# FUEL

E13AA--

**WARNING REGARDING SERVICING OF SUPPLEMENTAL RESTRAINT SYSTEM (SRS) EQUIPPED VEHICLES WARNING!**

**(1) Improper service or maintenance of any component of the SRS, or any SRS-related component, can lead to personal injury or death to service personnel (from inadvertent firing of the air bag) or to the driver (from rendering the SRS inoperative.)**

**(2) Service or maintenance of any SRS component or SRS-related component must be performed only at an authorized MITSUBISHI dealer.**

**(3) MITSUBISHI dealer personnel must thoroughly review this manual, and especially its GROUP 52B – Supplemental Restraint System (SRS) and GROUP 00 – Maintenance Service before beginning any service or maintenance of any component of the SRS or any SRS-related component.**

NOTE

The SRS includes the following components: SRS diagnosis unit, SRS warning light, air bag module, clock spring and interconnecting wiring. Other SRS-related components (that may have to be removed/installed in connection with SRS service or maintenance) are indicated in the table of contents by an asterisk (*).

## NOTES

# FUEL SYSTEM <6G72 Engine>

## GENERAL INFORMATION

### MULTI POINT INJECTION SYSTEM DIAGRAM

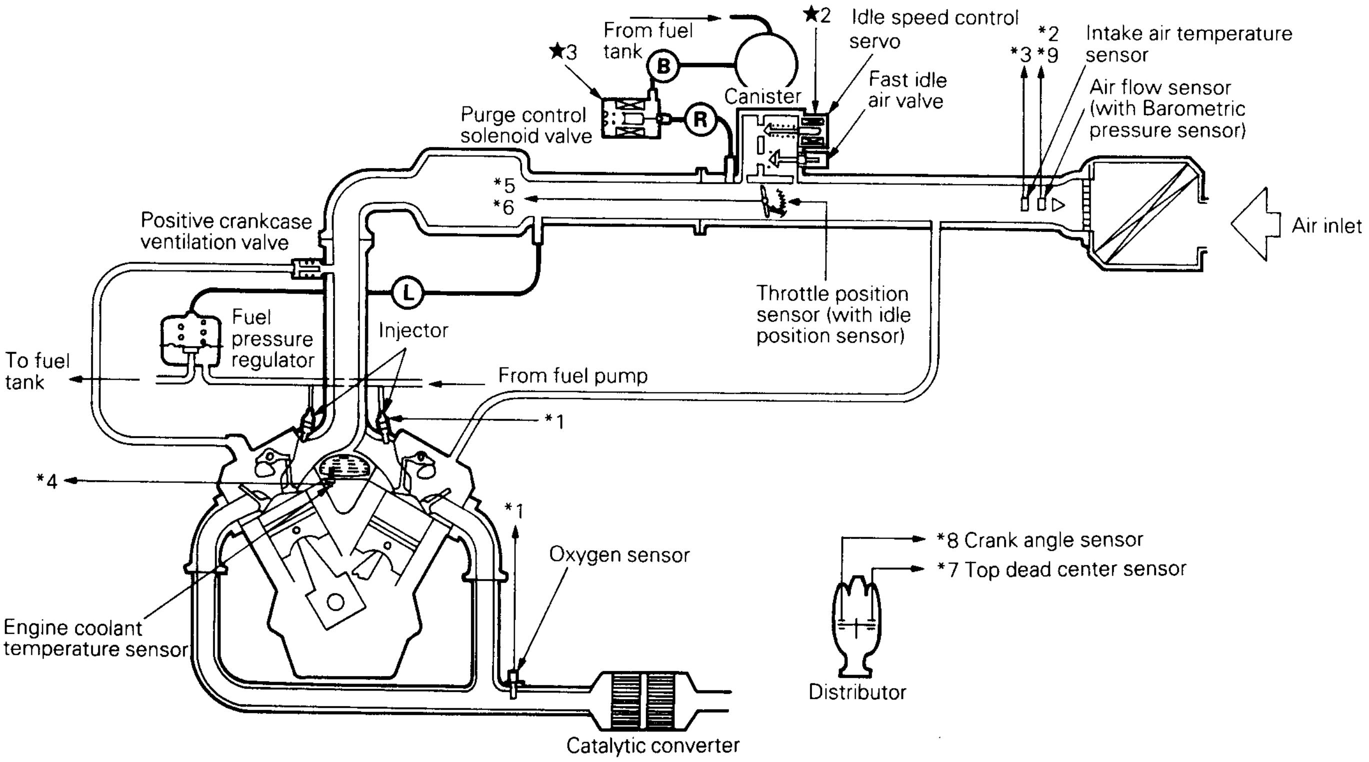
E13BBAG

*1 Oxygen sensor
*2 Air-flow sensor
*3 Intake air temperature sensor
*4 Engine coolant temperature sensor
*5 Throttle position sensor
*6 Idle position switch
*7 Top dead center sensor
*8 Crank angle sensor
*9 Barometric pressure sensor

- Ignition switch-ST
- Ignition switch-$IG_1$
- Power supply
- Vehicle-speed sensor
- Air conditioner switch
- Inhibitor switch <A/T>

⇨ Engine control unit ⇨

★1 Injector
★2 Idle speed control servo
★3 Purge control solenoid valve
- Fuel pump control (control relay)
- Air conditioner power relay
- Ignition timing control
- Self-diagnosis circuit
- Engine warning lamp



7FU1163

Vacuum hose colour
R: Red
B: Black
L: Light Blue

# SPECIFICATIONS

## GENERAL SPECIFICATIONS

E13CA-A

| Items | Specifications |
|---|---|
| Fuel | |
| Tank capacity $dm^3$ (U.S.gal., Imp.gal.) | |
| Standard Wheelbase | 75 (19.8, 16.5) |
| Long Wheelbase | 92 (24.3, 20.2) |
| Fuel pump | |
| Type | Electrical, in-tank type |
| Driven by | Electric motor |
| Throttle body | |
| Throttle bore mm (in.) | 55 (2.165) |
| Throttle position sensor | Variable resistor type |
| Idle speed control servo | Stepper motor type<br>Stepper motor type by-pass air control system with the Fast Idle Air Valve |
| Idle position switch | Rotary contact type |
| Engine control unit | |
| Identification model No. | E2T37472 |
| Sensors | |
| Air flow sensor | Karman vortex type |
| Barometric pressure sensor | Semiconductor type |
| Intake air temperature sensor | Thermistor type |
| Engine coolant temperature sensor | Thermistor type |
| Oxygen sensor | Zirconia type |
| Vehicle-speed sensor | Reed switch type |
| Top dead centre sensor | Photo interruptor type |
| Crank angle sensor | Photo interruptor type |
| Actuators | |
| Control relay type | Contact switch type |
| Injector type and number | Electromagnetic, 6 |
| Purge control solenoid valve | ON/OFF type solenoid valve |
| Fuel pressure regulator | |
| Regulated pressure kPa ($kg/cm^2$, psi) | 335 (3.35, 47.6) |

## SERVICE SPECIFICATIONS

E13CB-A

| Items | | Specifications |
|---|---|---|
| Standard value | | |
| Accelerator cable play | mm (in.) | 1–2 (0.04–0.08) |
| Basic ignition timing | | 5° ± 2° BTDC at curb idle |
| Curb idle speed | r/min. | 700 ± 100 |
| Idle speed when air conditioner ON | r/min. | 900 at neutral position<br>600 at D range <A/T> |
| Basic idle speed | r/min. | 700 ± 50 |
| Throttle position sensor output voltage | V | 0.4–1.0 |
| Throttle position sensor resistance | kΩ | 3.5–6.5 |
| Idle speed control servo (stepper motor) coil resistance [at 20°C (68°F)] | Ω | 28–33 |
| Intake air temperature sensor resistance [at 20°C (68°F)] | kΩ | 2.7 |
| Engine coolant temperature sensor resistance | kΩ | |
| 20°C (68°F) | | 2.4 |
| 80°C (176°F) | | 0.3 |
| Fuel pressure (at curb idle) | kPa (kg/cm$^2$, psi) | |
| Vacuum hose disconnection | | 330–350 (3.3–3.5, 47–50) |
| Vacuum hose connection | | Approx. 270 (2.7, 38) |
| Injector coil resistance [at 20°C (68°F)] | Ω | 13–16 |

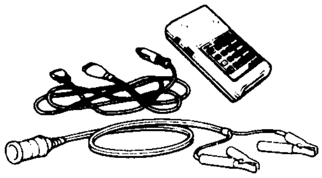
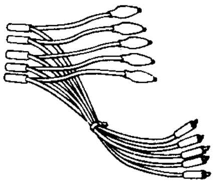
## SEALANT

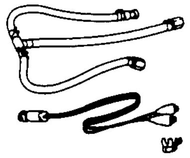
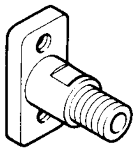
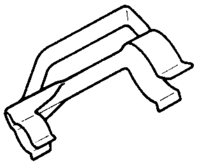
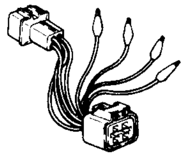
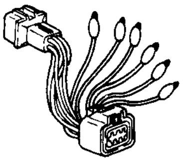
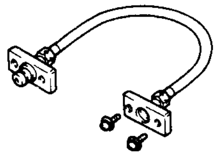
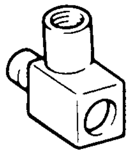
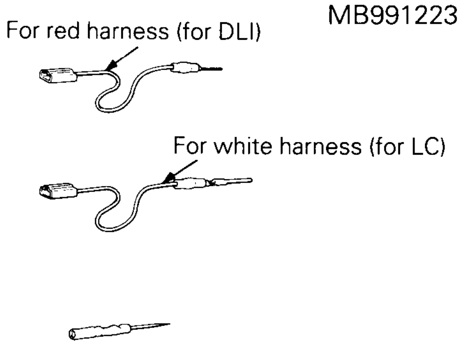
E13CE-A

| Items | Specified sealant | Quantity |
|---|---|---|
| Engine coolant temperature sensor threaded portion | 3M Nut Locking Part No. 4171 or equivalent | As required |

## SPECIAL TOOLS

E13DA-A

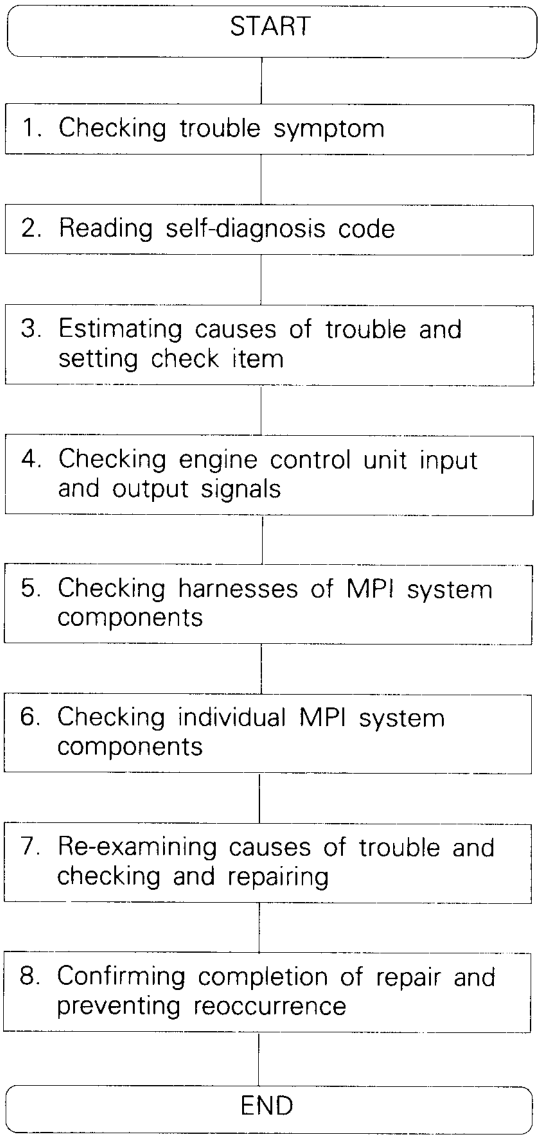
| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB991341 | Multi-use tester assembly | • Reading diagnosis code<br>• MPI system inspection |
|  | MB991419 | ROM pack (for multi-use tester) | • Reading diagnosis code<br>• MPI system inspection |
|  | MB991348 | Test harness set | • Adjustment of throttle position sensor<br>• Inspection with oscilloscope |

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MD998706 | Injector test set | • Checking injection condition of injector |
|  | MD998740 | Injector test adaptor | |
|  | MD998746 | Clip | |
|  | MD998464 | Test harness (4 pin, square) | • Oxygen sensor inspection |
|  | MD998463 | Test harness (6 pin, square) | • Idle speed control servo inspection<br>• Inspection with oscilloscope |
|  | MD998753 | Extension hose | • Measurement of fuel pressure |
|  | MD998700 | Hose adapter | |
|  | MB991223 | Inspection harness set connector<br>• Pin contact pressure inspection harness<br>• Marketing tester connection probe (for general connectors) | Measurement of terminal voltages |

# TROUBLESHOOTING

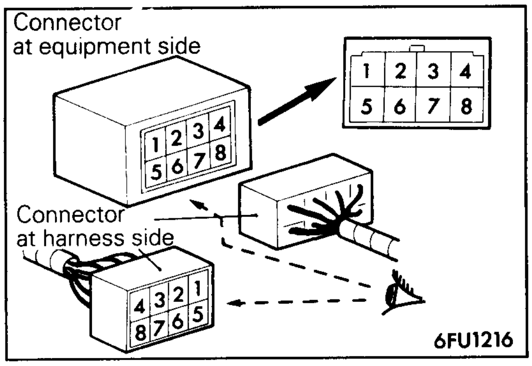
E13EFAJ

## EXPLANATION OF TROUBLESHOOTING PROCEDURES



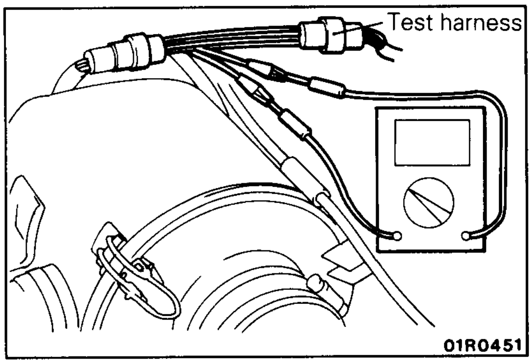
The effective troubleshooting procedures for troubles of the MPI system are explained in the following.

1. Checking trouble symptom
   - Reproduce the problem symptom and check the contents of the trouble and the conditions under which the symptom occures (engine condition, operating state, etc.).
2. Reading self-diagnosis code
   - Read the self-diagnosis code and when a fault code is output, correct the fault referring to DIAGNOSIS CHART.
3. Estimating causes of trouble and setting check item
   - Referring to CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS, determine the check items and procedures to be followed.
4. Checking engine control unit input and output signals
   - Using a multi-use tester or analyzer, check the input and output signals of the engine control unit.
   - If the input and output signals are normal, the sensor input/actuator control is judged as normal. Then, check the input and output signals of the next check item.
5. Checking harnesses of MPI system components
   - If the input and output signals of the engine control unit are not normal, check the body harnesses of the MPI system components and repair as necessary.
   - After repair, check the input and output signals of the engine control unit again. If they are normal this time, check the input and output signals of the next check item.
6. Checking individual MPI system components
   - If the body harnesses are normal but the input and output signals of the engine control unit are abnormal, check the MPI system components individually and repair or replace as necessary.
   - After repair or replacement, check the input and output signals of the engine control unit again. If they are normal this time, check the input and output signals of the next check item.
7. Re-examining causes of trouble and checking and repairing
   - If the harness check and individual component check have resulted normal but the input and output signals of the engine control unit are abnormal, re-examine the causes of trouble referring to the troubleshooting hints. Then, check and repair including other groups.
8. Confirming completion of repair and preventing reoccurrence
   - Try to reproduce the problem symptom to make sure that the symptom will not occur again.
   - Remove the true cause of the trouble to prevent its reoccurrence.

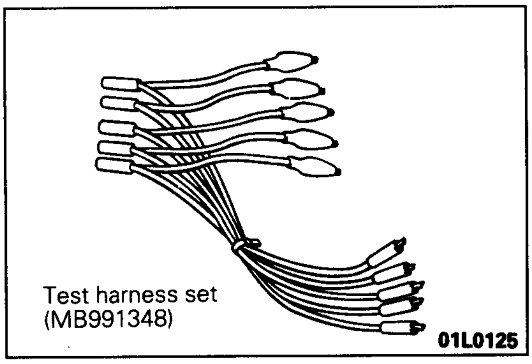


## EXPLANATION AND PRECAUTION RELATED TO HARNESS CHECKING

- Connector symbols are described as seen from the terminal end for the connector.
- The abbreviation "SV" used for the normal judgment value when checking the voltage is the abbreviation for system voltage.

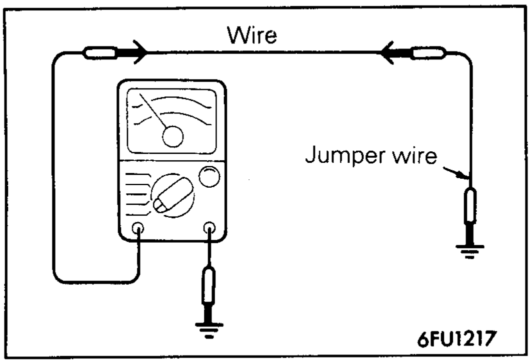


- Be sure to use the special tool (test harness) when, for a waterproof connector, checking while the circuit is conductive. If probe is inserted from the harness side, the waterproof capability will be lowered, thereby causing/corrosion, so never do so.
- When a connector is disconnected in order to check terminal voltage, etc., never insert a probe if the terminal to be checked is a female pin, because the forceful insertion of a probe will cause improper or incomplete contact.

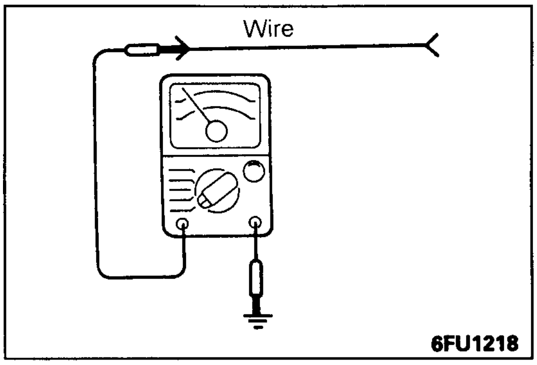


- Also, if there is no test harness that conforms to the connector, use the test harness set (MB991348) which can be directly connected between the terminals.

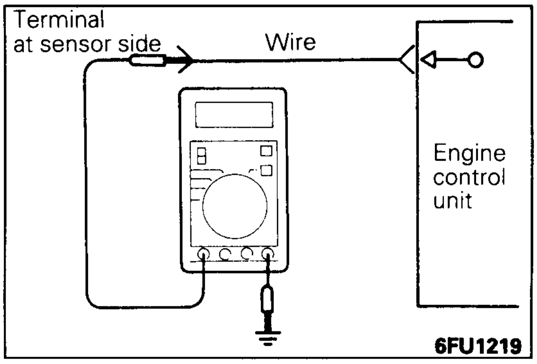
- When disconnecting the connector and inspecting the terminal voltage, etc., if the inspection terminal is a female pin, the special tool (inspection harness set: MB991223) should be used instead of inserting a probe.



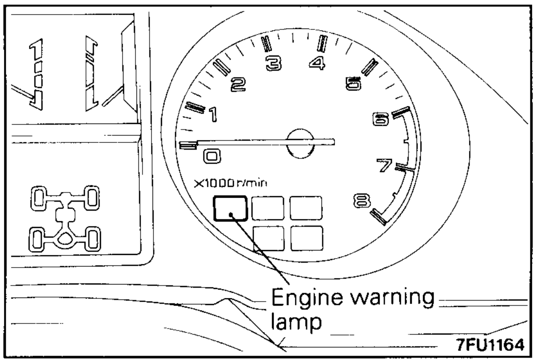
- When checking for damaged or disconnected wiring of a harness (open circuit) and if both ends of the harness are unconnected, use a jumper wire to earth one end of the harness, and then check for continuity between the other end and earth. By doing this, you can check for damaged or disconnected wiring, and, if there is no continuity, the harness should be repaired.



- When checking for a harness short-circuit (short-circuit to earth), open one end of the harness and then check for continuity between the other end and earth. If there is continuity, the harness is short-circuited to earth and should be repaired.



- If the voltage (power-supply voltage) supplied to a sensor is not normal, repair the harness. If the voltage to the sensor is still not normal after the harness has been repaired, replace the engine control unit and check again.



## ENGINE WARNING LAMP (CHECK ENGINE LAMP)

Among the self-diagnosis items, a engine warning lamp comes on to notify the driver of the emission control items when an irregularity is detected. However, when an irregular signal returns to normal and the engine control unit judges that it has returned to normal, the engine warning lamp goes out. Moreover, when the ignition switch is turned off, the lamp goes out. Even if the ignition switch is turned on again, the lamp does not come on until the irregularity is detected. Here, immediately after the ignition switch is turn on, the engine warning lamp is lit for 5 seconds to indicated that the engine warning lamp operates normally.

**Item indicated by the lightening engine warning lamp**

| | |
|---|---|
| Engine control unit | Crank angle sensor |
| Oxygen sensor | Top dead centre sensor |
| Air flow sensor | Barometric pressure sensor |
| Intake air temperature sensor | Ignition timing adjustment signal |
| Throttle position sensor | Injector |
| Engine coolant temperature sensor | |

**Caution**
**Engine warning lamp will come on when the line of terminal for ignition timing adjustment is short-circuited. Therefore, the lamp will come on even when the terminal for ignition timing adjustment is earthed at the time of adjusting ignition timing. In this case, however, it is not abnormal.**

## ENGINE WARNING LAMP INSPECTION

(1) Check to be sure, when the ignition switch is set to the "ON"position, that the lamp illuminates for about five seconds and then switches OFF.

(2) If the lamp does not illuminate, check for damage or disconnection of the harness, or for a blown fuse or a failed light bulb.

## SELF-DIAGNOSIS

The engine control unit monitors the input/output signals (some signals at all times and the others under specified conditions) of the engine control unit. When it is noticed that an irregularity has continued for a specified time or longer from when the irregular signal is initially monitored, passing a certain number, the engine control unit judges that an irregularity has occurred, memorizes the malfunction code, and outputs the signal to the self-diagnosis output terminals. There are 13 diagnosis items, including the normal state, and the diagnosis results can be read out with a multi-use tester. Moreover, since memorization of the malfunction codes is backed up direrctly by the battery, the diagnosis results are memorized even if the ignition key is turned off. The malfunction codes will, however, be erased when the battery terminal or the engine control unit connector is disconnected.

The malfunction codes are also erased by setting the ignition switch to the "ON" position and then sending the malfunction-code-erase signal from the multi-use tester to the engine control unit.

**Caution**

**If the sensor connector is disconnected while the ignition switch is ON, the malfunction code is memorized. In this instance, either send the malfunction-code-erase signal from the multi-use tester to the engine control unit, the diagnosis memory will be erased.**

The 13 diagnosis items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

**Caution**

**Ignition timing adjustment signal malfunction code is output when the ignition timing adjustment terminal line is short-circuited to the earth. Therefore, the malfunction code is output when the ignition timing adjustment terminal is earthed, however, this is not a malfunction.**

### DIAGNOSIS CHART

| Output preference order | Diagnosis item | Diagnosis code | | Check item (Remedy) |
|---|---|---|---|---|
| | | No. | Memory | |
| 1 | Engine control unit | — | — | (Replace engine control unit) |
| 2 | Oxygen sensor | 11 | Retained | • Harness and connector<br>• Oxygen sensor<br>• Fuel pressure<br>• Injectors (Replace if defective.)<br>• Intake air leaks |
| 3 | Air flow sensor | 12 | Retained | • Harness and connector (If harness and connector are normal, replace air flow sensor assembly.) |
| 4 | Intake air temperature sensor | 13 | Retained | • Harness and connector<br>• Intake air temperature sensor |
| 5 | Throttle position sensor | 14 | Retained | • Harness and connector<br>• Throttle position sensor<br>• Idle position switch |

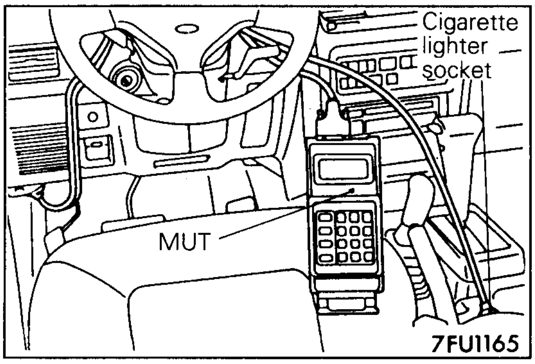
| Output preference order | Diagnosis item | Diagnosis code | | Check item (Remedy) |
|---|---|---|---|---|
| | | No. | Memory | |
| 6 | Engine coolant temperature sensor | 21 | Retained | • Harness and connector<br>• Engine coolant temperature sensor |
| 7 | Crank angle sensor | 22 | Retained | • Harness and connector (If harness and connector are normal, replace distributor assembly.) |
| 8 | Top dead centre sensor | 23 | Retained | • Harness and connector (If harness and connector are normal, replace distributor assembly.) |
| 9 | Vehicle speed sensor (reed switch) | 24 | Retained | • Harness and connector<br>• Vehicle speed sensor (reed switch) |
| 10 | Barometric pressure sensor | 25 | Retained | • Harness and connector (If harness and connector are normal, replace barometric pressure sensor assembly.) |
| 11 | Ignition timing adjustment signal | 36 | — | • Harness and connector |
| 12 | Injector | 41 | Retained | • Harness and connector<br>• Injector coil resistance |
| 13 | Normal state | — | — | — |

NOTE
Replace the engine control unit if a malfunction code is output although the inspection reveals that there is no problem with the check items.

## READ OUT OF MALFUNCTION CODE

### PRECAUTIONS FOR OPERATION

**(1) When battery voltage is low; no detection of failure is possible. Be sure to check the battery for voltage and other conditions before starting the test.**
**(2) Diagnosis item is erased if the battery or the engine control unit connector is disconnected. Do not disconnect the battery before the diagnosis result is completely read.**



### READING STEPS – USING THE MULTI-USE TESTER (MUT)

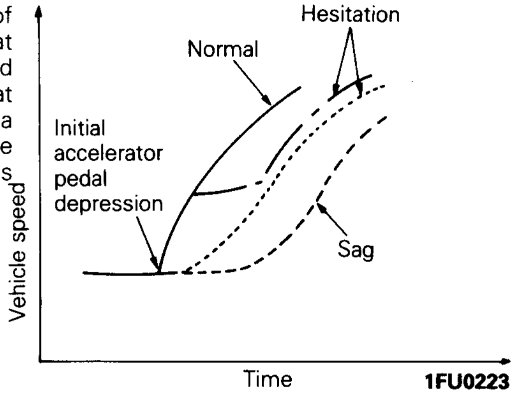
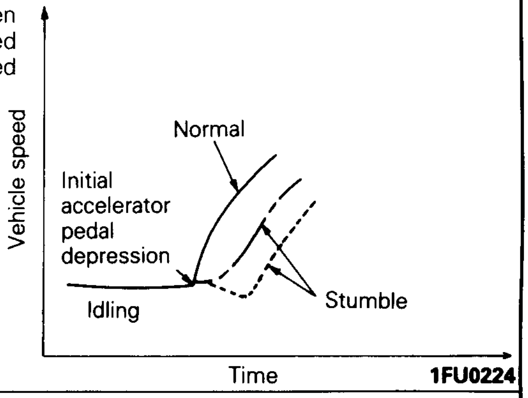
(1) Read and make a note of the self-diagnosis output.
(2) Refer to the diagnosis chart to remedy the problem.
(3) After turning the ignition switch once to OFF, turn it back to ON.
(4) Erase the problem codes.
(5) Recheck that everything is normal.

## CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

| Problem symptoms | Starting | | Idling stability | | | Driving | | | | | | Stopping | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Check Items | Will not start | Starting problem | Idling instability (Rough idling) | Incorrect idling speed | Improper idling continuity | Hesitation, sag | Poor acceleration | Stumble | Shock | Surge | Knocking | Run-on (Dieseling) | Reference page |
| Power Supply and Ignition Switch–IG | ①$\boxed{1}$ | | | | | | | | | | | | P. 13–23 |
| Engine Control Unit Power Earth | ②$\boxed{2}$ | | | | | | | | | | | | P. 13–26 |
| Fuel Pump | ③$\boxed{3}$ | ①$\boxed{1}$ | | | ①$\boxed{1}$ | ①$\boxed{1}$ | ①$\boxed{1}$ | | | | | | P. 13–27 |
| Air Flow Sensor | | | | | | ⑧$\boxed{8}$ | | ⑤$\boxed{5}$ | | | ③$\boxed{1}$ | | P. 13–30 |
| Intake Air Temperature Sensor | | | ⑤ | | | ④$\boxed{4}$ | ④$\boxed{4}$ | | | | ①$\boxed{1}$ | | P. 13–34 |
| Barometric Pressure Sensor | | | ⑦ | | | ⑦$\boxed{7}$ | ⑥$\boxed{6}$ | | | | ②$\boxed{2}$ | | P. 13–36 |
| Engine Coolant Temperature Sensor | | $\boxed{3}$ | ⑥$\boxed{5}$ | ①$\boxed{1}$ | ⑤$\boxed{5}$ | ⑥$\boxed{6}$ | ⑤$\boxed{5}$ | ④$\boxed{4}$ | | ③$\boxed{3}$ | | | P. 13–38 |
| Throttle Position Sensor | | | | | | ⑤$\boxed{5}$ | | ③$\boxed{3}$ | ④$\boxed{4}$ | | | | P. 13–40 |
| Idle Position Switch | | | ③$\boxed{3}$ | ②$\boxed{2}$ | ④$\boxed{4}$ | | | | | | | | P. 13–42 |
| Top Dead Center Sensor | ⑤$\boxed{5}$ | ⑥$\boxed{7}$ | | | ⑧$\boxed{7}$ | | | | ②$\boxed{2}$ | | | | P. 13–44 |
| Crank Angle Sensor | ⑥$\boxed{6}$ | ⑦$\boxed{8}$ | | | ⑨$\boxed{8}$ | | | | ③$\boxed{3}$ | | | | P. 13–48 |
| Ignition Switch-ST <M/T> | ④$\boxed{4}$ | ③$\boxed{4}$ | | | | | | | | | | | P. 13–50 |
| Ignition Switch-ST and Inhibitor Switch <A/T> | ④$\boxed{4}$ | ③$\boxed{4}$ | | ④ | | | | | | | | | P. 13–52 |
| Vehicle Speed Sensor | | | | | ⑥ | | | | | | | | P. 13–54 |
| Air Conditioner Switch and Power Relay | | | | ③ | | | | | | | | | P. 13–56 |
| Oxygen Sensor | | | ⑨ | | | | | | | | | | P. 13–58 |
| Injectors | ⑧$\boxed{8}$ | ②$\boxed{2}$ | ②$\boxed{2}$ | | ③$\boxed{3}$ | ②$\boxed{2}$ | ②$\boxed{2}$ | ①$\boxed{1}$ | | ①$\boxed{1}$ | | ① | P. 13–61 |
| Idle Speed Control Servo (Stepper Motor) | | ④$\boxed{5}$ | ①$\boxed{1}$ | ⑤$\boxed{3}$ | ②$\boxed{2}$ | | | | | | | | P. 13–66 |
| Ignition Coil and Power Transistor | ⑦$\boxed{7}$ | | | | ⑩$\boxed{9}$ | | ⑦$\boxed{7}$ | | ①$\boxed{1}$ | | | | P. 13–71 |
| Purge Control Solenoid Valve | | | ⑧ | | | | | | | | | | P. 13–75 |
| Fuel Pressure | | ⑤$\boxed{6}$ | ④$\boxed{4}$ | | ⑦$\boxed{6}$ | ③$\boxed{3}$ | ③$\boxed{3}$ | ②$\boxed{2}$ | | 2$\boxed{2}$ | | | P. 13–77 |

○: Warm engine (figures inside the ○ indicate the checking sequence.)
☐: Cold engine (figures inside the ☐ indicate the checking sequence.)

## PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

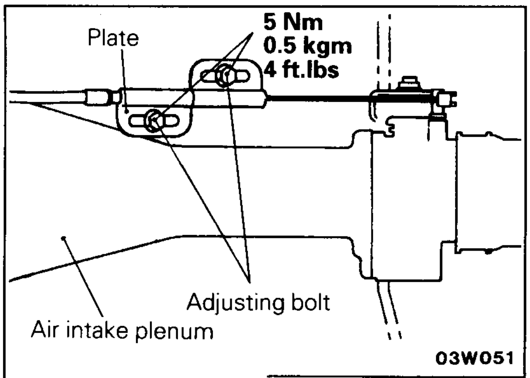
| Item | | Symptom |
|---|---|---|
| Starting | Won't start<br>(no initial combustion) | The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start. |
| | Starting problem<br>(initial combustion, then stall) | There is combustion within the cylinders, but then the engine soon stalls. |
| | (Starting takes a long time.) | Engine won't start quickly. |
| Idling stability | Idling instability<br>(Rough idling) | Engine speed doesn't remain constant; changes during idling.<br>Usually, a judgement can be based upon the movement of the tachometer pointer, and the vibration transmitted to the steering wheel, shift lever, body, etc. This is called rough idling. |
| | Incorrect idling speed | The engine doesn't idle at the usual correct speed. |
| | Improper idling continuity<br>Die out<br>Pass out | This non-continuity of idling includes the following elements.<br>(1) Die out ....... The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicle is moving or not.<br>(2) Pass out ..... The engine stalls when the accelerator pedal is depressed or while it is being used. |
| Driving | Hesitation<br>Sag | "Hesitation" is the delay in response of the vehicle speed (engine r/min) that occurs when the accelerator is depressed in order to accelerate from the speed at which the vehicle is now traveling, or a temporary drop in vehicle speed (engine r/min) during such acceleration. Serious hesitation is called "sag".<br> <br>1FU0223 |
| | Poor acceleration | Poor accleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth, or the inability to reach maximum speed. |
| | Stumble | Engine r/min response is delayed when the accelerator pedal is initially depressed for acceleration from the stopped condition.<br> <br>1FU0224 |
| | Shock | The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated. |
| | Surge | This is repeated surging ahead during constant speed travel or during variable speed travel. |
| | Knocking | A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving. |
| Stopp-ing | Run-on (Dieseling) | The engine continues to run even after the switch is turned OFF. This is called dieseling. |

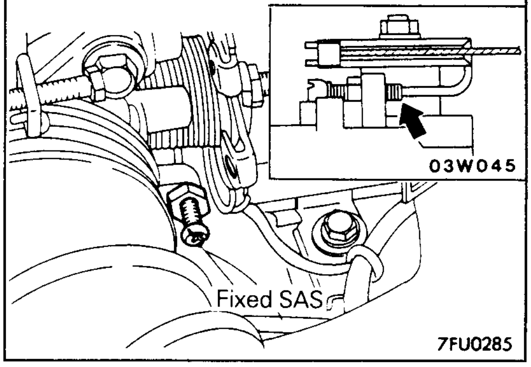
# SERVICE ADJUSTMENT PROCEDURES

## ACCELERATOR CABLE INSPECTION AND ADJUSTMENT <VEHICLES WITHOUT AUTO-CRUISE CONTROL SYSTEM>

E13FCAZ1

For models equipped with the auto-cruise control system, refer to P. 13-188.



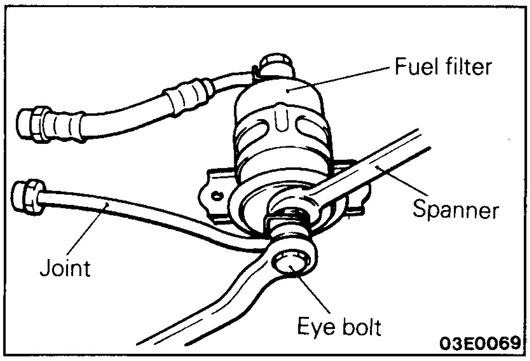


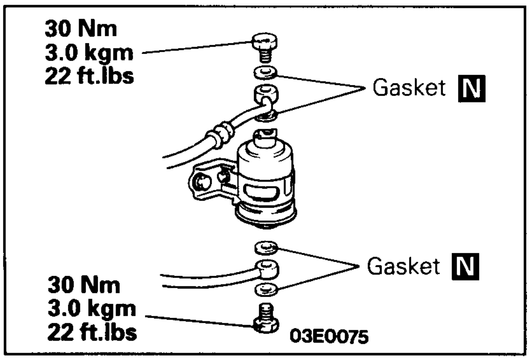
(1) Check that there are no sharp bends in the accelerator cable.
(2) Check that the throttle link is touching the fixed SAS stopper.
(3) Move the plate so that the inner cable play is at the standard value, and tighten the adjusting bolt.

**Standard value: 1–2 mm (0.04–0.08 in.)**

## FUEL FILTER REPLACEMENT

E13FZAL

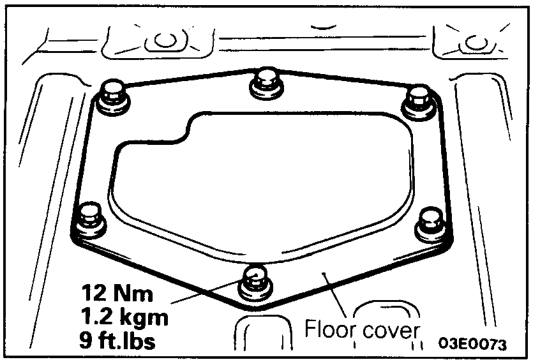




(1) Hold the fuel filter with a spanner, and remove the eye bolt.

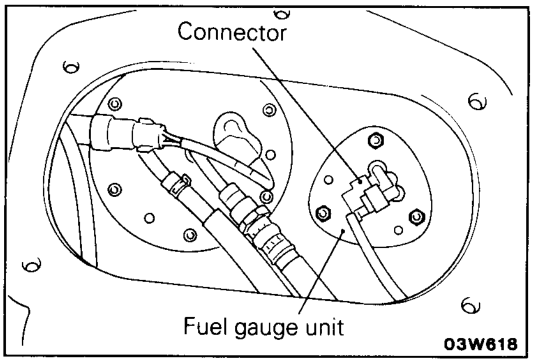
**Caution**
**The fuel line has some residual pressure, so cover it with a rag.**

(2) Remove the fuel filter.
(3) Use a new gasket when installing the fuel filter, and tighten the eye bolt of the high pressure fuel hose to the specified torque.
(4) After installing, check that there are no fuel leaks.
  ① Apply battery voltage to the fuel pump drive terminal to operate the fuel pump. (Refer to P.13-15)
  ② Check that there are no leaks in the fuel line when the fuel is under pressure.

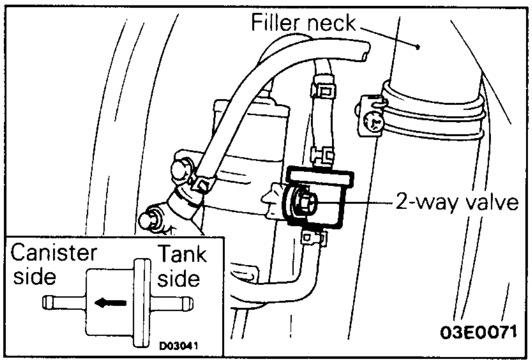


## FUEL GAUGE UNIT REPLACEMENT E13FDAC1

(1) Take out the carpet in the cargo compartment and remove the floor cover.



(2) Disconnect the connector from the fuel gauge unit, and remove the fuel gauge unit.
(3) Install the fuel gauge unit so that the packing stoppers (2 places) match the hole in the fuel gauge unit.
(4) Install the floor cover packing and the floor cover.



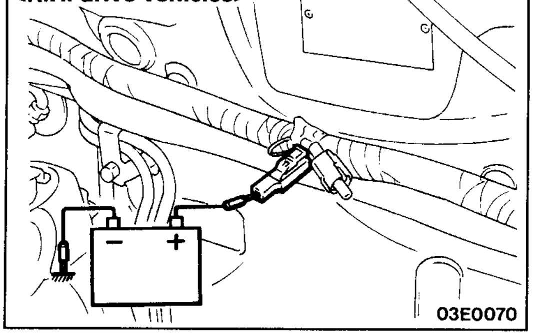
## 2-WAY VALVE REPLACEMENT E13FFAC1

(1) Remove the filler neck protector inside the left rear fender.
(2) Replace the 2-way valve.

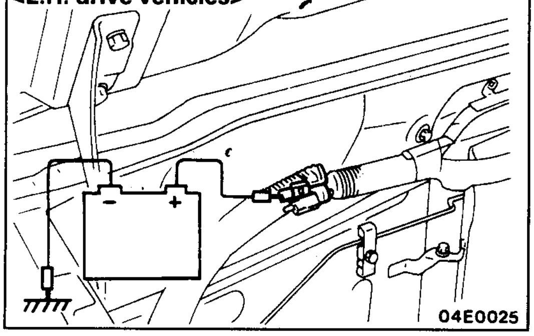
**Caution**
**Be careful not to mistake the direction of the 2-way valve.**

(3) Install the filler neck protector.

**<R.H. drive vehicles>**



**<L.H. drive vehicles>**



## FUEL PUMP OPERATION CHECK E13FGCE

(1) Use the multi-use tester to force-drive the fuel pump, and check the operation of the fuel pump.
(For inspection using the multi-use tester, refer to P.13-28.)
(2) If the fuel pump does not operate, inspect by the following procedure, and if the results are normal, then inspect the drive circuit.
① Turn the ignition switch to OFF.
② When the fuel pump drive connector is connected directly to the battery, check if the sound of the fuel pump operation can be heard.

NOTE
As the fuel pump is an in-tank type, the fuel pump sound is hard to hear, so remove the fuel tank cap and check from the tank inlet.

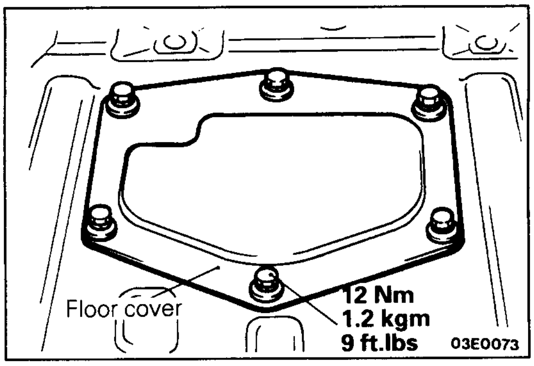
③ Check if the fuel pressure can be felt by pinching the high pressure fuel hose with fingertips.

## HOW TO REDUCE THE FUEL LINE INTERNAL PRESSURE

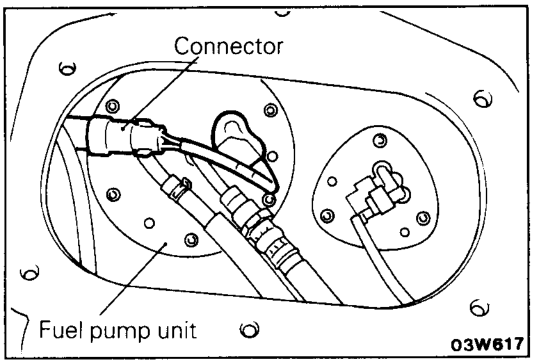
E13HABG

When removing the fuel pipe and hose, etc., fuel under high pressure will be inside the fuel line, so carry out the following procedure to release the pressure to prevent the fuel from spraying out.

(1) Take out the carpet in the cargo compartment and remove the floor cover.

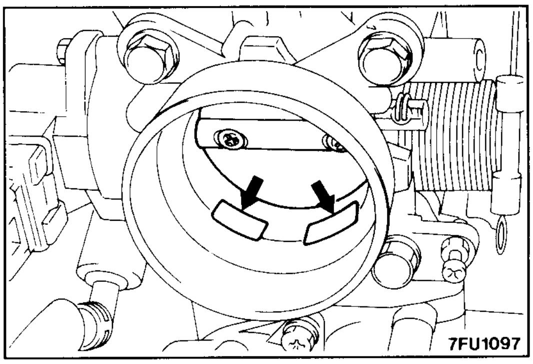


(2) Disconnect the fuel pump unit connector.
(3) After starting the engine and letting it run until it stops, turn the ignition switch to OFF.
(4) Connect the fuel pump unit connector.
(5) Install the floor cover packing and the floor cover.



## THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

E13HAJB1



(1) Start the engine and warm it up until the temperature of the engine coolant reaches 80°C (176°F) or higher; then stop the engine.
(2) Disconnect the air intake hose at the throttle body side.
(3) Plug the bypass intake port inlet in the throttle body.

**Caution**
**Never let cleaning liquid get into the bypass intake.**

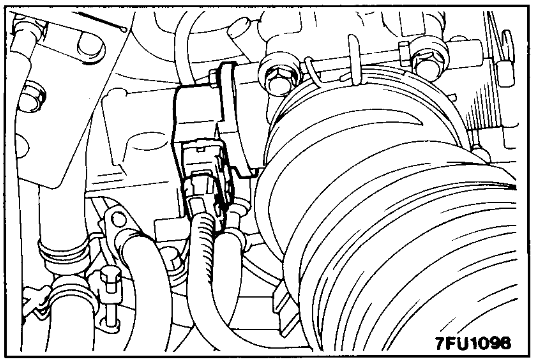
(4) Spray cleaning liquid (from the intake port of the throttle body) onto the valve, and then leave as is for about five minutes.
(5) Start the engine and race it a few times; then let it run at idle speed for about one minute.

NOTE
The engine idling speed is unstable (or the engine stalls), let the engine run with the throttle valve slightly open.

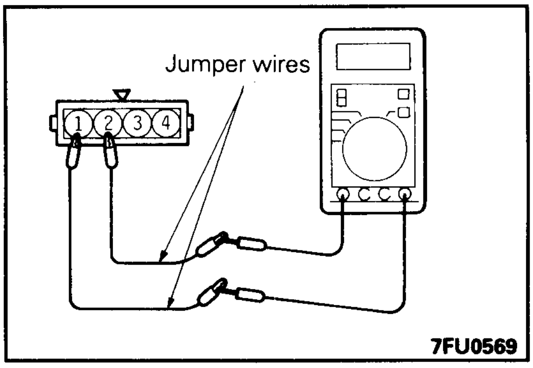
(6) If deposits are not removed from the throttle valve, repeat steps (4) and (5).
(7) Remove the plug from the bypass intake port inlet in the throttle body.
(8) Connect the air intake hose.
(9) Using the multi-use tester, erase the self-diagnosis code.
(10) Adjust the basic idle speed. (Refer to P. 13-18.)

NOTE
If hunting of the idling engine occurs after adjusting the basic idling speed, remove the battery (–) cable from the battery terminal for more than 10 seconds, and then idle the engine again.

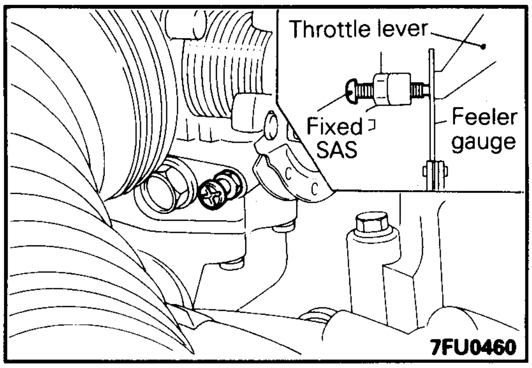
## IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT E13HAKD1



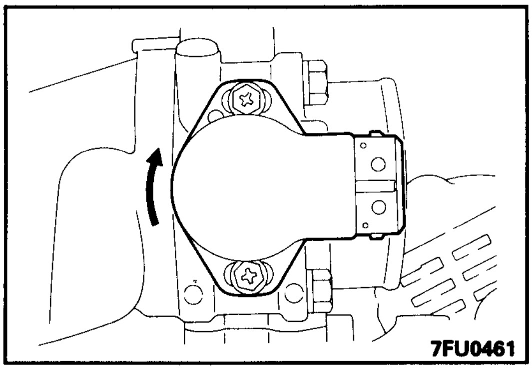
(1) Disconnect the connector of the throttle-position sensor.



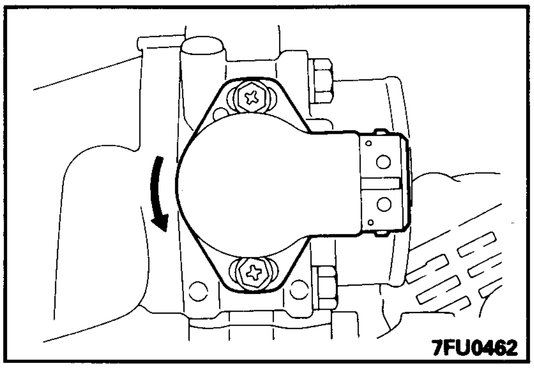
(2) Using jumper wires, connect an ohmmeter across terminal ② (idle position switch) and terminal ④ (sensor earth) of the throttle position sensor.



(3) Insert a 0.65 mm (0.0256 in.) thick feeler gauge between the fixed SAS and throttle lever.



(4) Loosen the throttle position sensor mounting bolts and turn the throttle position sensor body fully clockwise.
(5) In this condition, check that there is continuity across terminals ① and ②.



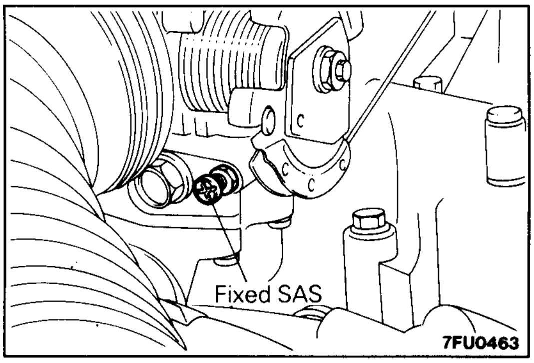
(6) Slowly turn the throttle position sensor counterclockwise until you find a point at which there is no continuity across terminals ① and ②. Then, tighten the throttle position sensor mounting bolt securely.
(7) Connect the throttle position sensor connector.

(8) Connect the multi use tester (MUT) to the diagnosis connector.
(9) Turn the ignition switch ON (but do not start the engine).
(10) Using the MUT, select item No. 14 and read the throttle position sensor output voltage.

**Standard value: 400–1,000 mV**

(11) If the voltage is out of specification, check the throttle position sensor and associated harnesses.
(12) Remove the feeler gauge.
(13) Turn the ignition switch OFF.

## FIXED SAS ADJUSTMENT E13HAMC1



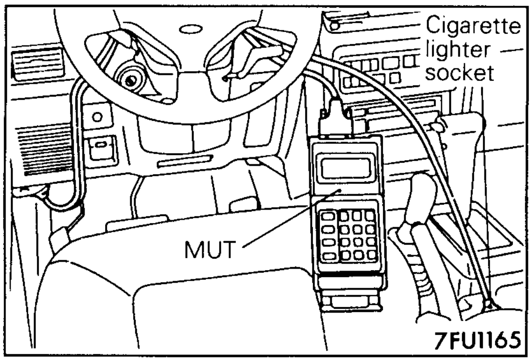
NOTE
1. The fixed SAS has been factory-adjusted. Never attempt to move it.
2. Should it be out of proper adjustment, adjust by following the procedure given below.

(1) Sufficiently slacken the accelerator cable.
(2) Loosen the lock nut on the fixed SAS.
(3) Sufficiently loosen the fixed SAS by turning it counterclockwise to fully close the throttle valve.
(4) Tighten the fixed SAS slowly to find a point at which it contacts the throttle lever (where the throttle valve starts opening). From that point, tighten the fixed SAS further 1¼ turns.
(5) Holding the fixed SAS to prevent it from turning, tighten the lock nut securely.
(6) Adjust the accelerator cable tension. (Refer to P. 13-14.).
(7) Adjust the basic idle speed.
(8) Adjust the idle position switch and throttle position sensor (TPS). (Refer to P. 13-17.).

## BASIC IDLE SPEED ADJUSTMENT E13HAND

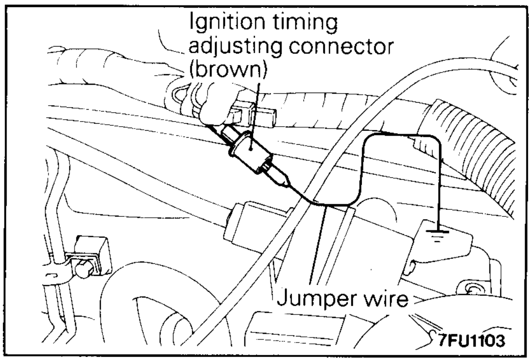
NOTE
1. The basic idle speed has been factory-adjusted with the speed adjusting screw (SAS) and does not normally require adjustment.
2. If the adjustment is required, first check that the ignition plug, injector, ISC servo, and compression pressure are normal.

(1) Before starting the inspection and adjustment procedures, set the vehicle in the following conditions:
   - Engine coolant temperature: 80 to 95°C (176 to 205°F)
   - Lights, electric cooling fan, accessories: OFF
   - Transmission: Neutral (P for vehicles with an automatic transmission)
   - Steering wheel: Straightforward position



(2) Connect the multi use tester (MUT) to the diagnosis connector.

NOTE
When the multi-use tester is connected, the diagnosis control terminal will be earthed.



(3) Remove the waterproof female connector from the ignition timing adjusting connector (brown).

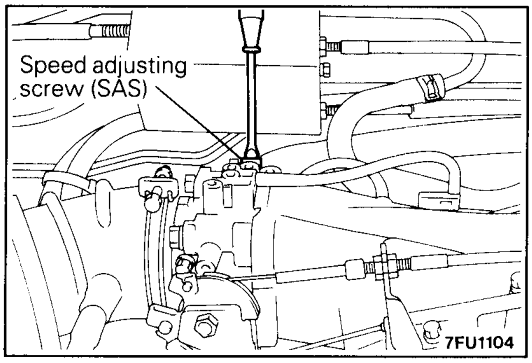
(4) Using a jumper wire, earth the ignition timing adjusting terminal.

(5) Start the engine and run at idle.

(6) Check the basic idle speed. Using the MUT, select item No. 22 and read the idle speed.

**Standard value: 700 ± 50 r/min.**

NOTE
1. The engine speed may be low by 20 to 100 r/min. while the vehicle is new [distance driven approx. 500 km (300 miles) or less], but no adjustment is necessary.
2. If the engine stalls or speed is low despite a sufficient distance driven [approx. 500 km (300 miles) or more], it is probably due to deposits on the throttle valve. In this case, clean the throttle valve. (Refer to P. 13-16.).



(7) If the basic idle speed is out of specification, adjust by turning the speed adjusting screw (SAS).

NOTE
If the idle speed is higher than the standard value even with SAS fully tightened, check to see if there is evidence of the fixed SAS being moved. If the fixed SAS seems to have been moved, adjust it. If it does not seem to have been moved, there may be a leak caused by deteriorated fast idle air valve (FIAV). In such a case, replace the throttle body.

(8) Turn the ignition switch OFF.

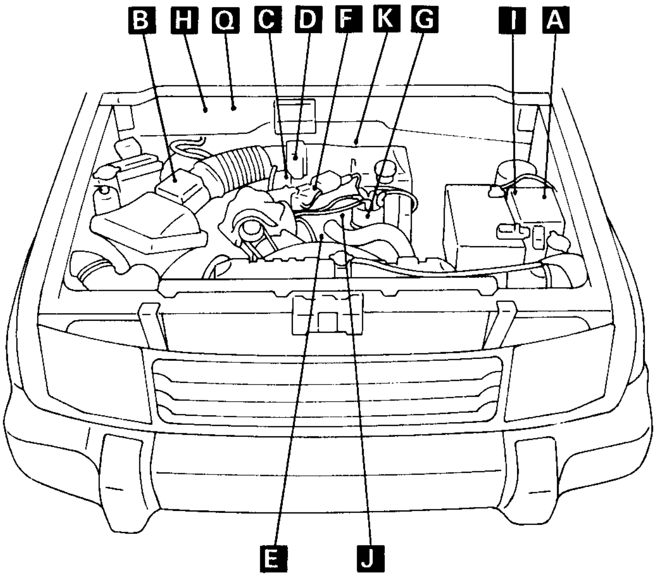
(9) Remove the jumper wire from the ignition timing adjusting terminal and replace the connector back again.

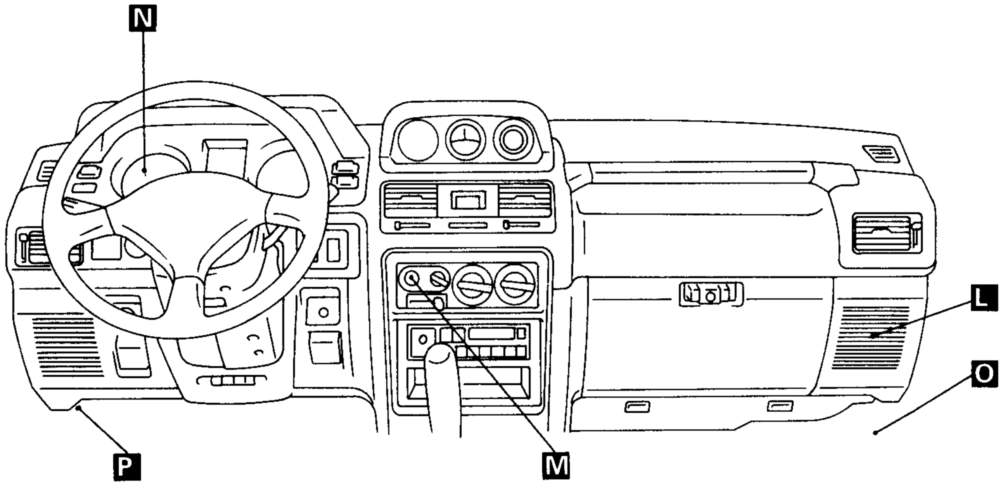
(10)Start the engine again and run at idle for 10 minutes to make sure that the engine runs at proper idle speed.

# ON-VEHICLE INSPECTION OF MPI COMPONENTS

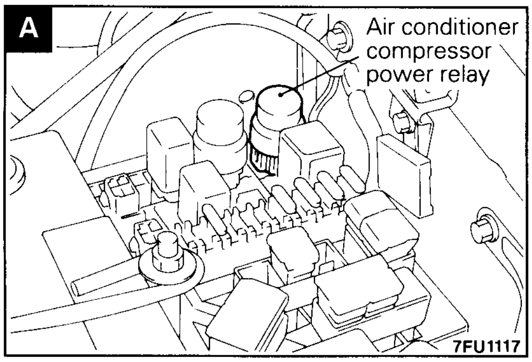
E13QAAC

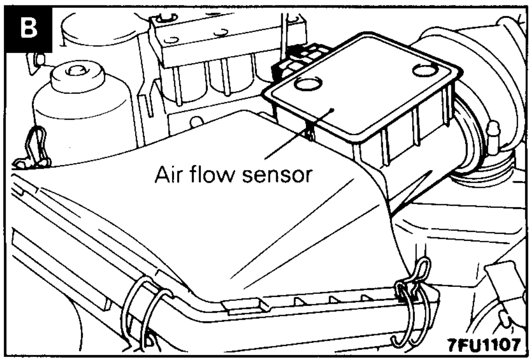
## COMPONENT LOCATION

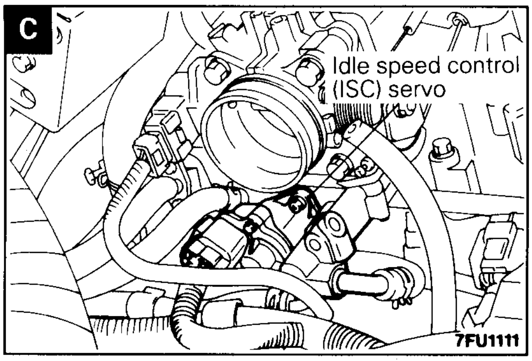


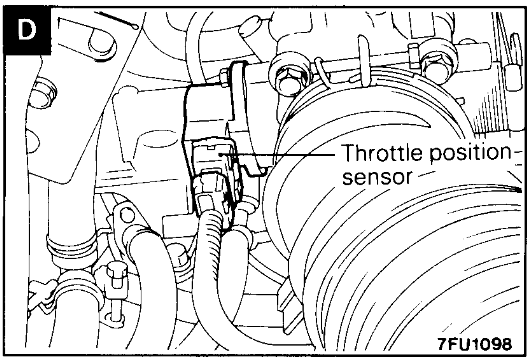


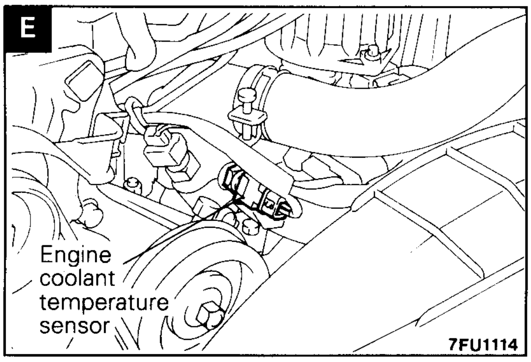
| Name | Symbol | Name | Symbol |
|---|---|---|---|
| Air conditioner relay | A | Idle speed control servo | C |
| Air conditioner switch | M | Ignition coil (power transistor) | F |
| Air flow sensor (incorporating intake air temperature sensor and barometric pressure sensor) | B | Ignition timing adjustment terminal | Q |
| Crank angle sensor and top dead center sensor | G | Injector | J |
| Engine control relay | L | Oxygen sensor | K |
| Engine control unit | O | Purge control solenoid valve | I |
| Engine coolant temperature sensor | E | Self-diagnosis connector | P |
| Fuel pump check terminal | H | Throttle position sensor (with idle position switch) | D |
| | | Vehicle-speed sensor (reed switch) | N |

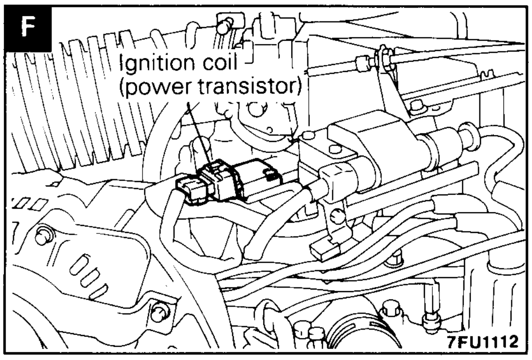

A
Air conditioner compressor power relay
7FU1117

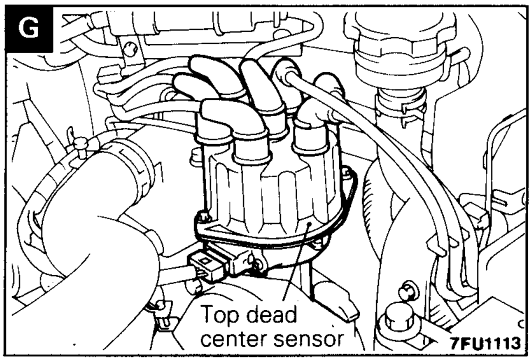

B
Air flow sensor
7FU1107

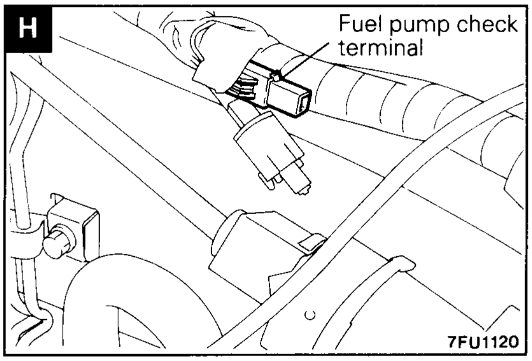

C
Idle speed control (ISC) servo
7FU1111

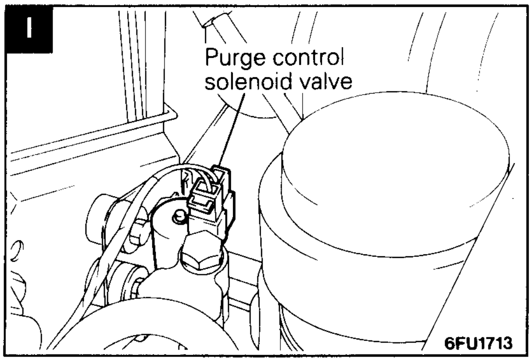

D
Throttle position sensor
7FU1098

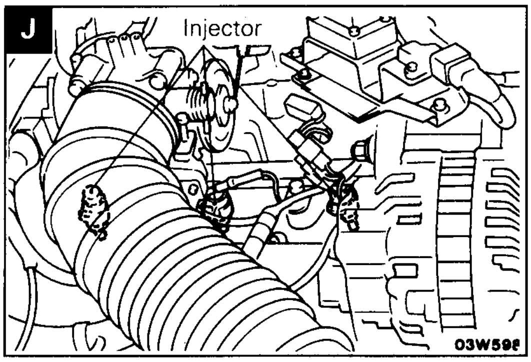

E
Engine coolant temperature sensor
7FU1114

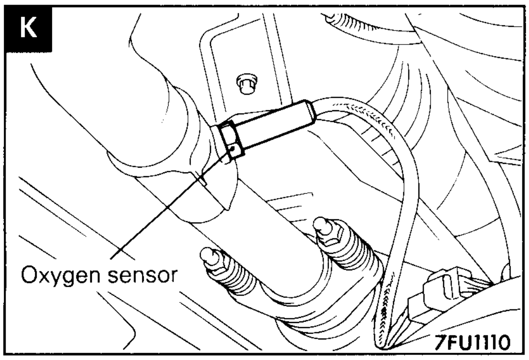

F
Ignition coil (power transistor)
7FU1112

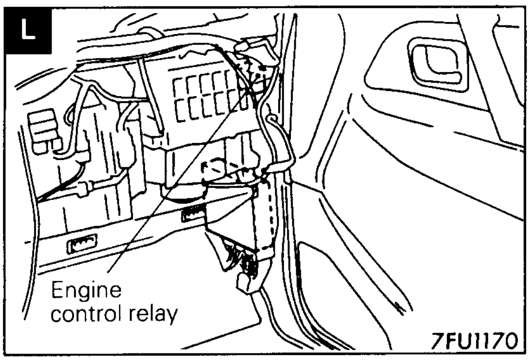

G
Top dead center sensor
7FU1113

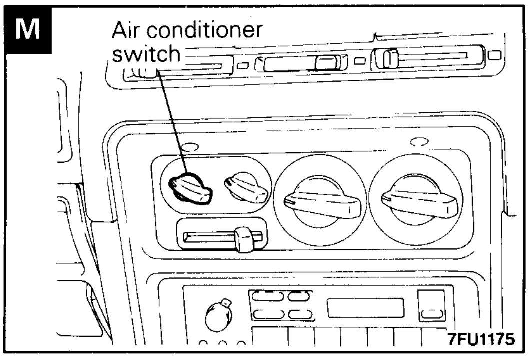

H
Fuel pump check terminal
7FU1120

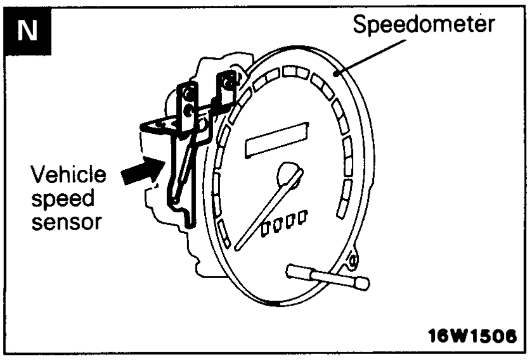

I
Purge control solenoid valve
6FU1713

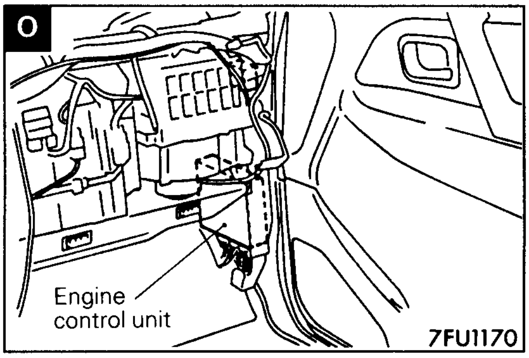

J
Injector
03W59F

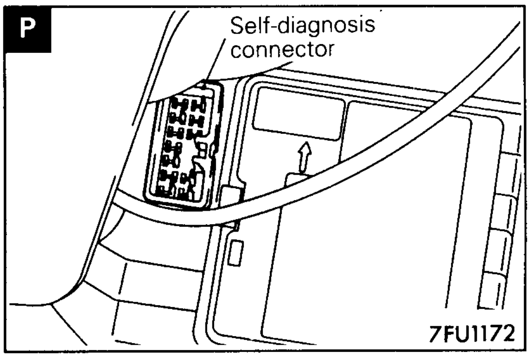


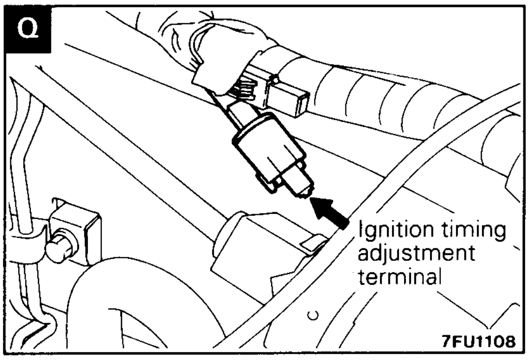


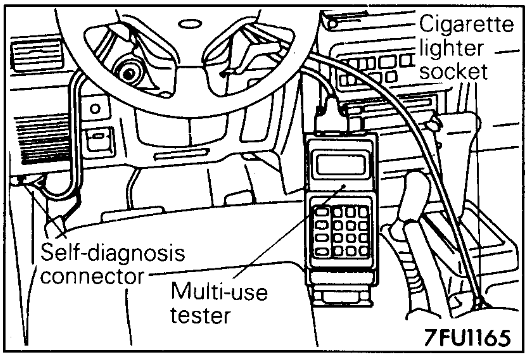










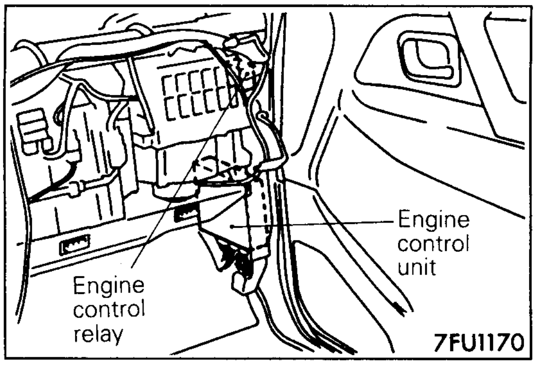


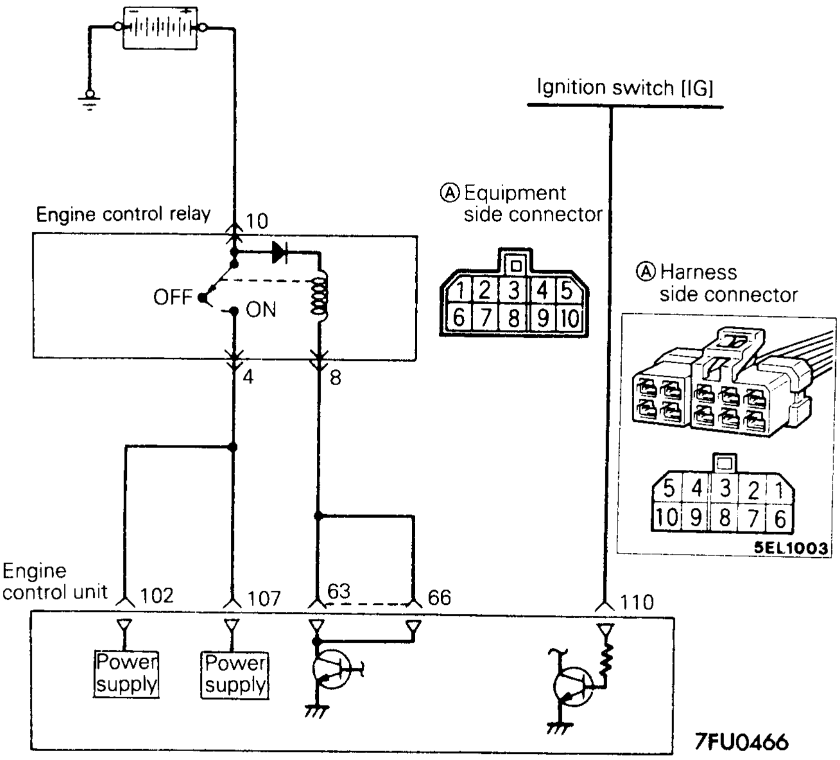
## COMPONENT INSPECTION PROCEDURE

### USING MULTI-USE TESTER (MUT)

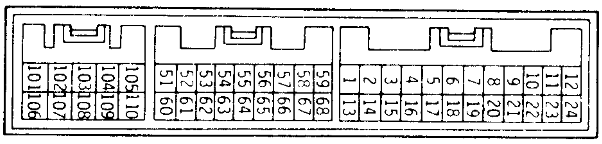
(1) Check by the service data and actuator test function. If any abnormality is found, check the body harness, components, etc. and repair as necessary.
(2) After repair, check again with the MUT to make sure that the input and output signals are now normal.
(3) Erase the self-diagnosis trouble code in memory.
(4) Disconnect the MUT.
(5) Start the engine and perform running test, etc. to make sure that the troubles have been corrected.

## POWER SUPPLY AND IGNITION SWITCH-IG





Engine control connector



### OPERATION

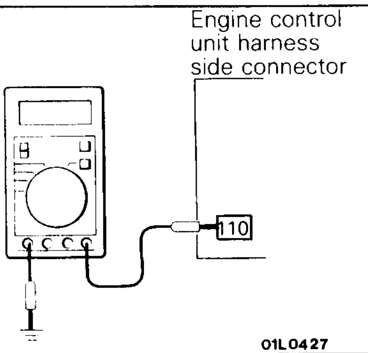
- While the ignition switch is ON, battery power supply is supplied to the engine control unit, injectors, air-flow sensor, etc.
- When the ignition switch is switched ON, battery voltage is supplied from the ignition switch to the engine control unit. When battery voltage is supplied to the engine control unit, the power transistor is switched ON and current flows to the engine control relay coil.
- As a result, the engine control relay switch is switched ON, and power is supplied, by way of the engine control relay switch, from the battery to the engine control unit.

## INSPECTION
### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Standard value V |
| --- | --- | --- | --- | --- |
| Data reading | 16 | Engine control unit power-supply voltage | Ignition switch: ON | SV |

## HARNESS INSPECTION

**1**



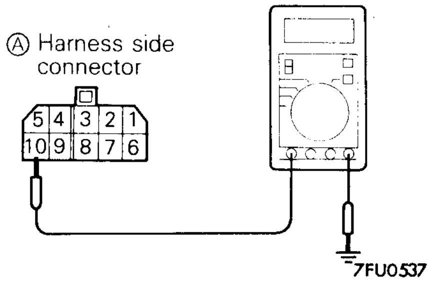
Measure the ignition switch terminal input voltage.
- Engine control unit connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
| --- |
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ignition switch–110)

**2**



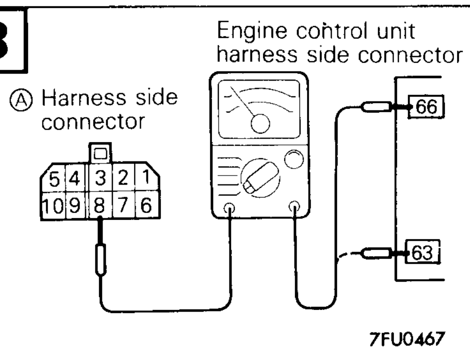
Measure the power supply voltage of the engine control relay
- Connector: Disconnected

| Voltage (V) |
| --- |
| SV |

OK → 3

~~OK~~ → Repair the harness. (Battery–Ⓐ10)

**3**

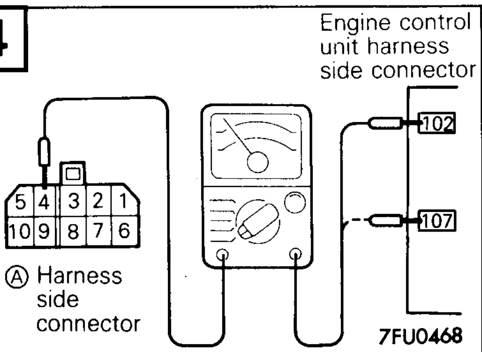


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the engine control relay.
- Engine control unit connector: Disconnected
- Engine control relay connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓐ8 – 63 Ⓐ8 – 66)

**4**

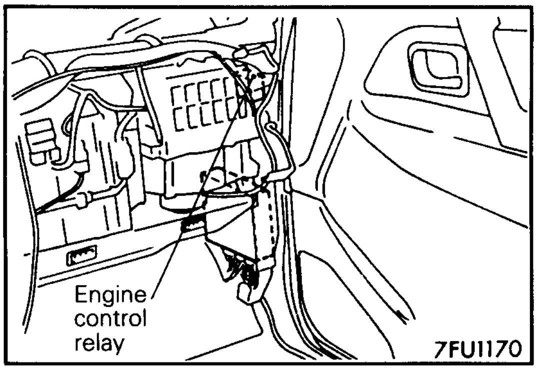


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the engine control relay.
- Engine control relay connector: Disconnected
- Engine control unit connector: Disconnected

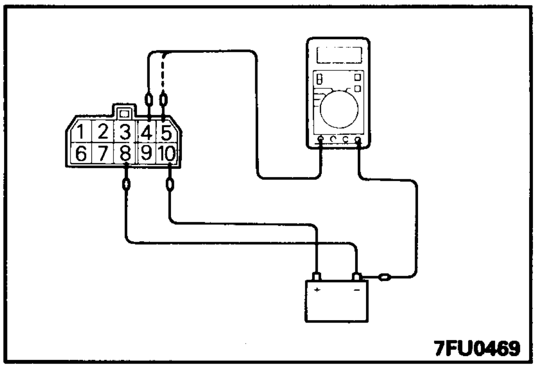
OK → STOP

~~OK~~ → Repair the harness. (Ⓐ4 – 102 107)

## ENGINE CONTROL RELAY INSPECTION



(1) Disconnect the control relay.



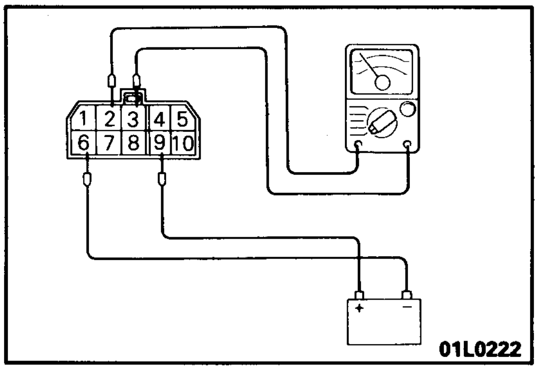
(2) Using jumper wires, connect terminal ⑩ of the control relay to the ⊕ terminal of the battery and connect terminal ⑧ of the relay to the ⊖ terminal of the battery.

**CAUTION**

- **When connecting the jumper wires, be careful not to connect them to the wrong terminals, since this could damage the relay.**

(3) Measure the voltage at terminal ④ and terminal ⑤ of the control relay while coming off and on the connection of the jumper wire to the battery ⊖ terminal.

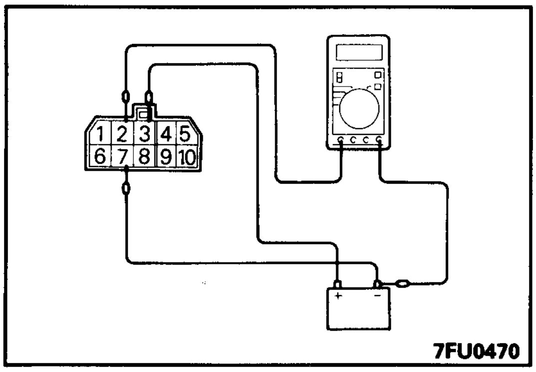
| Jumper wire | Terminal ④ voltage | Terminal ⑤ voltage |
|---|---|---|
| Connected | SV | SV |
| Disconnected | 0V | 0V |



(4) Using jumper wires, connect terminal ⑨ of the control relay to the ⊕ terminal of the battery and connect terminal ⑥ of the relay to the ⊖ terminal of the battery.

(5) Check the continuity between at terminal ② and terminal ③ of the control relay while coming off and on the connection of the jumper wire to the battery ⊖ terminal.

| Jumper Wire | Continuity between Terminals ② and ③ |
|---|---|
| Connected | Continuity |
| Disconnected | No Continuity |



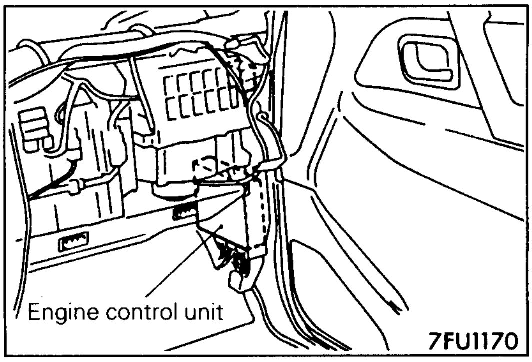
(6) Using jumper wires, connect terminal ③ of the control relay to the ⊕ terminal of the battery and connect terminal ⑦ of the relay to the ⊖ terminal of the battery.

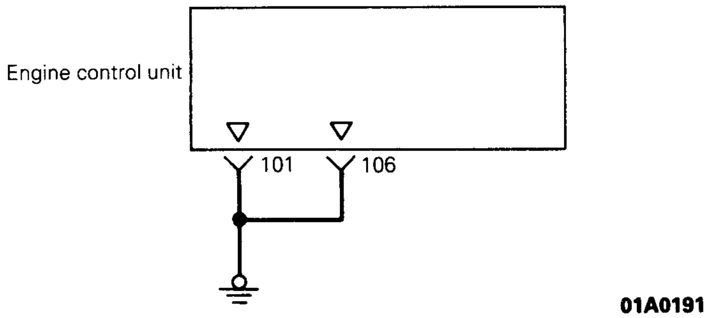
(7) Measure the voltage at terminal ② of the control relay while coming off and on the connection of the jumper wire to the battery ⊖ terminal.

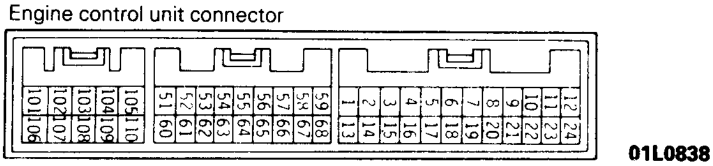
| Jumper Wire | Terminal ② Voltage |
|---|---|
| Connected | SV |
| Disconnected | 0V |

(8) Replace the control relay if faulty.

## ENGINE CONTROL UNIT POWER EARTH







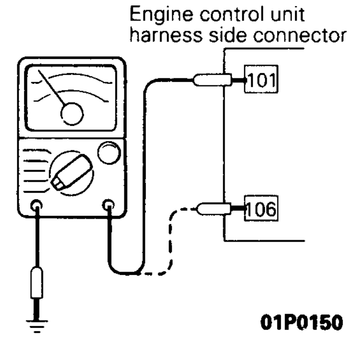
### OPERATION

Earthing of the engine control unit

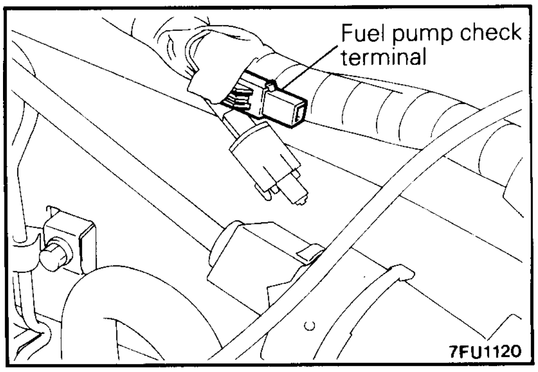
### TROUBLESHOOTING HINTS

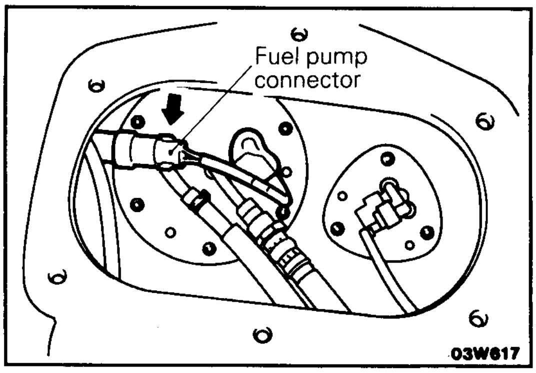
If there is incorrect or incomplete contact of the engine control unit's earth line, the engine control unit will not function correctly.

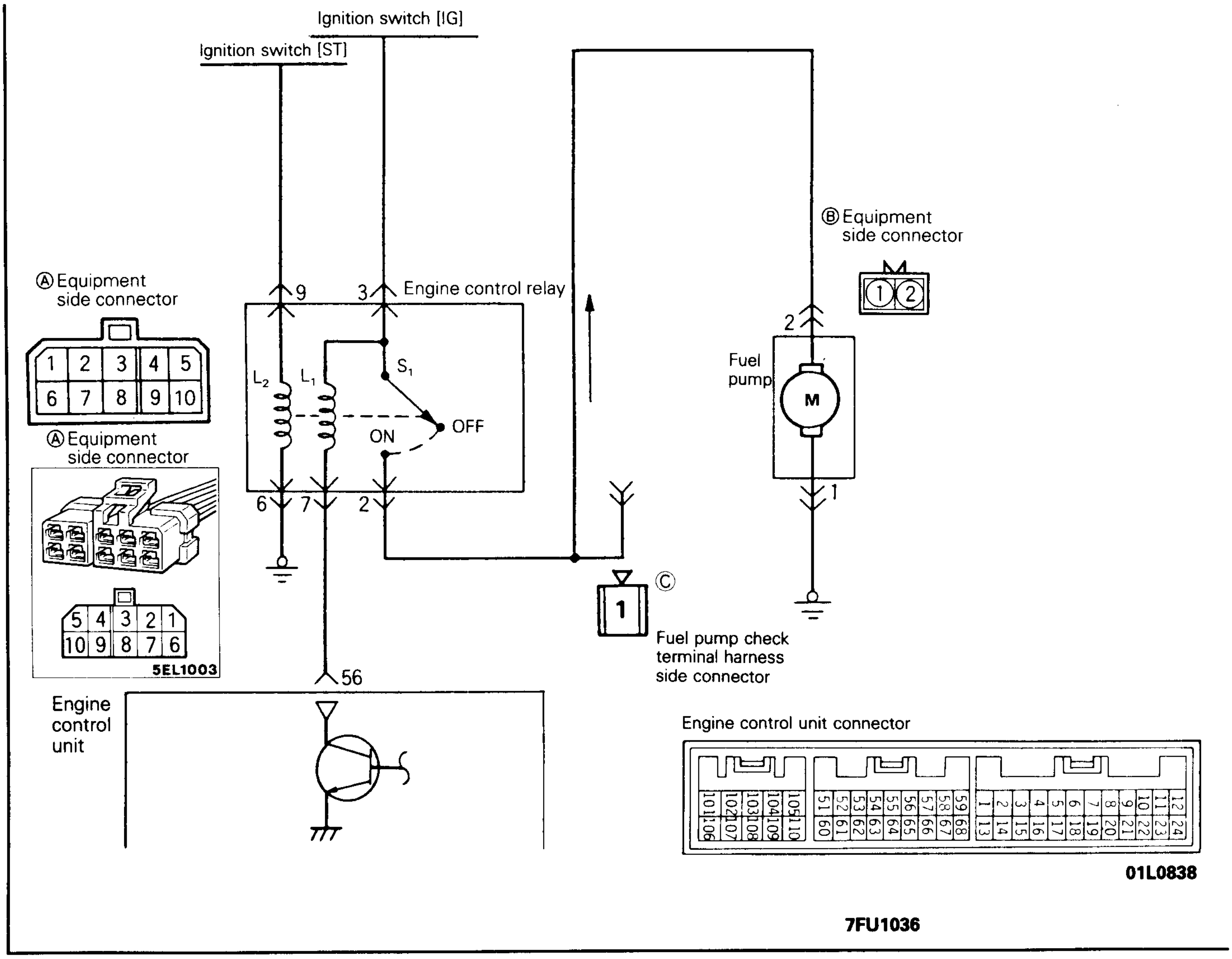
### HARNESS INSPECTION

| | | | |
|---|---|---|---|
| **1**  | Check for continuity of the earth circuit.<br>- Engine control unit connector: Disconnected | **OK** →<br>~~**OK**~~ → | STOP<br>Repair the harness. (101 -Earth 106- Earth) |

## FUEL PUMP







### OPERATION

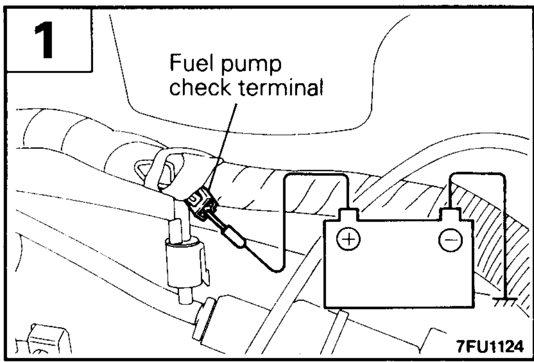
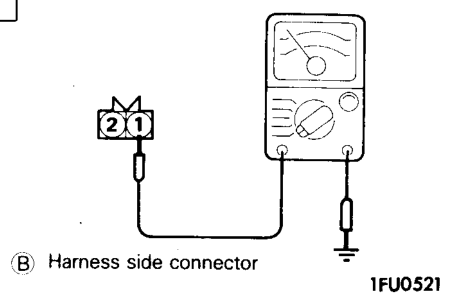
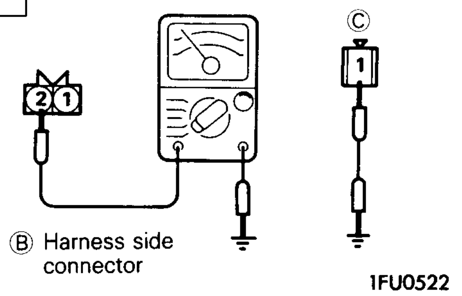
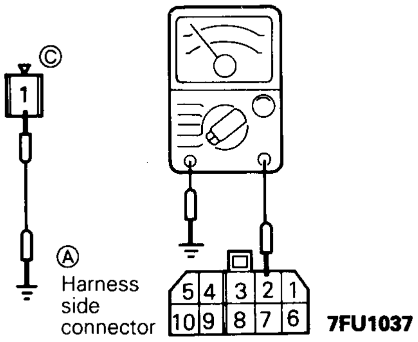
- Activates the fuel pump during engine cranking and while the engine is running.
- When the ignition switch is set to the START position, current flows, by way of the control relay coil, from the ignition switch to earth. As a result, the control relay switch is switched ON, and the power for activation of the fuel pump is supplied, by way of the control relay switch, from the battery to the fuel pump.
- While the engine is running, the engine control unit switches ON the power transistor, after which current flows to the control relay coil, and the power for activation of the fuel pump is supplied to the fuel pump.
- When the control relay switch is switched ON, battery voltage is also applied to the engine control unit, and so the engine control unit detects the fact that the power for activation of the fuel pump is being supplied to the fuel pump.

## INSPECTION

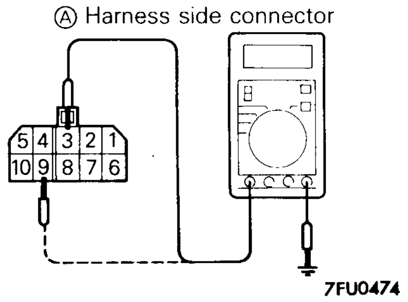
### Using Multi-use tester (MUT)

| Function | Item No. | Activation | Check conditions | Check description | Normal condition |
|---|---|---|---|---|---|
| Actuater test | 07 | Activates fuel pump and circulates fuel. | • Engine cranking<br>• Fuel pump forced activation Make the check under both of above conditions. | Pinch the return hose and feel the pulsations of the fuel flow. | Pulsations can be felt. |
| | | | | Listen (close to the fuel tank) for pump sounds. | Sounds can be heard. |

## HARNESS INSPECTION

| | | |
|---|---|---|
| **1**  | Check the fuel pump.<br>• Apply battery voltage to the checking terminal and operate the pump.<br>OK →<br>~~OK~~ → | 2<br>4 |
| **2**  | Check the earth circuit of the fuel pump.<br>• Connector: Disconnected<br>OK →<br>~~OK~~ → | 3<br>Repair the harness. (Ⓑ1- Earth) |
| **3**  | Check for continuity between the fuel pump and the checking terminal.<br>• Connector: Disconnected<br>OK →<br>~~OK~~ → | 4<br>Repair the harness. ( Ⓑ 2 - Ⓒ 1 ) |
| **4**  | Check for continuity between the checking terminal and the control relay terminal.<br>• Control relay connector: Disconnected<br>• Fuel pump connector: Disconnected<br>OK →<br>~~OK~~ → | 5<br>Repair the harness. ( Ⓐ 2 - Ⓒ 1) |

**5**



7FU0474

Measure the power supply voltage of the control relay.

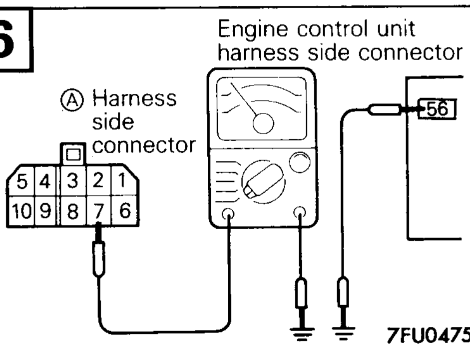
- Connector: Disconnected
- Ignition switch: START (when checking Ⓐ 9)
- Ignition switch: ON (when checking Ⓐ 3)

| Voltage (V) |
|---|
| 8 or higher |

OK → 6

~~OK~~ → Repair the harness. (Ignition switch [ON]-Ⓐ3 Ignition switch [ST]-Ⓐ9)

**6**



7FU0475

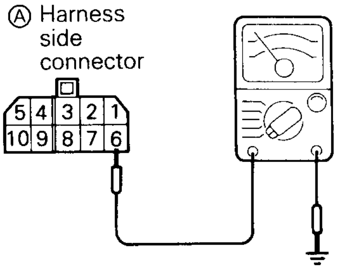
Check for an open-circuit, or a short-circuit to earth, between the control relay and the engine control unit.

- Control relay connector: Disconnected
- Engine control unit connector: Disconnected

OK → 7

~~OK~~ → Repair the harness. (Ⓐ7-56)

**7**



7FU0476

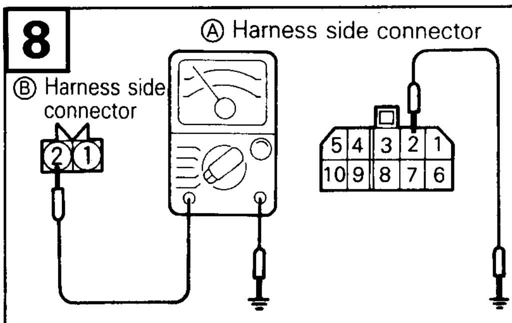
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 8

~~OK~~ → Repair the harness. (Ⓐ6-Earth)

**8**



6FU1333

Check for an open-circuit, or a short-circuit to earth, between the control relay and the fuel pump.

- Control relay connector: Disconnected
- Fuel pump connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ2-Ⓑ2)

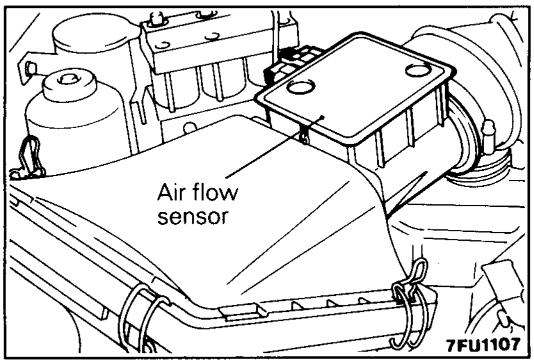
## ENGINE CONTROL RELAY INSPECTION

Refer to P. 13-25.

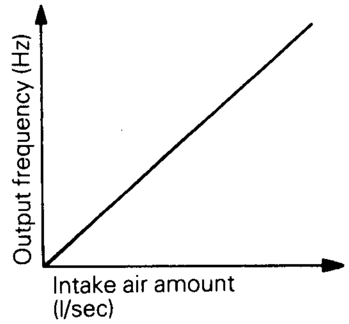
## FUEL PUMP INSPECTION

Refer to P. 13-15.

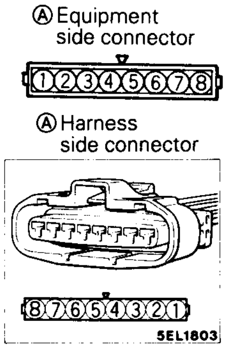
## AIR FLOW SENSOR



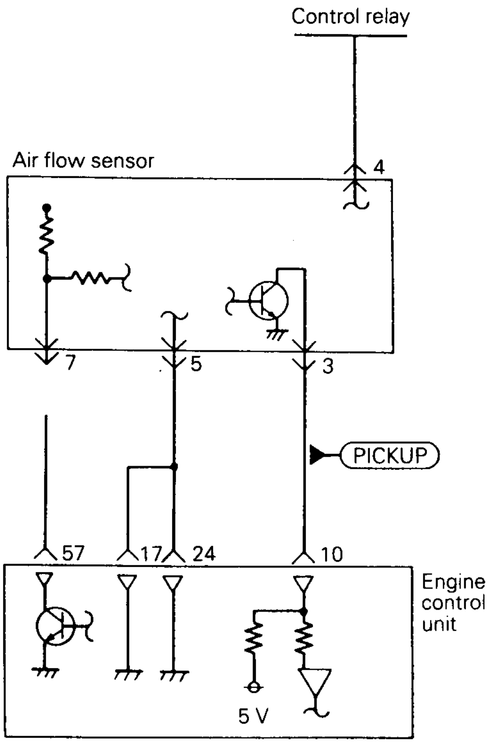
7FU1107



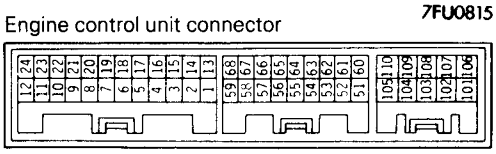
16Z451



5EL1803



7FU0815



01L0838

### OPERATION

- The flow sensor is incorporated within the air cleaner; it functions to convert the amount of engine air intake to pulse signals of a frequency proportional to the amount of engine air intake, and to input those signals to the engine control unit. The engine control unit then, based upon those signals, calculates the amount of fuel injection, etc.
- The power for the air flow sensor is supplied from the control relay to the air flow sensor, and is earthed at the engine control unit. The air flow sensor, by intermitting the flow of the 5V voltage applied from the engine control unit, produces pulse signals.

### TROUBLESHOOTING HINTS

Hint 1:
If the engine sometimes stalls, try starting the engine and shaking the air flow sensor harness. If the engine then stalls, incorrect or improper contact of the air flow sensor connector is the probable cause.
Hint 2:
If, when the ignition switch is switched ON (but the engine is not started), the air flow sensor output frequency is any value other than zero, a malfunction of the air flow sensor or of the engine control unit is the probable cause.

Hint 3:
If idling is possible even though the air flow sensor output frequency is deviated from the standard value, the cause is usually a malfunction other than of the air flow sensor.

[Examples]
(1) the flow of air within the air flow sensor is disturbed. (Air duct disconnection or clogged air cleaner element.)
(2) Incomplete combustion within a cylinder. (Malfunction of spark plugs, ignition coil, injectors, compression pressure, etc.)
(3) Air is taken into the intake manifold through a leaking gasket, etc.

## INSPECTION

### Using Multi-use tester (MUT)
### Air flow sensor

| Function | Item No. | Data display | Check conditions | Engine conditions | Standard value Hz |
|---|---|---|---|---|---|
| Data reading | 12 | Sensor detection air flow (frequency) | • Engine coolant temperature: 80–95°C (176–203°F)<br>• Lights and accessories: OFF<br>• Transmission: neutral (P range for vehicles with A/T)<br>• Steering wheel: neutral position | 700 r/min. (idling) | 25–45 |
| | | | | 2,000 r/min. | 70–90 |
| | | | | Racing | Frequency increases by racing. |

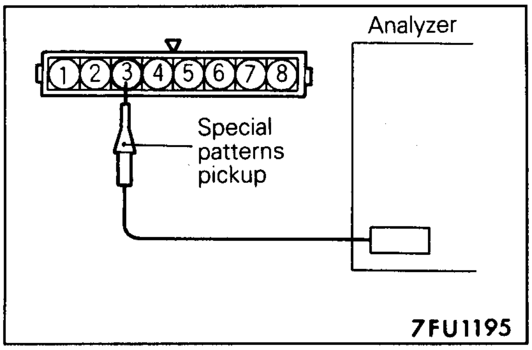
NOTE
When the vehicle is new [driven approximately 500 km (300 miles) or less], the air-flow sensor output frequency may be approximately 10% higher than indicated above.

### Air flow sensor reset signal

| Function | Item no. | Data display | Inspection condition | Engine condition | Normal display |
|---|---|---|---|---|---|
| Data list | 34 | Reset signal condition | • Engine is warming up | 700 r/min. (Idle) | ON |
| | | | | 2000 r/min. | OFF |

### Volumetric efficiency

| Function | Item no. | Data display | Inspection condition | Engine condition | Normal display |
|---|---|---|---|---|---|
| Data list | 37 | Volumetric efficiency | • Engine coolant temperature: 80–95°C (176–203°F)<br>• Lights, electrical cooling fan and all accessories: OFF<br>• Transmission: Neutral (P range for vehicles with A/T)<br>• Steering wheel: Straight forward position | 700 r/min. (idle) | 20–35% |
| | | | | 2000 r/min. | 15–30% |
| | | | | Racing | Volumetric efficiency increases according to amount of racing. |

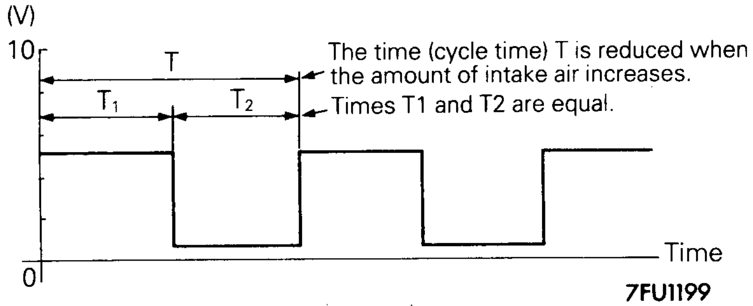


### Wave Pattern Inspection Using an Analyzer

### Measurement Method

(1) Disconnect the air flow sensor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
(2) Connect the analyzer special patterns pickup to terminal ③ of the air flow sensor connector.

**Standard wave pattern**

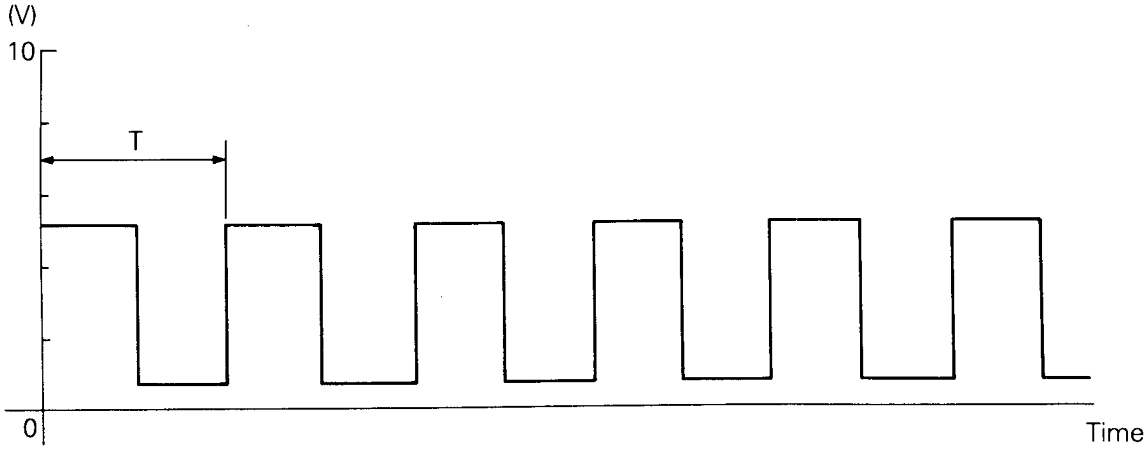


7FU1199

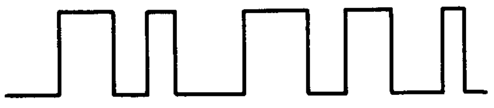
**Observation conditions**

| Function | Special patterns |
|---|---|
| Pattern height | Low |
| Pattern selector | Display |
| Engine r/min. | Idle r/min. (700 r/min.) |

**Observation conditions** (from conditions on previous page, engine speed is increased by racing.)



7FU0880



01P0199

**Wave pattern observation points**

Check that cycle time T becomes shorter and the frequency increases when the engine speed is increased.

**Examples of abnormal wave patterns**

- Example 1

  **Cause of problem**
  Sensor interface malfunction

  **Wave pattern characteristics**
  Rectangular wave pattern is output even when the engine is not started.

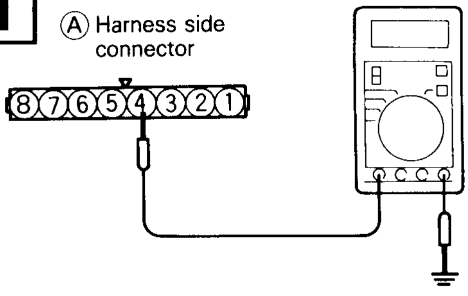
- Example 2

  **Cause of problem**
  Damaged rectifier or vortex generation column

  **Wave pattern characteristics**
  Unstable wave pattern with non-uniform frequency. However, when an ignition leak occurs during acceleration, the wave pattern will be distorted temporarily, even if the air flow sensor is normal.

## HARNESS INSPECTION

**1**



7FU0655

Measure the power supply voltage.

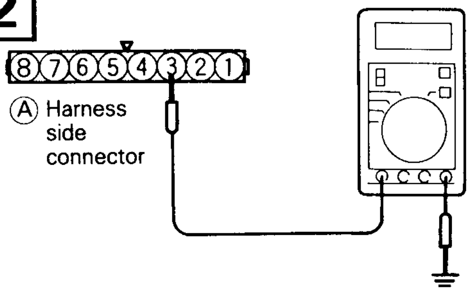
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ4 – Control relay) or check the control relay

**2**



7FU0656

Measure the terminal voltage.

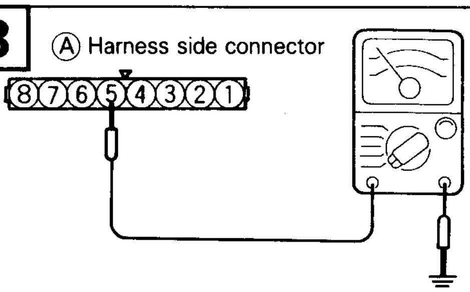
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

OK → 3

~~OK~~ → Repair the harness. (Ⓐ3 – 10)

**3**



7FU0657

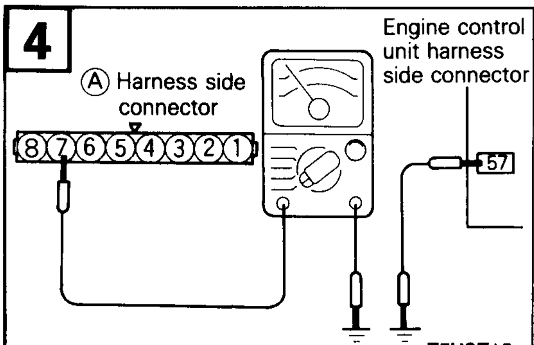
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. ( Ⓐ 5 – 17 , 24 )

**4**



7FU0745

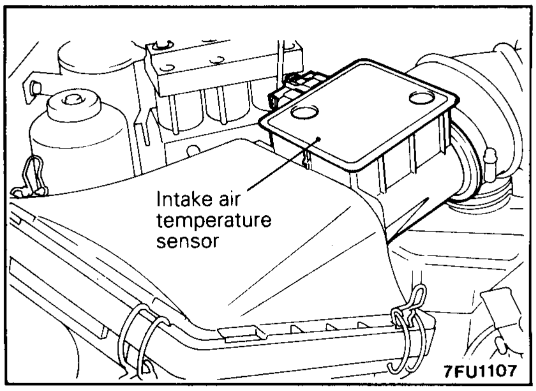
Check for continuity between the air flow sensor and the engine control unit.

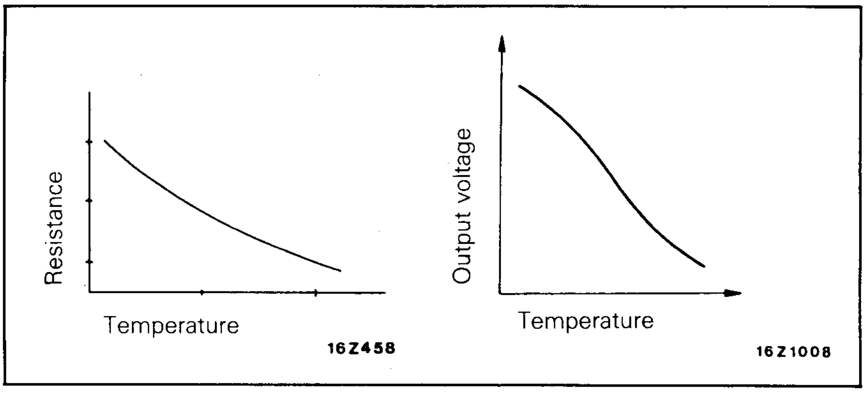
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

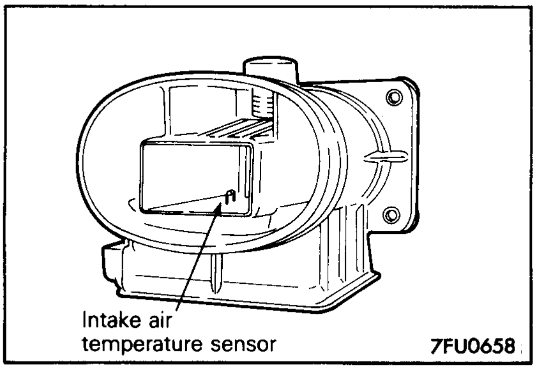
OK → STOP

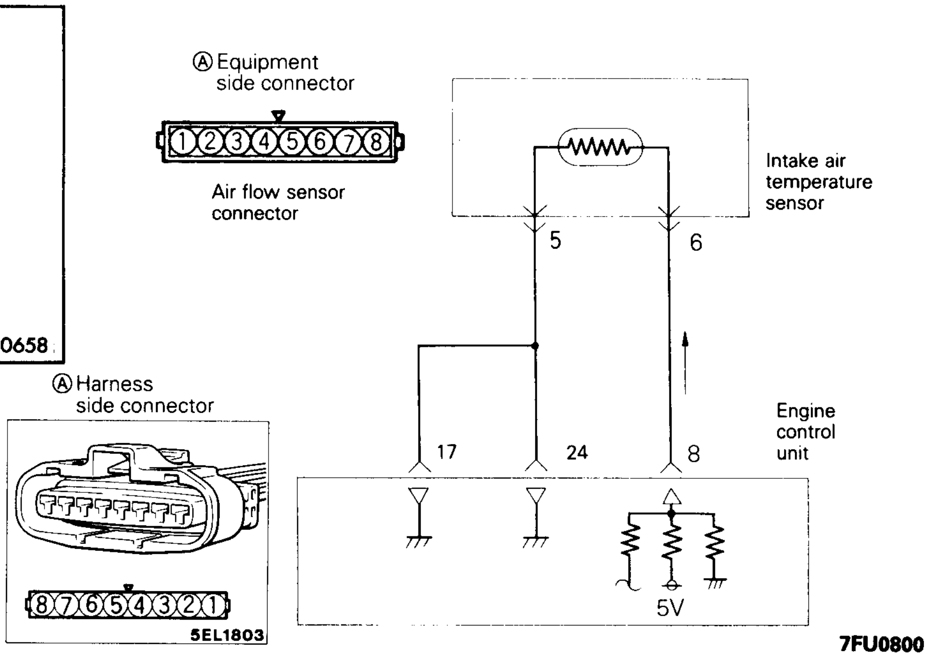
~~OK~~ → Repair the harness. ( Ⓐ 7 – 57 )

## INTAKE AIR TEMPERATURE SENSOR









## OPERATION

- The intake air temperature sensor functions to convert the temperature of the air (intaken to the engine) to voltage, and to input that voltage (as signals) to the engine control unit. The engine control unit, based upon those signals, then corrects the amount fo fuel injection, etc.
- The 5V power supply within the engine control unit is supplied, by way of the resistance within the unit, to the intake air temperature sensor, it passes through the intake air temperature sensor, which is a type of resistor, and is earthed at the engine control unit. Note that the resistance of the intake air temperature sensor decreases when the temperature of the intake air increases.
- The intake air temperature sensor terminal voltage becomes higher when the resistance of the intake air temperature sensor increases, and becomes lower when the resistance decreases. Consequently, the intake air temperaturesensor terminal voltage varies in accordance with the temperature of the intake air, becoming lower when the temperature of the intake air increases.

## TROUBLESHOOTING HINTS

Because the intake air temperature of the intake air in the air cleaner, it indicates a temperature different than the temperature of the outside air when the engine is running.

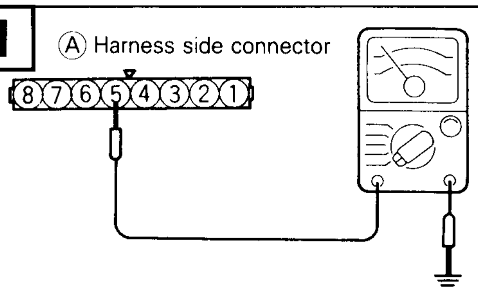
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Intake air temperature °C (°F) | Standard value °C |
|---|---|---|---|---|---|
| Data reading | 13 | Sensor detection temperature | Ignition switch: ON Or, engine running | When –20 (–4) | –20 |
| | | | | When 0 (32) | 0 |
| | | | | When 20 (68) | 20 |
| | | | | When 40 (104) | 40 |
| | | | | When 80 (176) | 80 |

## HARNESS INSPECTION

**1**



7FU0657

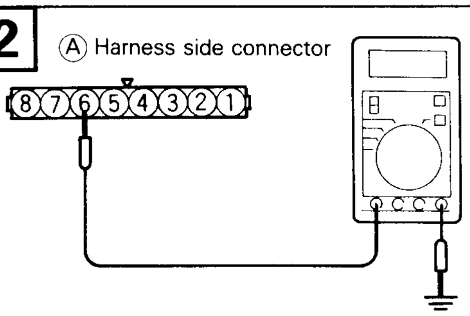
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ5 – 17, 24)

**2**



7FU0660

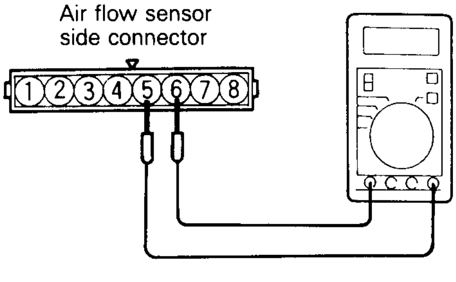
Measure the power supply voltage.

- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.5 – 4.9 |

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ6 – 8)



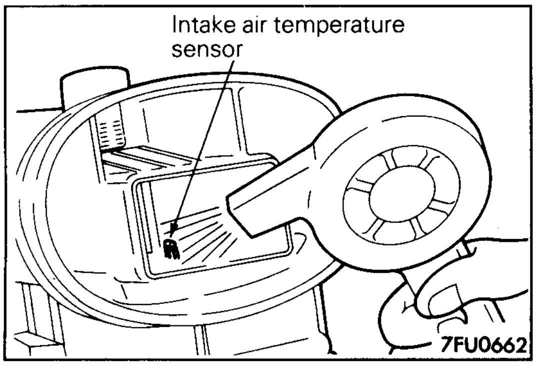
7FU0661

## SENSOR INSPECTION

(1) Disconnect the air flow sensor connectors.

(2) Measure resistance between terminals ⑤ and ⑥.

| Temperature °C (°F) | Resistance kΩ |
|---|---|
| 0 (32) | 6.0 |
| 20 (68) | 2.7 |
| 80 (176) | 0.4 |



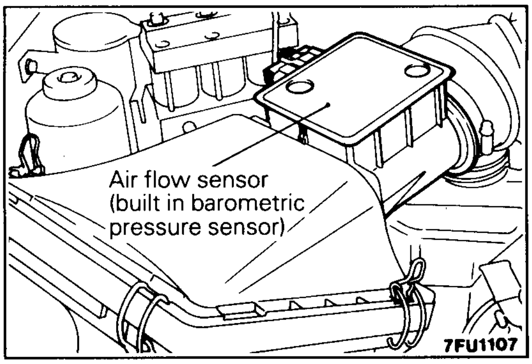
7FU0662

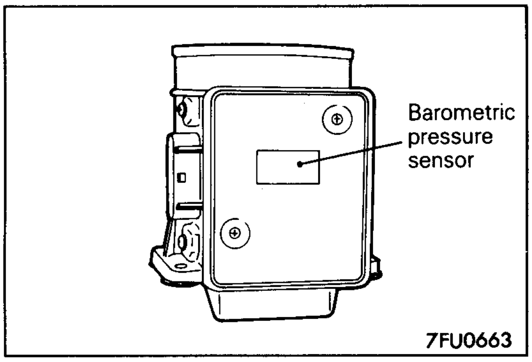
(3) Measure resistance while heating the sensor using a hair drier.

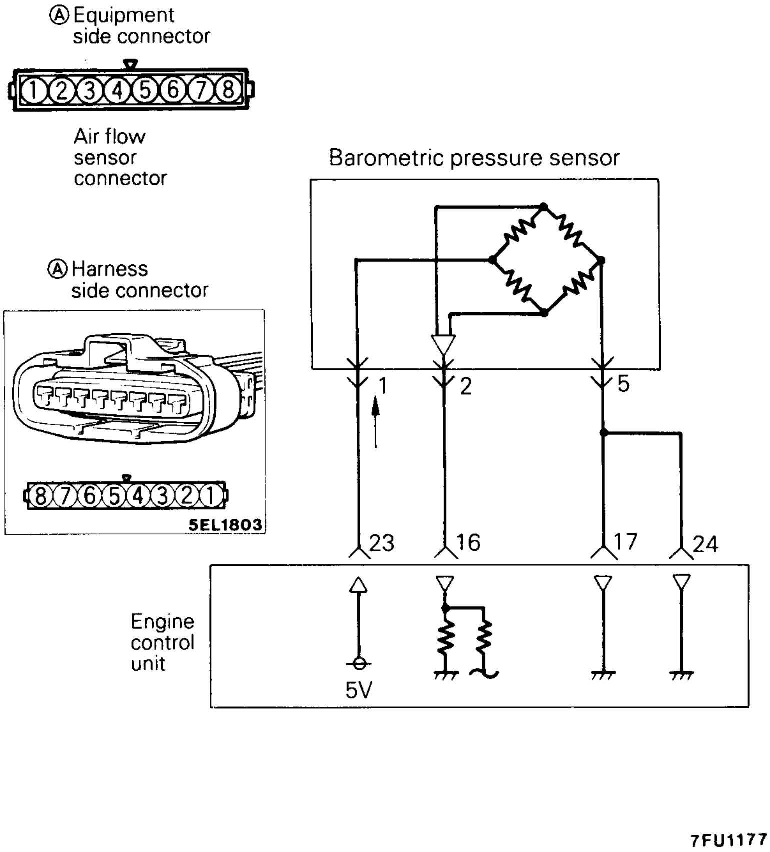
| Temperature °C (°F) | Resistance kΩ |
|---|---|
| Higher | Smaller |

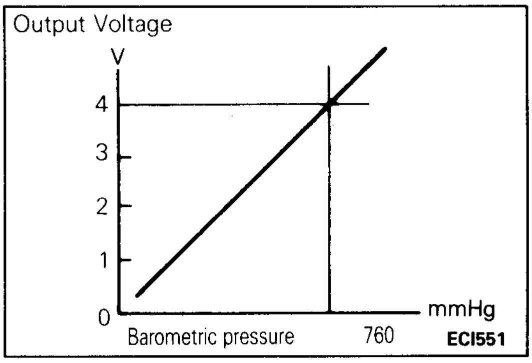
(4) If the value deviates from the standard value or the resistance remains unchanged, replace the air flow sensor assembly.

## BAROMETRIC PRESSURE SENSOR

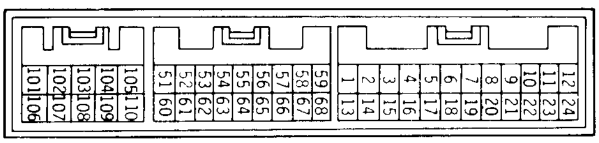








Engine control unit connector



### OPERATION

- The barometric pressure sensor functions to convert the barometric pressure to voltage, and to input that voltage (as signals) to the engine control unit. The engine control unit, based upon those signals, then corrects the amount of fuel injection, etc.
- The 5V power supply within the engine control unit is supplied to the barometric pressure sensor; it passes through the circuitry within the sensor, and is earthed at the engine control unit.
- The barometric-pressure sensor output voltage is supplied to the engine control unit in proportion to the barometric pressure (absolute pressure).

## TROUBLESHOOTING HINTS

Hint 1:
If there is a malfunction of the barometric pressure sensor, driveability of the vehicle will become worse particularly at high altitude.

Hint 2:
If, during high-speed driving, there is a noticeable sharp drop of the displayed pressure of the barometric-pressure sensor, check for clogging of the air cleaner.

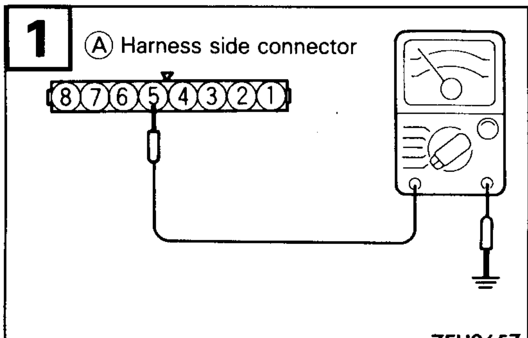
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Altitude m (ft.) | Standard value mmHg |
|---|---|---|---|---|---|
| Data reading | 25 | Sensor detection pressure | Ignition switch: ON | When at 0 (0) | 760 |
| | | | | When at 600 (1,969) | 710 |
| | | | | When at 1,200 (3,937) | 660 |
| | | | | When at 1,800 (5,906) | 610 |

## HARNESS INSPECTION

**1**



7FU0657

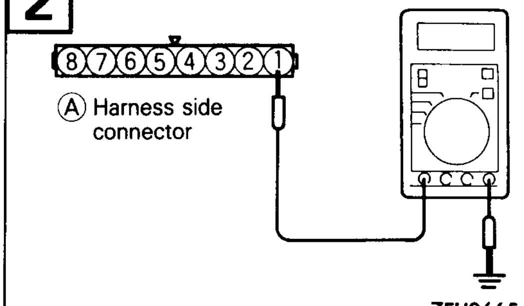
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ 5 – 14, 24)

**2**



7FU0665

Measure the power supply voltage of the barometric pressure sensor.

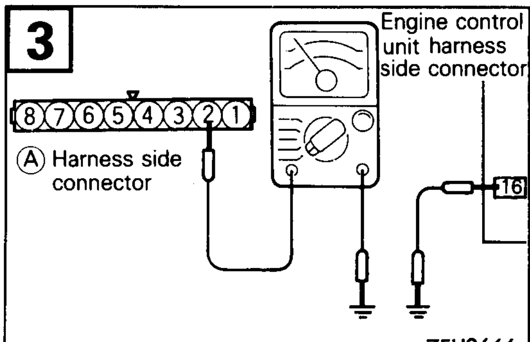
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

OK → 3

~~OK~~ → Repair the harness. (Ⓐ 1 – 23)

**3**



7FU0666

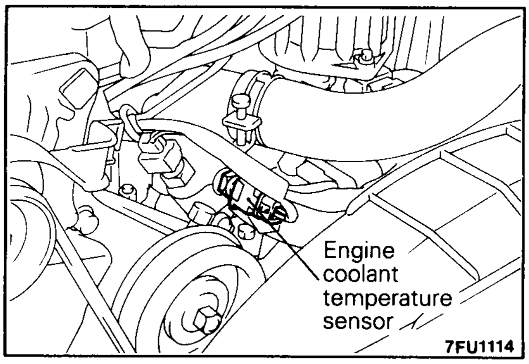
Check for an open-circuit or a short-circuit to earth, between the engine control unit and the barometric pressure sensor.

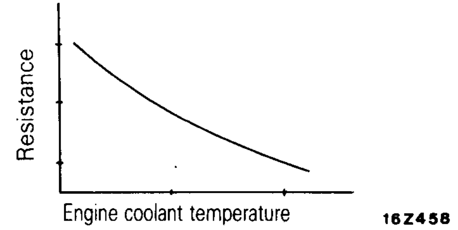
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

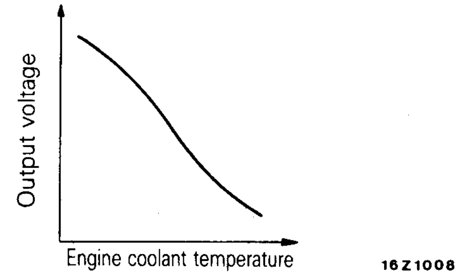
OK → STOP

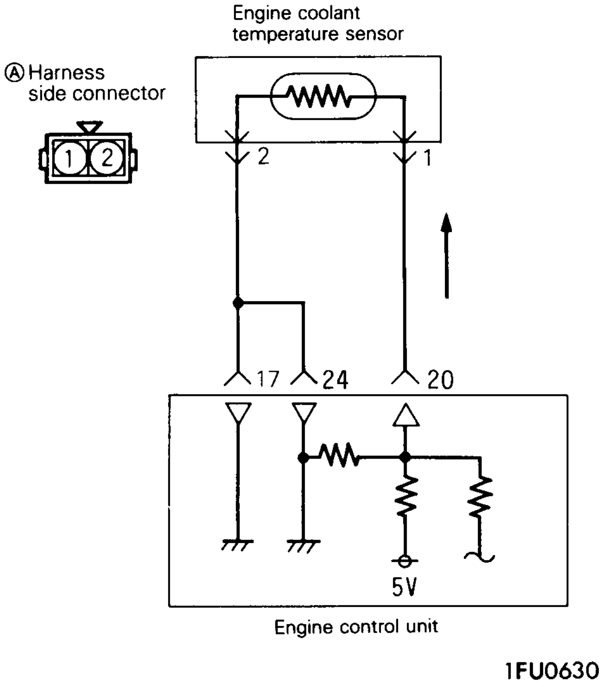
~~OK~~ → Repair the harness. (Ⓐ 2 – 16)

## ENGINE COOLANT TEMPERATURE SENSOR









### OPERATION

- The engine coolant temperature sensor functions to convert the barometric pressure to voltage, and to input that voltage (as signals) to the engine control unit.The engine control unit, based upon those signals, regulates the amount of fuel injection and the fast-idling speed when the engine is cold.
- The 5V power supply within the engine control unit is supplied, by way of the resistance within the unit, to the engine coolant temperature sensor; it passes through the engine coolant temperature sensor, which is a type of resistor, and is earthed at the engine control unit. Note that the resistance of the engine coolant temperature sensor decreases when the temperature of the engine coolant increases.
- The engine coolant temperature sensor terminal voltage becomes higher when the resistace of the engine coolant temperature sensor increases, and becomes lower when the resistance decreases. Consequently, the engine coolant temperature sensor terminal voltage varies in accordance with the temperature of the engine coolant, becoming lower when the temperature of the engine coolant increases.

### TROUBLESHOOTING HINTS

If, during engine warm-up, the fast-idling speed is not correct, or black smoke is emitted, the problem is usually a malfunction of the coolant temperature sensor.

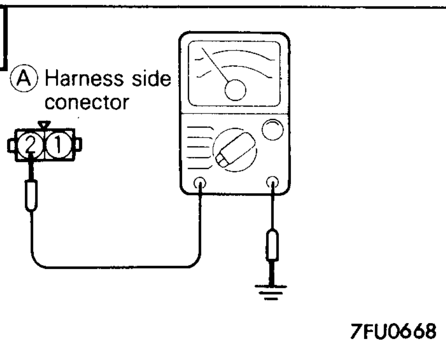
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Engine coolant temperature °C (°F) | Standard value °C |
|---|---|---|---|---|---|
| Data reading | 21 | Sensor detection temperature | Ignition switch: ON Or, engine running | When –20 (–4) | –20 |
| | | | | When 0 (32) | 0 |
| | | | | When 20 (68) | 20 |
| | | | | When 40 (104) | 40 |
| | | | | When 80 (176) | 80 |

## HARNESS INSPECTION

**$\boxed{1}$**



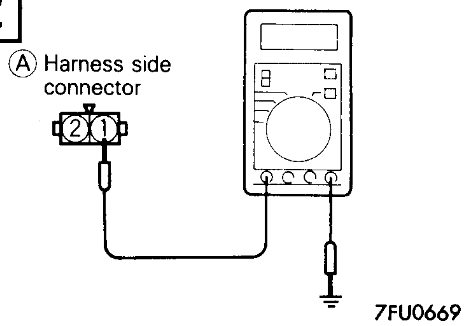
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → $\boxed{2}$

~~OK~~ → Repair the harness. (Ⓐ $\boxed{2}$ – $\boxed{17}$, $\boxed{24}$)

**$\boxed{2}$**



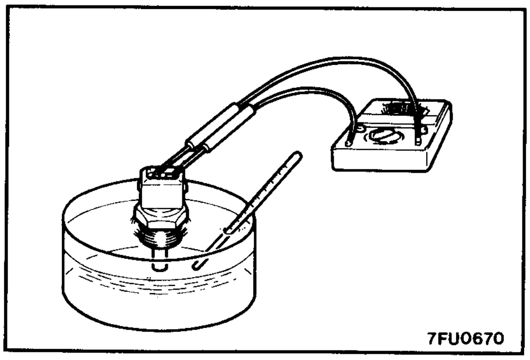
Measure the power supply voltage.

- Connector: Disconnected
- Ignition switch: ON

| **Voltage (V)** |
|---|
| **4.5 – 4.9** |

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ$\boxed{1}$–$\boxed{20}$)



## SENSOR INSPECTION

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

(2) With temperature sensing portion of coolant temperature sensor immersed in hot water check resistance.

| Temperature °C (°F) | Resistance kΩ |
|---|---|
| 0 (32) | 5.8 |
| 20 (68) | 2.4 |
| 40 (104) | 1.1 |
| 80 (176) | 0.3 |

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

## INSTALLATION

(1) Apply specified sealant to threaded portion.

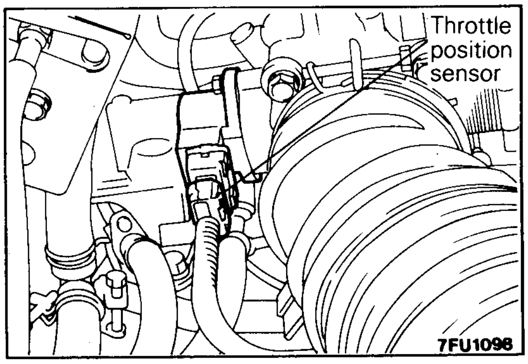
**Specified sealant: 3M Nut locking No. 4171 or equivalent**

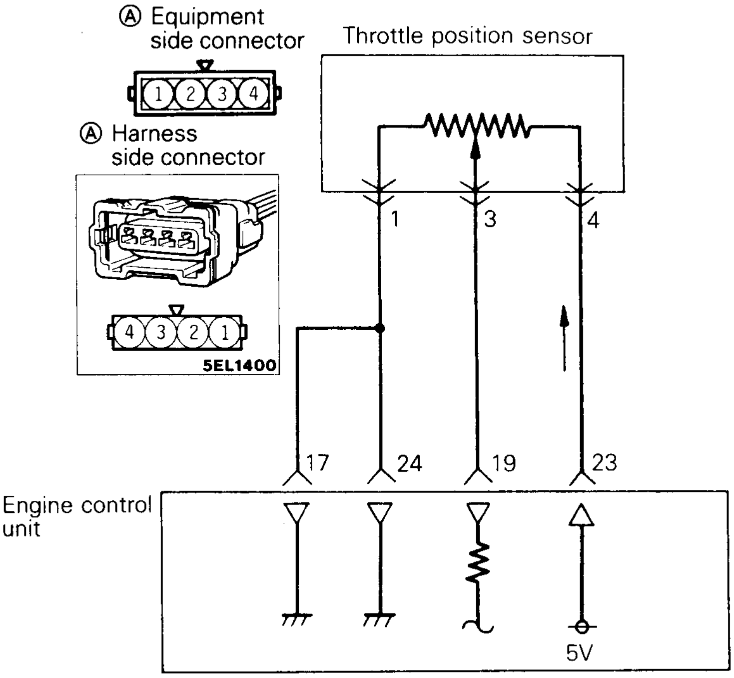
(2) Install engine coolant temperature sensor and tighten it to specified torque.

**Sensor tightening torque: 30 Nm (3.0 kgm, 22 ft.lbs)**

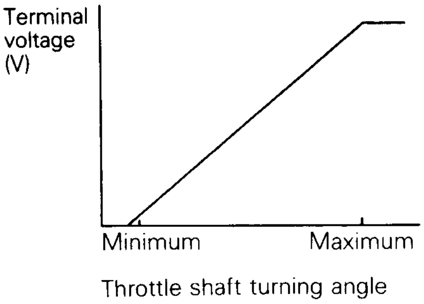
(3) Fasten harness connectors securely.

## THROTTLE POSITION SENSOR



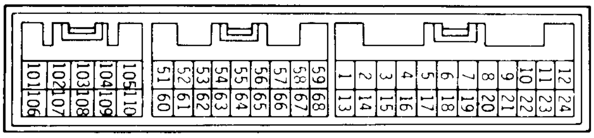


7FU0481



16Z461

Engine control unit connector



01L0838

### OPERATION

- The throttle position sensor functions to convert the degree of opening of the throttle valve to voltage, and to input that voltage (as signals) to the engine control unit. The engine control unit, based upon those signals, then regulates the amount of fuel injection, etc.
- The 5V power supply within the engine control unit is supplied to the throttle position sensor, after which it passes through the resistance within the sensor and is earthed at the engine control unit.
- When the throttle valve shaft is rotated all the way from the idling position to the fully open position, the resistance between the throttle position sensor's variable-resistance terminal and the earth terminal also increases in accordance with that rotation, and, as a result, the voltage of the throttle position sensor's variable-resistance terminal also becomes higher in accordance with that rotation.

### TROUBLESHOOTING HINTS

Hint 1:

The signals of the throttle position sensor are more important fore control of the automatic transmission than for control of the engine; shifting "impact shocks" are producec if there is a malfunction of the throttle position sensor.

Hint 2:

If the voltage of the throttle position sensor deviates from the standard value, check once again after making the throttle position sensor adjustment. In addition, if there are any indication that the fixed SAS has been moved, adjust the fixed SAS.

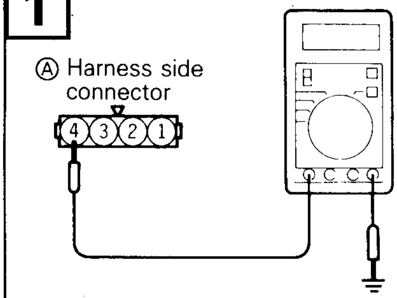
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Throttel valve | Standard value mV |
|---|---|---|---|---|---|
| Data reading | 14 | Sensor detection voltage | Ignition switch: left ON for 15 secondes or more | Set to idling position. | 300 – 1,000 |
| | | | | Open gradually. | Becomes higher proportionally to valve opening |
| | | | | Open fully. | 4,500 – 5,500 |

## HARNESS INSPECTION

**1**



Measure the power supply voltage of the throttle position sensor.

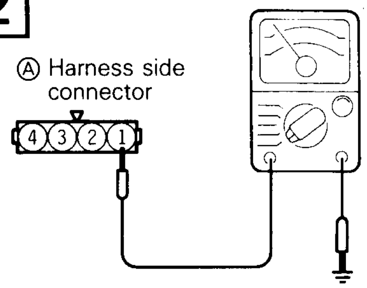
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ4 – 23)

**2**



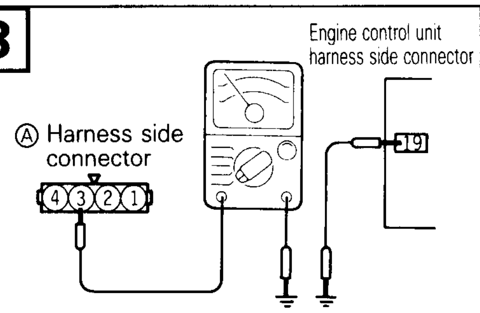
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ 1 – 17, 24)

**3**

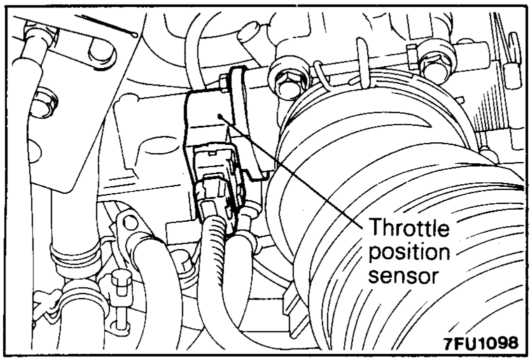


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the throttle position sensor.

- Throttle position sensor connector: Disconnected
- Engine control unit connector: Disconnected

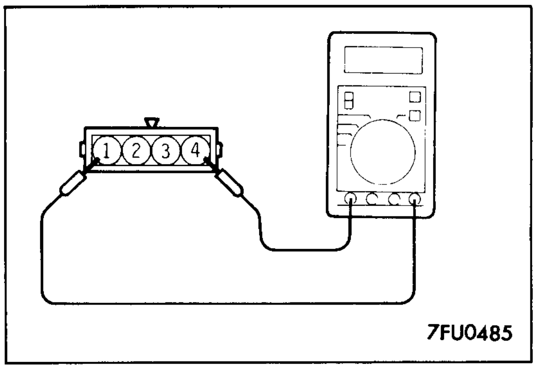
OK → STOP

~~OK~~ → Repair the harness. (Ⓐ3 – 19)



## SENSOR INSPECTION

(1) Disconnect the throttle position sensor connector.



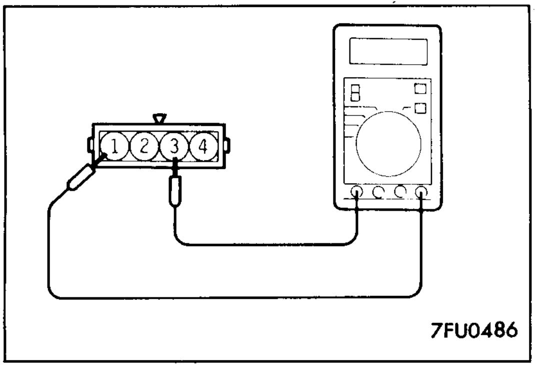
7FU0485

(2) Measure resistance between terminal ④ (sensor earth) and terminal ① (sensor power).

**Standard value: 3.5–6.5 kΩ**

(3) Connect a pointer type ohmmeter between terminal ④ (sensor earth) and terminal ② (sensor output).

(4) Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.



7FU0486

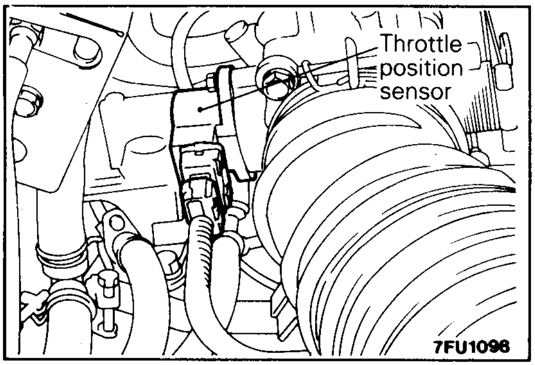
(5) If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

**TPS installation torque: 2.0 Nm (0.2 kgm, 1.5 ft.lbs)**

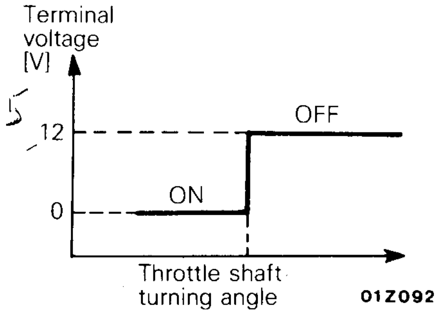
For the idle position switch and throttle position sensor adjusting procedure, refer to P. 13-17.

## IDLE POSITION SWITCH

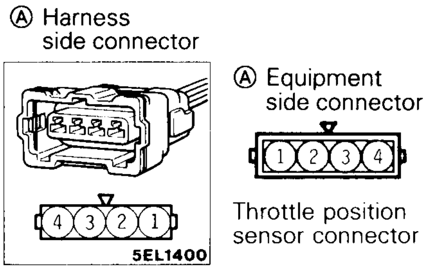
M13YKAA



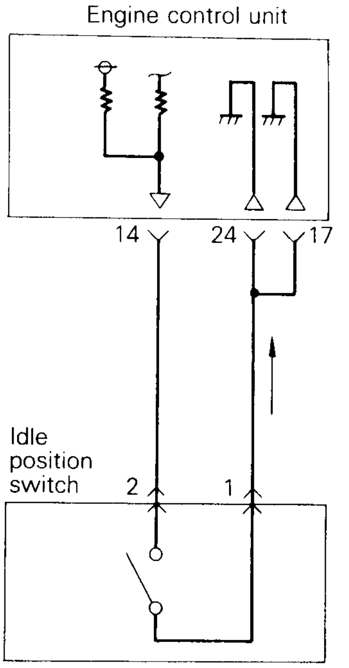
7FU1098



01Z092



5EL1400



7FU0488

### OPERATION

- The idle-position switch functions to convert (to HIGH/LOW-level voltage) data as to whether the accelerator is depressed or released, and to input that voltage (as signals) to the engine control unit. The engine control unit, based upon those signals, regulates the idle-speed control servo.
- Voltage within the engine control unit is applied, by way of the resistance, to the idle-position switch. When the foot is taken off the accelerator, the idle-position switch is switched ON, so the current is earthed. As result, the idle-position switch terminal voltage changes from HIGH to LOW level.

## TROUBLESHOOTING HINTS

If there is an abnormal condition of the idle-position switch output even though the results of the checking of the idle-position switch harness and of the component itself indicate a normal condition, the cause may be presumed to be one of the following.

(1) Improper adjustment of the accelerator cable or the automatic-cruise-control cable.
(2) Improper adjustment of the fixed SAS.

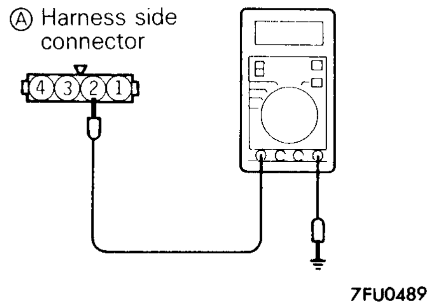
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Throttle valve | Normal display |
|---|---|---|---|---|---|
| Data reading | 26 | Switch status | Ignition switch: ON (Operate the accelerator several times and check.) | Set to idling position. | ON |
| | | | | Open slightly. | OFF |

## HARNESS INSPECTION

$\boxed{1}$



Measure the power supply voltage of the idle position switch.

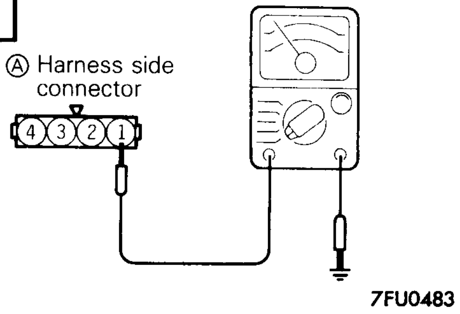
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4 or higher |

OK → $\boxed{2}$

~~OK~~ → Repair the harness. (Ⓐ$\boxed{2}$–$\boxed{14}$)

$\boxed{2}$

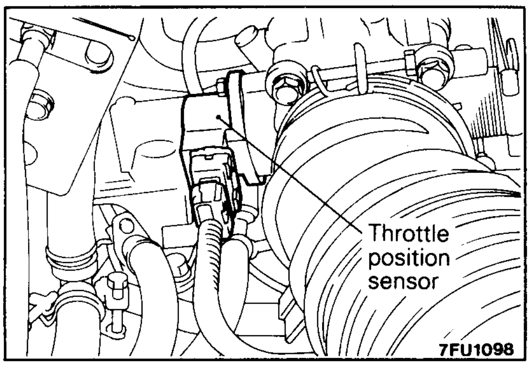


Check for continuity of the earth circuit.

- Connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ$\boxed{1}$–$\boxed{17}$, $\boxed{24}$)

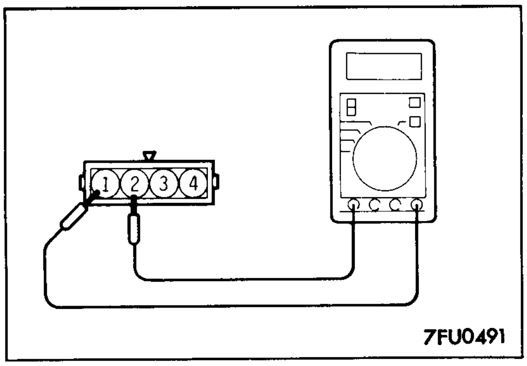


## SENSOR INSPECTION

(1) With the accelerator pedal released, check to be sure that the throttle valve lever or the fixed SAS is pushed.

NOTE
If it is not pushed, adjust the fixed SAS (Refer to P. 13-18.)

(2) Disconnect the throttle position sensor connector.



(3) Check the continuity across the throttle position sensor connector terminal ① (Sensor earth) and ② (Idle position switch).

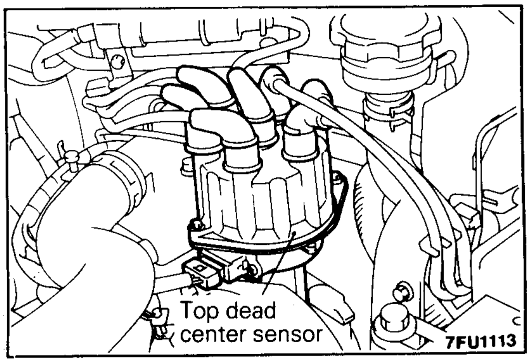
| Accelerator pedal | Continuity |
|---|---|
| Depressed | Non-conductive (∞Ω) |
| Released | Conductive (0Ω) |

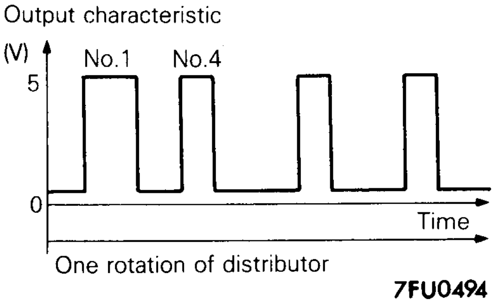
NOTE
If there is no continuity when the accelerator pedal is returned, loosen the throttle-position sensor installation screw; then, after turning all the way in the clockwise direction, check again.

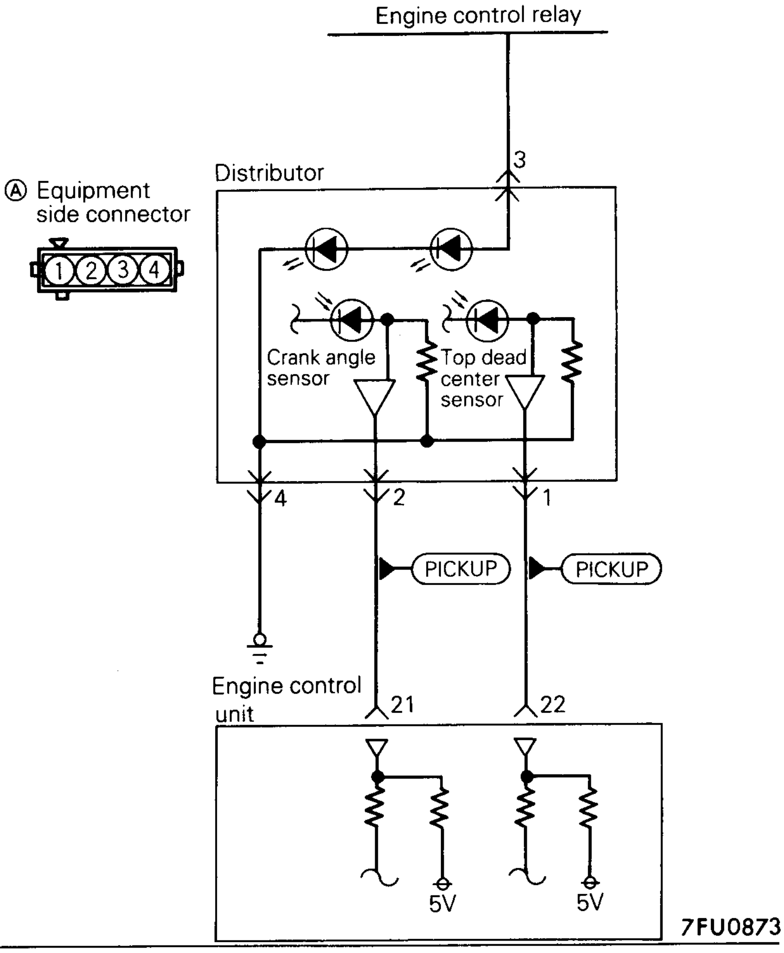
(4) Replace the throttle-position sensor (idle-position switch incorporated) if there is a malfunction.

NOTE
For the idle position switch and throttle position sensor adjusting procedure, refer to P. 13-17.

## TOP DEAD CENTER SENSOR







## OPERATION

- The top dead center sensor functions to detect the top dead center position of the No. 1 cylinder and to convert those data to pulse signals that are input to the engine control unit. the engine control unit, based upon those signals, calculates the sequence of fuel injection.

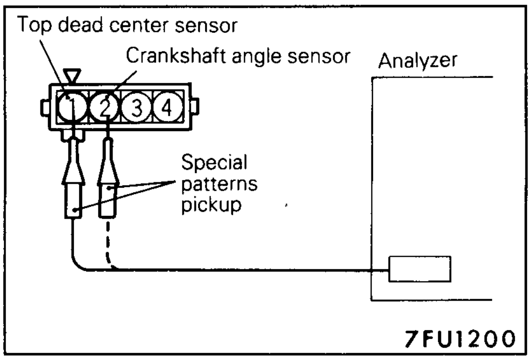
- The power for the top dead center sensor is supplied from the control relay and is earthed to the vehicle body. The top dead center sensor, by intermitting the flow (to earth) of the 5V voltage applied from the engine control unit, produces pulse signals.

## TROUBLESHOOTING HINTS

If there is a malfunction of the top dead center sensor, the sequential injection will not be correct, resulting in such problems as engine stalling, unstable idling, and poor acceleration.

## INSPECTION

### Wave Pattern Inspection Using an Analyzer



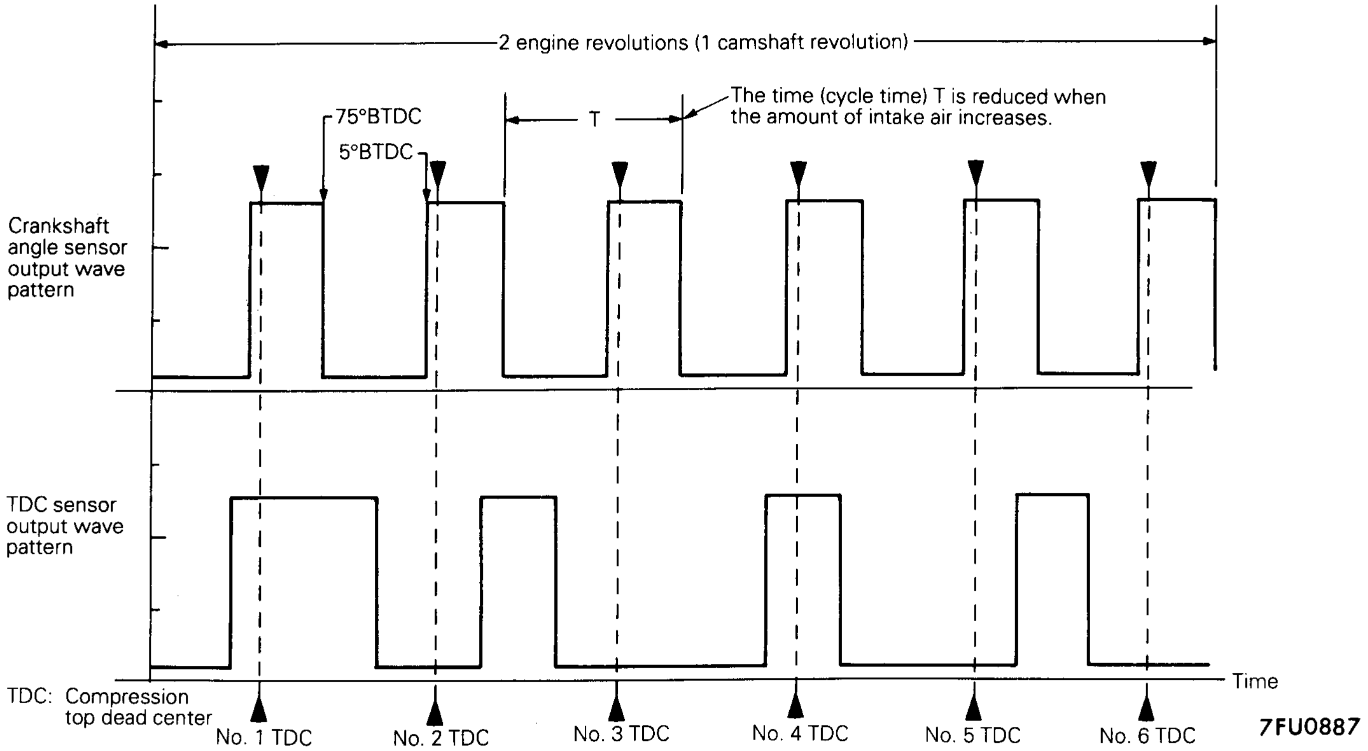
**Measurement Method**

(1) Disconnect the crankshaft angle sensor connector and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
(2) Connect the analyzer special patterns pickup to terminal ① of the crankshaft angle sensor connector. (When inspecting the TDC sensor signal wave pattern.)
(3) Connect the analyzer special patterns pickup to terminal ② of the crankshaft angle sensor connector. (When inspecting the crankshaft angle sensor signal wave pattern.)

**Standard wave pattern**

**Observation conditions**

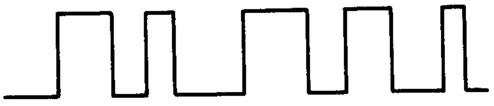
| | |
|---|---|
| Function | Special patterns |
| Pattern height | Low |
| Pattern selector | Display |
| Engine r/min. | Idle r/min. (700 r/min.) |



**Wave pattern observation points**

Check that cycle time T becomes shorter and the frequency increases when the engine speed is increased.

**Examples of abnormal wave patterns**

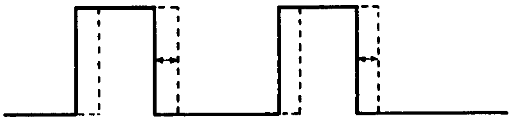


01P0199

- Example 1

  **Cause of problem**
  Sensor interface malfunction

  **Wave pattern characteristics**
  Short wave pattern is output even when the engine is not started.



7FU1193

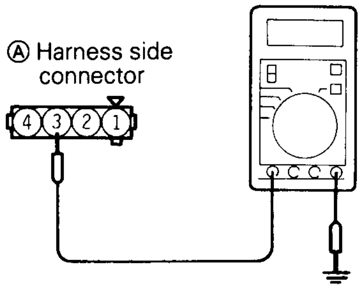
- Example 2

  **Cause of problem**
  Loose timing belt
  Abnormality in sensor disk

  **Wave pattern characteristics**
  Wave pattern is displaced to the left or right.

## HARNESS INSPECTION

**1**



7FU0496

Measure the power supply voltage.

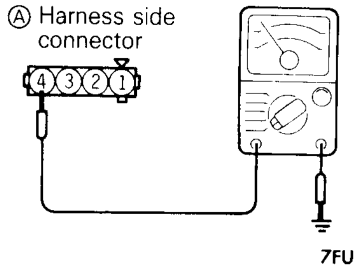
- Sensor connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ3–Engine control relay)

**2**



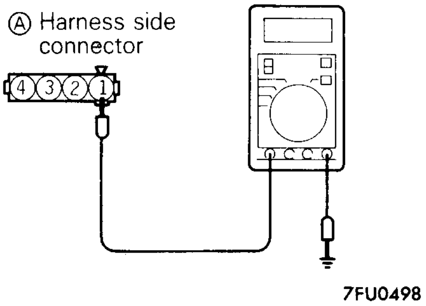
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ4– Earth)

**3**



Check the output circuit voltage.

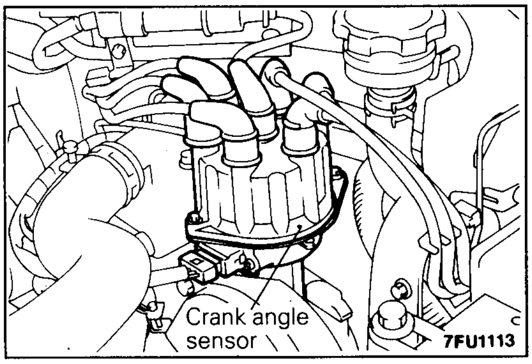
- Connector: Disconnected
- Ignition switch: ON

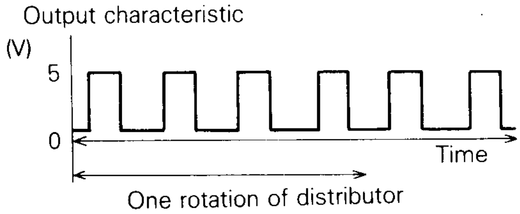
| Voltage (V) |
|---|
| 4.8 – 5.2 |

OK → STOP

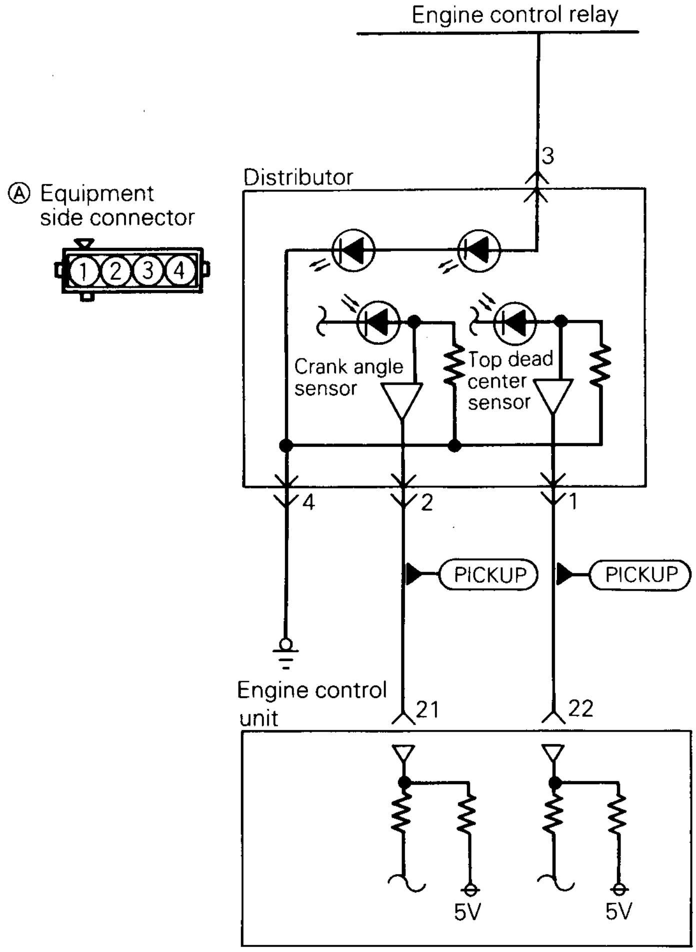
~~OK~~ → Repair the harness. (Ⓐ1–22)

## CRANK ANGLE SENSOR





7FU0553



7FU0873

## OPERATION

- The crank-angle sensor functions to detect the crank angle (position) of each cylinder, and to convert those data to pulse signals, which are then input to the engine control unit. The engine control unit, based upon those signals, calculates the engine rpm, and also regulates the fuel injection timing and the ignition timing.
- The power for the crank-angle sensor is supplied from the control relay and is earthed to the vehicle body. The crank-angle sensor, by intermitting the flow (to earth) of the 5V voltage applied from the engine control unit, produces pulse signals.

## TROUBLESHOOTING HINTS

Hint 1:
If an impact is suddenly felt during driving or the engine suddenly stalls during idling, try shaking the crank-angle sensor during idling. If the engine stalls, the cause may be presumed to be improper or incomplete contact of the crank-angle sensor's connector.

Hint 2:
If the crank-angle sensor output rpm is 0 r/min. during cranking when the engine cannot be started, the cause may be presumed to be a malfunction of the crank-angle sensor or a broken timing belt.

Hint 3:
If the indicated value of the crank-angle sensor output rpm is 0 r/min. during cranking when the engine cannot be started, the cause may be presumed to be a failure of the ignition coil's primary current to intermittently pulse correctly, so a malfunction of the ignition system circuitry, the ignition coil and/or the power transistor is the probable cause.

Hint 4:
If idling is possible even though the crank-angle sensor indicated r/min. is a deviation from the standard value, the cause is usually a malfunction of something other than the crank-angle sensor.

Examples:

(1) Malfunction of the engine coolant-temperature sensor.
(2) Malfunction of the idle-speed control servo.
(3) Improper adjustment of the standard idling speed.

## INSPECTION

### Using Multi-use tester (MUT)

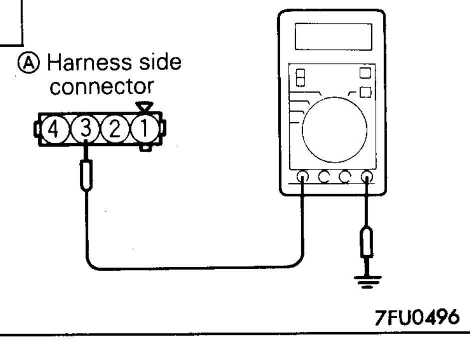
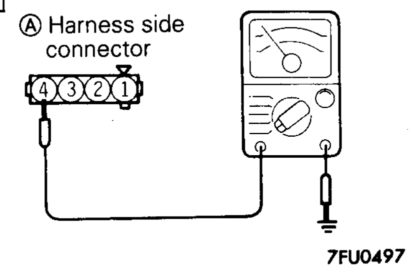
| Function | Item No. | Data display | Check conditions | Check description | Normal condition |
|---|---|---|---|---|---|
| Data reading | 22 | Cranking r/min. | • Engine is being cranked.<br>• Tachometer connected. (The tachometer is used to check the intermittent pulsation of the ignition coil's primary current.) | Compare the cranking rpm and the rpm indicated by the multi-use tester. | Both agree. |

| Function | Item No. | Data display | Check conditions | Engine coolant temperature °C (°F) | Standard value r/min. |
|---|---|---|---|---|---|
| Data reading | 22 | Idling r/min. | • Engine: idling<br>• Idle-position switch: ON | When –20 (–4) | 1,500–1,700 |
| | | | | When 0 (32) | 1,250–1,450 |
| | | | | When 20 (68) | 1,050–1,250 |
| | | | | When 40 (104) | 850–1,050 |
| | | | | When 80 (176) | 600–800 |

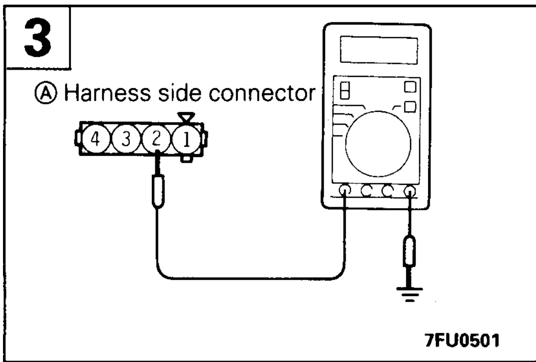
### Wave Pattern Inspection Using an Analyzer

Refer to the top dead center sensor section (P.13-44).

### HARNESS INSPECTION

| | | |
|---|---|---|
| **1**<br><br> | Measure the power supply voltage.<br>• Connector: Disconnected<br>• Ignition switch: ON<br>Voltage (V): SV<br>OK →<br>~~OK~~ → | 2<br>Repair the harness. (Ⓐ3–Engine control relay) |
| **2**<br><br> | Check for continuity of the earth circuit.<br>• Connector: Disconnected<br>OK →<br>~~OK~~ → | 3<br>Repair the harness. (Ⓐ4–Earth) |

**3**



Check the voltage of the output circuit.

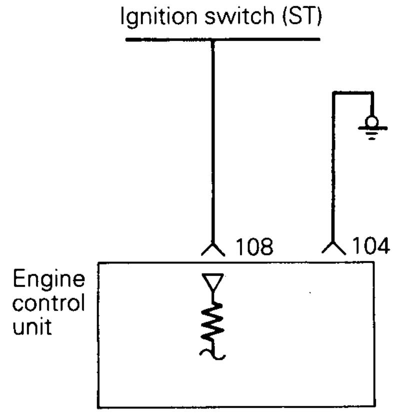
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8–5.2 |

OK → STOP

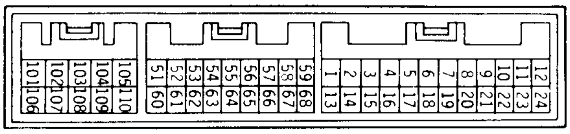
~~OK~~ → Repair the harness. (Ⓐ2-21)

## IGNITION SWITCH-ST [M/T ONLY]



1FU0638

Engine control unit connector



01L0838

## OPERATION

- The ignition switch-ST inputs HIGH-level signals to the engine control unit during engine cranking. The engine control unit, based on those signals, regulates fuel injection during starting, etc.
- When the ignition switch is set to START, the battery voltage during engine cranking is, by way of the ignition switch, applied to the engine control unit, and the engine control unit thus detects the fact that the engine is cranking.

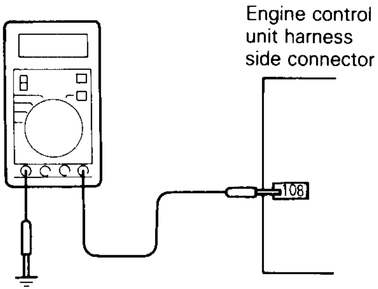
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Engine | Normal display |
|---|---|---|---|---|---|
| Data reading | 18 | Switch status | • Ignition switch: ON | Stopped | OFF |
| | | | | Cranking | ON |

## HARNESS INSPECTION

**1**



6FU1258

Measure the input voltage to the engine control unit.

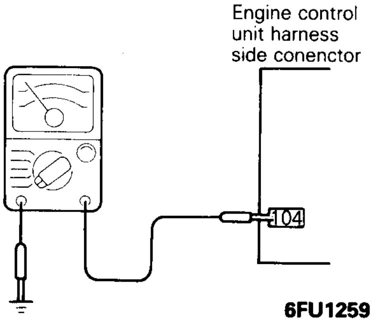
- Engine control unit connector: Disconnected
- Ignition switch: START

| Voltage (V) |
|---|
| 8 or higher |

OK → 2

~~OK~~ → Repair the harness. ( 108 – Ignicion switch)

**2**



6FU1259

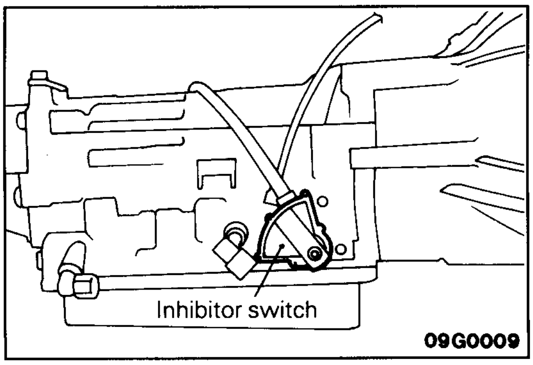
Check for continuity of the earth circuit.

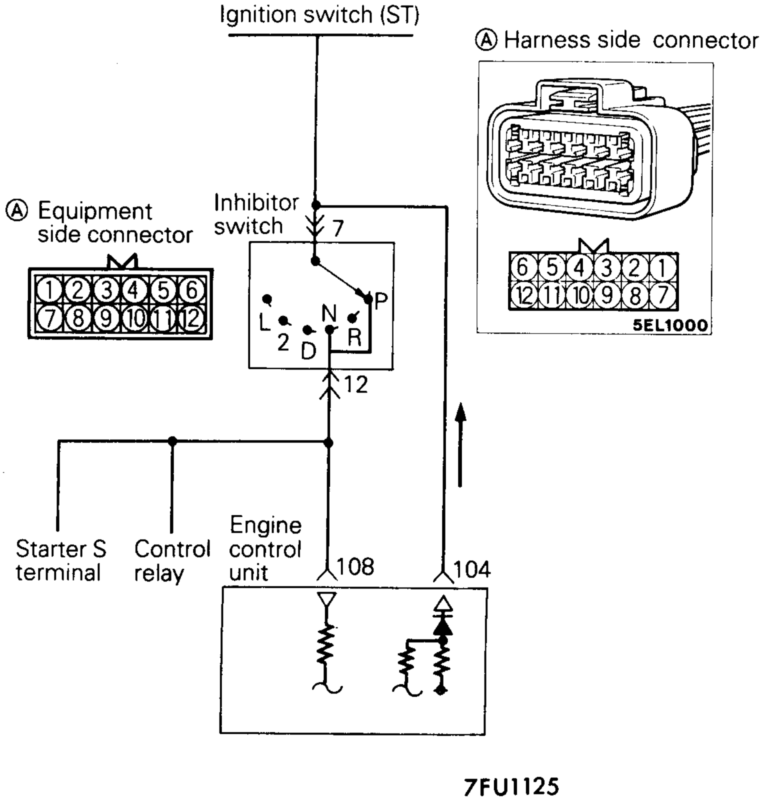
- Engine control unit connector: Disconnected

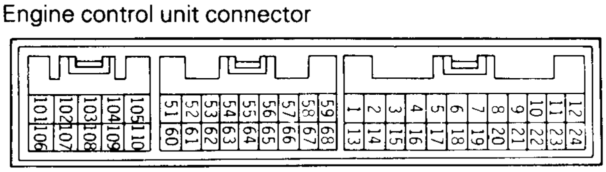
OK → STOP

~~OK~~ → Repair the harness (104–Earth)

## IGNITION SWITCH-ST and INHIBITOR SWITCH [A/T only]







### OPERATION

- The ignition switch-ST inputs HIGH-level signals to the engine control unit during engine cranking. The engine control unit, based on those signals, regulates fuel injection during starting, etc.
- When the ignition switch is set to START, the battery voltage during engine cranking is, by way of the ignition switch, and the inhibitor switch, applied to the engine control unit, and the engine control unit thus detects the fact that the engine is cranking. Note that battery voltage is not applied to the engine control unit if the position of the select lever is other than the "P" or "N" range.
- The inhibitor switch functions to convert the voltage to HIGH level or LOW level depending upon whether the select lever is at the "P" or "N" range or is at some position other than the "P" or "N" range, and inputs the result to the engine control unit. the engine control unit, based upon those signals, then regulates the operation of the idle-speed control servo.
- Battery voltage within the engine control unit is applied, by way of the resistance, to the inhibitor switch. When the select lever is set to the "P" or "N" range, contunuity is created, via the starter motor, between the engine control unit's inhibitor switch terminal and earth, and the terminal voltage becomes LOW level.

### TROUBLESHOOTING HINTS

If the output of the inhibitor switch is abnormal even though the results of the checking of the inhibitor switch harness and of the component itself are normal, it is probable that the cause is improper adjustment of the control cable.

## INSPECTION

### Using Multi-use tester (MUT)

Ignition switch – ST

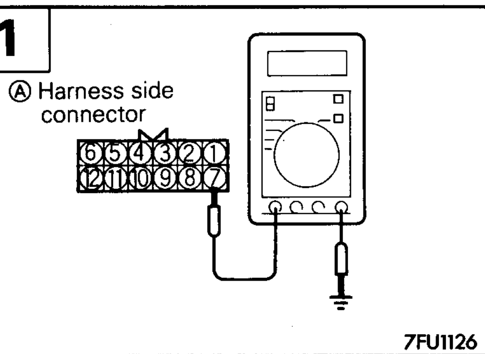
| Function | Item No. | Data display | Check conditions | Engine | Normal display |
|---|---|---|---|---|---|
| Data reading | 18 | Switch status | • Ignition switch: ON | Stopped | OFF |
| | | | | Cranking | ON |

Inhibitor switch

| Function | Item No. | Data display | Check conditions | Select lever position | Normal display |
|---|---|---|---|---|---|
| Data reading | 29 | Shift position | • Ignition switch: ON | P or N | P or N |
| | | | | D, 2, L or R | D, 2, L or R |

## HARNESS INSPECTION

**1**



Measure the power supply voltage of the inhibitor switch.

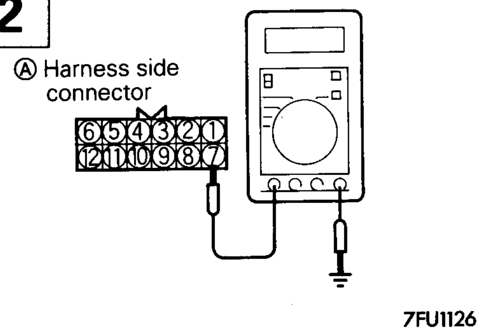
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected
- Ignition switch: START

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Check the power supply circuit.

**2**



Measure the inhibitor switch terminal input voltage.

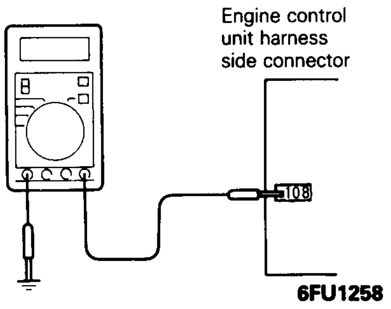
- Engine control unit connector: Connected
- Inhibitor switch connector: Disconnected
- Ignition switch:ON

| Voltage (V) |
|---|
| SV |

OK → 3

~~OK~~ → Repair the harness. (Ⓐ7-104)

**3**



Measure the input voltage of engine control unit

- Engine control unit connector: Disconnected
- Inhibitor switch connector: Connected
- Select lever: P range
- Ignition switch: START

| Voltage (V) |
|---|
| 8 or higher |

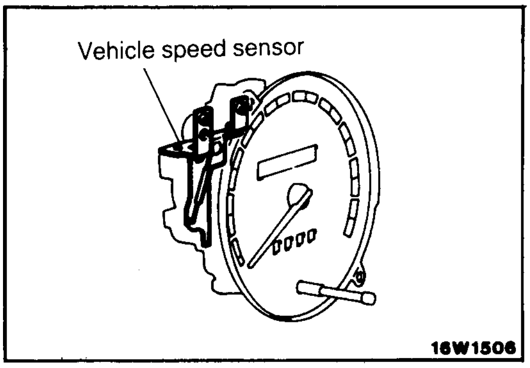
OK → STOP

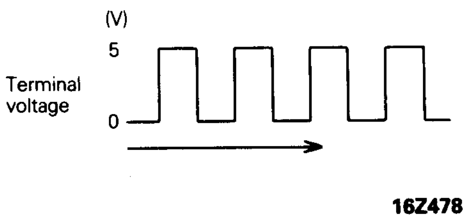
~~OK~~ → Repair the harness. (Ⓐ12-108)

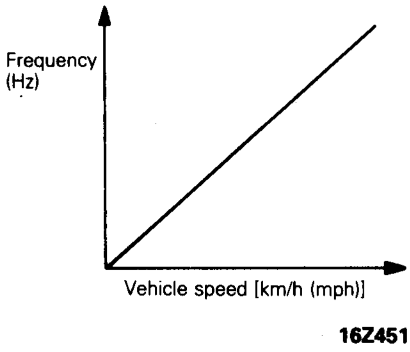
## INHIBITOR SWITCH INSPECTION

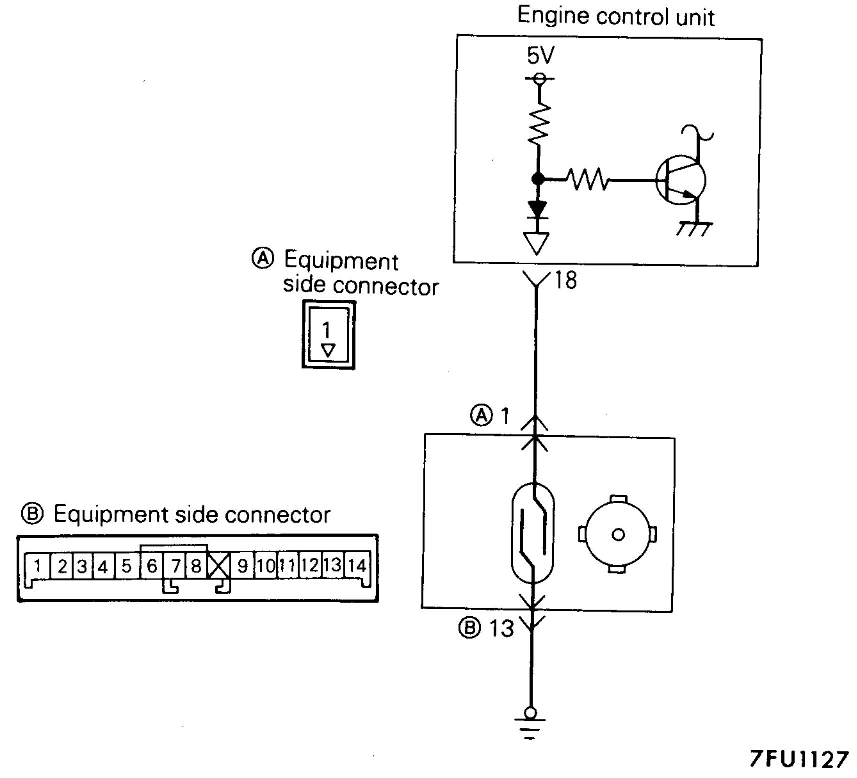
Refer to GROUP 23 – Service Adjustment Procedures.

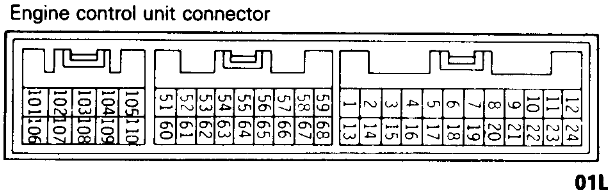
## VEHICLE SPEED SENSOR











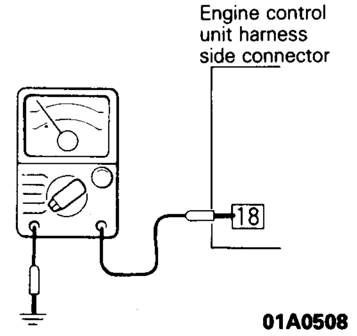
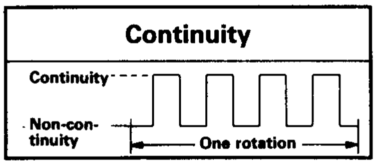
### OPERATION

- The vehicle-speed sensor is incorporated within the speedometer; it converts vehicle-speed data to pulse signals and inputs those signals to the engine control unit. The engine control unit, based upon those signals, regulates the idle-speed servo, etc.
- The vehicle-speed sensor, by intermitting by the lead switch the flow (to earth) of the approximately 5V voltage applied from the engine control unit, produces vehicle-speed signals.

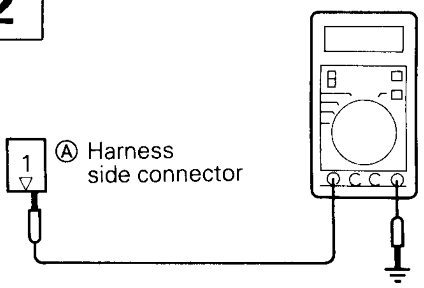
### TROUBLESHOOTING HINTS

If there is damaged or disconnected wiring, or a short-circuit, of the vehicle-speed sensor signal circuit, the engine may stall when the vehicle speed is reduced and the vehicle is stopped.

### HARNESS INSPECTION

| | | |
|---|---|---|
| **1**  | Check the vehicle speed sensor output circuit for continuity.<br>• Engine control unit connector: Disconnected.<br>• Move the vehicle.<br> | OK → STOP<br>~~OK~~ → 2 |

**2**



7FU1128

Measure the power supply voltage of the vehicle speed sensor.

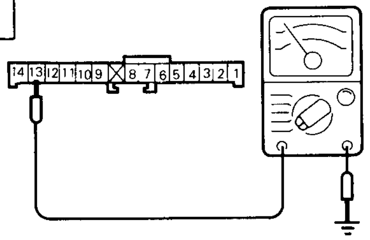
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.5 – 4.9 |

OK → 3

~~OK~~ → Repair the harness. (Ⓐ 1 – 18)

**3**



7FU1129

Check for continuity of the earth circuit.

- Connector: Disconnected

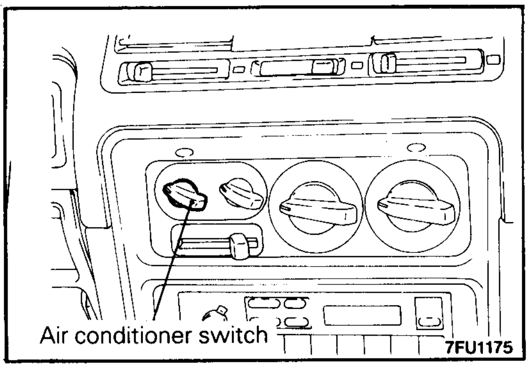
OK → STOP

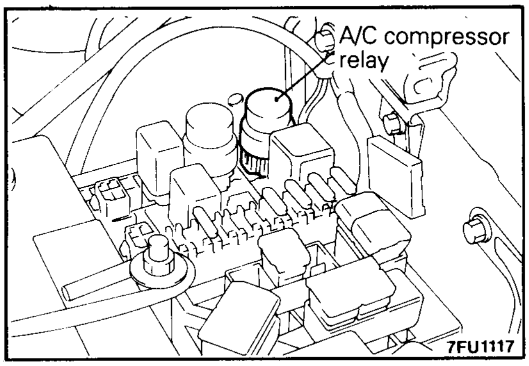
~~OK~~ → Repair the harness. (Ⓐ13– Earth)

## SENSOR INSPECTION

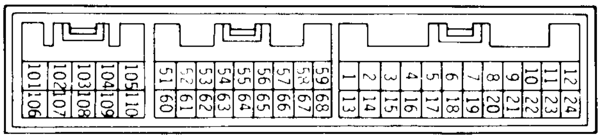
Refer to GROUP 54 – Meters and Gauges

## AIR CONDITIONER SWITCH AND POWER RELAY

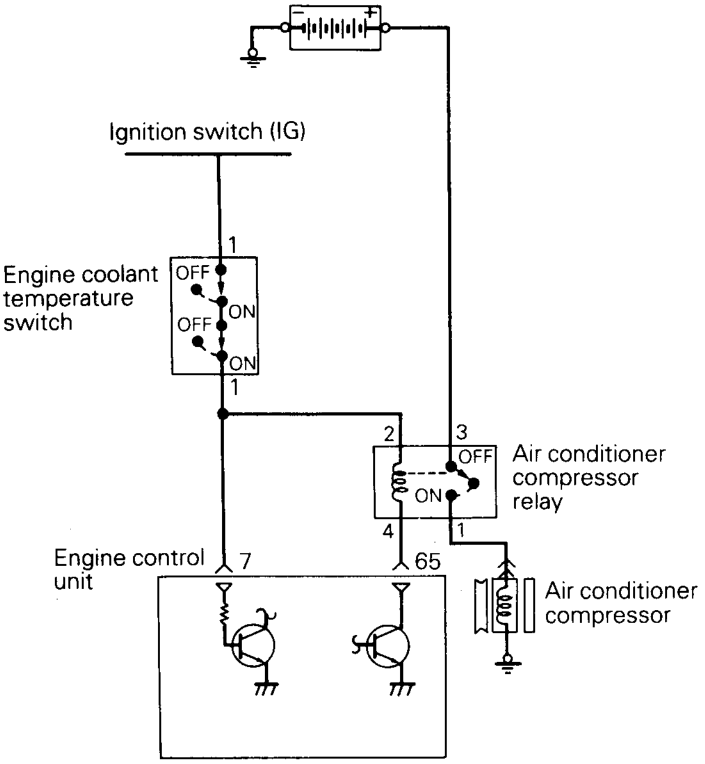




Engine control unit connector



01L0838



7FU0821

### OPERATION

- The air conditioner switch applies battery voltage to the engine control unit when the air conditioner is switched ON.
- When the air conditioner signals are input, the engine control unit activates the idle-speed control servo, and also switches ON the power transistor. As a result, current flows to the power relay coil and the relay switch is switched ON; the airconditioner compressor's magnetic clutch is activated.

### TROUBLESHOOTING HINTS

If the air conditioner compressor's magnetic clutch is not activated when the air conditioner switch is switched ON during idling, it is probable that the cause is a malfunction of the air conditioner control system.

## INSPECTION

### Using Multi-use tester (MUT)

### Air conditioner switch

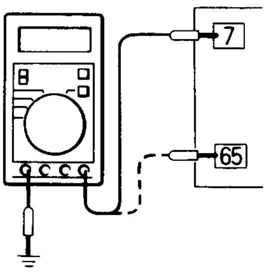
| Function | Item No. | Data display | Check conditions | Air conditioner switch | Normal display |
|---|---|---|---|---|---|
| Data reading | 28 | Switch status | • Engine idling (The air conditioner compressor should be activated when the air conditioner switch is switched ON.) | OFF | OFF |
| | | | | ON | ON |

### Air conditioner power relay

| Function | Item No. | Data display | Check conditions | Air conditioner switch | Normal display |
|---|---|---|---|---|---|
| Data reading | 49 | Air conditioner power relay status | • Engine: idling after warm up | OFF | OFF (Compressor clutch non-activation) |
| | | | | ON | ON (Compressor clutch activation) |

## HARNESS INSPECTION

**1**



01R0863

Measure the power supply voltage of the air conditioner circuit.
- Engine control unit connector: Disconnect
- Ignition switch: ON
- Air conditioner switch: ON

| Voltage (V) |
|---|
| SV |

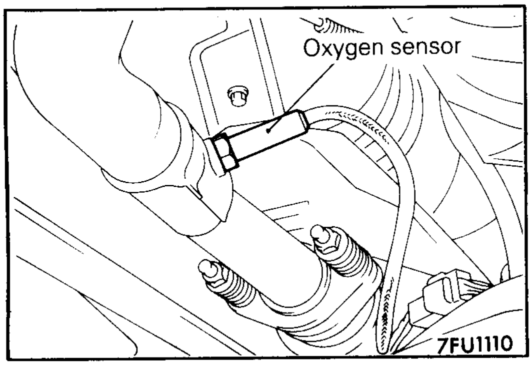
OK → STOP

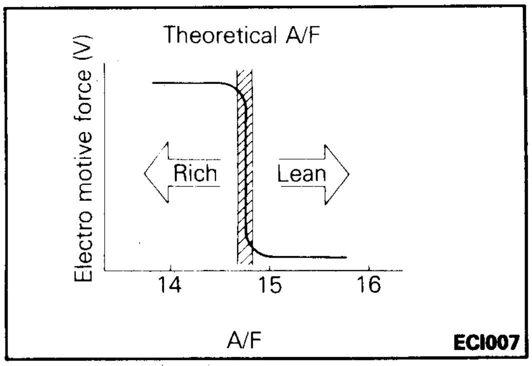
~~OK~~ → Check the Air conditioner circuit.

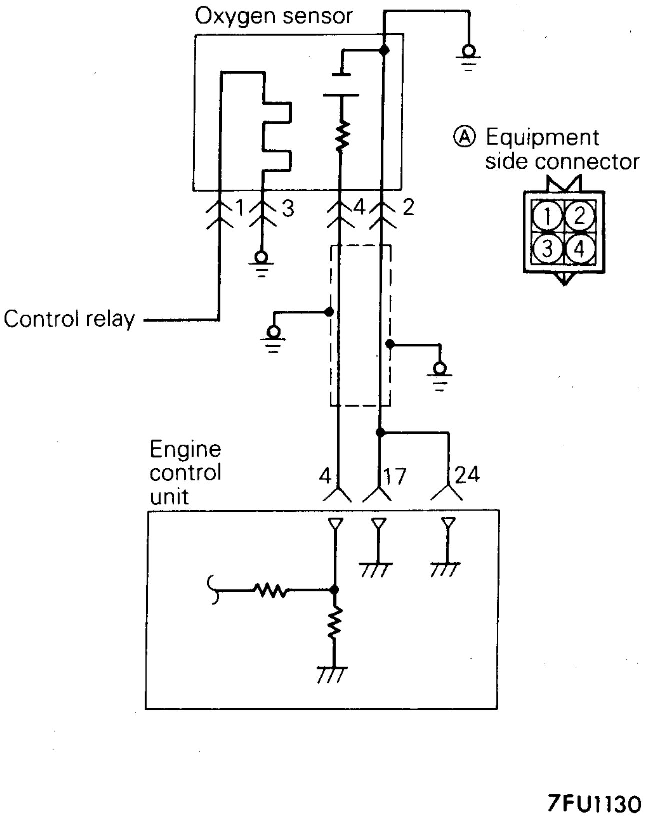
## AIR CONDITIONER INSPECTION

Refer to GROUP 55.

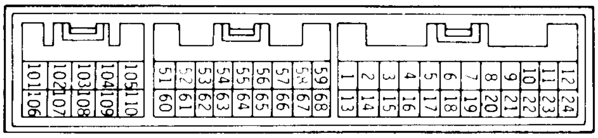
## OXYGEN SENSOR







Engine control unit connector



### OPERATION

- The oxygen sensor functions to detect the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the engine control unit.
- If the air/fuel mixture ratio is richer than the theoretical air/fuel mixture ratio (i.e., if the concentration of oxygen in the exhaust gas is sparse), a voltage of approximately 1V is output; if the air/fuel mixture ratio in leaner than the theoretical air/fuel mixture ratio (i.e., if the concentration is dense), a voltage of approximately 0V is output.
- The engine control unit, based upon those signals, regulates the amount of fuel injection so that the air/fuel mixture ratio becomes the theoretical air-/fuel mixture ratio.
- Battery power supply is applied, by way of the control relay, to the oxygen sensor heater. As a result, the sensor element is heated by the heater, so that the oxygen sensor shows excellent response even if the temperature of the exhaust gas is low.

### TROUBLESHOOTING HINTS

Hint 1:

The exhaust gas purification performance will worsen if there is a malfunction of the oxygen sensor.

Hint 2:

If the oxygen sensor output voltage deviates from the standard value even though the results of the checking of the oxygen sensor are normal, the cause is probably a malfunction of a component related to air/fuel mixture ratio control.

[Examples]

(1) Malfunction of an injector.
(2) Air leakage into the intake manifold from a leaking gasket.
(3) Malfunction of the air-flow sensor, the intake air temperature sensor, the barometric-pressure sensor, or the engine coolant temperature sensor.

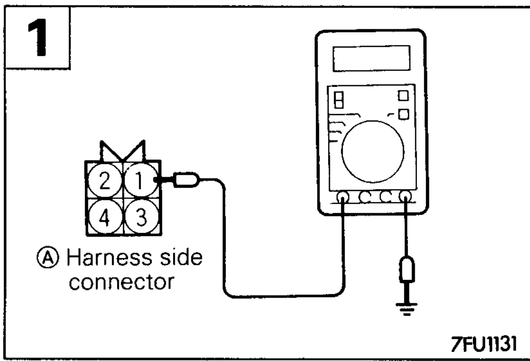
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value mV |
|---|---|---|---|---|---|
| Data reading | 11 | Sensor detection voltage | • Engine: warm-up (Make the mixture lean by engine speed reducion, and rich by racing.) | When sudden deceleration from 4,000 | 200 or lower |
| | | | | When engine is suddenly raced | 600–1,000 |
| | | | • Engine: warm up using the oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the engine control unit | 700 (Idling) | 400 or lower<br>↕ (changes)<br>600–1,000 |
| | | | | 2,000 | |

## HARNESS INSPECTION

**1**



Measure the power supply voltage of the oxygen sensor.

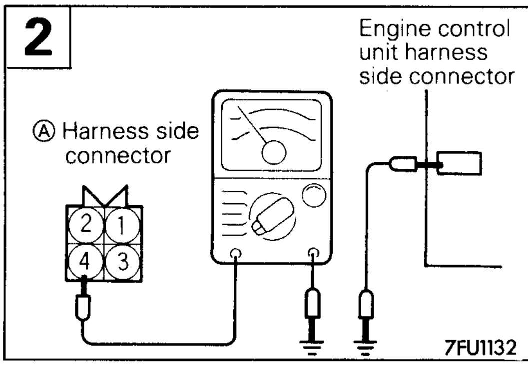
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ1–Engine control ralay)

**2**



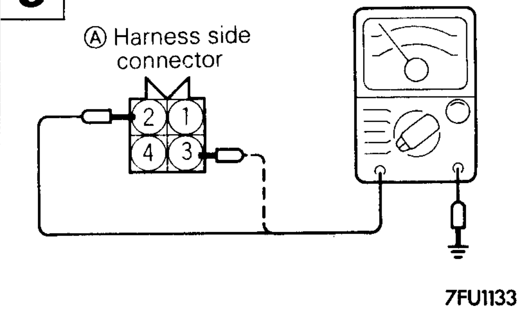
Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the oxygen sensor.

- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ4–4)

**3**

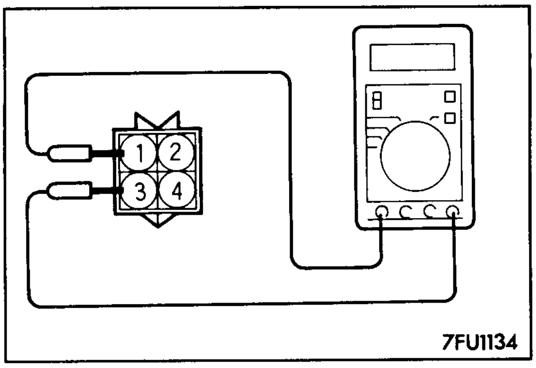


Check for continuity of the earth circuit.

- Connector: Disconnected

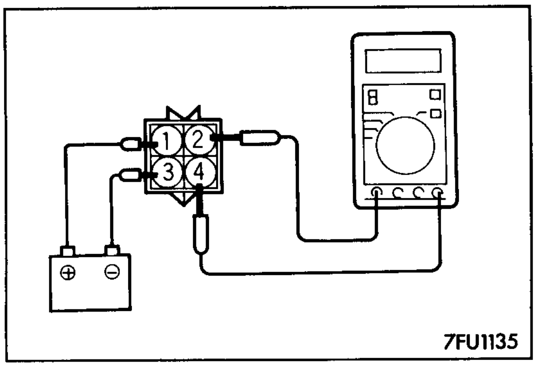
OK → STOP

~~OK~~ → Repair the harness. (Ⓐ2–17, 24) (Ⓐ3–Earth)



### SENSOR INSPECTION

(1) Disconnect the oxygen sensor connector.
(2) Check that there is continuity [approx. 20 Ω at 20°C (68°F)] between oxygen sensor connector terminal ① and terminal ③.
(3) If there is no continuity, replace the oxygen sensor.



(4) Warm the engine until the engine coolant temperature reaches 80°C (176°F) or more.
(5) Use the jumper leads to connect the oxygen sensor terminal ① (connect (+) terminal) and terminal ③ (connect (–) terminal) to the battery (+) and (–) terminals respectively.

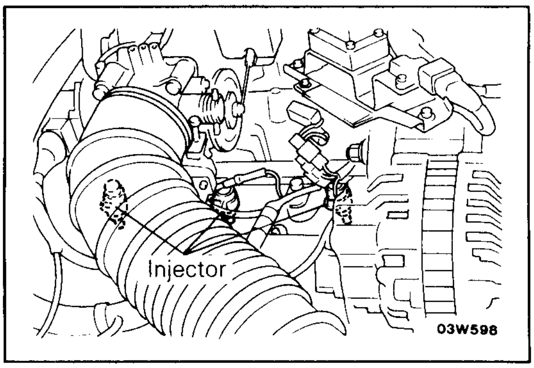
**Caution**
**Be careful when connecting the jumper leads, as connecting the terminals incorrectly will damage the oxygen sensor.**

(6) Connect a digital-type voltmeter to terminal ② and terminal ④.
(7) While repeatedly racing the engine, measure the oxygen sensor output voltage.

| Engine | Oxygen sensor output voltage | Notes |
|---|---|---|
| When racing the engine | 0.6–1.0V | When the air/fuel mixture ratio is enriched by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6–1.0V. |

NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe, Main Muffler and Catalytic Converter.

## INJECTORS



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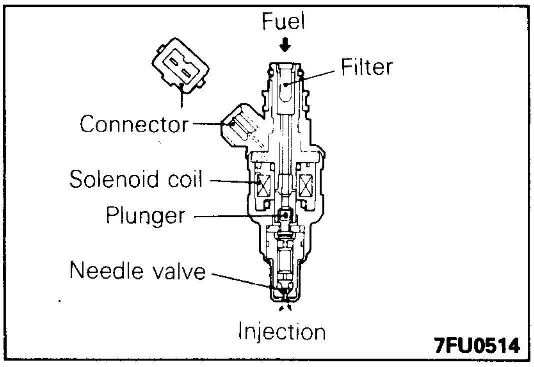

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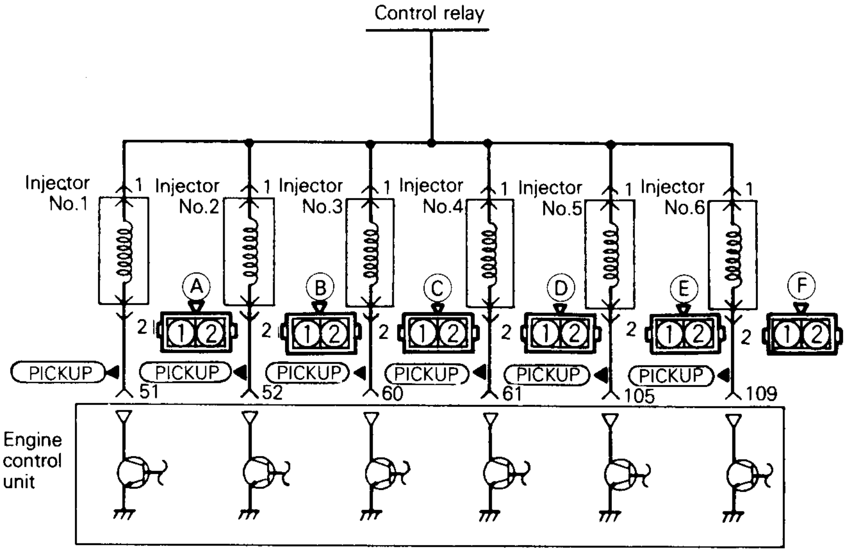

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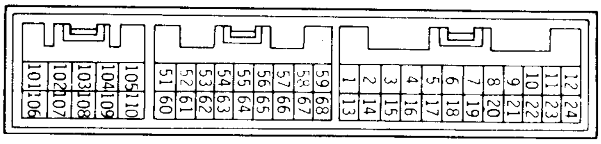
Engine control unit connector



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### OPERATION

- The injectors are electromagnetic-valve-equipped injection nozzles that function to inject fuel based upon injection signals from the engine control unit.
- Because the surface area of the injection ports is fixed and because the pressure of the fuel relative to the pressure within the manifold is also regulates to a fixed pressure, the amount of fuel injection by injectors is determined by the length of time that the needle valve is open, or, in other words, by the length of time of current flow to the solenoid coil.
- Battery power supply is supplied, by way of the control relay, to the injectors. When the engine control unit switches ON the power transistor within the unit and current flows to the solenoid coil, the injectors open and fuel is injected.

## TROUBLESHOOTING HINTS

Hint 1:

If there is a problem with starting while the engine is warm, perform the combustion test and check for leakage of the injectors.

Hint 2:

If the engine can't be started, and the injectors are not activated during cranking, the cause is probably a malfunction such as described below, not with the injectors.

(1) Malfunction of the circuit for supply of power to the engine control unit, or of the earth circuit.
(2) Malfunction of the control relay.
(3) Malfunction of the crank-angle sensor and/or the top dead center sensor.

Hint 3:

If there is a cylinder for which the idling condition does not change when, during idling, the fuel injection of the injectors is cut off in sequence, check that cylinder as described below.

(1) Check the injector and harness.
(2) Check the spark plugs and the high-tension cable.
(3) Check the compression pressure.

Hint 4:

If the injector activation time deviates from the standard value even though the results of the checking of the injector's harness and of the injector itself are normal, the cause may be presumed to be one of the following.

(1) Incomplete combustion within the cylinder. (Malfunction of the spark plugs, the ignition coil, the compression pressure, etc.)
(2) Increased engine resistance.

## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Engine coolant temperature C° (°F) | Standard value ms |
|---|---|---|---|---|---|
| Data reading | 41 | Activation time*[1] | Engine cranking | When 0 (32)*[2] | Approx. 14 |
| | | | | When 20 (68) | Approx. 40 |
| | | | | When 80 (176) | Approx. 9 |

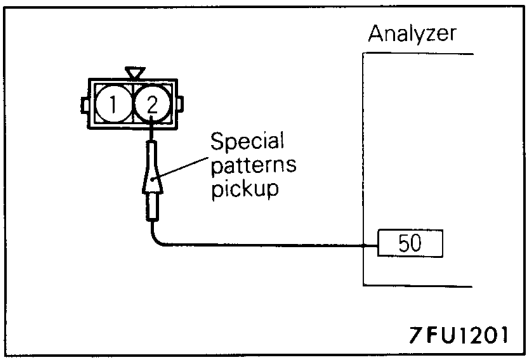
| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value ms |
|---|---|---|---|---|---|
| Data reading | 41 | Activation time*[3] | • Engine coolant temp: 85–95°C (185–205°F)<br>• Lights and accessories: OFF<br>• Transmission: neutral (P range for vehicles with A/T)<br>• Steering wheel: neutral position | 700 (idling) r/min. | 2.7–3.2 |
| | | | | 2,000 | 2.6–3.1 |
| | | | | When raced suddenly | Increases. |

NOTE

*[1]: Indicates the injector-activation time when the power source voltage is 11V and the cranking speed is 250 rpm or less.

*[2]: At a coolant temperature of 0°C (32°F), there is synchromous injection for all six cylinders.

*[3]: For a new vehicle [driven approximately 500 km (300 miles) or less] the injector-activation may be about ten percent linger then indicated above.

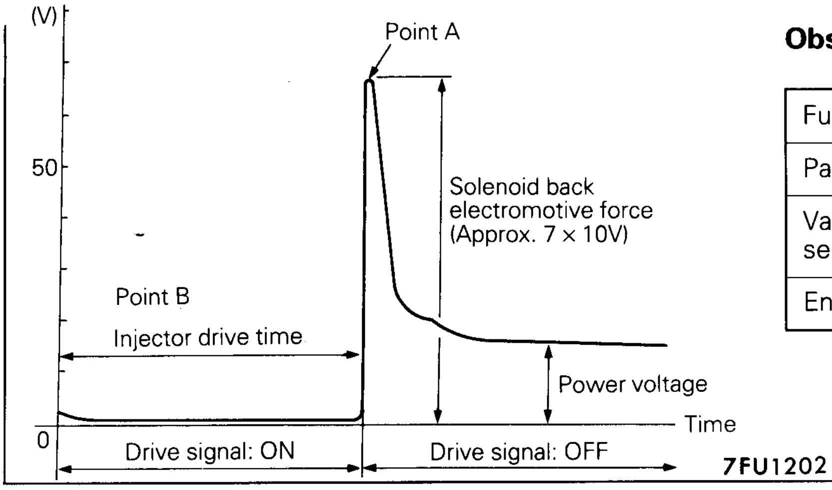


### Wave Pattern Inspection Using an Analyzer

(1) Disconnect the injector connector, and connect the special tool (test harness: MB991348) in between. (The power side and the ECU side terminals should both be connected.)

(2) Connect the analyzer special patterns pickup to the ECU test harness clip.

### Standard wave pattern



### Observation conditions

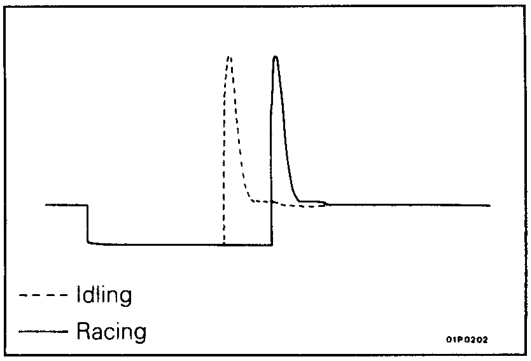
| Function | Special patterns |
|---|---|
| Pattern height | Variable |
| Variable knob Pattern selector | Display |
| Engine r/min. | Idle r/min. (700 r/min.) |

### Wave pattern observation points

Point A: Height of back electromotive force in the solenoid coil

| Contrast with standard wave pattern | Probable cause |
|---|---|
| Solenoid coil back electromotive force is low or doesn't appear at all. | Short in the injector solenoid |

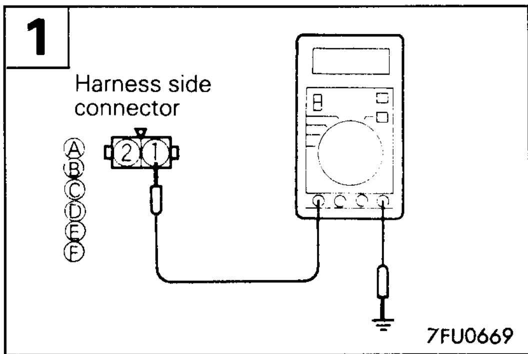
Point B: Injector drive time



- The injector drive timing will synchronized with the multi-use tester display.
- When the engine is suddenly raced, the drive time will be greatly extended at first, but the drive time will soon match the engine speed.

### HARNESS INSPECTION

**1**



Measure the power supply voltage of the injector.

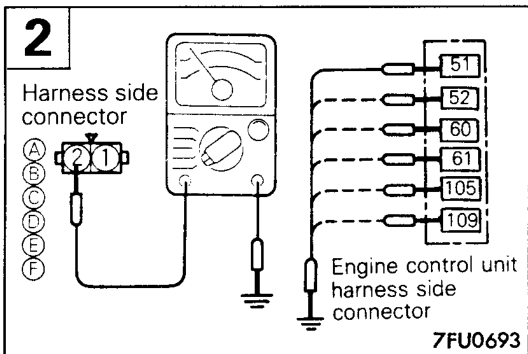
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (ⒶⒷⒸⒹⒺⒻ1 –Engine control relay) Check the power supply.

**2**

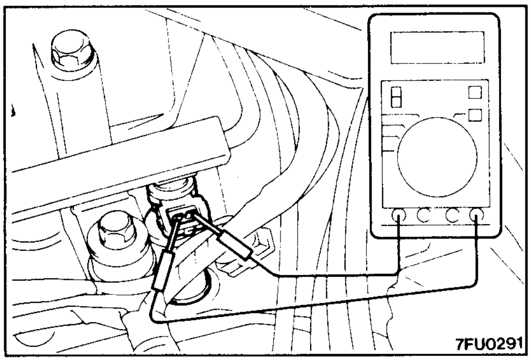


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the injector.

- Engine control unit connector: Disconnected
- Injector connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness. (ⒶⒷⒸⒹⒺⒻ 2 – 51 52 60 61 105 109)



### ACTUATOR INSPECTION

#### Measuring Resistance Between Terminals

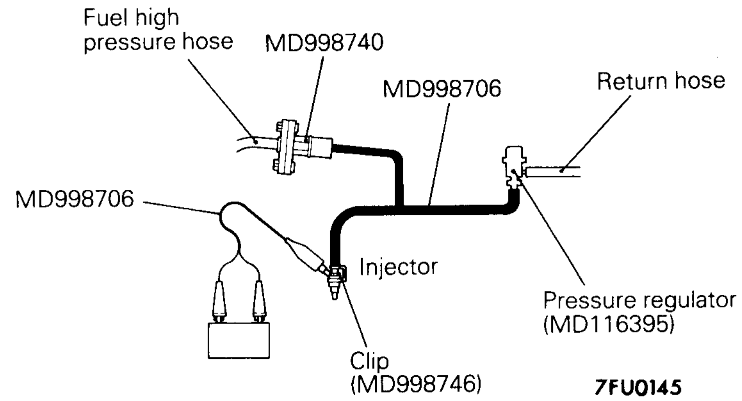
(1) Disconnect the connector for the injectors.
(2) Measure the resistance between terminals.

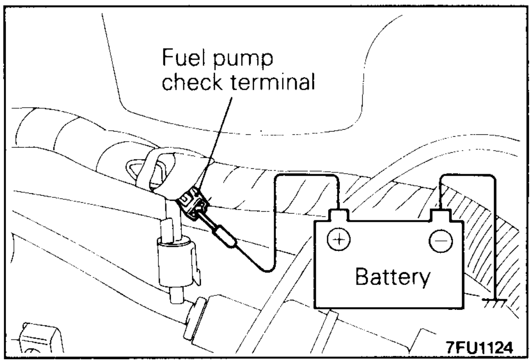
**Standard value: 13–16 Ω at 20°C (68°F)**

(3) Connect the connector for the injectors.

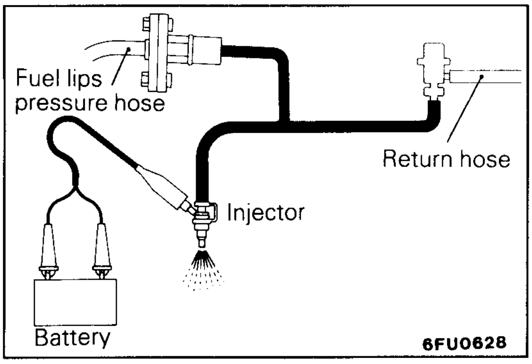
### Checking the Injection Condition

(1) Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel. (Refer to P. 13-16.)
(2) Remove the injector.
(3) Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.

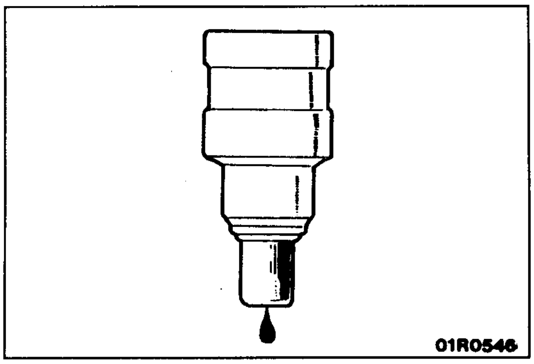




(4) Connect the battery's negative (–) terminal.
(5) Apply battery voltage to the fuel pump check terminal and activate the fuel pump.



(6) Activate the injector and check the atomized spray condition of the fuel. The condition can be considered satisfactory unless it is extremely poor.

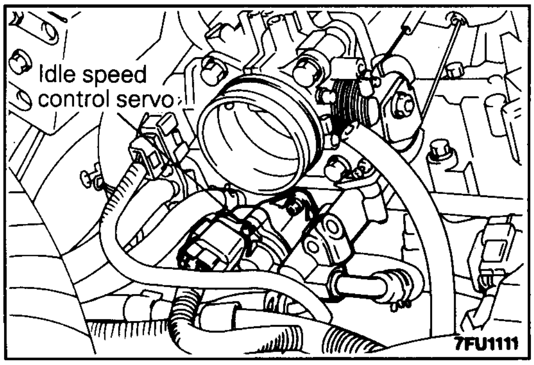


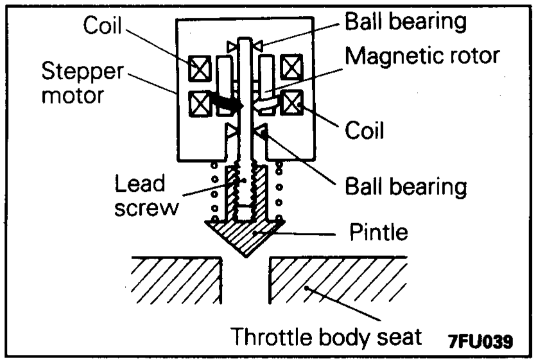
(7) Stop the actuation of the injector, and check for leakage from the injector's nozzle.

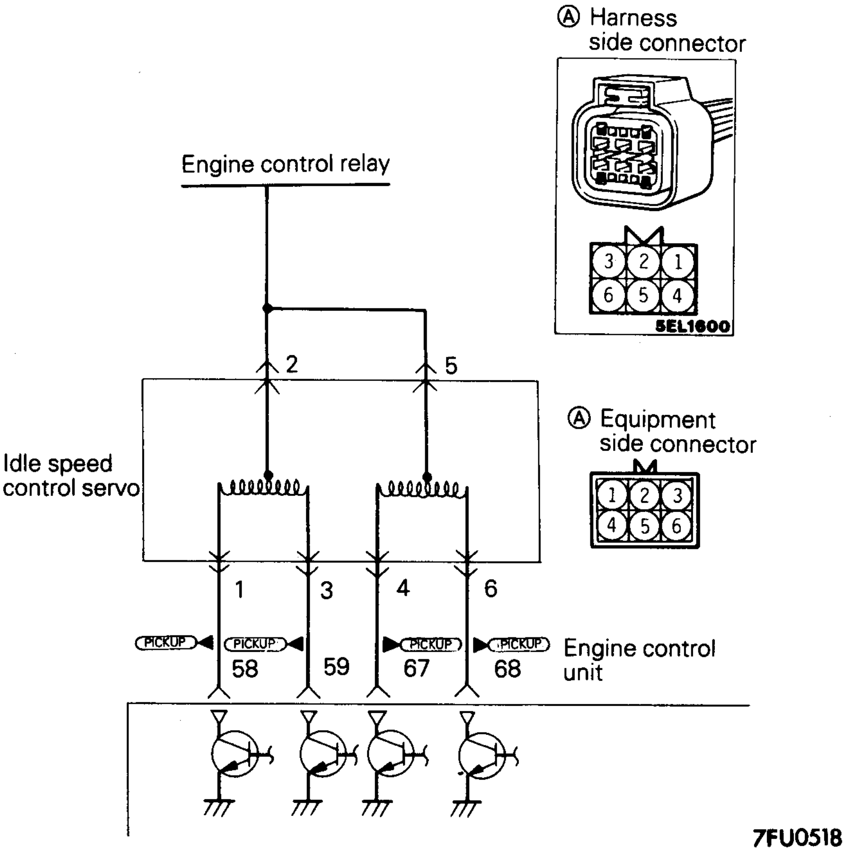
**Standard value: 1 drop or less per minute**

(8) Activate the injector without activating the fuel pump; then, when the spray emission of fuel from the injector stops. disconnect the special tool and restore it to its original condition.

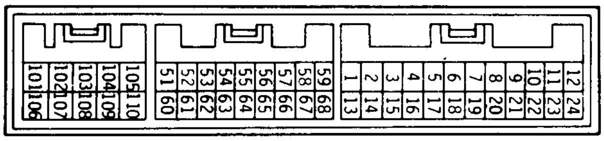
## IDLE SPEED CONTROL SERVO (STEPPER MOTOR)







Engine control unit connector



### OPERATION

- The amount of air taken in during idling is regulated by the opening and closing of the servo valve located in the air passage that that bypasses the throttle valve.
- The servp valve is opened or closed by the activation of the stepper motor (incorporated within the idle-speed control servo) in the forward or reverse direction.
- Battery power supply is supplied, by way of the control relay, to the coil of the stepper motor. The engine control unit switches ON the power transistors (located within the engine control unit) in sequential order, and, when current flows to the stepper motor coil, the stepper motor is activated in the forward or reverse direction.

## TROUBLESHOOTING HINTS

Hint 1:

If the number stepper motor steps increases to 100–120 steps or decreases to 0 step, the cause may be presumed to be a malfunction of the stepper moto or damaged or disconnected wiring of the harness.

Hint 2:

If the number of stepper motor steps deviates from the standard value even through the results of the checking of the harness of the idle-speed control servo and of the component itself indicate no abnormal condition, the cause may be presumed to be one of the following.

(1) Improper adjustment of the standard idling speed.
(2) Depossits adhered to the throttle valve.
(3) Leakage of air into the intake manifold from a gasket gap, etc.
(4) Incomplete combustion within the cylinder. (Malfunction of the spark plugs, the ignition coil, the injectors, the compression pressure, etc.)

## INSPECTION

### Using Multi-use tester (MUT)

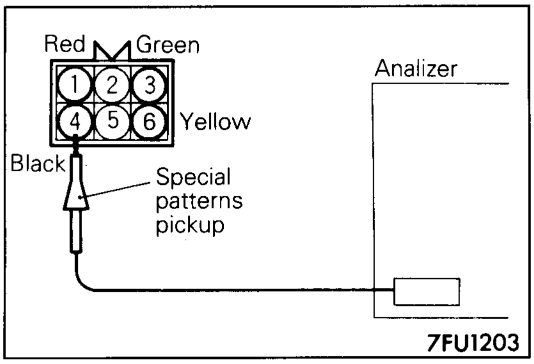
| Function | Item No. | Data display | Check conditions | Load conditions | Standard value STP |
|---|---|---|---|---|---|
| Data reading | 45 | Stepper motor steps | • Engine coolant temperature: 85–95°C (185–205°F)<br>• Lights and accessories: OFF<br>• Transmission: neutral (P range for vehicles with A/T)<br>• Steering wheel: neutral position<br>• Idle-position switch: ON (The compressor clutch should be actived when the air conditioner switch is switched ON.)<br>• Engine: idling | • Air conditioner switch: OFF | 2–12 |
| | | | | • Air conditioner switch: ON | 30–70 |
| | | | | • Air conditioner switch: ON<br>• Selector lever: shift to D range | 20–60 |

NOTE

When the vehicle is new [driven approximately 500 km (300 miles) or less] the number of steps may be about 30 steps greater than the standard value indicated above.

**Caution**

**When the select lever is shifted to the "D" range, the brakes must be used to prevent the vehicle from moving forward.**



### Wave Pattern Inspection Using an Analyzer

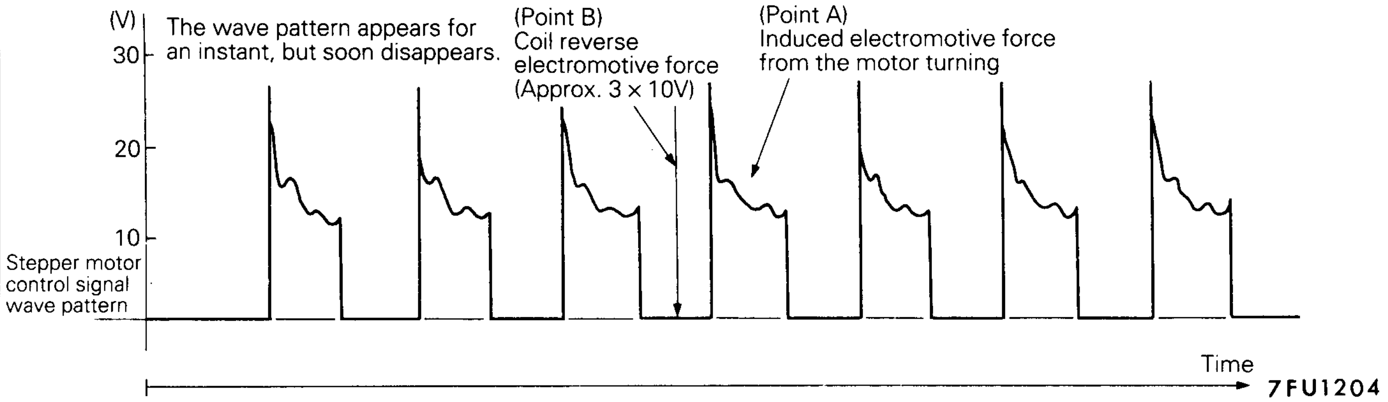
**Observation method**

(1) Disconnect the stepper motor connector, and connect the special tool (test harness: MB998463) in between.
(2) Connect the analyzer special patterns pickup to the stepper motor-side connector terminal ① (red clip on the special tool), terminal ③ (green clip), terminal ④ (black clip) and terminal ⑥ (yellow clip) respectively.

## Standard wave pattern

### Observation conditions

| | |
|---|---|
| Function | Special patterns |
| Pattern height | High |
| Pattern selector | Display |
| Engine condition | Turn the ignition switch from OFF to ON (without starting the engine). |
| | While the engine is idling, turn the air conditioner switch to ON. |
| | Immediately after starting the warm engine (approx. 1 minute). |



### Wave pattern observation points

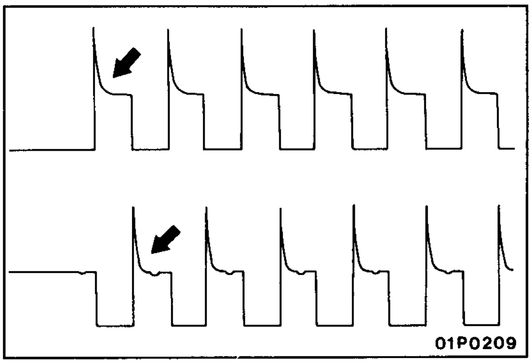
Check that the standard wave pattern appears when the stepper motor is operating.

(Point A): Presence or absence of induced electromotive force from the motor turning. (Refer to the abnormal wave pattern.)

| Contrast with standard wave pattern | Probable cause |
|---|---|
| Induced electromotive force does not appear or is extremely small. | Motor is malfunctioning |

(Point B): Height of coil reverse electromotive force

| Contrast with standard wave pattern | Probable cause |
|---|---|
| Coil reverse electromotive force does not appear or is extremely small. | Short in the coil |



### Abnormal wave pattern

**Cause of problem**

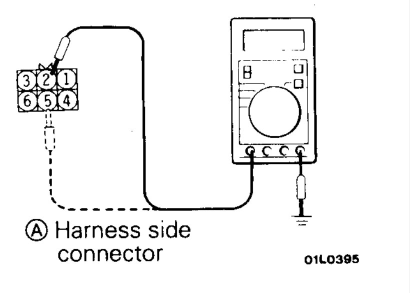
Motor is malfunctioning. (Motor is not operating.)

**Wave pattern characteristics**

Induced electromotive force from the motor turning does not appear.

## HARNESS INSPECTION

**1**



Measure the power supply voltage of idle speed control servo.

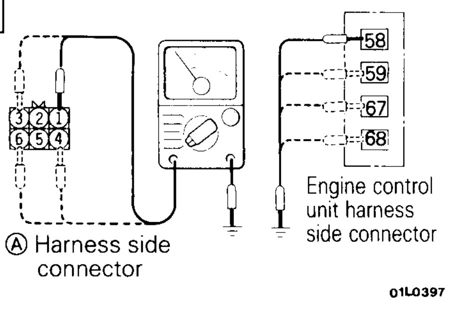
- Idle speed control servo connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Engine control relay-Ⓐ2 Engine control relay-Ⓐ5)

**2**

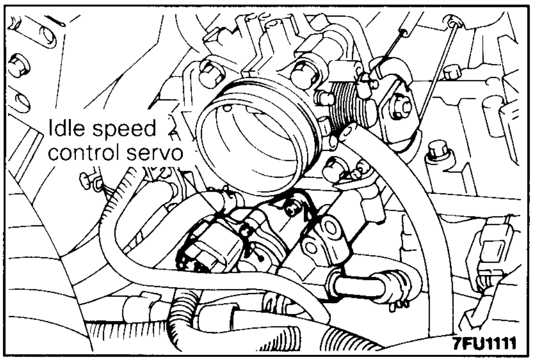


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and idle speed control servo.

- Engine control unit connector: Disconnected
- Idle speed control servo connector: Disconnected

OK → STOP

~~OK~~ → Repair then harness. (Ⓐ1–58, Ⓐ3–59, Ⓐ4–67, Ⓐ6–68)

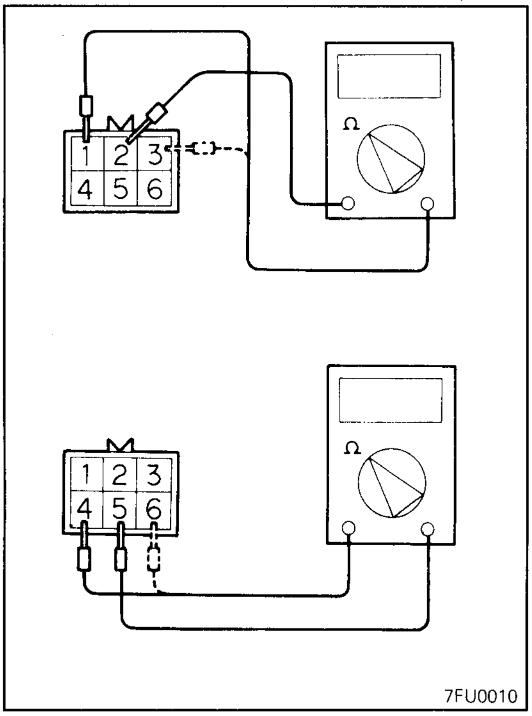


## ACTUATOR INSPECTION

### Checking Operation Sound

(1) Check that when the ignition switch is placed in the ON position (the engine not started), the operating sound of the stepper motor can be heard over the idle speed control servo.

(2) If no operating sound can be heard, check the stepper motor drive circuit. (If the circuit is good, a defective stepper motor or engine control unit is suspected.)



### Checking the Coil Resistance

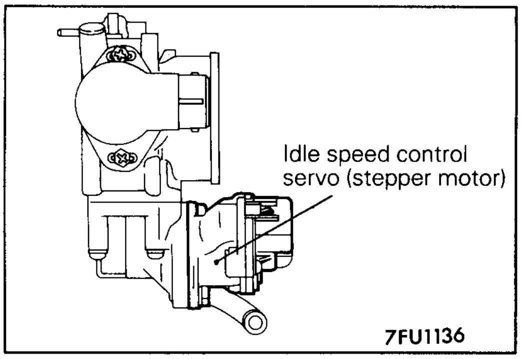
(1) Disconnect the idle speed control servo connector and connect the special tool (test harness).

(2) Measure the resistance between terminal ② (White clip of the special tool) of the connector at the idle speed control servo side and terminal ① (red clip) or terminal ③ (blue clip).

**Standard value: 28–33 Ω [at 20°C (68°F)]**

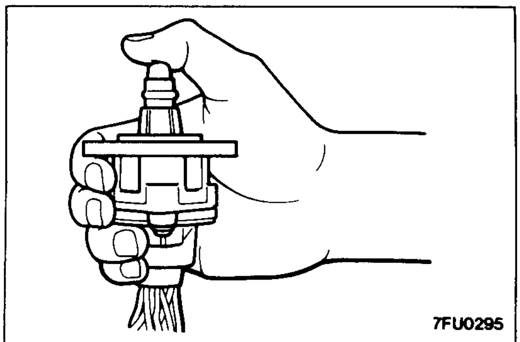
(3) Measure the resistance between terminal ⑤ (green clip of the special tool) of the connector at the idle speed control servo side and terminal ⑥ (yellow clip) or terminal ④ (black clip).

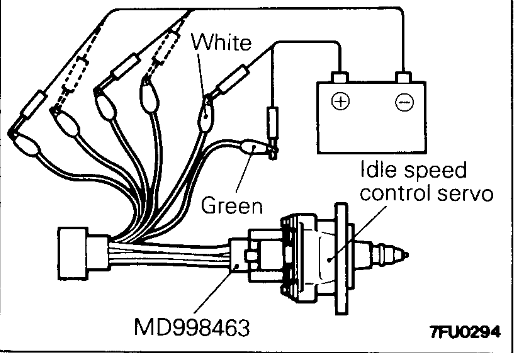
**Standard value: 28–33 Ω [AT 20°C (68°F]**



### Checking the operation

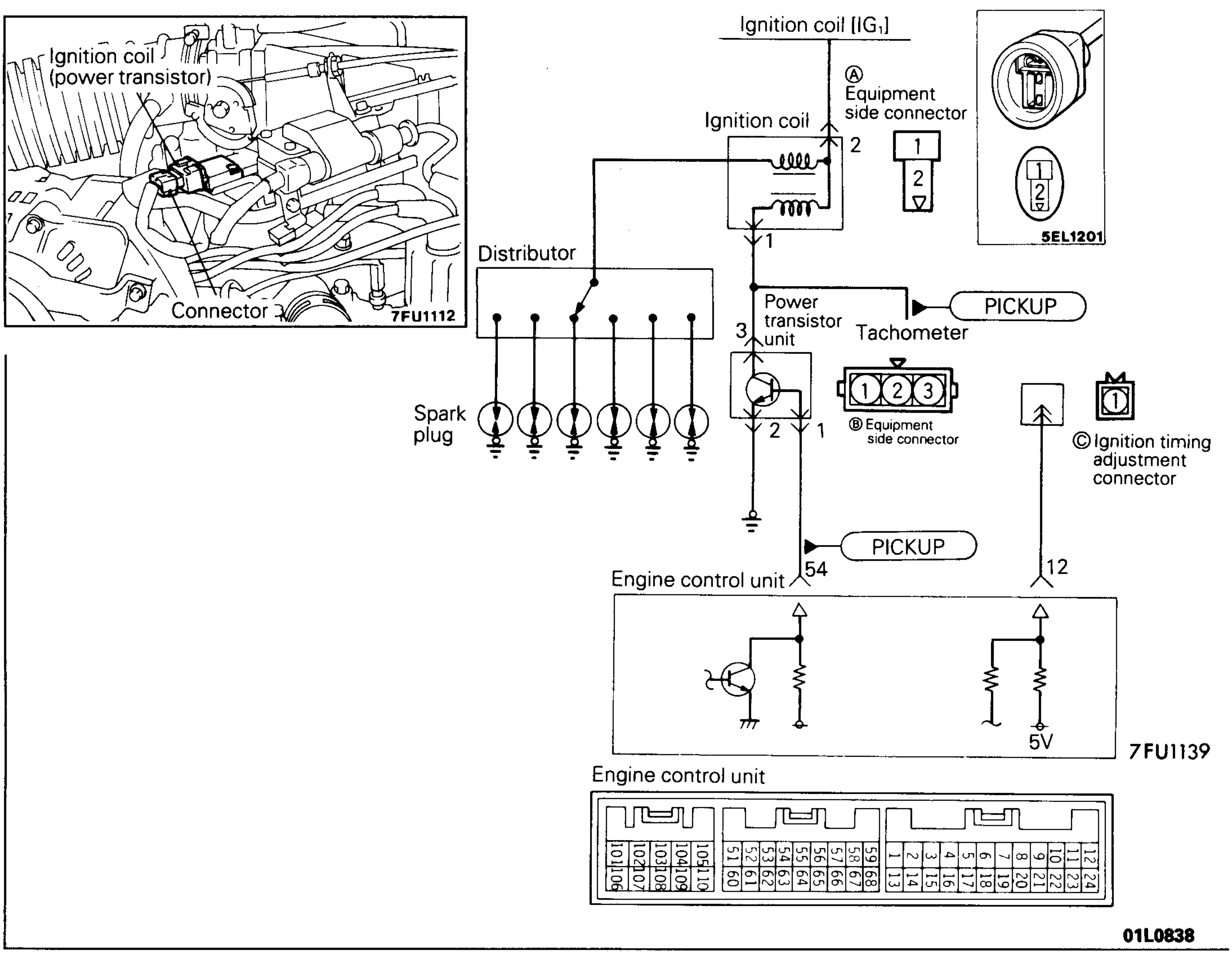
(1) Remove the throttle body.
(2) Remove the stepper motor.





(3) Connect the special tool (test harness) to the Idle speed control servo connector.
(4) Connect the positive ⊕ terminal of a power source (approx 6V) to the white clip or the green clip.
(5) Holding the idle speed control servo as shown in the illustration, connect the negative ⊖ terminal of the power source to each clip in the sequence described below, and check whether or not there is vibration (a feeling of very slight shaking of the stepper motor) as a result of activation of the stepper motor.
   ① Connect the negative ⊖ terminal of the power source to the red and black clips.
   ② Connect the negative ⊖ terminal of the power source to the blue and black clips.
   ③ Connect the negative ⊖ terminal of the power source to the blue and yellow clips.
   ④ Connect the negative ⊖ terminal of the power source to the red and yellow clips.
   ⑤ Connect the negative ⊖ terminal of the power source to the red and black clips.
   ⑥ Repeat the test in the reverse (⑤–①) sequence.
(6) If, as a result of this test, vibration is felt, the stepper motor can be considered to be normal.

## IGNITION COIL AND POWER TRANSISTOR



### OPERATION

- When the power transistor unit is switched ON by the signals from the engine control unit, the primary current of the ignition coil will flow. When the power transistor unit is switched OFF, the primary current flow is interrupted, and high voltage is produced at the secondary coil.
- When the engine control unit switches OFF the power transistor within the unit, the battery voltage within the unit is applied to the power transistor unit, and the power transistor unit is switched ON. In addition, the power transistor unit is switched OFF when the engine control unit switches ON the power transistor within the unit.

### INSPECTION

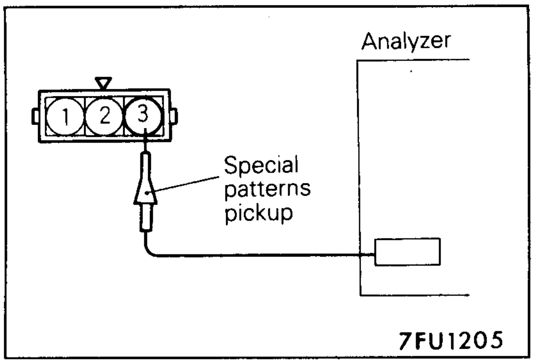
**Using Multi-use tester (MUT)**

Spark advance value

| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value °BTDC |
|---|---|---|---|---|---|
| Data reading | 44 | Spark advance | • Engine: warm<br>• Timing light: set (The timing light is set so as to check the actual ignition timing.) | 700 (Idling) | 7-23 |
| | | | | 2,000 | 25-31 |

### Ignition timing adjustment mode

| Function | Item No. | Data display | Inspection condition | Engine condition | Normal display |
|---|---|---|---|---|---|
| Data list | 36 | Existence of continuity at earth connection of the ignition timing adjustment terminal | Engine: idling | Earth the ignition timing adjustment terminal. | ON |
| | | | | Remove the earth connection of the ignition timing adjustment terminal. | OFF |



### Wave Pattern Inspection Using an Analyzer

- Ignition coil primary signal

Refer to GROUP 16 – Ignition System.

- Power transistor control signal

<Measurement method>

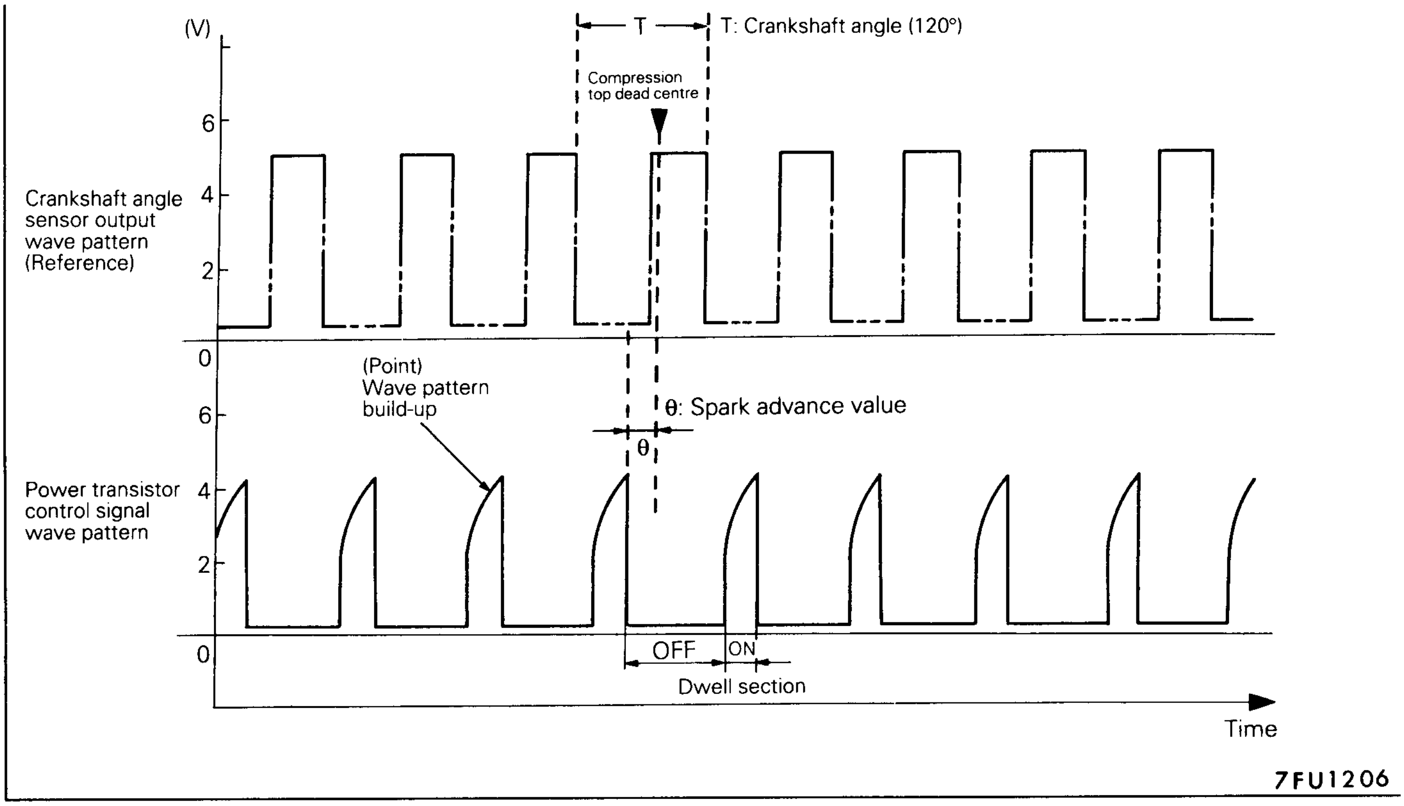
(1) Disconnect the power transistor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)

(2) Connect the analyzer special patterns pickup to the power transistor connector terminal ③.

### Standard wave pattern

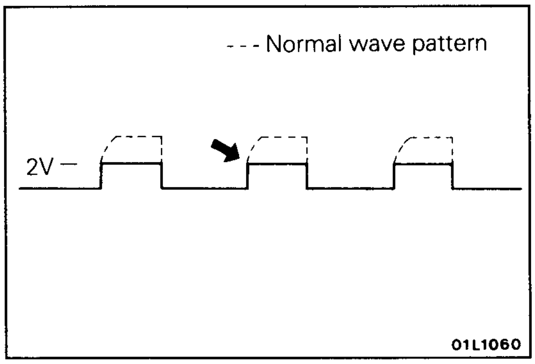
Observation conditions

| Function | Special patterns |
|---|---|
| Pattern height | Low |
| Pattern selector | Display |
| Engine | Approx. 1200 r/min. |



### Wave pattern observation points

(Point): Condition of wave pattern build-up and maximum voltage (Refer to abnormal wave pattern examples 1 and 2.)



### Examples of abnormal wave patterns

- Example 1

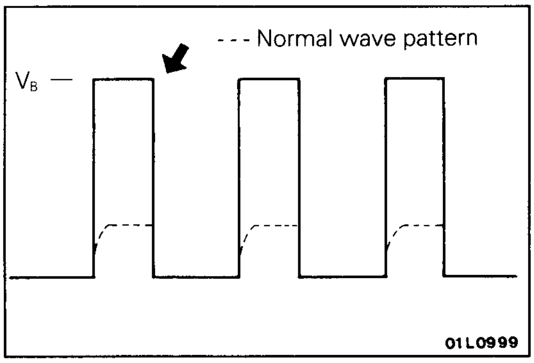
Wave pattern during engine cranking

**Cause of problem**

Broken wire in ignition primary circuit

**Wave pattern characteristics**

Top-right part of the build-up section cannot be seen, and voltage value is approximately 2V too low.



**Example 2**

Wave pattern during engine cranking

**Cause of problem**

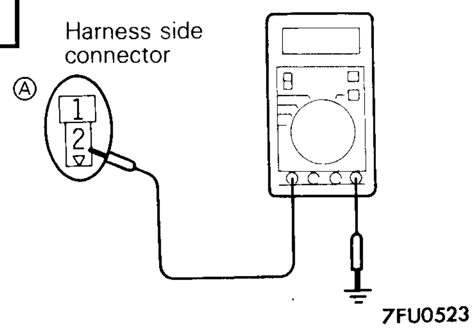
Malfunction in power transistor

**Wave pattern characteristics**

Power voltage results when the power transistor is ON.

### HARNESS INSPECTION

**1**



Measure the power supply voltage of the ignition coil.

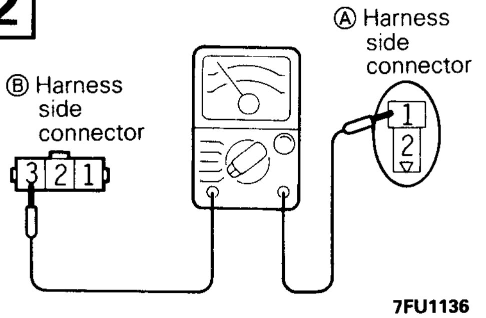
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ2–Ignition switch)

**2**



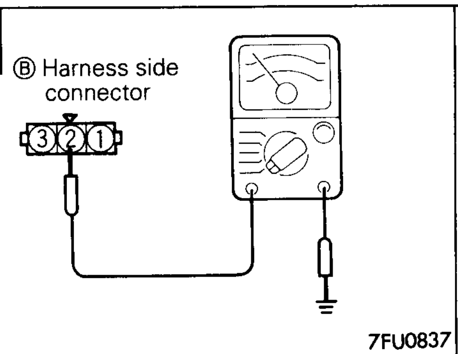
Check for an open-circuit, or a short-circuit to ground, between the power transistor and ignition coil.

- Ignition coil connector: Disconnected
- Power transistor connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ1–Ⓑ3)

**3**



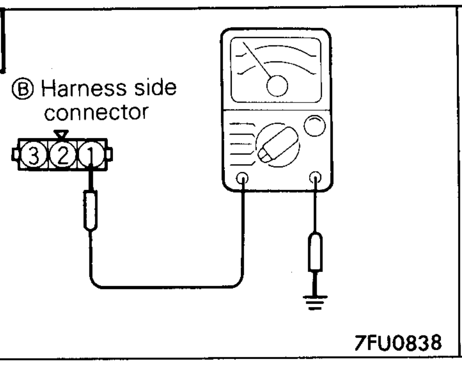
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓑ2-Earth)

**4**



Measure the voltage of the control signal circuit of the power transistor.

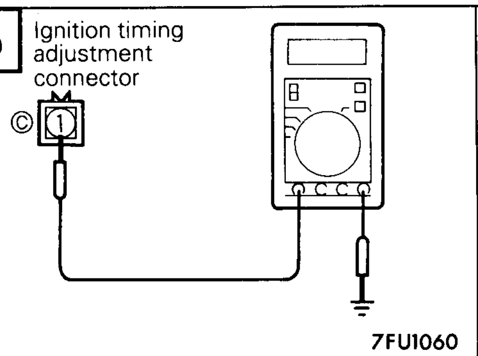
- Connector: Disconnected
- Ignition switch: START

| Voltage (V) |
|---|
| 2 – 6 |

OK → 5

~~OK~~ → Repair the harness. (Ⓑ1-54)

**5**



Measure the voltage of the ignition timing adjustment terminal.

- Ignition switch: ON

| Voltage (V) |
|---|
| 4.0 – 5.2 |

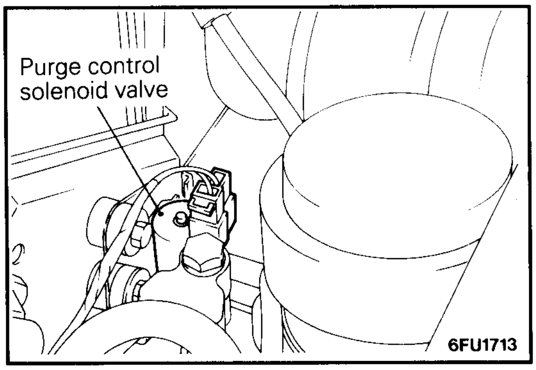
OK → STOP

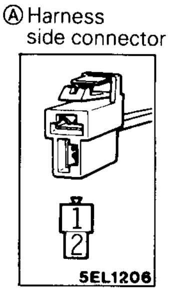
~~OK~~ → Repair the harness. (©1-12)

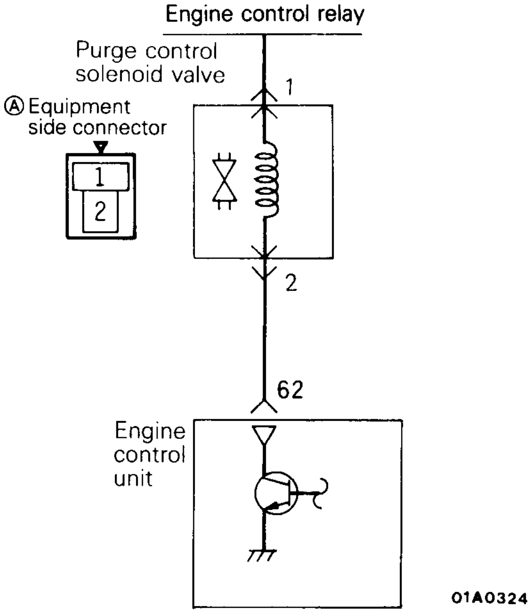
## ACTUATOR INSPECTION

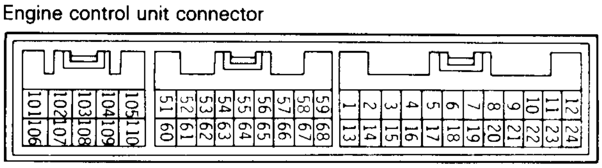
Refer to Group 16.

## PURGE CONTROL SOLENOID VALVE









### OPERATION

- The purge-control solenoid valve is an ON/OFF type of solenoid valve; it functions to regulate the introduction of purge air from the canister to the intake air plenum.
- Battery power supply is supplied, by way of the control relay, to the purge-control solenoid valve. When the engine control unit switches ON the power transistor within the unit, current flows to the coil, and purge air is introduced.

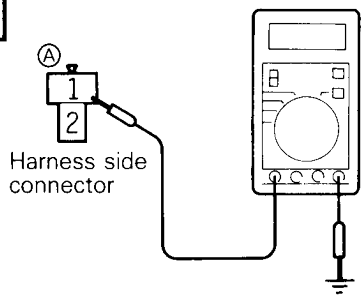
### INSPECTION

#### Using Multi-use tester (MUT)

| Function | Item No. | Activation | Check conditions | Normal condition |
|---|---|---|---|---|
| Actuator test | 08 | Solenoid valve is switched from OFF to ON. | • Ignition switch: ON | Operating sound is heard when driven. |

## HARNESS INSPECTION

**1**



7FU0525

Measure the power supply voltage.

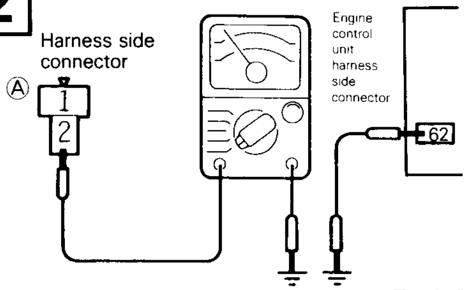
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Engine control relay – Ⓐ1)

**2**



7FU0526

Check for an open-circuit, or a short-circuit to earth, between the purge control solenoid valve and the engine control unit.

- Purge control solenoid valve connector: Disconnected
- Engine control unit connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ2–62)

## ACTUATOR INSPECTION

Refer to Group 17.

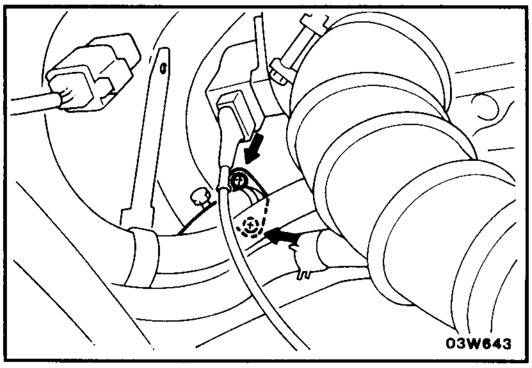
## FUEL PRESSURE

### HOW TO REDUCE THE FUEL LINE INTERNAL PRESSURE

Refer to P. 13-16.

### FUEL PUMP OPERATION CHECK

Refer to P. 13-15.

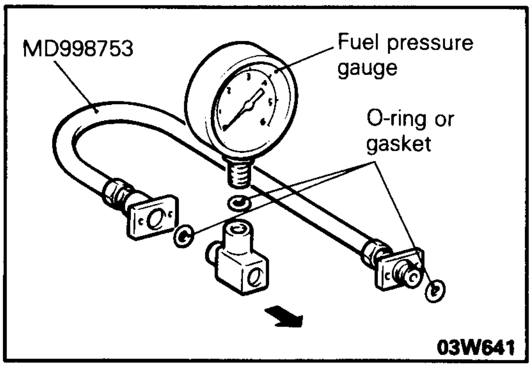


### FUEL PRESSURE TEST

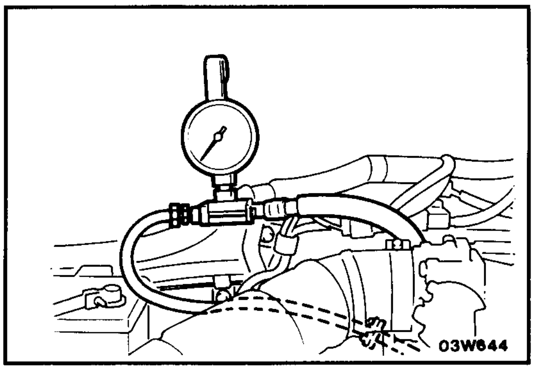
M13FNAD

(1) Reduce the internal pressure of the fuel pipes and hoses.
(2) Disconnect the fuel high pressure hose at the delivery pipe side.

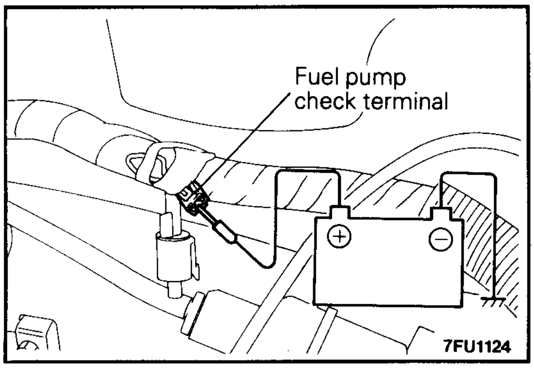
**Caution**
**Cover the hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.**



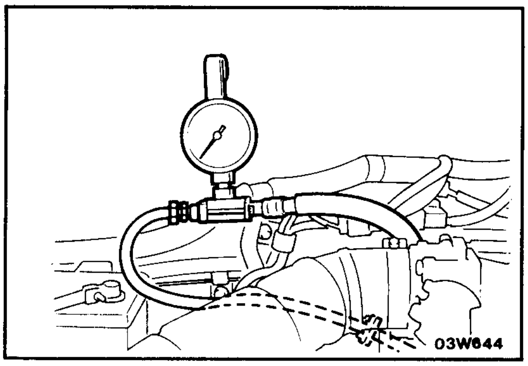
(3) Set a fuel pressure gauge on the special tool, placing an adequate O-ring or gasket between the gauge end special tool prevent fuel leaks.



(4) Attach the special tool set in step (3) to the delivery pipe.
(5) Connect the (–) battery terminal.

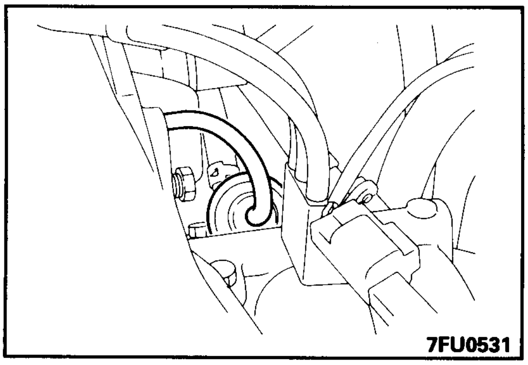


(6) Connect a jumper wire to the terminal for activation of the fuel pump and to the positive (+) terminal of the battery to activate the fuel pump. With fuel pressure applied, check to be sure that there is no fuel leakage from the fuel pressure gauge and the special tool connection part.
(7) Disconnect the jumper wire (from the terminal for activation of the fuel pump) to stop the fuel pump.
(8) Start the engine and let it idle.



(9) Measure the fuel pressure during idling.

**Standard value: Approx. 270 kPa (2.7 kg/cm$^2$, 38 psi) at curb idle**



(10) Disconnect the vacuum hose from the fuel pressure regulator, and then measure the fuel pressure while using a finger to plug the end of the hose.

**Standard value: 330–370 kPa (3.3–3.5 kg/cm$^2$, 47–53 psi) at curb idle speed**

(11) Check to be sure that the fuel pressure during idling does not decrease even after the engine is raced a few times.

(12) Use a finger to gently press the fuel return hose while repeatedly racing the engine, and check to be sure that there is fuel pressure in the return hose also.

NOTE
There will be no fuel pressure in the return hose if there is insufficient fuel flow.

(13) If the fuel pressure measured in steps (9) to (12) deviates from the standard value range, check for the probable cause by referring to the table below, and then make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| • Fuel pressure is too low.<br>• Fuel pressure drops during racing.<br>• No fuel pressure in fuel return hose. | Fuel filter is clogged. | Replace the fuel filter. |
| | Malfunction of the valve seat within the fuel pressure regulator, or fuel leakage to return side caused by spring deterioration. | Replace the fuel pressure regulator. |
| | Fuel pump low discharge pressure. | Replace the fuel pump. |
| Fuel pressure is too high. | The valve within the fuel pressure regulator is sticking. | Replace the fuel pressure regulator. |
| | Clogging of the fuel return hose and/or the pipe. | Clean or replace the hose and/or pipe. |
| No change of the fuel pressure when vacuum hose is connected and when not connected. | Damaged vacuum hose or nipple clogging. | Replace the vacuum hose, or clean the nipple. |

(14) Stop the engine and check for a change of the value indicated by the fuel pressure gauge. The condition is normal if there is no decrease of the indicated value within two minutes.
If there is a decrease of the indicated value, monitor the speed of the decrease, and, referring to the table below, determine the cause of the problem and make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| After the engine is stopped, the fuel pressure drops gradually. | Injector leakage. | Replace the injector. |
| | Leakage at the fuel pressure regulator valve seat. | Replace the fuel pressure regulator. |
| There is a sudden sharp drop of the fuel pressure immediately after the engine is stopped. | The check valve (within the fuel pump) is not closed. | Replace the fuel pump. |

(15) Remove all remaining pressure from inside the fuel pipe. (Refer to P. 13-16.)

(16) Disconnect the fuel pressure gauge and the special tool from the delivery pipe.

**Caution**
**Because there will be a slight amount of remaining pressure in the fuel pipe line, use rags to cover so that fuel doesn't splatter.**

(17) Replace the O-ring at the end of the fuel high-pressure hose with a new one.

(18) After connecting the fuel high-pressure hose to the delivery pipe, tighten the installation bolt at the specified torque.

**Tightening torque: 5 Nm (0.5 kmg, 3.6 ft.lbs)**

(19) Check to be sure that there is no fuel leakage.

① Apply battery voltage to the terminal for activation of the fuel pump so as to activate the fuel pump.
② With fuel pressure applied, check for leakage of the fuel line.

# FUEL SYSTEM <6G72 – 24Valve Engine, 6G74 Engine>

## GENERAL INFORMATION

### MULTI POINT INJECTION SYSTEM DIAGRAM

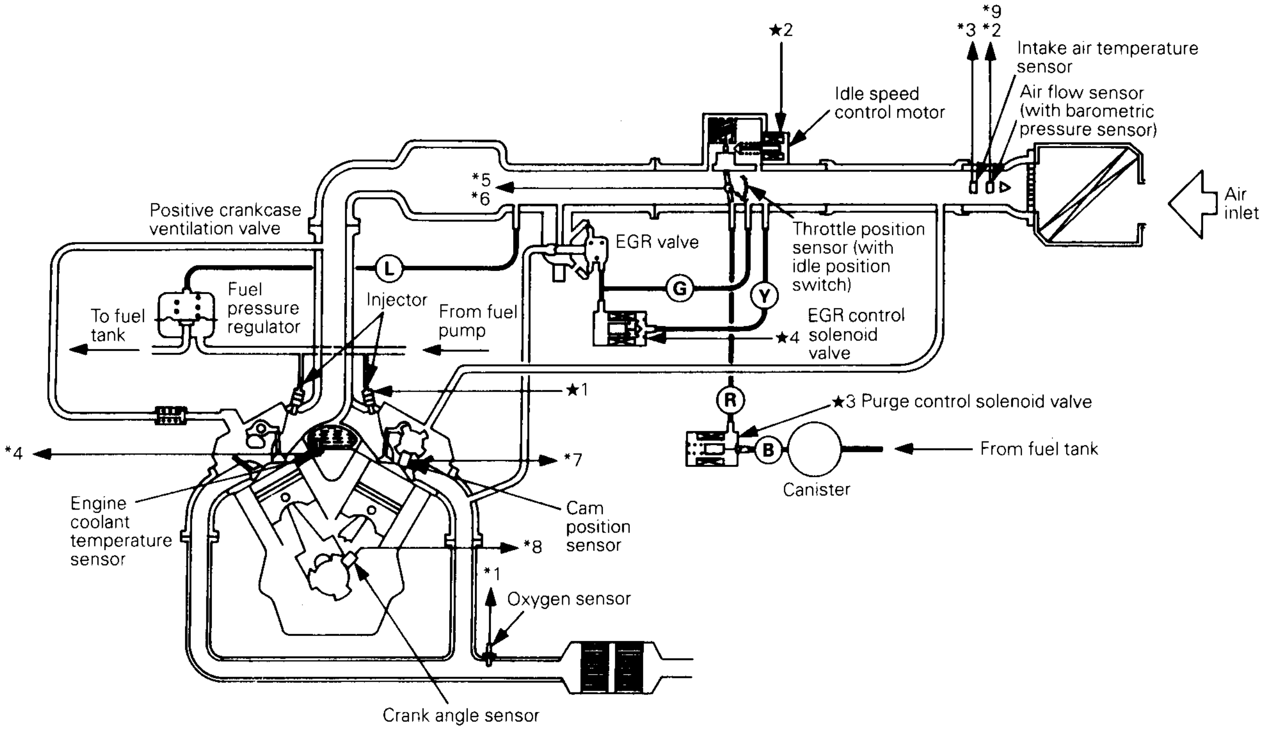
### <SOHC>

*1 Oxygen sensor
*2 Volume air flow sensor
*3 Intake air temperature sensor
*4 Engine coolant temperature sensor
*5 Throttle position sensor
*6 Idle position switch
*7 Cam position sensor
*8 Crank angle sensor
*9 Barometric pressure sensor

- Ignition switch-ST
- Ignition switch-$IG_1$
- Power supply
- Vehicle speed sensor
- Air conditioner switch
- Power steering pressure switch
- Inhibitor switch

⇨ Engine control unit ⇨

★1 Injector
★2 Idle speed control motor
★3 Purge control solenoid valve
★4 EGR control solenoid valve
- Fuel pump control (control relay)
- Air conditioner power relay
- Ignition timing control
- Self diagnostic circuit
- Engine warning lamp



Vacuum hose color
B: Black
G: Green
L: Light blue
R: Red
Y: Yellow

7FU1738

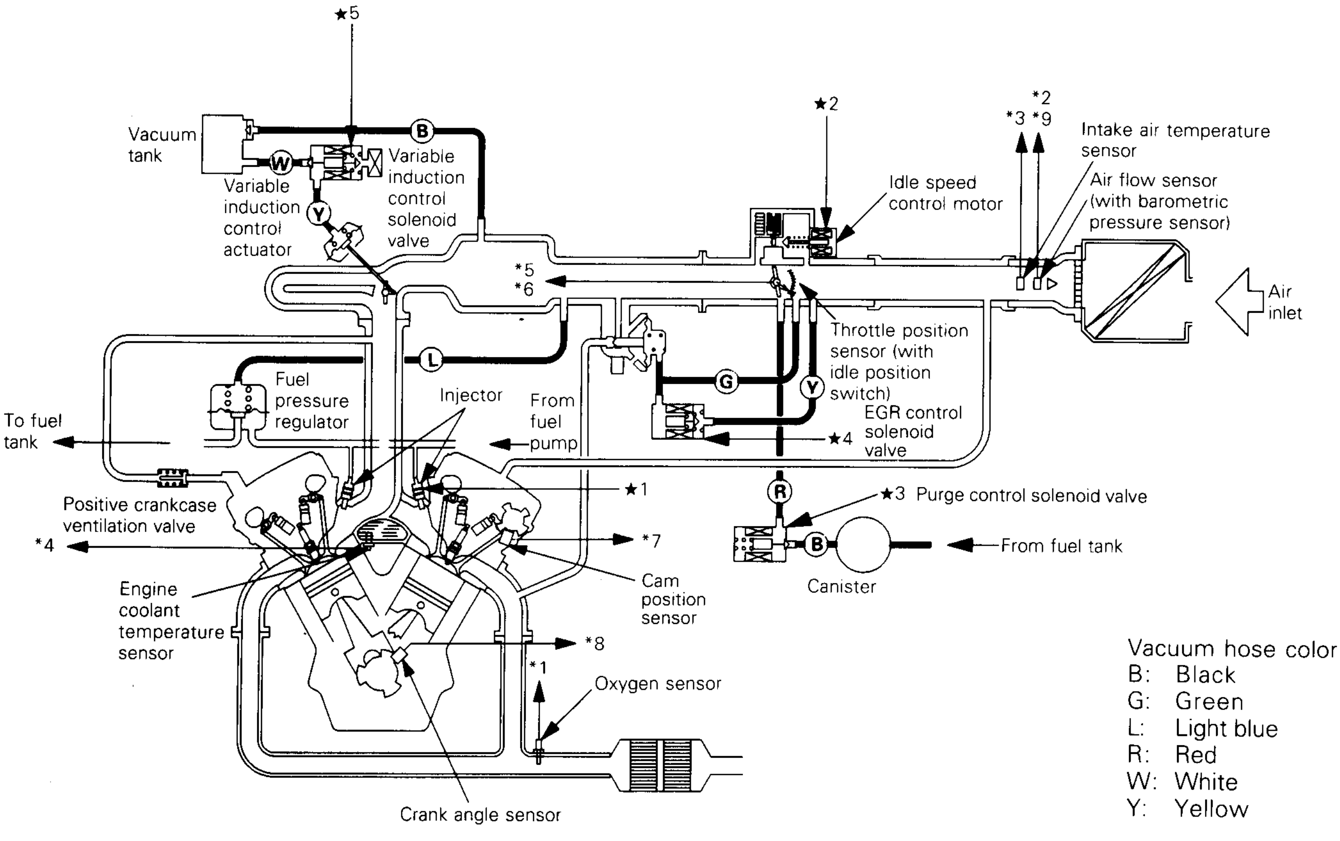
## <DOHC>

- *1 Oxygen sensor
- *2 Volume air flow sensor
- *3 Intake air temperature sensor
- *4 Engine coolant temperature sensor
- *5 Throttle position sensor
- *6 Idle position switch
- *7 Cam position sensor
- *8 Crank angle sensor
- *9 Barometric pressure sensor
- *10 EGR temperature sensor

- ● Ignition switch-ST
- ● Ignition switch-$IG_1$
- ● Power supply
- ● Vehicle speed sensor
- ● Air conditioner switch
- ● Power steering pressure switch
- ● Inhibitor switch
- ● Detonation sensor

⇨ Engine control unit ⇨

- ★1 Injector
- ★2 Idle speed control motor
- ★3 Purge control solenoid valve
- ★4 EGR control solenoid valve
- ★5 Variable induction control solenoid valve
- ● Fuel pump control (control relay)
- ● Air conditioner power relay
- ● Ignition timing control
- ● Self diagnostic circuit
- ● Engine warning lamp



7FU1510

# SPECIFICATIONS

## GENERAL SPECIFICATIONS

E13CA-A

| Items | | Specifications |
|---|---|---|
| Fuel | | |
| Tank capacity | $dm^3$ (U.S.gal., Imp.gal.) | |
| Standard Wheelbase | | 75 (19.8, 16.5) |
| Long Wheelbase | | 92 (24.3, 20.2) |
| Fuel pump | | |
| Type | | Electrical, in-tank type |
| Driven by | | Electric motor |
| Throttle body | | |
| Throttle bore | mm (in.) | 60 (2.36) |
| Throttle position sensor | | Variable resistor type |
| Idle speed control servo | | Stepper motor type<br>Stepper motor type by-pass air control system with the Fast Idle Air Valve |
| Idle position switch | | Rotary contact type |
| Engine control unit | | |
| Identification model No. | | |
| <SOHC> | | E2T37483 |
| <DOHC> | | E2T39974 <Up to 1994 model><br>E2T39977 <From 1995 model> |
| Sensors | | |
| Air flow sensor | | Karman vortex type |
| Barometric pressure sensor | | Semiconductor diffusion-type |
| Intake air temperature sensor | | Thermistor type |
| Engine coolant temperature sensor | | Thermistor type |
| Oxygen sensor | | Zirconia type |
| Vehicle-speed sensor | | Reed switch type |
| Inhibitor switch | | Contact switch type |
| Detnation sensor <DOHC> | | Piezoelectric type |
| Cam position sensor | | Hall element type |
| Crank angle sensor | | Hall element type |
| Power steering pressure switch | | Contact switch type |
| Actuators | | |
| Control relay type | | Contact switch type |
| Injector type and number | | Electromagnetic, 6 |
| Purge control solenoid valve | | ON/OFF type solenoid valve |
| EGR control solenoid valve | | Duty cycle type solenoid valve |
| Fuel pressure regulator | | |
| Regulated pressure | kPa ($kg/cm^2$, psi) | 329 (3.35, 47.6) |

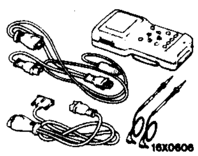
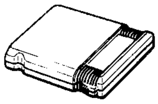
## SERVICE SPECIFICATIONS

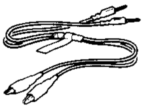
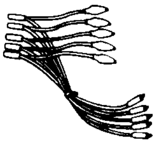
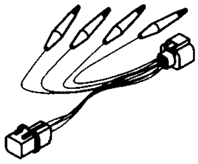
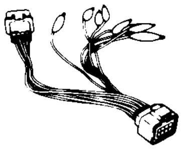
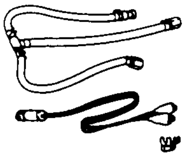
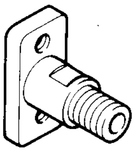
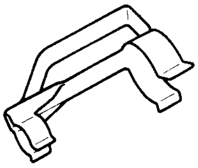
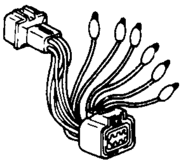
| Items | | Specifications |
|---|---|---|
| Standard value | | |
| Accelerator cable play | mm (in.) | 1–2 (0.04–0.08) |
| Basic ignition timing | | 5°±3° BTDC at curb idle |
| Curb idle speed | r/min. | 700±100 |
| Idle speed when air conditioner ON | r/min. | 900 at neutral position<br>650 at D range <A/T> |
| Basic idle speed | r/min. | 700±50 |
| Throttle position sensor output voltage | mV | 400–1000 |
| Throttle position sensor resistance | kΩ | 3.5–6.5 |
| Idle speed control servo (stepper motor) coil resistance [at 20°C (68°F)] | Ω | 28–33 |
| Intake air temperature sensor resistance [at 20°C (68°F)] | kΩ | 2.7 |
| Engine coolant temperature sensor resistance | kΩ | |
| 20°C (68°F) | | 2.4 |
| 80°C (176°F) | | 0.3 |
| Fuel pressure (at curb idle) | kPa (kg/cm², psi) | |
| Vacuum hose disconnected | | 324–343 (3.3–3.5, 47–50) |
| Vacuum hose connected | | Approx. 265 (2.7, 38) |
| Injector coil resistance [at 20°C (68°F)] | Ω | 13–16 |

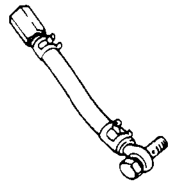
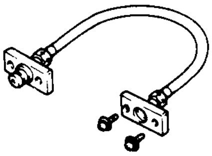
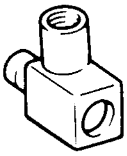
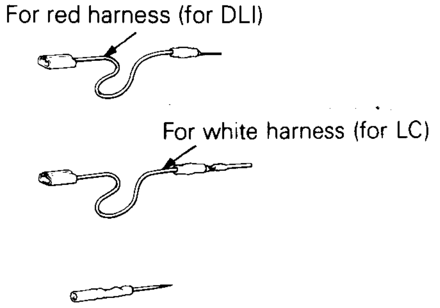
## SEALANT

| Items | Specified sealant | Remarks |
|---|---|---|
| Engine coolant temperature sensor threaded portion | 3M Nut Locking Part No. 4171 or equivalent | Drying sealant |

## SPECIAL TOOLS

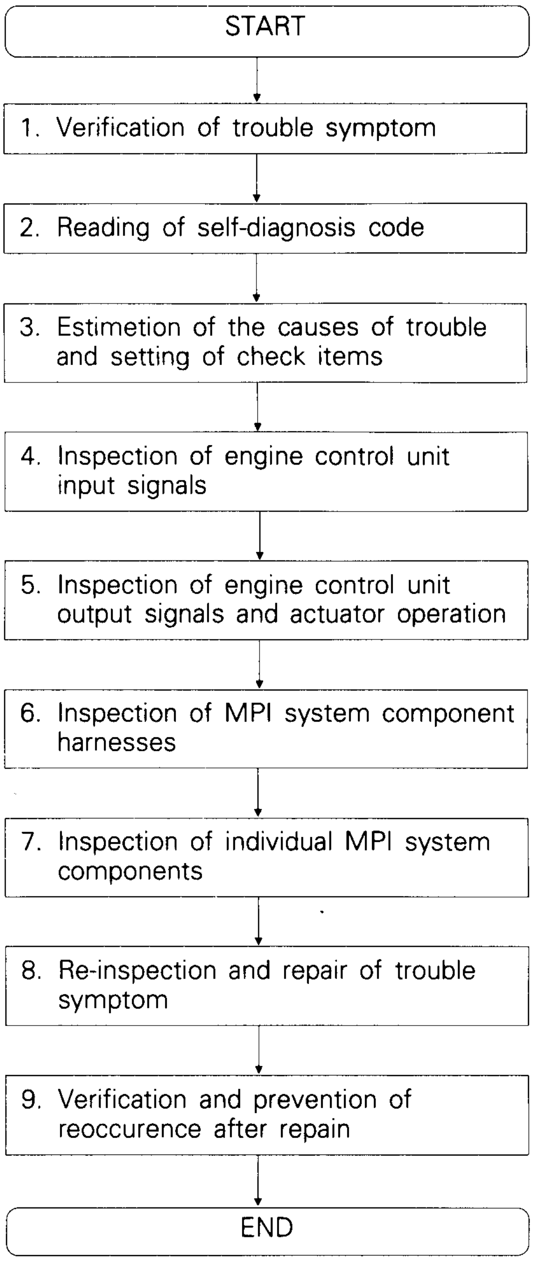
| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB991502 | MUT-II | ● Reading diagnosis code<br>● MPI system inspection |
|  | | ROM pack | |

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB991529 | Diagnosis code check harness | ● Reading diagnosis code<br>● Basic idle speed adjustment |
|  | MB991348 | Test harness set | ● Adjustment of throttle position sensor<br>● Inspection with analyzer |
|  | MD998464 | Test harness (4 pin, square) | ● Oxygen sensor inspection |
|  | MD998474 | Test harness (8 pin, square) | ● Inspection with analyzer |
|  | MD998706 | Injector test set | ● Checking injection condition of injector |
|  | MD998740 | Injector test adaptor | |
|  | MD998746 | Clip | |
|  | MD998463 | Test harness (6 pin, square) | ● Idle speed control servo inspection<br>● Inspection with analyzer |

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MD998709 | Adapter hose | <SOHC><br>Measurement of fuel pressure |
|  | MD998742 | Hose adapter | |
|  | MD998753 | Extension hose | <DOHC><br>● Measurement of fuel pressure |
|  | MD998700 | Hose adapter | |
|  | MB991223 | Inspection harness set connector<br>● Pin contact pressure inspection harness<br>● Marketing tester connection probe (for general connectors) | ● Measurement of terminal voltages |

# TROUBLESHOOTING

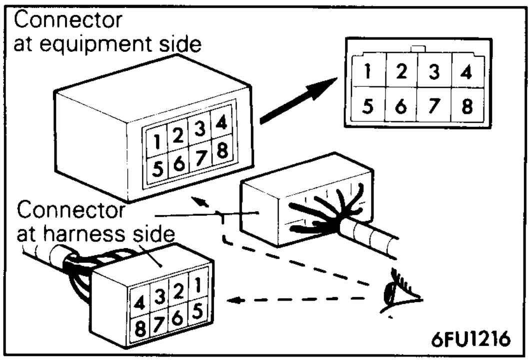
## EXPLANATION OF TROUBLESHOOTING PROCEDURES



Effective troubleshooting procedures for MPI system problems are given below.

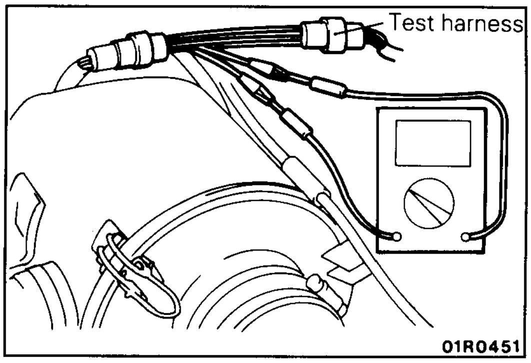
1. Verification of trouble symptom
   - Reproduce trouble symptom and verify the characteristics of the trouble and the conditions (engine condition, driving conditions, etc.) under which it is produced.
2. Reading of self-diagnosis code
   - Read self-diagnosis code and if a malfunction code is output, locate and correct the trouble referring to the DIAGNOSIS CHART.
3. Estimation of the causes of trouble and setting of check items
   - Referring to the Check Chart, verify the check items and checking order for the trouble symptom.
4. Inspection of engine control unit input signals
   - Inspect the engine control unit input signals by using the MUT-II or an analyzer.
   - Sensor input is normal if input signals are normal, then inspect the next inspection item.
5. Inspection of engine control unit output signals and actuator operation
   - Inspect the engine control unit output signals and actuator operation by using the MUT-II. Drive the actuator by instructing the actuator test function and verify the actuator operation.
   - Inspect the engine control unit output signals by using an oscilloscope.
   - Actuator control is normal if engine control unit output signals and actuator are normal, then inspect the next inspection item.
6. Inspection of MPI system component harness
   - If the engine control unit input/output signals are abnormal, check the MPI system component body harness and repair as necessary.
   - After repair, check the engine control unit input/output signals again. If they are normal, proceed to check the input/output signals of the next check item.
7. Inspection of individual MPI system components
   - If the body harness is normal but the engine control unit input/output signals are abnormal, check individual MPI system components and repair or replace as necessary.
   - After repair or replacement, check the engine control unit input/output signals again. If they are normal, proceed to check the input/output signals of the next check item.

8. Re-inspection and repair of trouble symptom
   - If the harness inspection and individual component inspection results are normal but the engine control unit input/output signals are abnormal, re-examine the causes of trouble referring to the troubleshooting hints and the checks and repairs included in other groups.
9. Verification and prevention of reoccurrence after repair
   - Perform tests to see if the same problems occur again and make sure that the same problems will not be repeated.
   - Remove the true causes of the trouble to prevent its reoccurrence.

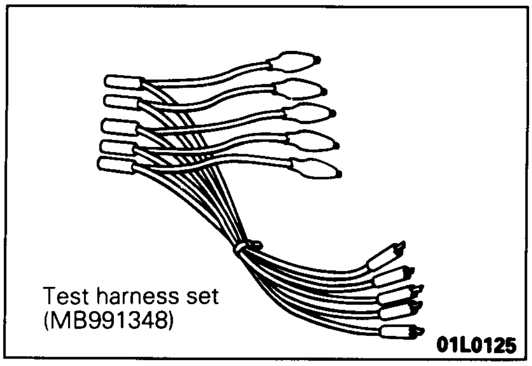


## EXPLANATION AND PRECAUTION RELATED TO HARNESS CHECKING

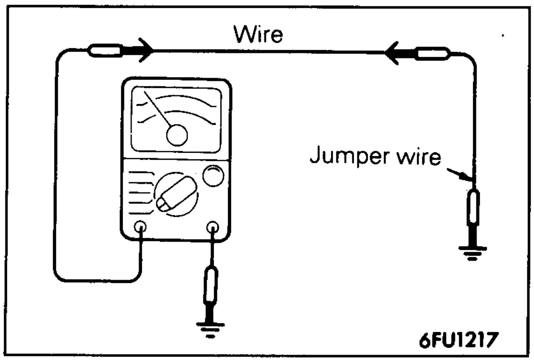
- Connector symbols are described as seen from the terminal end for the connector.
- The abbreviation "SV" used for the normal judgment value when checking the voltage is the abbreviation for system voltage.



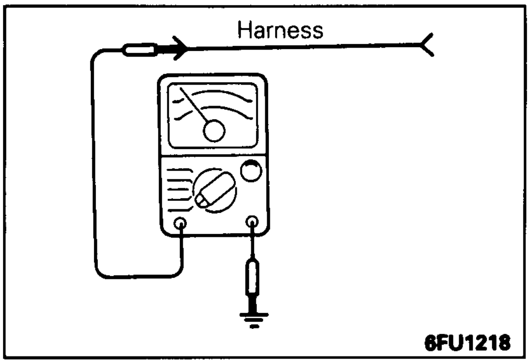
- Be sure to use the special tool (test harness) when, for a waterproof connector, checking while the circuit is conductive. If probe is inserted from the harness side, the waterproof capability will be lowered, thereby causing/corrosion, so never do so.
- When a connector is disconnected in order to check terminal voltage, etc., never insert a probe if the terminal to be checked is a female pin, because the forceful insertion of a probe will cause improper or incomplete contact.



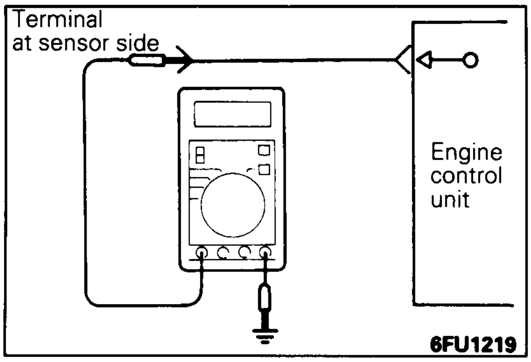
- Also, if there is no test harness that conforms to the connector, use the test harness set (MB991348) which can be directly connected between the terminals.
- When disconnecting the connector and inspecting the terminal voltage, etc., if the inspection terminal is a female pin, the special tool (inspection harness set: MB991223) should be used instead of inserting a probe.



- When checking for damaged or disconnected wiring of a harness (open circuit) and if both ends of the harness are unconnected, use a jumper wire to earth one end of the harness, and then check for continuity between the other end and earth. By doing this, you can check for damaged or disconnected wiring, and, if there is no continuity, the harness should be repaired.

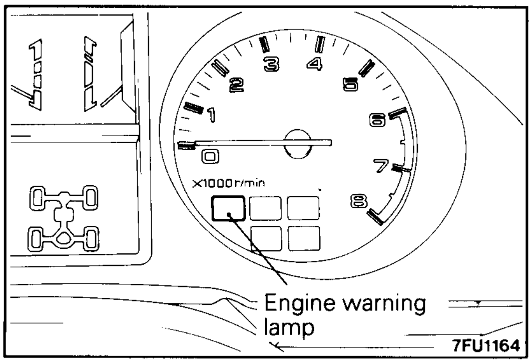


- When checking for a harness short-circuit (short-circuit to earth), open one end of the harness and then check for continuity between the other end and earth. If there is continuity, the harness is short-circuited to earth and should be repaired.
- Use an analog voltmeter resistor (or a circuit tester) when inspecting the continuity.



- If the impressed voltage is not normal even if wire is normal, change the engine control nuit and inspect again.
- Use a digital voltmeter (or a circuit tester) when measuring the voltage. Use an analog voltmeter, however, when inspecting the power transistor drive voltage.

## ENGINE WARNING LAMP (CHECK ENGINE LAMP)



Among the self-diagnosis items, a engine warning lamp comes on to notify the driver of the emission control items when an irregularity is detected.

However, when an irregular signal returns to normal and the engine control unit judges that it has returned to normal, the engine warning lamp goes out.
Moreover, when the ignition switch is turned off, the lamp goes out. Even if the ignition switch is turned on again, the lamp does not come on until the irregularity is detected.
Here, immediately after the ignition switch is turn on, the engine warning lamp is lit for 5 seconds to indicated that the engine warning lamp operates normally.

**Item indicated by the lightening engine warning lamp**

| | |
|---|---|
| Engine control unit | Cam position sensor |
| Oxygen sensor | Barometric pressure sensor |
| Air flow sensor | Detonation sensor <DOHC> |
| Intake air temperature sensor | Ignition timing adjustment signal |
| Throttle position sensor | Injector |
| Engine coolant temperature sensor | EGR system |
| Crank angle sensor | Ignition coil. Power transistor unit |

**Caution**
**Engine warning lamp will come on when the line of terminal for ignition timing adjustment is short-circuited. Therefore, the lamp will come on even when the terminal for ignition timing adjustment is earthed at the time of adjusting ignition timing. In this case, however, it is not abnormal.**

## ENGINE WARNING LAMP INSPECTION

(1) Check to be sure, when the ignition switch is set to the "ON"position, that the lamp illuminates for about five seconds and then switches OFF.

(2) If the lamp does not illuminate, check for damage or disconnection of the harness, or for a blown fuse or a failed light bulb.

## SELF-DIAGNOSIS

The engine control unit monitors the input/output signals (some signals at all times and the others under specified conditions) of the engine control unit. When it is noticed that an irregularity has continued for a specified time or longer from when the irregular signal is initially monitored, passing a certain number, the engine control unit judges that an irregularity has occurred, memorizes the malfunction code, and outputs the signal to the self-diagnosis output terminals. There are 18 diagnosis items, including the normal state, and the diagnosis results can be read out with a voltmeter or MUT-II. Moreover, since memorization of the malfunction codes is backed up directly by the battery, the diagnosis results are memorized even if the ignition key is turned off. The malfunction codes will, however, be erased when the battery terminal or the engine control unit connector is disconnected.

The malfunction codes are also erased by setting the ignition switch to the "ON" position and then sending the malfunction-code-erase signal from the MUT-II to the engine control unit.

**Caution**

**If the sensor connector is disconnected while the ignition switch is ON, the malfunction code is memorized. In this instance, either send the malfunction-code-erase signal from the MUT-II to the engine control unit, or disconnect the battery's negative (–) terminal for ten seconds or longer; the diagnosis memory will be erased.**

The 18 diagnosis items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

**Caution**

**Ignition timing adjustment signal malfunction code is output when the ignition timing adjustment terminal line is short-circuited to the earth. Therefore, the malfunction code is output when the ignition timing adjustment terminal is earthed, however, this is not a malfunction.**

## DIAGNOSIS CHART

| Output preference order | Diagnosis item | Diagnosis code | | Check item (Remedy) |
|---|---|---|---|---|
| | | No. | Memory | |
| 1 | Engine control unit | — | — | (Replace engine control unit) |
| 2 | Oxygen sensor | 11 | Retained | ● Harness and connector<br>● Oxygen sensor<br>● Fuel pressure<br>● Injectors (Replace if defective)<br>● Intake air leaks |
| 3 | Air flow sensor | 12 | Retained | ● Harness and connector (if harness and connector are normal, replace air flow sensor assembly.) |
| 4 | Intake air temperature sensor | 13 | Retained | ● Harness and connector<br>● Intake air temperature sensor |
| 5 | Throttle position sensor | 14 | Retained | ● Harness and connector<br>● Throttle position sensor<br>● Idle position switch |
| 6 | Engine coolant temperature sensor | 21 | Retained | ● Harness and connector<br>● Engine coolant temperature sensor |
| 7 | Crank angle sensor | 22 | Retained | ● Harness and connector (If harness and a connector are normal, replace distributor assembly.) |
| 8 | Cam position sensor | 23 | Retained | ● Harness and connector (If harness and a connector are normal, replace distributor assembly.) |
| 9 | Vehicle speed sensor (reed switch) | 24 | Retained | ● Harness and connector<br>● Vehicle speed sensor (reed switch) |
| 10 | Barometric pressure sensor | 25 | Retained | ● Harness and connector (If harness and connector are normal, replace barometric sensor assembly.) |

| Output preference order | Diagnosis item | Diagnosis code | | Check item (Remedy) |
|---|---|---|---|---|
| | | No. | Memory | |
| 11 | Detonation sensor <DOHC> | 31 | Retained | ● Harness and connector (If harness and connector are normal; replace detonation sensor.) |
| 12 | Ignition timing adjustment signal | 36 | — | ● Harness and connector |
| 13 | Injector | 41 | Retained | ● Harness and connector<br>● Injector oil resistance |
| 14 | EGR system | 43 | Retained | ● Harness and connector<br>● EGR temperature sensor<br>● EGR valve<br>● EGR solenoid<br>● EGR valve control vacuum |
| 15 | Ignition coil, Power transistor unit (No. 1–4 cylinder) | 44 | Retained | ● Harness and connector<br>● Ignition coil<br>● Power transistor unit |
| 16 | Ignition coil, Power transistor unit (No. 2–5 cylinder) | 52 | Retained | ● Harness and connector<br>● Ignition coil<br>● Power transistor unit |
| 17 | Ignition coil, Power transistor unit (No. 3–6 cylinder | 53 | Retained | ● Harness and connector<br>● Ignition coil<br>● Power transistor unit |
| 18 | Normal state | — | — | — |

NOTE
Replace the engine control unit if a malfunction code is output although the inspection reveals that there is no problem with the check items.

## TROUBLE DIAGNOSIS QUICK REFERENCE CHART

| Trouble code No. | Diagnosis item | Description | Major cause | Remarks (Symptoms, etc.) |
|---|---|---|---|---|
| – | Engine control unit | Trouble in engine control unit itself | – | ● Engine stalls<br>● Engine cannot be started. |
| 11 | Oxygen sensor | Air-fuel ratio feedback control (closed loop control) is in effect but oxygen sensor signal voltage does not change (air-fuel mixture lean/rich). | (1) Defective oxygen sensor<br>(2) Open or short circuit in oxygen sensor circuit, or connector in loose contact | ● Poor exhaust emission purifying performance |
| | | | (3) Improper fuel pressure<br>(4) Defective injector<br>(5) Air drawn in through gasket clearance, etc.<br>(6) Defective engine control unit | ● Poor exhaust emission purifying performance<br>● Poor startability<br>● Unstable idling<br>● Poor acceleration |
| 12 | Air flow sensor | Air flow sensor signal frequency 10Hz or less even with engine running | (1) Defective air flow sensor<br>(2) Open or short circuit in air flow sensor circuit, or connector in loose contact<br>(3) Defective engine control unit | ● Poor acceleration*<br>● Improper idling speed*<br>● Unstable idling* |
| 13 | Intake air temperature sensor | (1) Intake air temperature sensor signal voltage over 4.5V<br>(2) Intake air temperature sensor signal voltage less than 0.27V | (1) Defective intake air temperature sensor<br>(2) Open or short circuit in intake air temperature sensor circuit, or connector in loose contact<br>(3) Defective engine control unit | ● Somewhat poor driveability*<br>● At high temperatures<br>(a) Poor startability*<br>(b) Unstable idling* |
| 14 | Throttle position sensor | (1) Throttle position sensor signal voltage less than 0.2V<br>(2) Throttle position sensor signal voltage over 2V even with idle position switch at ON | (1) Throttle position sensor out of order or maladjusted<br>(2) Open or short circuit in throttle position sensor circuit, or connector in poor contact | ● Somewhat poor acceleration<br>● Engine stalls |
| | | | (3) Idle position switch ON failure<br>(4) Short circuit in idle position signal line<br>(5) Defective engine control unit | ● Engine stalls.<br>● Engine cannot be raced. |

NOTE
* : Failsafe/backup function is in operation.

| Trouble code No. | Diagnosis item | Description | Major cause | Remarks (Symptoms, etc.) |
|---|---|---|---|---|
| 21 | Engine coolant temperature sensor | (1) Engine coolant temperature sensor signal voltage over 4.6V<br>(2) Engine coolant temperature sensor signal voltage less than 0.11V<br>(3) Engine coolant temperature sensor signal indicates a low engine coolant temperature while the engine is in warmup operation. | (1) Defective engine coolant temperature sensor<br>(2) Open or short circuit in engine coolant temperature sensor circuit, or connector in poor contact<br>(3) Defective engine control unit | With engine cold<br>● Poor startability*<br>● Unstable idling*<br>● Poor acceleration* |
| 22 | Crank angle sensor | (1) Cranking the engine for more than four seconds does not cause the crank angle sensor signal voltage to change (go high or low).<br>(2) Abnormal crank angle sensor signal | (1) Defective crank angle sensor<br>(2) Open or short circuit in crank angle sensor circuit, or connector in loose contact<br>(3) Defective cam position sensor, or connector in loose contact<br>(4) Defective engine control unit | ● Engine stalls.<br>● Engine cannot be started. |
| 23 | Cam position sensor | (1) Cam position sensor signal voltage does not change (go high or low) even with the engine running.<br>(2) Abnormal top dead center signal pattern | (1) Defective cam position sensor<br>(2) Open or short circuit in cam position sensor circuit, or connector in loose contact<br>(3) Defective crank angle sensor, or connector in loose contact<br>(4) Defective engine control unit | ● Engine stalls.* |
| 24 | Vehicle speed sensor (reed switch) | With the engine in accelerated operation at an engine speed of over 3,000 r/min, the vehicle speed sensor signal voltage does not change (go high or low). | (1) Defective vehicle speed sensor<br>(2) Open or short circuit in vehicle speed sensor circuit, or connector in loose contact<br>(3) Defective engine control unit | When the vehicle is stopped with the engine in decelerated operation, the engine might stall. |

NOTE
* : Failsafe/backup function is in operation.

| Trouble code No. | Diagnosis item | Description | Major cause | Remarks (Symptoms, etc.) |
|---|---|---|---|---|
| 25 | Barometric pressure sensor | (1) Barometric pressure sensor signal voltage over 4.5V<br>(2) Barometric pressure sensor signal voltage less than 0.2V | (1) Defective barometric pressure sensor<br>(2) Open or short circuit in barometric pressure sensor circuit, or connector in loose contact<br>(3) Defective engine control unit | ● Unstable idling*<br>● Poor acceleration*<br>● Poor startability* |
| 31 | Detonation sensor <DOHC> | Abnormal detonation sensor signal voltage | (1) Defective detonation sensor<br>(2) Open or short circuit in detonation sensor circuit, or connector in loose contact<br>(3) Defective engine control unit | ● Poor acceleration* |
| 36 | Ignition timing adjustment signal | Ignition timing adjustment signal line short-circuited to earth | (1) Ignition timing adjustment signal line short-circuited to earth<br>(2) Defective engine control unit | ● Poor acceleration<br>● Overheated engine |
| 41 | Injector | Injector is not driven for more than four consecutive seconds during engine cranking or idling operation | (1) Defective injector<br>(2) Open or short circuit in injector circuit, or connector in loose contact<br>(3) Defective engine control unit | ● Poor idling<br>● Poor acceleration<br>● Poor startability |
| 44 | Ignition coil and power transistor unit for 1-4 cylinders | With the engine running, no ignition signal is input (except in cases where no ignition signal is input to all the cylinders) | (1) Defective ignition coil<br>(2) Open or short circuit in primary ignition circuit, or connector in loose contact<br>(3) Defective power transistor unit<br>(4) Defective engine control unit | ● Unstable idling*<br>● Poor acceleration*<br>● Poor startability* |
| 52 | Ignition coil and power transistor unit for 2-5 cylinders | With the engine running, no ignition signal is input (except in cases where no ignition signal is input to all the cylinders) | (1) Defective ignition coil<br>(2) Open or short circuit in primary ignition circuit, or connector in loose contact<br>(3) Defective power transistor unit<br>(4) Defective engine control unit | ● Unstable idling*<br>● Poor acceleration*<br>● Poor startability* |
| 53 | Ignition coil and power transistor unit for 3-6 cylinders | With the engine running, no ignition signal is input (except in cases where no ignition signal is input to all the cylinders) | (1) Defective ignition coil<br>(2) Open or short circuit in primary ignition circuit, or connector in loose contact<br>(3) Defective power transistor unit<br>(4) Defective engine control unit | ● Unstable idling*<br>● Poor acceleration*<br>● Poor startability* |

NOTE
* : Failsafe/backup function is in operation.

## LIST OF FAIL-SAFE/BACK-UP FUNCTIONS

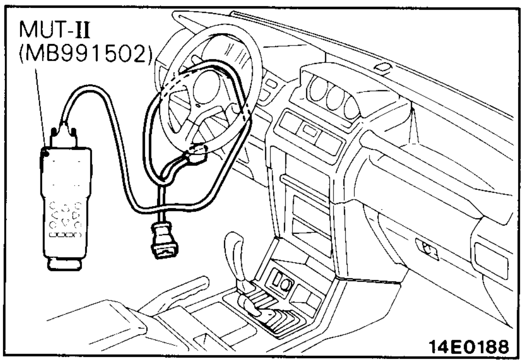
When the failure of a major sensor is detected by the self diagnosis functions, the preset control logic provides controls to assure safe operation of the vehicle.

| Trouble item | Controls to be provided in the event of trouble |
|---|---|
| Air flow sensor | (1) Injector basic drive timing and basic ignition timing read from the preset map based on the throttle position sensor (TPS) signal and engine speed signal (crank angle sensor signal).<br>(2) Idle speed control servo fixed at predetermined position, and no idling speed control achieved |
| Intake air temperature sensor | Controls provided on the assumption that intake air temperature is 25°C (77°F) |
| Throttle position sensor (TPS) | No additional fuel injection provided on the basis of throttle position sensor signal at acceleration |
| Engine coolant temperature sensor | Controls provided on the assumption that engine coolant temperature is 80°C (176°F)<br>(Even if the sensor signal returns to normal, this control mode is retained until the ignition switch is set to OFF.) |
| Cam position sensor | (1) Fuel injected into all cylinders simultaneously<br>(Provided that no No. 1 cylinder top dead center has been detected since the ignition switch was placed in the ON position)<br>(2) Fuel cut 4 seconds after a failure was detected<br>(Provided that no No. 1 cylinder top dead center has been detected since the ignition switch was placed in the ON position) |
| Barometric pressure sensor | Controls provided on the assumption that barometric pressure is 101 kPa (758 mm Hg, 29.8 in. Hg) |
| Detonation sensor <DOHC> | The ignition timing is switched from the timing for super petrol to the timing for standard petrol. |
| Ignition coil and power transistor unit | Fuel cut for cylinders whose ignition signal is abnormal |
| Oxygen sensor | No air-fuel ratio feedback control (closed loop control) achieved |

## READ OUT OF MALFUNCTION CODE

### Precautions for Operation

(1) When battery voltage is low, no detection of failure is possible. Be sure to check the battery for voltage and other conditions before starting the test.
(2) Diagnosis item is erased if the battery or the engine control unit connector is disconnected. Do not disconnect the battery before the diagnosis result is completely read.
(3) Be sure to connect or disconnect the MUT-II with the ignition switch turned off.

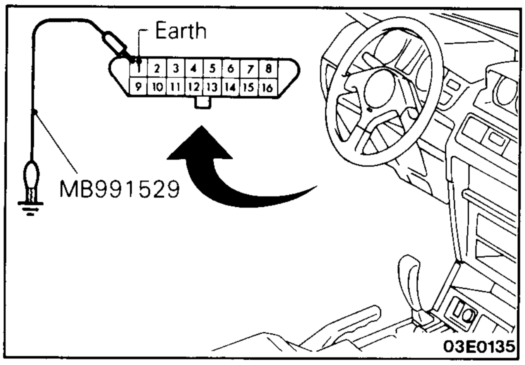


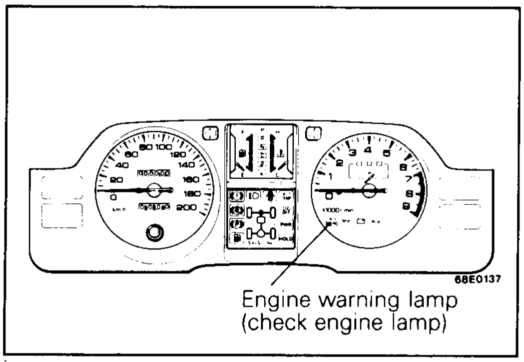
### WHEN USING THE MUT-II

**Caution**

**Turn off the ignition switch before disconnecting or connecting the MUT-II.**

(1) Connect the MUT-II to the self-diagnosis connector.
(2) Turn the ignition switch to ON.
(3) Take a reading of the self-diagnosis output.
(4) Repair the problem location, referring to the diagnosis chart.
(5) After turning the ignition switch once to OFF, turn it back to ON.
(6) Erase the malfunction code.
(7) Recheck to be sure that the condition is normal.

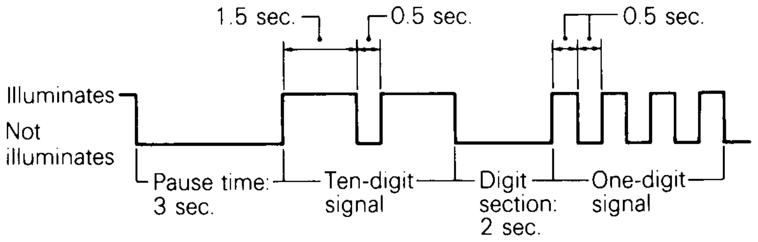
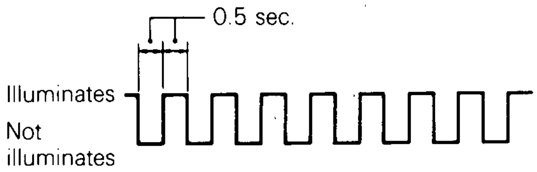




### WHEN USING THE ENGINE WARNING LAMP (CHECK ENGINE LAMP)

(1) Use the special tool (diagnosis code check harness) to earth the diagnosis test mode control terminal (terminal ①) of the diagnosis control terminal (16 pin).
(2) Turn the ignition switch to ON.
(3) Take a reading of a diagnosis output according to how often the engine warning lamp flashes.
(4) Repair the problem location, referring to the diagnostic chart.
(5) Erase the diagnostic trouble code by the following procedure.
   ① Turn the ignition switch to OFF.
   ② After removing the battery cable from the battery terminals for 10 seconds or more, reconnect the cable.
   ③ Warm up the engine and let it idle for approx. 15 minutes.
   ④ Turn the ignition switch to ON and take a reading of the diagnostic output to check if a normal code is output.

## DIAGNOSIS RESULT DISPLAY METHOD USING THE CHECK ENGINE/MALFUNCTION INDICATOR LAMP

| Example of flashing patterns when diagnosis code outputs | Normal flashing pattern |
|---|---|
| Diagnostic trouble code No. 24<br><br> <br>6FU2060 | <br> <br>6FU2061 |

NOTE
Other diagnosis items are also output as lamp flashing corresponding to MUT-II diagnosis code numbers.

### Diagnosis by DIAGNOSIS 2 MODE

(1) Using the MUT-II, changeover the diagnosis mode of the engine control unit to DIAGNOSIS 2 MODE.
(2) Carry out a road test.
(3) Read the diagnosis code in the same manner as "READ OUT OF MALFUNCTION CODE" and repair the malfunctioning part.
(4) Turn the ignition switch OFF and then turn it ON again.

NOTE
By turning the ignition switch OFF, the engine control unit will changeover the diagnosis mode from DIAGNOSIS 2 MODE to DIAGNOSIS 1 MODE.

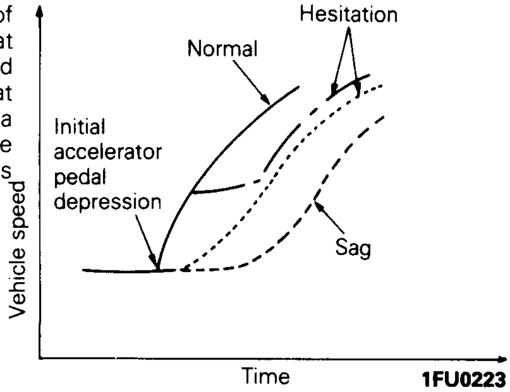
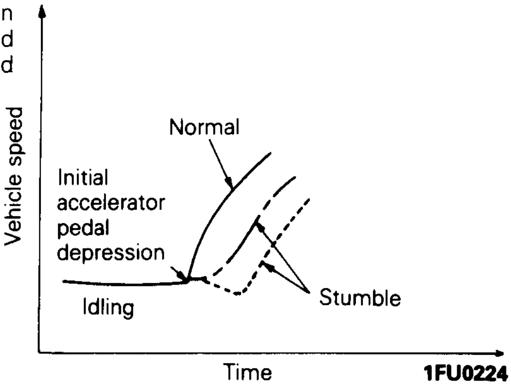
(5) Erase the malfunction codes.

## CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

| Problem symptoms / Check Items | Starting | | Idling stability | | | Driving | | | | | | Stopping | Reference page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Will not start | Starting problem | Idling instability (Rough idling) | Incorrect idling speed | Improper idling continuity | Hesitation, sag | Poor acceleration | Stumble | Shock | Surge | Knocking | Run-on (Dieseling) | |
| Power Supply and Ignition Switch-IG | ①$\boxed{1}$ | | | | | | | | | | | | P.13-79-34 |
| Engine Control Unit Power Earth | ②$\boxed{2}$ | | | | | | | | | | | | P.13-79-37 |
| Fuel Pump | ③$\boxed{3}$ | ①$\boxed{1}$ | | | ①$\boxed{1}$ | ①$\boxed{1}$ | ①$\boxed{1}$ | | | | | | P.13-79-38 |
| Air Flow Sensor | | | | | ⑪$\boxed{11}$ | ⑩$\boxed{10}$ | | ⑤$\boxed{5}$ | ⑤$\boxed{5}$ | | ④$\boxed{4}$ | | P.13-79-41 |
| Intake Air Temperature Sensor | | | ⑤ | | | ⑥$\boxed{6}$ | ⑤$\boxed{5}$ | | | | ②$\boxed{2}$ | | P.13-79-46 |
| Barometric Pressure Sensor | | | ⑦ | | | ⑨$\boxed{9}$ | ⑦$\boxed{7}$ | | | | ③$\boxed{3}$ | | P.13-79-49 |
| Engine Coolant Temperature Sensor | | $\boxed{3}$ | ⑥$\boxed{5}$ | ①$\boxed{1}$ | ⑤$\boxed{5}$ | ⑧$\boxed{8}$ | ⑥$\boxed{6}$ | ④$\boxed{4}$ | | ③$\boxed{3}$ | | | P.13-79-51 |
| Throttle Position Sensor | | | | | | ⑦$\boxed{7}$ | | ③$\boxed{3}$ | ④$\boxed{4}$ | | | | P.13-79-54 |
| Idle Position Switch | | | ③$\boxed{3}$ | ②$\boxed{2}$ | ④$\boxed{4}$ | | | | | | | | P.13-79-57 |
| Cam Position Sensor | ⑤$\boxed{5}$ | ⑥$\boxed{7}$ | | | ⑧$\boxed{7}$ | | | | ②$\boxed{2}$ | | | | P.13-79-60 |
| Crank Angle Sensor | ⑥$\boxed{6}$ | ⑦$\boxed{8}$ | | | ⑨$\boxed{8}$ | | | | ③$\boxed{3}$ | | | | P.13-79-64 |
| Ignition Switch-ST <M/T> | ④$\boxed{4}$ | ③$\boxed{4}$ | | | | | | | | | | | P.13-79-67 |
| Ignition Switch-ST and Inhibitor Switch <A/T> | ④$\boxed{4}$ | ③$\boxed{4}$ | | ⑤ | | | | | | | | | P.13-79-68 |
| Vehicle Speed Sensor | | | | | ⑥ | | | | ⑥ | | | | P.13-79-70 |
| Power Steering Fluid Pressure Switch | | | | ③ | | | | | | | | | P.13-79-72 |
| Air Conditioner Switch and Power Relay | | | | ④ | | | | | | | | | P.13-79-74 |
| Detonation Sensor <DOHC> | | | | | | | | | | | ①$\boxed{1}$ | | P.13-79-76 |
| Oxygen Sensor | | | ⑨ | | | | | | | | | | P.13-79-80 |
| Injectors | ⑧$\boxed{8}$ | ②$\boxed{2}$ | ②$\boxed{2}$ | | ③$\boxed{3}$ | ②$\boxed{2}$ | ②$\boxed{2}$ | ①$\boxed{1}$ | | ①$\boxed{1}$ | | ① | P.13-79-83 |
| Idle Speed Control Servo (Stepper Motor) | | ④$\boxed{5}$ | ①$\boxed{1}$ | ⑥$\boxed{3}$ | ②$\boxed{2}$ | | | | ⑧$\boxed{6}$ | | | | P.13-79-88 |
| Ignition Coil and Power Transistor | ⑦$\boxed{7}$ | | | | ⑩$\boxed{9}$ | | ⑦$\boxed{7}$ | | ①$\boxed{1}$ | | ⑤$\boxed{5}$ | | P.13-79-93, 99 |
| Variable Induction Control Solenoid Valve | | | | | | ④$\boxed{4}$ | ④$\boxed{4}$ | | | | | | P.13-79-103 |
| Purge Solenoid | | | ⑧ | | | | | | | | | | P.13-79-105 |
| EGR Control Solenoid Valve | | | | | | ⑤$\boxed{5}$ | | ⑥$\boxed{6}$ | | ④$\boxed{4}$ | | | P.13-79-107 |
| Anti-skid Brake Signal | | | | | | | | | ⑦ | | | | P.13-79-109 |
| Fuel Pressure | | ⑤$\boxed{6}$ | ④$\boxed{4}$ | | ⑦$\boxed{6}$ | ③$\boxed{3}$ | ③$\boxed{3}$ | ②$\boxed{2}$ | | ②$\boxed{2}$ | | | P.13-79-110, 113 |

○ : Warm engine (figures inside the ○ indicate the checking sequence.)
☐ : Cold engine (figures inside the ☐ indicate the checking sequence.)

## PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

| Item | | Symptom |
|---|---|---|
| Starting | Won't start<br>(no initial combustion) | The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start. |
| | Starting problem<br>(initial combustion, then stall) | There is combustion within the cylinders, but then the engine soon stalls. |
| | (Starting takes a long time.) | Engine won't start quickly. |
| Idling stability | Idling instability<br>(Rough idling) | Engine speed doesn't remain constant; changes during idling.<br>Usually, a judgement can be based upon the movement of the tachometer pointer, and the vibration transmitted to the steering wheel, shift lever, body, etc. This is called rough idling. |
| | Incorrect idling speed | The engine doesn't idle at the usual correct speed. |
| | Improper idling continuity<br>Die out<br>Pass out | This non-continuity of idling includes the following elements.<br>(1) Die out ....... The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicle is moving or not.<br>(2) Pass out ..... The engine stalls when the accelerator pedal is depressed or while it is being used. |
| Driving | Hesitation<br>Sag | "Hesitation" is the delay in response of the vehicle speed (engine r/min) that occurs when the accelerator is depressed in order to accelerate from the speed at which the vehicle is now traveling, or a temporary drop in vehicle speed (engine r/min) during such acceleration. Serious hesitation is called "sag".<br> <br>1FU0223 |
| | Poor acceleration | Poor accleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth, or the inability to reach maximum speed. |
| | Stumble | Engine r/min response is delayed when the accelerator pedal is initially depressed for acceleration from the stopped condition.<br> <br>1FU0224 |
| | Shock | The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated. |
| | Surge | This is repeated surging ahead during constant speed travel or during variable speed travel. |
| | Knocking | A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving. |
| Stopping | Run-on (Dieseling) | The engine continues to run even after the switch is turned OFF. This is called dieseling. |

# SERVICE ADJUSTMENT PROCEDURES

## ACCELERATOR CABLE INSPECTION AND ADJUSTMENT <VEHICLES WITHOUT AUTO-CRUISE CONTROL SYSTEM> E13FCAZ3

Refer to P.13-14.

For models equipped with the auto-cruise control system, refer to P.13-188.

## FUEL FILTER REPLACEMENT E13FZAM

Refer to P.13-14.

## FUEL GAUGE UNIT REPLACEMENT E13FDAD

Refer to P.13-15.

## 2-WAY VALVE REPLACEMENT E13FFAD

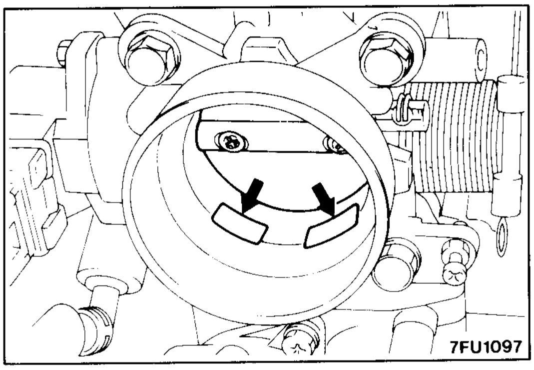
Refer to P.13-15.

## FUEL PUMP OPERATION CHECK E13FGCF

Refer to P.13-15.

## HOW TO REDUCE THE FUEL LINE INTERNAL PRESSURE E13HABH

Refer to P.13-16.



## THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

(1) Start the engine and warm it up until the temperature of the engine coolant reaches 80°C (176°F) or higher; then stop the engine.
(2) Disconnect the air intake hose at the throttle body side.
(3) Plug the bypass intake port inlet in the throttle body.

**Caution**
**Never let cleaning liquid get into the bypass intake.**

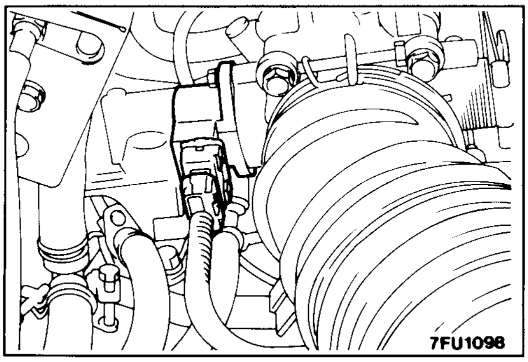
(4) Spray cleaning liquid (from the intake port of the throttle body) onto the valve, and then leave as is for about five minutes.
(5) Start the engine and race it a few times; then let it run at idle speed for about one minute.

NOTE
The engine idling speed becomes unstable (or the engine stalls) if the by-pass passage is plugged, (or the engine stalls), let the engine run with the throttle valve slightly open.

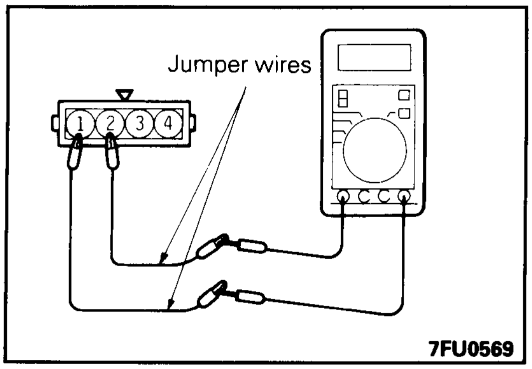
(6) If deposits are not removed from the throttle valve, repeat steps (4) and (5).
(7) Remove the plug from the bypass intake port inlet in the throttle body.
(8) Connect the air intake hose.
(9) Using the MUT-II, erase the self-diagnosis code or disconnect the negative battery cable for more than 10 seconds and then connect it again.
(10) Adjust the basic idle speed. (Refer to P.13-79-24)

NOTE
If hunting of the idling engine occurs after adjusting the basic idling speed, remove the battery (–) cable from the battery terminal for more than 10 seconds, and then idle the engine again.

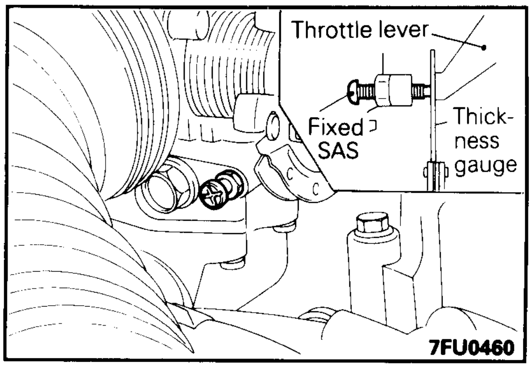
## IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT



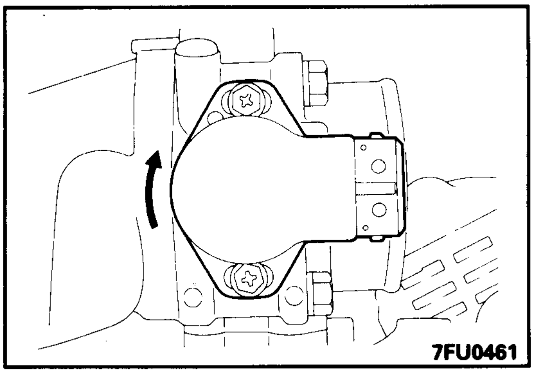
(1) Disconnect the connector of the throttle-position sensor.



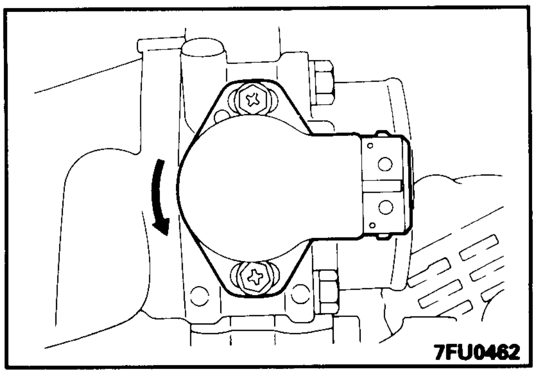
(2) Using jumper wires, connect an ohmmeter across terminal ② (idle position switch) and terminal ① (sensor earth) of the throttle position sensor.



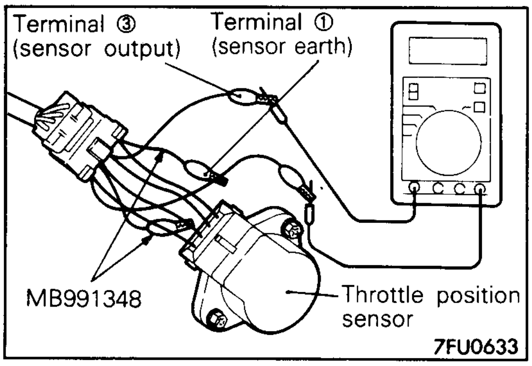
(3) Insert a 0.65 mm (0.0256 in.) thick thickness gauge between the fixed SAS and throttle lever.



(4) Loosen the throttle position sensor mounting bolts and turn the throttle position sensor body fully clockwise.
(5) In this condition, check that there is continuity across terminals ① and ②.



(6) Slowly turn the throttle position sensor counterclockwise until you find a point at which there is no continuity across terminals ① and ②. Then, tighten the throttle position sensor mounting bolt securely.
(7) Connect the throttle position sensor connector.



(8) If the MUT-II is used, connect it to the diagnosis connector.
(9) If a MUT-II is not used, perform the following operation.
  ① Disconnect the throttle position sensor's connector and make connections between the two disconnceted connector valves using the special tool (test harness set).
  ② Connect a digital voltmeter between terminal ③ (sensor output) and terminal ① (sensor earth) of the throttle position sensor.
(10)Switch ON the ignition switch.
(Do not start the engine.)
(11) Check the output voltage of the throttle-position sensor. Note, if the MUT-II is used, that item No. 14 should be selected to get the read-out of the throttle-position sensor's output voltage.

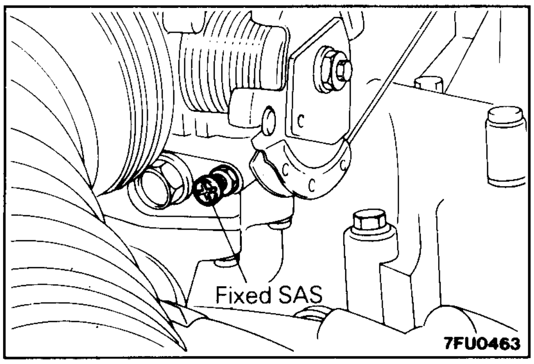
**Standard value : 400–1,000 mV**

(12)If the voltage is out of specification, check the throttle position sensor and associated harnesses.
(13)Remove the feeler gauge.
(14)Turn the ignition switch OFF.

## FIXED SAS ADJUSTMENT

NOTE
1. The fixed SAS has been factory-adjusted. Never attempt to move it.
2. Should it be out of proper adjustment, adjust by following the procedure given below.

(1) Sufficiently slacken the accelerator cable.
(2) Loosen the lock nut on the fixed SAS.
(3) Sufficiently loosen the fixed SAS by turning it counterclockwise to fully close the throttle valve.



(4) Tighten the fixed SAS slowly to find a point at which it contacts the throttle lever (where the throttle valve starts opening). From that point, tighten the fixed SAS further 1¼ turns.
(5) Holding the fixed SAS to prevent it from turning, tighten the lock nut securely.
(6) Adjust the accelerator cable tension. (Refer to P.13-79-21)
(7) Adjust the basic idle speed.
(8) Adjust the idle position switch and throttle position sensor (TPS). (Refer to P.13-79-22)

## BASIC IDLE SPEED ADJUSTMENT

NOTE

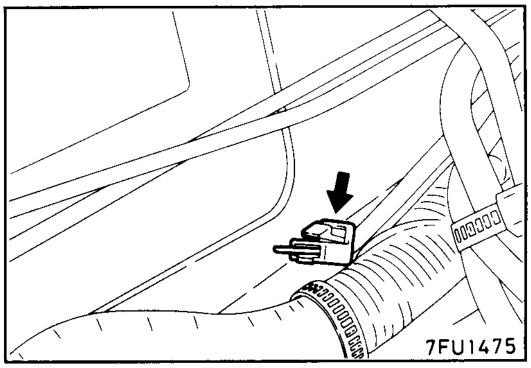
1. The basic idle speed has been factory-adjusted with the speed adjusting screw (SAS) and does not normally require adjustment.
2. If the adjustment is required, first check that the ignition plug, injector, ISC servo, and compression pressure are normal.

(1) Before starting the inspection and adjustment procedures, set the vehicle in the following conditions:
- Engine coolant temperature: 80 to 95°C (176 to 205°F)
- Lamps, accessories: OFF
- Transmission: Neutral (P for vehicles with an automatic transmission)

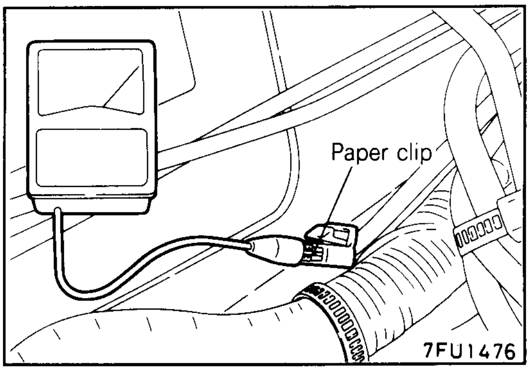
(2) If the MUT-II is used, connect it to the diagnosis connector.

NOTE
When the MUT-II is connected, the diagnostic control terminal is earthed.

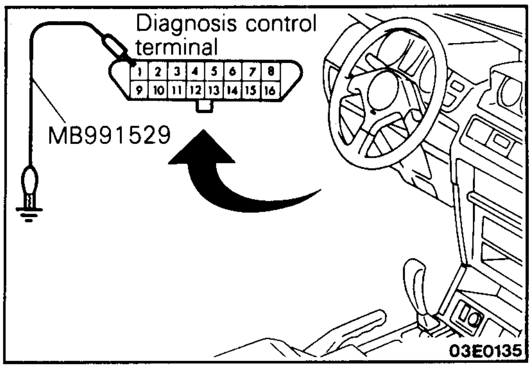
(3) If the MUT-II is not used, follow the steps below.



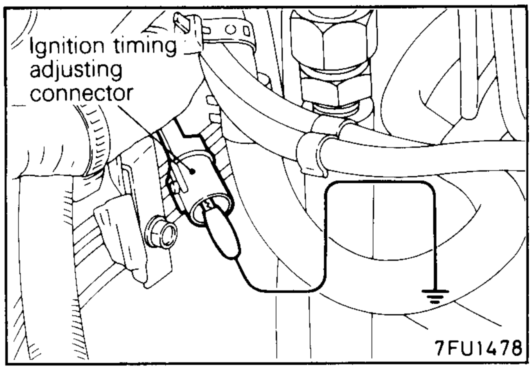
① Insert a paper clip into the 1-pin connector shown in the figure at the left.



② Connect a primary-voltage-detection type of tachometer to the paper clip.



③ Use the special tool (diagnosis code check harness) to earth the diagnosis test mode control terminal (terminal (1)) of the diagnosis control terminal (16 pin).



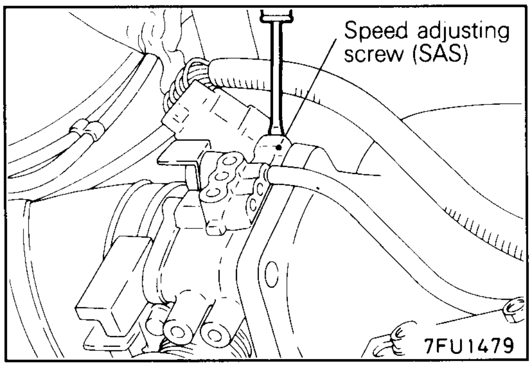
(4) Remove the water-resistant female connector from the ignition timing adjusting connector.
(5) Use a jumper wire to earth the terminal for adjustment of ignition timing.

(6) Start the engine and let it idle.
(7) Check the standard idling speed.

**Standard value: 700 ± 50 r/min.**

NOTE

1. The engine speed may be 20 to 100 r/min. lower than indicated above for a new vehicle (driven approximately 500 km (300 miles) or less), but no adjustment is necessary.
2. If the engine stalls or the r/min. is low even though the vehicle has been driven approximately 500 km (300 miles) or more, it is probable that deposits are adhered to the throttle valve, so clean it. (Refer to P.13-79-21)



(8) If not within the standard value range, turn the speed adjusting screw (SAS) to make the necessary adjustment.

NOTE

If the idling speed is higher then the standard value range even when the SAS is fully closed, check whether or not there is any indication that the fixed SAS has been moved. If there is an indication that it has been moved, adjust the fixed SAS. If there are no indications that it has been moved, it is possible that there is leakage as a result of deterioration of the fast idle air valve (FIAV), and, if so, the throttle body should be replaced.

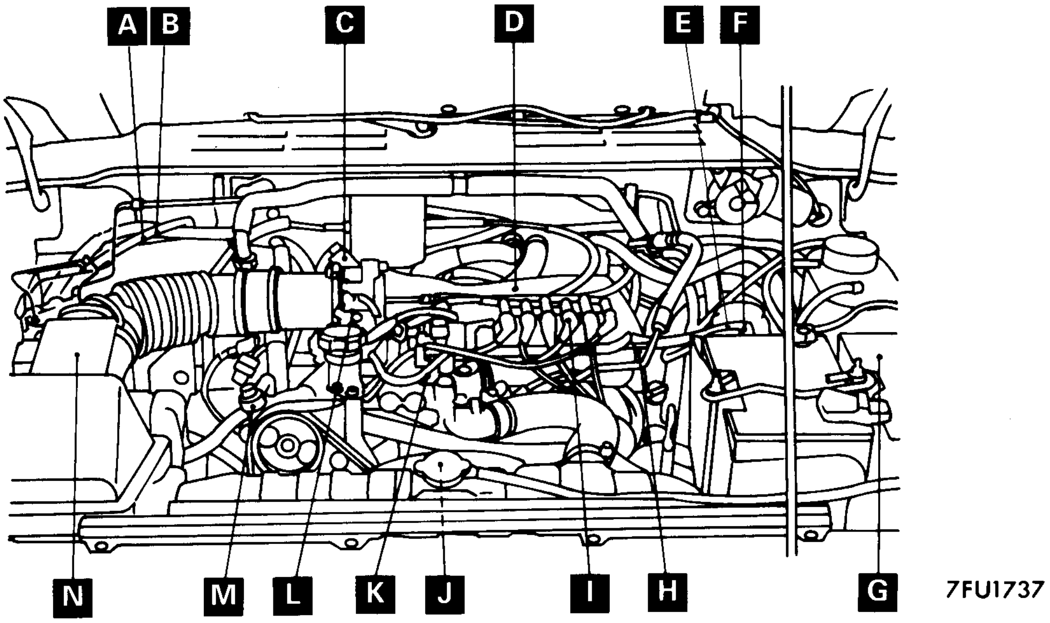
(9) Switch OFF the ignition switch.
(10) If the MUT-II was not used, disconnect the jumper wire from the diagnosis control terminal.
(11) Disconnect the jumper wire from the terminal for adjustment of ignition timing, and return the connector to its original condition.
(12) Start the engine again and let it run at idle speed for about ten minutes; check to be sure that the idling condition is normal.

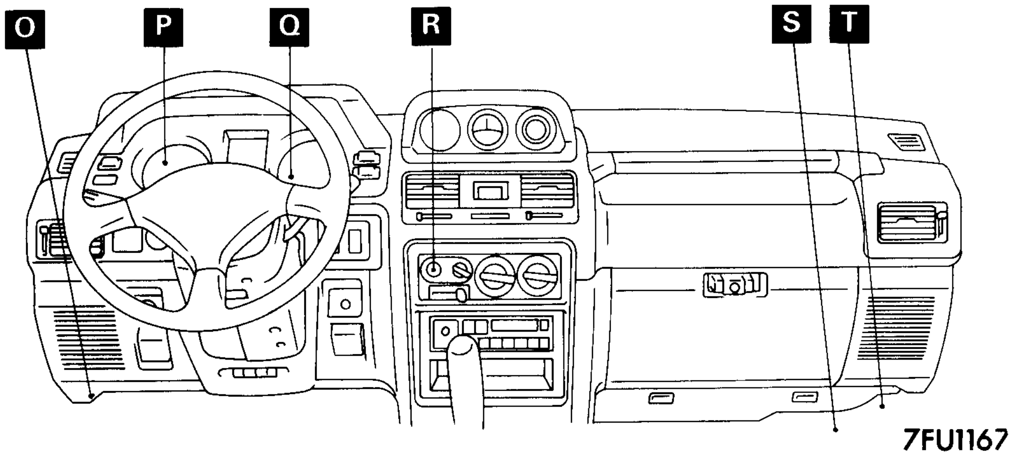
# ON-VEHICLE INSPECTION OF MPI COMPONENTS

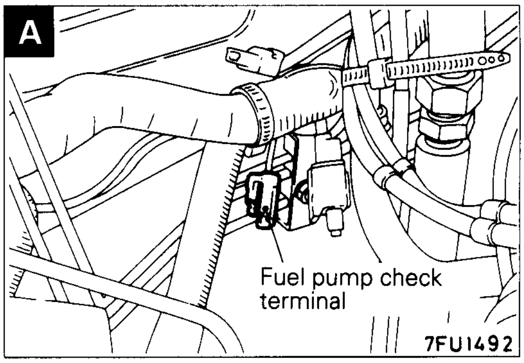
## COMPONENT LOCATION

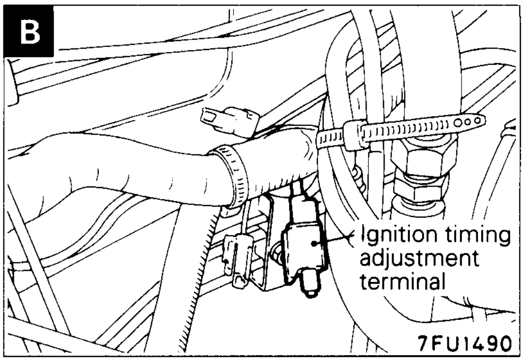
### <SOHC>

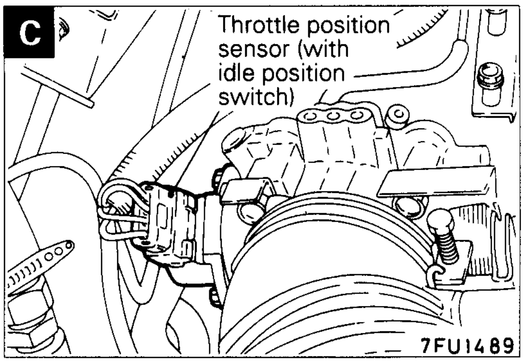
| Name | Symbol | Name | Symbol |
|---|---|---|---|
| Air conditioner relay | G | Fuel pump check terminal | A |
| Air conditioner switch | R | Idle speed control servo | L |
| Air flow sensor (incorporating intake air temperature sensor and barometric pressure sensor) | N | Ignition coil (power transistor) | I |
| | | Ignition timing adjustment terminal | B |
| Cam position sensor | H | Inhibitor switch | U |
| Control relay | T | Injector | D |
| Crank angle sensor | J | Oxygen sensor | V |
| Diagnosis connector | O | Power steering fluid pressure switch | M |
| EGR control solenoid valve | E | Purge control solenoid valve | F |
| Engine control unit | S | Throttle position sensor (with idle position switch) | C |
| Engine coolant temperature sensor | K | | |
| Engine warning lamp (check engine lamp) | Q | Vehicle speed sensor | P |

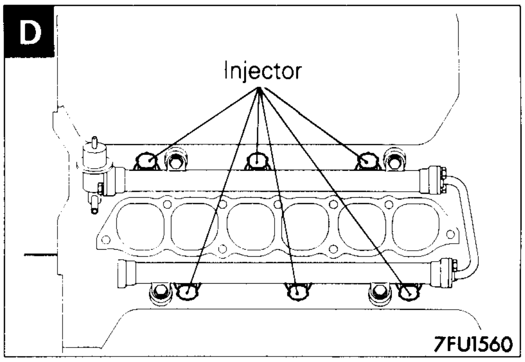


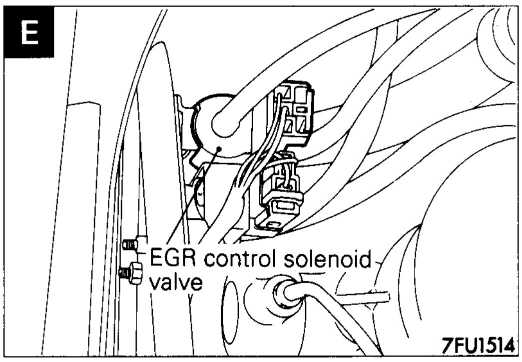


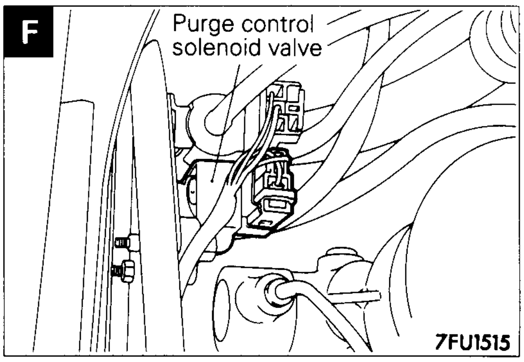

A
Fuel pump check terminal
7FU1492

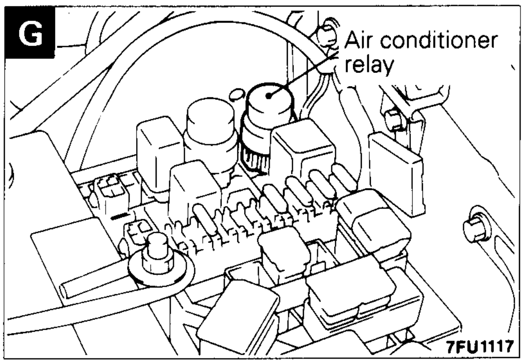

B
Ignition timing adjustment terminal
7FU1490

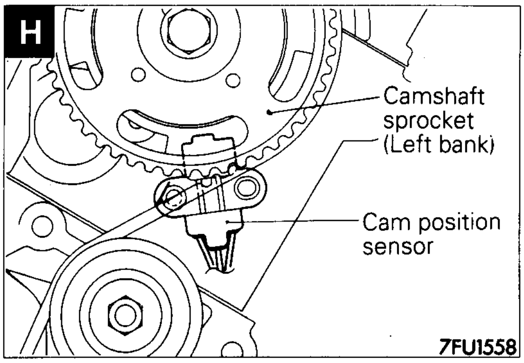

C
Throttle position sensor (with idle position switch)
7FU1489

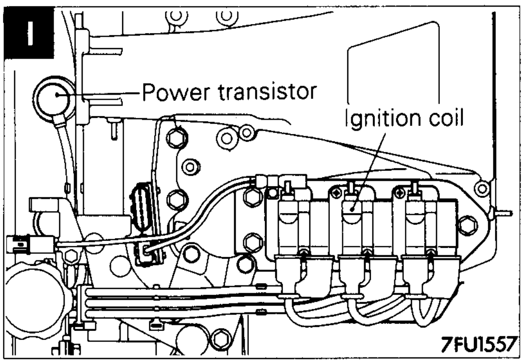

D
Injector
7FU1560

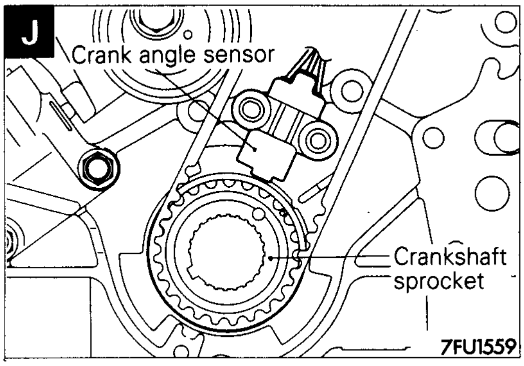

E
EGR control solenoid valve
7FU1514

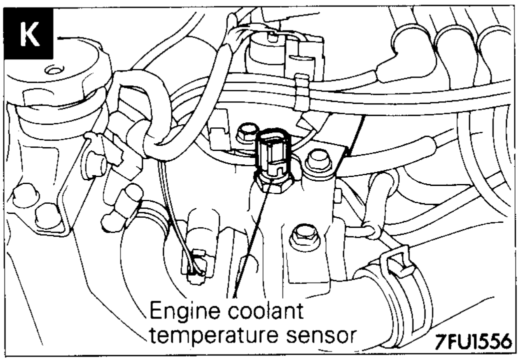

F
Purge control solenoid valve
7FU1515

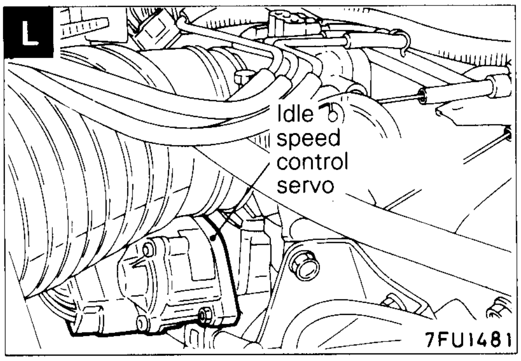

G
Air conditioner relay
7FU1117

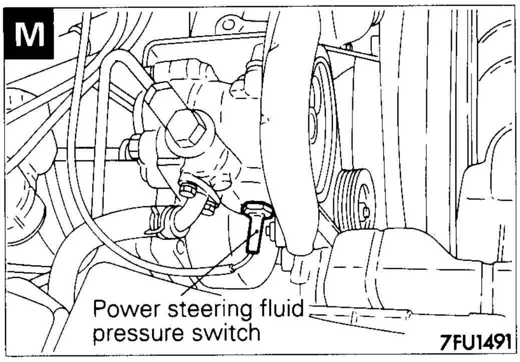

H
Camshaft sprocket (Left bank)
Cam position sensor
7FU1558

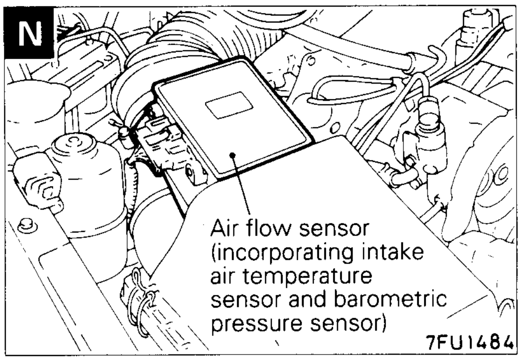

I
Power transistor
Ignition coil
7FU1557

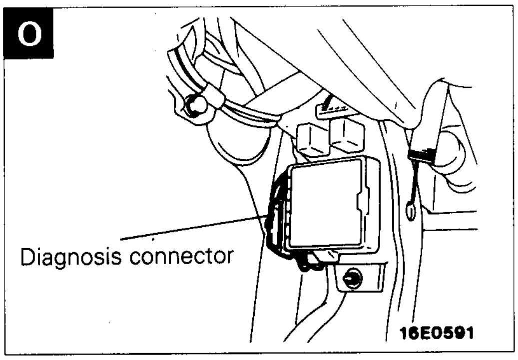

J
Crank angle sensor
Crankshaft sprocket
7FU1559

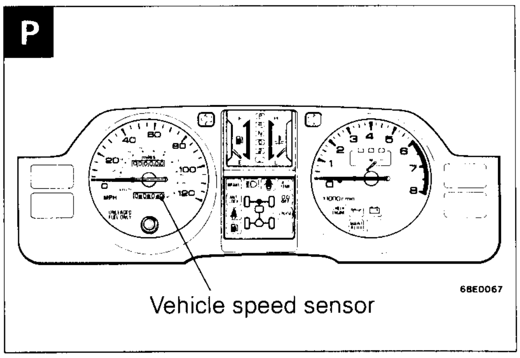

K
Engine coolant temperature sensor
7FU1556

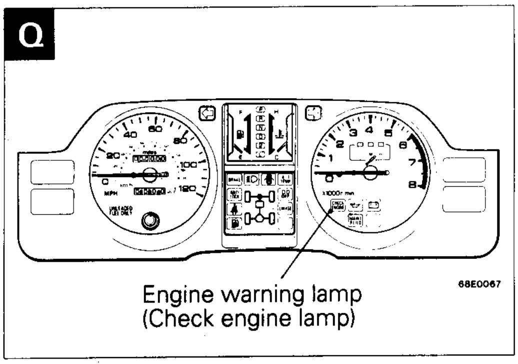

L
Idle speed control servo
7FU1481

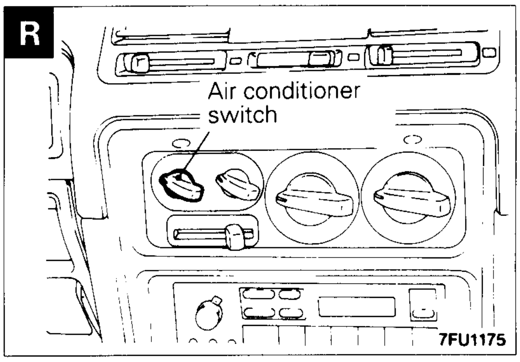

M
Power steering fluid pressure switch
7FU1491

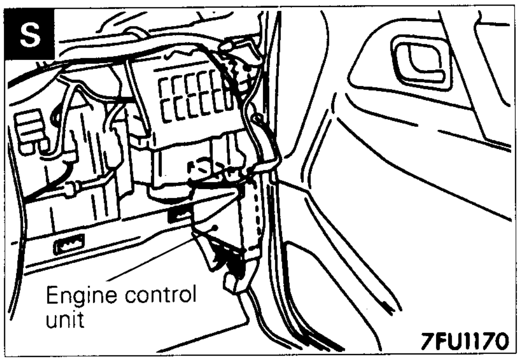

N
Air flow sensor (incorporating intake air temperature sensor and barometric pressure sensor)
7FU1484

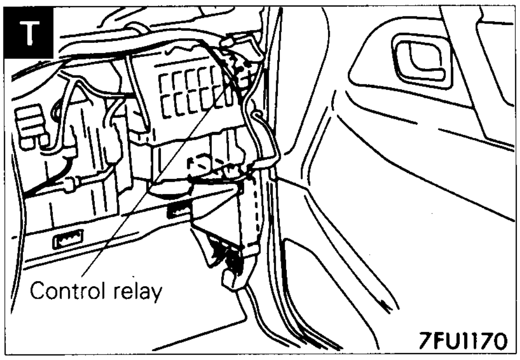

O
Diagnosis connector
16E0591

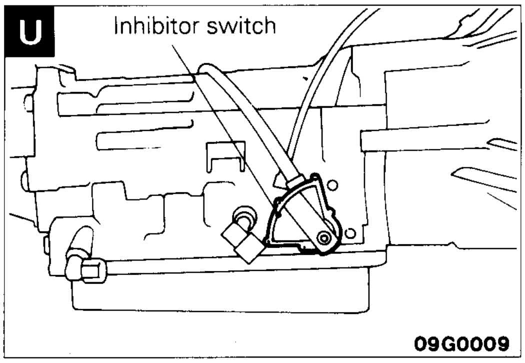

P
Vehicle speed sensor
68E0067

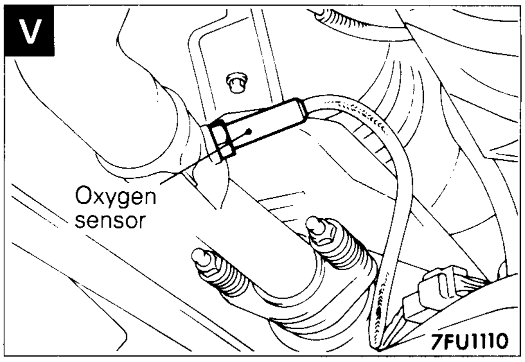

Q
Engine warning lamp (Check engine lamp)
68E0067


R
Air conditioner switch
7FU1175


S
Engine control unit
7FU1170

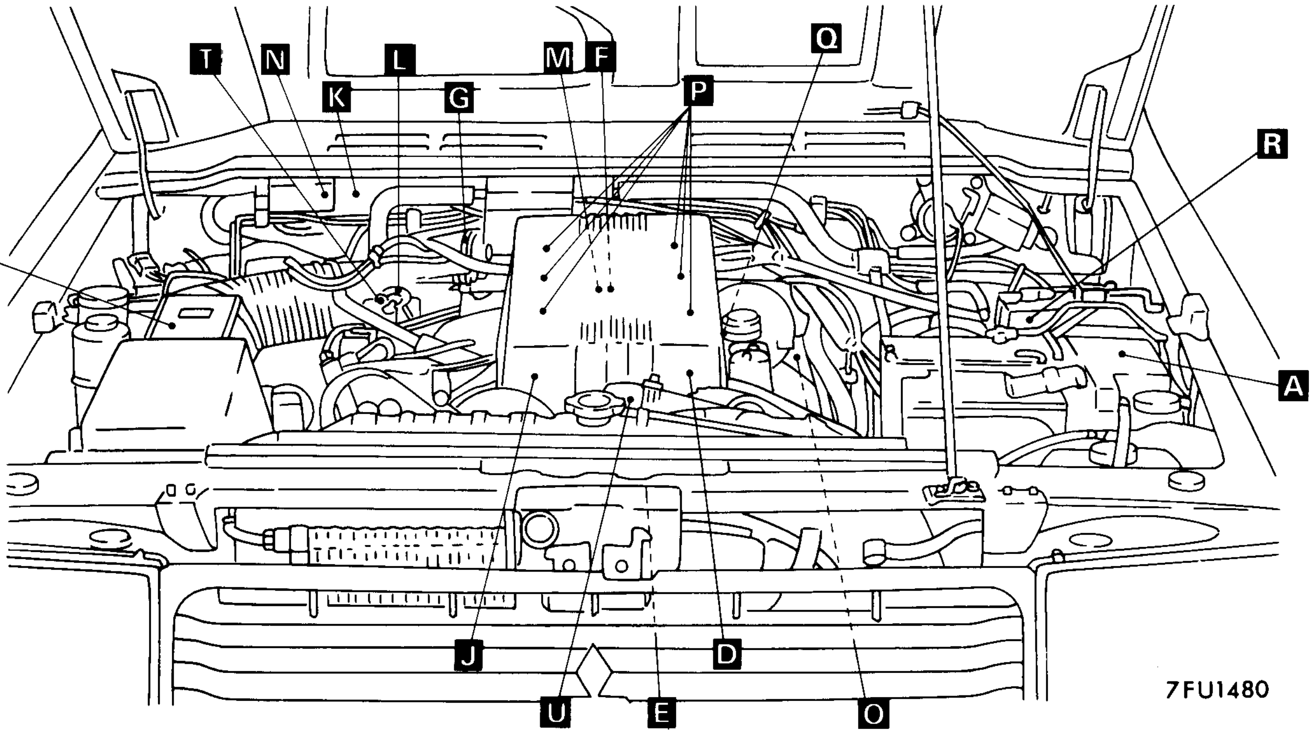

T
Control relay
7FU1170


U
Inhibitor switch
09G0009

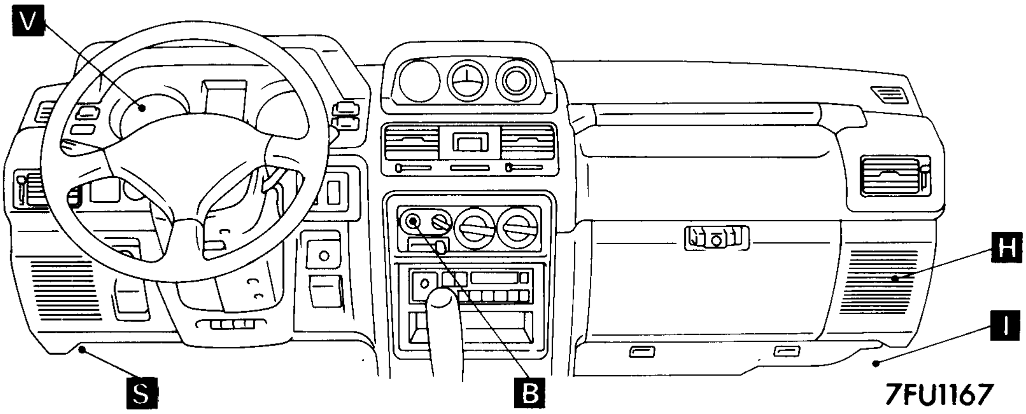

V
Oxygen sensor
7FU1110

## <DOHC>

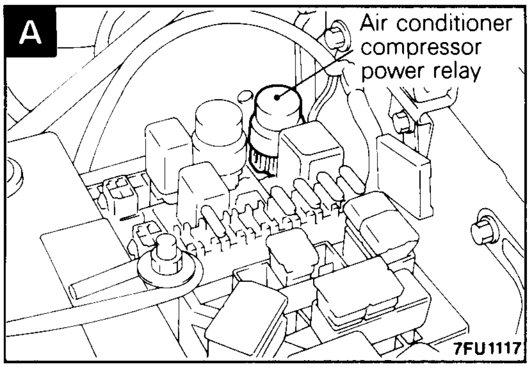
| Name | Symbol | Name | Symbol |
|---|---|---|---|
| Air conditioner relay | A | Idle speed control servo | L |
| Air conditioner switch | B | Ignition coil (power transistor) | M |
| Air flow sensor (incorporating intake air temperature sensor and barometric pressure sensor) | C | Ignition timing adjustment terminal | N |
| Cam position sensor | D | Inhibitor switch | O |
| Crank angle sensor | E | Injector | P |
| Detonation sensor | F | Oxygen sensor | Q |
| EGR control solenoid valve | G | Purge control solenoid valve | R |
| Engine control relay | H | Self-diagnosis connector | S |
| Engine control unit | I | Throttle position sensor (with idle position switch) | T |
| Engine coolant temperature sensor | J | Variable induction control solenoid valve | U |
| Fuel pump check terminal | K | Vehicle-speed sensor (reed switch) | V |

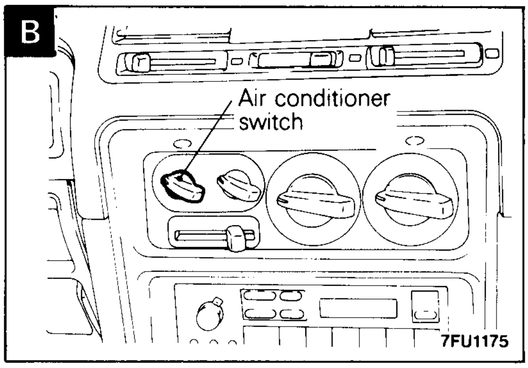


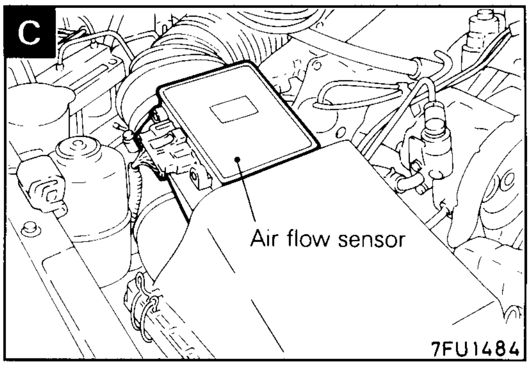
7FU1480

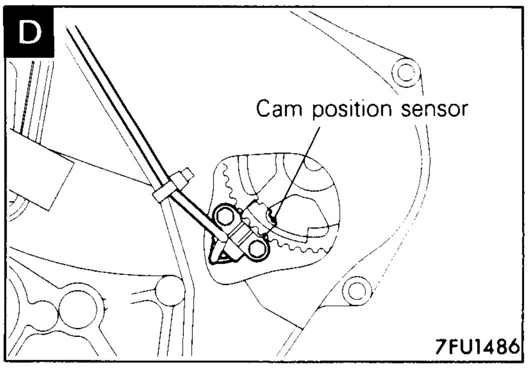


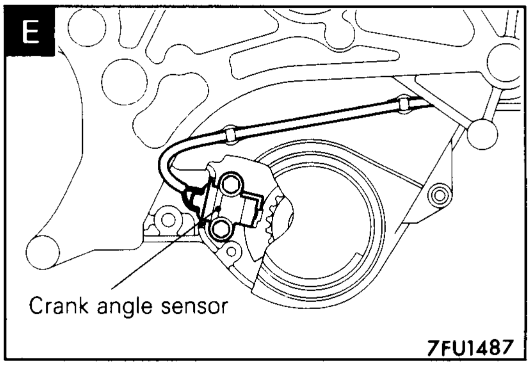
7FU1167

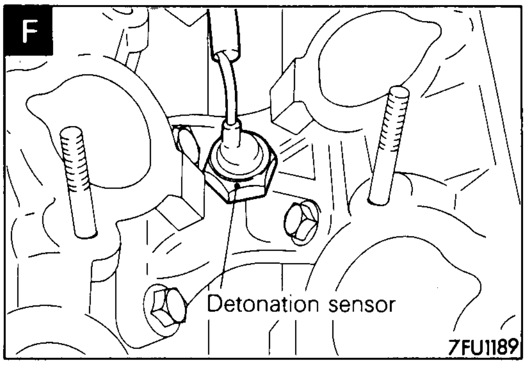

A
Air conditioner compressor power relay
7FU1117

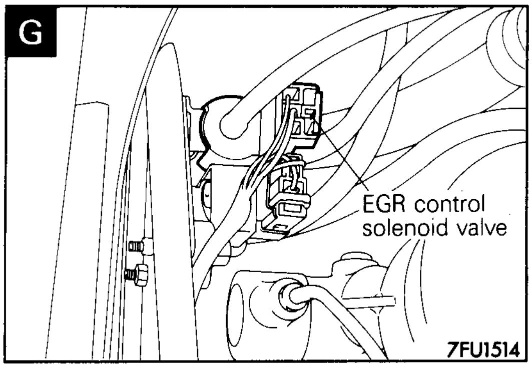

B
Air conditioner switch
7FU1175

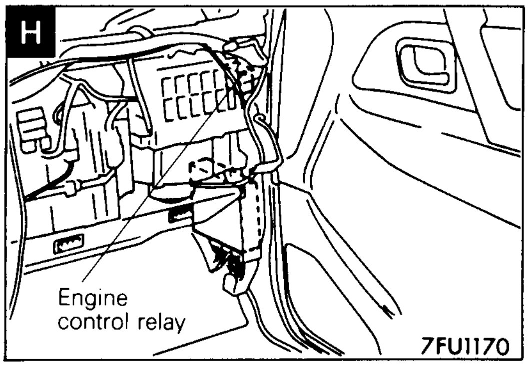

C
Air flow sensor
7FU1484

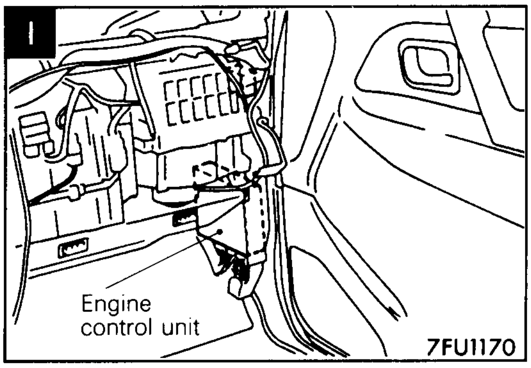

D
Cam position sensor
7FU1486

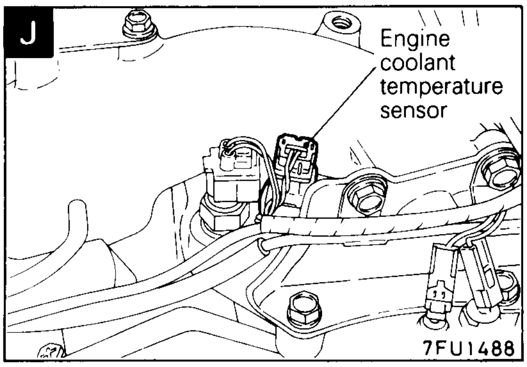

E
Crank angle sensor
7FU1487

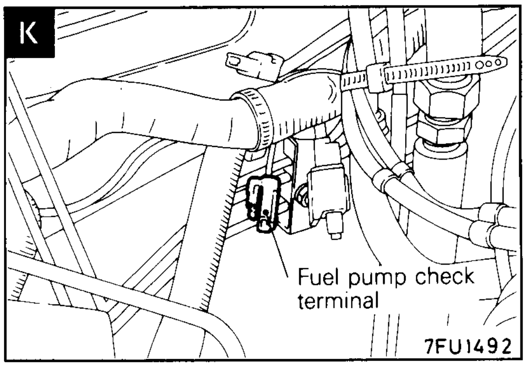

F
Detonation sensor
7FU1189

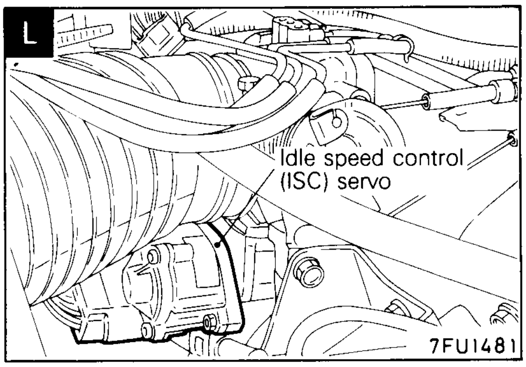

G
EGR control solenoid valve
7FU1514

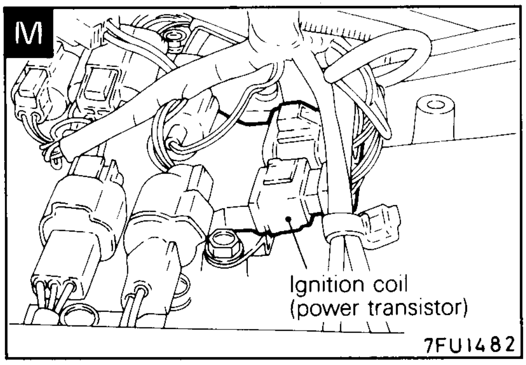

H
Engine control relay
7FU1170

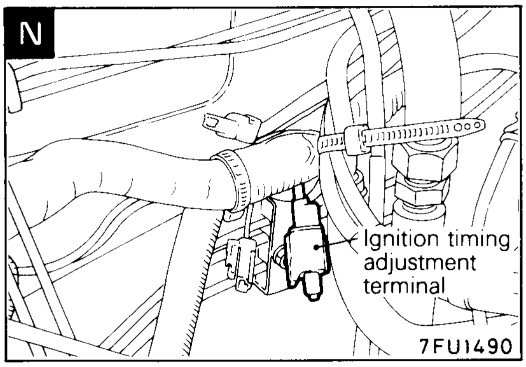

I
Engine control unit
7FU1170

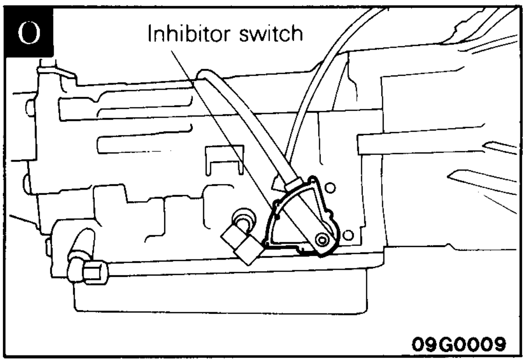

J
Engine coolant temperature sensor
7FU1488

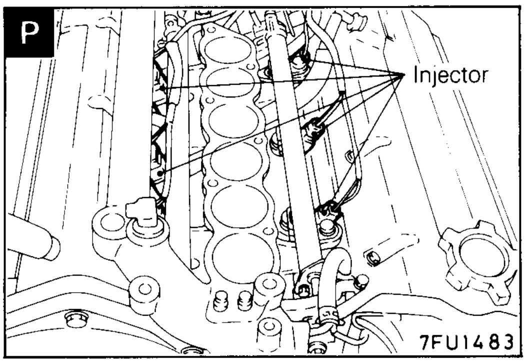

K
Fuel pump check terminal
7FU1492

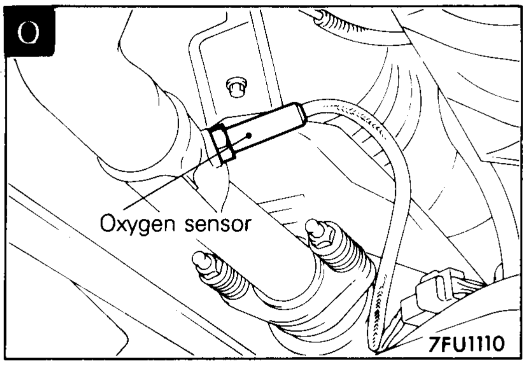

L
Idle speed control (ISC) servo
7FU1481

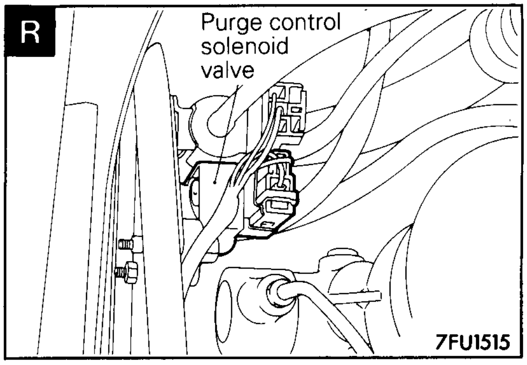

M
Ignition coil (power transistor)
7FU1482

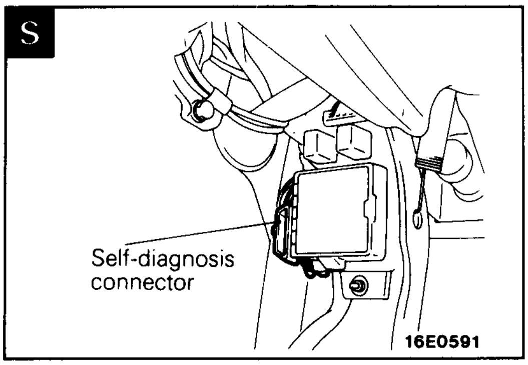

N
Ignition timing adjustment terminal
7FU1490

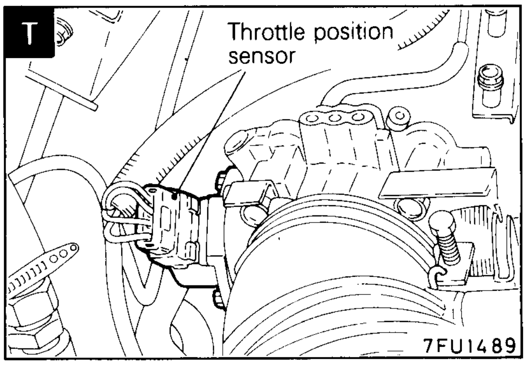

O
Inhibitor switch
09G0009

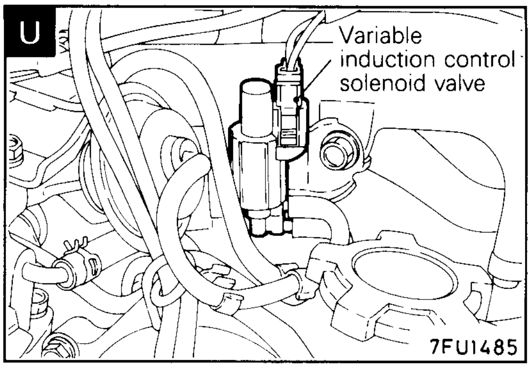

P
Injector
7FU1483

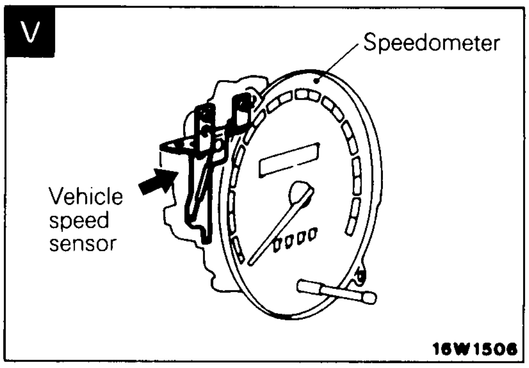

O
Oxygen sensor
7FU1110

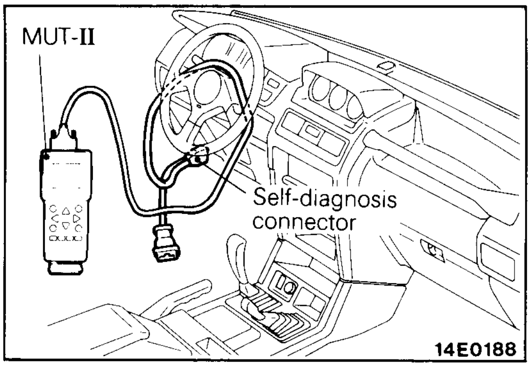

R
Purge control solenoid valve
7FU1515


S
Self-diagnosis connector
16E0591


T
Throttle position sensor
7FU1489





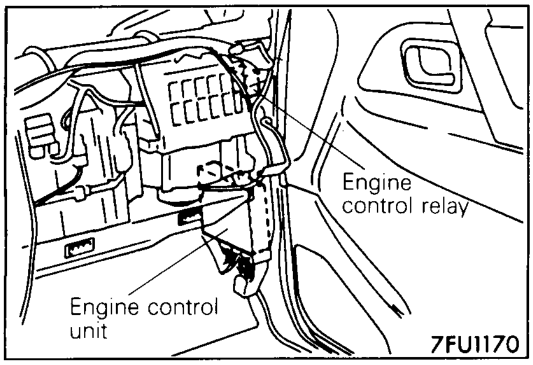


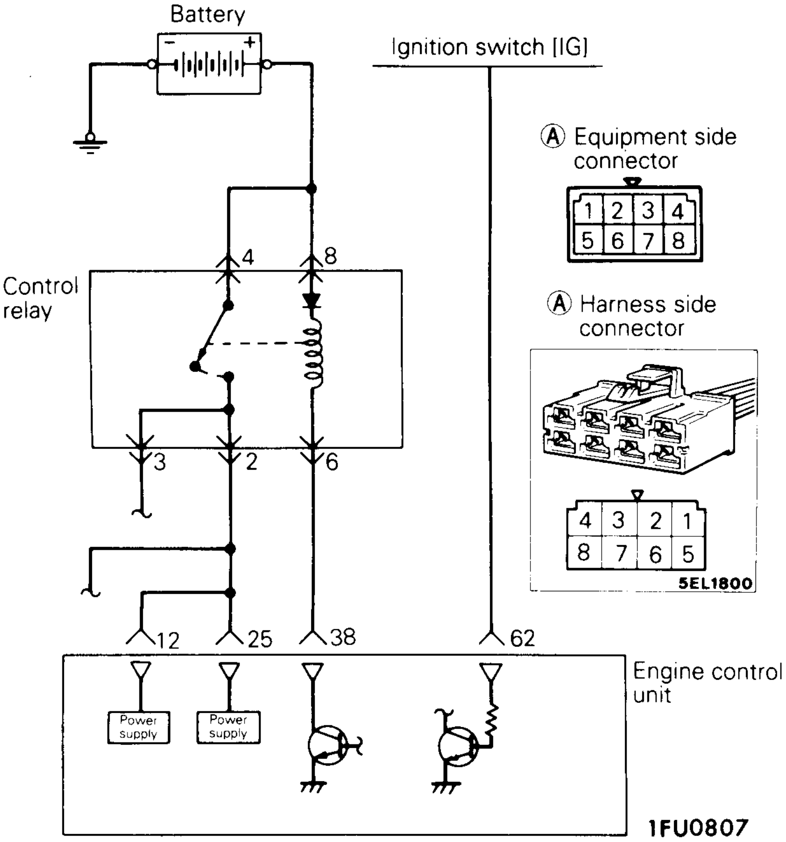
## COMPONENT INSPECTION PROCEDURE

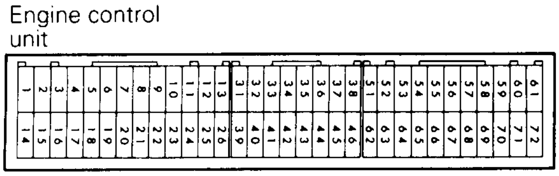
### USING MUT-II

(1) Check by the service data and actuator test function. If any abnormality is found, check the body harness, components, etc. and repair as necessary.
(2) After repair, check again with the MUT-II to make sure that the input and output signals are now normal.
(3) Erase the self-diagnosis malfunction code in memory.
(4) Disconnect the MUT-II.
(5) Start the engine and perform running test, etc. to make sure that the troubles have been corrected.

## POWER SUPPLY (Control relay) AND IGNITION SWITCH-IG







## OPERATION

- While the ignition switch is ON, battery power is supplied to the engine control unit, the injector, the air flow sensor, etc.
- When the ignition switch is turned ON, the battery voltage is applied from the ignition switch to the engine control unit, which then turns ON the power transistor to energize the control relay coil. This turns ON the control relay switch and the power is supplied from the battery to the engine control unit through the control relay switch.

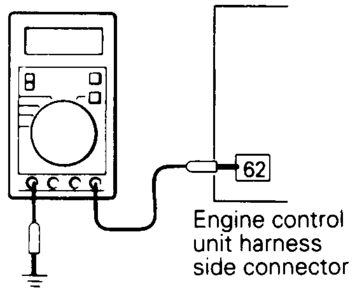
## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check condition | Standard value |
|---|---|---|---|---|
| Data reading | 16 | Engine control unit power voltage | Ignition switch: ON | SV |

## HARNESS INSPECTION

**1**



01L0427

Measure the ignition switch (IG) terminal input voltage.

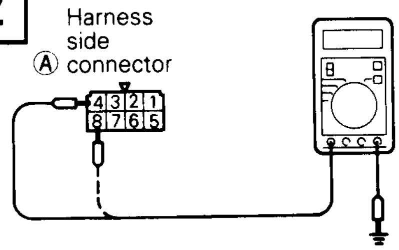
- Engine control unit connector: Disconnected

| Ignition switch | Voltage (V) |
|---|---|
| OFF | 0–1 |
| ON | SV |

OK → 2

~~OK~~ → Repair the harness. (Ignition switch – 62 ) or check the ignition switch

**2**



1FU0808

Measure the power supply voltage of the control relay.

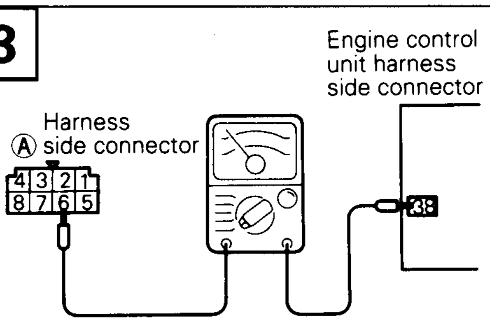
- Ignition switch: OFF
- Control relay connector: Disconnected

| Voltage (V) |
|---|
| SV |

OK → 3

~~OK~~ → Repair the harness. (Battery – Ⓐ4, Ⓐ8)

**3**



1FU0809

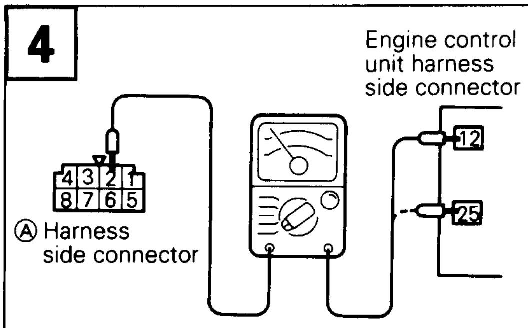
Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the control relay.

- Engine control unit connector: Disconnected
- Control relay connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓐ6 - 38)

**4**



6AF0050

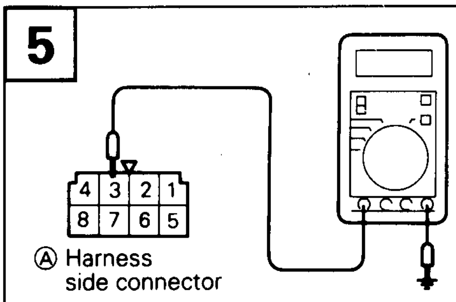
Check for an open-circuit, or a short-circuit to earth between the engine control unit and the control relay.

- Control relay connector: Disconnected
- Engine control unit connector: Disconnected

OK → 5

~~OK~~ → Repair the harness. (Ⓐ2–12, 25)

**5**



6AF0051

Measure power voltage to the actuator.

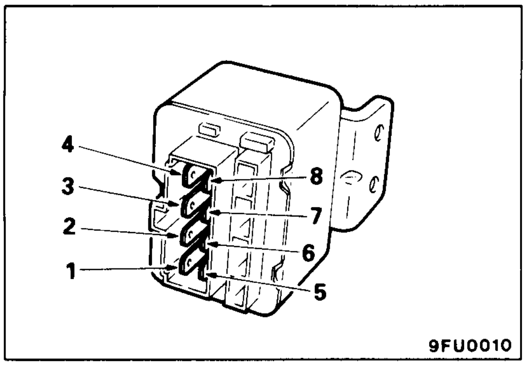
- Control relay connector: Connected
- Engine control unit connector: Connected

| Engine | Voltage (V) |
|---|---|
| Cranking | 8V oder higher |
| Racing | SV |

OK → STOP

~~OK~~ → Replace the control relay or defective engine control unit

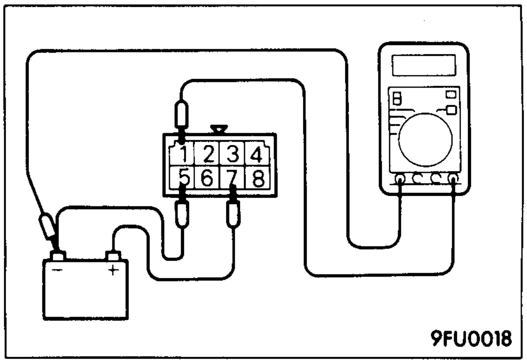
## CONTROL RELAY INSPECTION



(1) Remove the control relay.

(2) Check for continuity between control relay terminals

| Terminal No. | Continuity |
|---|---|
| 5 – 7 | Conductive |
| 6 – 8 | Conductive (only one direction) |



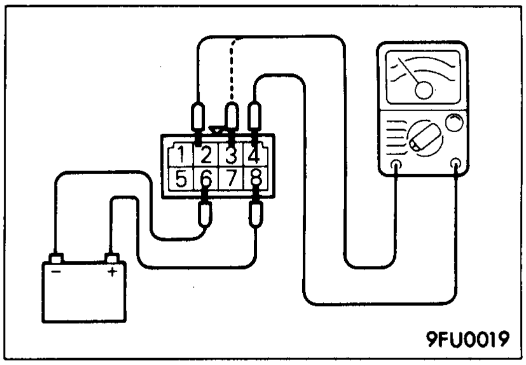
(3) Using jumper wires, connect terminal ⑦ of control relay to battery ⊕ terminal and terminal ⑤ of control relay to battery ⊖ terminal.

**Caution**

**When connecting jumper wires, make sure that it is applied to correct terminal. Otherwise, the relay could be damaged.**

(4) Connecting and disconnecting the jumper wire to battery ⊖ terminal, measure the voltage at terminal ① of the control relay.

| Jumper wire | Voltage |
|---|---|
| Connected | SV |
| Disconnected | 0V |



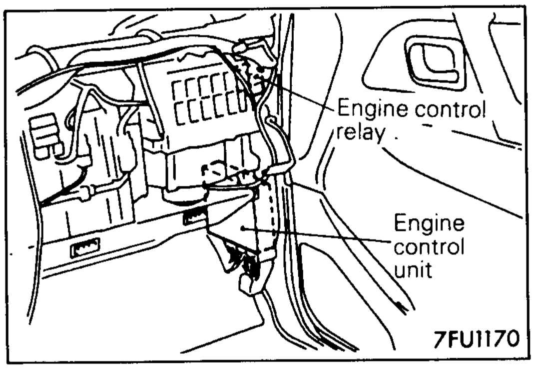
(5) Using jumper wires, connect terminal ⑧ of control relay to battery ⊕ terminal and terminal ⑥ of control relay to battery ⊖ terminal.

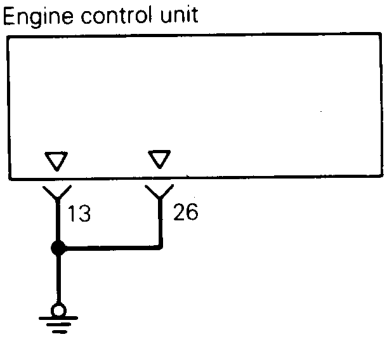
(6) Connecting and disconnecting the jumper wire to battery ⊖ terminal, check the continuity across terminals ② and ④ (or ③ and ④) of the control relay.

| Jumper wire | Continuity across terminals 2 and 4 | Continuity across terminals 3 and 4 |
|---|---|---|
| Connected | Conductive (0 Ω) | Conductive (0 Ω) |
| Disconnected | Nonconductive (∞ Ω) | Nonconductive (∞ Ω) |

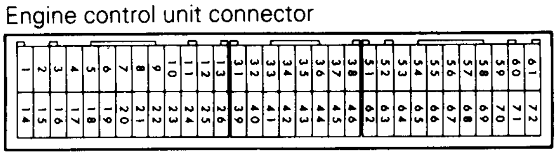
(7) Replace the control relay if any defect is evident.

## ENGINE CONTROL UNIT POWER EARTH





01A0191



9FU0101

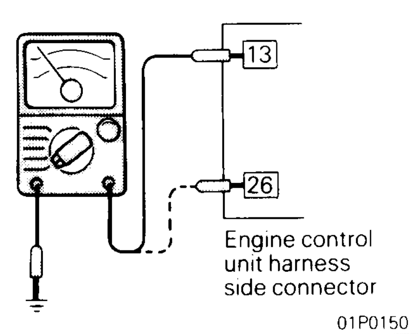
### OPERATION

Earth the engine control unit.

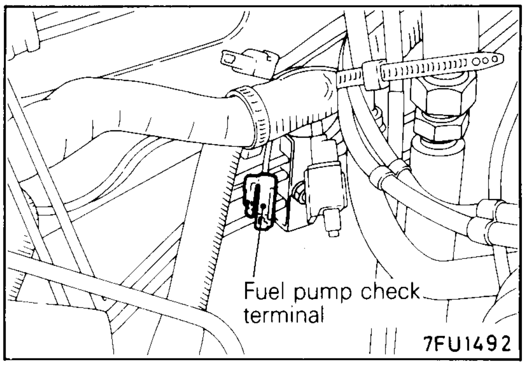
### TROUBLESHOOTING HINTS

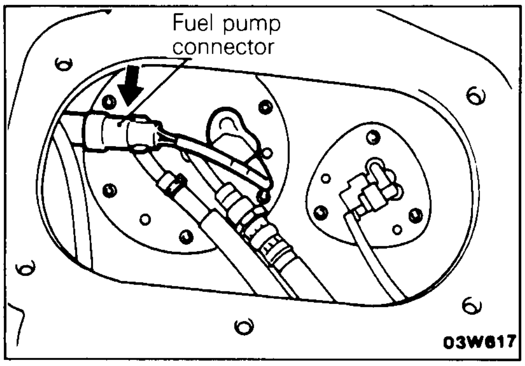
If the earth wire of the engine control unit is not connected securely to earth, the unit will not operate correctly.

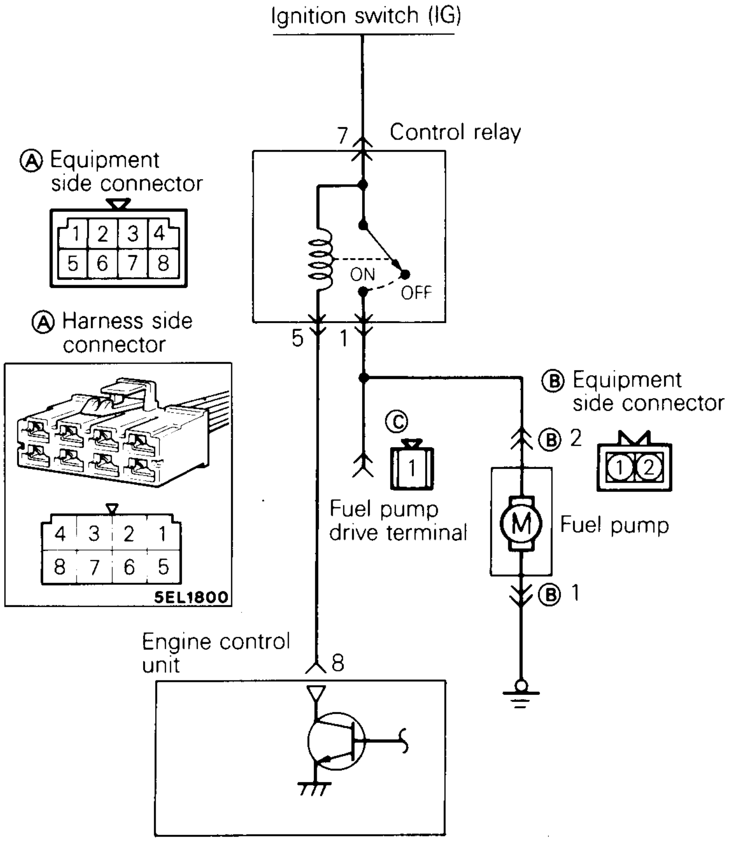
### HARNESS INSPECTION

| | | |
|---|---|---|
| **1**  | Check for continuity of the earth circuit<br>● Engine control unit connector: Disconnected<br>OK →<br>NG → | STOP<br>Repair the harness.<br>( 13 – Earth)<br>( 26 – Earth) |

## FUEL PUMP

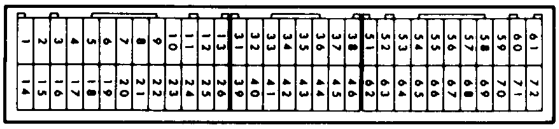






6AF0159

Engine control unit connector



9FU0101

## OPERATION

- The fuel pump is driven when the engine is cranking and while the engine is running.
- When the engine is cranking and while the engine is running, the engine control unit turns the power transistor ON to supply power to the control relay coil. This causes the control relay switch to turn ON, and current is supplied from the ignition switch via the control relay switch to drive the fuel pump.

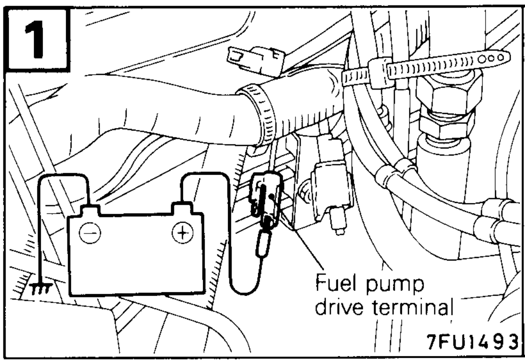
## INSPECTION

### Using MUT-II

| Function | Item No. | Drive | Check condition | Check content | Normal state |
|---|---|---|---|---|---|
| Actuator test | 07 | Fuel pump is driven to circulate fuel | ● Engine cranking<br>● Forced drive of fuel pump<br>Check is made for above two conditions. | Hold return hose with fingers to feel pulsation indicating fuel flow | Pulsation is felt |
| | | | | Listen to pump operating sound near fuel tank | Operating sound is heard |

## HARNESS INSPECTION

**1**



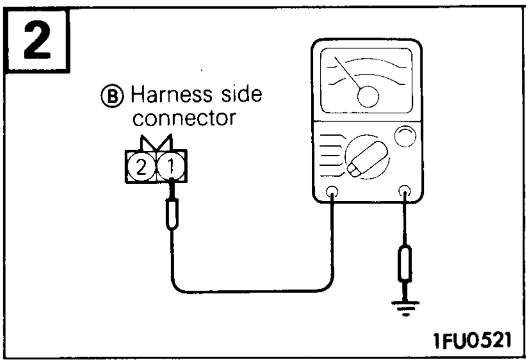
Check the fuel pump.

- Apply battery voltage to the fuel pump drive terminal and operate the pump.

OK → 4

~~OK~~ → 2

**2**



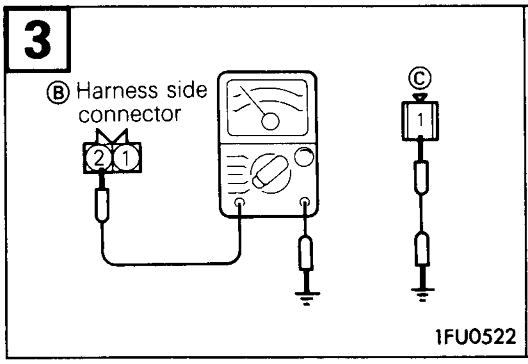
Check for continuity of the fuel pump earthing line.

- Fuel pump connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓑ1 - Earth)

**3**



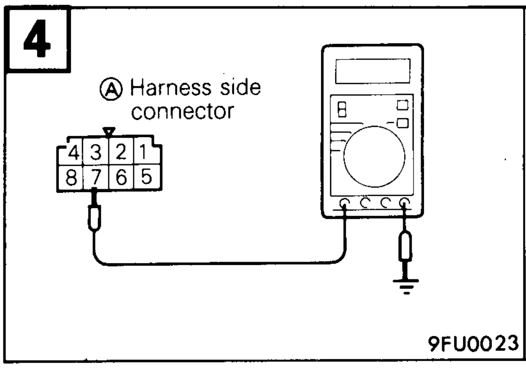
Check for open-circuit or short-circuit between the fuel pump and the fuel pump drive terminal.

- Fuel pump connector: Disconnected
- Control relay connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓑ2 - Ⓒ1)

**4**



Measure the power supply voltage of the control relay.

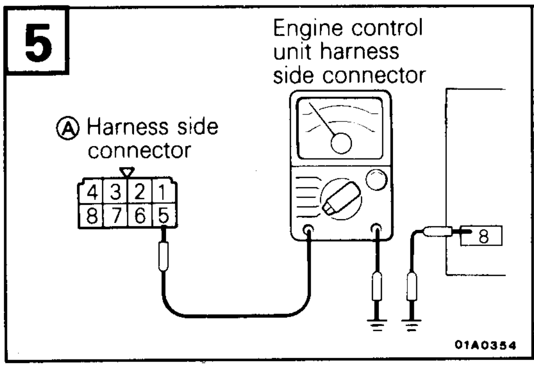
- Control relay connector: Disconnected

| Ignition switch | Voltage (V) |
|---|---|
| OFF | 0 – 1 |
| START | SV |

OK → 5

~~OK~~ → Repair the harness. (Ignition switch - Ⓐ7) or check for ignition switch.

**5**



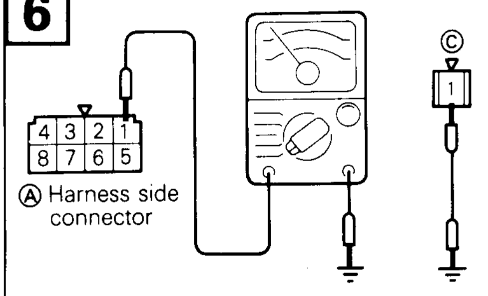
Check for an open-circuit, or a short-circuit to earth between the control relay and the engine control unit.

- Control relay connector: Disconnected
- Engine control unit connector: Disconnected

OK → 6

~~OK~~ → Repair the harness. (Ⓐ5 - 8)

**6**



9FU0024

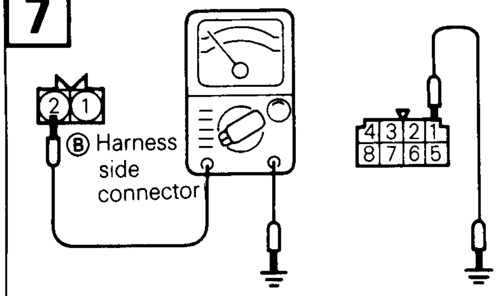
Check for continuity between the fuel pump drive terminal and the control relay.

- Control relay connector: Disconnected
- Fuel pump connector: Disconnected

OK → $\boxed{7}$

~~OK~~ → Repair the harness. (Ⓐ$\boxed{1}$ - Ⓒ$\boxed{1}$)

**7**



6AF0162

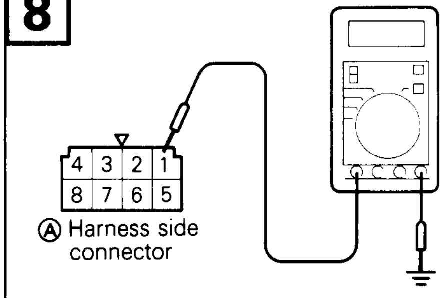
Check for an open-circuit, or a short-circuit to earth between the control relay and the fuel pump.

- Control relay connector: Disconnected
- Fuel pump connector: Disconnected

OK → $\boxed{8}$

~~OK~~ → Repair the harness. (Ⓐ$\boxed{1}$ - Ⓑ$\boxed{2}$)

**8**



6FU1753

Measure the power supply voltage of the fuel pump.

- Control relay connector: Connected
- Engine control unit connector: Connected

| Engine | Voltage (V) |
|---|---|
| Cranking | 8V or more |
| Racing | SV |

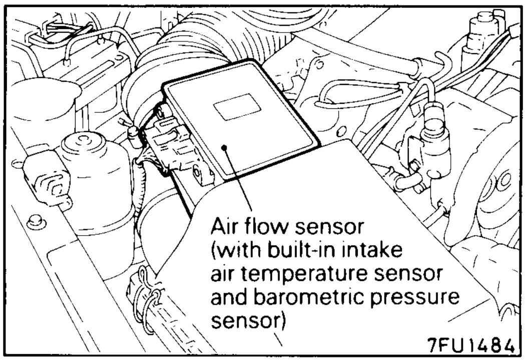
OK → STOP

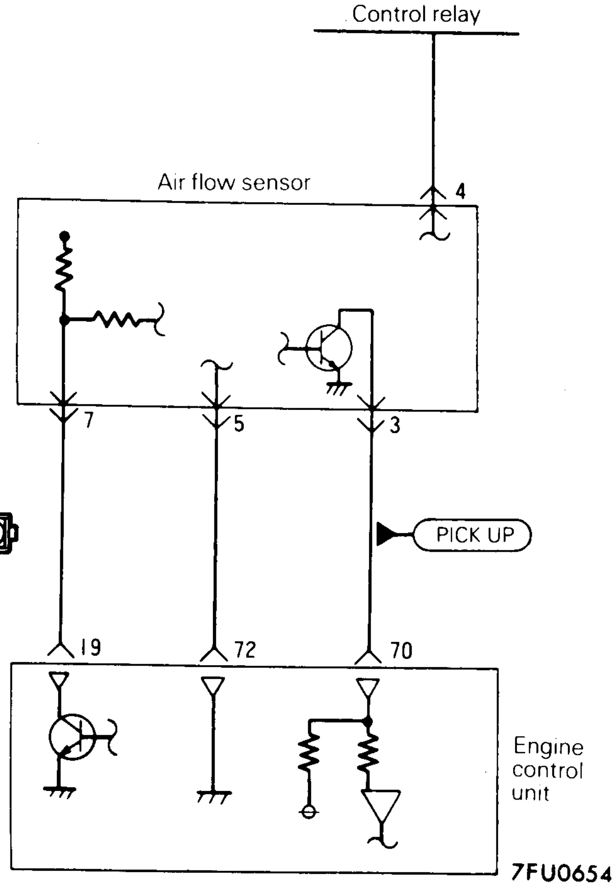
~~OK~~ → Control relay or engine control unit is defective.

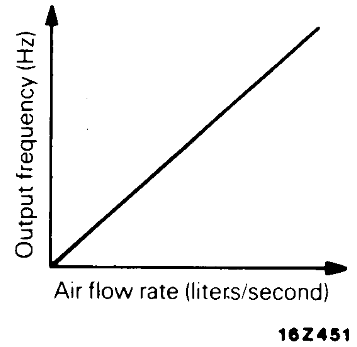
## CONTROL RELAY INSPECTION

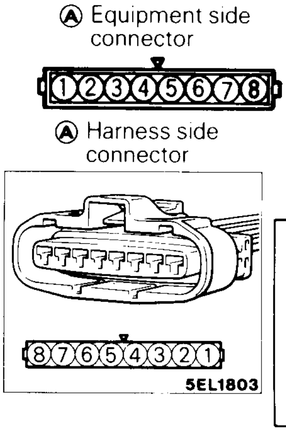
Refer to P.13-79-36.

## AIR FLOW SENSOR

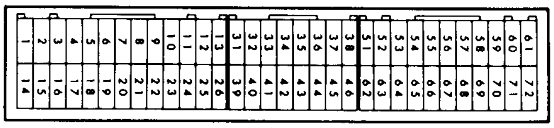








Engine control unit connector



## OPERATION

- The air flow sensor located in the air cleaner converts the engine intake air volume into a pulse signal of frequency proportional to the air volume and inputs it to the engine control unit, which then computes the fuel injection rate, etc. based on the input signal.
- The air flow sensor power is supplied from the control relay to the air flow sensor and is earthed in the engine control unit. The air flow sensor generates a pulse signal as it repeatedly opens and closes between the 5 V voltage supplied from the engine control unit and earth.

## TROUBLESHOOTING HINTS

Hint 1: If the engine stalls occasionally, crank the engine and shake the air flow sensor harness. If the engine stalls, poor contact of the air flow sensor connector is suspected.

Hint 2: If the air flow sensor output frequency is other than 0 when the ignition switch is turned on (but not starting the engine), faulty air flow sensor or engine control unit is suspected.

Hint 3: If the engine can be run idle even though the air flow sensor output frequency is out of specification, troubles are often found in other than the air flow sensor itself.

[Examples]

(1) Disturbed air flow in the air flow sensor (Disconnected air duct, clogged air cleaner element)
(2) Poor combustion in the cylinder (Faulty ignition plug, ignition coil, injector, incorrect compression pressure, etc.)
(3) Air leaking into the intake manifold through gap of gasket, etc.
(4) Loose EGR valve seat

## INSPECTION

### Using MUT-II

### <Air Flow Sensor>

| Function | Item No. | Data display | Check condition | Engine state | Standard value |
|---|---|---|---|---|---|
| Data reading | 12 | Sensor air volume (frequency) | ● Engine coolant temperature: 80–95°C (176–203°F)<br>● Lamps and accessories: OFF<br>● Transmission: Neutral | 700 r/min (Idle) | 25–51 Hz <SOHC><br>27–53 Hz <DOHC> |
| | | | | 2500 r/min <SOHC> | 74–114 Hz |
| | | | | 2000 r/min <DOHC> | 60–100 Hz |
| | | | | Racing | Frequency increases with racing |

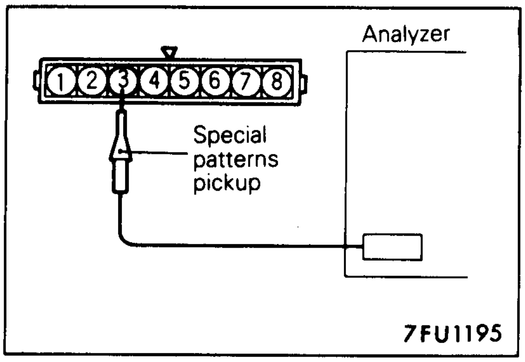
NOTE
When the vehicle is new [within initial operation of about 500 km (300 miles)] the air flow sensor output frequency may be about 10% higher.

### <Air Flow Sensor Reset Signal>

| Function | Item No. | Data display | Check condition | Engine state | Standard value |
|---|---|---|---|---|---|
| Data list | 34 | Reset signal condition | ● Warm up the engine | 700 r/min (Idle) | ON |
| | | | | 2500 r/min | OFF |

### <Volumetric Efficiency>

| Function | Item No. | Data display | Check condition | Engine state | Standard value |
|---|---|---|---|---|---|
| Data list | 37 | Volumetric efficiency | ● Engine coolant temperature: 80–95°C (176–203°F)<br>● Lamps, accessory operation: OFF<br>● Transmisson: Neutral | 700 r/min (Idle) | 15 – 35% |
| | | | | 2500 r/min | 15 – 35% |
| | | | | Sudden racing | Frequency increases with racing |



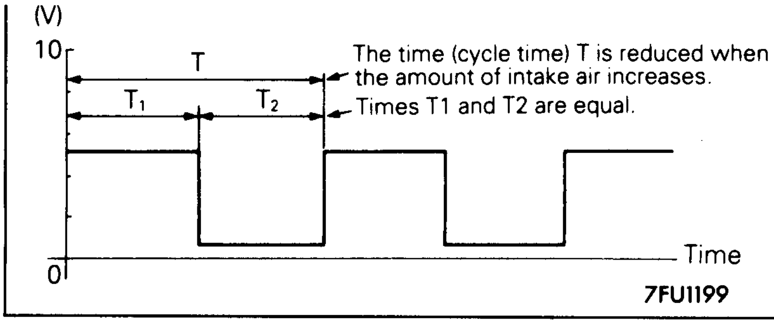
## Wave Pattern Inspection Using an Analyzer

### Measurement method

(1) Disconnect the air flow sensor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)

(2) Connect the analyzer special patterns pickup to terminal ③ of the air flow sensor connector.

### Standard wave pattern



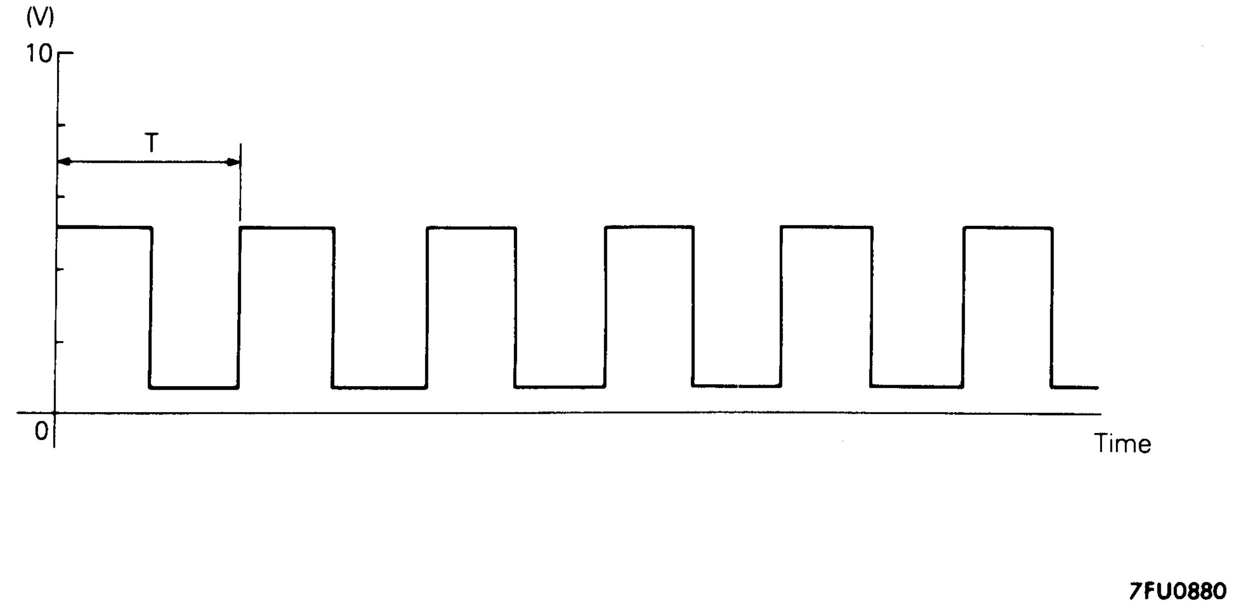
The time (cycle time) T is reduced when the amount of intake air increases.

Times T1 and T2 are equal.

### Observation conditions

| | |
|---|---|
| Function | Special patterns |
| Pattern height | Low |
| Pattern selector | Display |
| Engine r/min | Idle speed (700 r/min.) |

**Observation conditions** (from conditions on above engine speed is increased by racing.)



### Wave pattern observation points

Check that cycle time T becomes shorter and the frequency increases when the engine speed is increased.

**Examples of abnormal wave patterns**

- Example 1

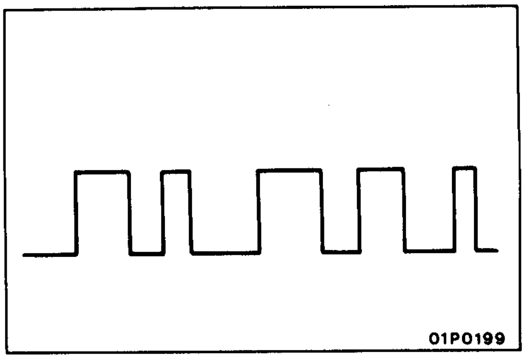
  **Cause of problem**
  Sensor interface malfunction

  **Wave pattern characteristics**
  Rectangular wave pattern is output even when the engine is not started.

- Example 2

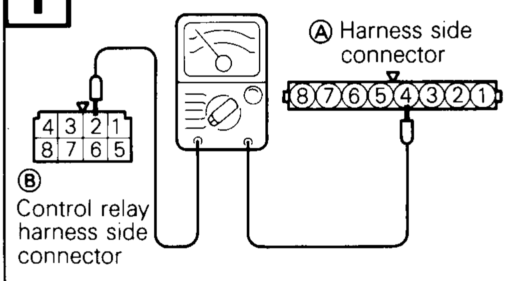
  **Cause of problem**
  Damaged rectifier or vortex generation column

  **Wave pattern characteristics**
  Unstable wave pattern with non-uniform frequency. However, when an ignition leak occurs during acceleration, the wave pattern will be distorted temporarily, even if the air flow sensor is normal.



## HARNESS INSPECTION

### 1



6AF0052

Check the continuity between the air flow sensor and the control relay.

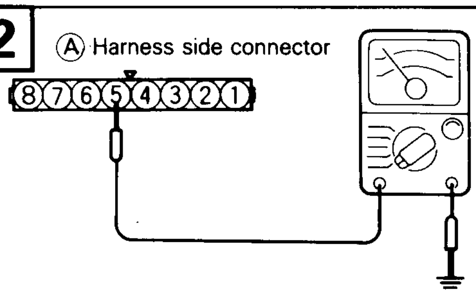
- Control relay connector: Disconnected
- Air flow sensor connector: Disconnected

NOTE
Touch the circuit tester probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness. (Ⓐ4 - Ⓑ2)

### 2



7FU0657

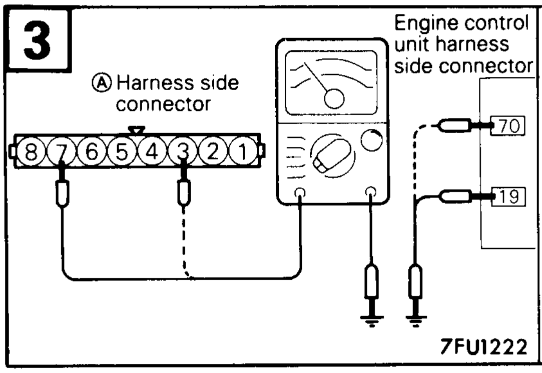
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ5 - 72)

### 3



7FU1222

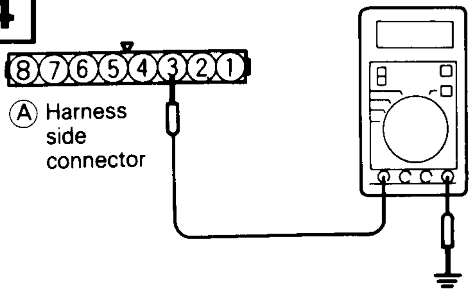
Check for open-circuit or short-circuit between the air flow sensor and the engine control unit.

- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓐ3 - 70) (Ⓐ7 - 19)

### 4



7FU0656

Measure the applied voltage.

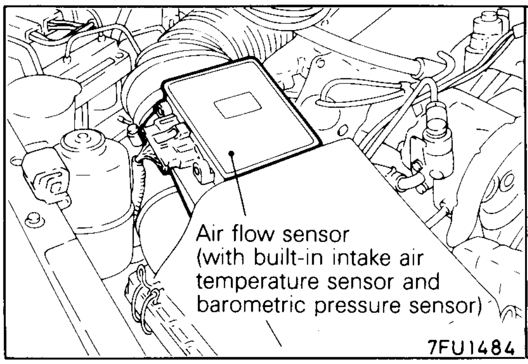
- Air flow sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

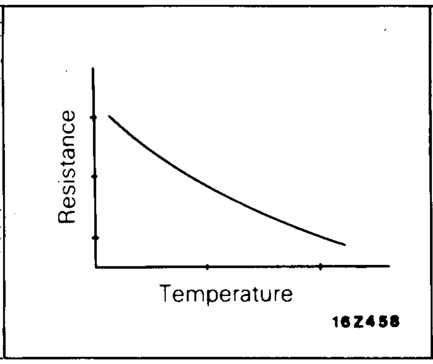
| Voltage (V) |
|---|
| 4.8 – 5.2 |

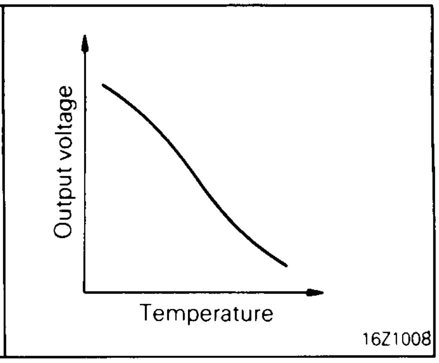
OK → STOP

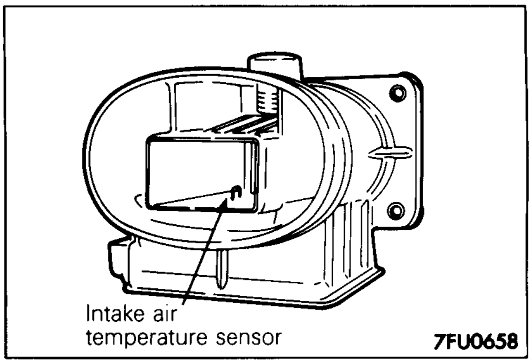
~~OK~~ → Replace the engine control unit.

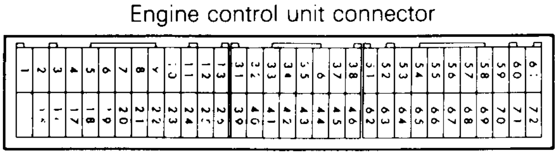
## INTAKE AIR TEMPERATURE SENSOR

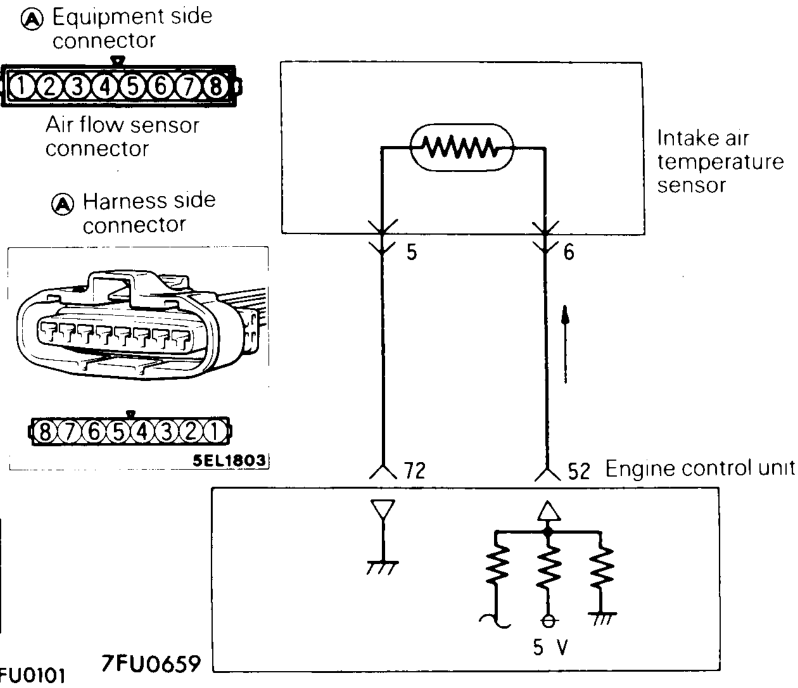












## OPERATION

- The intake air temperature sensor converts the engine intake air temperature into a voltage and inputs it to the engine control unit, which then corrects the fuel injection rate, etc. based on the input signal.
- The 5 V power in the engine control unit is supplied via a resistor in the unit to the intake air temperature sensor. Via the sensor which is a kind of resistor, it is earthed in the engine control unit. The intake air temperature sensor resistor has such characteristic that its resistance decreases as the intake air temperature rises.
- The intake air temperature sensor terminal voltage increases or decreases as the sensor resistance increases or decreases. Therefore, the intake air temperature sensor terminal voltage changes with the intake air temperature, decreasing as the temperature rises.

## TROUBLESHOOTING HINTS

The intake air temperature sensor senses the intake air temperature in the air cleaner so that it may indicate a temperature different from outside temperature depending on engine operating state.

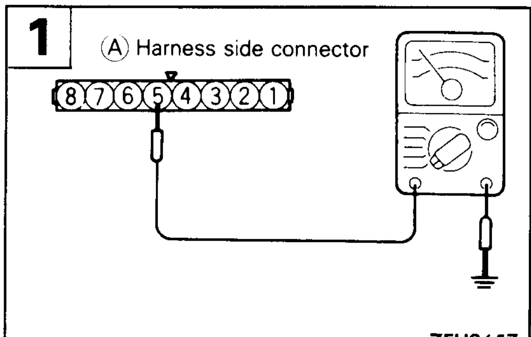
## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check condition | Intake air temperature °C (°F) | Standard value °C (°F) |
|---|---|---|---|---|---|
| Data reading | 13 | Sensor temperature | Ignition switch: ON or engine running | At –20 (–4) | –20 (–4) |
| | | | | At 0 (32) | 0 (32) |
| | | | | At 20 (68) | 20 (68) |
| | | | | At 40 (104) | 40 (104) |
| | | | | At 80 (176) | 80 (176) |

## HARNESS INSPECTION

**1**



7FU0657

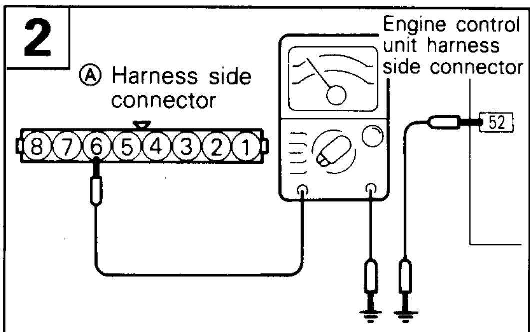
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ5 – 72)

**2**



7FU1223

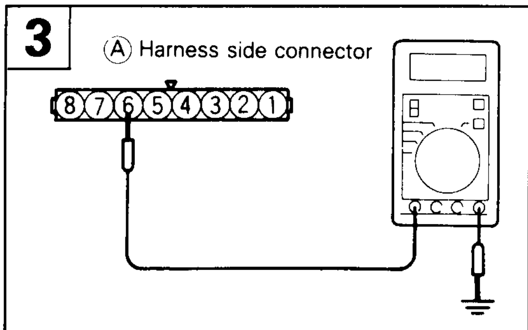
Check for open-circuit or short circuit between the intake air temperature sensor and the engine control unit.

- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ6 – 52)

**3**



7FU0660

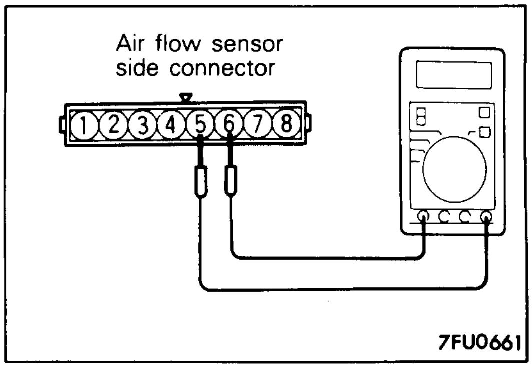
Measure the power supply voltage.

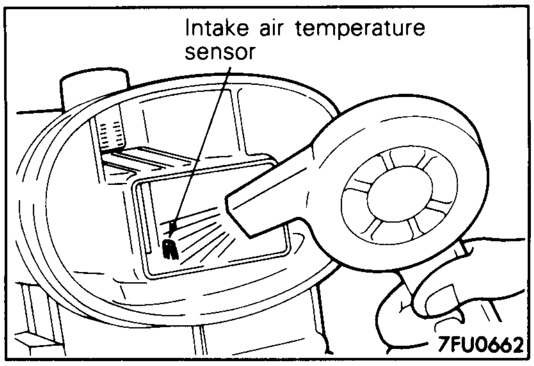
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.5 – 4.9 |

OK → STOP

~~OK~~ → Repair the engine control unit





## SENSOR INSPECTION

(1) Disconnect the air flow sensor connectors.
(2) Measure resistance between terminals ⑤ and ⑥.

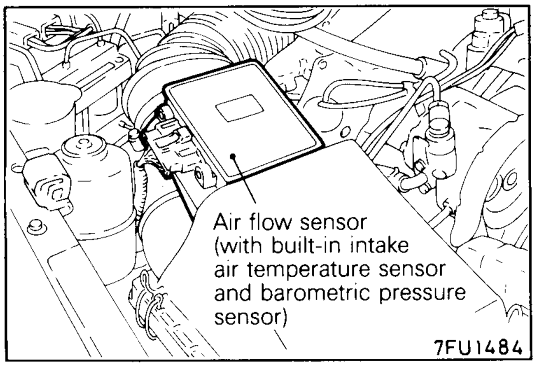
| Temperature °C (°F) | Resistance kΩ |
|---|---|
| 0 (32) | 6.0 |
| 20 (68) | 2.7 |
| 80 (176) | 0.4 |

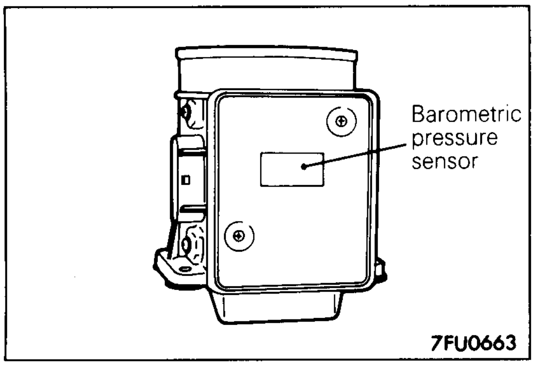
(3) Measure resistance while heating the sensor using a hair drier.

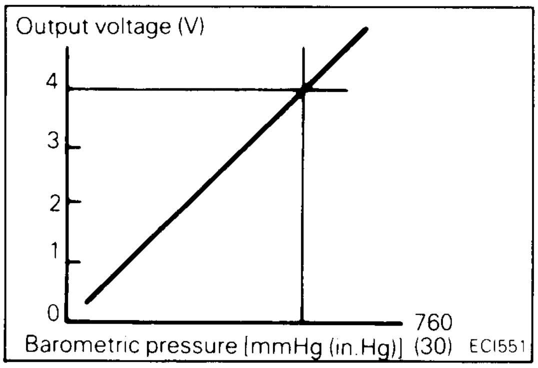
| Temperature | Resistance |
|---|---|
| Higher | Smaller |

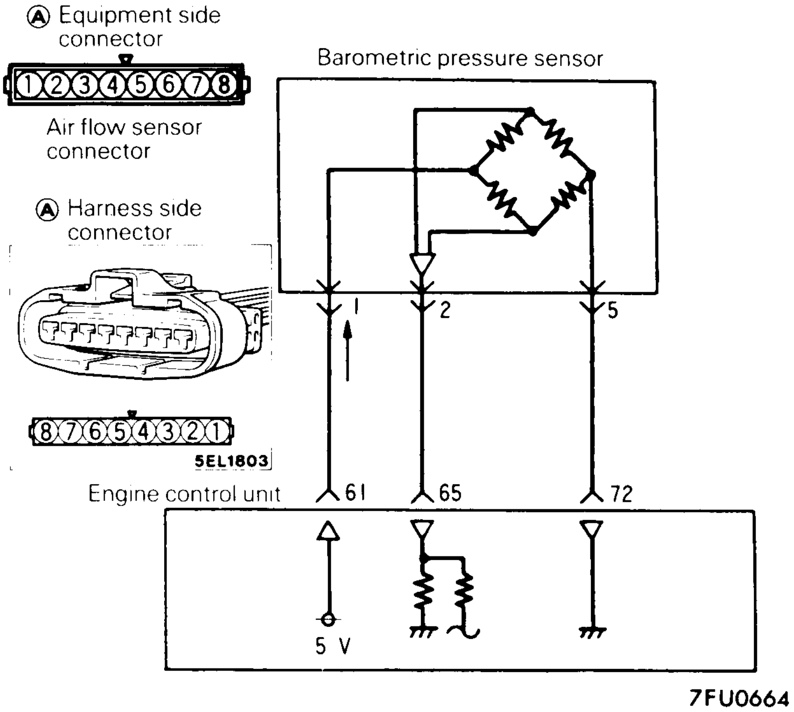
(4) If the value deviates from the standard value or the resistance remains unchanged, replace the air flow sensor assembly.

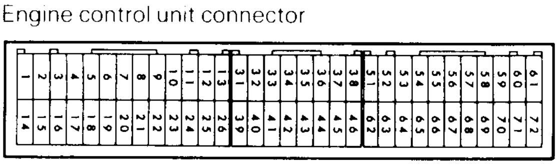
## BAROMETRIC PRESSURE SENSOR











## OPERATION

- The barometric pressure sensor converts the barometric pressure into a voltage and inputs it to the engine control unit, which then corrects the fuel injection rate, etc. based on the input signal.
- The 5 V power in the engine control unit is supplied to the barometric pressure sensor. Through the circuit in the sensor, it is earthed in the engine control unit.
- The barometric pressure sensor output voltage which is proportional to the barometric pressure (absolute pressure) is supplied to the engine control unit.

## TROUBLESHOOTING HINTS

Hint 1: If the barometric pressure sensor is faulty, poor driveability is caused at high altitude, in particular.

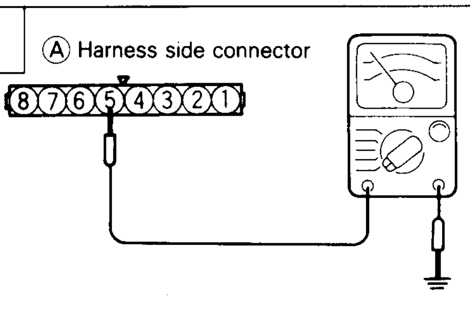
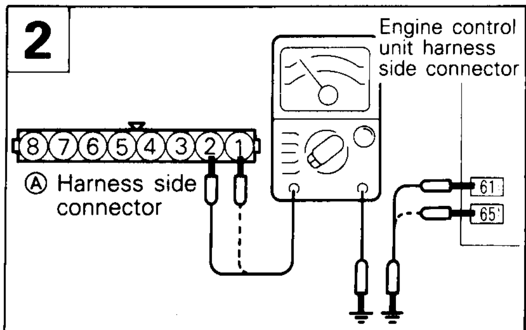
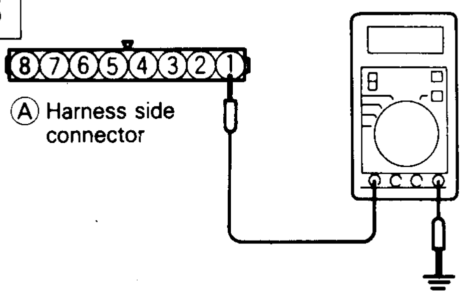
Hint 2: If teh pressure indication of the barometric pressure sensor drops significantly during high speed driving, check the air cleaner for clogging.

## INSPECTION

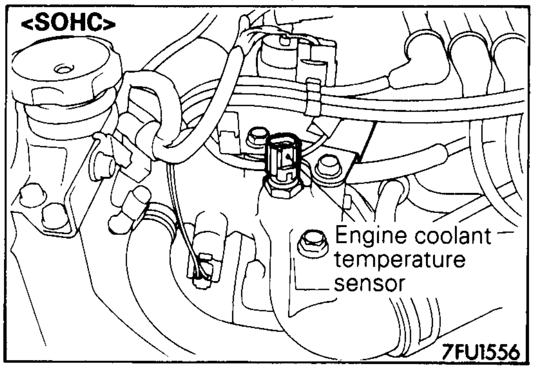
### Using MUT-II

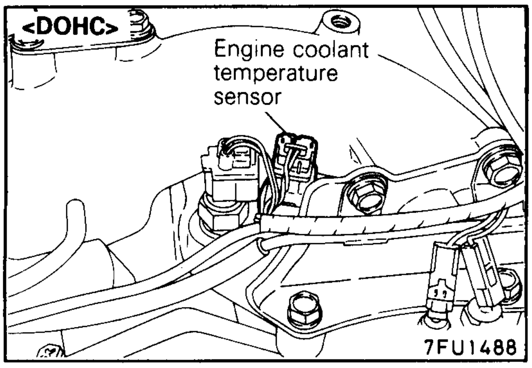
| Function | Item No. | Data display | Check condition | Altitude m (ft.) | Standard value kPa (kg/cm$^2$, psi) |
|---|---|---|---|---|---|
| Data reading | 25 | Sensor pressure | Ignition switch: ON | At 0 (0) | 101 (103, 14.6) |
| | | | | At 600 (1968.5) | 95 (0.97, 13.8) |
| | | | | At 1,200 (3937.0) | 88 (0.90, 12.8) |
| | | | | At 1,800 (5905.5) | 81 (0.83, 11.7) |

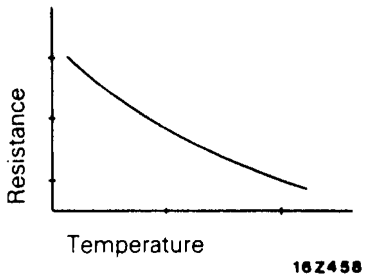
## HARNESS INSPECTION

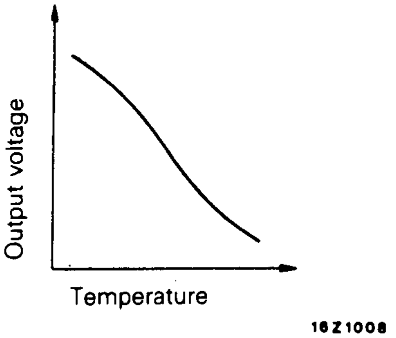
| | | |
|---|---|---|
| **1**  7FU0657 | Check for continuity of the earth circuit.<br>● Connector: Disconnected<br>OK →<br>~~OK~~ → | 2<br>Repair the harness. (Ⓐ 5 – 72) |
| **2**  7FU1224 | Check for an open-circuit, or a short-circuit to earth between the engine control unit and the barometric pressure sensor.<br>● Air flow sensor connector: Disconnected<br>● Engine control unit connector: Disconnected<br>OK →<br>~~OK~~ → | STOP<br>Repair the harness.<br>(Ⓐ 2 – 65)<br>(Ⓐ 1 – 61) |
| **3**  7FU0665 | Measure the power supply voltage of the barometric pressure sensor.<br>• Air flow sensor connector: Disconnected<br>• Ignition switch: ON<br>• Engine control unit connector: Connected<br>Voltage (V): 4.8 – 5.2<br>OK →<br>~~OK~~ → | 3<br>Replace the engine control unit |

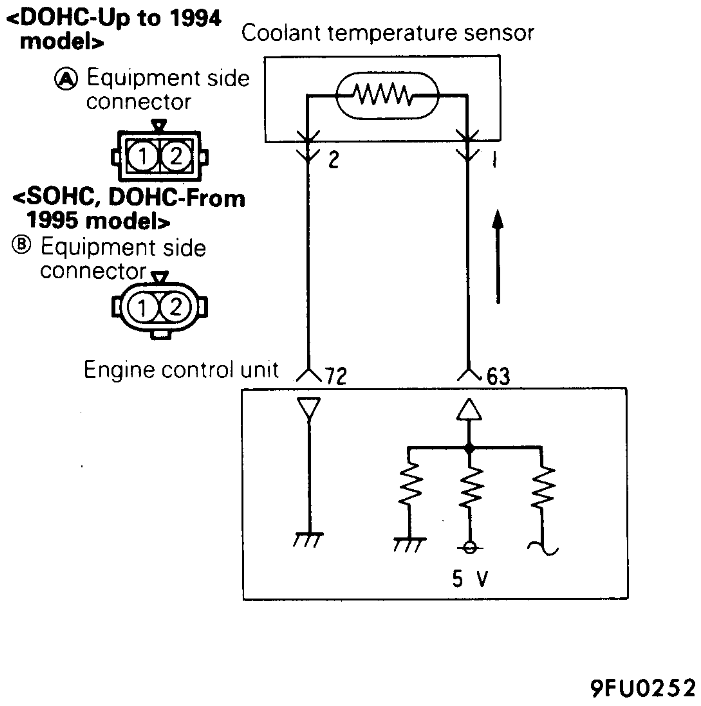
# ENGINE COOLANT TEMPERATURE SENSOR

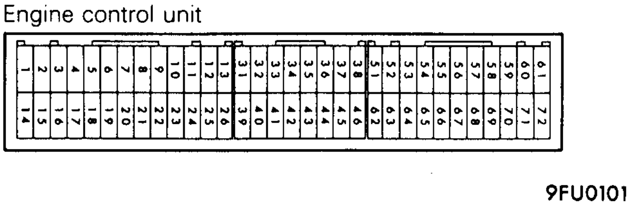












## OPERATION

- The engine coolant temperature sensor converts the engine coolant temperature into a voltage and inputs it to the engine control unit, which then controls the fuel injection rate and fast idle speed when the engine is cold based on the input signal.
- The 5 V power in the engine control unit is supplied via a resistor in the unit to the engine coolant temperature sensor. Through the sensor ness side ch is a kind of resistor, it is earthed in the nector engine control unit. The engine coolant temperature sensor resistor has such characteristic that its resistance decreases as the coolant temperature rises.
- The engine coolant temperature sensor terminal voltage increases or decreases as the sensor resistance increases or decreases. Therefore, the engine coolant temperature sensor terminal voltage changes with the coolant temperature, decreasing as the temperature rises.

## TROUBLESHOOTING HINTS

If the fast idle speed is inadequate or the engine emits dark smoke during engine warm up operation, the engine coolant temperature sensor is often faulty.

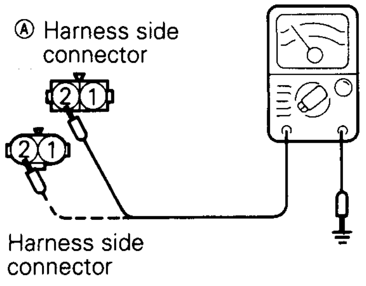
## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check condition | Coolant temperature °C (°F) | Standard value °C (°F) |
|---|---|---|---|---|---|
| Data reading | 21 | Sensor temperature | Ignition switch: ON or engine operating | At –20 (–4) | –20 (–4) |
| | | | | At 0 (32) | 0 (32) |
| | | | | At 20 (68) | 20 (68) |
| | | | | At 40 (104) | 40 (104) |
| | | | | At 80 (176) | 80 (176) |

## HARNESS INSPECTION

**1**



9FU0253

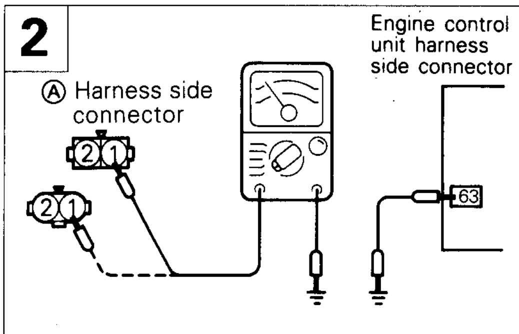
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ 2 - 72) (Ⓑ 2 - 72)

**2**



9FU0254

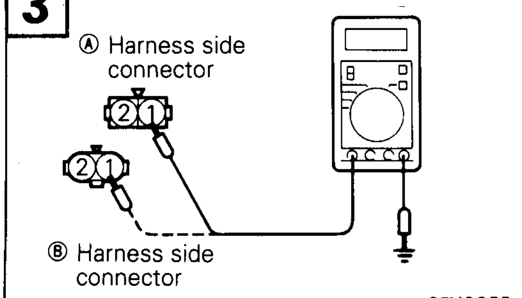
Check for open-circuit or short circuit between the engine coolant temperature sensor and the engine control unit.

- Engine coolant temperature sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

~~OK~~ → Repair the harness.
(Ⓐ1 - 63)
(Ⓑ1 - 63)

**3**



9FU0255

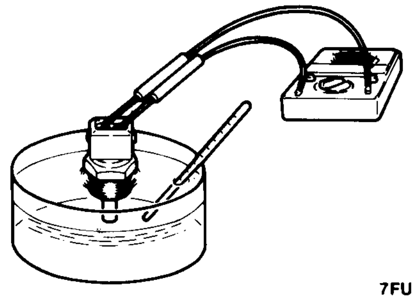
Measure the power supply voltage.

- Connector: Disconnected
- Ignition switch: ON

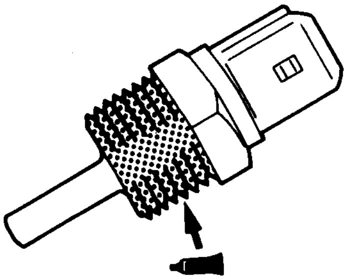
| Voltage (V) |
|---|
| 4.5 – 4.9 |

OK → STOP

~~OK~~ → Replace the engine control unit



7FU0670



7FU0671

## SENSOR INSPECTION

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

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

| Temperature °C (°F) | Resistance kΩ |
|---|---|
| 0 (32) | 5.8 |
| 20 (68) | 2.4 |
| 40 (104) | 1.1 |
| 80 (176) | 0.3 |

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

## INSTALLATION

(1) Apply sealant to threaded portion.

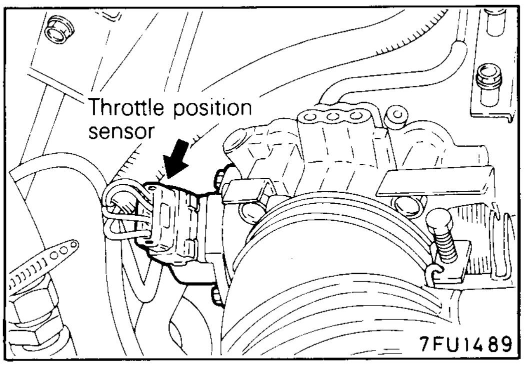
**Specified sealant: 3M NUT locking Part No. 4171 or equivalent**

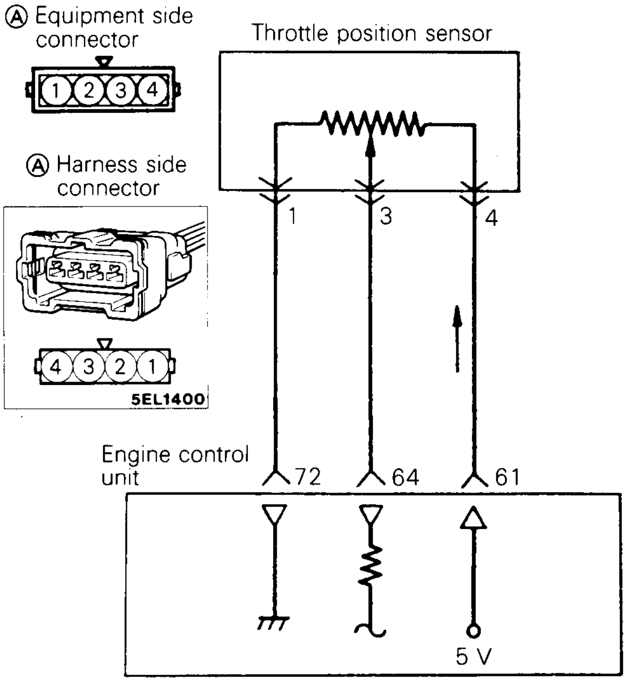
(2) Install engine coolant temperature sensor and tighten it to specified torque.

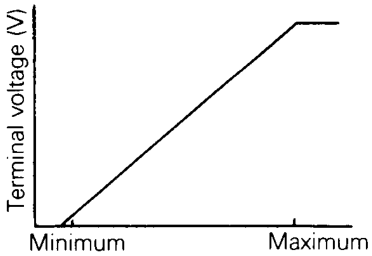
**Sensor tightening torque: 29Nm (3.0 kgm, 22 ft.lbs)**

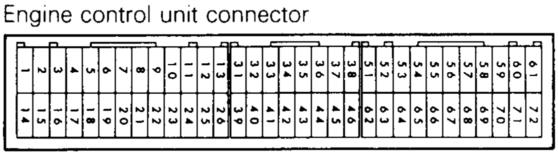
(3) Fasten harness connectors securely.

## THROTTLE POSITION SENSOR









## OPERATION

- The throttle position sensor converts the throttle position opening into a voltage and inputs it to the engine control unit, which then controls the fuel injection based on the input signal.
- The 5 V power in the engine control unit is supplied to the throttle position sensor. Through the resistor in the sensor, it is earthed in the engine control unit.
- As the throttle valve shaft rotates from the idle position to wide open position, the resistance between the variable resistor terminal of the throttle position sensor and the earth terminal increases. As a result, the voltage at the throttle position sensor variable resistance terminal also increases.

## TROUBLESHOOTING HINTS

Hint 1: The throttle position sensor signal is more important in the control of automatic transmission than in the engine control. Shifting shock and other troubles will be caused if this sensor is faulty.

Hint 2: If the output voltage of the throttle position sensor is out of specification, adjust the sensor and check the voltage again. If there is an evidence of disturbed fixed SAS setting, adjust the fixed SAS.

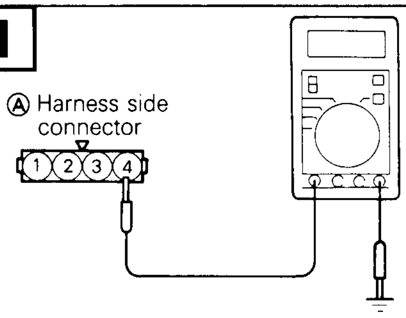
## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check conditions | Throttle valve | Standard value mV |
|---|---|---|---|---|---|
| Data reading | 14 | Sensor voltage | Ignition switch: left ON for 15 secondes or more | Set to idling position. | 300 – 1,000 |
| | | | | Open gradually. | Becomes higher proportionally to valve opening |
| | | | | Open fully. | 4,500 – 5,500 |

## HARNESS INSPECTION

**1**



6FU1241

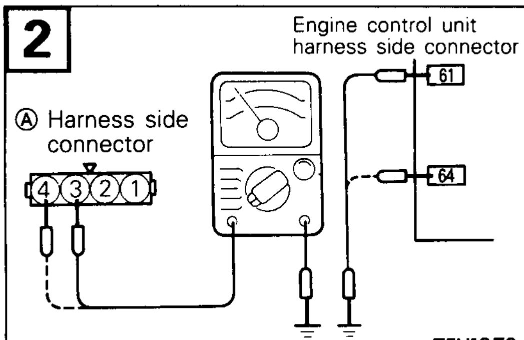
Check for continuity of the earth circuit.

- Throttle position sensor connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ1 - 72)

**2**



7FU1270

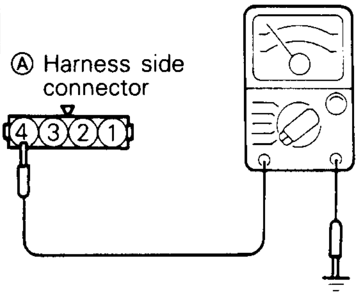
Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the throttle position sensor.

- Throttle position sensor connector: Disconnected
- Engine control unit connector: Disconnected
- Disconnect all other control unit connectors which are connected to the throttle position sensor.

OK → 3

~~OK~~ → Repair the harness. (Ⓐ3 - 64) (Ⓐ4 - 61)

**3**



6FU1242

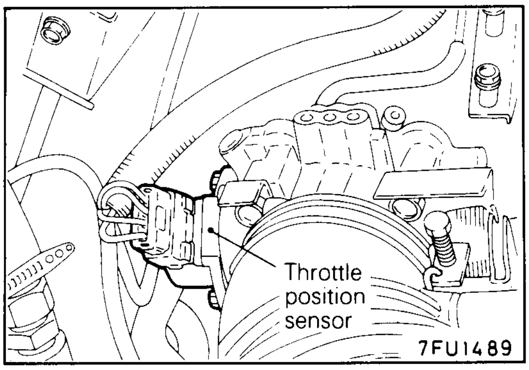
Measure the impressed voltage.

- Throttle position sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

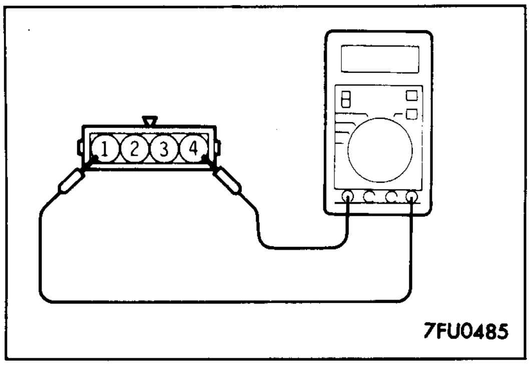
OK → STOP

~~OK~~ → Replace the engine control unit.



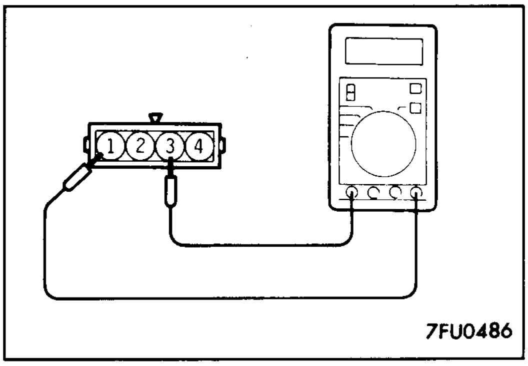
## SENSOR INSPECTION

(1) Disconnect the throttle position sensor connector.



(2) Measure resistance between terminal ① (sensor earth) and terminal ④ (sensor power).

**Standard value: 3.5 – 6.5 kΩ**



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

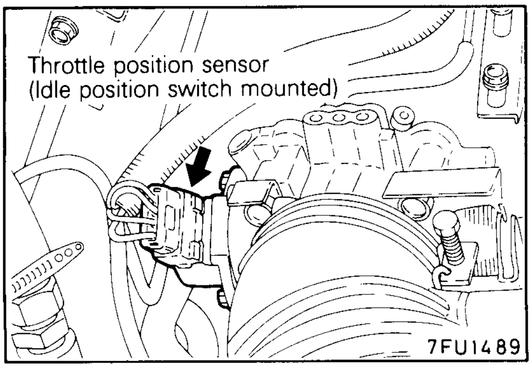
(4) Operate the throttle valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.

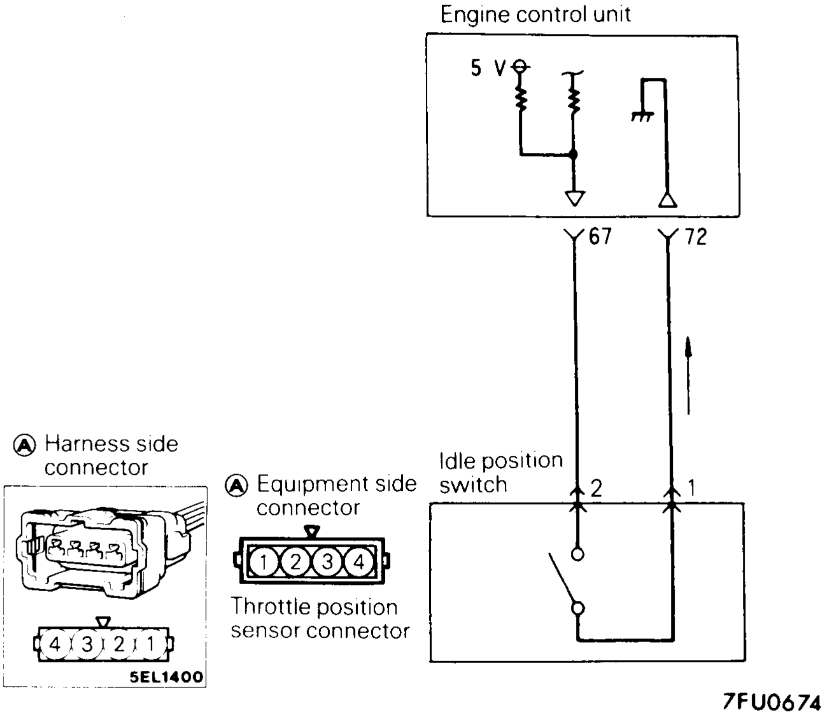
(5) If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

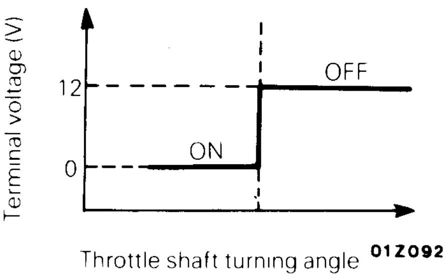
**TPS installation torque: 2.0 Nm (0.2 kgm, 1.5 ft.lbs)**

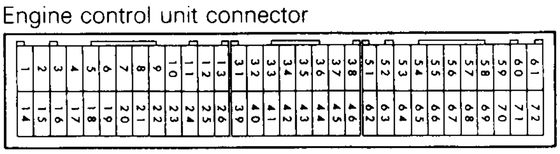
For the idle position switch and throttle position sensor adjusting procedure, refer to P.13-79-22.

## IDLE POSITION SWITCH









### OPERATION

- The idle position switch senses whether the accelerator pedal is depressed or not, converts it into high/low voltage and inputs the voltage to the engine control unit, which then controls the idle speed control servo based on the input signal.
- The voltage in the engine control unit is applied to the idle position switch through a resistor. When the accelerator pedal is released, the idle position switch is turned on to conduct the voltage to earth. This causes the idle position switch terminal voltage to go low from high.

### TROUBLESHOOTING HINTS

If the idle position switch harness and individual part check results are normal but the idle position switch output is abnormal, the following troubles are suspected.

(1) Poorly adjusted accelerator cable or auto-cruise control cable
(2) Poorly adjusted fixed SAS

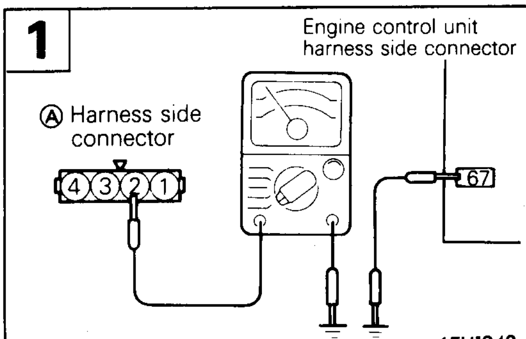
### INSPECTION

#### Using MUT-II

| Function | Item No. | Data display | Check condition | Throttle valve | Normal indication |
|---|---|---|---|---|---|
| Data reading | 26 | Switch state | Ignition switch: ON (check by operating accelerator pedal repeatedly) | At idle position | ON |
| | | | | Open a little | OFF |

## HARNESS INSPECTION

**1**



6FU1243

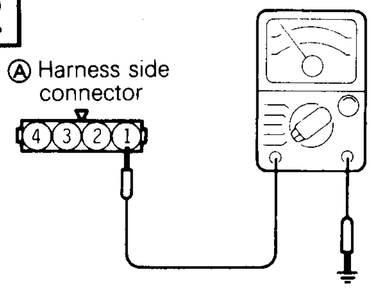
Check for open or short circuit between the idle position switch and the engine control unit.

- Engine control unit connector: Disconnected
- Throttle position sensor connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ2 - 67)

**2**



7FU0483

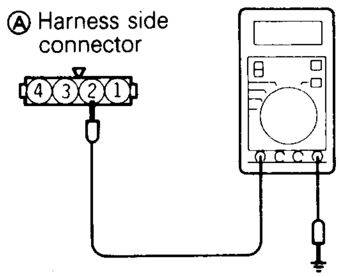
Check for continuity of the earth circuit.

- Throttle position sensor connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ1 - 72)

**3**



7FU0489

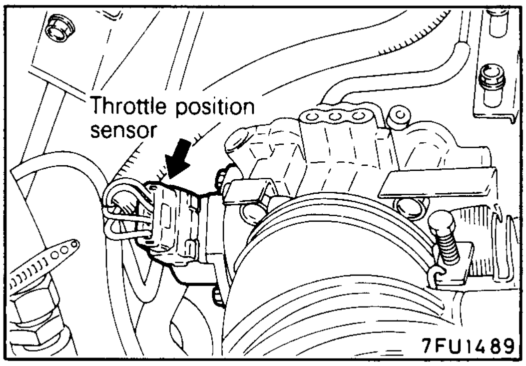
Measure the power supply voltage of the idle position switch.

- Throttle position sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4 or higher |

OK → STOP

~~OK~~ → Replace the engine control unit.

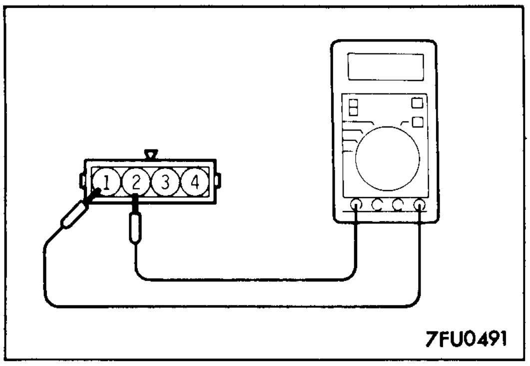


## SENSOR INSPECTION

(1) With the accelerator pedal released, check to be sure that the throttle valve lever or the fixed SAS is pushed.

NOTE
If it is not pushed, adjust the fixed SAS (Refer to P.13-79-23.)

(2) Disconnect the throttle position sensor connector.



(3) Check the continuity across the throttle position sensor connector terminal ① (Sensor earth) and ② (Idle position switch).

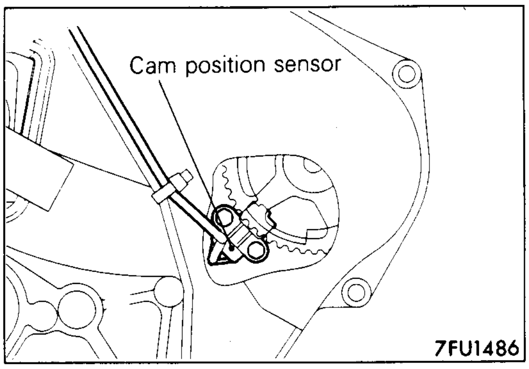
| Accelerator pedal | Continuity |
|---|---|
| Depressed | Non-conductive (∞Ω) |
| Released | Conductive (0Ω) |

NOTE
If there is no continuity when the accelerator pedal is returned, loosen the throttle-position sensor installation screw; then, after turning all the way in the clockwise direction, check again.

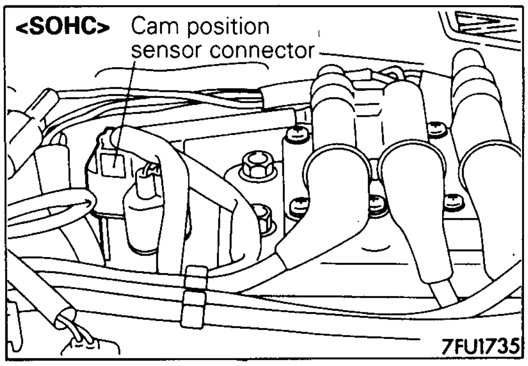
(4) Replace the throttle-position sensor (idle-position switch incorporated) if there is a malfunction.

NOTE
For the idle position switch and throttle position sensor adjusting procedure, refer to P.13-79-22.

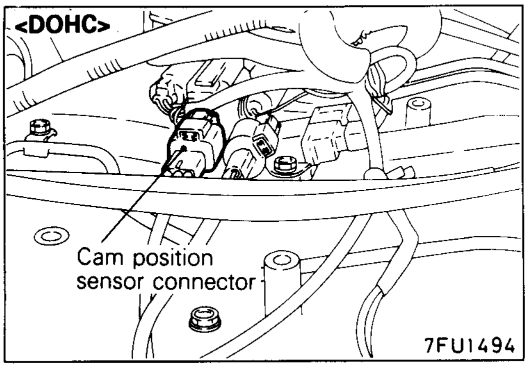
## CAM POSITION SENSOR



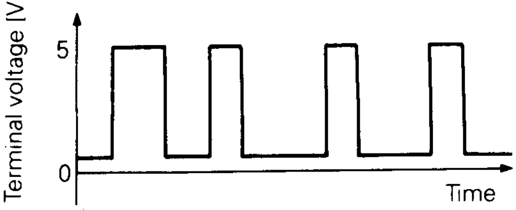
7FU1486



7FU1735

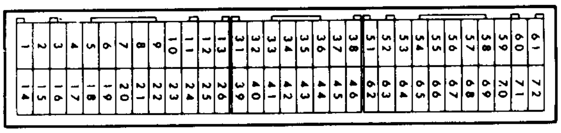


7FU1494

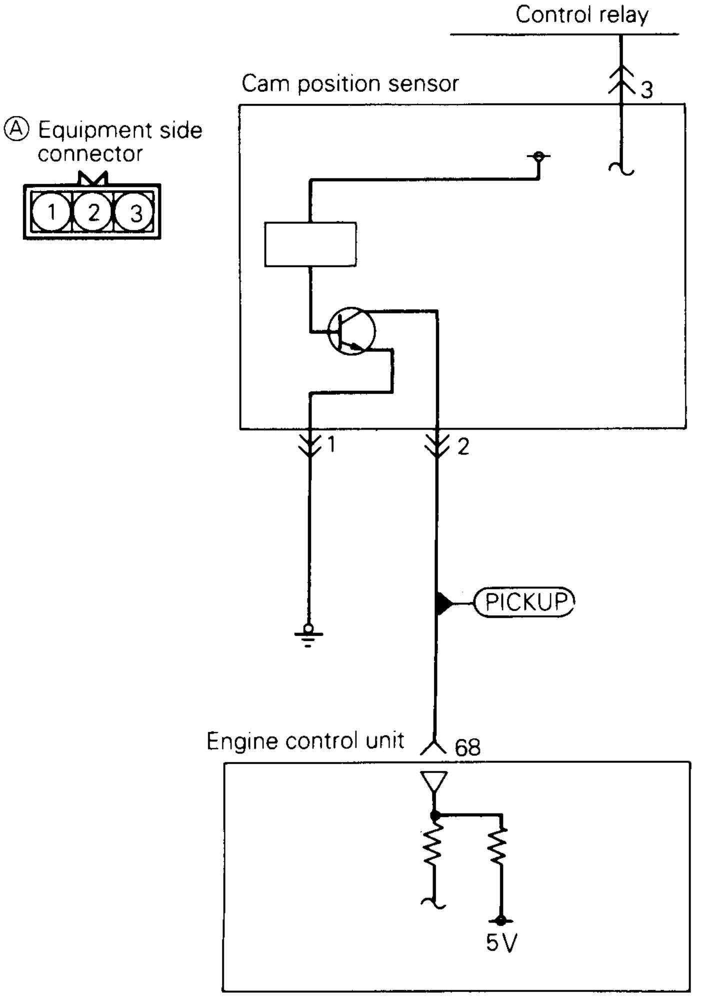


7FU0677

Engine control unit connector



9FU0101



6AF0054

## OPERATION

- The cam position sensor senses the top dead center on compression stroke, converts it into a pulse signal and inputs it to the engine control unit, which then computes the fuel injection sequence, etc. based on the input signal.
- Power to the cam position sensor is supplied from the control relay and is earthed to the body. The cam position sensor generates a pulse signal as it repeatedly connects and disconnects between 5 V voltage supplied from the engine control unit and earth.

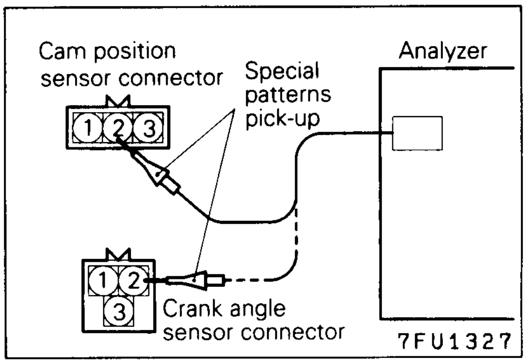
## TROUBLESHOOTING HINTS

Hint 1: If the cam position sensor does not function correctly, correct sequential injection is not made so that the engine may stall, run irregularly at idle or fail to accelerate normally.

Hint 2: If the sensor outputs a pulse signal when the ignition switch is turned ON (with the engine no running), a faulty cam position sensor or engine control unit is suspected.

## INSPECTION

### Waveform inspection with analyzer



### Measuring method

(1) Disconnect the connector of the cam position sensor, and connect the special tool (test harness: MB991348) across the disconnected connector parts. (Connect the tool to all terminals.)

(2) Connect the special patterns pick-up of the analyzer to the terminal ② of the cam position sensor connector (in order to inspect the signal waveform of the cam position sensor.)

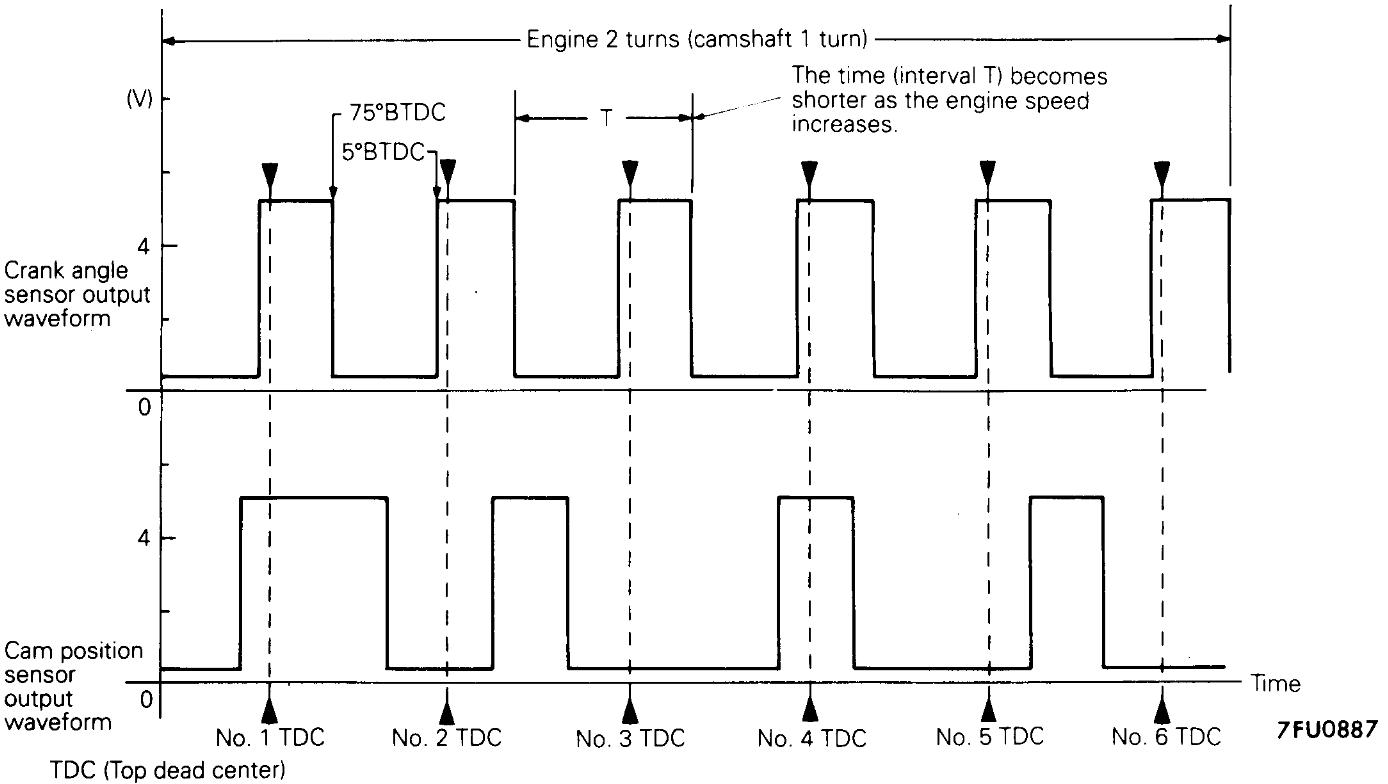
(3) Disconnect the connector of the crank angle sensor, and connect the special tool (test harness: MD998478) across the disconnected connector parts.

(4) Connect the special patterns pick-up of the analyzer to the terminal ② of the crank angle sensor connector (in order to inspect the signal waveform of the crank angle sensor).

## Standard waveform

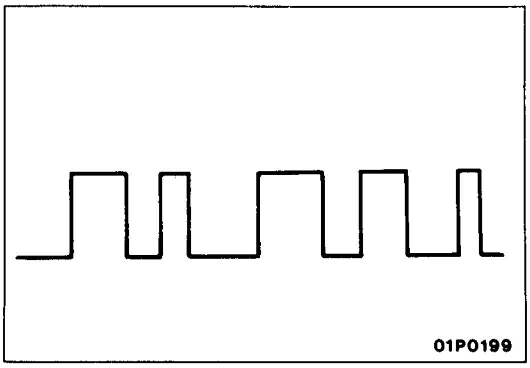
Observation conditions

| | |
|---|---|
| Function | Special patterns |
| Pattern height | Low |
| Pattern selector | Display |
| Engine speed | Idling speed (700 r/min) |



## Waveform observing point

Confirm that cycle T becomes shorter as the engine speed increases.



## Abnormal waveform example

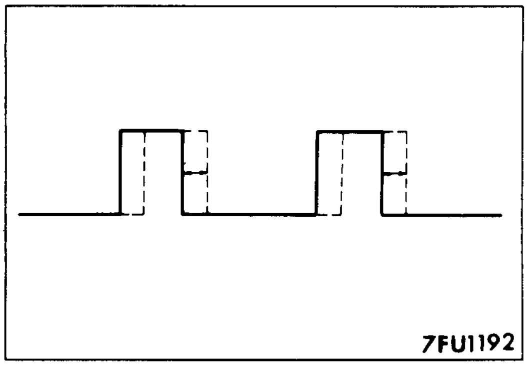
- Example 1

Trouble cause

The sensor interface is troubled.

Waveform feature

The engine does not start, but the rectangular waveform is output.


7FU1192

- Example 2

Trouble cause

The timing belt is loose.

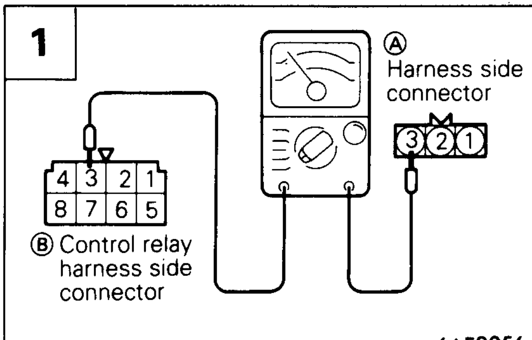
The sensor disc is abnormal.

Waveform feature

The waveform fluctuates fore and aft.

## HARNESS INSPECTION

**1**



6AF0056

Check for continuity between the cam position sensor and control relay.

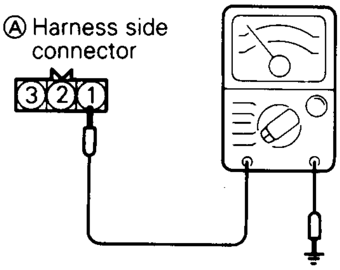
- Cam position sensor connector :Disconnected
- Control relay connector: Disconnected

NOTE
Touch ohmmeter probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness. (Ⓐ3 – Ⓑ3)

**2**



6AF0057

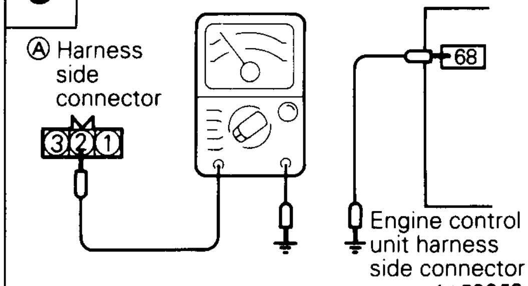
Check for continuity of the earth circuit.

- Cam position sensor connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ1 – Earth)

**3**



6AF0058

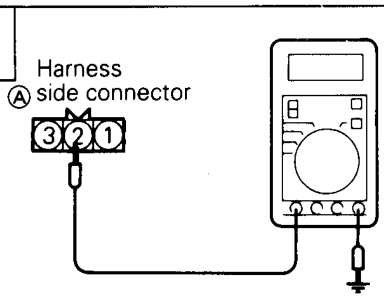
Check for an open-circuit, or a short-circuit to earth between the cam position sensor and the engine control unit.

- Engine control unit connector: Disconnected
- Cam position sensor connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓐ2 – 68)

**4**



6AF0059

Measure the impressed voltage

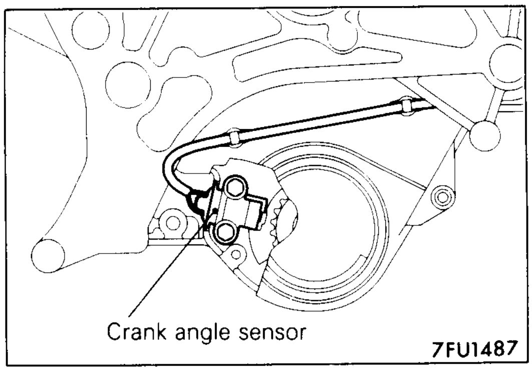
- Cam position sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

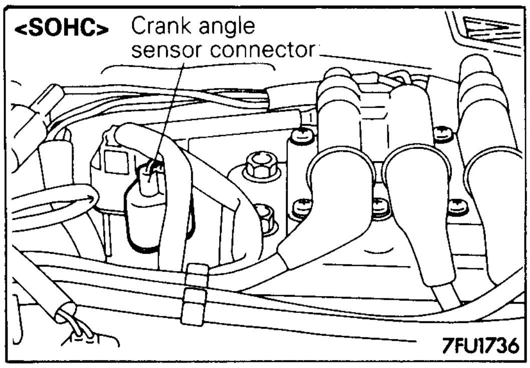
OK → STOP

~~OK~~ → Replace the engine control unit.

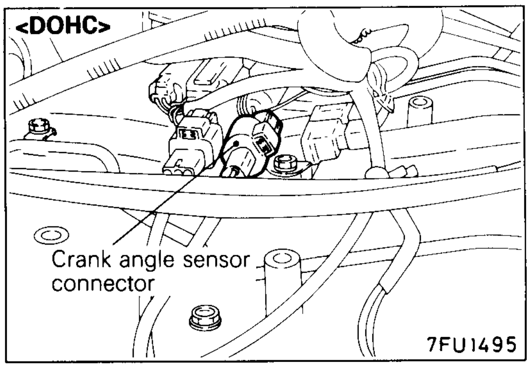
## CRANK ANGLE SENSOR



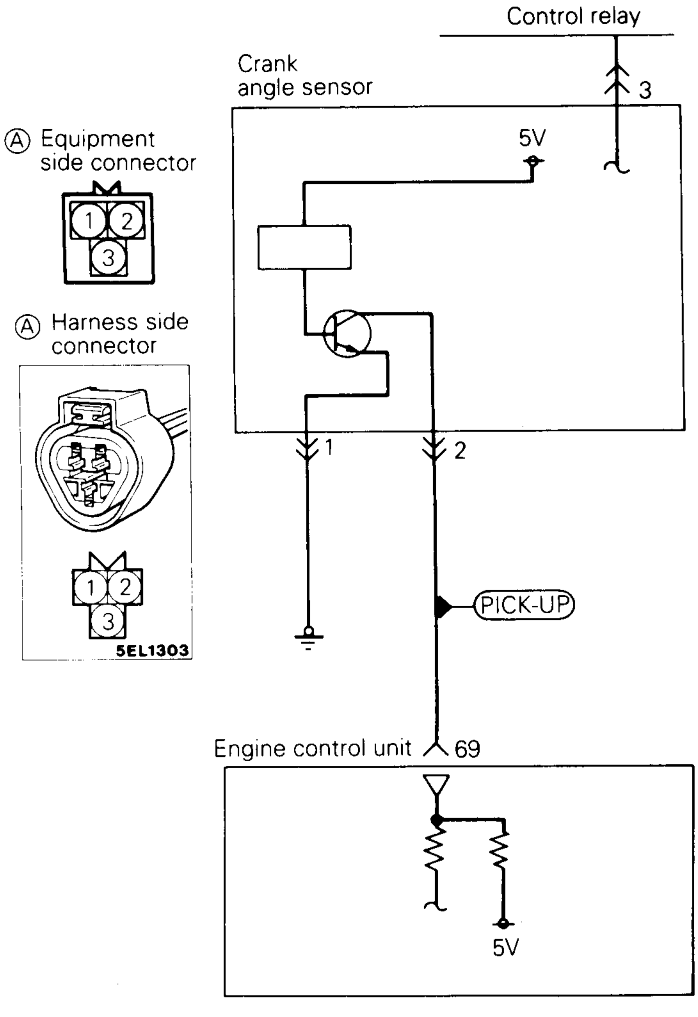
7FU1487



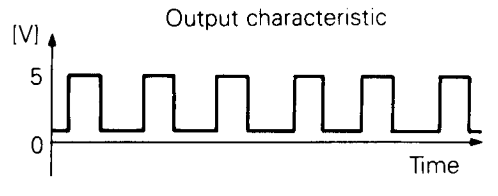
7FU1736



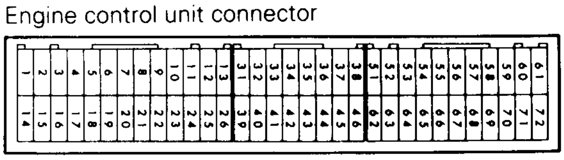
7FU1495



6AF0060



7FU0682



9FU0101

## OPERATION

- The crank angle sensor senses the crank angle (piston position) of each cylinder, converts it into a pulse signal and inputs it to the engine control unit, which then computes the engine speed and controls the fuel injection timing and ignition timing based on the input signal.
- Power to the crank angle sensor is supplied from the control relay and is earthed to the body. The crank angle sensor generates a pulse signal as it repeatedly connects and disconnects between 5 V voltage supplied from the engine control unit and earth.

## TROUBLESHOOTING HINTS

Hint 1: If unexpected shocks are felt during driving or the engine stalls suddenly during idling, shake the crank angle sensor harness. If this causes the engine to stall, poor contact of the sensor connector is suspected.

Hint 2: If the crank angle sensor outputs a pulse signal when the ignition switch is turned ON (with the engine not running), a faulty crank angle sensor or engine control unit is suspected.

Hint 3: If the tachometer reads 0 r/min when the engine that has failed to start is cranked, faulty crank angle sensor or broken timing belt is suspected.

Hint 4: If the tachometer reads 0 r/min when the engine that has failed to start is cranked, the primary current of the ignition coil is not turned on and off. Therefore, troubles in the ignition circuit and ignition coil or faulty power transistor is suspected.

Hint 5: If the engine can be run at idle even though the crank angle sensor reading is out of specification, troubles are often in other than the crank angle sensor.

[Examples]
(1) Faulty engine coolant temperature sensor
(2) Faulty idle speed control servo
(3) Poorly adjusted reference idle speed

## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check condition | Check content | Normal state |
|---|---|---|---|---|---|
| Data reading | 22 | Cranking speed | ● Engine cranking<br>● Tachometer connected | Compare cranking speed and MUT-II reading | Indicated speed to agree |

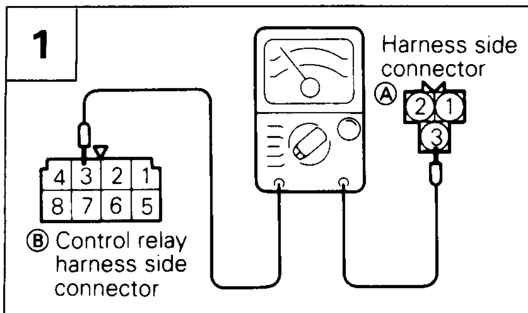
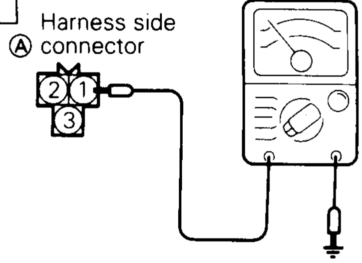
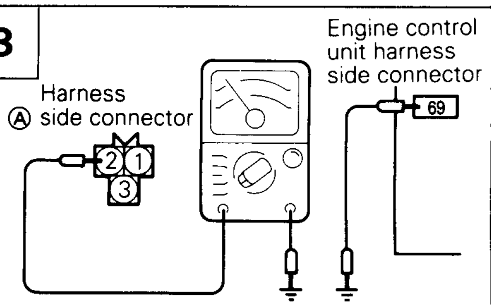
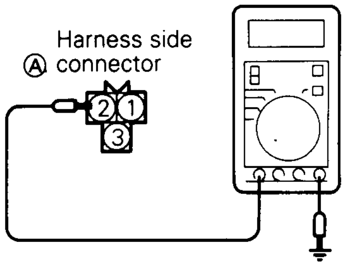
NOTE
(1) The tachometer indicates a third of the actual engine speed. Therefore, 3 times the tachometer indication is the actual engine speed.
(2) When the tachometer is set to the 2-cylinder range, it indicates actual engine speed.

| Function | Item No. | Data display | Check condition | Coolant temperature °C (°F) | tandard value r/min. |
|---|---|---|---|---|---|
| Data reading | 22 | Idle speed | ● Engine: Running at idle<br>● Idle position switch: ON | At –20 (–4) | 1275–1475 |
| | | | | At 0 (32) | 1225–1425 |
| | | | | At 20 (68) | 1100–1300 |
| | | | | At 40 (104) | 950–1150 |
| | | | | At 80 (176) | 600–800 |

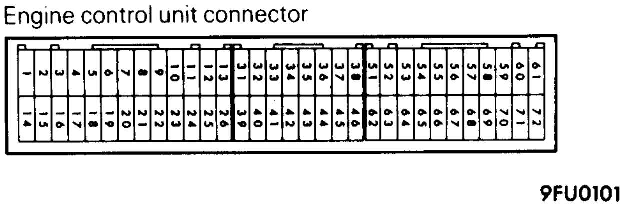
### Waveform inspection with analyzer

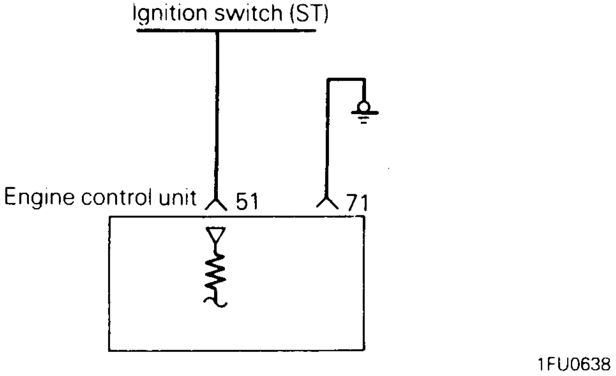
Refer to cam position sensor section (P.13-79-60.)

## HARNESS INSPECTION

| | | | | |
|---|---|---|---|---|
| 1 |  <br>6AF0061 | Check for continuity between the crank angle sensor and the control relay.<br>● Crank angle sensor connector: Disconnected<br>● Control relay connector: Disconnected<br>NOTE<br>Touch ohmmeter probes to both ends of the harness | OK →<br>~~OK~~ → | 2<br>Repair the harness. (Ⓐ$\boxed{3}$ – Ⓑ$\boxed{3}$) |
| 2 |  <br>6AF0062 | Check for continuity of the earth circuit.<br>● Crank angle sensor connector: Disconnected | OK →<br>~~OK~~ → | 3<br>Repair the harness. (Ⓐ$\boxed{1}$– Earth ) |
| 3 |  <br>6AF0063 | Check for an open-circuit, or a short-circuit to earth between the crank angle sensor and the engine control unit.<br>● Engine control unit connector: Disconnected<br>● Crank angle sensor connector: Disconnected | OK →<br>~~OK~~ → | 4<br>Repair the harness. (Ⓐ$\boxed{2}$–$\boxed{69}$) |
| 4 |  <br>6AF0064 | Measure the impressed voltage.<br>● Crank angle sensor connector: Disconnected<br>● Engine control unit connector: Connected<br>● Ignition switch: ON<br>Voltage (V)<br>4.8–5.2 | OK →<br>~~OK~~ → | STOP<br>Replace the engine control unit. |

## IGNITION SWITCH-ST [M/T only]





### OPERATION

- The ignition switch-ST inputs a high signal to the engine control unit while the engine is cranking. The engine control unit provides fuel injection control, etc., at engine startup based on this signal.
- When the ignition switch is set to START, the battery voltage at cranking is applied through the ignition switch to the engine control unit, which detects that the engine is cranking.

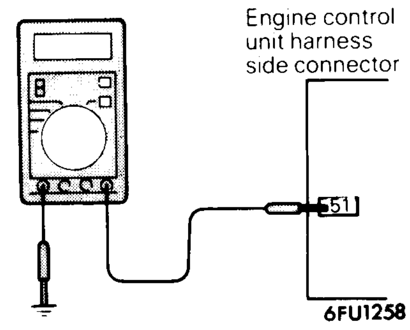
### INSPECTION

#### Using MUT-II

| Function | Item No. | Data display | Check condition | Engine | Normal indication |
|---|---|---|---|---|---|
| Data reading | 18 | Switch state | Ignition switch: ON | Stop | OFF |
| | | | | Cranking | ON |

### HARNESS INSPECTION

**1**



Measure the input voltage to the engine control unit.

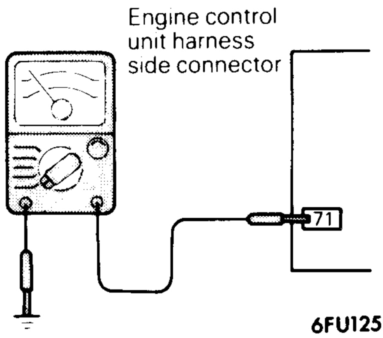
- Engine control unit connector: Disconnected
- Ignition switch: START

| Voltage (V) |
|---|
| 8 or more |

OK → 2

~~OK~~ → Repair the harness. (51 – Ignition switch)

**2**



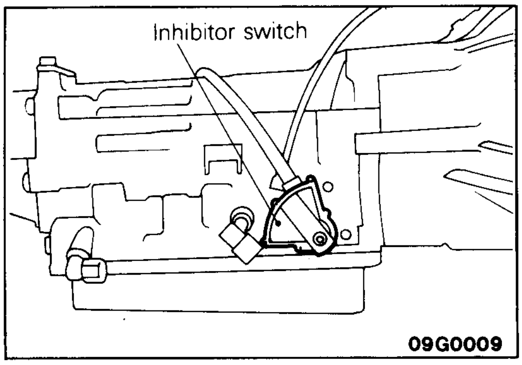
Check for continuity of the earth circuit.

- Engine control unit connector: Disconnected

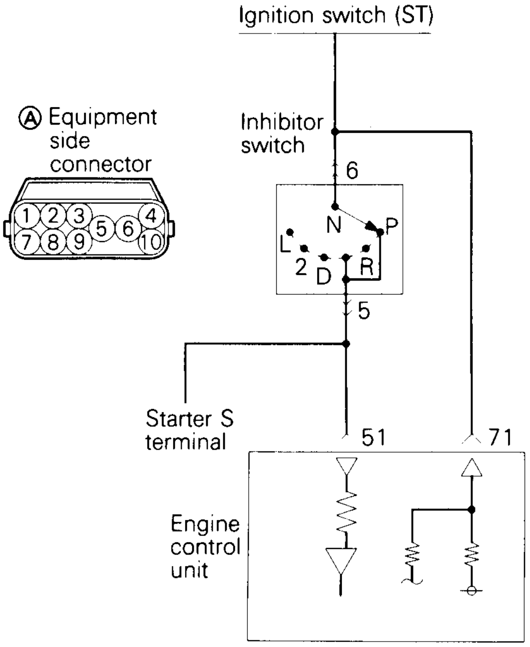
OK → STOP

~~OK~~ → Repair the harness. (71 – Earth)

# IGNITION SWITCH-ST AND INHIBITOR SWITCH [A/T only]

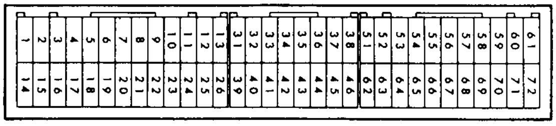


09G0009



7FU1528

Engine control unit connector



9FU0101

## OPERATION

- The ignition switch-ST inputs a high signal to the engine control unit while the engine is cranking. The engine control unit provides fuel injection control, etc., at engine startup based on this signal.
- When the ignition switch is set to START, the battery voltage at cranking is applied through the ignition switch and inhibitor switch to the engine control unit, which detects that the engine is cranking. In case the selector lever is in a position other than the P/N range, the battery voltage is not applied to the engine control unit.
- The inhibitor switch converts the selector lever position (whether it is at the P/N range or at others) into high/low voltage and inputs it to the engine control unit, which then controls the idle speed control servo based on this signal.
- The battery voltage in the engine control unit is applied through a resistor to the inhibitor switch. When the selector lever is set to the P/N range, continuity is produced between the inhibitor switch terminal of the engine control unit and earth through the starter motor, thereby making the terminal voltage go low.

## TROUBLESHOOTING HINTS

If the inhibitor switch harness and individual part check have resulted normal but the inhibitor switch output is abnormal, poorly adjusted control cable is suspected.

## INSPECTION

### Using MUT-II

IGNITION SWITCH-ST

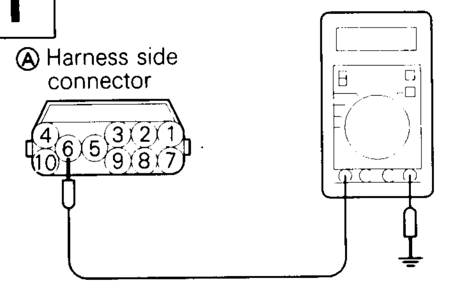
| Function | Item No. | Data display | Check condition | Engine | Normal indication |
|---|---|---|---|---|---|
| Data reading | 18 | Switch state | Ignition switch: ON | Stop | OFF |
| | | | | Cranking | ON |

INHIBITOR SWITCH

| Function | Item No. | Data display | Check condition | Select lever position | Normal indication |
|---|---|---|---|---|---|
| Data reading | 29 | Shift position | Ignition switch: ON | P or N | P or N |
| | | | | D, 2, L or R | D, 2, L or R |

## HARNESS INSPECTION

**1**



7FU1529

Measure the power supply voltage of the inhibitor switch

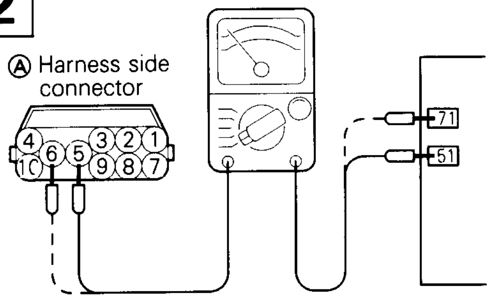
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected
- Ignition switch: START

| Voltage (V) |
|---|
| SV |

OK → **2**

~~OK~~ → Check the power supply circuit.

**2**



7FU1530

Check for continuity between the inhibitor switch and the engine control unit.

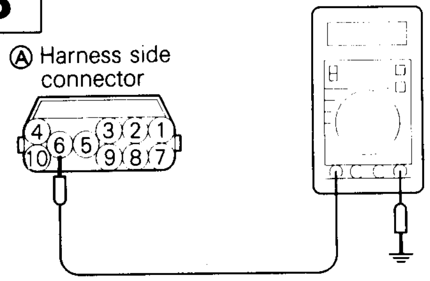
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → **3**

~~OK~~ → Repair the harness. (Ⓐ5 - 51) (Ⓐ6 - 71)

**3**



7FU1529

Measure the inhibitor switch terminal input voltage.

- Engine control unit connector: Connected
- Inhibitor switch connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

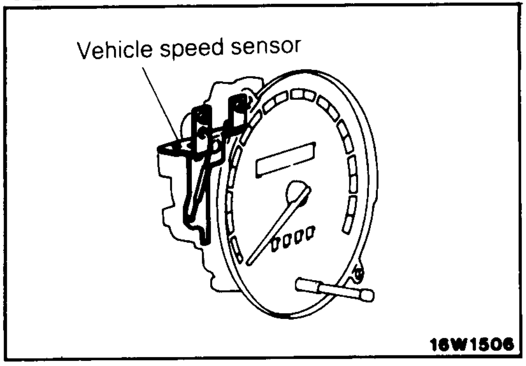
OK → STOP

~~OK~~ → Repair the engine control unit.

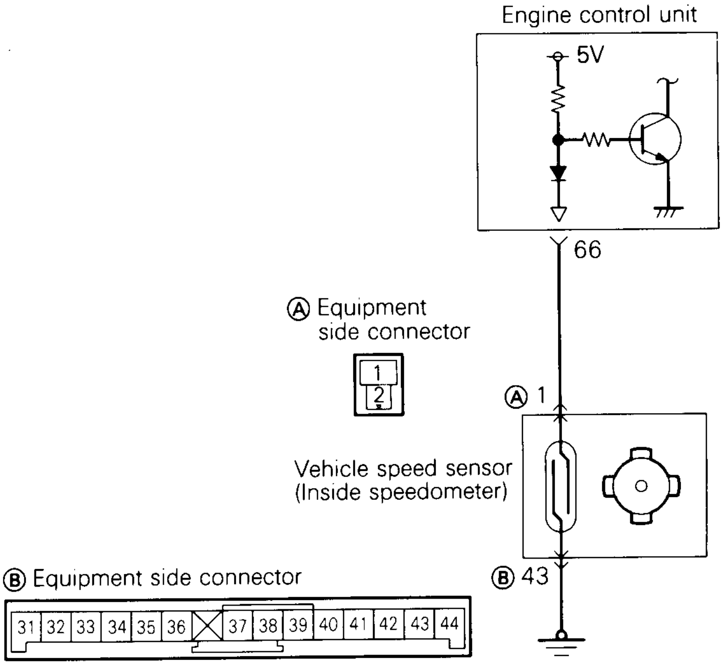
## INHIBITOR SWITCH INSPECTION

Refer to GROUP 23 – Service Adjustment Procedures.

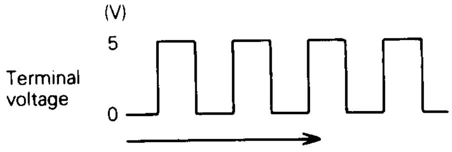
## VEHICLE SPEED SENSOR



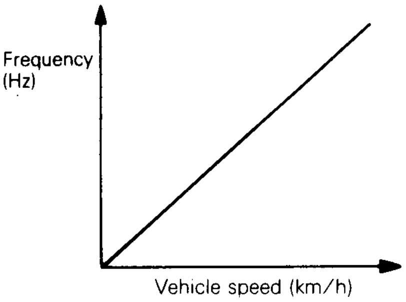
16W1506



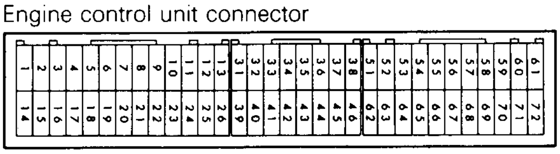
7FU1533



16Z478



16Z451



9FU0101

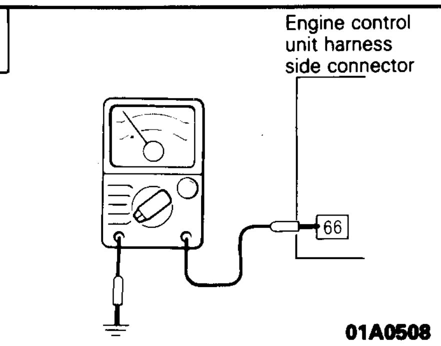
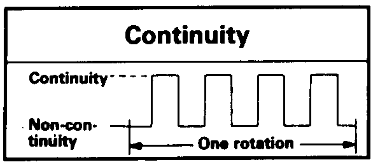
### OPERATION

- The vehicle-speed sensor is incorporated within the speedometer; it converts vehicle-speed data to pulse signals and inputs those signals to the engine control unit. The engine control unit, based upon those signals, regulates the idle-speed servo, etc.
- The vehicle-speed sensor, by intermitting by the reed switch the flow (to earth) of the approximately 5V voltage applied from the engine control unit, produces vehicle-speed signals.

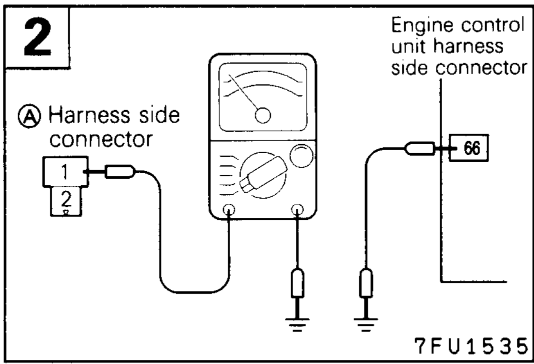
### TROUBLESHOOTING HINTS

If there is damaged or disconnected wiring, or a short-circuit, of the vehicle-speed sensor signal circuit, the engine may stall when the vehicle speed is reduced and the vehicle is stopped.

### HARNESS INSPECTION

| | | | |
|---|---|---|---|
| **1**<br><br> <br>01A0508 | Check the vehicle speed sensor output circuit for continuity.<br>● Engine control unit connector: Disconnected.<br>● Move the vehicle.<br><br> | OK → 4<br>~~OK~~ → 2 | |

**2**



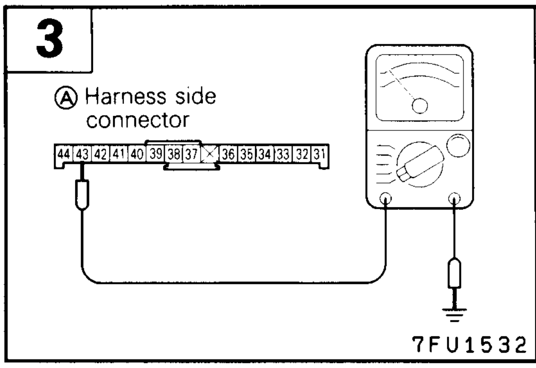
Check for an open-circuit or a short-circuit to earth, between the engine control unit and the vehicle speed sensor.

- Vehicle speed sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ1 - 66)

**3**



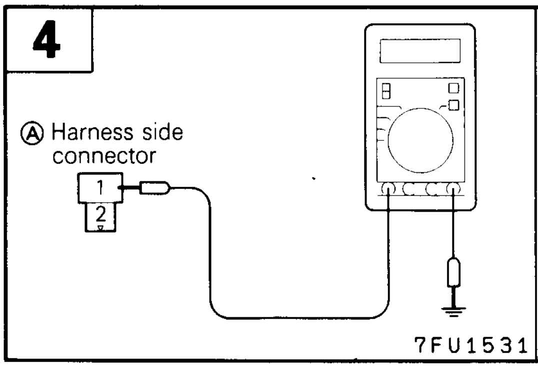
Check for continuity of the earth circuit.

- Vehicle speed sensor connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓐ43 - Earth)

**4**



Measure the impressed voltage.

- Vehicle speed sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.5 – 4.9 |

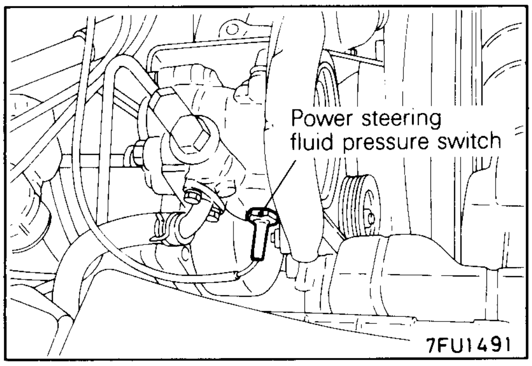
OK → STOP

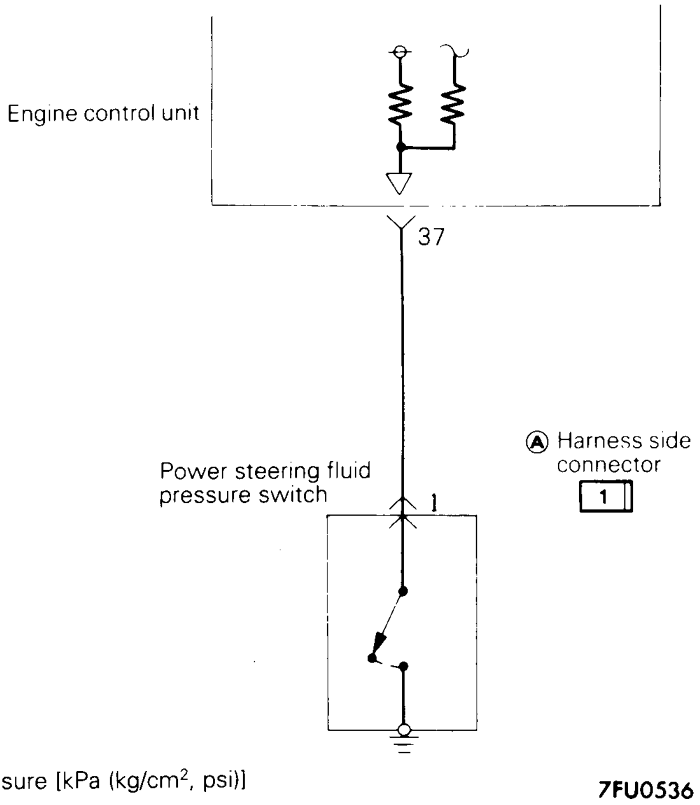
~~OK~~ → Replace the engine control unit.

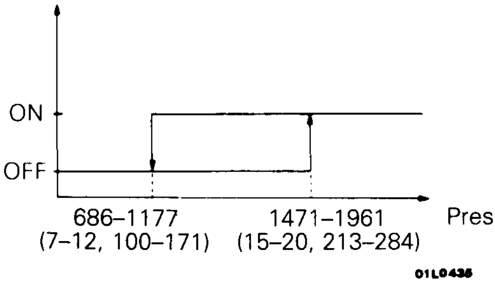
## SENSOR INSPECTION

Refer to GROUP 54 – Meters and Gauges.

## POWER STEERING FLUID PRESSURE SWITCH







## OPERATION

- The power steering fluid pressure switch converts presence/absence of power steering load into low/high voltage and inputs it to the engine control unit, which then controls the idle speed control servo based on this signal.
- The battery voltage in the engine control unit is applied through a resistor to the power steering fluid pressure switch. Steering operation causes the power steering fluid pressure to increase, turning the switch on. As a result, continuity is produced between the battery voltage applied and earth. This causes the power steering fluid pressure terminal voltage to go from high to low.

## INSPECTION

### Using MUT-II

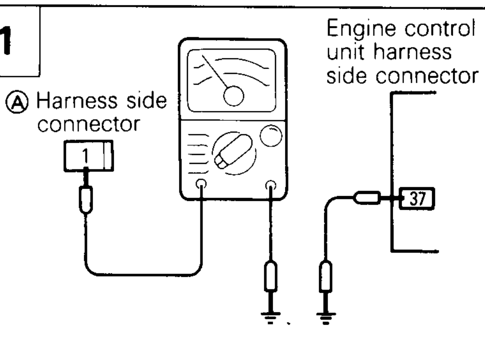
| Function | Item No. | Data display | Check condition | Steering wheel | Normal indication |
|---|---|---|---|---|---|
| Data reading | 27 | Switch state | Engine: Idling | Steering wheel neutral position (wheels straight-ahead direction) | OFF |
| | | | | Steering wheel half turn | ON |

### Checking Fluid Pressure

| Steering wheel | | Fluid pump delivery pressure (ref. value) |
|---|---|---|
| Straight forward | kPa ($kg/cm^2$, psi) | 686–1,177 (7–12, 100–171) |
| Turned | kPa ($kg/cm^2$, psi) | 1,471–1,961 (15–20, 213–284) |

## HARNESS INSPECTION

**1**



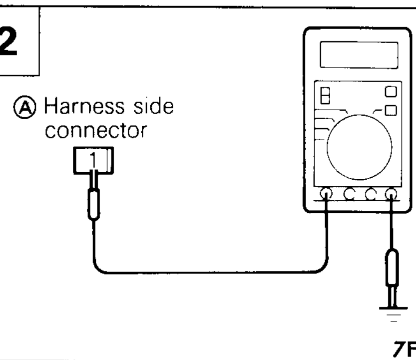
Check for open-circuit or short circuit between the power steering fluid pressure switch and the engine control uit.

- Power steering fluid pressure switch connector: Disconnected
- Engine control unit connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ1 - 37)

**2**



Measure the applied voltage.

- Power steering fluid pressure switch connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

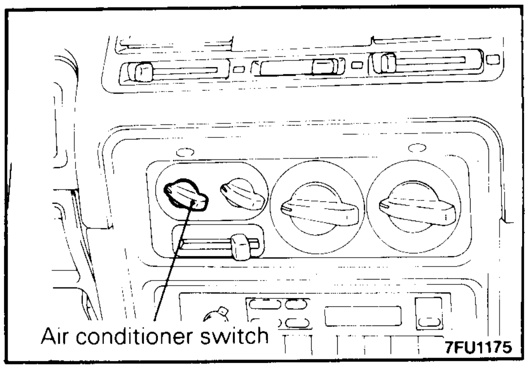
OK → STOP

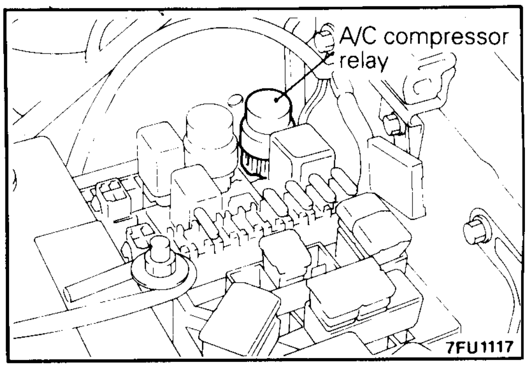
~~OK~~ → Replace the engine control unit.

## SENSOR INSPECTION

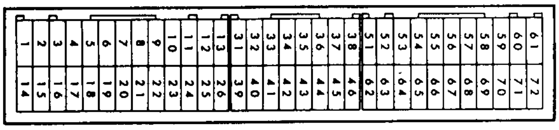
Refer to GROUP 37 – Service Adjustment Procedures.

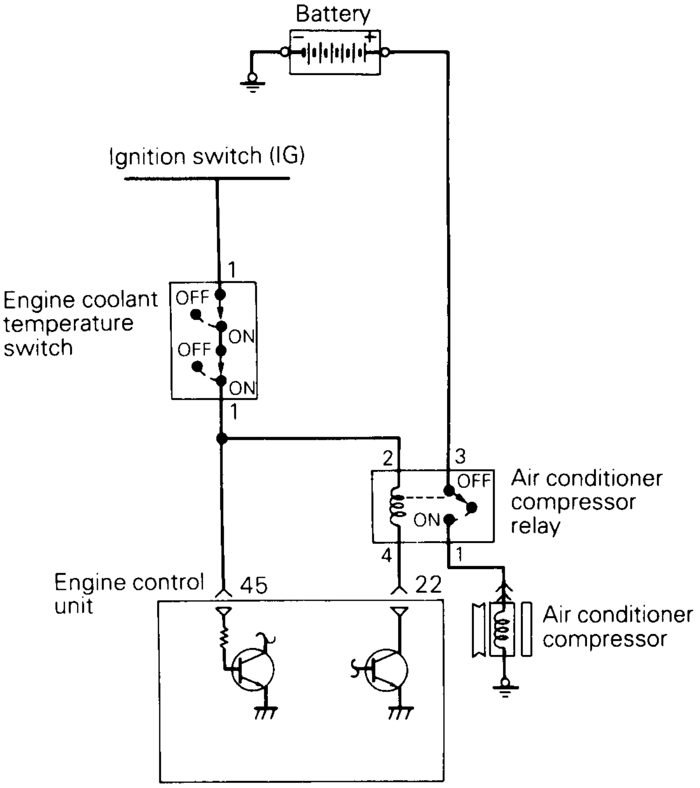
## AIR CONDITIONER SWITCH AND POWER RELAY





Engine control unit connector





## OPERATION

- The air conditioner switch applies battery voltage to the engine control unit when the air conditioner is switched ON.
- When the air conditioner signals are input, the engine control unit activates the idle-speed control servo, and also switches ON the power transistor. As a result, current flows to the power relay coil and the relay switch is switched ON; the airconditioner compressor's magnetic clutch is activated.

## TROUBLESHOOTING HINTS

If the air conditioner compressor's magnetic clutch is not activated when the air conditioner switch is switched ON during idling, it is probable that the cause is a malfunction of the air conditioner control system.

## INSPECTION

### Using MUT-II

### Air conditioner switch

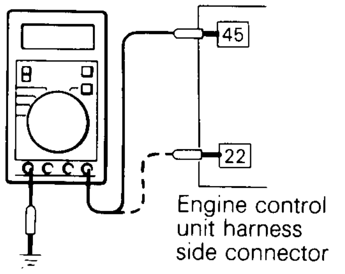
| Function | Item No. | Data display | Check conditions | Air conditioner switch | Normal display |
|---|---|---|---|---|---|
| Data reading | 28 | Switch status | • Engine idling (The air conditioner compressor should be activated when the air conditioner switch is switched ON.) | OFF | OFF |
| | | | | ON | ON |

### Air conditioner power relay

| Function | Item No. | Data display | Check conditions | Air conditioner switch | Normal display |
|---|---|---|---|---|---|
| Data reading | 49 | Air conditioner power relay status | • Engine: idling after warm up | OFF | OFF (Compressor clutch non-activation) |
| | | | | ON | ON (Compressor clutch activation) |

## HARNESS INSPECTION

**1**



01R0863

Measure the power supply voltage of the air conditioner circuit.

- Engine control unit connector: Disconnect
- Ignition switch: ON
- Air conditioner switch: ON

| Voltage (V) |
|---|
| SV |

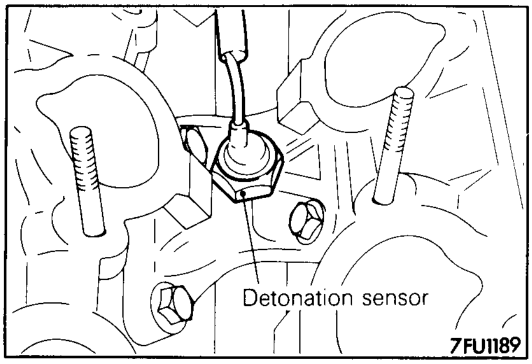
OK → STOP

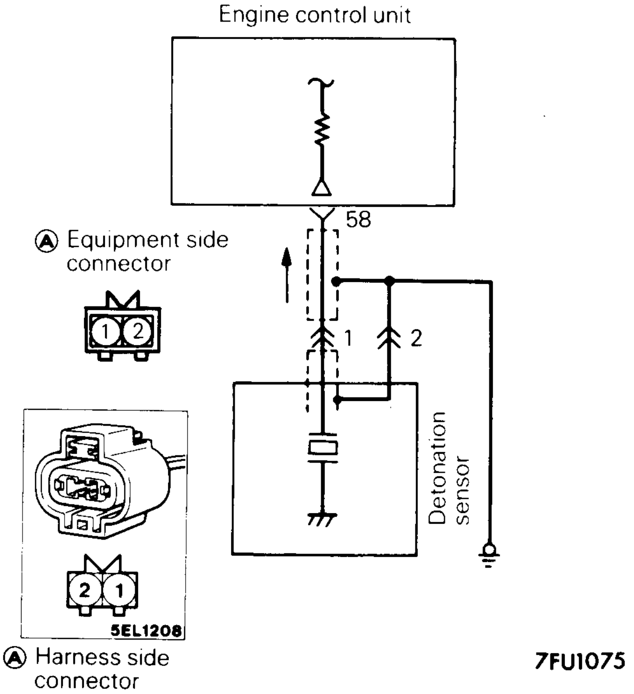
~~OK~~ → Check the Air conditioner circuit.

## AIR CONDITIONER INSPECTION

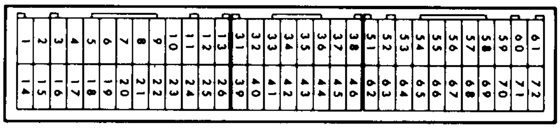
Refer to GROUP 55.

## DETONATION SENSOR <DOHC>





Engine control unit connector



### OPERATION

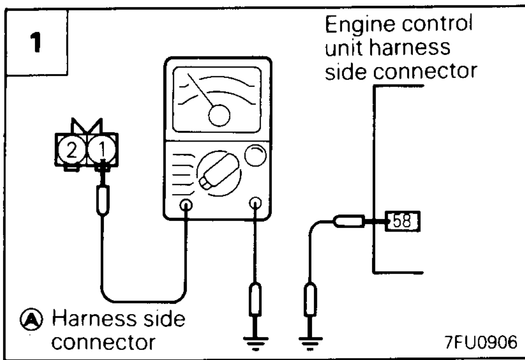
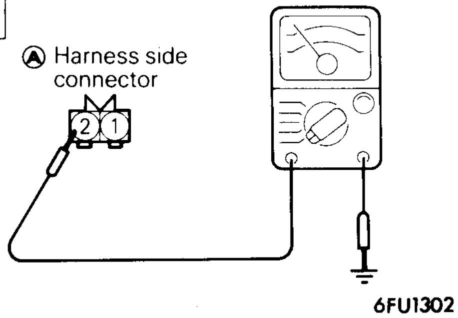
The detonation sensor generates a voltage proportional to the magnitude of cylinder block vibration due to knocking and inputs it to the engine control unit. Based on this signal, the engine control unit provides retard control of the ignition timing.

### TROUBLESHOOTING HINTS

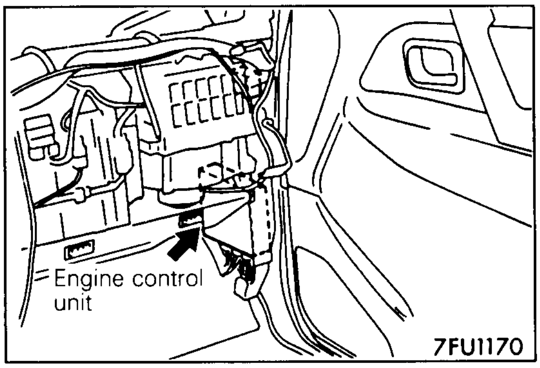
When knocking occurs while driving under high-load conditions, the following problems are suspected in addition to the detonation sensor itself.

(1) Inappropriate ignition plug heat range
(2) Inappropriate gasoline
(3) Incorrectly adjusted reference ignition timing

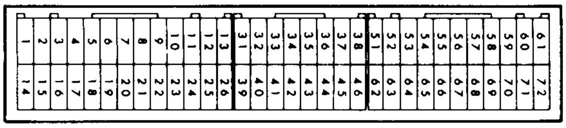
## HARNESS INSPECTION

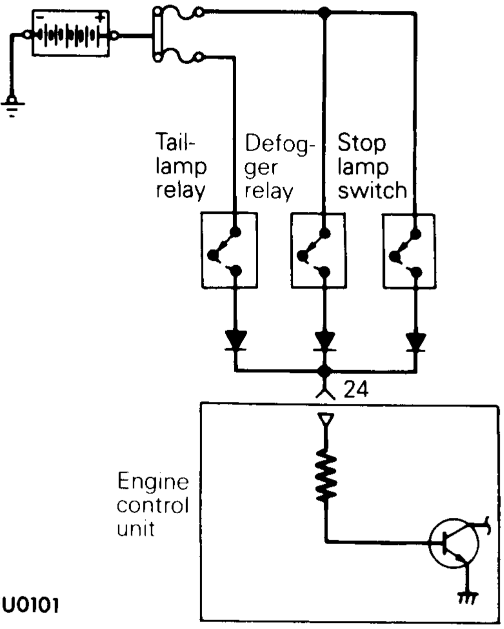
| | | |
|---|---|---|
| **1**<br> | Check for an open-circuit or a short-circuit to earth, between the engine control unit and detonation sensor.<br>● Detonation sensor connector: Disconnected<br>● Engine control unit connector: Disconnected<br>OK →<br>~~OK~~ → | 2<br>Repair the harness. (Ⓐ1 – 58) |
| **2**<br> | Check for continuity of the earth circuit.<br>● Connector: Disconnected<br>OK →<br>~~OK~~ → | STOP<br>Repair the harness. (Ⓐ2 – Earth ) |

# ELECTRICAL LOAD SWITCH <DOHC>



Engine control unit connector





## OPERATION

- The electrical load switch inputs ON/OFF state of the switch of equipment that consumes much power during idling, namely, equipment with a large electrical load, to the engine control unit. Based on this signal, the engine control unit controls the idle-speed control servo.
- When the switch of equipment with a large electrical load is turned ON, the battery voltage is applied to the engine control unit to indicate that the equipment switch is turned ON.

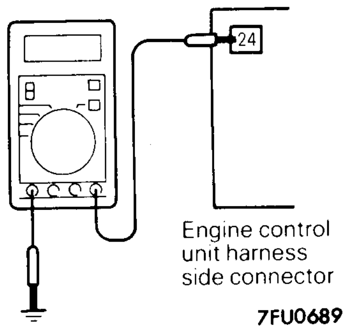
## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check condition | Equipment state | Normal display |
|---|---|---|---|---|---|
| Data reading | 33 | Switch state | Operation of equipment: OFF | Lighting switch only: OFF → ON | OFF → ON |
| | | | | Rear defogger switch only: OFF → ON | OFF → ON |
| | | | | Brake pedal only: depressed → Released | ON → OFF |

## HARNESS INSPECTION

**1**



Measure the input voltage of engine control unit.

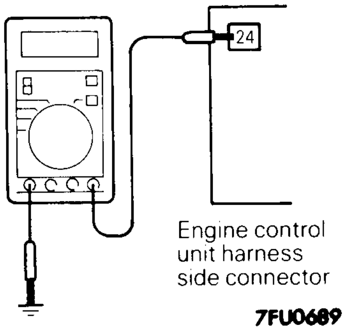
- Engine control unit connector: Disconnected
- Lighting switch: ON
  (Tail lamp relay ON)

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Check circuit related to tail lamp relay

**2**



Measure the input voltage of engine control unit.

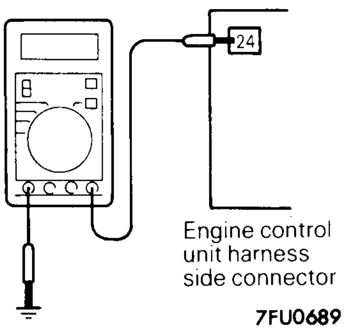
- Engine control unit connector: Disconnected
- Defogger switch: ON
  (Defogger relay ON)

| Voltage (V) |
|---|
| SV |

OK → 3

~~OK~~ → Check circuit related to defogger relay

**3**



Measure the input voltage of engine control unit.

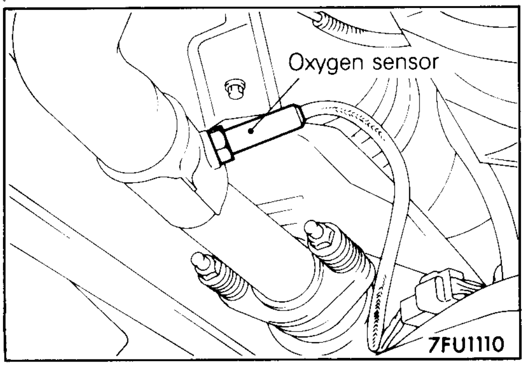
- Engine control unit connector: Disconnected
- Brake pedal: Depressed
  (Stop lamp switch ON)

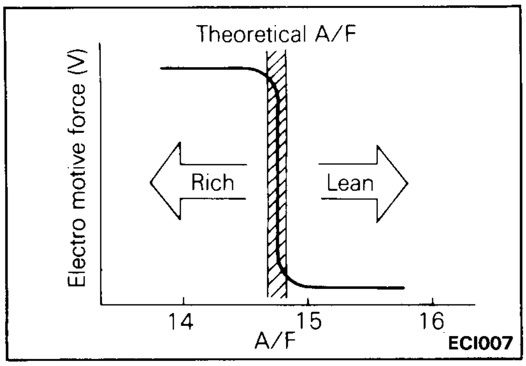
| Voltage (V) |
|---|
| SV |

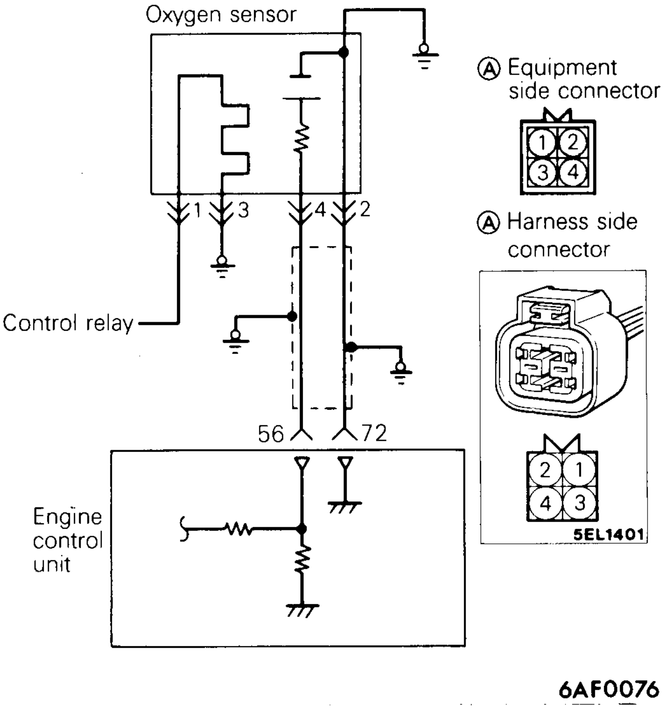
OK → STOP

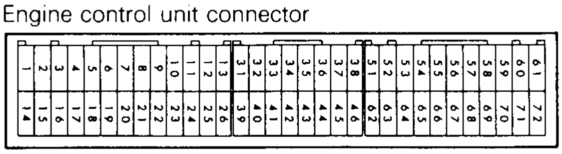
~~OK~~ → Check circuit related to stop lamp relay

## OXYGEN SENSOR









### OPERATION

- The oxygen sensor functions to detect the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the engine control unit.
- If the air/fuel mixture ratio is richer than the theoretical air/fuel mixture ratio (i.e., if the concentration of oxygen in the exhaust gas is sparse), a voltage of approximately 1V is output; if the air/fuel mixture ratio is leaner than the theoretical air/fuel mixture ratio (i.e., if the concentration is dense), a voltage of approximately 0V is output.
- The engine control unit, based upon those signals, regulates the amount of fuel injection so that the air/fuel mixture ratio becomes the theoretical air/fuel mixture ratio.
- Battery power supply is applied, by way of the control relay, to the oxygen sensor heater. As a result, the sensor element is heated by the heater, so that the oxygen sensor shows excellent response even if the temperature of the exhaust gas is low.

### TROUBLESHOOTING HINTS

Hint 1: The exhaust gas purification performance will worsen if there is a malfunction of the oxygen sensor.

Hint 2: If the oxygen sensor output voltage deviates from the standard value even though the results of the checking of the oxygen sensor are normal, the cause is probably a malfunction of a component related to air/fuel mixture ratio control.

[Examples]

(1) Malfunction of an injector.
(2) Air leakage into the intake manifold from a leaking gasket.
(3) Malfunction of the air-flow sensor, the intake air temperature sensor, the barometric-pressure sensor, or the engine coolant temperature sensor.

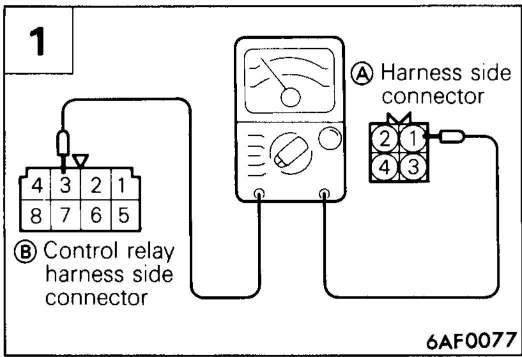
## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value mV |
|---|---|---|---|---|---|
| Data reading | 11 | Sensor detection voltage | ● Engine: warm-up (Make the mixture lean by engine speed reduction, and rich by racing.) | When sudden deceleration from 4,000 | 200 or lower |
| | | | | When engine is suddenly raced | 600– 1,000 |
| | | | ● Engine: warm up using the oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the engine control unit | 700 (Idling) | 400 or lower<br>↕ (changes)<br>600– 1,000 |
| | | | | 2,000 | |

## HARNESS INSPECTION

**1**



Check for continuity between the oxygen sensor and the control relay.

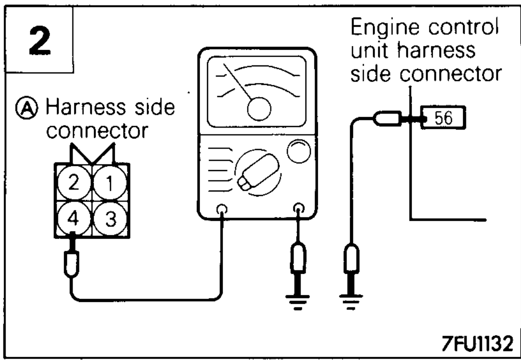
- Control relay connector: Disconnected
- Oxygen sensor connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness. (Ⓐ1 - Ⓑ3)

**2**



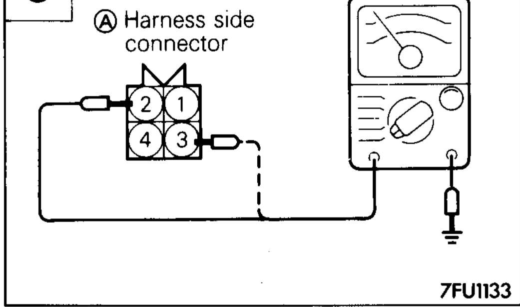
Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the oxygen sensor.

- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ4 - 56)

**3**

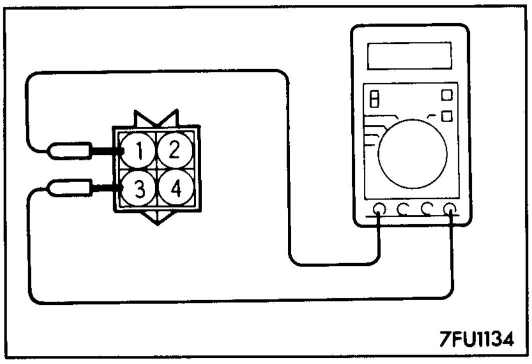


Check for continuity of the earth circuit.

- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

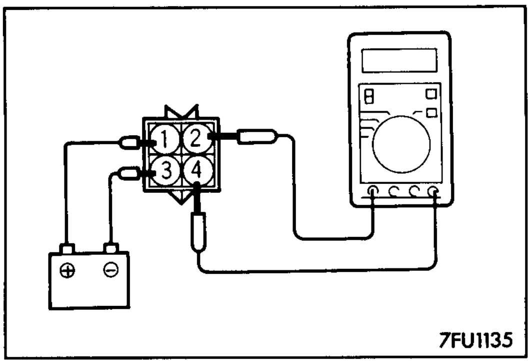
OK → STOP

~~OK~~ → Repair the harness. (Ⓐ2 - 72) (Ⓐ3 - Earth)



## SENSOR INSPECTION

(1) Disconnect the oxygen sensor connector.
(2) Check that there is continuity [approx. 20 Ω at 20°C (68°F)] between oxygen sensor connector terminal ① and terminal ③.
(3) If there is no continuity, replace the oxygen sensor.



(4) Warm the engine until the engine coolant temperature reaches 80°C (176°F) or more.
(5) Use the jumper leads to connect the oxygen sensor terminal ① (connect (+) terminal) and terminal ③ (connect (–) terminal) to the battery (+) and (–) terminals respectively.

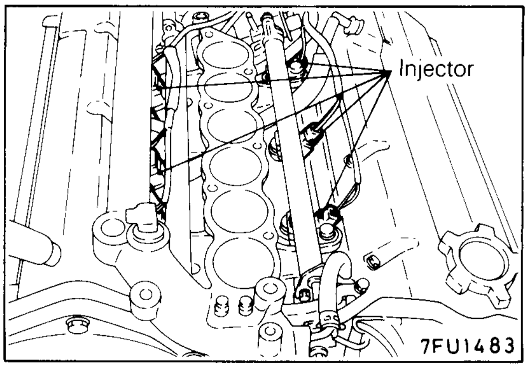
**Caution**
**Be careful when connecting the jumper leads, as connecting the terminals incorrectly will damage the oxygen sensor.**

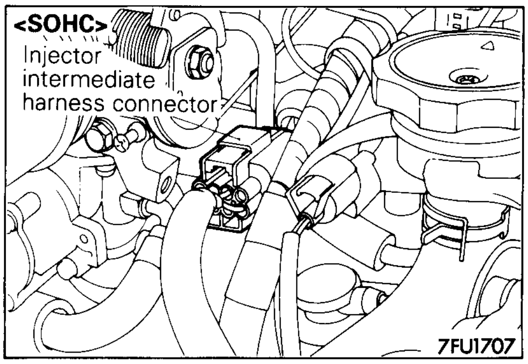
(6) Connect a digital-type voltmeter to terminal ② and terminal ④.
(7) While repeatedly racing the engine, measure the oxygen sensor output voltage.

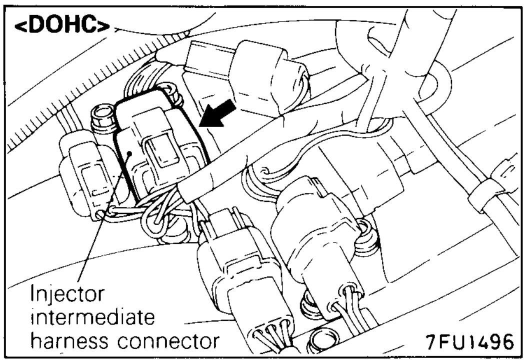
| Engine | Oxygen sensor output voltage | Notes |
|---|---|---|
| When racing the engine | 0.6–1.0V | When the air/fuel mixture ratio is enriched by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6–1.0V. |

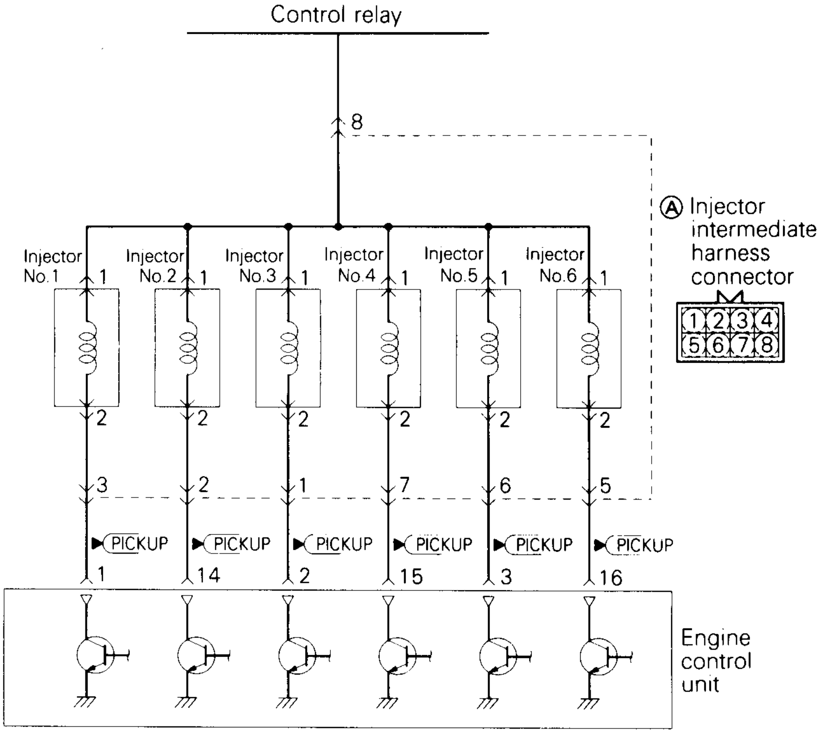
NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe, Main Muffler and Catalytic Converter.

## INJECTORS



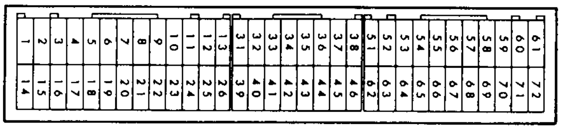






7FU1472

Engine control unit connector



9FU0101

## OPERATION

- The injectors are electromagnetic-valve-equipped injection nozzles that function to inject fuel based upon injection signals from the engine control unit.
- Because the surface area of the injection ports is fixed and because the pressure of the fuel relative to the pressure within the manifold is also regulates to a fixed pressure, the amount of fuel injection by injectors is determined by the length of time that the needle valve is open, or, in other words, by the length of time of current flow to the solenoid coil.
- Battery power supply is supplied, by way of the control relay, to the injectors. When the engine control unit switches ON the power transistor within the unit and current flows to the solenoid coil, the injectors open and fuel is injected.

## TROUBLESHOOTING HINTS

Hint 1: If there is a problem with starting while the engine is warm, perform the combustion test and check for leakage of the injectors.

Hint 2: If the engine can't be started, and the injectors are not activated during cranking, the cause is probably a malfunction such as described below, not with the injectors.

(1) Malfunction of the circuit for supply of power to the engine control unit, or of the earth circuit.
(2) Malfunction of the control relay.
(3) Malfunction of the crank-angle sensor and/or the top dead center sensor.

Hint 3: If there is a cylinder for which the idling condition does not change when, during idling, the fuel injection of the injectors is cut off in sequence, check that cylinder as described below.

(1) Check the injector and harness.
(2) Check the spark plugs and the high-tension cable.
(3) Check the compression pressure.

Hint 4: If the injector activation time deviates from the standard value even though the results of the checking of the injector's harness and of the injector itself are normal, the cause may be presumed to be one of the following.

(1) Incomplete combustion within the cylinder. (Malfunction of the spark plugs, the ignition coil, the compression pressure, etc.)
(2) Improper adhesion of EGR valve seat.
(3) Increased engine resistance.

## INSPECTION

### Using MUT-II

| Function | Item No. | Data Display | Check conditions | Engine coolant temperature °C (°F) | Standard value ms |
|---|---|---|---|---|---|
| Data reading | 41 | Activation time*1 | Engine cranking | When 0*2 (32) | 15.5–19 <SOHC><br>15–18 <DOHC> |
| | | | | When 20 (68) | 38–46.5 <SOHC><br>42–51 <DOHC> |
| | | | | When 80 (176) | 10–12 <SOHC><br>9–11 <DOHC> |

| Function | Item No. | Data Display | Check conditions | Engine condition r/min. | Standard value ms |
|---|---|---|---|---|---|
| Data reading | 41 | Activation time*3 | ● Engine coolant temperature: 89–95°C (185–205°F)<br>● Lamps and accessories: OFF<br>● Transmission: neutral (P range for vehicles with A/T)<br>● Steering wheel: neutral position | 700 (idling) | 2.6–3.8 <SOHC><br>2.3–3.5 <DOHC> |
| | | | | 2,500 <SOHC> | 2.3–3.5 |
| | | | | 2,000 <DOHC> | 2.0–3.2 |
| | | | | When raced suddenly | Increases |

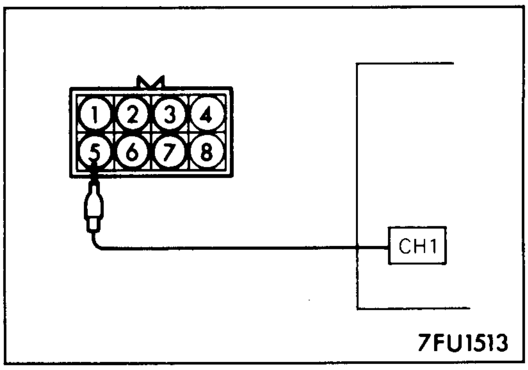
NOTE

*1 : Indicates the injector-activation time when the power source voltage is 11V and the cranking speed is 250 r/min or less.

*2: At a coolant temperature of 0°C (32°F), there is synchronous injection for all six cylinders.

*3: For a new vehicle [driven approximately 500 km (300 miles) or less)] the injector-activation may be about ten percent longer than indicated above.

| Function | Item No. | Drive content | Check condition | Normal condition |
|---|---|---|---|---|
| Actuator test | 01 | No. 1 injector shut off | Engine: Idling after warm-up (Shut off the injectors in sequence during after engine warm-up, check the idling condition) | Idle state to change further (becoming less stable or stalling) |
| | 02 | No. 2 injector shut off | | |
| | 03 | No. 3 injector shut off | | |
| | 04 | No. 4 injector shut off | | |
| | 05 | No. 5 injector shut off | | |
| | 06 | No. 6 injector shut off | | |



7FU1513

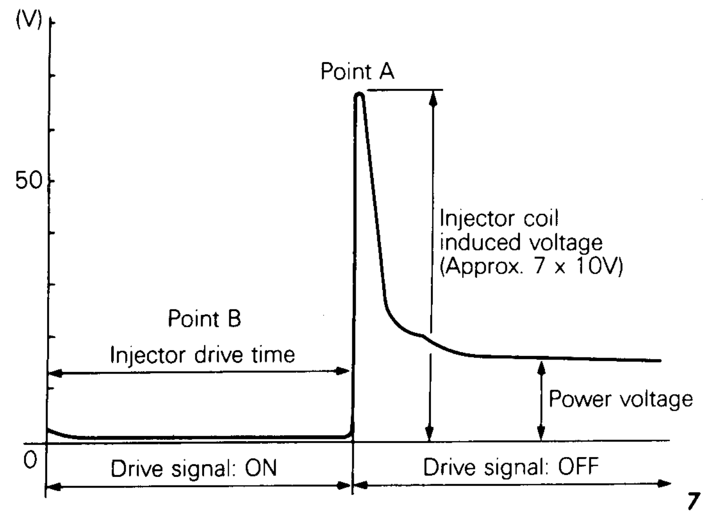
## Wave Pattern Inspection Using An Analyzer

(1) Remove the injector intermediate connector and connect the special tool (harness connector: MD998474).

(2) Connect the probe of an osciloscope as follows.

| | No. 1 cylinder | No. 2 cylinder | No. 3 cylinder | No. 4 cylinder | No. 5 cylinder | No. 6 cylinder |
|---|---|---|---|---|---|---|
| Male connector terminal No. | 3 | 2 | 1 | 7 | 6 | 5 |
| Clip colour (lead wire) | Green (Green/ black) | White (White) | Blue (Blue) | Yellow (Yellow) | Red (Red) | Black (Black) |

### Standard wave pattern



7FU1202

### Observation conditions

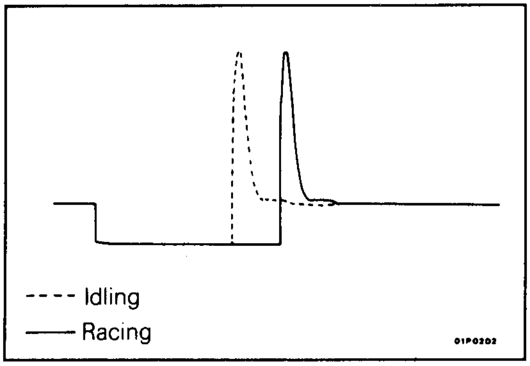
| | |
|---|---|
| Function | Special patterns |
| Pattent height | Variable |
| Variable knob pattern selector | Display |
| Engine r/min. | Idle speed (700 r/min.) |

### Wave pattern observation points

(Point A): Height of back electromotive force in the solenoid coil

| Contrast with standard wave pattern | Probable cause |
|---|---|
| Solenoid coil back electromotive force is low or doesn't appear at all. | Short in the injector solenoid |

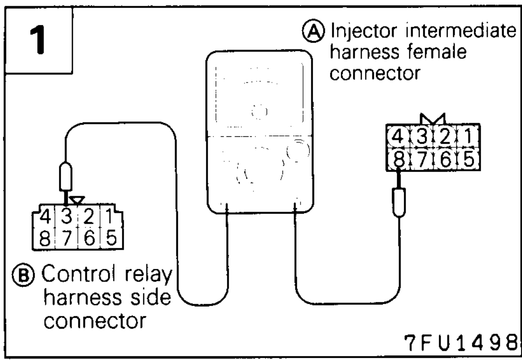
(Point B): Injector drive time



- The injector drive timing will synchronized with the MUT-II display.
- When the engine is suddenly raced, the drive time will be greatly extended at first, but the drive time will soon match the engine speed.

## HARNESS INSPECTION

**1**



Check for continuity between the injectors and the control relay.

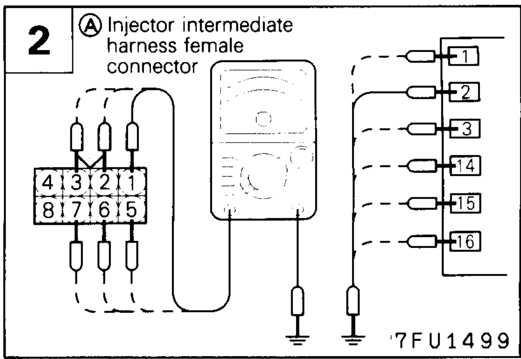
- Injector intermediate connector: Disconnected
- Control relay connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness. (Ⓐ8 - Ⓑ3)

**2**

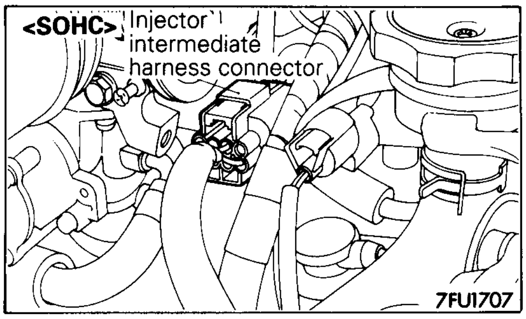


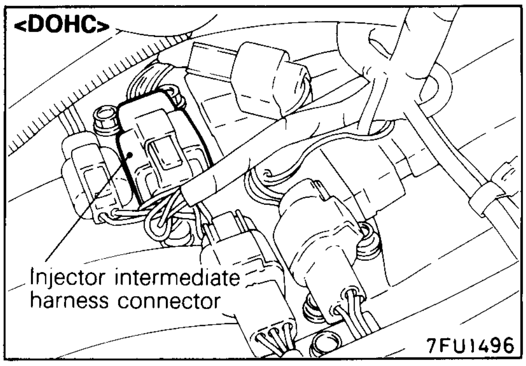
Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the injector.

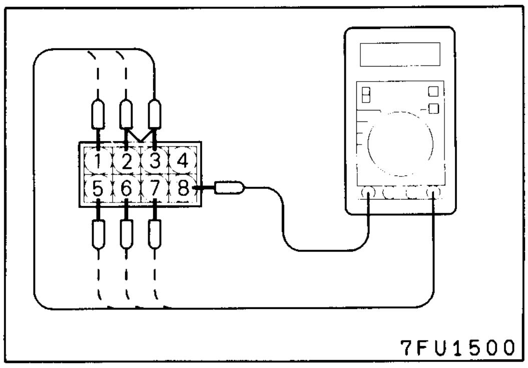
- Engine control unit connector: Disconnected
- Injector intermediate connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness.
(Ⓐ1 - 2)
(Ⓐ2 - 14)
(Ⓐ3 - 1)
(Ⓐ5 - 16)
(Ⓐ6 - 3)
(Ⓐ7 - 15)







## ACTUATOR INSPECTION

### Measuring Resistance Between Terminals

(1) Disconnect the injector intermediate harness connector.

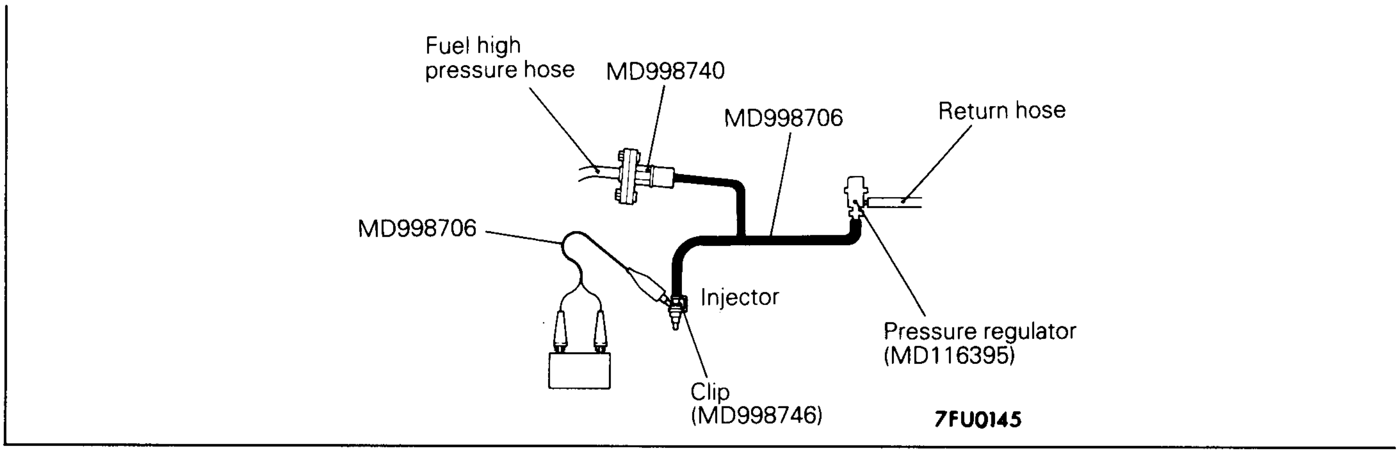
(2) Measure resistance value between terminals.

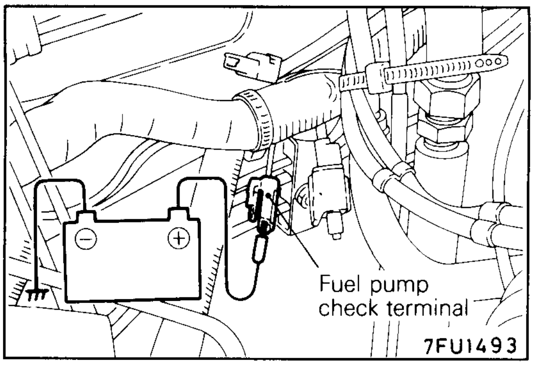
| Injector | Terminals | Resistance value |
|---|---|---|
| No. 1 | 8–3 | 13–16 Ω |
| No. 2 | 8–2 | |
| No. 3 | 8–1 | |
| No. 4 | 8–7 | |
| No. 5 | 8–6 | |
| No. 6 | 8–5 | |

(3) Connect the injector intermediate harness connector.

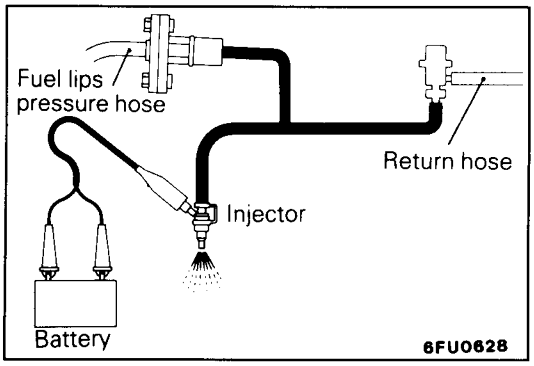
## Checking the Injection Condition

(1) Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel. (Refer to P.13-79-16.)
(2) Remove the injector.
(3) Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.

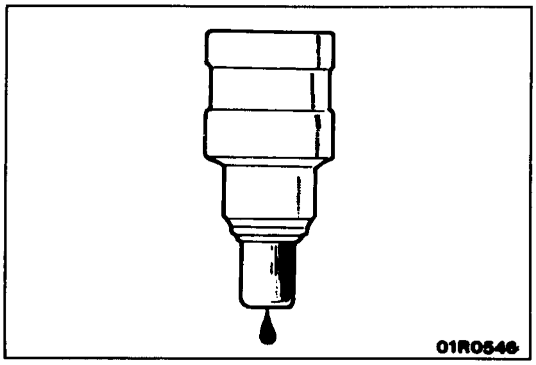




(4) Connect the battery's negative (–) terminal.
(5) Apply battery voltage to the fuel pump check terminal and activate the fuel pump.



(6) Activate the injector and check the atomized spray condition of the fuel. The condition can be considered satisfactory unless it is extremely poor.

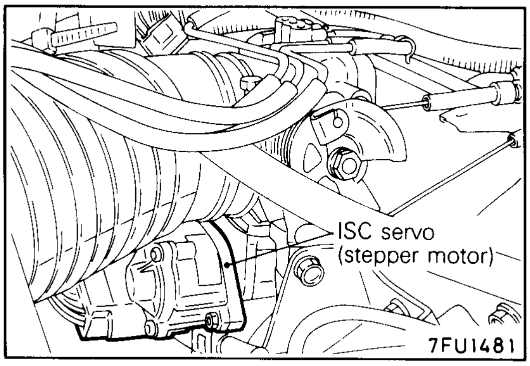


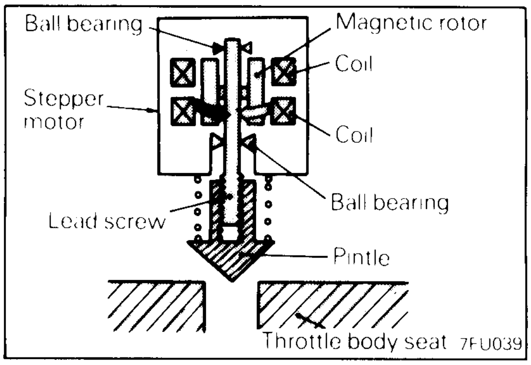
(7) Stop the actuation of the injector, and check for leakage from the injector's nozzle.

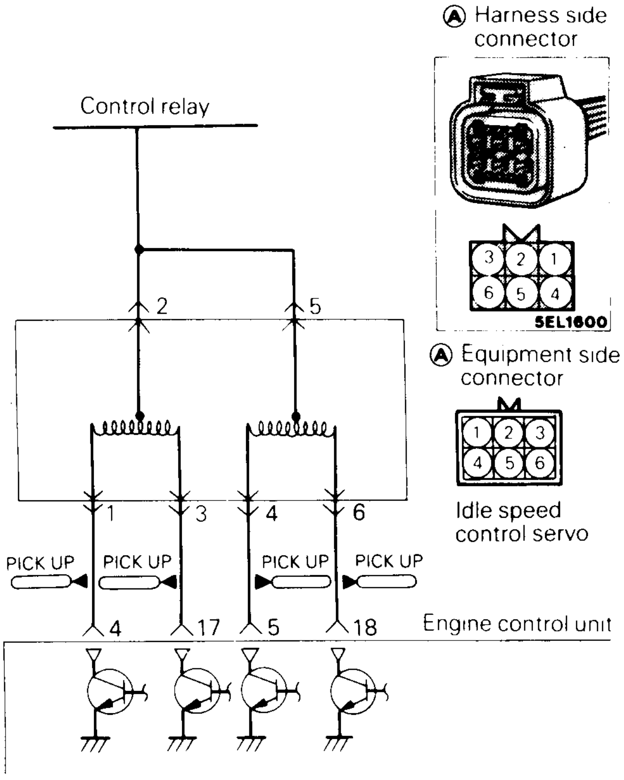
**Standard value: 1 drop or less per minute**

(8) Activate the injector without activating the fuel pump; then, when the spray emission of fuel from the injector stops. disconnect the special tool and restore it to its original condition.

# IDLE SPEED CONTROL SERVO (STEPPER MOTOR TYPE)

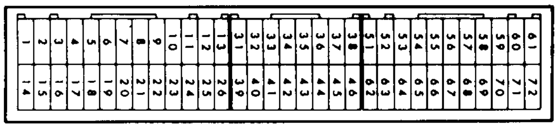






7FU0518

Engine control unit connector



9FU0101

## OPERATION

- The intake air volume during idling is controlled by opening or closing the servo valve provided in the air path that bypasses the throttle valve.
- The servo valve is opened or closed by operating the stepper motor in the speed control servo in normal or reverse direction.
- The battery power is supplied to the stepper motor through the control relay. As the engine control unit turns on power transistors in the unit one after another, the stepper motor coil is energized and the motor rotates in normal or reverse direction.

## TROUBLESHOOTING HINTS

Hint 1: If the stepper motor step increases to 100 to 120 steps or decreases to 0 step, faulty stepper motor or open circuit in the harness is suspected.

Hint 2: If the idle speed control servo harness and individual part checks have resulted normal but the stepper motor steps are out of specification, the following faults are suspected.

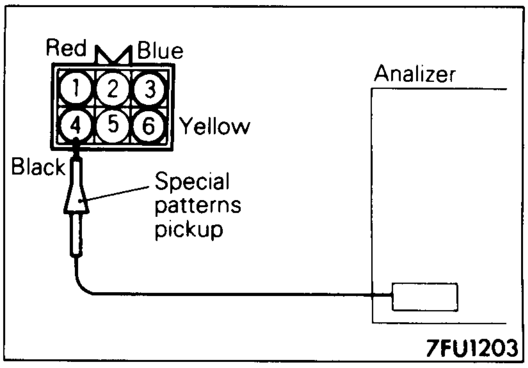
(1) Poorly adjusted reference idle speed
(2) Deposit on the throttle valve
(3) Air leaking into the intake manifold through gasket gap
(4) Loose EGR valve seat
(5) Poor combustion in the cylinder (faulty ignition plug, ignition coil, injector, low compression pressure, etc.)

## INSPECTION

### Using MUT-II

| Function | Item No. | Data display | Check condition | Load state | Standard value |
|---|---|---|---|---|---|
| Data reading | 45 | Stepper motor steps | ● Engine coolant temperature: 80–95°C (176–205°F)<br>● Lamps, accessory units: All OFF<br>● Transmission: Neutral<br>● Idle position switch: ON (compressor clutch to be ON if air conditioner switch is ON)<br>● Engine: Idling | Air conditioner switch: OFF | 2–25 steps |
| | | | | Air conditioner switch: ON | Increase by 10–70 steps |

NOTE
When the vehicle is new [within initial operation of about 500 km (300 miles)], the stepper motor steps may be about 30 steps more than standard.



### Wave Pattern Inspection Using an Analyzer

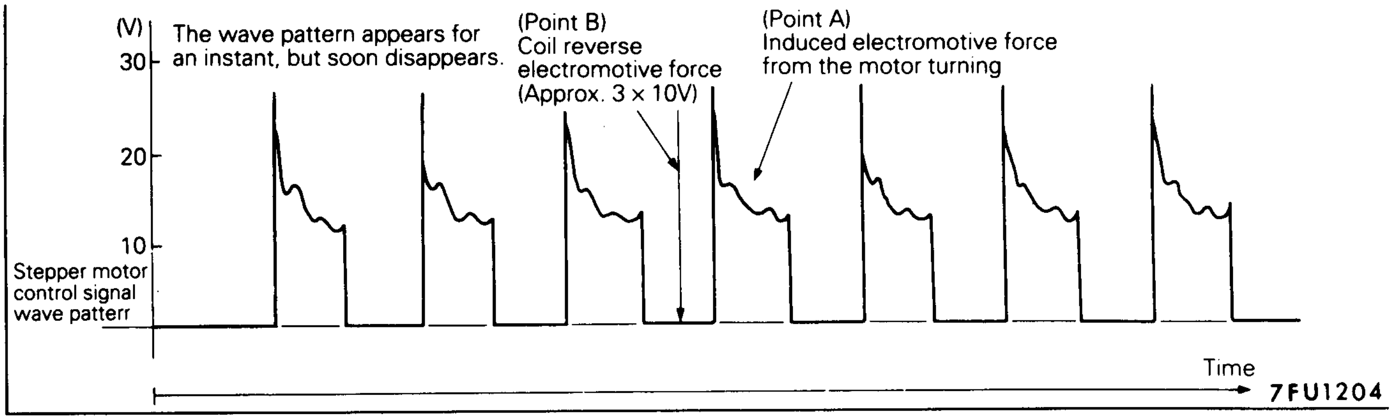
### Measurement method

(1) Disconnect the stepper motor connector, and connect the special tool (test harness: MB998463) in between.
(2) Connect the analyzer special patterns pickup to the stepper motor-side connector terminal ① (red clip on the special tool), terminal ③ (blue clip), terminal ④ (black clip) and terminal ⑥ (yellow clip) respectively.

### Standard wave pattern

### Observation conditions

| | |
|---|---|
| Function | Special patterns |
| Pattern height | High |
| Pattern selector | Display |
| Engine condition | Turn the ignition switch from OFF to ON (without starting the engine). |
| | While the engine is idling, turn the air conditioner switch to ON. |
| | Immediately after starting the warm engine (approx. 1 minute). |



## Wave pattern observation points

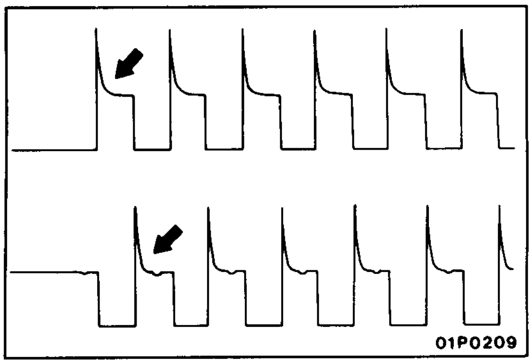
Check that the standard wave pattern appears when the stepper motor is operating.

(Point A): Presence or absence of induced electromotive force from the motor turning. (Refer to the abnormal wave pattern.)

| Contrast with standard wave pattern | Probable cause |
|---|---|
| Induced electromotive force does not appear or is extremely small. | Motor is malfunctioning |

(Point B): Height of coil reverse electromotive force

| Contrast with standard wave pattern | Probable cause |
|---|---|
| Coil reverse electromotive force does not appear or is extremely small. | Short in the coil |



### Abnormal wave pattern

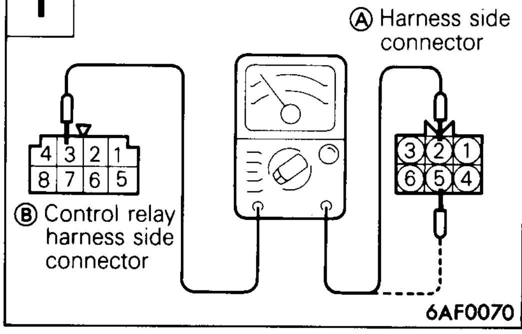
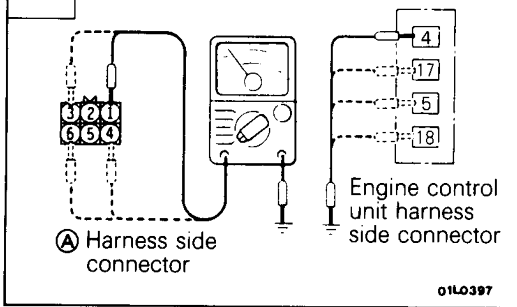
### Cause of problem

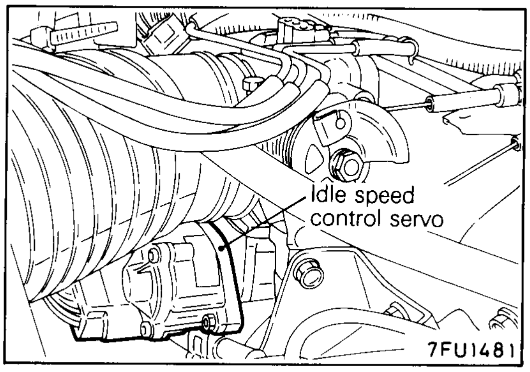
Motor is malfunctioning. (Motor is not operating.)

### Wave pattern characteristics

Induced electromotive force from the motor turning does not appear.

## HARNESS INSPECTION

| | | |
|---|---|---|
| **1**  | Check for continuity between the idle speed control seryo and the control relay.<br>- Idle speed control servo connector: Disconnected<br>- Control relay connector: Disconnected<br>NOTE<br>Touch the ohmmeter probes to both ends of the harness. | OK → 2<br>~~OK~~ → Repair the harness. (Ⓐ2 5 - Ⓑ3) |
| **2**  | Check for an open-circuit, or a short-circuit to earth between the engine control unit and the idle speed control servo.<br>- Engine control unit connector: Disconnected<br>- Idle speed control servo connector: Disconnected | OK → STOP<br>~~OK~~ → Repair the harness.<br>(Ⓐ1 - 4)<br>(Ⓐ3 - 17)<br>(Ⓐ4 - 5)<br>(Ⓐ6 - 18) |

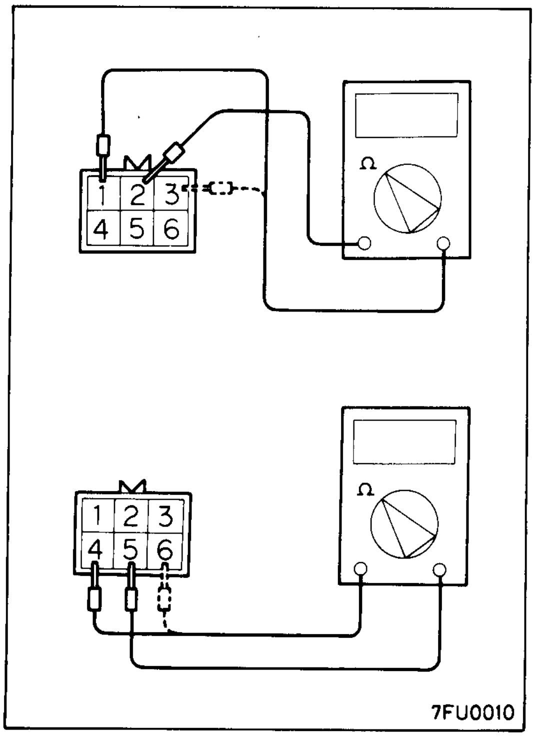


## ACTUATOR INSPECTION

### Checking the Operation Sound

(1) Check that the operation sound of the stepper motor can be heard after the ignition is switched ON (but without starting the motor).

(2) If the operation sound cannot be heard, check the stepper motor's activation circuit.
If the circuit is normal, it is probable that there is a malfunction of the stepper motor or of the engine control unit.



### Checking the Coil Resistance

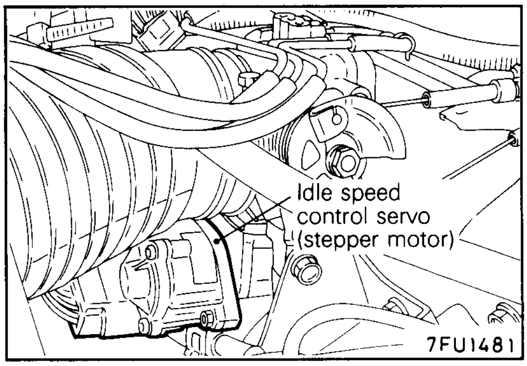
(1) Disconnect the idle speed control servo connector and connect the special tool (test harness).

(2) Measure the resistance between terminal ② (white clip of the special tool) and either terminal ① (red clip) or terminal ③ (blue clip) of the connector at the idle speed control servo side.

**Standard value: 28–33 Ω [at 20°C (68°F)]**

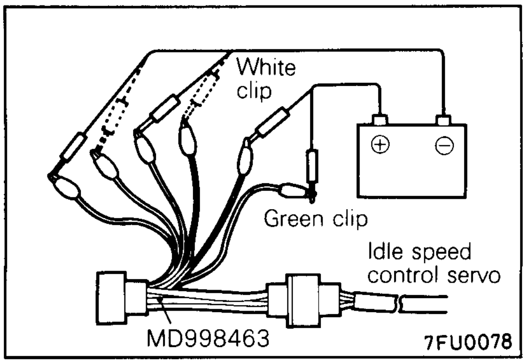
(3) Measure the resistance between terminal ⑤ (green clip of the special tool) and either terminal ⑥ (yellow clip) or terminal ④ (black clip) of the connector at the idle speed control servo side.

**Standard value: 28–33 Ω [at 20°C (68°F)]**

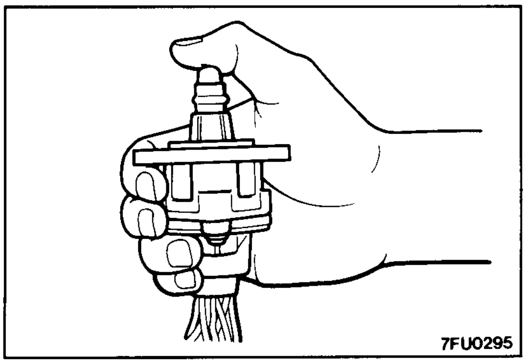


## Operation Check

(1) Remove the throttle body.
(2) Remove the stepper motor.

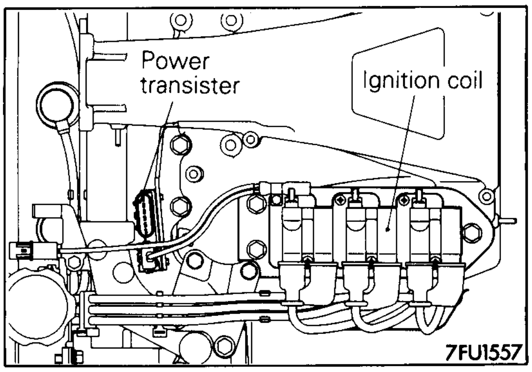


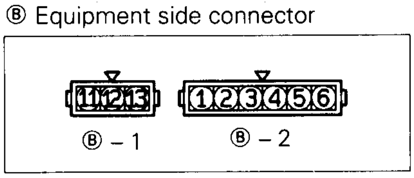
(3) Connect the special tool (test harness) to the idle speed control servo connector.
(4) Connect the positive ⊕ terminal of a power supply (approx. 6 V) to the white clip and the green clip.

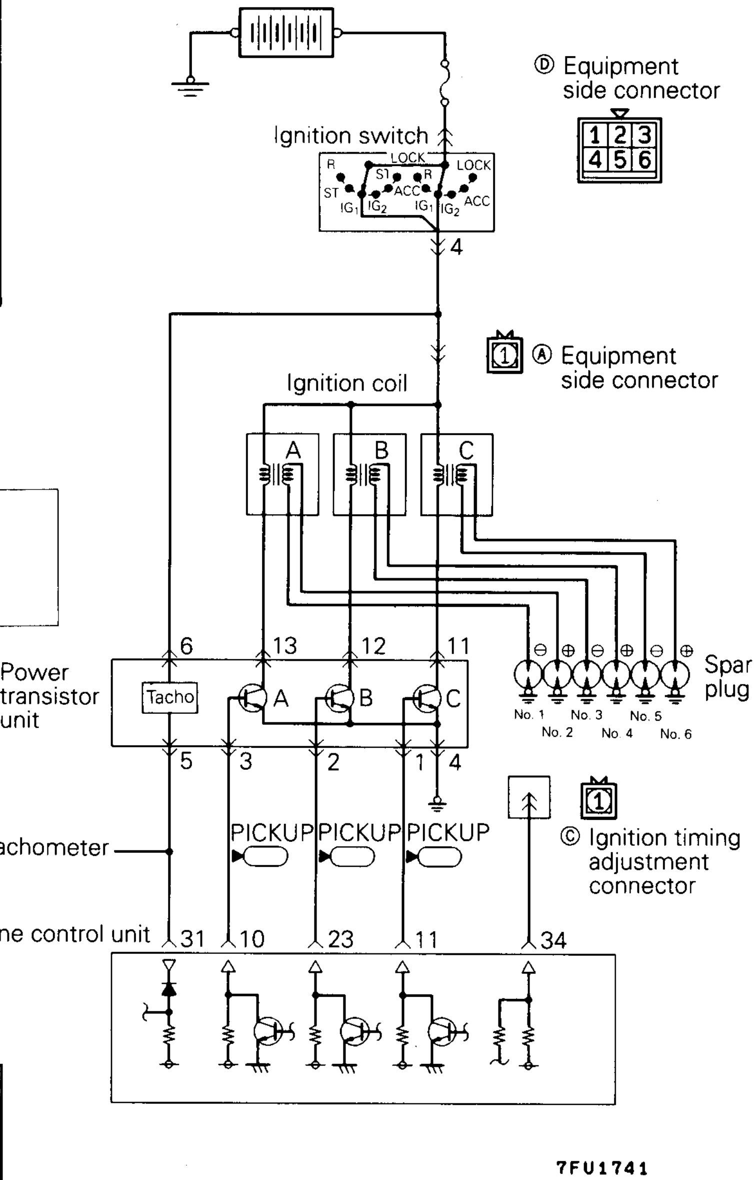


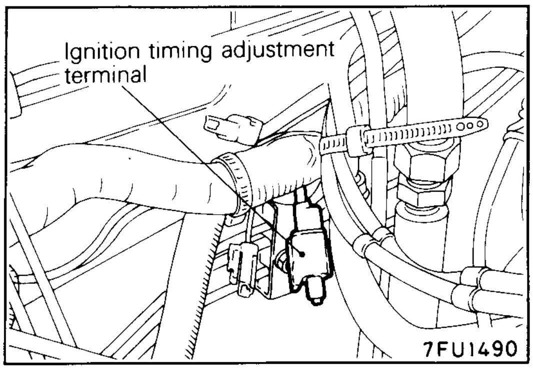
(5) With the idle speed control servo as shown in the illustration, connect the negative ⊖ terminal of the power supply to each clip as described in the following steps, and check whether or not a vibrating feeling (a feeling of very slight vibration of the stepper motor) is generated as a result of the activation of the stepper motor.
   ① Connect the negative ⊖ terminal of the power supply to the red and black clip.
   ② Connect the negative ⊖ terminal of the power supply to the blue and black clip.
   ③ Connect the negative ⊖ terminal of the power supply to the blue and yellow clip.
   ④ Connect the negative ⊖ terminal of the power supply to the red and yellow clip.
   ⑤ Connect the negative ⊖ terminal of the power supply to the red and black clip.
   ⑥ Repeat the tests in sequence from ⑤ to ①.
(6) If, as a result of these tests, vibration is detected, the stepper motor can be considered to be normal.

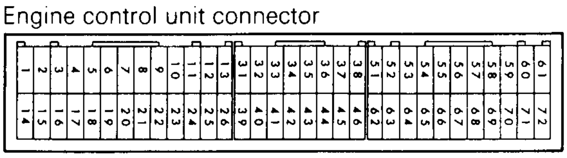
# IGNITION COIL AND IGNITION POWER TRANSISTOR <SOHC>











## OPERATION

- When the power transistor unit A is turned ON by the signal from the engine control unit, primary current flows to the ignition coil A. When the power transistor unit A is turned OFF, the primary current is shut off and a high voltage is induced in the secondary coil A, causing the ignition plugs of No. 1 and No. 4 cylinders to spark. When the power transistor unit B is turned OFF, the ignition plugs of No. 2 and No. 5 cylinders spark. In addition, when the power transistor unit C is turned OFF, the ignition plugs of No. 3 and No. 6 cylinders spark.
- When the engine control unit turns OFF the transistor in the unit, the battery voltage in the unit is applied to the power transistor unit to turn it ON. When the engine control unit turns ON the transistor in the unit, the power transitor unit is turned OFF.

## INSPECTION

### Using MUT-II

### <Spark Advance>

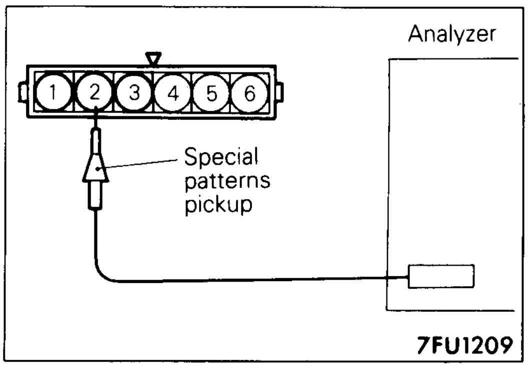
| Function | Item No. | Data display | Check condition | Engine state | Standard value |
|---|---|---|---|---|---|
| Data reading | 44 | Ignition advance | ● Engine: Warming up<br>● Timing lamp: Set (set timing lamp to check actual ignition timing) | 700 r/min (Idle) | 7–23° BTDC |
| | | | | 2,500 r/min | 27–47° BTDC |

### <Ignition Timing Adjustment Mode>

| Function | Item No. | Data display | Check condition | Terminal condition | Standard value |
|---|---|---|---|---|---|
| Data list | 36 | Continuity present or not present between ignition timing adjustment terminal and earth | ● Engine: Idling | Ignition timing adjustment terminal is earthed | ON |
| | | | | Ignition timing adjustment terminal is disconnected from earth | OFF |

### <Standard Ignition Timing>

| Function | Item No. | Drive | Check condition | Normal condition |
|---|---|---|---|---|
| Actuator test | 17 | Set to ignition timing adjustment mode | ● Engine: idling<br>● Timing lamp: set | 5° BTDC ± 3° |



### Wave Pattern Inspection Using an Analyzer

- Ignition coil primary signal
  Refer to GROUP 16 – Ignition System.
- Power transistor control signal.

### <Measurement method>

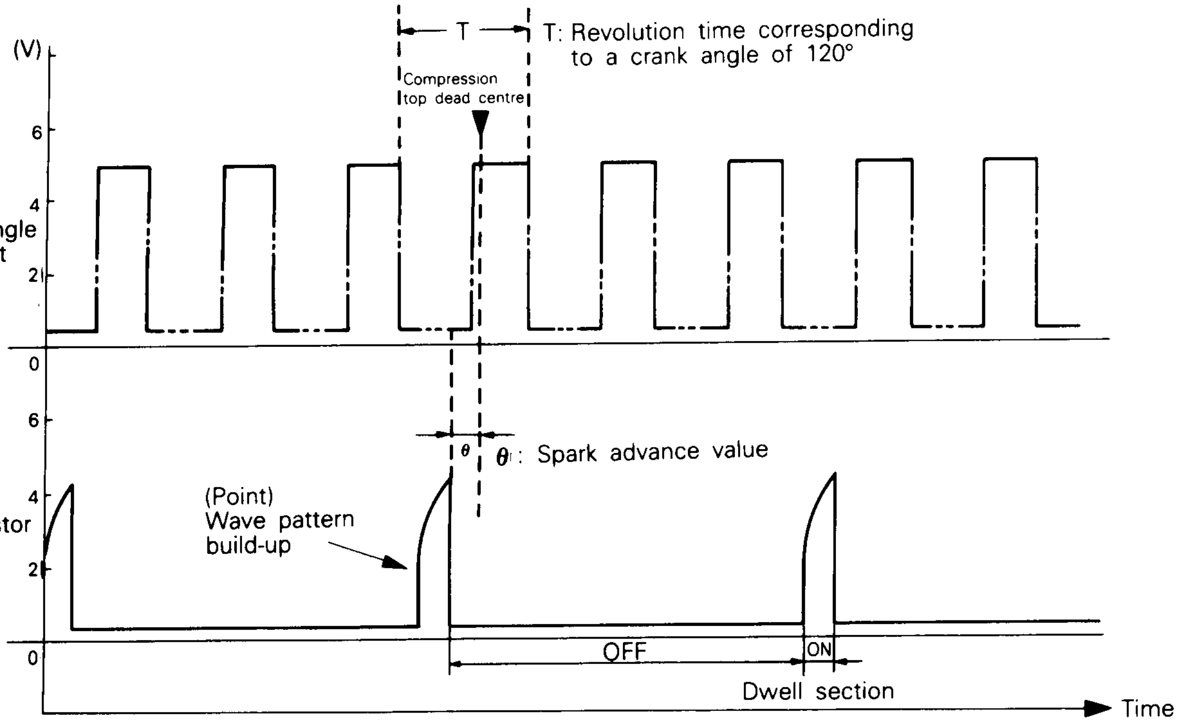
(1) Disconnect the power transistor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)

(2) Connect the analyzer special patterns pickup to the connector terminals ① (No.3 – No.6), ② (No. 2 – No. 5) and ③ (No.1 – No. 4) in that order.

### Standard wave pattern

### Observation conditions

| | |
|---|---|
| Function | Special patterns |
| Pattern height | Low |
| Pattern selector | Display |
| Engine revolutions | Approx. 1,200 r/min. |



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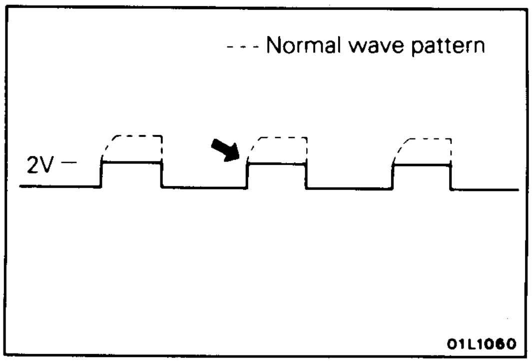
### Wave pattern observation points

(Point): Condition of wave pattern build-up and maximum voltage (Refer to abnormal wave pattern examples 1 and 2.)

| Condition of wave pattern build-up and maximum voltage | Probable cause |
|---|---|
| Rise to the right to approximately 4.5V from around 2V. | Normal |
| Becomes a rectangular wave at approx. 2V | Broken wire in ignition primary circuit |
| Becomes a rectangular wave at power voltage | Malfunction of the power transistor |



### Examples of abnormal wave patterns

- Example 1

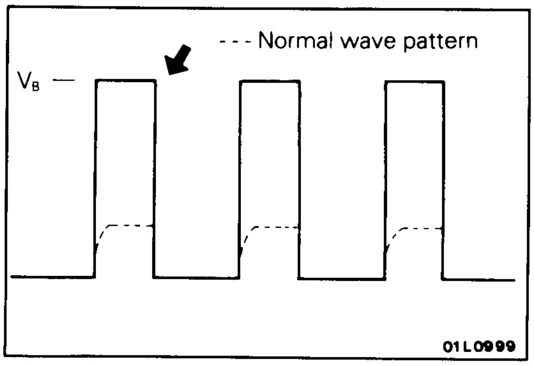
Wave pattern during engine cranking

**Cause of problem**

Broken wire in ignition primary circuit

**Wave pattern characteristics**

Top-right part of the build-up section cannot be seen, and voltage value is approximately 2V too low.



- Example 2

Wave pattern during engine cranking

**Cause of problem**

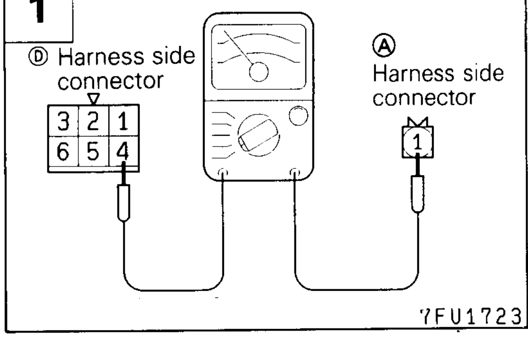
Malfunction in power transistor

**Wave pattern characteristics**

Power voltage results when the power transistor is ON.

## HARNESS INSPECTION

**1**



Check for continuity between the ignition coil and the ignition switch [IG].

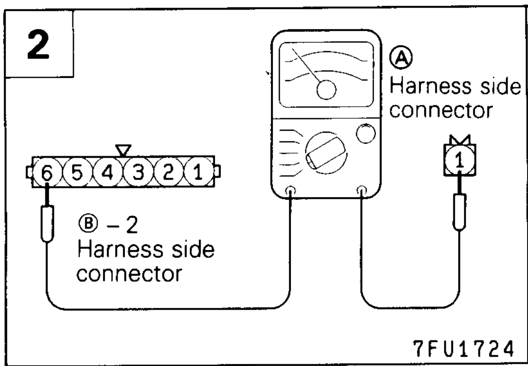
- Ignition switch connector: Disconnected
- Ignition coil connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness. (Ⓓ4 - Ⓐ1)

**2**



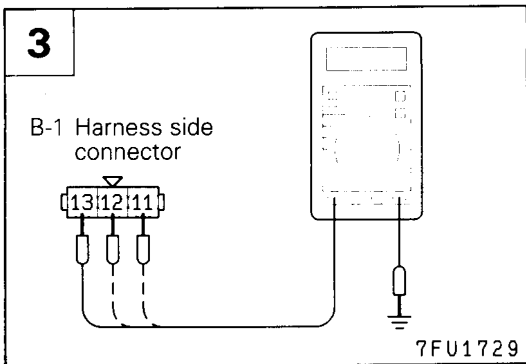
Check for continuity between the power transistor unit and ignition coil.

- Ignition coil connector: Disconnected
- Power transistor connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓑ6 - Ⓐ1)

**3**



Measure the power supply voltage of the ignition coil

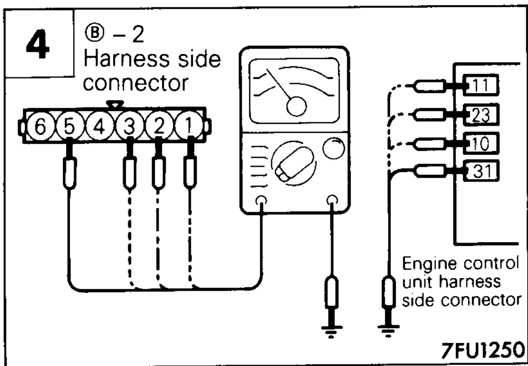
- Power transistor connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 4

~~OK~~ → Repair the harness. (Ⓑ11, Ⓑ12,Ⓑ13 – Ignition coil)

**4**



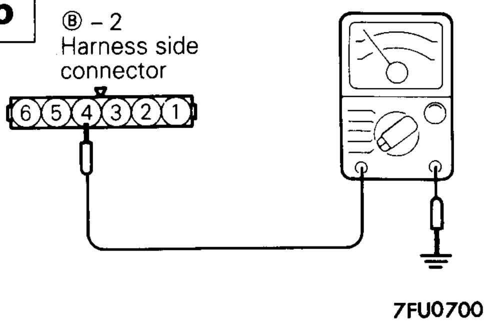
Check for open-circuit or short-circuit to earth between the power transistor and engine control unit.

- Power transistor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 5

~~OK~~ → Repair the harness.
(Ⓑ1 - 11)
(Ⓑ2 - 23)
(Ⓑ3 - 10)
(Ⓑ5 - 31)

**5**



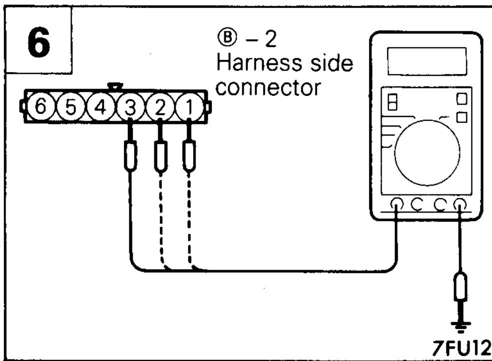
Check for continuity of the earth circuit of the ignition power transistor.

- Power transistor connector: Disconnected

OK → 6

~~OK~~ → Repair the harness. (Ⓑ4 - Earth)

**6**



Measure the power transistor control signal voltage.

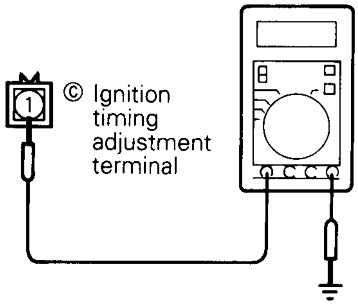
- Power transistor connector: Disconnected
- Ignition switch: START Disconnected

| Voltage (V) |
|---|
| 0.5 – 4.0 |

OK → 7

~~OK~~ → Repair the harness.
(Ⓑ1 - 11)
(Ⓑ2 - 23)
(Ⓑ3 - 10)

**7**



Measure the terminal voltage of the ignition timing adjustment terminal.

- Ignition switch: ON

| Voltage (V) |
|---|
| 4.0 – 5.2 |

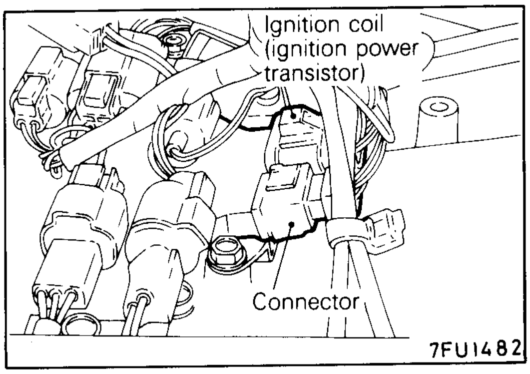
OK → STOP

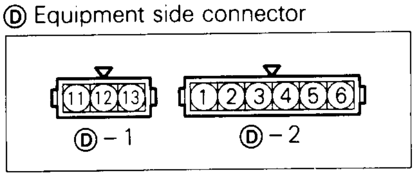
~~OK~~ → Repair the harness.
(Ⓒ1 - 34)

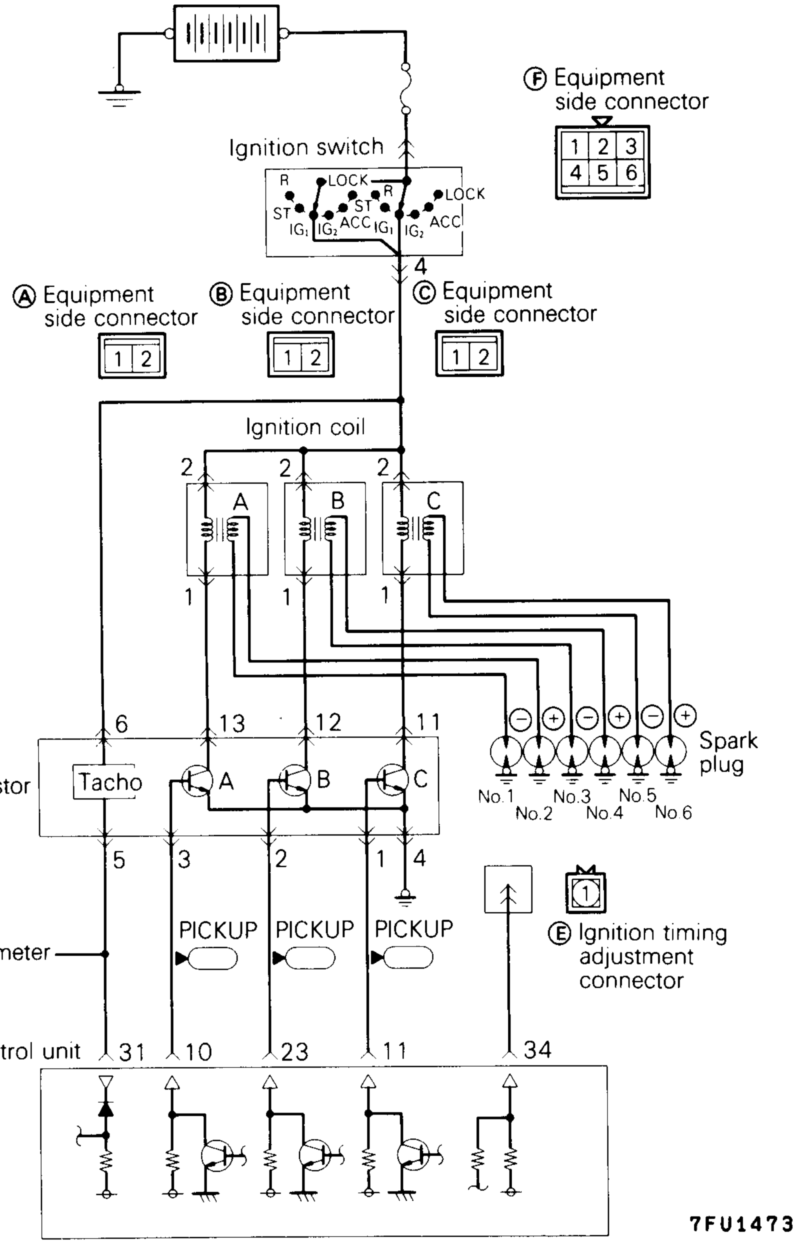
## ACTUATOR INSPECTION

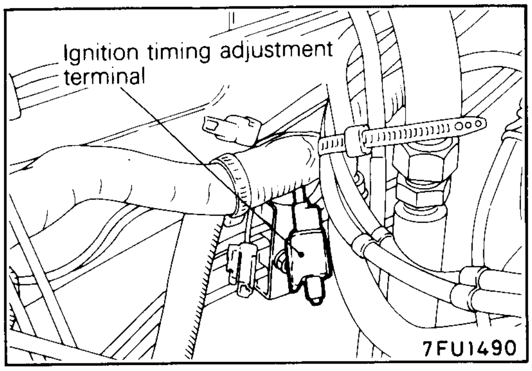
Refer to GROUP 16 – Ignition System.

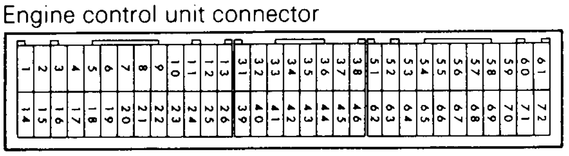
## IGNITION COIL AND IGNITION POWER TRANSISTOR <DOHC>











## OPERATION

Refer to P.13-79-93.

## INSPECTION

### Using MUT-II

### <Spark Advance>

| Function | Item No. | Data display | Check condition | Engine state | Standard value |
|---|---|---|---|---|---|
| Data reading | 44 | Ignition advance | ● Engine: Warming up<br>● Timing lamp: Set (set timing lamp to check actual ignition timing) | 700 r/min (Idle) | 2 – 18° BTDC |
| | | | | 2,000 r/min | 18 – 38° BTDC |

### <Ignition Timing Adjustment Mode>

| Function | Item No. | Data display | Check condition | Terminal condition | Standard value |
|---|---|---|---|---|---|
| Data list | 36 | Continuity present or not present between ignition timing adjustment terminal and earth | ● Engine: Idling | Ignition timing adjustment terminal is earthed | ON |
| | | | | Ignition timing adjustment terminal is disconnected from earth | OFF |

### <Standard Ignition Timing>

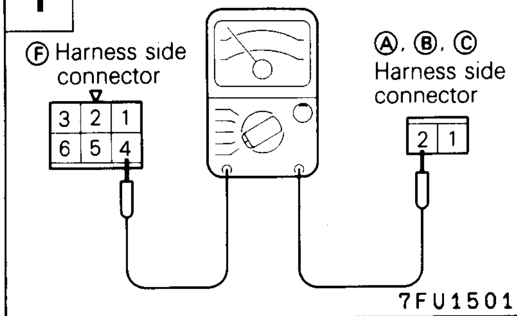
| Function | Item No. | Drive | Check condition | Normal condition |
|---|---|---|---|---|
| Actuator test | 17 | Set to ignition timing adjustment mode | ● Engine: idling<br>● Timing lamp: set | 5° BTDC ± 3° |

### Wave Pattern Inspection Using an Analyzer

Refer to P.13-79-94.

## HARNESS INSPECTION

**1**



Check for continuity between the ignition coil and the ignition switch [IG].

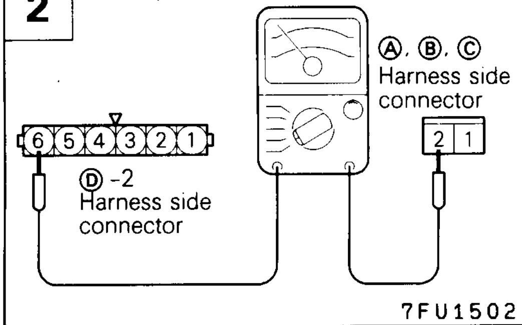
- Ignition switch connector: Disconnected
- Ignition coil connector: Disconnected

NOTE
Touch the ohmmeter probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness.
(Ⓐ2 - Ⓕ4)
(Ⓑ2 - Ⓕ4)
(Ⓒ2 - Ⓕ4)

**2**



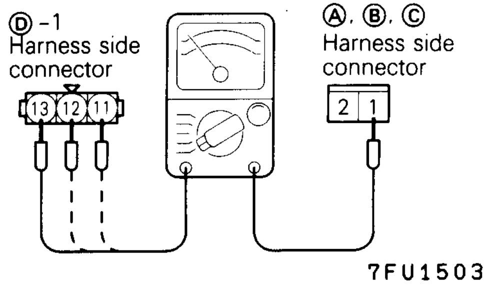
Check for continuity between the power transistor unit and ignition coil.

- Ignition coil connector: Disconnected
- Power transistor connector: Disconnected

OK → 3

~~OK~~ → Repair the harness.
(Ⓐ2 - Ⓓ6)
(Ⓑ2 - Ⓓ6)
(Ⓒ2 - Ⓓ6)

**3**



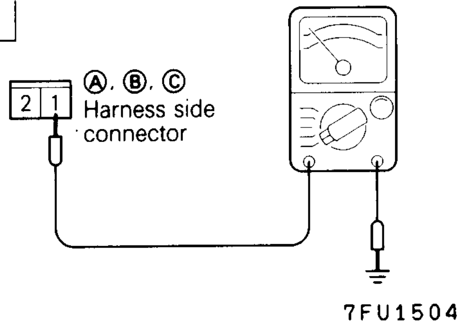
Check for continuity between the power transistor and ignition coil.

- Ignition coil connector: Disconnected
- Power transistor connector: Disconnected

OK → 4

~~OK~~ → Repair the harness.
(Ⓐ2 - Ⓓ6)
(Ⓐ2 - Ⓓ6)
(Ⓐ2 - Ⓓ6)

**4**



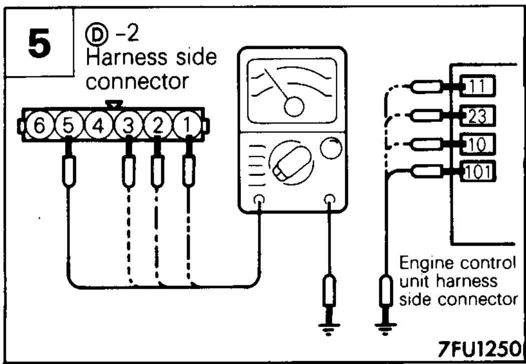
Check for short-circuit to earth between the power transistor and ignition coil.

- Ignition coil connector: Disconnected
- Power transistor connector: Disconnected

OK → 5

~~OK~~ → Check the primary circuit of the ignition coil for short-circuit.

**5**



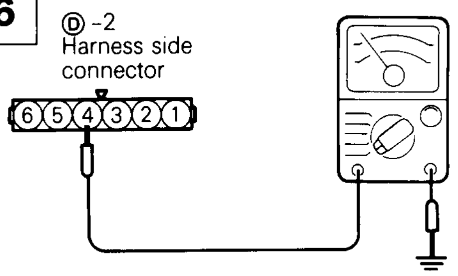
Check for open-circuit or short-circuit to earth between the power transistor and engine control unit.

- Power transistor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 6

~~OK~~ → Repair the harness.
(Ⓓ1 - 11)
(Ⓓ2 - 23)
(Ⓓ3 - 10)
(Ⓓ5 - 31)

**6**



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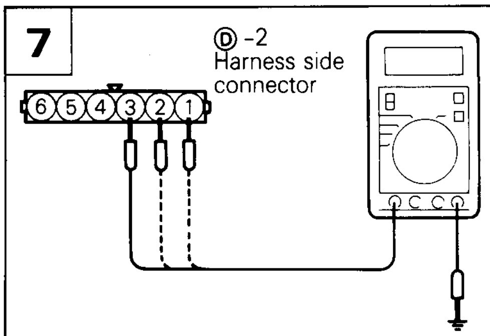
Check for continuity of the earth circuit of the ignition power transistor.

- Power transistor connector: Disconnected

OK → 7

~~OK~~ → Repair the harness. (Ⓓ4 - Earth)

**7**



7FU1252

Measure the power transistor control signal voltage.

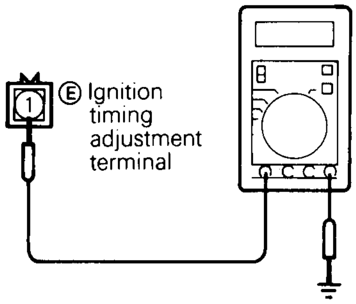
- Power transistor connector: Disconnected
- Ignition switch: START Disconnected

| Voltage (V) |
|---|
| 0.5–4.0 |

OK → 8

~~OK~~ → Repair the harness. (Ⓓ1 - 11) (Ⓓ2 - 23) (Ⓓ3 - 10)

**8**



7FU1060

Measure the terminal voltage of the ignition timing adjustment terminal.

- Ignition switch: ON

| Voltage (V) |
|---|
| 4.0–5.2 |

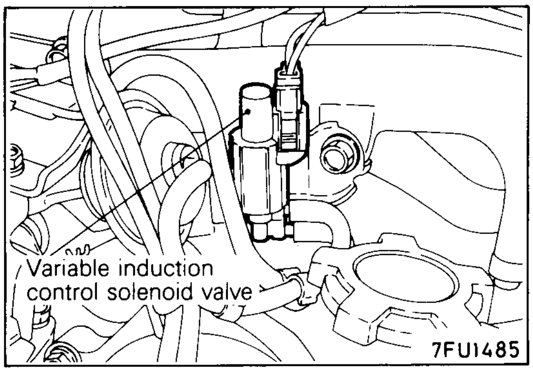
OK → STOP

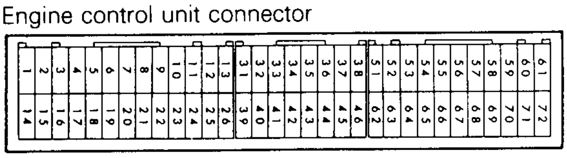
~~OK~~ → Repair the harness. (Ⓔ1 - 34)

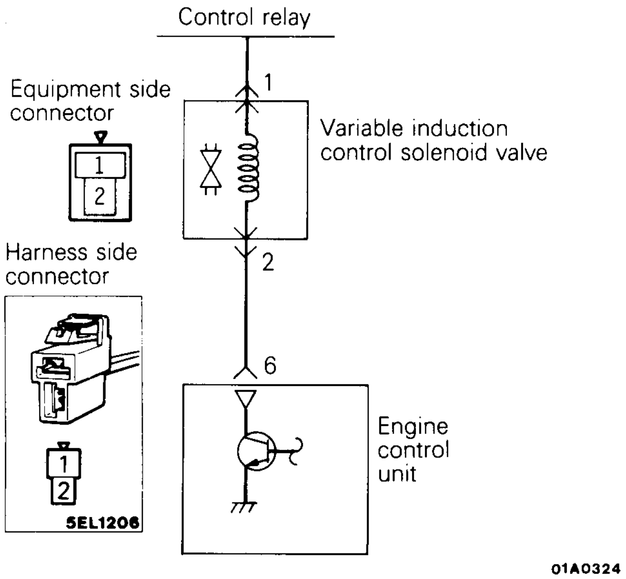
## ACTUATOR INSPECTION

Refer to GROUP 16 – Ignition System.

# VARIABLE INDUCTION CONTROL SOLENOID VALVE <DOHC>







## OPERATION

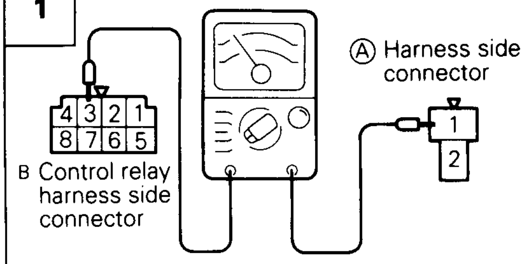
- The variable induction control solenoid valve is an ON-OFF type of solenoid valve, and converts the vacuum motor pressure into the intake manifold pressure or atmospheric pressure inside the vacuum tank.
- Battery voltage is supplied to the variable induction control valve via the control relay. When the engine control unit turns the power transistor inside the unit ON, current flows to introduce the intake manifold vacuum into the vacuum motor. This causes the vacuum motor to operate.
  Thus, the control valve will close.

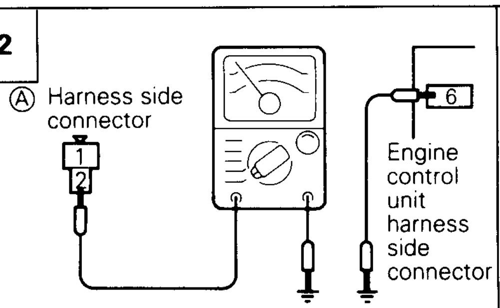
## INSPECTION

### Using MUT-II

| Function | Item No. | Drive contents | Check condition | Normal condition |
|---|---|---|---|---|
| Actuator test | 11 | Solenoid valve is switched from OFF to ON. | ● Ignition switch: ON | Operating noise is heard when driven |

## HARNESS INSPECTION

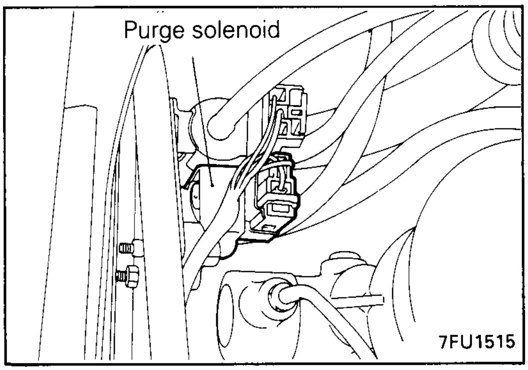
| | | |
|---|---|---|
| **1**<br><br> <br>6AF0073 | Check for continuity between variable induction control solenoid valve and control relay.<br>• Variable induction control solenoid valve connector: Disconnected<br>• Control relay connector: Disconnected<br>NOTE<br>Touch the ohmmeter probes to both ends of the harness.<br>OK →<br>~~OK~~ → | 2<br>Repair the harness. (Ⓐ1 - Ⓑ3) |

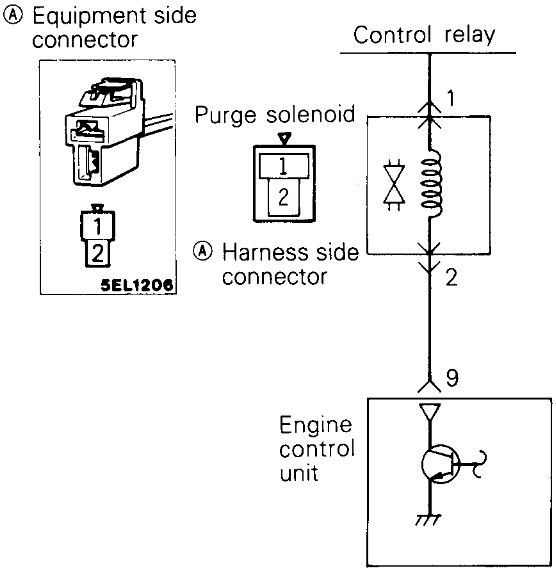
| | | |
|---|---|---|
| **2**<br><br> <br>9FU0040 | Check for an open-circuit, or a short-circuit to earth, between the variable induction control solenoid valve and the engine control unit.<br>• Variable induction control solenoid valve connector: Disconnected<br>• Engine control unit connector: Disconnected<br>OK →<br>~~OK~~ → | STOP<br>Repair the harness. (Ⓐ2 - 6) |

## ACTUATOR INSPECTION

Refer to GROUP 15 – Service Adjustment Procedures.

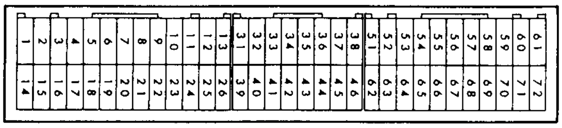
## PURGE SOLENOID





01A0324

Engine control unit connector



9FU0101

### OPERATION

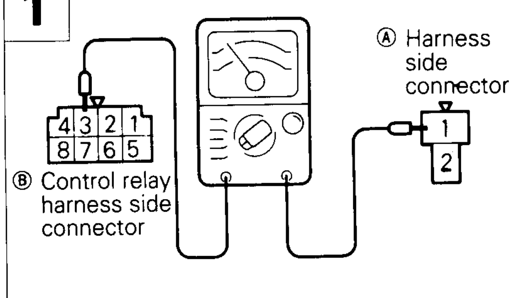
- The purge solenoid is an ON/OFF type of solenoid valve; it functions to regulate the introduction of purge air from the canister to the intake manifold plenum.
- Battery power supply is supplied, by way of the control relay, to the purge solenoid. When the engine control unit switches ON the ignition power transistor within the unit, current flows to the coil, and purge air is introduced.

### INSPECTION

#### Using MUT-II

| Function | Item No. | Drive contents | Check condition | Normal condition |
|---|---|---|---|---|
| Actuator test | 08 | Solenoid valve is switched from OFF to ON. | • Ignition switch: ON | Operating sound is heard when driven |

**1**



6AF0073

Check for continuity between the purge solenoid and the control relay.

- Purge solenoid connector: Disconnected
- Control relay connector: Disconnected

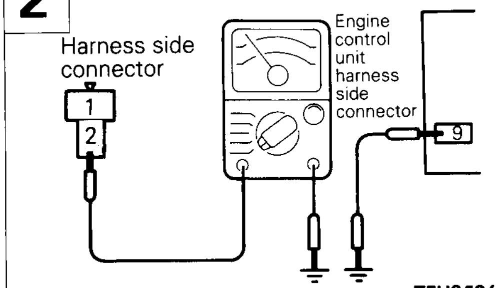
NOTE

- Touch the ohmmeter probes to both ends of the harness.

OK → 2

~~OK~~ → Repair the harness. (Ⓐ1 – Ⓑ3)

**2**



7FU0526

Check for an open-circuit, or a short-circuit to earth, between the purge solenoid and the engine control unit.

- Purge solenoid connector: Disconnected
- Engine control unit connector: Disconnected

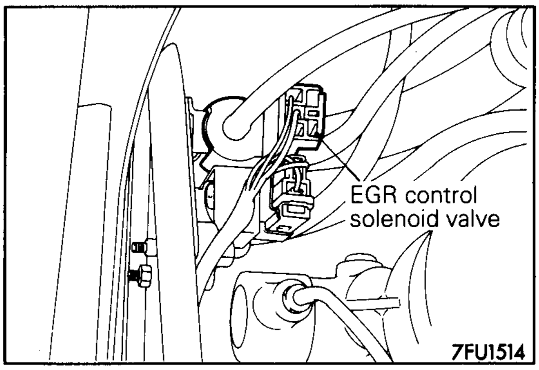
OK → STOP

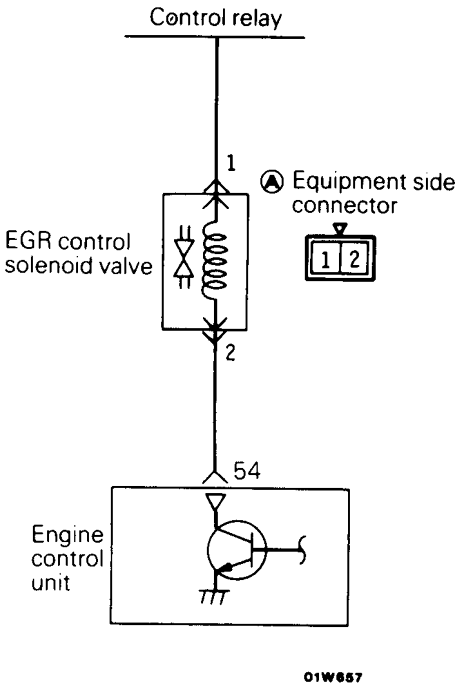
~~OK~~ → Repair the harness. (Ⓐ2- 9)

## ACTUATOR INSPECTION

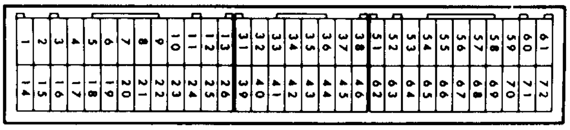
Refer to GROUP 17 – Service Adjustment Procedures.

## EGR CONTROL SOLENOID VALVE





Engine control unit connector



### OPERATION

- The EGR control solenoid valve is a duty control type solenoid valve. It makes control by leaking EGR valve operating negative pressure to the throttle body A port.
- Power supply from the battery is sent through the control relay to the EGR control solenoid valve. When the engine control unit turns off the power transistor inside the unit, current no more flows through the coil and EGR valve operating negative pressure leaks.

### TROUBLESHOOTING HINTS

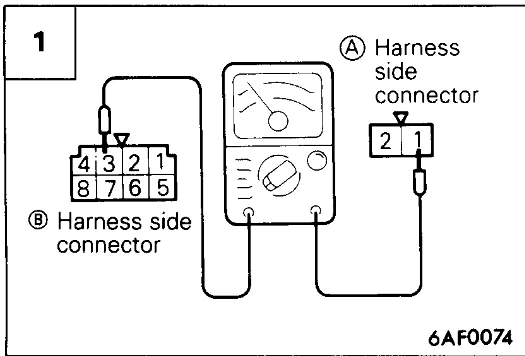
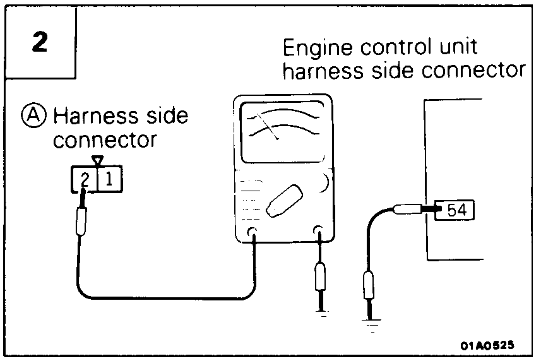
If the results of EGR control solenoid valve on-vehicle and off-vehicle inspections are normal but the self-diagnosis code for EGR system failure is displayed, check the EGR valve, vacuum hose and EGR passage for blocking.

## INSPECTION

### Using MUT-II

| Function | Item No. | Drive content | Check condition | Normal state |
|---|---|---|---|---|
| Actuator test | 10 | Change solenoid valve from OFF to ON state | Ignition switch: ON | Operating sound is heard when driven |

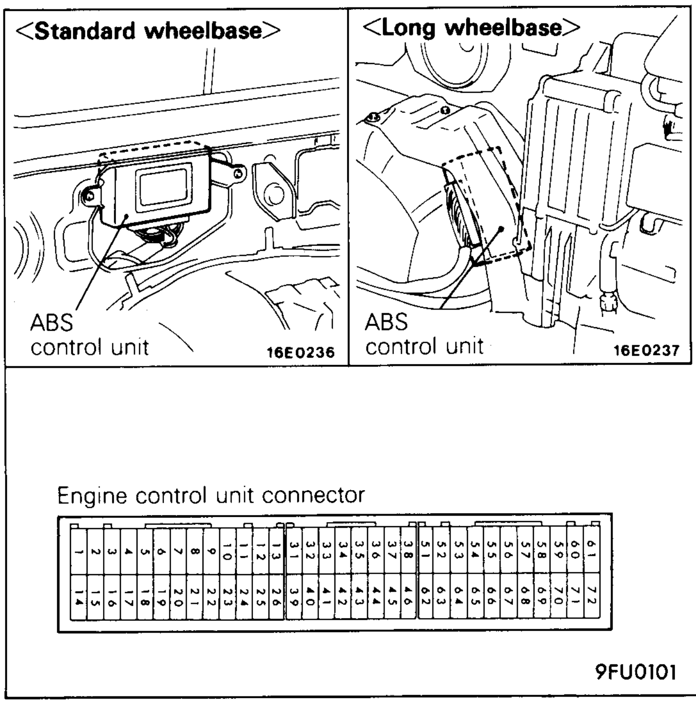
## HARNESS INSPECTION

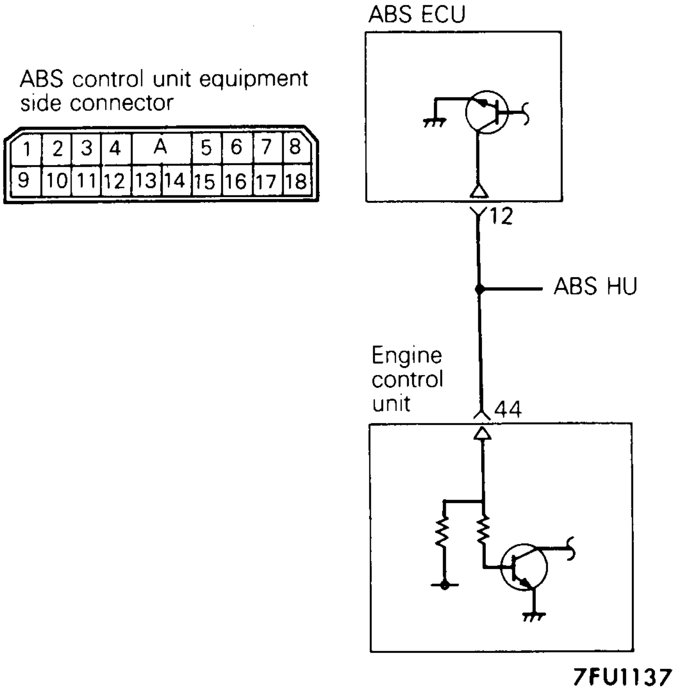
| | | | |
|---|---|---|---|
| **1** |  | Check for continuity between EGR control solenoid valve and control relay<br>• EGR control solenoid valve connector: Disconnected<br>• Control relay connector: Disconnected<br>NOTE<br>Touch the ohmmeter probes to both ends of the harness | OK → 2<br>~~OK~~ → Repair the harness. (Ⓐ1 - Ⓑ3) |
| **2** |  | Check for an open-circuit, or a short-circuit to earth, between the EGR control solenoid valve and the engine control unit.<br>• EGR control solenoid valve connector: Disconnected<br>• Engine control unit connector: Disconnected | OK → STOP<br>~~OK~~ → Repair the harness. (Ⓐ2 - 54) |

## ACTUATOR INSPECTION

Refer to GROUP 17 – Exhaust Gas Recirculation (EGR)System.

## ANTI-SKID BRAKE SIGNAL

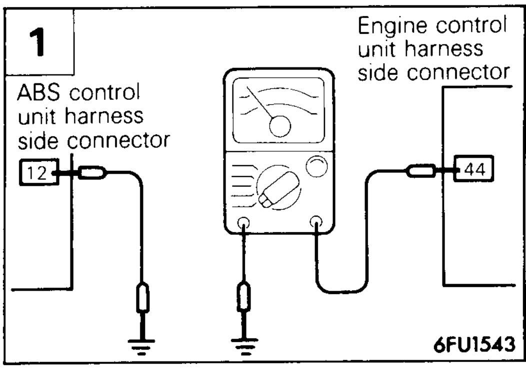




### OPERATION

- The anti-skid braking signal is output by the anti-skid braking system (ABS) control unit to the engine control unit as a signal to indicate whether the motor relay is being driven or not. The engine control unit controls the idle speed control servo by means of this signal, and gives accurate anti-skid braking effectiveness.
- The ABS control unit turns the power transistor ON when the motor relay is being driven, and the output terminal which has battery voltage applied is shorted to the earth. This causes the anti-skid braking signal to change from HIGH to LOW.

### HARNESS INSPECTION

| | | | |
|---|---|---|---|
|  | Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the ABS control unit.<br>• ABS control unit connector: Disconnected<br>• Engine control unit connector: Disconnected | OK →<br>~~OK~~ → | ⚠ STOP<br>Repair the harness. (Ⓐ12 - 44) |

## FUEL PRESSURE

### HOW TO REDUCE THE INTERNAL PRESSURE

Refer to P.13-79-21.

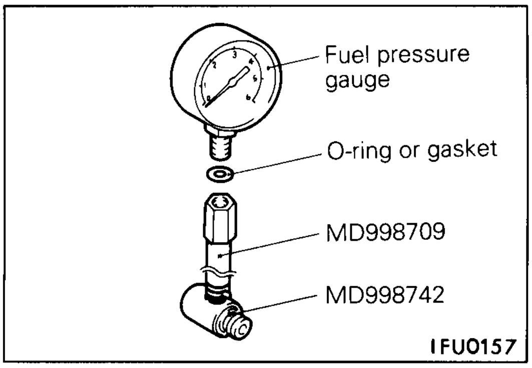
### FUEL PUMP OPERATION CHECK

Refer to P.13-79-21.

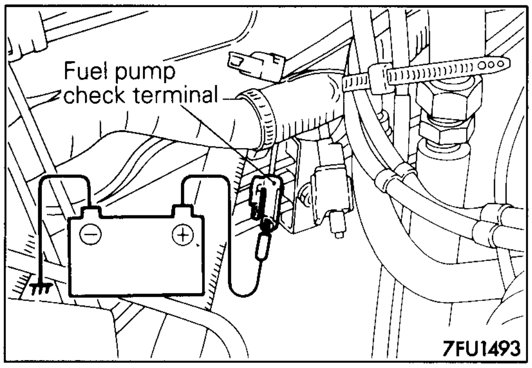
## FUEL PRESSURE TEST <SOHC>

(1) Reduce the internal pressure of the fuel pipes and hoses.
(2) Remove the fuel pressure regulator at the delivery pipe side.

**Caution**
**Cover the fuel pressure regulator with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.**

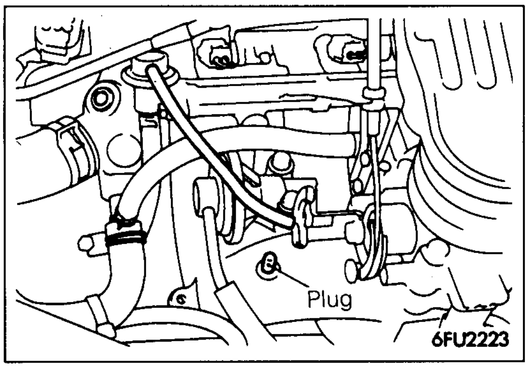


(3) Set a fuel pressure gauge on the special tool, placing an adequate O-ring or gasket between the gauge end special tool to prevent fuel leaks.
(4) Install the special tool set in the step (3) between the delivery pipe and the fuel pressure gauge.



(5) Connect a jumper wire to the terminal for activation of the fuel pump and to the positive (+) terminal of the battery to activate the fuel pump. With fuel pressure applied, check to be sure that there is no fuel leakage from the fuel pressure gauge and the special tool connection part.
(6) Disconnect the jumper wire from the terminal for activation of the fuel pump to stop the fuel pump.
(7) Start the engine and let it idle.
(8) Measure the fuel pressure during idling.

**Standard value: Approx. 270 kPa (38 psi) at curb idle**



(9) Disconnect the vacuum hose (blue stripe) from the intake manifold and plug the nipple. Then measure fuel pressure.

**Standard value: 330–370 kPa (3.3–3.5 kg/cm$^2$, 47–53 psi) at curb idle speed**

(10)Check to be sure that the fuel pressure during idling does not decrease even after the engine is raced a few times.

(11)Use a finger to gently press the fuel return hose while repeatedly racing the engine, and check to be sure that there is fuel pressure in the return hose also.

NOTE
There will be no fuel pressure in the return hose if there is insufficient fuel flow.

(12)If the fuel pressure measured in steps (8) to (11) deviates from the standard value range, check for the probable cause by referring to the table below, and then make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| • Fuel pressure is too low.<br>• Fuel pressure drops during racing.<br>• No fuel pressure in fuel return hose. | Fuel filter is clogged. | Replace the fuel filter. |
| | Malfunction of the valve seat within the fuel pressure regulator, or fuel leakage to return side caused by spring deterioration. | Replace the fuel pressure regulator. |
| | Fuel pump low discharge pressure. | Replace the fuel pump. |
| Fuel pressure is too high | The valve within the fuel pressure regulator is sticking. | Replace the fuel pressure regulator. |
| | Clogging of the fuel return hose and/or the pipe. | Clean or replace the hose and/or pipe. |
| No change of the fuel pressure when vacuum hose is connected and when not connected. | Damaged vacuum hose or nipple clogging. | Replace the vacuum hose, or clean the nipple. |

(13)Stop the engine and check for a change of the value indicated by the fuel pressure gauge. The condition is normal if there is no decrease of the indicated value within two minutes.
If there is a decrease of the indicated value, monitor the speed of the decrease, and, referring to the table below, determine the cause of the problem and make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| After the engine is stopped, the fuel pressure drops gradually. | Injector leakage. | Replace the injector. |
| | Leakage at the fuel pressure regulator valve seat. | Replace the fuel pressure regulator. |
| There is a sudden sharp drop of the fuel pressure immediately after the engine is stopped. | The check valve (within the fuel pump) is not closed. | Replace the fuel pump. |

(14)Remove all remaining pressure from inside the fuel pipe. (Refer to P. 13-16.)

(15)Disconnect the fuel pressure gauge and the special tool from the delivery pipe.

**Caution**
**Because there will be a slight amount of remaining pressure in the fuel pipe line, use rags to cover so that fuel doesn't splatter.**

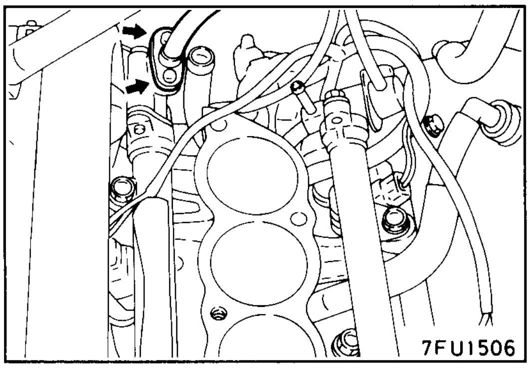
(16)Replace the O-ring at the end of the fuel high-pressure hose with a new one.

(17)After connecting the fuel high-pressure hose to the delivery pipe, tighten the installation bolt at the specified torque.

**Tightening torque: 5 Nm (0.5 kmg, 3.6 ft.lbs)**

(18)Check to be sure that there is no fuel leakage.

① Apply battery voltage to the terminal for activation of the fuel pump so as to activate the fuel pump.
② With fuel pressure applied, check for leakage of the fuel line.



## FUEL PRESSURE TEST <DOHC>

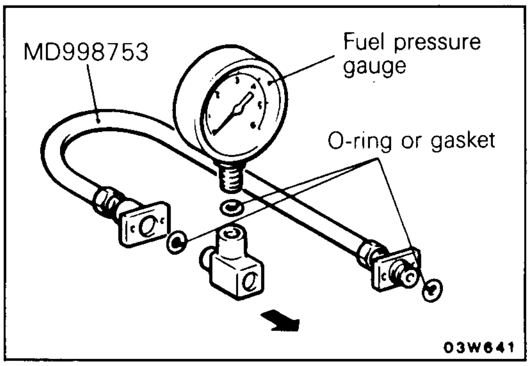
(1) Reduce the internal pressure of the fuel pipes and hoses.

(2) Remove the intake air plenum.

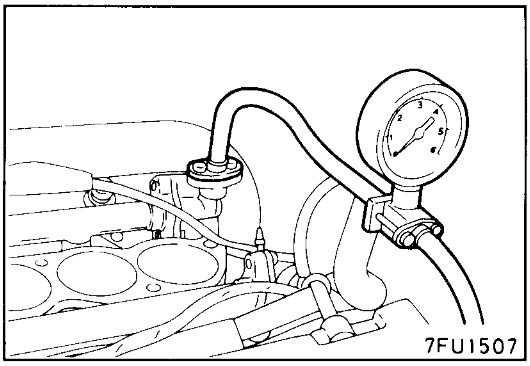
(3) Disconnect the fuel high pressure hose at the delivery pipe side.

**Caution**

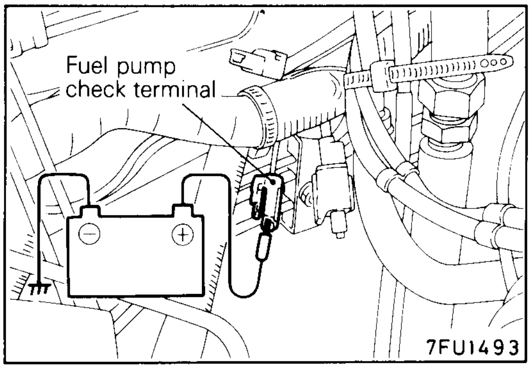
**Cover the hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.**



(4) Set a fuel pressure gauge on the special tool, placing an adequate O-ring or gasket between the gauge end special tool to prevent fuel leaks.



(5) Attach the special tool set in step (3) to the delivery pipe.



(6) Connect a jumper wire to the terminal for activation of the fuel pump and to the positive (+) terminal of the battery to activate the fuel pump. With fuel pressure applied, check to be sure that there is no fuel leakage from the fuel pressure gauge and the special tool connection part.

(7) Measure the fuel pressure.

**Standard value: 324–343 kPa (3.3–3.5 kg/cm$^2$, 47–50 psi)**

(8) If the fuel pressure measured in step (7) deviates from the standard value range, check for the probable cause by referring to the table on the next page, and then make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| Fuel pressure is too low. | Fuel filter is clogged. | Replace the fuel filter. |
| | Malfunction of the valve seat within the fuel pressure regulator, or fuel leakage to return side caused by spring deterioration. | Replace the fuel pressure regulator. |
| | Fuel pump low discharge pressure. | Replace the fuel pump. |
| Fuel pressure is too high. | The valve within the fuel pressure regulator is sticking | Replace the fuel pressure regulator. |
| | Clogging of the fuel return hose and/or the pipe. | Clean or replace the hose and/or pipe. |

(9) Disconnect the lead wire from the fuel pump activating terminal (black) to stop the fuel pump and check for a change of the value indicated by the fuel pressure gauge. The condition is normal if there is no decrease of the indicated value within two minutes.
If there is a decrease of the indicated value, monitor the speed of the decrease, and, referring to the table below, determine the cause of the problem and make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| After the fuel pump is stopped, the fuel pressure drops gradually. | Injector leakage. | Replace the injector. |
| | Leakage at the fuel pressure regulator valve seat. | Replace the fuel pressure regulator. |
| There is a sudden sharp drop of the fuel pressure immediately after the fuel pump is stopped. | The check valve (within the fuel pump) is not closed. | Replace the fuel pump. |

(10) Connect a hand vacuum pump to the fuel pressure regulator and apply vacuum of 80 kPa (600 mmHg, 23.6 in.Hg) to remove all remaining pressure from inside the fuel line.

(11) Disconnect the fuel pressure gauge and the special tool from the delivery pipe.

**Caution**
**Because there will be a slight amount of remaining pressure in the fuel pipe line, use rags to cover so that fuel doesn't splatter.**

(12) Replace the O-ring at the end of the fuel high-pressure hose with a new one.

(13) After connecting the fuel high-pressure hose to the delivery pipe, tighten the installation bolt at the specified torque.

**Tightening torque: 5 Nm (0.5 kgm, 3.6 ft.lbs.)**

(14) Check to be sure that there is no fuel leakage.
① Apply battery voltage to the terminal for activation of the fuel pump so as to activate the fuel pump.
② With fuel pressure applied, check for leakage of the fuel line.

(15) Install the intake air plenum.

# FUEL SYSTEM <4G64 Engine>

## GENERAL INFORMATION

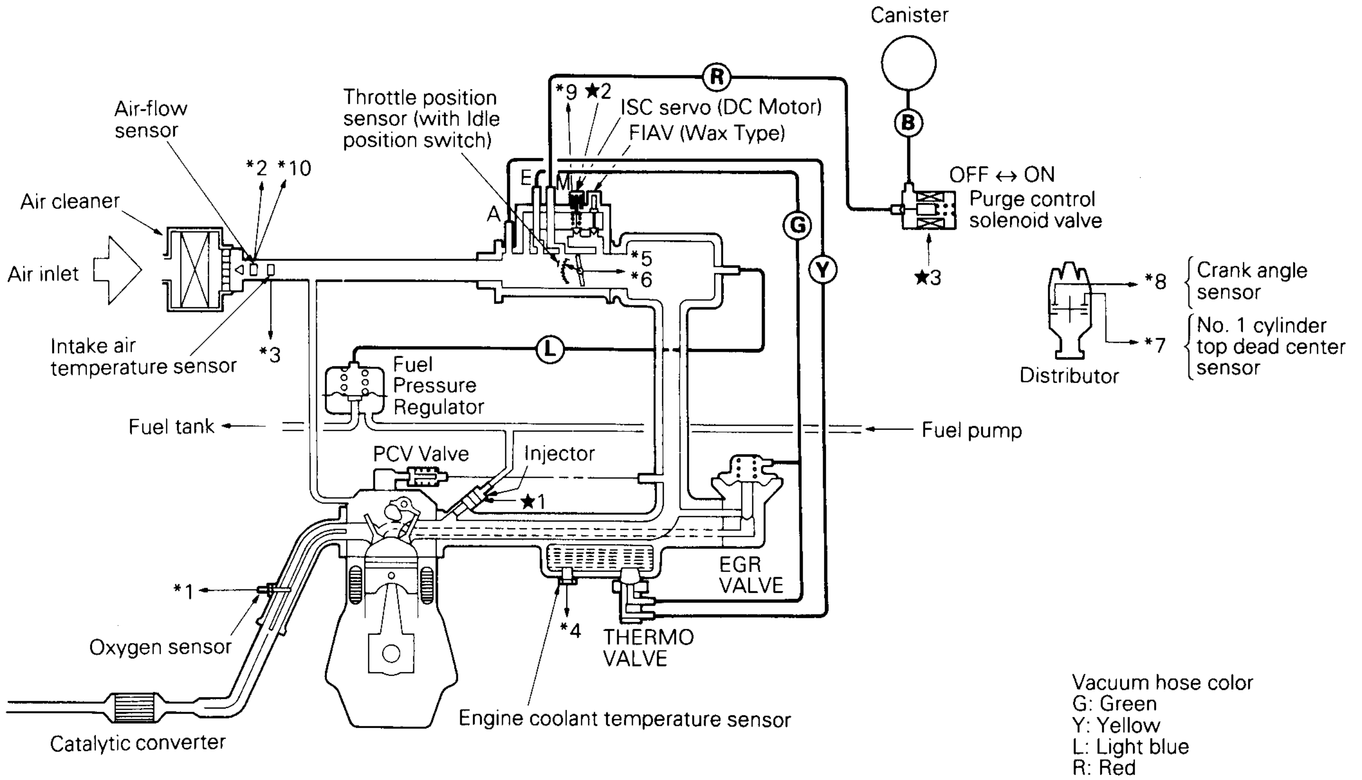
E13BBAH

### MULTI POINT INJECTION SYSTEM DIAGRAM

- *1 Oxygen sensor
- *2 Air-flow sensor
- *3 Intake air temperature sensor
- *4 Engine coolant temperature sensor
- *5 Throttle position sensor
- *6 Idle position switch
- *7 No. 1 cylinder top dead center sensor
- *8 Crank angle sensor
- *9 Motor position sensor
- *10 Barometric pressure sensor
- • Ignition switch – ST
- • Power supply
- • Vehicle-speed sensor
- • Air conditioner switch

⇨ Engine control unit ⇨

- ★1 Injector
- ★2 Idle speed control servo
- ★3 Purge control solenoid valve
- • Fuel pump control (control relay)
- • Air conditioner power relay
- • Ignition timing control
- • Self-diagnosis output
- • Engine warning lamp



Vacuum hose color
G: Green
Y: Yellow
L: Light blue
R: Red
B: Black

PCV: Positive Crankcase Ventilation
ISC: Idle Speed Control

6FU1695

# SPECIFICATIONS

## GENERAL SPECIFICATIONS

E13CA-B

| Items | Specifications |
|---|---|
| Fuel | |
| Tank capacity dm³ (U.S.gal., Imp.gal.) | |
| Standard Wheelbase | 75 (19.8, 16.5) |
| Long Wheelbase | 92 (24.3, 20.2) |
| Fuel pump | |
| Type | Electrical, in-tank type |
| Driven by | Electric motor |
| Throttle body | |
| Throttle bore mm (in.) | 50 (1.968) |
| Throttle position sensor | Variable resistor type |
| Idle speed control servo | Electric motor |
| Idle position switch | Contact type, within throttle position sensor |
| Motor position sensor | Variable resistor type |
| Engine control unit | |
| Identification model No. | E2T37771 |
| Input sensor | |
| Air flow sensor | Karman vortex type |
| Barometric pressure sensor | Semiconductor type |
| Intake air temperature sensor | Thermistor type |
| Engine coolant temperature sensor | Thermistor type |
| Oxygen sensor | Zirconia type |
| Vehicle speed sensor | Reed switch type |
| No. 1 cylinder top dead center sensor | Photo interruptor type |
| Crank angle sensor | Photo interruptor type |
| Actuators | |
| Control relay type | Contact switch type |
| Injector type and number | Electromagnetic 4 |
| Purge control solenoid valve | ON/OFF type solenoid valve |
| Fuel pressure regulator | |
| Regulated pressure kPa ($kg/cm^2$, psi) | 335 (3.35, 47.6) |

## SERVICE SPECIFICATIONS

E13CB-B

| Items | | Specifications |
|---|---|---|
| Standard value | | |
| Accelerator cable play | mm (in.) | 1–2 (0.04–0.08) |
| Basic ignition timing | | 5°±2° BTDC at curb idle |
| Curb idle speed | r/min. | 750±100 |
| Idle speed when air conditioner ON | r/min. | 900 at neutral position |
| Basic idle speed | r/min. | 750±50 |
| Throttle position sensor output voltage | V | 0.48–0.52 at curb idle |
| Throttle position sensor resistance | kΩ | 3.5–6.5 |
| Idle speed control servo coil resistance [at 20°C (68°F)] | Ω | 5–35 |
| Motor position sensor resistance | kΩ | 4–6 |
| Intake air temperature sensor resistance [at 20°C (68°F)] | kΩ | 2.7 |
| Engine coolant temperature sensor resistance | kΩ | |
| 20°C (68°F) | | 2.4 |
| 80°C (176°F) | | 0.3 |
| Fuel pressure regulator pressure | kPa (kg/cm², psi) | |
| Vacuum hose disconnection | | 330–350 (3.3–3.5, 47–50) |
| Vacuum hose connection | | Approx. 270 (2.7, 38) |
| Injector coil resistance [at 20°C (68°F)] | Ω | 13–16 |

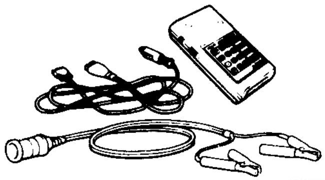
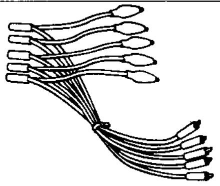
## SEALANT

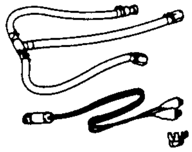
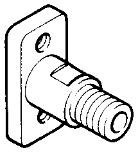
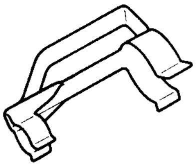
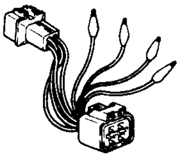
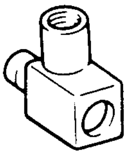
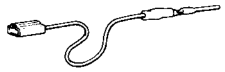
E13CE-B

| Items | Specified sealant | Quantity |
|---|---|---|
| Engine coolant temperature sensor threaded portion | 3M Nut locking Part No. 4171 or equivalent | As required |

## SPECIAL TOOLS

E13DA-B

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB991341 | Multi-use tester assembly | • Reading diagnosis code<br>• MPI system inspection |
|  | MB991419 | ROM pack (for multi-use tester) | • Reading diagnosis code<br>• MPI system inspection |
|  | MB991348 | Test harness set | • Adjustment of throttle position sensor<br>• Inspection with oscilloscope |

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MD998706 | Injector test set | • Checking injection condition of injector |
|  | MD998740 | Injector test adaptor | |
|  | MD998746 | Clip | |
|  | MD998464 | Harness connector (4P, square) | • Inspection with oscilloscope |
|  | MD998700 | Hose adapter | • Measurement of fuel pressure |
| Red harness (for DLI)<br><br>White harness (for LC)<br><br> | MB991223 | Inspection harness set connector<br>• Pin contact pressure inspection harness<br>• Marketing tester connection probe (for general connectors) | • Measurement of terminal voltages |

# TROUBLESHOOTING

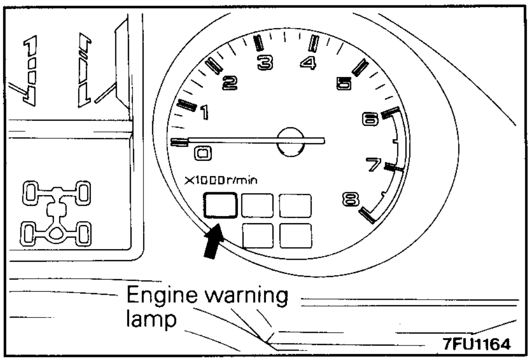
E13EFAK

## EXPLANATION OF TROUBLESHOOTING PROCEDURES

Refer to P.13-7.

## EXPLANATION AND PRECAUTION RELATED TO HARNESS CHECKING

Refer to P.13-8.



## ENGINE WARNING LAMP (CHECK ENGINE LAMP)

Among the self-diagnosis items, a engine warning lamp comes on to notify the driver of the emission control items when an irregularity is detected.
However, when an irregular signal returns to normal and the engine control unit judges that it has returned to normal, the engine warning lamp goes out.
Moreover, when the ignition switch is turned off, the lamp goes out. Even if the ignition switch is turned on again, the lamp does not come on until the irregularity is detected.
Here, immediately after the ignition switch is turn on, the lamp engine warning lamp is lit for 5 seconds to indicated that the engine warning lamp operates normally.

**Item indicated by the lightening engine warning lamp**

| | |
|---|---|
| Engine control unit | Crank angle sensor |
| Oxygen sensor | No. 1 cylinder top dead center sensor |
| Air flow sensor | Barometric pressure sensor |
| Engine coolant temperature sensor | Ignition timing adjustment signal |
| Intake air temperature sensor | Injector |
| Throttle position sensor | Fuel pump |

**Caution**
**Engine warning lamp will come on when the line of terminal for ignition timing adjustment is short-circuited. Therefore, the lamp will come on even when the terminal for ignition timing adjustment is earthed at the time of adjusting ignition timing. In this case, however, it is not abnormal.**

## ENGINE WARNING LAMP INSPECTION

Refer to P.13-10.

## SELF-DIAGNOSIS

The engine control unit monitors the input/output signals (some signals at all times and the others under specified conditions) of the engine control unit.

When it is noticed that an irregularity has continued for a specified time or longer from when the irregular signal is initially monitored, passing a certain number, the engine control unit judges that an irregularity has occurred, memorizes the malfunction code, and outputs the signal to the self-diagnosis output terminals.

There are 15 diagnosis items, including the normal state, and the diagnosis results can be read out with a multi-use tester.

Moreover, since memorization of the malfunction codes is backed up directly by the battery, the diagnosis results are memorized even if the ignition key is turned off. The malfunction codes will, however, be erased when the battery terminal or the engine control unit connector is disconnected.

The malfunction codes are also erased by setting the ignition switch to the "ON" position and then sending the malfunction-code-erase signal from the multi-use tester to the engine control unit.

**Caution**

**If the sensor connector is disconnected while the ignition switch is ON, the malfunction code is memorized. In this instance, either send the malfunction-code-erase signal from the multi-use tester to the engine control unit, the diagnosis memory will be erased.**

The 15 diagnosis items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

**Caution**

**Ignition timing adjustment signal malfunction code is output when the ignition timing adjustment terminal line is short-circuited to the earth. Therefore, the malfunction code is output when the ignition timing adjustment terminal is earthed, however, this is not a malfunction.**

### DIAGNOSIS CHART

| Output preference order | Diagnosis item | Diagnosis code | | Check item (Remedy) |
|---|---|---|---|---|
| | | No. | Memory | |
| 1 | Engine control unit | – | – | (Replace engine control unit) |
| 2 | Oxygen sensor | 11 | Retained | • Harness and connector<br>• Oxygen sensor<br>• Fuel pressure<br>• Injectors (Replace if defective.)<br>• Intake air leaks |
| 3 | Air flow sensor | 12 | Retained | • Harness and connector (If harness and connector are normal, replace air flow sensor assembly) |
| 4 | Intake air temperature sensor | 13 | Retained | • Harness and connector<br>• Intake air temperature sensor |
| 5 | Throttle position sensor | 14 | Retained | • Harness and connector<br>• Throttle position sensor<br>• Idle position switch |

| Output preference order | Diagnosis item | Diagnosis code | | Check item (Remedy) |
|---|---|---|---|---|
| | | No. | Memory | |
| 6 | Engine coolant temperature sensor | 21 | Retained | • Harness and connector<br>• Engine coolant temperature sensor |
| 7 | Crank angle sensor | 22 | Retained | • Harness and connector (If harness and connector are normal, replace distributor assembly.) |
| 8 | Top dead center sensor (No. 1 cylinder) | 23 | Retained | • Harness and connector (If harness and connector are normal, replace distributor assembly.) |
| 9 | Vehicle speed sensor (reed switch) | 24 | Retained | • Harness and connector<br>• Vehicle speed sensor (reed switch) |
| 10 | Barometric pressure sensor | 25 | Retained | • Harness and connector (If harness and connector are normal, replace barometric pressure sensor assembly.) |
| 11 | Ignition timing adjustment signal | 36 | – | • Harness and connector |
| 12 | Injector | 41 | Retained | • Harness and connector<br>• Injector coil resistance |
| 13 | Fuel pump | 42 | Retained | • Harness and connector<br>• Control relay |
| 14 | Servo valve position sensor | 55 | Retained | • Harness and connector<br>• ISC servo (If harness and connector are normal, replace ISC servo assembly.) |
| 15 | Normal state | – | – | – |

NOTE
Replace the engine control unit if a malfunction code is output although the inspection reveals that there is no problem with the check items.

## READ OUT OF MALFUNCTION CODE

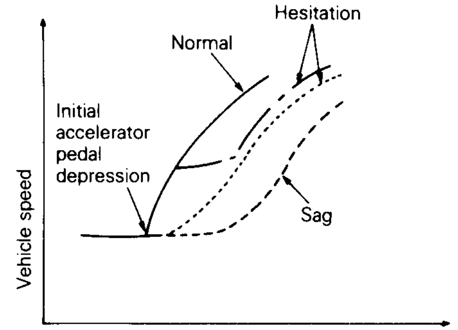
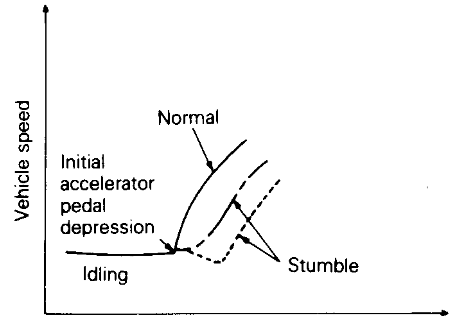
Refer to P.13-11.

## CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

| Problem symptoms | Starting | | Idling stability | | | Driving | | | | | | Stopping | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Check Items | Will not start | Starting problem | Idling instability (Rough idling) | Incorrect idling speed | Improper idling continuity | Hesitation, sag | Poor acceleration | Stumble | Shock | Surge | Knocking | Run-on (Dieseling) | Reference page |
| Power Supply | ① $\boxed{1}$ | | | | | | | | | | | | P.13- 98 |
| Engine Control Unit Power Earth | ② $\boxed{2}$ | | | | | | | | | | | | P.13-100 |
| Fuel Pump | ③ $\boxed{3}$ | ① $\boxed{1}$ | | | ① $\boxed{1}$ | ① $\boxed{1}$ | ① $\boxed{1}$ | | | | | | P.13-101 |
| Air Flow Sensor | | | | | ⑫ | ⑧ $\boxed{8}$ | | ⑤ $\boxed{5}$ | ⑥ $\boxed{6}$ | | ③ $\boxed{3}$ | | P.13-104 |
| Intake Air Temperature Sensor | | | ⑥ | | | ④ $\boxed{4}$ | ④ $\boxed{4}$ | | | | ① $\boxed{1}$ | | P.13-108 |
| Barometric Pressure Sensor | | | ⑧ | | | ⑦ $\boxed{7}$ | ⑥ $\boxed{6}$ | | | | ② $\boxed{2}$ | | P.13-110 |
| Engine Coolant Temperature Sensor | | $\boxed{3}$ | ⑦ $\boxed{6}$ | ① $\boxed{1}$ | ⑥ $\boxed{6}$ | ⑥ $\boxed{6}$ | ⑤ $\boxed{5}$ | ④ $\boxed{4}$ | | ③ $\boxed{3}$ | | | P.13-111 |
| Throttle Position Sensor | | | | | | ⑤ $\boxed{5}$ | | ③ $\boxed{3}$ | ④ $\boxed{4}$ | | | | P.13-112 |
| Idle Position Switch | | | ④ $\boxed{4}$ | ② $\boxed{2}$ | ⑤ $\boxed{5}$ | | | | | | | | P.13-114 |
| Servo Valve Position Sensor | | | ③ $\boxed{3}$ | ④ $\boxed{3}$ | ④ $\boxed{4}$ | | | | ⑤ $\boxed{5}$ | | | | P.13-116 |
| Top Dead Center Sensor | ⑤ $\boxed{5}$ | ⑥ $\boxed{7}$ | | | ⑨ $\boxed{8}$ | | | | ② $\boxed{2}$ | | | | P.13-118 |
| Crank Angle Sensor | ⑥ $\boxed{6}$ | ⑦ $\boxed{8}$ | | | ⑩ $\boxed{9}$ | | | | ③ $\boxed{3}$ | | | | P.13-121 |
| Ignition Switch – ST | ④ $\boxed{4}$ | ③ $\boxed{4}$ | | | | | | | | | | | P.13-123 |
| Vehicle Speed Sensor | | | | | ⑦ | | | | ⑦ | | | | P.13-123 |
| Air Conditioner Switch and Power Relay | | | | ③ | | | | | | | | | P.13-123 |
| Oxygen Sensor | | | ⑩ | | | | | | | | | | P.13-124 |
| Injectors | ⑧ $\boxed{8}$ | ② $\boxed{2}$ | ② $\boxed{2}$ | | ③ $\boxed{3}$ | ② $\boxed{2}$ | ② $\boxed{2}$ | ① $\boxed{1}$ | | ① $\boxed{1}$ | | ① | P.13-126 |
| Idle Speed Control Servo (DC Motor) | | ④ $\boxed{5}$ | ① $\boxed{1}$ | ⑤ $\boxed{4}$ | ② $\boxed{2}$ | | | | ⑧ $\boxed{7}$ | | | | P.13-131 |
| Ignition Coil and Power Transistor | ⑦ $\boxed{7}$ | | | | ⑪ $\boxed{10}$ | | ⑦ $\boxed{7}$ | | ① $\boxed{1}$ | | ④ $\boxed{4}$ | | P.13-133 |
| Purge Control Solenoid Valve | | | ⑨ | | | | | | | | | | P.13-137 |
| Fuel Pressure | | ⑤ $\boxed{6}$ | ⑤ $\boxed{5}$ | | ⑧ $\boxed{7}$ | ③ $\boxed{3}$ | ③ $\boxed{3}$ | ② $\boxed{2}$ | | ② $\boxed{2}$ | | | P.13-138 |

○: Warm engine (figures inside the ○ indicate the checking sequence.)
□: Cold engine (figures inside the □ indicate the checking sequence.)

## PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

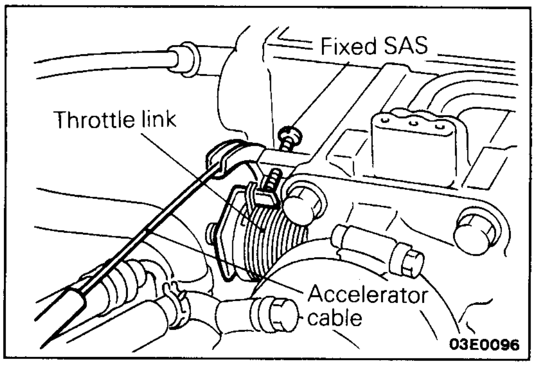
| Item | | Symptom |
|---|---|---|
| Starting | Won't start<br>(no initial combustion) | The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start. |
| | Starting problem<br>(initial combustion, then stall) | There is combustion within the cylinders, but then the engine soon stalls. |
| | (Starting takes a long time.) | Engine won't start quickly. |
| Idling Stability | Idling instability (Rough idling) | Engine speed doesn't remain constant; changes during idling.<br>Usually, a judgement can be based upon the movement of the tachometer pointer, and the vibration transmitted to the steering wheel, shift lever, body, etc. This is called rough idling. |
| | Incorrect idling speed | The engine doesn't idle at the usual correct speed. |
| | Improper idling continuity<br>Die out<br>Pass out | This non-continuity of idling includes the following elements.<br>(1) Die out ..... The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicle is moving or not.<br>(2) Pass out ..... The engine stalls when the accelerator pedal is depressed or while it is being used. |
| Driving | Hesitation<br>Sag | "Hesitation" is the delay in response of the vehicle speed (engine r/min.) that occurs when the accelerator is depressed in order to accelerate from the speed at which the vehicle is now traveling, or a temporary drop in vehicle speed (engine r/min.) during such acceleration. Serious hesitation is called "sag".<br><br> <br>1FU0223 |
| | Poor acceleration | Poor accleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth, or the inability to reach maximum speed. |
| | Stumble | Engine r/min. response is delayed when the accelerator pedal is initially depressed for acceleration from the stopped condition.<br><br> <br>1FU0224 |
| | Shock | The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated. |
| | Surge | This is repeated surging ahead during constant speed travel or during variable speed travel. |
| | Knocking | A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving. |

| Item | | Symptom |
|---|---|---|
| Driving | Surge | This is repeated surging ahead during constant speed travel or during variable speed travel. |
| | Knocking | A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving. |
| Stopping | Run-on (Dieseling) | The engine continues to run even after the switch is turned OFF. This is called dieseling. |

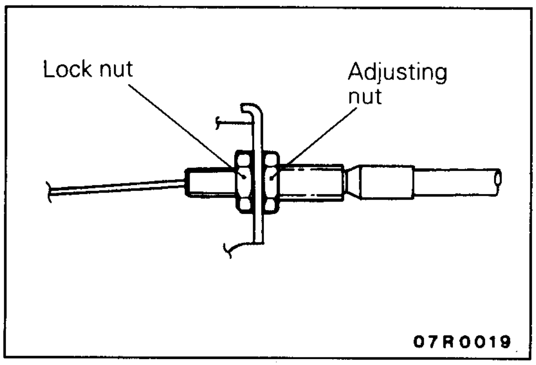
# SERVICE ADJUSTMENT PROCEDURES

## ACCELERATOR CABLE INSPECTION AND ADJUSTMENT

E13FCAZZ



(1) Check that there are no sharp bends in the accelerator cable.
(2) Check that the engine idling speed is at the normal value.
(3) Turn the ignition switch to OFF to stop the engine.



(4) Check that the throttle link is touching the fixed SAS stopper.
(5) Move the plate so that the inner cable play is at the standard value, and tighten the adjusting bolt.

**Standard value: 1–2 mm (0.04–0.08 in.)**

## FUEL FILTER REPLACEMENT

E13FZAM

Refer to P.13-14.

## FUEL GAUGE UNIT REPLACEMENT

E13FDAD

Refer to P.13-15.

## 2-WAY VALVE REPLACEMENT

E13FFAD

Refer to P.13-15.

## FUEL PUMP OPERATION CHECK

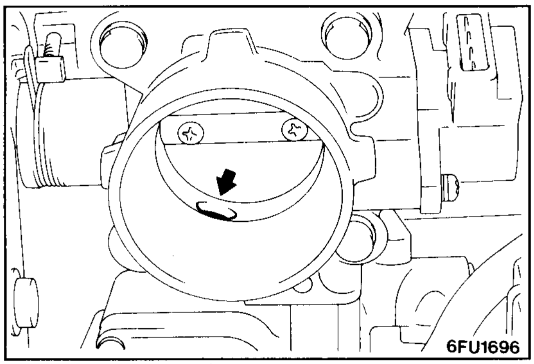
E13FGCF

Refer to P.13-15.

## HOW TO REDUCE THE FUEL LINE INTERNAL PRESSURE

E13HABH

Refer to P.13-16.



## THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

E13HAJB2

(1) Start the engine and warm it up until the temperature of the engine coolant reaches 80°C (176°F) or higher; then stop the engine.
(2) Disconnect the air intake hose at the throttle body side.
(3) Plug the bypass intake port inlet in the throttle body.

**Caution**
**Never let cleaning liquid get into the bypass intake.**

(4) Spray cleaning liquid (from the intake port of the throttle body) onto the valve, and then leave as is for about five minutes.
(5) Start the engine and race it a few times; then let it run at idle speed for about one minute.

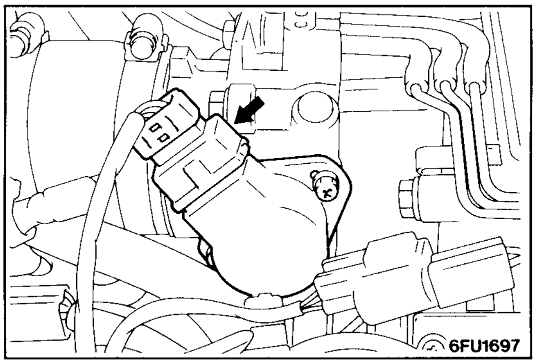
NOTE
The engine idling speed is unstable (or the engine stalls), let the engine run with the throttle valve slightly open.

(6) If deposits are not removed from the throttle valve, repeat steps (4) and (5).
(7) Remove the plug from the bypass intake port inlet in the throttle body.
(8) Connect the air intake hose.
(9) Using the multi-use tester, erase the self-diagnosis code.
(10)Adjust the basic idle speed. (Refer to P.13-93.)

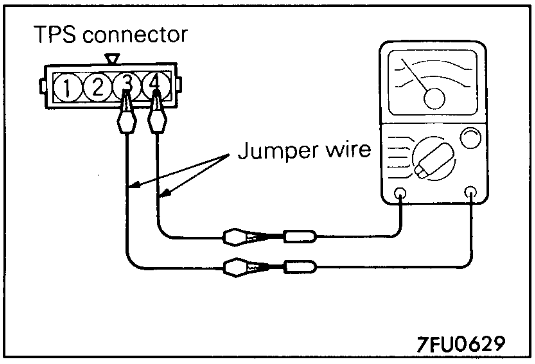
NOTE
If hunting of the idling engine occurs after adjusting the basic idling speed, remove the battery (–) cable from the battery terminal for more than 10 seconds, and then idle the engine again.

## IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT

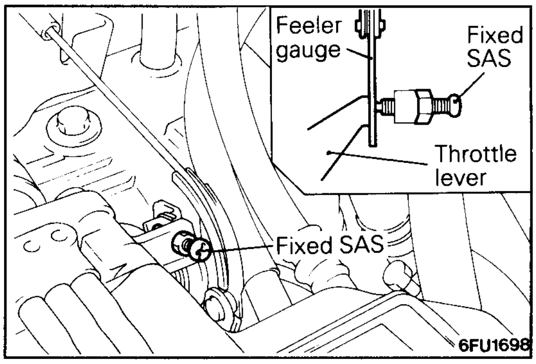
E13HAKD2



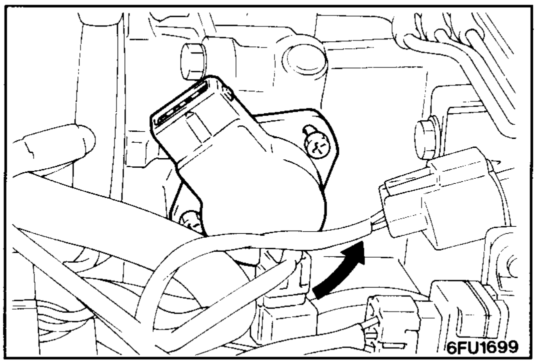
(1) Disconnect the connector of the throttle position sensor.



(2) Using jumper wires, connect an ohmmeter across terminal ③ (idle position switch) and terminal ④ (sensor earth) of the throttle position sensor.

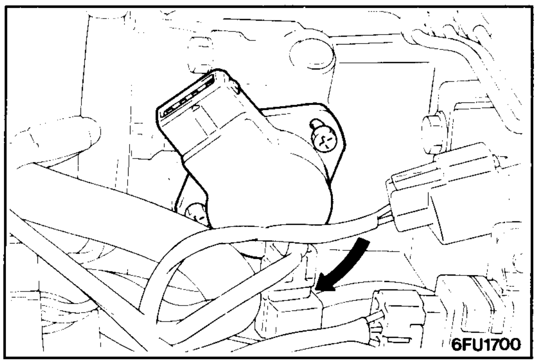


(3) Insert a 0.65 mm (0.0256 in.) thick feeler gauge between the fixed SAS and throttle lever.



(4) Loosen the throttle position sensor mounting bolts and turn the throttle position sensor body fully counterclockwise.

(5) In this condition, check that there is continuity across terminals ③ and ④.



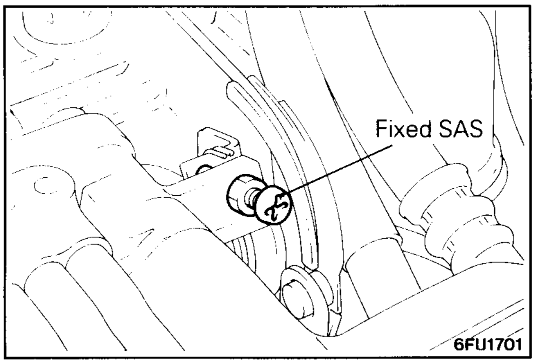
(6) Slowly turn the throttle position sensor clockwise until you find a point at which there is no continuity across terminals ③ and ④. Then, tighten the throttle position sensor mounting bolt securely.

(7) Connect the throttle position sensor connector.

(8) Connect the multi use tester (MUT) to the diagnosis connector.
(9) Turn the ignition switch ON (but do not start the engine).
(10)Using the MUT, select item No. 14 and read the throttle position sensor output voltage.

**Standard value: 400–1,000 mV**

(11)If the voltage is out of specification, check the throttle position sensor and associated harnesses.
(12)Remove the feeler gauge.
(13)Turn the ignition switch OFF.



## FIXED SAS ADJUSTMENT

E13HAMC2

NOTE
1. The fixed SAS has been factory-adjusted. Never attempt to move it.
2. Should it be out of proper adjustment, adjust by following the procedure given below.

(1) Sufficiently slacken the accelerator cable.
(2) Loosen the lock nut on the fixed SAS.
(3) Sufficiently loosen the fixed SAS by turning it counterclockwise to fully close the throttle valve.
(4) Tighten the fixed SAS slowly to find a point at which it contacts the throttle lever (where the throttle valve starts opening). From that point, tighten the fixed SAS further 1 1/4 turns.
(5) Holding the fixed SAS to prevent it from turning, tighten the lock nut securely.
(6) Adjust the accelerator cable tension. (Refer to P.13-89.)
(7) Adjust the basic idle speed. (Refer to P.13-93.)
(8) Adjust the idle position switch and throttle position sensor (TPS). (Refer to P.13-91.)

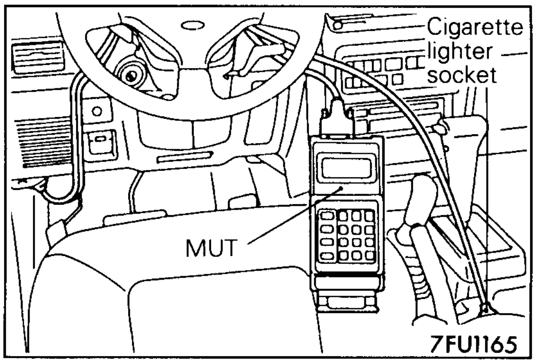
## BASIC IDLE SPEED ADJUSTMENT E13HANE

NOTE

1. The basic idle speed has been factory-adjusted with the speed adjusting screw (SAS) and does not normally require adjustment.
2. If the adjustment is required, first check that the ignition plug, injector, ISC servo, and compression pressure are normal.

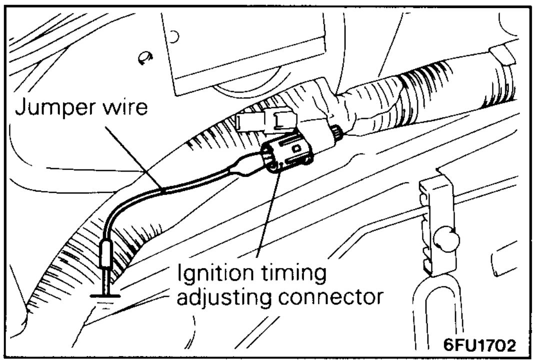
(1) Before starting the inspection and adjustment procedures, set the vehicle in the following conditions:

- Engine coolant temperature: 80 to 95°C (176 to 203°F)
- Lights, electric cooling fan, accessories: OFF
- Transmission: Neutral
- Steering wheel: Straightforward position



(2) Connect the multi use tester (MUT) to the diagnosis connector.

NOTE
When the multi-use tester is connected, the diagnosis control terminal will be earthed.



(3) Remove the waterproof female connector from the ignition timing adjusting connector (brown).

(4) Using a jumper wire, earth the ignition timing adjusting terminal.

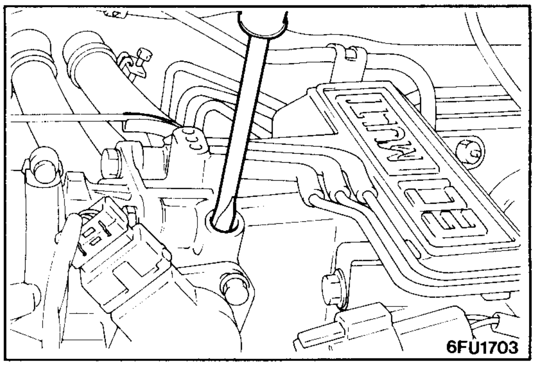
(5) Start the engine and run at idle.

(6) Check the basic idle speed.
Using the MUT, select item No. 22 and read the idle speed.

**Standard value: 750 ± 50 r/min.**

NOTE

1. The engine speed may be low by 20 to 100 r/min. while the vehicle is new [distance driven approx. 500 km (300 miles) or less], but no adjustment is necessary.
2. If the engine stalls or speed is low despite a sufficient distance driven [approx. 500 km (300 miles) or more], it is probably due to deposits on the throttle valve. In this case, clean the throttle valve. (Refer to P.13-90.)



(7) If the basic idle speed is out of specification, adjust by turning the speed adjusting screw (SAS).

NOTE
If the idle speed is higher than the standard value even with SAS fully tightened, check to see if there is evidence of the fixed SAS being moved. If the fixed SAS seems to have been moved, adjust it. If it does not seem to have been moved, there may be a leak caused by deteriorated fast idle air valve (FIAV). In such a case, replace the throttle body.

(8) Turn the ignition switch OFF.

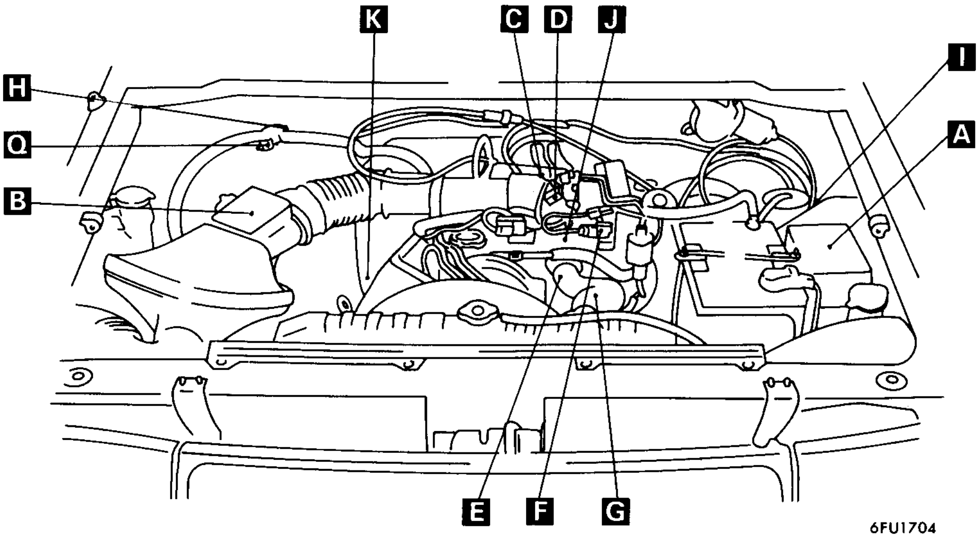
(9) Remove the jumper wire from the ignition timing adjusting terminal and replace the connector back again.

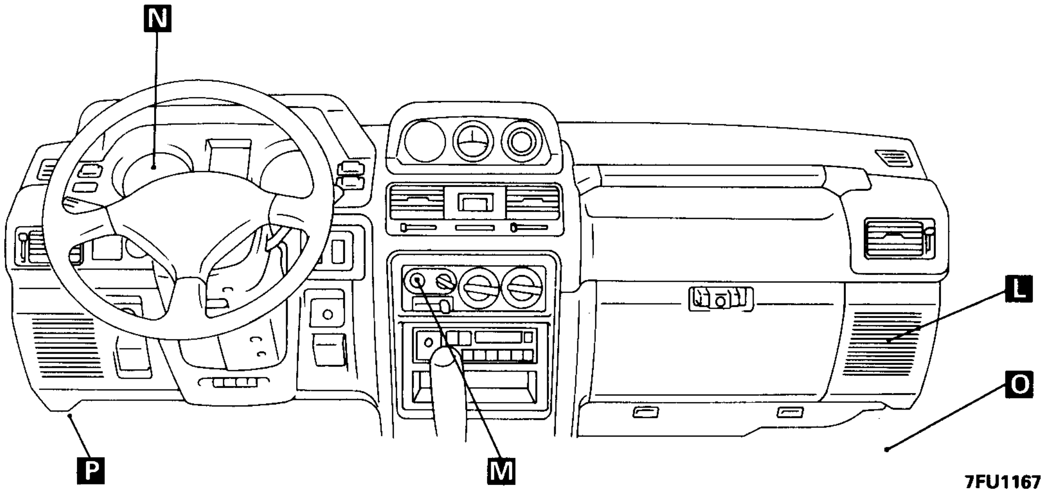
(10)Start the engine again and run at idle for 10 minutes to make sure that the engine runs at proper idle speed.

# ON-VEHICLE INSPECTION OF MPI COMPONENTS

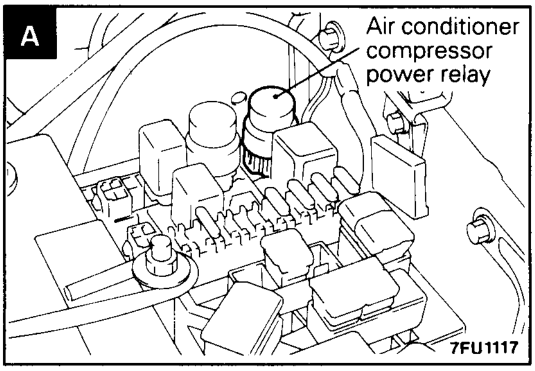
E13QAAD

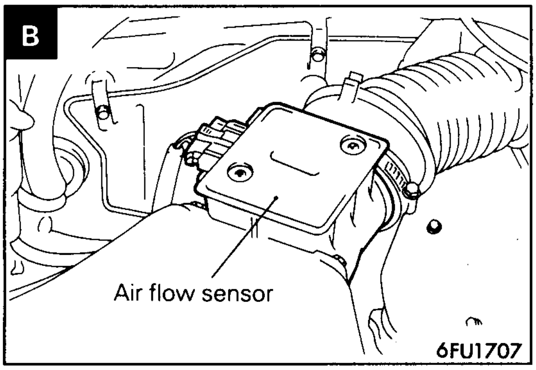
## COMPONENT LOCATION

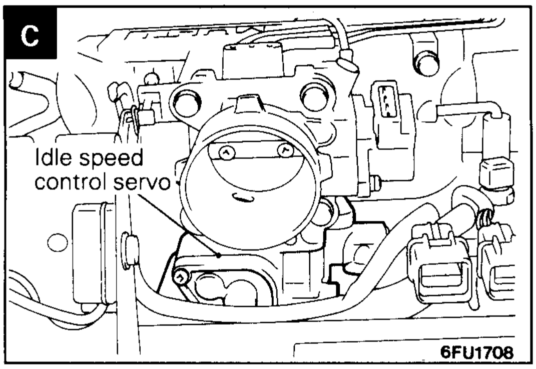


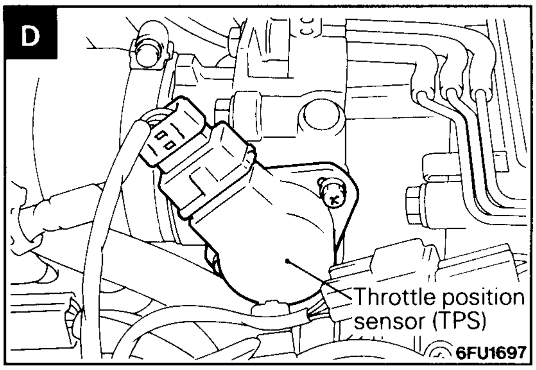


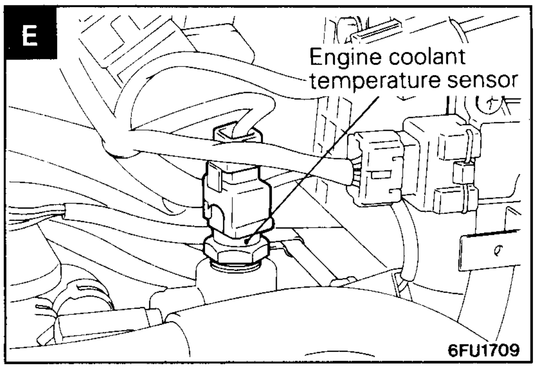
| Name | Symbol | Name | Symbol |
|---|---|---|---|
| Air conditioner relay | A | Ignition timing adjustment terminal | Q |
| Air conditioner switch | M | Injector | J |
| Air flow-sensor (incorporating intake air temperature sensor and barometric pressure sensor) | B | Idle speed control servo (incorporating servo, valve position sensor) | C |
| | | Oxygen sensor | K |
| Crank angle sensor and No. 1 cylinder top dead center sensor | G | Purge control solenoid valve | I |
| Engine control relay | L | Self-diagnosis connector | P |
| Engine control unit | O | Throttle position sensor (incorporating idle position switch) | D |
| Engine coolant temperature sensor | E | Vehicle-speed sensor (reed switch) | N |
| Fuel pump check terminal | H | | |
| Ignition coil (power transistor) | F | | |

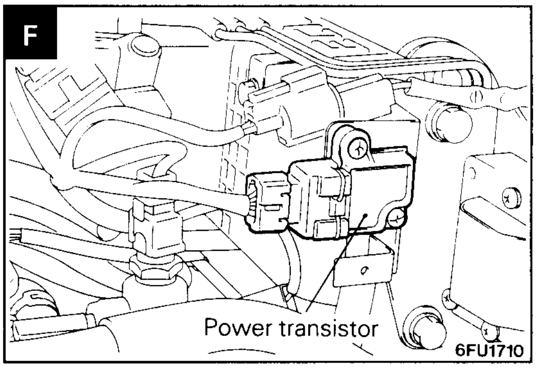

A
Air conditioner compressor power relay
7FU1117

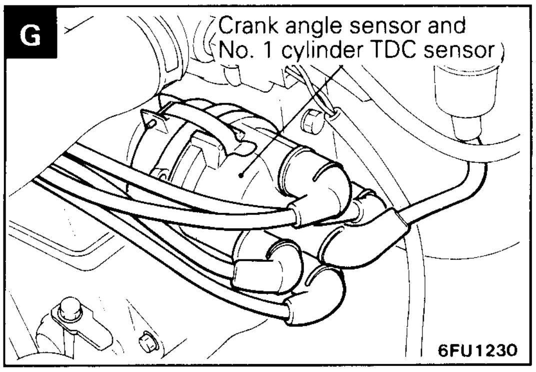

B
Air flow sensor
6FU1707

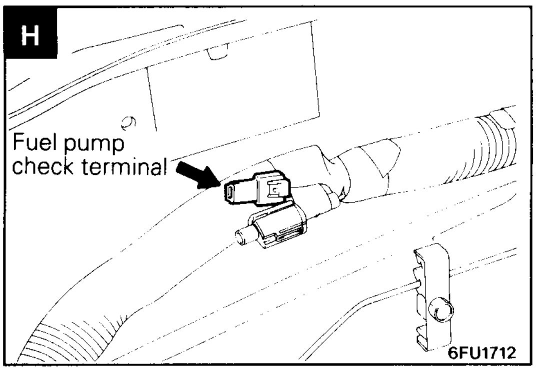

C
Idle speed control servo
6FU1708

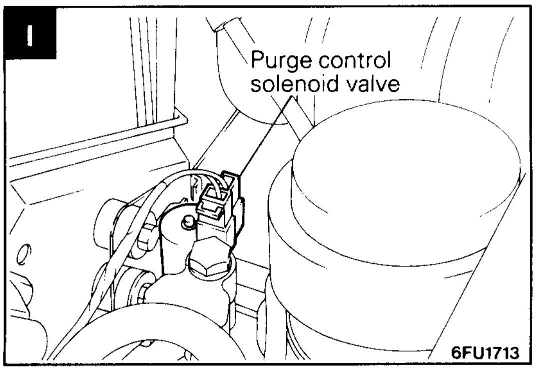

D
Throttle position sensor (TPS)
6FU1697

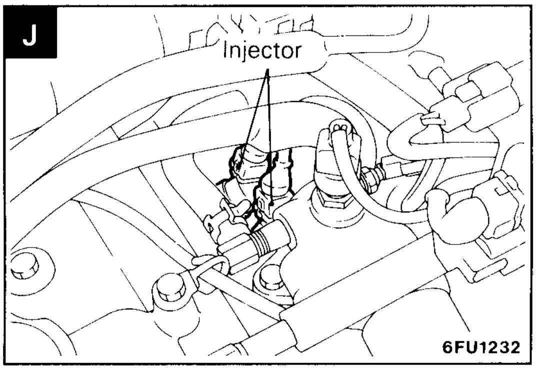

E
Engine coolant temperature sensor
6FU1709

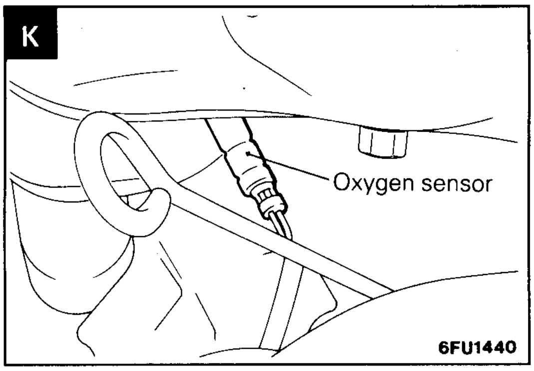

F
Power transistor
6FU1710

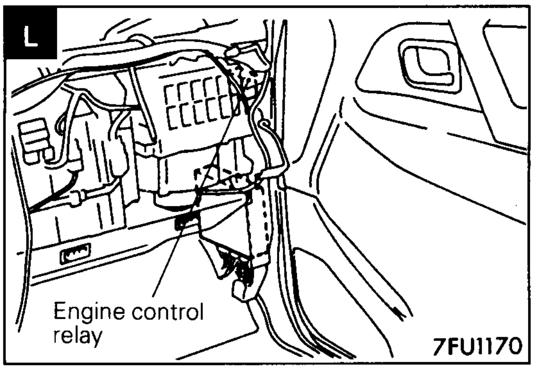

G
Crank angle sensor and No. 1 cylinder TDC sensor
6FU1230

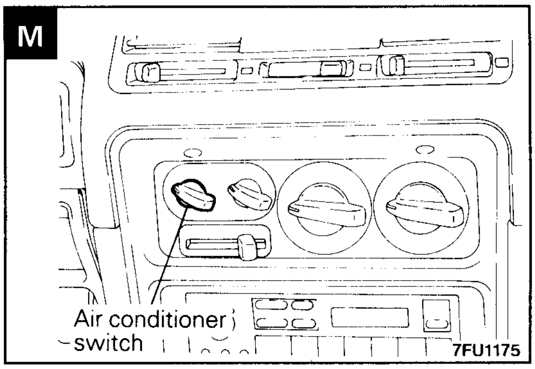

H
Fuel pump check terminal
6FU1712

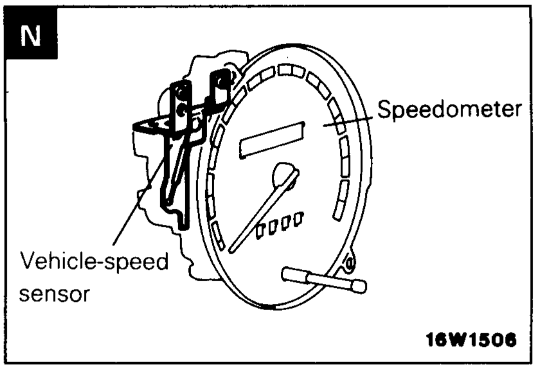

I
Purge control solenoid valve
6FU1713

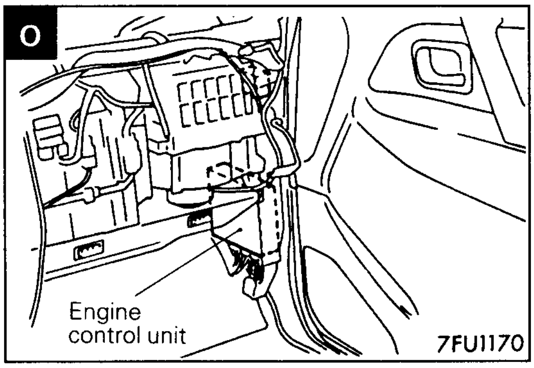

J
Injector
6FU1232

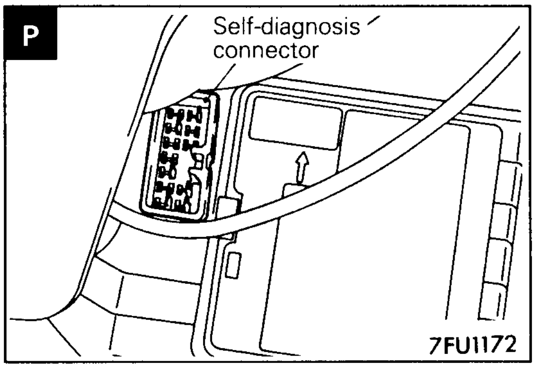


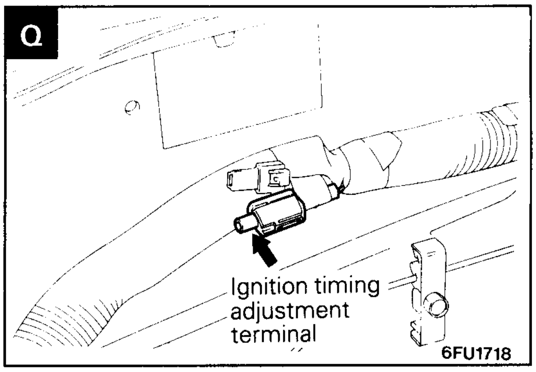










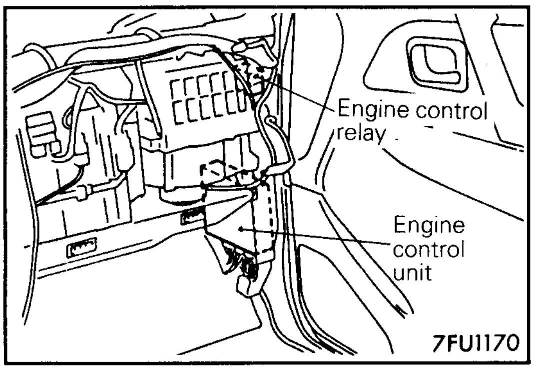


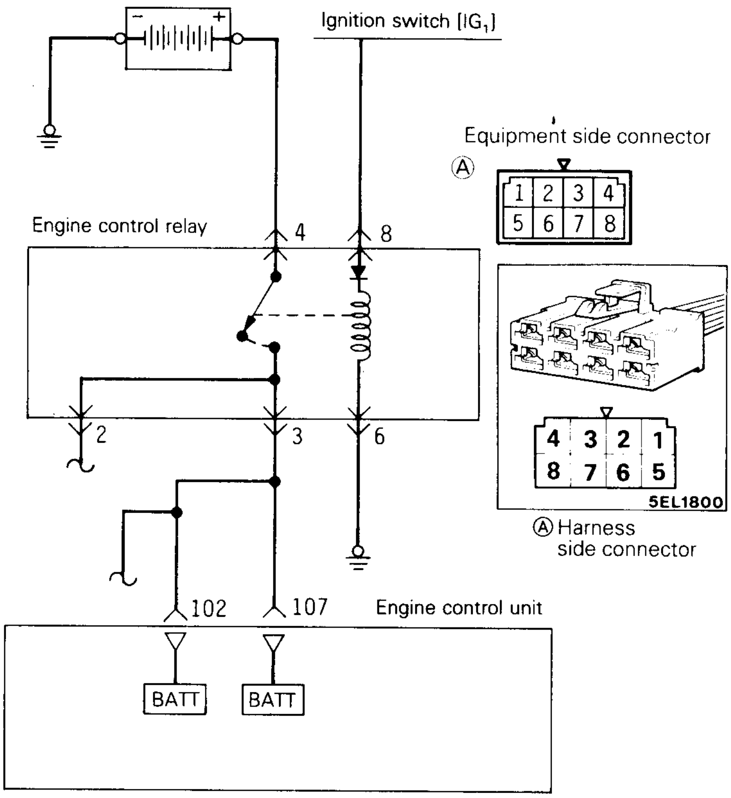
## COMPONENT INSPECTION PROCEDURE

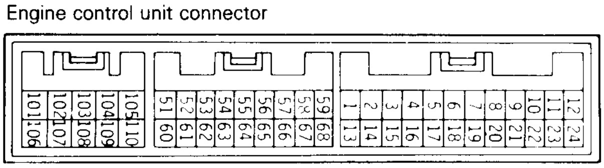
### USING MULTI USE TESTER

Refer to P.13-22.

## POWER SUPPLY







### OPERATION

- While the ignition switch is ON, battery power supply is supplied to the engine control unit, injectors, air-flow sensor, etc.
- Turning the ignition switch to the ON position causes current to flow from the ignition switch through the control relay coil to earth. This turns the control relay switch on and supplies power from the battery to the engine control unit via the control relay switch.

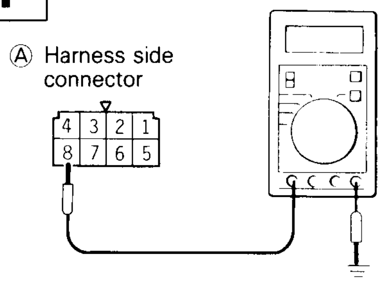
### INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Standard value |
|---|---|---|---|---|
| Data reading | 16 | Engine control unit power-supply voltage | Ignition switch:ON | SV |

## HARNESS INSPECTION

**1**



01A0521

Measure the power supply voltage of the engine control relay.

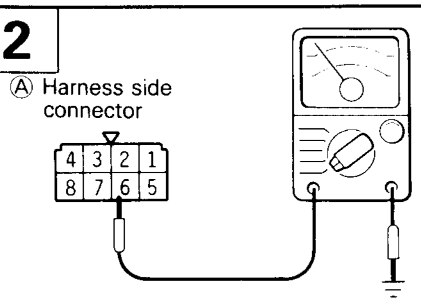
- Engine control relay: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → $\boxed{2}$

~~OK~~ → Repair the harness. (Ignition switch – Ⓐ $\boxed{8}$ )

**2**



01A0369

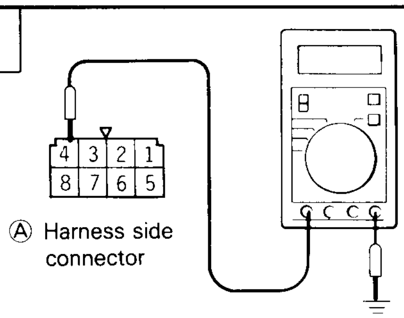
Check for continuity of the earth circuit

- Engine control relay connector: Disconnected

OK → $\boxed{3}$

~~OK~~ → Repair the harness. ( Ⓐ $\boxed{6}$ – Earth)

**3**



01A0361

Measure the power supply voltage of the engine control relay.

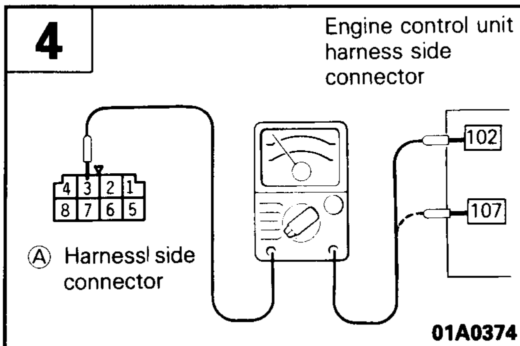
- Engine control relay connector: Disconnected

| Voltage (V) |
|---|
| SV |

OK → $\boxed{4}$

~~OK~~ → Repair the harness. (Battery – Ⓐ $\boxed{4}$ )

**4**



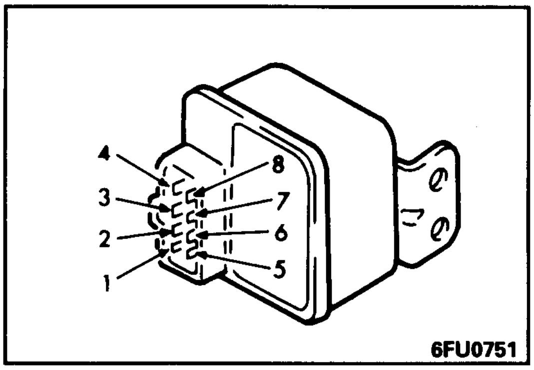
01A0374

Check for open-circuit, or short-circuit to earth, between the engine control unit and the engine control relay.

- Engine control unit connector: Disconnected
- Engine control relay connector: Disconnected.

OK → STOP

~~OK~~ → Repair the harness ($\boxed{102}$ –Ⓐ$\boxed{3}$) ($\boxed{107}$ –Ⓐ$\boxed{3}$)



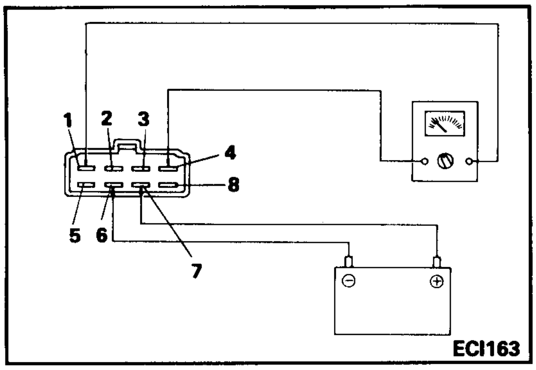
## ENGINE CONTROL RELAY INSPECTION

**Caution**

**When applying battery voltage directly, make sure that it is applied to correct terminal. Otherwise, the relay could be damaged.**

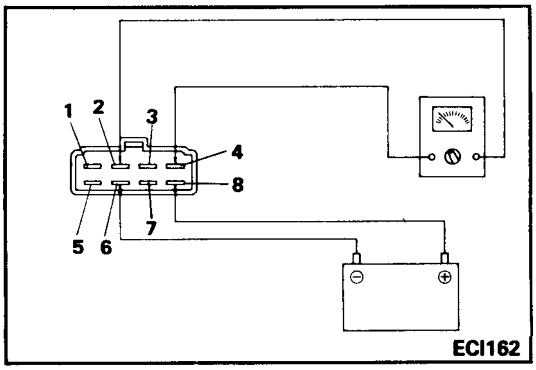
(1) Check the continuity of the engine control relay coil.

| Measured Terminals | Continuity |
|---|---|
| ③-⑤ | Yes (approx. 95Ω) |
| ②-⑤ | |
| ⑥-⑦ | Yes (approx. 35Ω) |
| ⑥-⑧ | Yes One direction only |



(2) Check the continuity between terminals 1 and 4 of the engine control relay contacts.

| Relay Coil (Between terminals ⑥-⑦) | Continuity |
|---|---|
| When not energized | No (∞Ω) |
| When energized | Yes (0Ω) |



(3) Check the continuity between terminals 2 and 4 of the engine control relay contacts.

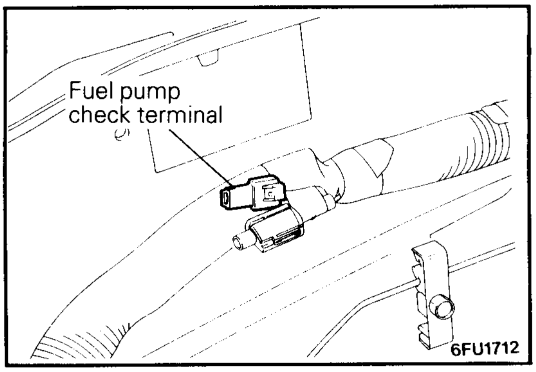
| Relay Coil (Between terminals ⑧-⑥) | Continuity |
|---|---|
| When not energized | No (∞Ω) |
| When energized | Yes (0Ω) |

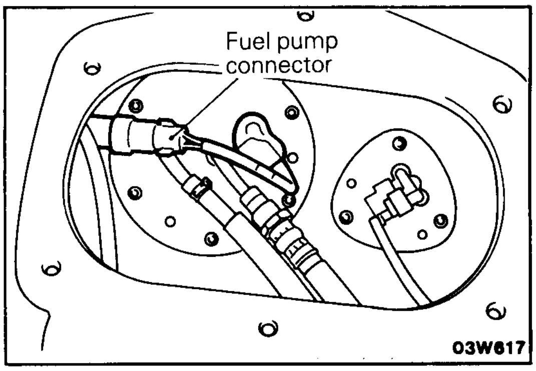
(4) If the control relay is faulty, replace it.

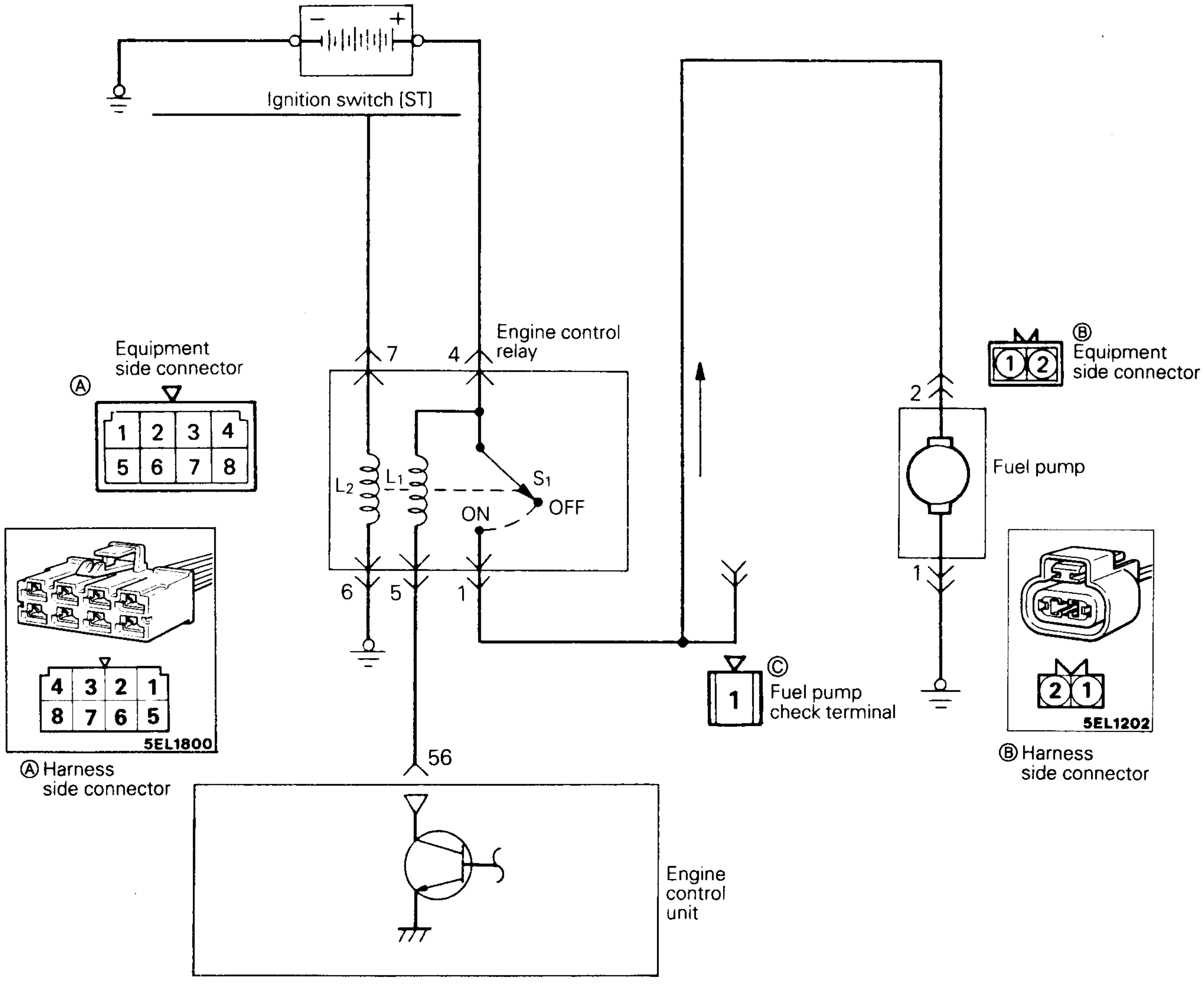
## ENGINE CONTROL UNIT POWER EARTH

Refer to P.13-26.

## FUEL PUMP

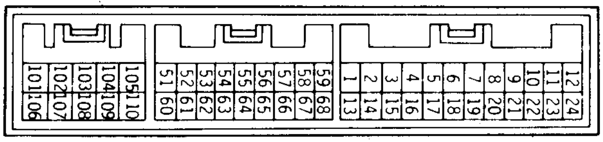






6FU1720

Engine control unit connector



01L0838

## OPERATION

- Activates the fuel pump during engine cranking and while the engine is running.
- When the ignition switch is set to the START position, current flows, by way of the control relay coil, from the ignition switch to earth. As a result, the control relay switch is switched ON, and the power for activation of the fuel pump is supplied, by way of the control relay switch, from the battery to the fuel pump.
- While the engine is running, the engine control unit switches ON the power transistor, after which current flows to the control relay coil, and the power for activation of the fuel pump is supplied to the fuel pump.
- When the control relay switch is switched ON, battery voltage is also applied to the engine control unit, and so the engine control unit detects the fact that the power for activation of the fuel pump is being supplied to the fuel pump.

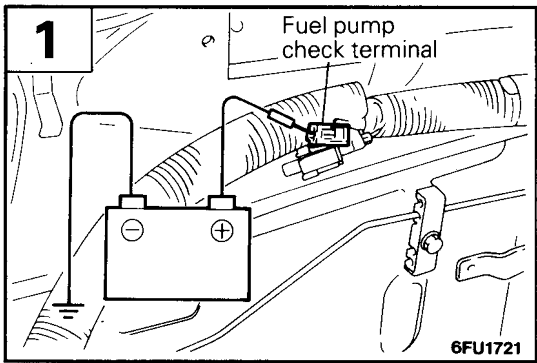
## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Activation | Check conditions | Check description | Normal condition |
|---|---|---|---|---|---|
| Actuater test | 07 | Activates fuel pump and circulates fuel. | • Engine cranking<br>• Fuel pump forced activation<br>Make the check under both of the above conditions. | Pinch the return hose and feel the pulsations of the fuel flow. | Pulsations can be felt. |
| | | | | Listen (close to the fuel tank) for pump sounds. | Sounds can be heard. |

## HARNESS INSPECTION

**1**

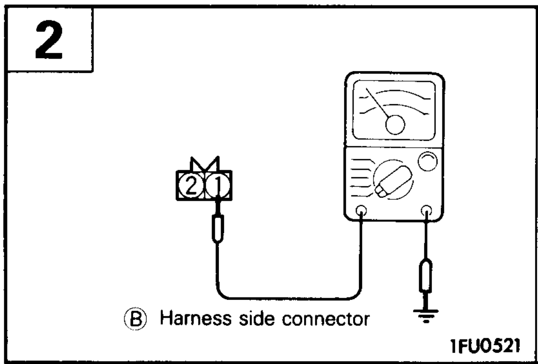


Check the fuel pump.
- Apply battery voltage to the checking terminal and operate the pump.

OK → 4

~~OK~~ → 2

**2**

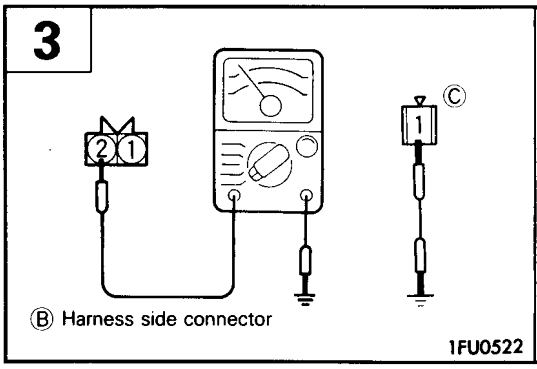


Check for continuity of the earth circuit.
- Fuel pump connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓑ 1 – Earth)

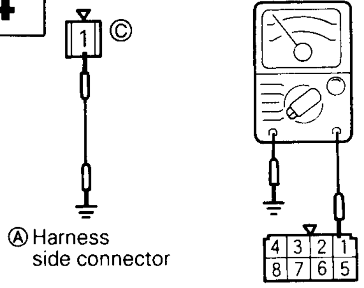
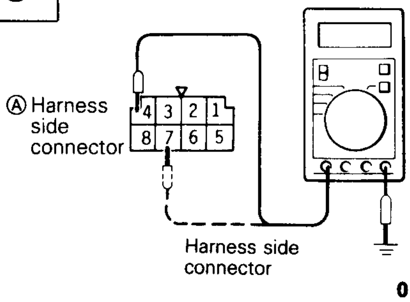
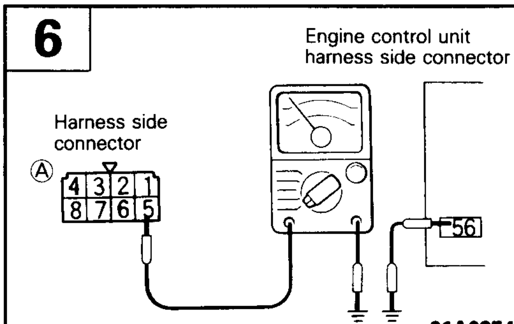
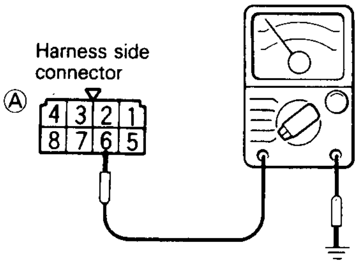
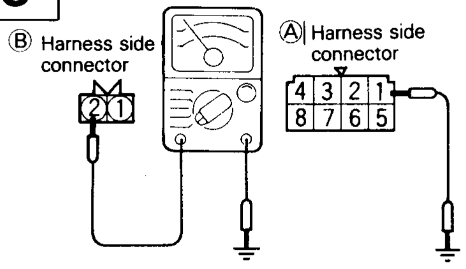
**3**



Check for continuity between the fuel pump and the checking terminal.
- Fuel pump connector: Disconnected

OK → 4

~~OK~~ → Repair the harness. (Ⓑ 2 – Ⓒ 1)

| | | |
|---|---|---|
| **4**<br> <br>8FU0308 | Check for continuity between the checking terminal; and between the engine control relay terminals.<br>• Engine control relay connector: Disconnected<br>• Fuel pump connector: Disconnected<br>OK →<br>~~OK~~ → | 5<br>Repair the harness.<br>( Ⓐ 1 – Ⓒ 1 )<br>( Ⓒ 1 – 109 ) |
| **5**<br> <br>01A0504 | Measure the power supply voltage of the engine control relay.<br>• Engine control relay connector: Disconnected<br>• Ignition switch: START (when checking Ⓐ 7 )<br>**Voltage (V)**<br>**8 or higher**<br>OK →<br>~~OK~~ → | 6<br>Repair the harness.<br>( Ⓐ 4 – Battery)<br>( Ⓐ 7 – Ignition switch) |
| **6**<br> <br>01A0354 | Check for an open-circuit, or a short-circuit to earth between the engine control relay and the engine control unit.<br>• Engine control relay connector: Disconnected<br>• Engine control unit connector: Disconnected<br>OK →<br>~~OK~~ → | 7<br>Repair the harness.<br>( Ⓐ 5 – 56 ) |
| **7**<br> <br>01A0351 | Check for continuity, of the earth circuit.<br>• Engine control relay connector: Disconnected.<br>OK →<br>~~OK~~ → | 8<br>Repair the harness.<br>( Ⓐ 6 – Earth) |
| **8**<br> <br>1FU0472 | Check for an open-circuit, or a short-circuit to earth between the engine control relay and the fuel pump.<br>• Engine control relay connector: Disconnected<br>• Fuel pump connector: Disconnected<br>OK →<br>~~OK~~ → | STOP<br>Repair the harness.<br>( Ⓐ 1 – Ⓑ 2 ) |

## FUEL PUMP INSPECTION

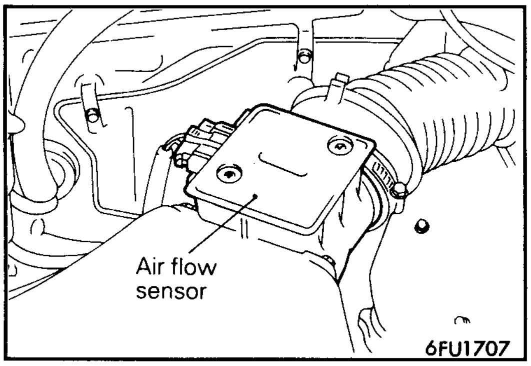
Refer to P.13-15.

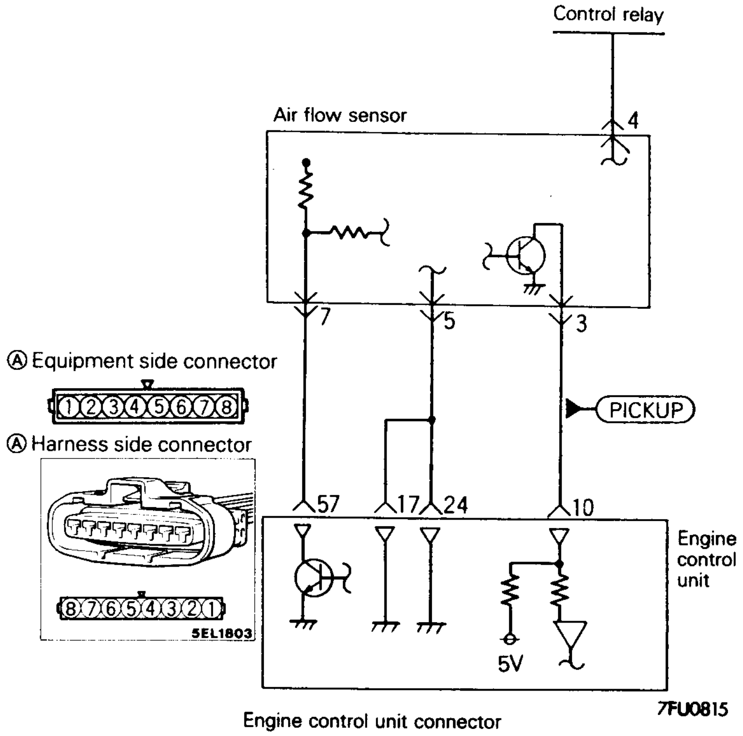
## ENGINE CONTROL RELAY INSPECTION

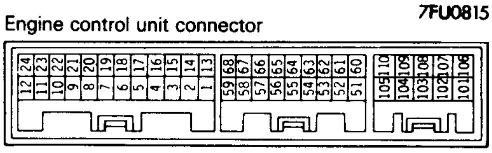
Refer to P.13-100.

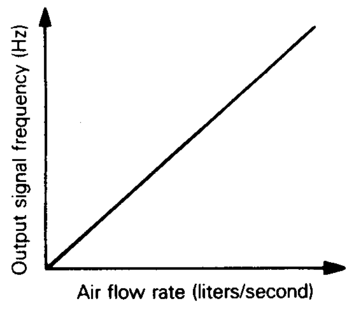
## AIR FLOW SENSOR

M13YFAA1









### OPERATION

- The air-flow sensor is incorporated within the cleaner; it functions to convert the amount of engine air intake to pulse signals of a frequency proportional to the amount of engine air intake, and to input those signals to the engine control unit.
  The engine control unit then, based upon those signals, calculates the amount of fuel injection, etc.
- The power for the air flow sensor is supplied from the control relay to the air flow sensor, and is earthed at the engine control unit. The air flow sensor, by intermitting the flow of the 5V voltage applied from the engine control unit produces pulse signals.

Hint 1:

If the engine sometimes stalls, try starting the engine and shaking the air flow sensor harness.

If the engine then stalls, incorrect or improper contact of the air flow sensor connector is the probable cause.

Hint 2:

If, when the ignition switch is switched ON (but the engine is not started), the air flow sensor output frequency is any value other than zero, a malfunction of the air flow sensor or of the engine control unit is the probable cause.

Hint 3:

If idling is possible even though the air flow sensor output frequency is deviated from the standard value, the cause is usually a malfunction other than of the air flow sensor.

[Examples]

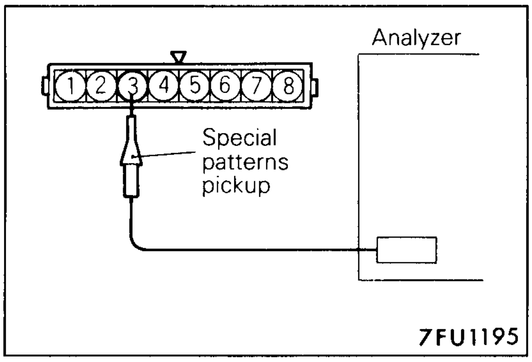
(1) The flow of air within the air flow sensor is disturbed. (Air duct disconnection or clogged air cleaner element.)
(2) Incomplete combustion within a cylinder. (Malfunction of spark plugs, ignition coil, injectors, compression pressure, etc.)
(3) Air is taken into the intake manifold through a leaking gasket, etc.
(4) EGR valve
Improper adhesion of valve sheet.

## INSPECTION

### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Engine conditions r/min. | Standard value Hz |
|---|---|---|---|---|---|
| Data reading | 12 | Sensor detection air flow (frequency) | • Engine coolant temperature: 80–95°C (176–205°F)<br>• Lights and accessories: OFF<br>• Transmission: neutral<br>• Steering wheel: neutral position | 750 (idling) | 37–63 |
| | | | | 2,000 | 75–115 |
| | | | | Racing | Frequency increases by racing. |

NOTE
When the vehicle is new [driven approximately 500 km (300 miles) or less], the air-flow sensor output frequency may be approximately 10% higher than indicated above.



7FU1195

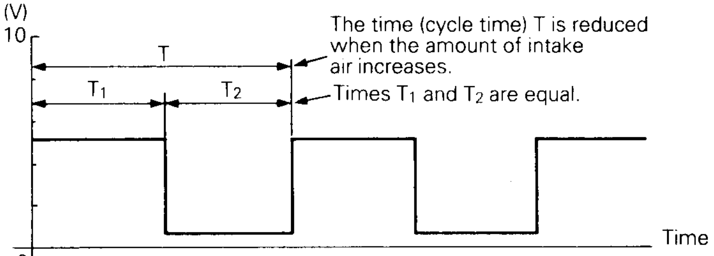
### Wave Pattern Inspection Using an Analyzer

### Measurement Method

(1) Disconnect the air flow sensor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)

(2) Connect the analyzer special patterns pickup to terminal ③ of the air flow sensor connector.

### Standard wave pattern



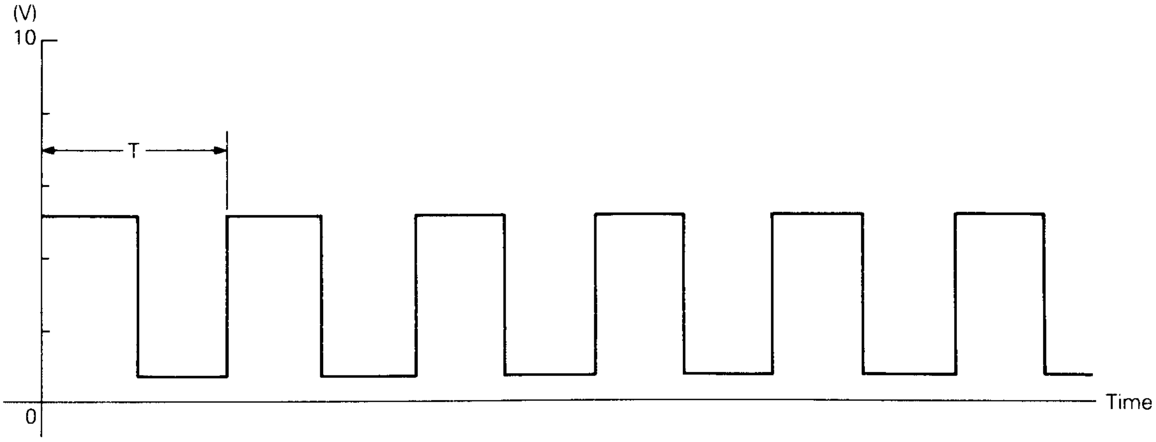
7FU1199

### Observation conditions

| Function | Special patterns |
|---|---|
| Pattern height | Low |
| Pattern selector | Display |
| Engine r/min. | Idle r/min. (750/min.) |

### Observation conditions

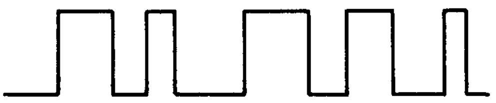
(from conditions on previous page, engine speed is increased by racing.)



7FU0880

**Wave pattern observation points**

Check that cycle time T becomes shorter and the frequency increases when the engine speed is increased.



01P0199

**Examples of abnormal wave patterns**

- Example 1

  **Cause of problem**

  Sensor interface malfunction

  **Wave pattern characteristics**

  Short wave pattern is output even when the engine is not started.
- Example 2

  **Cause of problem**

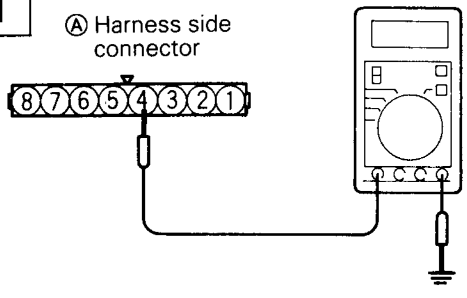
  Damaged rectifier or vortex generation column

  **Wave pattern characteristics**

  Unstable wave pattern with non-uniform frequency. However, when an ignition leak occurs during acceleration, the wave pattern will be distorted temporarily, even if the air flow sensor is normal.

## HARNESS INSPECTION

**1**



7FU0655

Measure the power supply voltage.

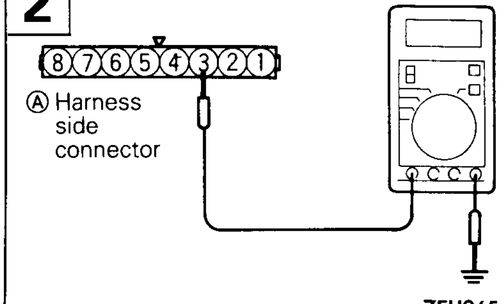
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ4 – Control relay) or check the control relay

**2**



7FU0656

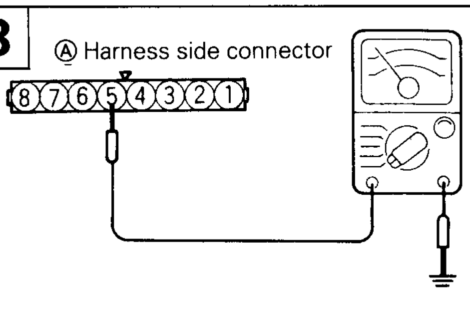
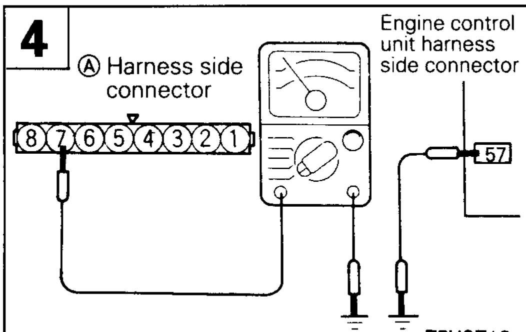
Measure the terminal voltage.

- Connector: Disconnected
- Ignition switch: ON

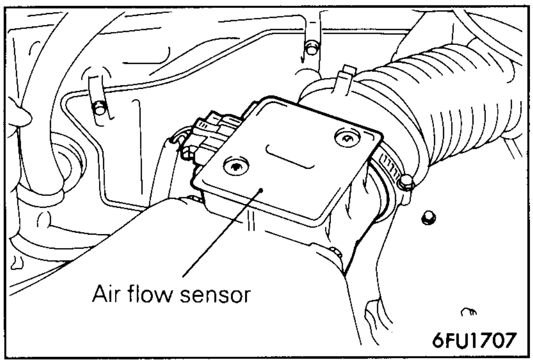
| Voltage (V) |
|---|
| 4.8–5.2 |

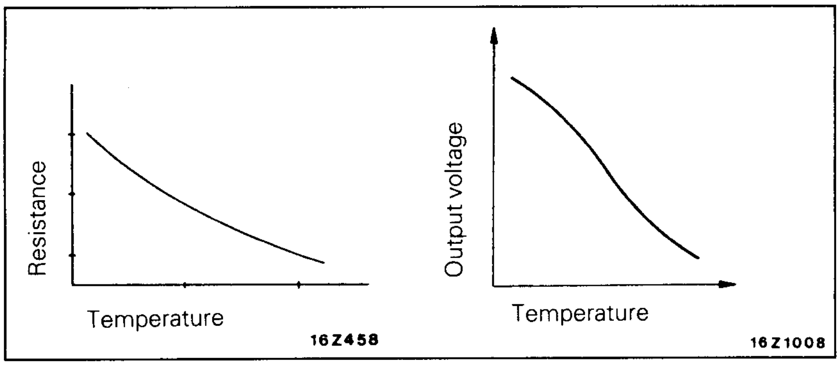
OK → 3

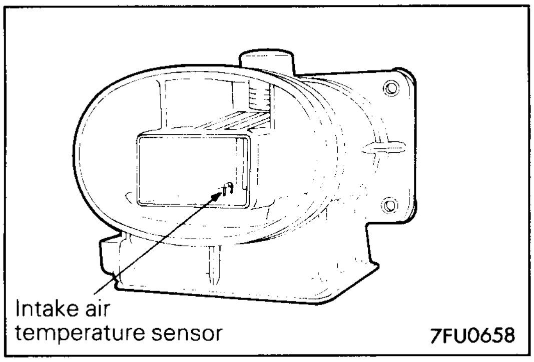
~~OK~~ → Repair the harness. (Ⓐ3 – 10)

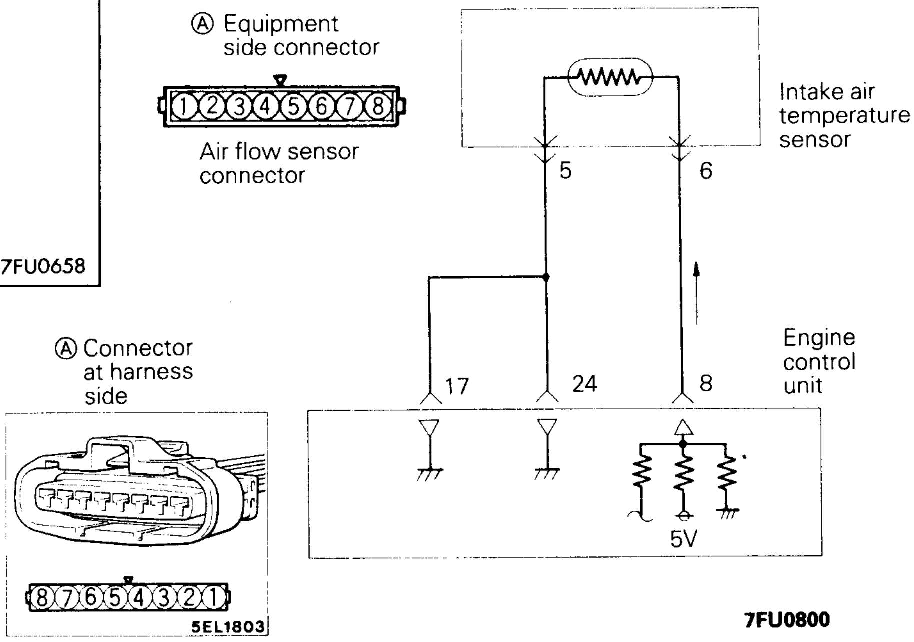
| | | | | |
|---|---|---|---|---|
| **3** |  <br>7FU0657 | Check for continuity of the earth circuit.<br>• Connector: Disconnected | OK | 4 |
| | | | ~~OK~~ | Repair the harness. (Ⓐ5 – 17, 24) |
| **4** |  <br>7FU0745 | Check for continuity between the air flow sensor and the engine control unit.<br>• Air-flow sensor connector: Disconnected<br>• Engine control unit connector: Disconnected | OK | STOP |
| | | | ~~OK~~ | Repair the harness. (Ⓐ7 – 57) |

## INTAKE AIR TEMPERATURE SENSOR









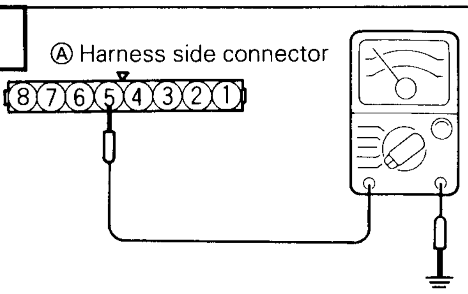
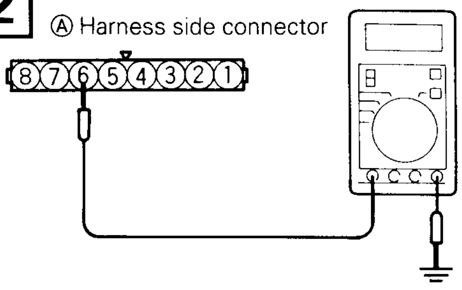
### OPERATION

### TROUBLESHOOTING HINTS

### INSPECTION

#### Using Multi-use tester (MUT)

FUEL SYSTEM <6G72 Engine> – Refer to Intake Air Temperature Sensor (P.13-34).

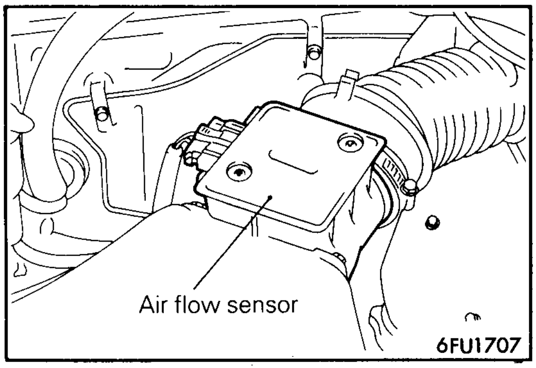
<table>
<tr>
<td><b>1</b><br> <br>7FU0657</td>
<td>Check for continuity of the earth circuit.<br>OK →<br>~~OK~~ →</td>
<td>2<br>Repair the harness. (Ⓐ5 – 17, 24)</td>
</tr>
<tr>
<td><b>2</b><br> <br>7FU0660</td>
<td>Measure the power supply voltage.<br>• Connector: Disconnected<br>• Ignition switch: ON<br><table><tr><th>Voltage (V)</th></tr><tr><td>4.5 – 4.9</td></tr></table>OK →<br>~~OK~~ →</td>
<td>STOP<br>Repair the harness. (Ⓐ6 – 8)</td>
</tr>
</table>

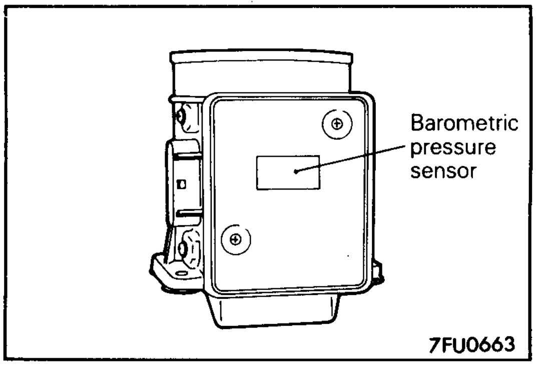
## SENSOR INSPECTION

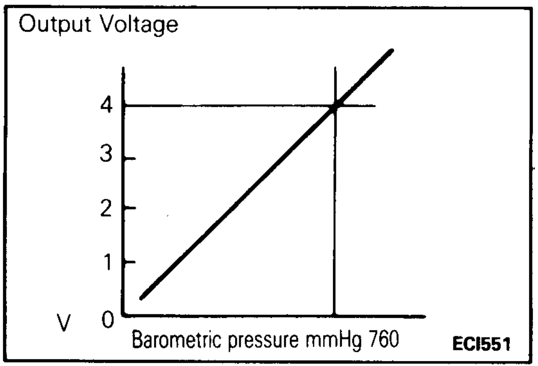
FUEL SYSTEM <6G72 Engine> – Refer to Intake Air Temperature Sensor (P.13-35).

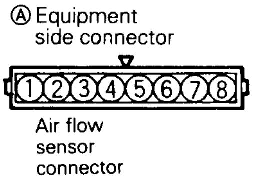
## BAROMETRIC PRESSURE SENSOR

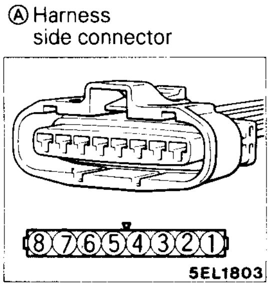
M13YHAA1

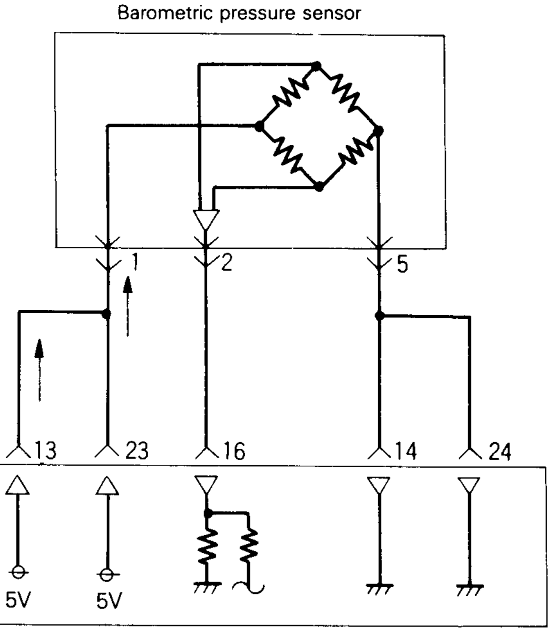




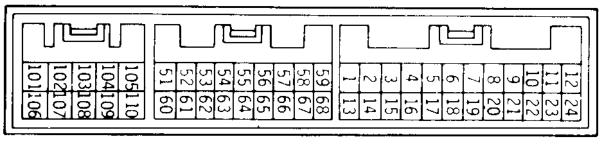








Engine control unit connector



### OPERATION

### TROUBLESHOOTING HINTS

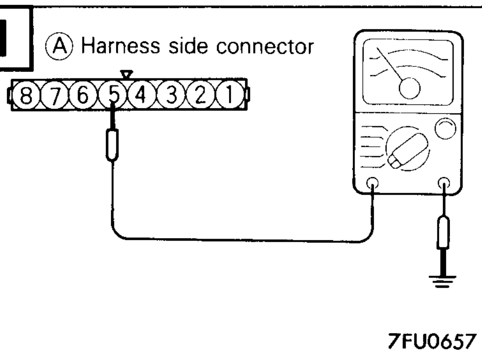
### INSPECTION

### Using Multi-use tester (MUT)

FUEL SYSTEM <6G72 Engine> – Refer to Barometric Pressure Sensor (P.13-36).

## HARNESS INSPECTION

**1**



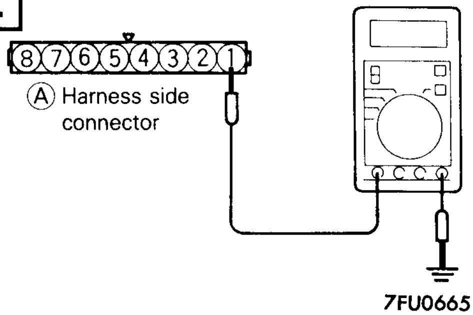
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 2

~~OK~~ → Repair the harness. (Ⓐ 5 – 17, 24)

**2**



Measure the power supply voltage of the barometric pressure sensor.

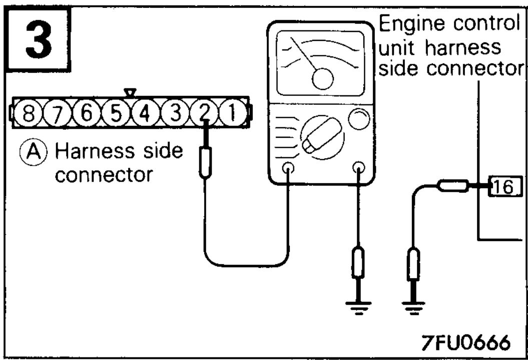
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

OK → 3

~~OK~~ → Repair the harness. (Ⓐ 1 – 13, 23)

**3**



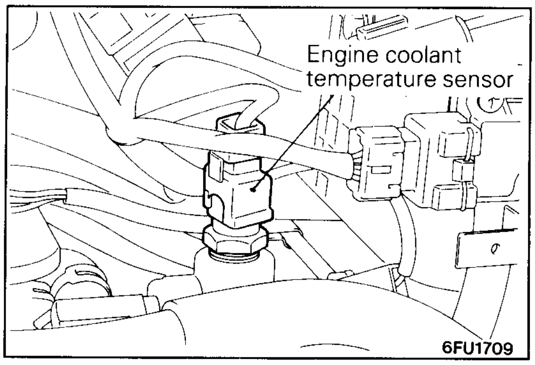
Check for an open-circuit or a short-circuit to earth, between the engine control unit and the barometric pressure sensor.

- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ 2 – 16)

## ENGINE COOLANT TEMPERATURE SENSOR



### OPERATION

### TROUBLESHOOTING HINTS

### INSPECTION

### Using Multi-use tester (MUT)

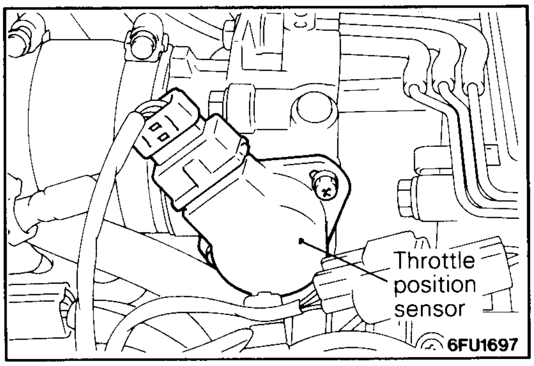
### HARNESS INSPECTION

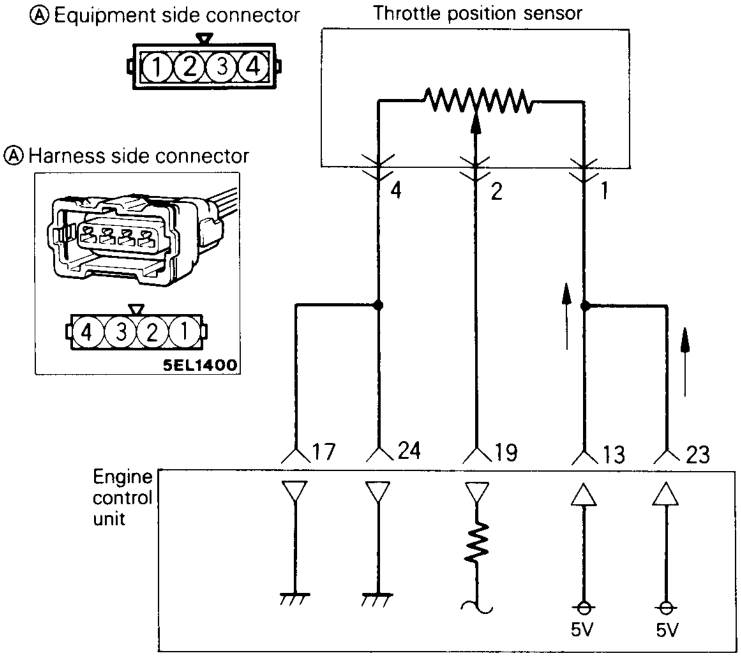
### SENSOR INSPECTION

FUEL SYSTEM <6G72 Engine> – Refer to Engine Coolant Temperature Sensor (P.13-38, 39).

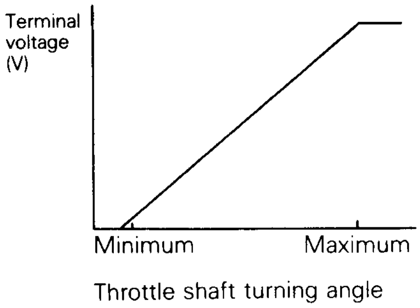
## THROTTLE POSITION SENSOR

M13YJAB

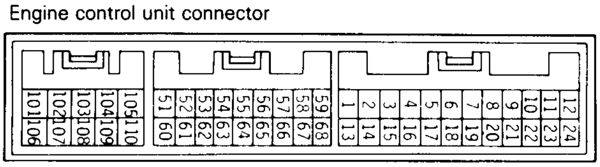




6FU1240



16Z461



01L0838

### OPERATION

### TROUBLESHOOTING HINTS

FUEL SYSTEM <6G72 Engine> – Refer to Throttle Position Sensor (P.13-40).

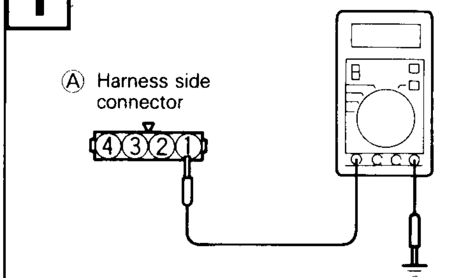
### INSPECTION

**Using Multi-use tester (MUT)**

| Function | Item No. | Data display | Check conditions | Throttle valve | Standard value mV |
|---|---|---|---|---|---|
| Data reading | 14 | Sensor detection voltage | Ignition switch: left ON for 15 secondes or more | Set to idling position. | 450 – 550 |
| | | | | Open gradually. | Becomes higher proportionally to valve opening |
| | | | | Open fully. | 4,500 – 5,500 |

## HARNESS INSPECTION

**1**



Measure the power supply voltage of the throttle position sensor.

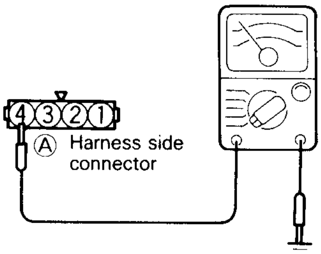
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8 – 5.2 |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ 4 – 17, 24)

**2**



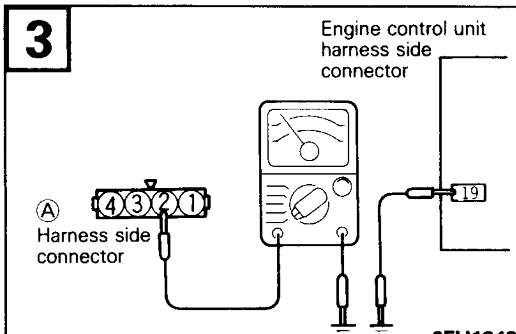
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ 4 – 17, 24)

**3**

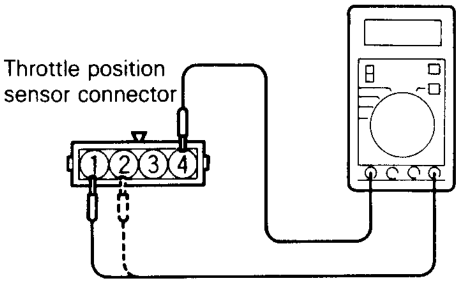


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the throttle position sensor.

- Throttle position sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ 2 – 19)



## SENSOR INSPECTION

(1) Disconnect the throttle position sensor connector.

(2) Measure resistance between terminal ④ (sensor earth) and terminal ① (sensor power).

**Standard value: 3.5–6.5 kΩ**

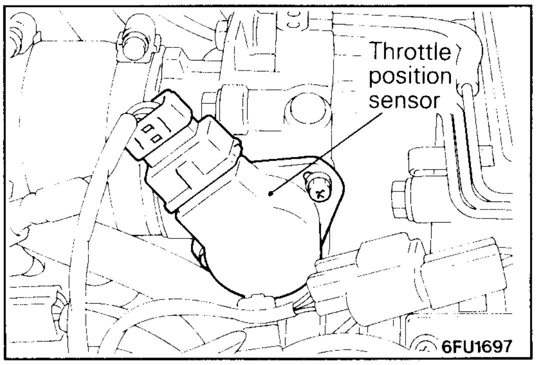
(3) Connect a pointer type ohmmeter between terminal ④ (sensor earth) and terminal ② (sensor output).

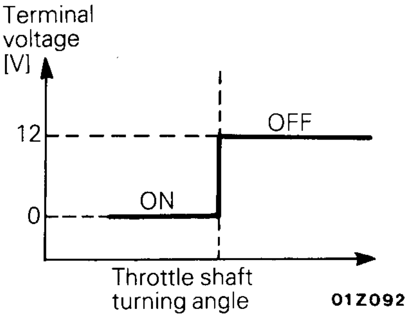
(4) Operate the throttle, valve slowly from the idle position to the full open position and check that the resistance changes smoothly in proportion with the throttle valve opening angle.

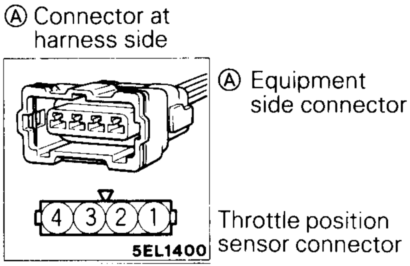
(5) If the resistance is out of specification, or fails to change smoothly, replace the throttle position sensor.

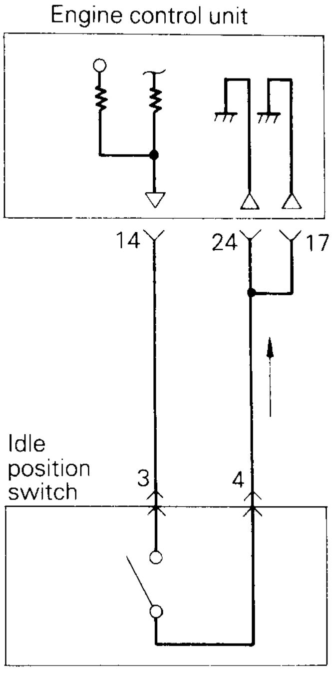
**TPS installation torque: 2.0 Nm (0.2 kgm, 1.5 ft.lbs.)**

# IDLE POSITION SWITCH









7FU0488

## OPERATION

## TROUBLESHOOTING HINTS

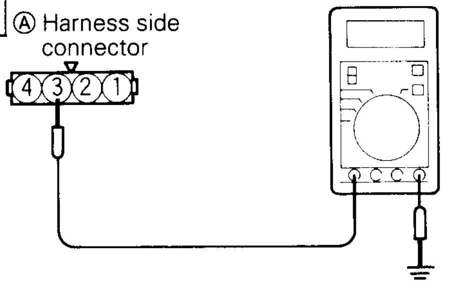
## INSPECTION

### Using Multi-use tester (MUT)

FUEL SYSTEM <6G72 Engine> – Refer to Idle Position Switch (P.13-43).

## HARNESS INSPECTION

**1**



7FU0675

Measure the power supply voltage of the idle position switch.

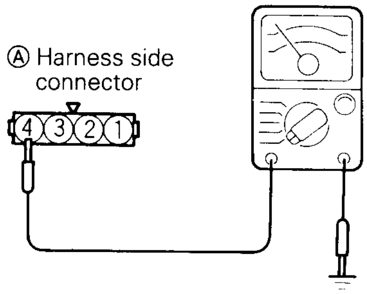
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4 or higher |

OK → 2

NG → Repair the harness. (Ⓐ3 – 14)

**2**



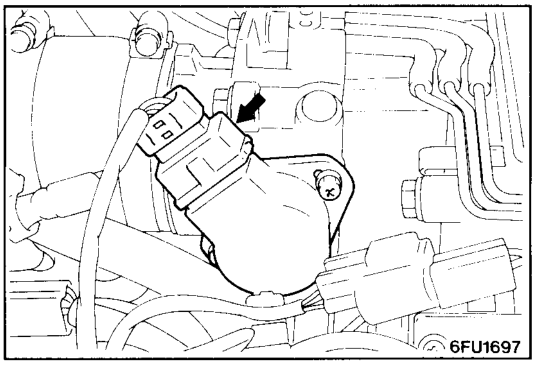
6FU1242

Check for continuity of the earth circuit.

- Connector: Disconnected

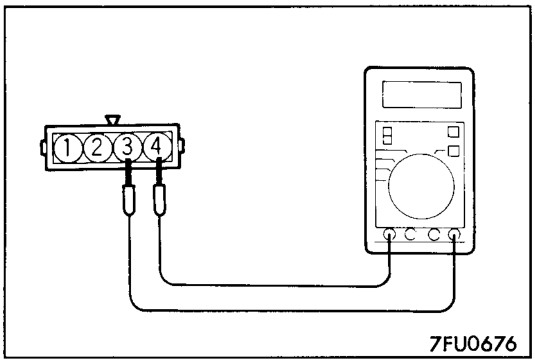
OK → STOP

NG → Repair the harness. (Ⓐ4 – 17, 24)



## SENSOR INSPECTION

(1) Disconnect the throttle position sensor connector.



(2) Check the continuity between the throttle position sensor connector terminal ③ and terminal ④.

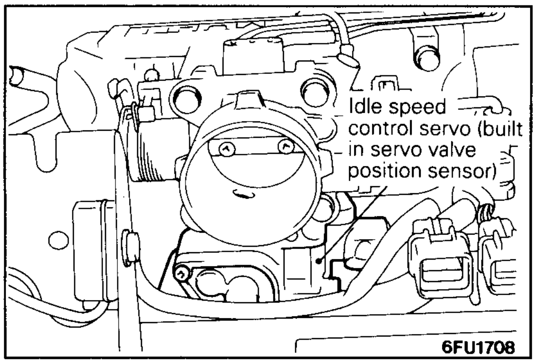
| Accelerator pedal | Continuity |
|---|---|
| Depressed | No continuity |
| Released | Continuity |

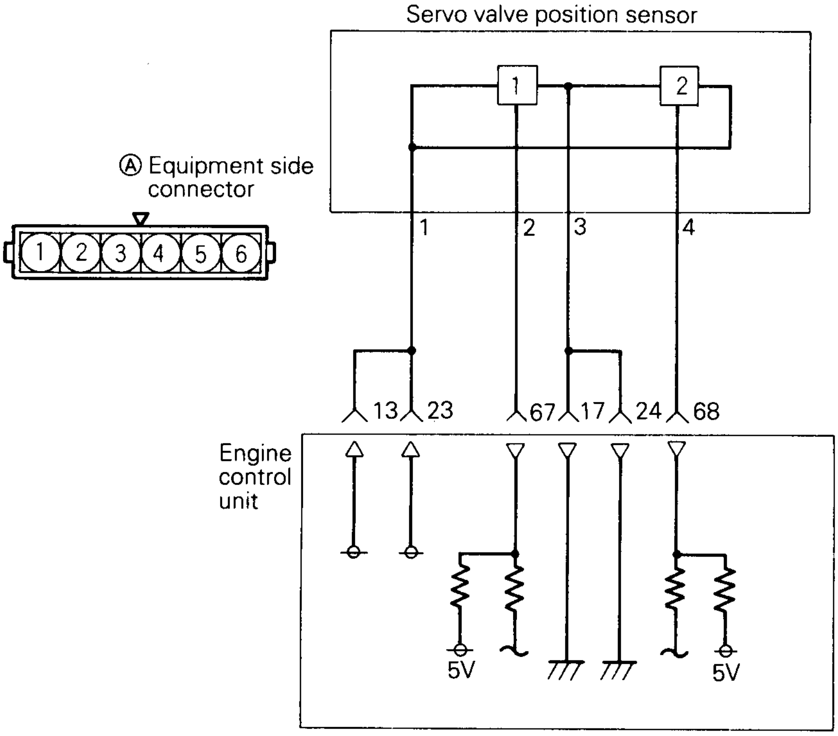
(3) If there is a malfunction, replace the throttle position sensor.

NOTE

- After replacement, the idle position switch and throttle position sensor should be adjusted. (Refer to P.13-91.)

## SERVO VALVE POSITION SENSOR





## OPERATION

- The servo valve position sensor converts the changes (increase or decrease) in the valve position of the engine idling speed control servo (ISC) into pulse signals and inputs these signals to the engine control unit. The engine control unit determines the valve position from these signals, and controls the engine idling speed control servo.
- 5V power is supplied to the servo valve position sensor from the engine control unit, and the earth connection is made from the engine control unit.
- 5V power is applied to the two servo valve position sensor output terminals. When the servo valve position is changed (increased or decreased) by the DC motor inside the servo, the servo valve position sensor generates a signal from the opening and closing between the output terminal and the earth.

## TROUBLESHOOTING

The servo valve position sensor is the most important sensor for controlling the engine idling speed. If a malfunction develops when the engine is idling and the electrical load is varied by turning the air conditioner switch to ON and OFF, etc., this sensor is probably defective.

## INSPECTION

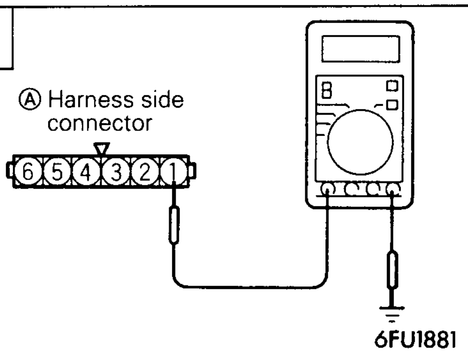
### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Load conditions | Standard value |
|---|---|---|---|---|---|
| Data reading | 55 | Servo valve position steps | • Engine coolant temperature: 80–95°C (176–203°F)<br>• Lights and accessories: OFF<br>• Transmission: neutral<br>• Steering wheel: neutral position<br>• Idle-position switch: ON (The compressor clutch should be actived when the air conditioner switch is switched ON.)<br>• Engine: idling | • Air conditioner switch: OFF | 2–20 STP |
| | | | | • Air conditioner switch: ON | 8–50 STP Increases |

NOTE
When the vehicle is new [driven approximately 500 km (300 miles) or less] the number of steps may be about 30 steps greater than the standard value indicated above.

## HARNESS INSPECTION

**1**



Measure the power supply voltage of the air intake control valve position sensor.

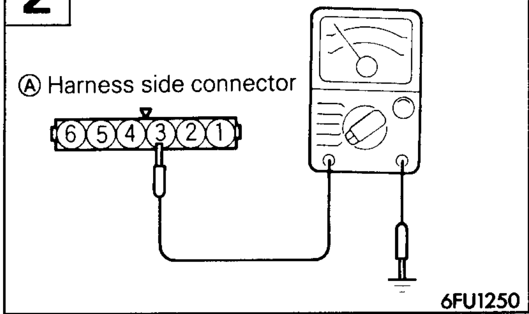
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8–5.2 |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ1 – 13, 23)

**2**



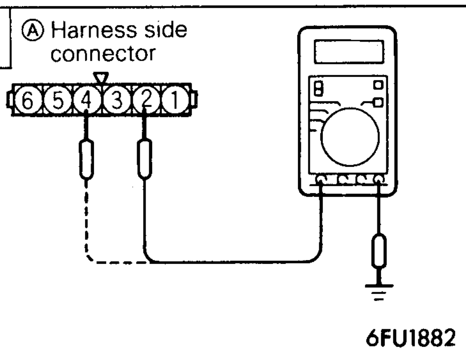
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ3 – 17, 24)

**3**



Measure the terminal voltage.

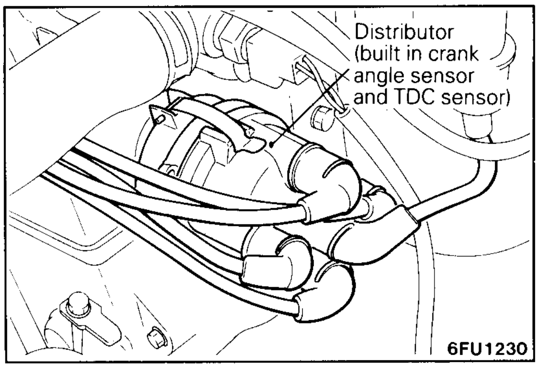
- Connector: Disconnected
- Ignition switch: ON

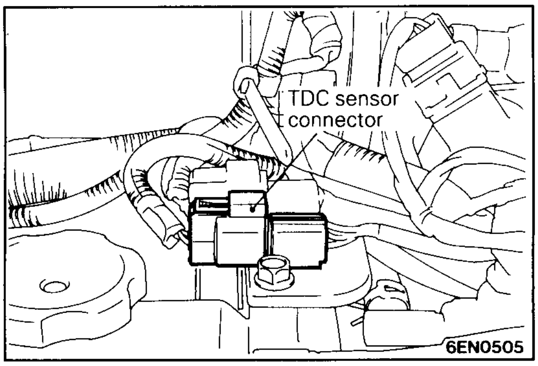
| Voltage (V) |
|---|
| 4.8–5.2 |

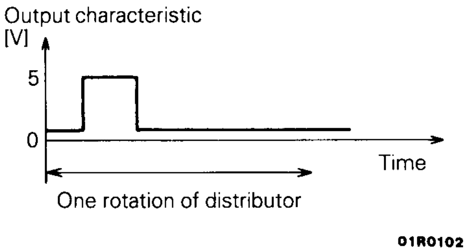
OK → STOP

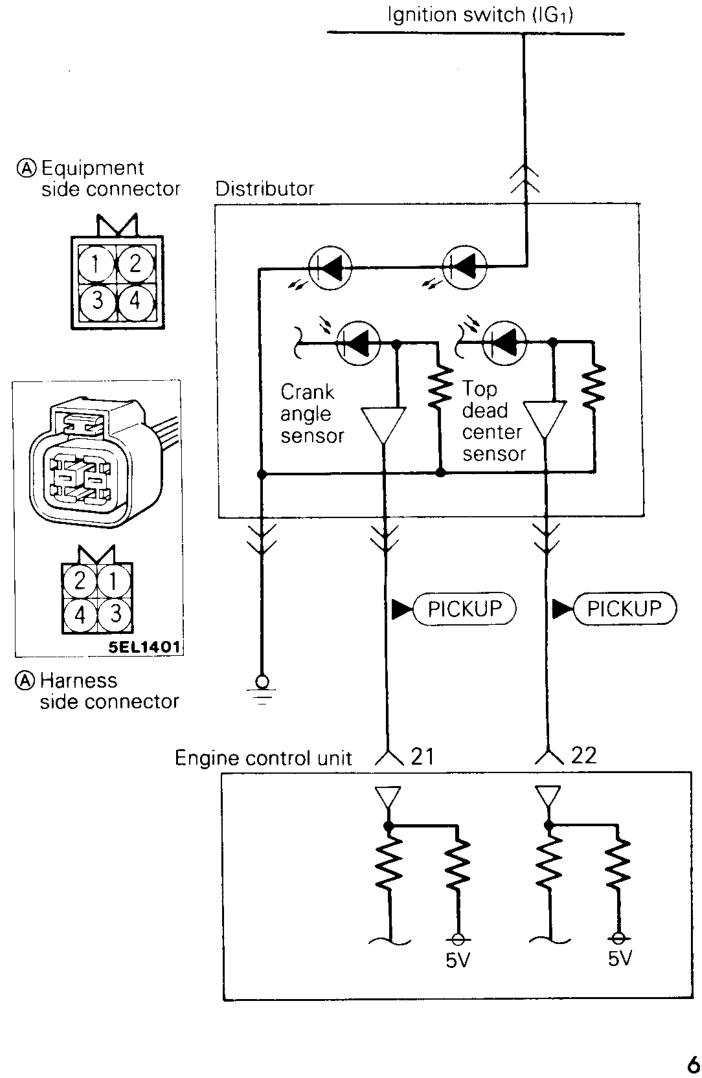
~~OK~~ → Repair the harness. (Ⓐ2 – 67) (Ⓐ4 – 68)

## TOP DEAD CENTER SENSOR









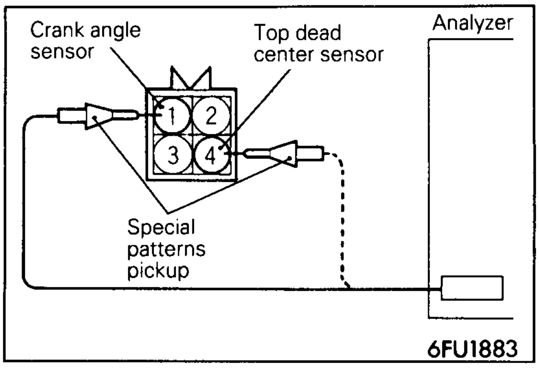
### OPERATION

### TROUBLESHOOTING HINTS

FUEL SYSTEM <6G72 Engine> – Top Dead Center Sensor (P.13-44).

### INSPECTION

### Wave Pattern Inspection Using an Analyzer



**Measurement method**

(1) Disconnect the crankshaft angle sensor connector and connect the special tool (test harness: MB998464) in between.

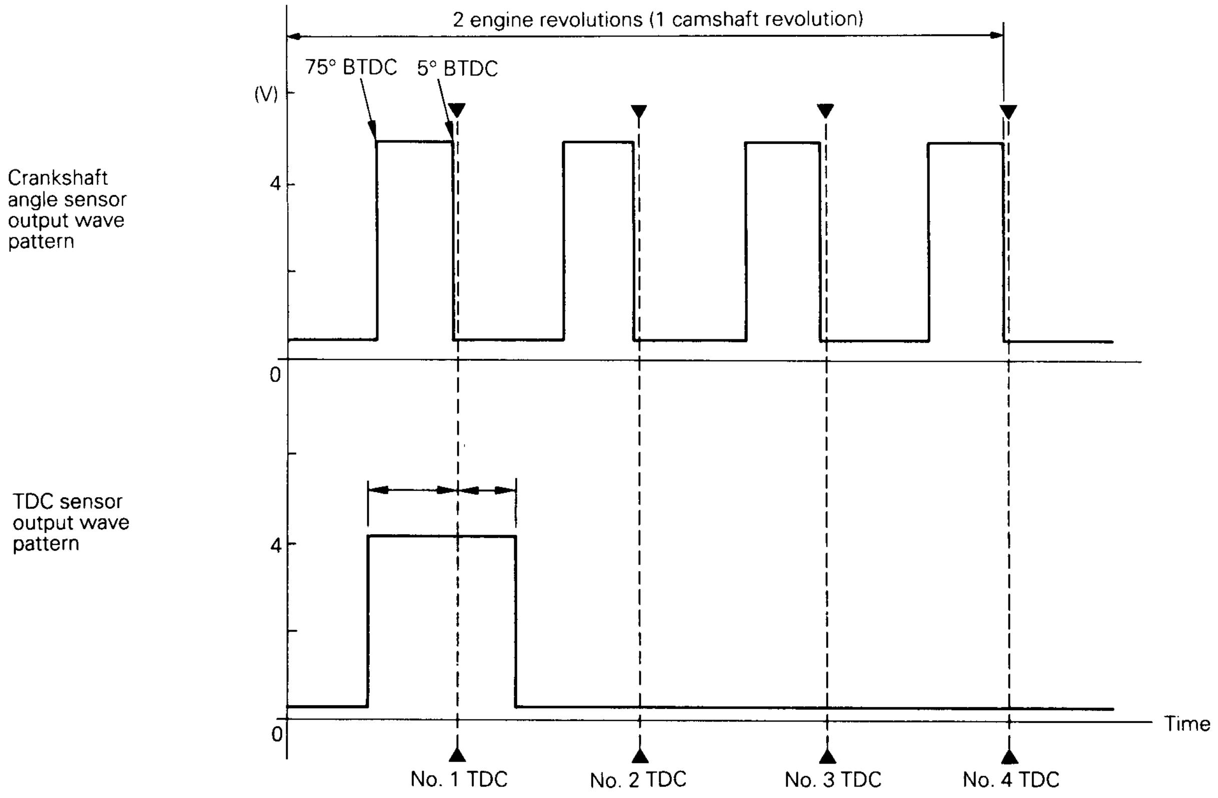
(2) Connect the analyzer special patterns pickup to terminal ④ (white clip) of the crankshaft angle sensor connector. (When inspecting the TDC sensor signal wave pattern.)

(3) Connect the analyzer special patterns pickup to terminal ① (red clip) of the crankshaft angle sensor connector. (When inspecting the crankshaft angle sensor signal wave pattern.)

## Standard wave pattern

### Observation conditions

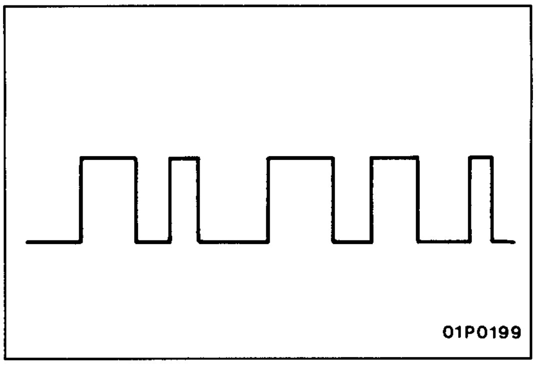
| | |
|---|---|
| Function | Special patterns |
| Pattern height | Low |
| Pattern selector | Display |
| Engine r/min. | Idle r/min. (750 r/min.) |



6FU1727

## Wave pattern observation points

Check that cycle time T becomes shorter and the frequency increases when the engine speed is increased.



**Examples of abnormal wave patterns**

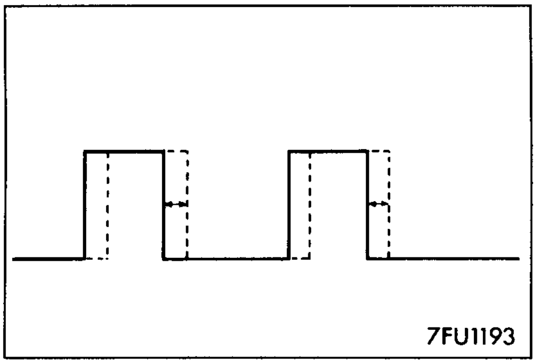
- Example 1

  **Cause of problem**

  Sensor interface malfunction

  **Wave pattern characteristics**

  Short wave pattern is output even when the engine is not started.



- Example 2

  **Cause of problem**

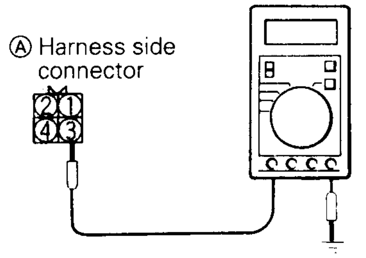
  Loose timing belt
  Abnormality in sensor disk

  **Wave pattern characteristics**

  Wave pattern is displaced to the left or right.

## HARNESS INSPECTION

**1**



01L0411

Measure the power supply voltage.

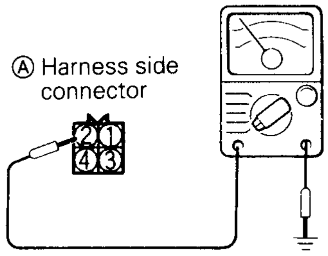
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ3 – ignition switch)

**2**



01A0270

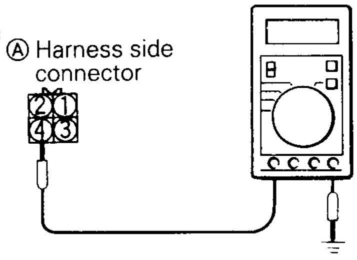
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ2 – Earth)

**3**



01L0407

Check the voltage of the output circuit.

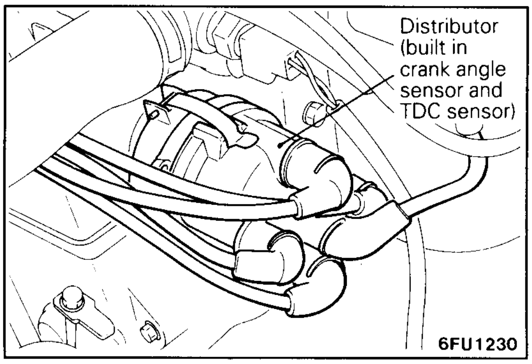
- Connector: Disconnected
- Ignition switch: ON

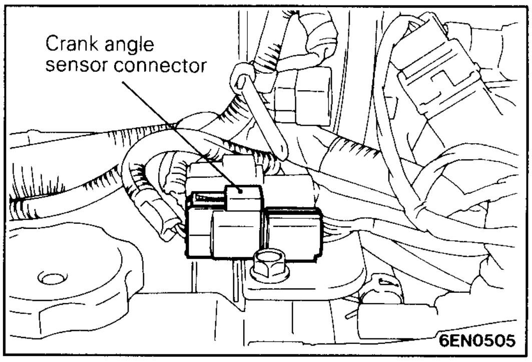
| Voltage (V) |
|---|
| 4.8–5.2 |

OK → STOP

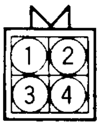
~~OK~~ → Repair the harness. (Ⓐ4 – 22)

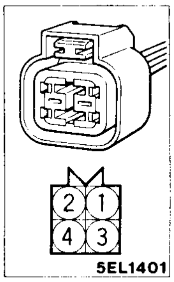
## CRANK ANGLE SENSOR



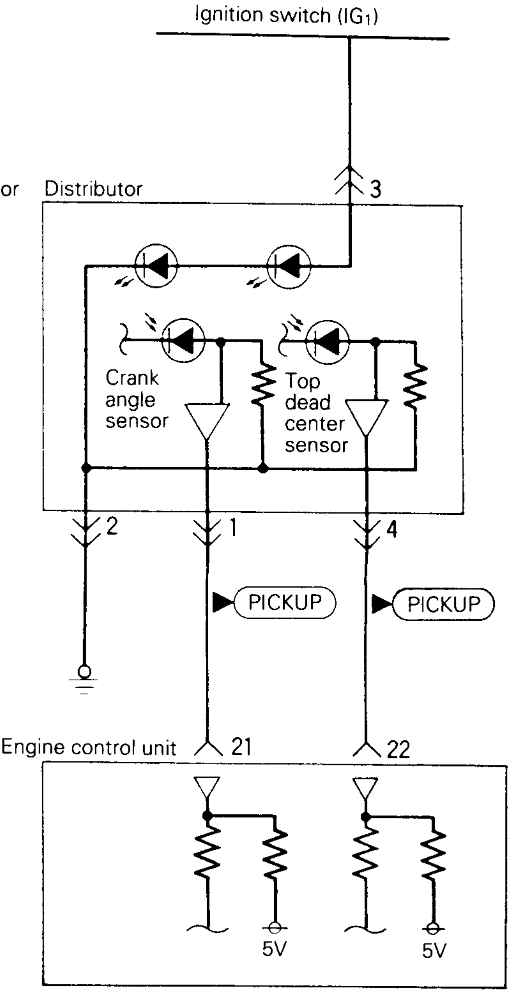


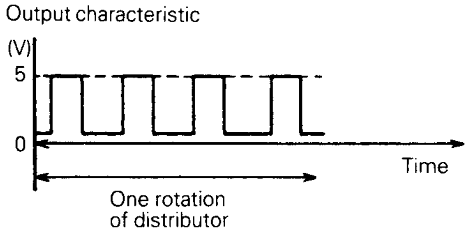
Ⓐ Equipment side connector





Ⓐ Harness side connector





6FU1745

## OPERATION

## TROUBLESHOOTING HINTS

FUEL SYSTEM <6G72 Engine> – Refer to Crank Angle Sensor (P.13-48.)

## INSPECTION

### Using Multi-use tester

| Function | Item No. | Data display | Check conditions | Check description | Normal condition |
|---|---|---|---|---|---|
| Data reading | 22 | Cranking r/min. | • Engine is being cranked.<br>• Tachometer connected. (The tachometer is used to check the intermittent pulsation of the ignition coil's primary current.) | Compare the cranking rpm and the rpm indicated by the multi-use tester. | Both agree. |

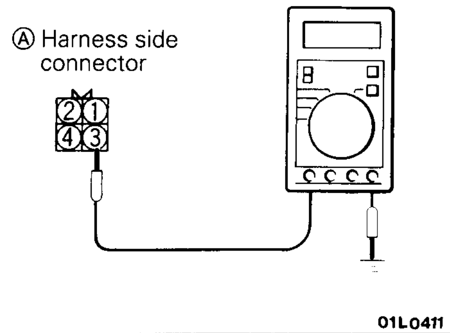
| Function | Item No. | Data display | Check conditions | Engine coolant temperature °C (°F) | Standard value r/min. |
|---|---|---|---|---|---|
| Data reading | 22 | Idling r/min. | • Engine: idling<br>• Idle-position switch: ON | When –20 (–4) | 1,300–1,500 |
| | | | | When 0 (32) | 1,300–1,500 |
| | | | | When 20 (68) | 1,150–1,350 |
| | | | | When 40 (104) | 950–1,150 |
| | | | | When 80 (176) | 650–850 |

### Wave Pattern Inspection Using an Analyzer

Refer to the top dead center sensor section (P.13-118).

## HARNESS INSPECTION

**1**



Measure the power supply voltage.

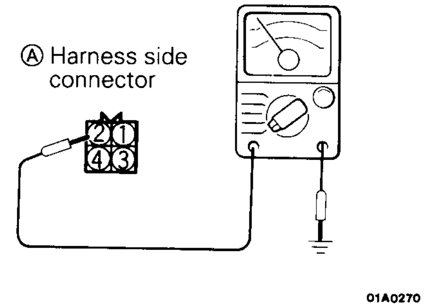
- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| SV |

OK → 2

~~OK~~ → Repair the harness. (Ⓐ3 – ignition switch)

**2**



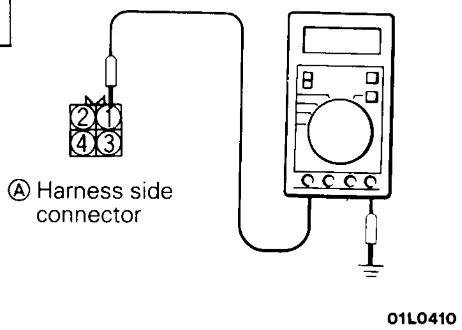
Check for continuity of the earth circuit.

- Connector: Disconnected

OK → 3

~~OK~~ → Repair the harness. (Ⓐ2 – Earth)

**3**



Check the voltage of the output circuit.

- Connector: Disconnected
- Ignition switch: ON

| Voltage (V) |
|---|
| 4.8–5.2 |

OK → STOP

~~OK~~ → Repair the harness. (Ⓐ1 – 21)

## IGNITION SWITCH - ST

Refer to P.13-50.

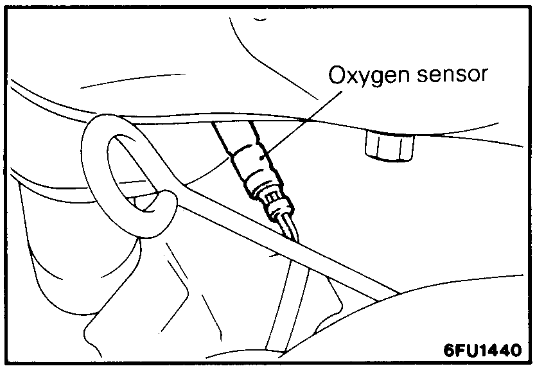
## VEHICLE SPEED SENSOR

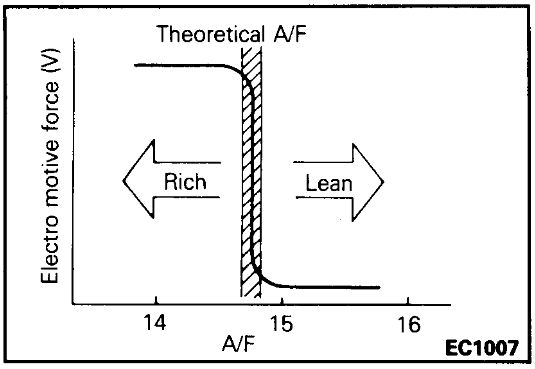
Refer to P.13-54.

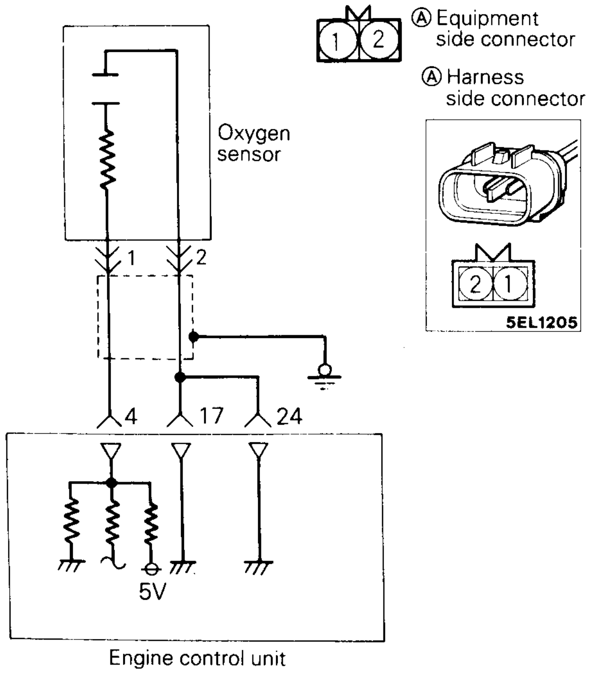
## AIR CONDITIONER SWITCH AND POWER RELAY

Refer to P.13-56.

## OXYGEN SENSOR

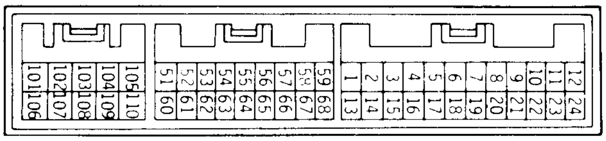






6FU1729

Engine control unit connector



### OPERATION

- The oxygen sensor functions to detect the concentration of oxygen in the exhaust gas; it converts those data to voltage, and inputs the resulting signals to the engine control unit.
- If the air/fuel mixture ratio is richer than the theoretical air/fuel mixture ratio (i.e., if the concentration of oxygen in the exhaust gas is sparse), a voltage of approximately 1V is output; if the air/fuel mixture ratio in leaner than the theoretical air/fuel mixture ratio (i.e., if the concentration is dense), a voltage of approximately 0V is output.
- The engine control unit, based upon those signals, regulates the amount of fuel injection so that the air/fuel mixture ratio becomes the theoretical air/fuel mixture ratio.

### TROUBLESHOOTING HINTS

Hint 1:
The exhaust gas purification performance will worsen if there is a malfunction of the oxygen sensor.

Hint 2:
If the oxygen sensor output voltage deviates from the standard value even though the results of the checking of the oxygen sensor are normal, the cause is probably a malfunction of a component related to air/fuel mixture ratio control.

[Examples]

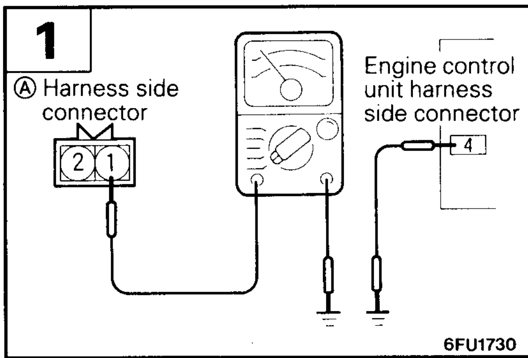
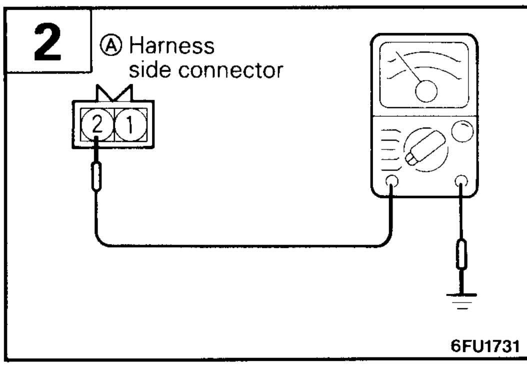
(1) Malfunction of an injector.
(2) Air leakage into the intake manifold from a leaking gasket.
(3) Malfunction of the air-flow sensor, the intake air temperature sensor, the barometric-pressure sensor, or the Engine coolant temperature sensor.

## INSPECTION

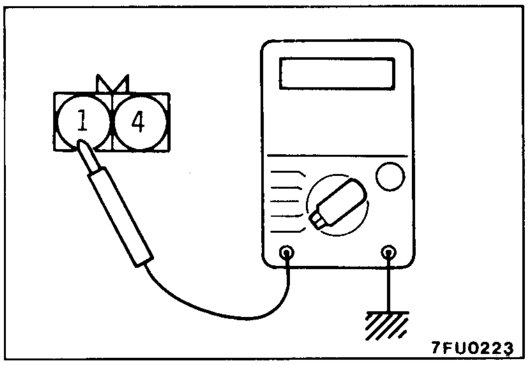
### Using Multi-use tester (MUT)

| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value mV |
|---|---|---|---|---|---|
| Data reading | 11 | Sensor detection voltage | • Engine: warm-up (Make the mixture lean by engine speed reducion, and rich by racing.) | When sudden deceleration from 4,000 | 200 or lower |
| | | | | When engine is suddenly raced | 600 – 1,000 |
| | | | • Engine: warm up using the oxygen sensor signal, check the air/fuel mixture ratio, and also check the condition of control by the engine control unit | 750 (Idling) | 400 or lower<br>↕ (changes)<br>600 – 1,000 |
| | | | | 2,000 | |

## HARNESS INSPECTION

| | | |
|---|---|---|
| **1**  | Check for an open-circuit or a short-circuit to earth, between the engine control unit and the oxygen sensor.<br>• Oxygen sensor connector: Disconnected<br>• Engine control unit connector: Disconnected | OK → 2<br>~~OK~~ → Repair the harness. ( A 1 – 4 ) |
| **2**  | Check for continuity of the earth circuit.<br>• Connector: Disconnected | OK → STOP<br>~~OK~~ → Repair the harness. (Ⓐ 2 – Earth) |

## SENSOR INSPECTION



**Caution**

1. **Before checking, warm up the engine until engine coolant temperature reaches 80 to 95°C (176 to 205°F).**
2. **Use an accurate digital voltmeter.**

(1) Disconnect the oxygen sensor connector and connect a volt-meter to the oxygen sensor connector.

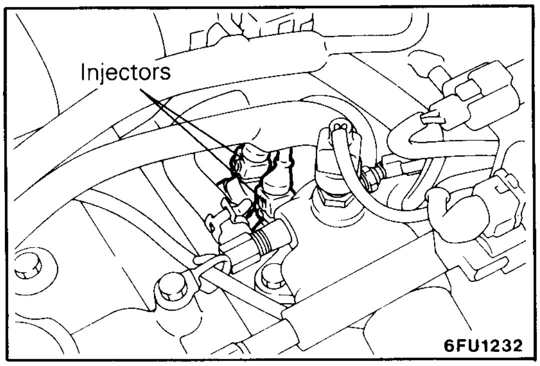
(2) While repeating engine racing, measure the oxygen sensor output voltage.

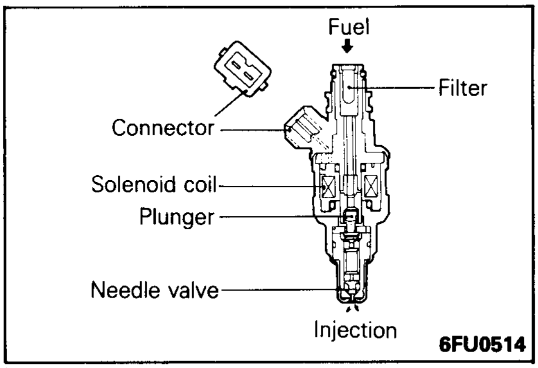
| Engine | Oxygen sensor output voltage | Remarks |
|---|---|---|
| Race | 0.6 – 1.0 V | Make air-fuel mixture rich by accelerator operation |

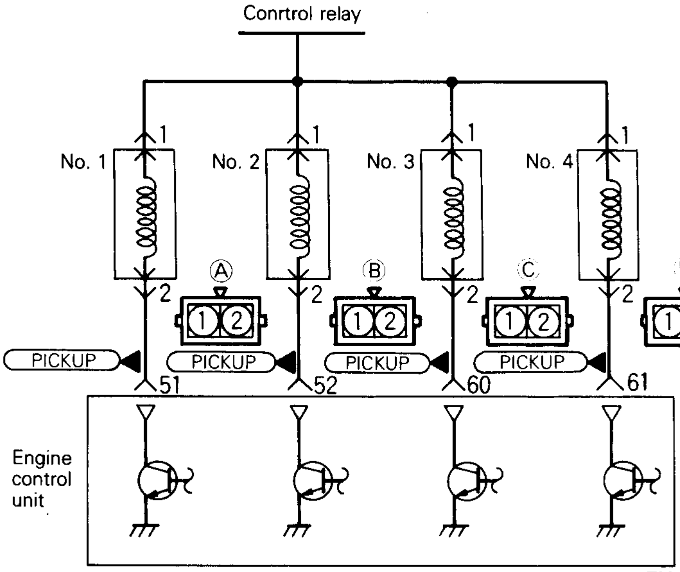
NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Manifold.

## INJECTORS

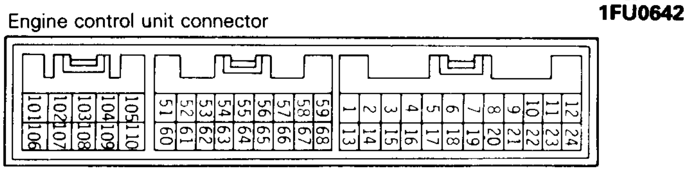
M13YTAB







Engine control unit connector



### OPERATION

- The injectors are electromagnetic-valve-equipped injection nozzles that function to inject fuel based upon injection signals from the engine control unit.
- Because the surface area of the injection ports is fixed and because the pressure of the fuel relative to the pressure within the manifold is also regulates to a fixed pressure, the amount of fuel injection by injectors is determined by the length of time that the needle valve is open, or, in other words, by the length of time of current flow to the solenoid coil.
- Battery power supply is supplied, by way of the control relay, to the injectors. When the engine control unit switches ON the power transistor within the unit and current flows to the solenoid coil, the injectors open and fuel is injected.

### TROUBLESHOOTING HINTS

Hint 1:
If there is a problem with starting while the engine is warm, perform the combustion test and check for leakage of the injectors.

Hint 2:
If the engine can't be started, and the injectors are not activated during cranking, the cause is probably a malfunction such as described below, not with the injectors.

(1) Malfunction of the circuit for supply of power to the engine control unit, or of the earth circuit.
(2) Malfunction of the control relay.
(3) Malfunction of the crank-angle sensor and/or the top dead center sensor.

Hint 3:
If there is a cylinder for which the idling condition does not change when, during idling, the fuel injection of the injectors is cut off in sequence, check that cylinder as described below.

(1) Check the injector and harness.
(2) Check the spark plugs and the high-tension cable.
(3) Check the compression pressure.

Hint 4:
If the injector activation time deviates from the standard value even though the results of the checking of the injector's harness and of the injector itself are normal, the cause may be presumed to be one of the following.

(1) Incomplete combustion within the cylinder. (Malfunction of the spark plugs, the ignition coil, the compression pressure, etc.)
(2) Improper adhesion of EGR valve sheet.
(3) Increased engine resistance.

## INSPECTION

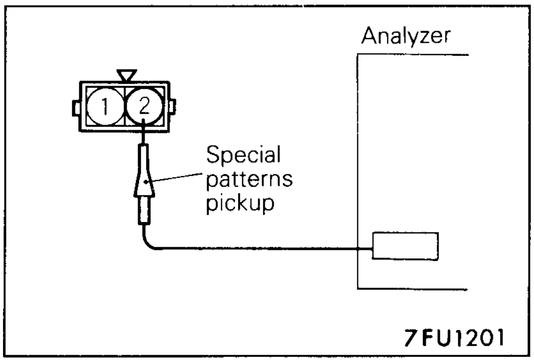
### Using Multi-use tester

| Function | Item No. | Data display | Check conditions | Engine coolant temperature °C (°F) | Standard value ms |
|---|---|---|---|---|---|
| Data reading | 41 | Activation time*1 | Engine cranking | When 0 (32)*2 | Approx. 20 |
| | | | | When 20 (68) | Approx. 41 |
| | | | | When 80 (176) | Approx. 10 |

| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value ms |
|---|---|---|---|---|---|
| Data reading | 41 | Activation time *3 | • Engine coolant temp: 80–95°C (176–203°F)<br>• Lights and accessories: OFF<br>• Transmission: neutral<br>• Steering wheel: neutral position | 750 (idling) | 2.9–4.1 |
| | | | | 2,000 | 2.0–3.2 |
| | | | | When raced suddenly | Increases. |

NOTE
*1: Indicates the injector-activation time when the power source voltage is 11V and the cranking speed is 250 rpm or less.
*2: At a coolant temperature of 0°C (32°F), there is synchronous injection for all four cylinders.
*3: For a new vehicle [driven approximately 500 km (300 miles) or less] the injector-activation may be about ten percent longer then indicated above.

| Function | Item No. | Activation description | Check conditions | Normal condition |
|---|---|---|---|---|
| Actuator test | 01 | No. 1 injector shut-off | • Engine: idling after warm-up (shut off the injectors in sequence during after engine warm-up, check the idling condition) | Idling condition changes more<br>(Becomes more unstable, or the engine stalls.) |
| | 02 | No. 2 injector shut-off | | |
| | 03 | No. 3 injector shut-off | | |
| | 04 | No. 4 injector shut-off | | |

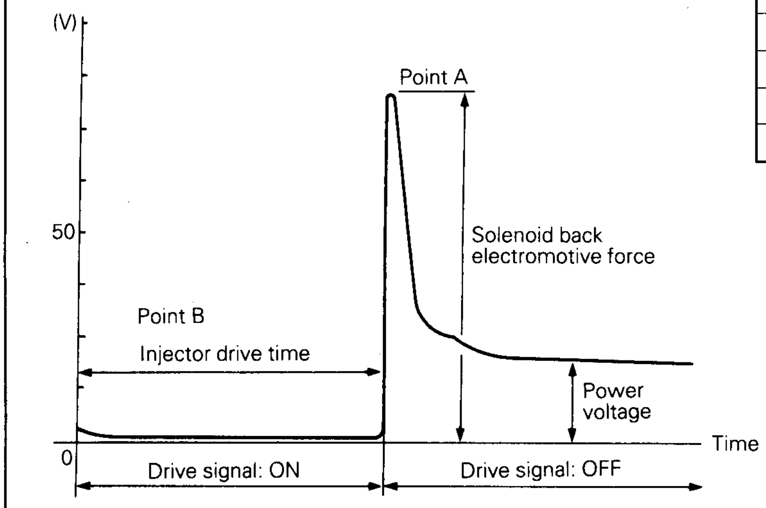


### Wave Pattern Inspection Using an Analyzer

### Measurement method

(1) Disconnect the injector connector, and connect the special tool (test harness: MB991348) in between. (The power side and the ECU side terminals should both be connected.)
(2) Connect the analyzer special patterns pickup to the ECU test harness clip.

## Standard wave pattern



### Observation conditions

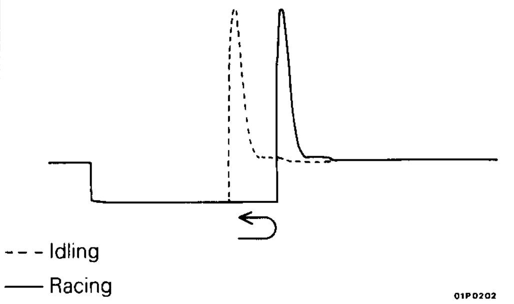
| | |
|---|---|
| Function | Special patterns |
| Pattern height | Variable |
| Variable knob | Adjust by monitoring wave |
| Pattern selector | Display |
| Engine r/min. | Idle r/min. (750 r/min.) |

7FU1202

## Wave pattern observation points

(Point A): Height of back electromotive force in the solenoid coil

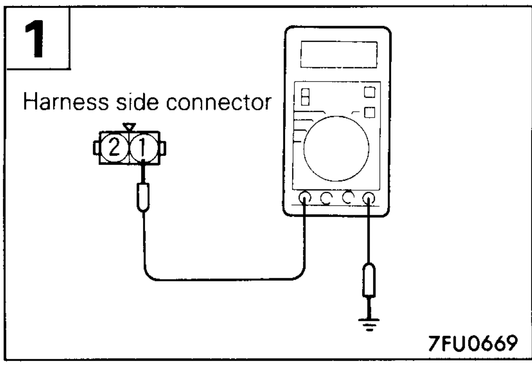
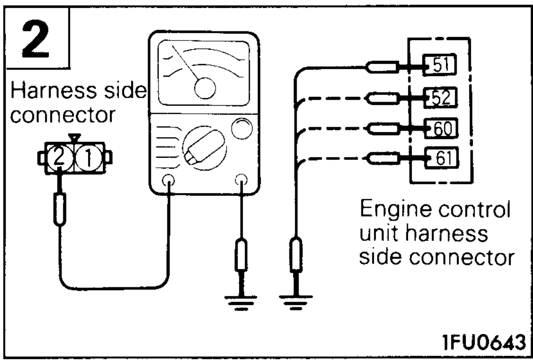
| Contrast with standard wave pattern | Probable cause |
|---|---|
| Solenoid coil back electromotive force is low or doesn't appear at all. | Short in the injector solenoid |

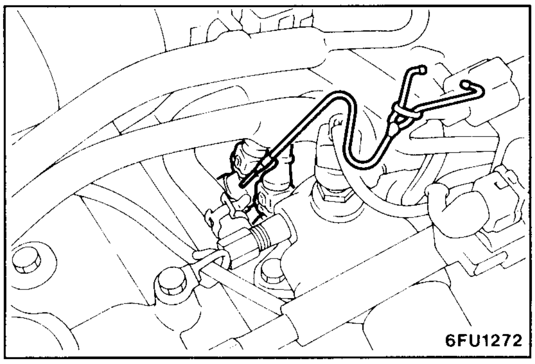


(Point B): Injector drive time

- The injector drive timing will synchronized with the multi-use tester display.
- When the engine is suddenly raced, the drive time will be greatly extended at first, but the drive time will soon match the engine speed.

## HARNESS INSPECTION

| | | |
|---|---|---|
| **1**  | Measure the power supply voltage of the injector.<br>• Connector: Disconnected<br>• Ignition switch: ON<br><br>**Voltage (V)**<br>**SV** | OK → 2<br><br>~~OK~~ → Repair the harness. (ⒶⒷⒸⒹ1 – Control relay) Check the power supply. |
| **2**  | Check for an open-circuit, or a short-circuit earth, between the engine control unit and the injector.<br>• Engine control unit connector: Disconnected<br>• Injector connector: Disconnected | OK → STOP<br><br>~~OK~~ → Repair the harness. (ⒶⒷⒸⒹ2 – 51, 52, 60, 61) |



## ACTUATOR INSPECTION

### Checking Operation Sound

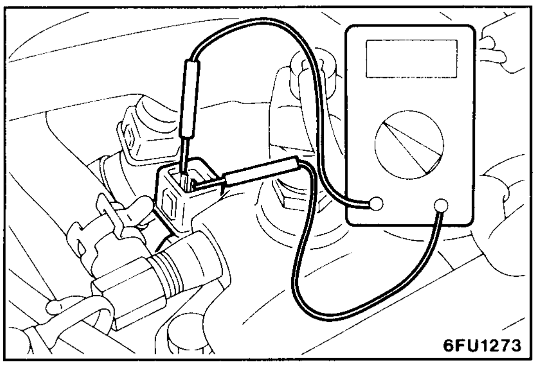
Using a sound scope, check the operation sound ("chi-chi-chi") of injectors during idling or during cranking.
Check that as the rotating speed increases, the frequency of the operating sound also increases.

**Caution**

**Note that even if the injector you are checking is not operating, you will hear the operating sound of the other injectors.**

NOTE

If no operating sound is heard from the injector that is being checked, check the injector drive circuit. If there is nothing wrong with the circuit, a defective injector or engine control unit is suspected.



### Measureing Resistance Between Terminals

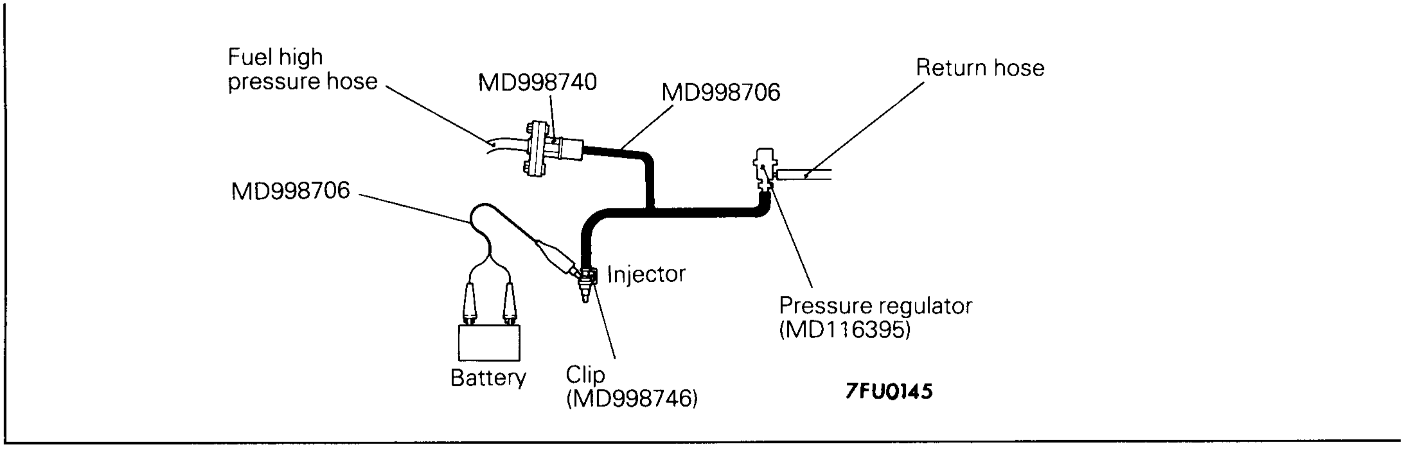
(1) Remove the injector connector.
(2) Measure the resistance between the terminals.

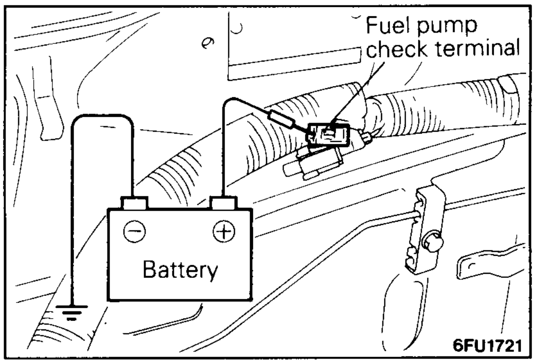
**Standard value: 13–16 Ω [at 20°C (68°F)]**

(3) Install the injector connector.

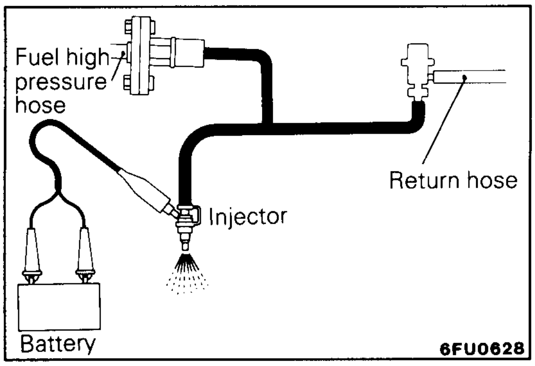
### Checking the Injection Condition

(1) Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel. (Refer to P.13-89.)
(2) Remove the injector.
(3) Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.

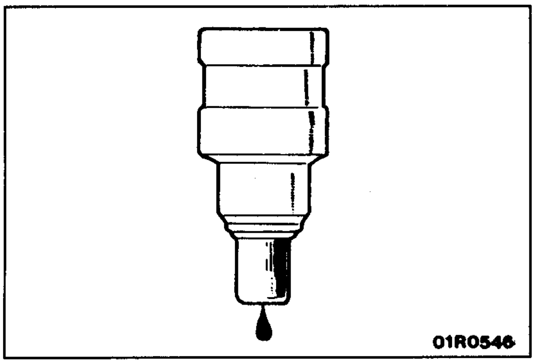




(4) Connect the battery's negative (–) terminal.
(5) Apply battery voltage to the fuel pump check terminal and activate the fuel pump.



(6) Activate the injector and check the atomized spray condition of the fuel.
The condition can be considered satisfactory unless it is extremely poor.

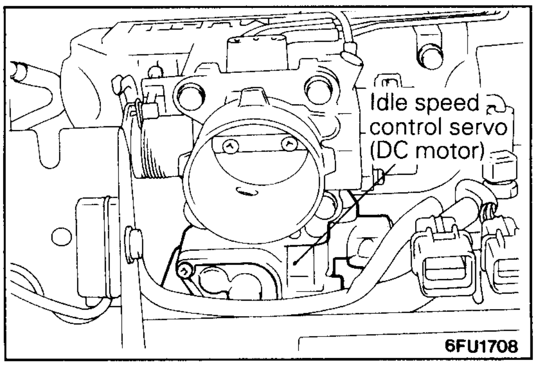


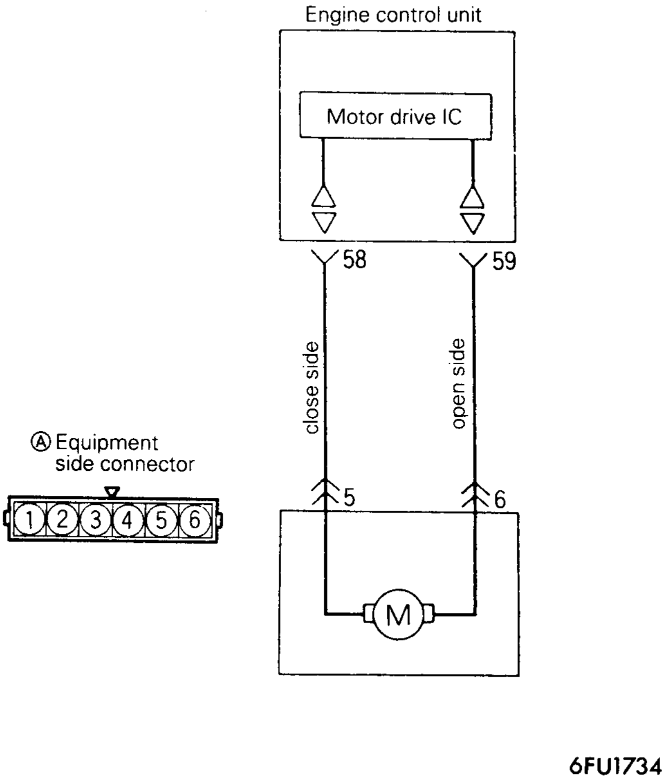
(7) Stop the actuation of the injector, and check for leakage from the injector's nozzle.

**Standard value: 1 drop or less per minute**

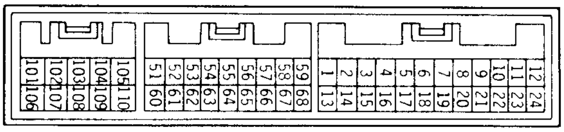
(8) Activate the injector without activating the fuel pump; then, when the spray emission of fuel from the injector stops, disconnect the special tool and restore it to its original condition.

## IDLE SPEED CONTROL SERVO (DC MOTOR)





Engine control unit connector



### OPERATION

- The volume of intake air during engine idling is controlled by the opening and closing of the servo valve for bypassing the throttle valve, located at the air intake port.
- The servo valve opens and closes depending on whether the DC motor inside the engine idling speed control servo is turning clockwise or anti-clockwise.
- The DC motor turns clockwise or anti-clockwise according to the change in the direction of current in the motor drive IC inside the engine control unit.

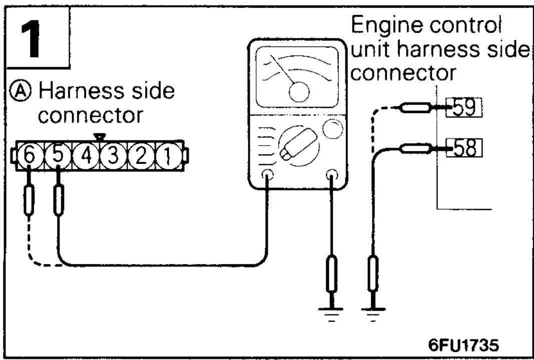
## TROUBLESHOOTING HINTS

Hint 1: While the engine is idling, if the engine idling speed and servo valve position (step) change when the air conditioner switch is turned to ON and OFF, it can be assumed that the engine idling speed control servo and the servo valve position sensor are operating normally.

Hint 2: If the servo valve position (step) is outside the standard position, the malfunction is probably one of the following:

(1) Basic engine idling speed adjustment is wrong.
(2) Some deposit is adhering to the throttle valve.
(3) Air is being drawn into the air intake manifold through a defective gasket seal.
(4) Fuel injection malfunction inside a cylinder.
(Spark plug, ignition coil, injector or compression pressure is defective.)

## HARNESS INSPECTION

| | | | |
|---|---|---|---|
| **1**  | Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the idle speed control servo. | OK → | STOP |
| | | ~~OK~~ → | Repair the harness.<br>(Ⓐ5 – 58<br>Ⓐ6 – 59) |

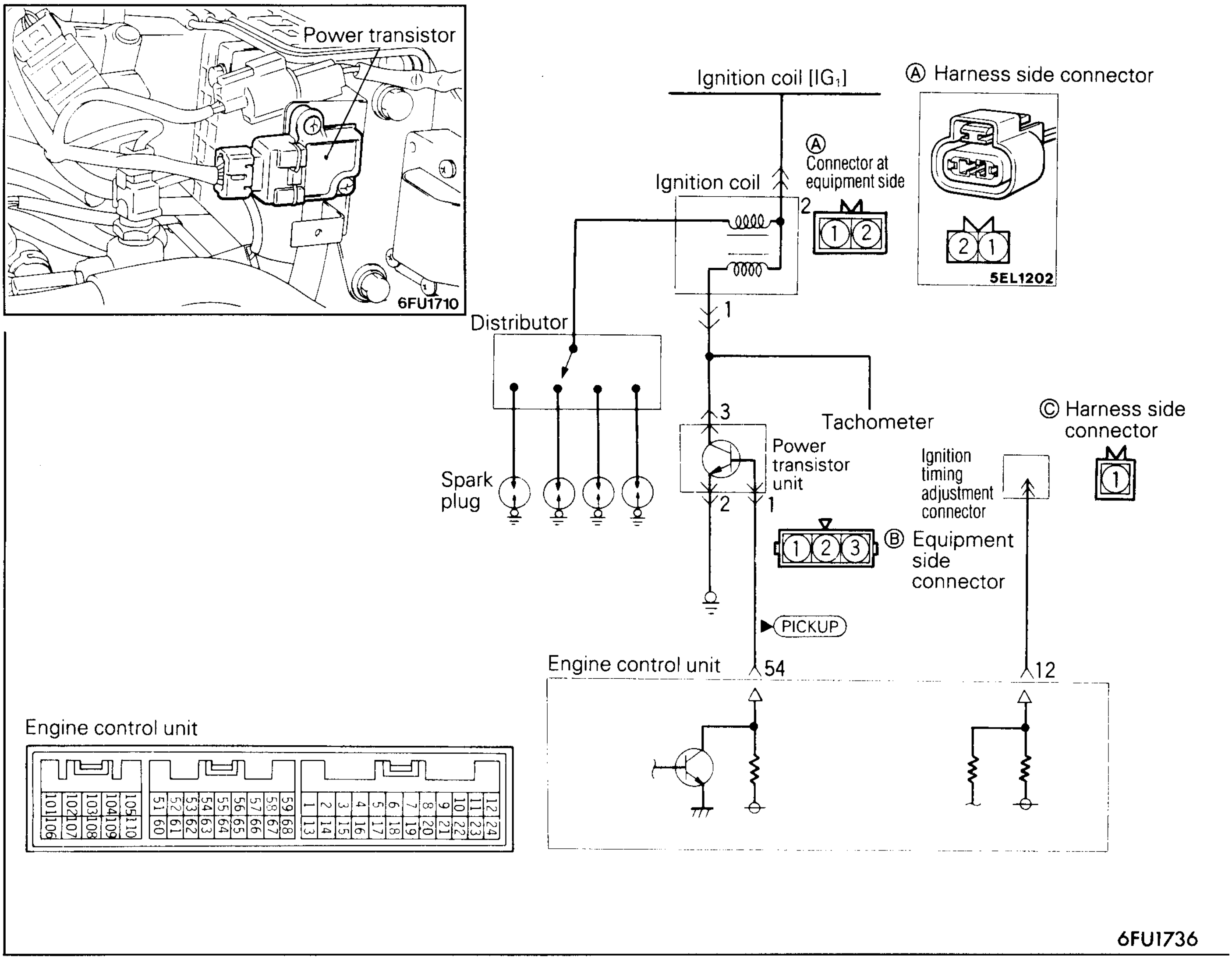
## ACTUATOR INSPECTION

Use a sound scope to check if the sound of the ISC servo operating can be heard immediately after the ignition switch is turned to "ON".

NOTE

If the sound of the servo operating cannot be heard, inspect the motor drive circuit and the ISC servo motor.

## IGNITION COIL AND POWER TRANSISTOR



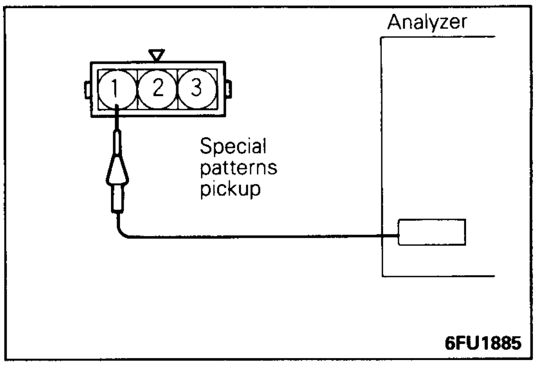
## OPERATION

FUEL SYSTEM <6G72 Engine> – Refer to Ignition Coil and Power Transistor (P.13-71).

## INSPECTION

### Using Multi-use tester

| Function | Item No. | Data display | Check conditions | Engine condition r/min. | Standard value °BTDC |
|---|---|---|---|---|---|
| Data reading | 44 | Spark advance | • Engine: warm<br>• Timing light: set (The timing light is set so as to check the actual ignition timing.) | 750 (Idling) | 2–16 |
| | | | | 2,000 | 30–50 |



## Wave Pattern Inspection Using an Analyzer

- Ignition coil primary signal
  Refer to GROUP 16 – Ignition System.
- Power transistor control signal

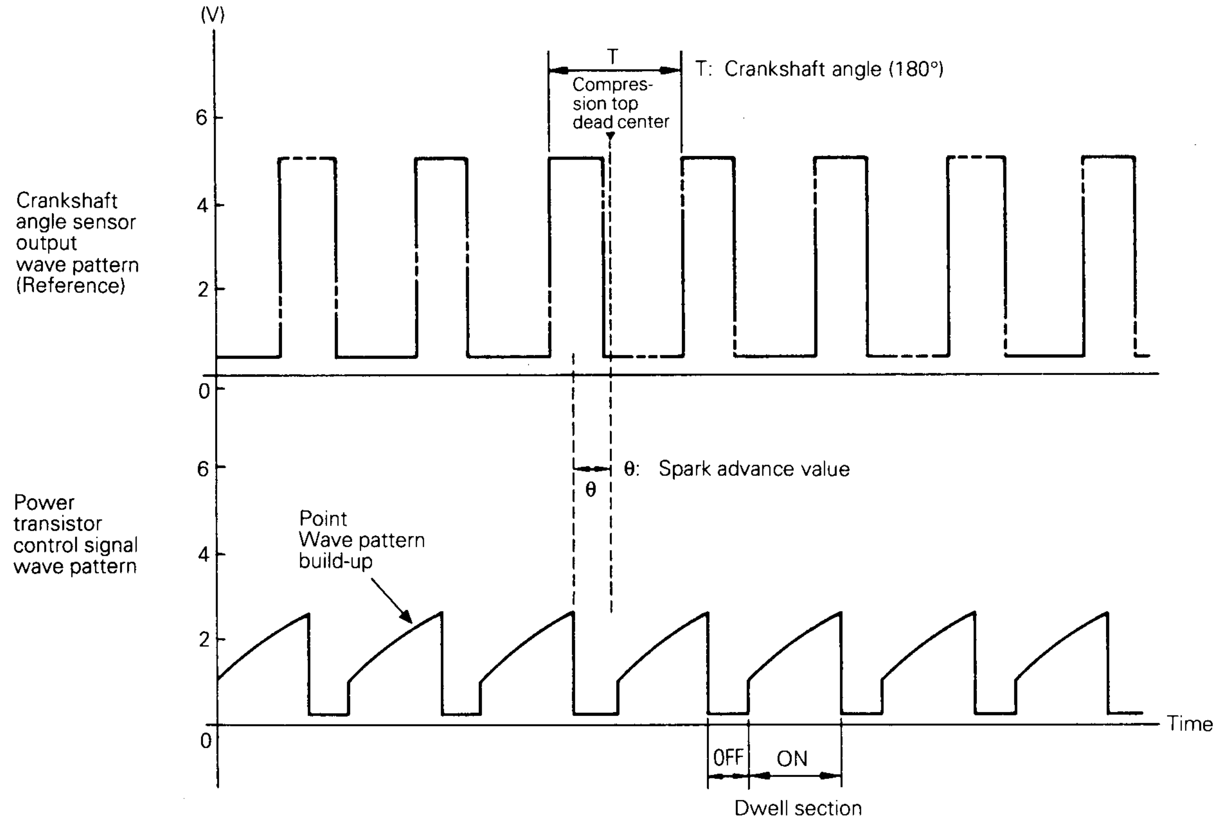
<Measurement method>

(1) Disconnect the power transistor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
(2) Connect the analyzer special patterns pickup to the power transistor connector terminal (3).

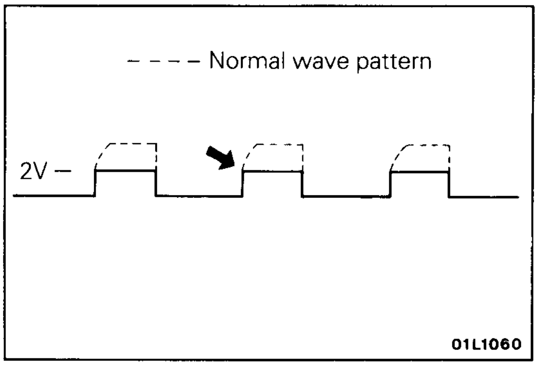
<Standard wave pattern>

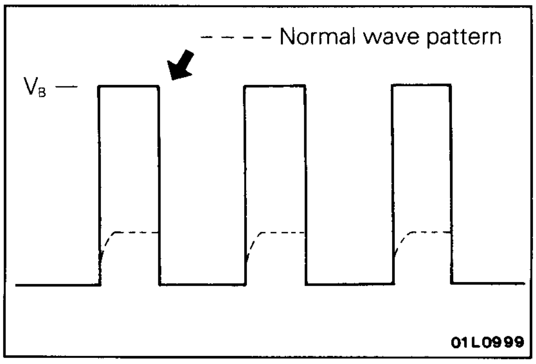
**Observation conditions**

| | |
|---|---|
| Function | Special patterns |
| Pattern height | Low |
| Pattern selector | Display |
| Engine r/min. | Approx. 2,000 r/min. |



6FU1884





**Wave pattern observation points**

(Point): Condition of wave pattern build-up and maximum voltage (Refer to abnormal wave pattern examples 1 and 2.)

**Examples of abnormal wave patterns**

- Example 1

  Wave pattern during engine cranking

  **Cause of problem**

  Broken wire in ignition primary circuit

  **Wave pattern characteristics**

  Top-right part of the build-up section cannot be seen, and voltage value is approximately 2V too low.

- Example 2

  Wave pattern during engine cranking

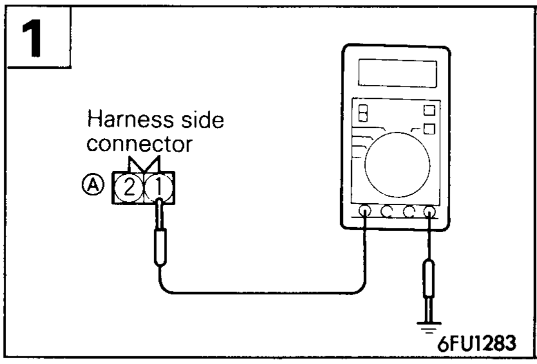
  **Cause of problem**

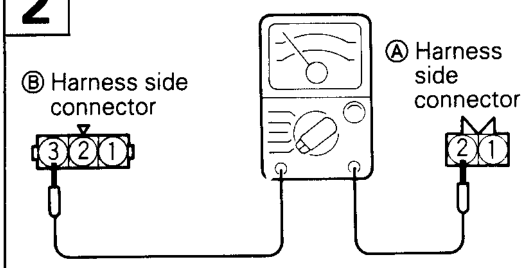
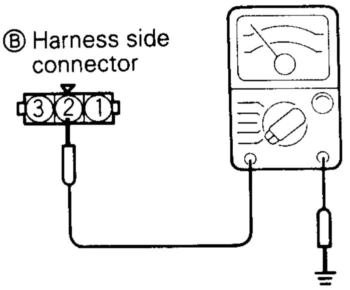
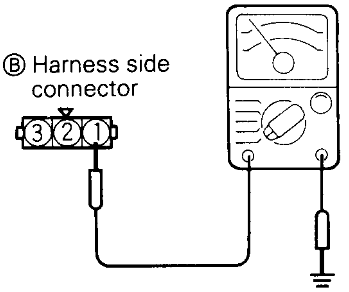
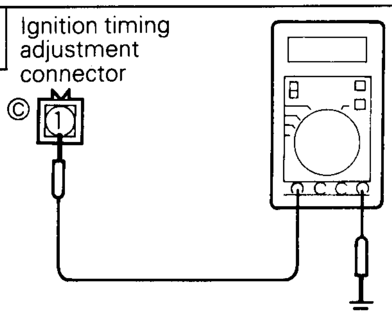
  Malfunction in power transistor

  **Wave pattern characteristics**

  Power voltage results when the power transistor is ON.

## HARNESS INSPECTION

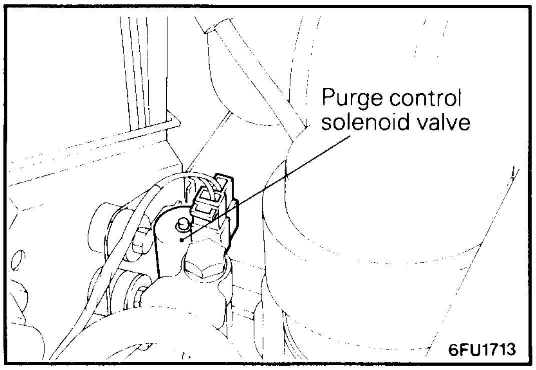
| | | |
|---|---|---|
| **1**<br> | Measure the power supply voltage of the ignition coil.<br>• Connector: Disconnected<br>• Ignition switch: ON<br>**Voltage (V)**<br>**SV** | OK → 2<br>~~OK~~ → Repair the harness. (Ⓐ1 – Ignition switch) |

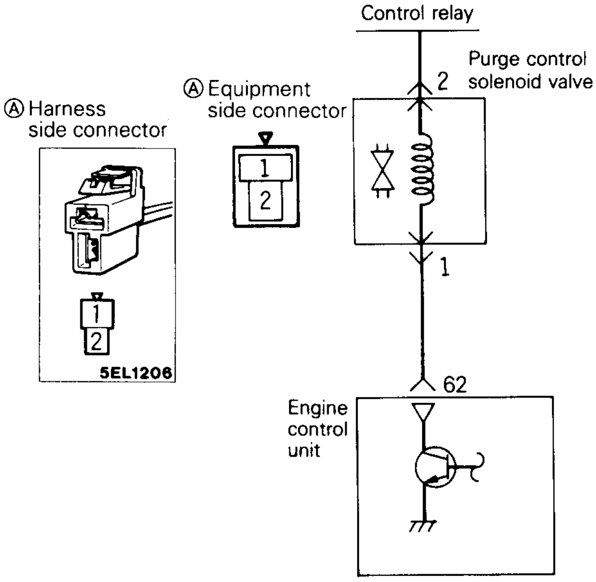
| | | | |
|---|---|---|---|
| **2**  6FU1739 | Check for an open-circuit, or a short-circuit to earth, between the power transistor and ignition coil.<br>• Ignition coil connector: Disconnected<br>• Power transistor connector: Disconnected | OK<br>~~OK~~ | → 3<br>→ Repair the harness. (Ⓐ2 – Ⓑ3) |
| **3**  7FU0837 | Check for continuity of the earth circuit.<br>• Connector: Disconnected | OK<br>~~OK~~ | → 4<br>→ Repair the harness. (Ⓑ2 – Earth) |
| **4**  7FU0838 | Measure the voltage of the control signal circuit of the power transistor.<br>• Connector: Disconnected<br>• Ignition switch: START<br>**Voltage (V)**<br>**2-6** | OK<br>~~OK~~ | → 5<br>→ Repair the harness. (Ⓑ1 – 54) |
| **5**  7FU1060 | Measure the voltage of the ignition timing adjustment terminal.<br>• Ignition switch: ON<br>**Voltage (V)**<br>**4.0-5.2** | OK<br>~~OK~~ | → STOP<br>→ Repair the harness. (Ⓒ1 – 12) |

## ACTUATOR INSPECTION

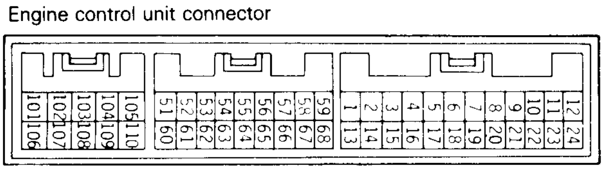
Refer to GROUP 16.

## PURGE CONTROL SOLENOID VALVE





01A0324



01L0838

### OPERATION

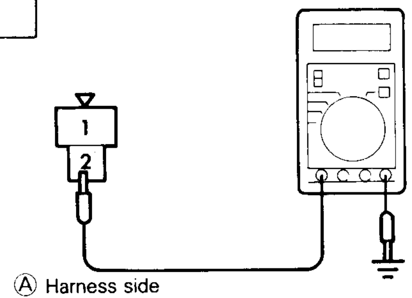
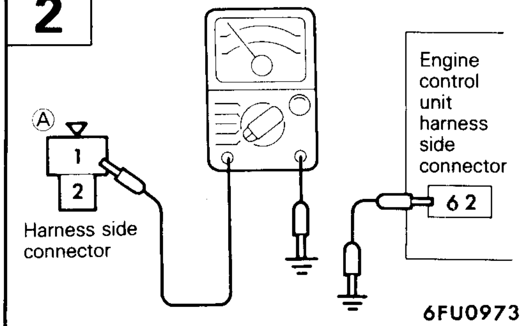
- The purge-control solenoid valve is an ON/OFF type of solenoid valve; it functions to regulate the introduction of purge air from the canister to the intake air plenum.
- Battery power is supplied, by way of the control relay, to the purge-control solenoid valve. When the engine control unit switches ON the power transistor within the unit, current flows to the coil, and purge air is introduced.

### INSPECTION

#### Using Multi-use tester

| Function | Item No. | Activation | Check conditions | Normal condition |
|---|---|---|---|---|
| Actuator test | 08 | Solenoid valve is switched from OFF to ON. | • Ignition switch: ON | Operating sound is heard when driven. |

## HARNESS INSPECTION

| | | |
|---|---|---|
| **1**<br><br> | Measure the power supply voltage.<br>● Connector: Disconnected<br>● Ignition switch: ON<br>**Voltage (V)**<br>**SV** | **OK** → 2<br>~~**OK**~~ → Repair the harness. (Control relay – Ⓐ 2 ) |
| **2**<br><br> | Check for an open-circuit, or a short-circuit to earth, between the purge control solenoid valve and the engine control unit.<br>● Purge control solenoid valve connector: Disconnected<br>● Engine control unit connector: Disconnected | **OK** → STOP<br>~~**OK**~~ → Repair the harness. ( Ⓐ 1 – 62 ) |

### ACTUATOR INSPECTION

Refer to GROUP 17.

## FUEL PRESSURE

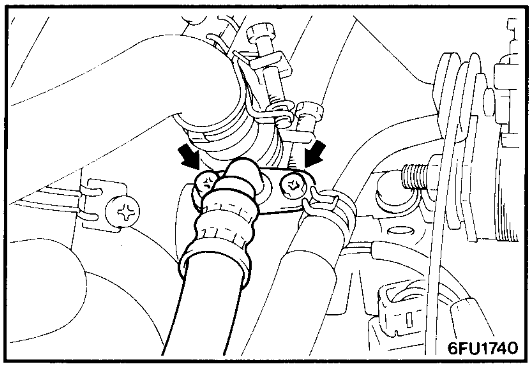
M13YXAE

### HOW TO REDUCE THE FUEL LINE INTERNAL PRESSURE

Refer to P.13-89.

### FUEL PUMP OPERATION CHECK

Refer to P.13-89.



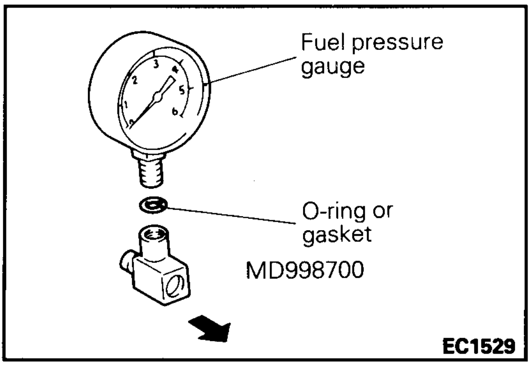
## FUEL PRESSURE TEST

(1) Remove all remaining pressure from inside the fuel pipe line to prevent splash of fuel. (Refer to P.13-89.)

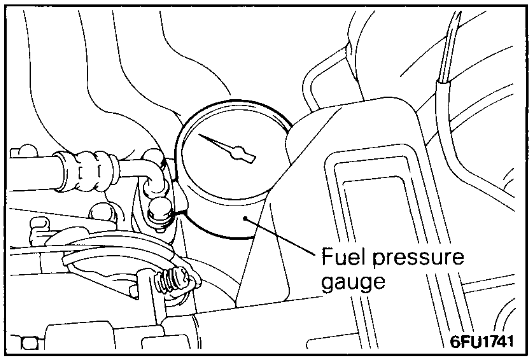
(2) Disconnect the fuel high pressure hose at the delivery pipe side.

**Caution**

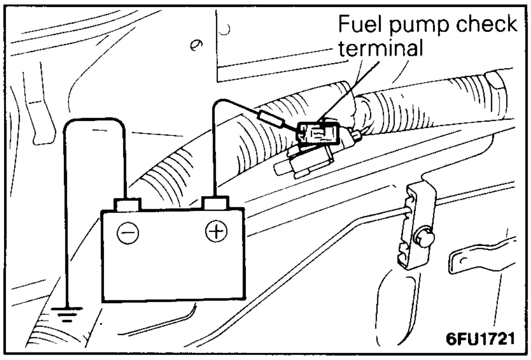
**Cover the hose connection with shop towel to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.**



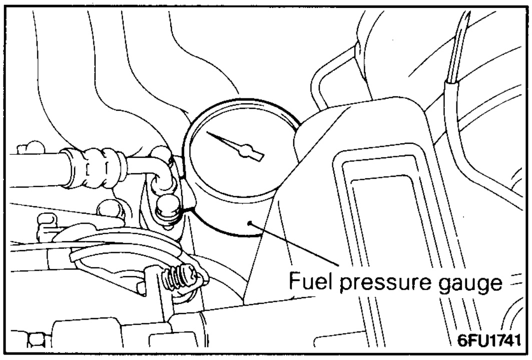
(3) Set a fuel pressure gauge on the special tool, placing an adequate O-ring or gasket between the gauge end special tool prevent fuel leaks.



(4) Attach pressure gauge set in step (3) to the delivery pipe.
(5) Connect the (–) battery terminal.

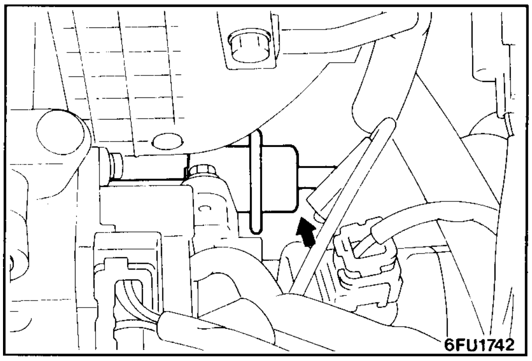


(6) Connect a jumper wire to the terminal for activation of the fuel pump and to the positive (+) terminal of the battery to activate the fuel pump. With fuel pressure applied, check to be sure that there is no fuel leakage from the fuel pressure gauge and the special tool connection part.
(7) Disconnect the jumper wire (from the terminal for activation of the fuel pump) to stop the fuel pump.
(8) Start the engine and let it idle.



(9) Measure the fuel pressure during idling.

**Standard value: Approx. 270 kPa (2.7 kg/cm$^2$, 38 psi) at curb idle**



(10)Disconnect the vacuum hose from the fuel pressure regulator, and then measure the fuel pressure while using a finger to plug the end of the hose.

**Standard value: 330–350 kPa (3.3–3.5 kg/cm$^2$, 47–50 psi) at curb idle speed**

(11)Check to be sure that the fuel pressure during idling does not decrease even after the engine is raced a few times.

(12)Use a finger to gently press the fuel return hose while repeatedly racing the engine, and check to be sure that there is fuel pressure in the return hose also.

NOTE
There will be no fuel pressure in the return hose if there is insufficient fuel flow.

(13)If the fuel pressure measured in steps (9) to (12) deviates from the standard value range, check for the probable cause by referring to the table below, and then make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| • Fuel pressure is too low.<br>• Fuel pressure drops during racing.<br>• No fuel pressure in fuel return hose. | Fuel filter is clogged. | Replace the fuel filter. |
| | Malfunction of the valve seat within the fuel pressure regulator, or fuel leakage to return side caused by spring deterioration. | Replace the fuel pressure regulator. |
| | Fuel pump low discharge pressure. | Replace the fuel pump. |
| Fuel pressure is too high. | The valve within the fuel pressure regulator is sticking. | Replace the fuel pressure regulator. |
| | Clogging of the fuel return hose and/or the pipe. | Clean or replace the hose and/or pipe. |
| No change of the fuel pressure when vacuum hose is connected and when not connected. | Damaged vacuum hose or nipple clogging. | Replace the vacuum hose, or clean the nipple. |

(14)Stop the engine and check for a change of the value indicated by the fuel pressure gauge. The condition is normal if there is no decrease of the indicated value within two minutes.
If there is a decrease of the indicated value, monitor the speed of the decrease, and, referring to the table below, determine the cause of the problem and make the appropriate repair.

| Condition | Probable cause | Remedy |
|---|---|---|
| After the engine is stopped, the fuel pressure drops gradually. | Injector leakage. | Replace the injector. |
| | Leakage at the fuel pressure regulator valve seat. | Replace the fuel pressure regulator. |
| There is a sudden sharp drop of the fuel pressure immediately after the engine is stopped. | The check valve (within the fuel pump) is not closed. | Replace the fuel pump. |

(15)Remove all remaining pressure from inside the fuel pipe. (Refer to P.13-89.)
(16)Disconnect the fuel pressure gauge and the special tool from the delivery pipe.

**Caution**
**Because there will be a slight amount of remaining pressure in the fuel pipe line, use rags to cover so that fuel doesn't splatter.**

(17) Replace the O-ring at the end of the fuel high-pressure hose with a new one.

(18) After connecting the fuel high-pressure hose to the delivery pipe, tighten the installation bolt at the specified torque.

**Tightening torque: 5 Nm (0.5 kgm, 3.6 ft.lbs.)**

(19) Check to be sure that there is no fuel leakage.

① Apply battery voltage to the terminal for activation of the fuel pump so as to activate the fuel pump.

② With fuel pressure applied, check for leakage of the fuel line.

# FUEL SYSTEM <4D56 Engine>

## SPECIFICATIONS

### GENERAL SPECIFICATIONS

E13CA-C

| Items | | Specifications |
|---|---|---|
| Fuel | | |
| Tank capacity | dm³ (U.S. gal., Imp. gal.) | |
| Standard Wheelbase | | 75 (19.8, 16.5) |
| Long Wheelbase | | 92 (24.3, 20.2) |
| Fuel injection pump | | |
| Type | | Distribution type |
| Governor type | | Half all speeds |
| Feed pump type | | Vane type |
| Injection nozzle | | |
| Nozzle type | | Throttle type |
| Holder type | | Screwed-in type |

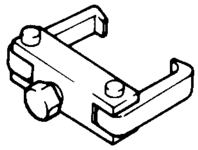
### SERVICE SPECIFICATIONS

E13CB-C

| Items | | Specifications |
|---|---|---|
| Standard value | | |
| Accelerator cable play | mm (in.) | 0–1 (0–0.04) |
| Fuel cut solenoid valve coil resistance | Ω | 8–10 |
| Injection pressure | kPa (kg/cm², psi) | 11,770–12,750 (120–130, 1,707–1,849) <Vehicles without EGR system built up to 1994><br>14,710–15,690 (150–160, 2,133–2,276) <Vehicles with EGR system built up to 1994, Vehicles built from 1995> |

## SPECIAL TOOL

E13DA-C

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MD998388 | Injection pump sprocket puller | Removal of sprocket from drive shaft of injection pump |

# SERVICE ADJUSTMENT PROCEDURES

## FUEL INJECTION TIMING INSPECTION AND ADJUSTMENT E13FKAD

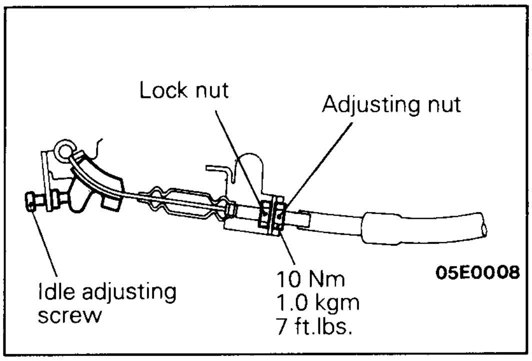
Refer to GROUP 11 – Service Adjustment Procedures.

## ENGINE IDLING SPEED INSPECTION AND ADJUSTMENT E13HBAA

Refer to GROUP 11 – Service Adjustment Procedures.

## ACCELERATOR CABLE INSPECTION AND ADJUSTMENT <VEHICLES WITHOUT AUTO-CRUISE CONTROL SYSTEM> E13FCAZ3

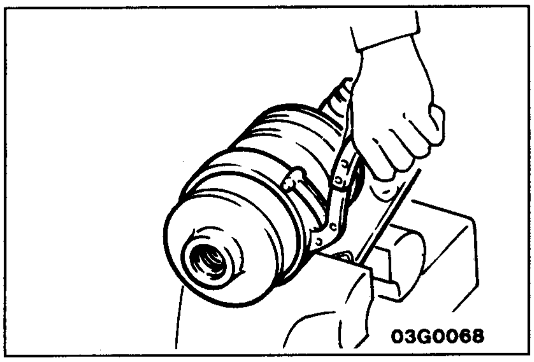
For models equipped with the auto-cruise control system, refer to P.13-188.



(1) Turn the air conditioner and all lights OFF so that there is no electrical load when inspecting.
(2) Warm the engine until the engine idling speed becomes stable.
(3) Check that the engine idling speed is at the specified value.
(4) Stop the engine and turn the ignition switch to OFF.
(5) Check that there are no sharp bends in the accelerator cable.
(6) Check the amount of play in the inner cable.
(7) If there is excessive play in the inner cable, or if there is no play, adjust by the following procedure.
    ① Loosen the adjusting nut and fully close the throttle lever.
    ② Tighten the adjusting nut so that the inner cable play is at the standard value, and fix it with the lock nut.

    **Standard value: 0–1 mm (0–0.04 in.)**

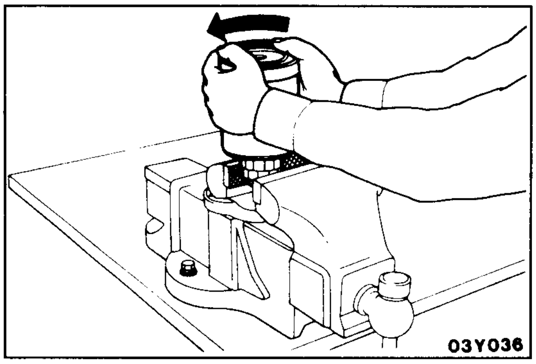
    ③ After adjusting, check that the throttle lever is touching the idle adjusting screw (stopper).



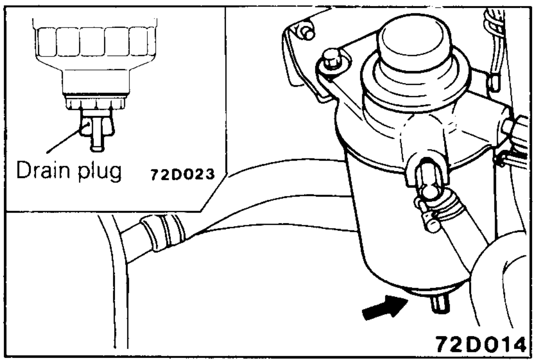
## FUEL FILTER REPLACEMENT E13FZAN

(1) Remove the intercooler. (Refer to GROUP 15 – Intercooler.)
(2) Remove the fuel tank cap to release the pressure inside the tank.
(3) Disconnect the water level sensor connector.
(4) Remove the fuel hose and then remove the fuel filter.

**Caution**
**Cover with a rag to prevent fuel from spraying out.**



(5) Secure the fuel filter pump in a vise, and use an oil filter wrench to remove the fuel filter cartridge.
(6) Secure the water level sensor in a vise and turn the fuel filter cartridge with both hands to remove the water filter sensor.
(7) After installing a new fuel filter, bleed all air from the fuel line.
(8) Start the engine, and check that there are no fuel leakages.

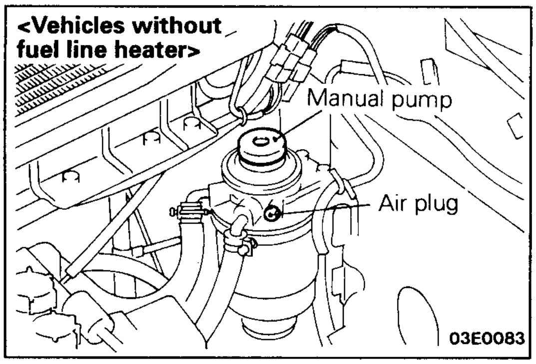


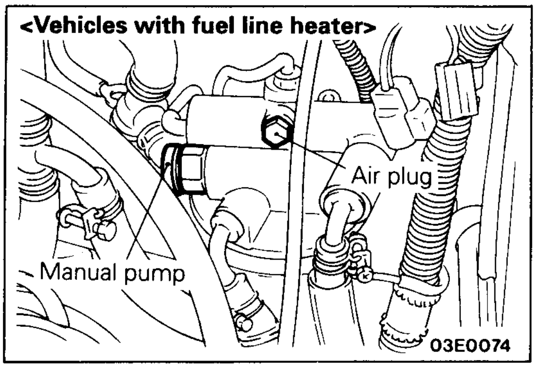
## EVACUATION OF WATER FROM FUEL FILTER

E13FVAB

Water is in the filter when fuel filter indicator lights. Evacuate water by the following procedures.

(1) Loosen drain plug.
(2) Drain water with hand pump. Finger-tighten drain plug.





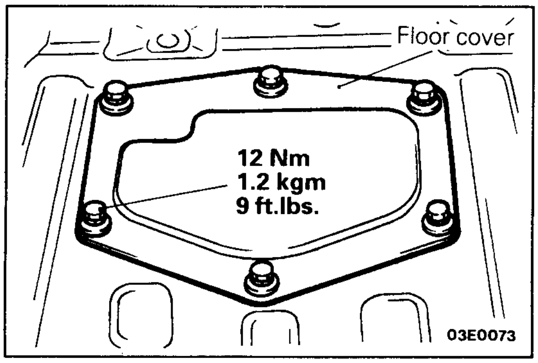
## EVACUATION OF AIR FROM FUEL LINE

E13FSAB

Evacuate air after following services.

- When fuel is drained and re-filled for service.
- When fuel filter is replaced.
- When main fuel line is removed.

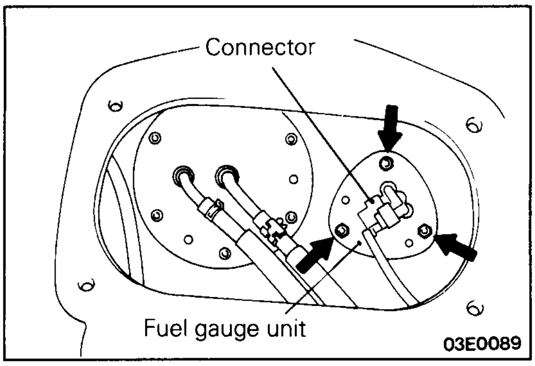
(1) Loosen fuel filter air plug.
(2) Place rags around air plug hole. Operate hand pump repeatedly until no bubbles come from plug hole. Tighten air plug.
(3) Repeat until hand pump operation becomes stiff.



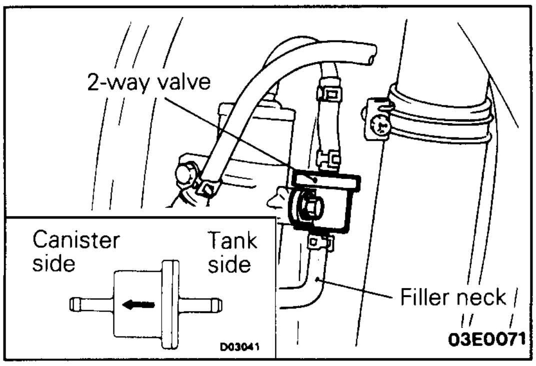
## FUEL GAUGE UNIT REPLACEMENT

E13FDAC2

(1) Take out the carpet in the cargo compartment and remove the floor cover.



(2) Disconnect the connector from the fuel gauge unit, and remove the fuel gauge unit.
(3) Install the fuel gauge unit so that the packing stoppers (2 places) match the hole in the fuel gauge unit.
(4) Install the floor cover packing and the floor cover.

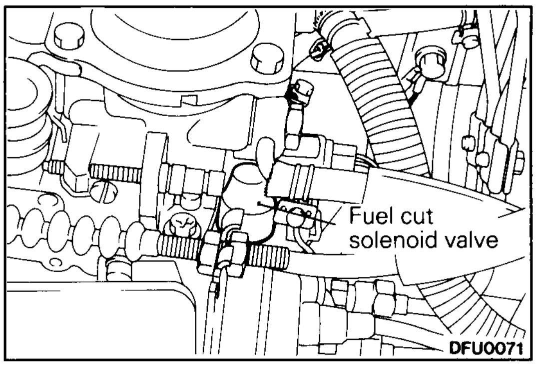


## 2-WAY VALVE REPLACEMENT E13FFAC2

(1) Remove the filler neck protector inside the rear left bumper.
(2) Replace the 2-way valve.

**Caution**
**Be careful not to mistake the direction of the 2-way valve.**

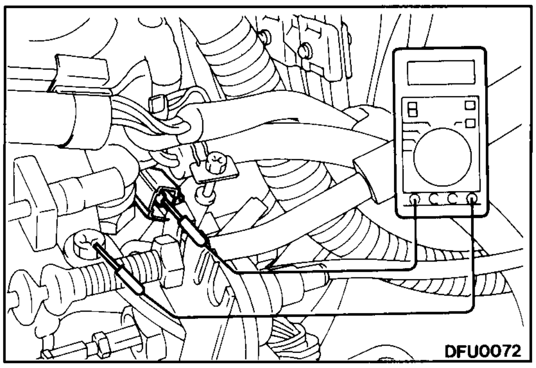
(3) Install the filler neck protector.



## FUEL INJECTION PUMP INSPECTION E13FMAB

### 1. INSPECTION OF FUEL CUT SOLENOID VALVE OPERATION

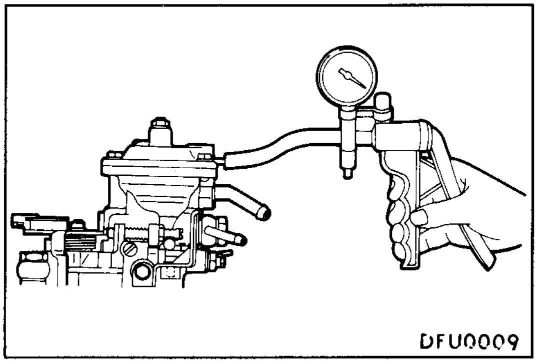
(1) When a sound scope is held against the fuel cut solenoid valve and the ignition switch is turned to "ON", check that the sound of the valve operating can be heard.



### 2. INSPECTION OF FUEL CUT SOLENOID VALVE COIL RESISTANCE

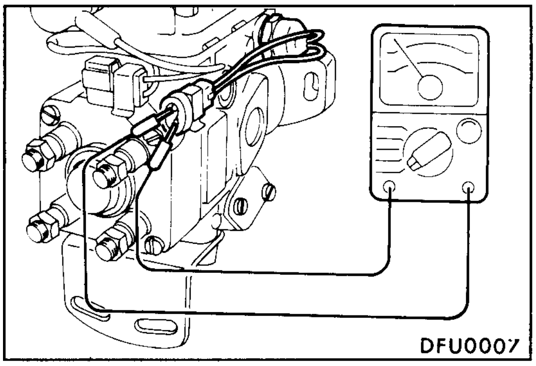
(1) Measure the resistance between the fuel cut solenoid valve terminal and the ignition pump and body.

**Standard value: 8–10 Ω**



### 3. BOOST COMPENSATOR INSPECTION

(1) Connect a hand pump (pressure pump type) to the boost compensator nipple.
(2) Apply positive pressure of 30 kPa (0.3 $kg/cm^2$, 4.3 psi.) and check that pressure is maintained.



**4. ENGINE SPEED SENSOR INSPECTION**

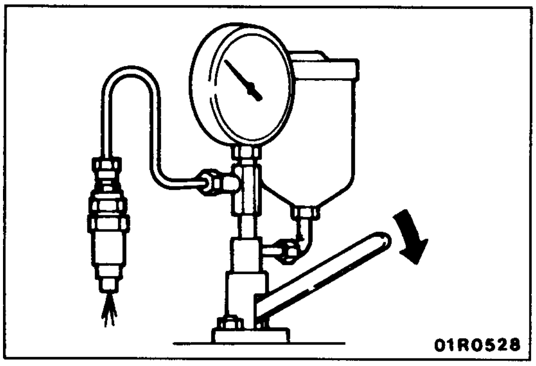
(1) Disconnect the engine speed sensor.
(2) Measure the resistance between the engine speed sensor terminals.

**Standard value: 1.3–1.9 kΩ**

## INJECTION NOZZLE INSPECTION AND ADJUSTMENT

E13FOAG

**Caution**
**Never touch the injection spray that is injected from the nozzle.**



**1. FUEL INJECTION INITIAL PRESSURE INSPECTION**

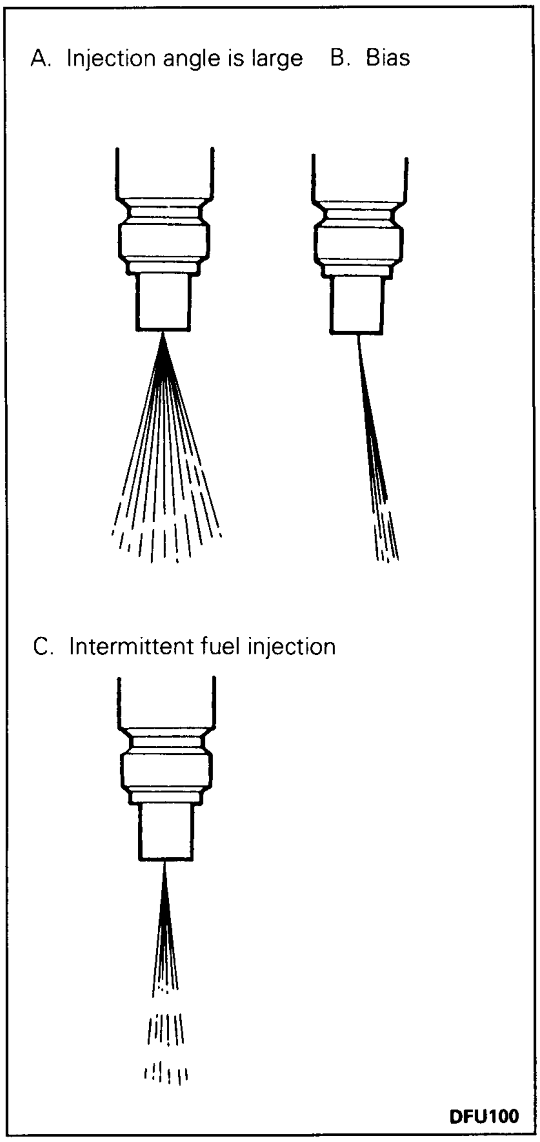
(1) Install the injection nozzle to a nozzle tester.
(2) Move the lever of the nozzle tester 2–3 times to inject fuel and to bleed the air.
(3) Gently press down the lever of the nozzle tester, and take a reading of the indication value on the pressure gauge at the point where the needle slowly rises and then suddenly drops.

**Standard value:**
**<Vehicles without EGR system built up to 1994>**
**11,770–12,750 kPa**
**(120–130 kg/cm$^2$, 1,707–1,849 psi.)**
**<Vehicles with EGR system built up to 1994, Vehicles built from 1995>**
**14,750–15,690 kPa**
**150–160 kg/cm$^2$, 2133–2276 psi.)**

(4) If the fuel injection initial pressure is outside the standard value, disassemble the nozzle holder to clean it, and then change the thickness of the shim to adjust the fuel injection initial pressure.

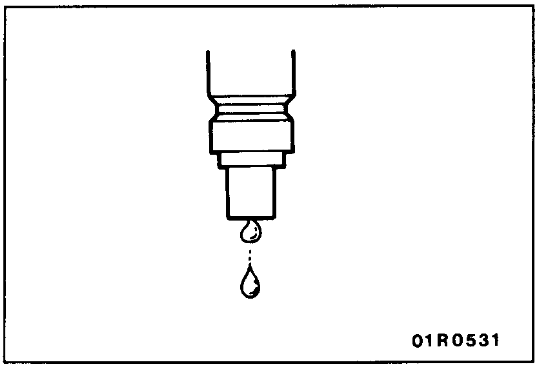
NOTE

- For disassembly and reassembly of the nozzle holder, refer to the engine workshop manual.
- There are 10 shims for adjustment, with thicknesses in the range 0.10–0.80 mm (0.0039–0.0315 in.).
- When the shim thickness is increased by 0.1 mm (0.0039 in.), the fuel injection initial pressure increases by 2350 kPa (24 kg/cm$^2$, 341 psi.).



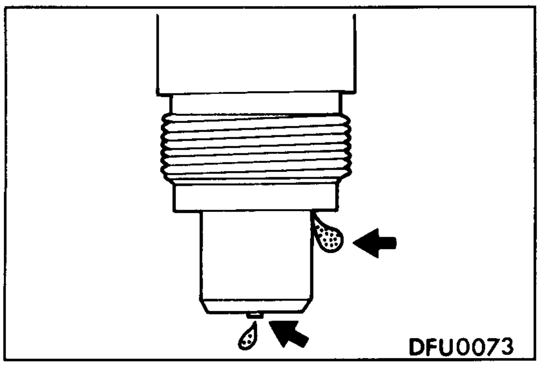
## 2. INJECTION SPRAY INSPECTION

(1) Move the lever of the nozzle tester rapidly (4–6 times per second) to eject the fuel continuously. Check that the injection spray comes out evenly in a straight, thin line (angle of spray is zero). The injection spray patterns shown in the illustration at left are wrong.



(2) Check that no fuel drips after injection is completed.

(3) If there are any drips, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.



## 3. NOZZLE FUELTIGHT INSPECTION

(1) Gently raise the lever of the nozzle tester until the pressure inside the nozzle becomes 9,810–10,790 kPa (100–110 kg/cm$^2$, 1,422–1,565 psi.) <Vehicles without EGR system built up to 1994, vehicles built from 1995> or 12,750–13,730 kPa (130–140 kg/cm$^2$, 1,850–1,990 psi.) <Vehicles with EGR system built from 1995>, and after holding this pressure for approximately 10 seconds, check that there are no fuel leaks from the nozzle.

(2) If there are any leaks, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.

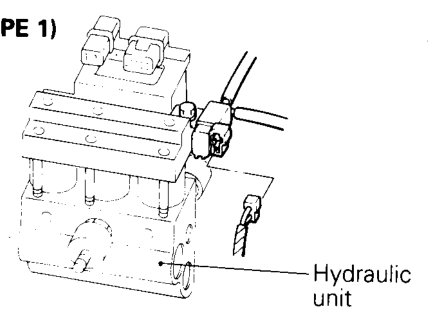
## ACCELERATOR LEVER CONTROL CHECK DURING ANTI-SKID BRAKE (ABS) OPERATION

### ACCELERATOR OPENER SOLENOID VALVE OPERATION CHECK

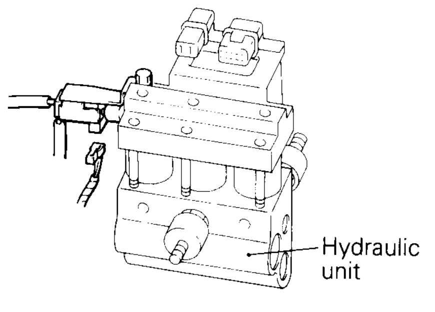
(1) Disconnect the No. 2 connector of the accelerator opener solenoid valve.
(2) Start the engine and run it at idle.

**<Vehicles built up to May, 1994>**

(TYPE 1)

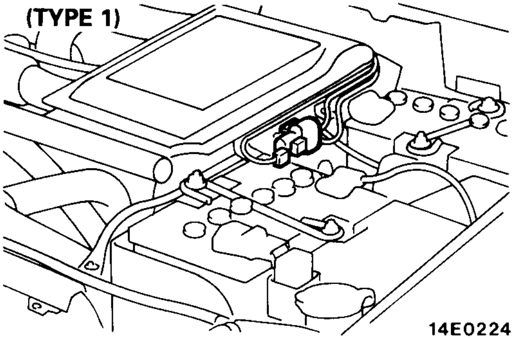


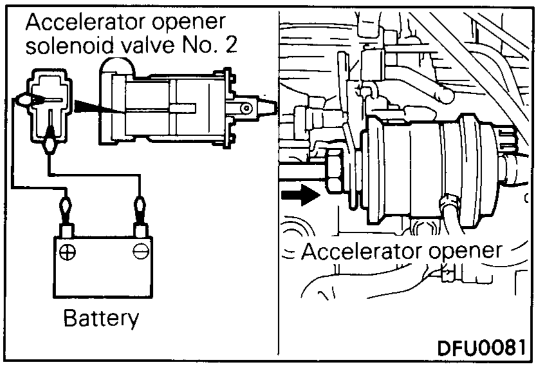
(TYPE 2)



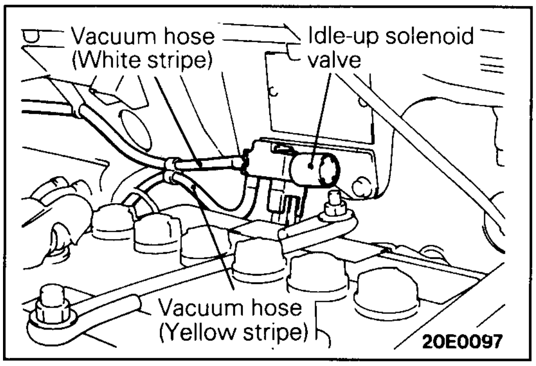
**<Vehicles built from June, 1994>**

(TYPE 1)





(3) When the solenoid valve terminals and the battery terminals are connected by jumper leads, check that the accelerator opener operates and that the engine r/min increases.

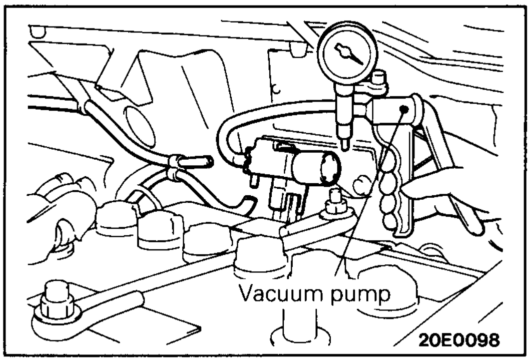


### ACCELERATOR OPENER SOLENOID VALVE NO. 1 (FOR AIR CONDITIONER) CHECK

(1) Remove the vacuum hose from the idle-up solenoid valve.

NOTE
When installing the vacuum hose, be careful not to confuse the connection ends.

(2) Remove the idle-up solenoid valve connection.

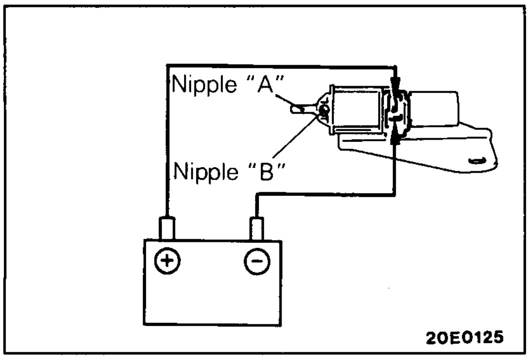


(3) Connect the vacuum pump (Mighty Vac) to nipple "A".

(4) Check the air flow with the vacuum pump (Mighty Vac) when battery voltage is applied between the idle-up solenoid valve terminals, and when battery voltage is removed.

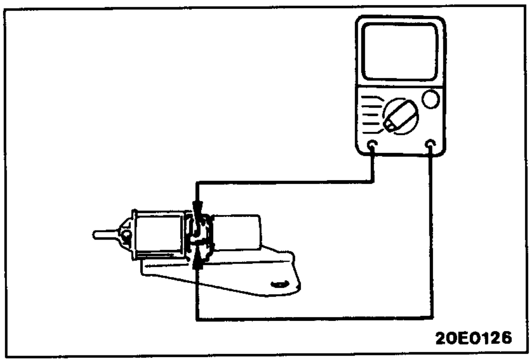
| Battery voltage | Nipple "B" | Vacuum condition |
|---|---|---|
| Applied | Open | Vacuum leaks from nipple "B" |
| | Covered with a finger*[1] | Vacuum is maintained |
| Not applied | Open | Vacuum is maintained |
| | Covered with a finger*[2] | |

NOTE
At *[1], negative pressure can be felt, but at *[2], negative pressure cannot be felt.



(5) Measure the resistance between the idle-up solenoid valve terminals.

**Standard value: approx. 40 Ω**

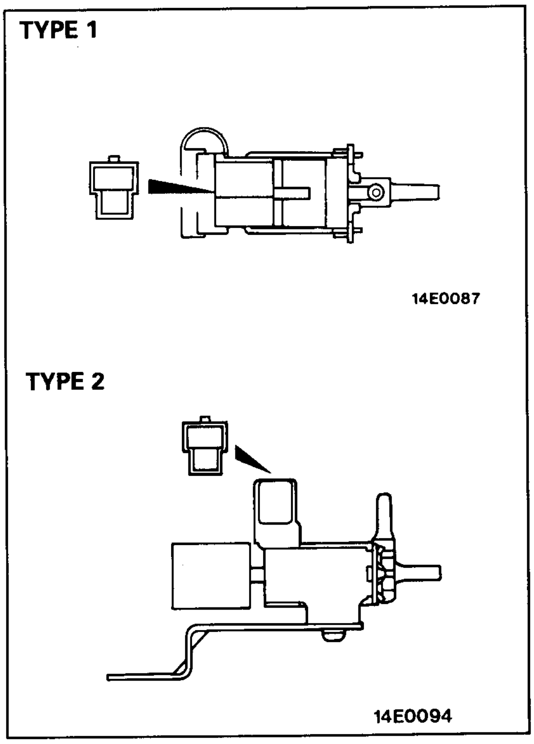


## ACCELERATOR OPENER SOLENOID VALVE NO. 2 (FOR ANTI-LOCK BRAKE) CHECK

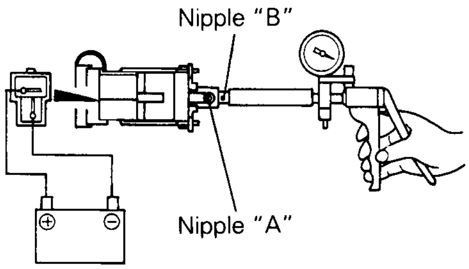
NOTE
When disconnecting the vacuum hose, always make a mark so that the hose can be connected at the original position.

1. Remove the idle-up solenoid valve from the hydraulic unit.
2. Measure the resistance between the solenoid valve terminals.

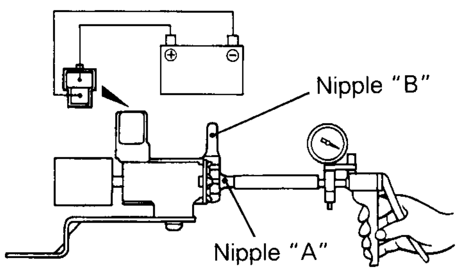
   **Standard value: <TYPE 1> 33–39 Ω**
   **<TYPE 2> 37–44 Ω**



**TYPE 1**

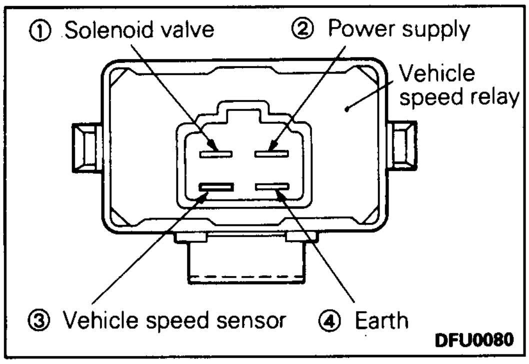


**TYPE 2**



3. Connect a hand vacuum pump to the nipple "A".
4. Check airtightness by applying a vacuum with voltage applied directly from the battery to the solenoid valve terminal and without applying voltage.

| Battery voltage | Solenoid valve nipple "B" | Normal condition |
|---|---|---|
| Applied | Open | Vacuum leaks |
| | Blocked with finger | Vacuum maintained |
| Not applied | Open | Vacuum maintained |



## VEHICLE SPEED SENSOR CHECK

(1) With the vehicle speed relay connector connected, connect an analog voltmeter to terminal (3).
(2) Turn the ignition switch to "ON".
(3) When the vehicle is moving slowly forward, check that the voltage repeatedly changes from 0 V to 5 V and back.

## VEHICLE SPEED RELAY CHECK

With the vehicle speed relay connector connected, check the continuity between the vehicle speed relay terminals (1) and (4).

NOTE
When checking the continuity, use an analog circuit tester, and connect the (–) probe to terminal (1).

| Vehicle speed | Continuity between terminals (1)–(4) |
|---|---|
| 15 km/h (9 mph) or less | No continuity |
| 35 km/h (21 mph) or more | Continuity |

# FUEL SYSTEM <4M40 Engine>

## SPECIFICATIONS

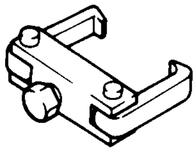
### GENERAL SPECIFICATIONS

| Items | | Specifications |
|---|---|---|
| Fuel | | |
| Tank capacity | $dm^3$ (U.S. gal., Imp gab.) | |
| Standard wheelbase | | 75 (19.8, 16.5) |
| Long wheelbase | | 92 (24.3, 20.2) |
| Fuel injection pump | | |
| Type | | Distribution type |
| Governor type | | Half all speeds |
| Feed pump type | | Vane type |
| Injection nozzle | | |
| Nozzle type | | Throttle type |
| Holder type | | Screwed-in type |

### SERVICE SPECIFICATIONS

| Items | | Specifications |
|---|---|---|
| Standard value | | |
| Accelerator cable play | mm (in.) | 0–1 (0–0.04) |
| Fuel cut solenoid valve coil resistance | Ω | 8–10 |
| Injection pressure | kPa ($kg/cm^2$, psi) | 14,710–15,690 (150–160, 2,133–2,276) |

## SPECIAL TOOL

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MH062464 | Injection pump sprocket puller | Removal of sprocket from drive shaft of injection pump |

# SERVICE ADJUSTMENT PROCEDURES

## FUEL INJECTION TIMING INSPECTION AND ADJUSTMENT E13FKAD

Refer to GROUP 11 – Service Adjustment Procedures.

## ENGINE IDLING SPEED INSPECTION AND ADJUSTMENT E13HBAA

Refer to GROUP 11 – Service Adjustment Procedures.

## ACCELERATOR CABLE INSPECTION AND ADJUSTMENT <VEHICLES WITHOUT AUTO-CRUISE CONTROL SYSTEM> E13FCAZ3

Refer to P.13-143.

For models equipped with the auto-cruise control system, refer to P.13-188.

## FUEL FILTER REPLACEMENT E13FZAM

Refer to P.13-143.

## EVACUATION OF WATER FROM FUEL FILTER E13FVAB

Refer to P.13-144.

## EVACUATION OF AIR FROM FUEL LINE E13FSAB

Refer to P.13-144.

## FUEL GAUGE UNIT REPLACEMENT E13FDAD

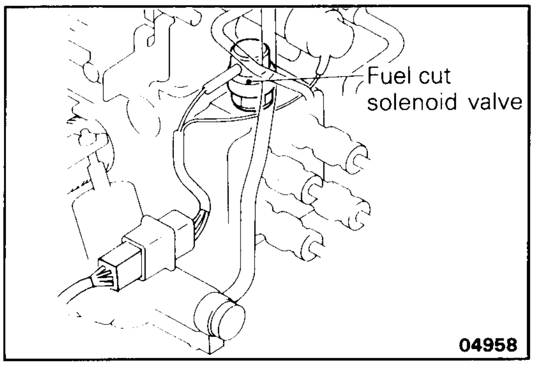
Refer to P.13-144.

## 2-WAY VALVE REPLACEMENT E13FFAD

Refer to P.13-145.

## ACCELERATOR LEVER CONTROL CHECK DURING ANTI-SKID BRAKE (ABS) OPERATION

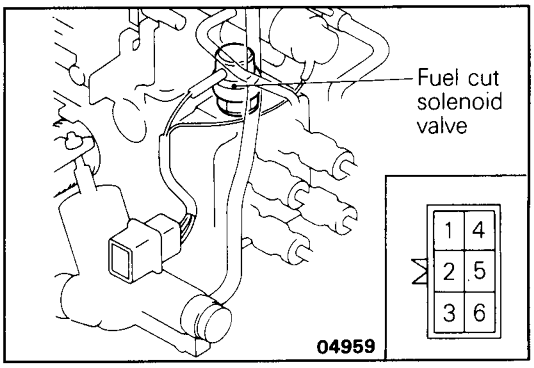
Refer to P.13-148



## FUEL INJECTION PUMP INSPECTION

### INSPECTION OF FUEL CUT SOLENOID VALVE OPERATION

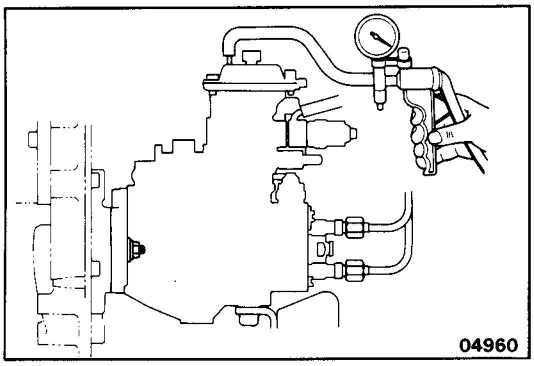
When a sound scope is held against the fuel cut solenoid valve and the ignition switch is turned to "ON", check that the sound of the valve operating can be heard.



## INSPECTION OF FUEL CUT SOLENOID VALVE COIL RESISTANCE

Measure the resistance between the fuel cut solenoid valve terminal ① and ⑤.

**Standard value: 8–10 Ω**



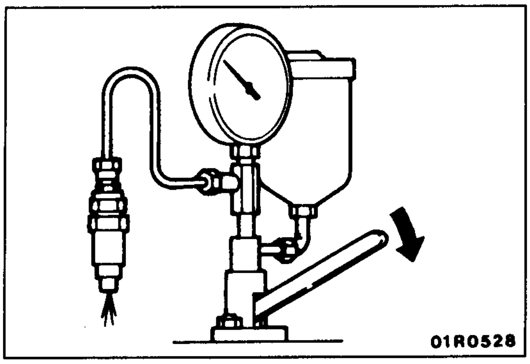
## BOOST COMPENSATOR INSPECTION

(1) Connect a hand pump (pressure pump type) to the boost compensator nipple.
(2) Apply positive pressure of 29.4 kPa (0.3 kg/cm$^2$, 4.3 psi.), and check that pressure is maintained.

# INJECTION NOZZLE INSPECTION AND ADJUSTMENT

**Caution**
**Never touch the injection spray that is injected from the nozzle.**

## FUEL INJECTION INITIAL PRESSURE INSPECTION

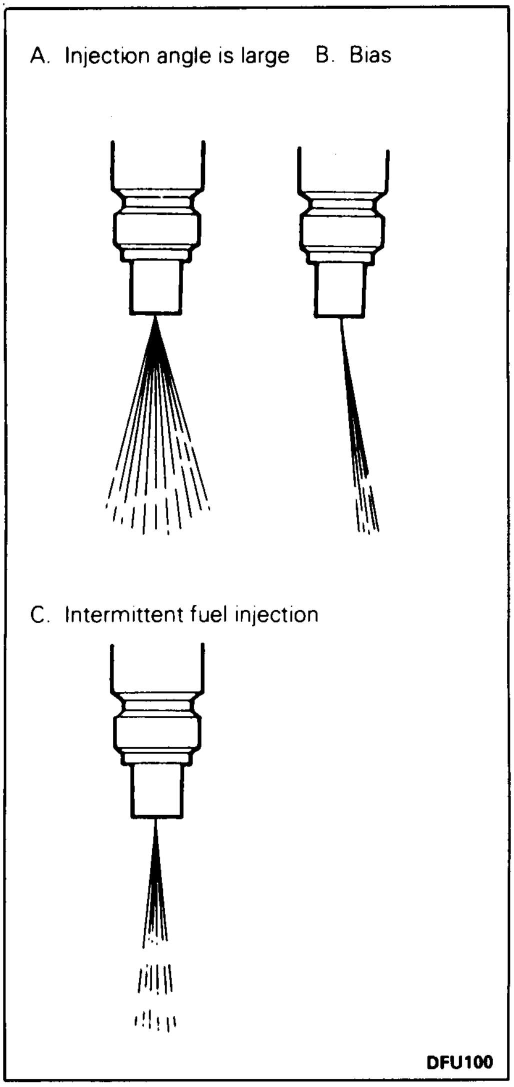


(1) Install the injection nozzle to a nozzle tester.
(2) Apply positive pressure of 29.4 kPa (0.3 kg/cm$^2$, 4.3 psi.), and check that pressure is maintained.
(3) Gently press down the lever of the nozzle tester, and take a reading of the indication value on the pressure gauge at the point where the needle slowly rises and then suddenly drops.

**Standard value: 14,710–15,690 kPa (150–160 kg/cm$^2$, 2,133–2,276 psi)**

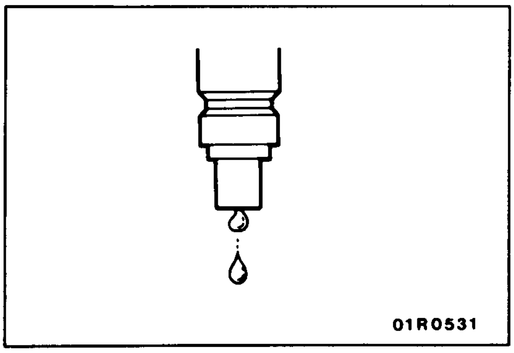
(4) If the fuel injection initial pressure is outside the standard value, disassemble the nozzle holder to clean it, and then change the thickness of the shim to adjust the fuel injection initial pressure.

NOTE
- For disassembly, reassembly and adjustment of the nozzle holder, refer to the engine workshop manual.
- When the shim thickness is increased by 0.1 mm (0.004 in.), the fuel injection initial pressure increases by approx. 1,177–2,157 kPa (12–22 kg/cm$^2$, 171–313 psi).

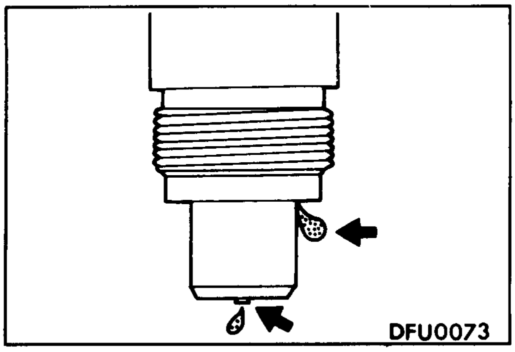


## INJECTION SPRAY INSPECTION

(1) Move the lever of the nozzle tester rapidly (4–6 times per second) to eject the fuel continuously. Check that the injection spray comes out evenly in a straight, thin line angle of spray is 10°. The injection spray patterns shown in the illustration at left are wrong.

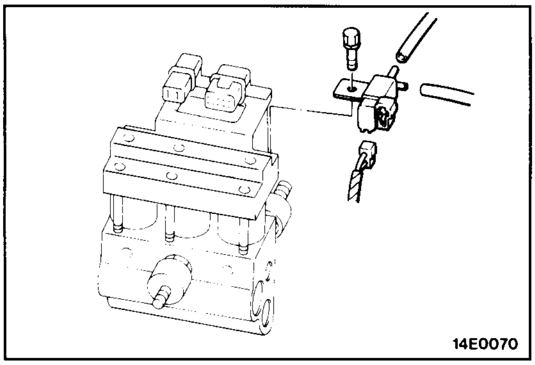


(2) Check that no fuel drips after injection is completed.
(3) If there are any drips, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.



## NOZZLE FUELTIGHT INSPECTION

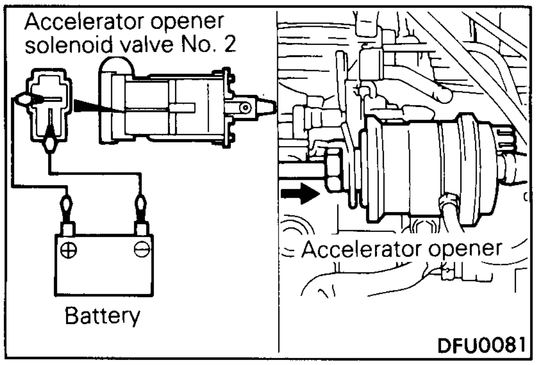
(1) Gently raise the lever of the nozzle tester until the pressure inside the nozzle becomes 12,749–13,729 kPa (130–140 kg/cm$^2$, 1,849–1,991 psi.). Check that no fuel leaks from the nozzle within approx. 10 seconds.
(2) If there are any leaks, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.



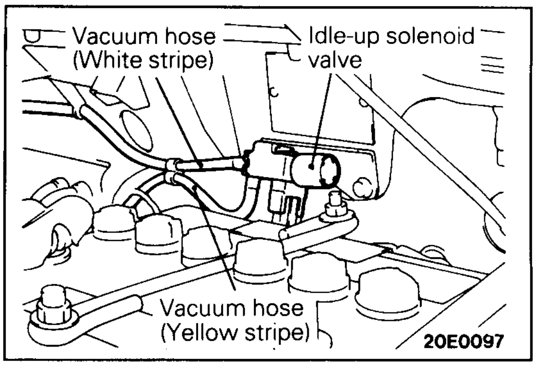
## ACCELERATOR LEVER CONTROL CHECK DURING ANTI-SKID BRAKE (ABS) OPERATION

### ACCELERATOR OPENER SOLENOID VALVE OPERATION CHECK

(1) Disconnect the No. 2 connector of the accelerator opener solenoid valve.
(2) Start the engine and run it at idle.



(3) When the solenoid valve terminals and the battery terminals are connected by jumper leads, check that the accelerator opener operates and that the engine r/min increases.

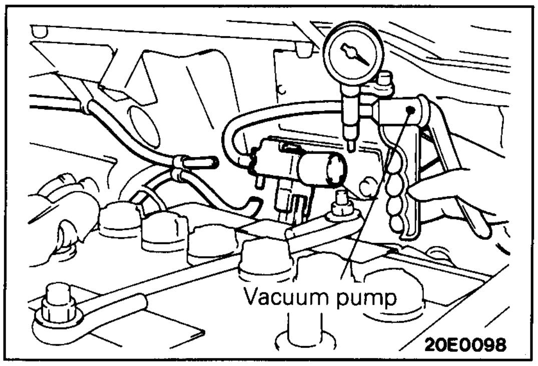


### ACCELERATOR OPENER SOLENOID VALVE NO. 1 (FOR AIR CONDITIONER) CHECK

(1) Remove the vacuum hose from the idle-up solenoid valve.

NOTE
When installing the vacuum hose, be careful not to confuse the connection ends.

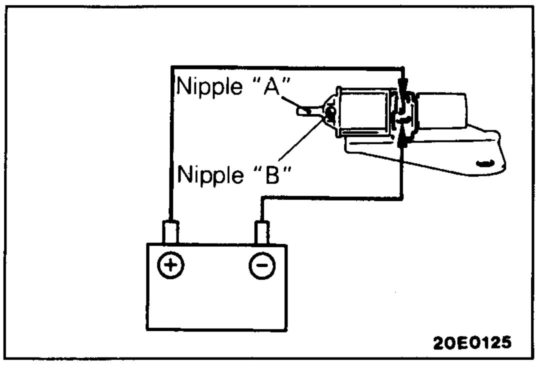
(2) Remove the idle-up solenoid valve connection.
(3) Connect the vacuum pump (Mighty Vac) to nipple "A".

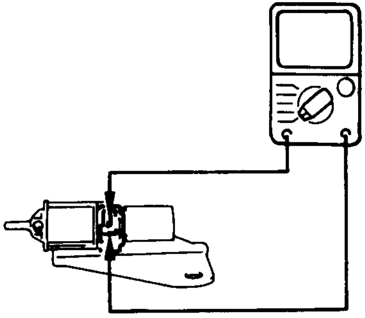


(4) Check the air flow with the vacuum pump (Mighty Vac) when battery voltage is applied between the idle-up solenoid valve terminals, and when battery voltage is removed.

| Battery voltage | Nipple "B" | Vacuum condition |
|---|---|---|
| Applied | Open | Vacuum leaks from nipple "B" |
| | Covered with a finger*$^1$ | Vacuum is maintained |
| Not applied | Open | Vacuum is maintained |
| | Covered with a finger*$^2$ | |

NOTE
At *$^1$, negative pressure can be felt, but at *$^2$, negative pressure cannot be felt.





20E0126

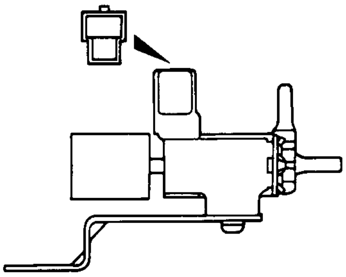
(5) Measure the resistance between the idle-up solenoid valve terminals.

**Standard value: approx. 40 Ω**

## ACCELERATOR OPENER SOLENOID VALVE NO. 2 (FOR ANTI-LOCK BRAKE) CHECK

NOTE
When disconnecting the vacuum hose, always make a mark so that the hose can be connected at the original position.

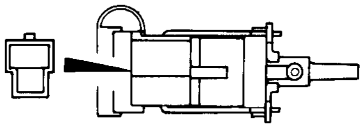
**<L.H. drive vehicles>**



14E0094

1. Remove the idle-up solenoid valve from the hydraulic unit.

**<R.H. drive vehicles>**

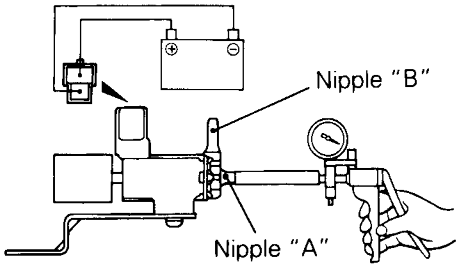


14E0087

2. Measure the resistance between the solenoid valve terminals.

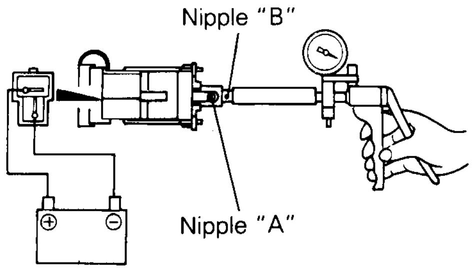
**Standard value: <L.H. drive vehicles> 38–44 Ω**
**<R.H. drive vehicles> 33–39 Ω**

**<L.H. drive vehicles>**



14E0095

**<R.H. drive vehicles>**



14E0088

3. Connect a hand vacuum pump to the nipple "A".
4. Check airtightness by applying a vacuum with voltage applied directly from the battery to the solenoid valve terminal and without applying voltage.

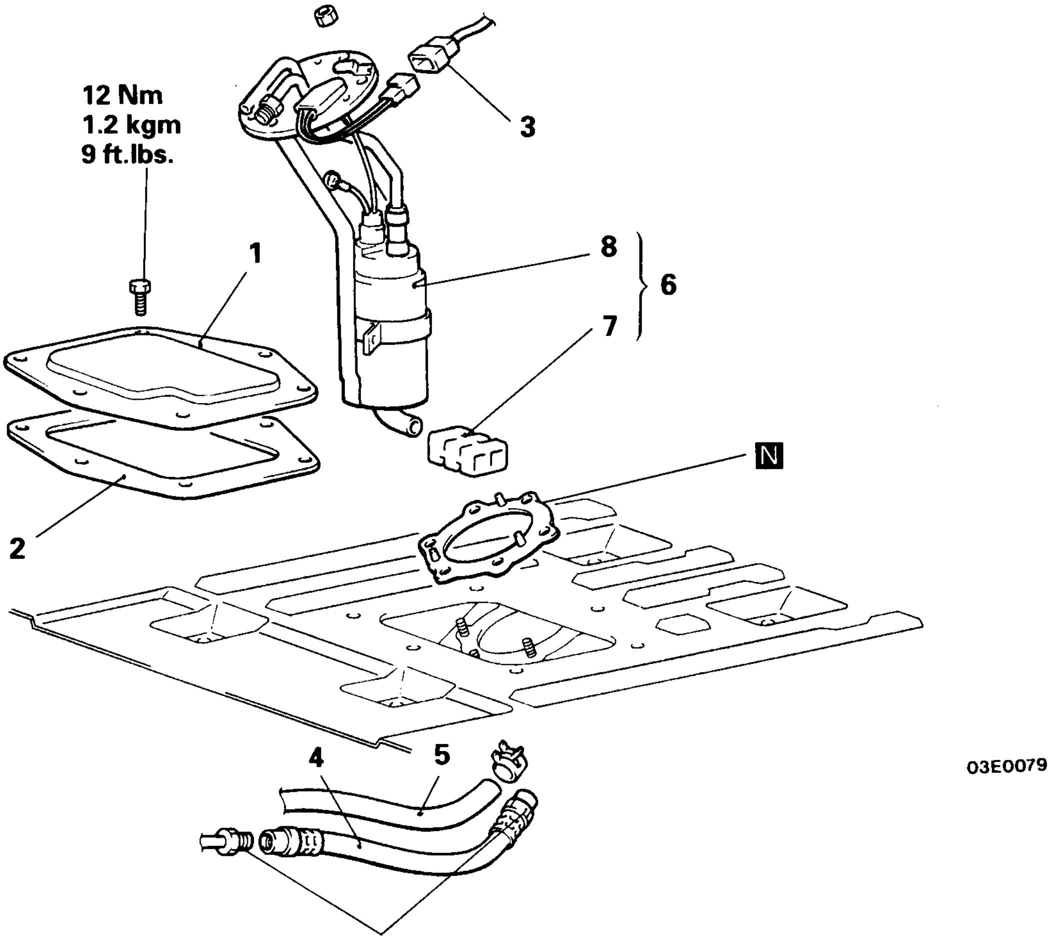
| Battery voltage | Solenoid valve nipple "B" | Normal condition |
|---|---|---|
| Applied | Open | Vacuum leaks |
| | Blocked with finger | Vacuum maintained |
| Not applied | Open | Vacuum maintained |

# FUEL PUMP <4G64, 6G72, 6G74>

## REMOVAL AND INSTALLATION

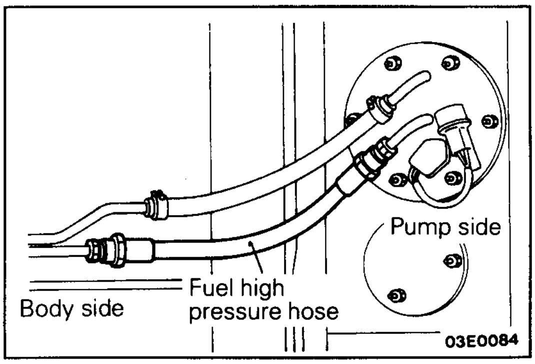
E13LA--

**Pre-removal and Post-installation Operation**
- Drain and Filling of Fuel
- Removal and Installation of the Floor Carpet



**Removal steps**

1. Floor cover
2. Packing
3. Fuel pump connector
4. ◆▶ ▶◆ Fuel high pressure hose
5. Fuel return hose connection
6. Fuel pump and filter assembly
7. Filter
8. Fuel pump assembly



## SERVICE POINT OF REMOVAL AND INSTALLATION

E13LDAB

### 4. REMOVAL AND INSTALLATION OF FUEL HIGH PRESSURE HOSE

(1) After disconnecting the high-pressure fuel pipe at the body-side main pipe connection, disconnect the pump-side connection.

(2) To install, carry out the removal procedure in reverse.

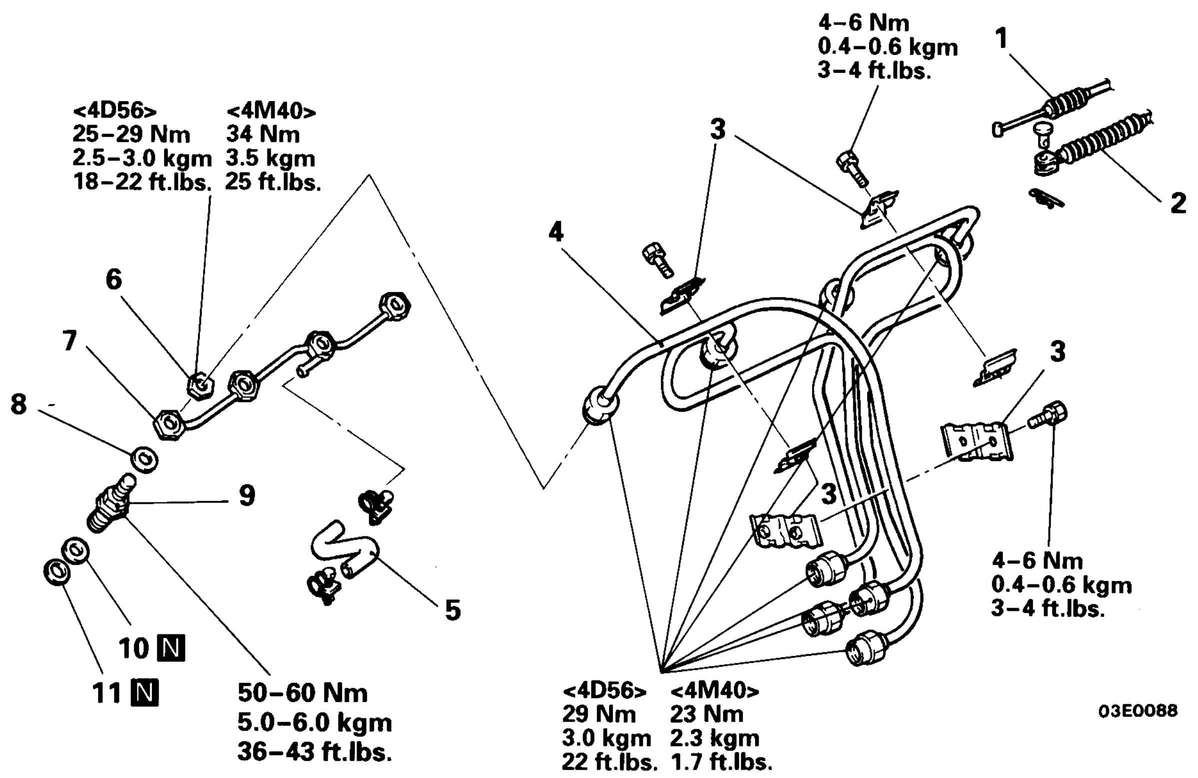
# INJECTION NOZZLE <4D56, 4M40>

## REMOVAL AND INSTALLATION

E13NA-

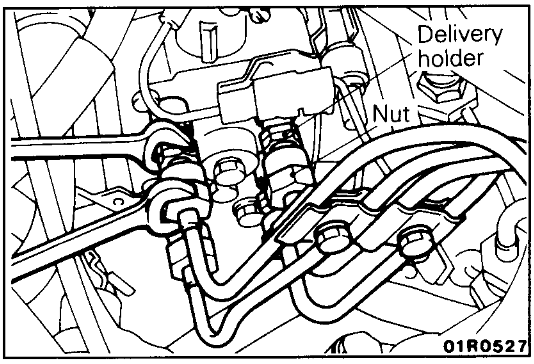
**Pre-removal Operation**
- Removal of Intercooler
  (Refer to GROUP15 – Intercooler)

**Post-installation Operation**
- Installation of Intercooler
  (Refer to GROUP 15 – Intercooler)
- Adjustment of Accelerator Cable
  (Refer to P.13-14, 89.)
- Adjustment of Throttle Control Cable
  (Refer to GROUP 23 – Service Adjustment Procedures)



**Removal steps**

1. Accelerator cable connection
2. Throttle control cable connection <A/T>
3. Injection pipe clamp
4. ◆▶ Injection pipe
5. Fuel return hose
6. Nut
7. ◆▶ Fuel return pipe
8. Fuel return pipe gasket
9. ◆▶ ▶◆ Nozzle holder
10. Holder gasket
11. Nozzle gasket

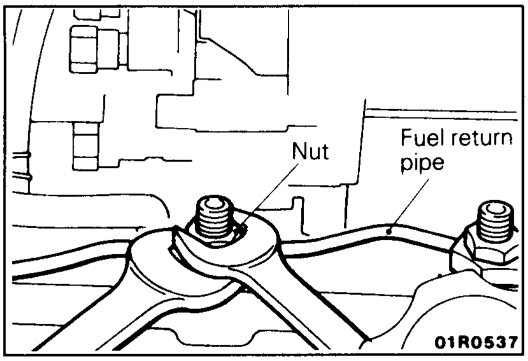


## SERVICE POINTS OF REMOVAL

E13NBAB

### 4. DISCONNECTION OF INJECTION PIPE

When loosening nuts at both ends of injection pipe, hold the other side (pump side-delivery holder, nozzle side-nozzle holder) with wrench and loosen nut.

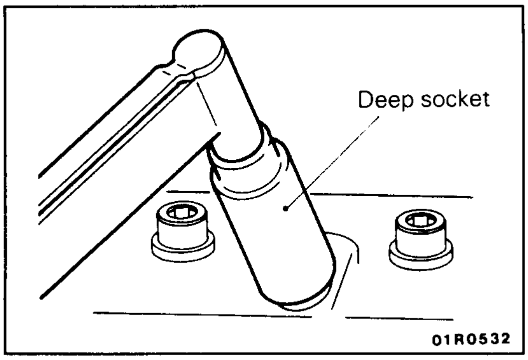


### 7. DISCONNECTION OF FUEL RETURN PIPE

Hold fuel return line hexagon nut with wrench and remove nut.

**Caution**

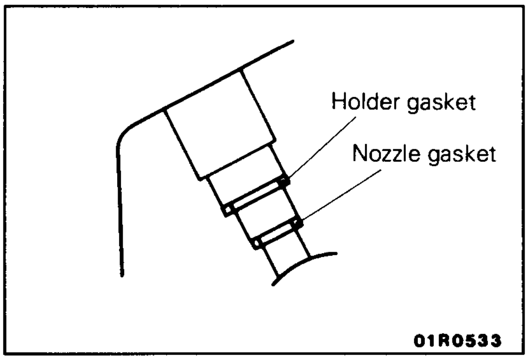
**Loosening nut without holding fuel return line may damage the line. Be sure to hold line.**



### 9. REMOVAL OF NOZZLE HOLDER

**Caution**

**Label cylinder No. on removed injection nozzle holder to ensure correct nozzle to cylinder reassembly.**



## SERVICE POINTS OF INSTALLATION E13NDAB

### 9. INSTALLATION OF NOZZLE HOLDER

(1) Clean cylinder head injection nozzle aperture and install new gasket.

**Caution**

**A defective gasket can cause improper idle rpm.**

(2) Tighten to specified torque with deep socket wrench.

# INJECTION PUMP <4D56>

## REMOVAL AND INSTALLATION

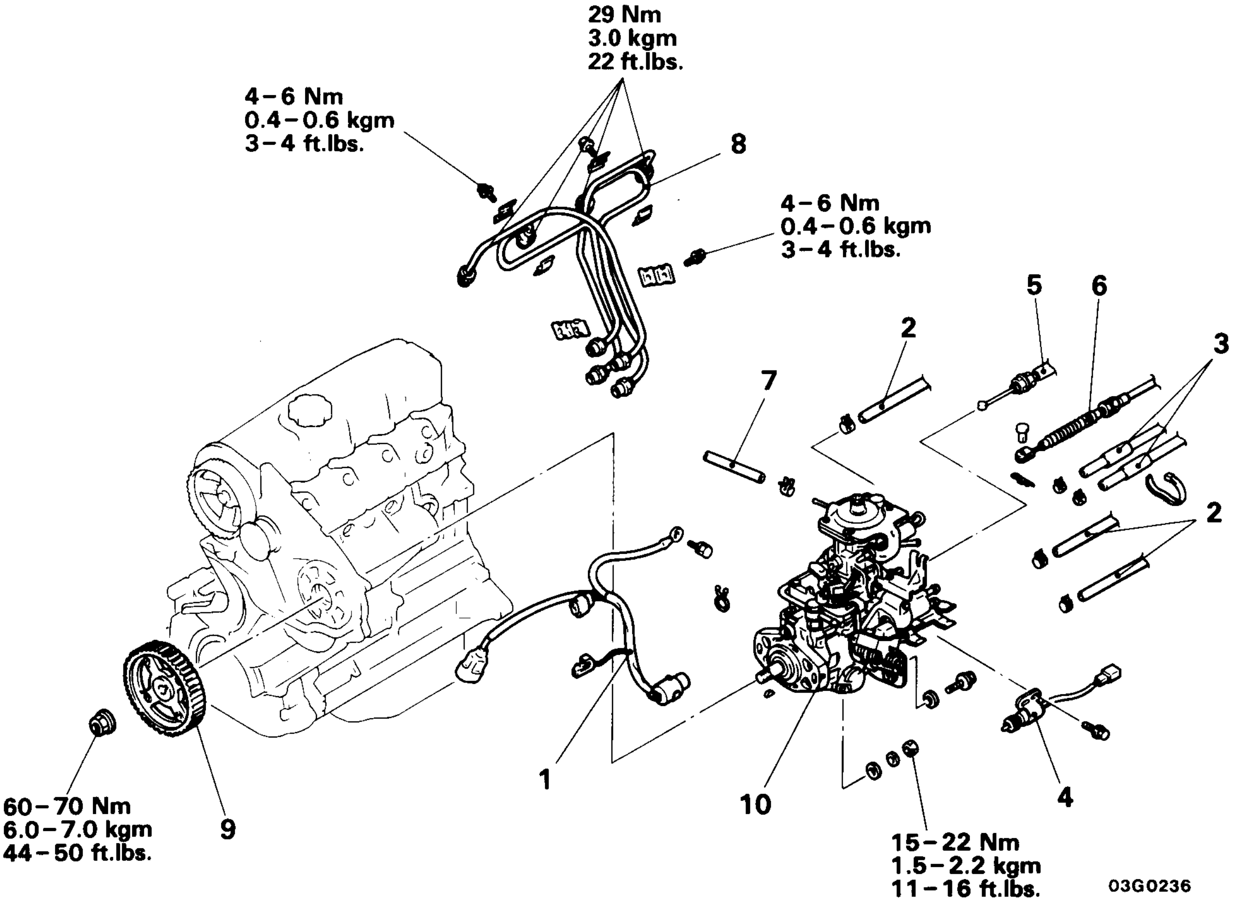
E13MA-

**Pre-removal Operation**

- Draining of Engine Coolant <Vehicles with CSD>
- Removal of the Timing Belt (Refer to GROUP 11 – Timing Belt.)

**Post-installation Operation**

- Supplying of Engine Coolant <Vehicles with CSD>
- Installation of the Timing Belt (Refer to GROUP 11 – Timing Belt.)
- Adjustment of Injection Timing (Refer to GROUP 11 – Service Adjustment Procedures.)
- Adjustment of Accelerator Cable (Refer to P.13-143)
- Adjustment of Throttle Control Cable (Refer to GROUP 23 – Service Adjustment Procedures.)
- Adjustment of Lever Position Switch (Refer to GROUP 55 – Lever Position Switch.)



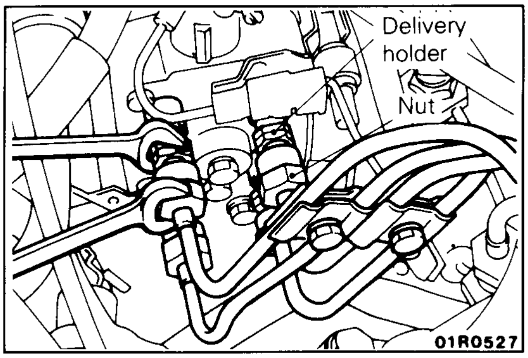
**Removal steps**

1. Fuel injection pump wiring harness
2. Water hose connection <Vehicles with CSD>
3. Fuel hoses
4. Lever position switch <A/T – A/C>
5. Accelerator cable connection
6. Throttle control cable connection <A/T>
7. Boost hose connection

◀▶ ▶◀ 8. Fuel injection pipe

◀▶ 9. Fuel injection pump sprocket

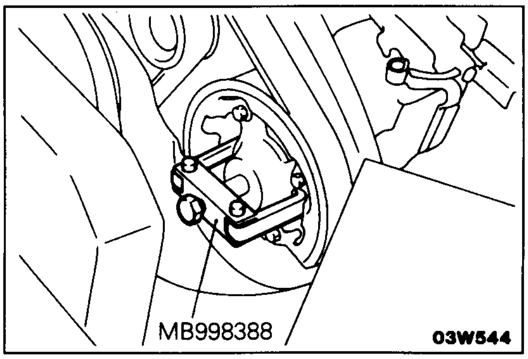
10. Fuel injection pump



## SERVICE POINT OF REMOVAL E13MBAG

### 8. REMOVAL OF INJECTION PIPE

Loosen the nuts at the end of the injection pipe with the correspouding holders (delivery holder for pump side and nozzle holder for nozzle side) relained by a spanner, etc..

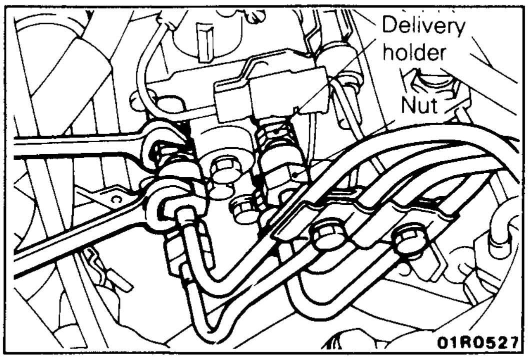


### 9. REMOVAL OF FUEL INJECTION PUMP SPROCKET

Remove sprocket installing nut and remove sprocket from pump drive shaft with special tool.

**Caution**

1. **Do not hit pump drive shaft with hammer, etc.**
2. **When holding injection pump, do not allow to dangle by holding accelerator lever or fast idle lever.**
   **Do not remove these levers. Removal will cause injection pump malfunction.**



## SERVICE POINT OF INSTALLATION E13MDAF

### 8. INSTALLATION OF INJECTION PIPE

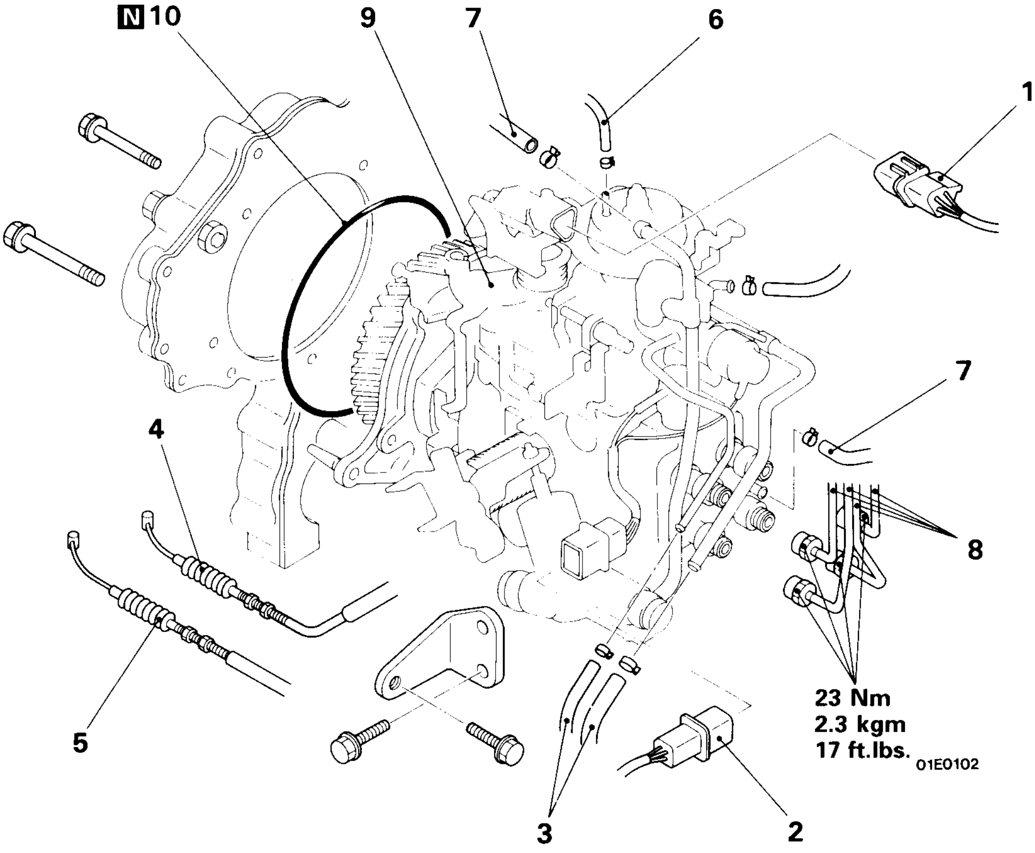
Tighten the nuts at the end of the injection pipe to the specified value with the correspouding holders (delivery holder for pump side and nozzle holder for nozzle side) relained by a spanner, etc..

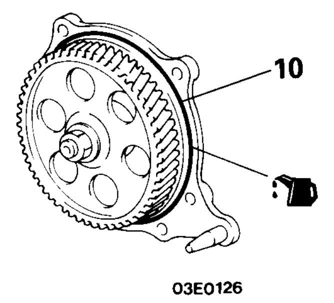
# INJECTION PUMP <4M40>

## REMOVAL AND INSTALLATION

**Pre-removal Operation**
- Draining of Engine Coolant
- Removal of Intercooler
  (Refer to GROUP 15 – Intercooler.)
- Removal of Starter Motor

**Post-installation Operation**
- Adjustment of Injection Timing (Refer to GROUP 11 – Service Adjustment Procedures.)
- Installation of Starter Motor
- Adjustment of Accelerator Cable (Refer to P.13-150-2.)
- Adjustment of Throttle Control Cable
- Supplying of Engine Coolant (Refer to GROUP 14 – Service Adjustment Procedures.)
- Air Bleeding of Fuel Line
- Installation of Intercooler
  (Refer to GROUP 15 – Intercooler)





**Engine oil**

**Removal steps**

1. Throttle position sensor connector
2. Fuel injection pump wiring harness connector
3. Fuel hoses connection
4. Accelerator cable connection
5. Throttle control cable connection
6. Boost hose connection
7. Water hoses connection

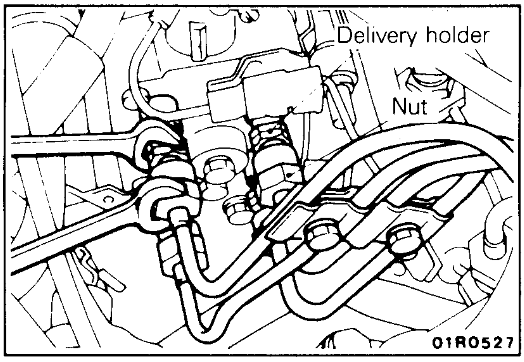
◀▶ ▶◀ 8. Fuel injection pipe

◀▶ ▶◀ 9. Fuel injection pump

10. O-ring

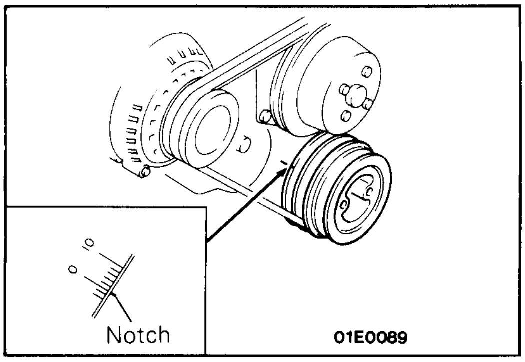
## SERVICE POINTS OF REMOVAL

### 8. REMOVAL OF INJECTION PIPE

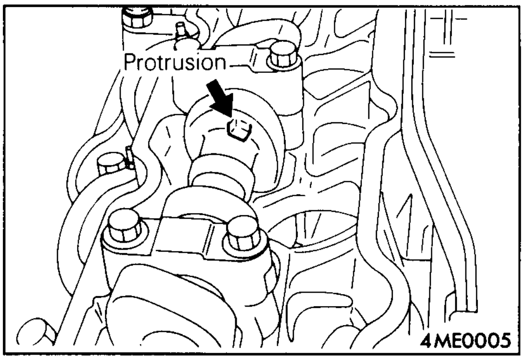


Loosen the nuts at the end of the injection pipe with the corresponding holders (delivery holder for pump side and nozzle holder for nozzle side) retained by a spanner, etc..

### 9. REMOVAL OF FUEL INJECTION PUMP



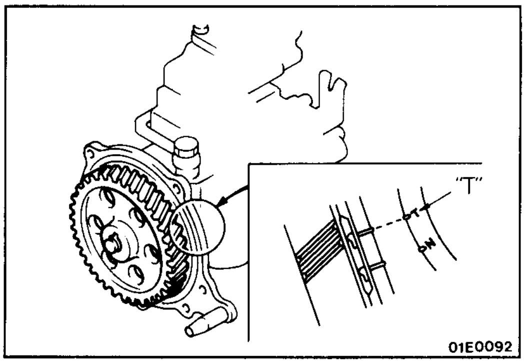
Align the notch of the crankshaft pulley with the "0" timing mark to set the No. 1 cylinder to the compression top dead centre position.



NOTE
If the protrusion on the camshaft is pointing directly upwards when the filler cap is removed, the No. 1 cylinder will be at the compression top dead centre position.

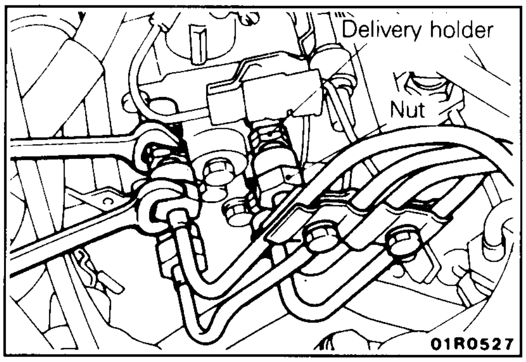
## SERVICE POINTS OF INSTALLATION

### 9. INSTALLATION OF INJECTION PUMP



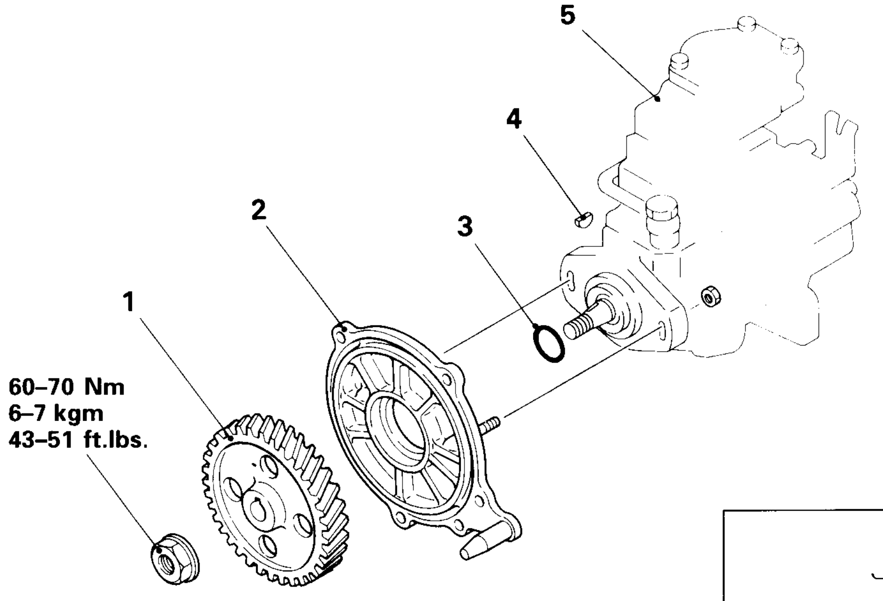
Check that the No. 1 cylinder is at the compression top dead centre position and aligning the notch of the injection pump gear with the "T" mating mark on the flange plate, and then install the injection pump to the timing gear case.

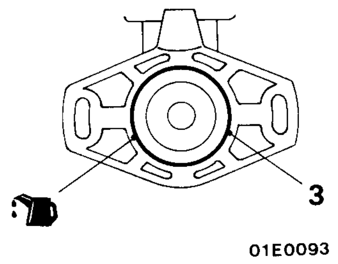
### 8. INSTALLATION OF INJECTION PIPE



Tighten the nuts at the end of the injection pipe to the specified value with the corresponding holders (delivery holder for pump side and nozzle holder for nozzle side) retained by a spanner, etc..

## DISASSEMBLY AND ASSEMBLY

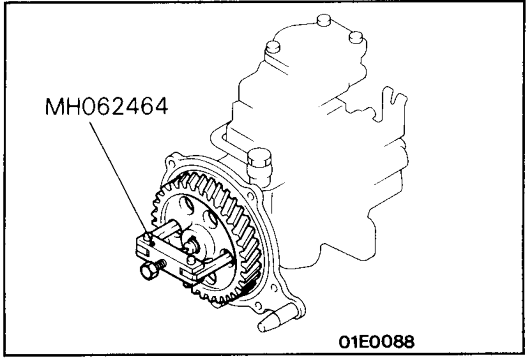




**Engine oil**

### Disassembly steps

◆◆ 1. Injection pump gear
2. Flange plate
3. O ring
4. Key
5. Injection pump



## SERVICE POINTS OF REMOVAL

### 1. REMOVAL OF INJECTION PUMP GEAR

Use the special tool to remove the injection pump gear.

## NOTES

# FUEL TANK

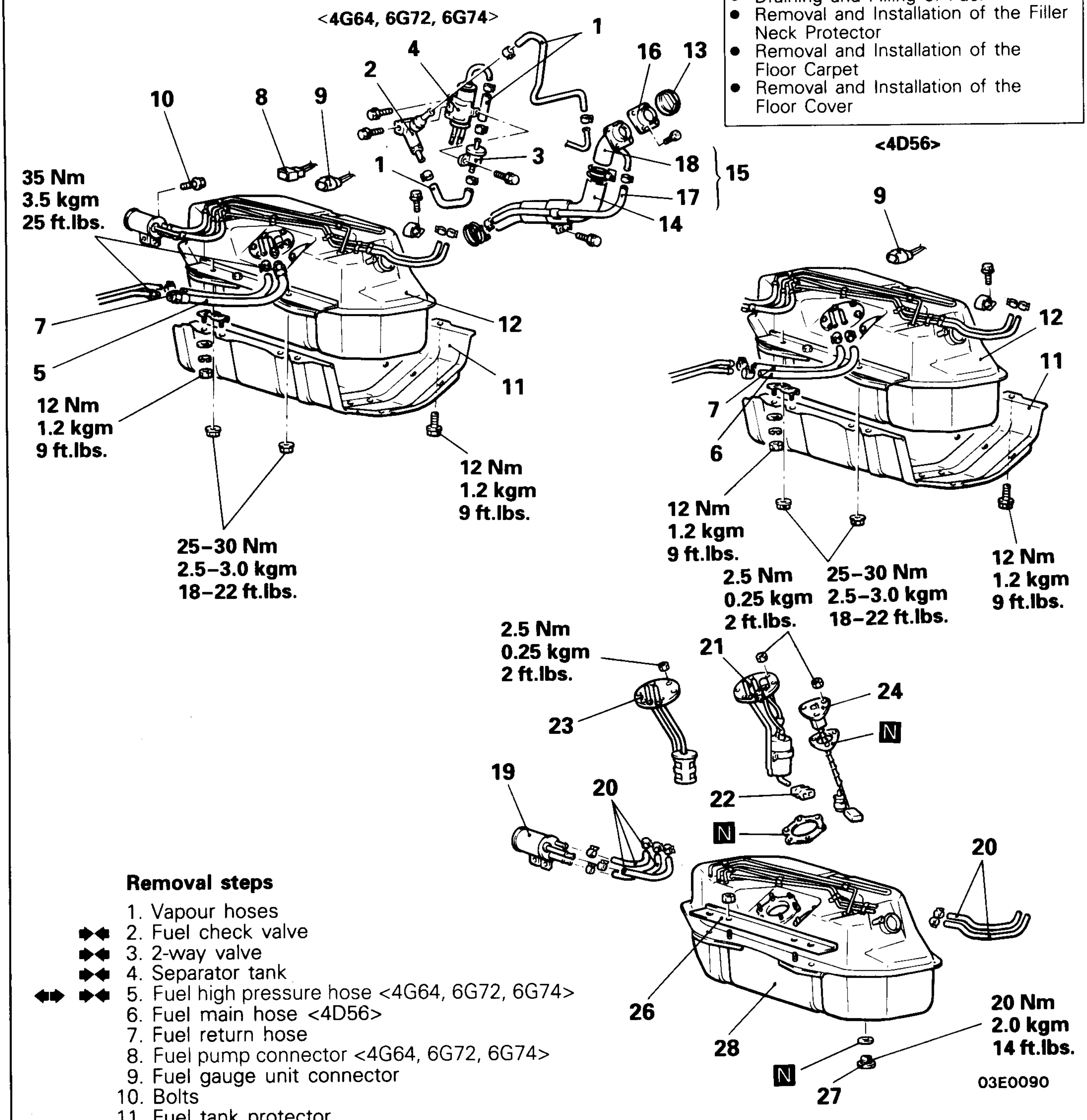
## REMOVAL AND INSTALLATION

E13GA--

**[Vehicles built up to May, 1994]**

**<Standard Wheelbase>**

**Pre-removal and Post-installation Operation**
- Draining and Filling of Fuel
- Removal and Installation of the Filler Neck Protector
- Removal and Installation of the Floor Carpet
- Removal and Installation of the Floor Cover

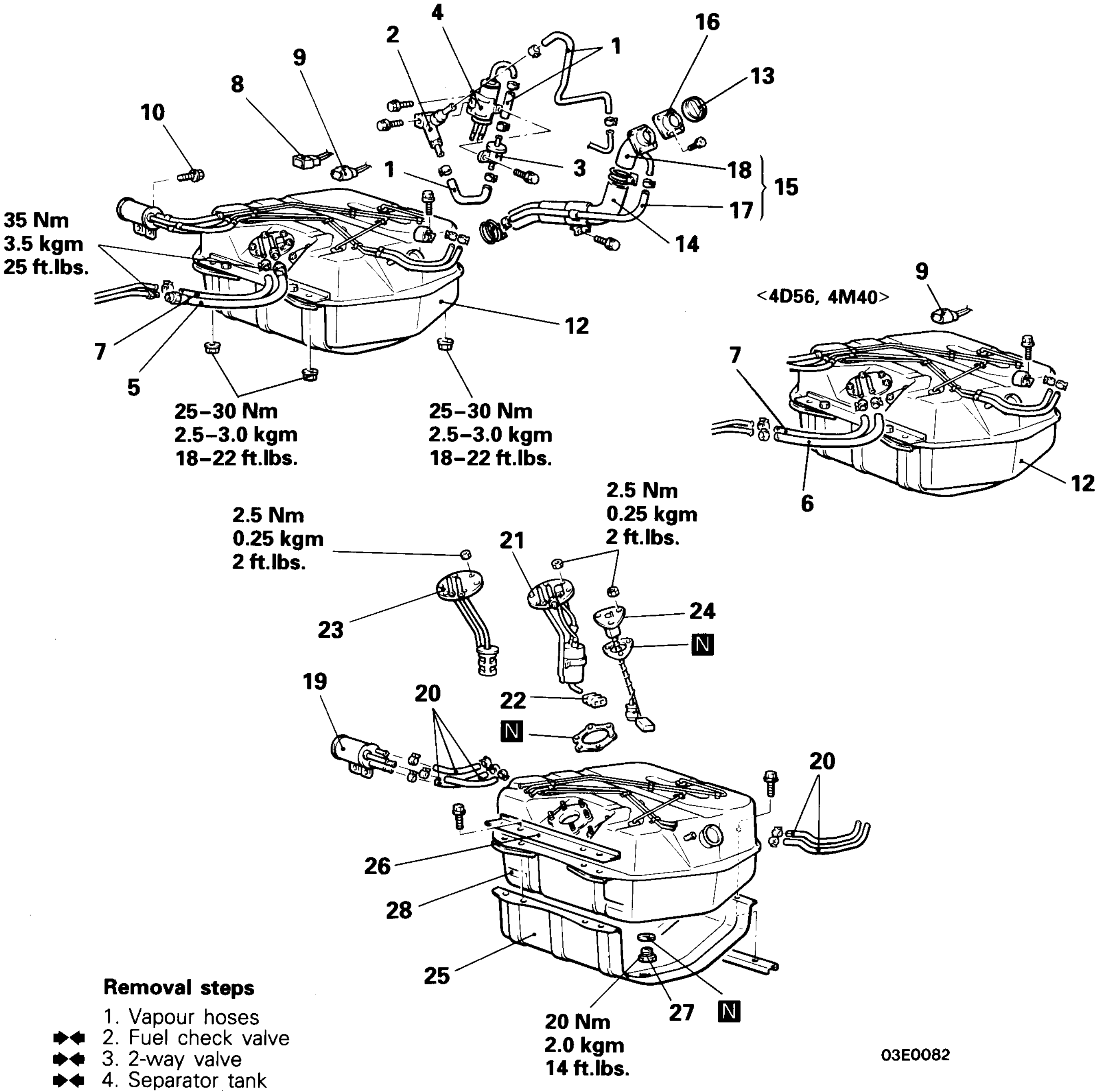


**Removal steps**

1. Vapour hoses
➡◆ 2. Fuel check valve
➡◆ 3. 2-way valve
➡◆ 4. Separator tank
◆➡ ➡◆ 5. Fuel high pressure hose <4G64, 6G72, 6G74>
6. Fuel main hose <4D56>
7. Fuel return hose
8. Fuel pump connector <4G64, 6G72, 6G74>
9. Fuel gauge unit connector
10. Bolts
11. Fuel tank protector
◆➡ 12. Fuel tank assembly
13. Fuel tank cap
14. Fuel filler hose
15. Fuel filler neck and vapour hose assembly
16. Packing
17. Vapour hose
18. Fuel filler neck
➡◆ 19. Separator tank
➡◆ 20. Vapour hoses
21. Fuel pump assembly } <4G64, 6G72, 6G74>
22. Filter
23. Pipe assembly <4D56>
24. Fuel gauge unit
26. Plate
27. Drain plug
28. Fuel tank

### <Long Wheelbase>

**<4G64, 6G72, 6G74>**



**Removal steps**

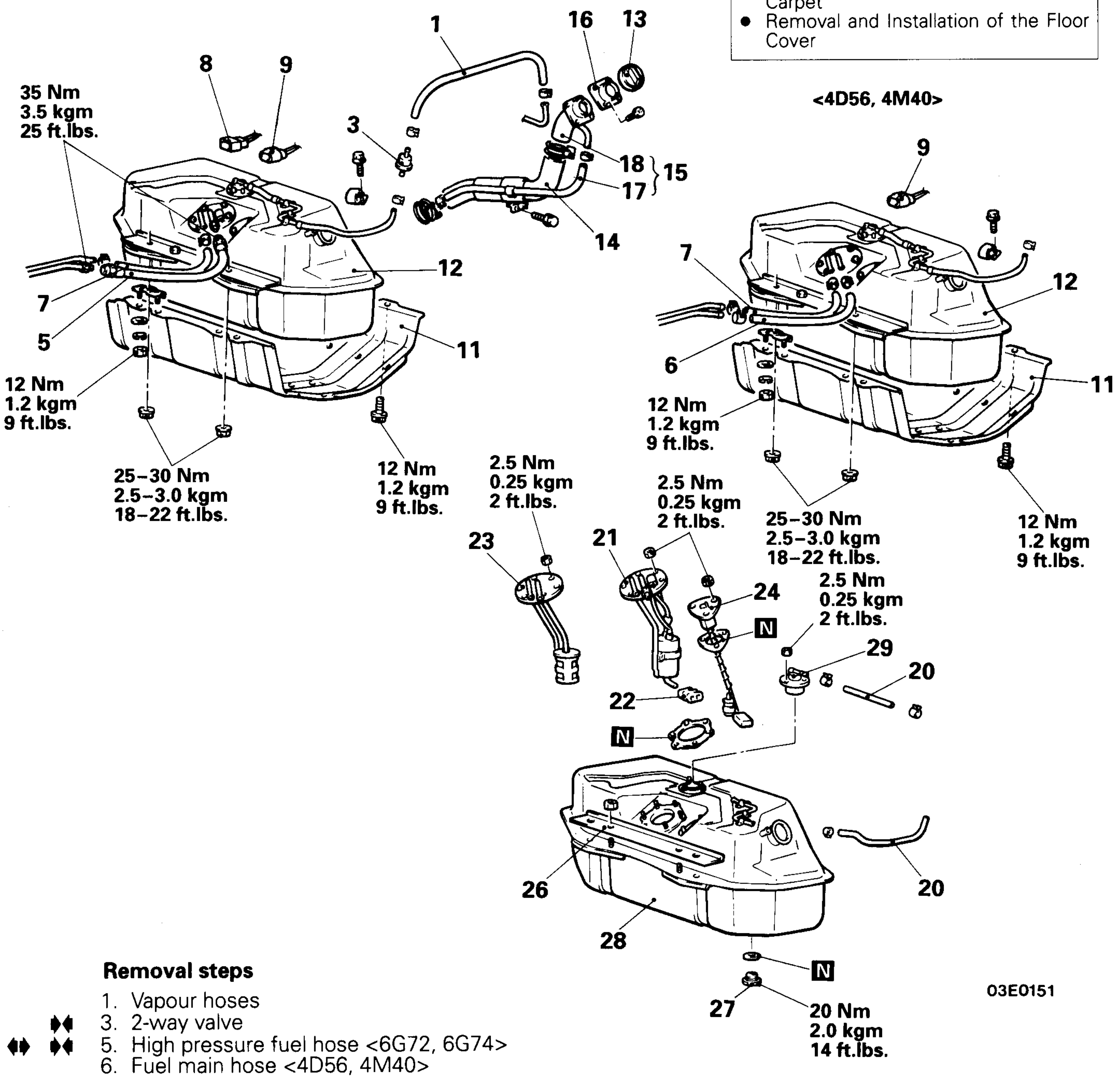
1. Vapour hoses
➡◆ 2. Fuel check valve
➡◆ 3. 2-way valve
➡◆ 4. Separator tank
◆➡ ➡◆ 5. Fuel high pressure hose <4G64, 6G72, 6G74>
6. Fuel main hose <4D56, 4M40>
7. Fuel return hose
8. Fuel pump connector
9. Fuel gauge unit connector
10. Bolt
12. Fuel tank assembly
13. Fuel tank cap
14. Fuel filler hose
15. Fuel filler neck and vapour hose assembly
16. Packing
17. Vapour hose
18. Fuel filler neck
➡◆ 19. Separator tank
➡◆ 20. Vapour hoses
21. Fuel pump assembly } <4G64, 6G72, 6G74>
22. Filter }
23. Pipe assembly <4D56, 4M40>
24. Fuel gauge unit
25. Fuel tank protector
26. Plate
27. Drain plug
28. Fuel tank

## [Vehicles built from June, 1994]

### <Standard Wheelbase>

**Pre-removal and Post-installation Operation**
- Draining and Filling of Fuel
- Removal and Installation of the Filler Neck Protector
- Removal and Installation of the Floor Carpet
- Removal and Installation of the Floor Cover

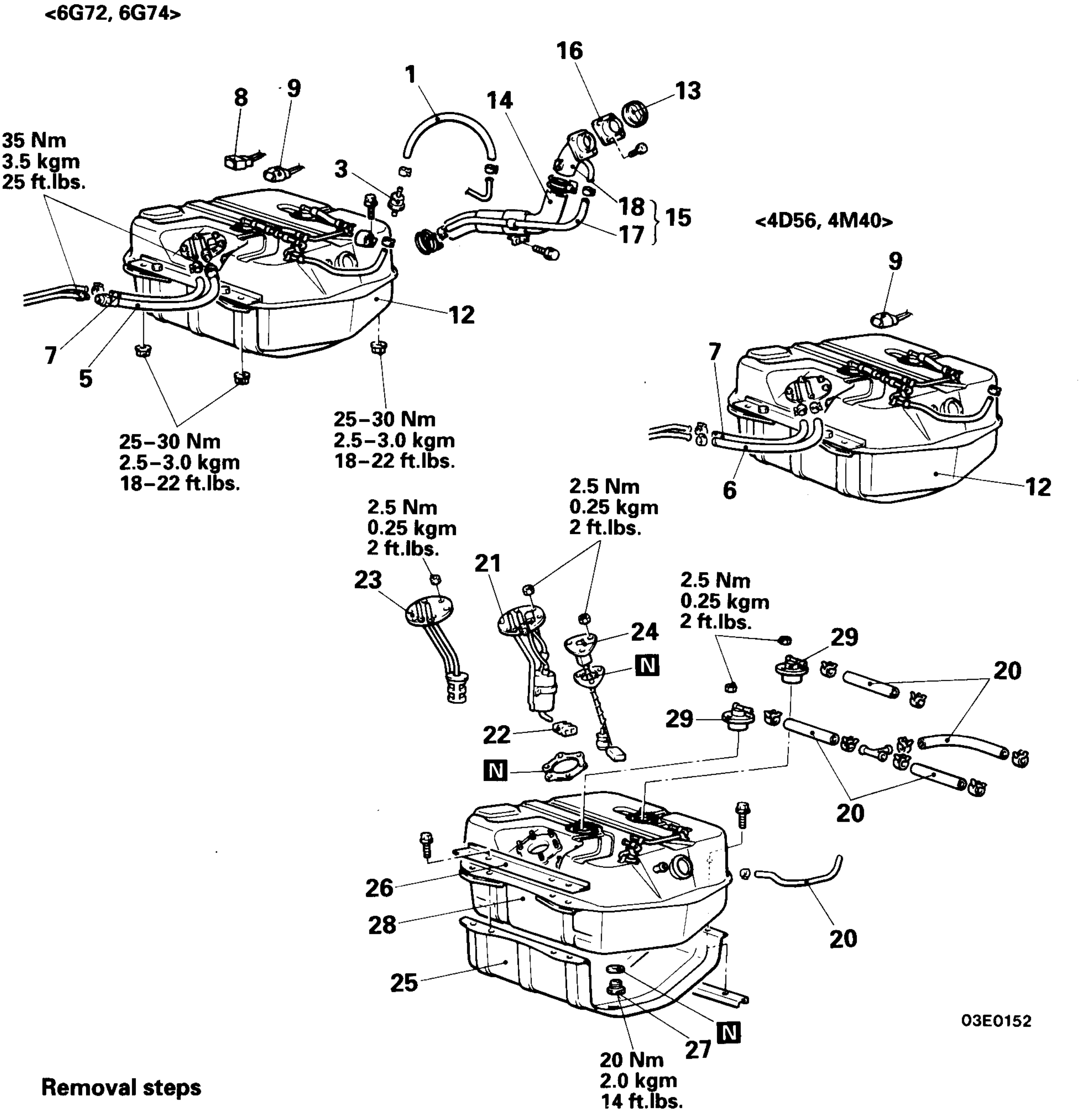
<6G72, 6G74>



**Removal steps**

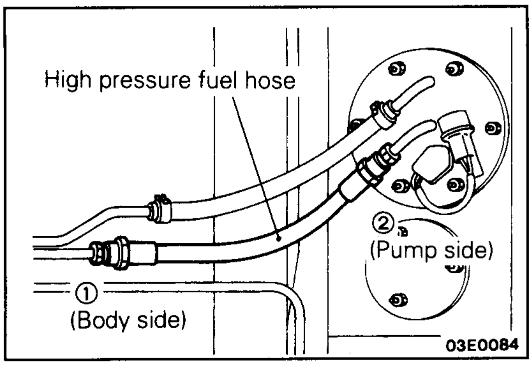
1. Vapour hoses
▶◀ 3. 2-way valve
◀▶ ▶◀ 5. High pressure fuel hose <6G72, 6G74>
6. Fuel main hose <4D56, 4M40>
7. Fuel return hose
8. Fuel pump connector <6G72, 6G74>
9. Fuel gauge unit connector
11. Fuel tank protector
◀▶ 12. Fuel tank assembly
13. Fuel tank cap
14. Fuel filler hose
15. Fuel filler neck and vapour hose assembly
16. Packing
17. Vapour hose
18. Fuel filler neck
▶◀ 20. Vapour hoses
21. Fuel pump assembly } <6G72, 6G74>
22. Filter }
23. Pipe assembly <4D56, 4M40>
24. Fuel gauge unit
26. Plate
27. Drain plug
28. Fuel tank
29. Fuel cut off valve

## <Long Wheelbase>



**Removal steps**

1. Vapour hoses
▶◀ 3. 2-way valve
◀▶ ▶◀ 5. High pressure fuel hose <6G72, 6G74>
6. Fuel main hose <4D56, 4M40>
7. Fuel return hose
8. Fuel pump connector
9. Fuel gauge unit connector
12. Fuel tank assembly
13. Fuel tank cap
14. Fuel filler hose
15. Fuel filler neck and vapour hose assembly
16. Packing
17. Vapour hose
18. Fuel filler neck
▶◀ 20. Vapour hoses
21. Fuel pump assembly } <6G72, 6G74>
22. Filter }
23. Pipe assembly <4D56, 4M40>
24. Fuel gauge unit
25. Fuel tank protector
26. Plate
27. Drain plug
28. Fuel tank
29. Fuel cut off valve



## SERVICE POINTS OF REMOVAL E13GBAN

### 5. REMOVAL OF HIGH PRESSURE FUEL HOSE <4G64, 6G72, 6G74>

After disconnecting the high-pressure fuel hose at the body-side main pipe connection, disconnect the pump-side connection.

**Caution**
**The fuel line has some residual pressure, so cover it with a rag.**

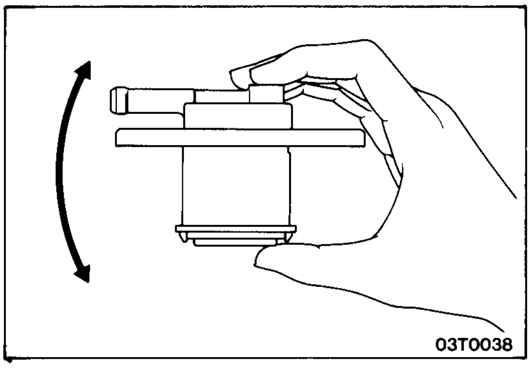
### 12. REMOVAL OF FUEL TANK ASSEMBLY <Standard Wheelbase>

(1) Support the fuel tank with the transmission jack or similar tool.
(2) Remove the fuel tank installation nut and lower the fuel tank.
(3) Disconnect the fuel filler hose and the vapour hose connector of the fuel tank side, and then disconnect the fuel tank.

## INSPECTION E13GCAM

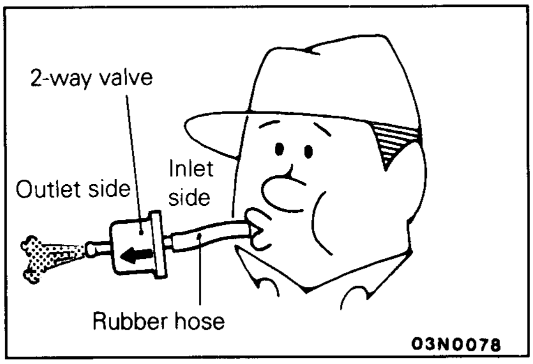
- Check the hoses and the pipes for crack or damage.
- Check the fuel tank cap for malfunction
- Check the fuel tank for deformation, corrosion or crack.
- Check the fuel tank for dust or foreign material.

  NOTE
  If the inside of the fuel tank is to be cleaned, use any one of the following:
  (1) Kerosene
  (2) Trichloroethylene
  (3) A neutral emulsion type detergent
- Check the in-tank fuel filter for damage or clogging.
- Check the check valve for malfunction.



### FUEL CUT OFF VALVE INSPECTION

If the sound of the float valve moving (knocking sound) can be heard when the valve assembly is gently shaken up and down, then the valve is okay.



### CHECKING 2-WAY VALVE

Attach a clean rubber hose, and check the operation of the 2-way valve.

| Inspection procedure | Normal condition |
|---|---|
| Blow lightly from the inlet side (fuel tank side). | Air passes through after a slight resistance is felt. |
| Blow lightly from the outlet side (canister side). | Air passes through. |

## SERVICE POINTS OF INSTALLATION E13GDAZ

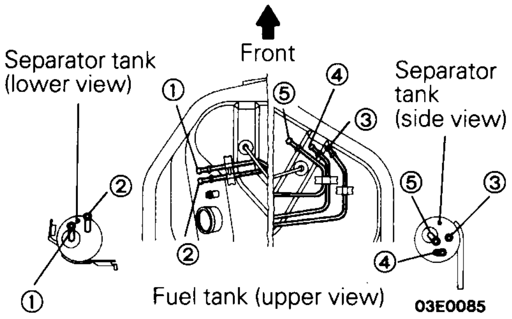
### 20. INSTALLATION OF VAPOUR HOSES/19./4. SEPARATOR TANK <Vehicle built up to May, 1994>

Connect the vapour hoses with the corresponding numbers as shown in the illustration.

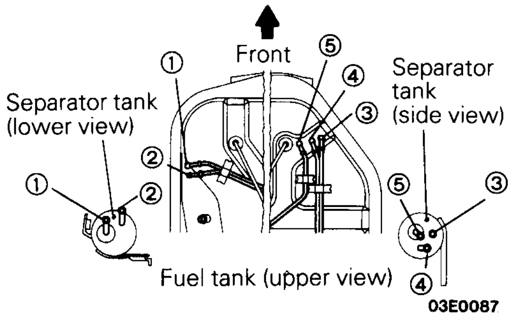
**Caution**

**Connect the vapour hose with the identification mark (yellow tape) between (1)–(1), with the mark towards the separator tank side.**

**<Standard Wheelbase>**

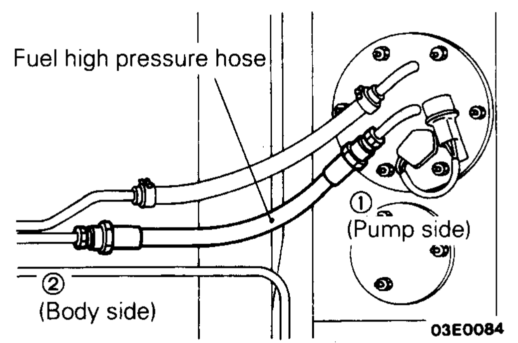


**<Long Wheelbase>**



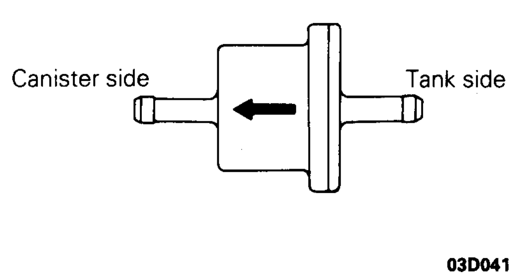
### 5. INSTALLATION OF FUEL HIGH PRESSURE HOSE <4G64, 6G72, 6G74>

After tightening the high pressure fuel hose at the pump side, tighten the connection at the body-side main pipe.



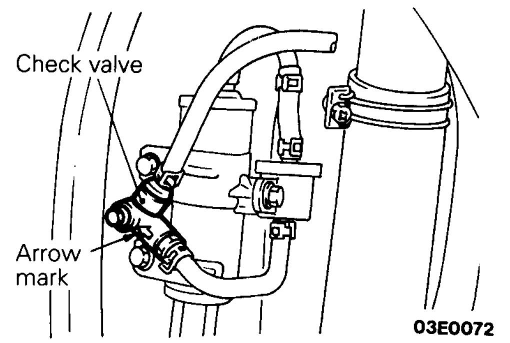
### 3. INSTALLATION OF 2-WAY VALVE

Install the 2-way valve, being careful not to mistake the direction.



### 2. INSTALLATION OF FUEL CHECK VALVE

Install the fuel check valve as shown in the illustration, being careful not to mistake the direction.



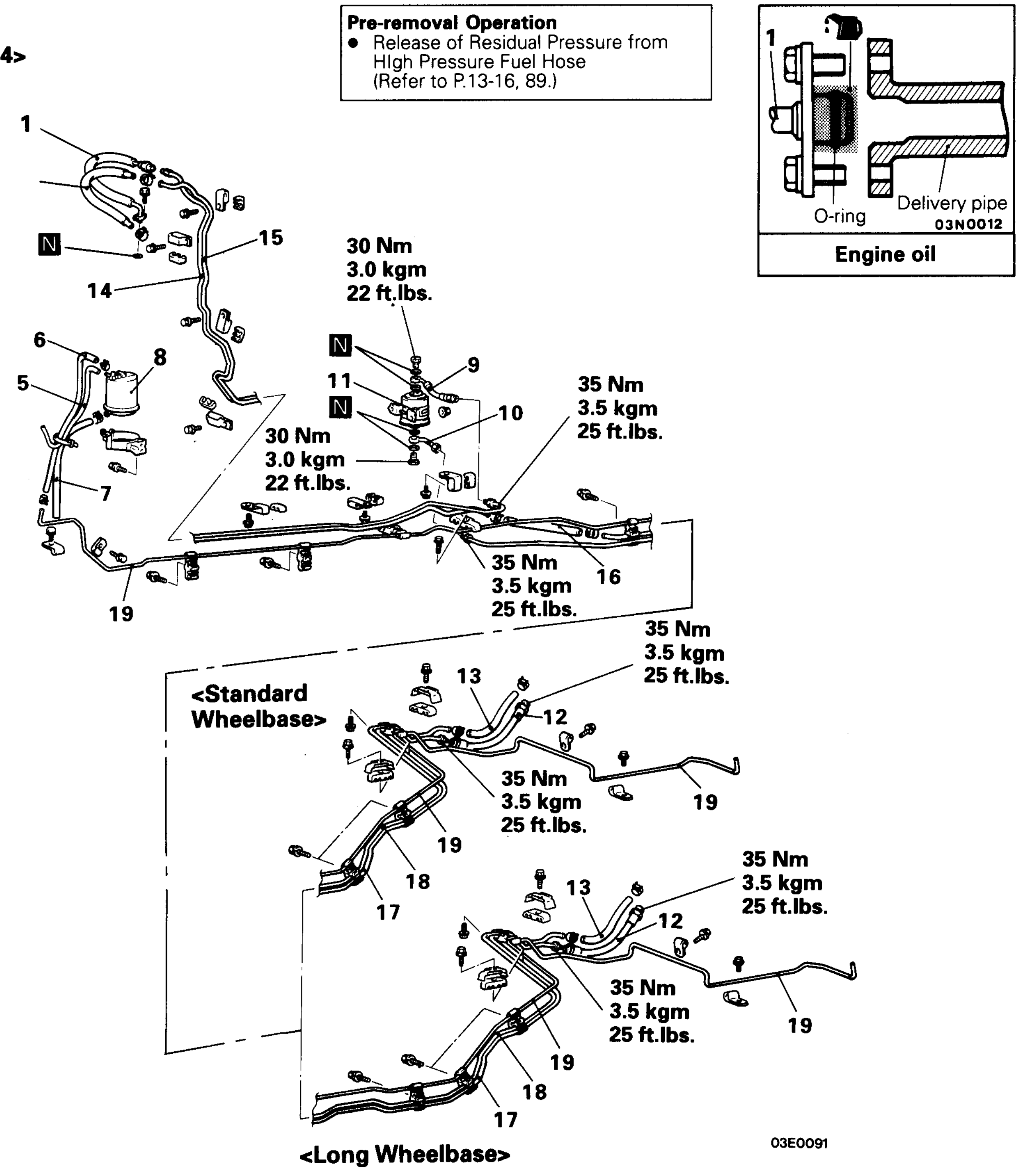
# FUEL LINE AND VAPOUR LINE <4G64, 6G72, 6G74>

## REMOVAL AND INSTALLATION

E13KA-A

**<4G64>**

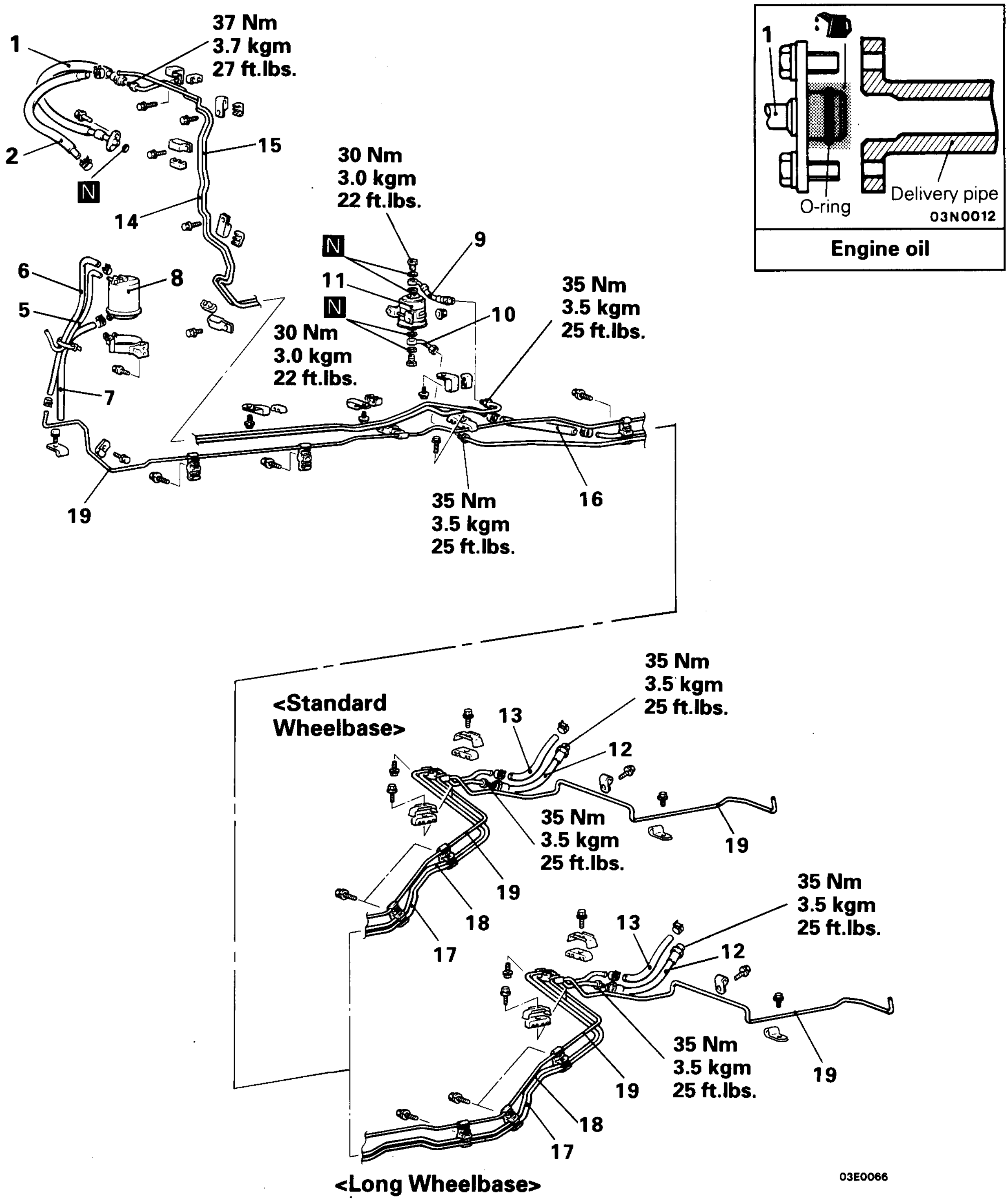
**Pre-removal Operation**
- Release of Residual Pressure from HIgh Pressure Fuel Hose (Refer to P.13-16, 89.)



**Removal steps**

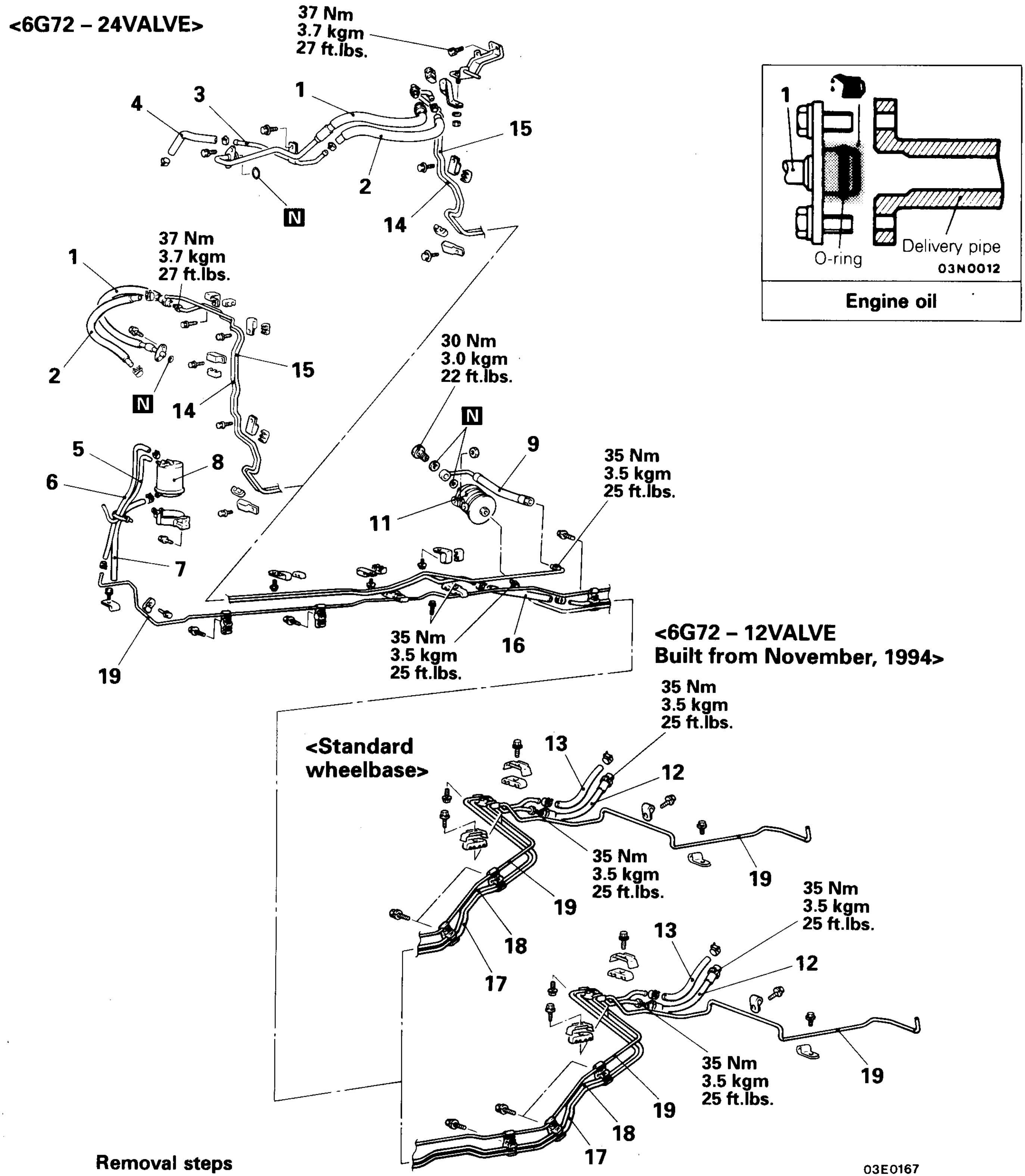
◄► ►◄ 1. High pressure fuel hose
►◄ 2. Fuel return hose
►◄ 5. Fuel vapour hose
►◄ 6. Fuel vapour hose
►◄ 7. Fuel vapour hose
8. Canister
◄► 9. High pressure fuel hose
◄► 10. Joint assembly
11. Fuel filter
◄► 12. High pressure fuel hose
►◄ 13. Fuel return hose
14. Fuel main pipe (front)
15. Fuel return pipe (front)
►◄ 16. Fuel return hose
17. Fuel main pipe (rear)
18. Fuel return pipe (rear)
19. Fuel vapour pipe

### <6G72 – 12 VALVE built up to October, 1993>



**Removal steps**

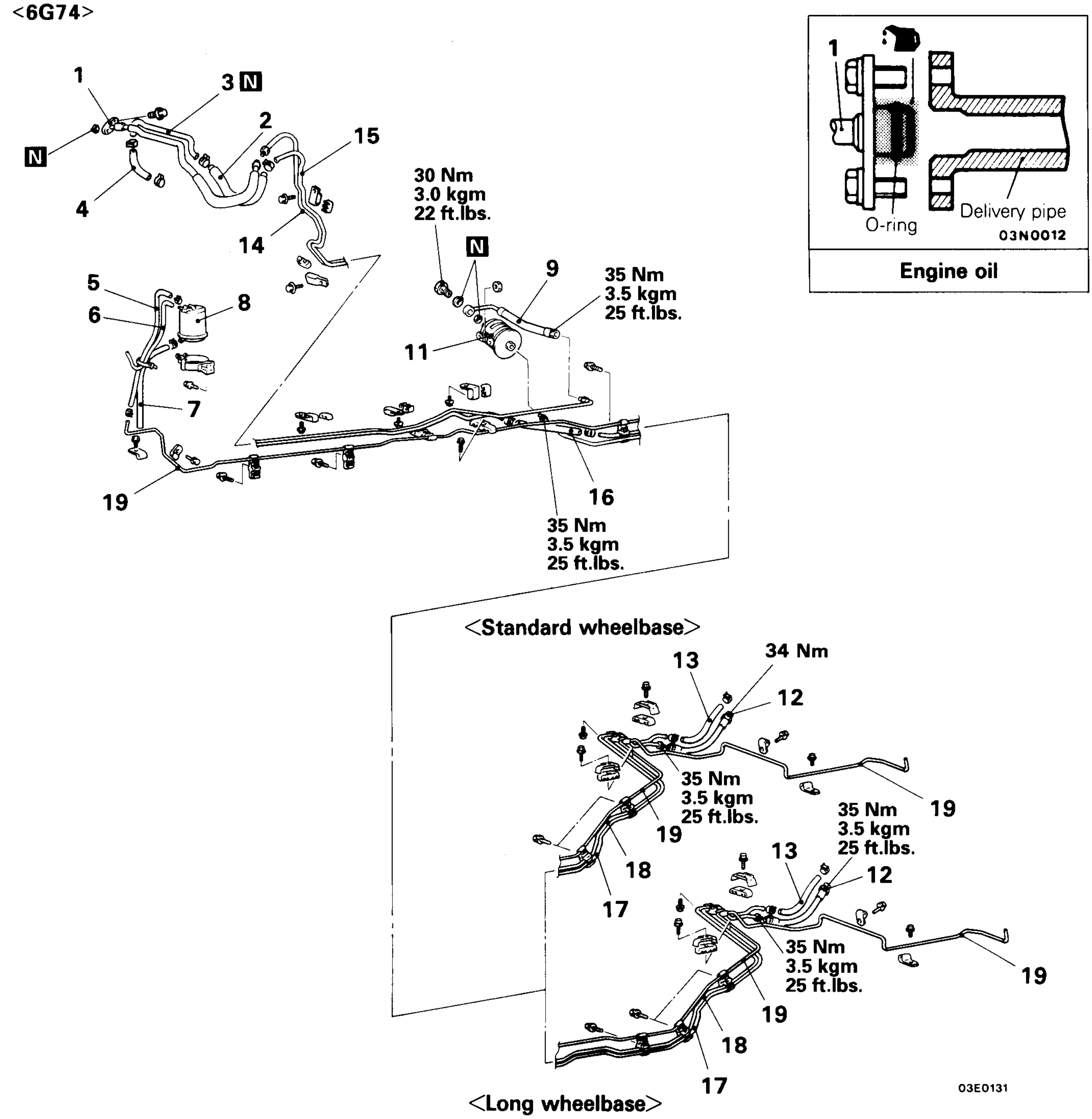
- ◀▶ ▶◀ 1. High pressure fuel hose
- ▶◀ 2. Fuel return hose
- ▶◀ 5. Fuel vapour hose
- ▶◀ 6. Fuel vapour hose
- ▶◀ 7. Fuel vapour hose
- 8. Canister
- 9. High pressure fuel hose
- ◀▶ 10. Joint assembly
- 11. Fuel filter
- ◀▶ 12. High pressure fuel hose
- ▶◀ 13. Fuel return hose
- 14. Fuel main pipe (front)
- 15. Fuel return pipe (front)
- ▶◀ 16. Fuel return hose
- 17. Fuel main pipe (rear)
- 18. Fuel return pipe (rear)
- 19. Fuel vapour pipe



**Removal steps**

◀▶ ▶◀ 1. High pressure fuel hose
▶◀ 2. Fuel return hose
3. Fuel return pipe
▶◀ 4. Fuel return hose
▶◀ 5. Fuel vapour hose
▶◀ 6. Fuel vapour hose
▶◀ 7. Fuel vapour hose
8. Canister
9. High pressure fuel hose
◀▶ 10. Joint assembly
11. Fuel filter
◀▶ 12. High pressure fuel hose
▶◀ 13. Fuel return hose
14. Fuel main pipe (front)
15. Fuel return pipe (front)
▶◀ 16. Fuel return hose
17. Fuel main pipe (rear)
18. Fuel return pipe (rear)
19. Fuel vapour pipe

<6G74>



**Engine oil**

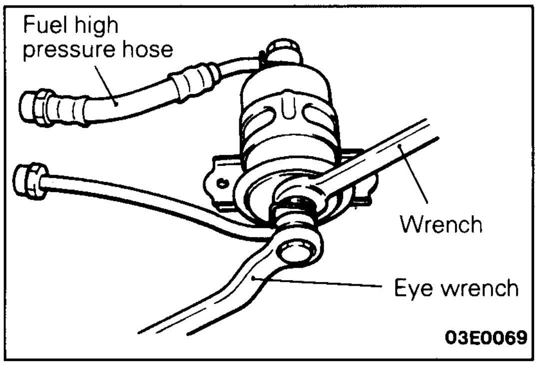
**Removal steps**

◀▶ ▶◀ 1. High pressure fuel hose
▶◀ 2. Fuel return hose
3. Fuel return pipe
▶◀ 4. Fuel return hose
▶◀ 5. Fuel vapour hose
▶◀ 6. Fuel vapour hose
▶◀ 7. Fuel vapour hose
8. Canister
◀▶ 9. High pressure fuel hose
◀▶ 10. Joint assembly
11. Fuel filter
◀▶ 12. High pressure fuel hose
▶◀ 13. Fuel return hose
14. Fuel main pipe (front)
15. Fuel return pipe (front)
▶◀ 16. Fuel return hose
17. Fuel main pipe (rear)
18. Fuel return pipe (rear)
19. Fuel vapour pipe

## SERVICE POINTS OF REMOVAL E13KBAN

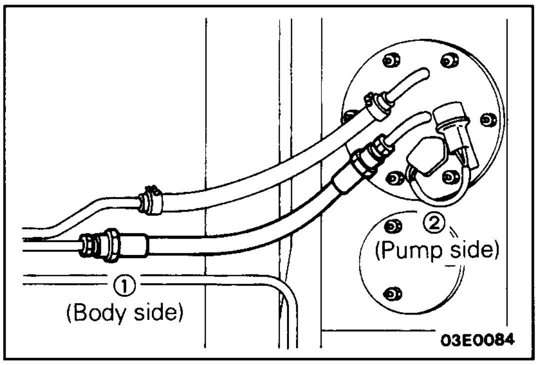
### 1. REMOVAL OF HIGH PRESSURE FUEL HOSE

**Caution**
**Cover the high pressure hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.**



### 9. REMOVAL OF HIGH PRESSURE FUEL HOSE/10. JOINT ASSEMBLY

Hold fuel filter with a wrench and remove eye bolt retaining high pressure fuel hose joint assembly with an eye wrench.

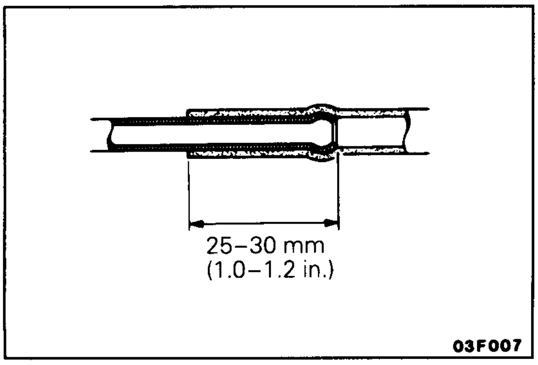


### 12. REMOVAL OF HIGH PRESSURE FUEL HOSE

After disconnecting the high-pressure fuel hose at the body-side main pipe connection, disconnect the pump-side connection.

## INSPECTION E13KCAM

- Check the fuel hoses and pipes for cracks, bend, deformation, deterioration or clogging.
- Check the fuel filter for clogging or damage.
- Check the canister for clogging or damage.



## SERVICE POINTS OF INSTALLATION E13KDBA

### 16./13./4./2. INSTALLATION OF FUEL RETURN HOSE/ 7./6./5. FUEL VAPOUR HOSE

Insert each hose approximately 25–30 mm (1.0–1.2 in.) into the corresponding pipe.

### 1. INSTALLATION OF HIGH PRESSURE FUEL HOSE (DELIVERY PIPE SIDE)

Insert the hose, being careful not to damage the O-ring, and tighten securely.

# FUEL LINE <4D56, 4M40>

## REMOVAL AND INSTALLATION

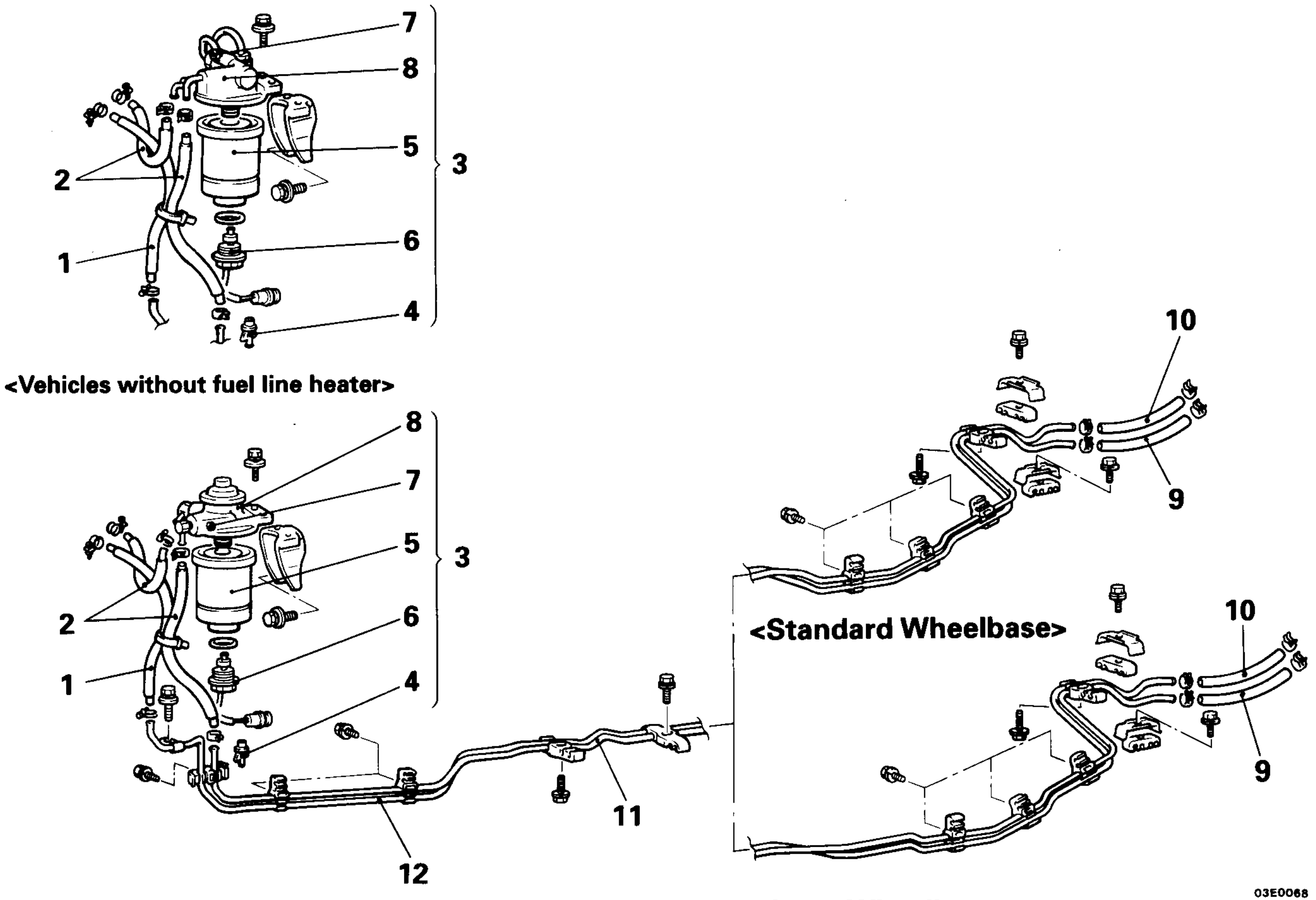
E13KA-B

**Pre-removal Operation**
- Removal of the Intercooler
  (Refer to GROUP 15 – Intercooler)

**Post-installation Operation**
- Installation of the Intercooler
  (Refer to GROUP 15 – Intercooler)
- Air Bleeding of Fuel Line
  (Refer to P.13-144.)

<4D56>

**<Vehicles with fuel line heater>**

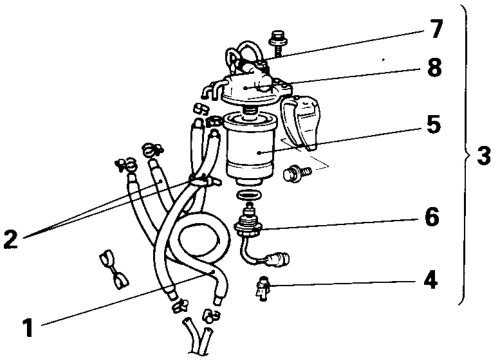


**Removal steps**

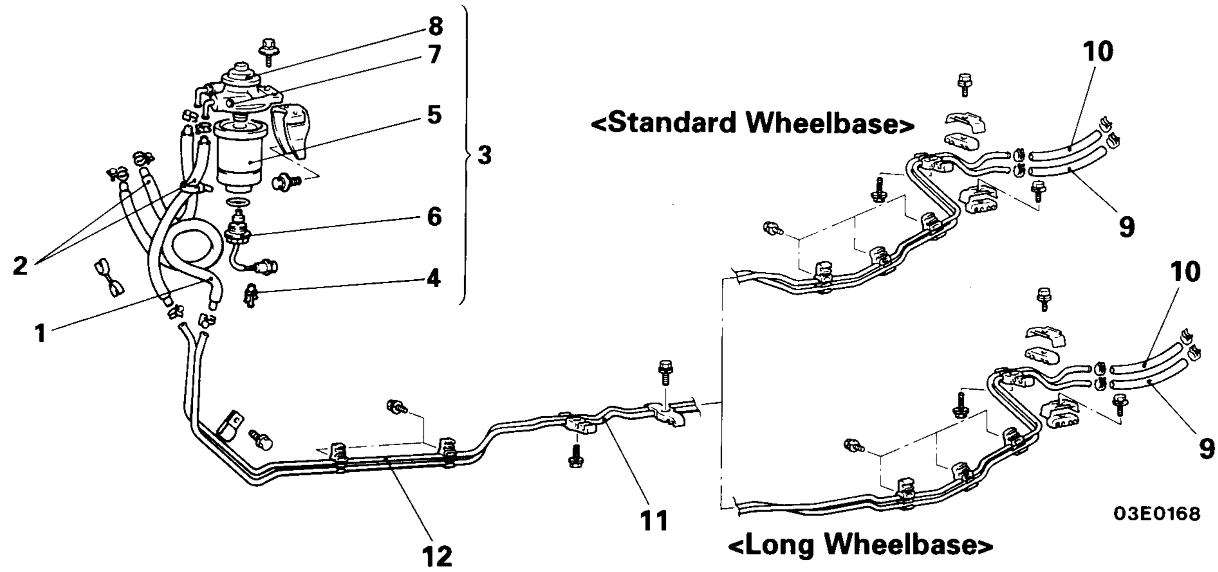
◀▶ ▶◀ 1. Fuel return hose
◀▶ ▶◀ 2. Fuel main hose
3. Fuel filter assembly
4. Drain plug
◀▶ 5. Fuel filter cartridge
◀▶ 6. Water level sensor
7. Air plug
8. Fuel filter pump body
▶◀ 9. Fuel main hose
▶◀ 10. Fuel return hose
11. Fuel main pipe
12. Fuel return pipe

**<4M40>**

**<Vehicles with line heater>**



**<Vehicles without line heater>**



**Removal steps**

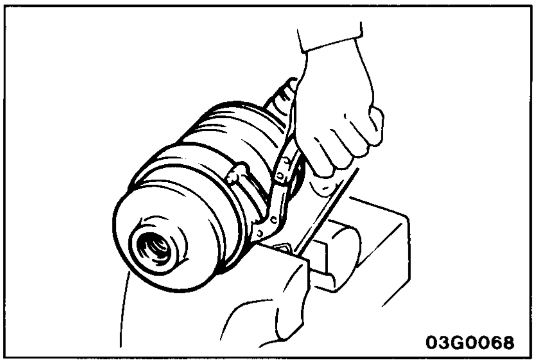
◀▶ ▶◀ 1. Fuel return hose
◀▶ ▶◀ 2. Fuel main hose
3. Fuel filter assembly
4. Drain plug
◀▶ 5. Fuel filter cartridge
◀▶ 6. Water level sensor
7. Air plug
8. Fuel filter pump body
▶◀ 9. Fuel main hose
▶◀ 10. Fuel return hose
11. Fuel main pipe
12. Fuel return pipe

## SERVICE POINTS OF REMOVAL E13KBAO

### 1. REMOVAL OF FUEL RETURN HOSE/2. FUEL MAIN HOSE

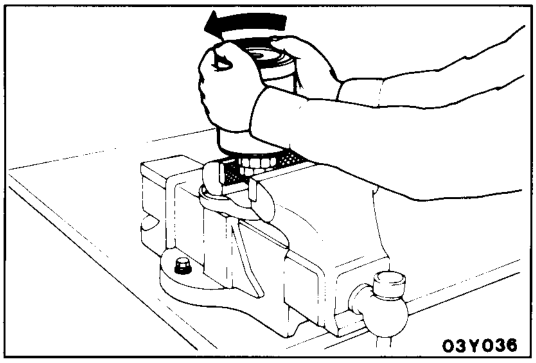
**Caution**

**Cover with a rag to prevent fuel from spraying out.**



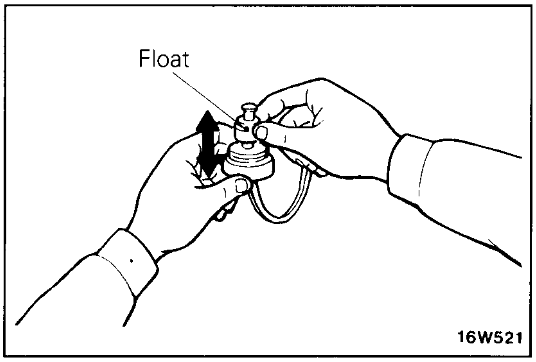
### 5. REMOVAL OF FUEL FILTER CARTRIDGE

Hold fuel filter pump in vice. Remove fuel filter cartridge with oil filter wrench.



### 6. REMOVAL OF WATER LEVEL SENSOR

Hold water level sensor in vice. Remove fuel filter cartridge by hand.



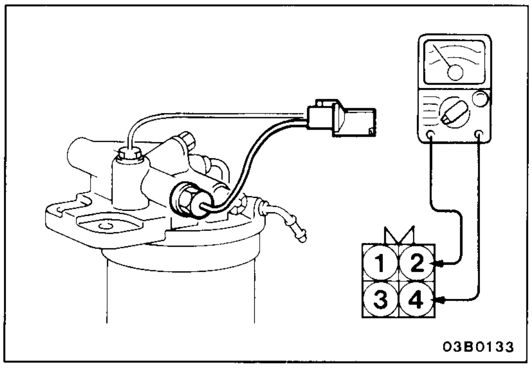
## INSPECTION

E13KCAN

- Check hoses and line for cracks, bends, deterioration or clogging.
- Check fuel filter for clogging or damage.

### WATER LEVEL SENSOR OPERATION

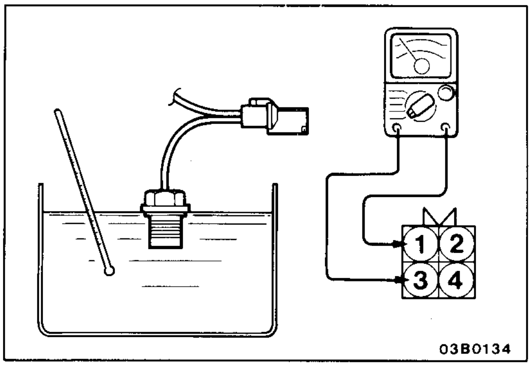
Connect circuit tester to water level sensor connector. Water level sensor is operating correctly if there is continuity when float is raised and no continuity when lowered.



### HEATER <Vehicles with fuel line heater>

Measure resistance between terminals ② and ④ of the heater connector.

**Standard value: 1.3±0.2 Ω**



### FUEL TEMPERATURE SENSOR <Vehicles with fuel line heater>

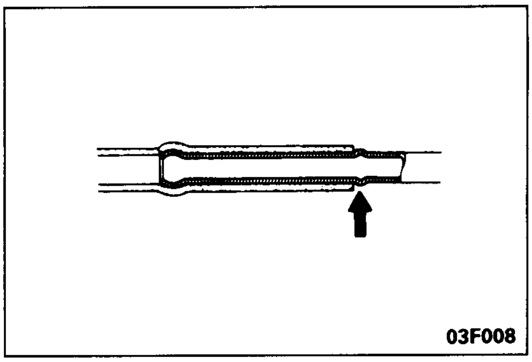
(1) Immerse the fuel temperature sensor in warm water as shown in the illustration.

(2) Check the continuity between terminals ① and ③ with a circuit tester as the temperature of the liquid changes.

**Standard value:**

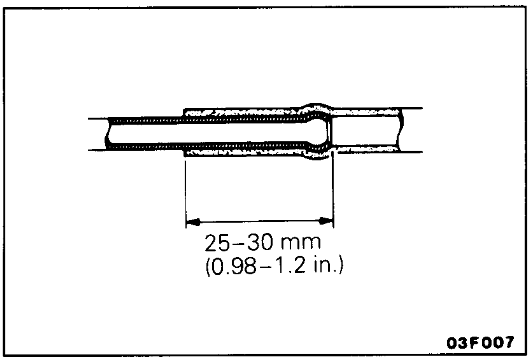
| Temperature °C (°F) | 0 (32) | 10 (50) | 20 (68) |
|---|---|---|---|
| Resistance kΩ | 1.85–2.5 | 3.3–4.6 | 6.0–8.0 |

## SERVICE POINTS OF INSTALLATION E13KDBB



### 10. INSTALLATION OF FUEL RETURN HOSE/9. FUEL MAIN HOSE

Insert each hose securely as far as the stepped section on the pipes.



### 2. INSTALLATION OF FUEL MAIN HOSE/1. FUEL RETURN HOSE

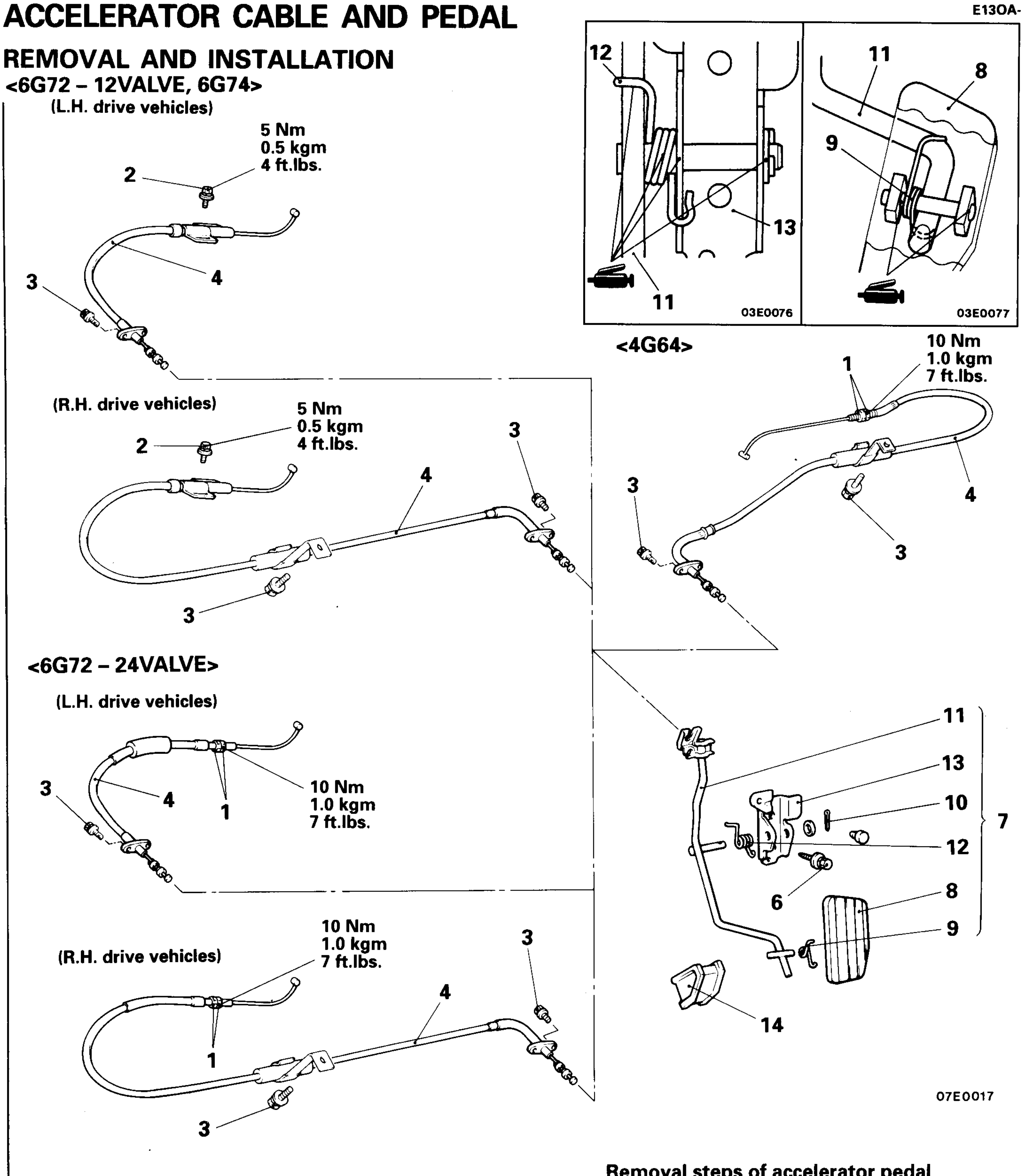
Insert each hose 25–30 mm (1.0–1.2 in.). If the pipe side is too short, insert the hose as far as possible.

# ACCELERATOR CABLE AND PEDAL

E13OA-

## REMOVAL AND INSTALLATION

<6G72 – 12VALVE, 6G74>



### Removal steps of accelerator cable

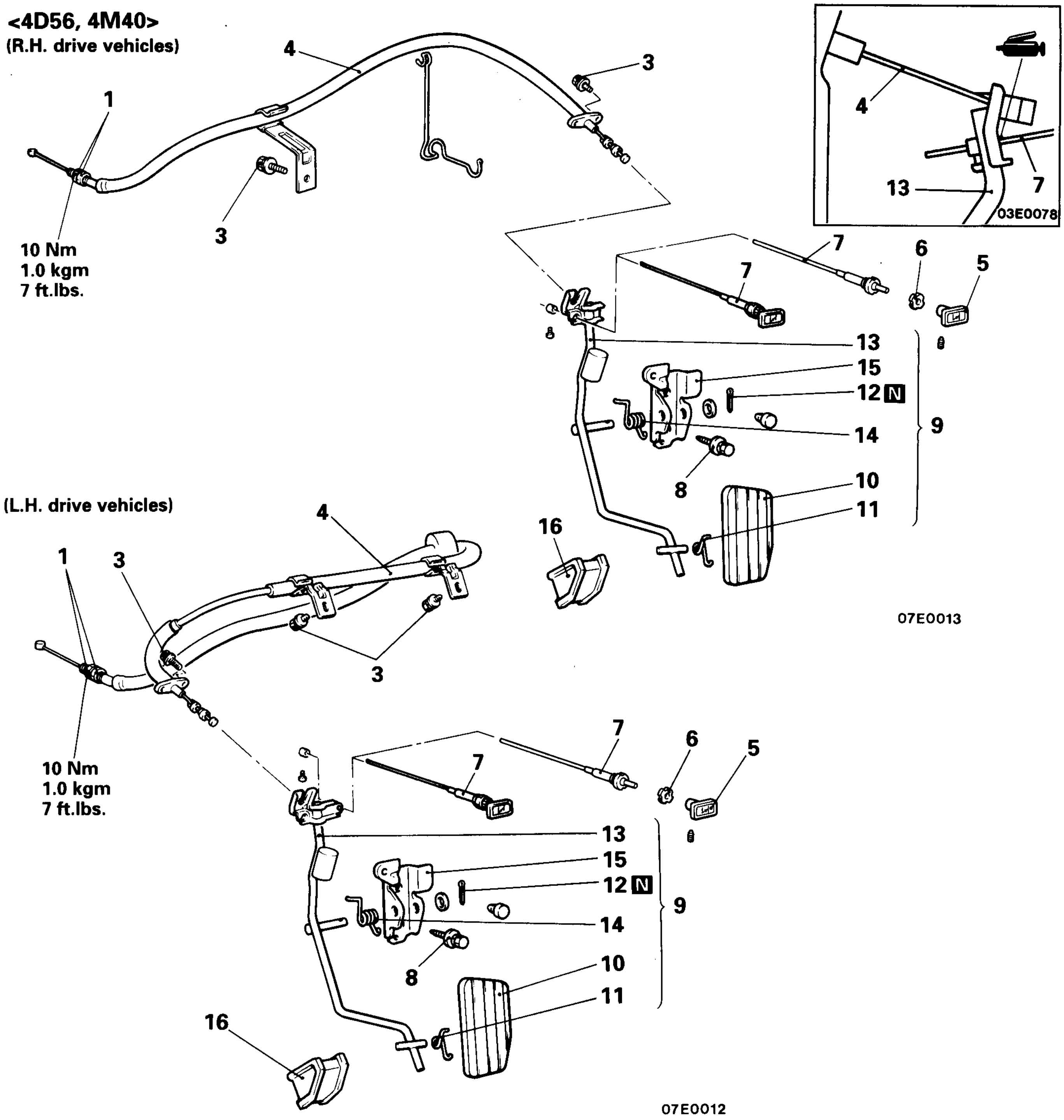
- Adjustment of accelerator cable (Refer to P.13-14, 89.)

1. Accelerator cable adjusting nuts
2. Accelerator cable adjusting bolts
3. Accelerator cable mounting bolts
4. Accelerator cable

### Removal steps of accelerator pedal

6. Accelerator arm bracket mounting bolts
7. Accelerator pedal assembly
8. Pedal
9. Spring
10. Split pin
11. Accelerator arm
12. Return spring
13. Accelerator arm bracket
14. Stopper

## <4D56, 4M40>



### Removal steps of accelerator cable

- Intercooler
  (Refer to GROUP 15 – Intercooler)
- Adjustment of accelerator cable
  (Refer to P.13-143, 150-2.)

1. Accelerator cable adjusting nuts
3. Accelerator cable mounting bolts
4. Accelerator cable

### Removal steps of accelerator pedal

5. Nob } (Vehicles built from June 1991)
6. Nut } (Vehicles built from June 1991)
7. ▶◀ Idle control cable
8. Accelerator arm bracket mounting bolts
9. Accelerator pedal assembly
10. Pedal
11. Spring
12. Split pin
13. Accelerator arm
14. Return spring
15. Accelerator arm bracket
16. Stopper

## INSPECTION

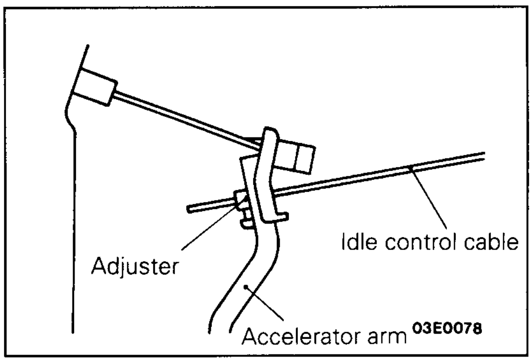
E13OCAM

- Check inner cable for damage.
- Check outer cable for damage.
- Check sliding condition of cable.
- Check accelerator arm bend.
- Check return spring for wear.
- Check connection of inner cable and end metal fittings.

## SERVICE POINTS OF INSTALLATION

E13ODAP

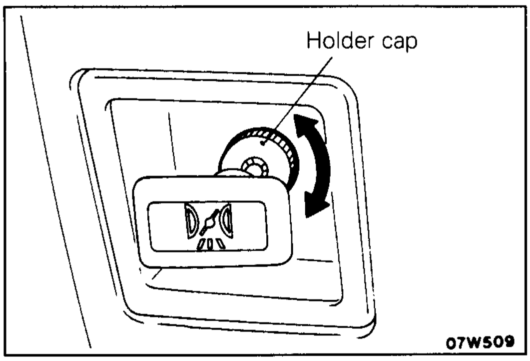
### 7. INSTALLATION OF IDLE CONTROL CABLE



(1) With the idle control knob pushed in fully, move the adjuster until there is no play in the idle control cable, and then tighten the cable.

**Caution**

**Check that there is no tension on the accelerator arm from the idle control cable.**



(2) Adjust the holder cap so that when the idle control knob is pulled out by hand fully and then released, the knob moves back no more than 10 mm (0.4 in.).

(Vehicles built up to May 1991)

# AUTO-CRUISE CONTROL SYSTEM

## SPECIFICATIONS

### GENERAL SPECIFICATIONS

E13CA--

| Items | | Specifications |
|---|---|---|
| Main switch | | |
| Rated load | A | 1 |
| Voltage drop | V | 0.15 or less |
| Control switch | | |
| Rated load | A | |
| SET | | 0.1 |
| RESUME | | 0.1 |
| CANCEL | | 1.2 |
| Voltage drop | V | 0.2 or less |
| Auto-cruise control unit | | |
| Set error | km/h (mph) | $0^{0}_{-1.0}$ $(0^{0}_{-0.6})$ |
| Range of speed control | km/h (mph) | 40–200 (25–125) |
| Actuator | | |
| Drive system | | Vacuum type |
| Stroke | mm (in.) | 38–42 (1.5–1.7) |
| Motor-driven vacuum pump | | |
| Rated load | A | 0.4 or less |

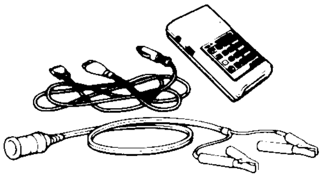
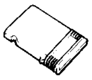
### SERVICE SPECIFICATIONS

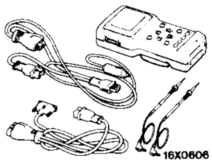
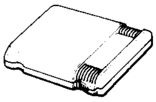
E13CB--

| Items | | Specifications |
|---|---|---|
| Accelerator cable play | mm (in.) | 0–1 (0–0.04) |
| Throttle cable play | mm (in.) | 1–2 (0.04–0.08) |
| Auto-cruise control cable play | mm (in.) | 1–2 (0.04–0.08) |
| Control valve, release valve resistance | Ω | 50–60 |

## SPECIAL TOOLS

E13DA--

| Tool | Number | Name | Use |
|---|---|---|---|
|  | MB991341 | Multi-use tester assembly | Vehicles built up to October, 1993<br>● Checking of the self-diagnosis output |
|  | MB991419 | ROM pack | |

| Tool | Number | Name | Use |
|---|---|---|---|
| <br>16X0606 | MB991502 | MUT-II | All models<br>● Checking of the diagnostic output |
| <br>16X0607 |  | ROM pack |  |

## NOTES

# TROUBLESHOOTING <AUTO-CRUISE CONTROL SYSTEM>

E13EDACa

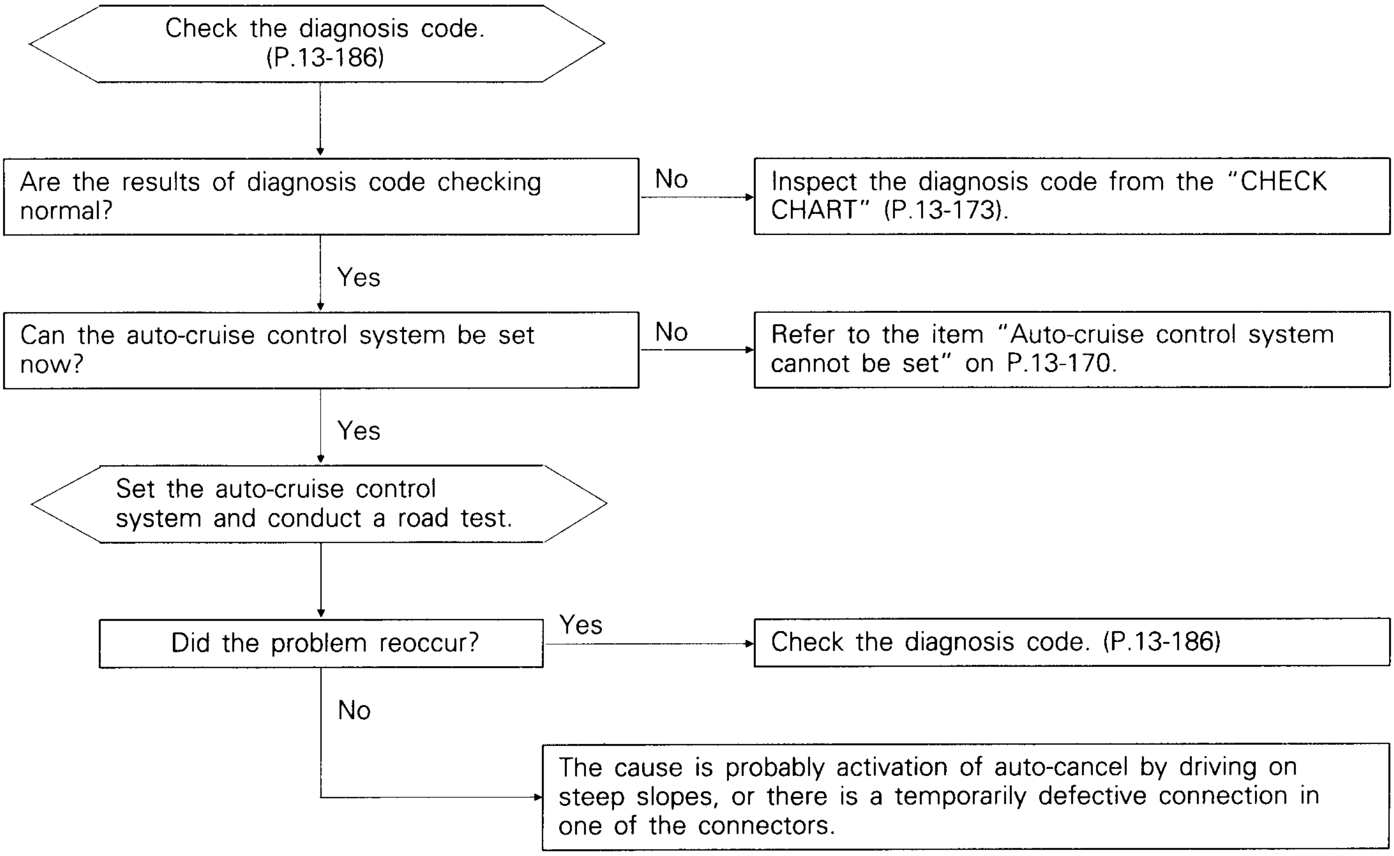
Before commencing troubleshooting, carry out each of the following inspections, and make repairs if necessary.

1. Check that the motor-driven vacuum pump assembly, actuator, intermediate link, each cable and the vacuum hose are all installed correctly, and that each cable and vacuum hose circuit is correct.
2. Check that the movement of the intermediate link and each cable is smooth.
3. Check that there is not too much play or tension in each cable.

## TROUBLESHOOTING QUICK-REFERENCE CHART

**Auto-cruise control system is canceled when cancellation not wanted.**
**Or, the auto-cruise control system cannot be set after an automatic cancellation.**

ECU: Electronic control unit



**Auto-cruise control system cannot be set.**

NOTE
This chart is to be used, then, for troubleshooting if it is not possible to use the self-diagnosis for checking.

Prepare to conduct input checking. (P.13-187)

Are the results of all input checks normals?

Yes

No

| Check results | Probable cause | Remedy | Check chart No. |
|---|---|---|---|
| Code 21 remains even though SET switch is set to OFF. | SET switch ON malfunction | Replace the control switch. | No. 2 |
| | SET switch input line short-circuit | Repair the harness. | |
| Code 22 remains even though RESUME switch is set to OFF. | RESUME switch ON malfunction | Replace the control switch. | No. 3 |
| | RESUME switch input line short-circuit | Repair the harness. | |
| Code 23 remains even if the stop lamp switch is turned OFF by releasing the brake pedal. | Malfunction of stop lamp switch circuit. | Replace stop lamp switch or repair harness. | No. 7 |
| Code 25 remains, and code 24 does not appear, even though vehicle speed reaches approximately 40 km/h (25 mph) or higher. | Malfunction of the vehicle-speed sensor circuit (damaged or disconnected wiring, or short-circuit) | Check or repair the vehicle speed sensor circuit. | No. 5 |
| Code 26 remains even if the clutch switch is turned OFF by releasing the clutch pedal. <M/T> | Malfunction of clutch switch circuit. | Replace clutch switch or repair harness. | No. 8 |
| Code 26 remains even if the selector lever is moved to anything but N, P. <A/T> | Malfunction of inhibitor switch circuit. | Replace inhibitor switch or repair harness. | No. 9 |
| Code 27 remains even though CANCEL switch is set to OFF. | Malfunction of CANCEL switch circuit. | Replace the control switch or repair harness. | No. 4 |
| Code 28 remains even if the accelerator is released. <3000> | Malfunction of throttle position sensor circuit. | Replace the sensor or repair harness. | No. 11 |
| Code 29 remains even though the idle switch is set to ON. <3000> | Malfunction of idle switch circuit | Replace the switch or repair harness. | No. 11 |

Check the motor-driven vacuum pump circuit. (Go to check chart No. 6)

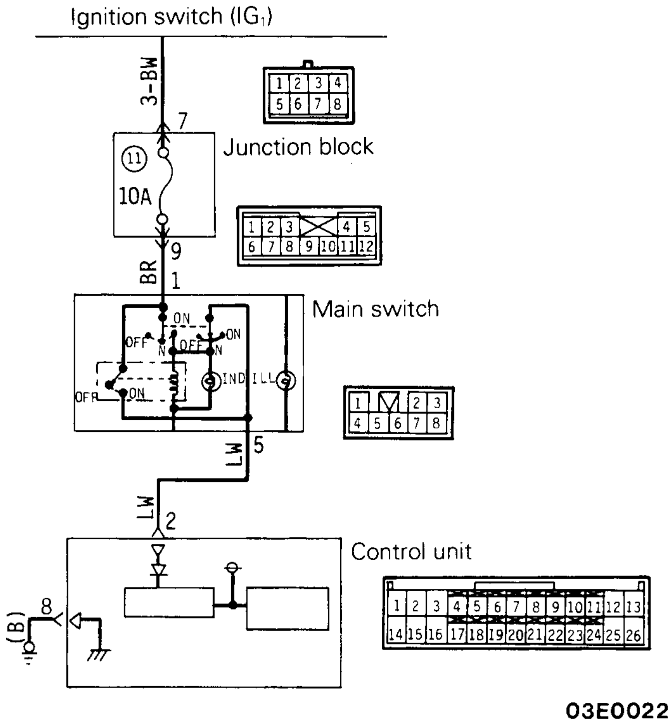
NOTE
If the results of the check of the motor-driven vacuum pump circuit (check chart No. 6) and actuator reveal no abnormal condition, replace the electronic control unit (ECU).

| Trouble symptom | Probable cause | Check chart No. | Remedy |
|---|---|---|---|
| • The set vehicle speed varies greatly upward or downward.<br>• "Hunching" (repeated alternating acceleration and deceleration) occurs after setting is made. | Malfunction of the vehicle speed sensor circuit | No. 5 | Repair the vehicle speed sensor system, or replace the part. |
| | Malfunction of the speedometer cable or speedometer drive gear | | |
| | Motor-driven vacuum pump circuit poor contact | No. 6 | Repair the motor-driven vacuum pump or replace the part. |
| | Malfunction of the motor-driven vacuum pump | | |
| | Malfunction of the ECU | — | Replace the ECU. |
| The auto-cruise control system is not canceled when the brake pedal is depressed. | Damaged or disconnected wiring of the stop lamp switch input circuit or stop lamp switch (for auto-cruise control) poor contact (short-circuit) | If the input check code No. 23 indicates a malfunction, see the check chart No. 7 | Repair the harness or replace the stop lamp switch. |
| | Motor-driven vacuum pump drive circuit short-circuit | No. 6 | Repair the harness or replace the motor-driven vacuum pump. |
| | Malfunction of the ECU | — | Replace the ECU. |
| The auto-cruise control system is not canceled when the clutch pedal is depressed. <M/T><br>(It is canceled, however, when the brake pedal is depressed.) | Damaged or disconnected wiring of clutch switch input circuit | If the input check code No. 23 indicates a malfunction, see the check chart No. 8 | Repair the harness, or repair or replace the clutch switch. |
| | Clutch switch improper installation (won't switch ON) | | |
| | Malfunction of the ECU | — | Replace the ECU. |
| The auto-cruise control system is not canceled when the selector lever is moved to the "N" position. <A/T><br>(It is canceled, however, when the brake pedal is depressed.) | Damaged or disconnected wiring of inhibitor switch input circuit | If the input check code No. 23 indicates a malfunction, see the check chart No. 9 | Repair the harness, or repair or replace the inhibitor switch. |
| | Improper adjustment of inhibitor switch | | |
| | Malfunction of the ECU | — | Replace the ECU. |

| Trouble symptom | Probable cause | Check chart No. | Remedy |
|---|---|---|---|
| Cannot decelerate by using the SET switch | Temporary damaged or disconnected wiring of SET switch input circuit | No. 2 | Repair the harness or replace the control switch. |
| | Motor-driven vacuum pump circuit poor contact | No. 6 | Repair the harness or replace the motor-driven vacuum pump. |
| | Malfunction of the auto-cruise actuator | | |
| | Malfunction of the ECU | — | Replace the ECU. |
| Cannot accelerate or resume speed by using the RESUME switch. | Damaged or disconnected wiring, or short-circuit, of RESUME switch input circuit | No. 3 | Repair the harness or replace the control switch. |
| | Motor-driven vacuum pump circuit poor contact | No. 6 | Repair the harness or replace the motor-driven vacuum pump. |
| | Malfunction of the motor-driven vacuum pump | | |
| | Malfunction of the ECU | — | Replace the ECU. |
| Auto-cruise control system can be set while traveling at a vehicle speed of less than 40 km/h (25 mph), or there is no automatic cancellation at that speed. | Malfunction of the vehicle-speed sensor circuit | No. 5 | Repair the vehicle-speed sensor system, or replace the part. |
| | Malfunction of the speedometer cable or the speedometer drive gear | | |
| | Malfunction of the ECU | — | Replace the ECU. |
| The indicator lamp of the main switch does not illuminate.<br>(But auto-cruise control system is normal.) | Damaged or disconnected bulb of indicator lamp or malfunction of the main switch | — | Repair the harness or replace the main switch. |
| | Harness damaged or disconnected | | |
| Overdrive is not canceled during fixed speed driving. <3000-A/T> | Malfunction of circuit related to overdrive cancelation, or malfunction of ECU | No. 10 | Repair the harness or replace the part. |
| No shift to overdrive during manual driving. <3000-A/T> | | | |

## CHECK CHART

### 1. CHECKING THE CONTROL UNIT POWER SUPPLY CIRCUIT



### Description of operation

When the main switch is switched ON while the ignition switch is ON, current flows to the ignition switch ($IG_1$), to fuse No. 11 of the junction block, and to the main switch, the control unit, and to earth. When the ignition switch is turned off, the main switch is also turned off.

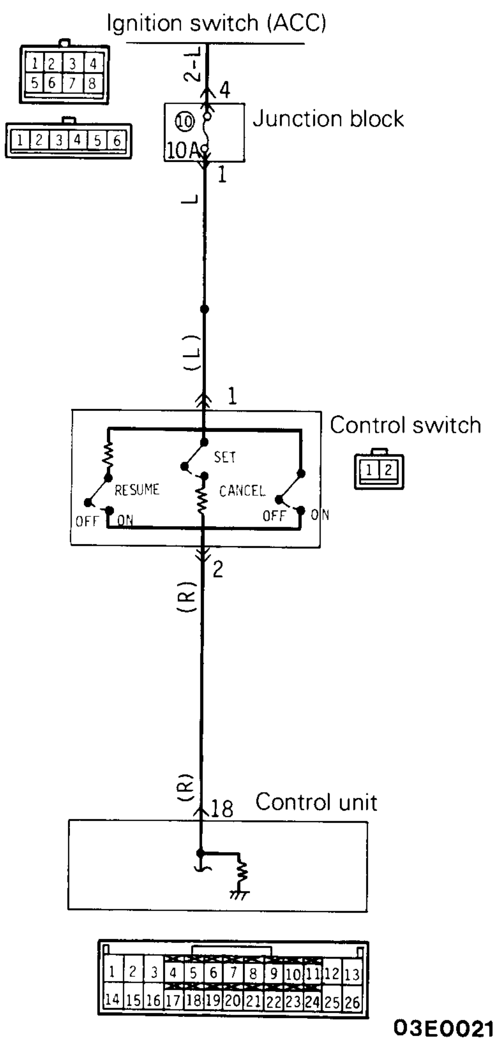
### Troubleshooting hint

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 2 | Control unit power supply | When the main switch is switched ON | System voltage |
| 8 | Control unit earth | At all times | 0 V |

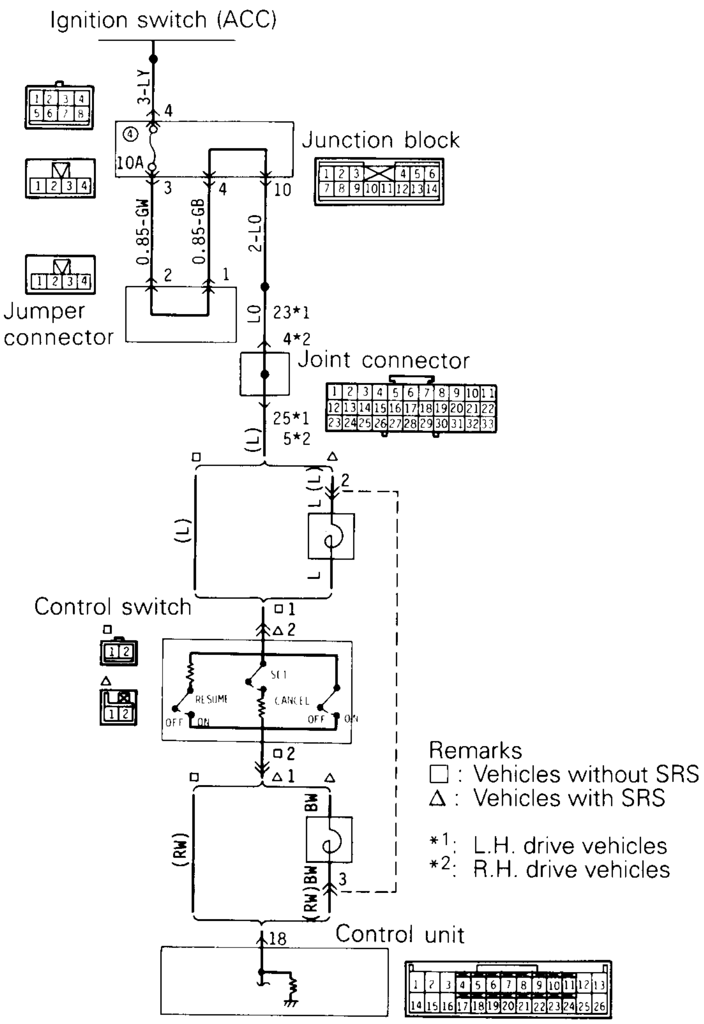
## 2. CHECKING THE SET SWITCH CIRCUIT

**<Vehicles built up to October, 1993>**



03E0021

**<Vehicles built from November, 1993>**



Remarks
□ : Vehicles without SRS
△ : Vehicles with SRS
*1: L.H. drive vehicles
*2: R.H. drive vehicles

03E0139

### Description of operation

When driving at the desired speed [40–200 km/h (25–125 mph) and the main switch of the auto-cruise control system is pressed to ON, by turning the control switch to SET, the vehicle speed at this time will become the constant driving speed. Also, during constant speed driving, if the control switch is held continuously in the SET position, the vehicle speed will gradually decrease (COAST), and when the control switch is released, the speed at that time will be the constant driving speed. Current flows to fuse No. 4 of the junction block, to the control switch (SET) and to the control unit.

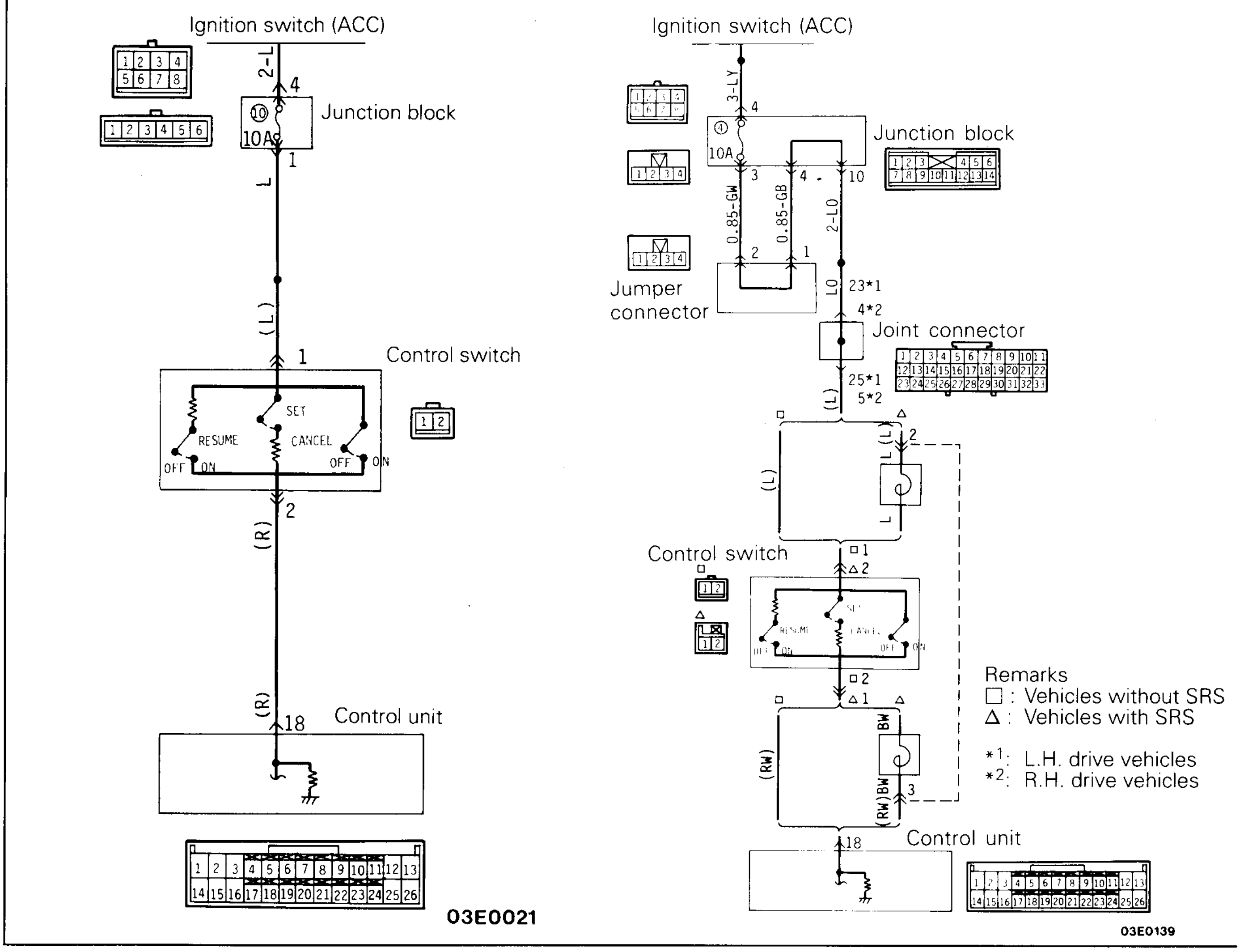
### Troubleshooting hint

### Diagnosis–No. 15 (automatically cancelled)

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 18 | SET switch | When the control switch is turned to the SET position | 3 V |
| | | When the control switch is turned to the off position | 0 V |

## 3. CHECKING THE RESUME SWITCH CIRCUIT



<Vehicles built up to October, 1993>

<Vehicles built from November, 1993>

### Description of operation

The set speed (before cancellation) resumes when the control switch is turned to RESUME position, even if the constant-speed control has been cancelled.

That speed will not resume, however, even if the control switch is turned to RESUME position, if the main switch is switched OFF and if the vehicle speed decreases to 40 km/h (25 mph) or lower.

In addition when the control switch is turned to RESUME position and held while the vehicle is traveling at a constant speed the vehicle speed will increase the speed at which the switch is subsequently released will become the newly set constant speed.

Current flows to the fuse No. 4 of the junction block, to the control switch (RESUME), and to the control unit.

### Troubleshooting hint

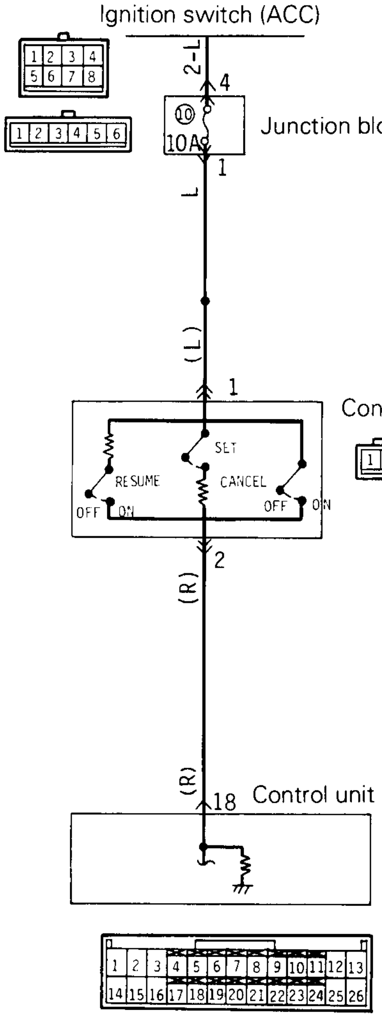
### Diagnosis–No. 5 (automatically cancelled)

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 18 | RESUME switch | When the control switch is turned to the RESUME position | 6 V |
| | | When the control switch is turned to the off position | 0 V |

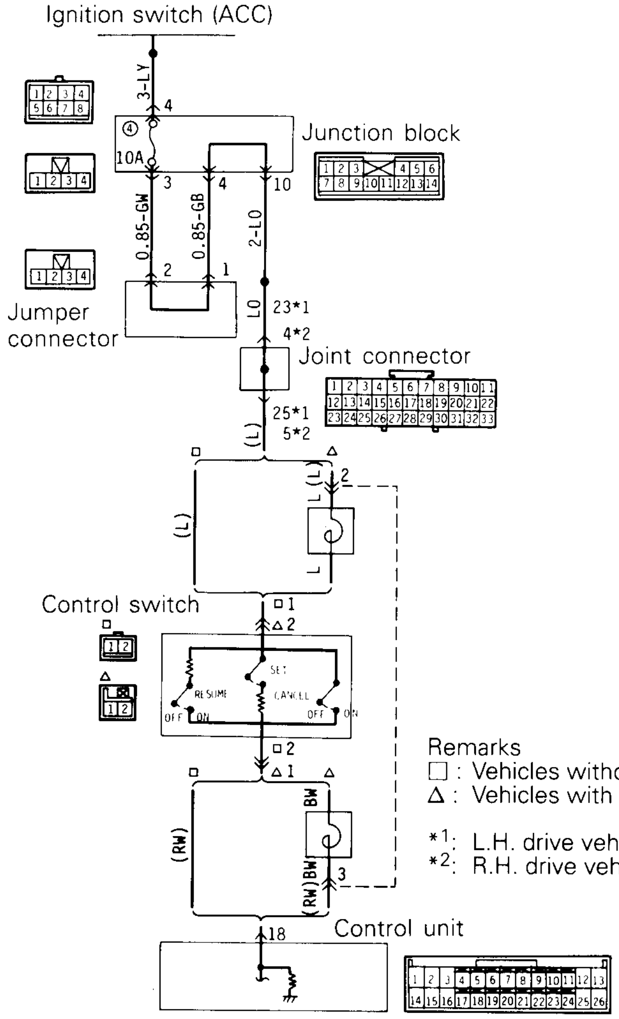
## 4. CHECKING THE CANCEL SWITCH CIRCUIT

**<Vehicles built up to October, 1993>**



03E0021

**<Vehicles built from November, 1993>**



Remarks
□ : Vehicles without SRS
△ : Vehicles with SRS
*1: L.H. drive vehicles
*2: R.H. drive vehicles

03E0139

### Description of operation

During constant speed driving, when the control switch is turned to the CANCEL position, a cancel signal is sent to the control unit, the current to the motor-driven vacuum pump is stopped, and constant speed driving is cancelled.
Current flows to the fuse No. 4 of the junction block, to the control switch (CANCEL) and to the control unit.

### Troubleshooting hint

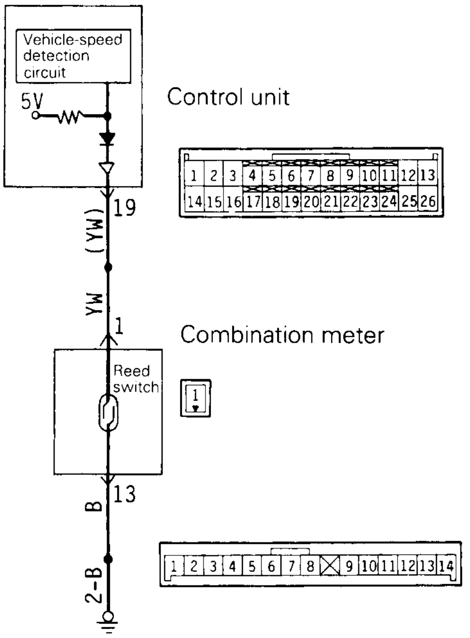
### Diagnosis–No. 15 (automatically cancelled)

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 18 | CANCEL switch | When the control switch is turned to the CANCEL position | System voltage |
| | | When the control switch is turned to the off position | 0 V |

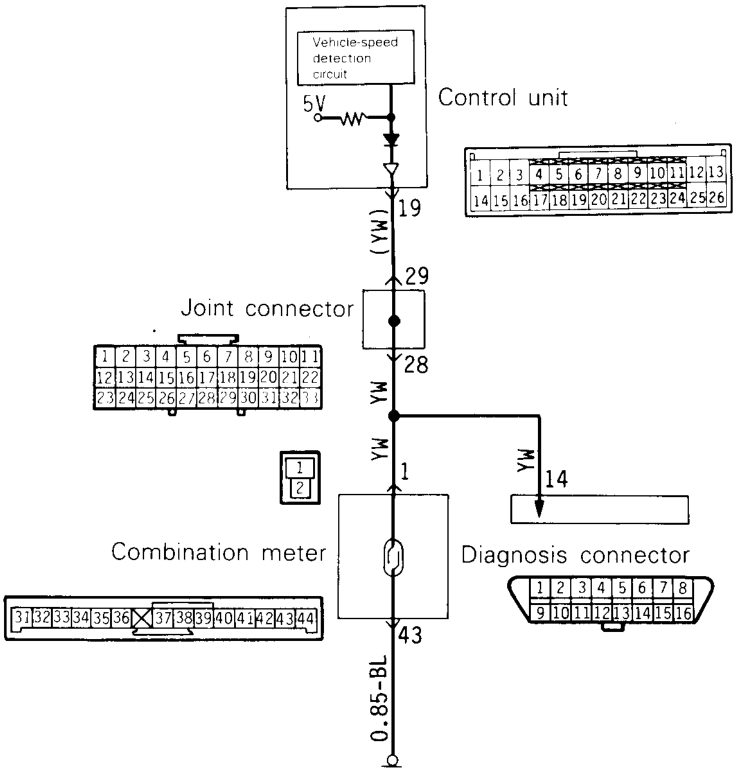
## 5. CHECKING THE VEHICLE-SPEED SENSOR CIRCUIT

**<Vehicles built up to October, 1993>**



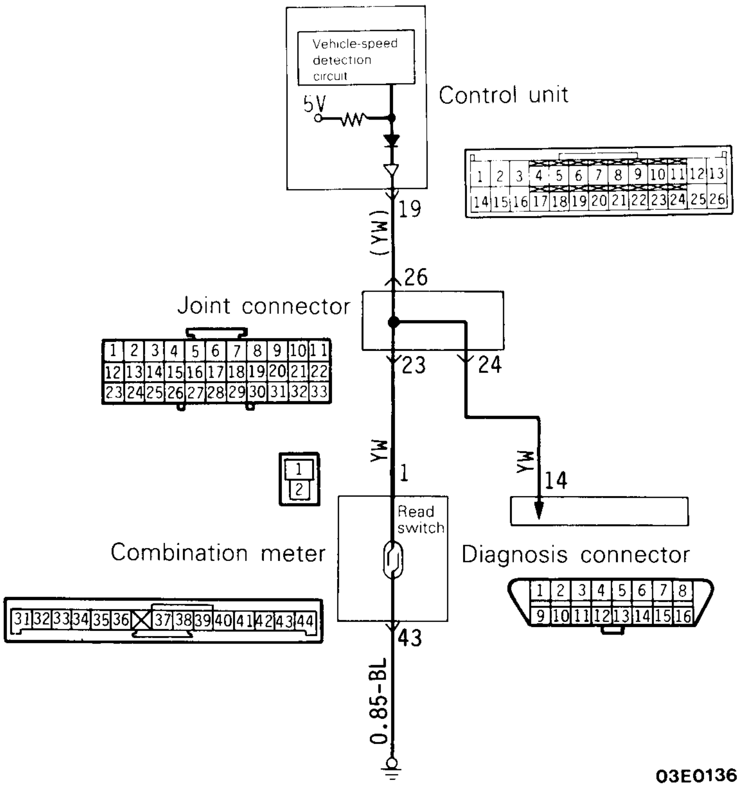
03E0019

**<Vehicles built from November, 1993 (L.H. drive vehicles)>**



03E0138

**<Vehicles built from November, 1993 (R.H. drive vehicles)>**



03E0136

## Description of operation

The vehicle-speed sensor is installed within the speedometer; it sends to the control unit pulse signals that are proportional to the rotation speed (i.e., the vehicle speed) of the transmission's output gear.

This vehicle-speed sensor is the reed switch type of sensor; it generates four pulse signals for each rotation of the speedometer's driven gear.

## Troubleshooting hint

### Diagnosis–No. 12 (automatically cancelled)

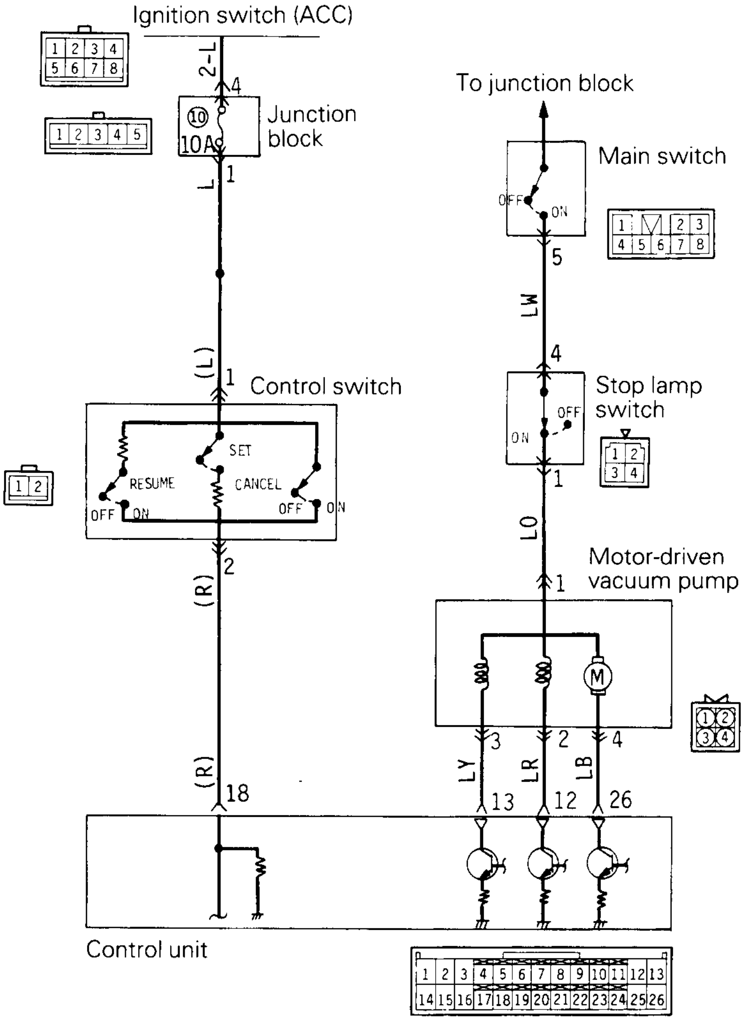
### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 19 | Vehicle-speed sensor | Set the shift lever to the 1st range <M/T> or the selector lever to D-range <A/T>, move the vehicle forward slowly. | 0 V– 0.6 V ← Flashing → 2 V or higher |

## NOTES

## 6. CHECKING THE MOTOR-DRIVEN VACUUM PUMP CIRCUIT

### <Vehicles built up to October, 1993>



03E0020

## Description of operation

HOLD MODE

When driving at 40 km/h (25 mph) and the main switch is pressed to ON and the control switch is turned to the SET position, the control unit receives a "set" signal. The control unit stops current from flowing to the motor-driven vacuum pump, and makes current flow to the solenoid coils in the control valve and the release valve to close both valves together.

Also, after reaching the desired speed, the motor-driven vacuum pump and the control valve turn ON and OFF repeatedly according to the driving conditions.

ACCELERATION MODE

When the control switch is moved to the RESUME position, the control unit receives a "resume" signal. The control unit controls current flow to the motor-driven vacuum pump, and controls current flow to the solenoid coils in the control valve and the release valve to close both valves together.

DECELERATION MODE

When the control switch is moved to the SET position, the control unit receives a "set" signal. The control unit stops current from flowing to the motor-driven vacuum pump, and stops current from flowing to the solenoid coil in the control valve to open the valve. At the same time, the current flowing to the solenoid coil in the release valve is stopped, closing the valve.

RELEASE MODE

When the control switch is moved to the CANCEL position, the control unit receives a "cancel" signal. The control unit stops current from flowing to the motor-driven vacuum pump, and stops current from flowing to the solenoid coils in the control valve and the release valve to open both valves together.

**Troubleshooting hint**

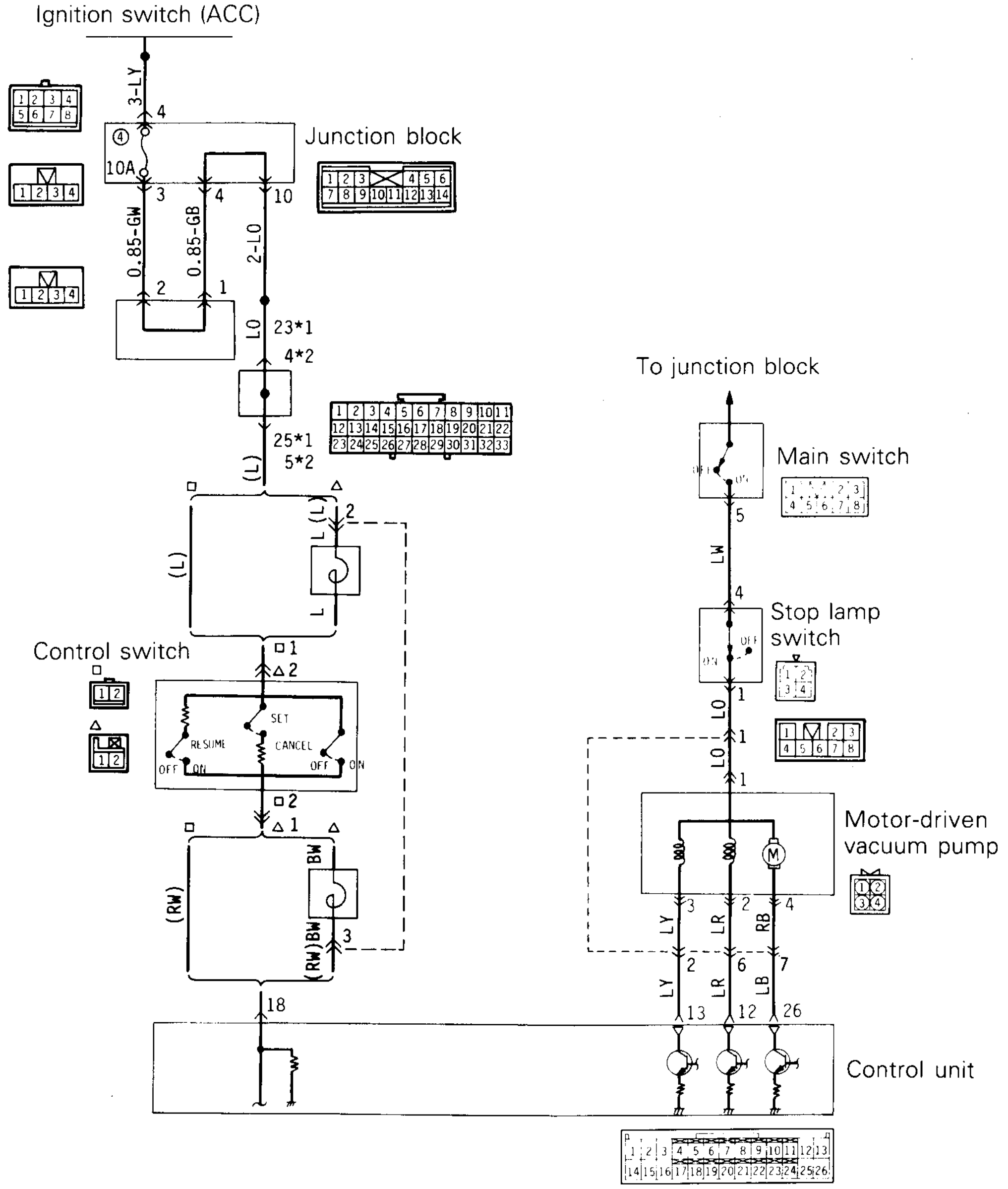
**Diagnosis–No. 11 (automatically cancelled)**

**ECU terminal voltage**

| Terminal No. | Signal | Mode/Terminal voltage (V) | | | |
|---|---|---|---|---|---|
| | | Hold | Acceleration | Deceleration | Release |
| 26 | Motor-driven vacuum pump drive | System voltage | 0 | System voltage | System voltage |
| 13 | Control valve open/close | | 0 | System voltage | System voltage |
| 12 | Release valve open/close | | 0 | 0 | System voltage |

## 6. CHECKING THE MOTOR-DRIVEN VACUUM PUMP CIRCUIT

### <Vehicles built from November, 1993>



Remarks
□ : Vehicles without SRS
△ : Vehicles with SRS
*1: L.H. drive vehicles
*2: R.H. drive vehicles

03E0137

### Description of operation

HOLD MODE

When driving at 40 km/h (25 mph) and the main switch is pressed to ON and the control switch is turned to the SET position, the control unit receives a "set" signal. The control unit stops current from flowing to the motor-driven vacuum pump, and makes current flow to the solenoid coils in the control valve and the release valve to close both valves together.

Also, after reaching the desired speed, the motor-driven vacuum pump and the control valve turn ON and OFF repeatedly according to the driving conditions.

ACCELERATION MODE

When the control switch is moved to the RESUME position, the control unit receives a "resume" signal. The control unit controls current flow to the motor-driven vacuum pump, and controls current flow to the solenoid coils in the control valve and the release valve to close both valves together.

DECELERATION MODE

When the control switch is moved to the SET position, the control unit receives a "set" signal. The control unit stops current from flowing to the motor-driven vacuum pump, and stops current from flowing to the solenoid coil in the control valve to open the valve. At the same time, the current flowing to the solenoid coil in the release valve is stopped, closing the valve.

RELEASE MODE

When the control switch is moved to the CANCEL position, the control unit receives a "cancel" signal. The control unit stops current from flowing to the motor-driven vacuum pump, and stops current from flowing to the solenoid coils in the control valve and the release valve to open both valves together.

**Troubleshooting hint**

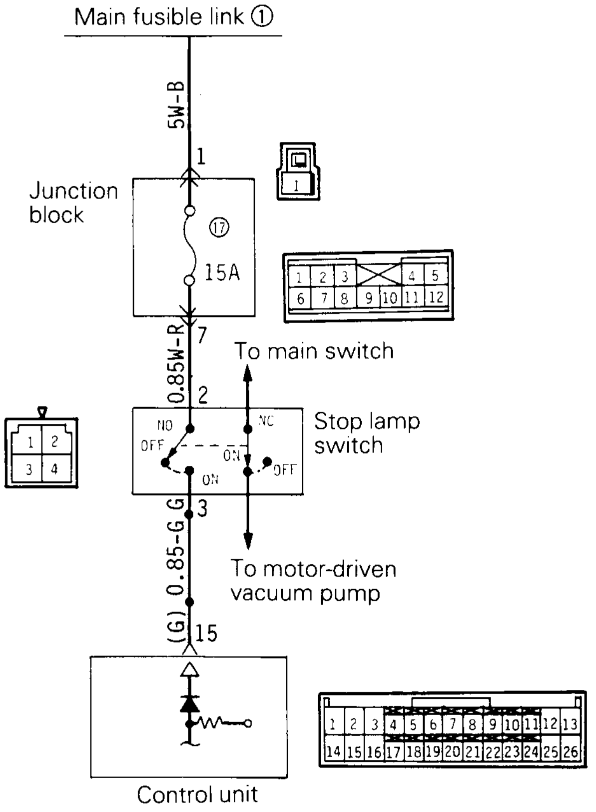
**Diagnosis–N0. 11 (automatically cancelled)**

**ECU terminal voltage**

| Terminal No. | Signal | Mode/Terminal voltage (V) | | | |
|---|---|---|---|---|---|
| | | Hold | Acceleration | Deceleration | Release |
| 26 | Motor-driven vacuum pump drive | System voltage | 0 | System voltage | System voltage |
| 13 | Control valve open/close | | 0 | System voltage | System voltage |
| 12 | Release valve open/close | | 0 | 0 | System voltage |

## 7. CHECKING THE STOP LAMP SWITCH CIRCUIT

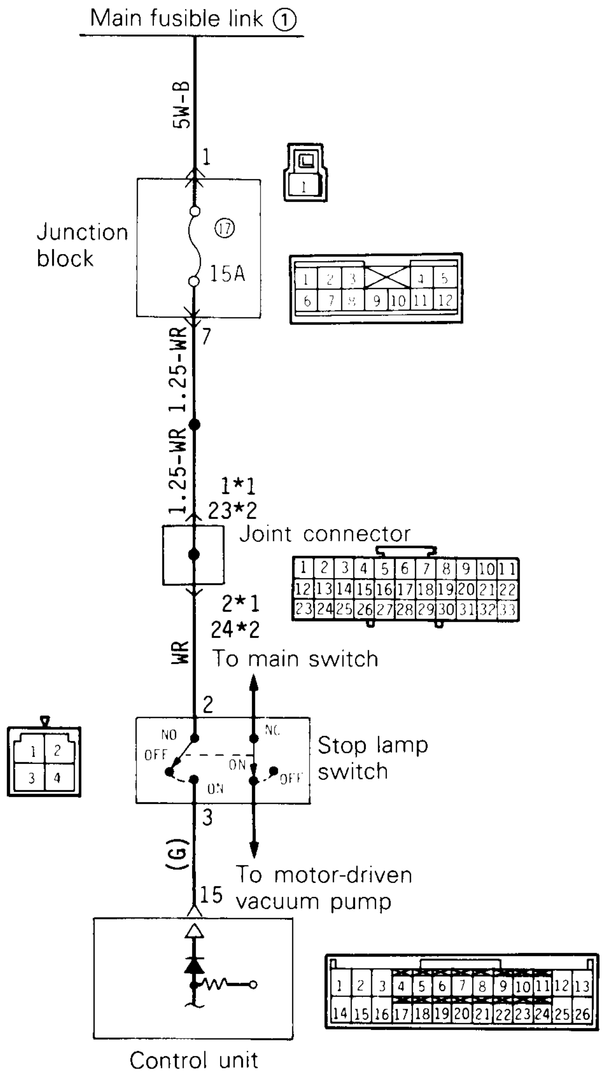
**<Vehicles built up to October, 1993>**



03E0017

NOTE
(1) NC: ON at all times
(2) NO: OFF at all times

**<Vehicles built from November, 1993>**



03E0140

Remarks
*1: L.H. drive vehicles
*2: R.H. drive vehicles

### Description of operation

When the brake pedal is depressed during constant-speed travel, the stop lamp switch's (NC) contacts for the auto-cruise control system open, with the result that the current to the motor-driven vacuum pump is interrupted, thus cancelling the constant-speed travel.

At the same time, moreover, the closing of the (NO) contacts for the stop lamp results in the sending of the cancel signal to the control unit, so that the motor-driven vacuum pump current is discontinued within the control unit, thereby canceling the constant-speed travel.

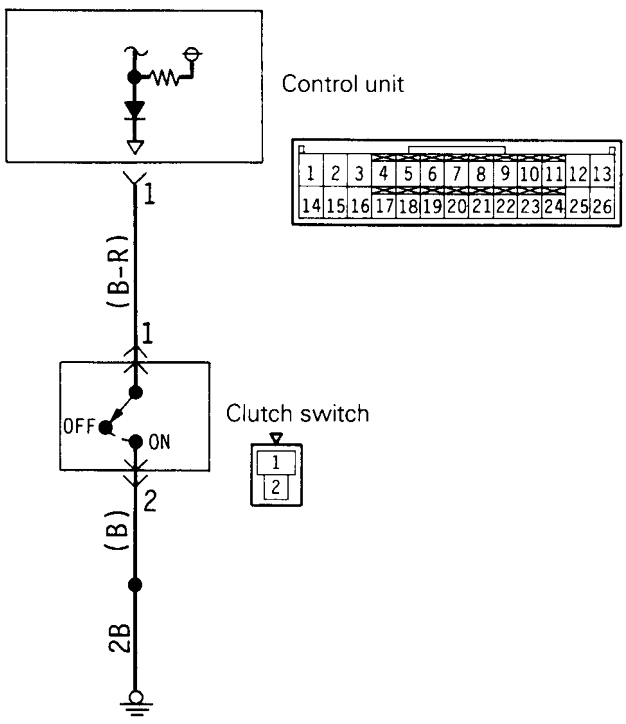
### Troubleshooting hint

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 15 | Stop lamp switch (load side) | When the brake pedal is depressed | System voltage |
| | | When the brake pedal is not depressed | 0 V |

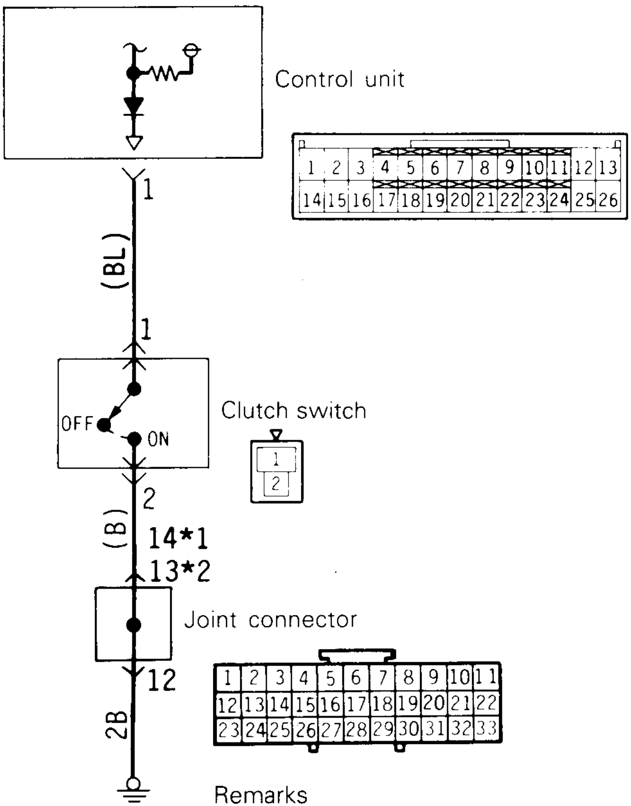
## 8. CHECKING THE CLUTCH SWITCH CIRCUIT <M/T>

**<Vehicles built up to October, 1993>**



03E0018

**<Vehicles built from November, 1993>**



Remarks
*1: L.H. drive vehicles
*2: R.H. drive vehicles

03E0141

### Description of operation

If the clutch pedal is pressed when driving at a constant speed, the clutch switch is turned ON and a cancel signal is input to the control unit and the determined driving speed is canceled, because the current flows to the control unit, to the clutch switch and to the earth.

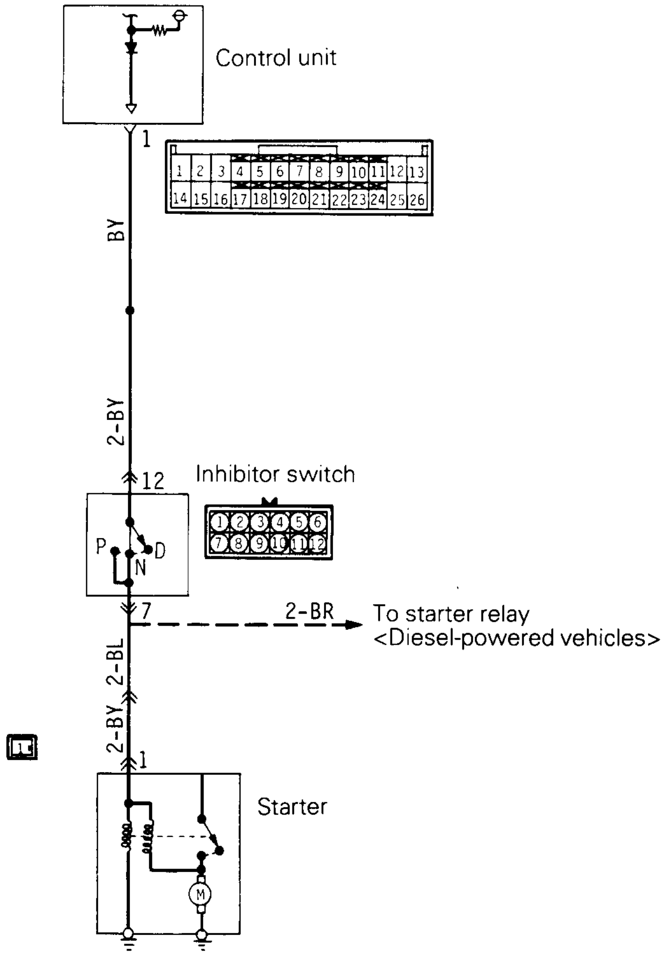
### Troubleshooting hint

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 1 | Clutch switch | When the clutch pedal is depressed | System voltage |
| | | When the clutch pedal is not depressed | 0 V |

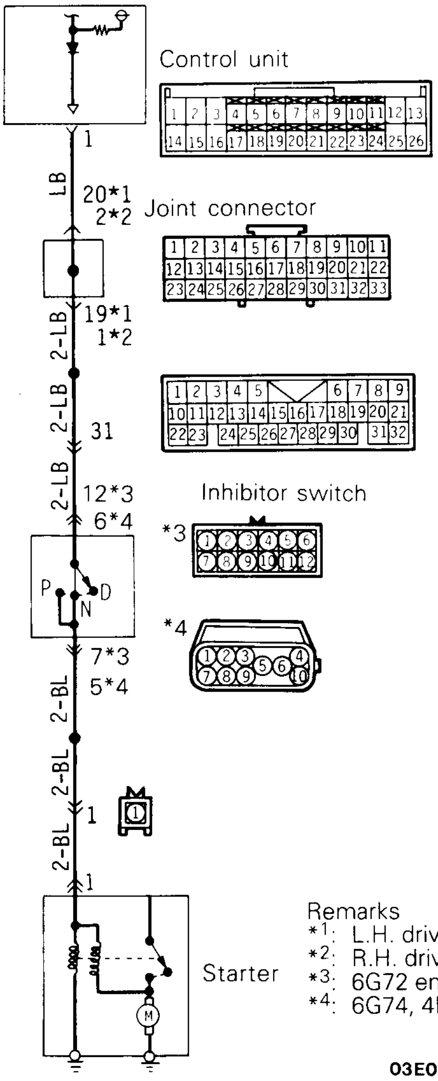
## 9. CHECKING THE INHIBITOR SWITCH CIRCUIT <A/T>

<Vehicles built up to October, 1993>



03E0016

<Vehicles built from November, 1993>



Remarks
*1: L.H. drive vehicles
*2: R.H. drive vehicles
*3: 6G72 engine
*4: 6G74, 4M40 engine

03E0142

### Description of operation

The inhibitor switch also functions as the switch for the starter.

If the selector lever is moved to the "N" position during constant-speed travel, current flows to the control unit, inhibitor switch, starter motor, and to earth; the cancel signal is therefore input to the control unit, thus canceling the constant-speed travel.

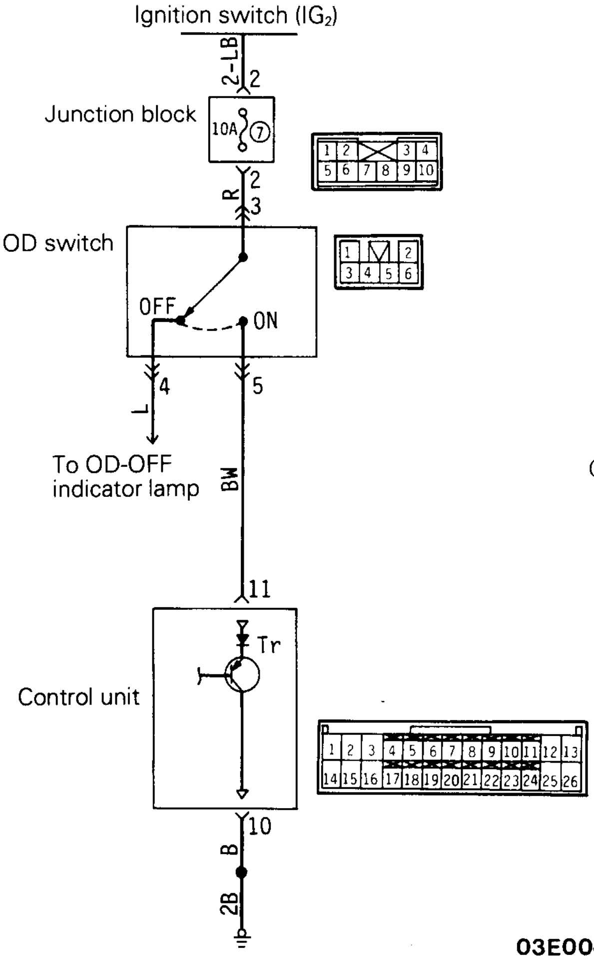
### Troubleshooting hint

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 1 | Inhibitor switch | Neutral | System voltage |

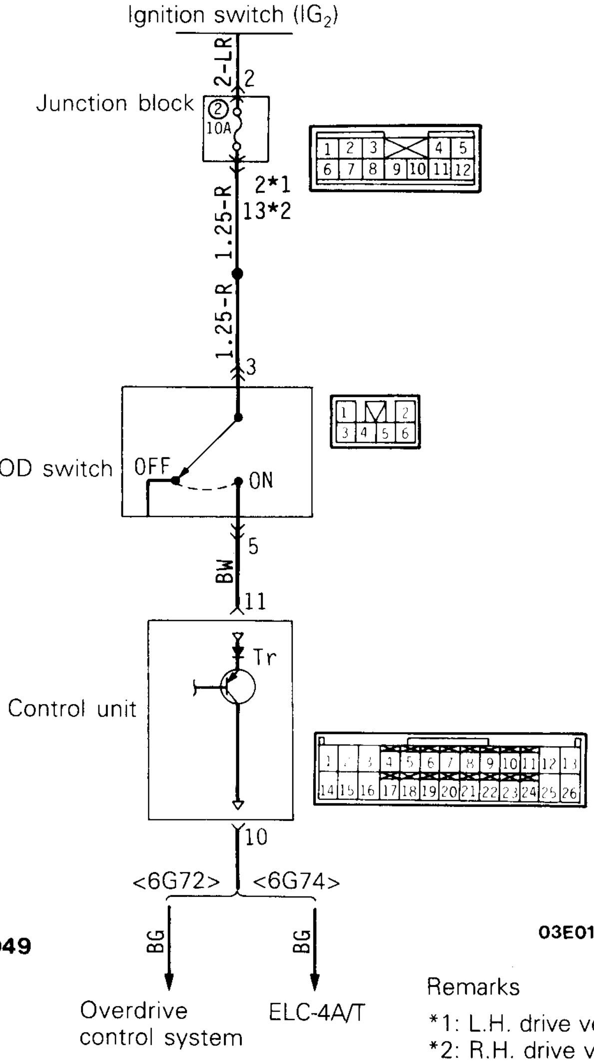
## 10. CHECKING THE CIRCUIT RELATED TO THE OVERDRIVE-CANCELLATION FUNCTION <3000-A/T, 3500-A/T>

**<Vehicles built up to October, 1993>**



03E0049

**<Vehicles built from November, 1993>**



03E0143

Remarks
*1: L.H. drive vehicles
*2: R.H. drive vehicles

### Description of operation

This is a function that cancels the overdrive function for a certain fixed period of time, if during constant-speed travel in overdrive, the actual vehicle speed decreases to less than the vehicle speed retained in the memory, and then after a short time causes the vehicle speed to return to the vehicle speed retained in the memory.

Overdrive will be cancelled in the following cases:

- If the control switch is turned to the RESUME position.
- If the actual vehicle speed decreases to 7 km/h (4.4 mph) or more below the constant driving speed.

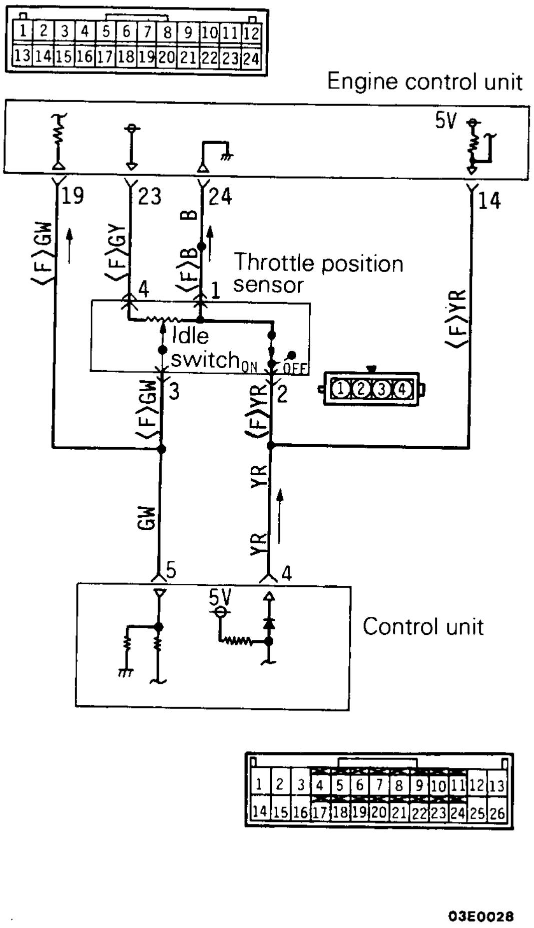
In these case, the OD-ON signal output from the control unit turns the transistor Tr off, and so the current flowing through the overdrive switch is stopped at the transistor Tr, and is then controlled by the 3-speed automatic transmission.

### Troubleshooting hint

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 11 | OD switch | When the OD switch is switched ON | System voltage |

## 11.CHECKING THE THROTTLE POSITION SENSOR AND IDLE SWITCH CIRCUIT <3000, 3500> <Vehicles built up to October, 1993>



### Description of operation

The throttle position sensor and idle switch are mounted in the throttle body and are sensors in the MPI system

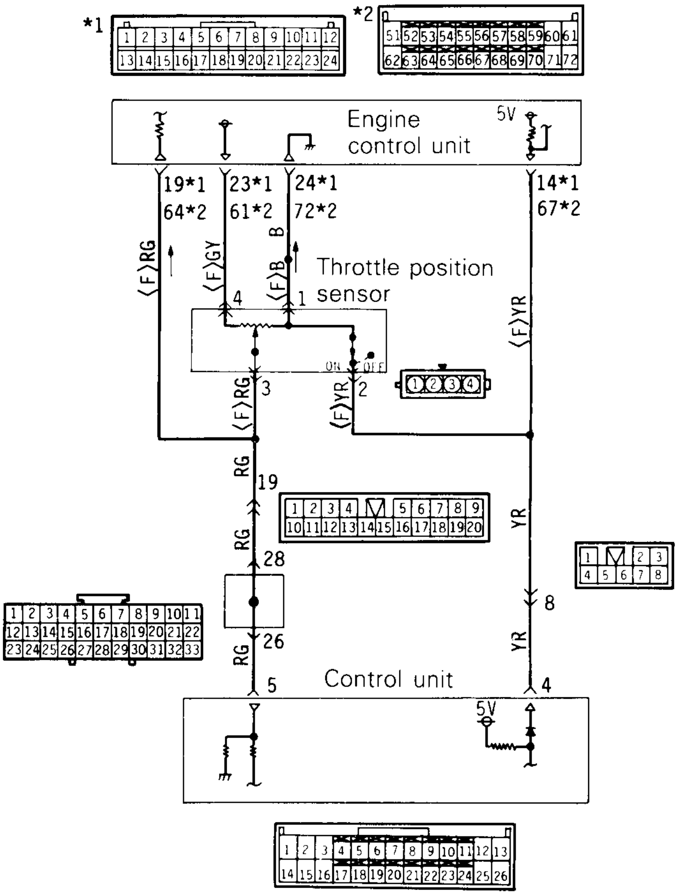
The throttle position sensor converts the opening position of the throttle valve to a voltage value, and inputs it to the control unit. The control unit compares this signal with the vehicle speed signal and changes the amount of actuator control accordingly. The idle switch turns ON and OFF depending on the voltage value from the throttle position sensor to compensate for fluctuations or deviations in the voltage.

### Diagnosis–No. 17 (automatically cancelled)

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 4 | Idle switch | When accelerator pedal is pressed | 4.5–5.5 V |
| | | When accelerator pedal is released | 0 V |
| 5 | Throttle position sensor | When accelerator pedal is pressed all the way down | 4.0–5.5 V |
| | | When accelerator pedal is released | 0.5–0.7 V |

## 11.CHECKING THE THROTTLE POSITION SENSOR AND IDLE SWITCH CIRCUIT <3000, 3500> <Vehicles built from November, 1993>



Remarks
*1: 6G72 engine
*2: 6G74 engine

### Description of operation

The throttle position sensor and idle switch are mounted in the throttle body and are sensors in the MPI system.

The throttle position sensor converts the opening position of the throttle valve to a voltage value, and inputs it to the control unit. The control unit compares this signal with the vehicle speed signal and changes the amount of actuator control accordingly. The idle switch turns ON and OFF depending on the voltage value from the throttle position sensor to compensate for fluctuations or deviations in the voltage.

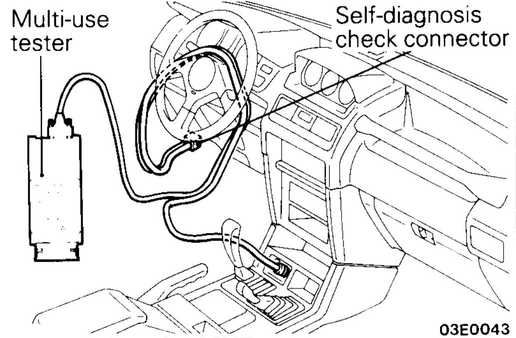
### Diagnosis–No. 17 (automatically cancelled)

### ECU terminal voltage

| Terminal No. | Signal | Conditions | Terminal voltage |
|---|---|---|---|
| 4 | Idle switch | When accelerator pedal is pressed | 4.5–5.5 V |
| | | When accelerator pedal is released | 0 V |
| 5 | Throttle position sensor | When accelerator pedal is pressed all the way down | 4.0–5.5 V |
| | | When accelerator pedal is released | 0.5–0.7 V |

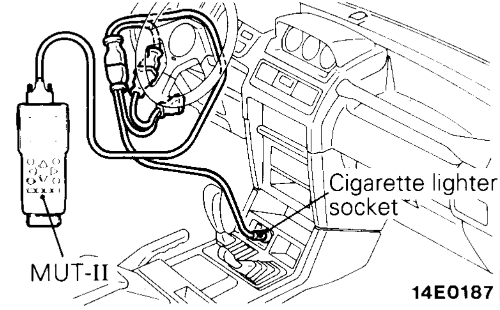
## NOTES

**When using the Multi-use tester**

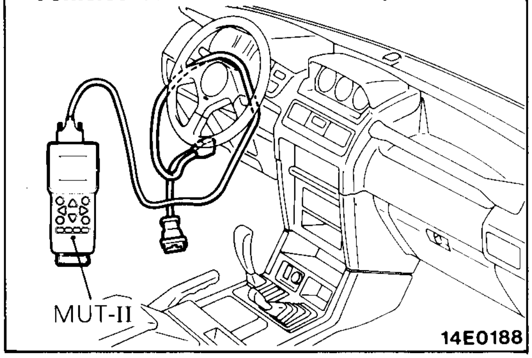


**When using the MUT-II**

**<Vehicles built up to October, 1993>**



**<Vehicles built from November, 1993>**



## SELF-DIAGNOSIS CHECKING

Self-diagnosis checking is performed when there has been an automatic cancellation, without cancel switch operation.

(1) Note that the diagnosis check connector is located under the driver's side instrument panel.
Connect the multi-use tester's or MUT-II's socket and connector to the accessories socket and the self-diagnosis check connector, and set the tester.

**Caution**
**The ignition switch should always be turned off when connecting or disconnecting the tester.**

Use the multi-use tester or MUT-II according to its operation instructions; display the diagnosis code number and then check.

(2) When diagnosis code No. is displayed, check by referring to the check chart applicable to that number.

## ERASURE OF DIAGNOSIS CODE

Diagnosis codes are memorized until battery power source is disconnected. It, however, can be erased without removing battery terminal by the following procedure.

1. Turn the ignition switch to ON.
2. With the control switch in the SET position, press the main switch to ON, and within 1 second, turn the control switch to RESUME.
3. Turn the control switch back to the SET position, and turn the stop lamp switch to ON for a continuous period of 5 seconds or more.
4. Check the self-diagnosis code, and check that the abnormal code is erased and a normal code is output.

## DIAGNOSIS DISPLAY PATTERNS AND CODES

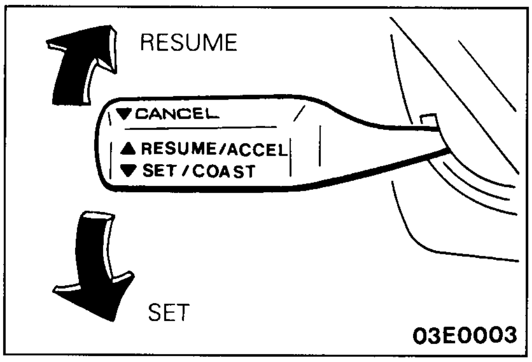
| Code No. | Probable cause | Check chart No. |
|---|---|---|
| 11 | Abnormal condition of motor-driven vacuum pump system | No. 6 |
| 12 | Abnormal condition of vehicle-speed signal system | No. 5 |
| 15 | Control switch malfunction (when SET and RESUME switches switched ON simultaneously.) | No. 2, 3 |
| 16 | Abnormal condition of ECU | No. 7, 8, 9 |
| 17 | Abnormal condition of throttle position sensor <3000, 3500><br>Abnormal condition of idle switch <3000, 3500> | No. 11 |

NOTE
1. These diagnosis codes are displayed when not driving at continuous speed with the main switch at ON.
2. After the diagnosis codes in the memory are erased, if (when the power supply of the control unit is switched ON once again) the power supply of the control unit is normal, the diagnosis output code display will be normal, regardless of whether the system condition is normal or not.

## INPUT CHECKING

Input checks should be made when the auto-cruise control system cannot be set and when it is necessary to check (when a malfunction related to the auto-cruise control system occurs) whether or not the input signals are normal.

NOTE
1. Self-diagnosis terminal outputs display patterns.
2. Display codes are displayed only if the circuit is normal according to the conditions shown in the "Input Check Table".



03E0003

Carry out input checking by the following procedure:
(1) The setting of the multi-use tester or the MUT-II is the same as for self-diagnosis check.
(2) Turn the ignition switch to ON.
(3) When the control switch is moved to the SET position, press the main switch to ON, and within 1 second, turn the control switch to RESUME to display the results of input checking.

(4) Perform each input operation according to the Input Check Table and read the codes.

NOTE
1. If two or more input operations are performed at the same time, the codes will be output in order starting from the lowest number.
2. Each code will be displayed in order of priority beginning from No. 1.
If there is no display, it is possible that there is a malfunction of the ECU power-supply circuit or the SET and/or RESUME switch (control switch), so check according to check chart 1, 2 and 3.

## INPUT CHECK TABLE

| Check No. | Input operation | Code No. | Check results |
|---|---|---|---|
| 1 | SET switch ON | 21 | SET switch circuit normal |
| 2 | RESUME switch ON | 22 | RESUME switch circuit normal |
| 3 | Stop lamp switch (brake pedal depressed) | 23 | Stop lamp switch normal |
| 4 | Driving at approximately to 40 km/h (25 mph) or higher | 24 | When both No. 4 and No. 5 can be confirmed, vehicle-speed sensor circuit normal. |
| 5 | Driving at less than approximately 40 km/h (25 mph) | 25 | |
| 6 | 1. Clutch switch ON (clutch pedal depressed) <M/T><br>2. Inhibitor switch ON (selector lever to "N" range) <A/T> | 26 | Clutch switch or inhibitor switch normal |
| 7 | CANCEL switch ON | 28 | CANCEL switch circuit normal |
| 8 | Throttle position sensor output (when the accelerator pedal is pressed more than half way) <3000, 3500> | 28 | Throttle position sensor normal |
| 9 | Idle switch OFF (accelerator pedal depressed) <3000, 3500> | 29 | Idle switch normal |

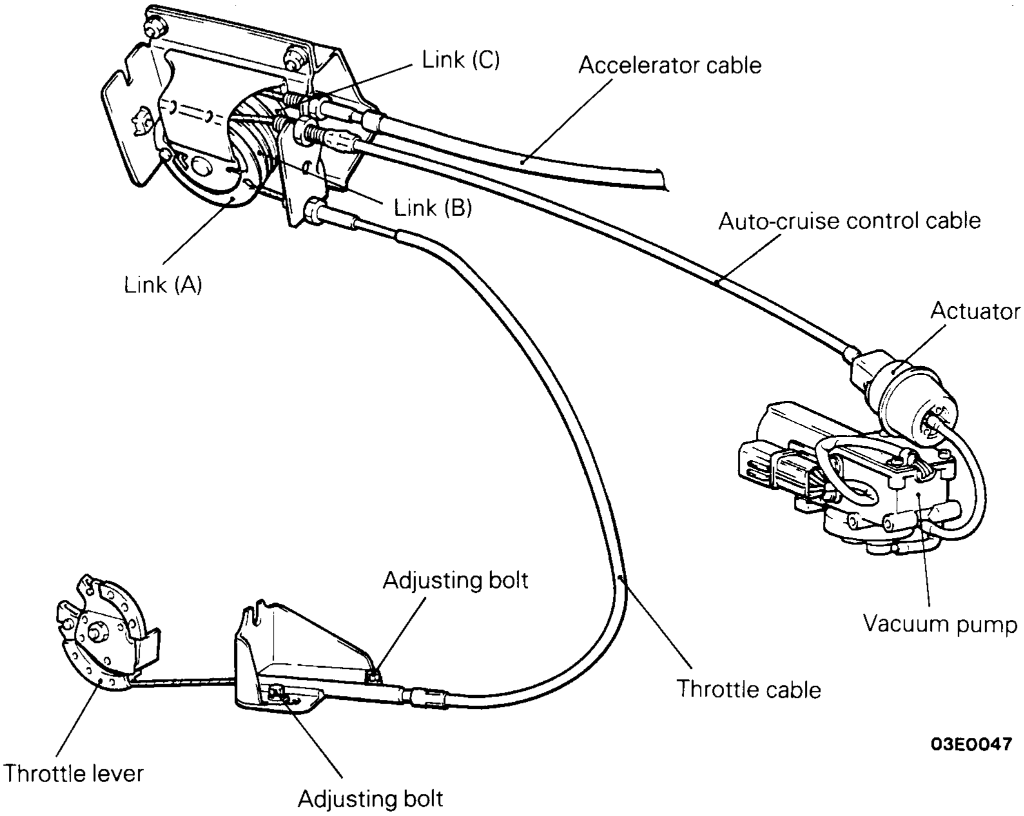
# SERVICE ADJUSTMENT PROCEDURES

## CONTROL CABLES INSPECTION AND ADJUSTMENT

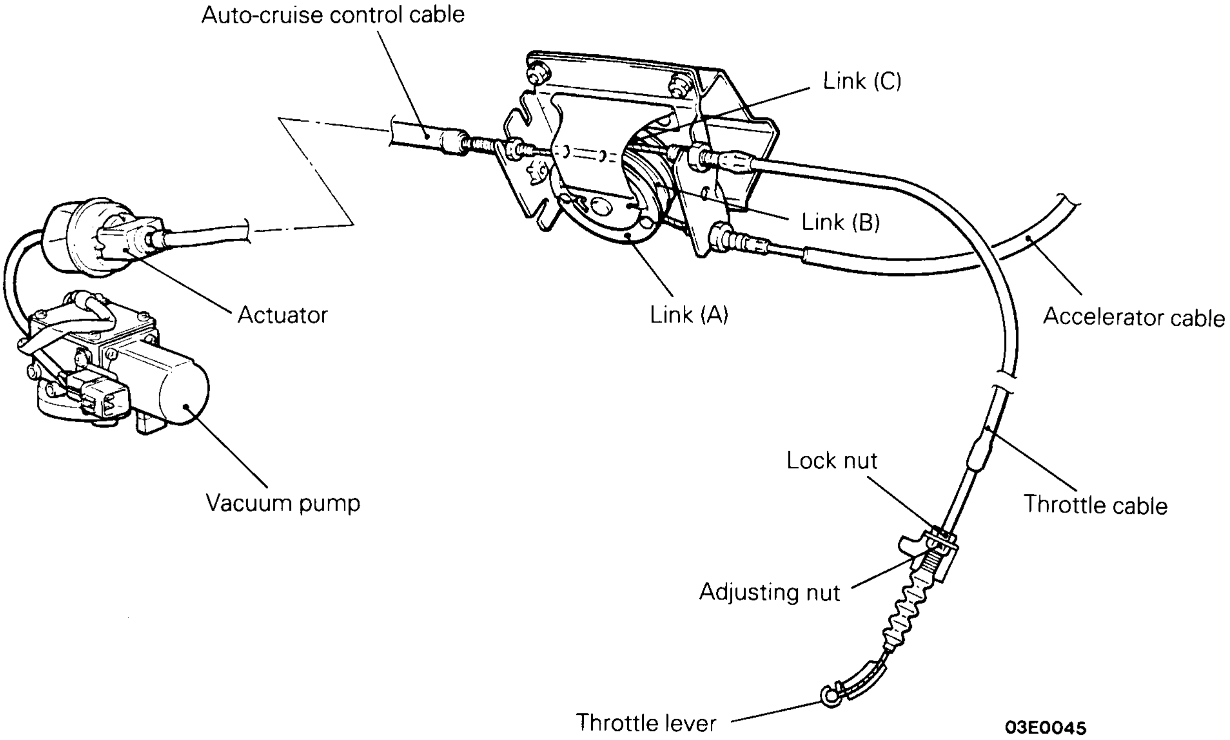
E13FYAEc

**<L.H. drive vehicles>**

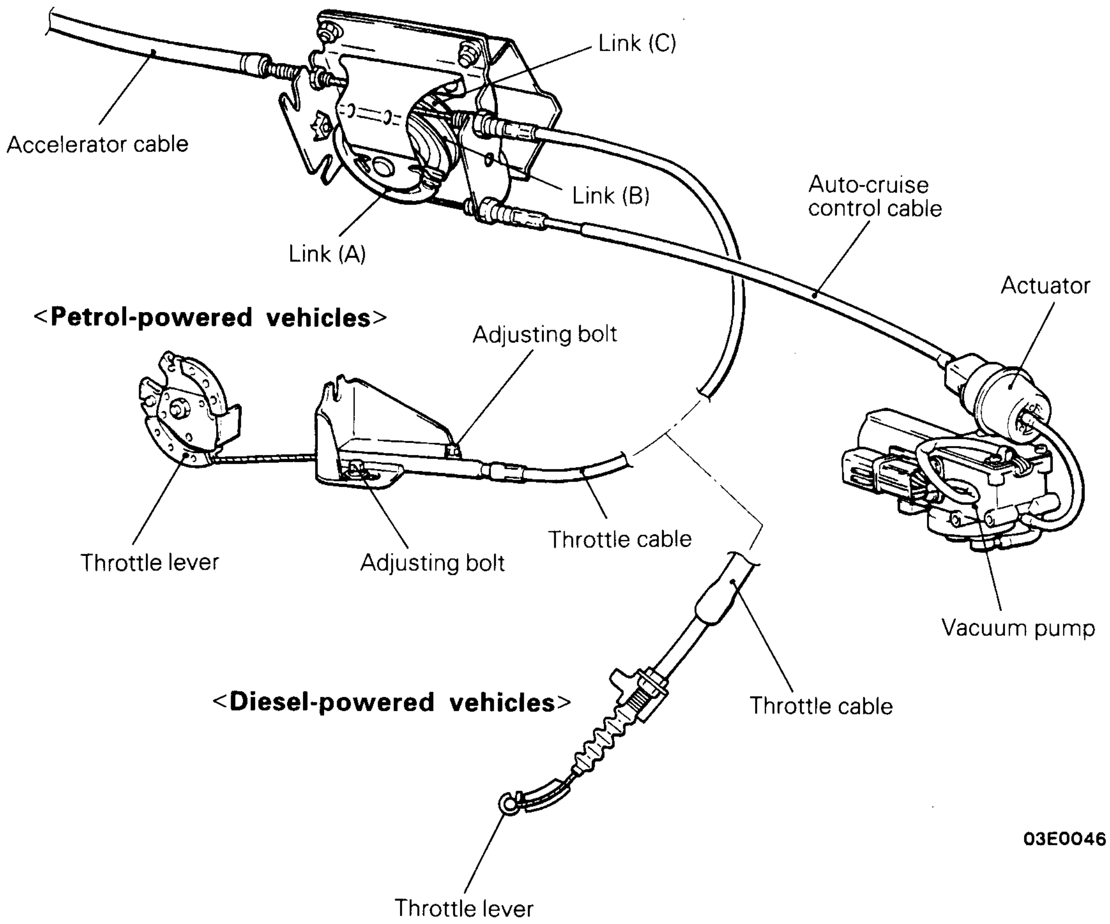
**<Petrol-powered vehicles>**



**<Diesel-powered vehicles>**



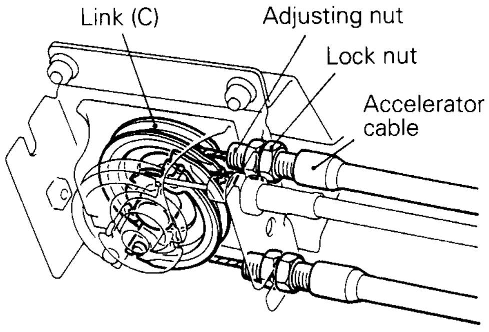
**<R.H. drive vehicles>**



(1) Remove the link protector. (Refer to P.13-195.)

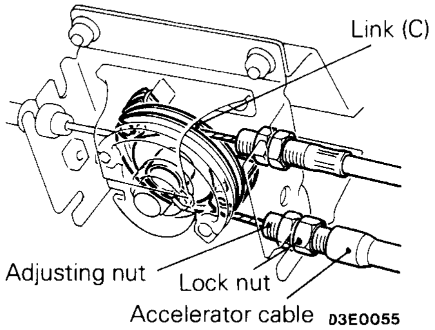
(2) Check if there is any flexion in the inner cables of the accelerator cable, auto-cruise control cable and throttle cable.
If there is excessive flexion or no play in one of the inner cables, loosen the adjusting bolts and nuts of the throttle lever and each link to release each link from the throttle lever.
(Do not remove the adjusting bolts or nuts.)

**<L.H. drive vehicles with petrol engine>**



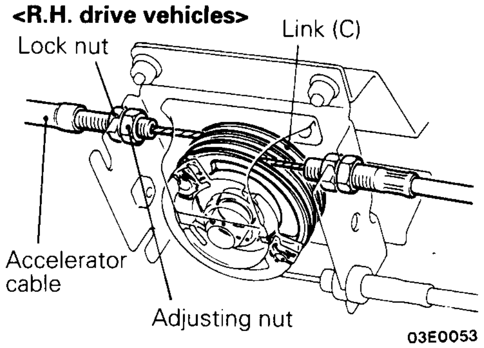
03E0052

**<L.H. drive vehicles with diesel engine>**



03E0055

**<R.H. drive vehicles>**



03E0053

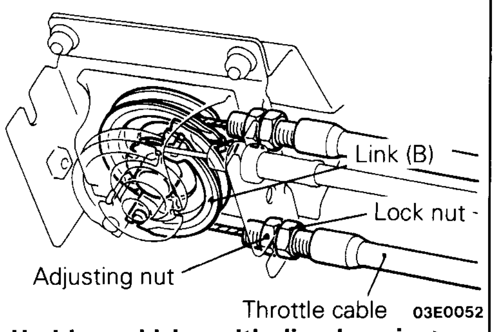
## Accelerator Cable

(1) While holding link (C) so that it is touching the stopper, adjust the play of the accelerator cable with the adjusting nut so that the cable play is at the standard value.

**Standard value: 0–1 mm (0–0.04 in.)**

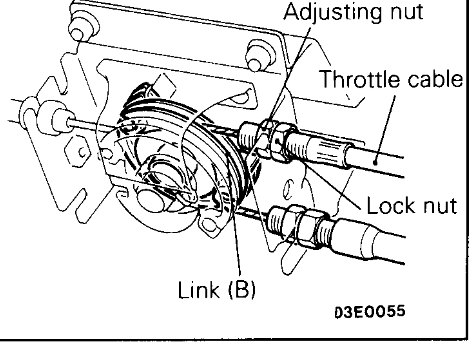
(2) After adjusting, fix the cable with the lock nut.

**<L.H. drive vehicles with petrol engine>**



03E0052

**<L.H. drive vehicles with diesel engine>**



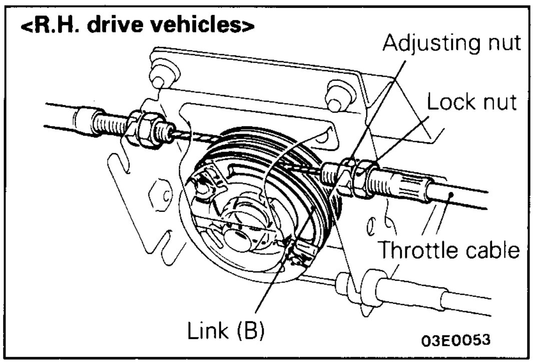
03E0055

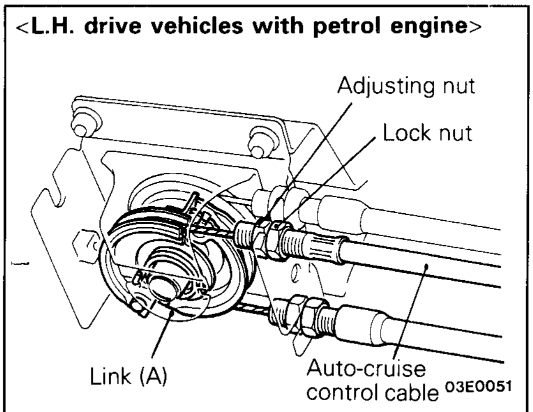
## Throttle Cable

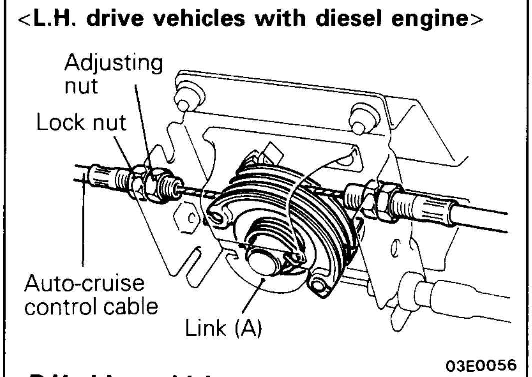
(1) While holding link (B) so that it is touching link (C), adjust the play of the throttle cable with the adjusting nut and adjusting bolts so that the cable play is at the standard value.

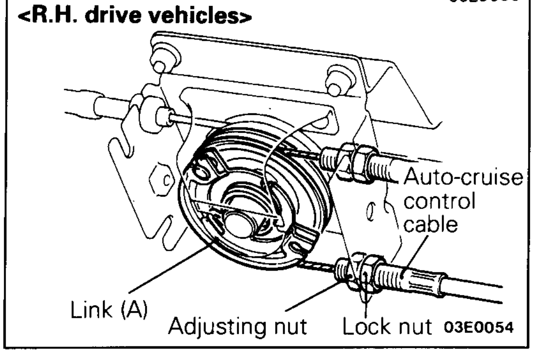
**Standard value: 1–2 mm (0.04–0.08 in.)**

(2) After adjusting, fix the cable with the lock nut.







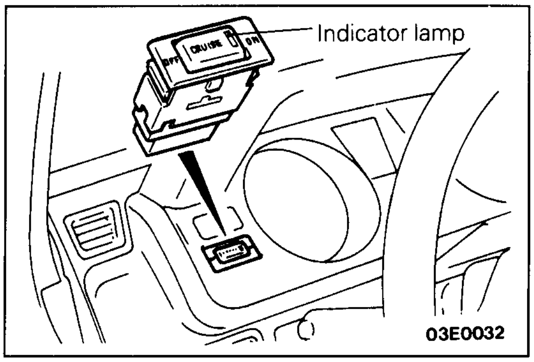


## Auto-cruise Control Cable

(1) While holding link (A) so that it is touching link (B), adjust the play of the auto-cruise control cable with the adjusting nut so that the cable play is at the standard value.

**Standard value: 1–2 mm (0.04–0.08 in.)**

(2) After adjusting, fix the cable with the lock nut.

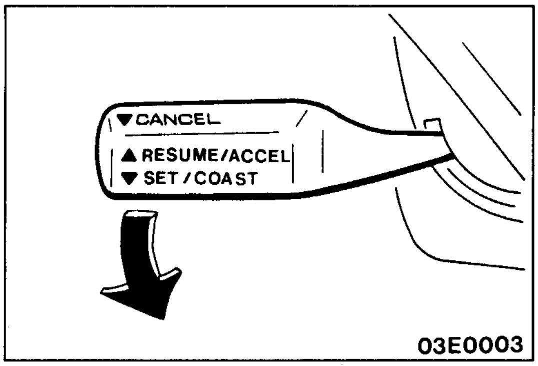


## AUTO-CRUISE CONTROL MAIN SWITCH INSPECTION

(1) Turn the ignition key to ON.

(2) Check to be sure that the indicator lamp within the switch illuminates when the main switch is switched ON.

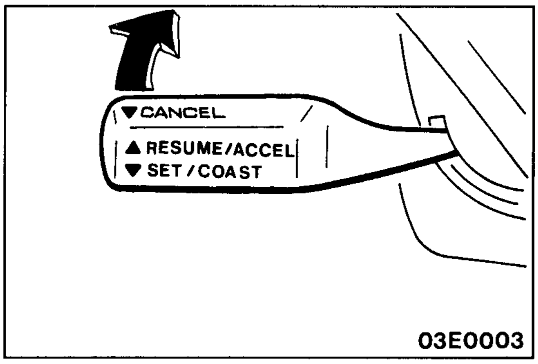
## AUTO-CRUISE CONTROL SWITCH INSPECTION



### Auto-cruise Control Setting Check

(1) Switch ON the main switch.
(2) Drive at the desired speed within the range of approximately 40–200 km/h (25–125 mph).
(3) Turn the control switch to the SET position.
(4) Check to be sure that when the switch is released the speed is the desired constant speed.

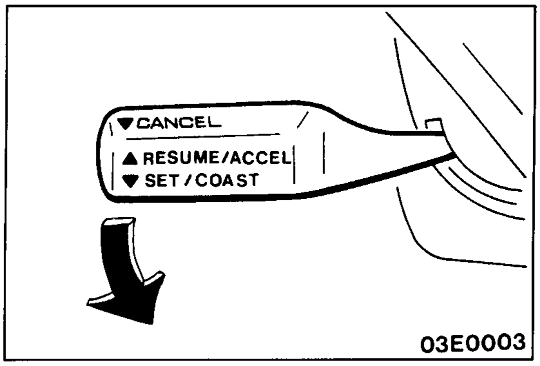
NOTE
If the vehicle speed decreases to approximately 15 km/h (9 mph) below the set speed, because of climbing a hill for example, the auto-cruise control will be cancelled.



### Speed-increase Setting Check

(1) Set to the desired speed.
(2) Turn the control switch to RESUME position.
(3) Check to be sure that acceleration continues while the switch is hold, and that when it is released the constant speed at the time when it was released becomes the driving speed.

NOTE
Even if, during acceleration, the vehicle speed reaches or exceeds the high limit [approximately 200 km/h (125 mph)], acceleration will continue, however, when the switch is released, the set speed ("memorized speed") will become the high limit of the vehicle speed.



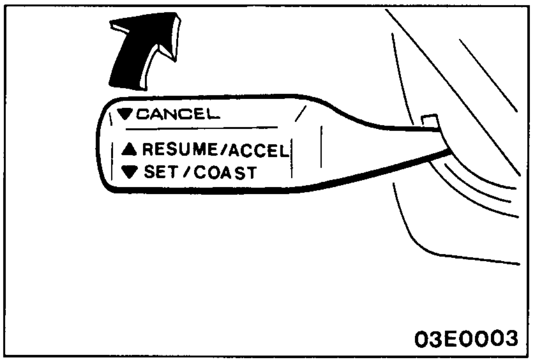
### Speed Reduction Setting Check

(1) Set to the desired speed.
(2) Turn the control switch to the SET position.
(3) Check to be sure that deceleration continues while the switch is pressed, and that when it is released the constant speed at the time when it was released becomes the driving speed.

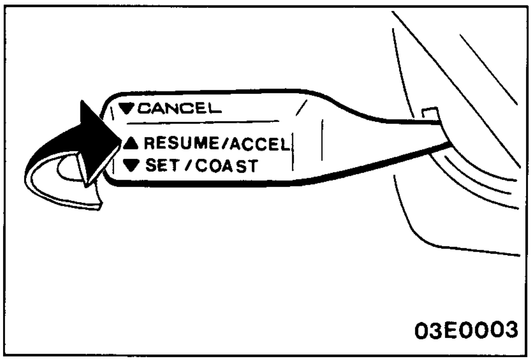
NOTE
When the vehicle speed reaches the low limit [approximately 40 km/h (25 mph)] during deceleration, the automatic speed control will be cancelled.

### Auto-cruise Control Cancellation Check and Check of Return to the Set Speed before Cancellation

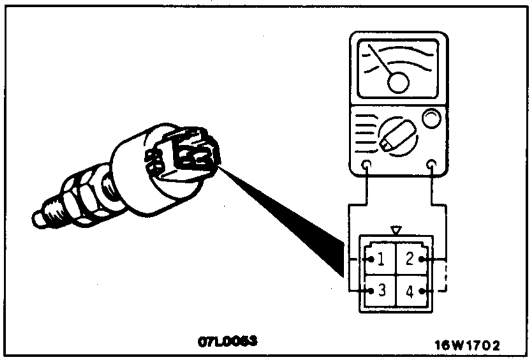
(1) Set the auto-cruise speed control.
(2) Check to be sure that there is a return to ordinary driving when either of the operations below is performed.



① The auto-cruise control switch is turned to the CANCEL position.
② The brake pedal is depressed.
③ The clutch pedal is depressed. <M/T>
④ The selector lever is moved to the "N" range. <A/T>



(3) Turn the control switch to RESUME position while driving at a vehicle speed of approximately 40 km/h (25 mph) or higher, and check to be sure that there is a return to the auto-cruise control speed before it will be cancelled and the vehicle will travel at the constant speed.
(4) When driving at constant speed and the main switch is turned to OFF, check that the vehicle returns to normal driving conditions.



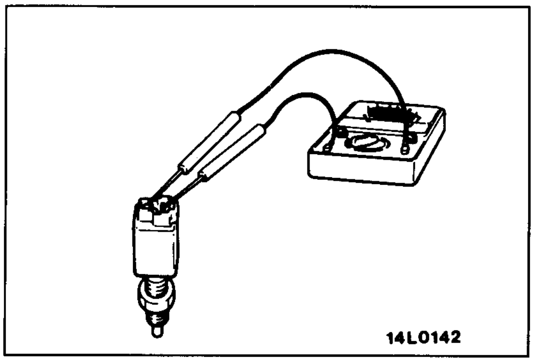
## INDIVIDUAL PARTS INSPECTION E13HAEEc

### Stop Lamp Switch/Brake Switch Inspection

(1) Disconnect the connector.
(2) Check for continuity between the terminals of the switch.

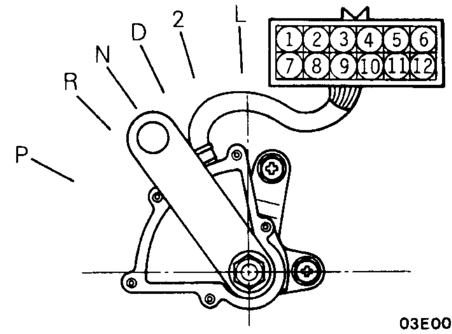
○—○: continuity

| Switch / Measurement conditions / Terminal | Brake switch | | Stop lamp switch | |
|---|---|---|---|---|
| | 1 | 4 | 2 | 3 |
| When brake pedal depressed. | | | ○—○ | |
| When brake pedal not depressed. | ○—○ | | | |



### Clutch Switch Inspection <M/T>

(1) Disconnect the connector.
(2) Check to be sure that there is continuity between connector terminals when the clutch pedal is depressed.



03E0015

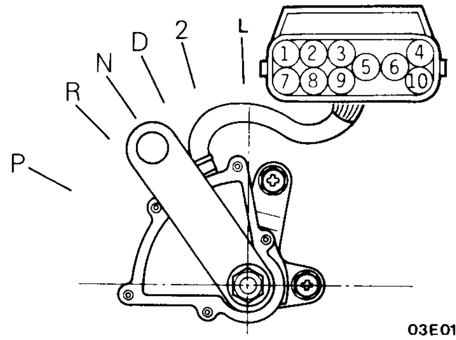
## Inhibitor Switch ("N" position) Inspection <A/T>

**<Vehicles built up to October, 1993>**

(1) Disconnect the connector.
(2) Check to be sure that there is continuity between connector terminals (7) and (12) when the selector lever is moved to the "N" range.

**<Vehicles built from November, 1993>**

(1) Disconnect the connector
(2) Check to be sure that there is continuity between connector terminals (5) and (6) when the selector lever is moved to the "N" range.



03E0145

## Throttle Position Sensor Inspection <3000, 3500>

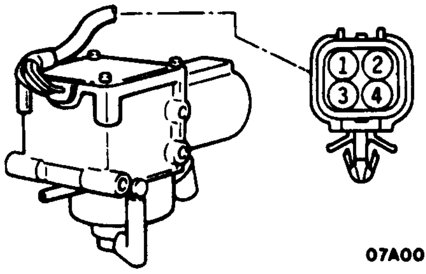
Refer to P.13-17.

## Idle Switch Inspection <3000, 3500>

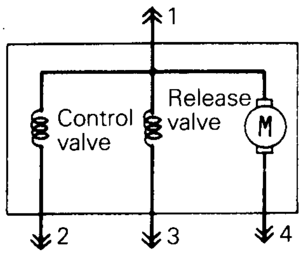
Refer to P.13-17.

## Vehicle-speed Sensor Inspection

Refer to GROUP 54 – Meters and Gauges.



07A0051



07A0050

## Auto-cruise Vacuum Pump Inspection

**<Solenoid valve (Control valve, Release valve)>**

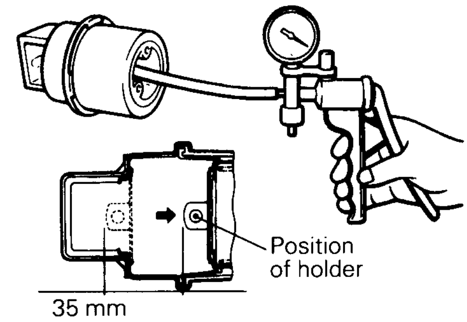
(1) Remove the auto-cruise vacuum pump connector.
(2) Measure the resistance value between terminals (1)–(2) and between (1)–(3).

**Standard value: 50–60 Ω**

(3) Check that the solenoid valve makes an operating noise when battery voltage is impressed between terminals (1)–(2) and between (1)–(3).
(4) If there is a malfunction of the solenoid valve, replace the auto-cruise vacuum pump assembly.

**<Motor>**

(1) Remove the auto-cruise vacuum pump connector.
(2) Check that the motor revolves when battery voltage is impressed between terminals (1)–(4).



07A0052

## Actuator Inspection

(1) Remove the actuator.
(2) Apply negative pressure to the actuator with the vacuum pump and check that the holder moves more than 35 mm (1.38 in.). In addition, check that there is no change in the position of the holder when negative pressure is maintained in that condition.
(3) First install the actuator and then inspect and adjust the auto-cruise control cable. (Refer to P.13-188.)

# AUTO-CRUISE CONTROL

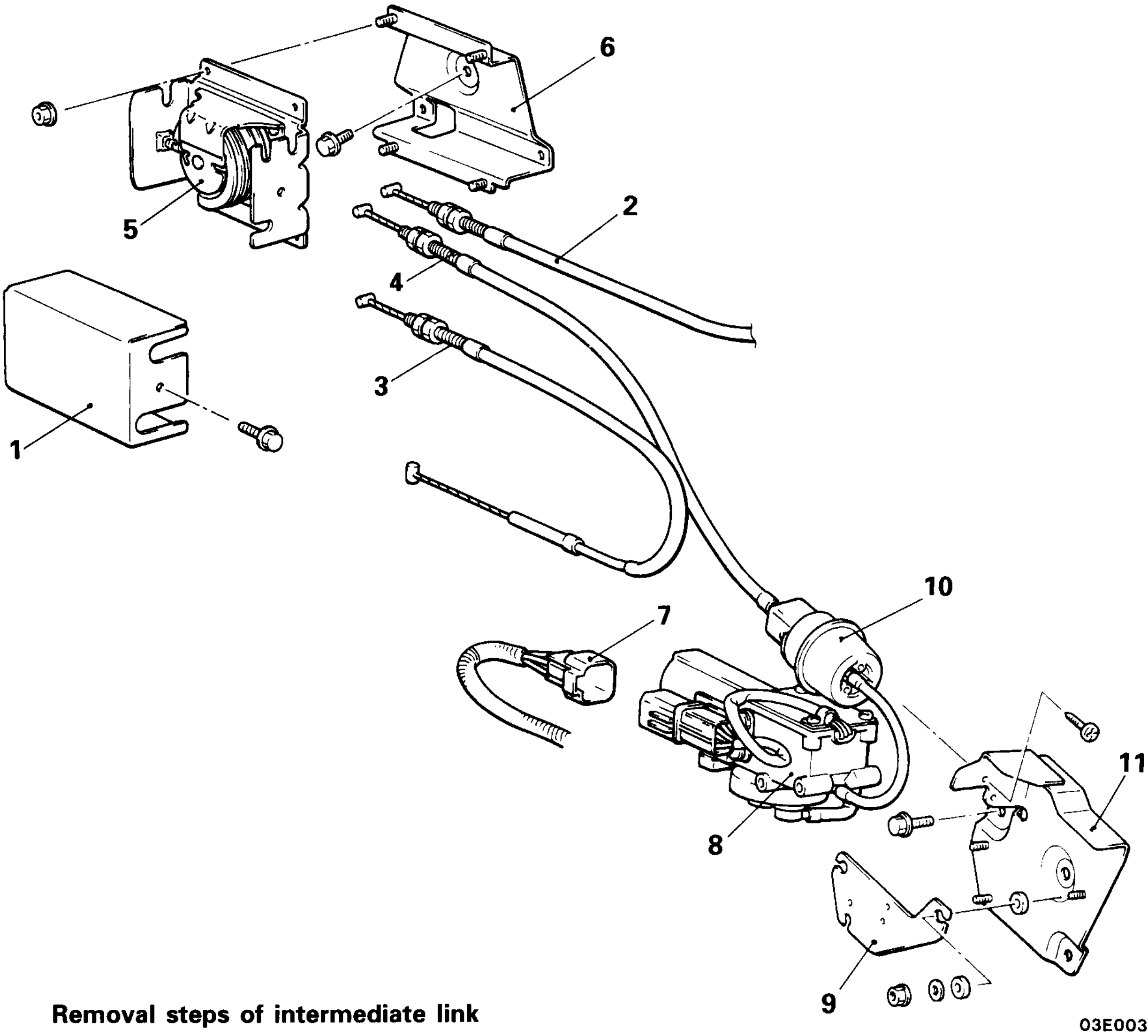
## REMOVAL AND INSTALLATION <LINK AND ACTUATOR>

E13SA--

**<L.H. drive vehicles>**

**Post-installation Operation**
- Control Cables Adjustment (Refer to P.13-188.)

**<Petrol-powered vehicles>**



03E0034

**Removal steps of intermediate link**

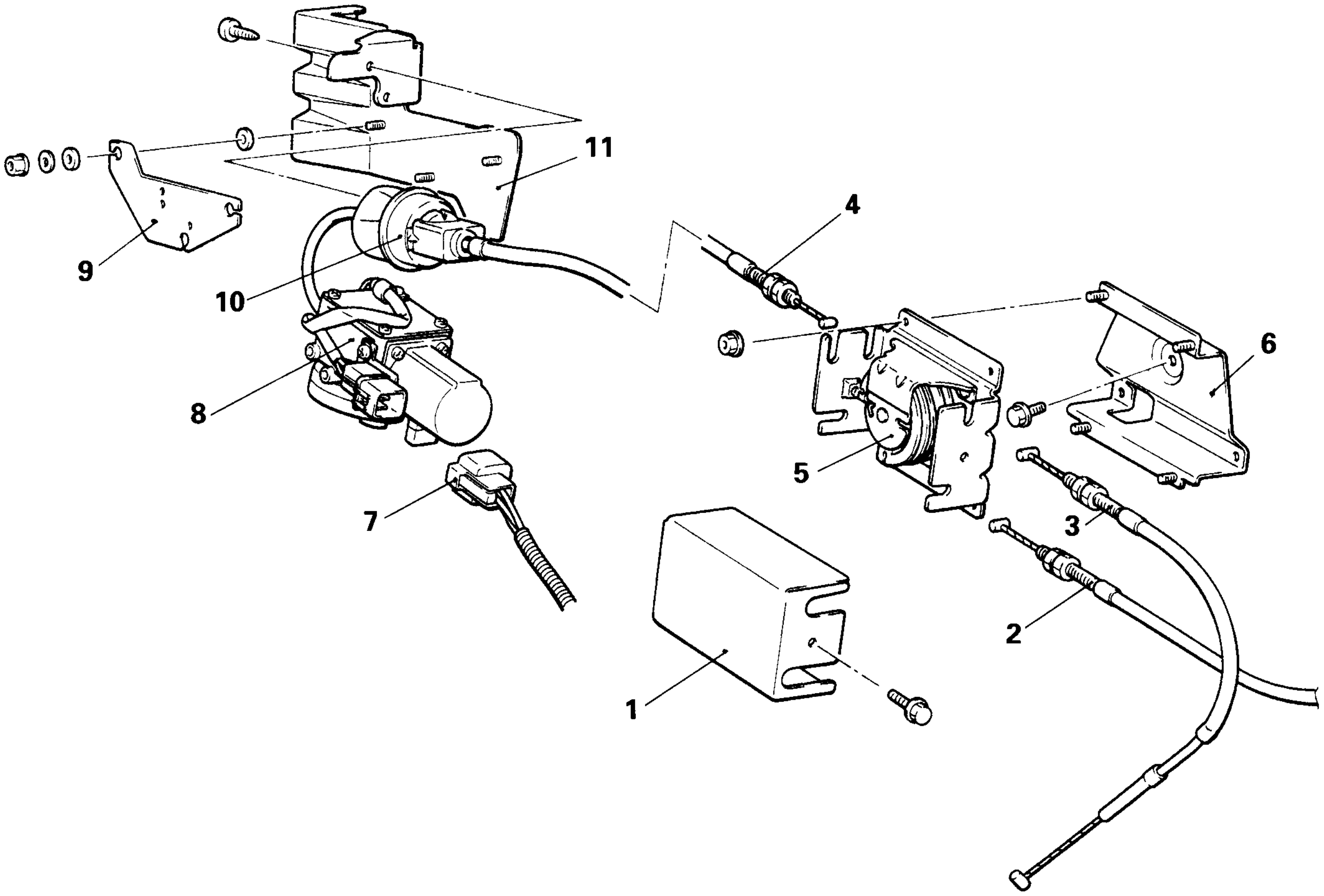
1. Link protector
2. Connection for accelerator cable and link
3. Connection for throttle cable and link
4. Connection for auto-cruise control cable and link
5. Intermediate link
6. Link bracket

**Removal steps of actuator**

4. Connection for auto-cruise control cable and link
7. Wiring connector
8. Vacuum pump
9. Pump bracket
10. Actuator
11. Actuator bracket

**<Diesel-powered vehicles>**

**Post-installation Operation**
- Control Cables Adjustment (Refer to P.13-188.)



03E0035

**Removal steps of intermediate link**

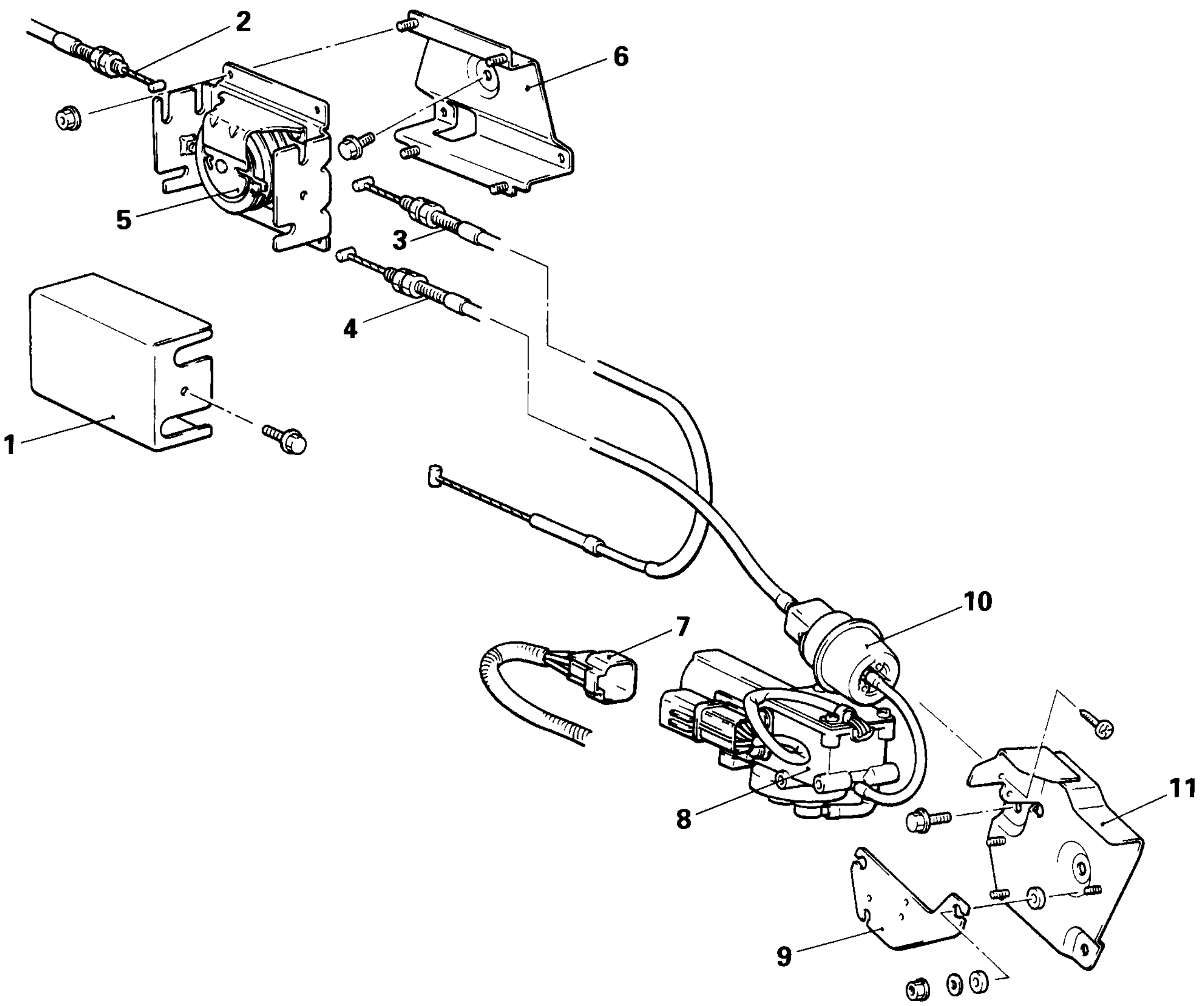
1. Link protector
2. Connection for accelerator cable and link
3. Connection for throttle cable and link
4. Connection for auto-cruise control cable and link
5. Intermediate link
6. Link bracket

**Removal steps of actuator**

4. Connection for auto-cruise control cable and link
7. Wiring connector
8. Vacuum pump
9. Pump bracket
10. Actuator
11. Actuator bracket

## <R.H. drive vehicles>

**Post-installation Operation**
- Control Cables Adjustment (Refer to P.13-189.)



03E0014

**Removal steps of intermediate link**

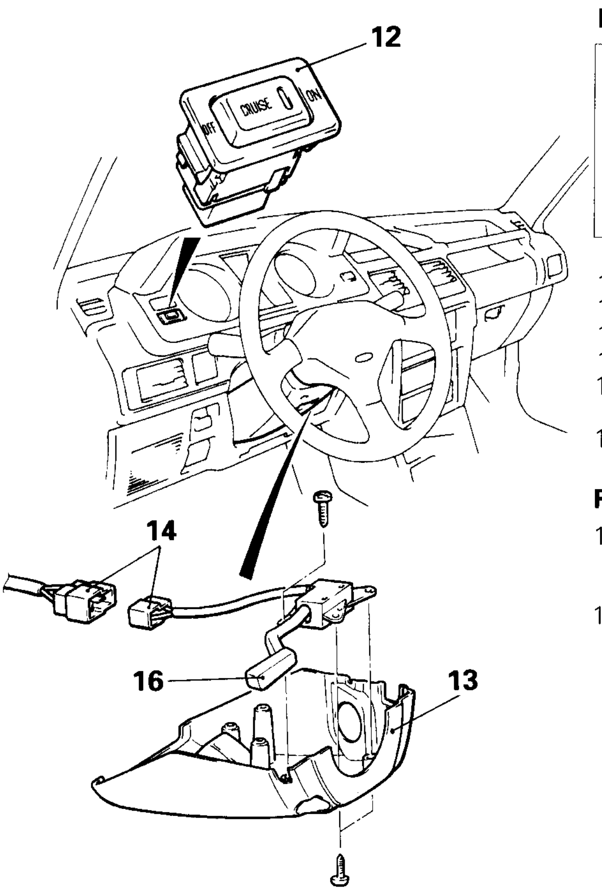
1. Link protector
2. Connection for accelerator cable and link
3. Connection for throttle cable and link
4. Connection for auto-cruise control cable and link
5. Intermediate link
6. Link bracket

**Removal steps of actuator**

4. Connection for auto-cruise control cable and link
7. Wiring connector
8. Vacuum pump
9. Pump bracket
10. Actuator
11. Actuator bracket

## REMOVAL AND INSTALLATION <SWITCHES, CONTROL UNIT AND SENSORS>

E13SA-A



### Removal steps of switches

**CAUTION: SRS**
**Before removal of air bag module, refer to GROUP 52B – SRS Service Precautions and Air Bag Module and Clock Spring.**

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12. Main switch
13. Steering column lower trim
14. Wiring connectors
16. Control switch

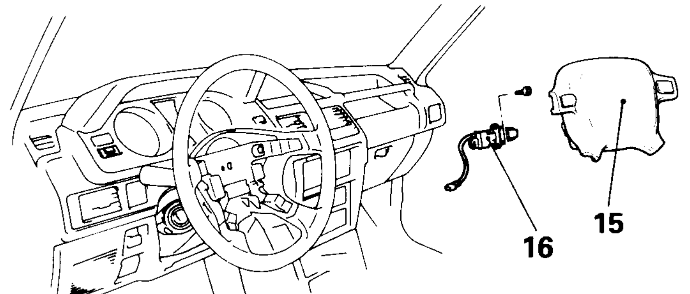
<Vehicles built up to October, 1993>

15. Air bag module (Refer to GROUP 52B – Air Bag Module and Clock Spring.)
16. Control switch

<Vehicles built from November, 1993>

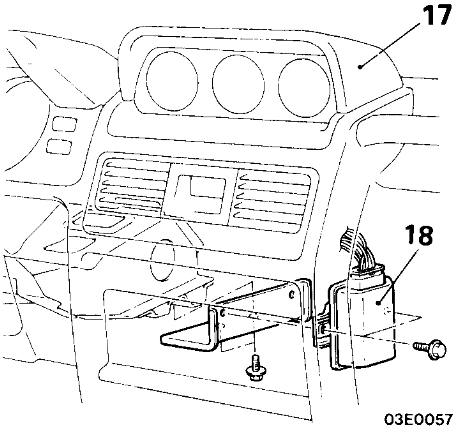
### Removal steps of control unit

17. Instrument panel (Refer to GROUP 52A – Instrument Panel.)
18. Control unit



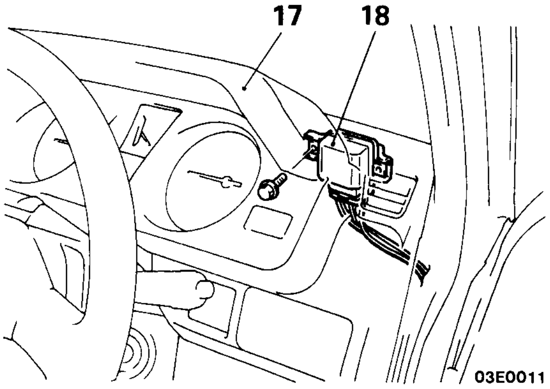
03E0128

**<L.H. drive vehicles>**

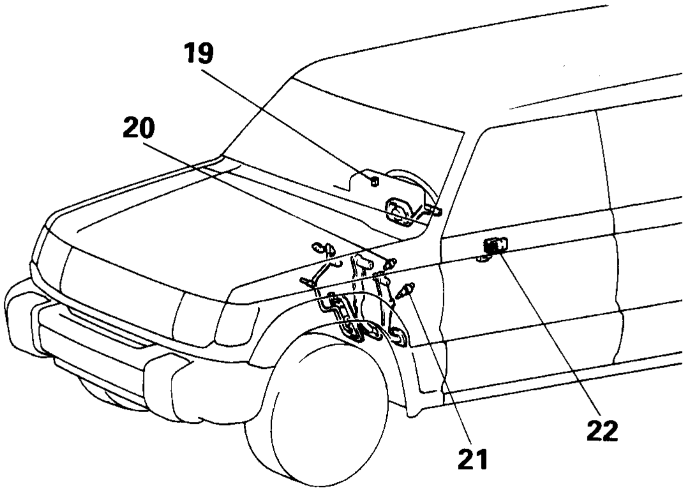


03E0057

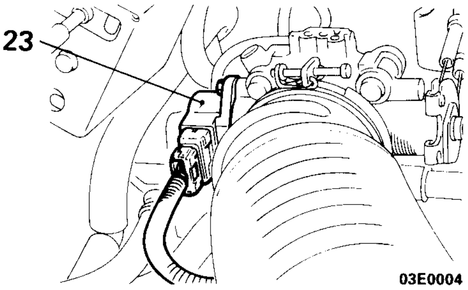
**<R.H. drive vehicles>**



03E0011



03E0033



03E0004

**Removal steps of sensors**

19. Vehicle speed sensor (reed switch)
    (Refer to GROUP 54 – Meters and Gauges.)
20. Stop lamp switch
21. Clutch switch <M/T>
22. Inhibitor switch <A/T>
23. TPS (Throttle position sensor) <3000, 3500>