SECTION 6E

ELECTRONIC FUEL INJECTION SYSTEM

CONTENTS

ABBREVIATIONS USED IN THIS SECTION

A/C	:	Air-Conditioner
ATS	:	Air Temperature Sensor
BVSV	:	Bimetal Vacuum Switching Valve
CAS	:	Crank Angle Sensor
ECM	:	Electronic Control Module
EGR	:	Exhaust Gas Recirculation
ESA	:	Electronic Spark Advance
ISC	:	Idle Speed Control
M/T	:	Manual Transmission
PCV	:	Positive Crankcase Ventilation
PS	:	Pressure Sensor
TB	:	Throttle Body
TPS	:	Throttle Position Sensor
VSS	:	Vehicle Speed Sensor
VSV	:	Vacuum Switching Valve
WTG	:	Water Temperature Gauge
WTS	:	Water Temperature Sensor

GENERAL DESCRIPTION

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

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 not only the system related to the electronic fuel injection but also such functions of ECM as listed below.

- EGR control system
- Throttle opener control system
- ESA (Electronic Spark Advance) system
- Fuel evaporative emission control system
- Lock-up relay control system (A/T only)

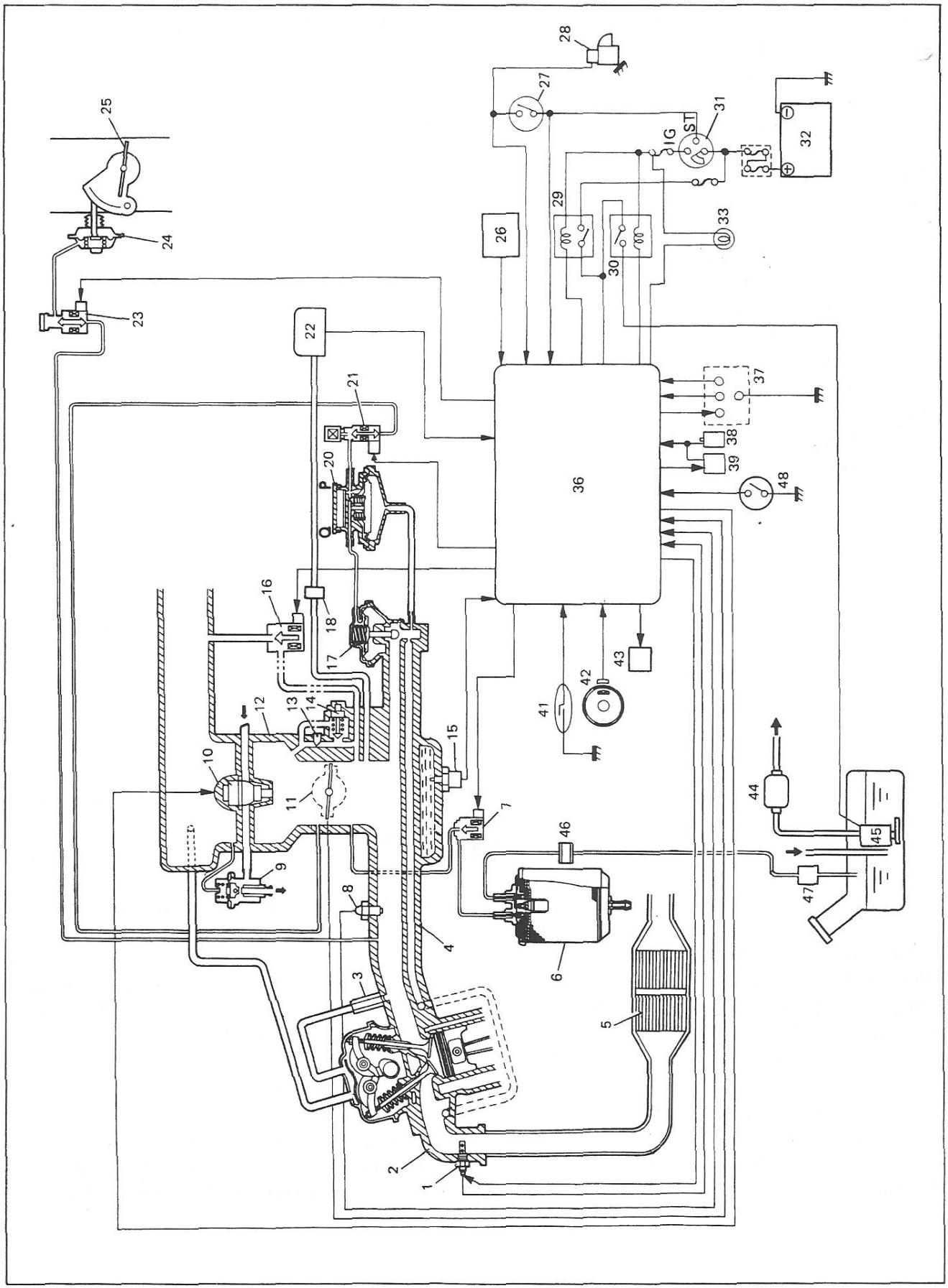


Fig. 6E-1 Electronic Fuel Injection System

1. Oxygen sensor with heater
2. Exhaust manifold
3. PCV valve
4. Intake manifold
5. Three way catalyst
6. Charcoal canister
7. Canister purge VSV
8. ATS
9. Fuel pressure regulator
10. Fuel injector
11. TPS
12. Throttle body
13. Idle speed adjusting screw
14. Air valve
15. WTS
16. ISC solenoid valve
17. EGR valve
18. Filter
19. Blank
20. EGR modulator
21. EGR VSV (Blue)
22. Pressure sensor
23. Throttle opener VSV (Brown)
24. Throttle opener
25. Throttle valve
26. A/C amplifier (if equipped)
27. Shift switch (A/T)
28. Starter magnetic switch
29. Main relay
30. Fuel pump relay
31. Main switch
32. Battery
33. "CHECK ENGINE" light
34. Blank
35. Blank
36. ECM
37. Monitor coupler
38. Ignition coil
39. Igniter
40. Blank
41. VSS
42. CAS
43. Lock-up relay (A/T only)
44. Fuel filter
45. Fuel pump
46. 2-way check valve
47. Fuel/vapor separator
48. Power steering pressure switch (if equipped)

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 and ISC solenoid valve), fuel feed line, fuel return line and air cleaner.

The fuel in the fuel tank is pumped up by the fuel pump, filtered by the fuel filter and fed under pressure to injector installed in throttle body. As the fuel pressure applied to the fuel injector (the fuel pressure in the fuel feed line) is always kept a certain amount higher than the pressure in the throttle body (the pressure around the injector) by the fuel pressure regulator, the fuel is injected into the throttle body 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 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".

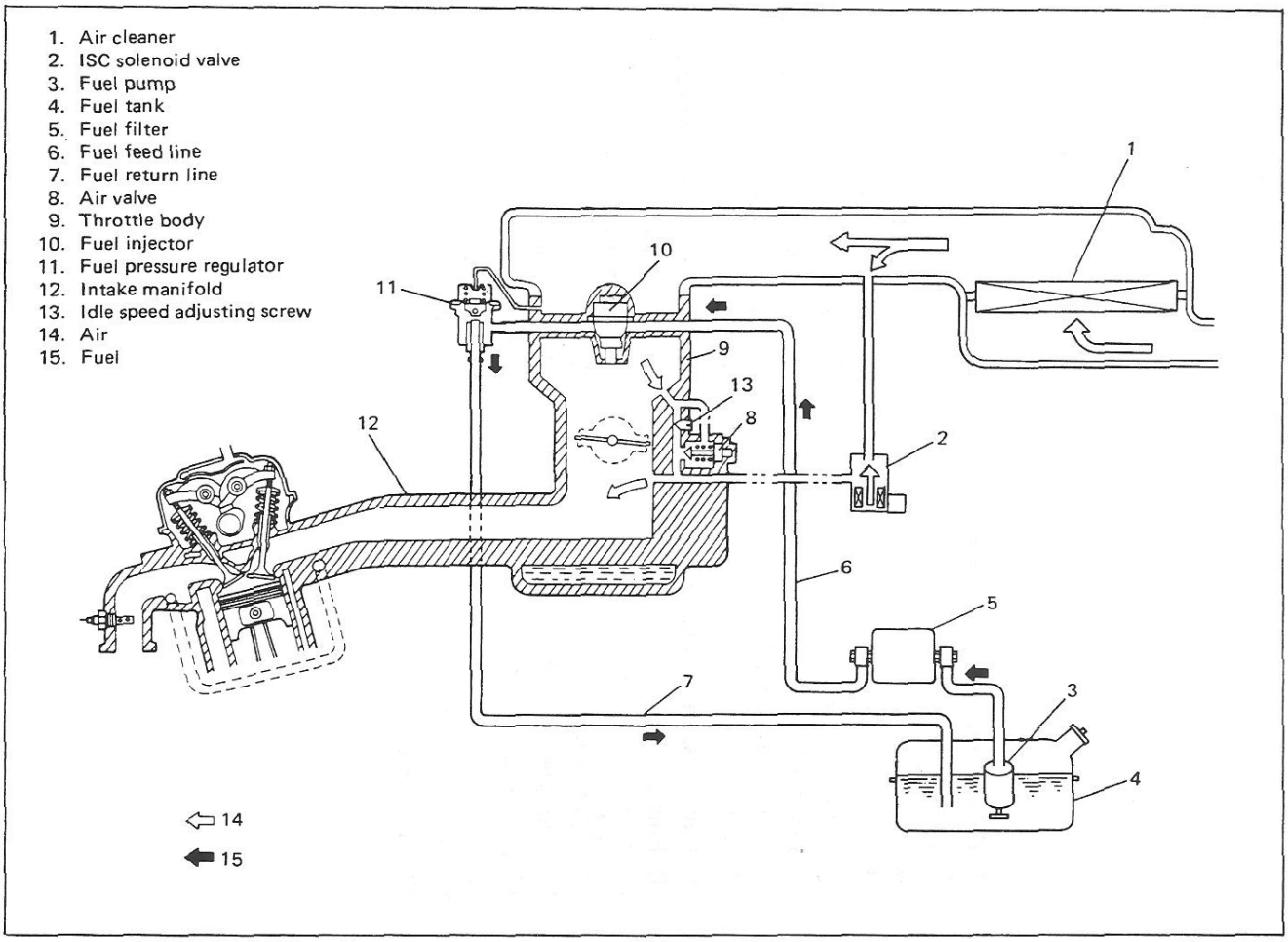


Fig. 6E-2 Air and Fuel Delivery System

Fuel Pump

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

Operation

When power is supplied to the fuel pump, the motor in the pump runs and so does the impeller. This causes a pressure difference to occur between both sides of the impeller as there are many grooves around it. Then the fuel is drawn through the inlet port, and with its pressure increased it is discharged through the outlet port.
The fuel pump also has a relief valve to prevent excessive rise of the discharge pressure and a check valve to keep some pressure in the fuel feed line even when the fuel pump is stopped.

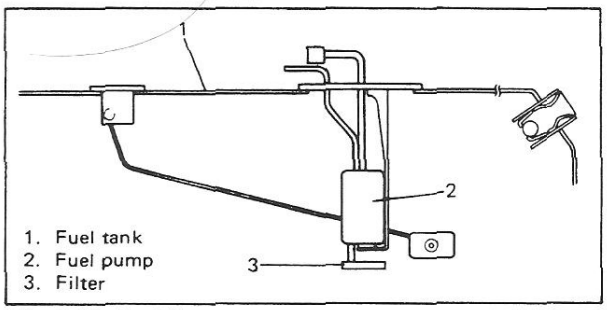


Fig. 6E-3 Fuel Pump

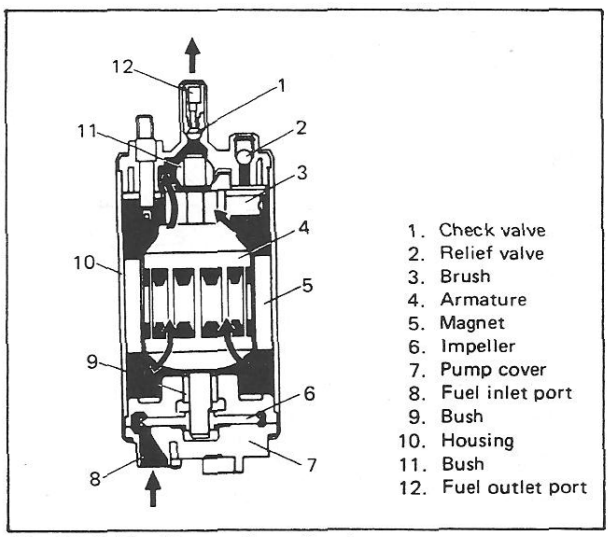


Fig. 6E-4 Fuel Pump Cross-Section

Throttle Body

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

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

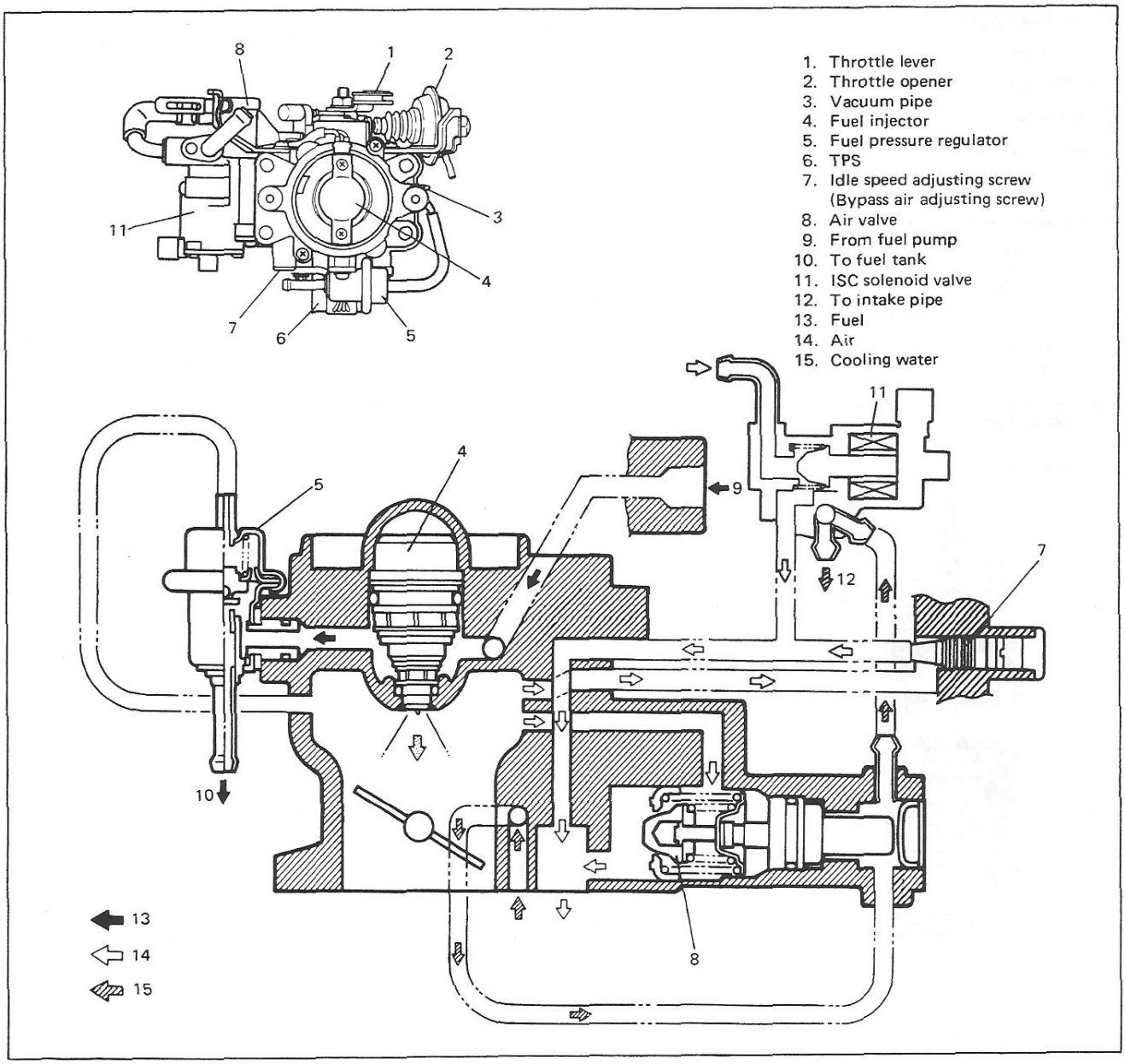


Fig. 6E-5 Throttle Body Cross-Section

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).

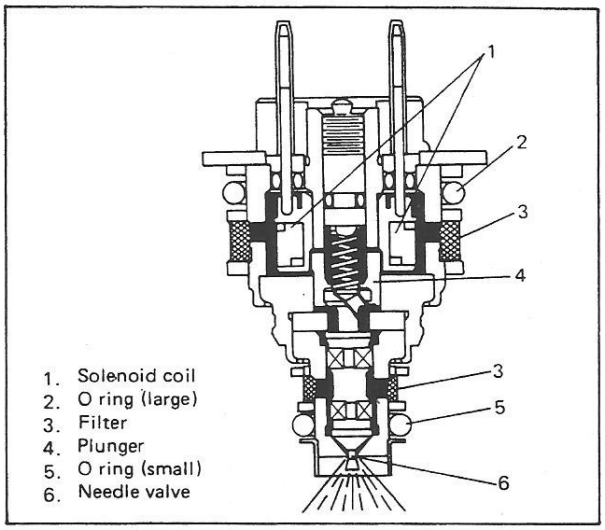


Fig. 6E-6 Injector Cross-Section

Fuel Pressure Regulator

The fuel pressure regulator keeps the fuel pressure applied to the injector 2.65 kg/cm² (265 kPa) higher than that in the throttle body (around injector) at all times.

The pressure applied to the chamber "A" of fuel pressure regulator is the pressure in throttle body and that to the chamber "B" is fuel pressure.

When the fuel pressure rises more than 2.65 kg/cm² (265 kPa) higher than the pressure in the throttle body, the fuel pushes the valve in the regulator open and excess fuel returns to the fuel tank via the return pipe.

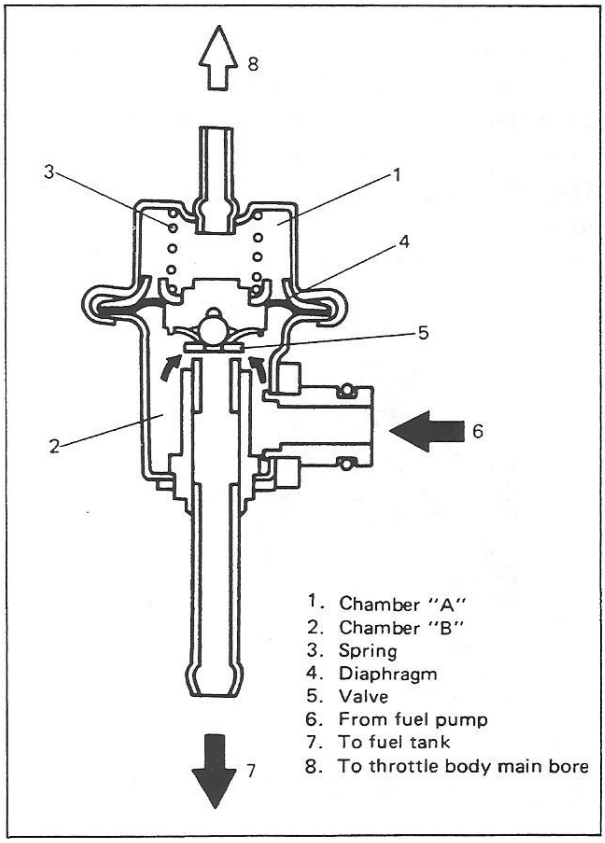


Fig. 6E-7 Pressure Regulator Cross-Section

Air Valve

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

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

Operation

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

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

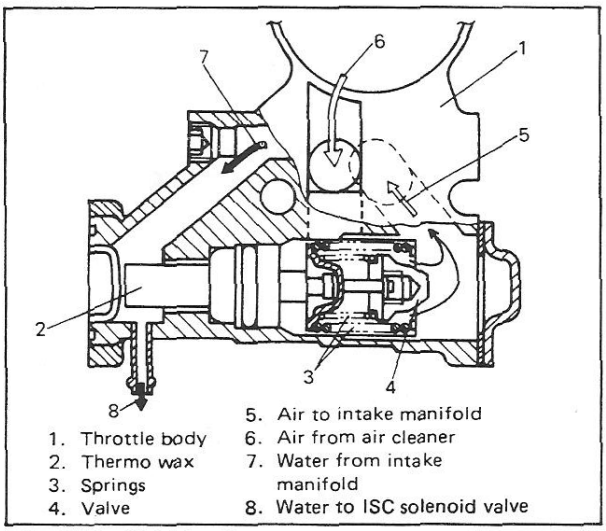


Fig. 6E-8 Air Valve Open

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

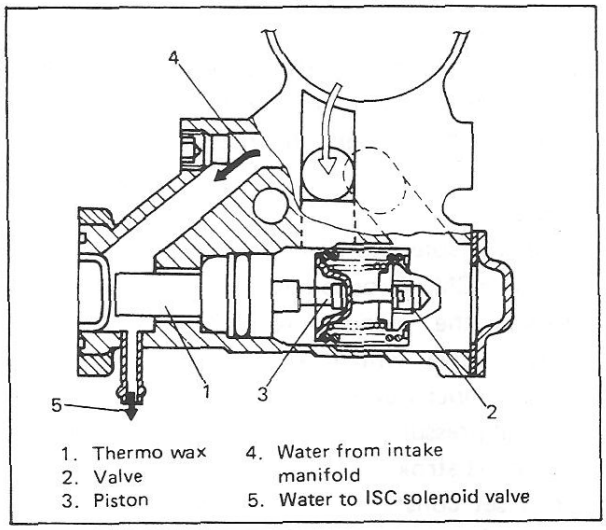


Fig. 6E-9 Air Valve Closed

ISC (Idle Speed Control) Solenoid Valve

The ISC solenoid valve controls opening of the bypass air passage (i.e., bypass air flow). The opening increases and decreases according to the electric current flow to the ISC solenoid which is controlled by ECM.

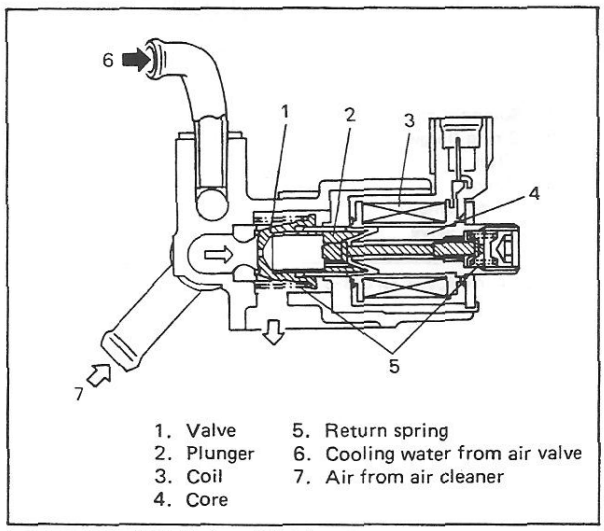
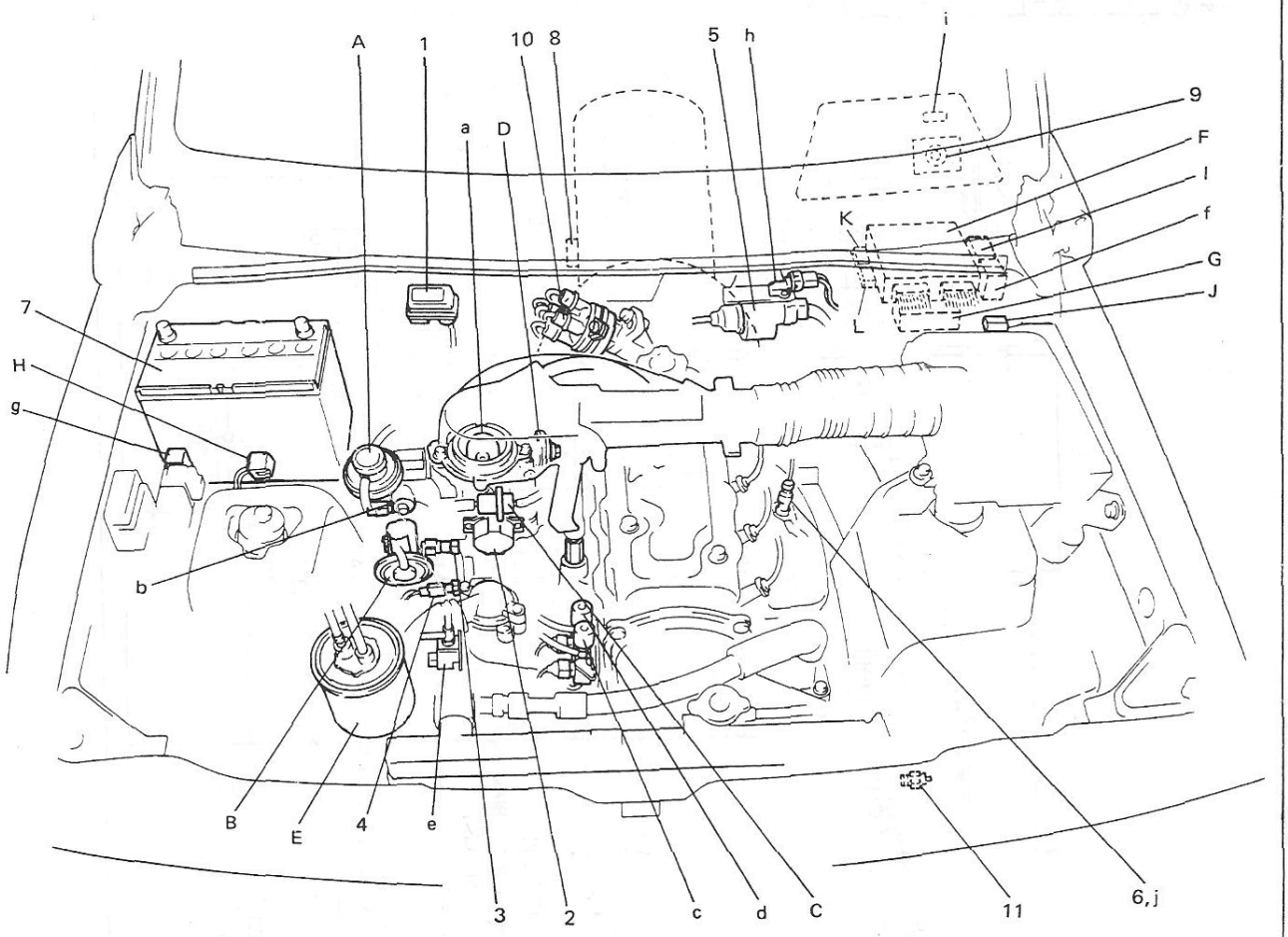


Fig. 6E-10 ISC Solenoid Valve Cross-Section

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.
Functionally, it is divided into 9 sub systems:

- Fuel injection control system
- ISC solenoid valve control system
- Fuel pump control system
- Throttle opener control system
- EGR control system
- ESA control system
- Fuel evaporative emission control system
- Lock-up relay control system (A/T only)
- Oxygen sensor heater control system



INFORMATION SENSORS
1. Pressure sensor
2. Throttle position sensor
3. Air temp. sensor
4. Water temp. sensor
5. Ignition coil
6. Oxygen sensor with heater
7. Battery
8. Shift switch (A/T only)
9. Vehicle speed sensor
10. CAS (in distributor)
11. Power steering pressure switch (if equipped)

CONTROLLED DEVICES
a : Injector
b : ISC solenoid valve
c : Throttle opener VSV (Brown)
d : EGR VSV (Blue)
e : Canister purge VSV
f : Fuel pump relay
g : Lock-up relay (A/T only)
h : Igniter (Power unit)
i : "CHECK ENGINE" light
j : Oxygen sensor heater

OTHERS
A : EGR modulater
B : EGR valve
C : Fuel pressure regulator
D : Throttle opener
E : Canister
F : ECM
G : Fuse box
H : Monitor coupler
I : Main relay
J : Noise suppressor
K : Monitor coupler
L : Serial data link

Fig. 6E-11 Component Parts Location

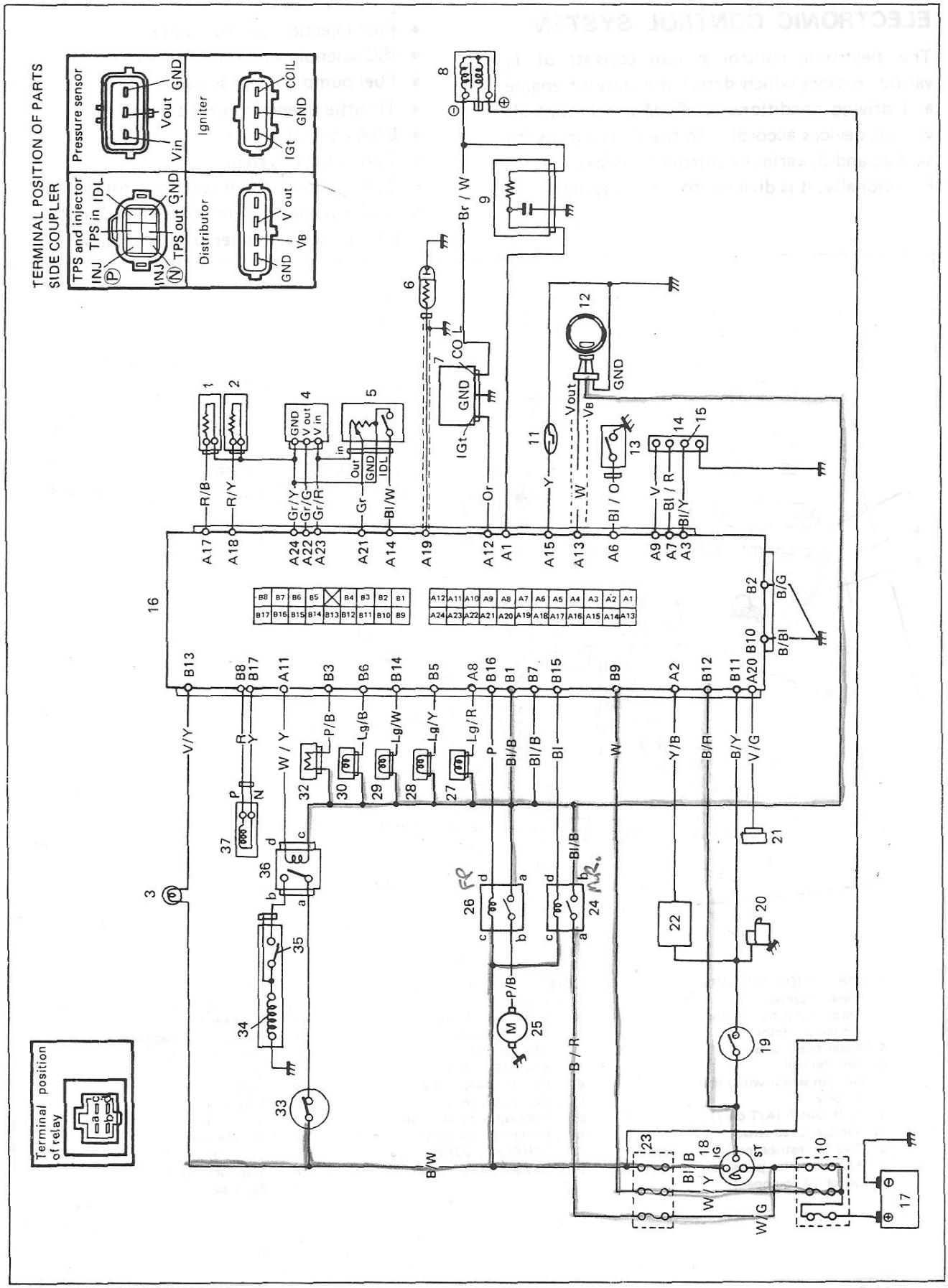


Fig. 6E-12 System Wiring Diagram

1. ATS
2. WTS
3. "CHECK ENGINE" light
4. Pressure sensor
5. TPS
6. Oxygen sensor
7. Igniter (Power unit)
8. Ignition coil
9. Noise suppressor
10. Main fuse
11. VSS
12. CAS (in distributor)
13. Power steering pressure switch (if equipped)
14. Monitor coupler
15. Diag. switch terminal
16. ECM
17. Battery
18. Main switch
19. Shift switch (A/T)
20. Starter magnetic switch
21. Serial data terminal
22. A/C amplifier (if equipped)
23. Circuit fuse
24. Main relay
25. Fuel pump
26. Fuel pump relay
27. Canister purge VSV
28. EGR VSV
29. Throttle opener VSV
30. ISC solenoid valve
31. Blank
32. Oxygen sensor heater
33. Brake pedal switch (A/T)
34. Lock-up solenoid (A/T)
35. Oil pressure switch (A/T)
36. Lock-up relay
37. Fuel injector

Wire color

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

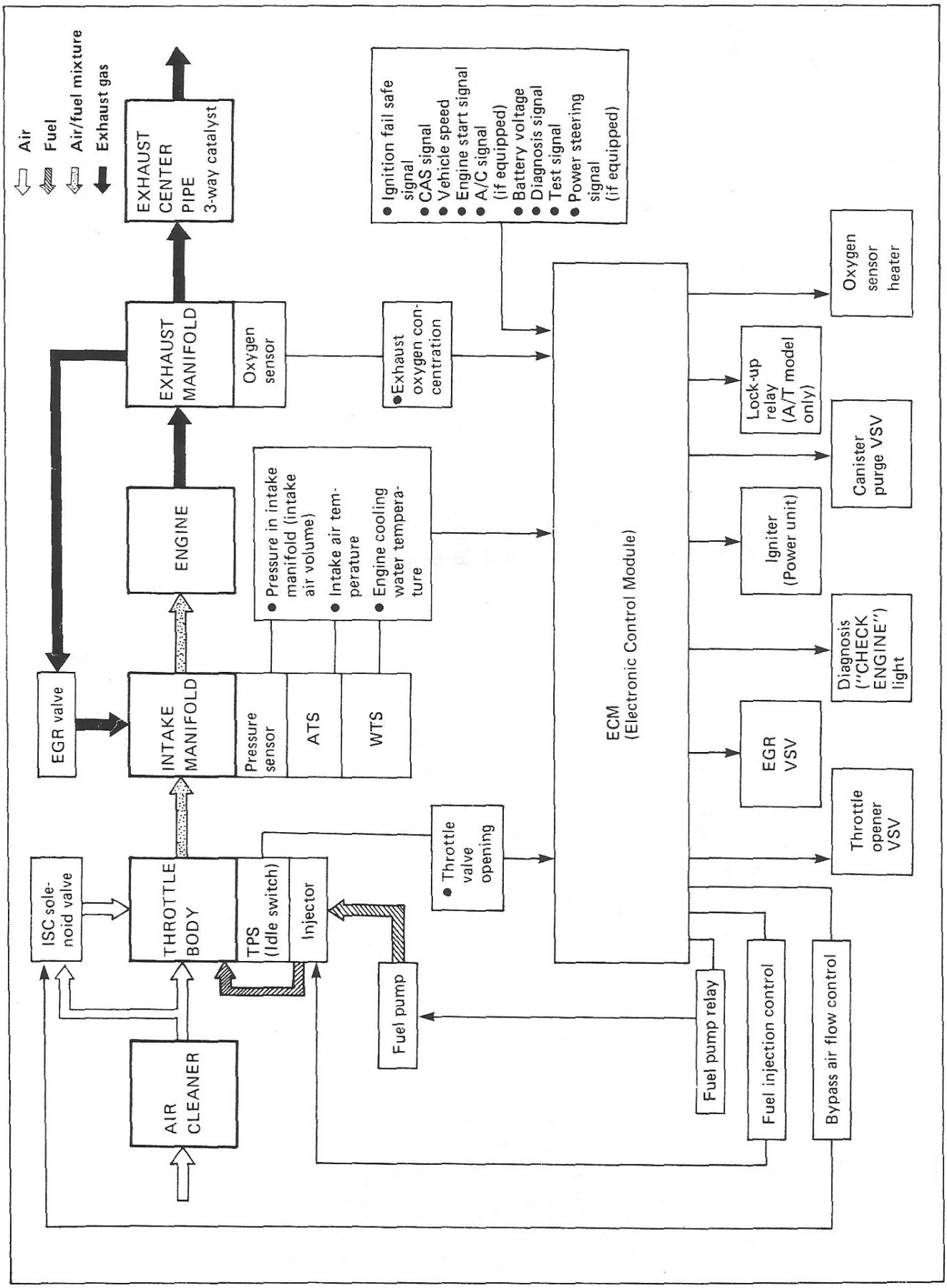


Fig. 6E-13 System Schematic

Electronic Control Module (ECM)

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

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

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

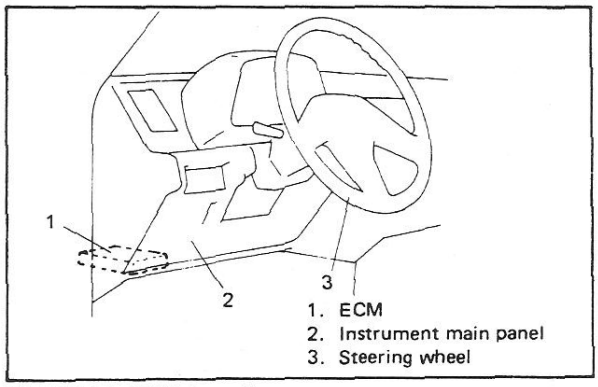


Fig. 6E-14 ECM Location

Self-diagnosis function

When any of such troubles as listed below occurs in Electronic Fuel Injection system, ECM activates "CHECK ENGINE" light while engine is running to warn the driver of occurrence of such trouble and stores the data on defective area (where trouble occurred) in its 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 20 seconds or longer.) ECM also indicated defective 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).

- When ECM received a defect informing signal from any one of following sensors and circuits or no signal whatever
  - *Oxygen sensor
  - *ATS
  - *Pressure sensor
  - *WTS
  - *TPS
  - *VSS
  - *Idle switch
  - *CAS
  - *Ignition circuit

- When CPU (Central Processing Unit) of ECM fails to operate

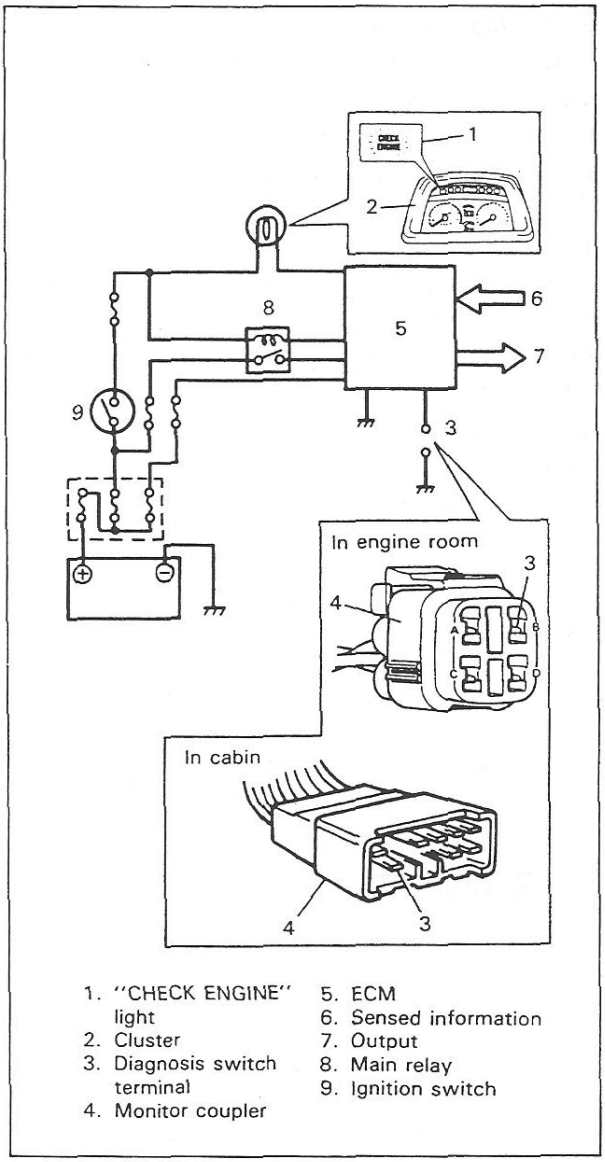
NOTE:

- **Even when a trouble occurs in CAS or idle switch circuit (circuit open), ECM does not indicate it (or activate "CHECK ENGINE" light) while engine is running.**
  And when that troubled circuit regains good condition, the memory of defective area will be erased automatically even if the power circuit to ECM is not opened as described above.

- **Only ignition circuit trouble (code No. 41 among the above areas is not stored in back-up memory of ECM. (In other words, even if ECM has detected a trouble in ignition circuit, once ignition switch is turned OFF, code No. 41 will not be indicated even when diagnosis switch terminal is grounded and ignition switch is turned ON.).**
  Therefore, to check diagnostic code when engine fails to start, crank engine and then ground diagnosis switch terminal with ignition switch ON.

["CHECK ENGINE" light]
"CHECK ENGINE" light is located among the instrument cluster. It indicates each result of diagnosis done by ECM's self-diagnosis function. It also lights under the conditions as described below regardless of Electronic Fuel Injection system condition.

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



1. "CHECK ENGINE" light
2. Cluster
3. Diagnosis switch terminal
4. Monitor coupler
5. ECM
6. Sensed information
7. Output
8. Main relay
9. Ignition switch

Fig. 6E-15 "CHECK ENGINE" Light Circuit

Fail-safe function

When a failure occurs in any of the sensors listed below and their circuits, a signal indicating such failure is fed to ECM, which judges that signal as such.

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

- WTS
- TPS
- ATS
- Pressure sensor

Back-up function

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

Pressure (Intake manifold absolute pressure) Sensor (PS)

This sensor senses pressure change in the intake manifold and converts it into voltage change. It consists of a semi-conductor type pressure converting element which converts a pressure change into an electrical change and an electronic circuit which amplifies and corrects the electric change.

The ECM sends a 5-volt reference voltage to the pressure sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By monitoring the sensor output voltage, ECM knows the manifold pressure (intake air volume).

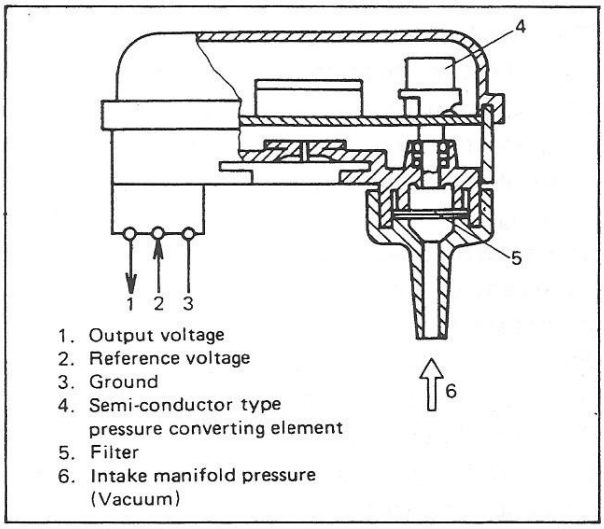


Fig. 6E-17 Pressure Sensor

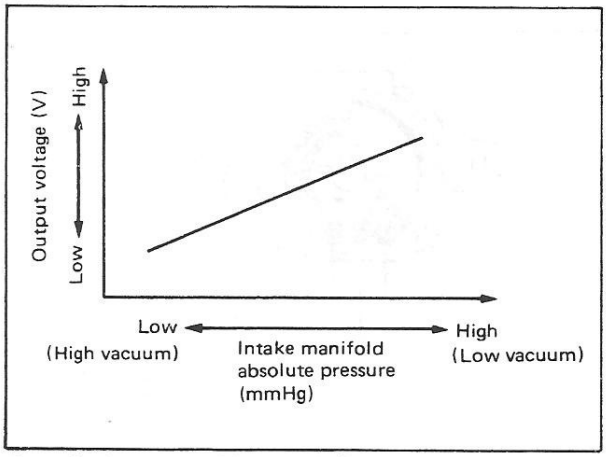


Fig. 6E-18 Output Characteristic

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

Throttle Position Sensor (TPS)

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

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

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

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

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

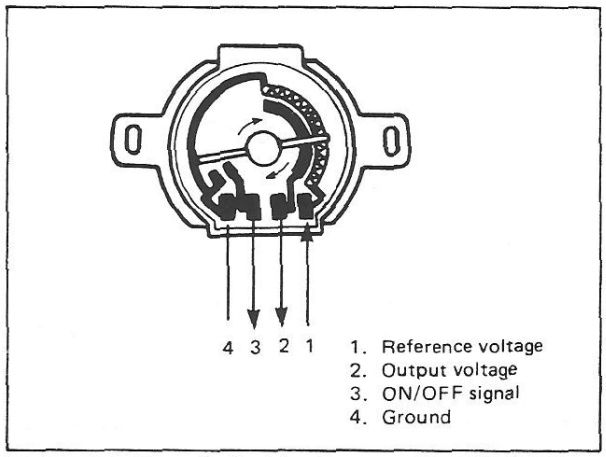


Fig. 6E-19 Throttle Position Sensor

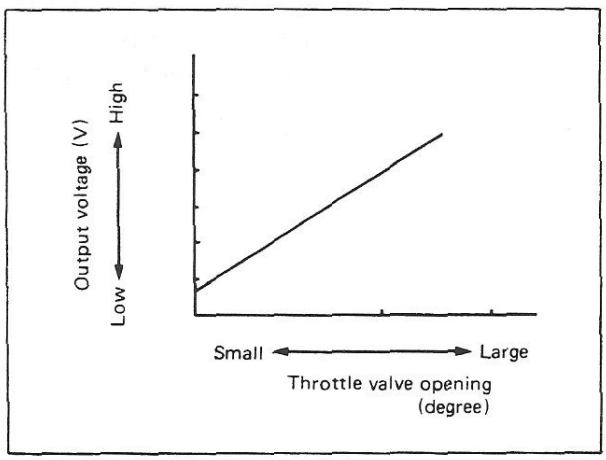


Fig. 6E-20 Output Characteristic

Air Temperature Sensor (ATS)

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

Water Temperature Sensor (WTS)

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

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

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

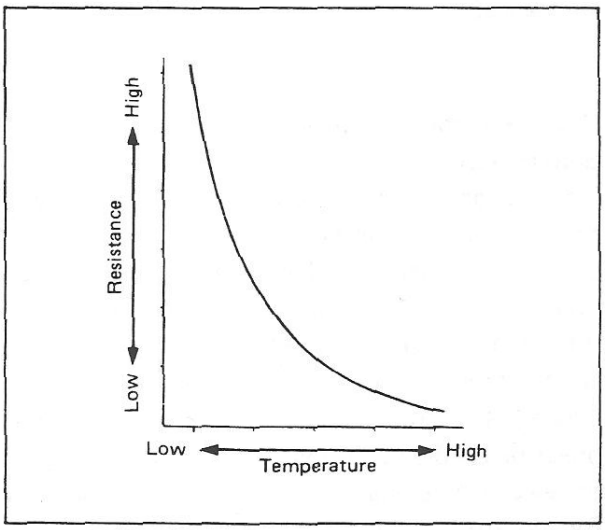


Fig. 6E-21 Air/Water Temperature Sensor Characteristic

Oxygen Sensor with Heater

The oxygen sensor is installed on the exhaust manifold to detect the concentration of oxygen in the exhaust gases. The heater promotes activation of the oxygen sensor.

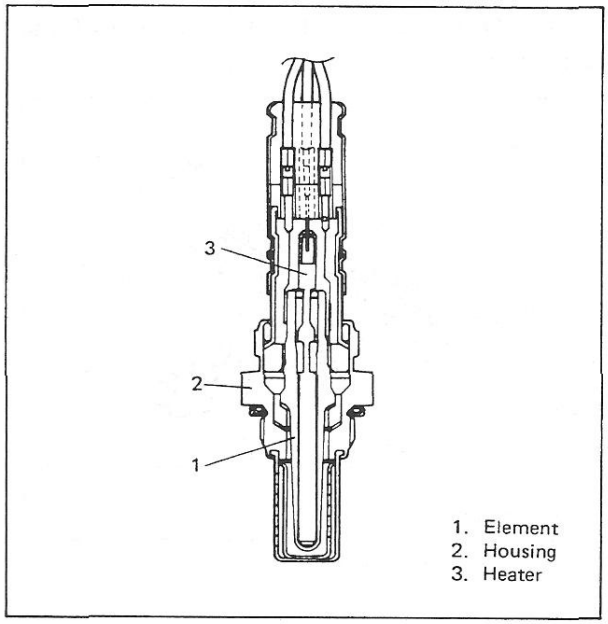


Fig. 6E-23 Oxygen Sensor

Vehicle Speed Sensor (VSS)

The VSS 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 vehicle speed and is sent to ECM as pulse signals.

ECM uses it as one of the signals to control the ISC solenoid valve.

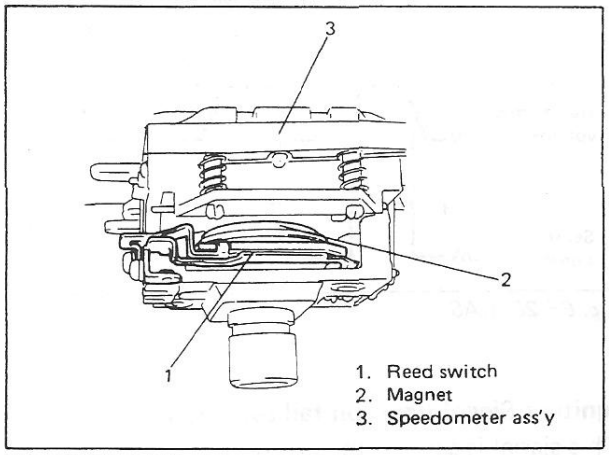


Fig. 6E-24 VSS

Crank Angle Sensor (CAS)

The crank angle sensor located in the distributor consists of the signal generator (hall element and magnet) and signal rotor.

As the signal rotor turns, it causes the magnetic flux from the magnet to be applied to the hall element intermittently. The hall element generates the voltage in proportion with the magnetic flux as shown below. This voltage is wave-shaped into the pulse signal (sensor signal) by the comparator.

This pulse signal (4 pulses/revolution) is sent to ECM where it is used to calculate the engine speed and also as one of the signals to control fuel injector and ignition timing.

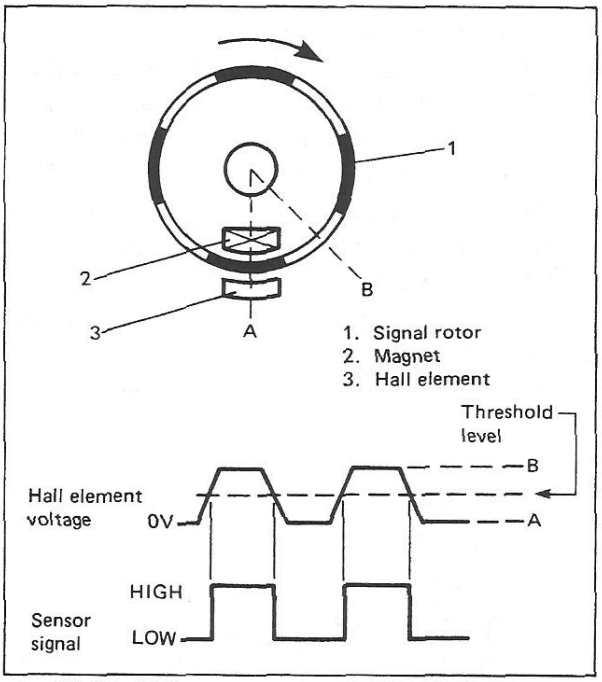


Fig. 6E-25 CAS

Ignition Signal (ignition fail safe signal)
This signal is sent from ignition circuit.
ECM uses it as one of the signals for controlling fuel injector.

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

Power Steering Signal (For vehicle with power steering)
This signal is sent from the power steering pressure switch. The power steering pressure switch is installed on the power steering pump body. The switch turns ON when the oil pressure is higher than 15 – 20 kg/cm^2 (215 – 285 psi).
The turning of the steering wheel causes increased oil pressure.
ECM uses it as one of the signals for controlling ISC solenoid valve operation.

Shift Switch (A/T only)
Located on the transmission, it turns ON when the select lever is in the park or neutral position. ECM detects whether the transmission is in the parking or neutral state or in any other state through this ON/OFF signal and uses it as one of the signals to control ISC solenoid valve.

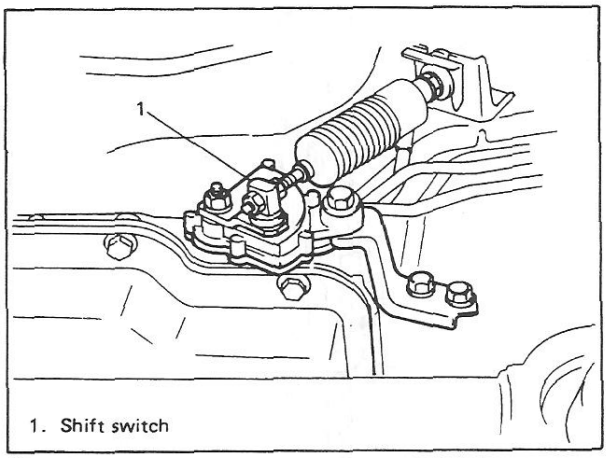


Fig. 6E-26 Shift Switch Position

Air-Conditioner Signal (For vehicle with A/C)
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 monitor coupler in the cabin 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 outputs ISC duty through duty check terminal.

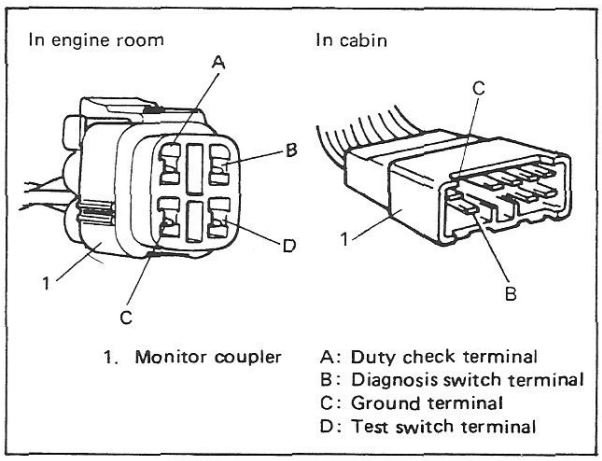


Fig. 6E-27 Diagnosis and Test Switch Terminals

Test Switch Terminal

The test switch terminal is included in the engine-room monitor coupler. When this terminal is grounded, ECM sets the ignition timing to the initial one.

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

FUEL INJECTION CONTROL SYSTEM

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

Injection Timing

- At start

Fuel is injected at a certain cycle starting immediately after the initial CAS signal is inputted.

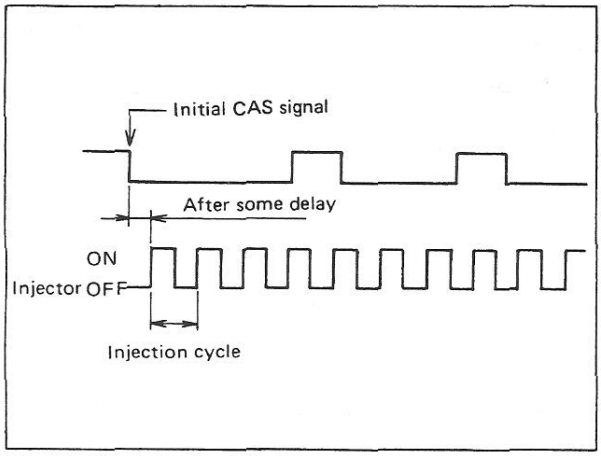


Fig. 6E-28 Injection Timing at Start

- In normal driving (Standard injection timing)

Fuel is injected at every ignition signal (ignition fail safe signal) synchronously.

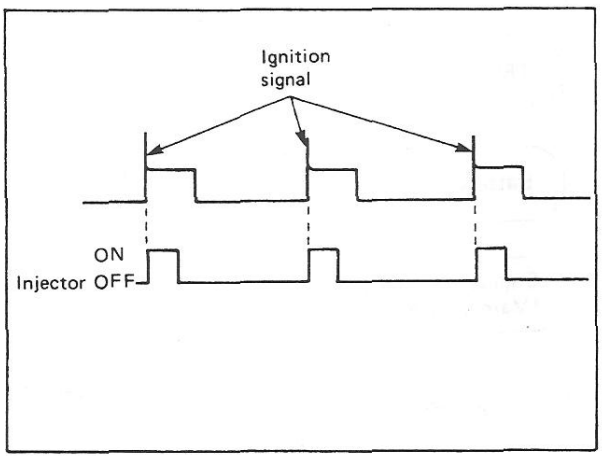


Fig. 6E-28-1 Injection Timing in Normal Driving

- When accelerating (Additional injection timing)

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

Injection Time (amount of injection)

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

NOTE:

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

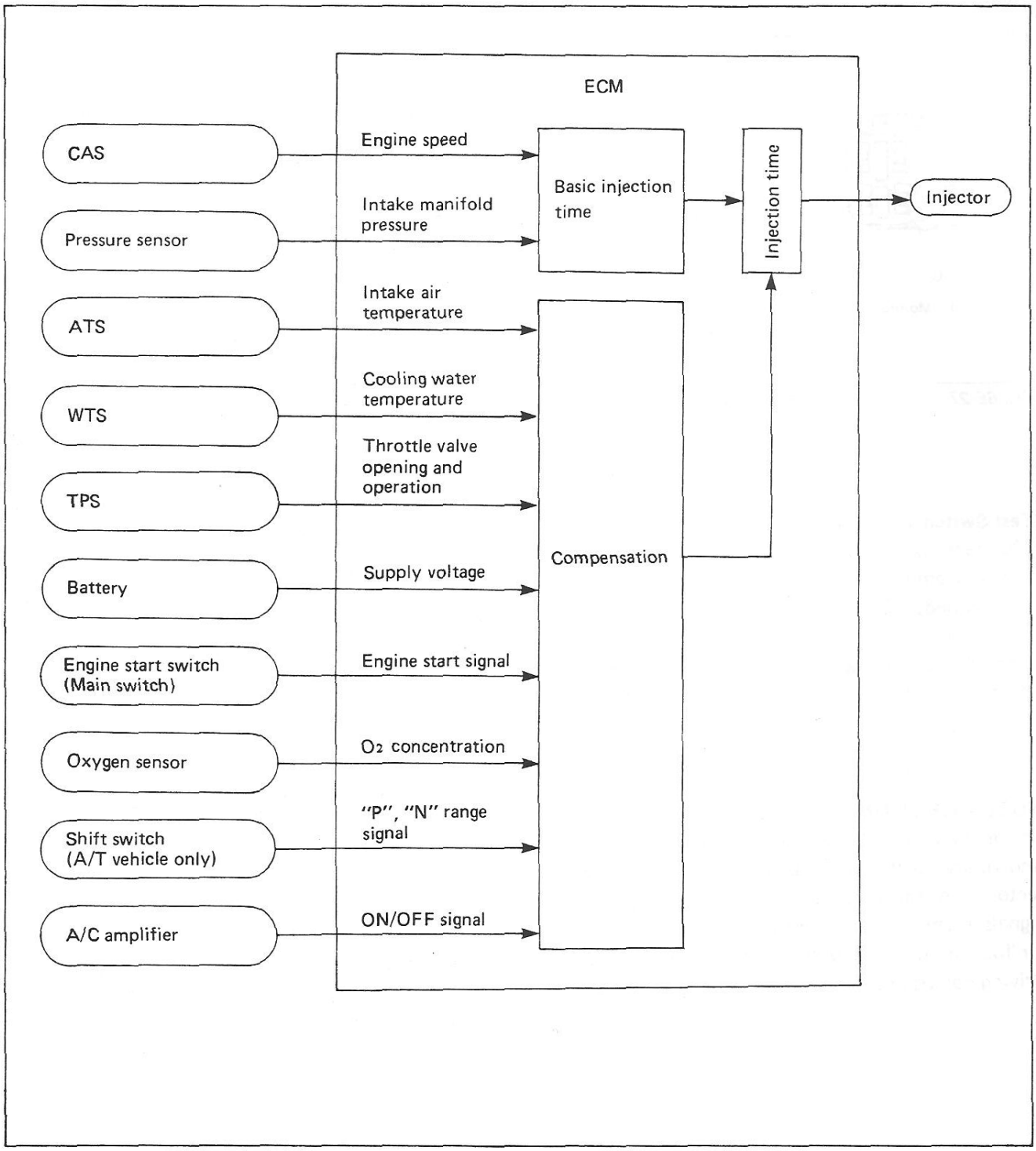


Fig. 6E-28-2 Parameter Diagram

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

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

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

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

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

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

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

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

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

Fuel cut
When decelerating quickly, the fuel supply is cut or decreased to prevent unburned gas from being emitted by making the injector operating time as ineffective injection time.
Also, when the engine speed exceeds 6,800 r/min, the fuel supply is cut to protect the engine by making the injector operating time as ineffective injection time. The normal injection is restored when the engine speed is 6,500 r/min or lower.

Fuel feed back compensation (Air/fuel ratio compensation)

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

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

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

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

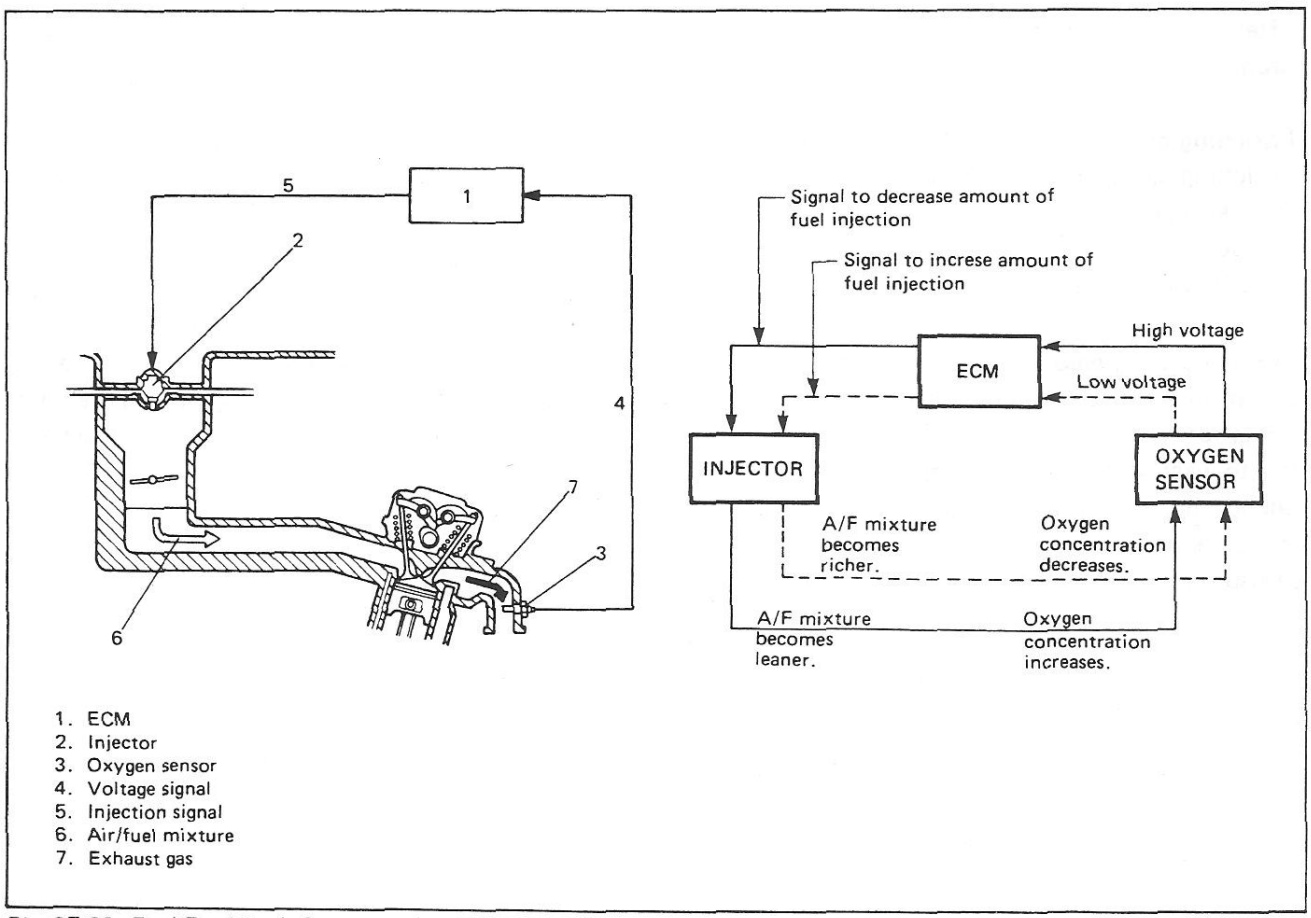


Fig. 6E-29 Fuel Feed Back Compensation

OXYGEN SENSOR HEATER CONTROL SYSTEM

The oxygen sensor heater is located in the oxygen sensor. Controlled by ECM, it operates when the engine is running at a low speed with a low load to activate the oxygen sensor.

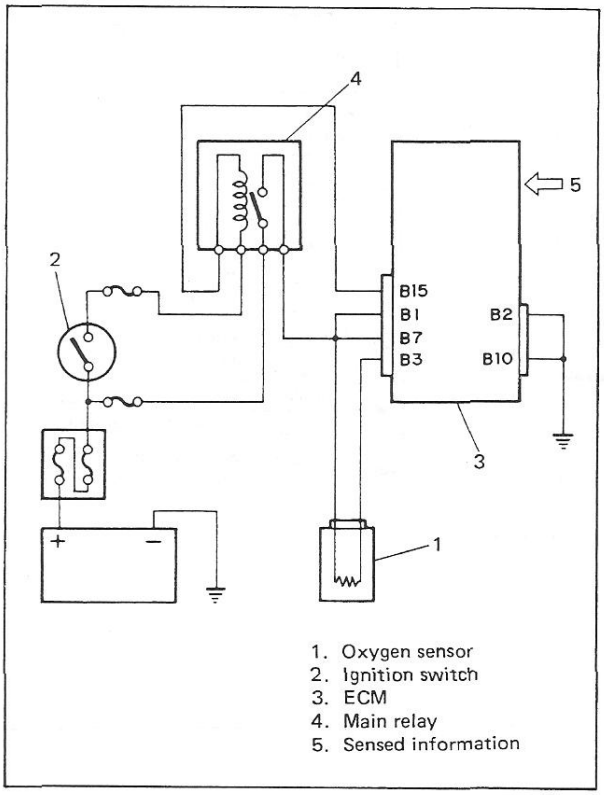


Fig. 6E-29-1 System Circuit

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, 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

ECM detects the engine condition by using signals from various sensors and switches, and controls bypass air flow (ISC solenoid valve opening) by increasing and decreasing the electric current of ISC solenoid.

While the engine is cranking, ECM opens ISC solenoid valve (maximum electric current) so as to obtain better start of the engine.

When the accelerator pedal is depressed while the engine is running (the idle switch is OFF and the throttle valve is at other than idle position), ECM allows the electric current to flow to the ISC solenoid by such amount that is determined according to the engine conditions (thus controlling bypass air flow) and keeps it.
When decelerating, on the other hand, ECM reduces the electric current of ISC solenoid gradually (i.e., the bypass air flow is reduced gradually) to obtain dash-pot effect.

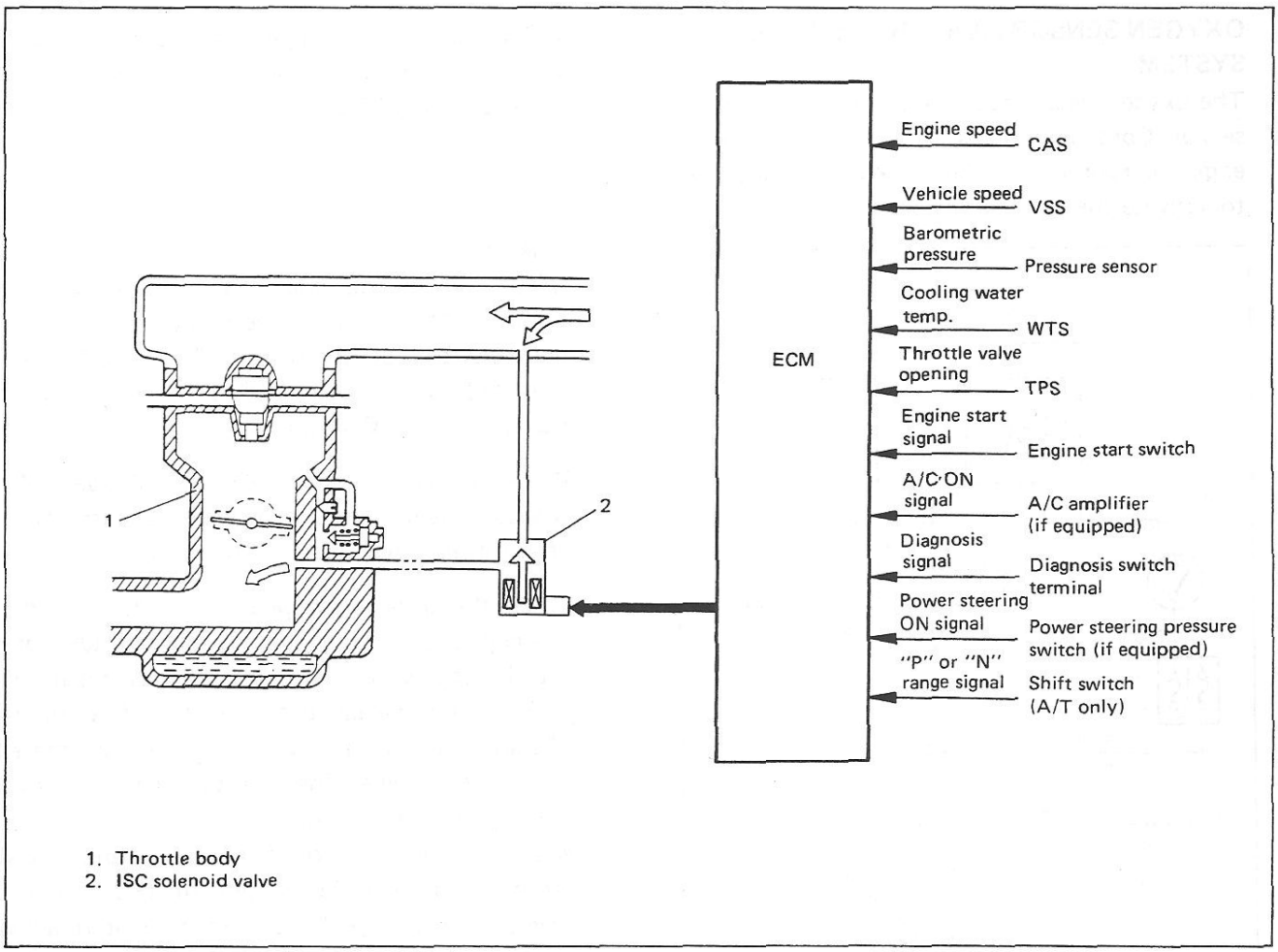
When the vehicle is at a stop, the throttle valve is at the idle position and the engine is running, ECM controls the bypass air flow by increasing or decreasing the electric current of ISC solenoid valve so that the engine speed is kept at a specified idle speed.

M/T vehicle

	A/C OFF	A/C ON
Engine idle speed specification	800 ± 50 r/min.	1,000 ± 50 r/min.

A/T vehicle

		A/C OFF	A/C ON
Engine idle speed specification	"P" or "N" range	800 ± 50 r/min.	1,000 ± 50 r/min.
	"R", "D", "2" or "L" range	800 ± 50 r/min.	800 ± 50 r/min.



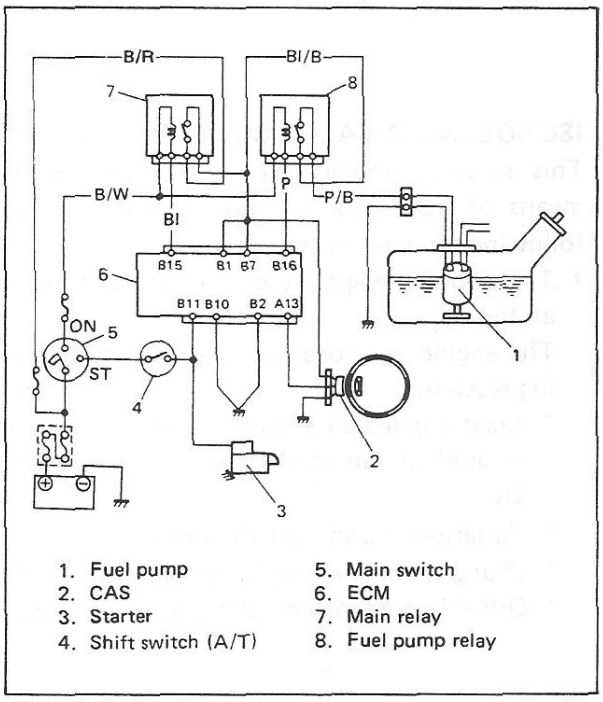
1. Throttle body
2. ISC solenoid valve

Fig. 6E-30 ISC Solenoid Valve Control System

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



1. Fuel pump
2. CAS
3. Starter
4. Shift switch (A/T)
5. Main switch
6. ECM
7. Main relay
8. Fuel pump relay

Fig. 6E-31 Fuel Pump Circuit

THROTTLE OPENER CONTROL SYSTEM

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

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

ECM controls VSV according to the engine speed, starter signal and signal from the WTS and turns ON the electric circuit of VSV when;

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

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

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

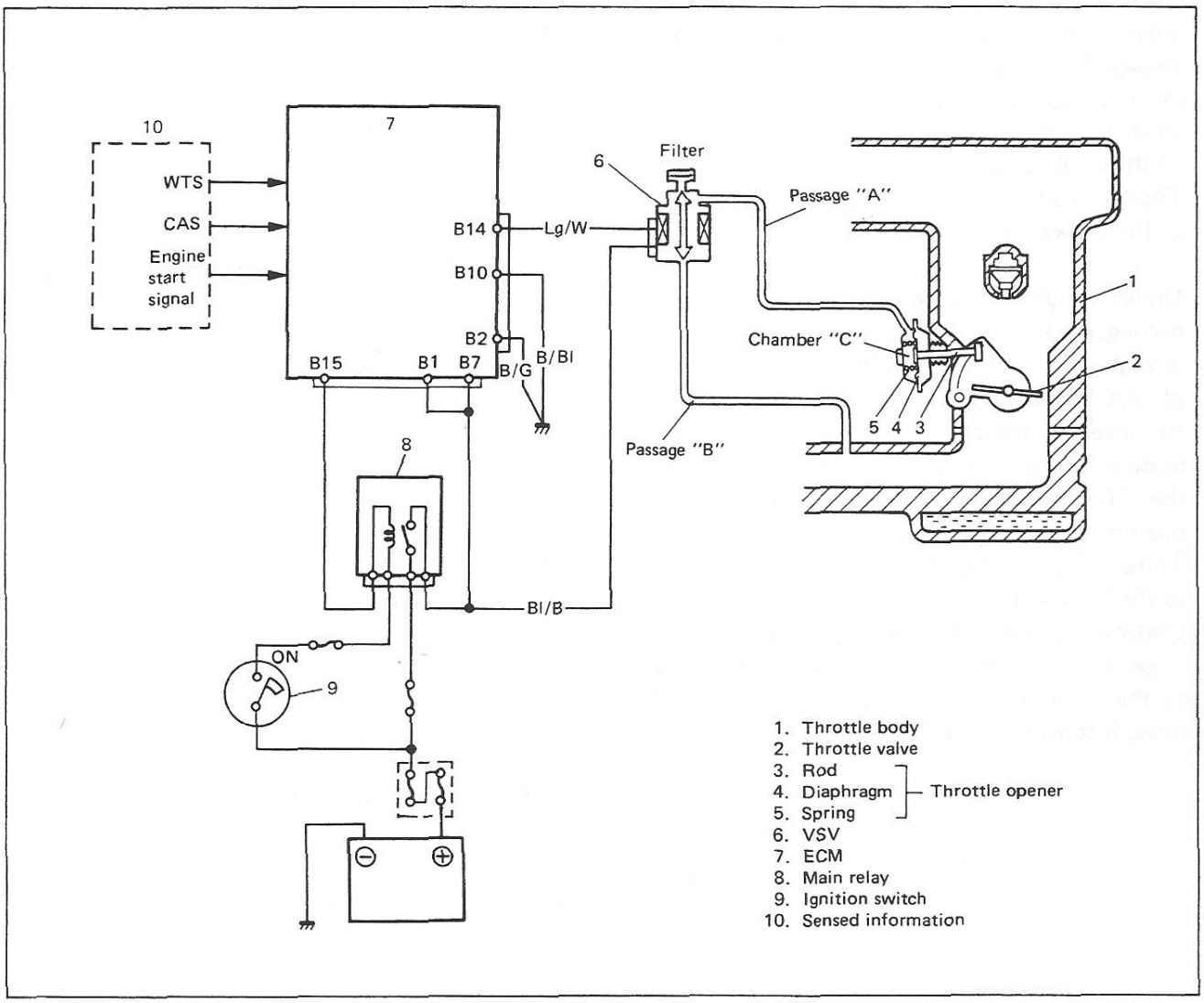


Fig. 6E-32 Throttle Opener Control System

EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM

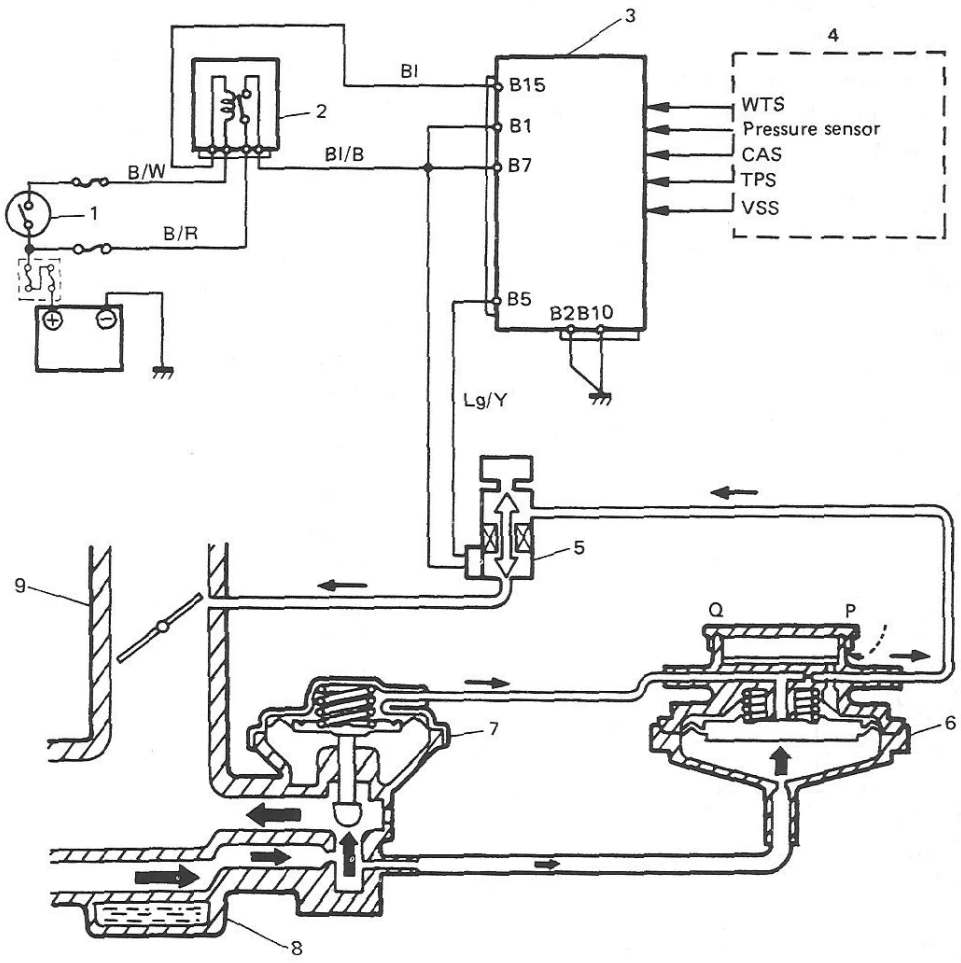
This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifold.
The EGR valve is controlled by EGR modulator and VSV controlled by ECM according to signals from various sensors.
The diaphragm mounted in the EGR modulator is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

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

Under a high load condition such as high speed driving, on the other hand, the exhaust pressure is high. By the high exhaust pressure, the diaphragm in the modulator is pushed up and closes its valve. As the air does not enter the vacuum passage in this state, the vacuum transmitted to the EGR valve grows larger and so does the opening of the EGR valve.
Thus, larger amount of exhaust gas is recirculated to the intake manifold.
Under any one of the following 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 barometric pressure is low (at high altitude)
- When engine is running at high load
- When engine speed is low.

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



1. Ignition switch
2. Main relay
3. ECM
4. Sensed information
5. VSV
6. EGR modulator
7. EGR valve
8. Intake manifold
9. Throttle body
10. Exhaust gas
11. Vacuum
12. Air

Fig. 6E-33 EGR Control System

ESA (ELECTRONIC SPARK ADVANCE) SYSTEM

This system controls electronically the time of electric current flow to ignition primary coil as well as ignition timing.

ECM judges the engine condition by using signals from various sensors, selects the most suitable electric current flow time and ignition timing for that engine condition from among those pre-stored in its memory and sends a signal to the igniter (power unit).

The igniter turns ON and OFF the primary current of the ignition coil according to the signal from ECM.

Control of this system includes three different types as follows.

- Ignition timing control at engine start
- Ignition timing control after engine start
- Electric current flow time control

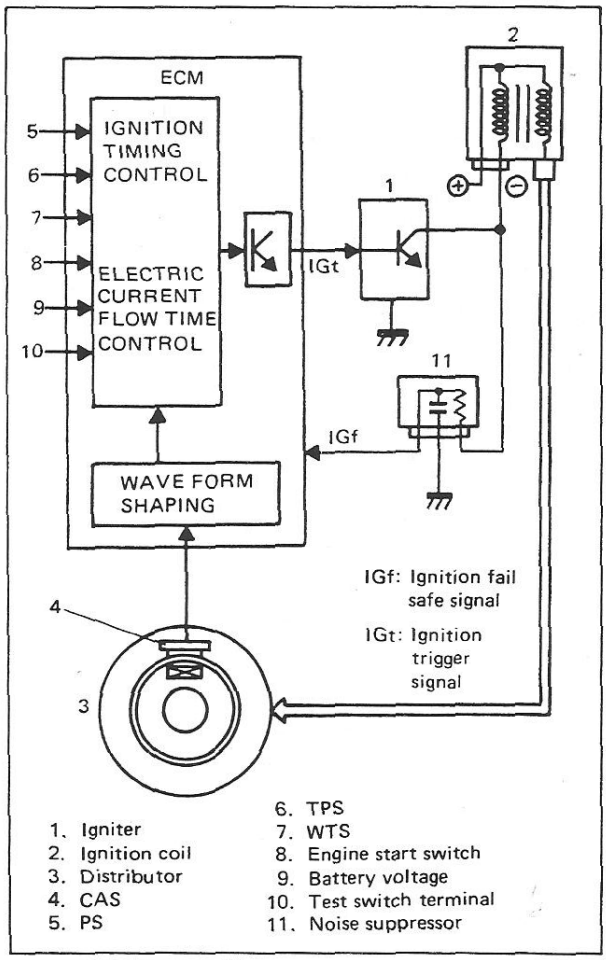


Fig. 6E-34 System Diagram

Ignition Timing Control at Engine Start

To obtain better starting performance of the engine at the engine start (when the engine start switch is turned ON or the engine speed is lower than 400 r/min.) ESA system sets the ignition timing to the initial ignition timing (BTDC 8°).

Ignition Timing Control After Engine Start

Under any conditions other than engine start, the ignition timing is determined according to the intake manifold pressure and the engine speed.

Electric Current Flow Time Control

To stabilize the secondary voltage generated in the ignition coil to a proper level, ESA system controls the time of primary current flow to the ignition coil.

NOTE:

The ignition timing is controlled by ECM as described above. Therefore, when checking or adjusting the ignition timing, the ignition timing must be fixed to the initial one by grounding the test switch terminal.

FUEL EVAPORATIVE EMISSION CONTROL SYSTEM

A fuel 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.

The canister purge VSV is controlled by ECM according to signals from various sensors.
Only when the following conditions are all satisfied, ECM opens vacuum passage of VSV.

- When engine cooling water temp. is higher than 50°C (122°F)
- When engine speed is higher than 1500 r/min.
- When throttle valve opens wider than idle position (Idle switch OFF)
- When engine is running with the load higher than specified.
- When vehicle speed is higher than 1.4 km/h (0.9 mile/h).

As a result, fuel vapor in the canister is sucked into intake manifold.

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

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

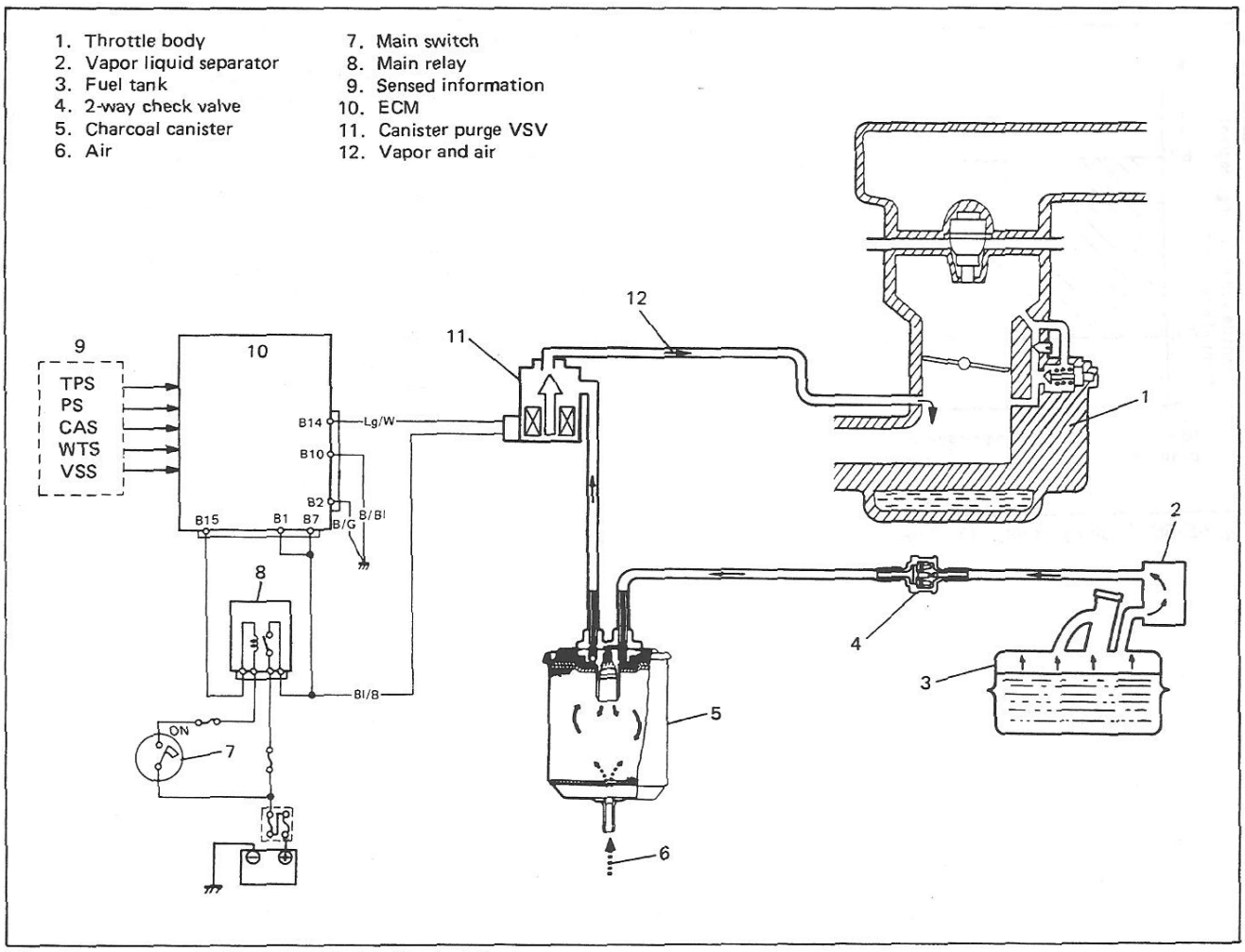


Fig. 6E-35 Fuel Evaporative Emission Control System

LOCK-UP RELAY CONTROL SYSTEM
(A/T vehicle only)

This system controls the lock-up solenoid which is one of the parts for controlling A/T torque converter clutch. Its circuit construction is as shown in Fig. 6E-37.

The lock-up solenoid, under the control of the brake pedal switch (stop light switch), A/T oil pressure switch and lock-up relay, opens and closes the A/T oil passage to lock and unlock torque converter clutch.

The factors which ECM uses to control the lock-up relay are the signals from the throttle position sensor (throttle opening), the ignition coil and the water temperature sensor (engine cooling water temperature). It turns ON the lock-up relay only when the throttle valve opening is in the shaded zone in the figure below, provided that the engine cooling water temperature is 60°C (140°F) or higher).

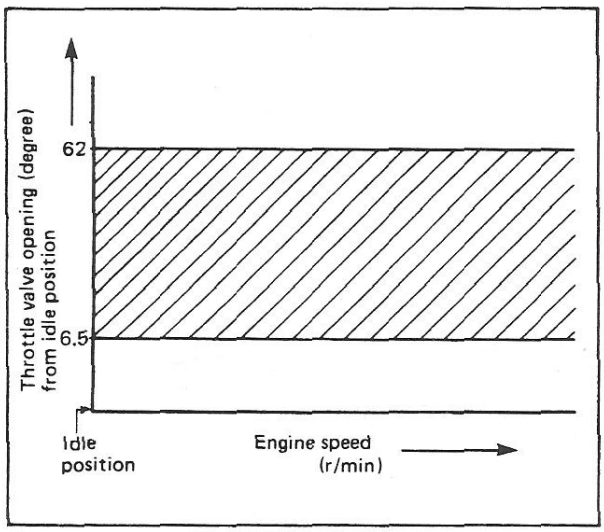


Fig. 6E-36 Lock-up Relay ON Zone

The battery voltage is applied to lock-up solenoid only when the lock-up relay is ON, the brake pedal is released (the brake pedal switch is ON) and the A/T oil pressure is higher than the specified pressure (the oil pressure switch is ON).

Even when the lock-up relay is ON, if the brake pedal is depressed or the A/T oil pressure is too low, the lock-up solenoid circuit opens and no voltage is applied.

For operation of the A/T torque converter clutch, refer to SECTION 7B "AUTOMATIC TRANSMISSION".

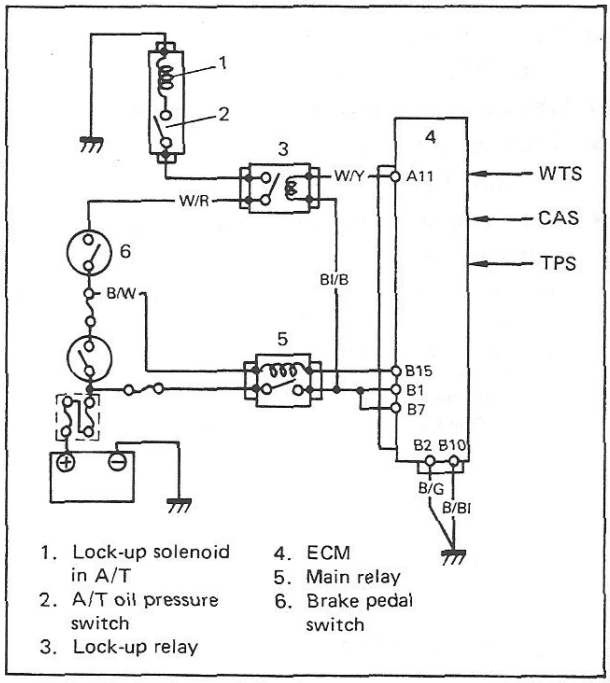


Fig. 6E-37 Lock-up Relay Control System

DIAGNOSIS

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

PRECAUTIONS IN DIAGNOSING TROUBLES

[PRECAUTIONS IN IDENTIFYING DIAGNOSTIC CODE]

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

[INTERMITTENT TROUBLE]

- 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 troubles
  Most intermittent problems are caused by faulty electrical connection 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 negative probe to body ground. Any other way is prohibited even by accident.
  Applying it improperly may cause the sensor or ECM to be shorted and damaged.

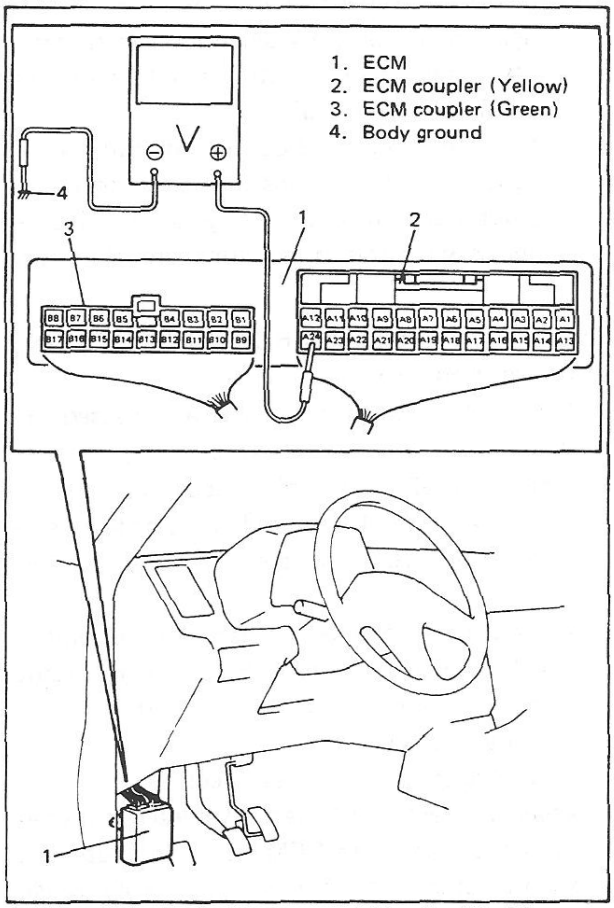


Fig. 6E-38 Checking Voltage and Terminal Position

- For ECM coupler terminal positions (A1, A2 . . . to A24 and B1, B2 . . . to B17), refer to Fig. 6E-38.
- When disconnecting and connecting coupler, make sure to turn ignition switch OFF.
- When there is a question "Are couplers connected properly? " in FLOW CHART, check male half of terminal for bend and female half for excessive opening, terminal for poor locking (looseness), corrosion, dust, etc.
- When connecting a probe of ohmmeter, voltmeter, etc. to coupler terminal, be sure to connect it from wire harness side of coupler.

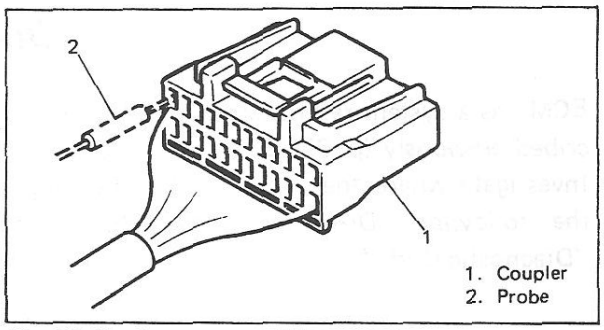


Fig. 6E-39 Connecting Meter Probe

- 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.

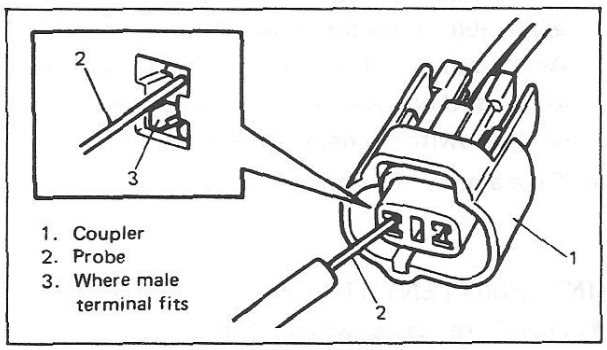


Fig. 6E-40 Connecting Meter Probe

- 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.

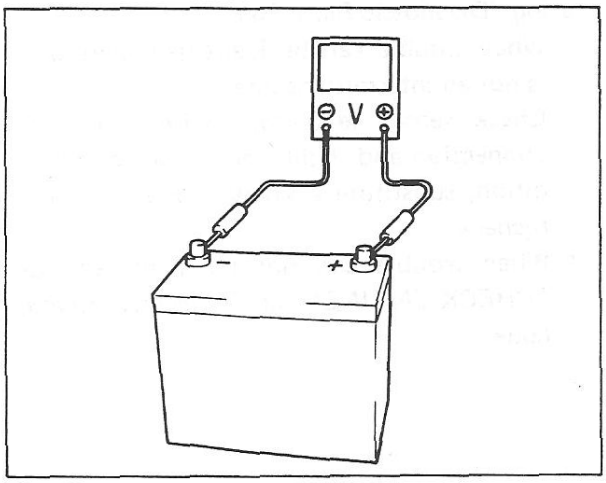


Fig. 6E-41 Checking Battery Voltage

DIAGNOSTIC FLOW CHART

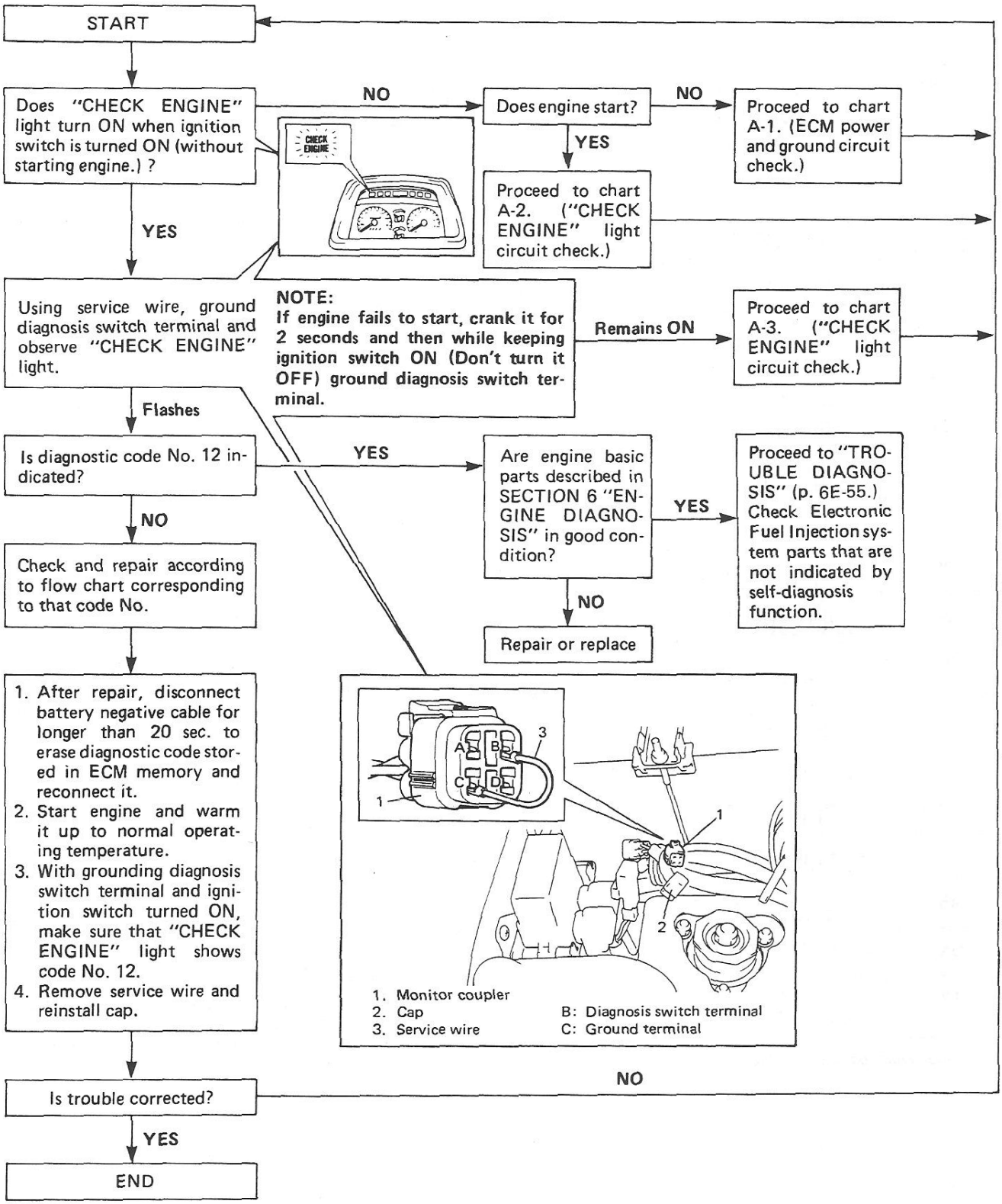
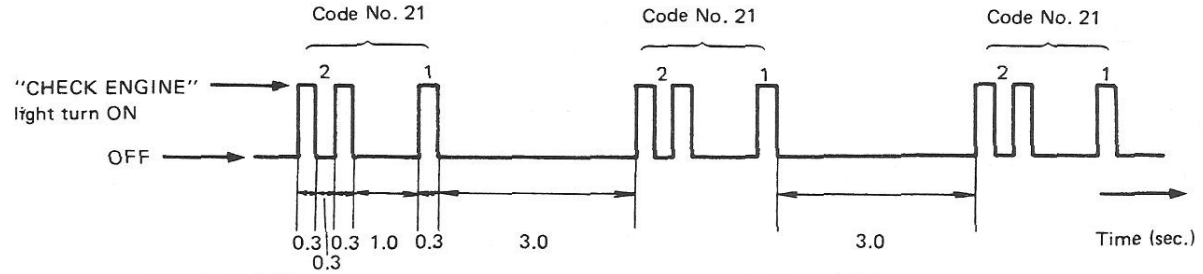


Fig. 6E-42 Diagnostic Flow Chart For Electronic Fuel Injection System

DIAGNOSIS CODE TABLE

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



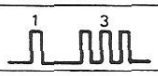
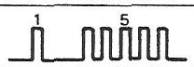
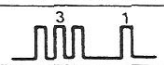
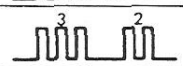
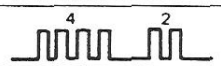
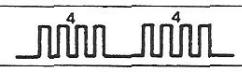
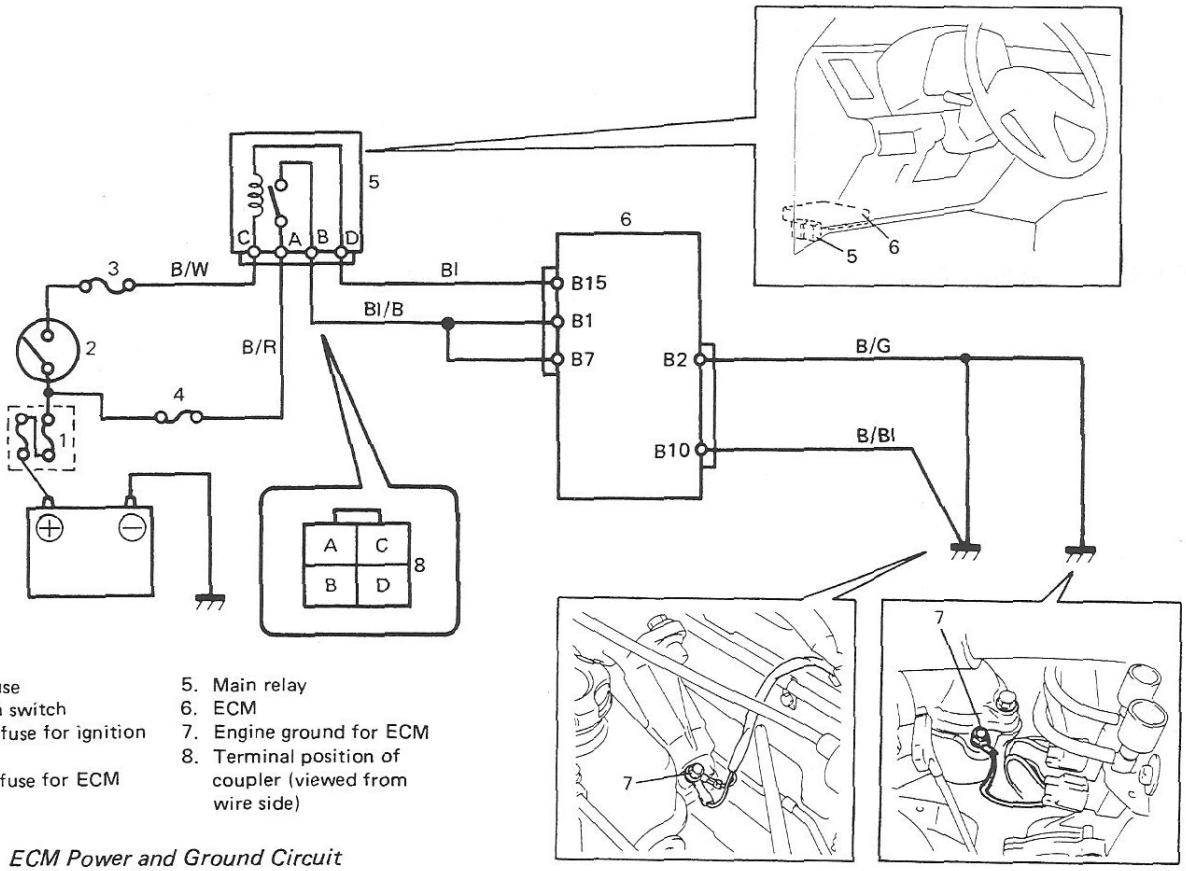
DIAGNOSTIC CODE NO.	"CHECK ENGINE" LIGHT FLASHING PATTERN	DIAGNOSTIC ITEM	DIAGNOSIS
13		Oxygen sensor	Diagnose trouble according to "DIAGNOSTIC FLOW CHART" corresponding to each code No.
14		WTS	
15			
21		TPS	
22			
23		ATS	
25			
24		VSS	
31		Pressure sensor	
32			
41		Ignition fail safe signal	
42		CAS	
44		Idle switch of TPS	
45			
ON		ECM	ECM failure.
12		Normal	This code appears when none of the other codes (Above codes) are identified.

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.)



1. Main fuse
2. Ignition switch
3. Circuit fuse for ignition coil
4. Circuit fuse for ECM
5. Main relay
6. ECM
7. Engine ground for ECM
8. Terminal position of coupler (viewed from wire side)

Fig. 6E-44 ECM Power and Ground Circuit

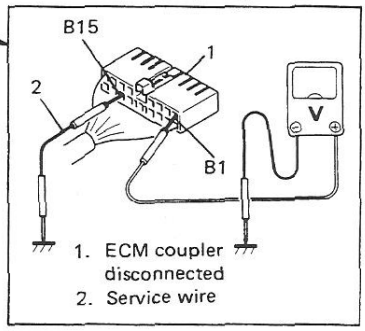
Is operation of main relay heard at ignition switch ON?

YES

Is circuit fuse (for ECM) in good condition?

YES

1. Disconnect ECM coupler (Green) with ignition switch OFF.
2. Using service wire, ground B15 terminal.
3. Is battery voltage applied to B1 or B7 terminal at ignition switch ON?



1. ECM coupler disconnected
2. Service wire

To be continued

NO

Repair and replace.

NO

Are main fuse and circuit fuse (for ignition coil) in good condition?

YES

Is main relay in good condition? (Check main relay referring to p. 6E-96.)

NO

Repair and replace.

YES

Poor relay-to-coupler connection, B/W wire open, "BI" wire open poor B15 connection or poor engine ground. If all above are OK, substitute a known-good ECM and recheck.

NO

Replace.

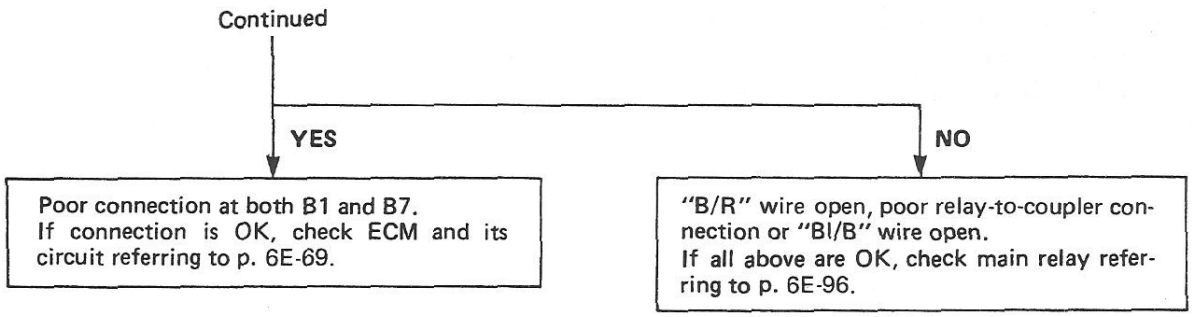
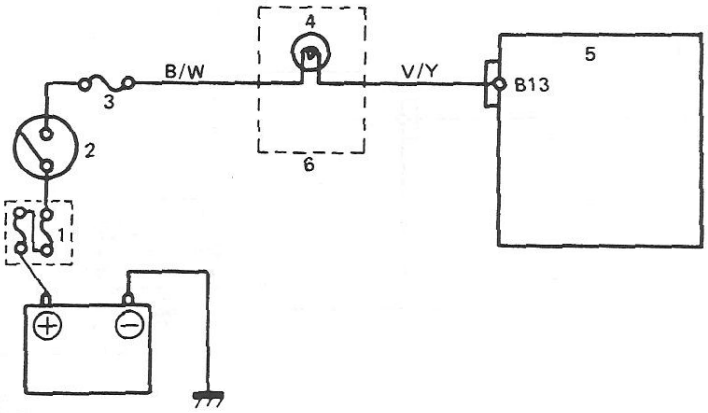


Fig. 6E-45 Diagnostic Flow Chart A-1 For ECM Power and Ground Circuit

A-2 "CHECK ENGINE" LIGHT CIRCUIT CHECK

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



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

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

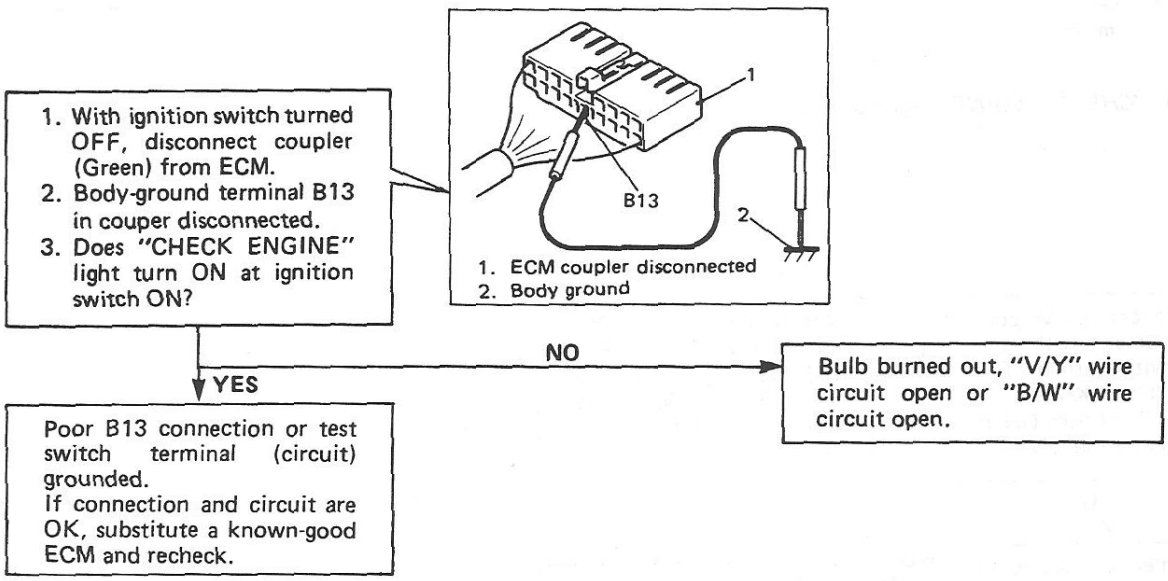
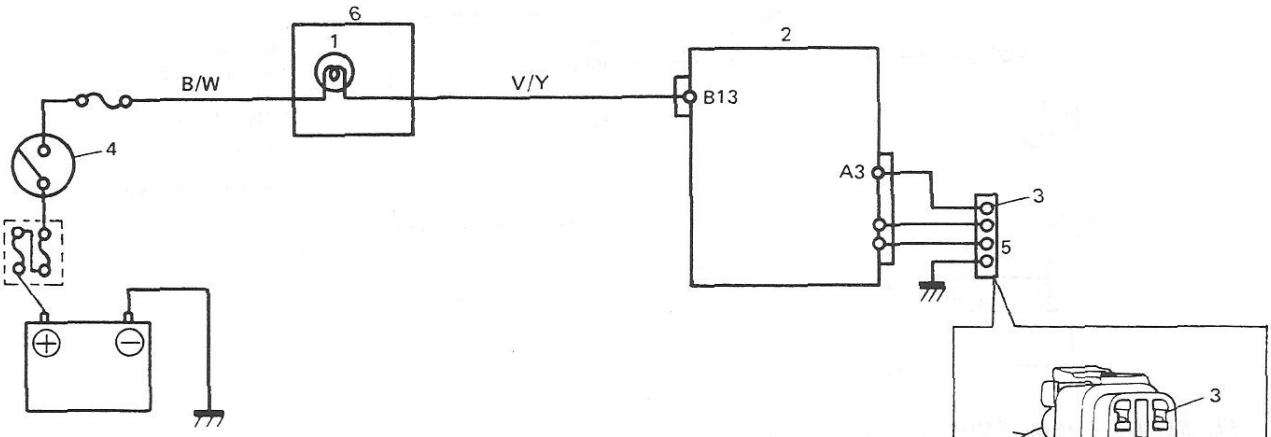


Fig. 6E-47 Diagnostic Flow Chart A-2 for "CHECK ENGINE" Light Circuit

A-3 "CHECK ENGINE" LIGHT CIRCUIT CHECK

("CHECK ENGINE" LIGHT DOESN'T FLASH OR JUST REMAINS ON EVEN WITH DIAGNOSIS SWITCH TERMINAL GROUNDED.)



1. "CHECK ENGINE" light
2. ECM
3. Diagnosis switch terminal
4. Ignition switch
5. Moniter coupler
6. Combination meter

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

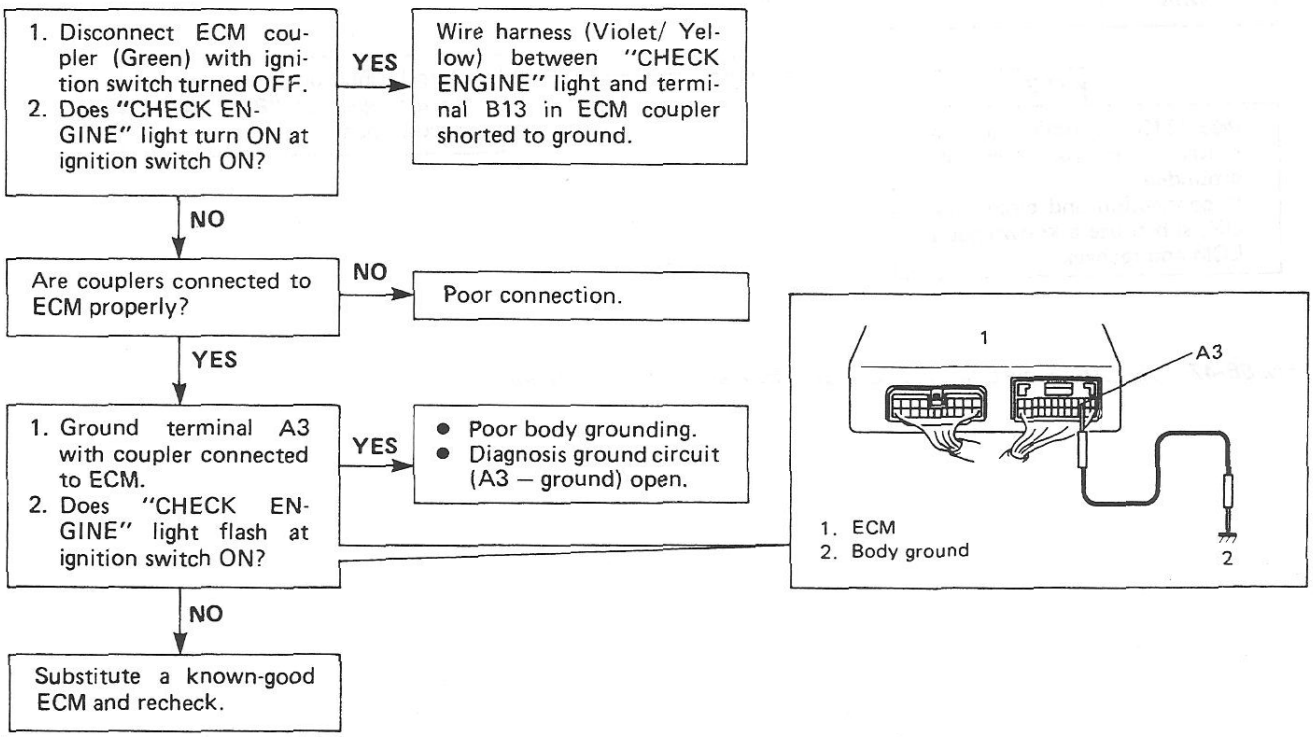


Fig. 6E-49 Diagnostic Flow Chart A-3 For "CHECK ENGINE" Light Circuit (For California and Canada Spec. Model)

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

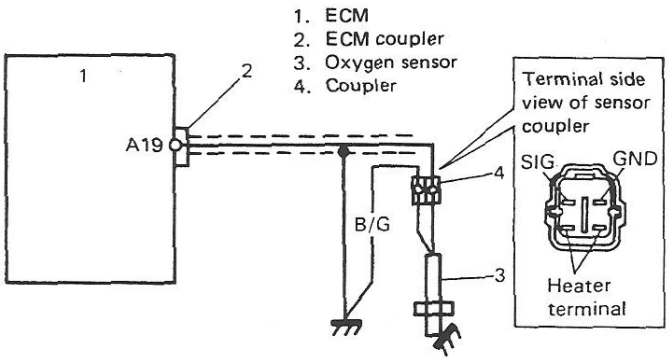


Fig. 6E-51 Oxygen Sensor Circuit

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.**

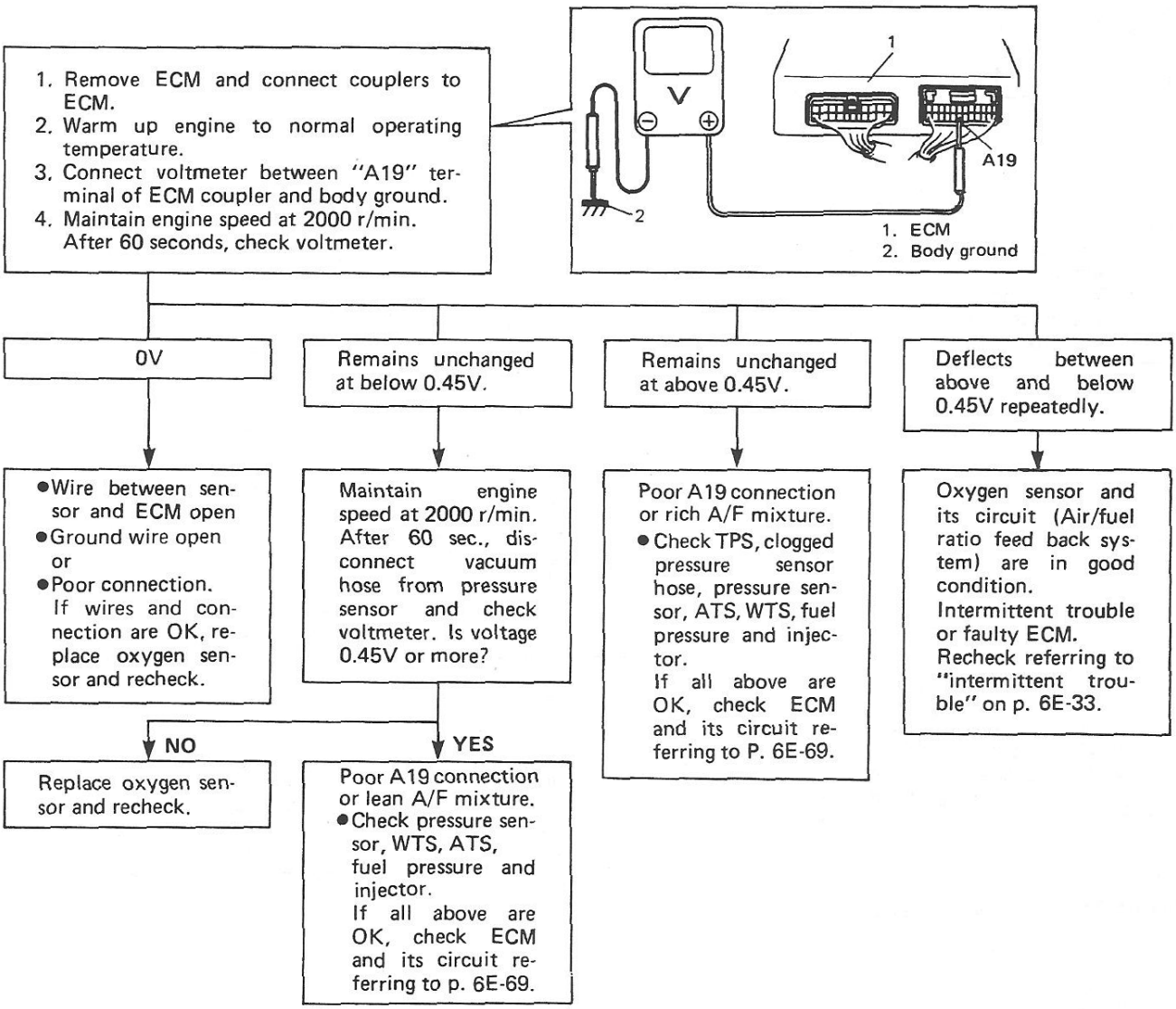
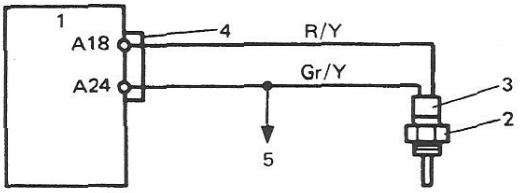


Fig. 6E-52 Diagnostic Flow Chart For Code No. 13

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



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

NOTE:
When Code Nos. 14, 21, 23, 31 and 44 are indicated together, it is possible that "Gr/Y" wire is open or A24 terminal connection is poor.

Fig. 6E-53 WTS Circuit

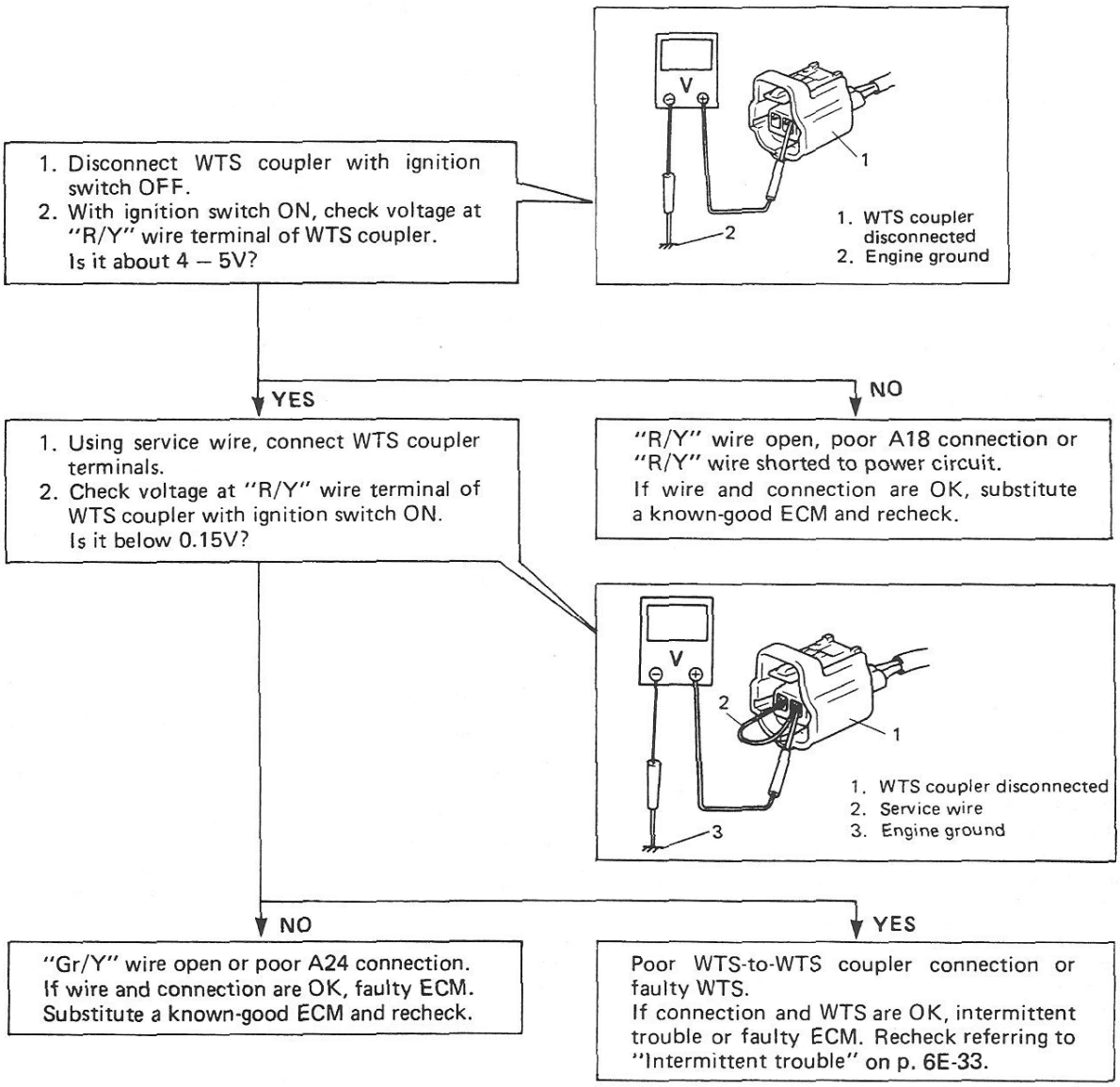


Fig. 6E-54 Diagnostic Flow Chart For Code No. 14

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

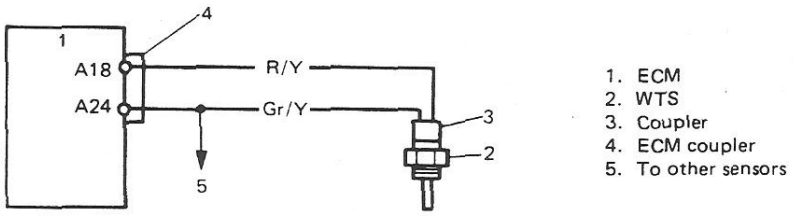


Fig. 6E-55 WTS Circuit

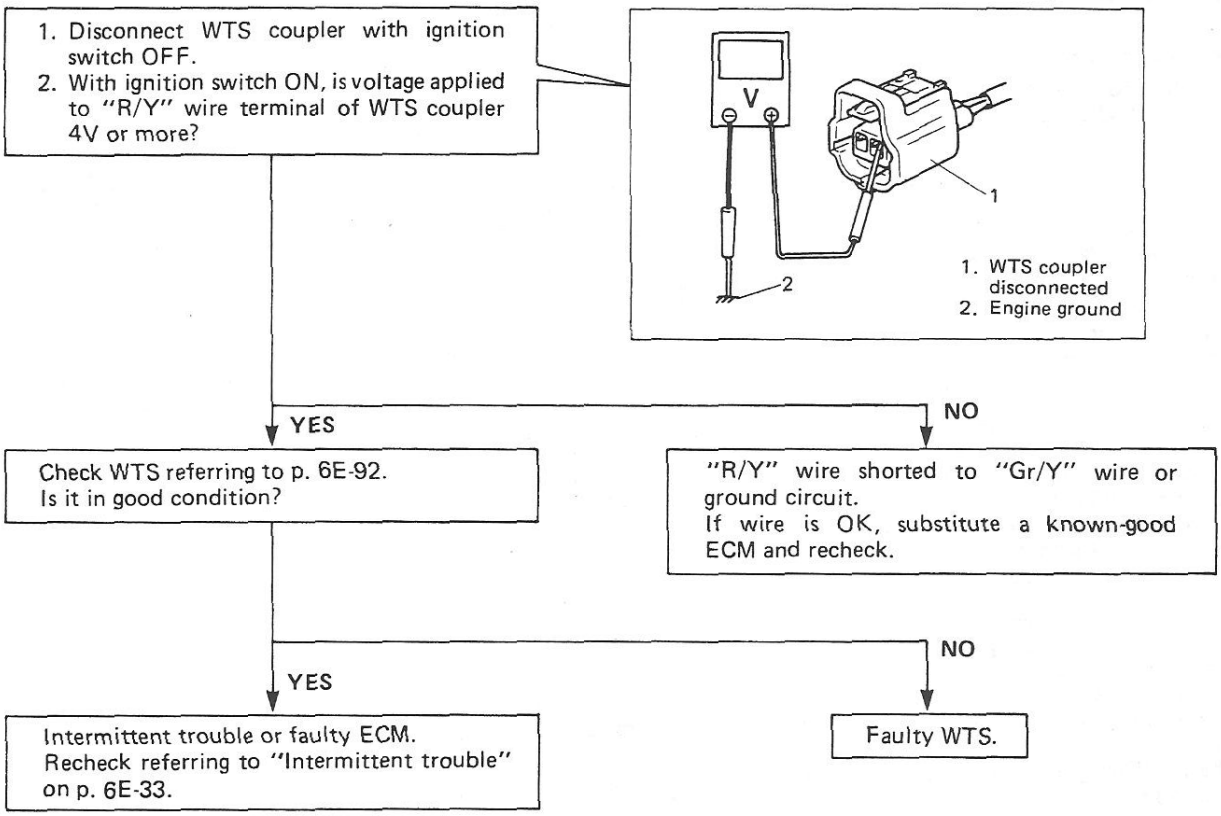
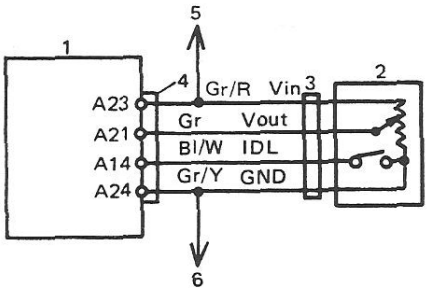


Fig. 6E-56 Diagnostic Flow Chart For Code No. 15

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



1. ECM
2. TPS
3. Coupler
4. ECM coupler
5. To pressure sensor
6. To other sensors

Fig. 6E-57 TPS Circuit

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

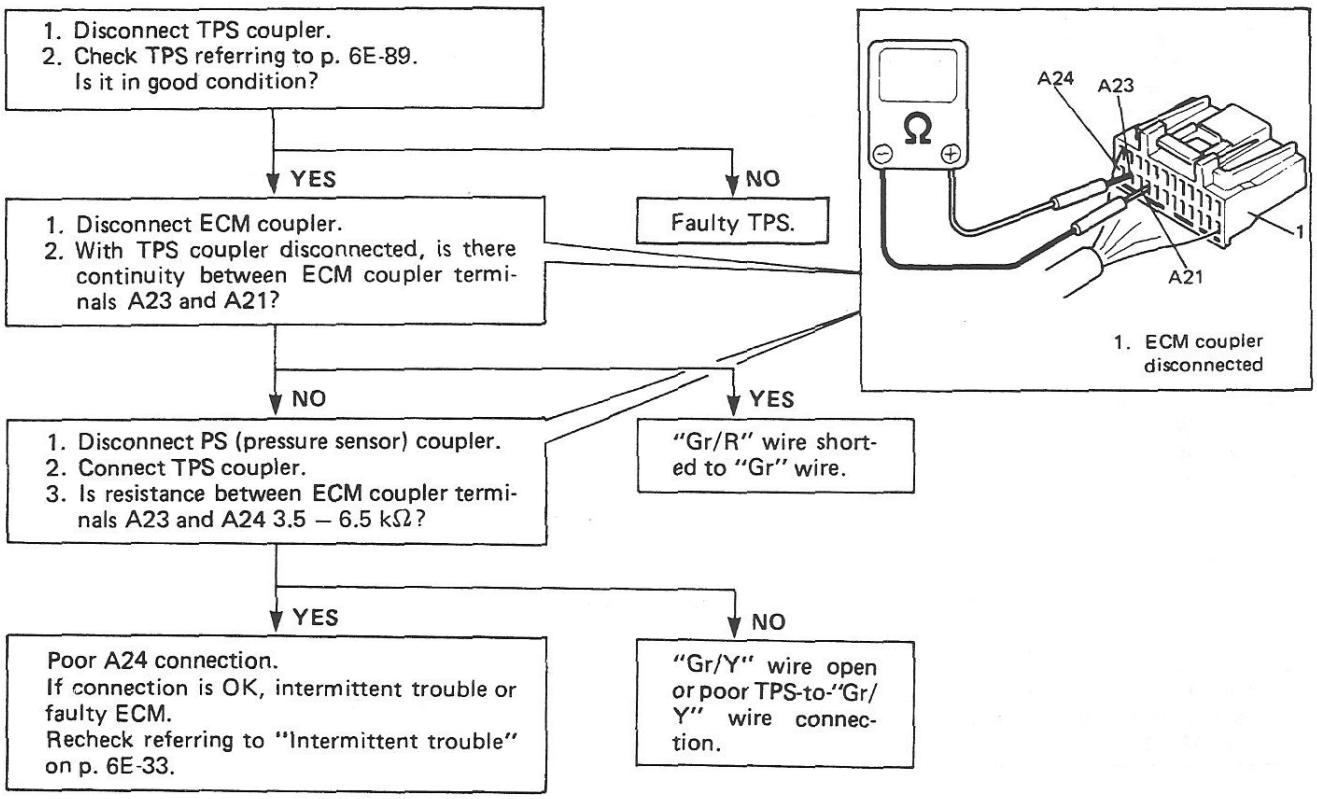
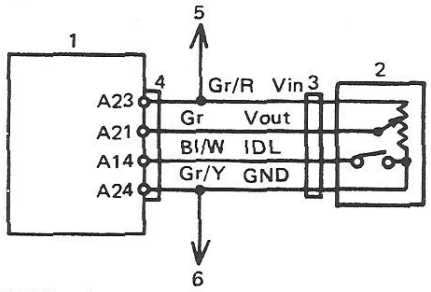


Fig. 6E-58 Diagnostic Flow Chart For Code No. 21

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



1. ECM
2. TPS
3. Coupler
4. ECM coupler
5. To pressure sensor
6. To other sensors

Fig. 6E-59 TPS Circuit

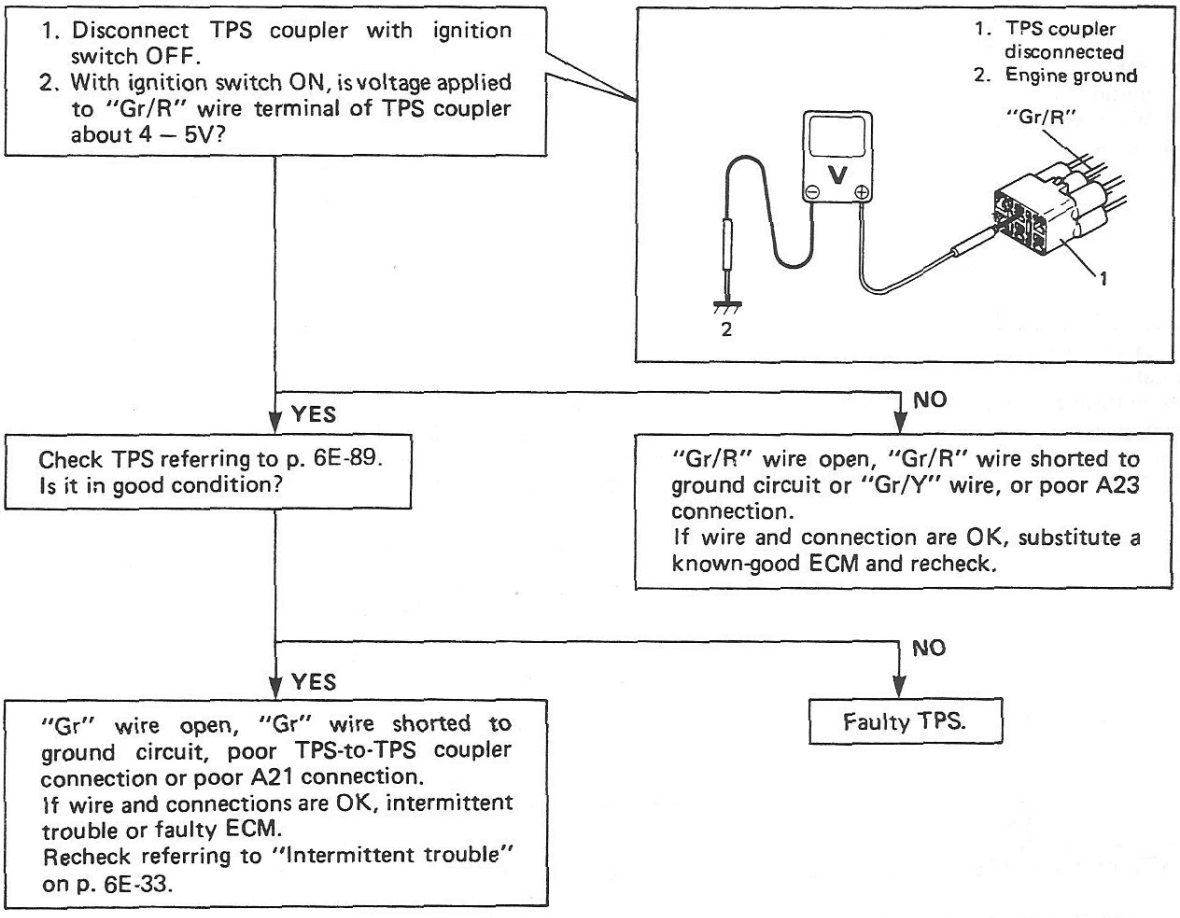
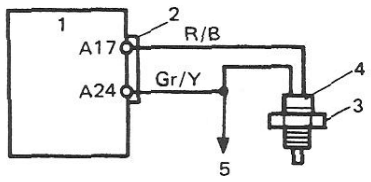


Fig. 6E-60 Diagnostic Flow Chart For Code No. 22

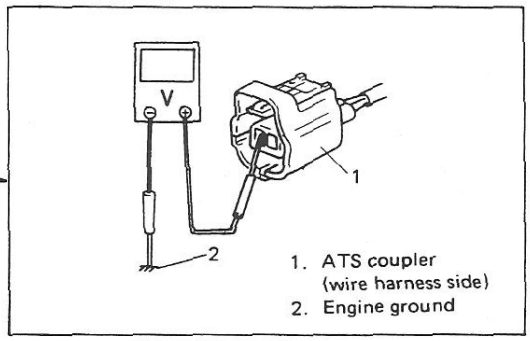
CODE NO. 23 ATS (AIR TEMPERATURE SENSOR) CIRCUIT (LOW TEMPERATURE INDICATED, SIGNAL VOLTAGE HIGH)



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

Fig. 6E-61 ATS Circuit

1. Disconnect ATS coupler with ignition switch OFF.
2. With ignition switch ON, check voltage at "R/B" wire terminal of ATS coupler. Is it about 4 – 5V?



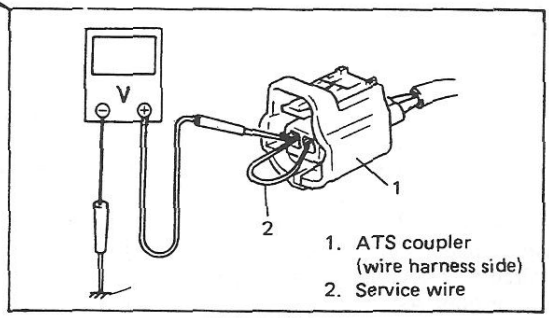
1. ATS coupler (wire harness side)
2. Engine ground

NO

"R/B" wire open, poor A17 connection or "R/B" wire shorted to power circuit.
If wire and connection are OK, substitute a known-good ECM and recheck.

YES

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



1. ATS coupler (wire harness side)
2. Service wire

NO

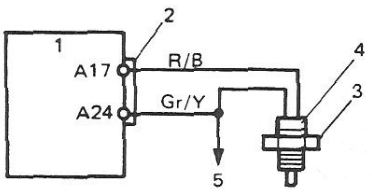
"Gr/Y" wire open or poor A24 connection.
If wire and connection are OK, substitute a known-good ECM and recheck.

YES

Faulty ATS or poor ATS coupler connection.
If ATS and connection are OK, intermittent trouble or faulty ECM. Recheck referring to "Intermittent trouble" on p. 6E-33.

Fig. 6E-62 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-63 ATS Circuit

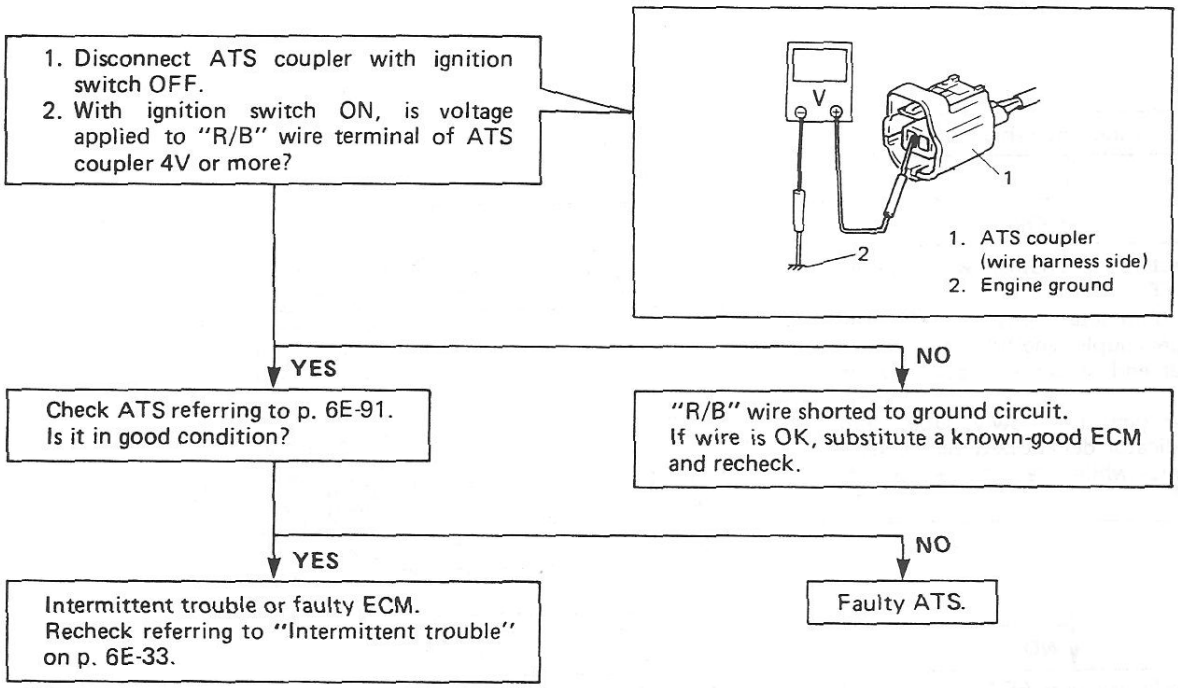
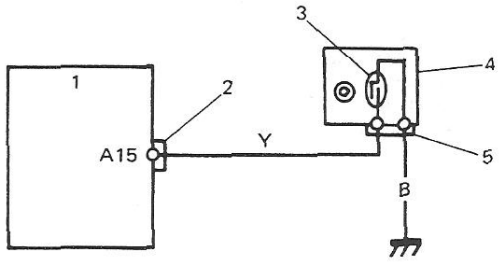


Fig. 6E-64 Diagnostic Flow Chart For Code No. 25

CODE NO. 24 VSS (VEHICLE SPEED SENSOR) CIRCUIT (VEHICLE SPEED LOWER THAN 1.4 km/h (0.9 mile/h) ALTHOUGH FUEL IS KEPT CUT FOR LONGER THAN 3.5 SECONDS)



1. ECM
2. ECM coupler
3. VSS
4. Speedometer
5. Coupler

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

Fig. 6E-65 VSS Circuit

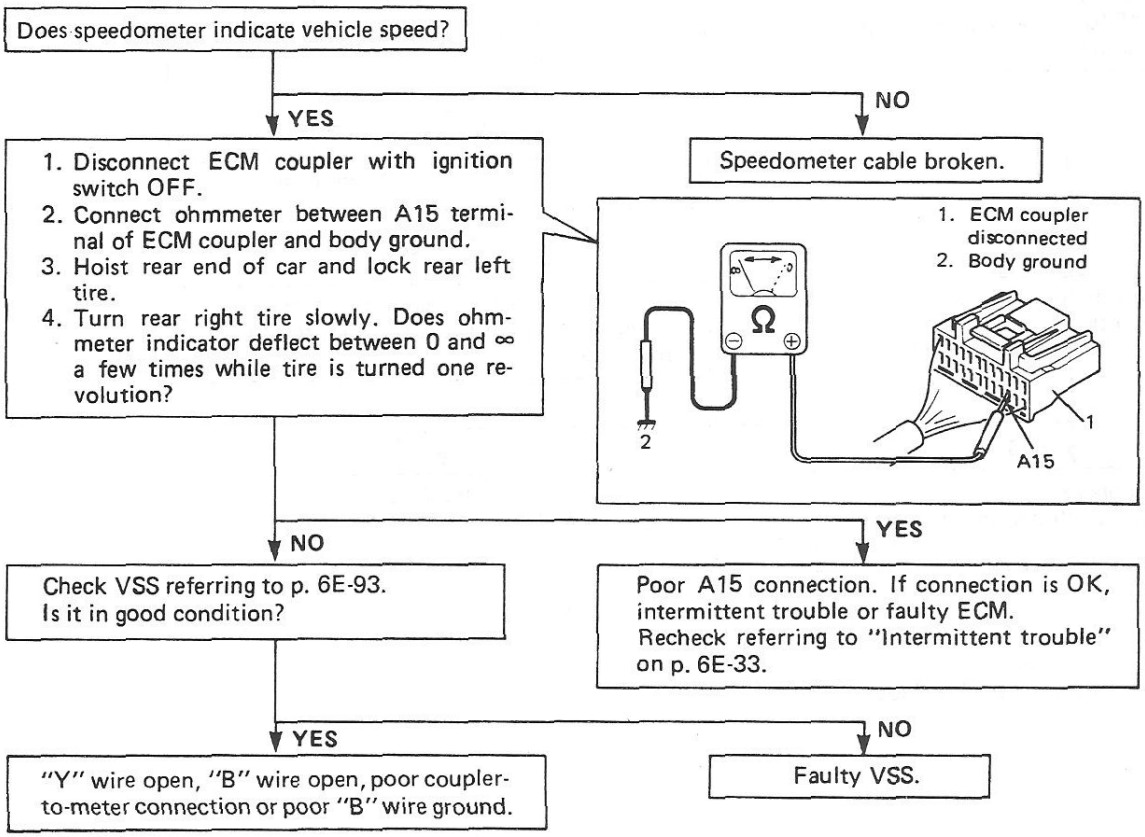
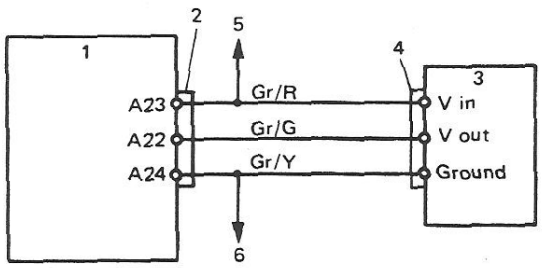


Fig. 6E-66 Diagnostic Flow Chart For Code No. 24

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



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

Fig. 6E-67 PS Circuit

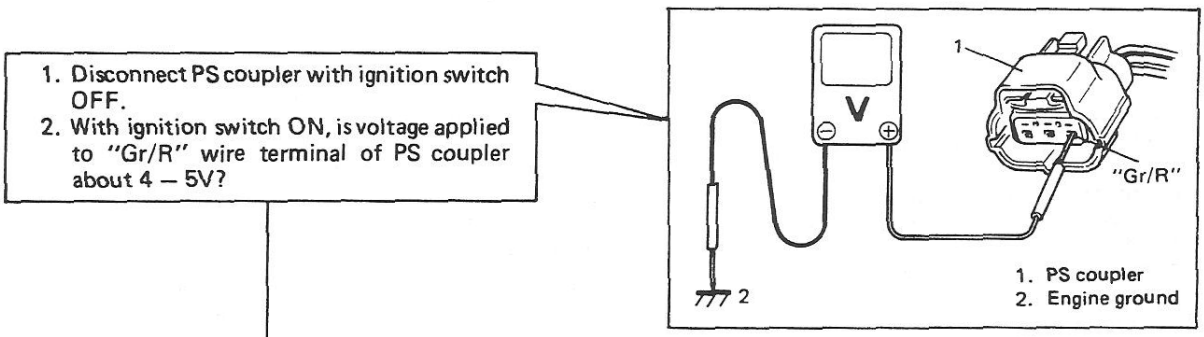
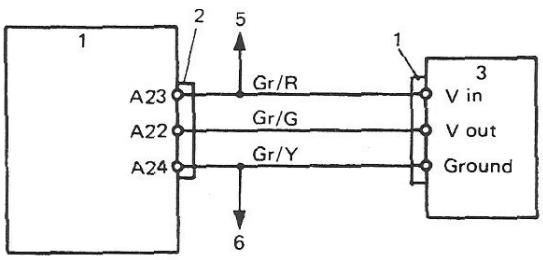


Fig. 6E-68 Diagnostic Flow Chart For Code No. 31

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



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

Fig. 6E-69 PS Circuit

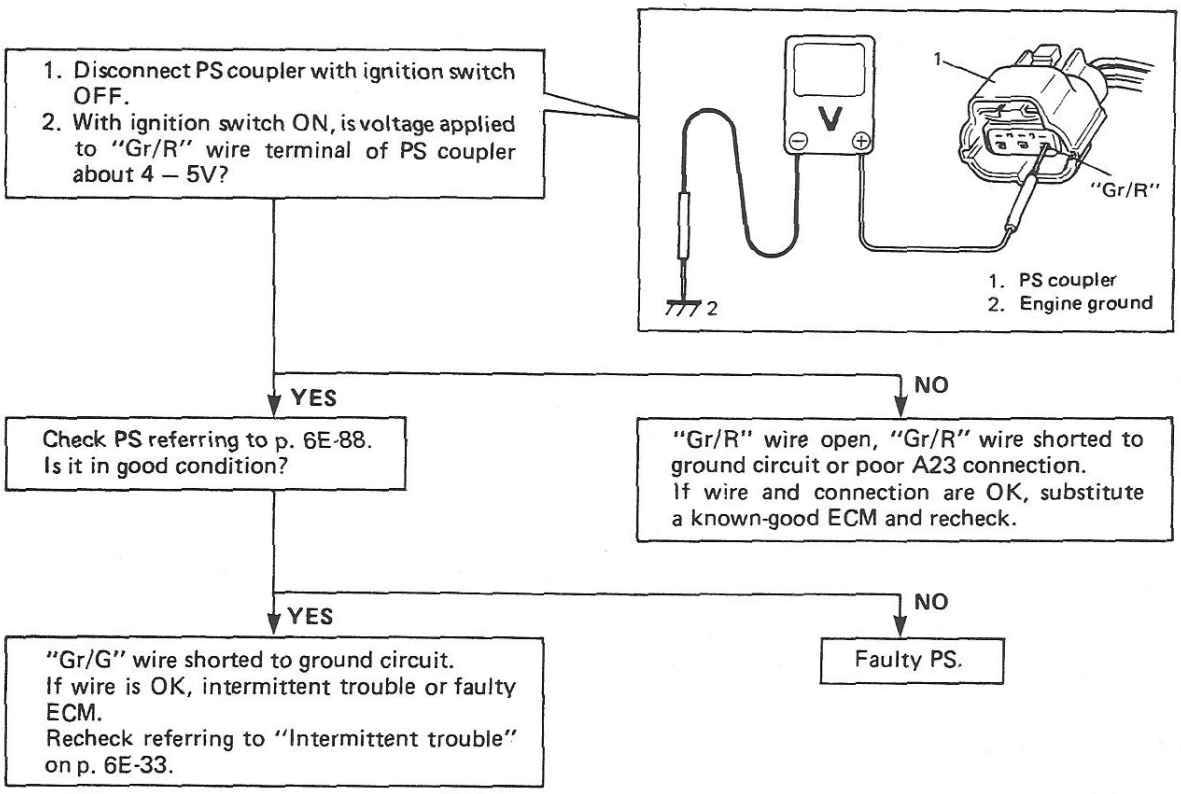
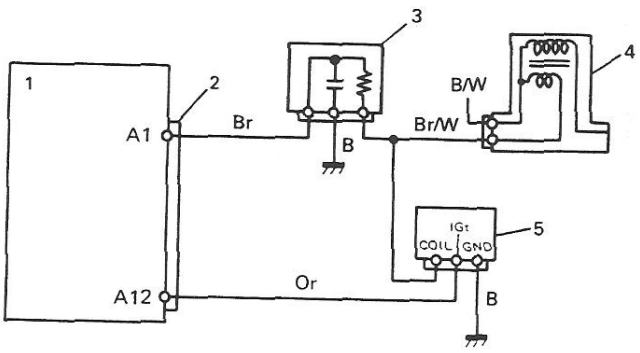


Fig. 6E-70 Diagnostic Flow Chart For Code No. 32

CODE NO. 41 IGNITION SIGNAL CIRCUIT (IGNITIONS FAIL SAFE SIGNAL NOT INPUTTED)



1. ECM
2. ECM coupler
3. Noise suppressor
4. Ignition coil
5. Igniter (Power unit)

Fig. 6E-71 Ignition Signal Circuit

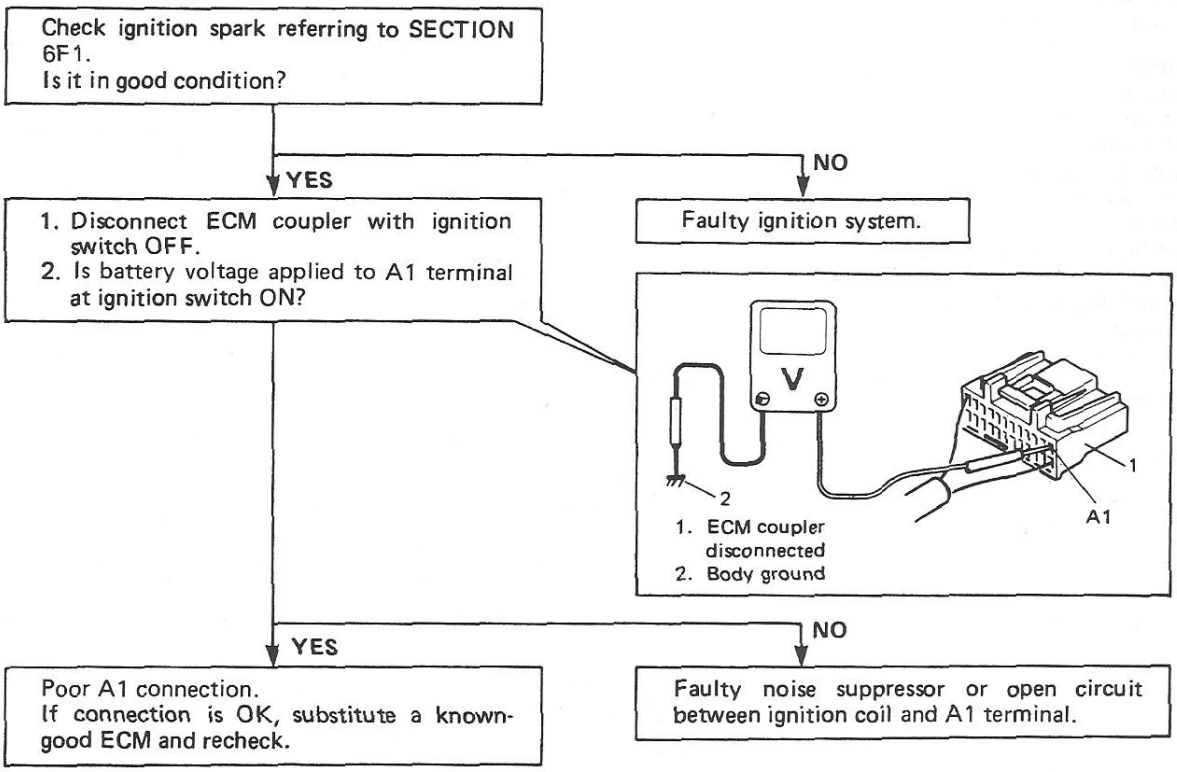
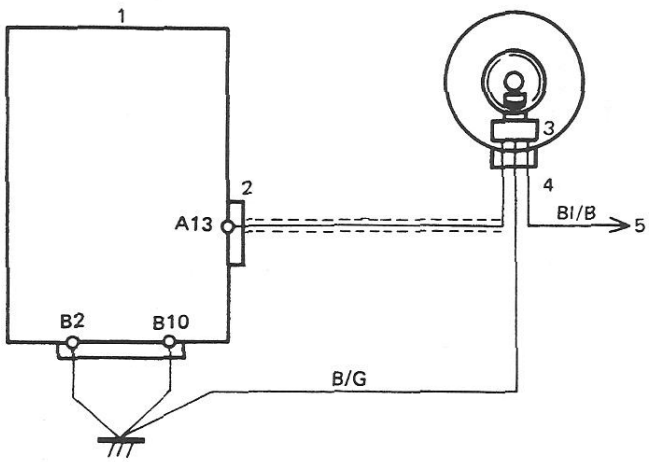


Fig. 6E-72 Diagnostic Flow Chart For Code No. 41

CODE NO. 42 CAS (CRANK ANGLE SENSOR) CIRCUIT (SENSOR SIGNAL NOT INPUTTED FOR 3 SECONDS AT ENGINE CRANKING)



1. ECM
2. ECM coupler
3. CAS (in distributor)
4. Coupler
5. To main relay

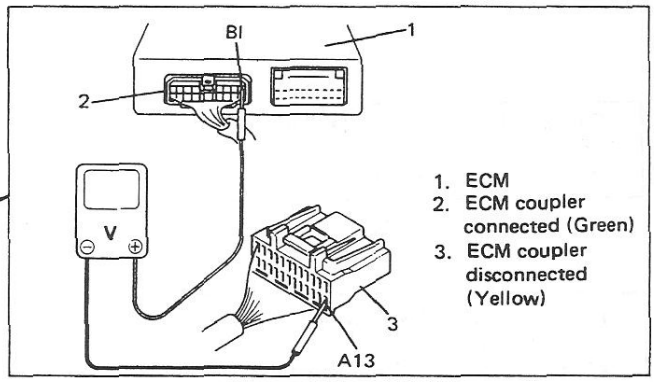
Fig. 6E-73 CAS Circuit

NOTE:
- **Be sure to use a voltmeter with high impedance (10 kΩ/V minimum).**
- **Don't remove signal rotor from shaft.**

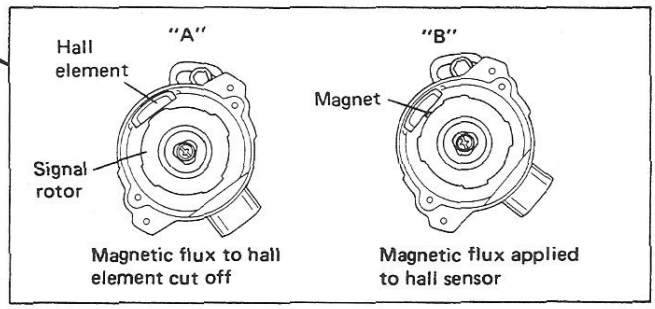
1. With ignition switch OFF, disconnect ECM coupler (Yellow).
2. Connect voltmeter between B1 terminal of ECM coupler (Green) and A13 terminal of yellow coupler (disconnected).
3. Remove distributor cap, rotor and shield cover.
4. With ignition switch ON, check voltage with signal rotor inserted between hall element and magnet ("A") and without it ("B") respectively, by turning crankshaft.

"A"	0 – 1.0 V
"B"	Battery voltage

Is it in good condition?



1. ECM
2. ECM coupler connected (Green)
3. ECM coupler disconnected (Yellow)



NO

0 – 1V at both "A" and "B" → A13 wire open, "B/G" wire open, poor CAS coupler connection of faulty CAS.

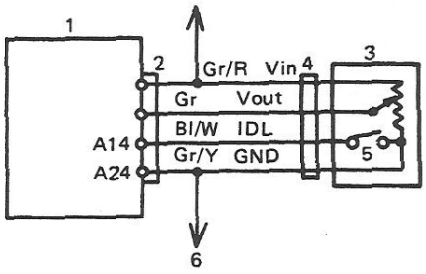
YES

Battery voltage at both "A" and "B" → A13 wire short to ground or faulty CAS.

Poor A13 connection.
If connection is OK, substitute a known-good ECM and recheck.

Fig. 6E-74 Diagnostic Flow Chart For Code No. 42

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



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

Fig. 6E-75 Idle Switch Circuit

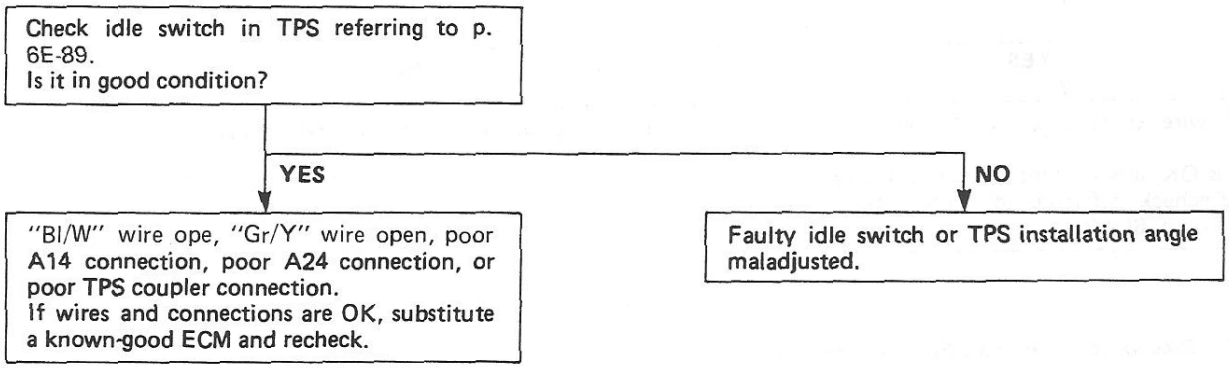
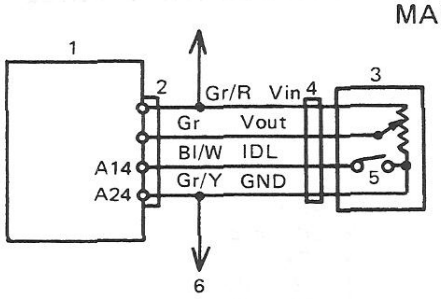


Fig. 6E-75-1 Diagnostic Flow Chart For Code No. 44

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



1. ECM
2. ECM coupler
3. TPS
4. TPS coupler
5. Idle switch in TPS
6. To other sensors

Fig. 6E-76 Idle Switch Circuit

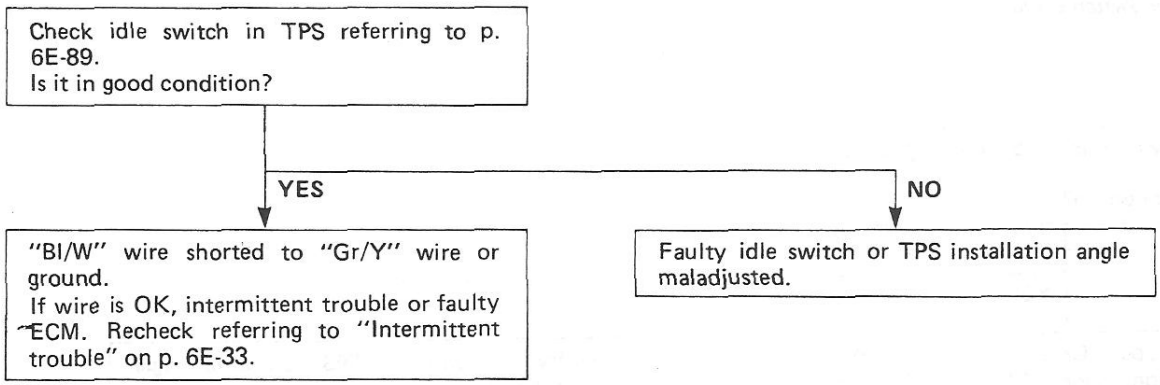


Fig. 6E-77 Diagnostic Flow Chart For Code No. 45

TROUBLE DIAGNOSIS

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

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

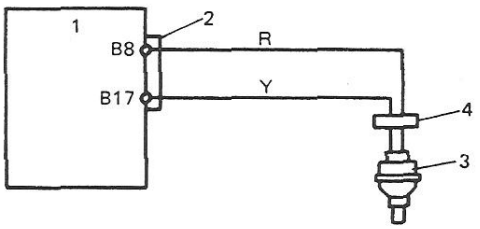
SYMPTOM	POSSIBLE CAUSE	INSPECTION
Hard or no starting (Engine cranks OK)	• Shortage of fuel in fuel tank	
	• Faulty fuel pump or its circuit open	Check if fuel pressure is felt at fuel return hose for 3 seconds after ignition switch ON. If not, advance to Diagnostic flow chart B-2
	• Injector or its circuit defective	Diagnostic flow chart B-1
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty air valve	See p. 6E-80
	• Open starter signal circuit	Check voltage at ECM coupler terminal B11 (refer to p. 6E-69)
	• Faulty throttle opener system	Diagnostic flow chart B-4
	• Poor performance of WTS, ATS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69
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 and then engine starter signal circuit.** • **If engine starts easily with help of accelerator pedal operation, check throttle opener system first. (Advance to Diagnostic flow chart B-4.)**		
Engine fails to idle	• Shortage of fuel in fuel tank	
	• Faulty ISC solenoid valve control system	Diagnostic flow chart B-5
	• Maladjusted idle speed adjusting screw	See p. 6E-75
	• Faulty air valve	See p. 6E-80
	• Faulty EGR system	See p. 6E-99
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-83)

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Engine fails to idle	• Poor performance of WTS, ATS or pressure sensor	See p. 6E-92, 6E-91, 6E-88
	• Faulty ECM	See p. 6E-69
NOTE: **If engine fails to idle when it is cold, check air valve first.**		
Improper engine idle speed	• Maladjusted accelerator cable play	See p. 6E-74
	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Faulty throttle opener system	Diagnostic flow chart B-4
	• Faulty ISC solenoid valve control system	Diagnostic flow chart B-5
	• Maladjusted idle speed adjusting screw	See p. 6E-75
	• Faulty air valve	See p. 6E-80
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-83)
	• Poor performance of WTS, ATS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69
NOTE: **If engine idle speed lowers below specification only when electric load (e.g. headlight ON), check ISC solenoid valve control system first.**		
Engine has no or poor power	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Maladjusted accelerator cable play	See p. 6E-74
	• Maladjusted installation angle of throttle position sensor	See p. 6E-89
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-6
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage. (Refer to p. 6E-83)
	• Poor performance of TPS, WTS, ATS or pressure sensor	See p. 6E-89, 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Engine hesitates when acceleration	• Clogged pressure sensor vacuum passage	Check vacuum hose and filter
	• Defective throttle valve operation	Check throttle valve for smooth operation
	• Poor performance TPS	See p. 6E-89
	• Fuel pressure out of specification (Low fuel pressure)	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-6
	• Faulty injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-83)
	• Poor performance of WTS or pressure sensor	See p. 6E-92 or 6E-88
	• Faulty ECM	See p. 6E-69
Surges (Variation in vehicle speed is felt although accelerator pedal is not operated)	• Variable fuel pressure (Clogged fuel filter, defective fuel pressure regulator, etc.)	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistance, injection condition and fuel leakage (Refer to p. 6E-83)
	• Poor performance of TPS, WTS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69
Excessive detonation (Engine makes sharp metallic knocks that change with throttle opening)	• Low fuel pressure	Diagnostic flow chart B-3
	• Defective EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for resistfance, injection condition and fuel leakage (Refer to p. 6E-83)
	• Poor performance of TPS, WTS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69
Poor gasoline mileage	• High idle speed	Refer to previous item "Improper engine idle speed"
	• Fuel pressure out of specification of fuel leakage	Diagnostic flow chart B-3
	• Faulty EGR system	Diagnostic flow chart B-6
	• Defective injector	Check injector for fuel leakage (See p. 6E-83)
	• Poor performance of TPS, WTS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69

SYMPTOM	POSSIBLE CAUSE	INSPECTION
Excessive hydrocarbon (HC) emission (Rich or lean fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc.)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic coverter	Check for absence of filler neck restrictor
	• Fuel leakage from injector	See p. 6E-83
	• Fuel pressure out of specification	Diagnostic flow chart B-3
	• Poor performance of WTS, ATS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69
Excessive carbon monoxide (CO) emission (Rich fuel mixture)	• Faulty basic engine parts (Clogged air cleaner, vacuum leaks, faulty ignition system, engine compression, etc.)	
	• Engine not at normal operating temperature	
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Fuel leakage from injector	See p. 6E-83
	• Fuel pressure out of specification (High fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of WTS, ATS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69
Excessive nitrogen oxides (NOx) emission (Lean fuel mixture)	• Improper ignition timing	See section 6F1.
	• Lead contamination of catalytic converter	Check for absence of filler neck restrictor
	• Misrouted vacuum hoses	
	• Defective EGR system	Diagnostic flow chart B-6
	• Fuel pressure out of specfication (Low fuel pressure)	Diagnostic flow chart B-3
	• Poor performance of WTS, ATS or pressure sensor	See p. 6E-92, 6E-91 or 6E-88
	• Faulty ECM	See p. 6E-69

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



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

Fig. 6E-85 Injector Circuit

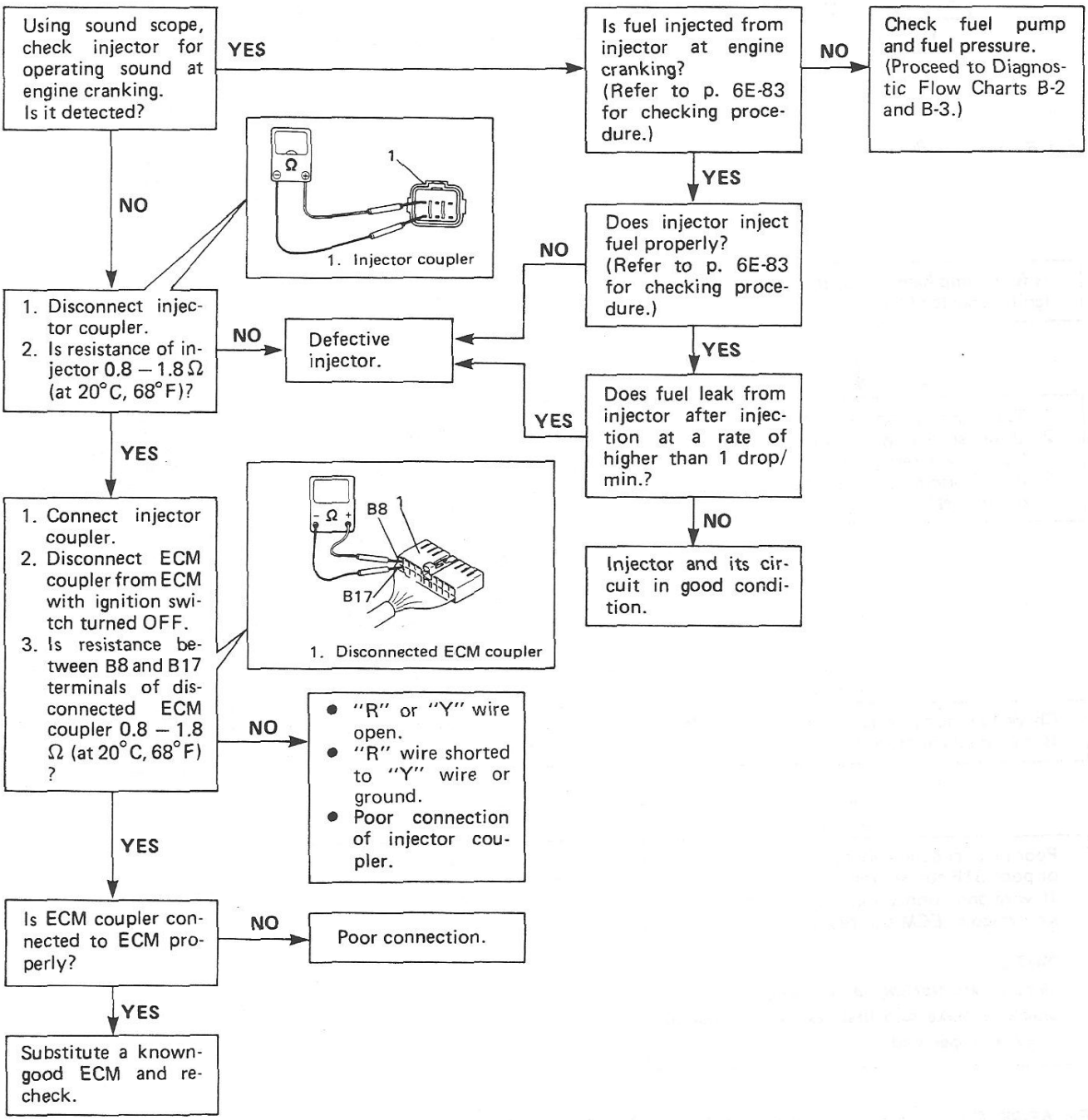
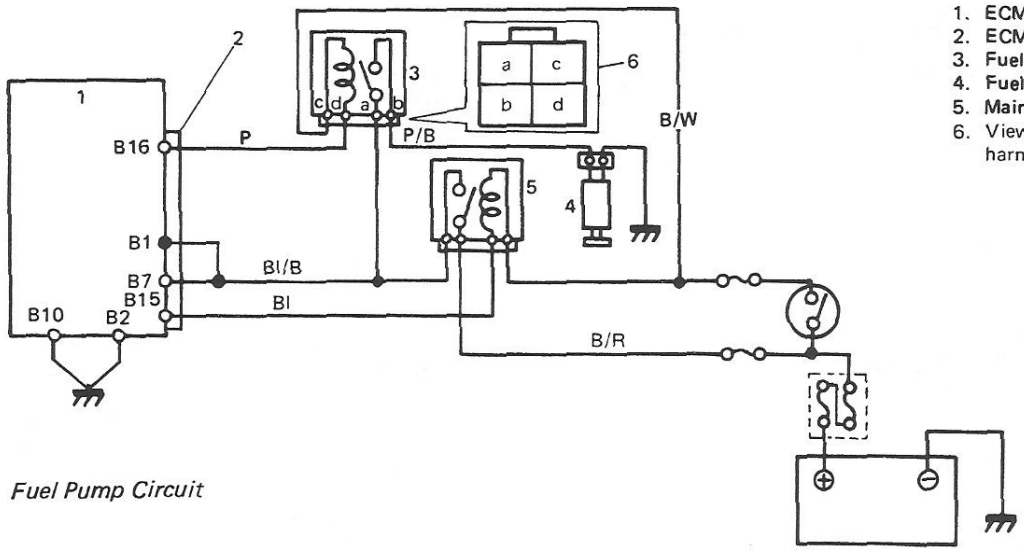


Fig. 6E-86 Diagnostic Flow Chart B-1 For Injector and Its Circuit

B-2 FUEL PUMP CIRCUIT CHECK



1. ECM
2. ECM coupler
3. Fuel pump relay
4. Fuel pump
5. Main relay
6. Viewed from wire harness side

Fig. 6E-87 Fuel Pump Circuit

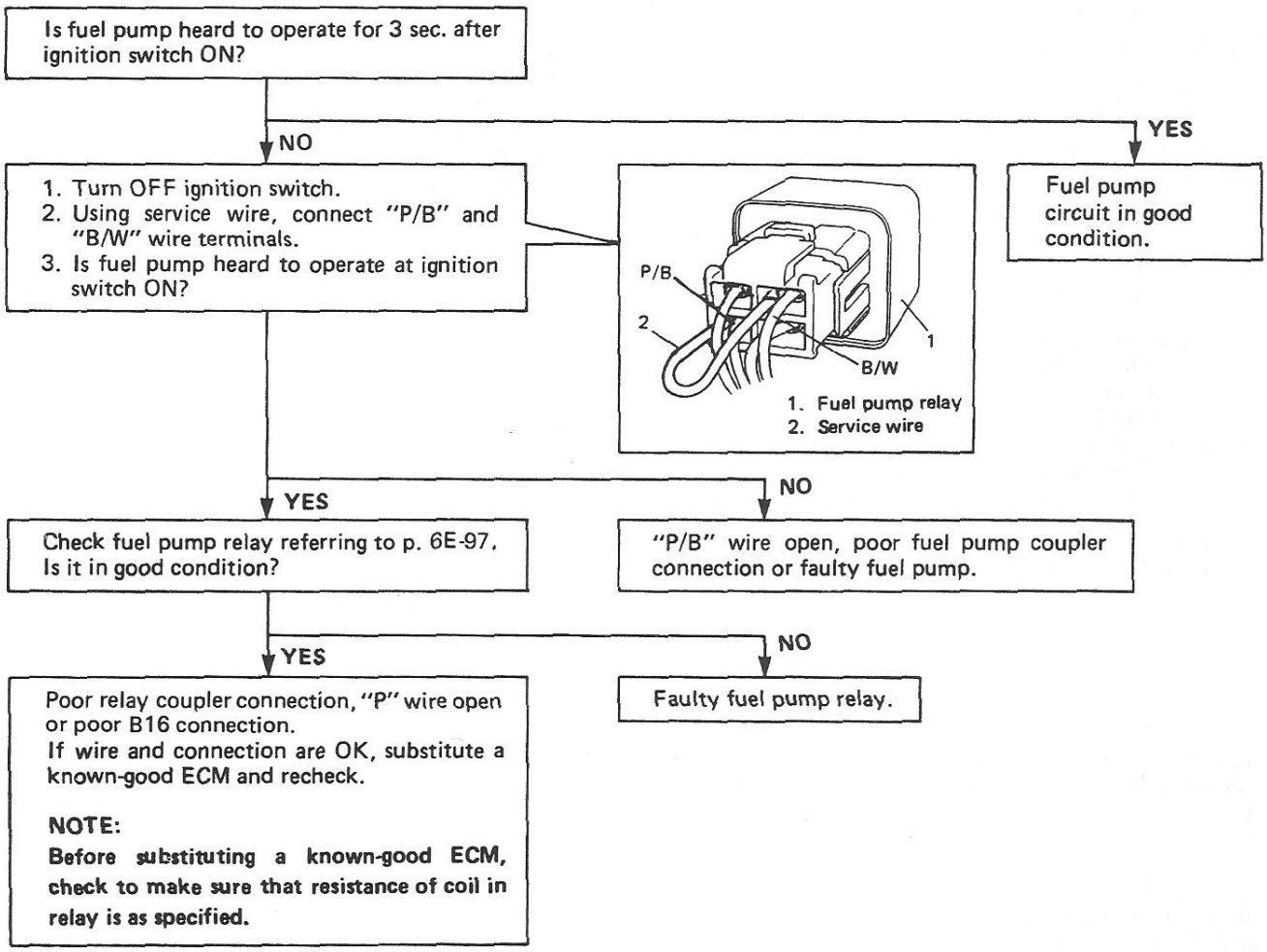


Fig. 6E-88 Diagnostic Flow Chart B-2 For Fuel Pump and Its Circuit Check

B-3 FUEL PRESSURE CHECK

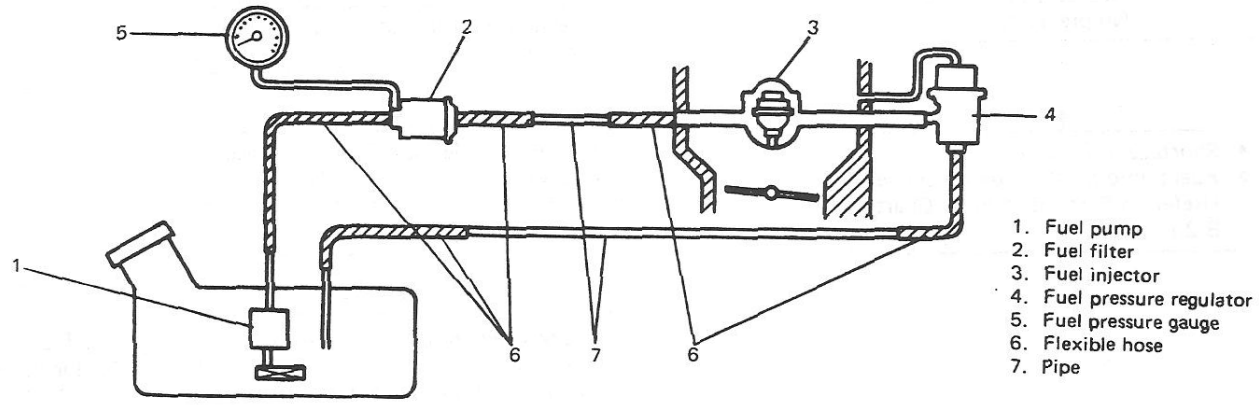


Fig. 6E-89 Fuel Pressure Check

NOTE:
Before using following flow chart, check to make sure that battery voltage is higher than 11V. If battery voltage is low, pressure becomes lower than specification even if fuel pump and line are in good condition.

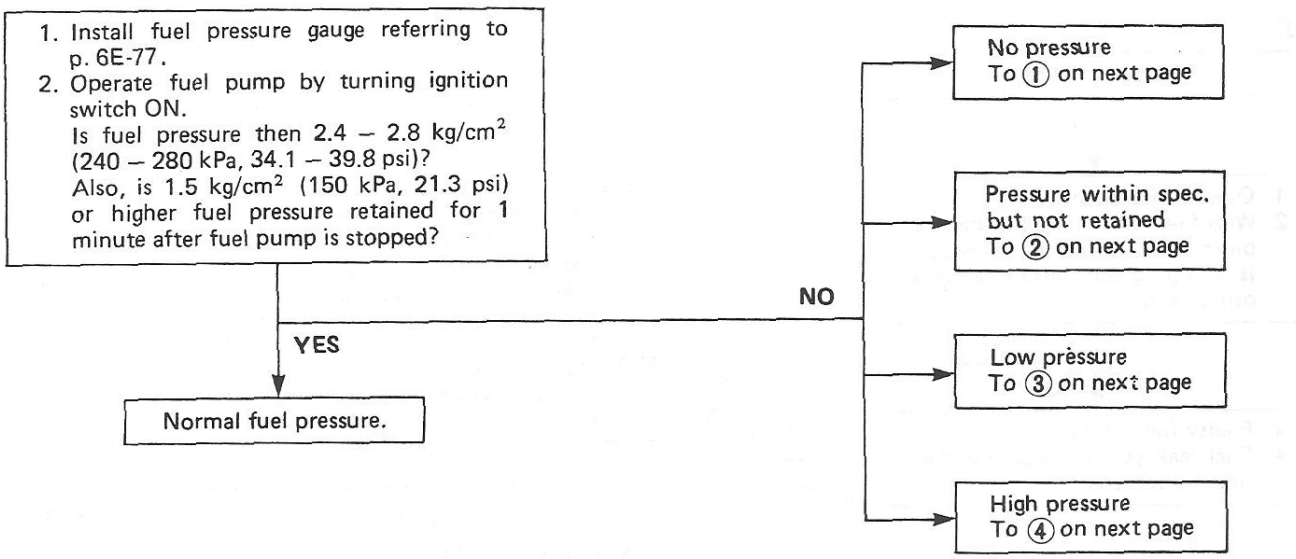


Fig. 6E-90 Diagnostic Flow Chart B-3 For Fuel Pressure Check (1)

B-3 FUEL PRESSURE CHECK (Continued)

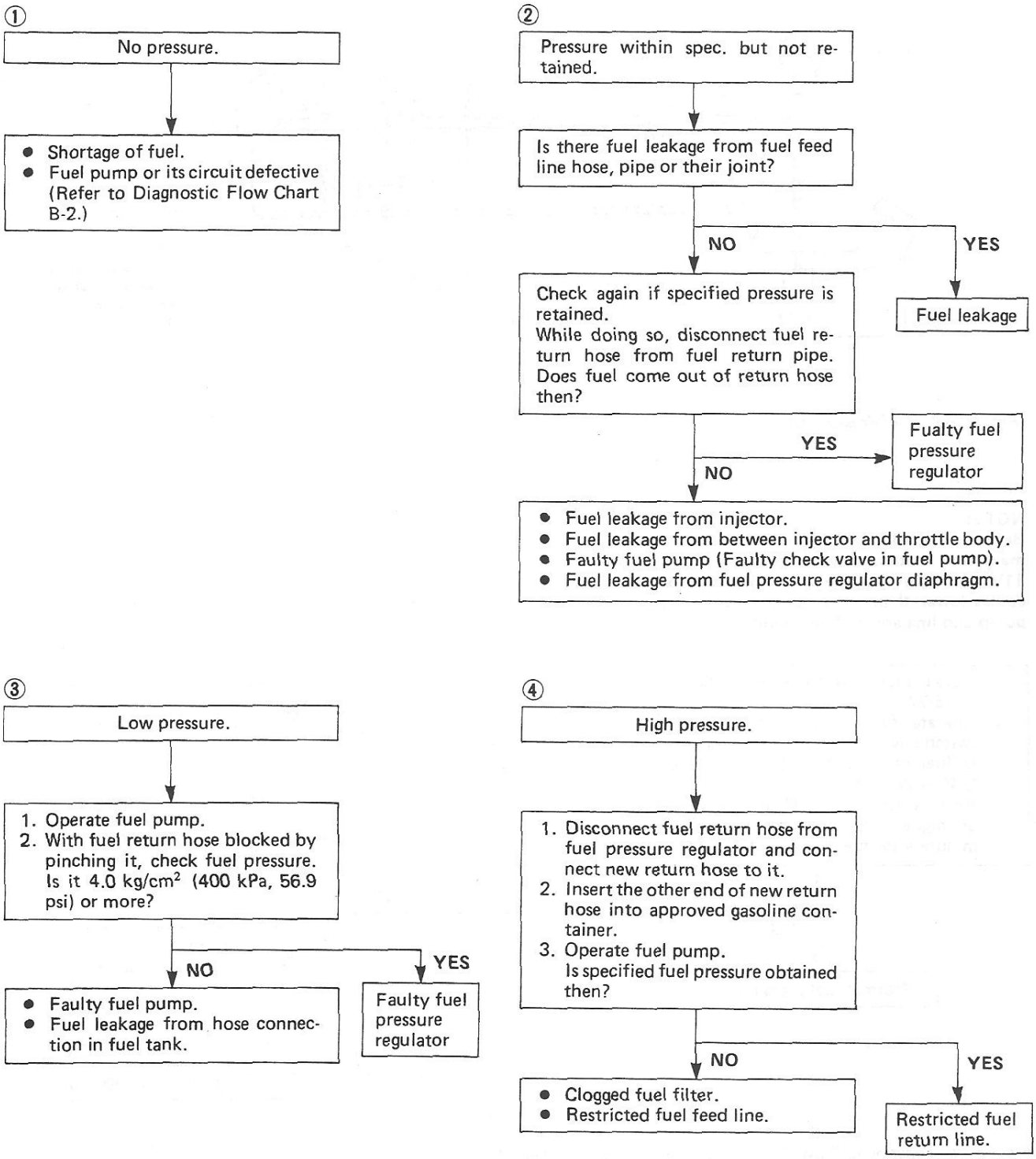
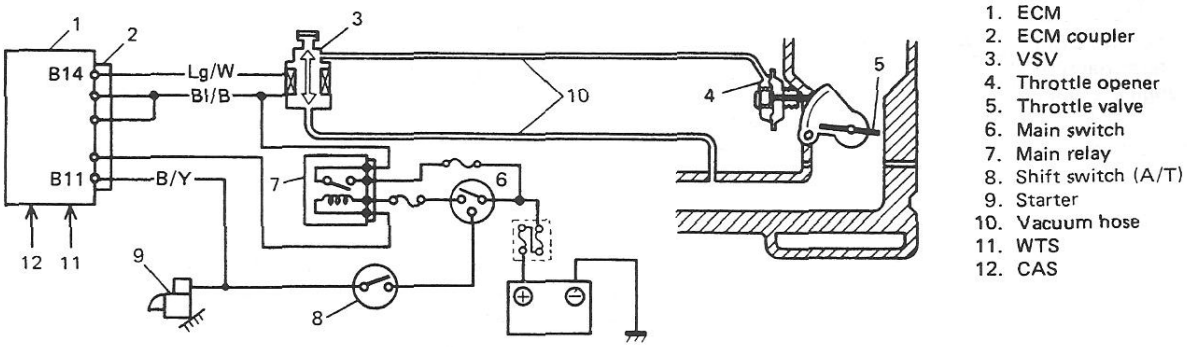


Fig. 6E-91 Diagnostic Flow Chart B-3 For Fuel Pressure Check (2)

B-4 THROTTLE OPENER SYSTEM CHECK



1. ECM
2. ECM coupler
3. VSV
4. Throttle opener
5. Throttle valve
6. Main switch
7. Main relay
8. Shift switch (A/T)
9. Starter
10. Vacuum hose
11. WTS
12. CAS

Fig. 6E-92 Throttle Opener System

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

NO → Check throttle opener for operation referring to p. 6E-98. Is it in good condition?

YES → Adjust throttle valve opening by throttle opener referring to p. 6E-76.

NO → Faulty opener

YES → Does throttle opener rod retract 0 — 1 second after engine start?

YES → Check throttle valve opening by throttle opener referring to p. 6E-76.

YES → Throttle opener system in good condition.

NO → Check throttle valve opening by throttle opener referring to p. 6E-76.

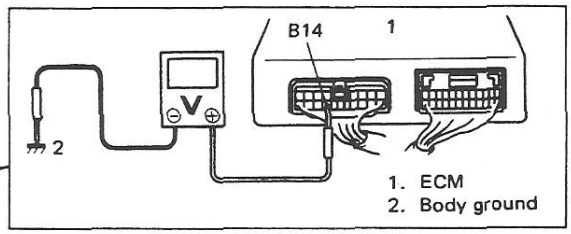
NO → Check vacuum hose and opener referring to p. 6E-97. Are they in good condition?

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

YES → Check VSV for resistance and operation referring to p. 6E-98. Are they both in good condition?

NO →
- Faulty VSV.

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



NO →
- "Bl/B" wire open.
- "Lg/W" wire open.
- "Lg/W" wire shorted to ground or
- Poor VSV coupler connection.

If wires and connections are OK, substitute a known-good ECM and recheck.

YES → To be continued

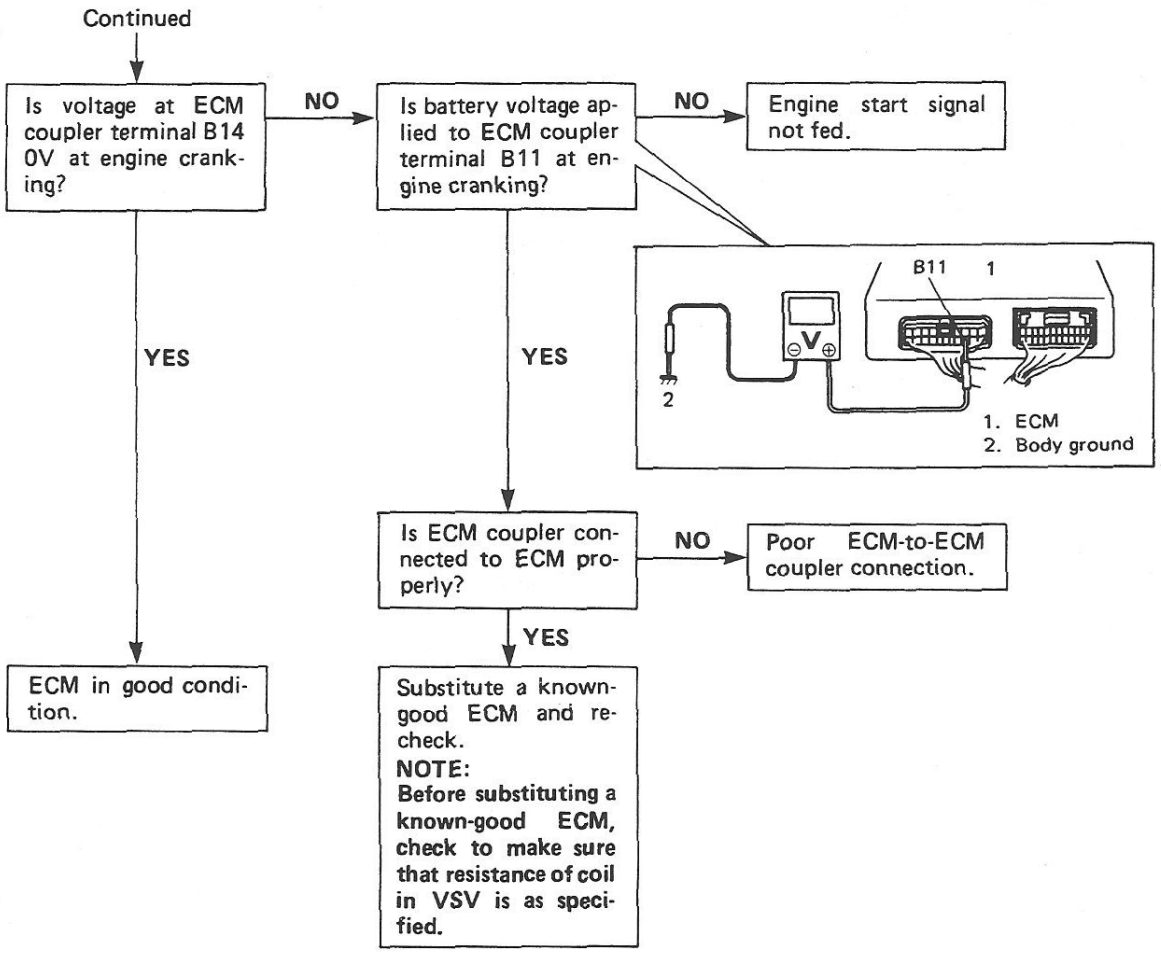


Fig. 6E-93 Diagnostic Flow Chart B-4 For Throttle Opener System

B-5 ISC SOLENOID VALVE CONTROL SYSTEM CHECK

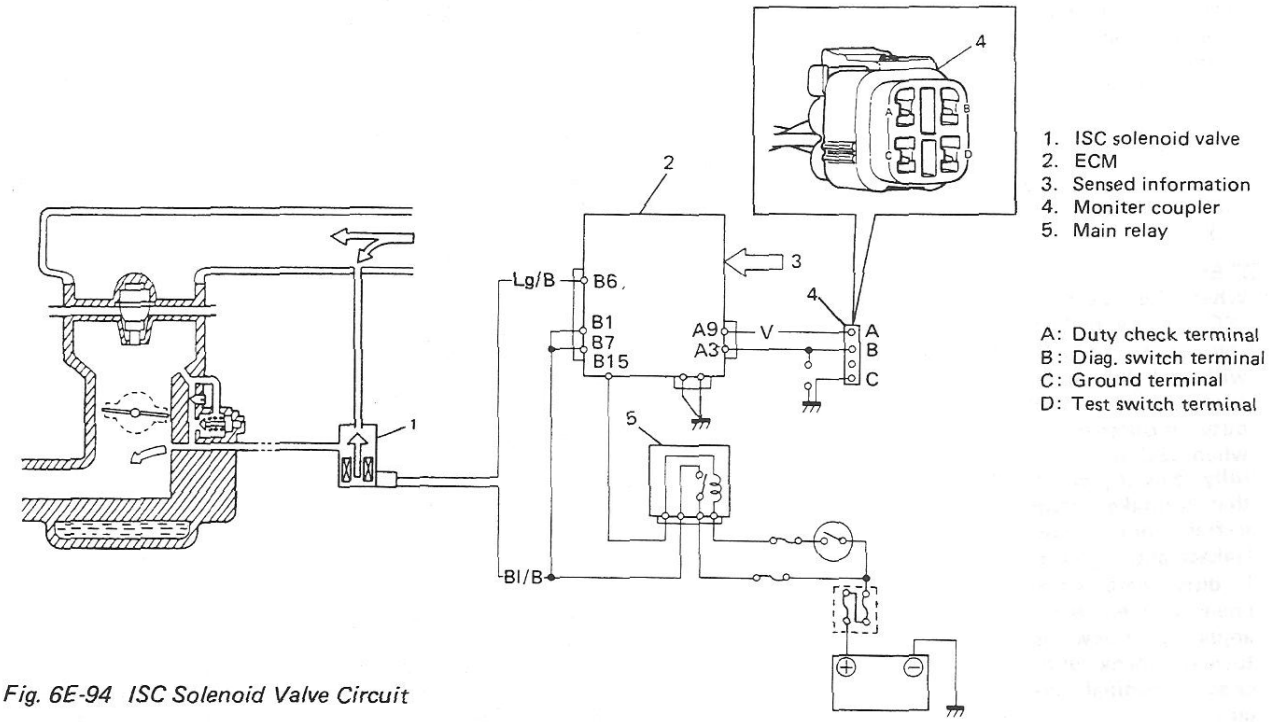


Fig. 6E-94 ISC Solenoid Valve Circuit

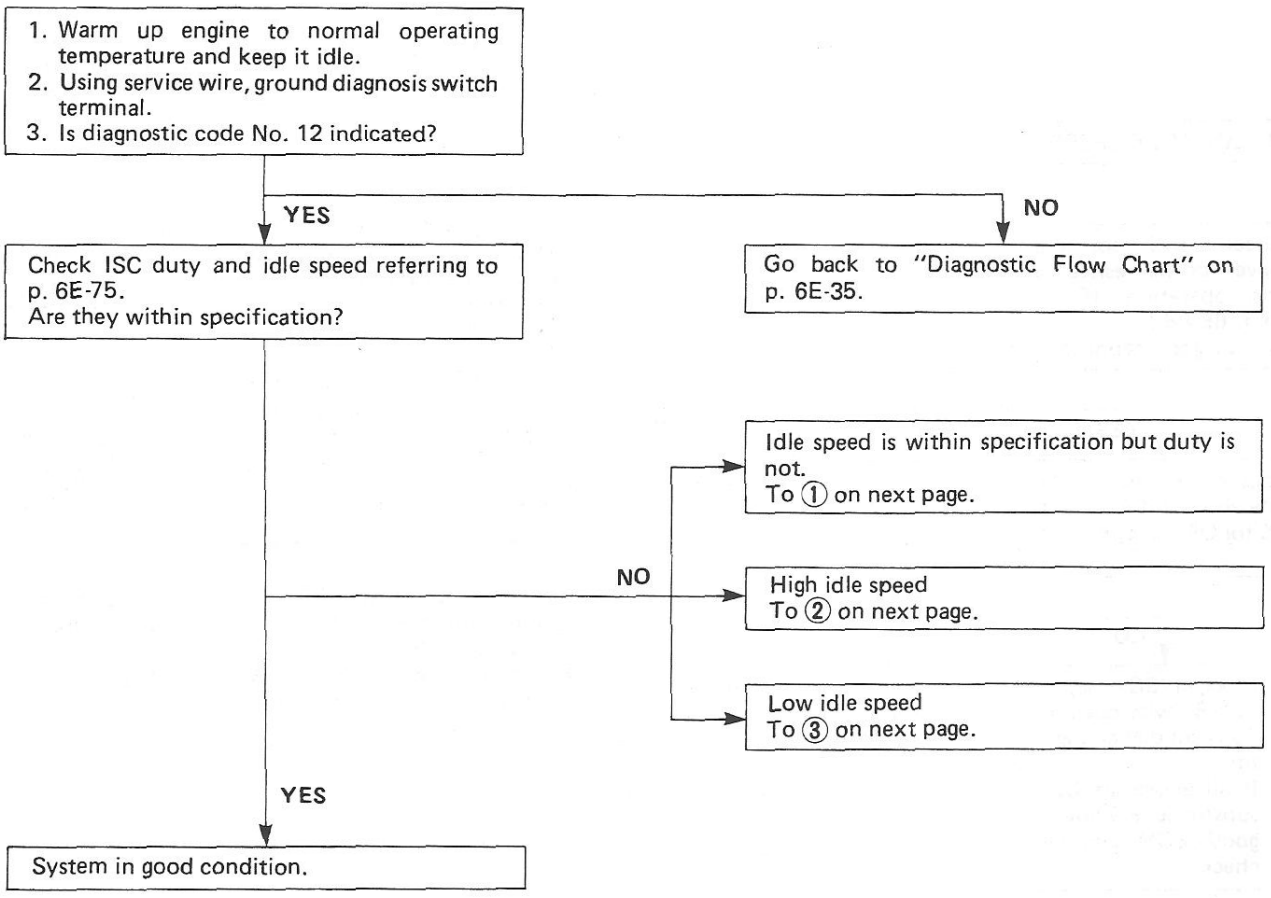
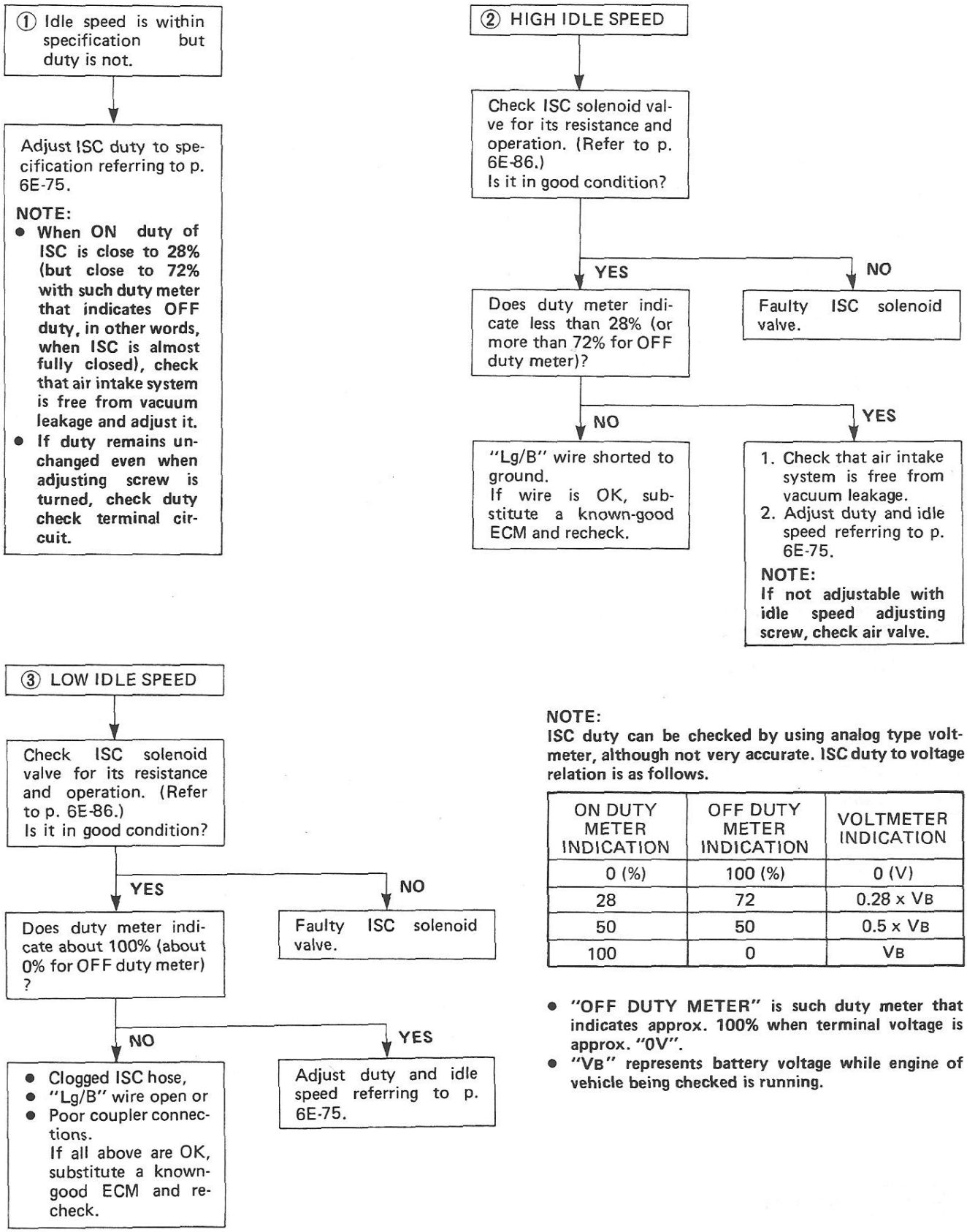


Fig. 6E-95 Diagnostic Flow Chart B-5 For ISC Solenoid Valve Control System (1)

B-5 ISC SOLENOID VALVE CONTROL SYSTEM CHECK (Continued)



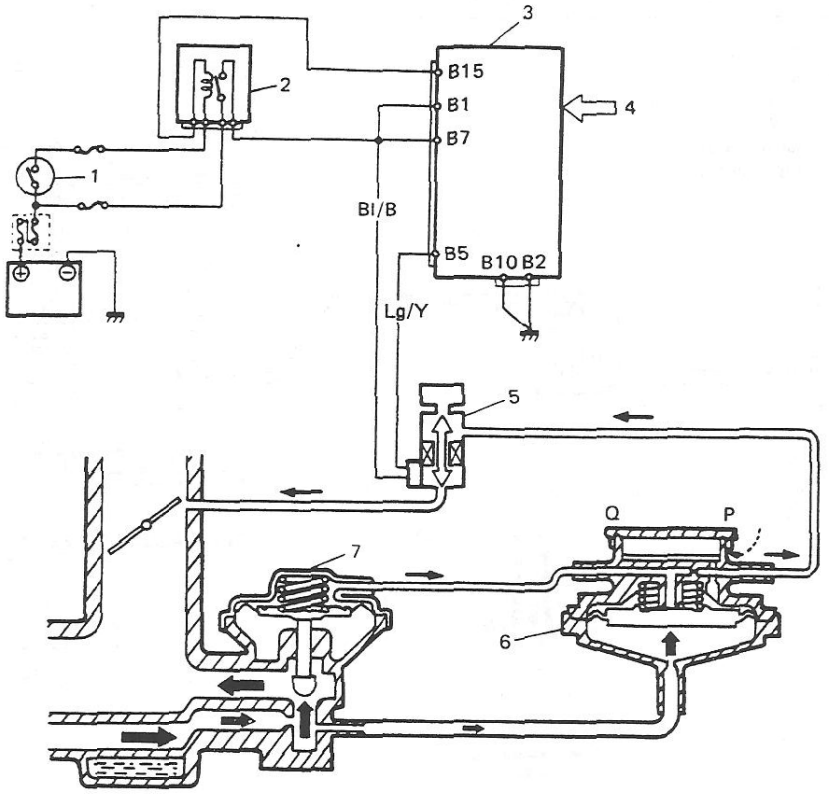
NOTE:
ISC duty can be checked by using analog type voltmeter, although not very accurate. ISC duty to voltage relation is as follows.

ON DUTY METER INDICATION	OFF DUTY METER INDICATION	VOLTMETER INDICATION
0 (%)	100 (%)	0 (V)
28	72	0.28 x V_B
50	50	0.5 x V_B
100	0	V_B

- **"OFF DUTY METER" is such duty meter that indicates approx. 100% when terminal voltage is approx. "0V".**
- **"V_B" represents battery voltage while engine of vehicle being checked is running.**

Fig. 6E-96 Diagnostic Flow Chart B-5 For ISC Solenoid Valve Control System (2)

B-6 EGR SYSTEM CHECK



1. Ignition switch
2. Main relay
3. ECM
4. Sensed information
5. EGR VSV
6. EGR modulator
7. EGR valve

Fig. 6E-97 EGR System

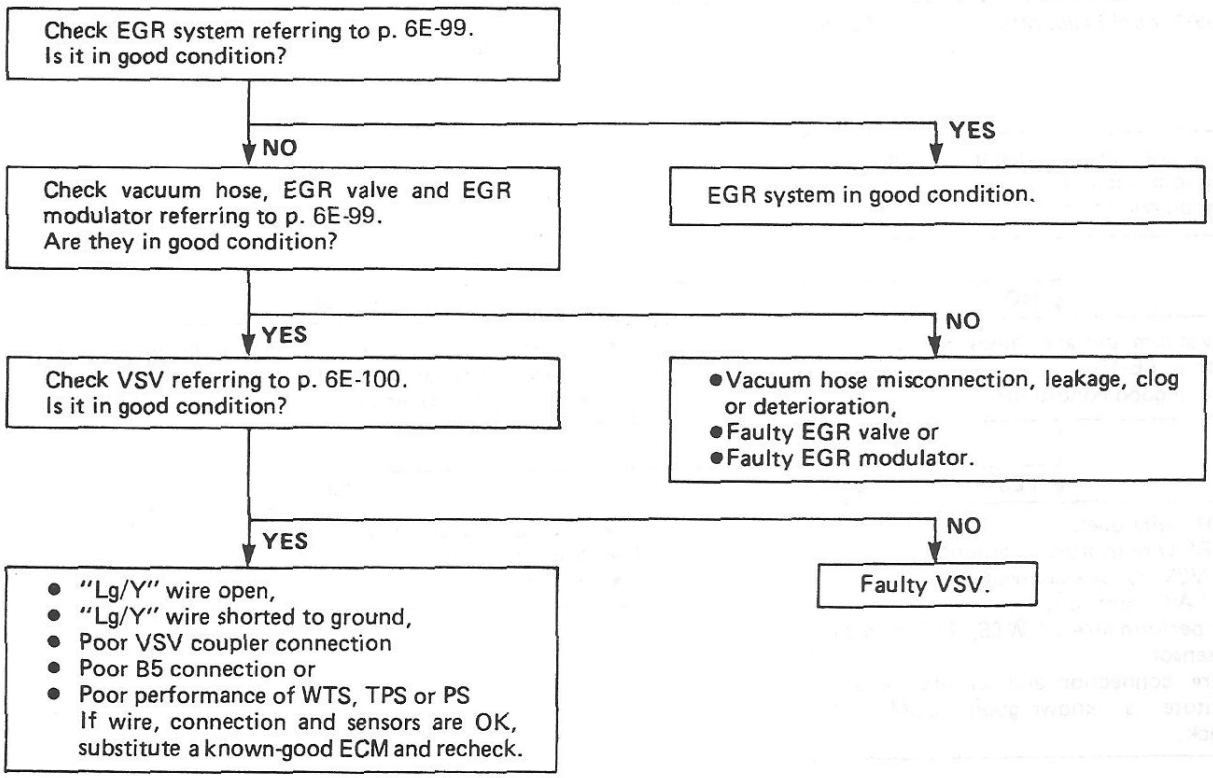


Fig. 6E-98 Diagnostic Flow Chart B-6 For EGR System

B-7 FUEL EVAPORATIVE EMISSION CONTROL SYSTEM CHECK

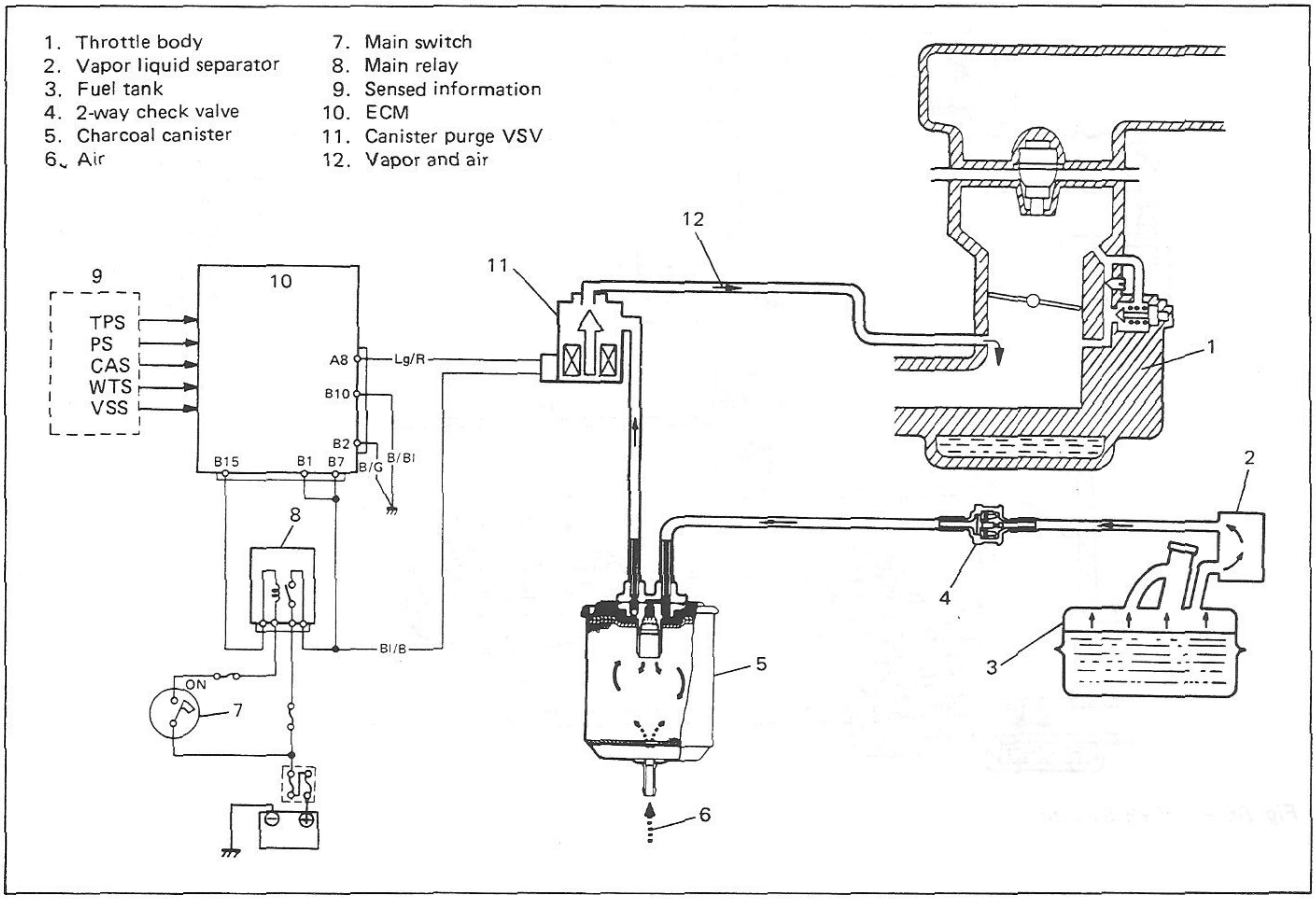


Fig. 6E-98-1 Fuel Evaporative Emission Control System

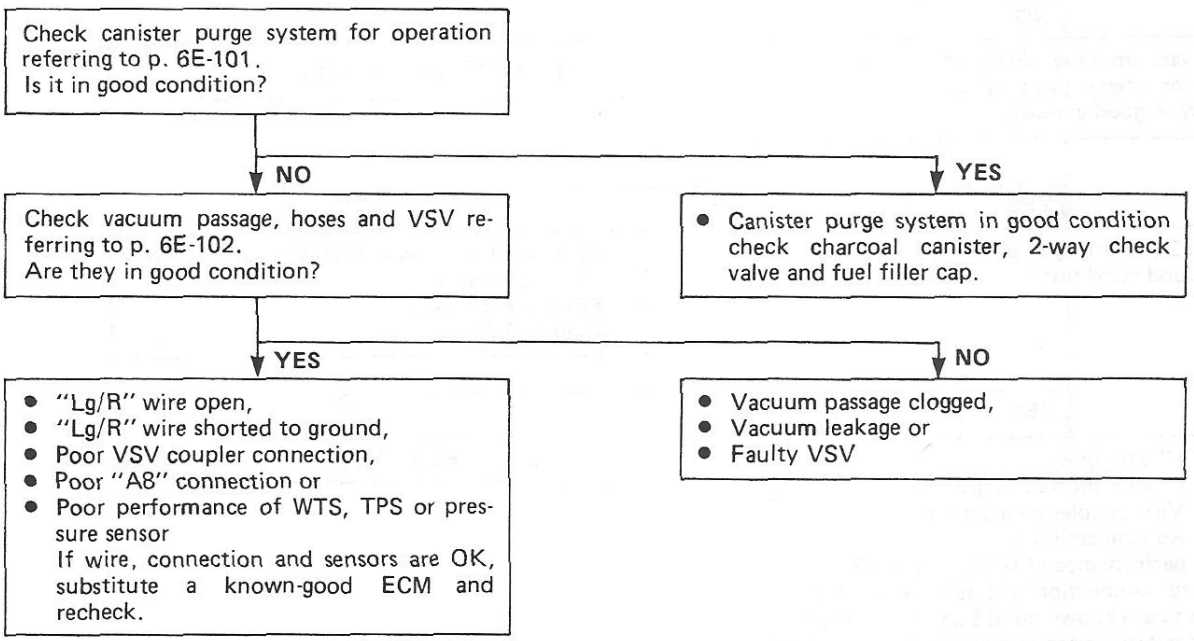


Fig. 6E-98-2 Diagnostic Flow Chart B-7 For Evaporative Emission Control System

ECM AND ITS CIRCUIT CHECK

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 radio speaker cover (front left side). Refer to Fig. 6E-135.
2. Remove radio speaker, if equipped.
3. Remove ECM with its bracket, fuse box, relays and wire harness from steering colum holder.
4. Remove ECM cover.
5. Check that ECM couplers are connected securely.
6. Check voltage at each terminal of couplers connected.

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

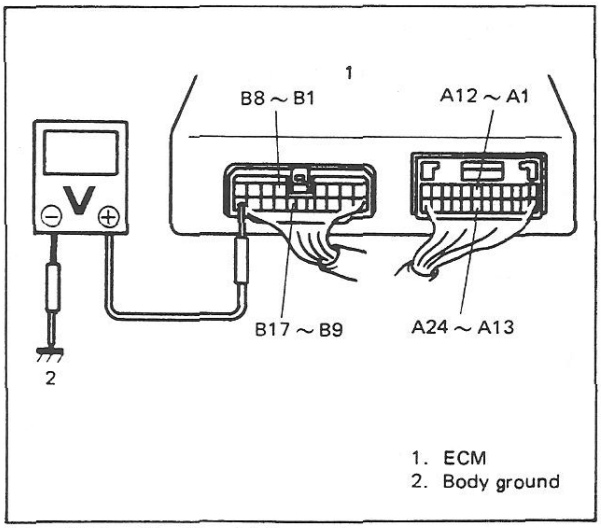


Fig. 6E-99 Checking Voltage

TERMINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A1	Ignition (fail safe) signal	10 – 14V	Ignition switch ON
A2	Air-conditioner circuit (if equipped)	10 – 14V	Ignition switch ON
		0 – 1V	With engine running Air-conditioner ON
A3	Diagnosis switch terminal	10 – 14V	Ignition switch ON
		0V	Ignition switch ON Diagnosis switch terminal grounded
A4	Blank	———	———
A5	Blank	———	———
A6	Power steering pressure switch (if equipped)	10 – 14V	Ignition switch ON
		0 – 1V	With engine running at idle speed, turning steering wheel to the right and left as far as it stops, repeating it a few times
A7	Test switch terminal	10 – 14V	Ignition switch ON
		0V	Ignition switch ON Test switch terminal grounded
A8	Canister purge VSV	10 – 14V	Ignition switch ON
A9	Duty check terminal	———	———
A10	Blank	———	———

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
A11	Lock-up relay for A/T	10 – 14V	Ignition switch ON
		0 – 1V	With "D" range position, driving vehicle at 67 km/h (42 mile/h) on flat road and keeping it for 4 seconds or more
A12	Ignition output signal	0V	Ignition switch ON
		0.5 – 3V	While engine cranking
A13	CAS	Indicator deflection repeated between 0V and about 5V	Ignition switch ON Crankshaft turned slowly
A14	Idle switch of TPS	0 – 1V	Ignition switch ON Throttle valve is at idle position (with throttle opener rod drawn in by vacuum pump gauge)
		3 – 5V	Ignition switch ON Throttle valve opens larger than idle position
A15	VSS	Indicator deflection repeated between 0V and 3 – 5V	Ignition switch ON Rear left tire turned slowly with rear right tire locked
A16	Blank	———	———
A17	ATS	2.2 – 3.0V	Ignition switch ON Sensor ambient temperature: 20°C (68°F)
A18	WTS	0.5 – 0.9V	Ignition switch ON Cooling water temperature: 80°C (176°F)
A19	Oxygen sensor	Refer to Diagnostic Flow Chart for Code No. 13	
A20	Serial data terminal	3 – 5V	Ignition switch ON
A21	TPS	0.5 – 1.2V	Ignition switch ON Throttle valve at idle position (with throttle opener rod drawn in by vacuum gauge)
		3.4 – 4.7V	Ignition switch ON Throttle valve at full open position
A22	Pressure sensor	3.6 – 4.4V	Ignition switch ON Barometric pressure: 760 mmHg
A23	Power source of sensors	4.75–5.25V	Ignition switch ON
A24	Ground of sensors	———	———
B1	Power source	10 – 14V	Ignition switch ON
B2	Ground	———	———
B3	Oxygen sensor heater	10 – 14V	Ignition switch ON
		0 – 1V	Engine running at idle speed
B4	Blank	———	———
B5	EGR VSV	10 – 14V	Ignition switch ON

TER-MINAL	CIRCUIT	NORMAL VOLTAGE	CONDITION
B6	ISC solenoid valve	———	———
B7	Power source	10 – 14V	Ignition switch ON
B8	Injector ⊕	———	———
B9	Power source for back-up circuit	10 – 14V	Ignition switch OFF and ON
B10	Ground	———	———
B11	Engine start switch (Engine start signal)	6 – 10V	While engine cranking
		0V	Other than above
B12	Shift switch (A/T only)	0 – 1V	Ignition switch ON Selector lever in "P" or "N" range
		10 – 14V	Ignition switch ON Selector lever in any other range than "P" and "N"
B13	"CHECK ENGINE" light	0 – 1V	Ignition switch ON
		10 – 14V	When engine running
B14	Throttle opener VSV	10 – 14V	Ignition switch ON
B15	Main relay ground	0 – 2V	Ignition switch ON
B16	Fuel pump relay ground	0 – 4V	For 3 sec. after ignition switch ON
		10 – 14V	When over 3 sec. after ignition switch ON
B17	Injector ⊖	———	———

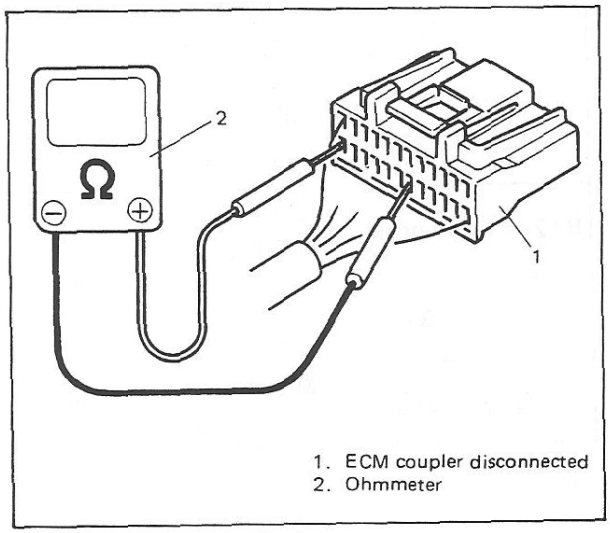
RESISTANCE CHECK

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

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

2. Check resistance between each pair of terminals of disconnected couplers as listed in table on the next page.

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 table represents that when parts temperature is 20°C (68°F).**



1. ECM coupler disconnected
2. Ohmmeter

Fig. 6E-100 Checking Resistance

TERMINALS	CIRCUIT	STANDARD RESISTANCE	CONDITION
A3 – Body ground	Diagnosis switch terminal	∞ (infinity)	———
A7 – Body ground	Test switch terminal	∞ (infinity)	———
A8 – B1	Canister purge VSV	30 – 38 Ω	———
A9 – Body ground	Duty check terminal	∞ (infinity)	———
A11 – B1	Lockup relay	90 – 110 Ω	———
A14 – A24	Idle switch	0 – 500 Ω	Throttle valve is at idle position
		∞ (inifinity)	Throttle valve opens larger than idle position
A15 – Body ground	VSS	Ohmmeter indicator deflects between 0 and ∞	Rear left tire turned slowly with rear right tire locked
A17 – A24	ATS	2.28 – 2.87 kΩ	Sensor ambient temp. 20°C (68°F)
A18 – A24	WTS	0.29 – 0.35 kΩ	Engine cooling water temp. 80°C (176°F)
A21 – A24	TPS	0.3 – 2 kΩ	Throttle valve at idle position (with PS coupler disconnected)
		2.0 – 6.5 kΩ	Throttle valve at full open position (with PS coupler disconnected)
B5 – B1	EGR VSV	33 – 39 Ω	———
B6 – B1	ISC solenoid valve	11 – 14 Ω	———
B8 – B17	Fuel injector	0.8 – 1.8 Ω	———
B12 – Body ground	Shift switch (M/T only)	Continuity	Select lever in "P" or "N" range
		∞ (infinity)	Select lever in any other range than "P" and "N"
B14 – B1	Throttle opener VSV	33 – 39 Ω	———
B15 – B16	Main and fuel pump relay	124 – 153 Ω	———

ON VEHICLE SERVICE

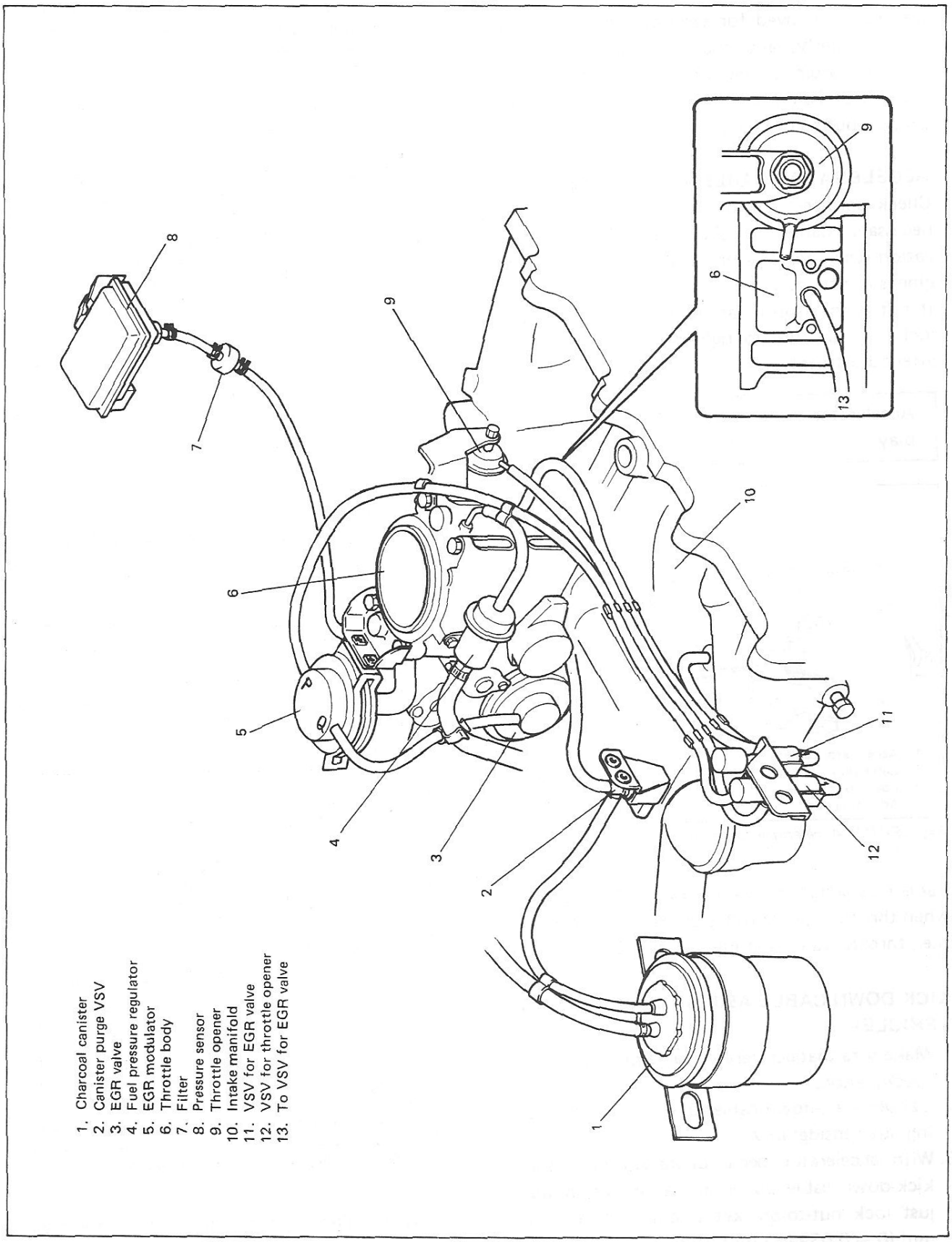


Fig. 6E-101 Vacuum Hose Routing

GENERAL

When hoses are disconnected and system's component is removed for service, reinstall component properly, and route and connect hoses correctly after service. Refer to Fig. 6E-101 or Vehicle Emission Control Information Label for proper routing of hoses.

ACCELERATOR CABLE ADJUSTMENT

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

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

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

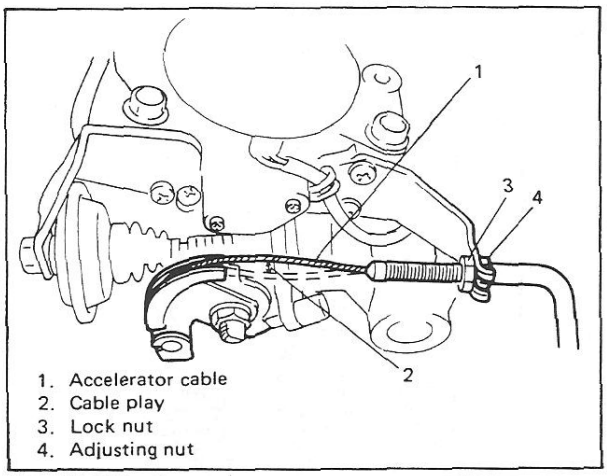


Fig. 6E-102 Accelerator Cable Play

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

KICK-DOWN CABLE ADJUSTMENT (FOR A/T VEHICLE)

1. Make sure that accelerator cable play is within specification.
2. Loosen kick-down cable lock nut and adjusting nut considerably.
3. With accelerator pedal depressed fully and kick-down cable pulled in "A" direction, adjust lock nut-to-bracket clearance to 0 – 1 mm (0 – 0.039 in.) by turning lock nut.

NOTE:

When adjusting clearance, make sure that adjusting nut does not contact against bracket.

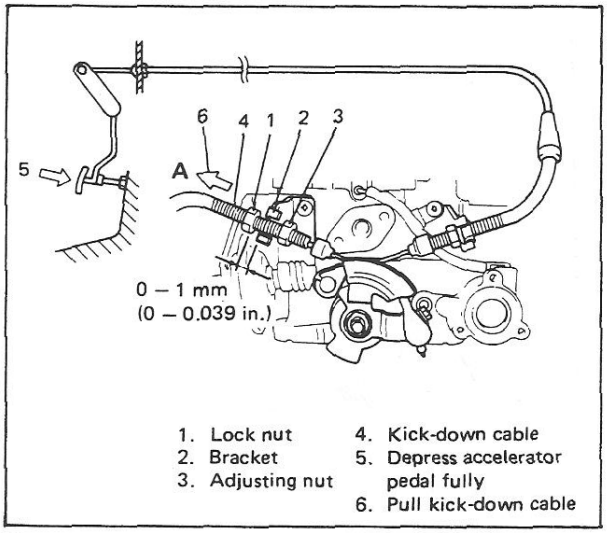


Fig. 6E-103 Adjusting Kick-down Cable (1)

4. Release accelerator pedal and adjust lock nut-to-bracket clearance as specified above by tightening adjusting nut using care to keep lock nut in place.
   Turn adjusting nut at such position as shown with dotted line in figure below, where it can be turned smoothly.
   When adjusting nut position is determined, fit adjusting nut to bracket as shown with solid line.

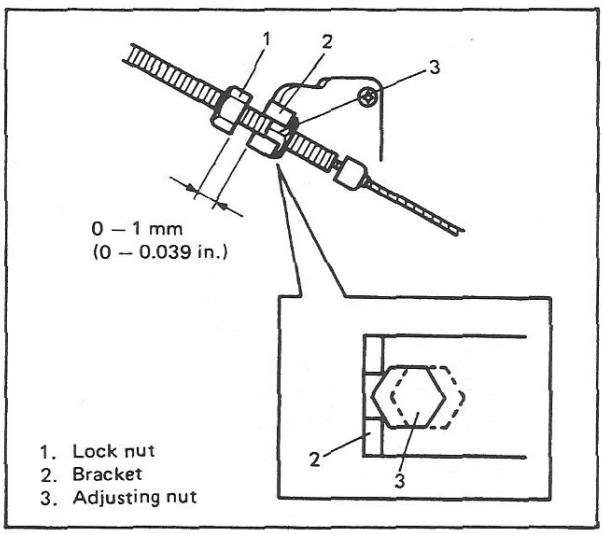


Fig. 6E-104 Adjusting Kick-down Cable (2)

5. With adjusting nut positioned as shown with solid line, tighten lock nut securely.

IDLE SPEED/ISC DUTY ADJUSTMENT

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

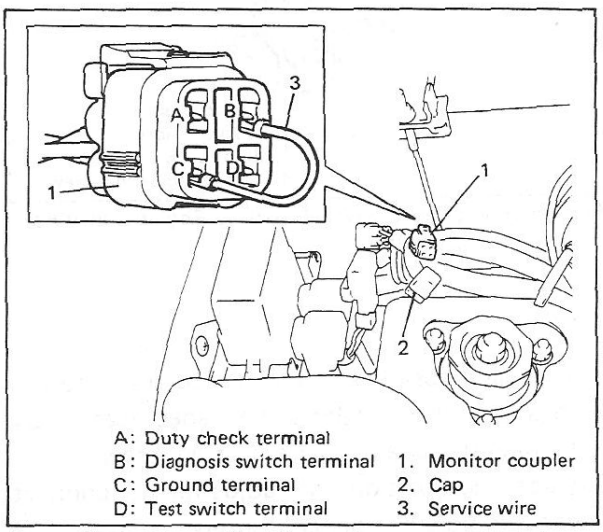
- Lead wires and hoses of Electronic Fuel Injection and engine emission control systems are connected securely.
- Accelerator cable has some play, that is, it is not tight.
- Valve lash is checked and adjusted according to maintenance schedule.
- Ignition timing is within specification.
- All accessories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

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

NOTE:

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

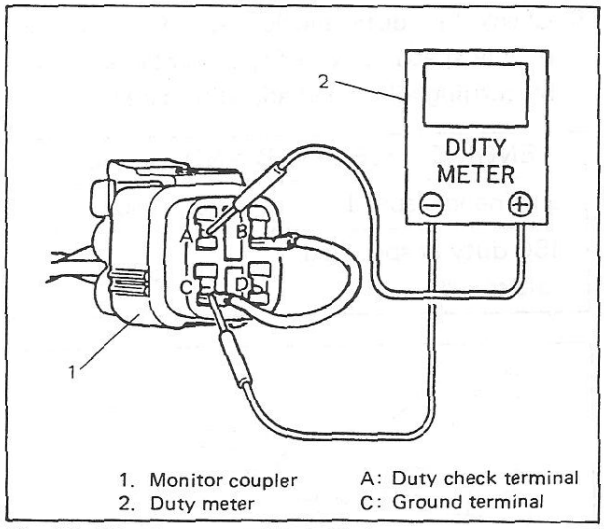
1. Warm up engine to normal operating temperature.
2. Using service wire, ground diagnosis switch terminal in monitor coupler and make sure that "CHECK ENGINE" light indicate diagnostic code No. 12.
   The monitor coupler is located beside battery.



A: Duty check terminal
B: Diagnosis switch terminal
C: Ground terminal
D: Test switch terminal
1. Monitor coupler
2. Cap
3. Service wire

Fig. 6E-105 Grounding Diagnosis Switch Terminal

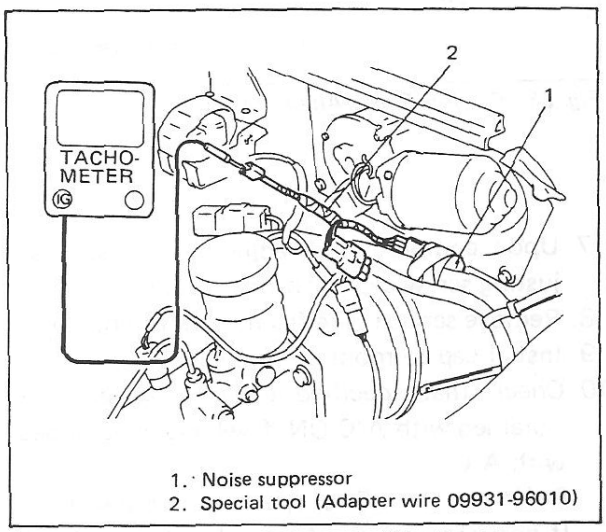
3. Stop engine and connect duty meter between duty check terminal and ground terminal of monitor coupler.



1. Monitor coupler
2. Duty meter
A: Duty check terminal
C: Ground terminal

Fig. 6E-106 Connecting Duty Meter

4. Disconnect noise suppressor coupler and connect special tool (Adapter wire) between suppressor and coupler disconnected. Set tachometer.

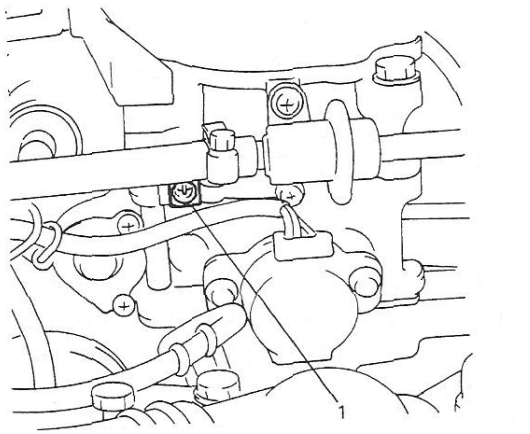


1. Noise suppressor
2. Special tool (Adapter wire 09931-96010)

Fig. 6E-106-1 Connecting Adapter Wire For Tachometer

5. Turn ON ignition switch and wait for 5 seconds. Then restart engine and run it at 2,000 r/min. for 5 minutes to warm it up completely and let it slow down to idle speed.
6. Check ISC duty and idle speed. If duty and/or idle speed is out of specifications, adjust it by turning idle speed adjusting screw.

ENGINE IDLE SPEED AND ISC DUTY	
Engine idle speed	800 ± 50 r/min.
ISC duty at specified idle speed	50%



1. Idle speed adjusting screw

Fig. 6E-107 Idle Speed Adjusting Screw

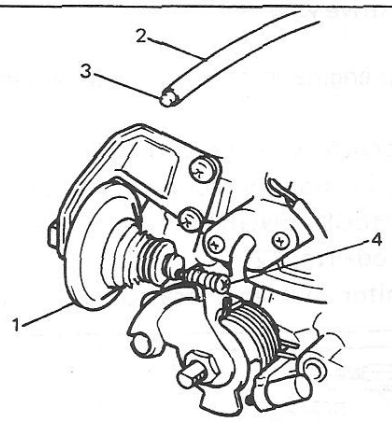
7. Upon completion of adjustment, install adjusting screw cap to throttle body.
8. Remove service wire from monitor coupler.
9. Install cap to monitor coupler.
10. Check that specified engine idle speed is obtained with A/C ON if vehicle is equipped with A/C.
    Refer to p. 6E-25 for specified idle speed.
    If not, check A/C ON signal circuit and ISC solenoid valve.

THROTTLE OPENER ADJUSTMENT

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

1. Turn ignition switch ON and leave it for 5 sec. Run engine at 2000 r/min. for 5 min. after warming up and let it slow down to idle speed.
2. Check to make sure that no electric load is applied to engine.
3. Disconnect vacuum hose from throttle opener and put blind plug in disconnected vacuum hose.
   Check that engine speed is within specification then.

Engine speed while opener operating	2100 – 2300 r/min.



1. Throttle opener
2. Vacuum hose
3. Blind plug
4. Opener adjusting screw

Fig. 6E-108 Checking and Adjusting Engine Speed For Opener

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

AIR AND FUEL DELIVERY SYSTEM

FUEL PRESSURE INSPECTION

1. Relieve fuel pressure in fuel feed line referring to p. 6-3.
2. Hoist vehicle.
3. Remove plug bolt on fuel filter union bolt and connect special tool (fuel pressure gauge set) to fuel filter inlet union bolt.

CAUTION:
A small amount of fuel may be released when plug bolt is loosened.
Cover bolt hole with shop cloth so that released fuel is absorbed on it. Place that cloth in an approved container.

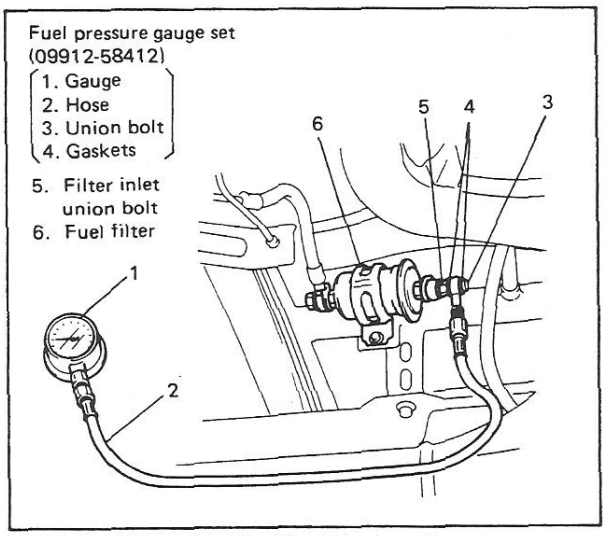


Fig. 6E-109 Connecting Fuel Pressure Gauge

4. Check that battery voltage is above 11V.
5. Turn ignition switch ON to operate fuel pump and after 3 seconds turn it OFF. Repeat this 3 or 4 times and then check fuel pressure.
6. Start engine.
7. Measure fuel pressure at idling.

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

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

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

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

9. Install plug bolt to fuel filter inlet union bolt. Use new gasket.
   Tighten it to specified torque.
10. With engine "OFF" and ignition switch "ON", check for fuel leaks.

FUEL PUMP

On Vehicle Inspection

CAUTION:
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 3 seconds and stop. Be sure to reinstall fuel filler cap after checking.

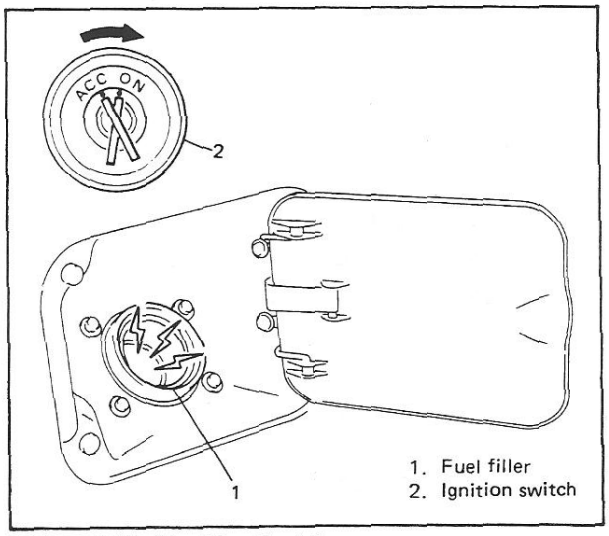


Fig. 6E-110 Checking Fuel Pump

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

2. Fuel pressure should be felt at fuel return hose for 3 seconds after ignition switch ON.

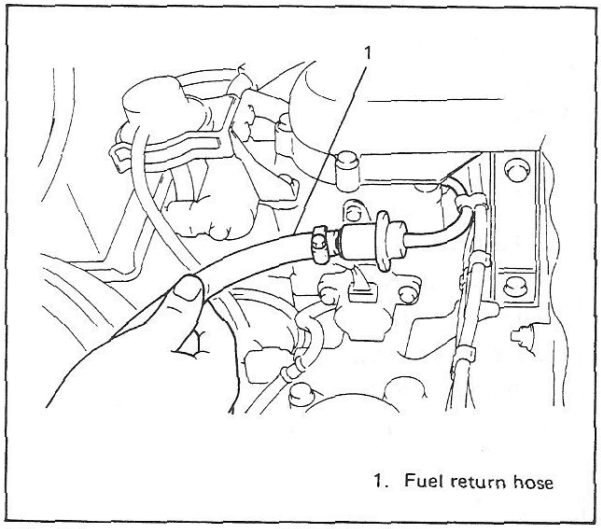


Fig. 6E-111 Checking Fuel Pressure

If fuel pressure is not felt, advance to "Diagnostic Flow Chart B-3".

Removal

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

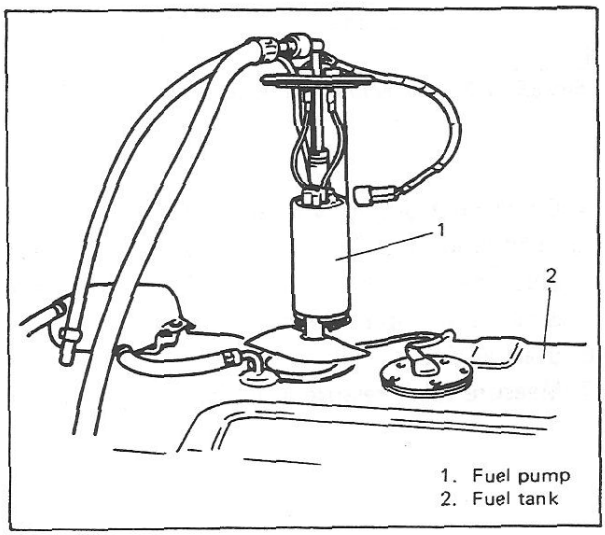


Fig. 6E-112 Removing Fuel Pump

Inspection

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

Installation

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

THROTTLE BODY

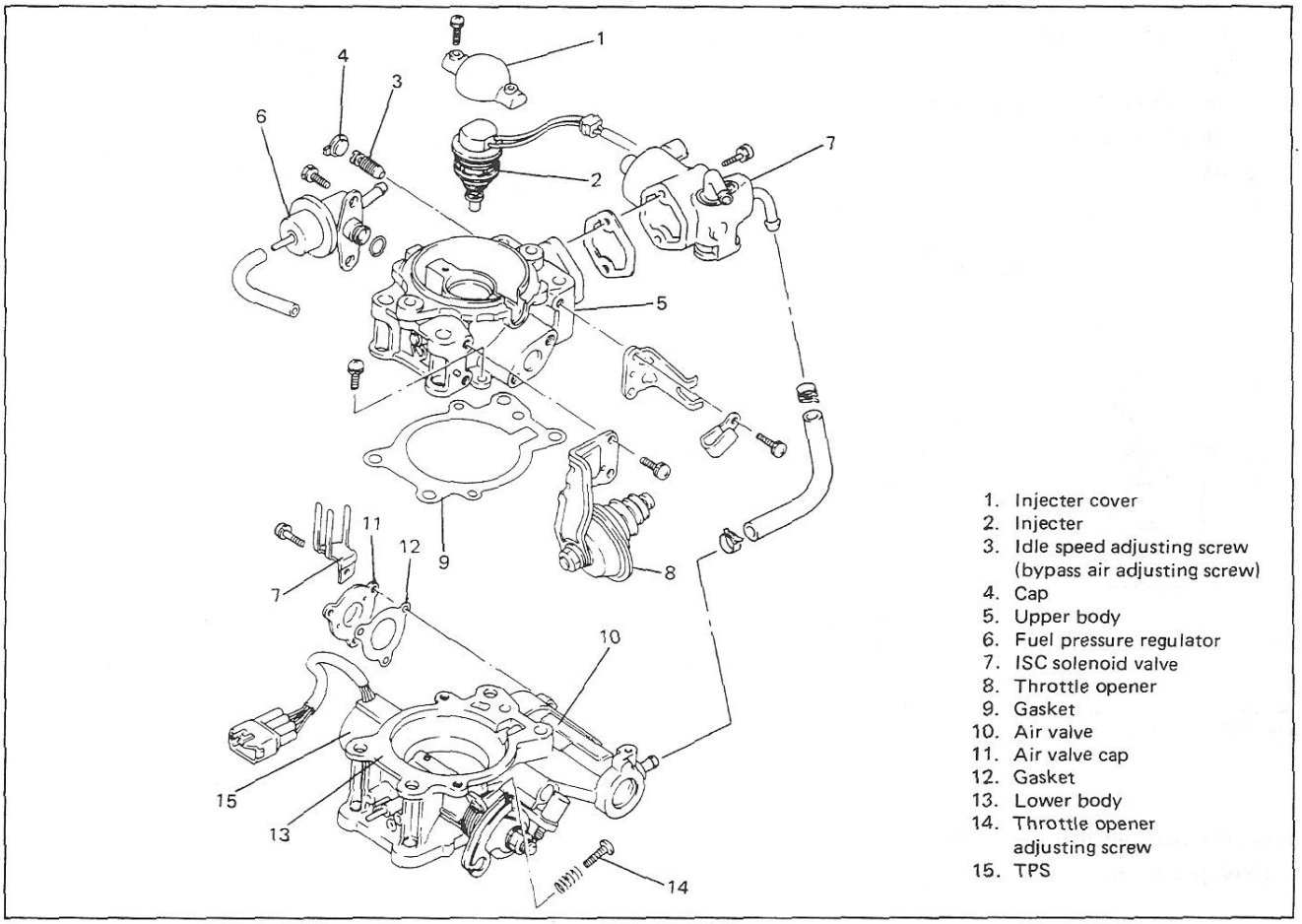


Fig. 6E-113 Throttle Body Parts Identification

On Vehicle Inspection

- Check throttle valve lever for smooth movement.
- Vacuum passage inspection
  With finger placed against vacuum nozzle, increase engine speed a little and check that vacuum is applied.

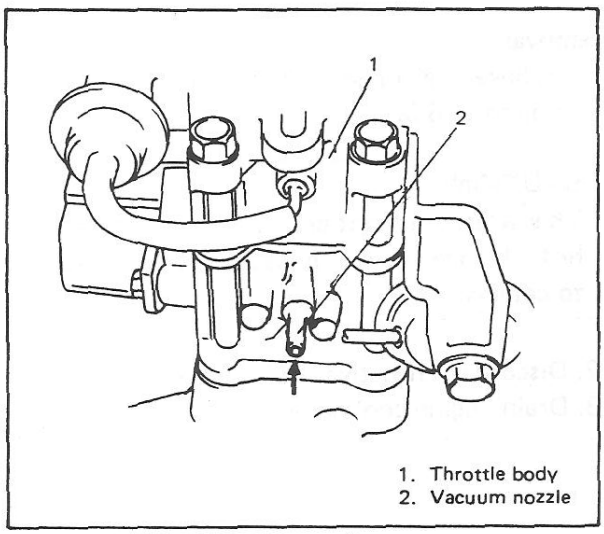


Fig. 6E-114 Checking Vacuum Passage

- Air valve inspection

1. Remove air valve cap with engine stopped when engine is cold (engine cooling water temperature is 60°C, 140°F or lower) and checking procedure as shown in Fig. 6E-115.
2. Reinstall air valve cap and warm up engine to its normal operating temperature (engine cooling water temperature is 70°C, 158°F or higher).
   Then remove air valve cap again with engine stopped and check visually that air valve is closed.

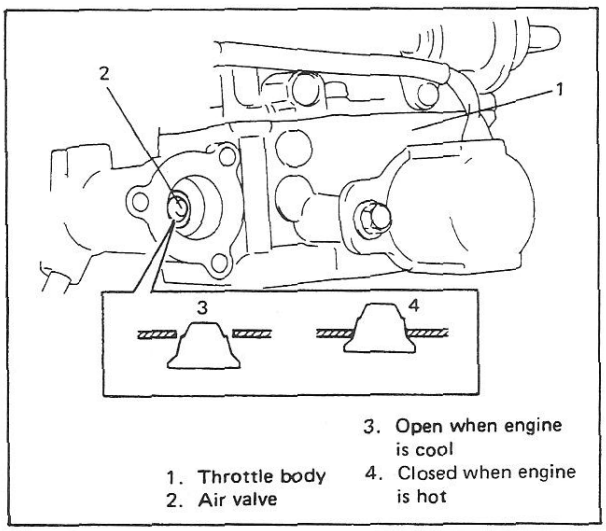


Fig. 6E-115 Inspecting Air Valve

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

Removal

1. Relieve fuel pressure in fuel feed line referring to p. 6-3.

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

2. Disconnect negative cable at battery.
3. Drain engine cooling water.
4. Remove air intake case from throttle body and air cleaner hose.
5. Disconnect fuel feed pipe from throttle body.
6. Disconnect fuel return hose from fuel pressure regulator.
7. Disconnect accelerator cable and A/T kick-down cable (if equipped) from throttle body.
8. Disconnect vacuum hoses from throttle body.
9. Disconnect cooling water hose from throttle body.
10. Disconnect fuel injector, TPS and ISC solenoid valve couplers.
11. Remove throttle body from intake manifold.

Disassembly

NOTE:

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

1. Remove injector from throttle body according to procedure described in p. 6E-84.
2. Remove TPS.
3. Remove fuel pressure regulator from throttle body.
4. Remove throttle opener.
5. Remove ISC solenoid valve.
6. After removing screws, separate upper and lower bodies.

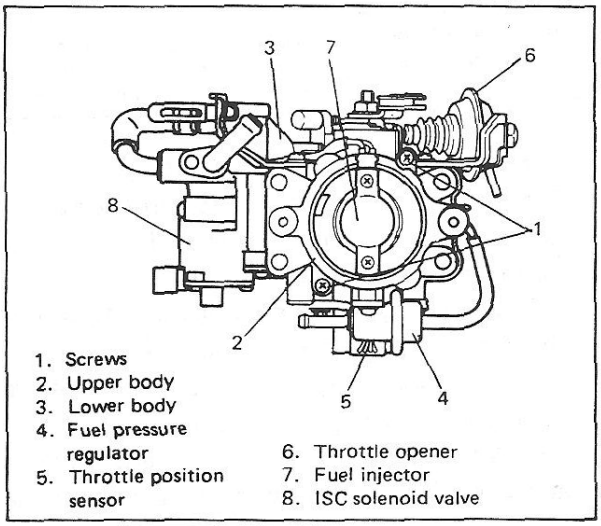


Fig. 6E-117 Disassembling Throttle Body

Cleaning

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

NOTE:

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

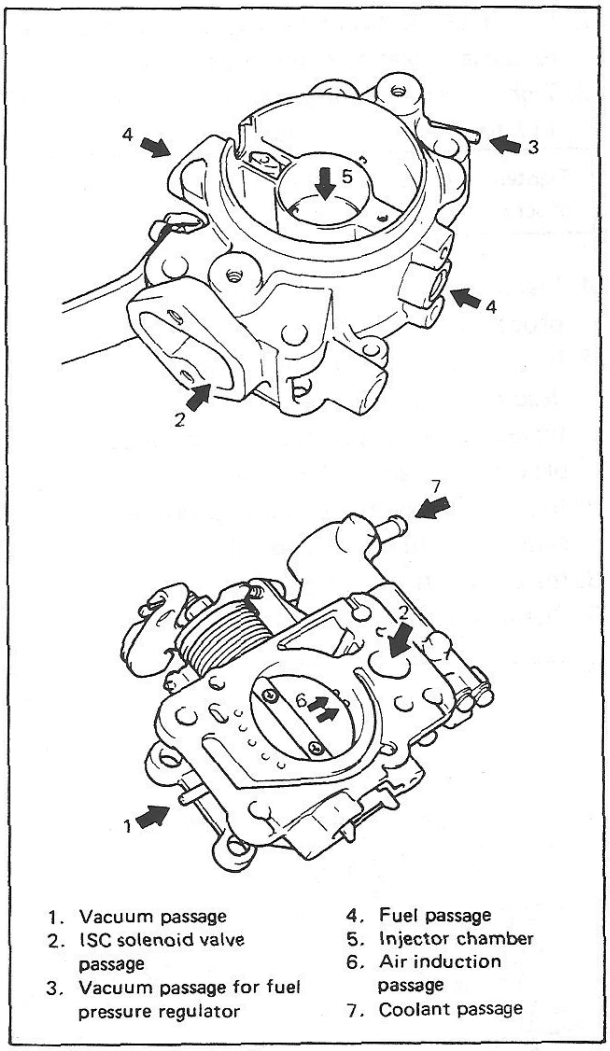


Fig. 6E-118 Cleaning Passage

Assembly

1. Install new gasket to lower body.

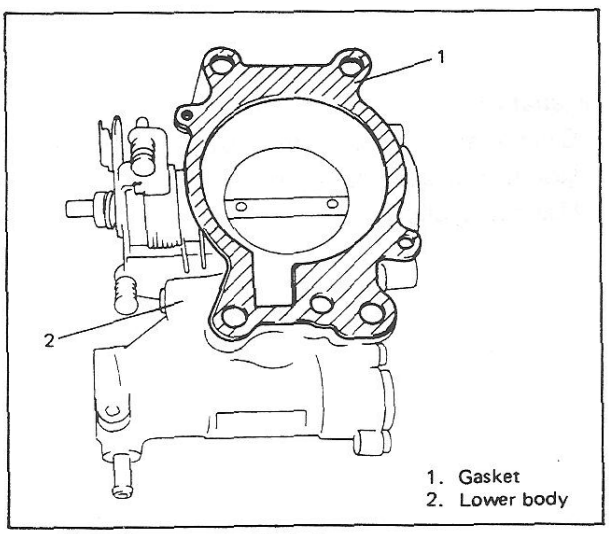


Fig. 6E-119 Installing Gasket

2. Install upper body on gasket, using care not to cause gasket to slip out of place.
3. Tighten screws indicated by "1" in Fig. 6E-117 to specified torque.

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

4. Install fuel pressure regulator according to procedure described in p. 6E-85.
5. Install fuel injector according to procedure described on p. 6E-84.
6. Install throttle position sensor according to procedure described on p. 6E-91.
7. Install ISC solenoid valve according to procedure described on p. 6E-87.
8. Install throttle opener.
9. Clamp wire harness securely.

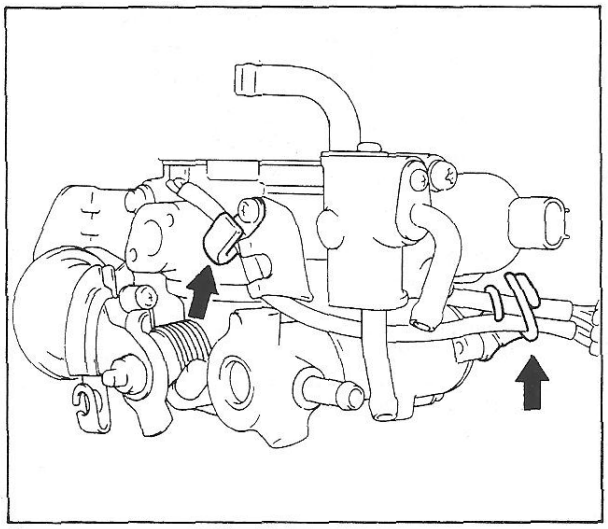


Fig. 6E-120 Clamping Wire Harness

Installation

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

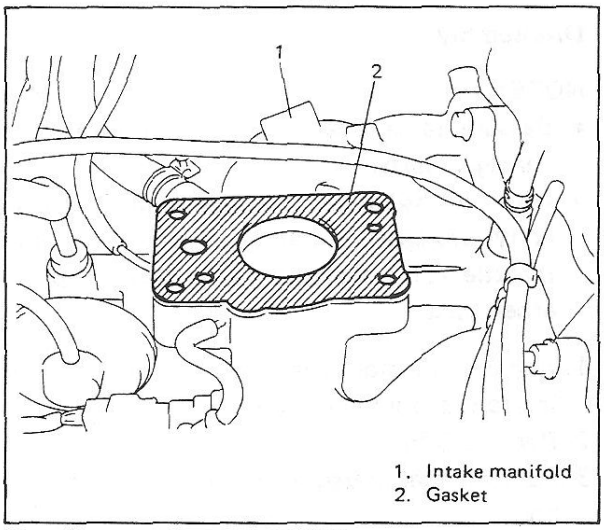


Fig. 6E-121 Gasket Installation

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

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

3. Connect fuel injector and TPS coupler.
4. Connect cooling water hose to throttle body.
5. Connect vacuum hose to throttle body.
6. Connect accelerator cable to throttle body.
   Adjust cable play to specification according to procedure described in p. 6E-74.
7. Connect fuel return hose to fuel pressure regulator and clamp it securely.
8. Connect fuel feed pipe to throttle body after applying thin coat of spindle oil or gasoline to O ring.
   Use new O ring.
   Tighten pipe bolts to specified torque.

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

9. Refill engine cooling system.
10. Connect negative cable at battery.
11. With engine "OFF" and ignition switch "ON", check for fuel leaks around fuel line connection.
12. Install air intake case seal and joint to throttle body.

13. Install air intake case to throttle body and air cleaner hose.
14. Upon completion of installation, start engine and check for fuel leaks and engine cooling water leaks.

FUEL INJECTOR

On Vehicle Inspection

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

Resistance of injector	0.8 – 1.8 Ω at 20° C (68° F)

If resistance is out of specification, replace fuel injector.

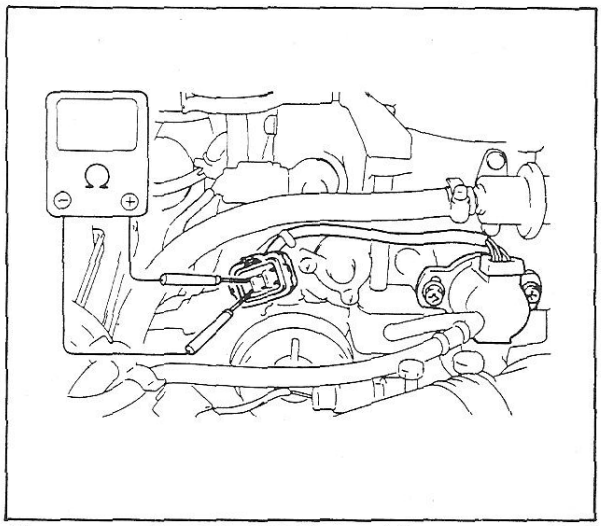


Fig. 6E-123 Checking Resistance of Fuel Injector

3. Connect injector coupler.
4. Remove air intake case.
5. Connect battery negative cable.
6. Make sure that fuel pressure is felt at fuel return hose for 3 seconds after ignition switch ON.
7. Check that fuel is injected out in conical shape from fuel injector when cranking engine or running engine.

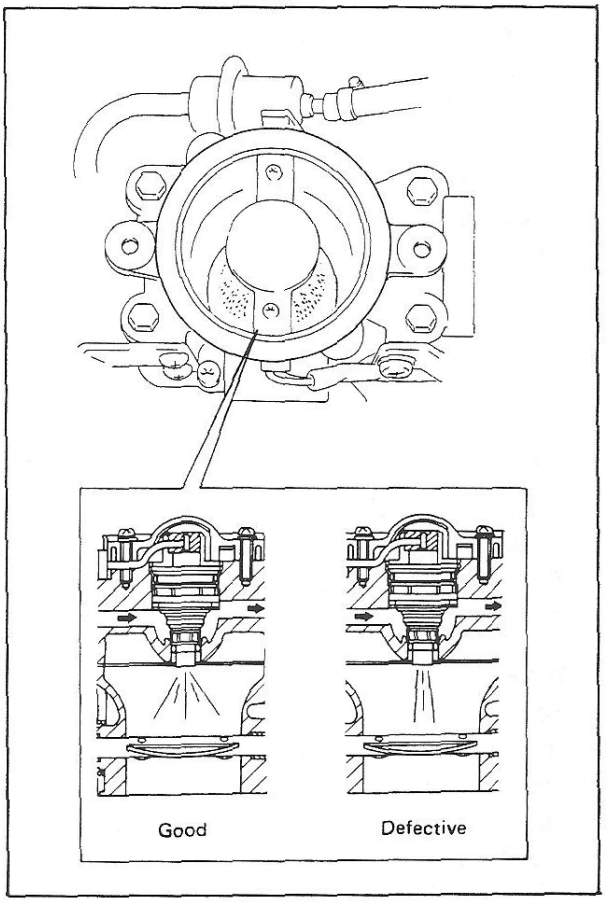


Fig. 6E-124 Checking Fuel Injection

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

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

Fuel leakage	Less than 1 drop/min.

9. Install air intake case.

Removal

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

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

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

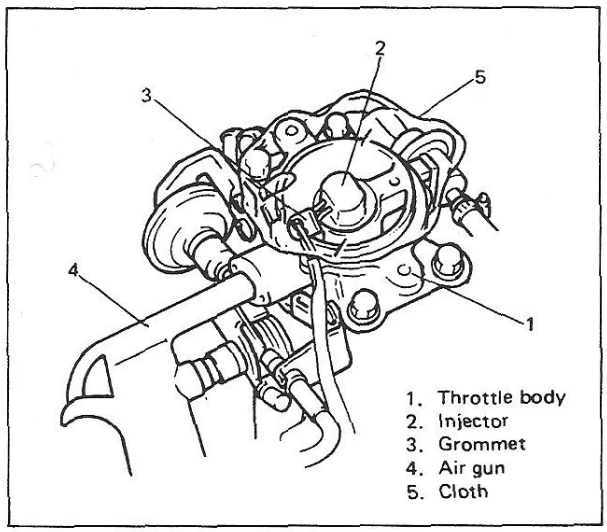


Fig. 6E-125 Removing Injector

8. Pull out fuel injector wire harness terminals from coupler after unlocking terminal lock.

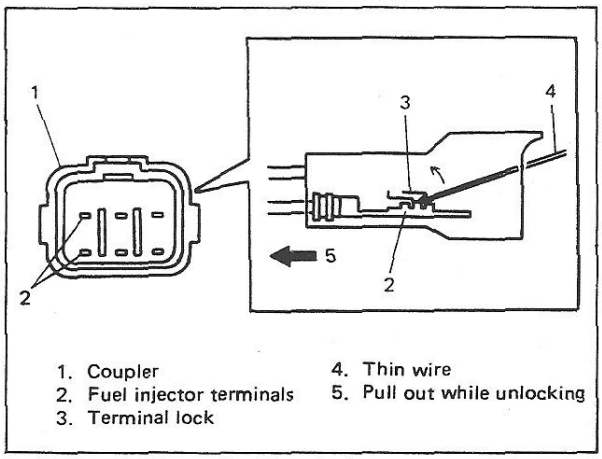


Fig. 6E-126 Removing Terminals

Inspection

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

Installation

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

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

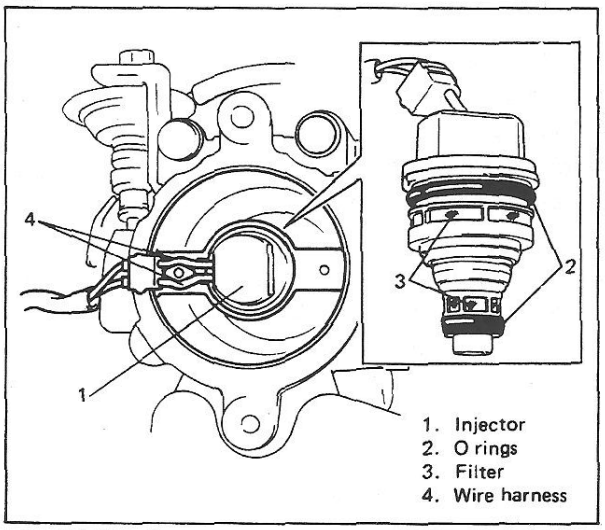


Fig. 6E-127 Installing Injector

3. Install injector cover.
   Use new screws and tighten them to specified torque.

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

4. Connect fuel feed pipe to throttle body after applying thin coat of engine oil to O ring.
5. Connect battery negative cable.
6. Repeat ignition switch ON for 3 sec. and OFF until fuel pressure is felt at fuel return hose and check that no fuel leaks from where fuel feed pipe is connected and where injector is installed.
7. Install air intake case and joint.
8. Connect fuel injector terminals into coupler, check to make sure that they are locked securely.

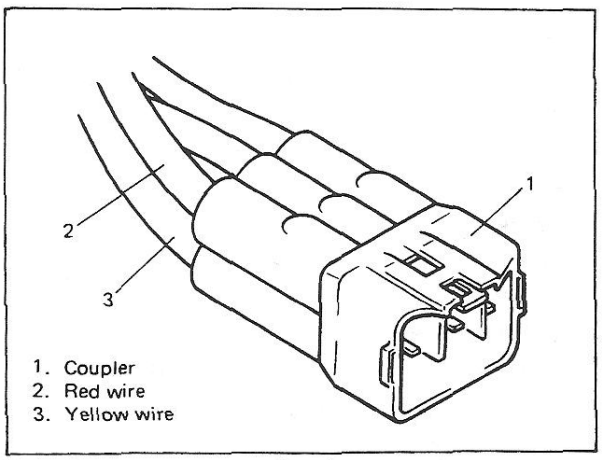


Fig. 6E-128 Connecting Fuel Injector Wires

FUEL PRESSURE REGULATOR

Removal

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

CAUTION:
A small amount of fuel may be released when regulator is removed. Cover its hole with shop cloth.

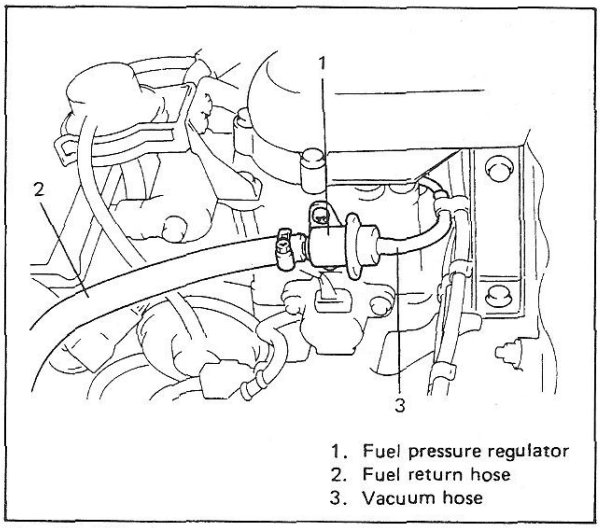


Fig. 6E-129 Fuel Pressure Regulator Removal

Installation

For installation, reverse removal procedure and note following precautions.

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

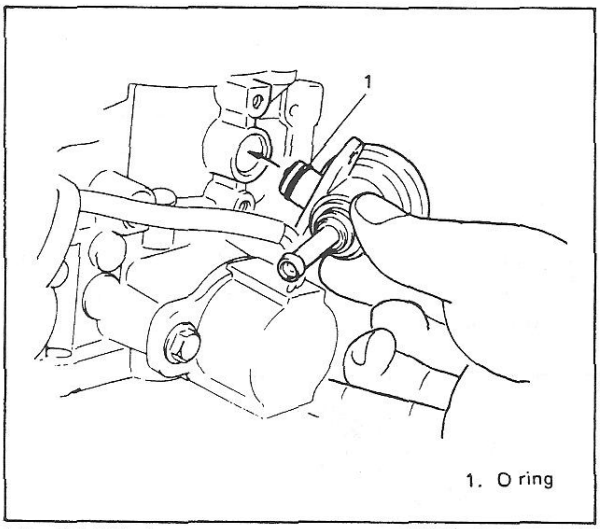


Fig. 6E-130 Installing Fuel Pressure Regulator

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

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

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

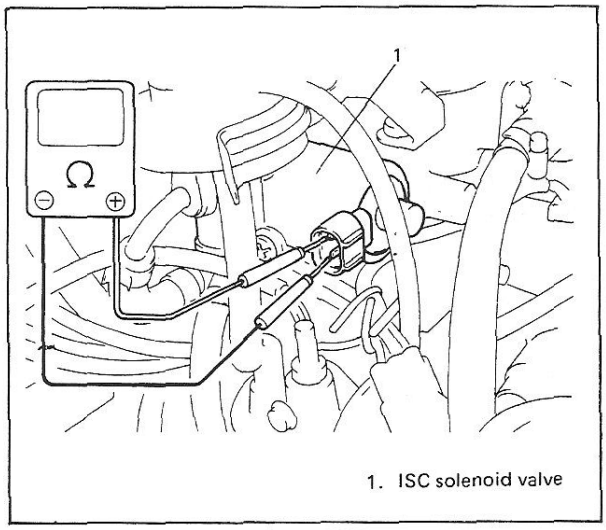
ISC SOLENOID VALVE

On Vehicle 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	11 – 14 Ω at 20°C, 68°F

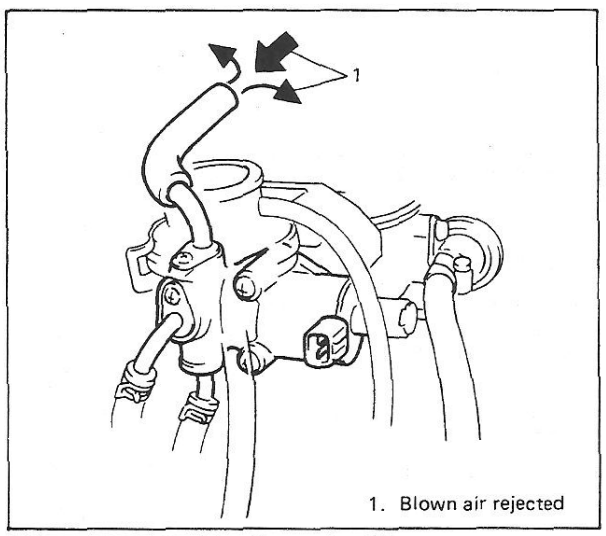
If it is within specification, proceed to next operation check. If not, replace.



1. ISC solenoid valve

Fig. 6E-131 Checking Resistance

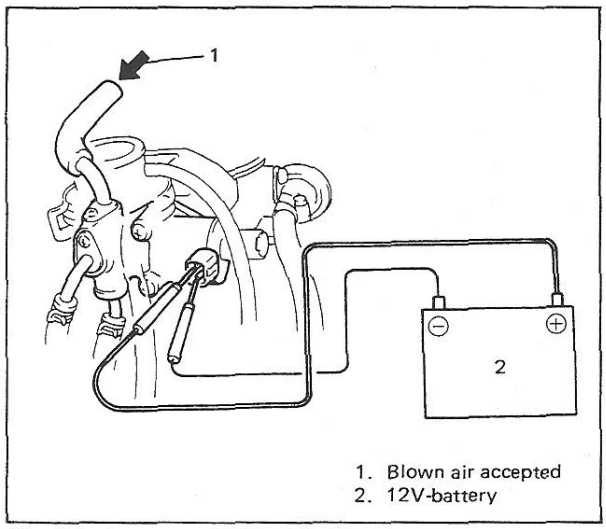
3. Disconnect ISC air hose from air intake case. Try blowing air into air hose and check that air will not go in (hard to blow).



1. Blown air rejected

Fig. 6E-132 Checking Operation (1)

4. Connect 12V-battery to ISC solenoid valve terminals and check that air can blown into air hose.



1. Blown air accepted
2. 12V-battery

Fig. 6E-133 Checking Operation (2)

If check result is not satisfactory, replace ISC solenoid valve.

5. Connect hose and coupler securely.

Removal

1. Disconnect battery negative cable at battery.
2. Disconnect ISC solenoid valve coupler.
3. Remove EGR modulator from its bracket.
4. Disconnect air hose from ISC solenoid valve.
5. Remove radiator cap to relieve engine cooling water pressure and reinstall 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.

6. Disconnect cooling water hoses from ISC solenoid.

NOTE:
Cooling water, although small amount, may be released then. Cover hose-to-pipe joint with shop cloth so that released water is absorbed on it.

7. Remove ISC solenoid valve from throttle body.

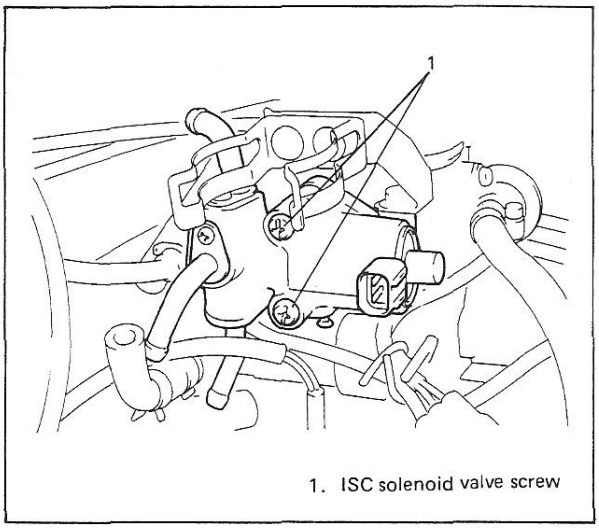


Fig. 6E-134 Removing ISC Solenoid Valve

Installation

For installation, reverse removal procedure and note following precautions.

- Use new gasket.
- Tighten ISC solenoid valve screws to specified torque.

Tightening torque for ISC solenoid valve screw	N·m	kg-m	lb-ft
	5	0.5	3.6

ELECTRONIC CONTROL SYSTEM

ELECTRONIC CONTROL MODULE (ECM)

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

Removal

1. Disconnect battery negative cable from battery.
2. Remove radio speaker cover (front left side).
3. Remove radio speaker (front left side), if equipped.
4. Remove ECM with its bracket, fuse box and relays from steering column holder.

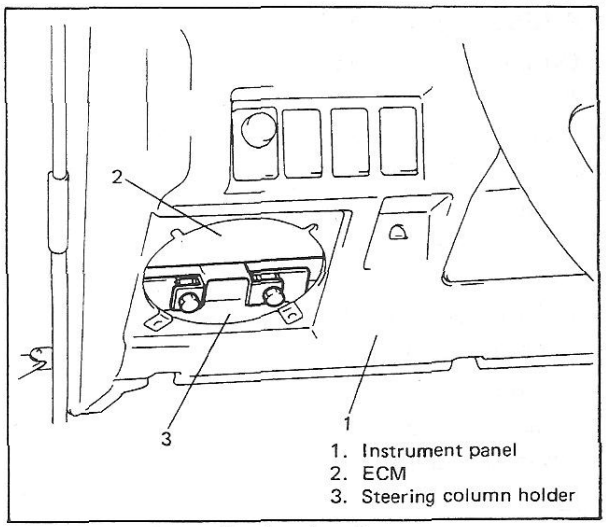


Fig. 6E-135 Removing Speaker Cover

5. Remove cover and disconnect couplers from ECM, and remove ECM from its bracket.

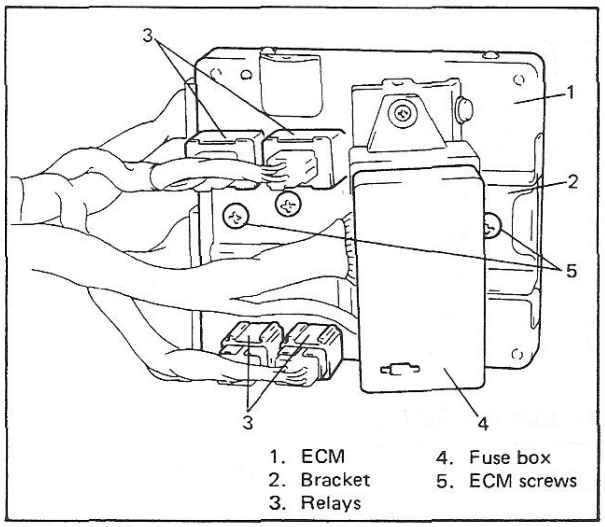


Fig. 6E-136 Removing ECM

Installation

Reverse removal procedure noting the following.

- Connect couplers to ECM securely.

PRESSURE SENSOR (PS)

Output Voltage Check

1. Remove ECM with bracket, relays, fuse box and wire harness previously outlined.
2. With coupler connected to ECM, connect digital type voltmeter as shown below and check that ECM supply voltage 4.75 – 5.25V is applied to coupler terminal A23.
3. Check output voltage at coupler terminal A22. Note that it varies with atmospheric pressure and altitude.
   Also, start engine, if it can, and check if output voltage varies.

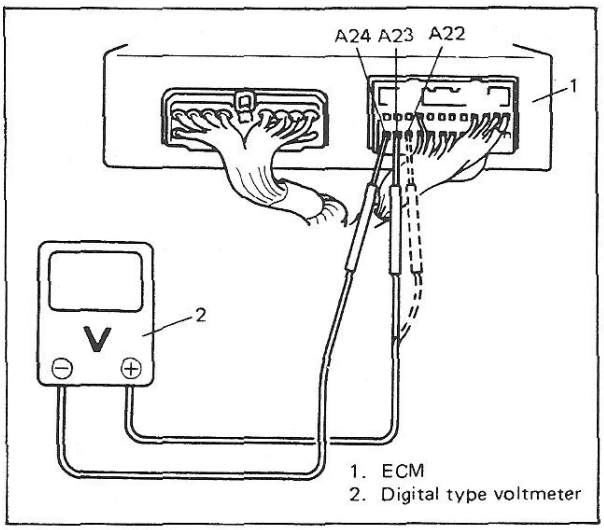


Fig. 6E-137 Checking Pressure Sensor

Output voltage (ECM supply voltage 4.75 – 5.25V)

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

NOTE:
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 2 or 3, check pressure sensor and its circuit according to Code No. 31 or 32 Diagnostic Flow Chart.

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

4. Upon completion of checking, install ECM.

Pressure Sensor Individual Check

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

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

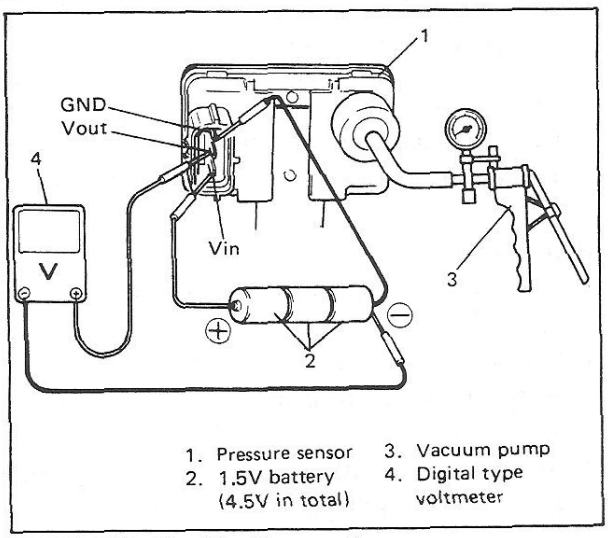


Fig. 6E-138 Checking Pressure Sensor

Output voltage (Vin voltage 4.5V)

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

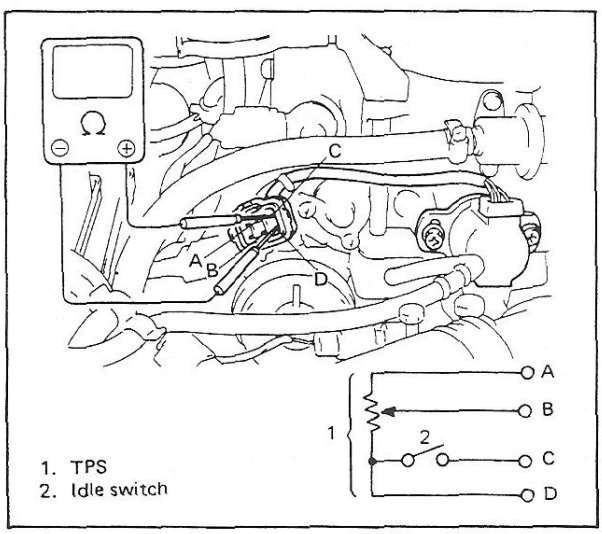
If check result is not satisfactory, replace pressure sensor.

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

THROTTLE POSITION SENSOR (TPS)

Inspection

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



1. TPS
2. Idle switch

Fig. 6E-139 Checking TPS

Resistance between C and D terminals (Idle switch)	When throttle lever-to-stop screw clearance is 0.3 mm (0.012 in.)	0 – 500 Ω
	When throttle lever-to-stop screw clearance is 0.5 mm (0.020 in.)	∞ (Infinity)
Resistance between A and D terminals	———	3.5 – 6.5 kΩ
Resistance between B and D terminals	When throttle valve is at idle position	0.3 – 2 kΩ
	When throttle valve is fully open	2 – 6.5 kΩ

NOTE:

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

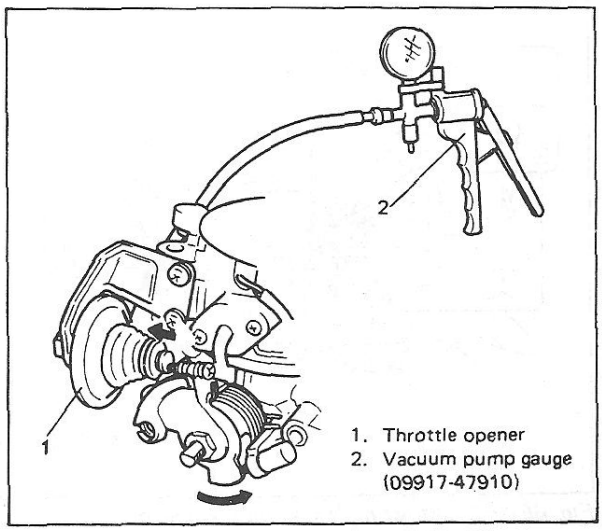
If idle switch check result is not satisfactory, adjust installation angle of TPS and then check again.

If found defective in above check, replace.

3. Connect TPS coupler securely and battery negative cable to battery.

Adjustment

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



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

Fig. 6E-140 Applying Vacuum to Throttle Opener

3. Insert 0.4 mm (0.016 in.) thickness gauge between throttle valve lever and throttle stop screw.

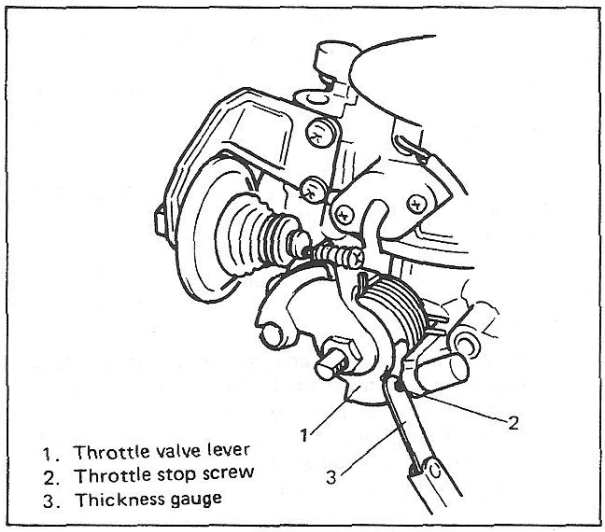


Fig. 6E-141 Inserting Thickness Gauge

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

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

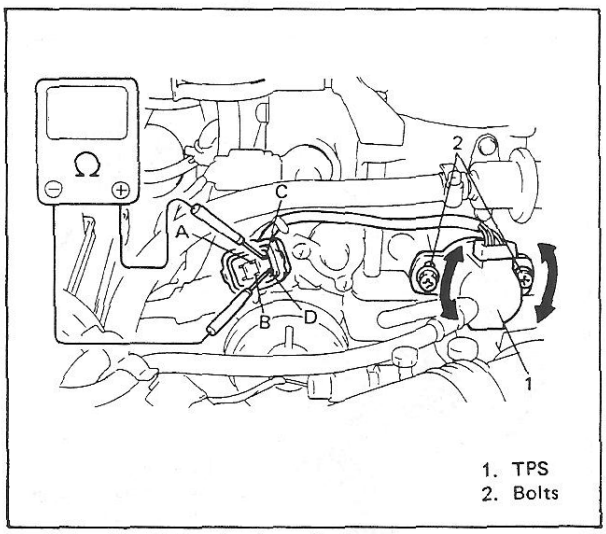


Fig. 6E-142 Adjusting Installation Angle of TPS

7. Check that there is no continuity between terminals C and D when 0.5 mm (0.020 in) thickness gauge is inserted.
8. Check that there is continuity between terminals C and D when 0.3 mm (0.012 in) thickness gauge is inserted.

   If check result is unsatisfactory in steps 7 and 8, 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.

9. Connect coupler to TPS securely, connect throttle opener vacuum hose to VSV and connect battery negative cable.

Removal

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

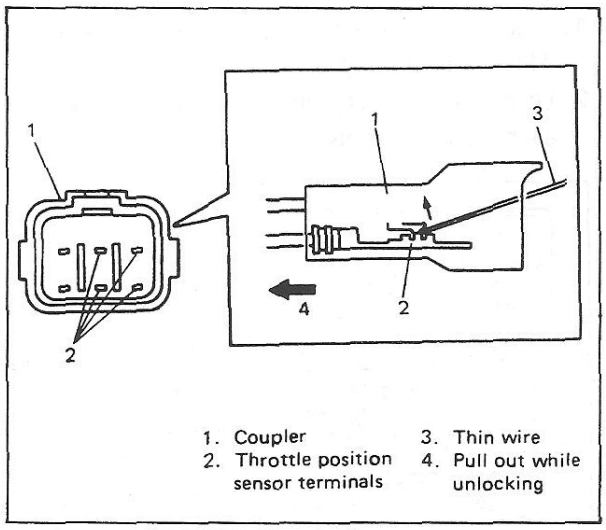


Fig. 6E-143 Removing Terminals

4. Remove TPS from throttle body.

Installation

1. Install TPS to throttle body.
   Fit sensor to throttle body in such way that its adjusting holes are a little away from sensor mounting bolt holes as shown in Fig. 6E-144 and turn sensor clockwise so that those holes align. Then hand-tighten sensor mounting bolts in aligned holes.

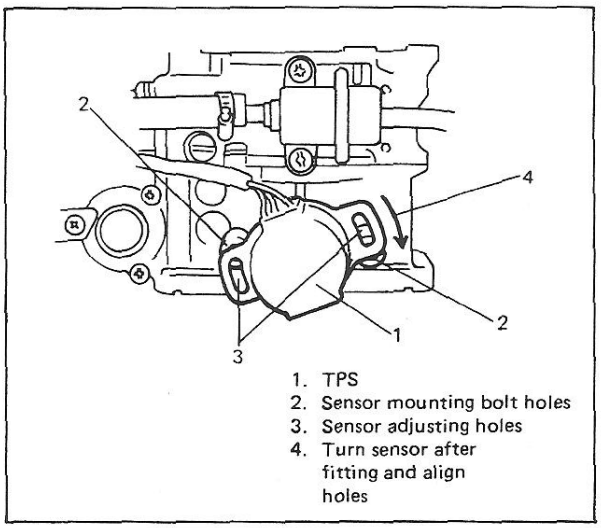


Fig. 6E-144 Installing TPS

2. Insert TPS terminals into coupler and check to make sure that they are locked.

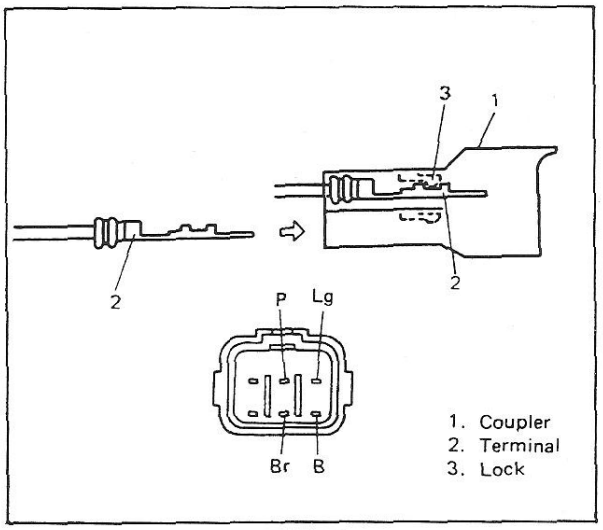


Fig. 6E-145 Inserting Terminals

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

AIR TEMPERATURE SENSOR (ATS)

Removal

1. Disconnect negative cable from battery.
2. Disconnect ATS coupler.
3. Remove ATS from intake manifold.

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-147, replace air temperature sensor.

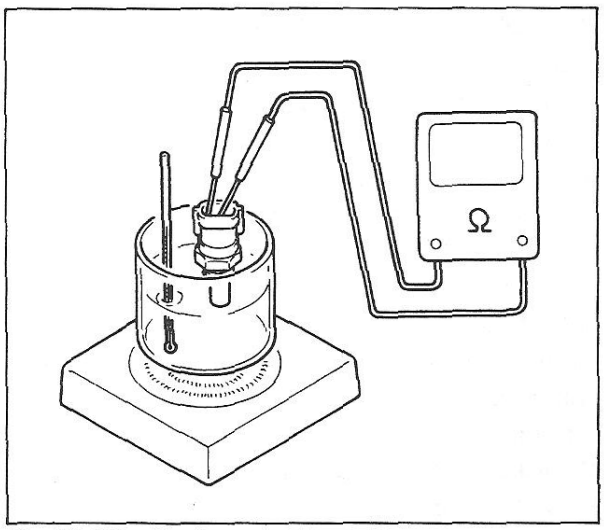


Fig. 6E-146 Checking ATS

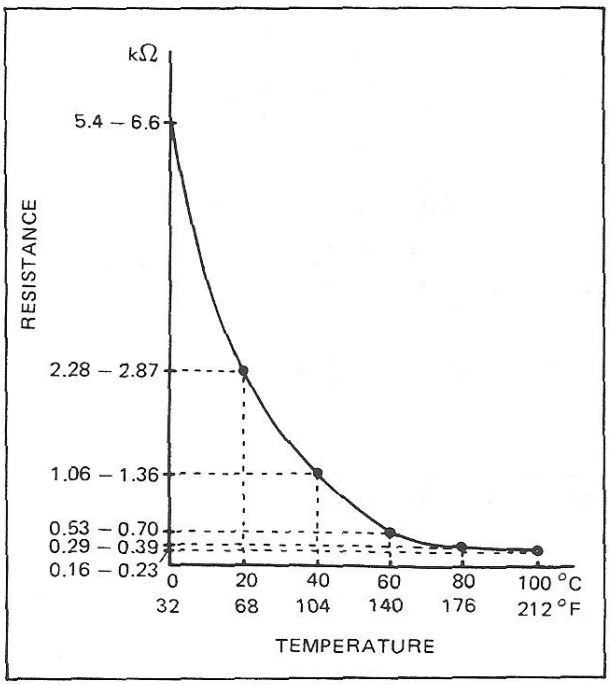


Fig. 6E-147 ATS Characteristic

Installation

Reverse removal procedure noting the following.

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

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

- Connect sensor coupler securely.

WATER TEMPERATURE SENSOR (WTS)

Removal

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

Inspection

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

If measured resistance doesn't show such characteristic as shown in Fig. 6E-149, replace WTS.

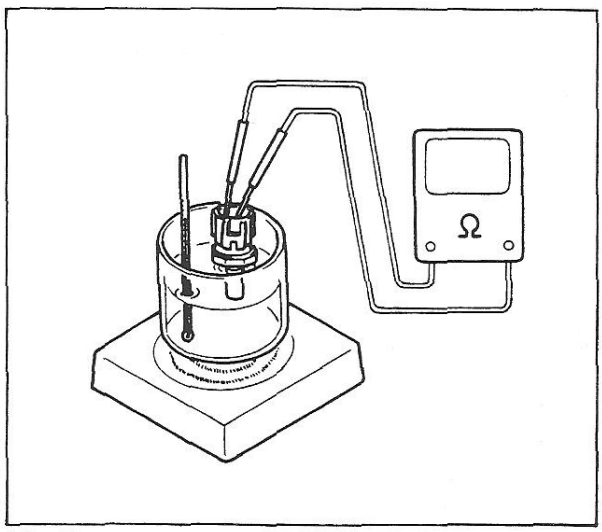


Fig. 6E-148 Checking WTS

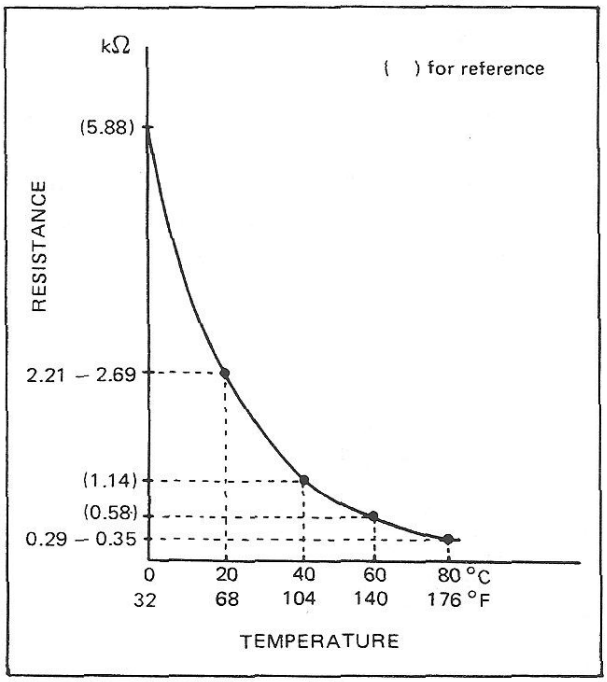


Fig. 6E-149 WTS Characteristic

Installation

Reverse removal procedure noting the following.

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

Tightening torque for water temperature sensor	N·m	kg-m	lb-ft
	12.5–17.5	1.25–1.75	9.5–12.5

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

OXYGEN SENSOR

Removal

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

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

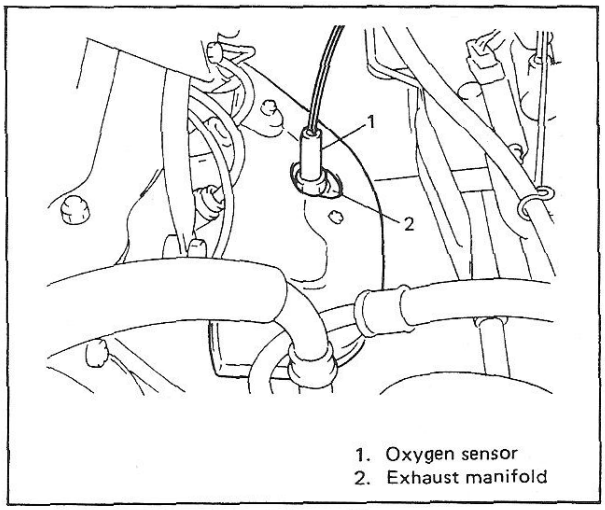


Fig. 6E-152 Removing Oxygen Sensor

Installation

Reverse removal procedure noting the following.

- Tighten oxygen sensor to specified torque.

Tightening torque for oxygen sensor	N·m	kg-m	lb-ft
	40 – 50	4.0 – 5.0	29.0 – 36.0

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

VEHICLE SPEED SENSOR (VSS)

Inspection

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

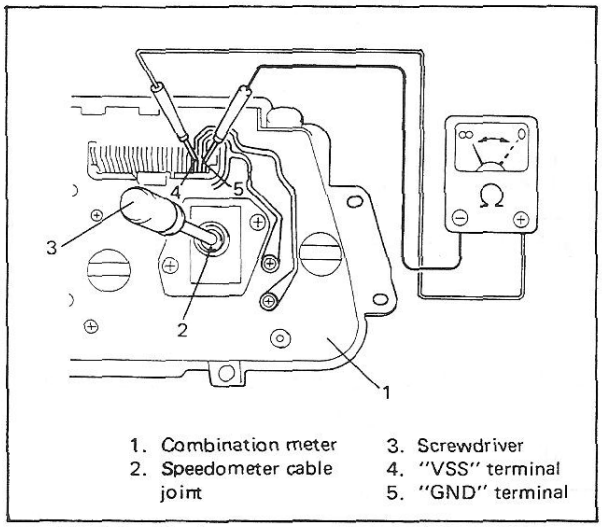


Fig. 6E-153 Checking Speed Sensor

Replace speedometer if check result is not satisfactory.

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

SHIFT SWITCH (A/T only)

Inspection

1. Disconnect negative cable from battery.
2. Disconnect shift switch coupler which is located under intake manifold.

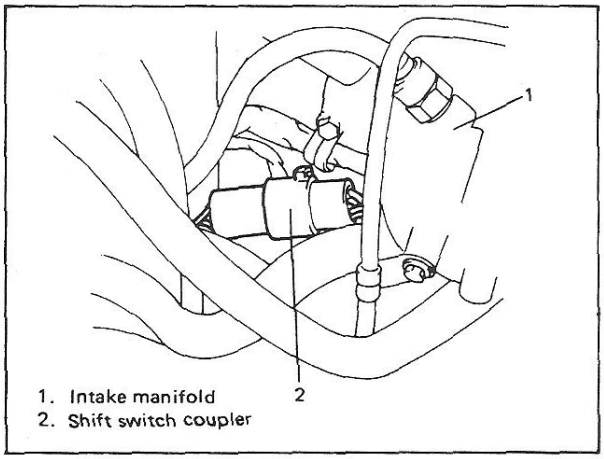


Fig. 6E-154 Shift Switch Coupler Location

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

TERMINALS	CONDITION	METER INDICATOR
Between Black/Yellow and Black/ Red wires	Selector lever in "P" and "N" range respectively.	0 (Zero)
	Selector lever in other than "P" and "N" range.	∞ (Infinity)
Between Red and Yellow wires	Selector lever in "R" range.	0 (Zero)
	Selector lever in other than "R" range.	∞ (Infinity)

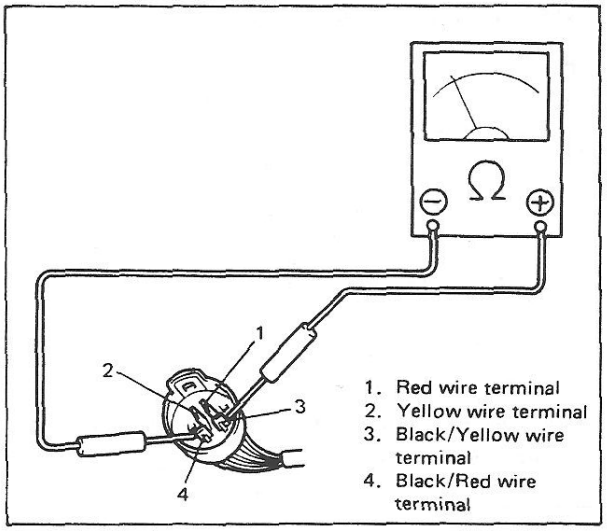


Fig. 6E-155 Checking Shift Switch

If check result is not satisfactory, adjust shift switch position as follows.

Adjustment

1. Shift selector lever to "N" range.
2. Hoist vehicle.
3. Remove lock nut and disconnect selector cable from shift lever by shifting shift lever to "L" range position.

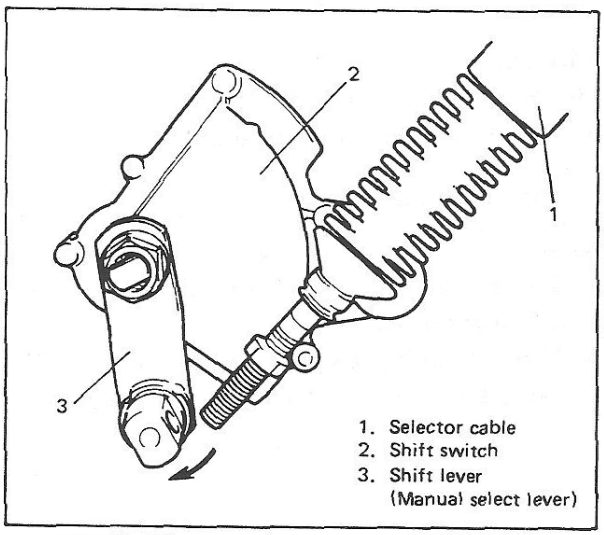


Fig. 6E-156 Disconnecting Selector Cable

4. Set shift lever to "N" range position and remove shift switch flange bolt.
   After turning shift lever switch clockwise fully, turn it counterclockwise gradually till restriction is felt and tighten flange bolt there.

Tightening torque for shift switch flange bolt	N·m	kg-m	lb-ft
	18 – 23	1.8 – 2.3	13.5 – 16.5

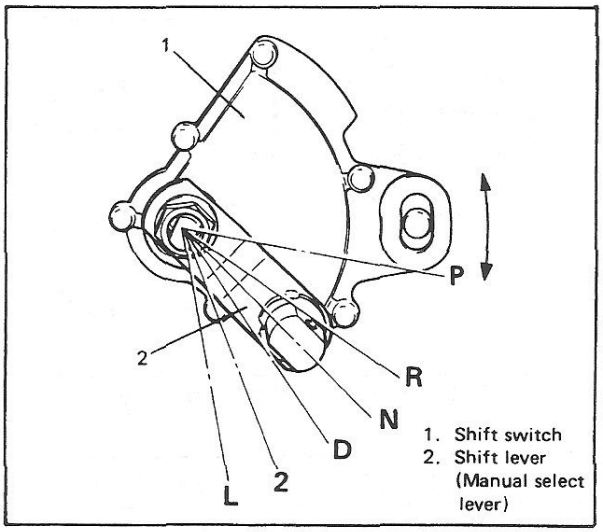


Fig. 6E-157 Adjusting Shift Switch Position

5. Perform continuity check as described in Step 3 of "Inspection" in previous page. But this time, move shift lever from "P" to "L" and "L" to "P" range position instead of shifting selector lever and check for continuity between each terminals.
   If check result is not satisfactory, replace shift lever switch.
6. With both selector lever and shift lever in "N" range position respectively, tighten adjusting nut and lock nut.

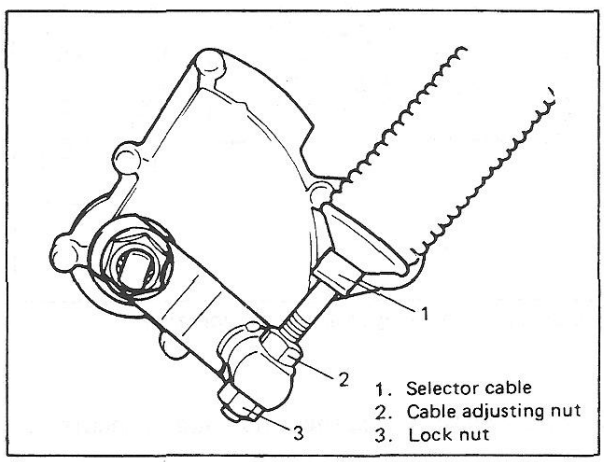


Fig. 6E-159 Installing Selector Cable

7. Lower vehicle.
8. Try shifting selector lever from "P" to "L" and "L" to "P" to confirm that it can be shifted properly.
9. Connect shift switch coupler and battery negative cable.

Removal and Installation

Refer to Section 7B "AUTOMATIC TRANSMISSION".

MAIN RELAY

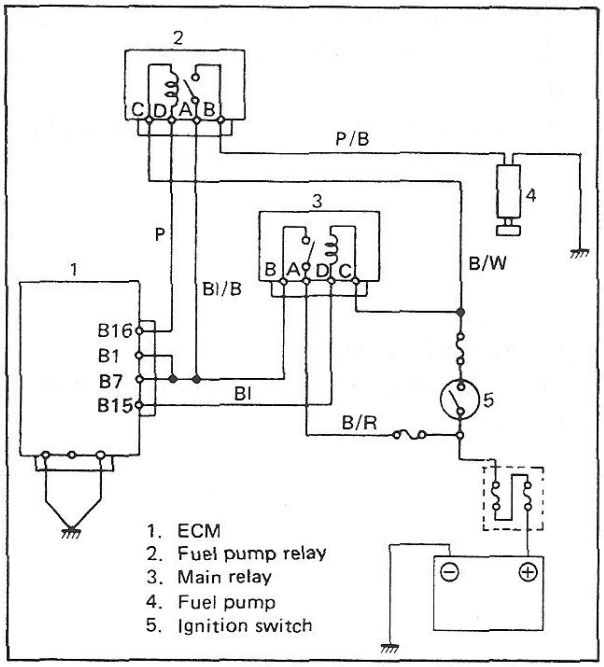


Fig. 6E-161 Main Relay and Fuel Pump Relay Circuits

NOTE:
Distinguish between main relay and fuel pump relay by wire colors.

Inspection

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

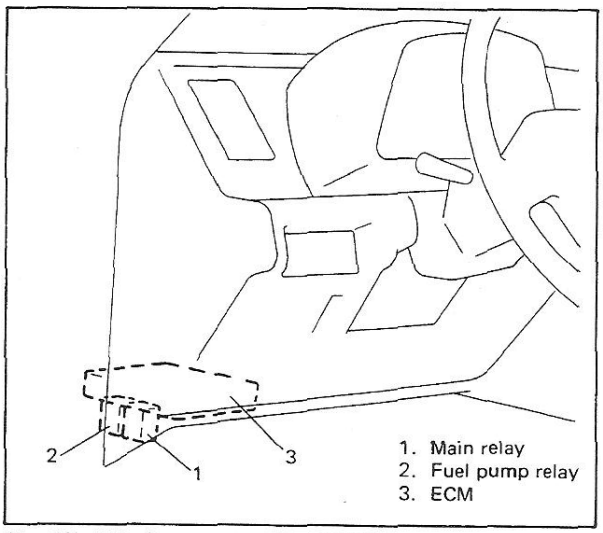


Fig. 6E-162 Removing Main Relay

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.

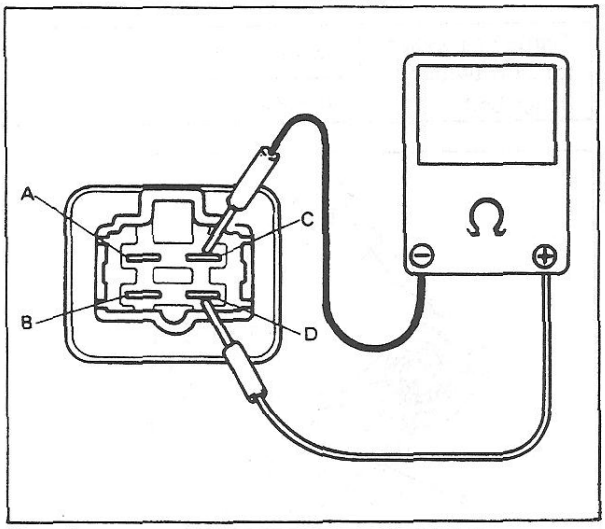


Fig. 6E-163 Checking Main Relay Resistance

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.

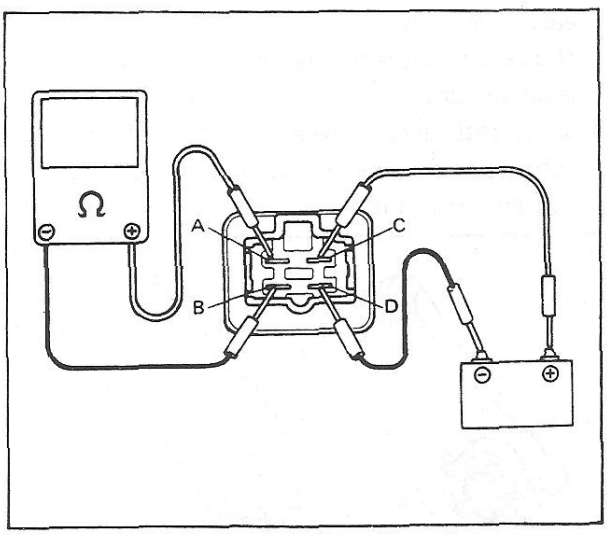


Fig. 6E-164 Checking Main Relay Operation

5. Install relay and connect its coupler securely.

FUEL PUMP RELAY

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 CUT OPERATION

Inspection

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

1. Warm up engine to normal operating temperature.
2. While listening to sound of injector by using sound scope or such, increase engine speed to higher than 3,000 r/min.
3. Check to make sure that sound to indicate operation of injector stops when throttle valve is closed instantly and it is heard again when engine speed is reduced to less than about 1,600 r/min.

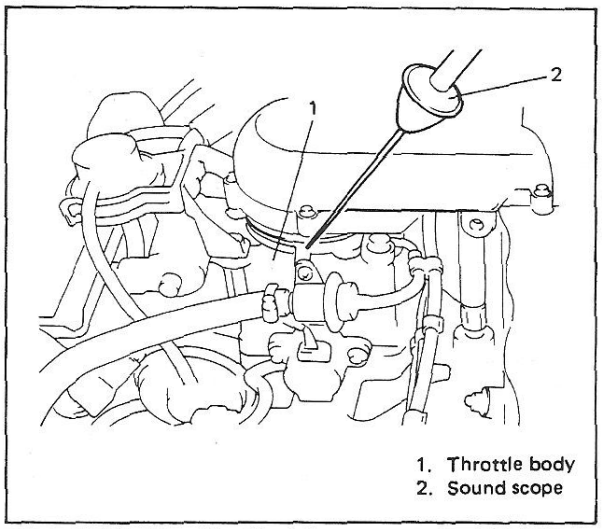


Fig. 6E-165 Checking Fuel Cut Operation

THROTTLE OPENER SYSTEM

System Inspection

1. Warm up engine to normal operating temperature.
2. Check that there is clearance between throttle stop screw and throttle lever at engine stop and cranking and that 0 — 1.0 second after engine start, throttle opener rod retracts and clearance disappears.

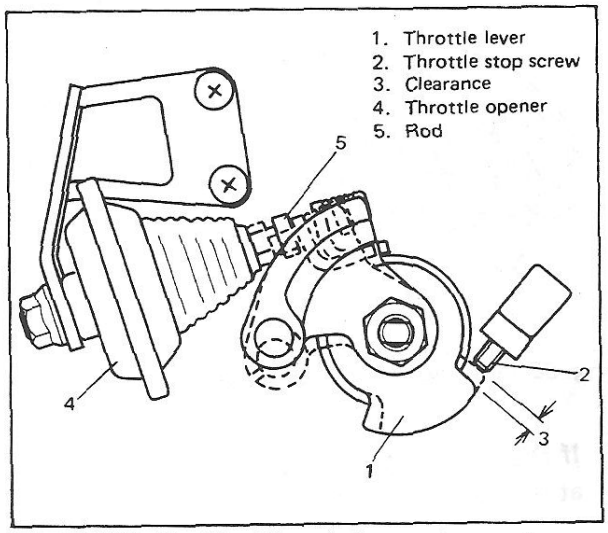


Fig. 6E-166 Checking Throttle Opener Operation

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

Vacuum Hoses Inspection

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

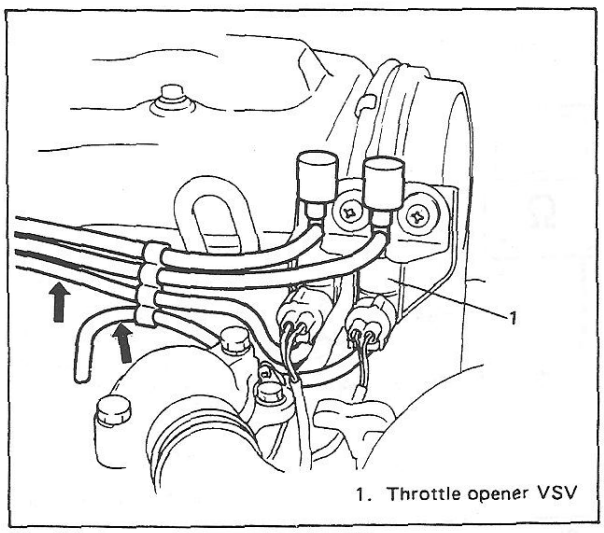


Fig. 6E-167 Checking Vacuum Hoses

Throttle Opener Inspection

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

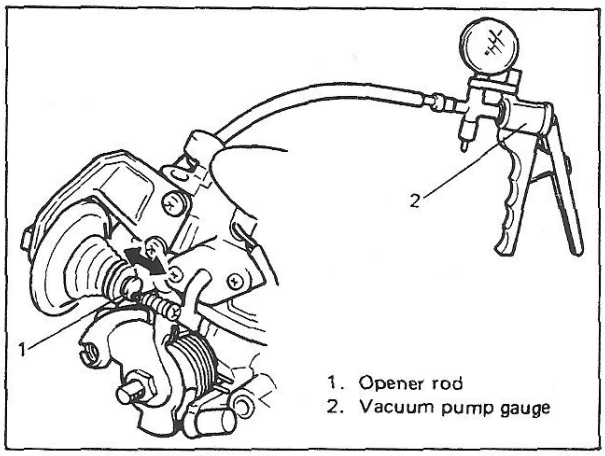


Fig. 6E-168 Checking Throttle Opener

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

VSV (Vacuum Switching Valve) Inspection

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

Resistance of throttle opener VSV	33 – 39 Ω

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

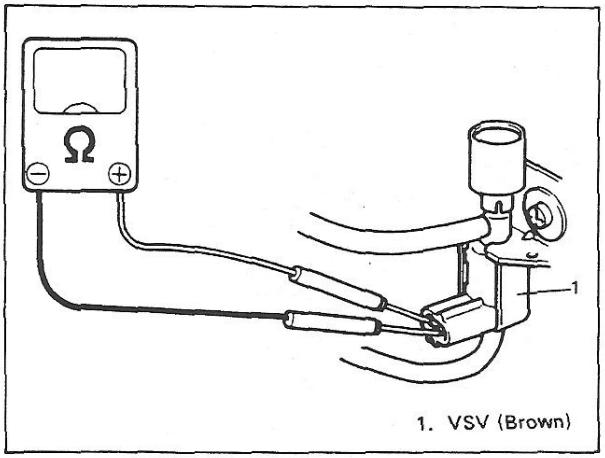


Fig. 6E-169 Checking Resistance

3. Disconnect vacuum hoses from throttle opener and intake manifold.
4. Blow into hose "A". Air should come out of hose "B" and not out of filter.

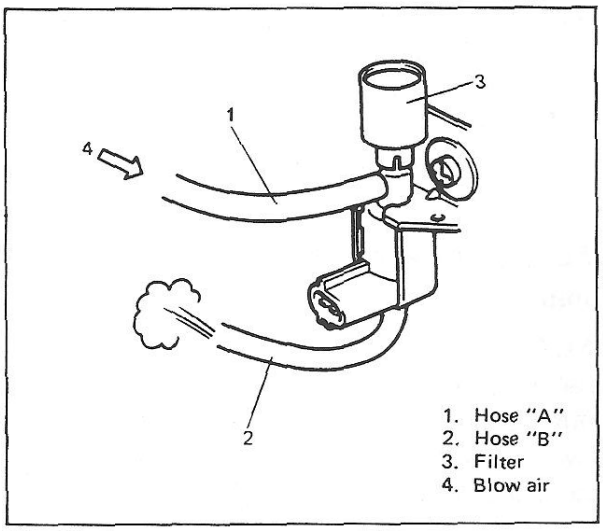


Fig. 6E-170 Checking Opener VSV (1)

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

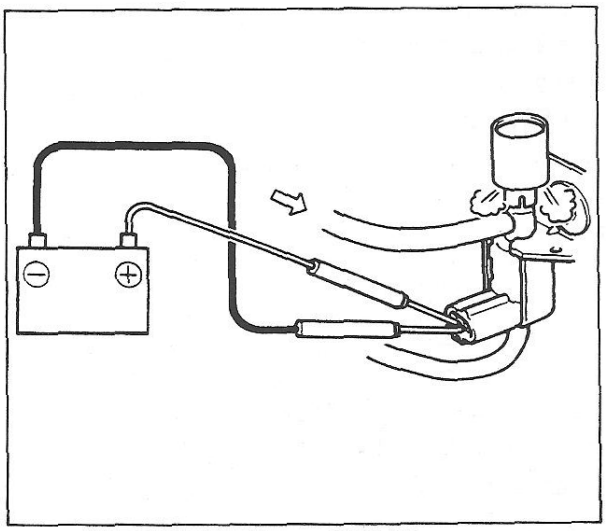


Fig. 6E-171 Checking Opener VSV (2)

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

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

EGR SYSTEM

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

- **Altitude is 8,200 ft, 2,500 m above sea level or lower and atmospheric pressure is 585 mmHg or higher.**
- **VSS, WTS, TPS and pressure sensor are in good condition.**
  If even one of above conditions is not satisfied, EGR valve don't operate.

System Inspection

NOTE:
Make sure that M/T is set in "Neutral" or A/T in "Parking" and that parking brake lever is pulled all the way up.

1. When engine is cool (cooling water temperature is below 58°C, 136°F), race engine to higher than 3500 r/min. and check that EGR valve diaphragm is not operating in this state, by touching diaphragm with finger.

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

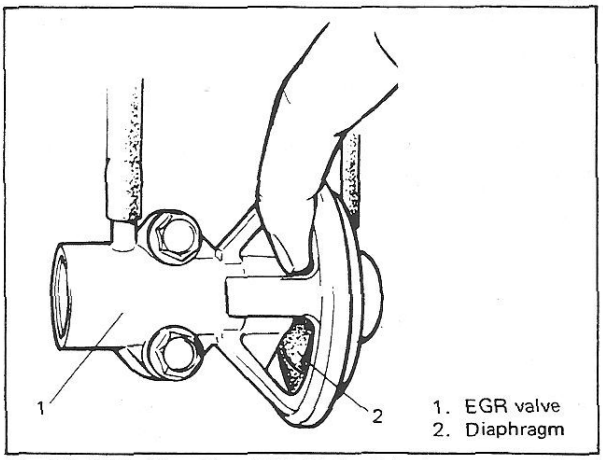


Fig. 6E-172 Checking EGR Valve Diaphragm

2. Warm up engine to normal operating temperature and race it to higher than 3500 r/min. after warming up. Then check to be sure that diaphragm moves toward 1 in Fig. 6E-173 during acceleration and toward 2 during deceleration.

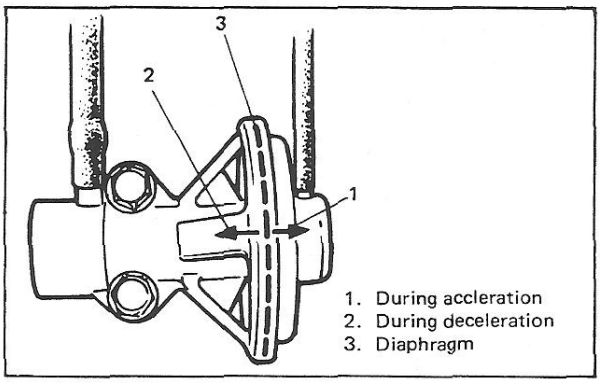


Fig. 6E-173 Movement of EGR Valve Diaphragm

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

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 fails to move smoothly, or it isn't held at the same position, replace EGR valve.

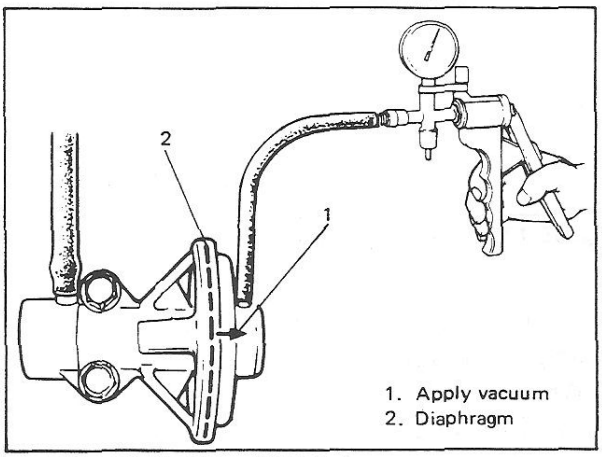


Fig. 6E-174 Checking EGR Valve

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

EGR Modulator Inspection

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

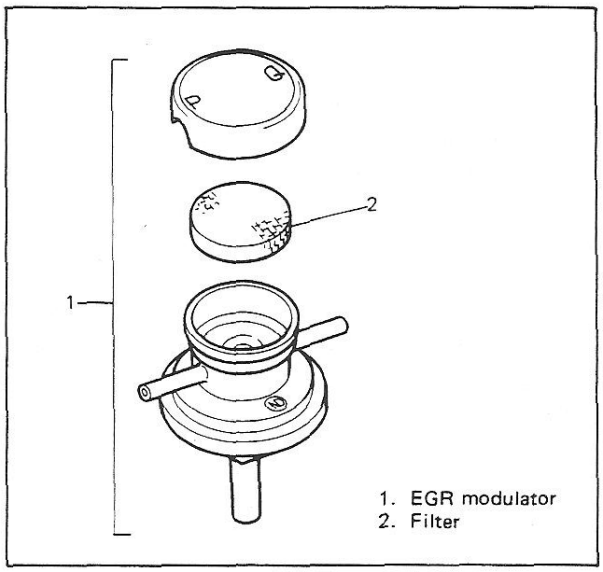


Fig. 6E-175 Filter of EGR Modulator

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.

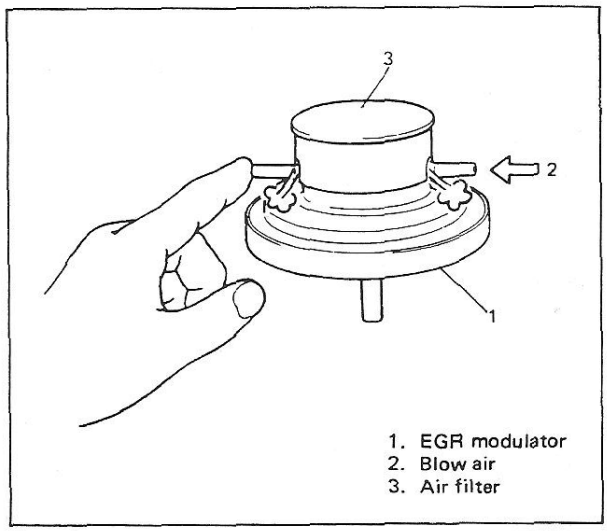


Fig. 6E-176 Checking EGR Modulator (1)

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.

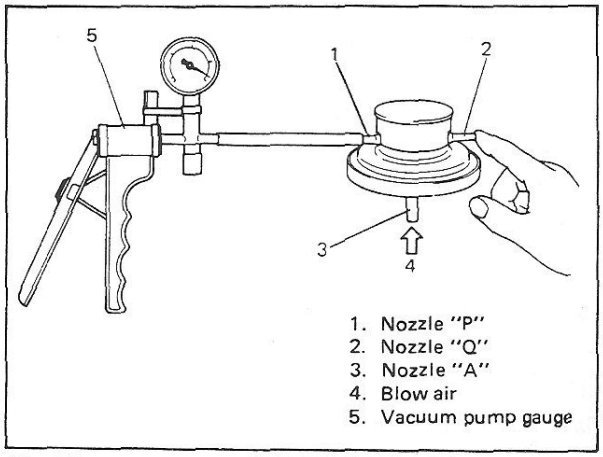


Fig. 6E-177 Checking EGR Modulator (2)

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.

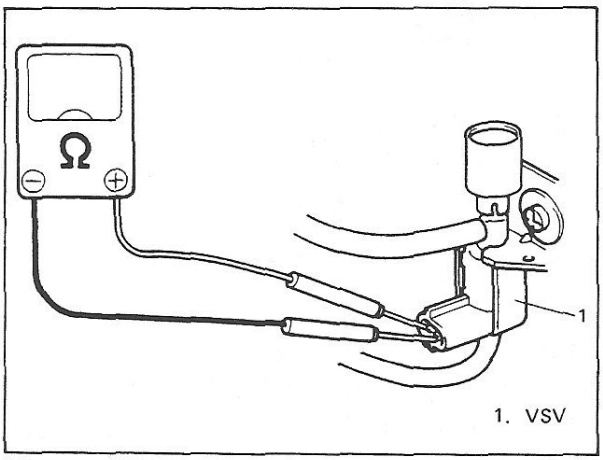


Fig. 6E-178 Checking Resistance

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

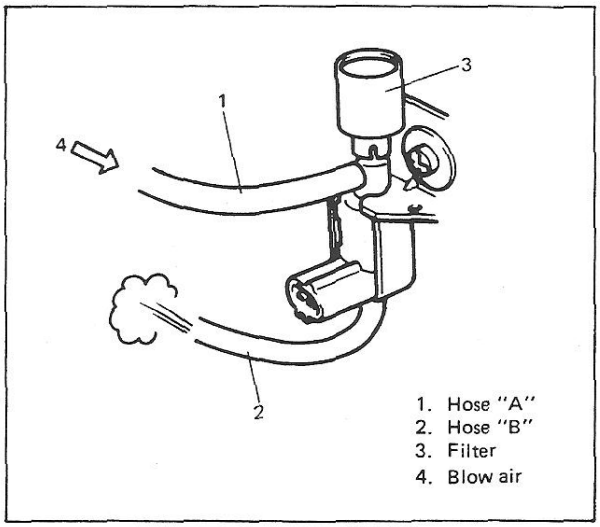


Fig. 6E-179 Checking Opener VSV (1)

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

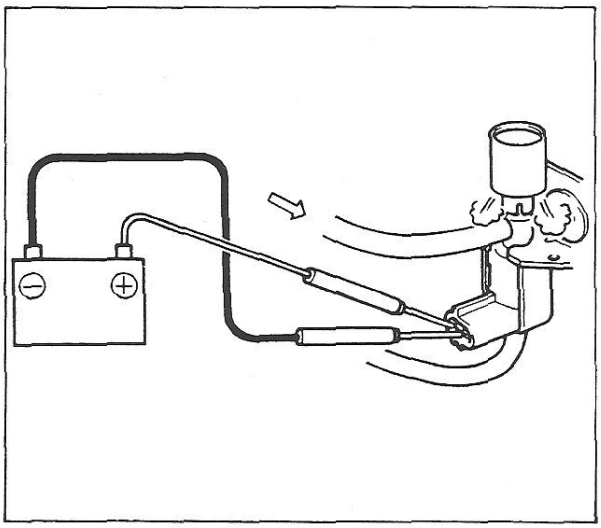


Fig. 6E-180 Checking Opener VSV (2)

   If check result is not as described above, replace VSV.
6. Connect VSV coupler securely.
7. Connect vacuum hoses securely.

FUEL EVAPORATIVE EMISSION CONTROL SYSTEM

Canister Purge Inspection

NOTE:
Before inspecting, be sure to confirm the following.

- **"CHECK ENGINE" light indicates code No. 12. (All sensors are in good condition.)**
- **Engine is in normal operating temperature.**

1. Hoist vehicle so that rear wheels rotate freely.
2. Set M/T or A/T in "Neutral" and transfer in "2H".
3. Start engine, release parking brake lever and check that rear propeller shaft (tires) is turning.
   If not, perform following check with one rear tire locked and the other turned by hand.

CAUTION:
Make sure that M/T or A/T is set to "Neutral" position for this check. If it is set to any other position, rear tires will turn at high speed and a very dangerous situation may occur.

4. Disconnect purge hose from canister. Place finger against the end of disconnected hose as shown and check that vacuum is not felt there when engine is running at idle speed.
   Also check that vacuum is felt when engine speed is increased to higher than 1,500 r/min. by opening throttle valve.

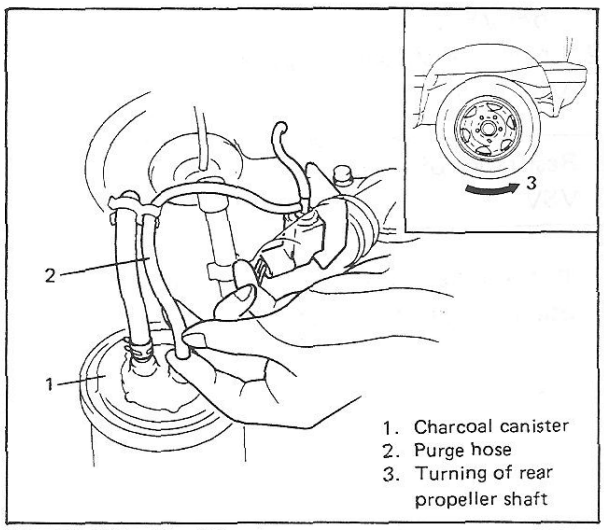


Fig. 6E-181 Checking System Operation

If check result is not satisfactory, check vacuum passage, hoses, VSV, wire harness and ECM.

Vacuum Passage Inspection

Start engine and run it at idle speed. With finger placed against vacuum nozzle, check that vacuum is applied.

If it is not applied, clean vacuum passage by blowing compressed air.

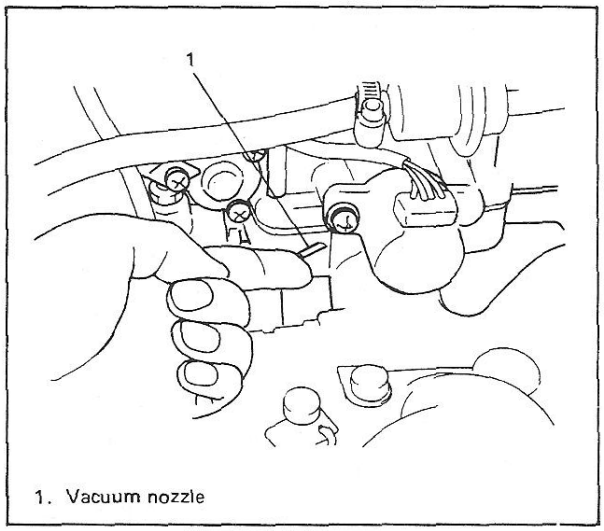


Fig. 6E-182 Checking Vacuum Passage

Vacuum Hose Inspection

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

VSV (Vacuum Switching Valve) Inspection

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

Resistance of purge VSV	30 – 38 Ω

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

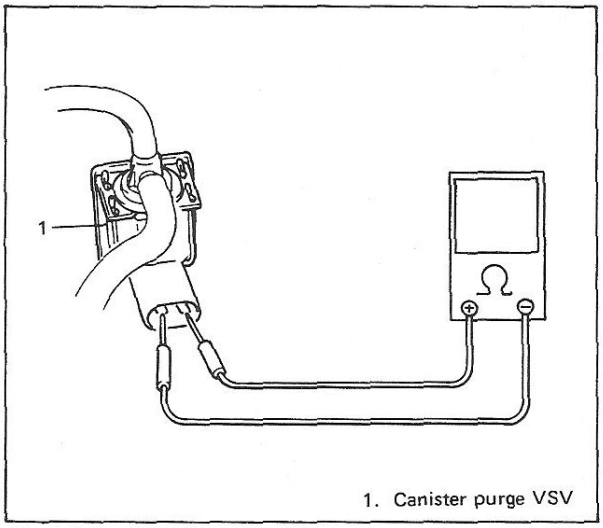


Fig. 6E-183 Checking Resistance

3. Disconnect vacuum hoses from intake manifold and canister.
4. With coupler disconnected, blow into hose "A". Air should not come out of hose "B".

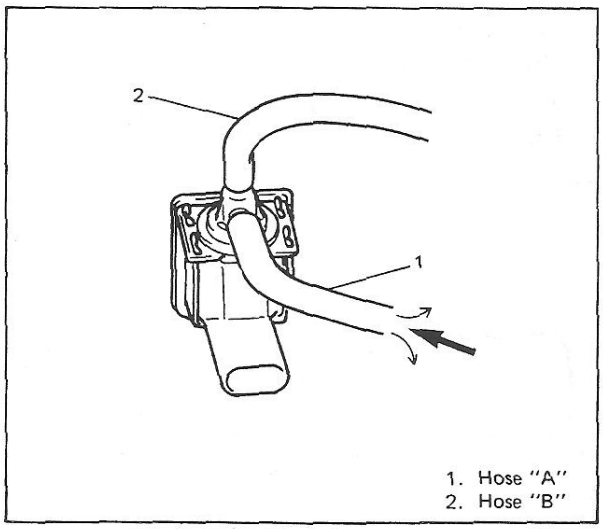


Fig. 6E-184 Checking VSV (1)

5. Connect 12V-battery to VSV terminals. In this state, blow hose "A".
   Air should come out of hose "B".

WARNING:
Do not suck the air through VSV. Fuel vapor inside VSV is harmful.

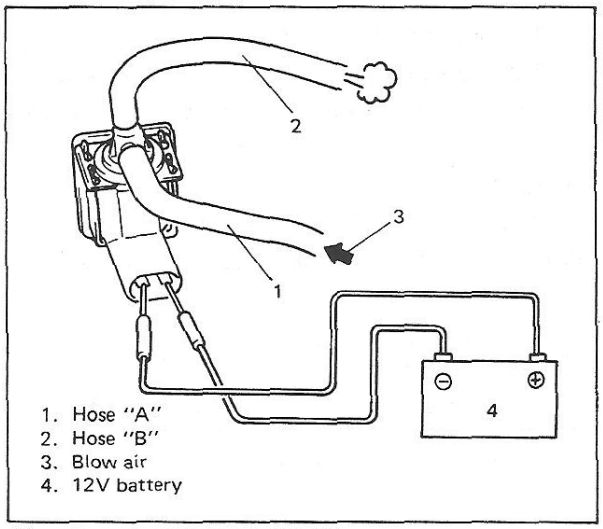


Fig. 6E-185 Checking VSV (2)

   If check result is not as described, replace VSV.
6. Install VSV and connect vacuum hoses.
7. Connect VSV coupler securely.

Charcoal Canister Inspection

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

1. Disconnect vacuum hoses from canister.
2. When air is blown into pipe "A", there should be no restriction of flow through pipes "B" and "C".

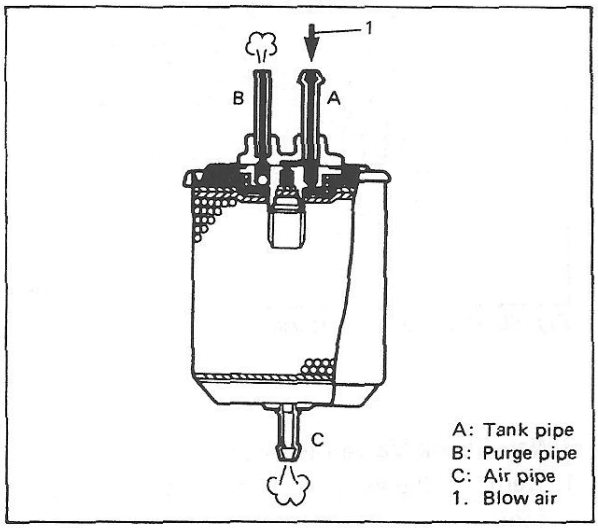


Fig. 6E-186 Checking Canister (1)

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

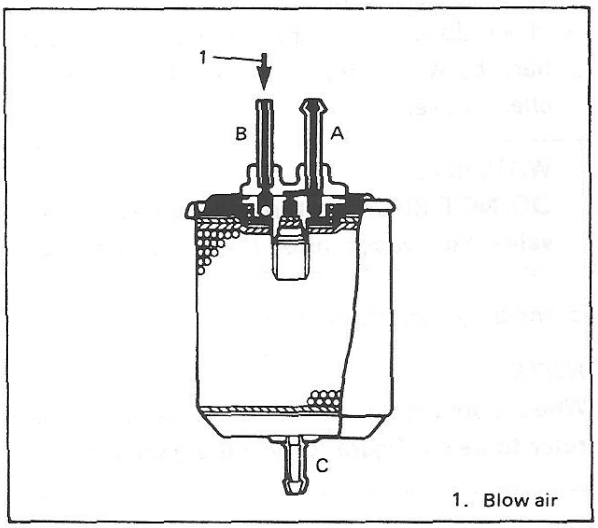


Fig. 6E-187 Checking Canister (2)

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

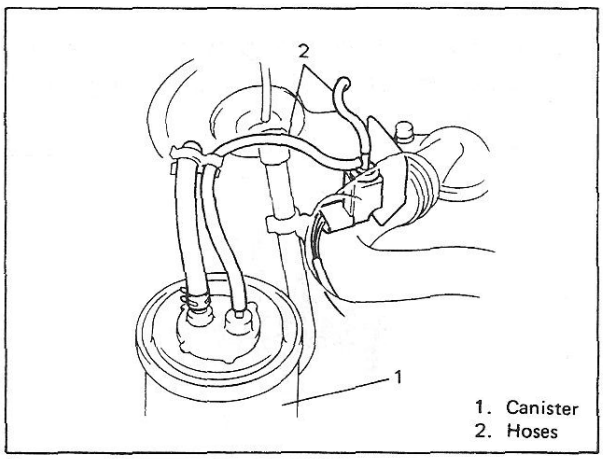


Fig. 6E-188 Canister Hoses

2-Way Check Valve Inspection

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

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

5. Install 2-way check valve.

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

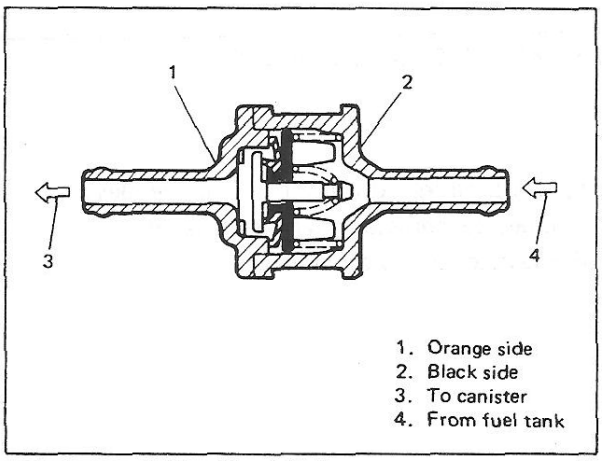


Fig. 6E-189 2-Way Check Valve

OXYGEN SENSOR HEATER

Oxygen Sensor Heater Inspection

1. Disconnect sensor coupler.
2. Using ohmmeter, measure resistance between terminals "HB" and "HE" of sensor coupler.

CAUTION:
As connection to wrong terminal will cause damage to oxygen sensor, make absolutely sure to connect properly as shown in figure.

NOTE:
Temperature of sensor affects resistance value largely. Make sure that sensor heater is at correct temperature.

Resistance of oxygen sensor heater	11.7 – 15.5 Ω at 20°C, 68°F

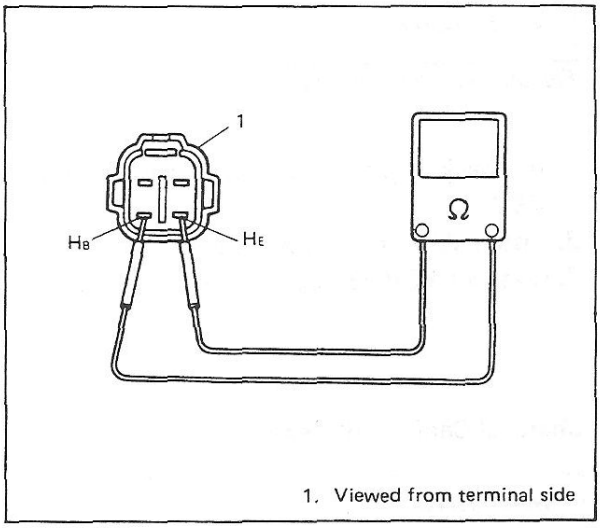


Fig. 6E-192 Checking Heater Resistance

If found faulty, replace oxygen sensor.

3. Connect sensor coupler securely.

LOCK-UP RELAY CONTROL SYSTEM (A/T Only)

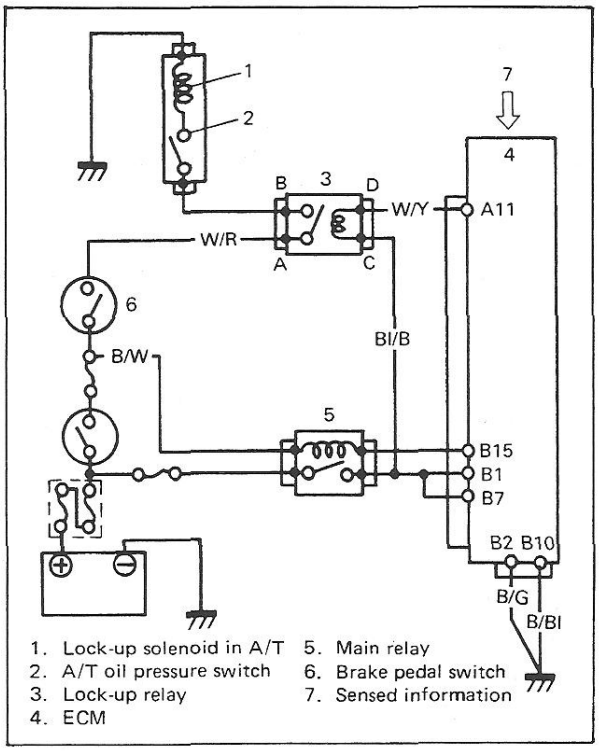


Fig. 6E-196 System Circuit

System Circuit Inspection

This inspection is to check if ECM turns ON lock-up relay at specified throttle valve opening.

1. Remove ECM as previously outlined and connect couplers to ECM securely.
2. Warm up engine to normal operating temperature.
3. Connect voltmeter between ECM coupler terminal "A11" and ground.

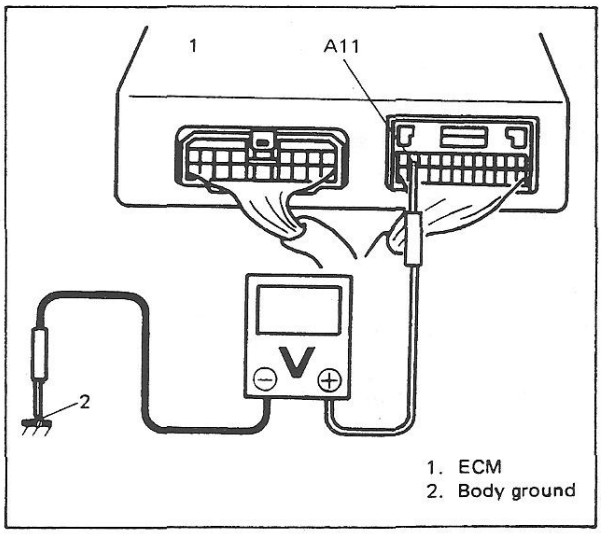


Fig. 6E-197 Checking System Operation

4. While engine running at idle speed. Take reading of voltmeter. It should be 10-14V.

   Then increase throttle valve opening up to within 6.5%—63%. Voltmeter then should indicate 0—1V.

> CAUTION:
> When increasing throttle valve opening be careful not to overrev the engine.

If checked voltage is not as specified above, check lock-up relay and wire harness. If they are all in good condition, possibility is that ECM is defective.

Lock-up Relay and Its Circuit

1. With coupler connected to lock-up relay and ignition switch ON, check if battery voltage (about 12V) is applied to lock-up relay terminals "A" and "C". When checking voltage at terminal "A", be sure not to depress brake pedal.

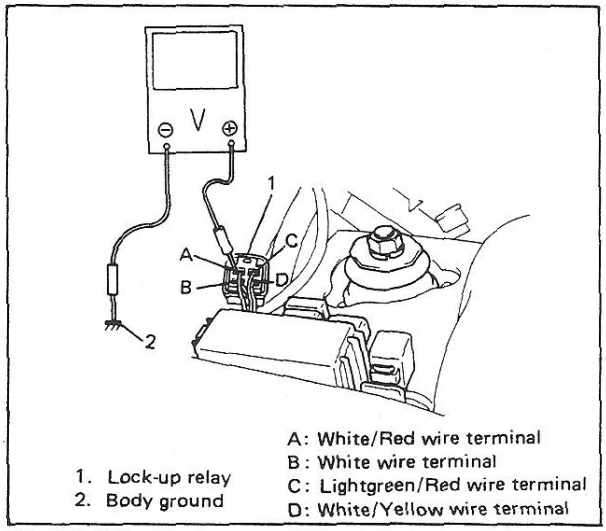


Fig. 6E-198 Checking Voltage

If no voltage is applied, check electric circuit of each terminal (including brake pedal switch).

2. Using wire harness as thick as the one used for relay circuit, connect "D" terminal and body (ground).
   At this time, relay should be heard to operate and battery voltage (about 12V) should be applied to terminal "B".

CAUTION:
Make absolutely sure to ground properly. Grounding wrong terminal will blow fuse.

If check result is not satisfactory, replace lock-up relay.

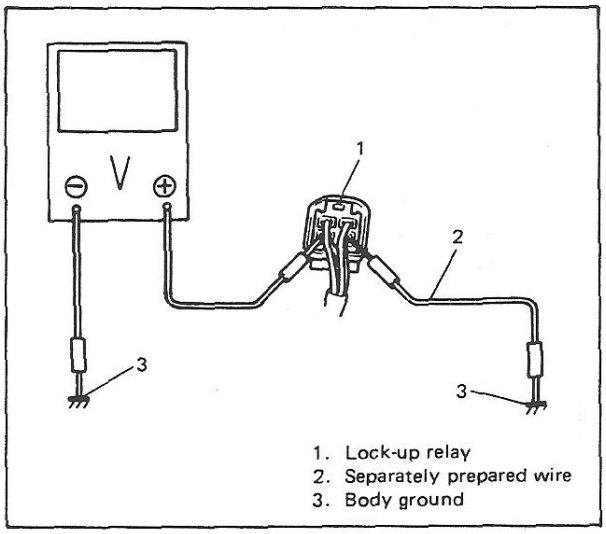


Fig. 6E-199 Checking Lock-up Relay Operation

Brake Pedal Switch (Including stop light switch)

1. Disconnect brake pedal switch coupler and remove it from pedal bracket.

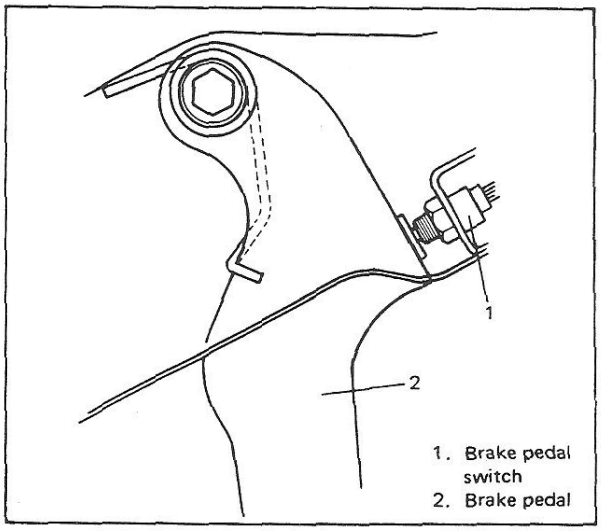


Fig. 6E-200 Removing Switch

2. Connect ohmmeter to terminals for lock-up circuit in brake pedal switch.
   Ohmmeter should indicate 0 Ω when switch button is pushed and ∞ (infinity) when it is released.
   If check result is not satisfactory, replace.

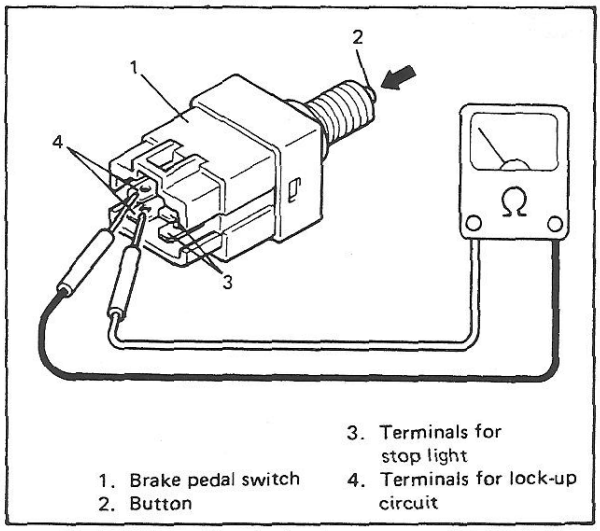
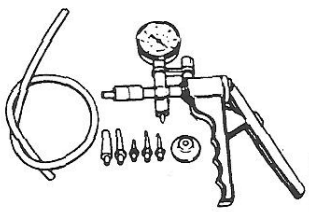


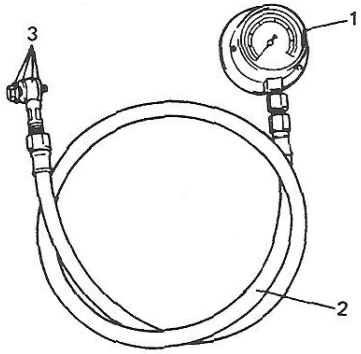
Fig. 6E-201 Checking Brake Pedal Switch

3. Install brake pedal switch to pedal bracket and adjust installing position according to procedure described in Section 5 "BRAKE".

SPECIAL TOOLS

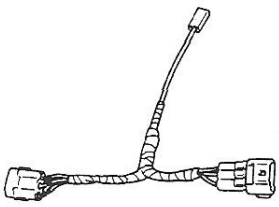


09917-47910
Vacuum pump gauge



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

09912-58412
Fuel pressure gauge set



09931-96010
Adapter wire
(For tachometer)

RECOMMENDED TORQUE SPECIFICATIONS

Fastening parts	Tightening torque		
	N·m	kg-m	lb-ft
Throttle body mounting bolt	18 – 28	1.8 – 2.8	13.5 – 20.0
Fuel inlet pipe bolt of throttle body	8 – 12	0.8 – 1.2	6.0 – 8.5
Throttle upper and lower body screw	3.5	0.35	2.5
Fuel pressure regulator screw	3.5	0.35	2.5
Injector cover screw	2.0	0.2	1.4
TPS bolt	3.5	0.35	2.5
ISC solenoid valve screw	5	0.5	3.6
ATS	10 – 20	1.0 – 2.0	7.5 – 14.0
WTS	12.5 – 17.5	1.25 – 1.75	9.5 – 12.5
Oxygen sensor	40 – 50	4.0 – 5.0	29.0 – 36.0