords from spark plugs while gripping each cap.

CAUTION:
- **Removal of high tension cords together with clamps will be recommended so as not to damage their inside wire (resistive conductor).**
- **For the same reason, pull out each connection by gripping cap portion.**

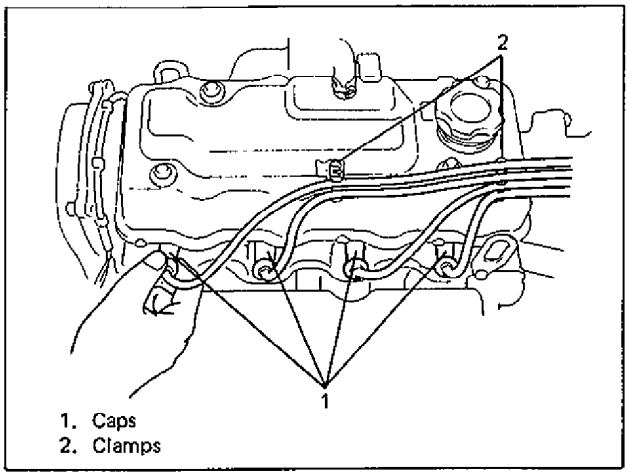


Fig. 6F-6 Removing High Tension Cord

5. Measure resistance of high tension cord by using ohmmeter.

High tension cord resistance	10 – 22 kΩ/m (3 – 6.7 kΩ/ft)

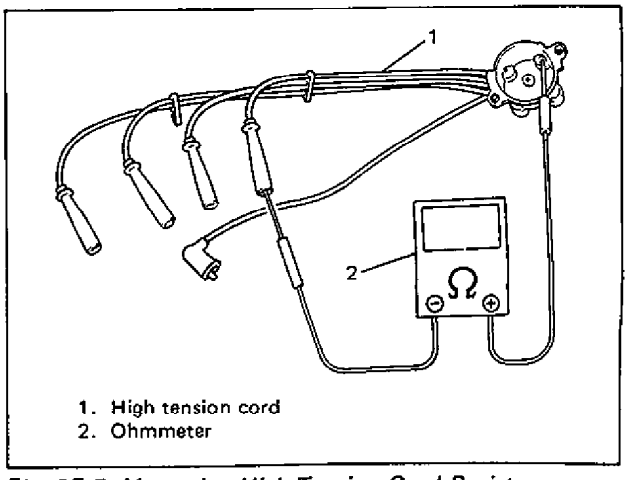


Fig. 6F-7 Measuring High Tension Cord Resistance

6. If resistance exceeds specification, inspect distributor cap terminals and replace high tension cord(s) and/or distributor cap as required.

CAUTION:
- **Never attempt to use metal conductor high tension cords as replacing parts.**
- **Insert each cap portion fully when installing high tension cords.**

SPARK PLUGS

1. Pull out high tension cords by gripping their caps and then remove spark plugs.
2. Inspect them for:
   - Electrode wear
   - Carbon deposits
   - Insulator damage
3. If any abnormality is found, adjust air gap, clean with spark plug cleaner or replace them with specified new plugs.

Spark plug type	NGK	BPR6ES
	NIPPON DENSO	W20EPR-U
Air gap A	0.7 – 0.8 mm (0.028 – 0.031 in.)	

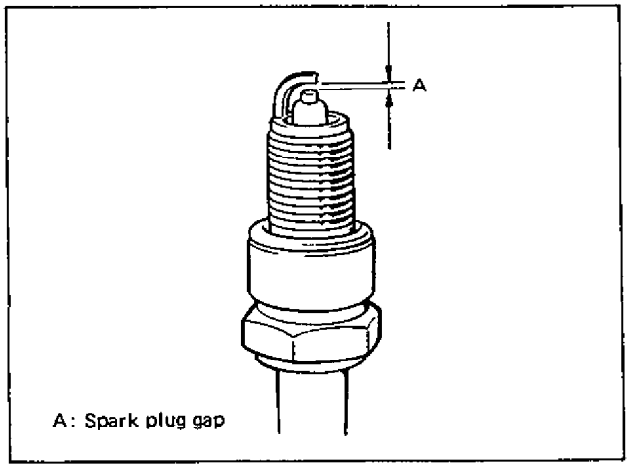


Fig. 6F-8 Checking Spark Plug Gap

4. Install spark plugs and torque them to specification.

Spark plug tightening torque	N-m	kg-m	lb-ft
	25 – 30	2.5 – 3.0	18.0 – 21.5

5. Install high tension cords securely by gripping their caps.

IGNITION COIL

1. Remove ignition coil cap.
2. Pull out high tension cord by gripping its cap.
3. Disconnect ignition coil lead coupler.
4. Measure primary and secondary coil resistances.

Ignition coil resistance (at 20°C, 68°F)	Primary	1.12 – 1.38 Ω
	Secondary	11.4 – 15.6 kΩ

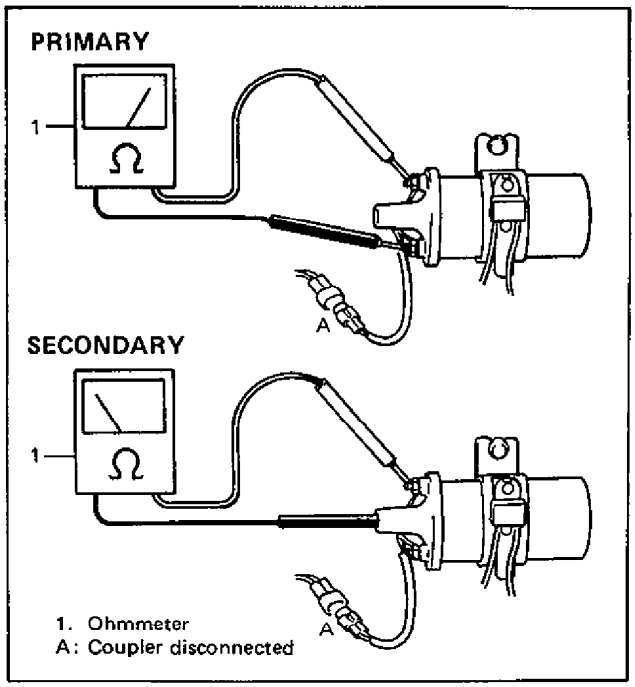


Fig. 6F-9 Measuring Ignition Coil Resistance

5. If resistance is out of specification, replace coil with new one.

NOISE SUPPRESSOR

1. Disconnect coupler of noise suppressor.
2. Using ohmmeter, check to be sure that condenser is not conductive and resister has resistance of about 2.2 kΩ.
3. If check result is not satisfactory, replace noise suppressor.

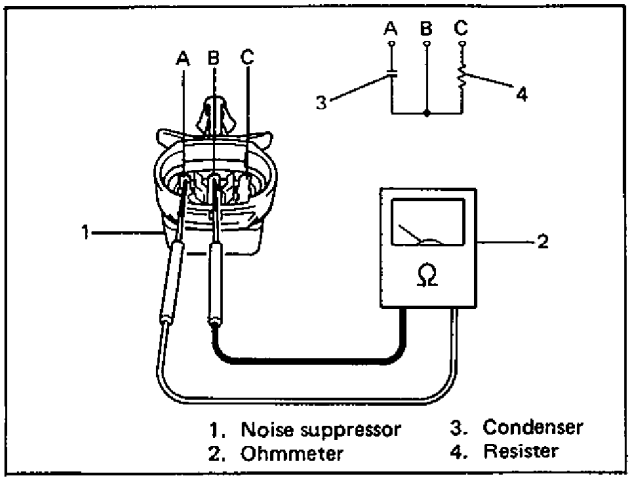


Fig. 6F-10 Checking Noise Suppressor

DISTRIBUTOR

Distributor Cap and Rotor

Check cap and rotor for crack and their terminals for corrosion and wear. Replace as necessary.

Signal Rotor Air Gap

1. Remove distributor cap and rotor.
2. Using thickness gauge, measure air gap, between signal rotor tooth and pickup coil.

Signal rotor air gap	0.2 – 0.4 mm (0.008 – 0.016 in.)

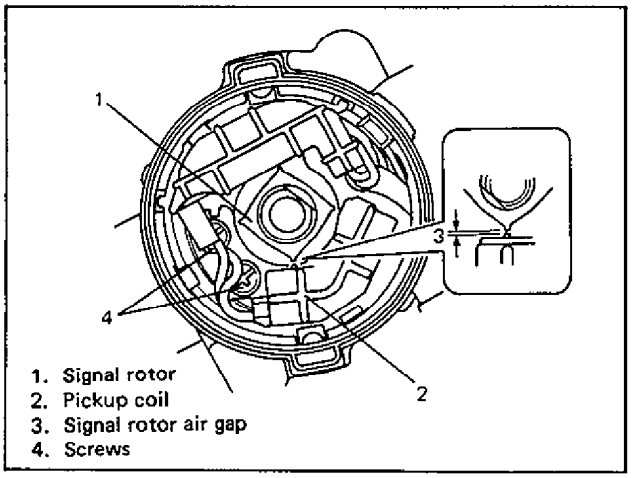


Fig. 6F-11 Checking Air Gap

3. If gap is out of specification, remove igniter and loose pickup coil securing screws.
   Using blade (–) screw driver, move pickup coil and adjust gap to specification.
   After adjustment, tighten securing screws and recheck gap.

NOTE:
Check to make sure that pickup coil tooth is free from any metal particles.

4. Install ignitor, rotor and distributor cap.

Centrifugal Advancer

1. Remove distributor cap.
2. Turn rotor counterclockwise by using fingers and release it. Rotor should return clockwise smoothly by spring force.
3. Also check if shaft is excessively loose.
4. Replace distributor housing assembly if any abnormality is found.

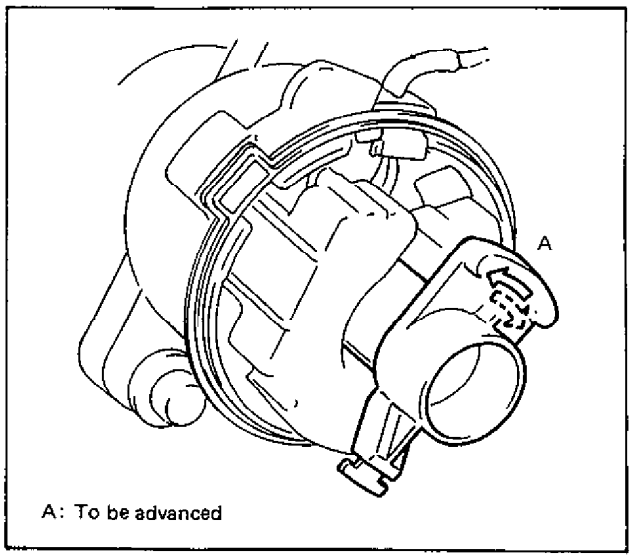


Fig. 6F-12 Checking Centrifugal Advancer

Vacuum Advancer

1. Remove distributor cap.
2. Disconnect vacuum hoses and connect vacuum pump gauge to outside diaphragm.
3. Apply about 400 mmHg (15 inHg) vacuum and release it, then check to make sure that pick up coil moves with base plate smoothly.
4. Repeat same procedure to inside diaphragm.
5. If any abnormality is found, replace vacuum controller or distributor housing assembly.

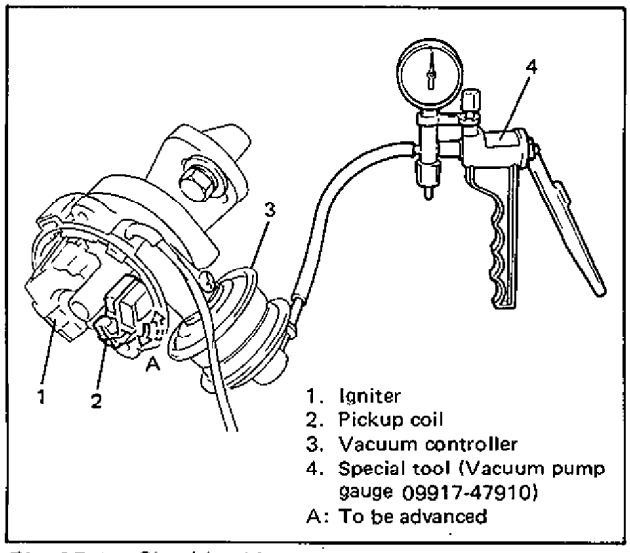


Fig. 6F-14 Checking Vacuum Advancer

IGNITION TIMING

INSPECTION AND ADJUSTMENT

NOTE:
Before starting engine, place transmission gear shift lever in "Neutral" (shift selector lever to "P" range for A/T model), and set parking brake and block drive wheels.

1. Start engine and warm it up to normal operating temperature.
2. Make sure that all of electrical loads except ignition are switched off.
3. Check to be sure that idle speed is within specification.
4. Set timing light to No. 1 high tension cord.
5. Disconnect vacuum hose at gas filter on intake manifold and plug gas filter.

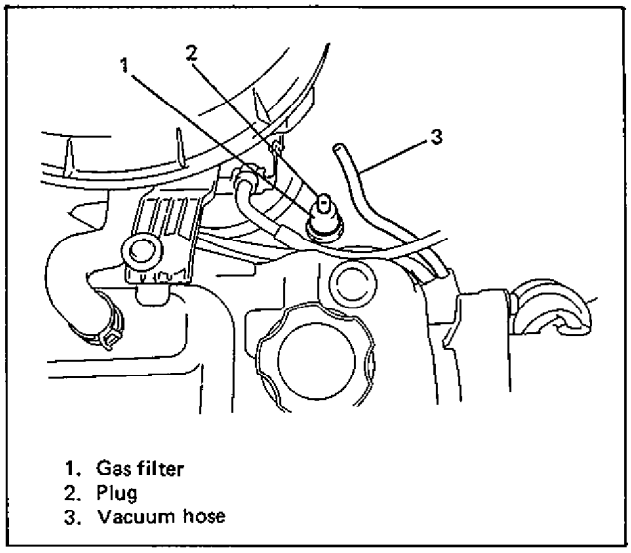


Fig. 6F-14 Plugging Gas Filter

6. Using timing light, check that initial ignition timing is within specification.

IGNITION TIMING SPECIFICATION			
Model	Idle speed	Initial (Vacuum disconnected)	Advanced (Vacuum connected)
M/T	650 ± 50 r/min	6 ± 1° BTDC	12 ± 1° BTDC
A/T	750 ± 50 r/min		

Ignition order	1–3–4–2

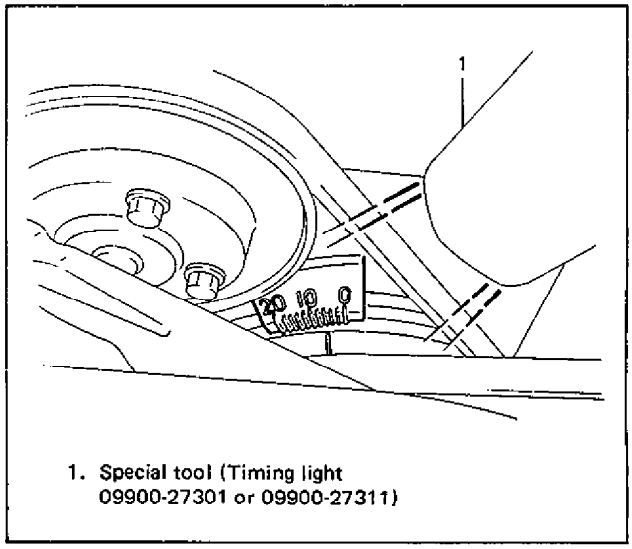
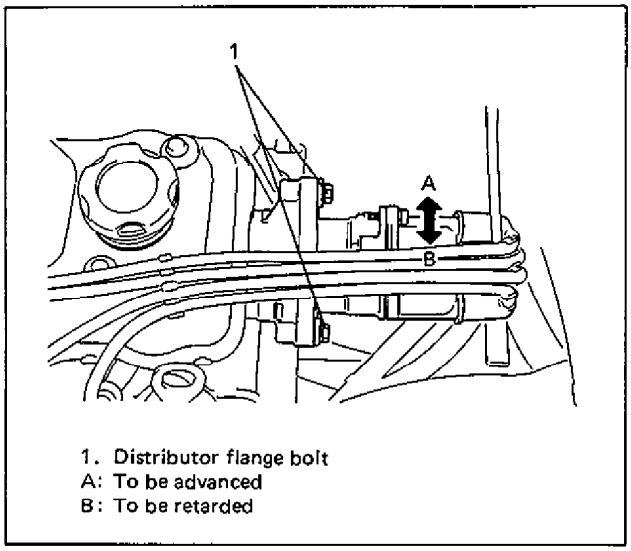


Fig. 6F-15 Checking Ignition Timing

7. If ignition timing is out of specification, loosen flange bolts, adjust timing by turning distributor assembly while engine is running, and then tighten bolts.

Tightening torque for distributor flange bolts	N·m	kg-m	lb-ft
	10 – 16	1.0 – 1.6	7.0 – 11.5

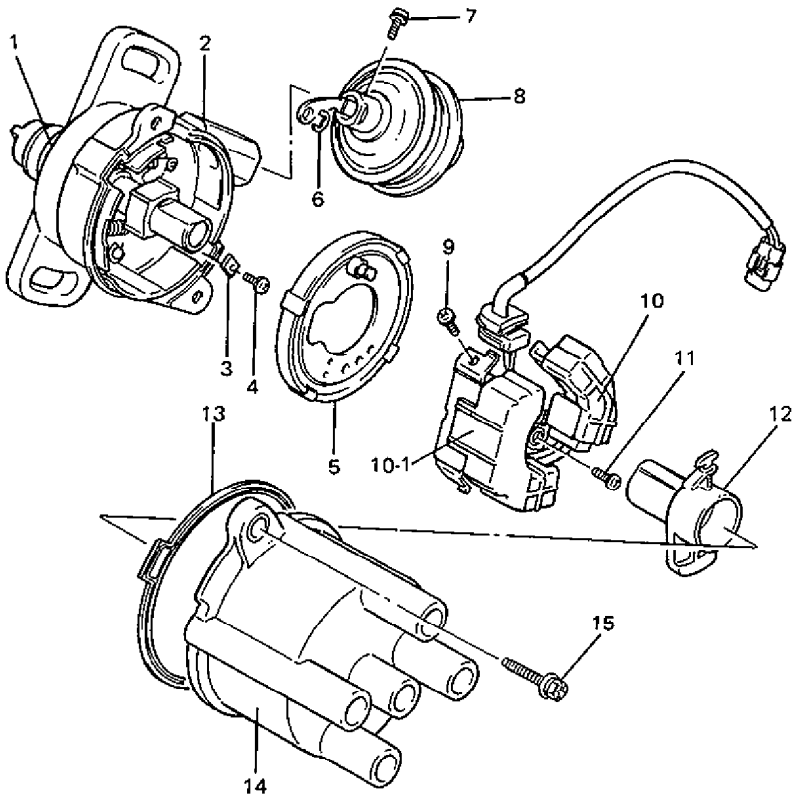


1. Distributor flange bolt
A: To be advanced
B: To be retarded

Fig. 6F-16 Adjusting Ignition Timing

8. After tightening distributor flange bolts, recheck that ignition timing is within specification.
9. Connect vacuum hose as it was and make sure that advanced timing is within specification.

DISTRIBUTOR UNIT



1. O ring
2. Housing with centrifugal advancer
3. Base plate washer
4. Screw
5. Base plate
6. E ring
7. Controller screw
8. Vacuum controller
9. Igniter screw
10. Pickup coil
10-1. Igniter
11. Pickup coil screw
12. Rotor
13. Cap seal
14. Cap
15. Cap screw

Fig. 6F-17 Distributor Components

REMOVAL

1. Disconnect negative cable at battery.
2. Disconnect distributor lead coupler.
3. Disconnect vacuum hoses at vacuum controller.
4. Remove distributor cap screws and cap.
5. Remove distributor flange bolts.
6. Pull out distributor housing assembly.

DISASSEMBLY

1. Remove distributor cap, if it has been dismounted assembled with housing.
2. Remove rotor and cap seal.
3. Remove igniter fastening screws and take out igniter.

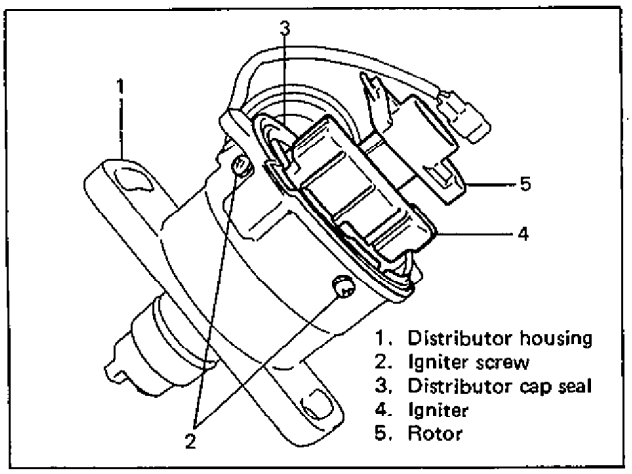


Fig. 6F-18 Removing Igniter

4. Remove pickup coil screws and then take out pickup coil together with igniter.
5. Remove E ring and screw and then pull out vacuum controller.

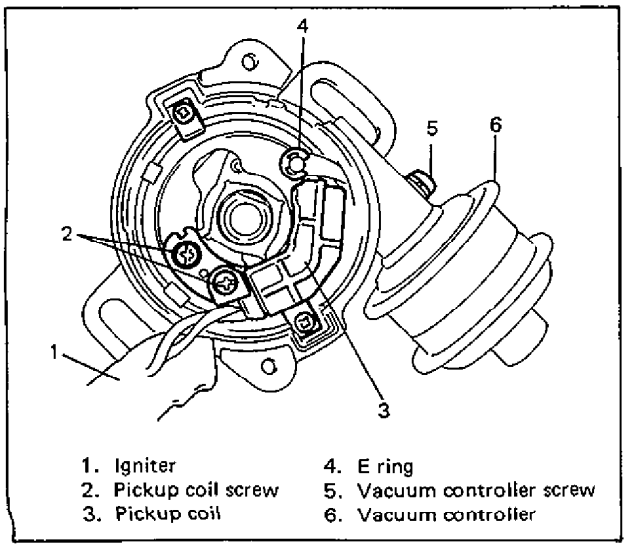


Fig. 6F-19 Removing Pickup Coil

6. If necessary, remove base plate screws with washers and then take out base plate assembly.

NOTE:
Base plate clips have specific location for housing grooves.

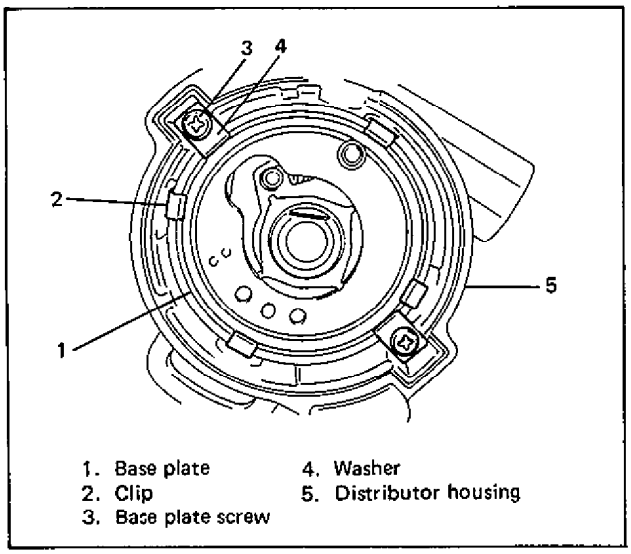


Fig. 6F-20 Removing Base Plate

INSPECTION

Centrifugal Advancer

1. Check advancer for rust or abnormal wear.
2. Check shaft for looseness by turning it by hand.
3. If any abnormality is found in the above inspection, replace as housing assembly.

NOTE:
If rust is found in housing inner parts, check breather holes in housing and distributor cap.

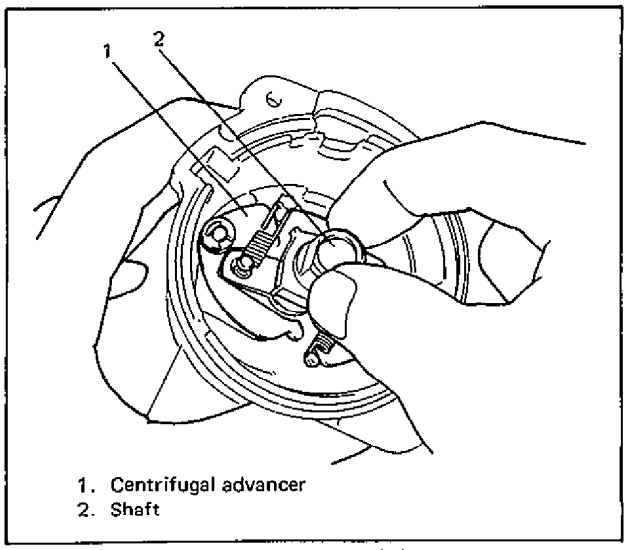


Fig. 6F-21 Checking Centrifugal Advancer

Base Plate

Check plate bearing for smooth rotation. If any abnormality is found, replace it as housing assembly. Do not wash or disassemble it.

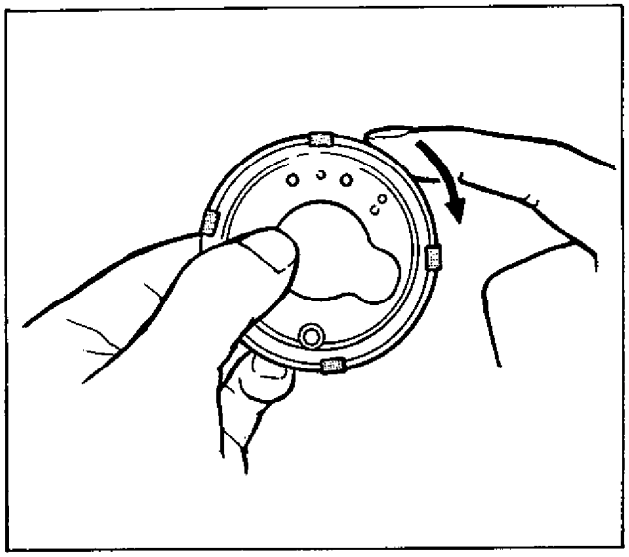


Fig. 6F-22 Checking Base Plate

Pickup Coil (Signal Generator)

1. Remove dust cover from igniter.
2. Disconnect red and white wires from igniter.

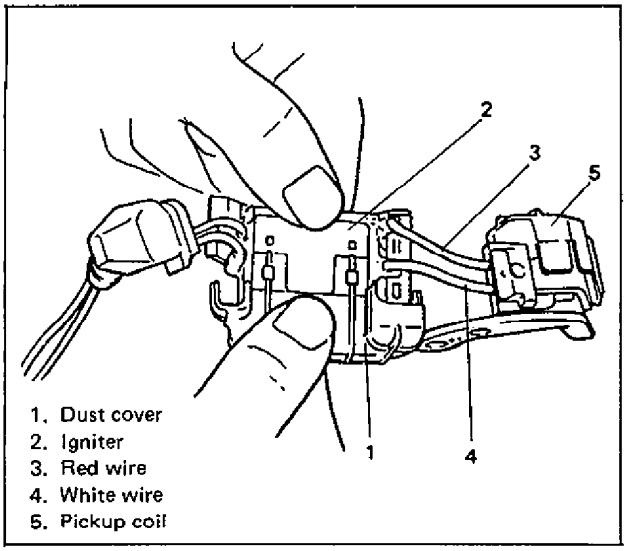


Fig. 6F-22-1 Dust Cover and Red and White Wires

3. Connect an ohmmeter to red and white wires, and measure pickup coil resistance.
   The pickup coil resistance should be within 130–190 homs. If the resistance is not within specification, replace pickup coil.

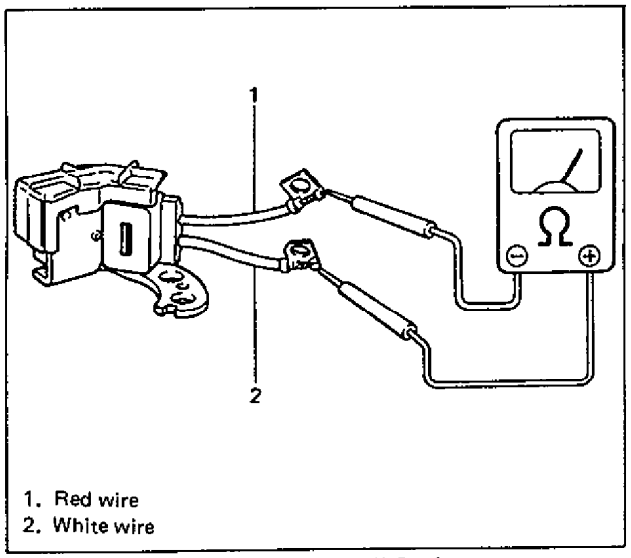


Fig. 6F-22-2 Measuring Pickup coil Resistance

4. After checking, connect the red and white wires to igniter as shown in Fig. 6F-22-3, and then install dust cover.

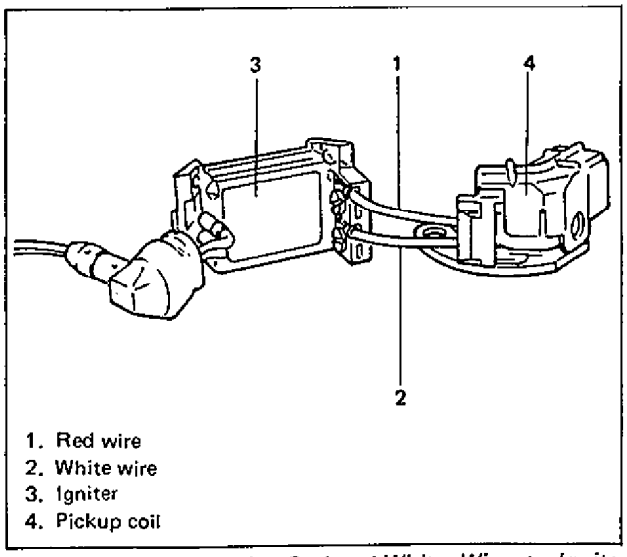


Fig. 6F-22-3 Connecting Red and White Wires to Igniter

REASSEMBLY

Judging from faulty conditions noted before disassembly and what is found through inspection after disassembly, prepare replacing parts and reassemble distributor by reversing removal procedure, noting the following points.

- Align base plate clips with housing grooves when installing.
- When installing pickup coil, use screws with lock washer and washer.
- Adjust signal rotor air gap to specification as previously outlined.
- After tightening pickup coil screws, recheck base plate for smooth rotation by pushing pickup coil cover with finger and releasing it.
- Check to make sure that pickup coil tooth is free from any metal particles.

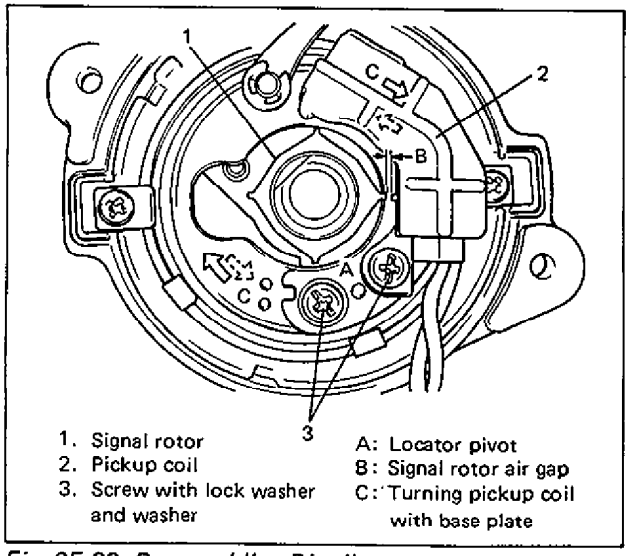


Fig. 6F-23 Reassembling Distributor

INSTALLATION

1. If distributor case has been removed or replaced, install it with new gasket and fasten with bolts.

Tightening torque for distributor case bolts	N-m	kg-m	lb-ft
	8 – 12	0.8 – 1.2	6.0 – 8.5

2. Check to make sure that its O ring is in good condition.
   If new O ring is installed, apply oil.
3. Install distributor without cap to camshaft.
   Fit the dogs of distributor coupling into the slots of camshaft, when installing. The dogs of distributor coupling are offset. Therefore, if the dogs can not be fitted into the slots, turn the distributor shaft by 180 degree and try again.

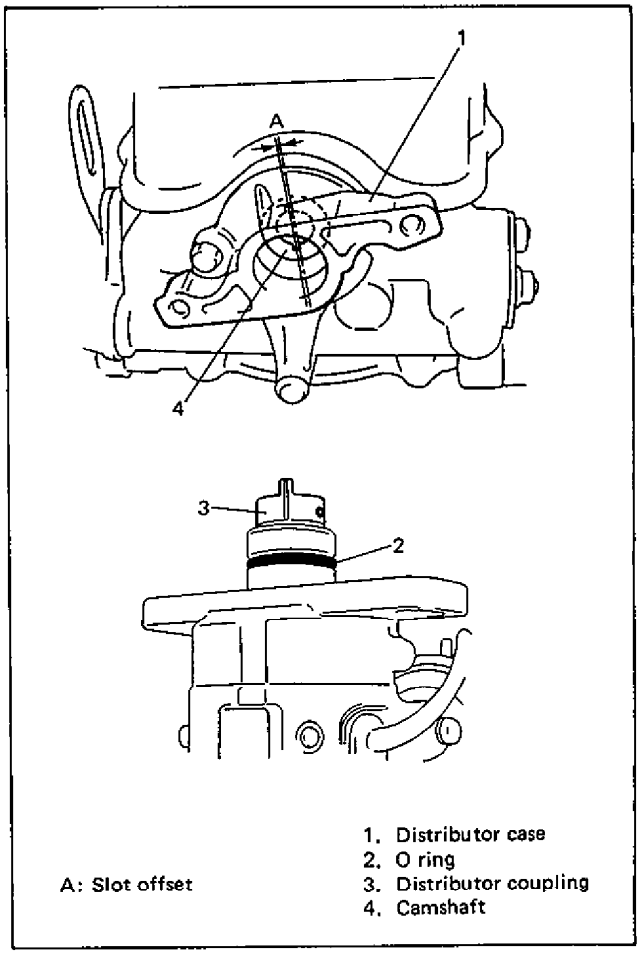
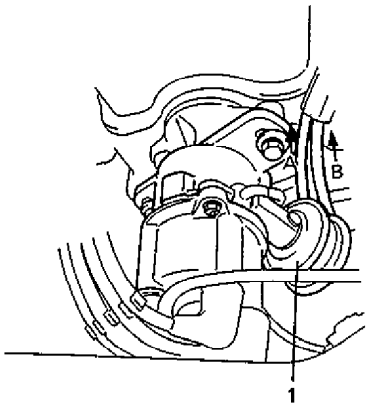


Fig. 6F-24 Installing Distributor

4. Lightly install flange bolts and prepare for ignition timing adjustment.
5. Check to make sure that rotor is in good condition and inserted in shaft securely.
6. Inspect distributor cap and clean or replace as required.
7. Make sure that distributor cap seal is placed properly and install cap, and then fasten it with screws.
8. Connect vacuum hoses with vacuum controller.

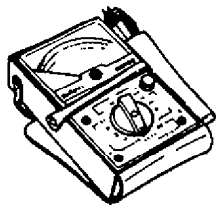
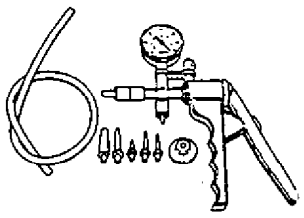
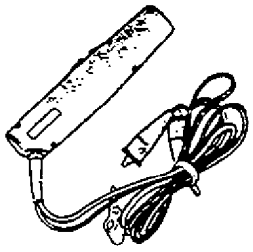
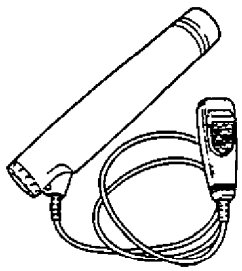


1. Vacuum controller
A: To throttle body sensing port center
B: To intake manifold gas filter

Fig. 6F-25 Connecting Vacuum Hoses

9. Connect distributor lead coupler.
10. Check and adjust ignition timing as previously outlined.

SPECIAL TOOLS

			
09900-25002 Pocket tester	09917-47910 Vacuum pump gauge	09900-27301 Timing light (DC 12V)	09900-27311 Timing light (Dry cell type)

SECTION 6J

EMISSION CONTROLS

CONTENTS

GENERAL DESCRIPTION

EMISSION CONTROL INFORMATION LABEL (If equipped)

The emission Control Information Label is located under hood, if equipped.
The label contains important emission specifications and setting procedures.
When servicing the engine or emission systems, the Emission Control Information Label should be checked for up-to-date information.

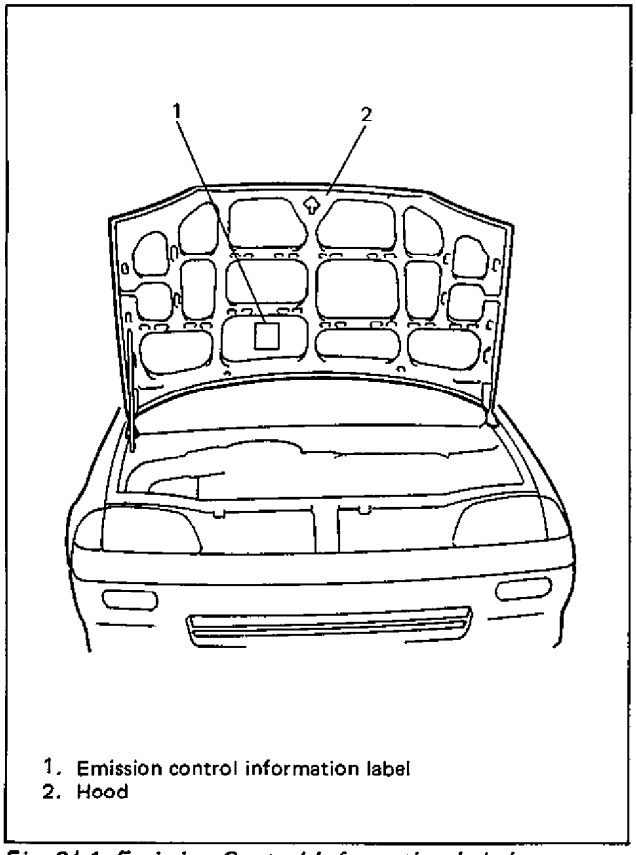


Fig. 6J-1 Emission Control Information Label

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.

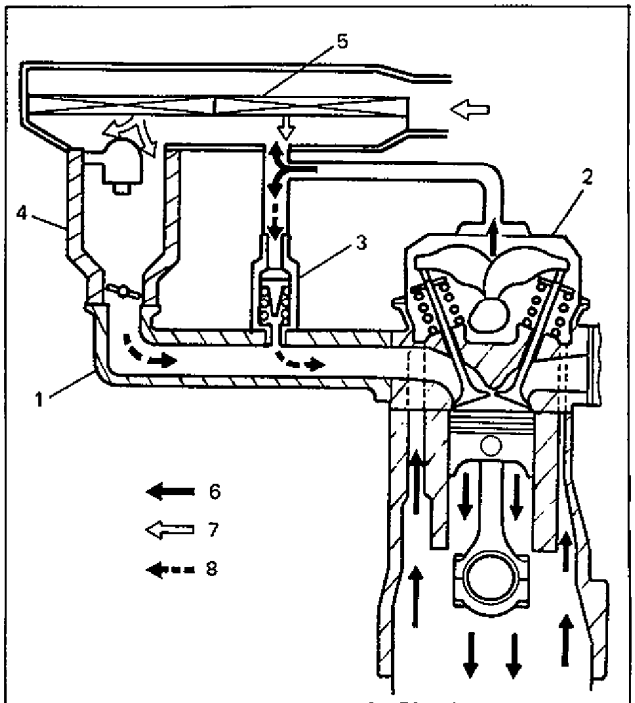


Fig. 6J-2 PCV System Operation

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.

Only when the following conditions are all satisfied, throttle body vacuum is applied to canister purge control valve and the valve opens.

- Engine is running.
- Engine cooling water temperature is high. (Engine is warmed up)
- Throttle valve opens larger than idle position.

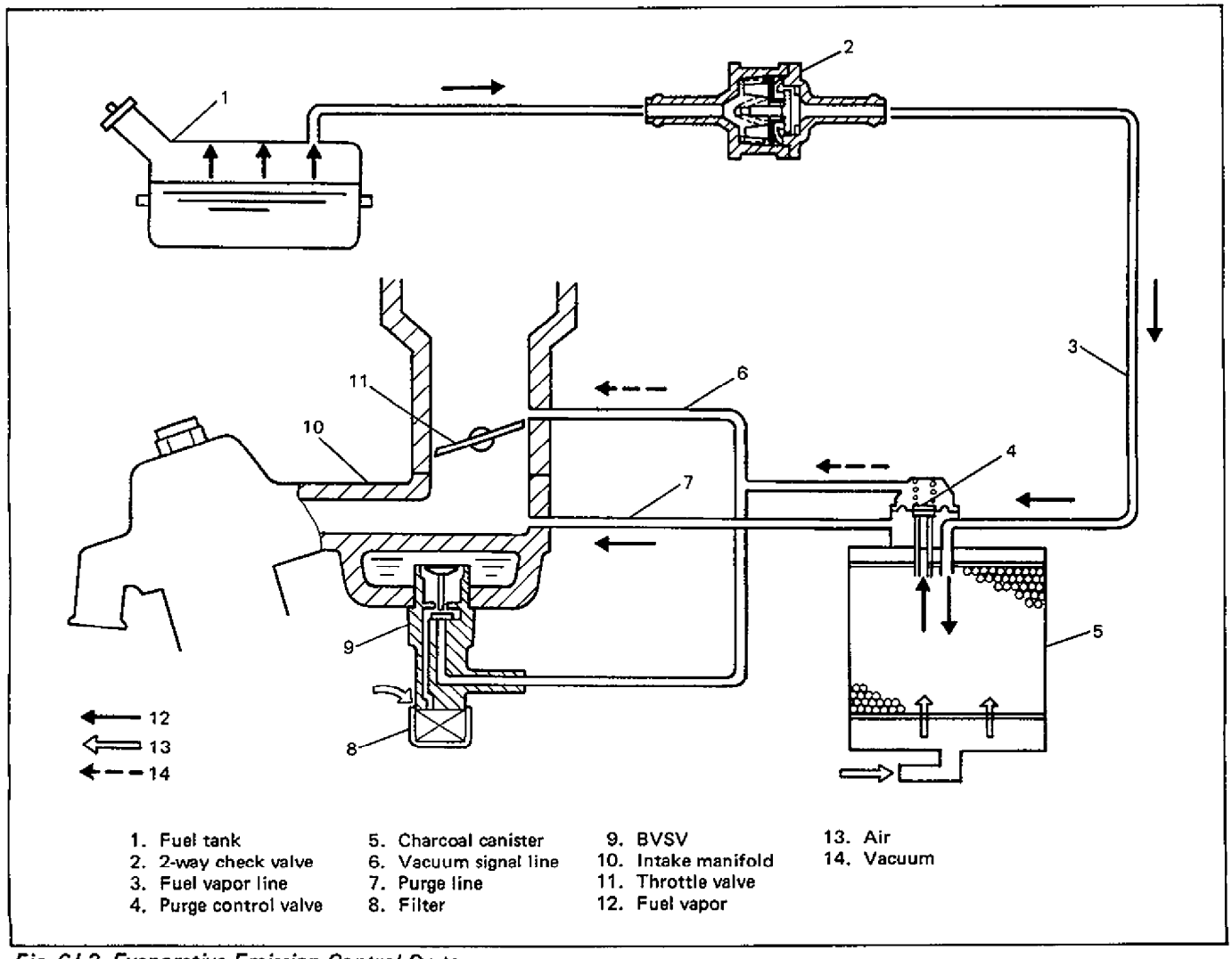
As a result, fuel vapor in the canister is sucked into intake manifold through purge control valve and purge line.

In this state, the canister is purged or cleaned by air drawn through the filter at the bottom of the canister.

When engine cooling water temperature is low, the vacuum signal line communicates with atmosphere through BVSV.

Therefore, throttle body vacuum is not applied to purge control valve, and the valve is closed. In this state, the canister is not purged.

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.



1. Fuel tank
2. 2-way check valve
3. Fuel vapor line
4. Purge control valve
5. Charcoal canister
6. Vacuum signal line
7. Purge line
8. Filter
9. BVSV
10. Intake manifold
11. Throttle valve
12. Fuel vapor
13. Air
14. Vacuum

Fig. 6J-3 Evaporative Emission Control System

THREE-WAY CATALYST

The three-way catalyst is provided in the exhaust system (exhaust No. 1 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.

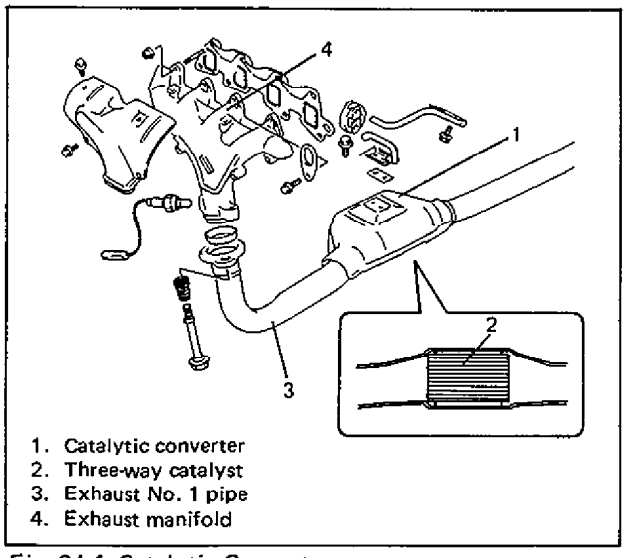


Fig. 6J-4 Catalytic Converter

ON CAR 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.

PCV SYSTEM

NOTE:
Be sure to check that there is no obstruction in PCV valve or its hoses before adjusting engine idle speed, for obstructed PCV valve or hose hampers its accurate adjustment.

PCV HOSE INSPECTION

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

PCV VALVE INSPECTION

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.

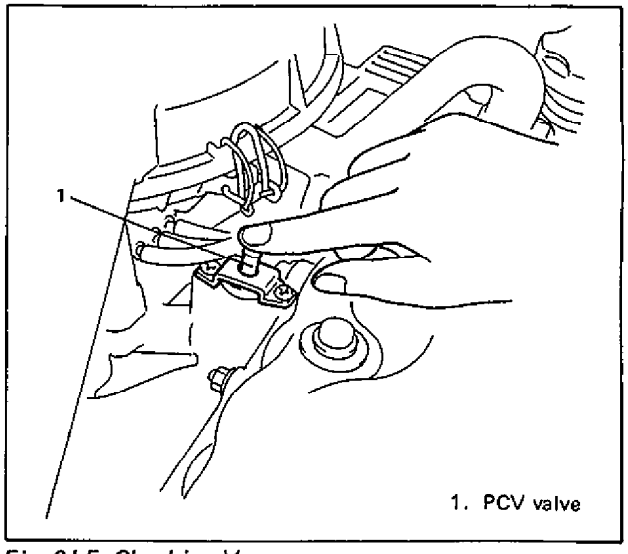


Fig. 6J-5 Checking Vacuum

4. After checking vacuum, stop engine and check PCV valve for sticking.
   With engine stopped, connect a proper size hose to PCV valve for inspection.
   Blow air into the 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.

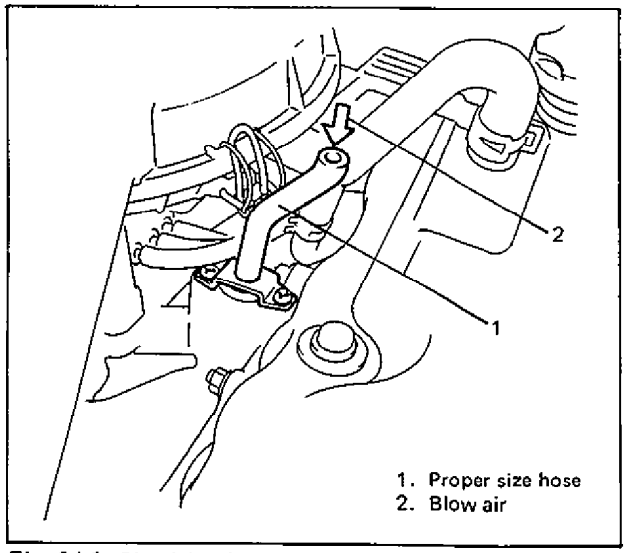


Fig. 6J-6 Checking PCV Valve for Sticking

5. After removing the hose, connect PCV hose and clamp securely.

EVAPORATIVE EMISSION CONTROL SYSTEM

SYSTEM HOSE INSPECTION

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

CHARCOAL CANISTER INSPECTION

1. Disconnect hoses from canister.

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

2. When air is blown into "TANK" nozzle, air should come out from air nozzle located at the bottom of canister.

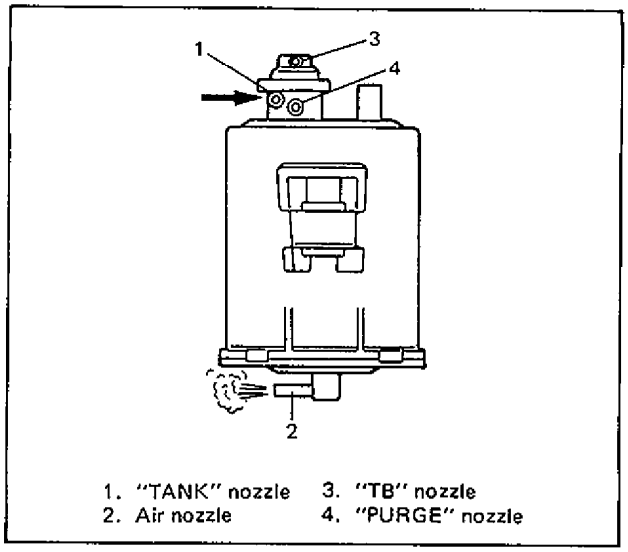


Fig. 6J-7 Blowing "TANK" Nozzle

3. When air is blown into "PURGE" nozzle, no air should come out from other three nozzles due to closing of purge control valve.

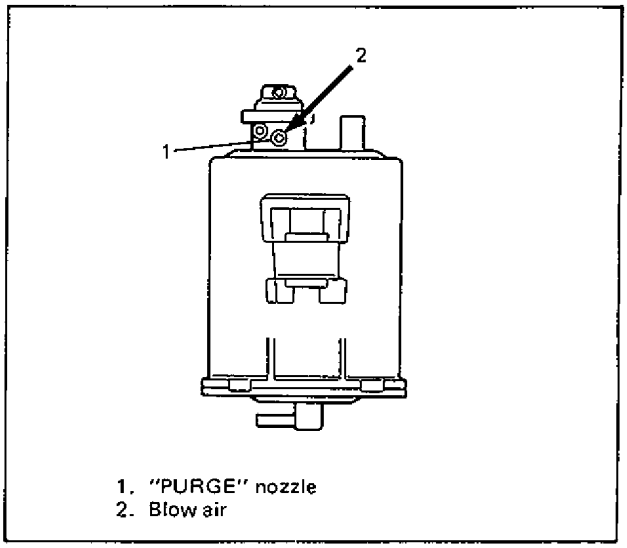


Fig. 6J-8 Blowing "PURGE" Nozzle

4. When air is blown into "PURGE" nozzle while applying more than 80 mmHg vacuum to "TB" nozzle, air should come out from "TANK" nozzle and air nozzle located at the bottom of canister.

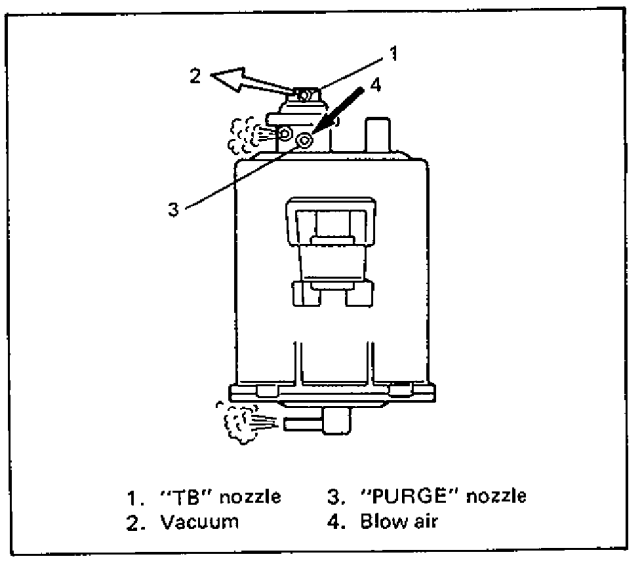


Fig. 6J-9 Blowing "PURGE" Nozzle with Vacuum Applied to "TB" Nozzle

If operation differs from above description, charcoal canister must be replaced.

5. Connect hoses to canister.

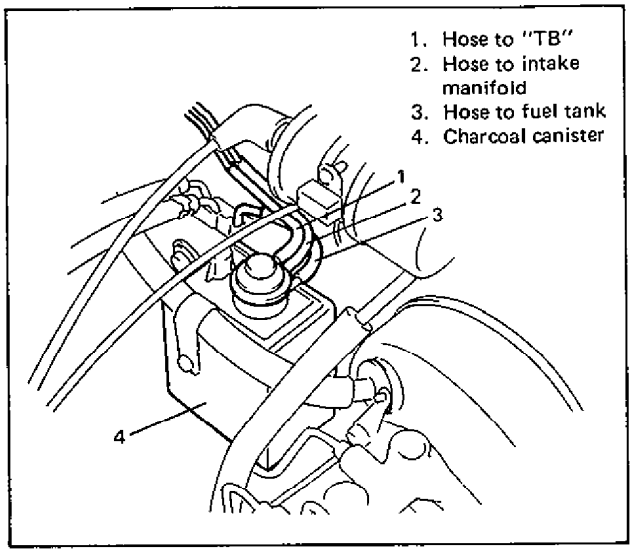


Fig. 6J-10 Connecting Hoses

BI-METAL VACUUM SWITCHING VALVE (BVSV) INSPECTION

NOTE:

For the rough check of the operation, BVSV can be checked by warming up or cooling down the engine without being removed from the intake manifold.

The check procedure is the same as the following except items 1, 2 and 5.

1. Drain cooling system when engine is cold.
2. Remove ISC solenoid valve bracket from intake manifold and remove BVSV from intake manifold.
3. While keeping BVSV cool (below 45°C (113°F)), blow nozzle. Air should come out of filter.

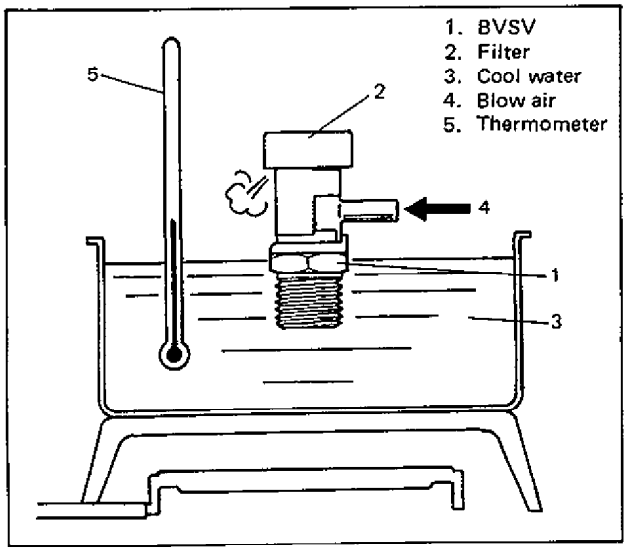


Fig. 6J-11 Checking BVSV (1)

4. While keeping BVSV warm (above 60°C (140°F)) in hot water, blow nozzle. Air should not come out of filter.

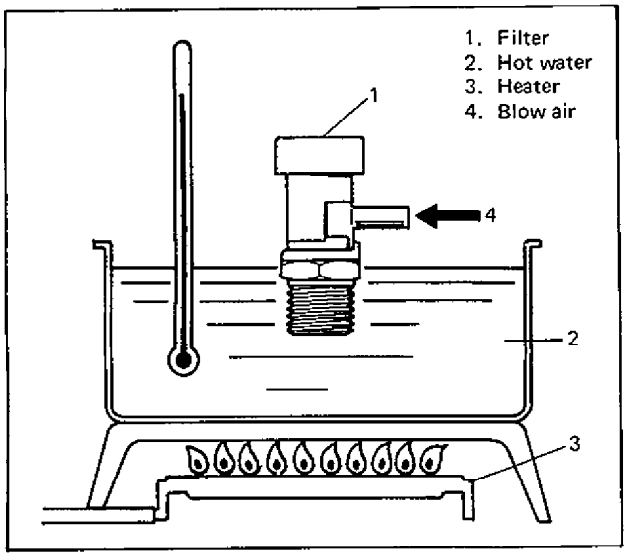


Fig. 6J-12 Checking BVSV (2)

5. Reinstall BVSV to intake manifold. Before installing, wind sealing tape on its thread. Install ISC solenoid valve bracket to intake manifold.
6. Connect BVSV vacuum hose.

2-WAY CHECK VALVE

Removal

1. Remove fuel tank from body according to procedure described in section 6C.
2. Remove 2-way check valve from fuel tank.

Inspection

1. Blow hard from fuel tank side (black side of check valve), and air should pass through valve smoothly and come out from its orange side.
2. Blow only softly from orange side, and air should come out from black side.
3. If air doesn't pass through valve in step 1 or hard blow is required in step 2, replace 2-way check valve.

WARNING:
DO NOT SUCK air through 2-way check valve. Fuel vapor inside the valve is harmful.

Installation

Reverse removal sequence to install 2-way check valve.

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

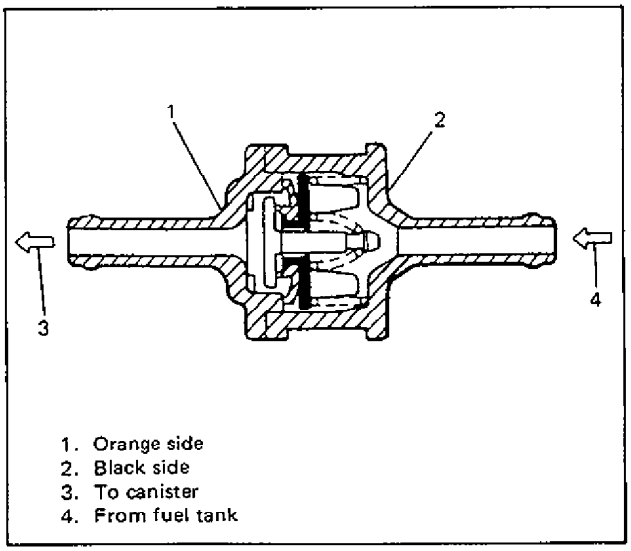


Fig. 6J-13 2-Way Check Valve

SECTION 6K

EXHAUST SYSTEM

CONTENTS

GENERAL DESCRIPTION

The exhaust system consists of an exhaust manifold, an exhaust No. 1 pipe, a muffler, seals, gaskets and etc.
The exhaust No. 1 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.

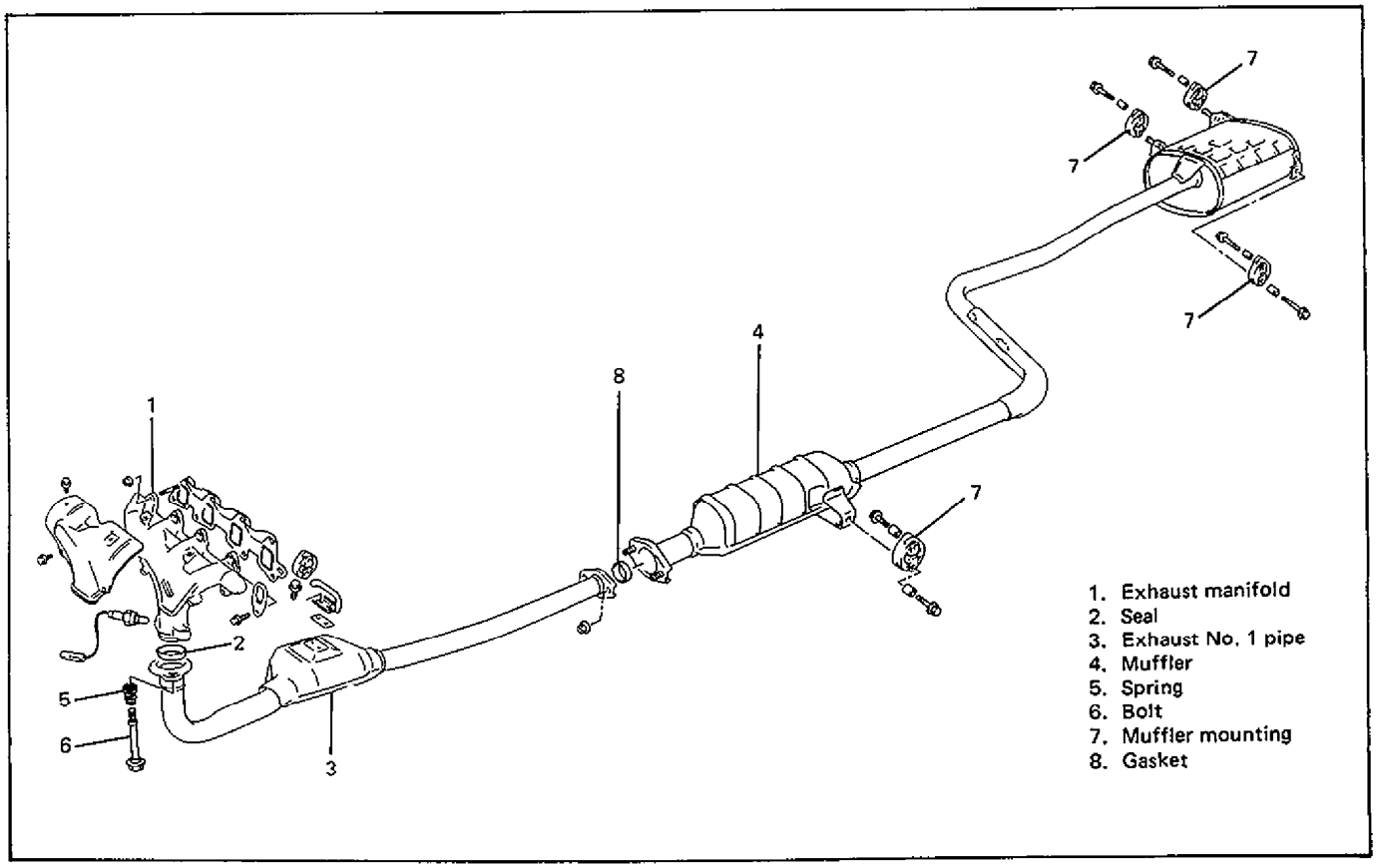


Fig. 6K-1 Exhaust System

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 car 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 CAR 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 car.
- 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 CAR SERVICE

- Refer to Section 6A for removal and installation procedures of exhaust manifold.
- For replacement of No. 1 pipe, muffler or any part used to mount or connect them, be sure to hoist car and observe WARNING given at the left of this page.

CAUTION:
As exhaust No. 1 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.

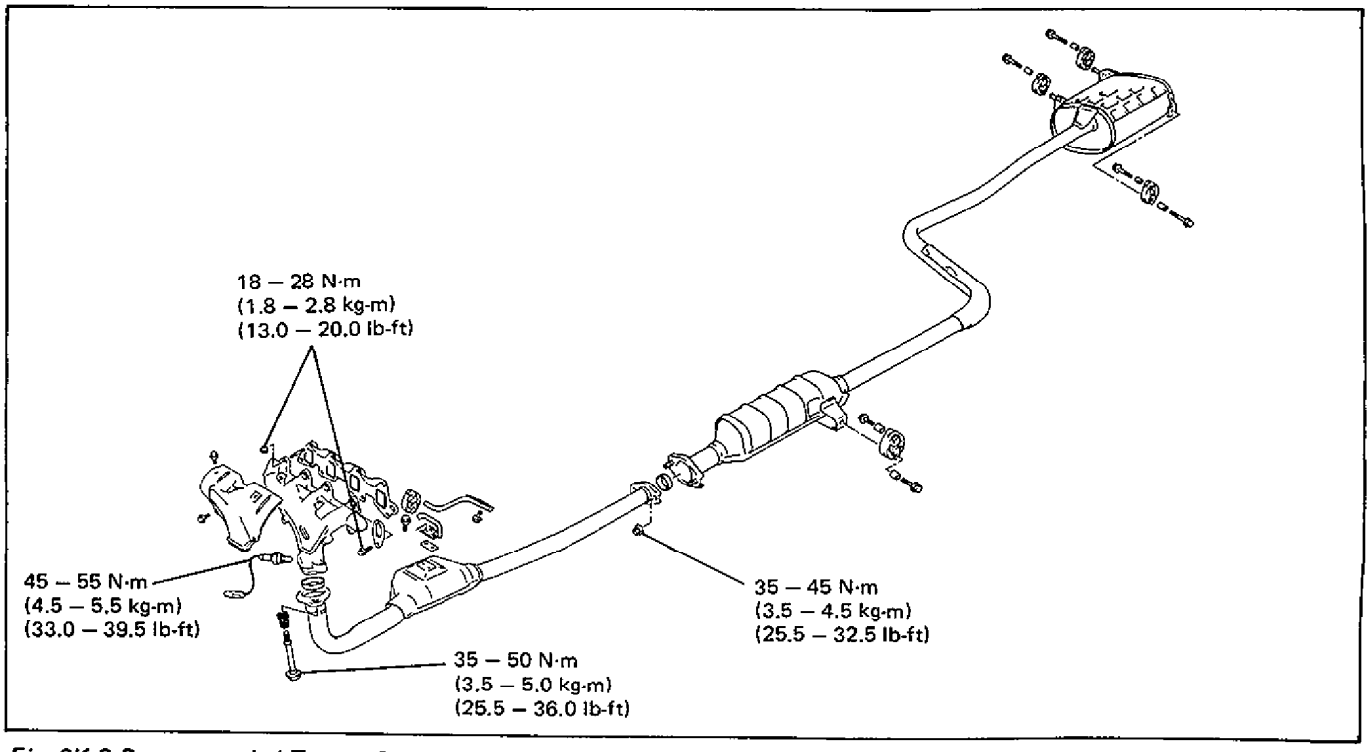


Fig. 6K-2 Recommended Torque Specification

SECTION 7B

AUTOMATIC TRANSMISSION

NOTE:
For the items not found in this section, refer to the same section of the SF413 Service Manual.

CONTENTS

GENERAL DESCRIPTION

ELECTRIC SHIFT CONTROL SYSTEM

The electric shift control system of these models with Electronic Fuel Injection system differs from that of the models with carburetor in the TPS structure and automatic shift schedule of A/T control module.

THROTTLE POSITION SENSOR (TPS)

The throttle position sensor consisting of an idle switch and a potentiometer is connected to the throttle valve shaft.

Idle signal (ON signal when idling) and throttle valve opening signal (output voltage) are transmitted from TPS to ECM as voltage signal. The signal is converted to ON OFF informations in ECM and they are sent to A/T controller through three lines.

Refer to Section 6E of this supplement for TPS inspection.

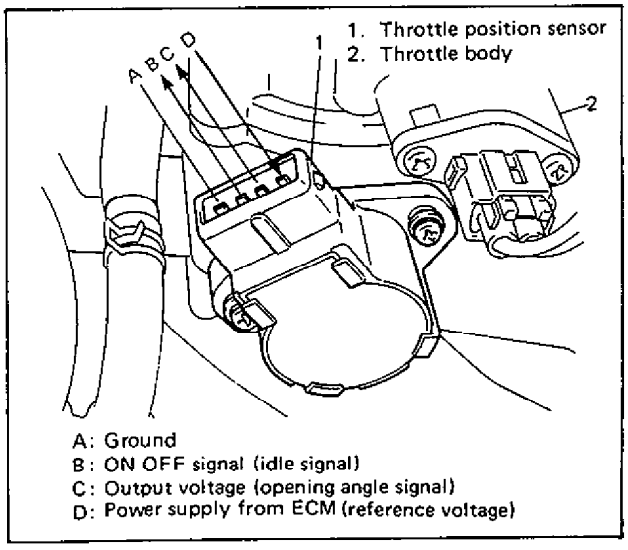
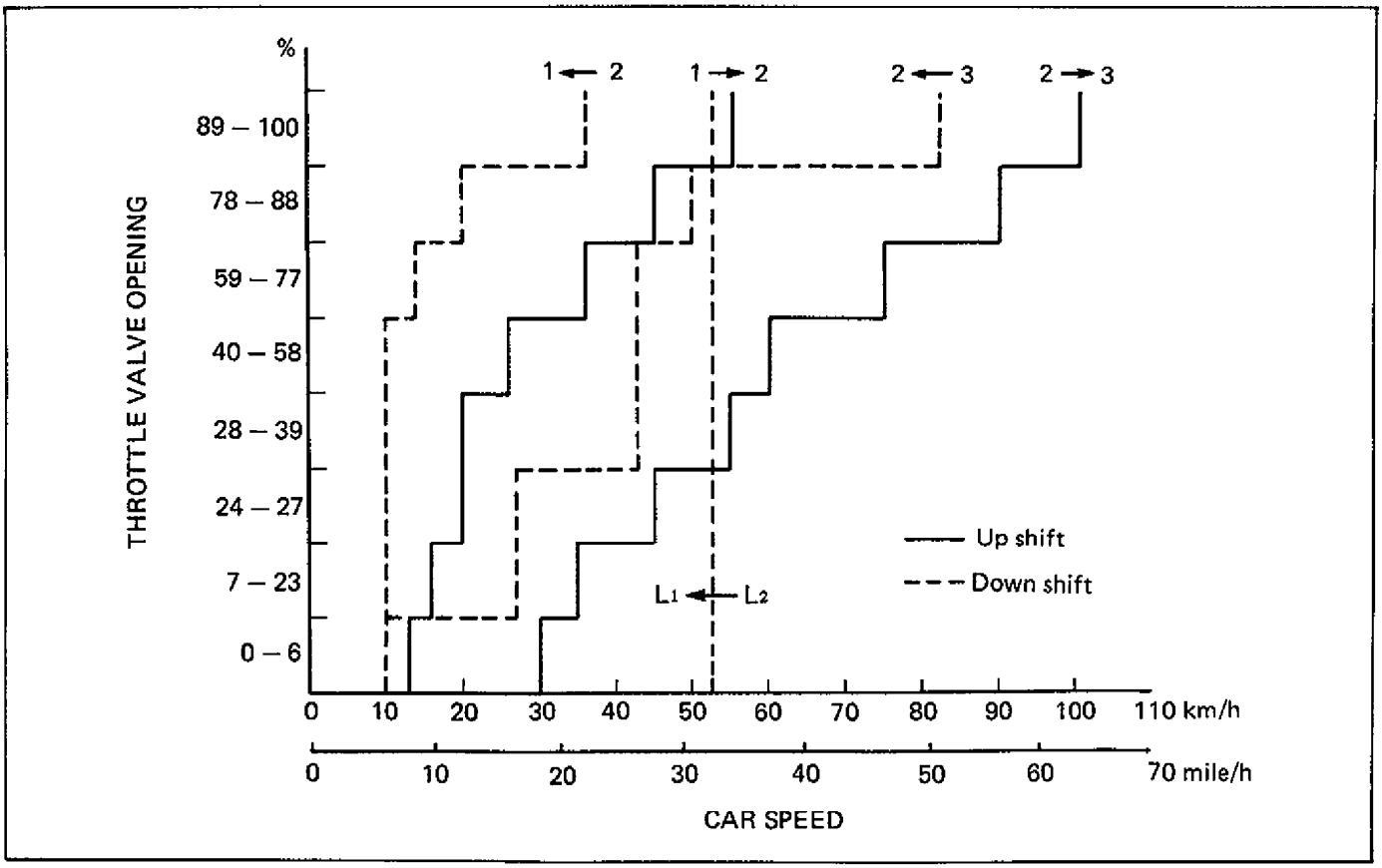


Fig. 7B-1 Throttle Position Sensor

AUTOMATIC SHIFT DIAGRAM



Throttle / Selector / Gear / Speed		D or 2	D		D or 2	L
		1 → 2	2 → 3	3 → 2	2 → 1	2 → 1
Full close	Km/h	13	30	10	10	53
	mile/h	8	19	6	6	33
Full open	Km/h	55	100	82	36	53
	mile/h	34	62	51	22	33

DIAGNOSIS

TRANSMISSION UNIT

SYSTEMATIC TROUBLESHOOTING

Before diagnosing trouble according to procedure (flow chart) described in Section 7B of SF413 Service Manual, make sure to check each of the following.

1. Engine coolant temperature is at normal operating temperature.
2. Engine idle speed is within specification.
3. Transmission fluid level is between FULL HOT and LOW HOT on oil level gauge at normal operating temperature of transmission fluid.
4. Accelerator cable, oil pressure control cable and select cable are adjusted properly.
5. Electric circuit of gear shift control system is free from break, coupler disconnection and poor contact.

LINE PRESSURE TEST

Use the same line pressure test procedure described in Section 7B of SF413 Service Manual, but for specifications for this model, refer to below table.

Engine speed	Line pressure	
	D range	R range
Idling speed (700 – 800 r/min)	2 – 4 kg/cm^2 28.5 – 56.8 psi 200 – 400 kPa	5.5 – 8 kg/cm^2 78.2 – 113.7 psi 550 – 800 kPa
Stall speed (2,000 – 2,500 r/min)	5 – 7 kg/cm^2 71.1 – 99.5 psi 500 – 700 kPa	10.5 –14.0 kg/cm^2 149.4 – 199.1 psi 1050 – 1400 kPa

ROAD TEST

This test is to check if upshift and downshift take place at specified speeds while actually driving car on a level road.

WARNING:
- **Carry out the test in very little traffic area to prevent an accident.**
- **The test requires 2 persons, a driver and a tester.**

1. Warm up engine.
2. With engine running at idle, shift selector lever to D.
3. Accelerate car speed by depressing accelerator pedal very little (within 4 deg. of throttle valve opening).
4. Check if upshift takes place from 1st to 2nd at about 13 km/h (8 mile/h) and from 2nd to 3rd at about 30 km/h (19 mile/h).
5. Stop car once. Then start it again and while accelerating by depressing accelerator pedal fully, check if upshift takes place from 1st to 2nd at 55 km/h (34 mile/h) and from 2nd to 3rd at 100 km/h (62 mile/h).
6. Stop car again.
7. Start car and keep it running at 25 km/h (15 mile/h) and then release accelerator pedal completely. 1 or 2 seconds later, depress accelerator pedal fully and check if downshift from 2nd to 1st takes place.
8. Keep car running at 75 km/h (47 mile/h) and in the same way as in step 7, check if downshift from 3rd to 2nd takes place.
9. If upshift or downshift fails to take place at each specified speed in the road test, possible causes for such failure are as follows. Check each part which is suspected to be the cause.

Condition	Possible causes
No upshift from 1st to 2nd	• 1 – 2 shift valve defective • 2nd brake solenoid defective • Controller defective, or disconnection or poor connection in controller electric circuit
No upshift from 2nd to 3rd	• 2 – 3 shift valve defective • Direct clutch solenoid defective • Controller defective, or disconnection or poor connection in controller electric circuit
No downshift from 2nd to 1st or 3rd to 2nd	• Throttle position sensor defective • Controller defective, or disconnection or poor connection in controller electric circuit

TRANSMISSION UNIT REPAIR OVERHAUL

DISMOUNTING

1. Take down engine with transmission referring to Section 6A of this supplement.
2. Remove torque converter (clutch) housing lower plate.
3. Remove drive plate bolts.
   To lock drive plate, engage a minus screwdriver with the drive plate gear.

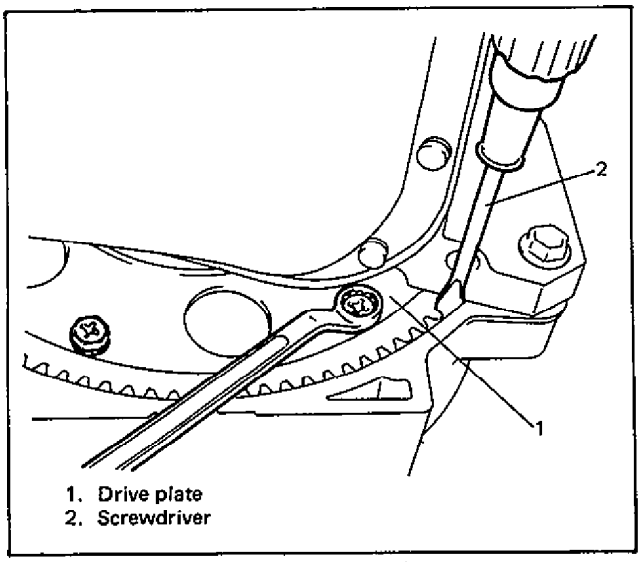


Fig. 7B-2 Removing Drive Plate Bolts

4. Remove starter motor.
5. Remove bolts and nut fastening engine and transmission, and remove transmission from engine.

NOTE:
When removing transmission from engine, move it in parallel with crankshaft and use care so as not to apply excessive force to drive plate and torque converter.

WARNING:
Be sure to keep transmission with torque converter horizontal or facing up throughout the work. Should it be tilted with torque converter down, converter may fall off and cause personal injury.

REMOUNTING

Reverse dismounting procedure. The important steps in installation are as follows.

- Before installing transmission:
  a) Apply grease around the cup at center of torque converter (Fig. 7B-3).
  b) Measure the distance A shown in Fig. 7B-3. The distance should be more than 21.4 mm (0.85 in). If it is less than 21.4 mm (0.85 in), it means that the torque converter is improperly installed. Therefore, in such a case, remove the torque converter, and then, reinstall it for proper installation.

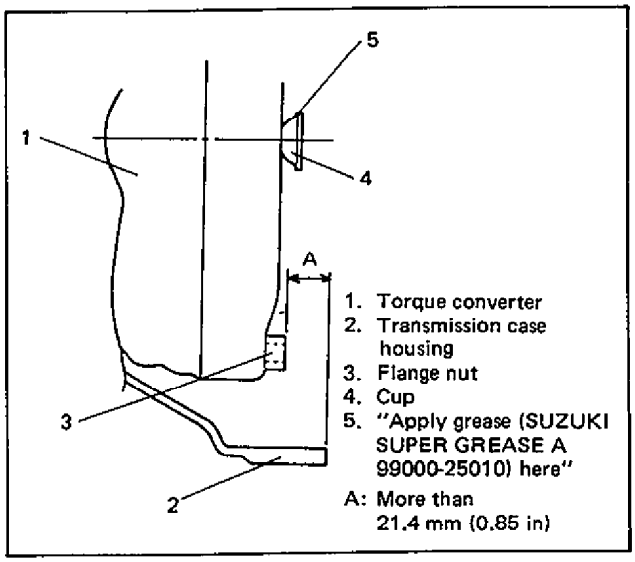


Fig. 7B-3 Installing Torque Converter

- Tighten drive plate bolts to specified torque.

Tightening torque of drive plate bolts	N·m	kg-m	lb-ft
	18 – 19	1.8 – 1.9	13.0 – 14.0

- Remount engine with transmission according to procedure described in Section 6A of this supplement.

SECTION 8

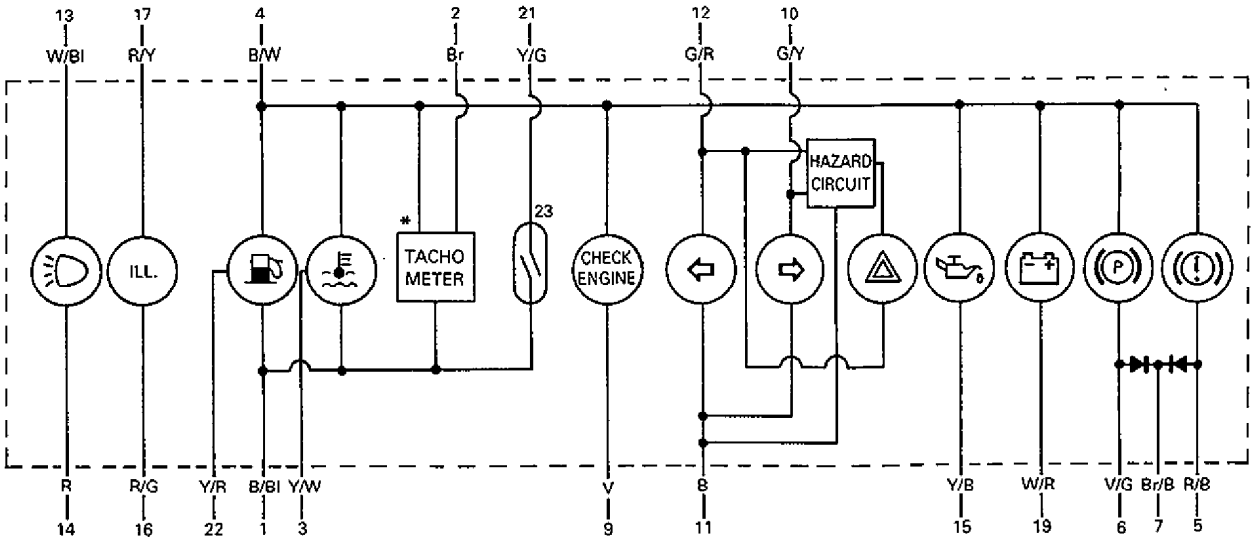
BODY ELECTRICAL SYSTEM

NOTE:
For the items not found in this section, refer to the same section of SF413 Service Manual.
Whether DRL control system or headlight washer is provided or not depends on specifications.

CONTENTS

INSTRUMENTS AND GAUGES

COMBINATION METER WIRING



1. To earth
2. To ignition coil ⊖
3. To water temperature gauge unit
4. To ignition switch
5. To brake fluid level switch
6. To parking brake switch
7. To ignition switch
8. Blank
9. To ECM
10. To turn signal switch (Right)
11. To earth
12. To turn signal switch (Left)
13. To fuse block
14. To turn signal/diameter switch
15. To oil pressure switch
16. To illumination controller or earth
17. To lighting switch
18. Blank
19. To generator
20. Blank
21. To ECM
22. To fuel level gauge unit
23. Speed sensor

NOTE:
***Whether tachometer is provided or not depends on car specification.**

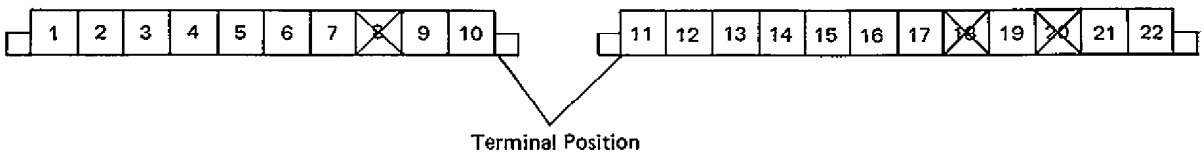


Fig. 8-1 Combination Meter Wiring

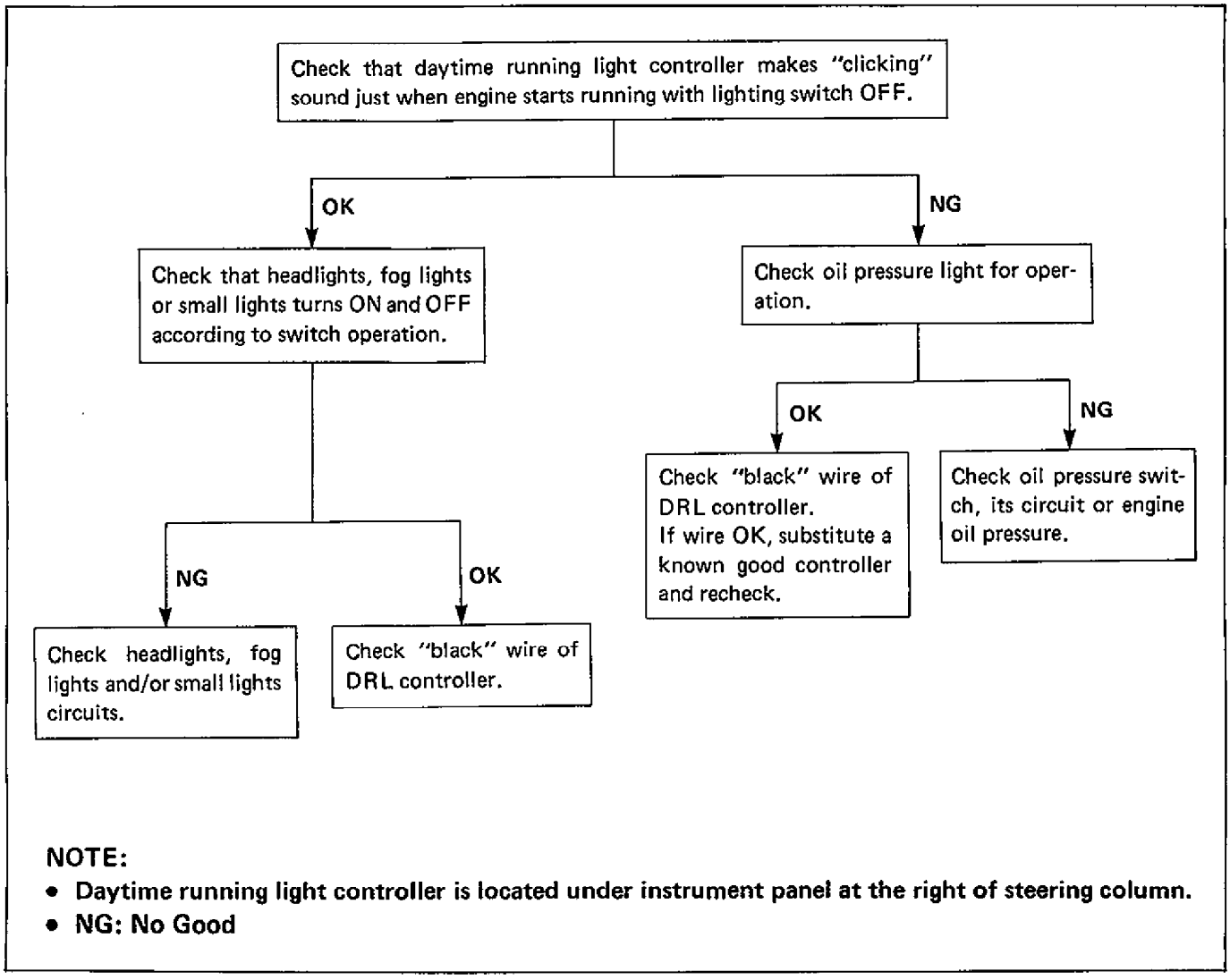
ON CAR SERVICE

DAYTIME RUNNING LIGHT (DRL) CONTROL SYSTEM (If equipped)

With this system, low beam of headlights (or front fog lights instead of headlights, if equipped) and small lights turn ON when engine is started and they turn OFF when it is stopped.
This system is so designed that lighting switch has a priority. That is, when lighting switch is set to the small light position while engine is running and this system is at work (headlights (or fog lights) and small lights are ON), only small lights remain ON and headlights (or fog lights) turn OFF.

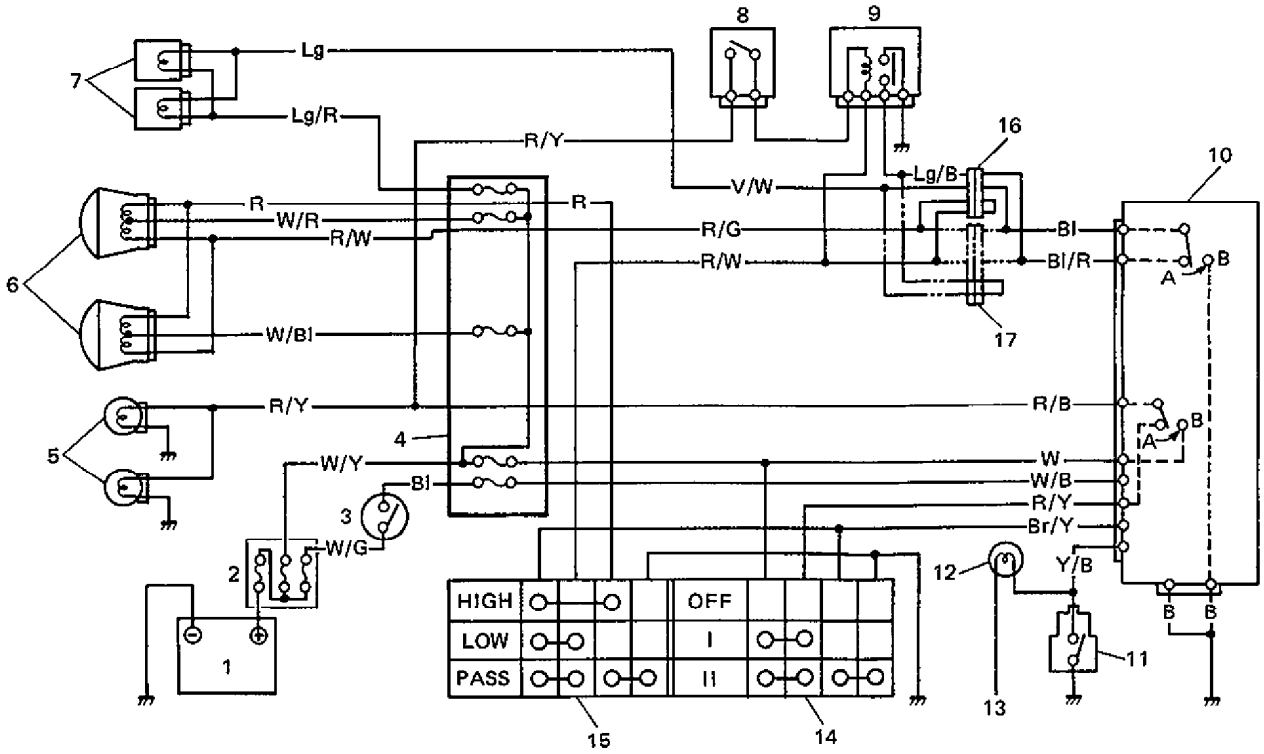
Diagnostic Flow Chart

When a trouble has occurred in this system, check it according to the following flow chart.



NOTE:

- **Daytime running light controller is located under instrument panel at the right of steering column.**
- **NG: No Good**



1. Battery
2. Main fuse box
3. Ignition switch
4. Junction/fuse block
5. Small lights
6. Headlights
7. Front fog lights (if equipped)
8. Front fog light switch (if equipped)
9. Front fog light relay (if equipped)
10. DRL controller
11. Engine oil pressure switch
12. Oil pressure light
13. To ignition switch
14. Lighting switch
15. Dimmer switch
16. For car equipped with fog lights serving for DRL system.
17. For car equipped with headlights serving for DRL system.

A: Engine OFF or lighting switch ON

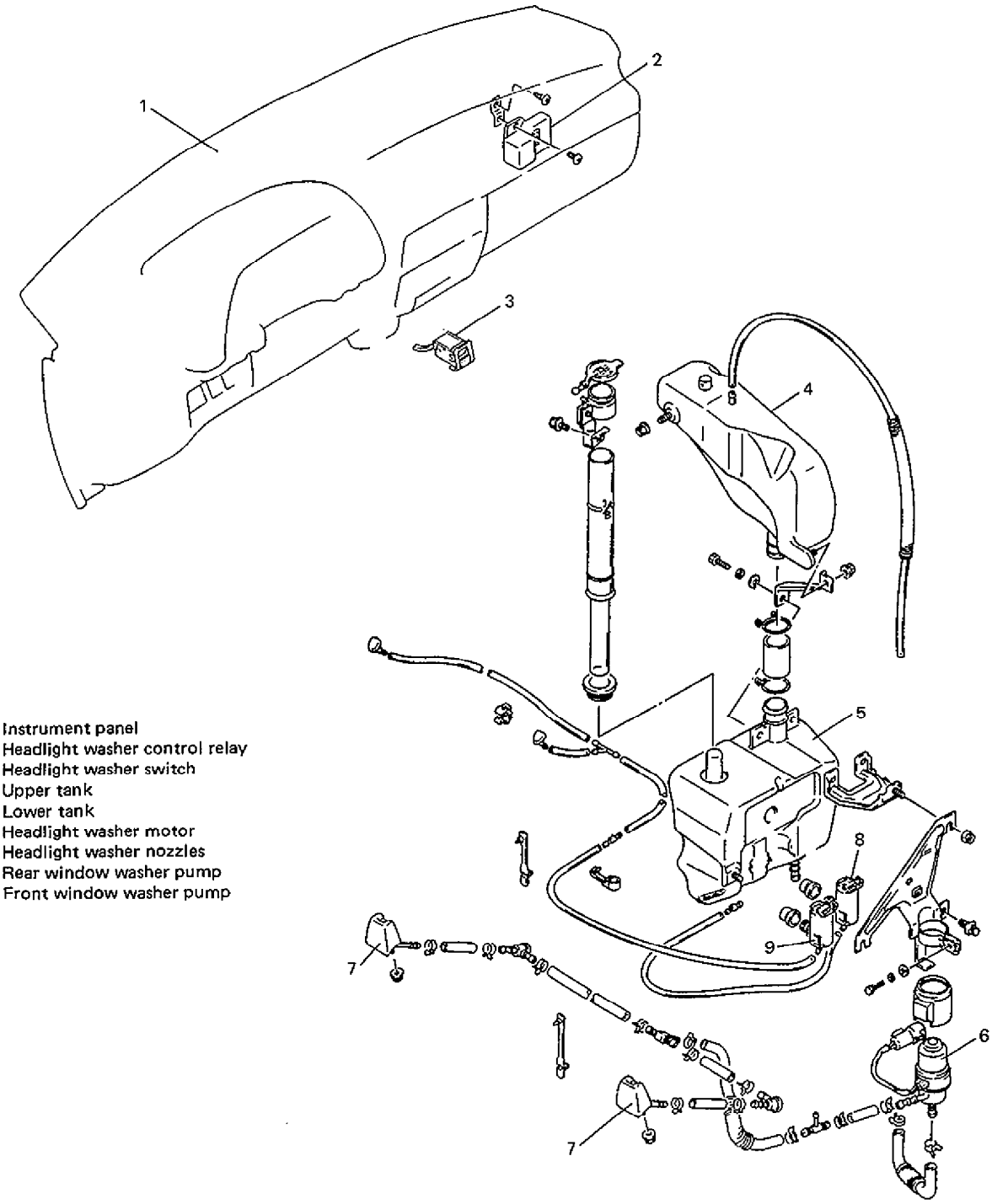
B: Engine running with lighting switch OFF

Fig. 8-2 DRL Circuit

HEADLIGHT WASHER (If equipped)

(HEADLIGHT CLEANER)

This washer consists of fluid tank, motor, control relay, switch, hoses and nozzles. Its system allow about 60cc (2.02/2.11 US/Imp. oz) of washer fluid to be sprayed onto headlights for half a second every time the cleaner switch is turned ON but only when the ignition switch is also ON.



1. Instrument panel
2. Headlight washer control relay
3. Headlight washer switch
4. Upper tank
5. Lower tank
6. Headlight washer motor
7. Headlight washer nozzles
8. Rear window washer pump
9. Front window washer pump

Fig. 8-3 Headlight Washer

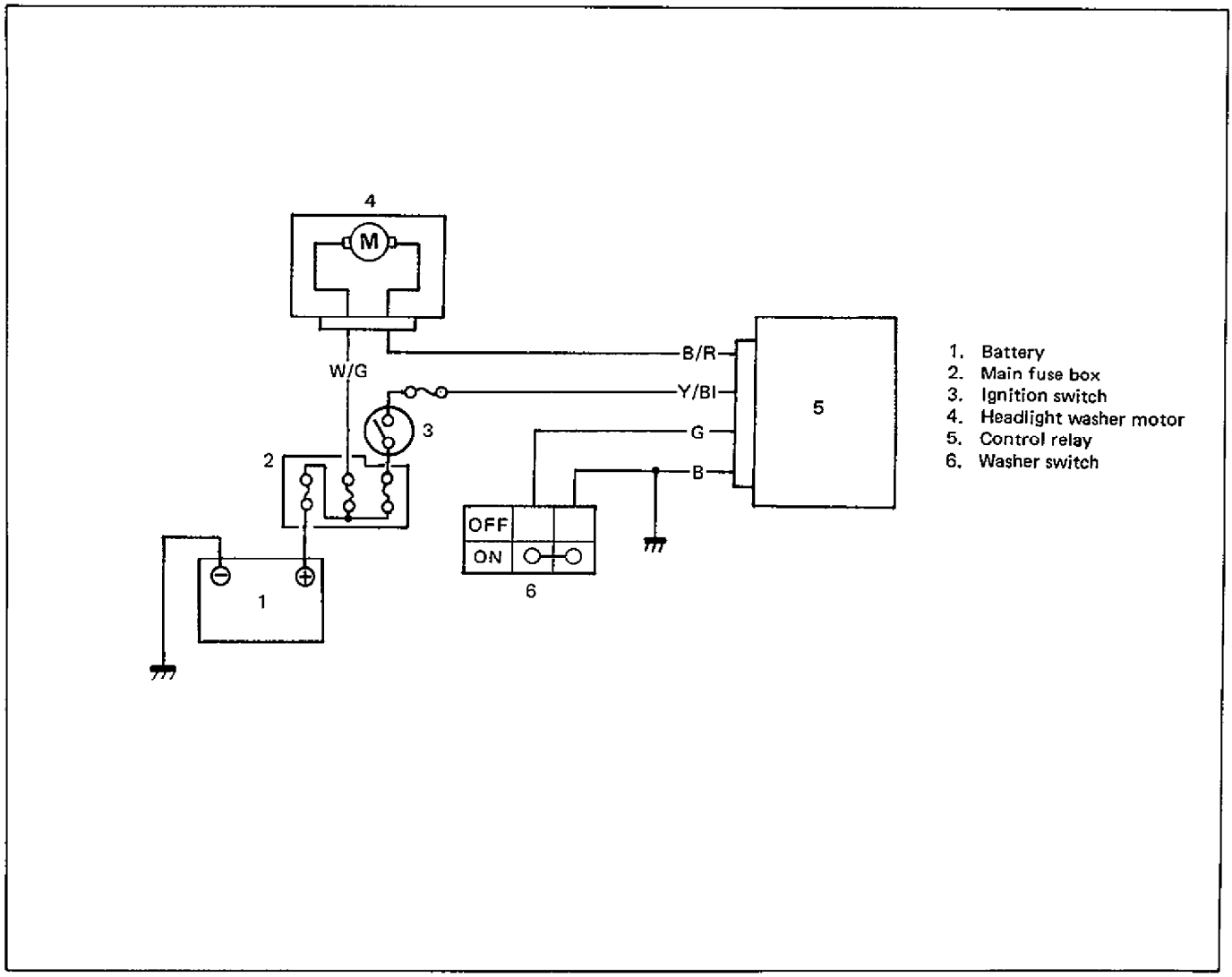


Fig. 8-4 Headlight Washer Circuit

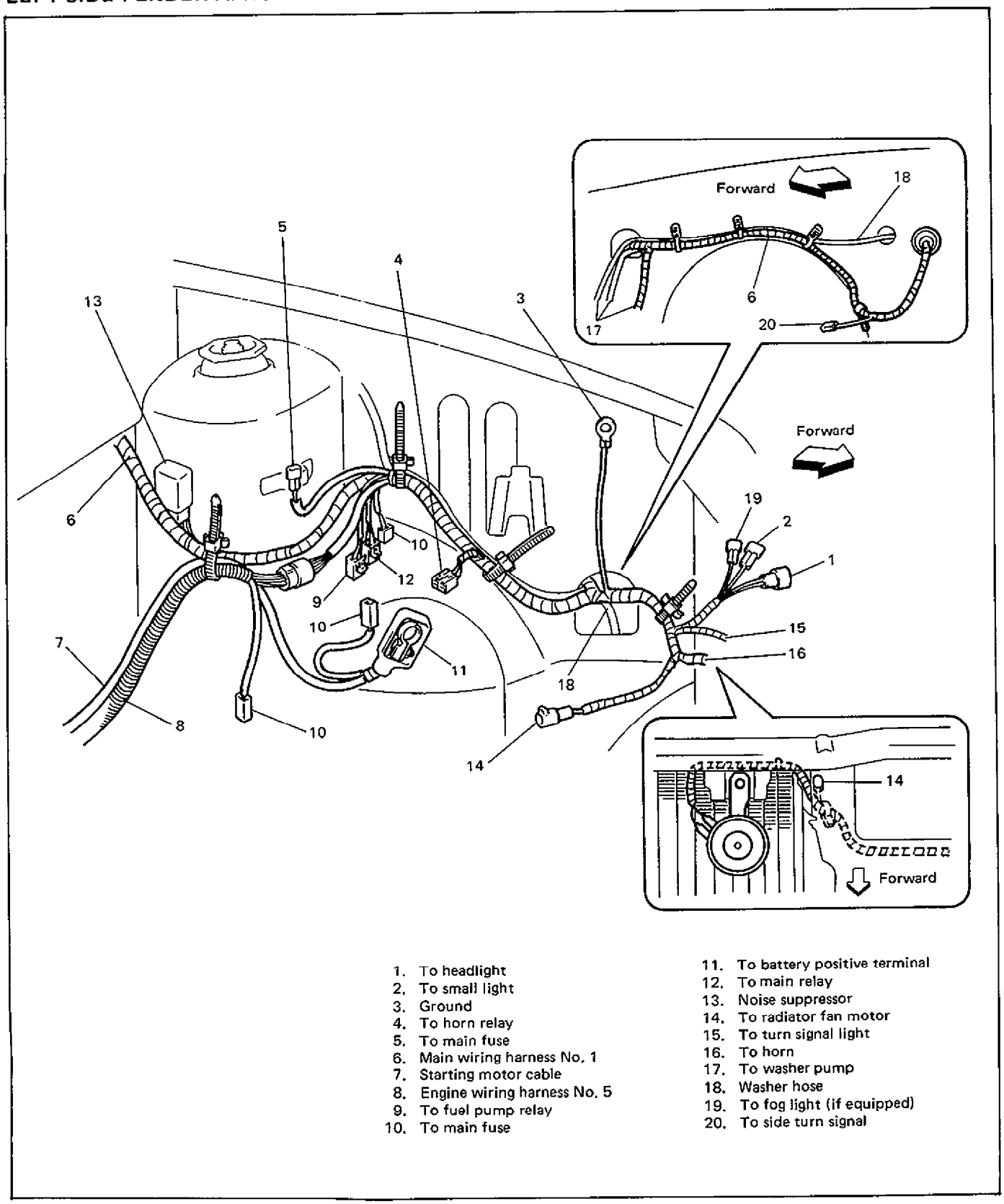
TROUBLE DIAGNOSIS

TROUBLE	POSSIBLE CAUSE
Washer fluid don't spout though pump is operating	• Shortage of fluid • Fluid passage clogged (hose or nozzle)
Washer pump does not operate.	• Fuse blown • Faulty switch • Faulty relay • Faulty motor • Faulty wiring harness or poor connection

WIRING HARNESS ROUTING

For the wirings not found in this section, refer to SF413 Service Manual.

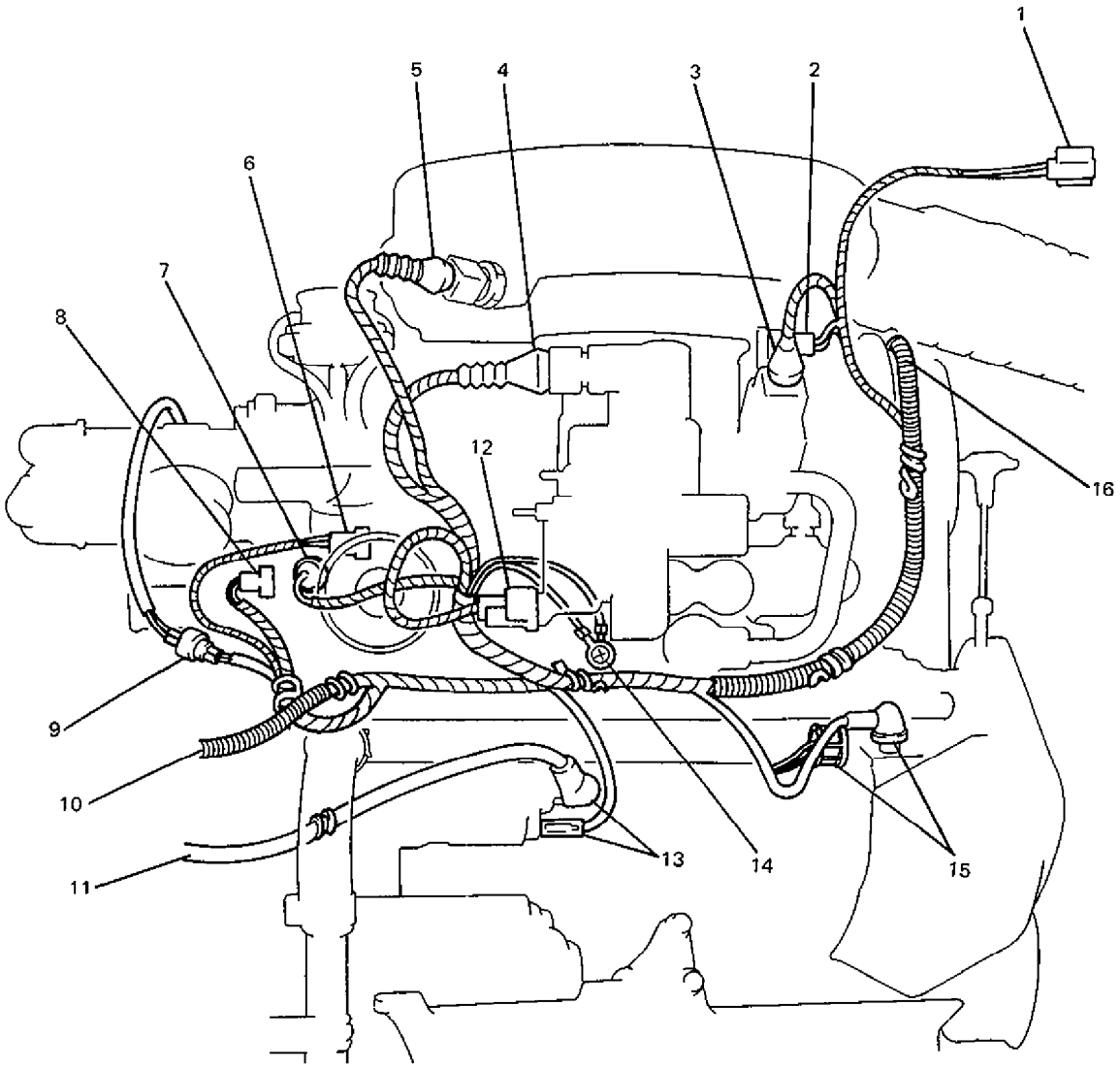
LEFT SIDE FENDER APRON WIRING



1. To headlight
2. To small light
3. Ground
4. To horn relay
5. To main fuse
6. Main wiring harness No. 1
7. Starting motor cable
8. Engine wiring harness No. 5
9. To fuel pump relay
10. To main fuse
11. To battery positive terminal
12. To main relay
13. Noise suppressor
14. To radiator fan motor
15. To turn signal light
16. To horn
17. To washer pump
18. Washer hose
19. To fog light (if equipped)
20. To side turn signal

Fig. 8-5 Left Side Fender Apron Wiring

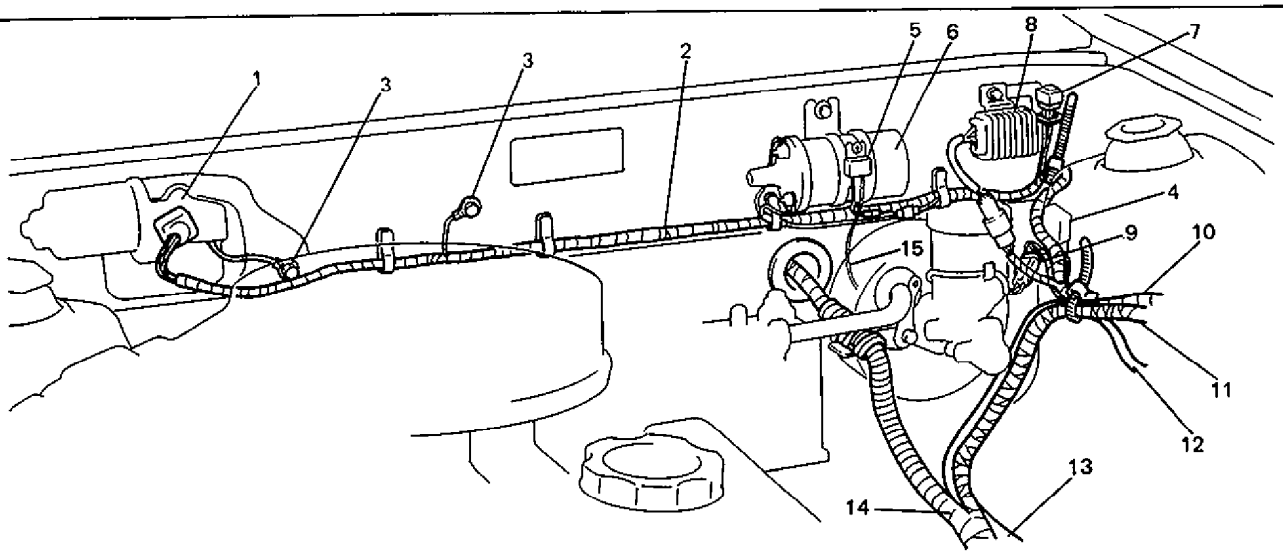
ENGINE WIRING



1. To pressure sensor
2. To injector
3. To throttle switch
   (For M/T model)
   To throttle position sensor
   (For A/T model)
4. To water temperature sensor
5. To air temperature sensor
6. To EGR V.S.V. (Calif. only)
7. To water temperature gauge
8. To radiator fan motor switch
9. To distributor
10. Engine wiring harness No. 5
11. Starting motor cable
12. ISC solenoid valve
13. To starting motor
14. Ground
15. To generator
16. To oil pressure switch and oxygen sensor

Fig. 8-6 Engine Wiring

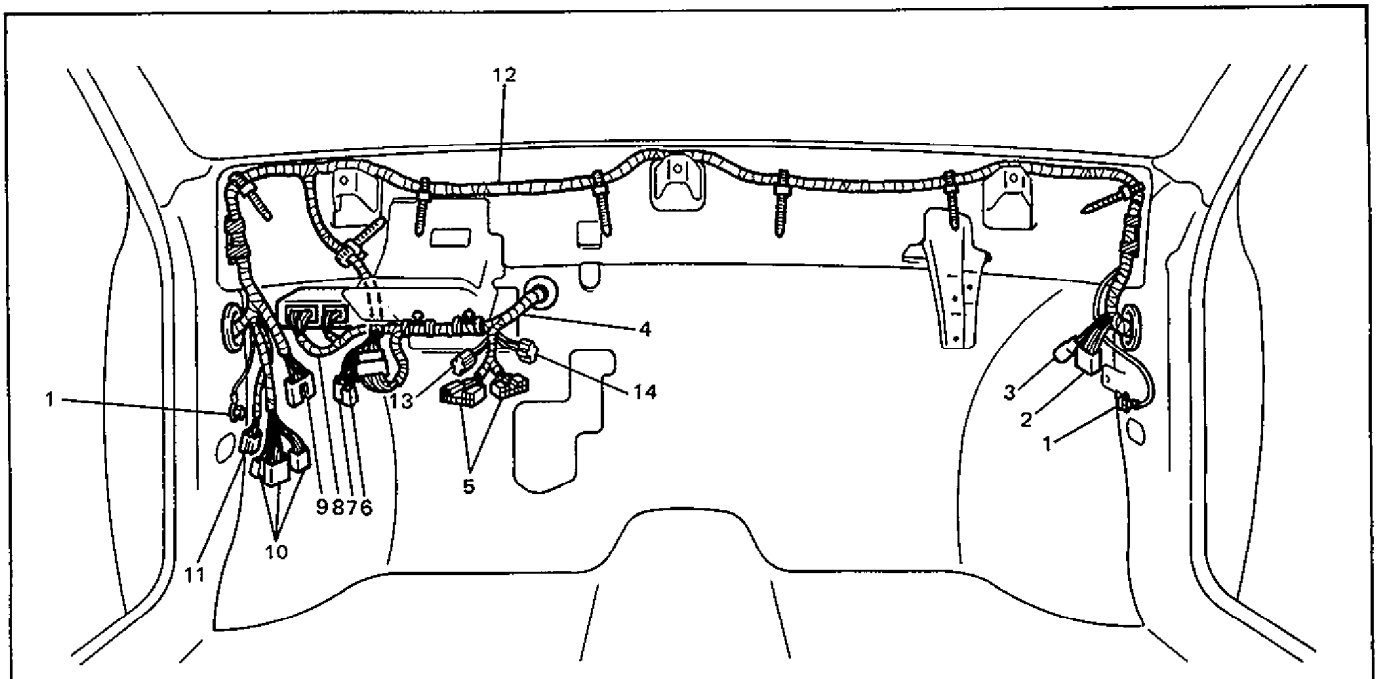
COWL TOP PANEL WIRING



1. Wiper motor
2. Main wiring harness No. 1
3. Ground
4. Noise suppressor
5. Condenser
6. Ignition coil
7. Moniter coupler
8. Resister
9. To brake fluid level switch
10. To left headlight, turn signal and small light
11. To main fuse
12. To battery positive terminal
13. To starting motor
14. Engine wiring harness No. 5
15. To ground

Fig. 8-7 Cowl Top Panel Wiring

COWL UPPER WIRING



1. Ground
2. To air con. wiring harness (Optional)
3. To dome light
4. Engine wiring harness No. 5
5. To A/T control module (For A/T model only)
6. To stop light switch
7. To combination switch
8. To electric control module
9. To instrument panel wiring harness No. 2
10. To junction block
11. To floor wiring harness No. 3
12. Main wiring harness No. 1
13. Monitor coupler for A/T control module
14. Diag switch coupler for A/T control module

Fig. 8-8 Cowl Upper Wiring

GROUNDING POINTS

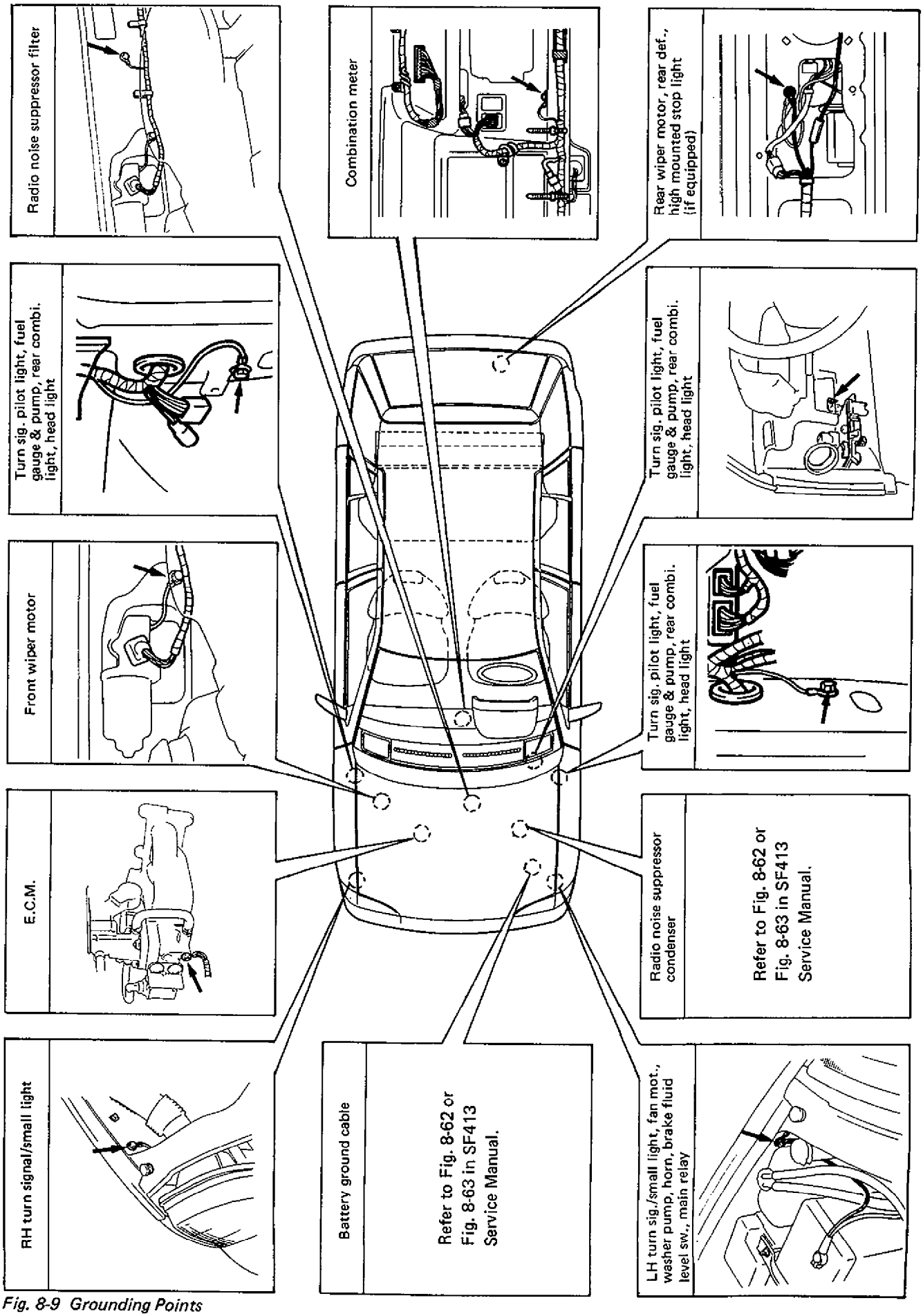
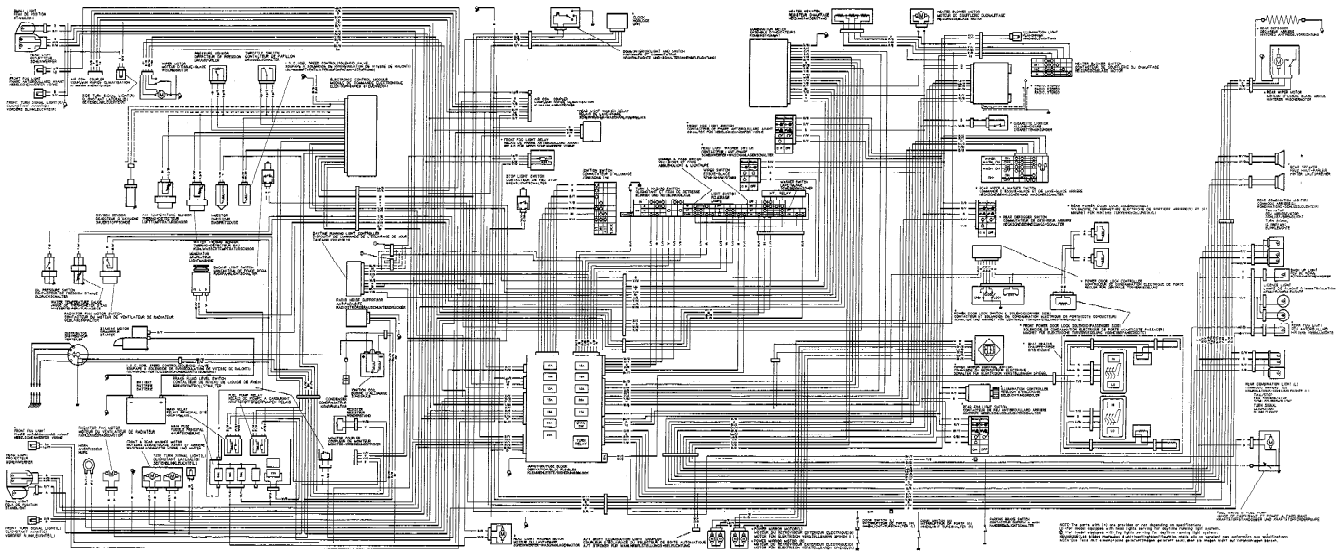


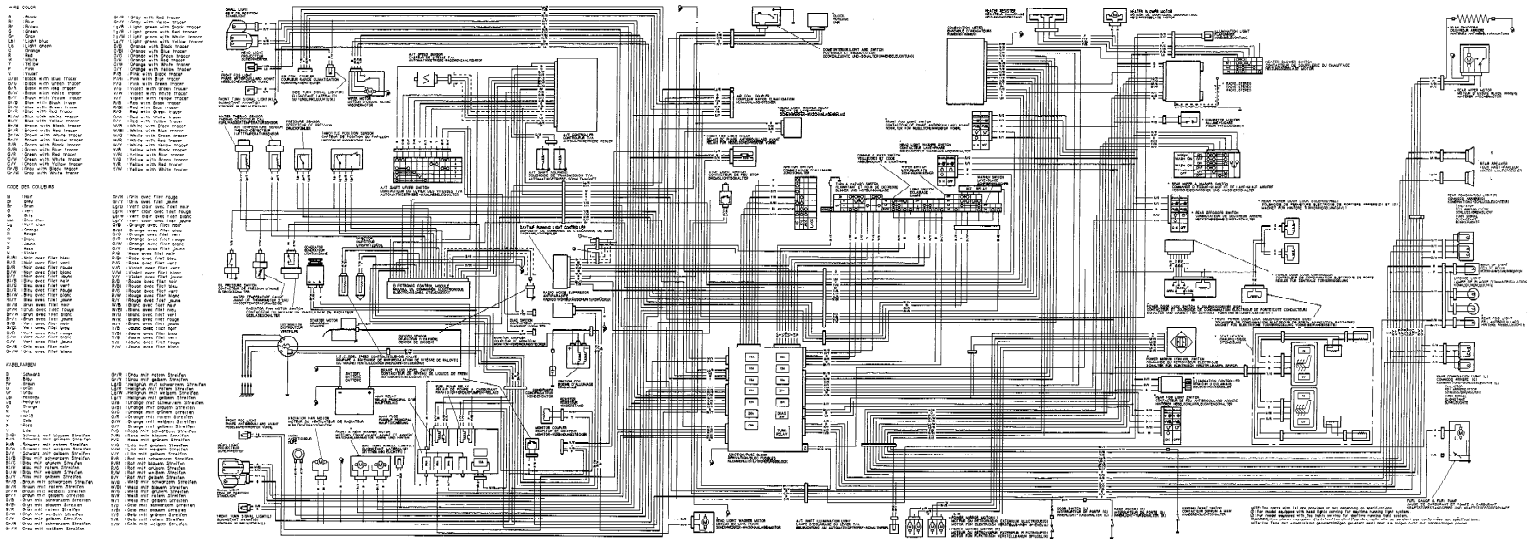
Fig. 8-9 Grounding Points

WIRING DIAGRAM

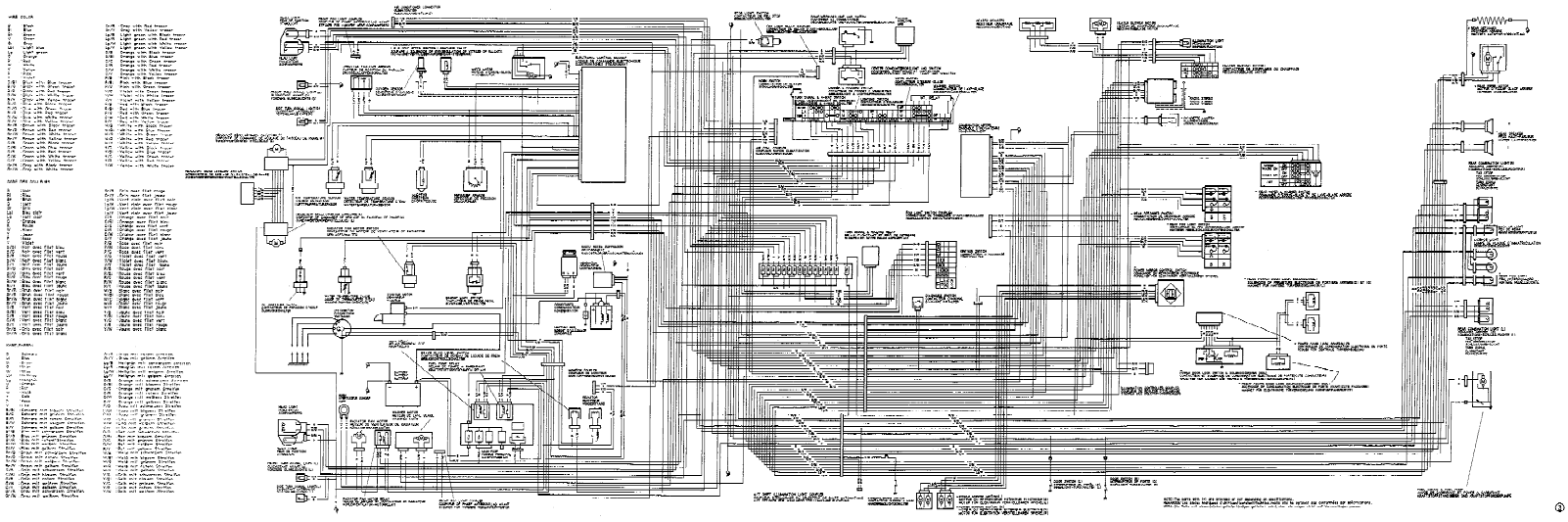
M/T MODEL WITH DRL SYSTEM



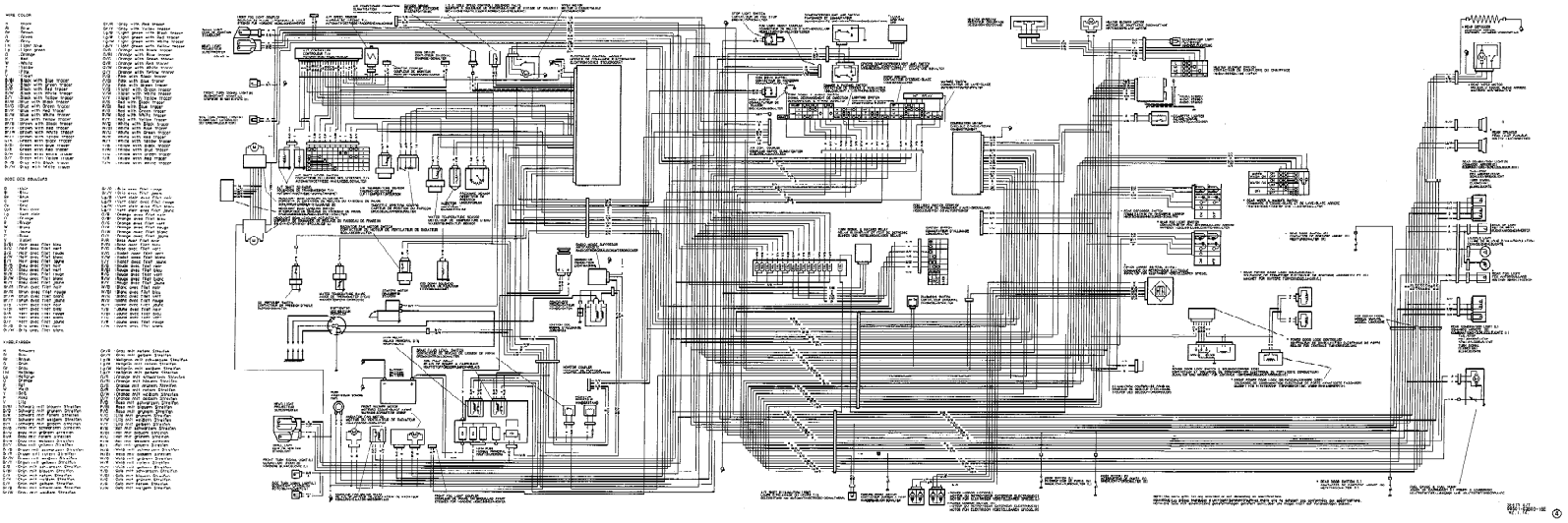
A/T MODEL WITH DRI SYSTEM



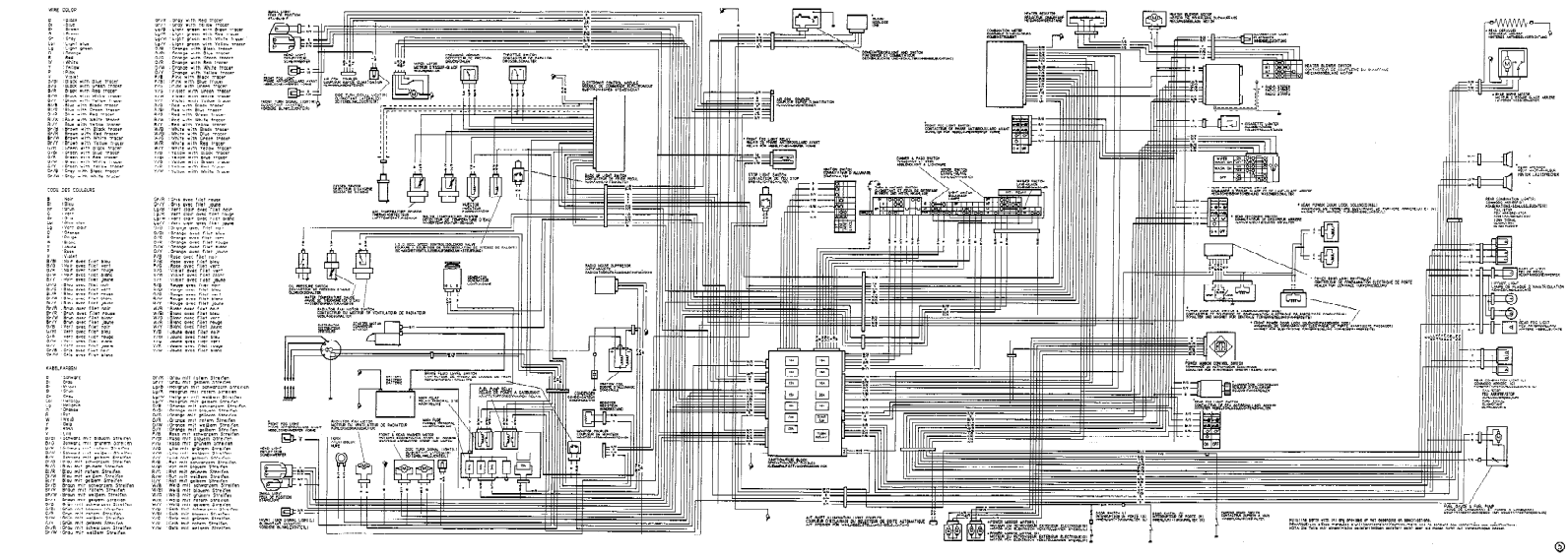
M/T MODEL WITH HEADLIGHT LEVELING SYSTEM



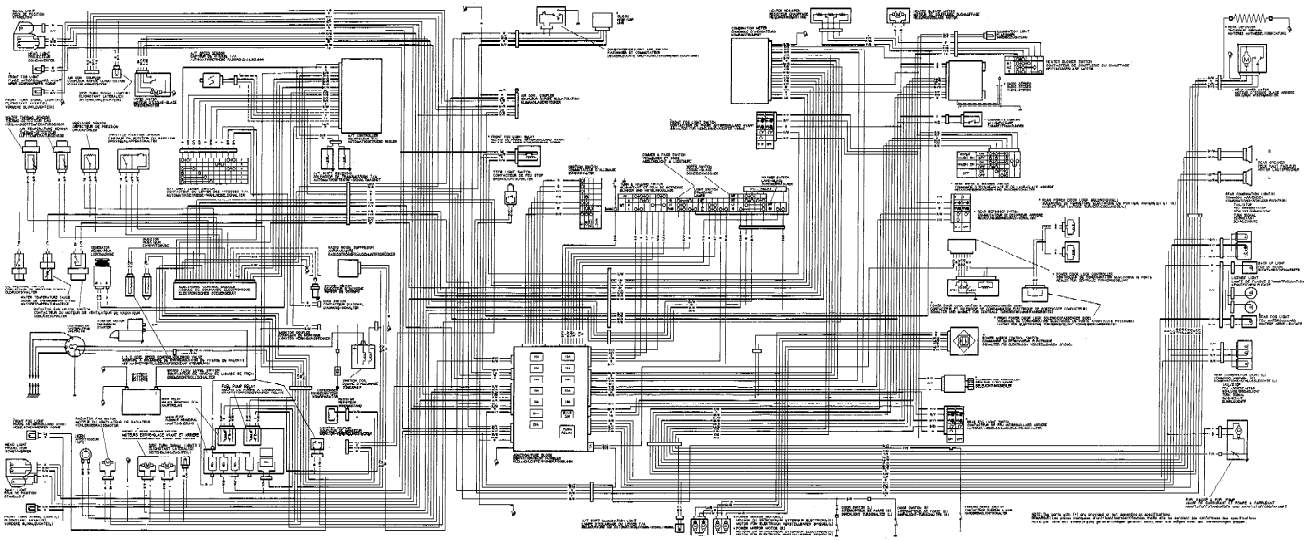
A/T MODEL WITH HEADLIGHT LEVELING SYSTEM



M/T MODEL WITHOUT DRL SYSTEM AND HEADLIGHT LEVELING SYSTEM



A/T MODEL WITHOUT DRL SYSTEM AND HEADLIGHT LEVELING SYSTEM



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