

SERVICE ADJUSTMENT PROCEDURES <4G13-MPI – Vehicles built from June 1992>

GENERAL INSPECTION

ACCELERATOR CABLE INSPECTION AND ADJUSTMENT

E13PCBF

- (1) Turn air conditioner and lamps OFF.
Inspect and adjust at no load.
- (2) Warm engine until stabilized at idle.
- (3) Confirm idle speed is at prescribed rpm.
- (4) Stop engine (ignition switch OFF).
- (5) Confirm there are no sharp bends in accelerator cable.
- (6) Check inner cable for correct slack.
- (7) If there is too much slack or no slack, adjust play by the following procedures.
- ① Turn the ignition switch to the ON position (without starting the engine) and leave in that condition for approximately 15 seconds in order to initialize the ISC motor.

- ② Loosen the adjusting bolts on the air intake plenum, and then secure the outer cable so that the free play of the inner cable will be the standard value.

Standard value:

<M/T>

1 – 2 mm (0.04 – 0.08 in.)

<A/T>

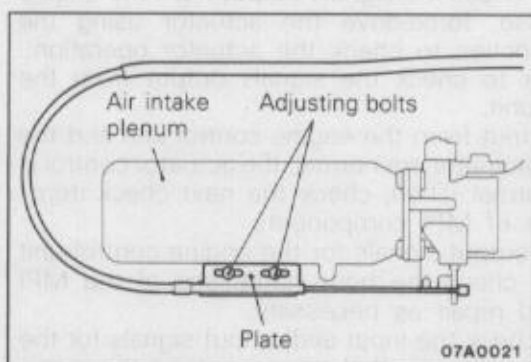
3 – 5 mm (0.12 – 0.20 in.)

NOTE

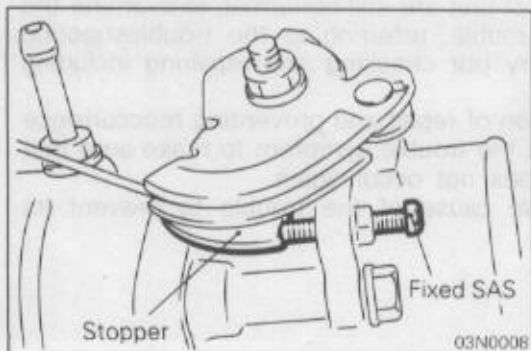
If there is excessive play of the accelerator cable, the vehicle speed drop ("undershoot") when climbing a slope will be large.

If there is no play (excessive tension) of the accelerator cable, the idling speed will increase.

- (8) After adjusting, confirm that throttle valve fully opens and closes by operating pedal.



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- (9) Adjust accelerator cable play and confirm throttle lever stopper touches the fixed SAS.

FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE THE FUEL PRESSURE)

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Refer to P. 13-56.

FUEL FILTER REPLACEMENT

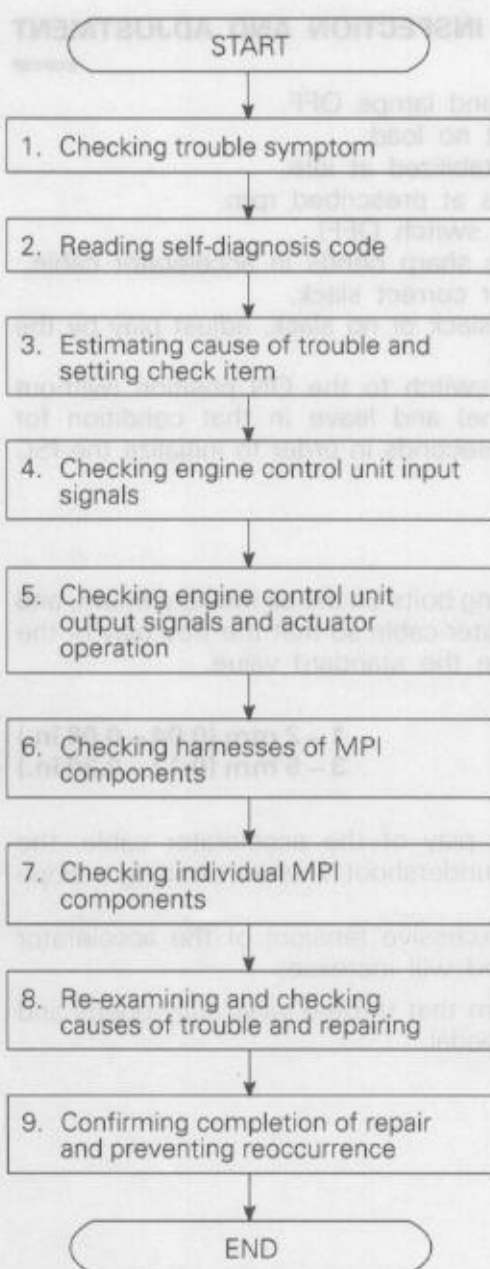
E13FZAO

Refer to P. 13-57.

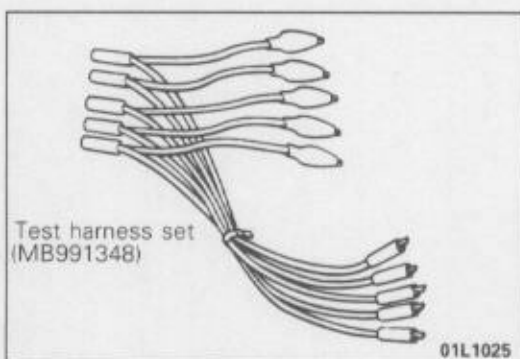
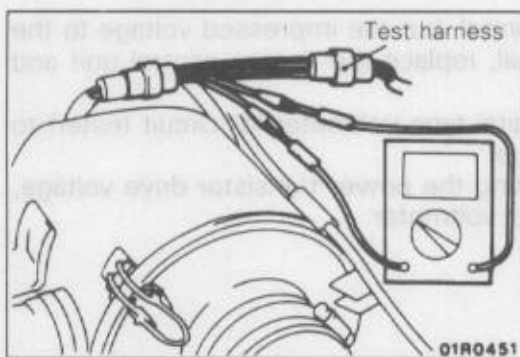
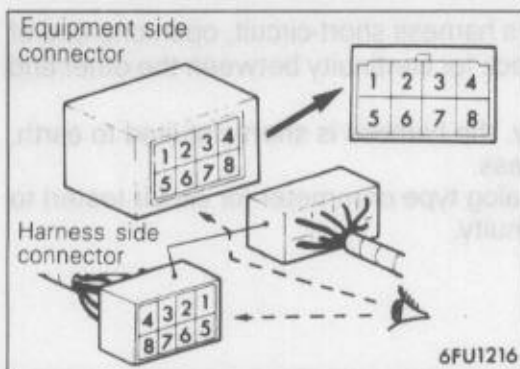
TROUBLESHOOTING

EXPLANATION OF TROUBLESHOOTING PROCEDURES

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



- (1) Checking trouble symptom
 - Reproduce the trouble symptom and check the contents of the trouble and the conditions under which the symptom occurs (engine condition, operating state, etc.).
- (2) Reading self-diagnosis code
 - Read the self-diagnosis code and correct the malfunction when a malfunction code is output, referring to the diagnostic chart.
- (3) Estimating cause 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 signals
 - Use the MUT or an analyzer to check the signals input to the engine control unit.
 - If the input signals are normal, the sensor input is judged to be normal. Then, check the next check item.
- (5) Checking engine control unit output signals and actuator operation
 - Use the MUT to check the signals output from the engine control unit. Also, force-drive the actuator using the actuator test function to check the actuator operation.
 - Use an analyzer to check the signals output from the engine control unit.
 - If the signals output from the engine control unit and the operation of the actuator are normal, the actuator control is judged to be normal. Then, check the next check item.
- (6) Checking harnesses of MPI components
 - If the input and output signals for the engine control unit are not normal, check the body harnesses of the MPI components and repair as necessary.
 - After repairing, check the input and output signals for the engine control unit again. If they are normal this time, check the input and output signals for the next check item.
- (7) Checking individual MPI components
 - If the body harnesses are normal but the input and output signals for the engine control unit are still abnormal, check the MPI 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.
- (8) Re-examining and checking causes of trouble and repairing
 - If the results of the harness check and individual component check are normal but the input and output signals for the engine control unit are still abnormal, re-examine the causes of the trouble, referring to the troubleshooting hints. Then, carry out checking and repairing including other groups.
- (9) Confirming completion of repair and preventing reoccurrence
 - Try to reproduce the trouble symptom to make sure that the symptom does not occur again.
 - Remove the true cause of the trouble to prevent its reoccurrence.

**EXPLANATION AND CAUTIONS FOR CIRCUIT CHECKING**

- The connector symbols show the pin arrangement as seen from the direction of the terminal end of the connector actually mounted in the vehicle.
- When the standard value when checking the voltage is recorded as SV, this is an abbreviation for system voltage.

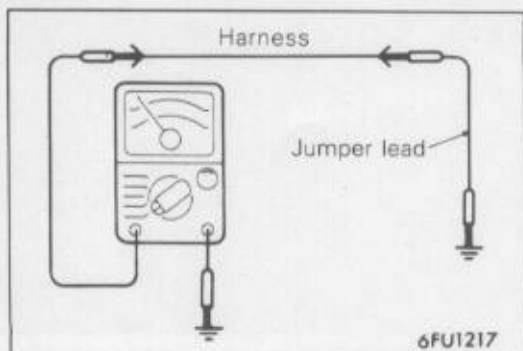
- When checking a waterproof connector with the circuit in a live state, be sure to use the special tool (test harness). Inserting the test probe from the harness side should never be done, as it will adversely affect waterproof performance, which may lead to corrosion. Furthermore, the test harness is used for each setting, so the appropriate item for the connector should be selected.

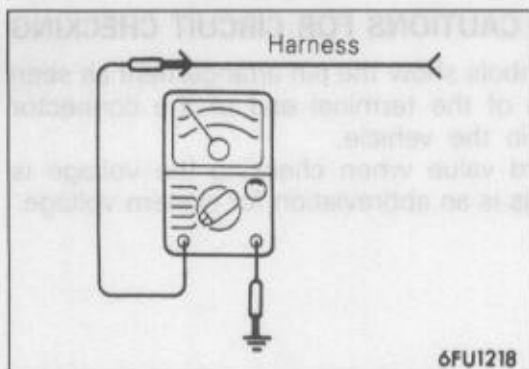
- In addition, if there is no test harness for the appropriate connector, the test harness set (MB991348) which can be connected directly between the terminals can be used.

- When checking the terminal voltage, etc., with the connectors disconnected, do not insert the test probe if the check terminal has female pins. Use the special tool (inspection harness set MB991223) instead. Forcing the test probe into such a terminal can cause poor contact.

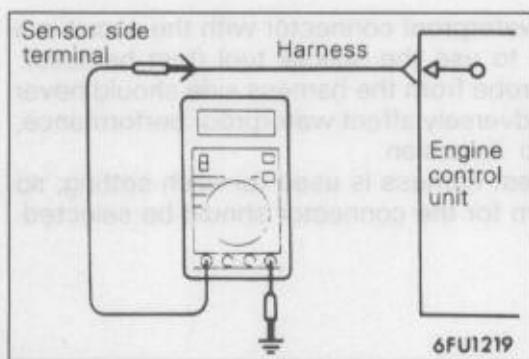
- When checking for an open circuit in a harness with both ends of the harness separated physically, use a jumper lead to earth one end and check continuity between the other end and the earth. This enables checking for an open circuit in the harness to be made. If there is no continuity, repair the harness.

However, when checking for an open circuit in the power supply line, check the continuity between both ends directly, without using a jumper lead to earth one end of the harness.





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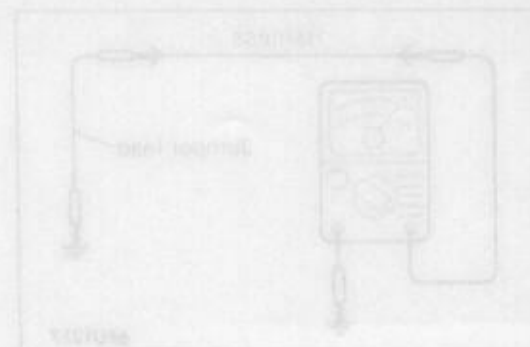
6FU1219

- When checking for a harness short-circuit, open one end of the harness and check for continuity between the other end and the earth. If there is continuity, the harness is short-circuited to earth, so repair the harness.
- As a rule, use an analog type ohmmeter (or circuit tester) to measure the continuity.

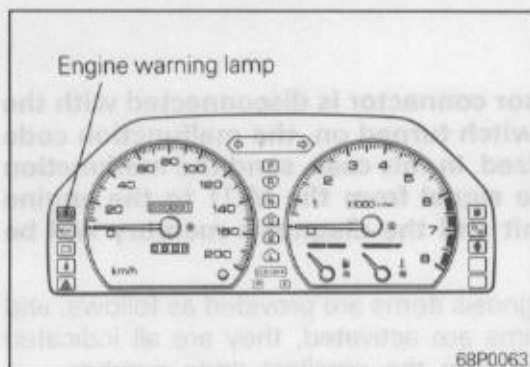
- If the harness is normal, but the impressed voltage to the sensor is not normal, replace the engine control unit and recheck.
- As a rule, use a digital type voltmeter (or circuit tester) to measure the voltage. However, for checking the power transistor drive voltage, use an analog type voltmeter.

When checking the terminal voltage, use the correct probe. Do not use the test probe if the check probe is damaged. Do not use the test probe if the check probe is damaged. Do not use the test probe if the check probe is damaged.

When checking for a open circuit in a harness with both ends of the harness separated physically, use a jumper lead to each one end and check continuity between the other end and the earth. This enables checking for a open circuit in the harness to be made. If there is no continuity, repair the harness.



6FU1220



ENGINE WARNING LAMP (CHECK ENGINE LAMP)

Among the self-diagnosis items, an 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 turned on, the engine warning lamp is lit for 5 seconds to indicate that the engine warning lamp operates normally.

ITEMS INDICATED BY THE ENGINE WARNING LAMP

Engine control unit
Oxygen sensor
Intake air temperature sensor
Throttle position sensor
Coolant temperature sensor
Crank angle sensor
Top dead centre sensor (No. 1 cylinder top dead centre)
Vacuum sensor (manifold absolute pressure sensor)
Ignition timing adjustment signal
Injector

Caution

Engine warning lamp will come on even when terminal for ignition timing adjustment is short-circuited. Therefore, it is not abnormal that the lamp comes on even when terminal for ignition timing adjustment is short-circuited at the time of ignition timing adjustment.

ENGINE WARNING LAMP INSPECTION

- (1) Check that when the ignition switch is turned ON, the lamp illuminates for about 5 seconds and then goes out.
- (2) If the lamp does not illuminate, check for open circuit in harness, blown fuse and blown 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 terminal.

There are 13 diagnosis items, including the normal state, and the diagnosis results can be read out with a MUT.

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. In addition, the malfunction code can also be erased by turning the ignition switch to ON and sending the malfunction code erase signal from the MUT to the engine control unit.

Caution

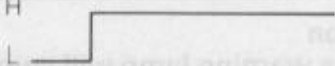
If the sensor connector is disconnected with the ignition switch turned on, the malfunction code is memorized. In this case, send the malfunction code erase signal from the MUT to the engine control unit and the diagnosis memory will be erased.

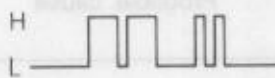
The 13 diagnosis items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

Caution

The malfunction code of ignition timing adjustment signal is outputted when terminal for ignition timing adjustment is short-circuited. Therefore, it is not abnormal that the code is outputted even when terminal for ignition timing adjustment is short-circuited at the time of ignition timing adjustment.

Diagnosis Chart

Output preference order	Diagnosis item	Malfunction code			Check item (Remedy)
		Output signal pattern	No.	Memory	
1	Engine control unit		—	—	(Replace engine control unit)
2	Oxygen sensor		11	Retained	• Harness and connector • Fuel pressure • Injectors (Replace if defective.) • Intake air leaks • Oxygen sensor
3	Intake air temperature sensor		13	Retained	• Harness and connector • Intake air temperature sensor
4	Throttle position sensor		14	Retained	• Harness and connector • Throttle position sensor • Idle position switch
5	Coolant temperature sensor		21	Retained	• Harness and connector • Coolant temperature sensor

Output preference order	Diagnosis item	Malfunction code			Check item (Remedy)
		Output signal pattern	No.	Memory	
6	Crank angle sensor		22	Retained	• Harness and connector (If harness and connector are normal, replace distributor assembly.)
7	No. 1 cylinder top dead centre sensor		23	Retained	• Harness and connector (If harness and connector are normal, replace distributor assembly.)
8	Vehicle speed sensor (reed switch)		24	Retained	• Harness and connector • Vehicle speed sensor (reed switch)
9	Vacuum sensor (Manifold absolute pressure sensor)		32	Retained	• Harness and connector (If harness and connector are normal, replace vacuum sensor (manifold absolute pressure sensor) assembly)
10	Ignition timing adjustment signal	 12A0107	36	—	• Harness and connector
11	Injector	 12A0108	41	Retained	• Harness and connector • Injector coil resistance
12	Servo valve position sensor	 12A0109	55	Retained	• Harness and connector • Servo valve position sensor • Idle speed control servo (DC motor)
13	Normal state	 (continue)	—	—	—

NOTE

1. Replace the engine control unit if a malfunction code is output although the inspection reveals that there is no problem with the check items.
2. The code numbers will be displayed in order, starting from the lowest.

PROBLEM DIAGNOSIS CONTENT CHART

NOTE

*: Fail-Safe/backup function is operating.

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remarks (Trouble symptom, etc.)
–	Engine control unit	Abnormality in engine control unit	–	• Engine stalls • Starting is impossible
11	Oxygen sensor	Oxygen sensor signal voltage does not change (lean/rich) even when air/fuel ratio feedback control (close loop control) operates.	(1) Oxygen sensor malfunction (2) Open circuit or short circuit in oxygen sensor, or connector contact is defective.	• Reduction in exhaust gas purification efficiency*
			(3) Inappropriate fuel pressure (4) Injector malfunction (5) Air leaking in through clearance in gasket	• Reduction in exhaust gas purification efficiency* • Poor starting • Unstable idling • Poor acceleration
13	Intake air temperature sensor	(1) Voltage of intake air temperature sensor signal is 4.5V or more. (2) Voltage of intake air temperature sensor signal is 0.27V or less.	(1) Intake air temperature sensor malfunction (2) Open circuit or short circuit in the intake air temperature sensor, or connector contact is defective	• Slightly poor driveability* • At high temperatures: (a) Poor starting* (b) Unstable idling*
14	Throttle position sensor	(1) Voltage of throttle position sensor signal is 0.2V or less. (2) Voltage of throttle position sensor signal is 2V or more, even though idle position switch is ON.	(1) Throttle position sensor malfunction, or adjustment is defective. (2) Open circuit or short circuit in throttle position sensor, or connector contact is defective	• Slightly poor acceleration <M/T> • Poor driveability <A/T> • Engine stalls
			(3) Idle position switch ON malfunction (4) Short circuit in idle position switch signal wire	• Engine stalls • Racing is impossible

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remarks (Trouble symptom, etc.)
21	Coolant temperature sensor	(1) Voltage of coolant temperature sensor signal is 4.6V or more. (2) Voltage of coolant temperature sensor signal is 0.11V or less. (3) While engine is warming up, coolant temperature sensor signal shows a drop in engine coolant temperature.	(1) Coolant temperature sensor malfunction (2) Open circuit or short circuit in coolant temperature sensor, or connector contact is defective	When engine is cold: • Poor starting* • Unstable idling* • Poor acceleration*
22	Crank angle sensor	Voltage of crank angle sensor signal does not change (high/low), even though engine has been cranking for 4 seconds or more.	(1) Crank angle sensor malfunction (2) Open circuit or short circuit in crank angle sensor, or connector contact is defective	• Engine stalls • Starting is impossible
23	Top dead centre sensor	Voltage of top dead centre sensor signal does not change (high/low), even though engine is running.	(1) Top dead centre sensor malfunction (2) Open circuit or short circuit in top dead centre sensor, or connector contact is defective	• Unstable idling* • Poor acceleration*
24	Vehicle speed sensor (reed switch)	Voltage of vehicle speed sensor does not change (high/low) even though vehicle is accelerating at an engine speed of 3,000 r/min. or more.	(1) Vehicle speed sensor malfunction (2) Open circuit or short circuit in vehicle speed sensor, or connector contact is defective	Engine stalls when vehicle stops after decelerating

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remarks (Trouble symptom, etc.)
32	Vacuum sensor (Manifold absolute pressure sensor)	(1) Voltage of vacuum sensor signal is 4.5V or more. (2) Voltage of vacuum sensor signal is 0.2V or less.	(1) Vacuum sensor malfunction (2) Open circuit or short circuit in vacuum sensor, or connector contact is defective.	● Poor acceleration* ● Inappropriate idle speed* ● Unstable idling*
36	Ignition timing adjustment signal	Ignition timing adjustment signal wire is short-circuited to earth.	(1) Ignition timing adjustment signal wire is short-circuited to earth.	● Poor acceleration ● Engine overheats
41	Injector	Injectors do not operate for a continuous 4 second period while engine is cranking or idling.	(1) Injector malfunction (2) Open circuit or short circuit in injector, or connector contact is defective	● Poor starting ● Unstable idling ● Poor acceleration
55	Servo valve position sensor	Servo valve does not move to the intended position (opening angle), even though idle speed control servo motor operates many times.	(1) Servo valve position sensor malfunction (2) Open circuit or short circuit in servo valve position sensor, or connector contact is defective (3) Idle speed control servo motor (DC motor) malfunction (4) Open circuit or short circuit in idle speed control servo motor (DC motor), or connector contact is defective	● Inappropriate idle speed* ● Engine stops* ● Unstable idling*

FAIL-SAFE/BACKUP FUNCTION TABLE

When the main sensor malfunctions are detected by the self-diagnosis function, the vehicle is controlled by means of the pre-set control logic to maintain safe conditions for driving.

Malfunctioning item	Control contents during malfunction
Vacuum sensor (Manifold absolute pressure sensor)	(1) Determines the fuel injection timing and ignition timing by means of the throttle position sensor (TPS) signal and the engine speed signal (crank angle sensor signal). (2) Fixes the ISC servo in the appointed position so idle speed control is not performed.
Intake air temperature sensor	Controls as if the intake air temperature is 45°C (113°F).
Throttle position sensor (TPS)	No increase in fuel injection amount during acceleration due to the throttle position sensor signal.
Coolant temperature sensor	Controls as if the coolant temperature is 80°C (176°F).
Top dead centre sensor	Injects fuel simultaneously into all cylinders. (However, after the ignition switch is turned to ON, the No. 1 cylinder top dead centre is not detected at all.)
Servo valve position sensor	Idle speed control is not performed.
Oxygen sensor	Air/fuel ratio feedback control (closed loop control) is not performed.

READ OUT OF MALFUNCTION CODE**PRECAUTIONS FOR OPERATION**

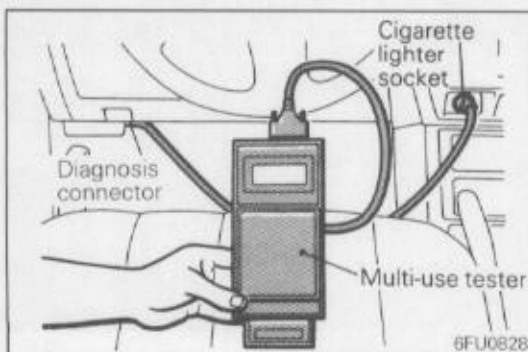
- (1) When battery voltage is low, no detection of failure is possible. Be sure to check the battery for voltage and other conditions before starting the test.
- (2) Diagnosis item is erased if the battery or the engine control unit connector is disconnected. Do not disconnect the battery before the diagnosis result is completely read.
- (3) Connection and disconnection of the MUT should always be made with the ignition switch in the OFF position.

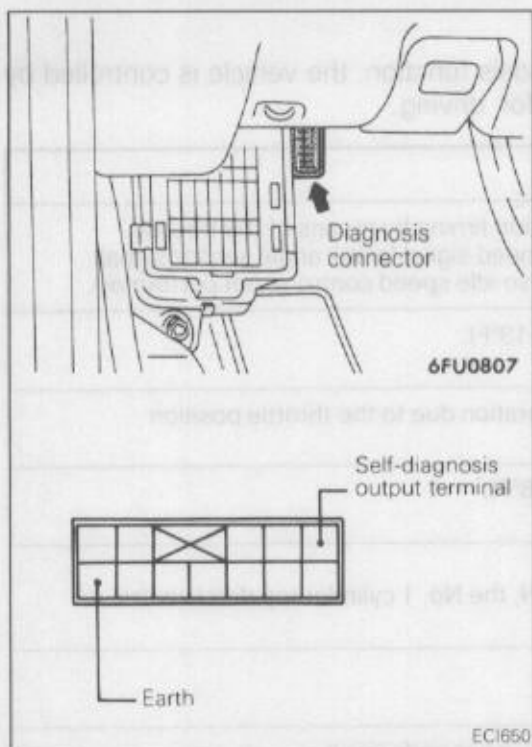
USING MULTI-USE TESTER (MUT)

- (1) Read and make a note of the self-diagnosis output.
- (2) Repair the problem location, referring to the diagnosis chart.
- (3) After turning the ignition switch once to OFF, turn it back to ON.
- (4) Erase the malfunction code.
- (5) Recheck to be sure that the condition is normal.

NOTE

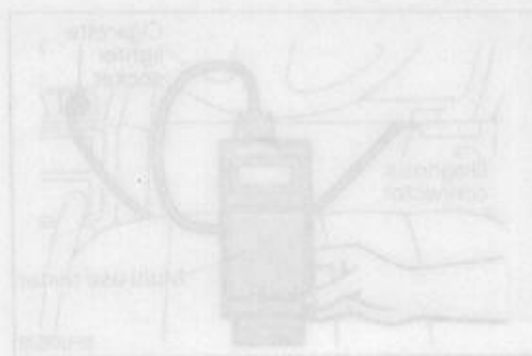
Connect the MUT to the white diagnosis connector.





USING A VOLTMETER

- (1) Connect an analog type voltmeter between the self diagnosis output terminal and the earth terminal of the diagnosis connector.
- (2) Turn the ignition switch to ON.
- (3) Take a reading of the self diagnosis output pattern from the movement of the needle on the voltmeter, and make a note of the reading.
- (4) Refer to the diagnosis chart to correct the malfunction location.
- (5) Erase the malfunction 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 Turn the ignition switch to ON and take a reading of the self diagnosis codes to check if a normal diagnosis code is output.



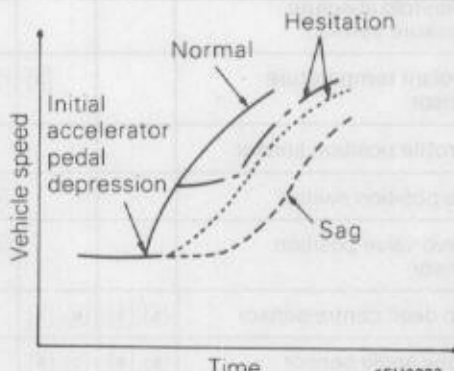
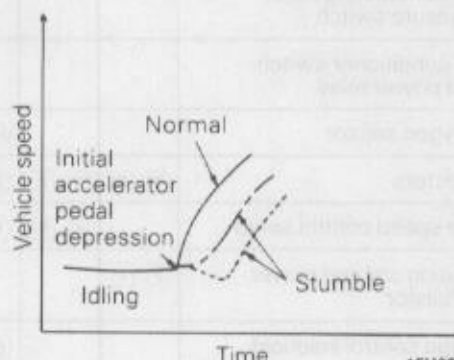
CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

Problem symptoms Check items	Starting		Idling stability			Driving						Stop- ping	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	① ①												P.13-123-68
Engine control unit power earth	② ②												P.13-123-71
Fuel pump	③ ③	① ①			① ①	① ①	① ①						P.13-123-72
Intake air temperature sensor			⑥			④ ④	④ ④				① ①		P.13-123-75
Vacuum sensor (Manifold absolute pressure sensor)			⑧			⑦ ⑦	⑥ ⑥				② ②		P.13-123-78
Coolant temperature sensor		③	⑦ ⑥	① ①	⑥ ⑥	⑥ ⑥	⑤ ⑤	④ ④		③ ③			P.13-123-80
Throttle position sensor						⑤ ⑤		③ ③	④ ④				P.13-123-83
Idle position switch			④ ④	② ②	⑤ ⑤								P.13-123-86
Servo valve position sensor			③ ③	⑤ ③	④ ④				⑤ ⑤				P.13-123-88
Top dead centre sensor	⑤ ⑤	⑥ ⑦			⑨ ⑧				② ②				P.13-123-91
Crank angle sensor	⑥ ⑥	⑦ ⑧			⑩ ⑨				③ ③				P.13-123-95
Ignition switch-ST	④ ④	③ ④											P.13-123-98
Vehicle speed sensor					⑦				⑥				P.13-123-99
Power steering fluid pressure switch				③									P.13-123-101
Air conditioner switch and power relay				④									P.13-123-103
Oxygen sensor			⑩										P.13-123-105
Injectors	⑧ ⑧	② ②	② ②		③ ③	② ②	② ②	① ①		① ①		①	P.13-123-108
Idle speed control servo		④ ⑤	① ①	⑥ ④	② ②				⑦ ⑥				P.13-123-114
Ignition coil and power transistor	⑦ ⑦				⑪ ⑩		⑦ ⑦		① ①		③ ③		P.13-123-116
Purge control solenoid valve			⑨										P.13-123-120
Fuel pressure		⑤ ⑥	⑤ ⑤		⑧ ⑦	③ ③	③ ③	② ②		② ②			P.13-123-122

○: Warm engine (number inside indicates check order)

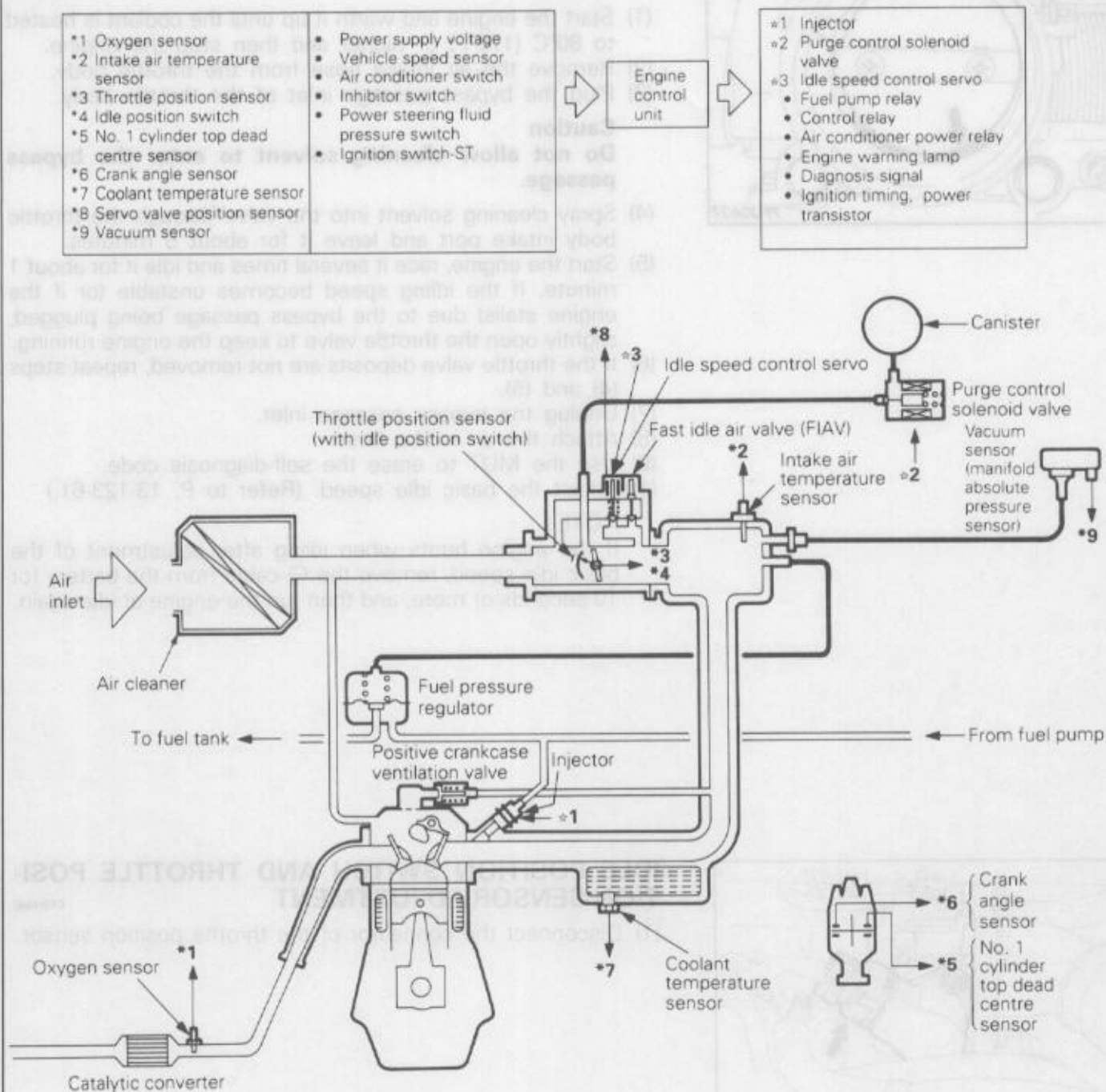
□: Cold engine (number inside indicates check order)

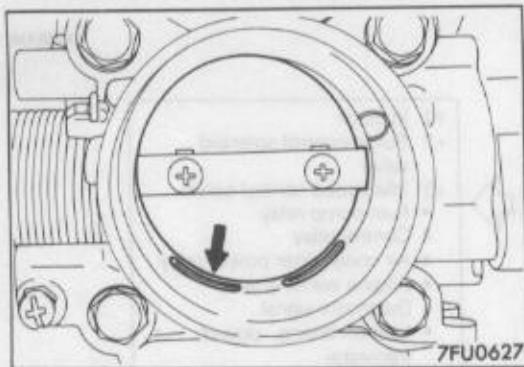
PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

Items		Symptom
Starting	Won't start (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 (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. 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 Die out Pass out	This non-continuity of idling includes the following elements. (1) Die out The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicle is moving or not. (2) Pass out ... The engine stalls when the accelerator pedal is depressed or while it is being used.
Driving	Hesitation Sag	"Hesitation" is the delay in response of the vehicle speed (engine rpm) 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 rpm) during such acceleration. Serious hesitation is called "sag".  1FU0223
	Poor acceleration	Poor acceleration 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 rpm response is delayed when the accelerator pedal is initially depressed for acceleration from the stopped condition.  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.
Stop-ping	Run on ("Dieseling")	The condition in which the engine continues to run after the ignition switch is turned to OFF. Also called "Dieseling".

E13BBAM

VACUUM HOSE PIPING DIAGRAM





THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

E13HAJE

- (1) Start the engine and warm it up until the coolant is heated to 80°C (176°F) or higher and then stop the engine.
- (2) Remove the air intake hose from the throttle body.
- (3) Plug the bypass passage inlet of the throttle body.

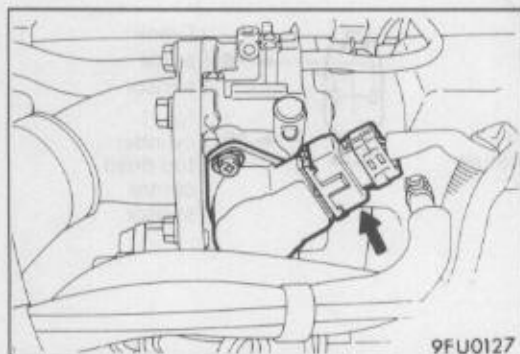
Caution

Do not allow cleaning solvent to enter the bypass passage.

- (4) Spray cleaning solvent into the valve through the throttle body intake port and leave it for about 5 minutes.
- (5) Start the engine, race it several times and idle it for about 1 minute. If the idling speed becomes unstable (or if the engine stalls) due to the bypass passage being plugged, slightly open the throttle valve to keep the engine running.
- (6) If the throttle valve deposits are not removed, repeat steps (4) and (5).
- (7) Unplug the bypass passage inlet.
- (8) Attach the air intake hose.
- (9) Use the MUT to erase the self-diagnosis code.
- (10) Adjust the basic idle speed. (Refer to P. 13-123-61.)

NOTE

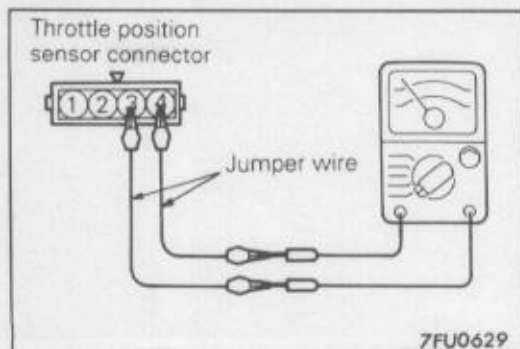
If the engine hunts when idling after adjustment of the basic idle speed, remove the $\ominus$ cable from the battery for 10 seconds or more, and then run the engine at idle again.



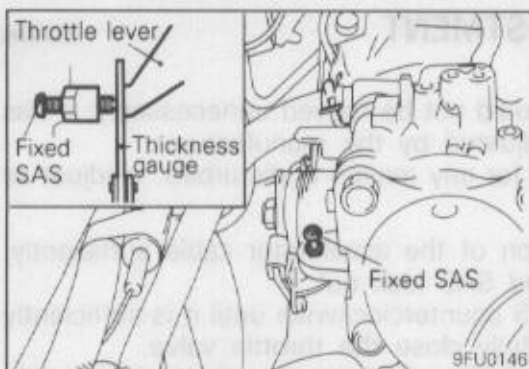
IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT

E13HAKI

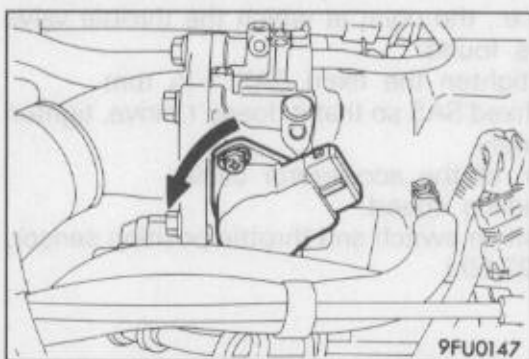
- (1) Disconnect the connector of the throttle position sensor.



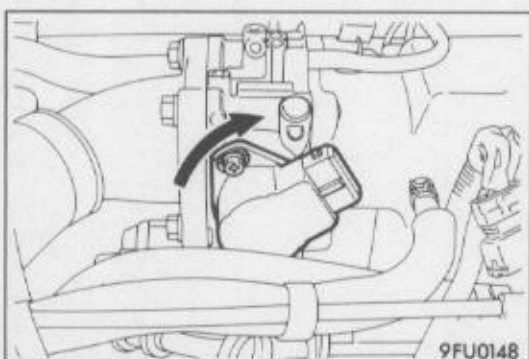
- (2) Connect an ohmmeter between terminal ③ (Idle position switch) and ④ (sensor earth) by using jumper wires.



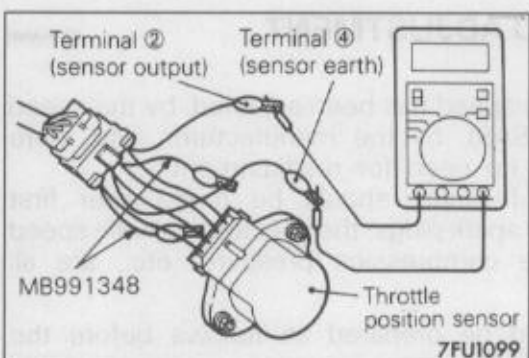
- (3) Insert a feeler gauge with a thickness of 0.45 mm (0.0177 in.) between the fixed SAS and the throttle lever.



- (4) Loosen the throttle position sensor mounting bolt; then turn the throttle position sensor body fully counter clockwise.
 (5) In this condition, check for continuity between terminals ③ and ④.



- (6) Slowly turn the throttle position sensor in the clockwise direction until the point at which continuity between terminals ③ and ④ changes to non-continuity is found. Tighten the throttle position sensor installation bolt at that position.
 (7) Connect the connector of the throttle position sensor.



- (8) When using the MUT, connect it to the diagnosis connector (white).
 (9) When not using the MUT, proceed as follows:
 ① Disconnect the throttle position sensor connectors and connect the special tool, Test Harness Set, between the disconnected connectors.
 ② Connect a digital voltmeter between the throttle position sensor terminal ② (sensor output) and terminal ④ (sensor earth).
 (10) Turn the ignition switch ON (but do not start the engine).
 (11) Check the throttle position sensor output voltage. When using the MUT, select item No.14 and read the throttle position sensor output voltage.

Standard value: 400 – 1,000 mV

- (12) If there is a deviation from the standard value, check the throttle position sensor and the related harness.
 (13) Remove the feeler gauge.
 (14) Switch OFF the ignition switch.



FIXED SAS ADJUSTMENT

E13HAME

NOTE

1. The fixed SAS should not be moved unnecessarily; it has been precisely adjusted by the manufacturer.
2. If the adjustment for any reason is disturbed, readjust as follows.
 - (1) Loosen the tension of the accelerator cable sufficiently.
 - (2) Back out the fixed SAS lock nut.
 - (3) Turn the fixed SAS counterclockwise until it is sufficiently backed out, and fully close the throttle valve.
 - (4) Tighten the fixed SAS until the point where the throttle lever is touched (i.e., the point at which the throttle valve begins to open) is found.
From that point, tighten the fixed SAS 1-1/4 turn.
 - (5) While holding the fixed SAS so that it doesn't move, tighten the lock nut securely.
 - (6) Adjust the tension of the accelerator cable.
 - (7) Adjust the basic idling speed.
 - (8) Adjust the idle position switch and throttle position sensor. (Refer to P. 13-123-59.)



BASIC IDLE SPEED ADJUSTMENT

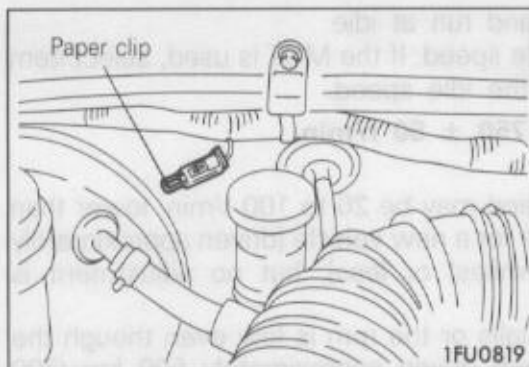
E13HANH

NOTE

1. The standard idling speed has been adjusted, by the speed adjusting screw (SAS), by the manufacturer, and there should usually be no need for readjustment.
2. The adjustment, if made, should be made after first confirming that the spark plugs, the injectors, the idle speed control servo, the compression pressure, etc., are all normal.
 - (1) The vehicle should be prepared as follows before the inspection and adjustment.
 - Engine coolant temperature: 80 – 95°C (176 – 203°F)
 - Lamps, cooling fan and accessories: OFF
 - Transmission: Neutral (A/T for P range)
 - (2) Connect the MUT to the diagnosis connector (white).

NOTE

When the MUT is connected, the diagnosis control terminal should be earthed.

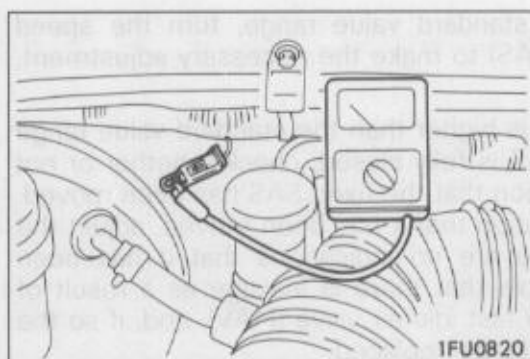


(3) If the MUT is not used, follow the steps below.

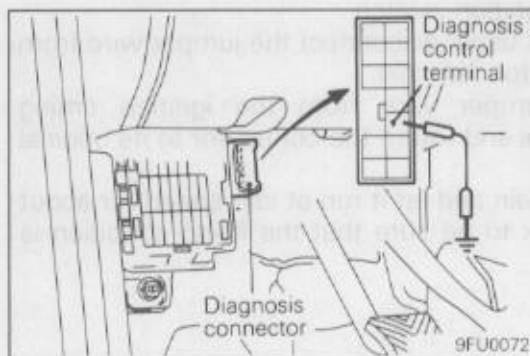
- ① Insert a paper clip (from the harness side) into the 1 -pin connector shown in the figure at the left. Take care not to disconnect the connector.

Caution

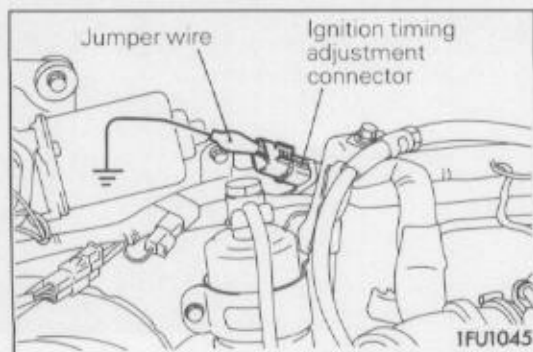
Insert the paper clip as in the illustration at left along the terminal from the opposite side of the locking pawl on the female connector.



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



- ③ Use a jumper wire to earth the self diagnosis control terminal of the diagnosis connector.



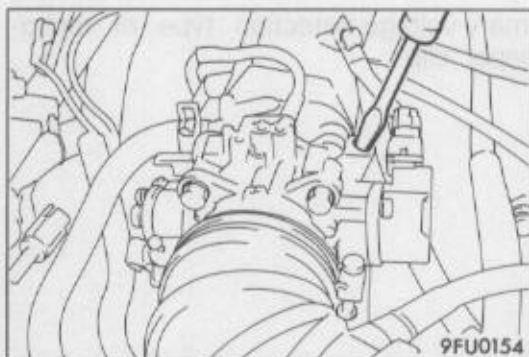
- ④ Remove the waterproof female connector from the ignition timing adjustment connector.
- ⑤ Use a jumper wire to earth the ignition timing adjustment terminal.

- (6) Start the engine and run at idle.
- (7) Check the basic idle speed. If the MUT is used, select item No. 22 and read the idle speed.

Standard value: 750 ± 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 rpm 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. 13-123-59.)

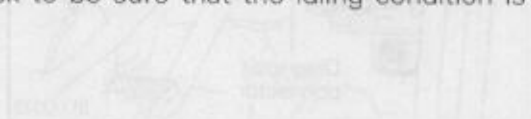


- (8) If not within the standard value range, turn the speed adjusting screw (SAS) to make the necessary adjustment.

NOTE

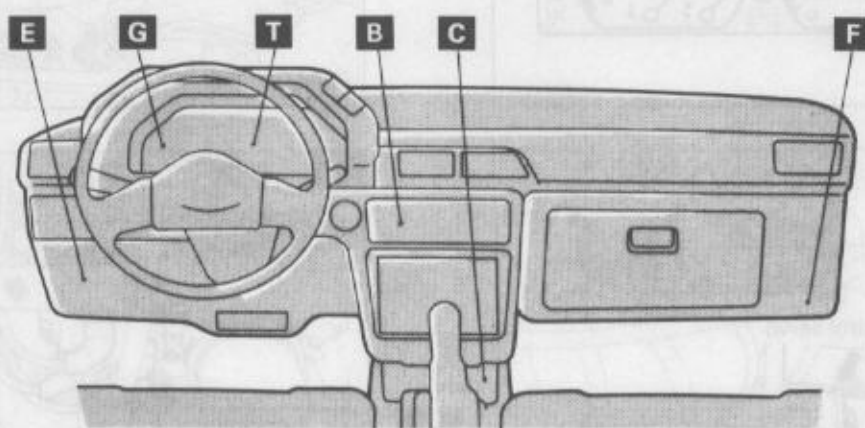
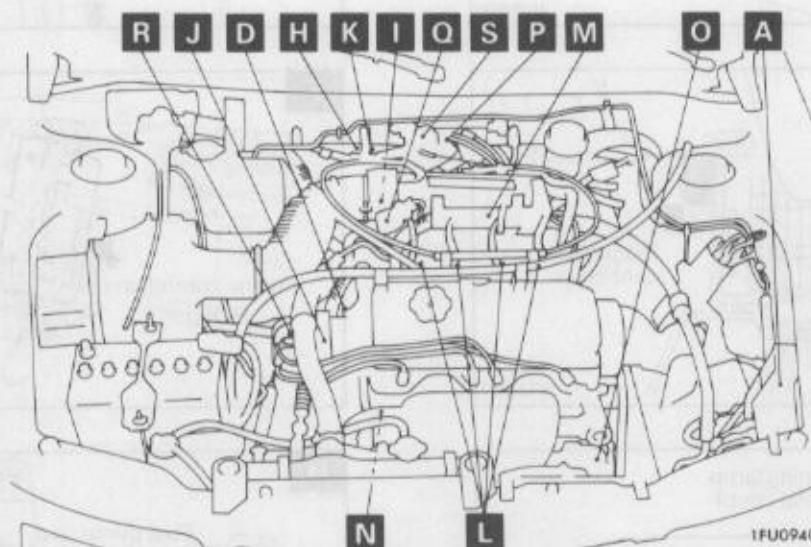
If the idling speed is higher than the standard value range even when the SAS is fully closed, check whether or not there is any indication that the fixed SAS has been moved. If there is an indication that it has been moved, adjust the fixed SAS. If there are no indications that it has been moved, it 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.

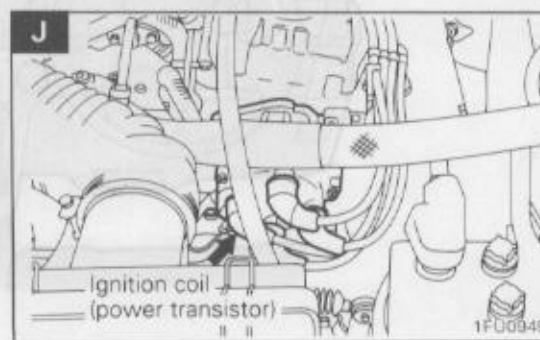
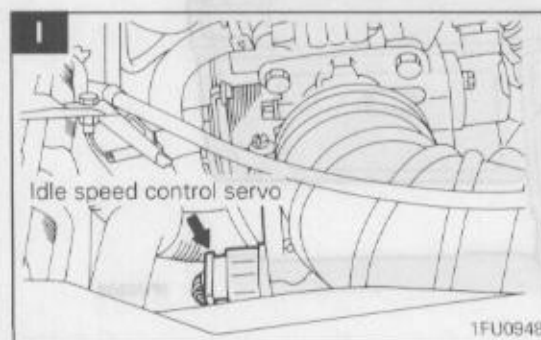
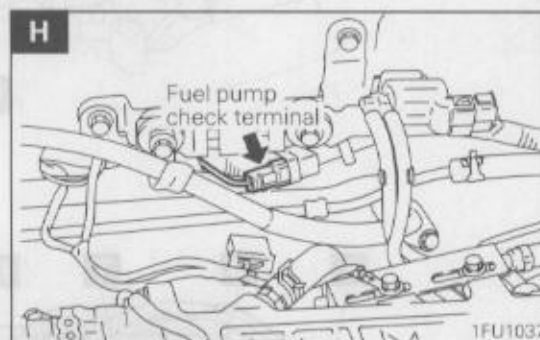
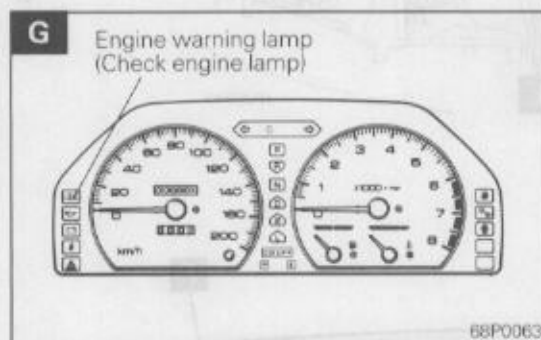
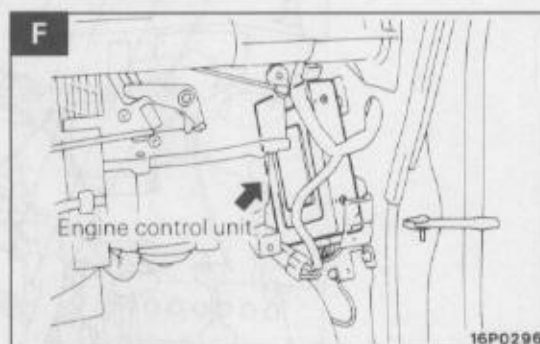
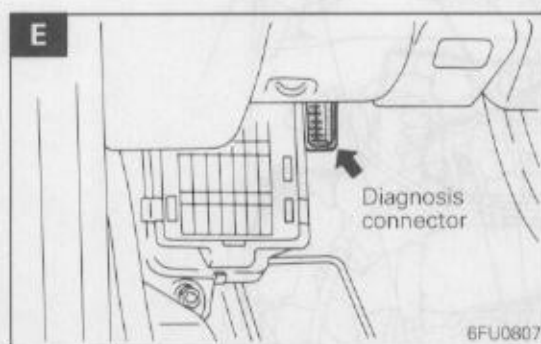
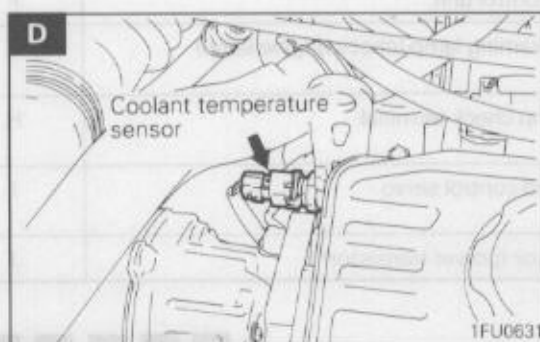
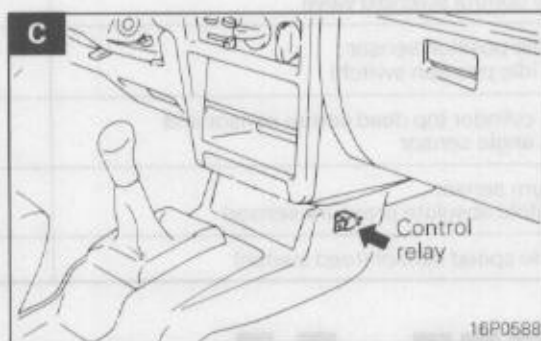
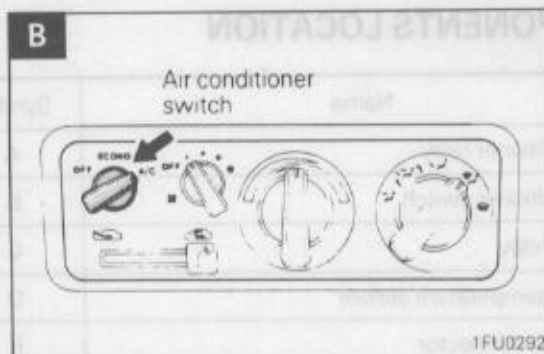
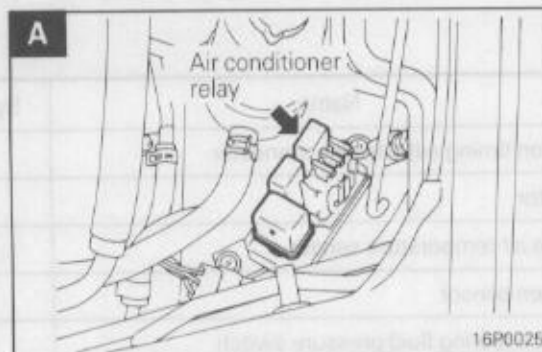
- (9) Switch OFF the ignition switch.
- (10) If the MUT was not used, disconnect the jumper wire from the diagnosis control terminal.
- (11) Disconnect the jumper wire from the ignition timing adjustment terminal and return the connector to its original condition.
- (12) Start the engine again and let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

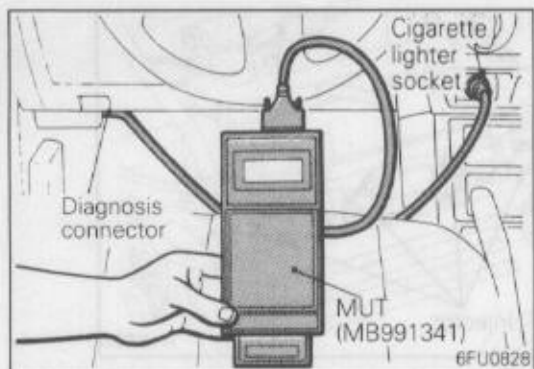


COMPONENTS LOCATION

Name	Symbol	Name	Symbol
Air conditioner relay	A	Ignition timing adjustment connector	K
Air conditioner switch	B	Injector	L
Control relay	C	Intake air temperature sensor	M
Coolant temperature sensor	D	Oxygen sensor	N
Diagnosis connector	E	Power steering fluid pressure switch	O
Engine control unit	F	Purge control solenoid valve	P
Engine warning lamp (check engine lamp)	G	Throttle position sensor (with idle position switch)	Q
Fuel pump check terminal	H	No. 1 cylinder top dead centre sensor and crank angle sensor	R
Idle speed control servo	I	Vacuum sensor (Manifold absolute pressure sensor)	S
Ignition coil (power transistor)	J	Vehicle speed sensor (reed switch)	T



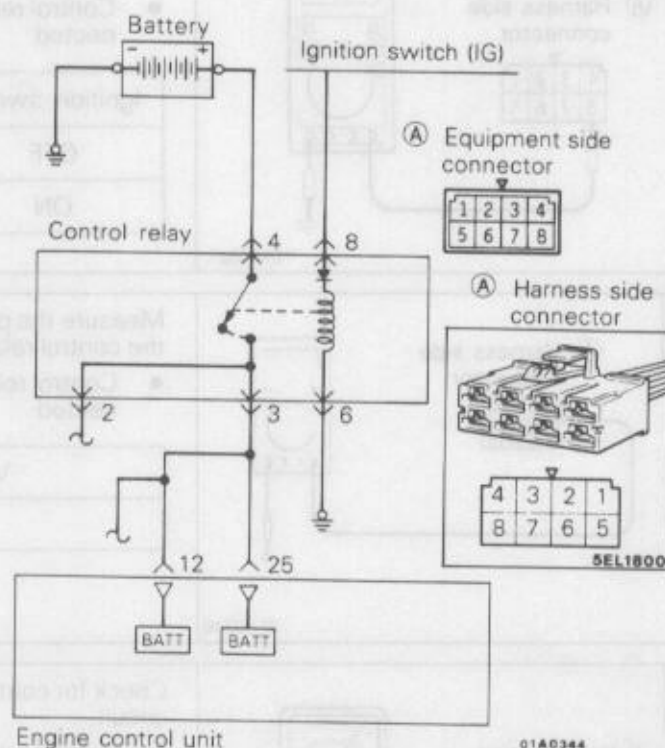
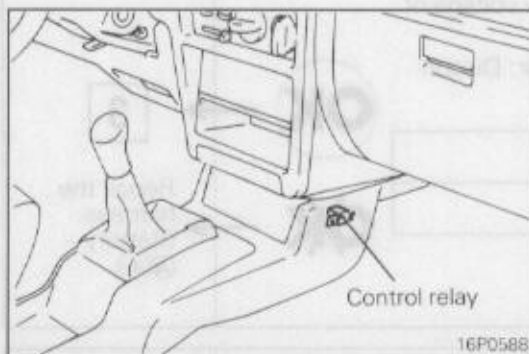
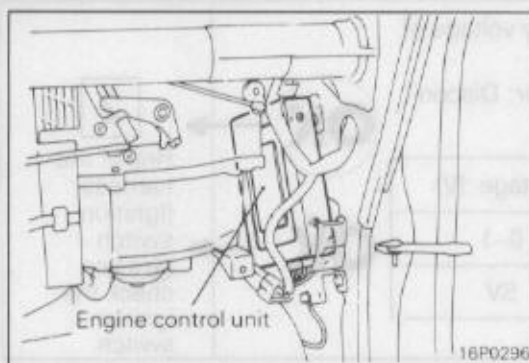




INSPECTION PROCEDURE USING THE MULTI-USE TESTER (MUT)

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

POWER SUPPLY



OPERATION

- While the ignition switch is ON, battery power is supplied to the engine control unit, the injector, etc.
- When the ignition switch is turned ON, current flows from the ignition switch through the

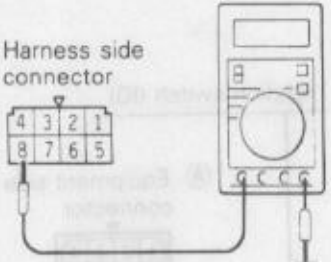
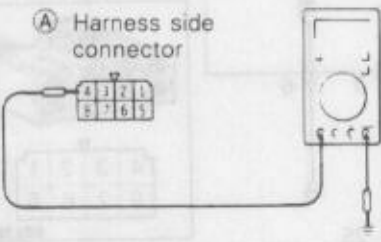
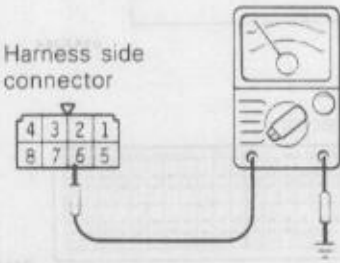
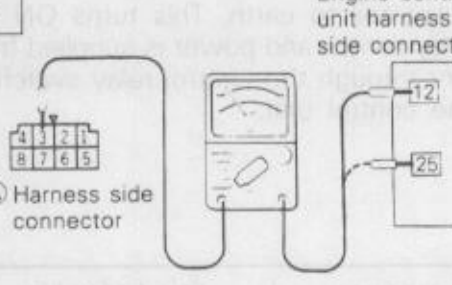
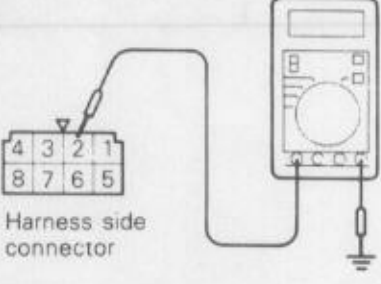
control relay coil to earth. This turns ON the control relay switch and power is supplied from the battery through the control relay switch to the engine control unit.

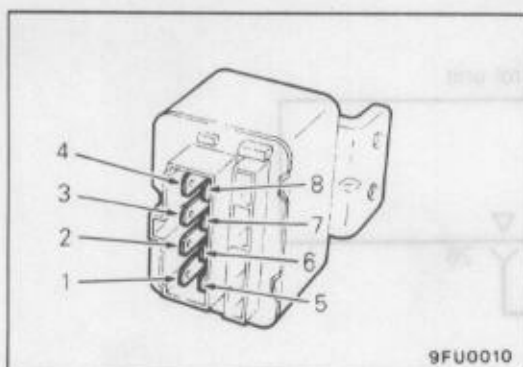
INSPECTION

Using MUT

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

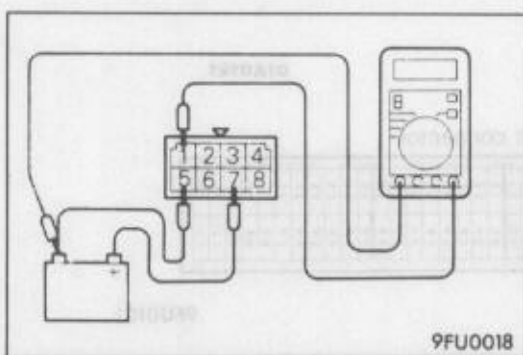
HARNESS INSPECTION

1 (A) Harness side connector  01A0521	Measure the power supply voltage of the control relay. Control relay connector: Disconnected <table border="1"> <thead> <tr> <th>Ignition switch</th> <th>Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>0-1</td> </tr> <tr> <td>ON</td> <td>SV</td> </tr> </tbody> </table> OK → 2 ✗ → Repair the harness. (Ignition switch – (A) 8) or check the ignition switch.	Ignition switch	Voltage (V)	OFF	0-1	ON	SV
Ignition switch	Voltage (V)						
OFF	0-1						
ON	SV						
2 (A) Harness side connector  3FU0296	Measure the power supply voltage of the control relay. Control relay connector: Disconnected <table border="1"> <thead> <tr> <th>Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>SV</td> </tr> </tbody> </table> OK → 3 ✗ → Repair the harness. (Battery – (A) 4)	Voltage (V)	SV				
Voltage (V)							
SV							
3 (A) Harness side connector  01A0369	Check for continuity of the earth circuit. Control relay connector: Disconnected OK → 4 ✗ → Repair the harness. ((A) 6 – Earth)						
4 Engine control unit harness side connector (A) Harness side connector  01A0374	Check for open-circuit, or short-circuit to earth, between the engine control unit and the control relay. - Engine control unit connector: Disconnected - Control relay connector: Disconnected OK → 5 ✗ → Repair the harness. (12 – (A) 3) (25 – (A) 3)						
5 (A) Harness side connector  6FU1751	Measure the power voltage to the actuator. - Control relay connector: Connected - Engine control unit connector: Connected <table border="1"> <thead> <tr> <th>Engine</th> <th>Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>Cranking</td> <td>8V or more</td> </tr> <tr> <td>Racing</td> <td>SV</td> </tr> </tbody> </table> OK → STOP ✗ → Replace the control relay.	Engine	Voltage (V)	Cranking	8V or more	Racing	SV
Engine	Voltage (V)						
Cranking	8V or more						
Racing	SV						

**CONTROL RELAY INSPECTION**

- (1) Remove the control relay.
- (2) Check the continuity between the control relay terminals.

Inspection terminals	Continuity
5-7	Continuity
6-8	Continuity in one direction



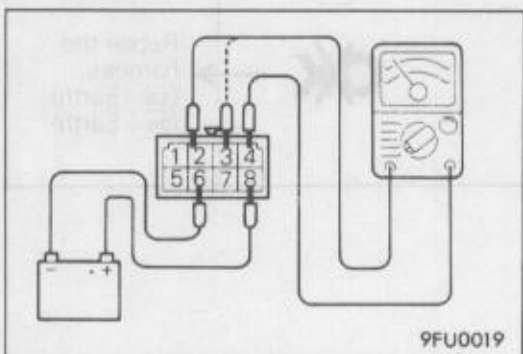
- (3) Use jumper leads to connect control relay terminal ⑦ to the battery (+) terminal and terminal ⑤ to the battery (-) terminal.

Caution

When connecting the jumper leads, be careful not to mistake the connection terminals, as damage to the relay will result.

- (4) Check the voltage at control relay terminal ① while connecting and disconnecting the jumper lead at the battery (-) terminal.

Jumper lead	Voltage at terminal 1
Connected	SV
Disconnected	0V

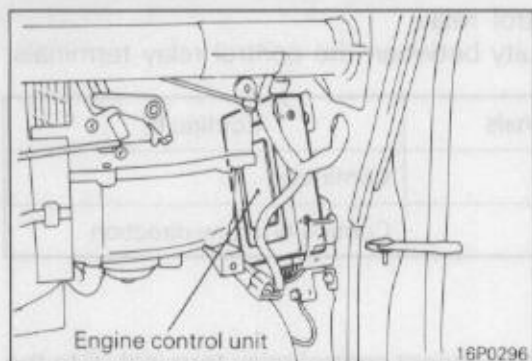


- (5) Use the jumper leads to connect control relay terminal ⑧ to the battery (+) terminal and terminal ⑥ to the battery (-) terminal.
- (6) Check the continuity between control relay terminals ② – ④ and terminals ③ – ④ while connecting and disconnecting the jumper lead at the battery (-) terminal.

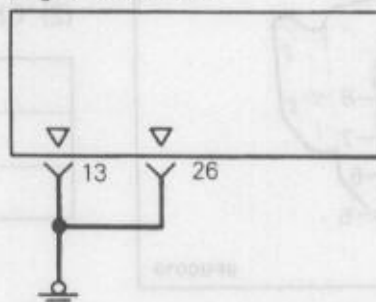
Jumper lead	Continuity between terminals 2 – 4	Continuity between terminals 3 – 4
Connected	Continuity (0Ω)	Continuity (0Ω)
Disconnected	No continuity (∞Ω)	No continuity (∞Ω)

- (7) If there is a defect, replace the control relay.

ENGINE CONTROL UNIT POWER EARTH



Engine control unit



Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
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01A0191

9FU0101

OPERATION

Earth the engine control unit.

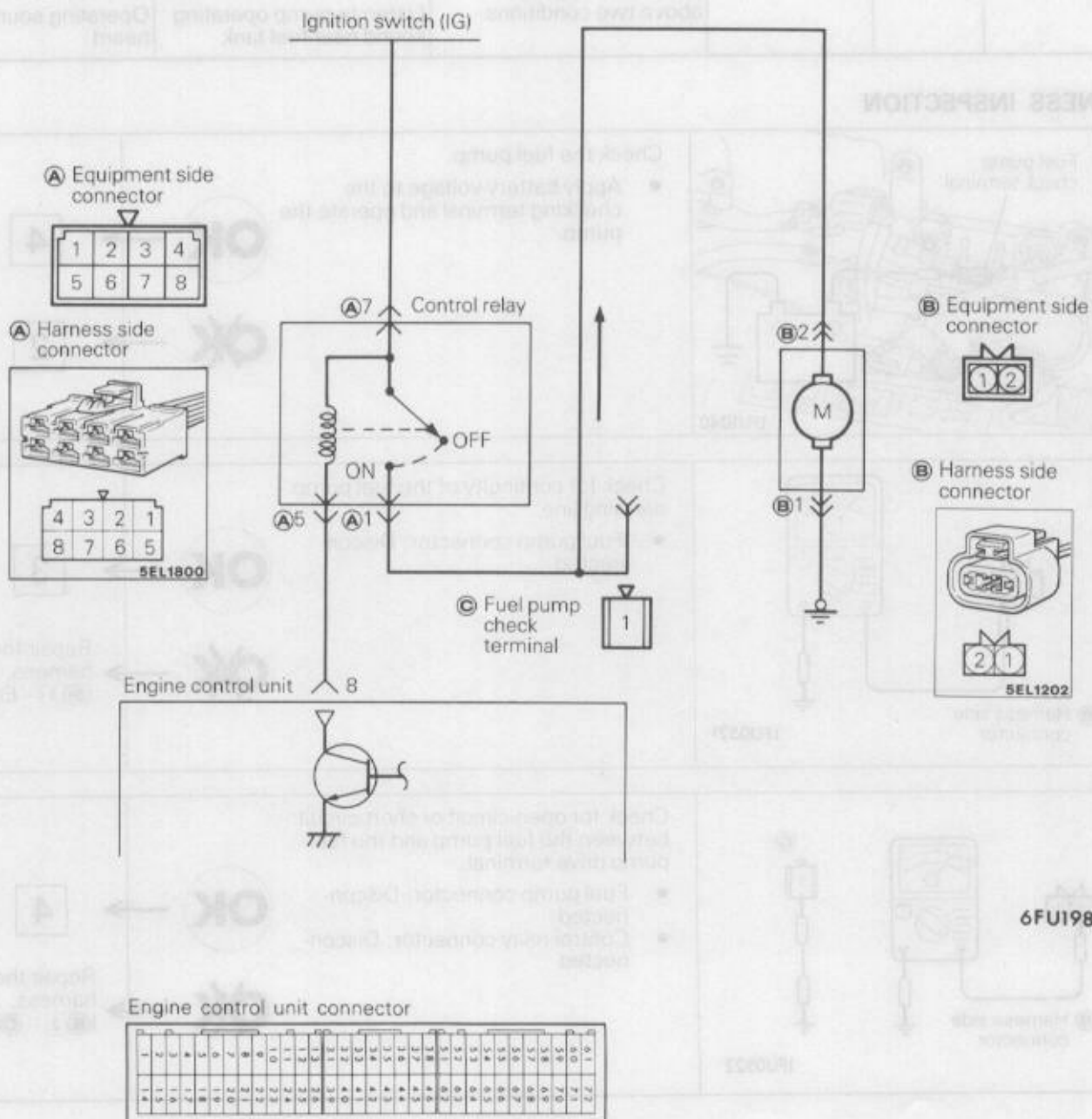
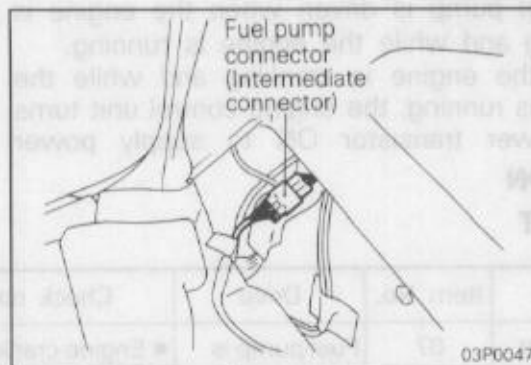
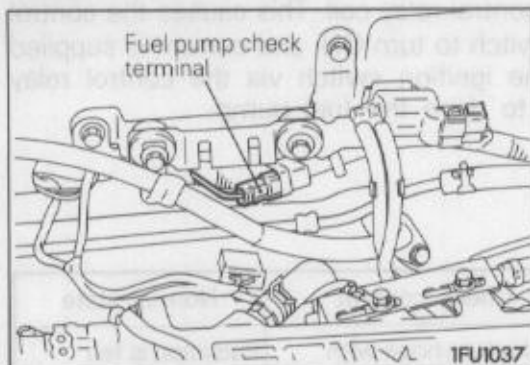
TROUBLESHOOTING HINTS

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. Connector: Disconnected	OK → STOP ✗ → Repair the harness. (13 – Earth) (26 – Earth)
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FUEL PUMP



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

Function	Item No.	Drive	Check condition	Check content	Normal state
Actuator test	07	Fuel pump is driven to circulate fuel	• Engine cranking • Forced drive of fuel pump 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 checking terminal and operate the pump. OK → 4 ✗ → 2
2 (B) Harness side connector	Check for continuity of the fuel pump earthing line. • Fuel pump connector: Disconnected OK → 3 ✗ → Repair the harness. (B1 – Earth)
3 (B) Harness side connector (C) Control relay connector	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 ✗ → Repair the harness. (B2 – C1)

4 (A) Harness side connector 9FU0023	Measure the power supply voltage of the control relay. Control relay connector: Disconnected <table border="1"> <thead> <tr> <th>Ignition switch</th> <th>Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>OFF</td> <td>0</td> </tr> <tr> <td>START</td> <td>8V or more</td> </tr> </tbody> </table> OK → 5 ✗ → Repair the harness. (Ignition switch – (A) 7) or check the ignition switch.	Ignition switch	Voltage (V)	OFF	0	START	8V or more
Ignition switch	Voltage (V)						
OFF	0						
START	8V or more						
5 (A) Harness side connector Engine control unit harness side connector 01A0354	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 ✗ → Repair the harness. (A) 5 – (B) 8						
6 (A) Harness side connector 9FU0024	Check for continuity between the fuel pump checking terminal and between the control relay terminals. - Control relay connector: Disconnected - Fuel pump connector: Disconnected OK → 7 ✗ → Repair the harness. (A) 1 – (C) 1						
7 (B) Harness side connector (A) Harness side connector 1FU0472	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 → 8 ✗ → Repair the harness. (A) 1 – (B) 2						
8 (A) Harness side connector 6FU1753	Measure the power supply voltage of the fuel pump. - Control relay connector: Connected - Engine control unit connector: Connected <table border="1"> <thead> <tr> <th>Engine</th> <th>Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>Cranking</td> <td>8V or more</td> </tr> <tr> <td>Racing</td> <td>SV</td> </tr> </tbody> </table> OK → STOP ✗ → Control relay or engine control unit is defective.	Engine	Voltage (V)	Cranking	8V or more	Racing	SV
Engine	Voltage (V)						
Cranking	8V or more						
Racing	SV						

CONTROL RELAY INSPECTION

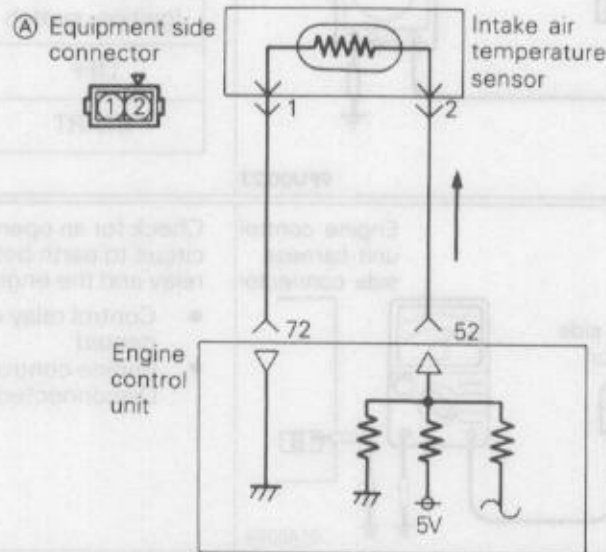
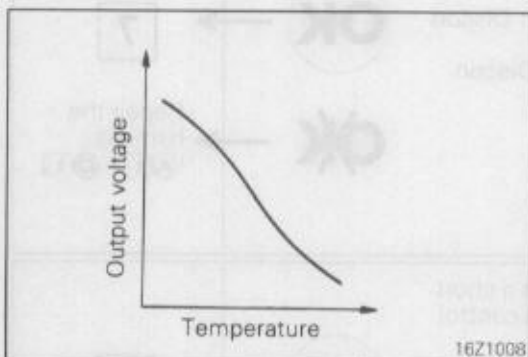
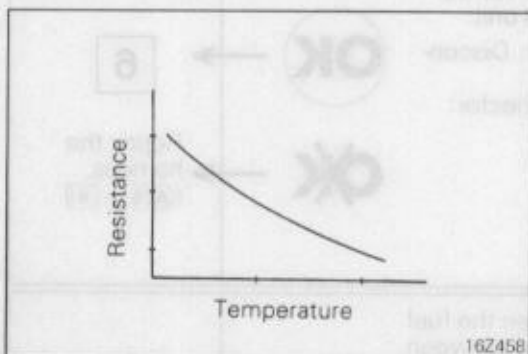
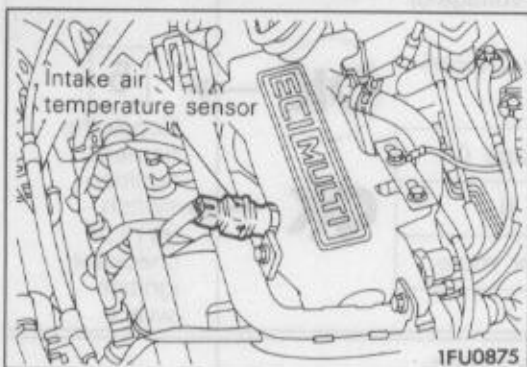
Refer to P. 13-123-70.

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PWME8802-F

ADDED

INTAKE AIR TEMPERATURE SENSOR



Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1FU0959

9FU0101

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 5V 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 then 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

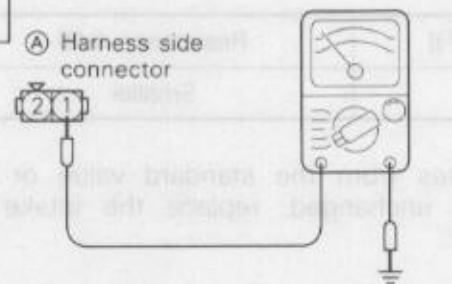
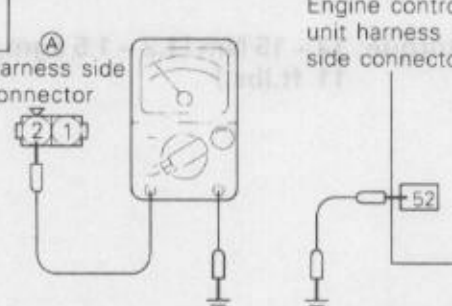
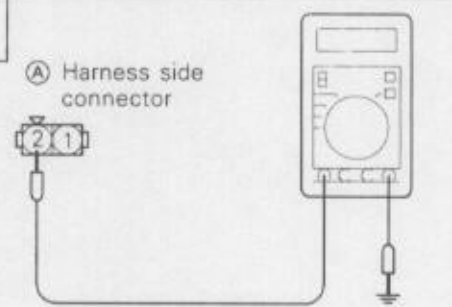
The intake air temperature sensor senses the intake air temperature in the air intake plenum so that it may indicate a temperature different from outside temperature depending on engine operating state.

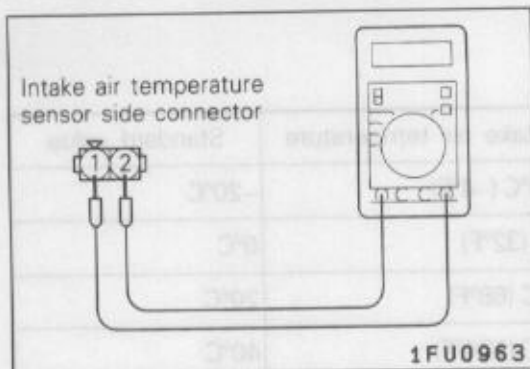
INSPECTION

Using MUT

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

HARNESS INSPECTION

1  Ⓐ Harness side connector 1FU0960	Check for continuity of the earth circuit. Intake air temperature sensor connector: Disconnected OK → 2 ✗ → Repair the harness. (A1 - 72)		
2  Ⓐ Harness side connector Engine control unit harness side connector 1FU0961	Check for open-circuit or short-circuit to earth, between intake air temperature sensor and engine control unit. - Intake air temperature sensor connector: Disconnected - Engine control unit connector: Disconnected OK → 3 ✗ → Repair the harness. (A2 - 52)		
3  Ⓐ Harness side connector 1FU0962	Measure the impressed voltage. - Intake air temperature sensor connector: Disconnected - Engine control unit connector: Disconnected - Ignition switch: ON <table border="1"> <tr> <td>Voltage (V)</td> </tr> <tr> <td>4.5-4.9</td> </tr> </table> OK → STOP ✗ → Replace the engine control unit.	Voltage (V)	4.5-4.9
Voltage (V)			
4.5-4.9			



SENSOR INSPECTION

- (1) Disconnect the intake air temperature sensor connectors.
- (2) Measure resistance between terminals ① and ②.

Temperature [°C (°F)]	Resistance (kΩ)
0 (32)	6.0
20 (68)	2.6
80 (176)	0.3

- (3) Remove intake air temperature sensor from intake manifold.
- (4) Measure resistance while heating the sensor using a hair drier.

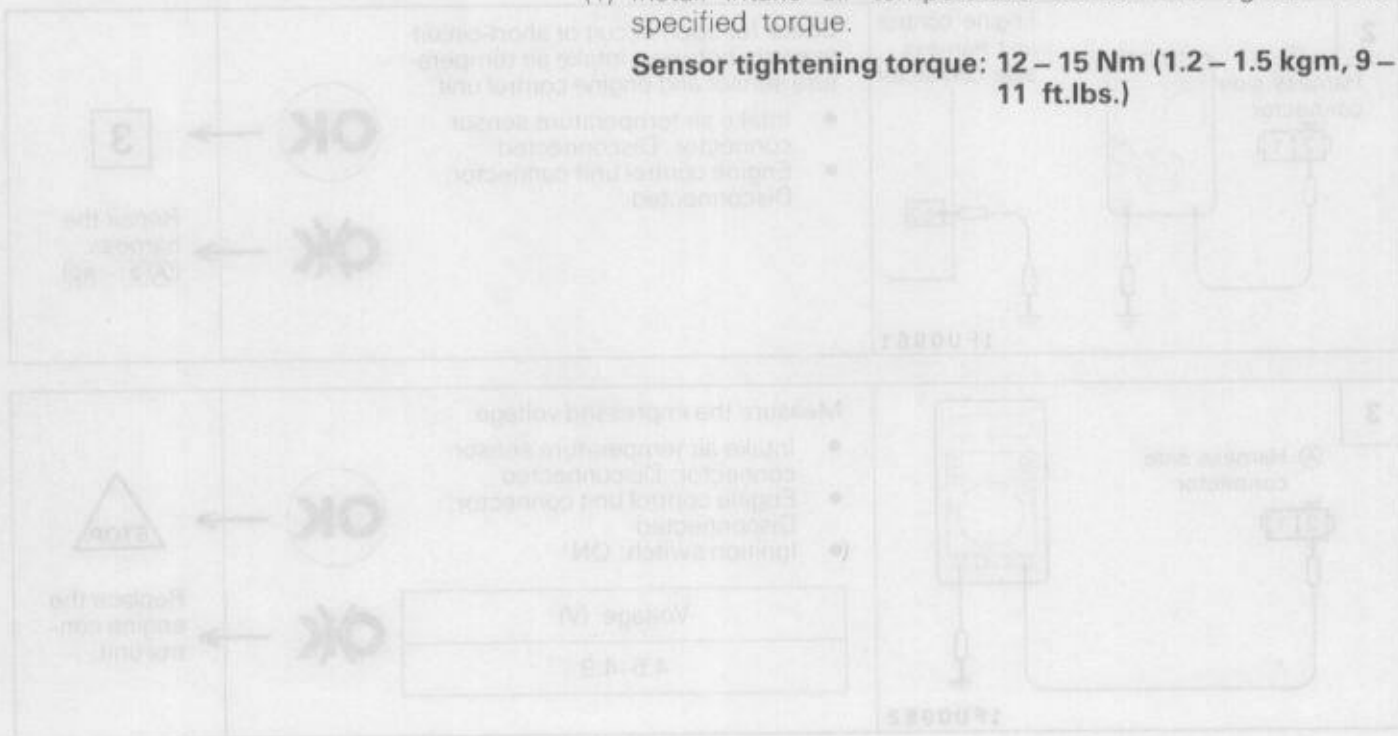
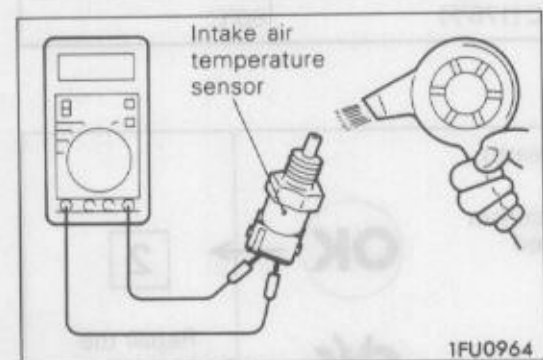
Temperature [°C (°F)]	Resistance (kΩ)
Higher	Smaller

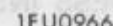
- (5) If the value deviates from the standard value or the resistance remains unchanged, replace the intake air temperature sensor.

INSTALLATION

- (1) Install intake air temperature sensor and tighten it to specified torque.

Sensor tightening torque: 12 – 15 Nm (1.2 – 1.5 kgm, 9 – 11 ft.lbs.)





1	0.1	7.2
2	5.9	7.1
3	5.8	7.0
4	5.7	6.8
5	5.0	6.7
6	5.5	6.6
7	5.4	6.5
8	5.3	6.4
9	5.2	6.3
10	5.1	6.2
11	4.8	6.0
12	4.5	5.8
13	4.4	5.6
14	4.3	5.5
15	4.2	5.4
16	4.0	5.2
17	3.9	5.0
18	3.8	4.8
19	3.7	4.6
20	3.6	4.4
21	3.5	4.3
22	3.4	4.2
23	3.3	4.1
24	3.2	4.0
25	3.1	3.9
26	3.0	3.8
27	2.9	3.6
28	2.8	3.5
29	2.7	3.4
30	2.6	3.3
31	2.5	3.2
32	2.4	3.1
33	2.3	3.0
34	2.2	2.9
35	2.1	2.8
36	2.0	2.7
37	1.9	2.6
38	1.8	2.5
39	1.7	2.4
40	1.6	2.3
41	1.5	2.2
42	1.4	2.1
43	1.3	2.0
44	1.2	1.9
45	1.1	1.8
46	1.0	1.7
47	0.9	1.6
48	0.8	1.5
49	0.7	1.4

9FU0101

[illegible]

INSPECTION

Using MUT

Function	Item No.	Data display	Check condition	Engine state		Standard value
Data reading	32	Air intake plenum pressure	● Coolant temperature: 80 to 95°C (176 to 203°F) ● Lamps, electric cooling fan, accessory units: All OFF ● Transmission: Neutral ● Ignition switch: ON	Stopped	When height is 0m (0 ft.)	760 mmHg
					When height is 600m (1,969 ft.)	710 mmHg
					When height is 1,200m (3,937 ft.)	660 mmHg
					When height is 1,800m (5,906 ft.)	610 mmHg
				750 r/min. (idling)		180–280 *1 mmHg
				When engine is suddenly raced.		Increase

NOTE

*1: In a new vehicle [driven approximately 500 km (300 miles) or less], the air intake plenum pressure is sometimes 10% higher than the standard pressure.

HARNESS INSPECTION

1

① Harness side connector

1FU0967

Check for continuity of the earth circuit.

- Vacuum sensor connector: Disconnected

OK → **2**

✗ → Repair the harness. (A3 – 72)

2

① Harness side connector

Engine control unit harness side connector

70

1FU0968

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

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

OK → **3**

✗ → Repair the harness. (A2 – 70)

3

① Harness side connector

1FU0969

Measure the impressed voltage of the vacuum sensor.

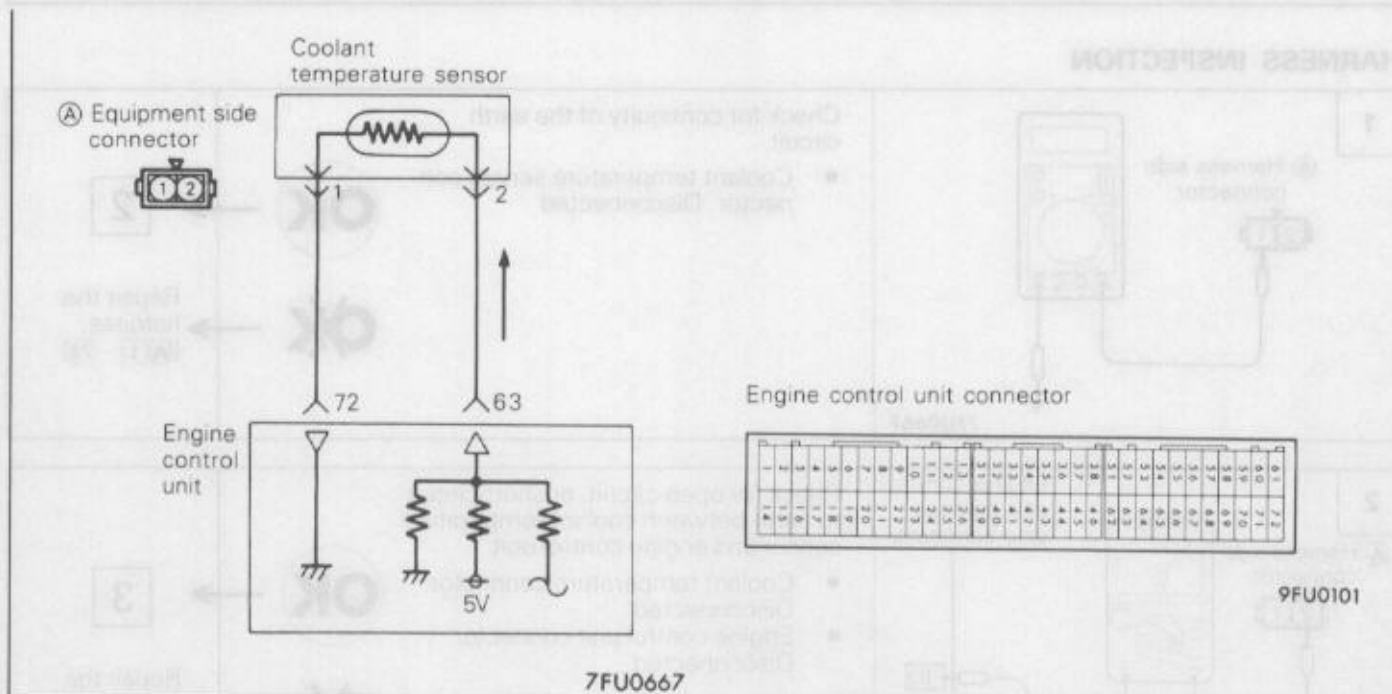
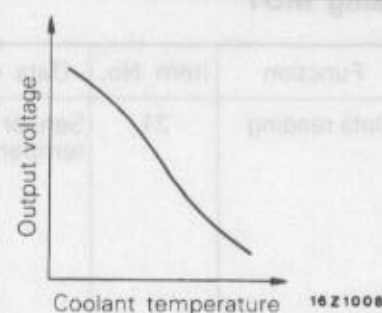
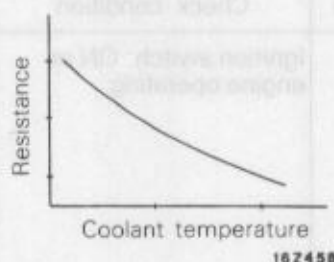
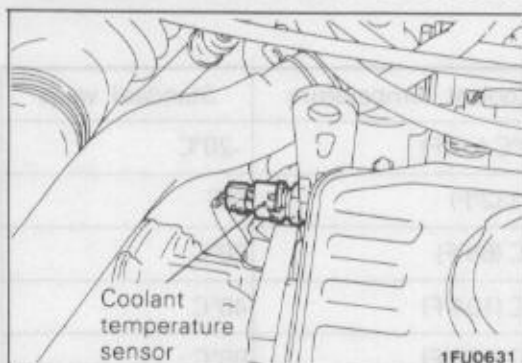
- Vacuum sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.8–5.2

OK → **STOP**

✗ → Replace the engine control unit.

COOLANT TEMPERATURE SENSOR



OPERATION

- The coolant temperature sensor converts the 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 coolant temperature sensor. Via the sensor which is a kind of resistor, it is then earthed in the engine control unit. The coolant temperature sensor resistor has such characteristic that its resistance decreases as the coolant temperature rises.

- The coolant temperature sensor terminal voltage increases or decreases as the sensor resistance increases or decreases. Therefore, the coolant temperature sensor terminal voltage changes with the coolant temperature, decreasing as the temperature rises.

TROUBLESHOOTING HINTS

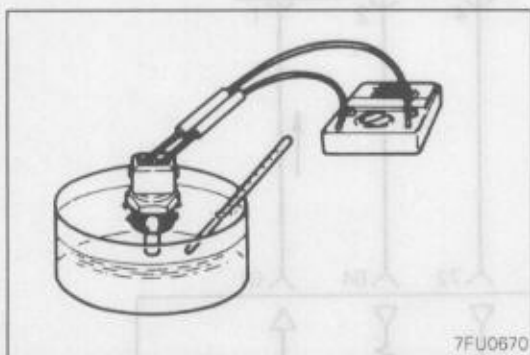
If the fast idle speed is inadequate or the engine emits dark smoke during engine warm up operation, the coolant temperature sensor is often faulty.

SENSOR INSPECTION

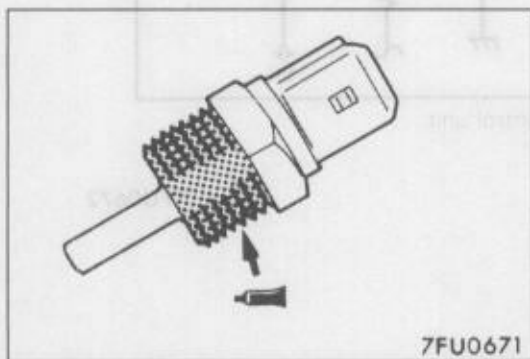
Caution

Be careful not to touch the tool against the connector (resin section) when removing and installing.

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



7FU0670



7FU0671

- (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)	2.5
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 coolant temperature sensor and tighten it to specified torque.

Sensor tightening torque: 20 – 40 Nm (2.0 – 4.0 kgm, 15 – 29 ft.lbs.)

- (3) Fasten harness connectors securely.

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 the 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.

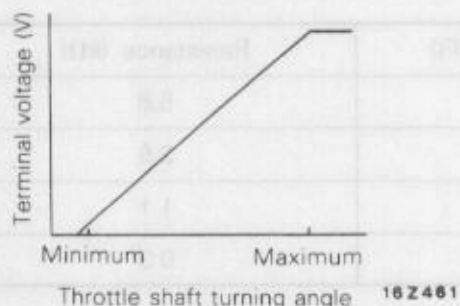
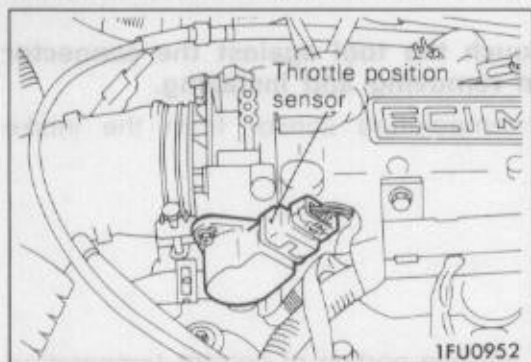
If there is an evidence of disturbed fixed SAS setting, adjust the fixed SAS.

• The throttle position sensor converts the throttle position 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. It flows through the resistor in the sensor and is then 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.

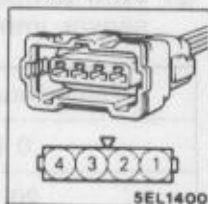
THROTTLE POSITION SENSOR



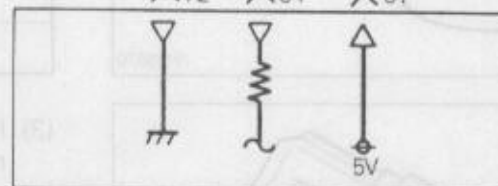
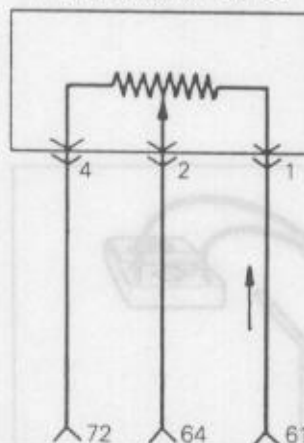
① Equipment side connector



① Harness side connector



Throttle position sensor



Engine control unit

7FU0672

9FU0101

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. It flows through the resistor in the sensor and is then 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

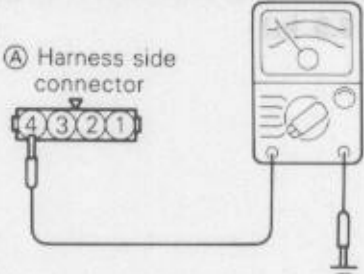
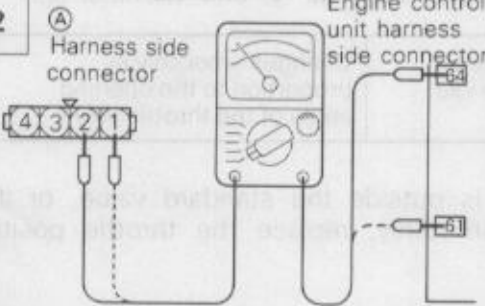
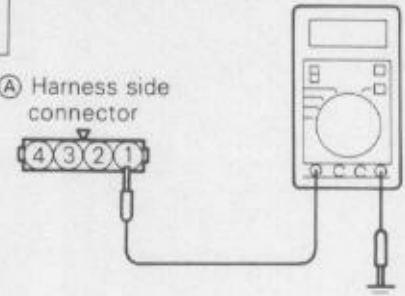
- Hint 1: The throttle position sensor signal is more important in the control of automatic transmission than in the engine control. Shifting shock and other troubles will be caused if this sensor is faulty.
- Hint 2: If the output voltage of the throttle position sensor is out of specification, adjust the sensor and check the voltage again. If there is an evidence of disturbed fixed SAS setting, adjust the fixed SAS.

INSPECTION

Using MUT

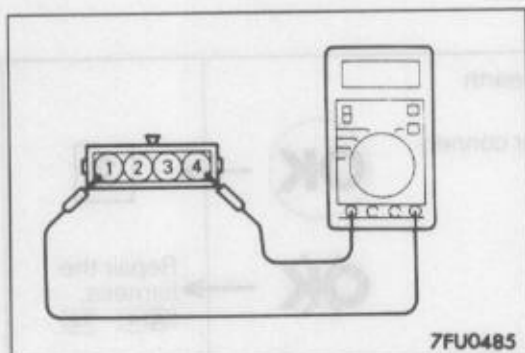
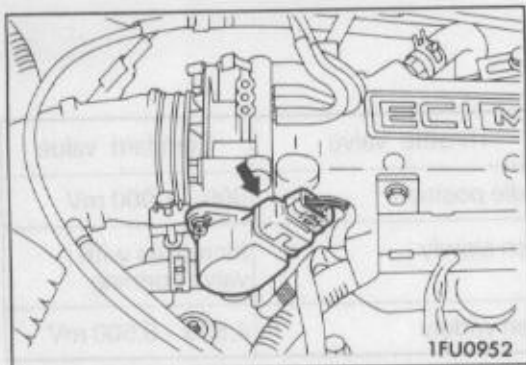
Function	Item No.	Data display	Check condition	Throttle valve	Standard value
Data reading	14	Sensor voltage	Ignition switch: ON	At idle position	300 – 1,000 mV
				Open slowly	Increases with valve opening
				Open widely	4,500 – 5,500 mV

HARNESS INSPECTION

1  ④ Harness side connector 6FU1242	Check for continuity of the earth circuit. Throttle position sensor connector: Disconnected OK → 2 ✗ → Repair the harness. (A 4 – 72)		
2  ④ Harness side connector Engine control unit harness side connector 1FU0970	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 → 3 ✗ → Repair the harness. (A 2 – 64) (A 1 – 61)		
3  ④ Harness side connector 6FU1241	Measure the impressed voltage of the throttle position sensor. - Throttle position sensor connector: Disconnected - Engine control unit connector: Connected - Ignition switch: ON <table border="1"> <tr> <td>Voltage (V)</td> </tr> <tr> <td>4.8–5.2</td> </tr> </table> OK → STOP ✗ → Replace the engine control unit.	Voltage (V)	4.8–5.2
Voltage (V)			
4.8–5.2			

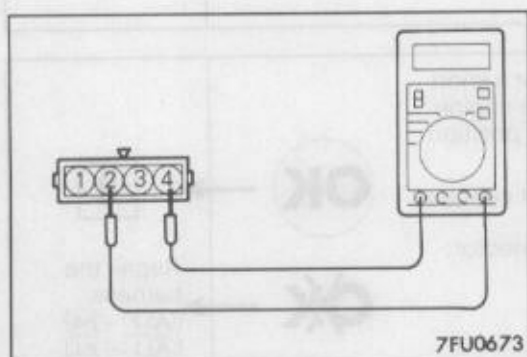
SENSOR INSPECTION

- (1) Disconnect the throttle position sensor connector.



- (2) Measure the resistance between the throttle position sensor side connector terminal ① and terminal ④.

Standard value: 3.5 – 6.5 kΩ



- (3) Measure the resistance between the throttle position sensor side connector terminal ② and terminal ④.

Throttle valve slowly opens until fully open from the idle position

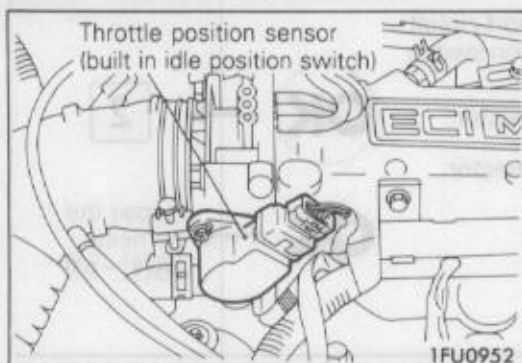
Changes smoothly in proportion to the opening angle of the throttle valve

- (4) If the resistance is outside the standard value, or if it doesn't change smoothly, replace the throttle position sensor.

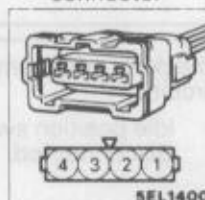
NOTE

For the throttle position sensor adjustment procedure, refer to P.13-123-59.

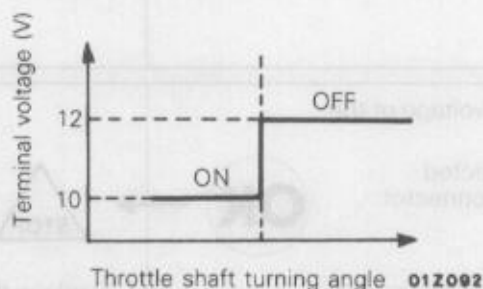
IDLE POSITION SWITCH



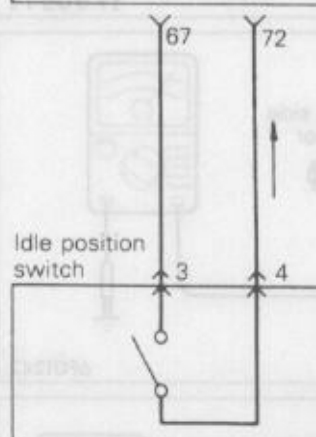
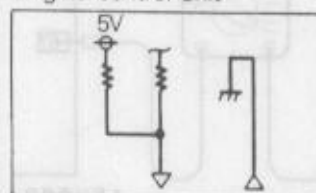
① Harness side connector



① Equipment side connector



Engine control unit



7FU0674

Engine control unit connector

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HARNESS INSPECTION

1

(A) Harness side connector

Engine control unit harness side connector

1FU0971

Check for open-circuit, or short-circuit to earth, between idle position switch and engine control unit.

- Engine control unit connector: Disconnected
- Idle position switch connector: Disconnected

OK → **2**

✗ → Repair the harness. (A3 – 67)

2

(A) Harness side connector

6FU1242

Check for continuity of the earth circuit.

- Idle position switch connector: Disconnected

OK → **3**

✗ → Repair the harness. (A4 – 72)

3

(A) Harness side connector

7FU0675

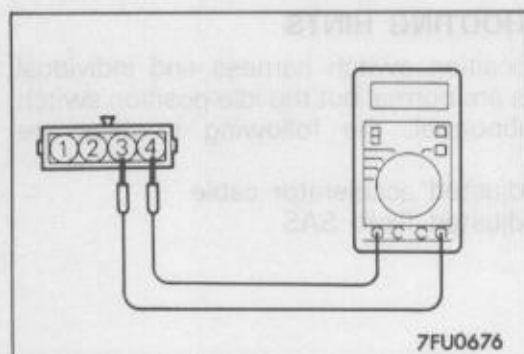
Measure the impressed voltage of the idle position switch.

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

Voltage (V)
4 or more

OK → STOP

✗ → Replace the engine control unit.



SENSOR INSPECTION

- Disconnect the throttle position sensor connector.
- Check the continuity between the throttle position sensor connector side terminal (3) and terminal (4).

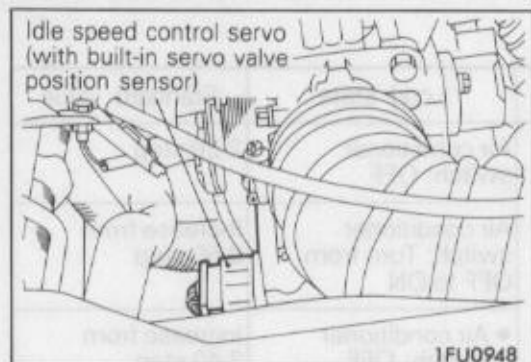
Accelerator pedal	Continuity
Depressed	Non-conductive ($\infty \Omega$)
Released	Conductive (0 Ω)

- If out of specification, replace the throttle position sensor.

NOTE

After replacement, the throttle position sensor and idle position switch should be adjusted. (Refer to P.13-123-59.)

SERVO VALVE POSITION SENSOR

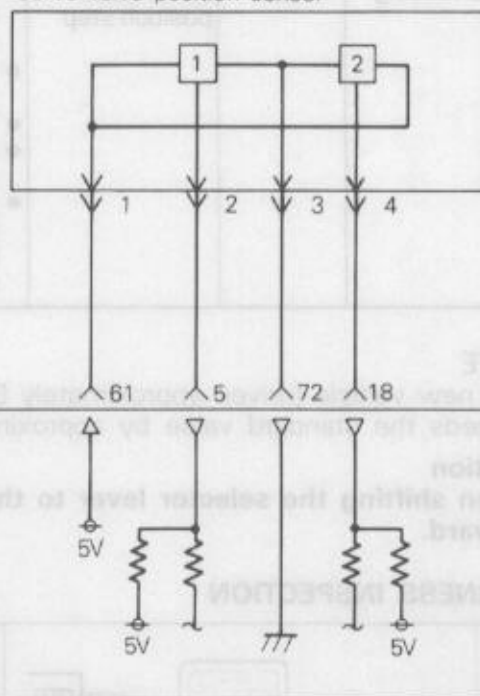


Engine control unit connector

61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
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9FU0101

Servo valve position sensor



9FU0026

OPERATION

- The servo valve position sensor converts the changes (increase or decrease) in the valve position of the idle 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 also controls the idle speed control servo.
- 5V power is supplied to the servo valve position sensor from the engine control unit, and the earth connection is positioned in the engine control unit.
- 5V power is applied to the two servo valve position sensor output terminals from the engine control unit. When the servo valve position is changed (increased or decreased) by the DC motor inside the servo, the servo valve position sensor generates a pulse signal from the opening and closing between the output terminal and the earth.

TROUBLESHOOTING HINTS

Hint 1: The servo valve position sensor is the most important sensor for controlling the idle speed. If a malfunction develops when the engine is idling and the engine load is varied by turning the air conditioner switch to ON and OFF, etc., this sensor is probably defective.

INSPECTION

Using MUT

Function	Item No.	Data display	Check condition	Load state	Standard value
Data reading	55	Servo valve position step	• Coolant temperature: 80 to 95°C (176 to 203°F) • Lamps, electric cooling fan, accessories: OFF • Transmission: Neutral • Idle position switch: ON • Engine: At idle (Compressor clutch to be operating in case air conditioner switch is ON)	Air conditioner switch: OFF	2-20 step
				Air conditioner switch: Turn from OFF to ON	Increase from 8-50 step
				• Air conditioner switch: OFF • Selector lever: Shift to D range	Increase from 3-40 step

NOTE

In a new vehicle [driven approximately 500 km (300 miles) or less], the servo valve position sometimes exceeds the standard value by approximately 20 steps.

Caution

When shifting the selector lever to the D range, apply brake to prevent the vehicle from moving forward.

HARNESS INSPECTION

1 ① Harness side connector Engine control unit harness side connector 6FU1776	Check for open-circuit, or short-circuit to earth, between engine control unit and servo valve position sensor. • Engine control unit connector: Disconnected • Servo valve position sensor connector: Disconnected OK → 2 ✗ → Repair the harness. (A) 1 - 61 (A) 2 - 5 (A) 4 - 18
2 ① Harness side connector 6FU1250	Check for continuity of the earth circuit. • Servo valve position sensor connector: Disconnected OK → 3 ✗ → Repair the harness. (A) 3 - 72

3 ① Harness side connector

Measure the impressed voltage.

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

Voltage (V)
4.8–5.2

OK → **4**

✗ → Replace the engine control unit.

4

A Harness side connector

Measure the impressed voltage.

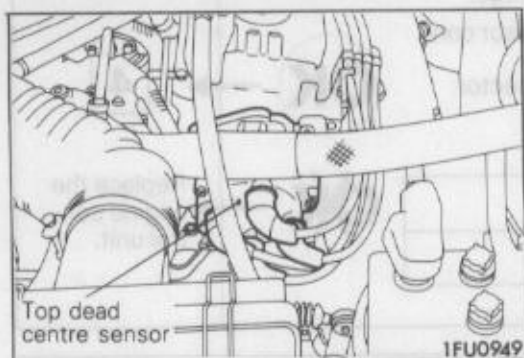
- Servo valve position sensor connector : Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.8-5.2

OK →

NG → Replace the engine control unit.

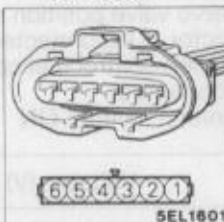
TOP DEAD CENTRE SENSOR



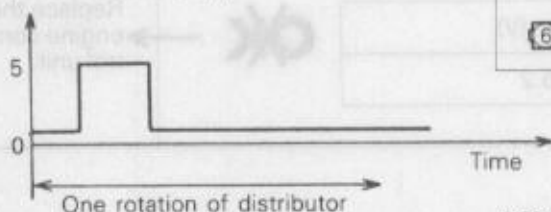
(A) Equipment side connector



(A) Harness side connector



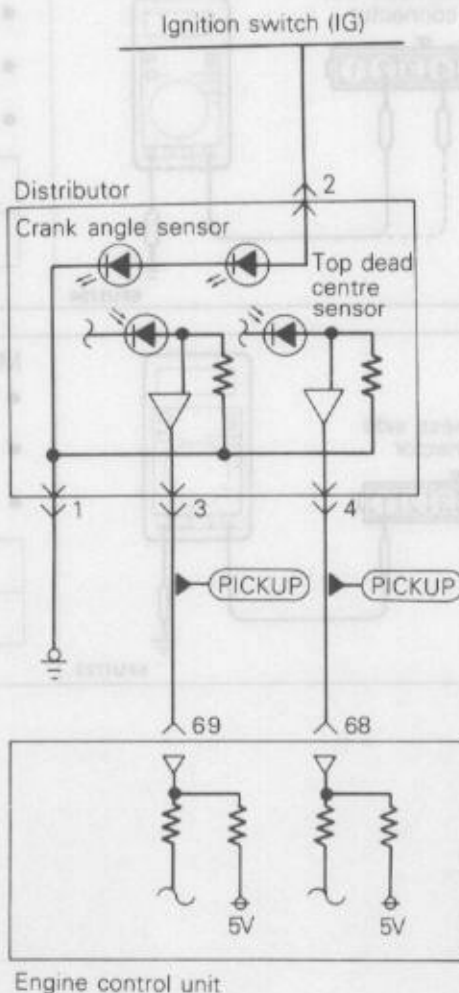
Output characteristic (V)



Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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9FU0101

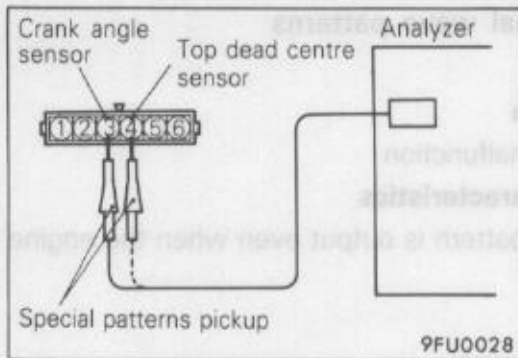


OPERATION

- The top dead centre sensor detects the top dead centre on the compression stroke of the No.1 cylinder, converts it into a pulse signal and inputs it to the engine control unit. The engine control unit determines the fuel injection sequence based on this signal.
- Power to the top dead centre sensor is supplied from the ignition switch (IG) and is earthed to the body. The top dead centre sensor generates a pulse signal as it repeatedly connects and disconnects between 5V voltage supplied from the engine control unit and earth.

TROUBLESHOOTING HINTS

- Hint 1: If the top dead centre sensor is defective, proper sequential injection will not occur, so the engine will stall, or unstable idling and poor acceleration will occur.
- Hint 2: When the top dead centre sensor outputs a pulse signal when the ignition switch is turned to ON (without starting the engine), the top dead centre sensor or engine control unit is probably defective.



INSPECTION

Wave Pattern Inspection Using an Analyzer

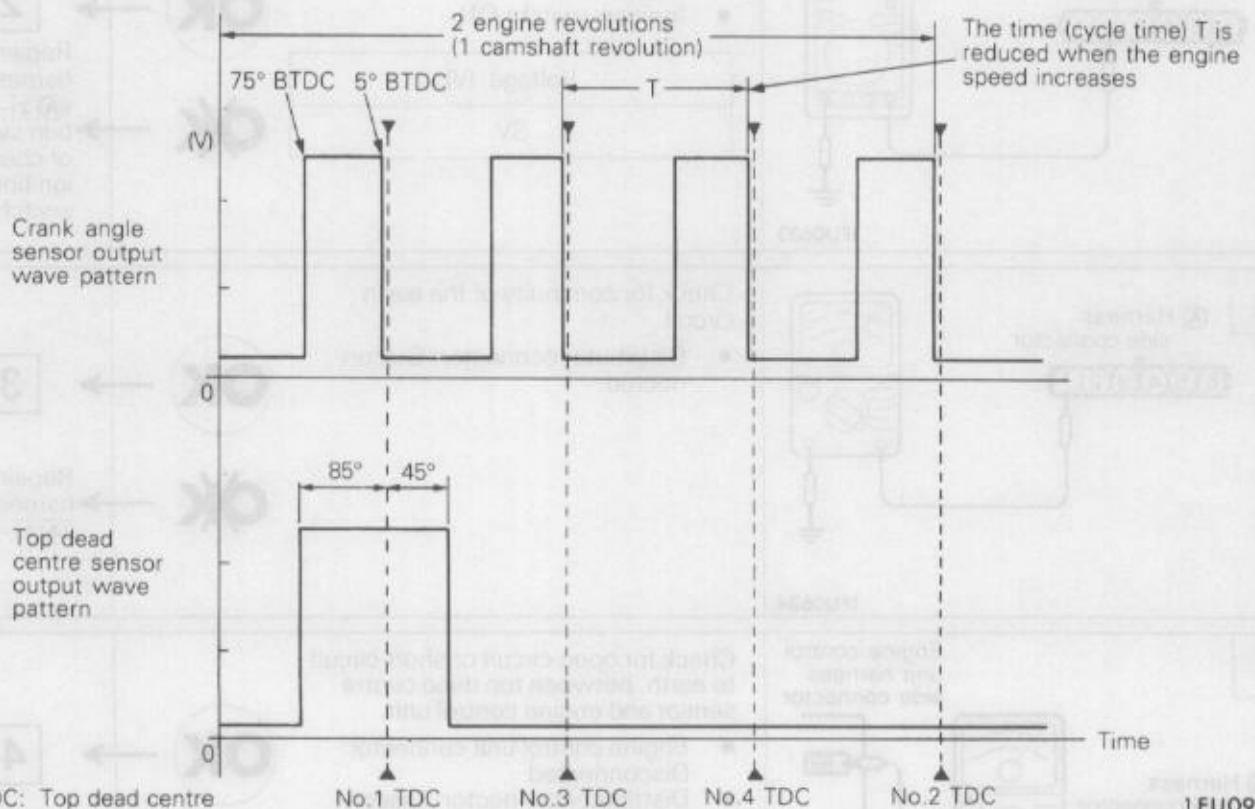
Measurement method

- (1) Disconnect the top dead centre sensor & crank 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 crank angle sensor terminal ④. (When checking the top dead centre sensor signal wave pattern.)
- (3) Connect the analyzer special patterns pickup to crank angle sensor connector terminal ③. (When inspecting the crank angle sensor signal wave pattern.)

Standard wave pattern

Observation conditions

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min.	Idle speed (750 r/min.)



Wave Pattern Observation Points

Check to be sure that cycle time T becomes shorter when the engine speed increases.

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

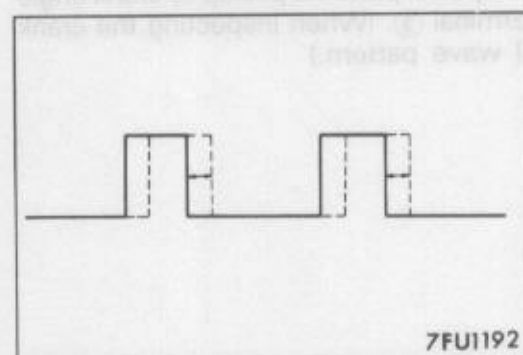
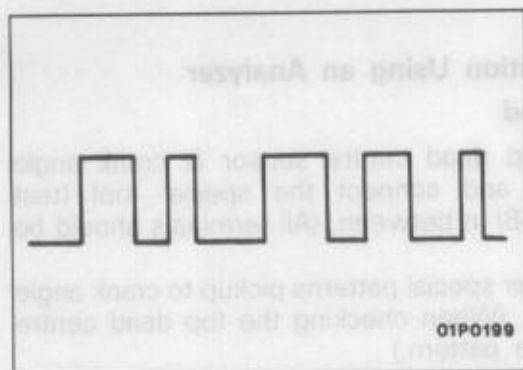
Cause of problem

Loose timing belt

Abnormality in sensor disk

Wave pattern characteristics

Wave pattern is displaced to the left or right.

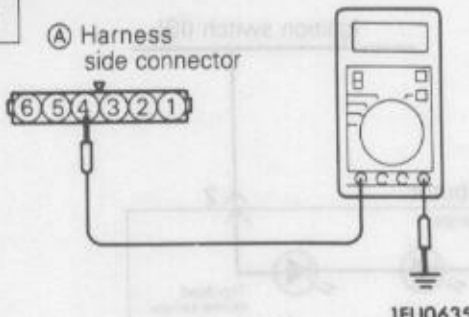


HARNESS INSPECTION

1 Ⓐ Harness side connector 1FU0633	Measure the power supply voltage. - Distributor connector: Disconnected - Ignition switch: ON <table border="1"> <thead> <tr> <th>Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>SV</td> </tr> </tbody> </table> OK → 2 ✗ → Repair the harness. (Ⓐ2 – Ignition switch) or check the ignition switch.	Voltage (V)	SV
Voltage (V)			
SV			
2 Ⓐ Harness side connector 1FU0634	Check for continuity of the earth circuit. Distributor connector: Disconnected OK → 3 ✗ → Repair the harness. (Ⓐ1 – Earth)		
3 Ⓐ Harness side connector Engine control unit harness side connector 9FU0029	Check for open-circuit or short-circuit to earth, between top dead centre sensor and engine control unit. - Engine control unit connector: Disconnected - Distributor connector: Disconnected OK → 4 ✗ → Repair the harness. (Ⓐ4 – 68)		

4

① Harness side connector



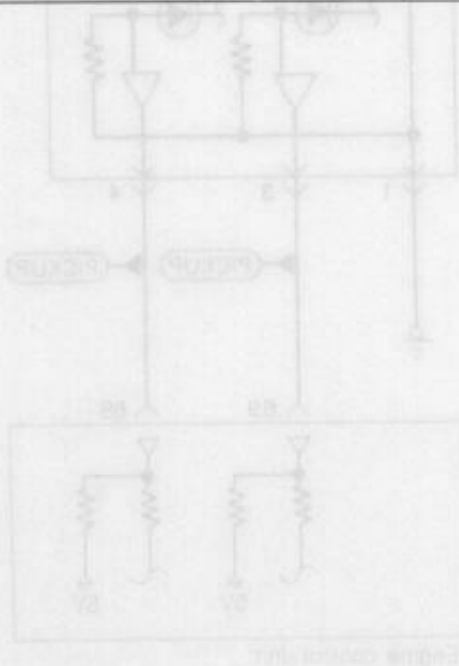
Measure the impressed voltage.

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

Voltage (V)
4.8-5.2

OK → **STOP**

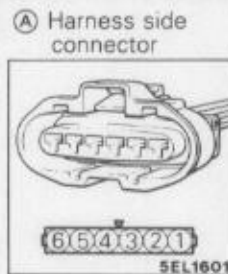
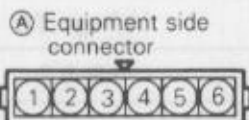
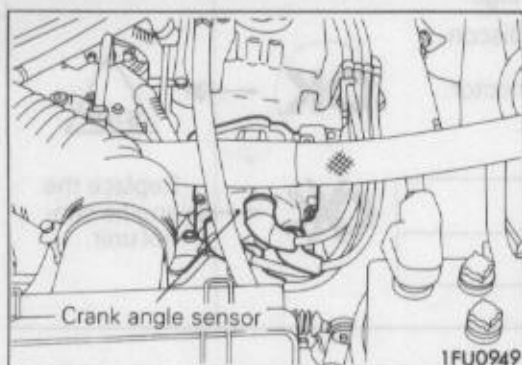
✗ → Replace the engine control unit.



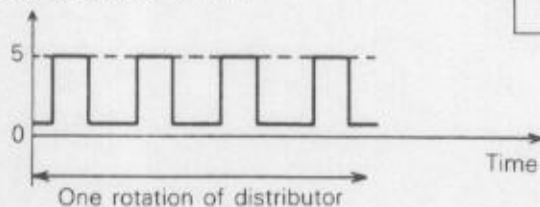
OPERATION

- The crank angle sensor converts the crank angle (position) of each cylinder 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 position timing based on the input signal.
- Power to the crank angle sensor is supplied from the ignition switch (IG) and is routed to the body. The crank angle sensor generates a pulse signal as it repeatedly connects and disconnects between 5V voltage supplied from the engine control unit and earth.

CRANK ANGLE SENSOR



Output characteristic (V)



01R0103

Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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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 to ON, (without starting the engine), the crank angle sensor or engine control unit is probably defective.

- 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 coolant temperature sensor
- (2) Faulty idle speed control servo
- (3) Poorly adjusted basic idle speed

INSPECTION**Using MUT**

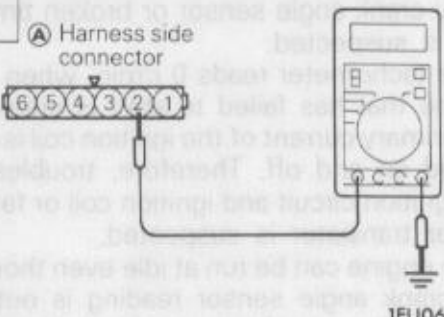
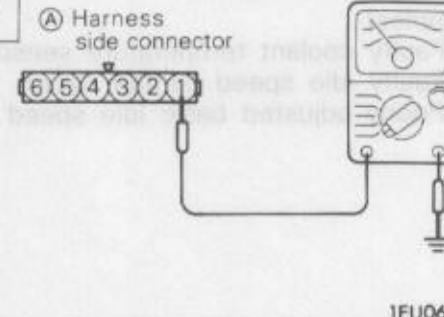
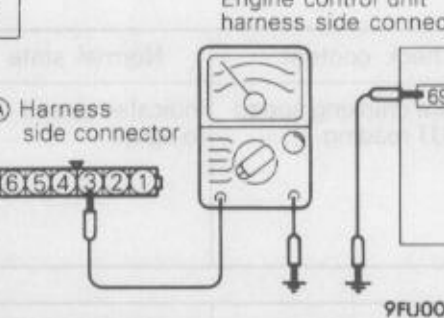
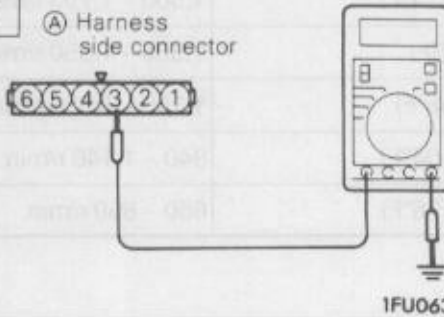
Function	Item No.	Data display	Check condition	Check content	Normal state
Data reading	22	Cranking speed	- Engine cranking - Tachometer connected (Check on and off of primary current of ignition coil by tachometer)	Compare cranking speed and MUT reading	Indicated speed to agree

Function	Item No.	Data display	Check condition	Check content	Normal state
Data reading	22	Idle speed	- Engine: Idling - Idle position switch: ON	-20°C (-4°F)	1,500 – 1,700 r/min.
				0°C (32°F)	1,350 – 1,550 r/min.
				20°C (68°F)	1,150 – 1,350 r/min.
				40°C (104°F)	940 – 1,140 r/min.
				80°C (176°F)	650 – 850 r/min.

Wave Pattern Inspection Using an Analyzer

(Refer to P.13-123-92.)

HARNESS INSPECTION

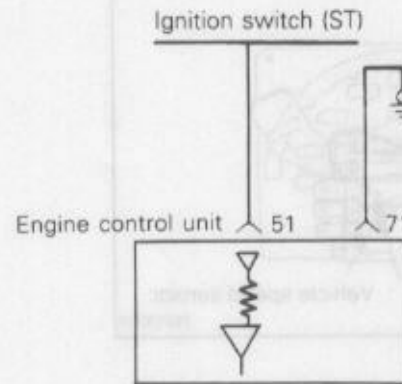
1 (A) Harness side connector  1FU0633	Measure the power supply voltage. • Distributor connector: Disconnected • Ignition switch: ON <table border="1"> <tr> <td>Voltage (V)</td> </tr> <tr> <td>SV</td> </tr> </table> OK → 2 ✗ →	Voltage (V)	SV	2 Repair the harness. (A2 – Ignition switch) or check the ignition switch.
Voltage (V)				
SV				
2 (A) Harness side connector  1FU0634	Check for continuity of the earth circuit. • Distributor connector: Disconnected OK → 3 ✗ →	3 Repair the harness. (A1 – Earth)		
3 Engine control unit harness side connector (A) Harness side connector  9FU0030	Check for open-circuit or short-circuit to earth, between crank angle sensor and engine control unit. • Engine control unit connector: Disconnected • Distributor connector: Disconnected OK → 4 ✗ →	4 Repair the harness. (A3 – 69)		
4 (A) Harness side connector  1FU0637	Measure the impressed voltage. • Distributor connector: Disconnected • Engine control unit connector: Connected • Ignition switch: ON <table border="1"> <tr> <td>Voltage (V)</td> </tr> <tr> <td>4.8–5.2</td> </tr> </table> OK → STOP ✗ →	Voltage (V)	4.8–5.2	STOP Replace the engine control unit.
Voltage (V)				
4.8–5.2				

IGNITION SWITCH-ST

Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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9FU0101



6FU1257

OPERATION

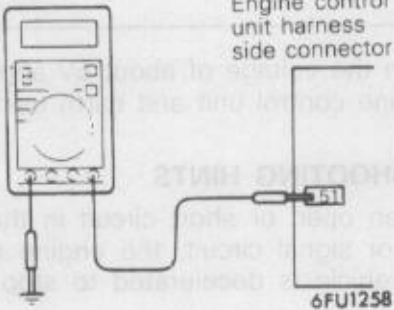
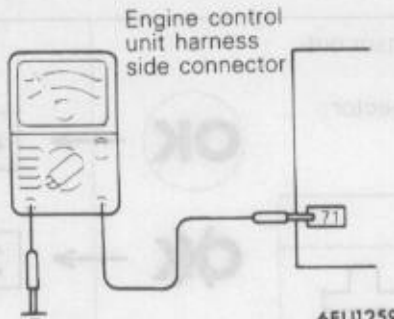
- The ignition switch-ST inputs a high signal to the engine control unit while the engine is cranking. The engine control unit provides fuel injection control, etc., at engine start up based on this signal.
- When the ignition switch is set to START, the battery voltage at cranking is applied through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

INSPECTION

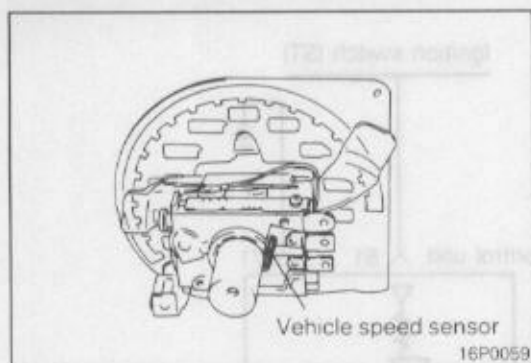
Using MUT

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

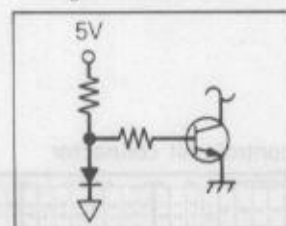
HARNESS INSPECTION

1  Engine control unit harness side connector 6FU1258	Measure the input voltage to the engine control unit. - Engine control unit connector: Disconnected - Ignition switch: START <table border="1"><thead><tr><th>Voltage (V)</th></tr></thead><tbody><tr><td>8 or more</td></tr></tbody></table> OK → 2 ✗ → Repair the harness. (51 – Ignition switch) or check the ignition switch.	Voltage (V)	8 or more
Voltage (V)			
8 or more			
2  Engine control unit harness side connector 6FU1259	Check for continuity of the earth circuit. Engine control unit connector: Disconnected OK →  ✗ → Repair the harness. (71 – Earth)		

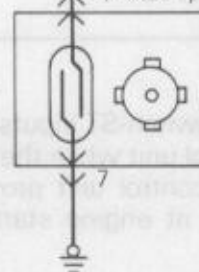
VEHICLE SPEED SENSOR



Engine control unit

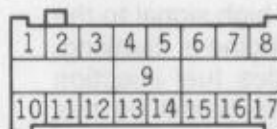


66

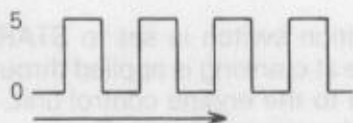
Vehicle speed sensor
(inside speedometer)

7

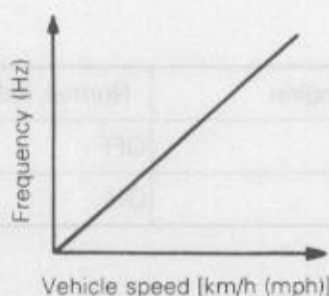
A Equipment side connector



Terminal voltage (V)



16Z478



16Z451

01A0332

Engine control unit connector



9FU0101

OPERATION

- The vehicle speed sensor which is located in the speedometer converts the vehicle speed into a pulse signal and inputs it to the engine control unit, which then provides the idle speed control, etc., based on this signal.
- The vehicle speed sensor generates the vehicle speed signal by repeatedly opening and closing

between the voltage of about 5V applied from the engine control unit and earth using a reed switch.

TROUBLESHOOTING HINTS

If there is an open or short circuit in the vehicle speed sensor signal circuit, the engine may stall when the vehicle is decelerated to stop.

HARNESS INSPECTION

1

Engine control unit
harness side connector

66

01A0508

Check the vehicle speed sensor output circuit for continuity.

- Engine control unit connector:
Disconnected
- Move the vehicle.

Continuity

Continuity -----

Non-continuity -----

One rotation

OK → **4**

OK → **2**

2 8 7 6 5 4 3 2 1 17 16 15 14 13 12 11 10 9
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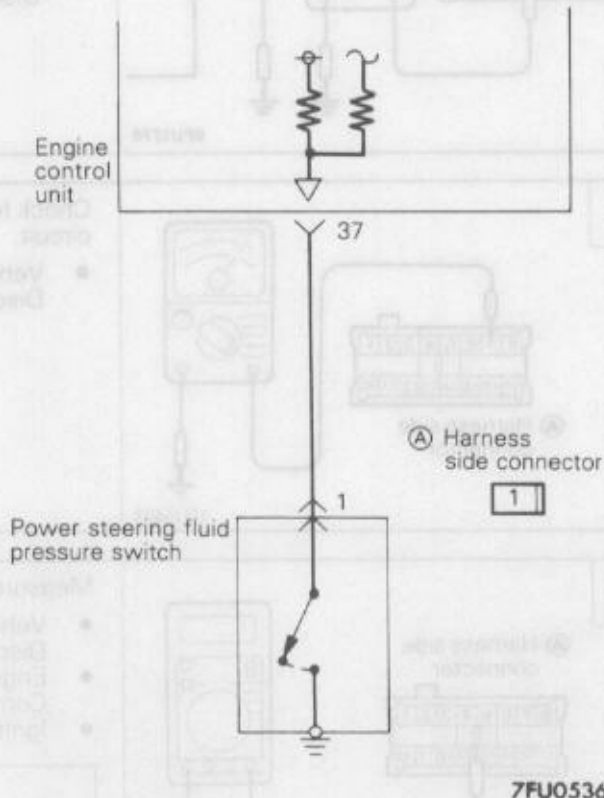
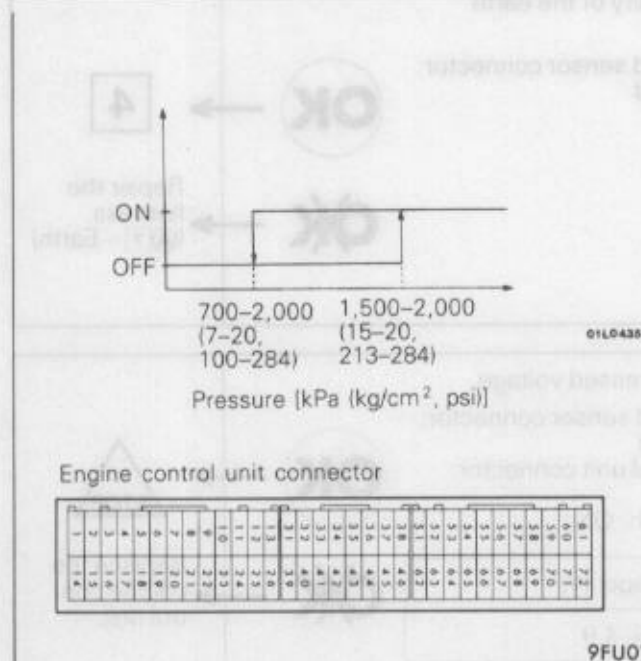
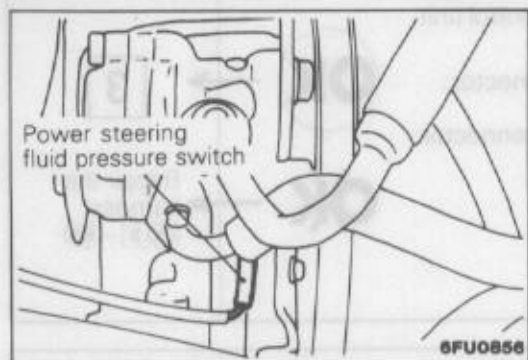
The battery voltage in the engine control unit is applied through a resistor to the power steering fluid pressure switch. Steering operation causes the power steering fluid pressure to increase, turning the switch on. As a result, continuity is provided between the battery voltage applied and earth. This causes the power steering fluid pressure (terminal voltage) to go from high to low.

The power steering fluid pressure switch can vary its resistance to power steering load. This lowers the voltage and sends it to the engine control unit, which then controls the oil pump control valve based on this signal.

INSPECTION
Using MUT

Item No.	Item Name	Check condition	Setting wheel	Terminal location
25	Swashplate	Engine idling	When stationary	OFF
			When being turned	ON

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.

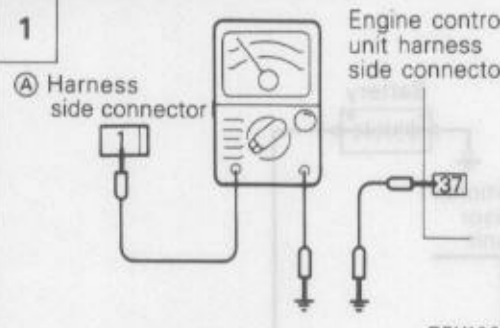
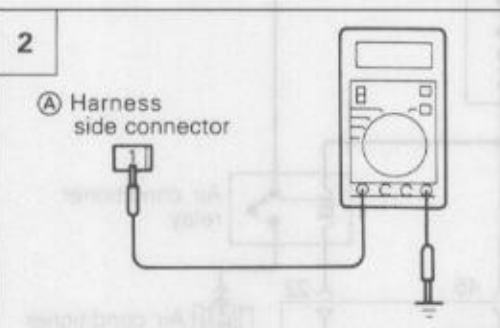
- The battery voltage in the engine control unit is applied through a resistor to the power steering fluid pressure switch. Steering operating causes the power steering fluid pressure to increase, turning the switch on. As a result, continuity is produced between the battery voltage applied and earth. This causes the power steering fluid pressure terminal voltage to go from high to low.

INSPECTION

Using MUT

Function	Item No.	Data display	Check condition	Steering wheel	Normal indication
Data reading	27	Switch state	Engine: Idling	When stationary	OFF
				When being turned	ON

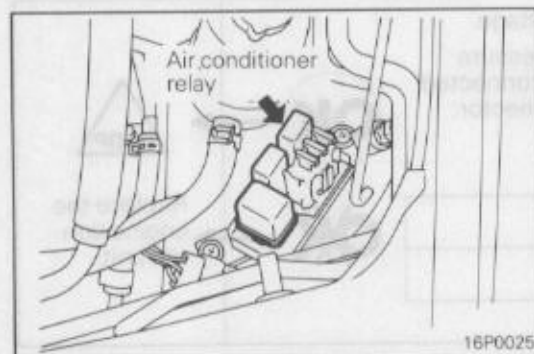
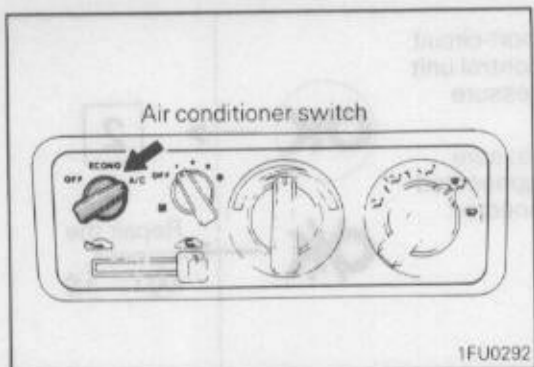
HARNESS INSPECTION

1  Engine control unit harness side connector 7FU1235	Check for open-circuit or short-circuit to earth, between engine control unit and power steering fluid pressure switch. - Power steering fluid pressure switch connector: Disconnected - Engine control unit connector: Disconnected	OK → 2 ✗ → Repair the harness. (A1 – 37)		
2  7FU0505	Measure the impressed voltage. - Power steering fluid pressure switch connector: Disconnected - Engine control unit connector: Connected - Ignition switch: ON <table border="1"> <tr> <td>Voltage (V)</td> </tr> <tr> <td>SV</td> </tr> </table>	Voltage (V)	SV	OK → STOP ✗ → Replace the engine control unit.
Voltage (V)				
SV				

SENSOR INSPECTION

Refer to GROUP 37 – Service Adjustment Procedures.

AIR CONDITIONER SWITCH AND POWER RELAY



Engine control unit connector

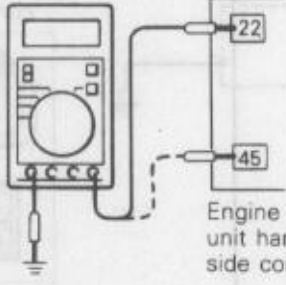
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AIR CONDITIONER COMPRESSOR POWER RELAY

Function	Item No.	Data display	Check condition	Air conditioner switch	Normal indication
Data reading	49	Air conditioner compressor power relay state	Engine: Idling after warm-up	OFF	OFF (Compressor clutch non-activation)
				ON	ON (Compressor clutch activation)

HARNESS INSPECTION

1



Engine control unit harness side connector

01R0863

Measure the power supply voltage of the air conditioner circuit.

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

Voltage (V)
6V or more

OK

→

STOP

NG

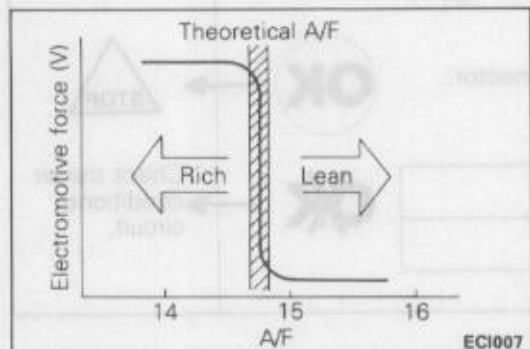
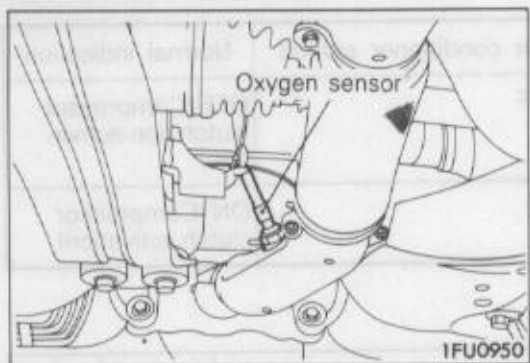
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Check the air conditioner circuit.

AIR CONDITIONER INSPECTION

Refer to GROUP 55 – Service Adjustment Procedures.

OXYGEN SENSOR



Engine control unit connector

61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224	1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241	1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	125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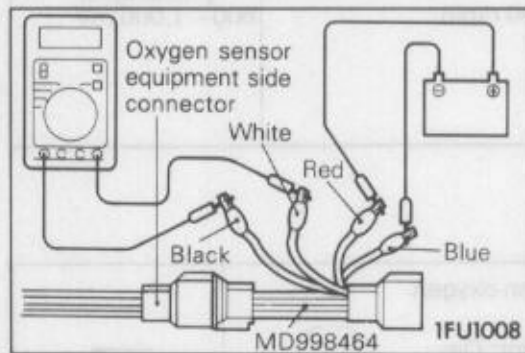
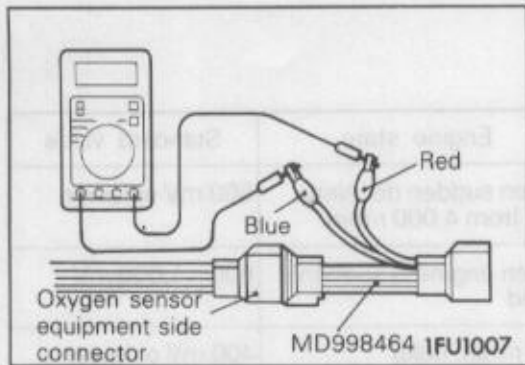
INSPECTION

Using MUT

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	11	Sensor voltage	Engine: Warm-up (make the mixture lean by engine speed reduction, and rich by racing)	When sudden deceleration from 4,000 r/min.	500 mV or lower
				When engine is suddenly raced	600 – 1,000 mV
			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 r/min. (Idle)	400 mV or lower
				2,000 r/min.	↑ (changes) 600 – 1,000 mV

HARNESS INSPECTION

1 1FU1041	Check for continuity between oxygen sensor and control relay. - Oxygen sensor connector: Disconnected - Control relay connector: Disconnected NOTE Touch the circuit tester probes to both ends of the harness. OK → 2 ✗ → Repair the harness. (A2 – B2)
2 9FU0214	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 ✗ → Repair the harness. (A3 – 56) (A4 – 35)
3 01A0362	Check for continuity of the earth circuit. Oxygen sensor connector: Disconnected OK → STOP ✗ → Repair the harness. (A1 – 72)



SENSOR INSPECTION

- (1) Disconnect the oxygen sensor connector and connect the special tool (test harness) to the connector on the oxygen sensor side.
- (2) Make sure that there is continuity [Approx. $20\ \Omega$ at 20°C (68°F)] between terminal ② and terminal ④ on the oxygen sensor connector.
- (3) If there is no continuity, replace the oxygen sensor.

- (4) Warm up the engine until engine coolant is 80°C (176°F) or higher.
- (5) Use jumper wires to connect oxygen sensor terminal ② (connect to (+) terminal) and terminal ④ (connect to (-) terminal) with the battery (+) terminal and (-) terminal.

Caution

Be very careful when connecting the jumper wires; incorrect connection can damage the oxygen sensor.

- (6) Connect a digital voltage meter between terminal ① and terminal ③.
- (7) While repeatedly racing the engine, measure the oxygen sensor output voltage.

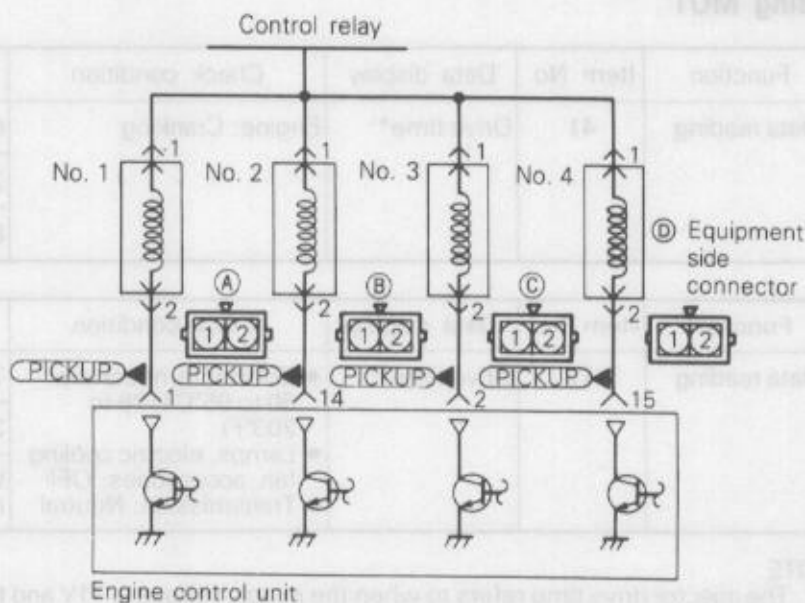
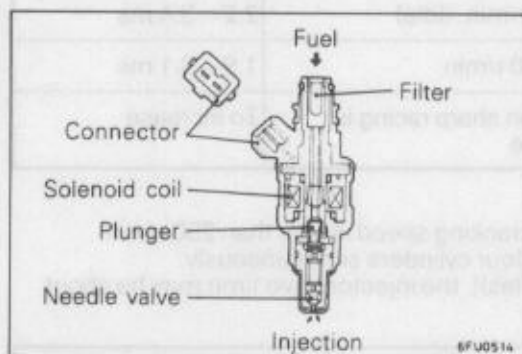
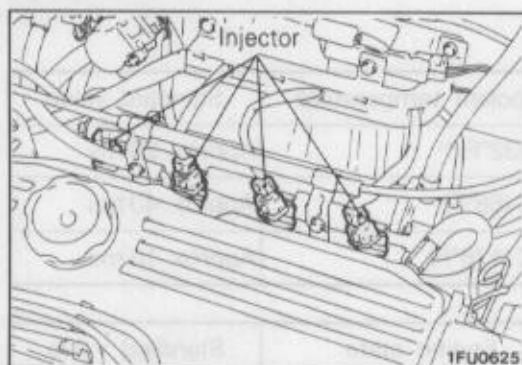
Engine	Oxygen sensor output voltage	Remarks
When racing engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6 – 1.0 V.

- (8) If the sensor is defective, replace the oxygen sensor.

NOTE

For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Manifold.

INJECTORS



Engine control unit
connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30

9FU0101

OPERATION

- The injector is an injection nozzle with a solenoid valve which injects fuel according to the injection signal coming from the engine control unit.
- The injector has a fixed nozzle opening area and the fuel pressure against manifold inside pressure is regulated to a fixed level. Therefore, the volume of fuel injected by the injector is determined by the time during which the needle valve is open, namely, by the time during which the solenoid coil is energized.
- The battery voltage is applied through the control relay to this injector. When the engine control unit turns ON the power transistor in the unit, the solenoid coil is energized to open injector valve, which then injects fuel.

TROUBLESHOOTING HINTS

Hint 1: If the engine is hard to start when hot, check fuel pressure and check the injector for leaks.

Hint 2: If the injector does not operate when the engine that is hard to start is cranked, the following as well as the injector itself may be responsible.

- (1) Faulty power supply circuit to the engine control unit, faulty earth circuit
- (2) Faulty control relay
- (3) Faulty crank angle sensor, top dead centre sensor

Hint 3: If there is any cylinder whose idle state remains unchanged when the fuel injection of injectors is cut one after another during idling, make following checks about such cylinder.

- (1) Injector and harness check
- (2) Spark plug and spark plug cable check
- (3) Compression pressure check

Hint 4: If the injector harness and individual part checks have resulted normal but the injector drive time is out of specification, the following troubles are suspected.

- (1) Poor combustion in the cylinder (faulty spark plug, ignition coil, compression pressure, etc.)
- (2) Loose EGR valve seating
- (3) High engine resistance

INSPECTION

Using MUT

Function	Item No.	Data display	Check condition	Coolant temperature	Standard value
Data reading	41	Drive time* ¹	Engine: Cranking	0°C (32°F)* ²	Approx. 20 ms
				20°C (68°F)	Approx. 40 ms
				80°C (176°F)	Approx. 10 ms

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	41	Drive time* ³	- Coolant temperature: 80 to 95°C (176 to 203°F) - Lamps, electric cooling fan, accessories: OFF - Transmission: Neutral	750 r/min. (Idle)	2.2 – 3.4 ms
				2,000 r/min.	1.9 – 3.1 ms
				When sharp racing is made	To increase

NOTE

*¹: The injector drive time refers to when the supply voltage is 11V and the cranking speed is less than 250 r/min.

*²: When coolant temperature is lower than 0°C (32°F), injection is made by four cylinders simultaneously.

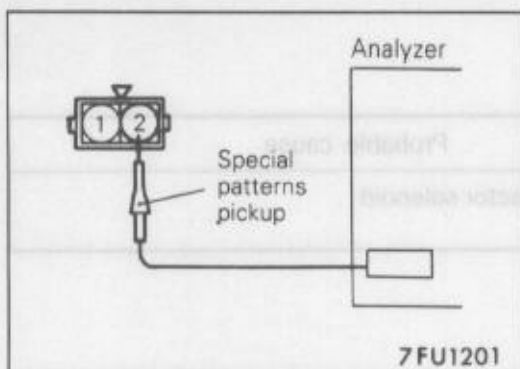
*³: When the vehicle is new [within initial operation of about 500 km (300 miles)], the injector drive time may be about 10% longer.

Function	Item No.	Drive content	Check condition	Normal state
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		

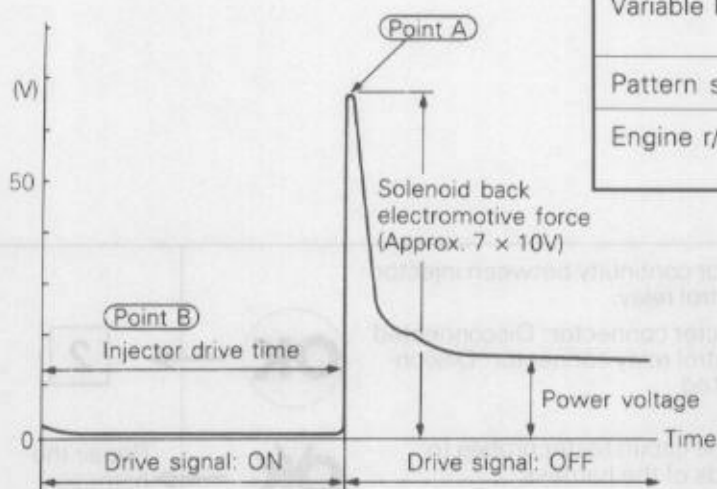
- The injector is an electric solenoid valve which injects fuel according to the electric signal coming from the engine control unit.
- The injector has a feed needle driven by the solenoid coil. The feed needle is closed when the solenoid coil is energized. The volume of fuel injected by the injector is determined by the time during which the needle valve is open. Normally, by the time during which the solenoid coil is energized.
- The battery voltage is applied through the control relay to the injector. When the engine control unit turns ON the power transistor in the control unit, the solenoid coil is energized to open the injector valve, which then injects fuel.

TROUBLESHOOTING HINTS

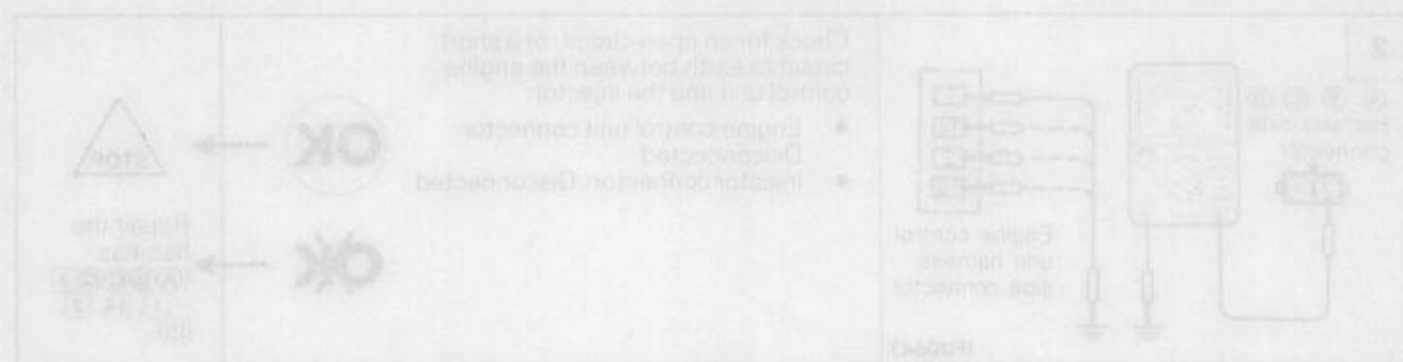
- Hint 1: If the engine is hard to start when hot, check fuel pressure and check the injector for leaks.

**Wave Pattern Inspection Using an Analyzer****Measurement method**

- (1) Disconnect the injector connector and connect the special tool (test harness: MB991348) in between. (Both the terminal on the engine control unit side and the terminal on the power supply side should be connected.)
- (2) Connect the analyzer special patterns pickup to the test harness clip on the engine control unit side.

Standard wave pattern**Observation conditions**

Function	Special patterns
Pattern height	Variable
Variable knob	Adjust while viewing the wave pattern
Pattern selector	Display
Engine r/min.	Idle speed (750 r/min.)

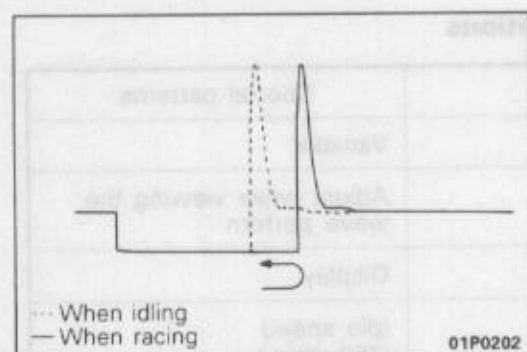


Wave pattern observation points

Point A : Height of solenoid back electromotive force

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

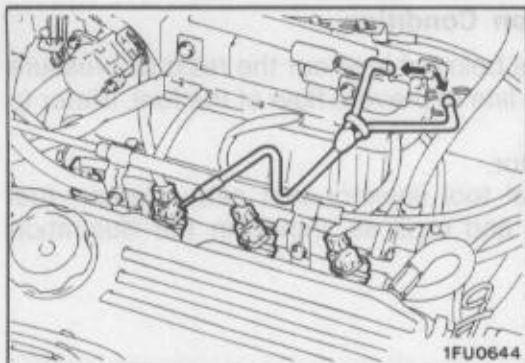
Point B : Injector drive time



- The injector drive time will be synchronized with the MUT 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 Control relay harness side connector Harness side connector 6FU1779	Check for continuity between injector and control relay. - Injector connector: Disconnected - Control relay connector: Disconnected NOTE Touch the circuit tester probes to both ends of the harness. OK → 2 ✗ → Repair the harness. (A B C D 1 - E 2)
2 Harness side connector Engine control unit harness side connector 1FU0643	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 ✗ → Repair the harness. (A B C D 2 - 1, 14, 2, 15)



ACTUATOR INSPECTION

Checking Operation Sound

Using a sound scope, check the operation sound ("chi-chi-chi") of injectors during idling or during cranking.

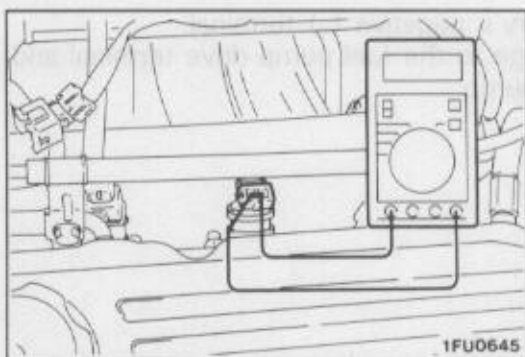
Check that as the rotating speed increases, the frequency of the operating sound also increases.

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.



Measurement of Resistance between Terminals

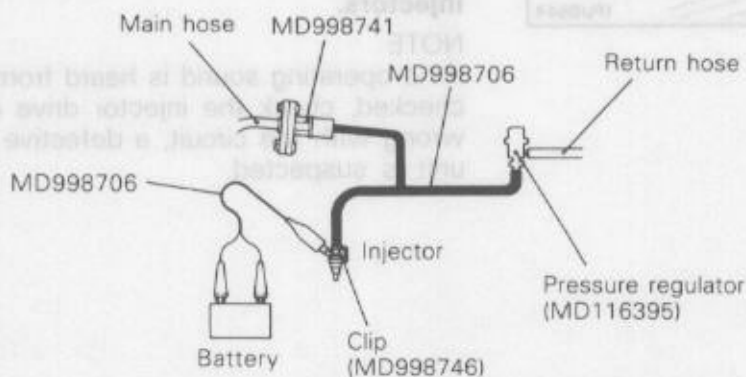
- (1) Remove the injector connector.
- (2) Measure the resistance between terminals.

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

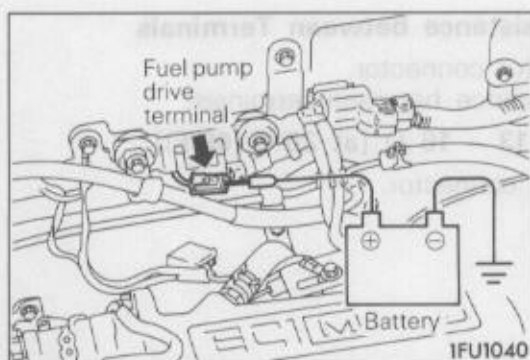
- (3) Install the injector connector.

Checking the Injection Condition

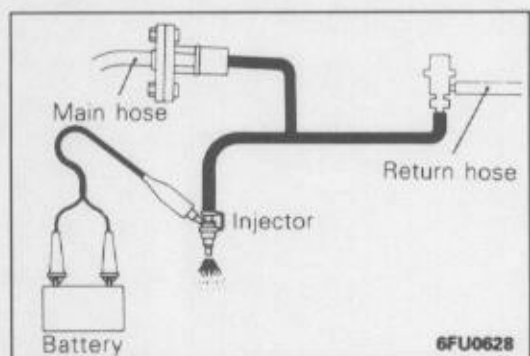
- (1) Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel. (Refer to P. 13-56.)
- (2) Remove the injector.
- (3) Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.



7FU0145



- (4) Connect the battery's negative (-) terminal.
- (5) Apply battery voltage to the fuel pump drive 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.

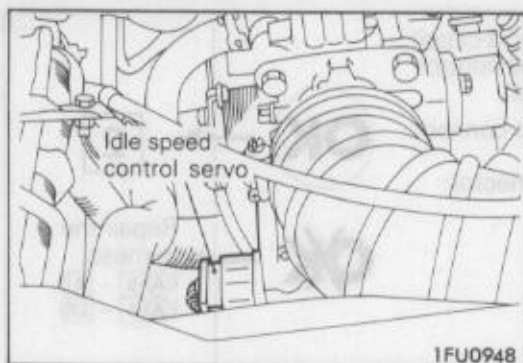


- (7) Stop the actuation of the injector, and check for leakage from the injector's nozzle.

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.

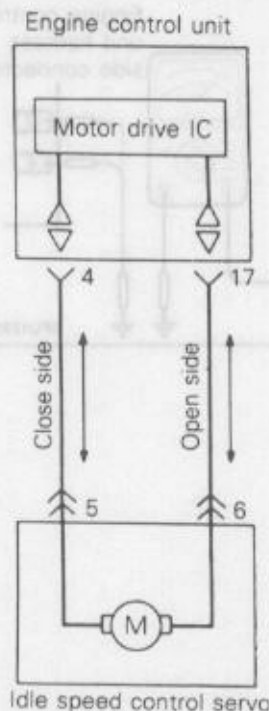
IDLE SPEED CONTROL SERVO (DC MOTOR)



① Harness side connector



① Equipment side connector



6FU1734

Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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9FU0101

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 idle 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 idle speed and servo valve position (step) change when the air conditioner switch is turned ON and OFF, it can be assumed that the idle 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 idle 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) EGR valve sheet adhesion is defective.
 - (5) Combustion malfunction inside a cylinder.
(Spark plug, ignition coil, injector or compression pressure is defective.)

HARNESS INSPECTION

1 Engine control unit harness side connector (A) Harness side connector 6FU1735	Check for open-circuit or short-circuit to earth, between idle speed control servo and engine control unit. - Idle speed control servo connector: Disconnected - Engine control unit connector: Disconnected	OK → 2 ✗ → Repair the harness. (A) 5 - 4 (A) 6 - 17
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ACTUATOR INSPECTION

Use a sound scope to check if the sound of the idle speed control 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, check the motor drive circuit and the idle speed control servo motor.

TROUBLESHOOTING HINTS

Hint 1: While the engine is idling, if the idle speed and servo valve position (step) change when the air conditioner switch is turned to ON and OFF, it can be assumed that the idle speed control servo and the servo valve position sensor are operating normal.

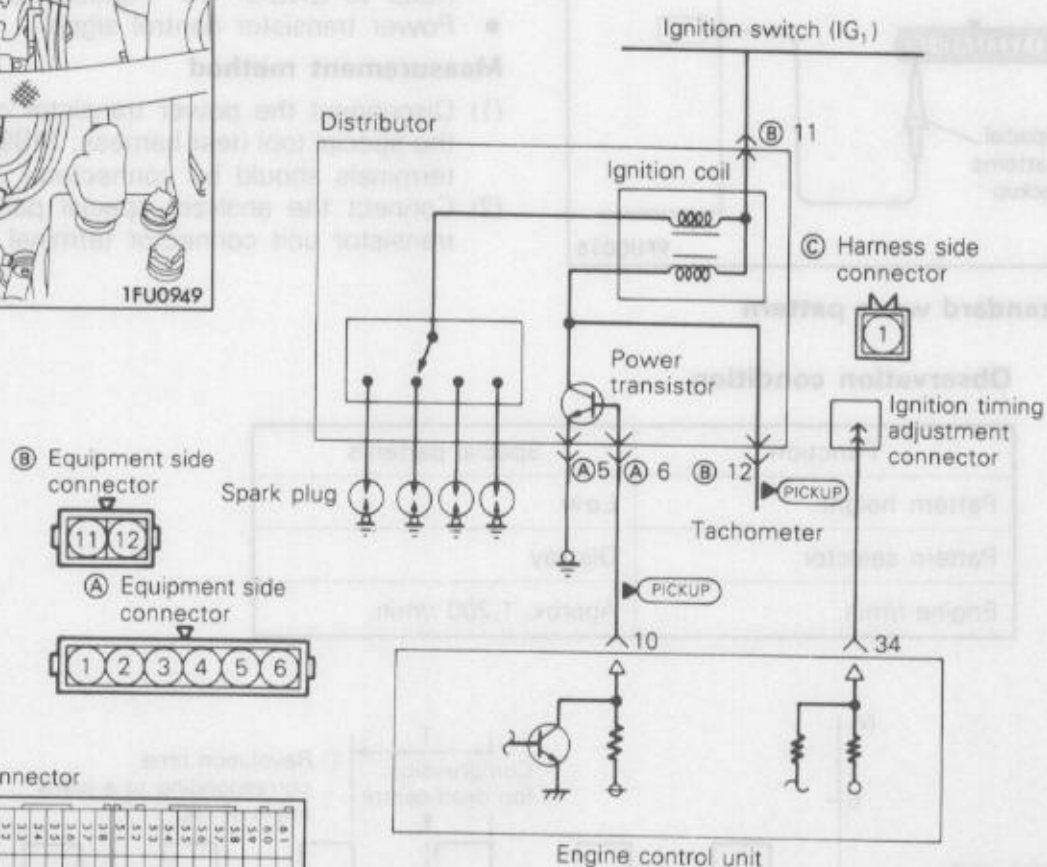
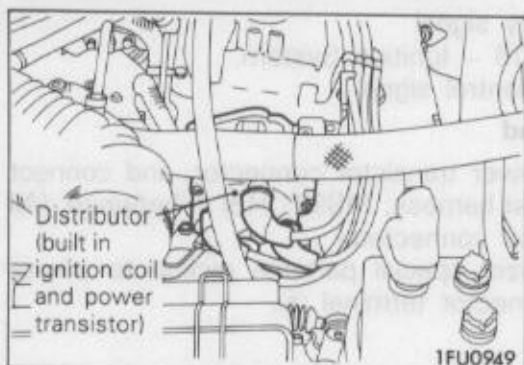
Hint 2: If the servo valve position (step) is outside the standard position, the malfunction is probably one of the following.

- (1) Check the speed adjustment is wrong.
- (2) Some harness is adhering to the throttle valve.
- (3) Air is being drawn into the air intake manifold through a defective gasket seal.
- (4) EGR valve seat adhesion is detected.
- (5) Combustion obstruction inside a cylinder.
- (6) Spark plug, ignition coil, injector or compression pressure is defective.

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 idle speed control servo is turning clockwise or anticlockwise.
- The DC motor turns clockwise or anticlockwise according to the change in the direction of current in the motor drive IC inside the engine control unit.

IGNITION COIL AND POWER TRANSISTOR



9FU0101

9FU0035

OPERATION

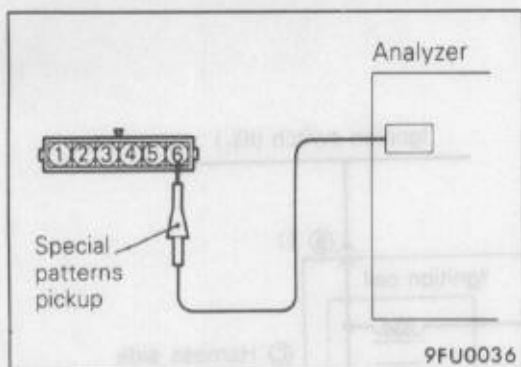
- When the power transistor is turned ON by the signal from the engine control unit, primary current flows to the ignition coil. When the power transistor is turned OFF, primary current is shut off and a high voltage is induced in the secondary coil.

- 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 transistor unit is turned OFF.

INSPECTION

Using MUT

Function	Item No.	Data display	Check condition	Check content	Normal state
Data reading	44	Ignition advance	- Engine: Warming up - Timing lamp: Set (set timing lamp to check actual ignition timing)	750 r/min. (Idle)	2-18°BTDC
				2,000 r/min.	15-35°BTDC



Wave Pattern Inspection Using an Analyzer

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

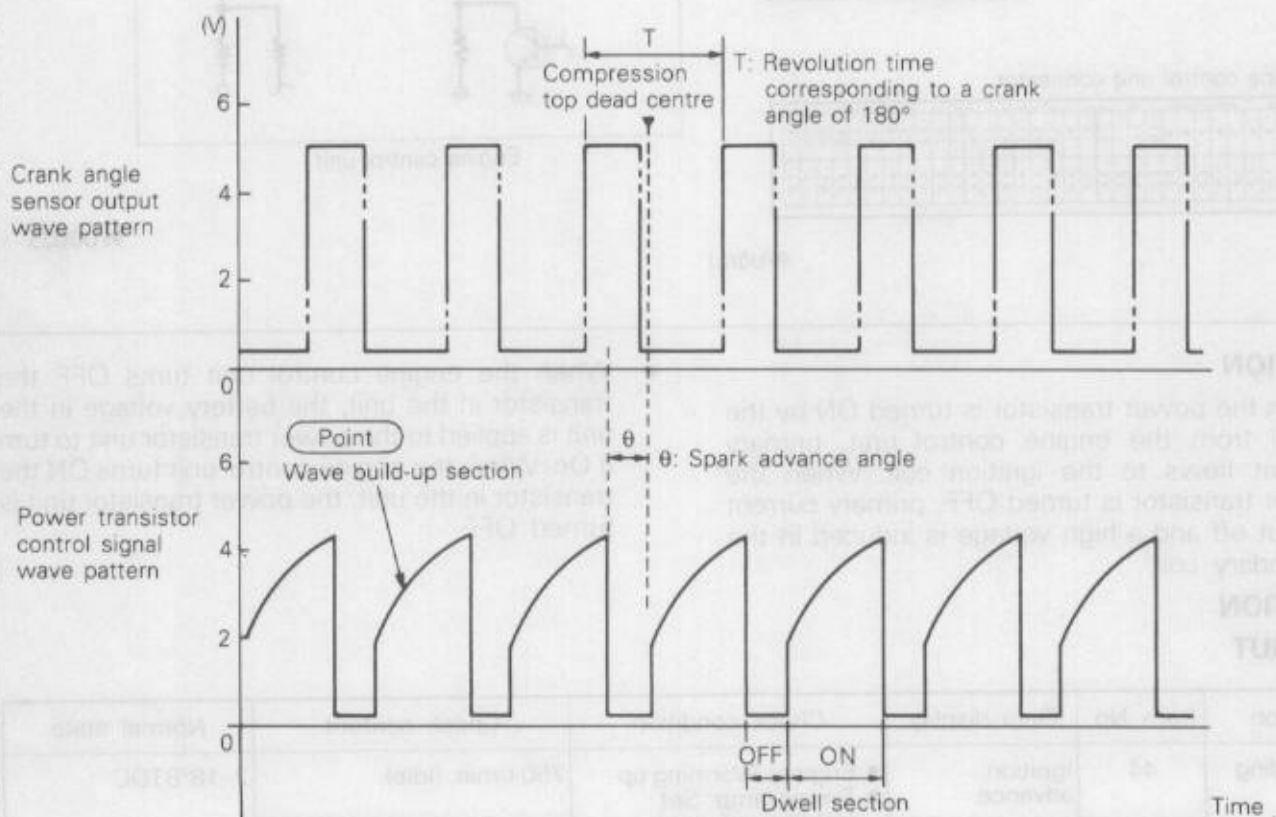
Measurement method

- (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 power transistor unit connector terminal (6).

Standard wave pattern

Observation condition

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

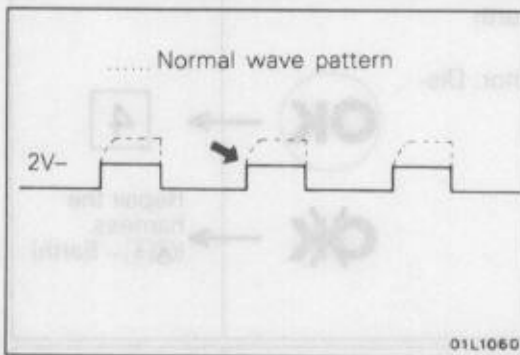


1FU0981

Wave pattern observation points

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

Condition of wave pattern build-up section and maximum voltage	Probable cause
Rises from approx. 2V to approx. 4.5V at the top-right	Normal
2V rectangular wave	Open-circuit in ignition primary circuit
Rectangular wave at power voltage	Power transistor malfunction

**Examples of abnormal wave patterns**

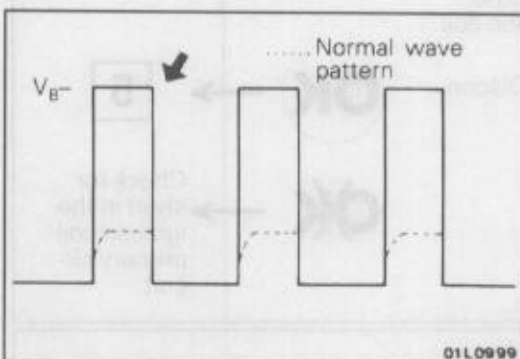
- Example 1
Wave pattern during engine cranking

Cause of problem

Open-circuit 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

① Ignition switch connector at junction block

② Harness side connector

1FU1042

Check for continuity between ignition coil and ignition switch.

- Ignition switch connector: Disconnected
- Ignition coil connector: Disconnected

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

OK → **2**

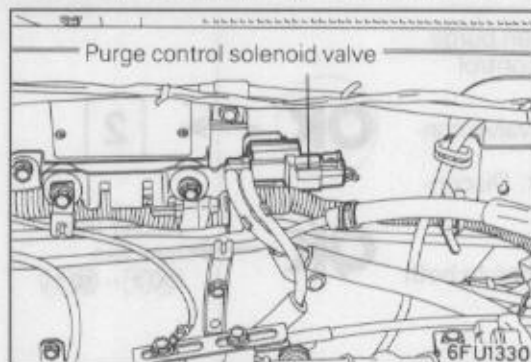
✗ → Repair the harness. (B11 - D6)

2 <
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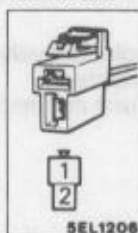
ACTUATOR INSPECTION

Refer to GROUP 16 – Ignition System.

PURGE CONTROL SOLENOID VALVE



④ Harness side connector



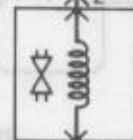
④ Equipment side connector



Engine control unit

Control relay

Purge control solenoid valve



01A0324

Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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HARNESS INSPECTION

1

Control relay harness side connector (B)

Harness side connector (A)

9FU0039

Check for continuity between purge control solenoid valve and control relay.

- Purge control solenoid valve connector: Disconnected
- Control relay connector: Disconnected

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

OK → **2**

✗ → Repair the harness. (A 2 – B 2)

2

Harness side connector (A)

Engine control unit harness side connector

9FU0040

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**

✗ → Repair the harness. (A 1 – 9)

ACTUATOR INSPECTION

Refer to GROUP 17 – Evaporative Emission Control System.



1010019

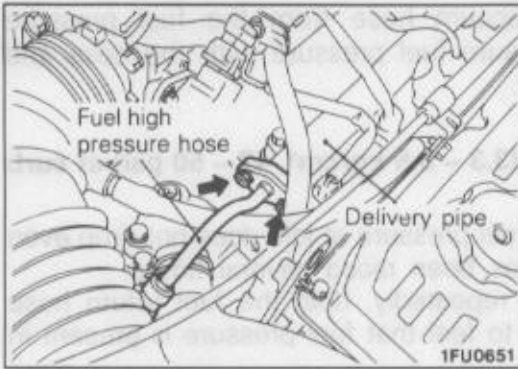
OPERATION

- The purge control solenoid valve is an EXHAUST type in which controls direction of purge air from the canister into the intake manifold.
- The battery power is supplied to the purge control valve through the control relay. When the engine control unit turns ON the power transistor in the unit, current flows to the coil, introducing purge air.

INSPECTION

Using MUT

Function	Item No.	Drive content	Check condition	Normal state
Actuator test	08	Solenoid valve from OFF to ON	Ignition switch: ON	Operating sound is heard when driven

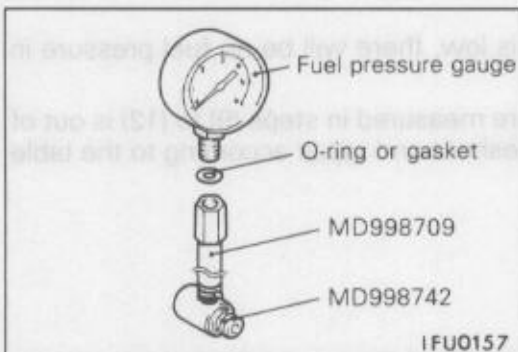


FUEL PRESSURE TEST

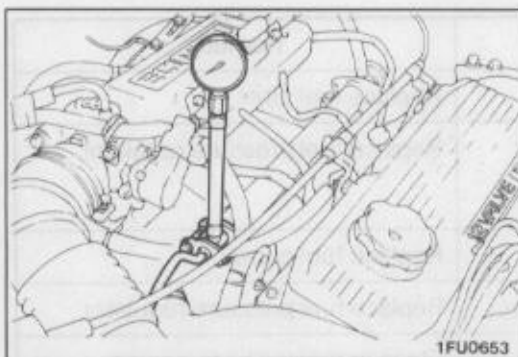
- (1) Release residual pressure from the fuel pipe line to prevent fuel gush out. (Refer to P.13-56.)
- (2) Disconnect the fuel high pressure hose at the delivery pipe side.

Caution

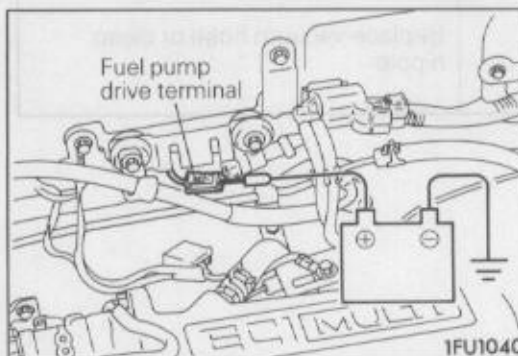
Cover the hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.



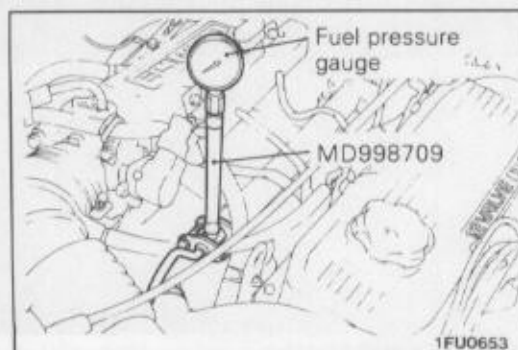
- (3) Remove the union joint and bolt from the special tool (adapter hose MD998709) and instead attach the special tool (hose adapter MD998742) to the adapter hose.
- (4) Install a fuel pressure gauge on the adapter hose that was set up in step (3).
Use a suitable O-ring or gasket between the fuel pressure gauge and the special tool so as to seal in order to prevent fuel leakage at this time.



- (5) Install the special tool, which was set in place in steps (3) and (4) between the delivery pipe and the high pressure hose.
- (6) Connect the (–) battery terminal.



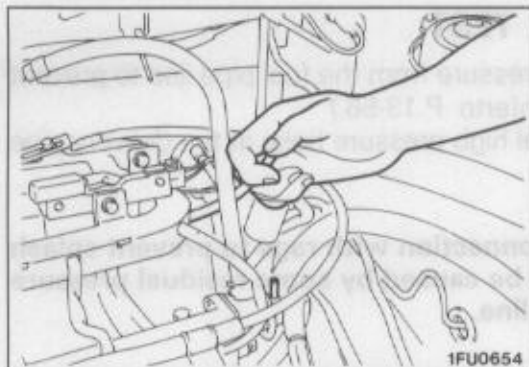
- (7) Connect the fuel pump drive terminal with the battery (+) terminal using a jumper wire and drive the fuel pump. Under fuel pressure, check the fuel pressure gauge and special tool connections for leaks.
- (8) Disconnect the jumper wire from the fuel pump drive terminal to stop the fuel pump.
- (9) Start the engine and run at idle.



- (10) Measure fuel pressure while the engine is running at idle.

Standard value:

Approx. 270 kPa (2.7 kg/cm², 38 psi) at curb idle



- (11) Disconnect the vacuum hose from the fuel pressure regulator and measure fuel pressure with the hose end closed by a finger.

Standard value:

330 – 350 kPa (3.3 – 3.5 kg/cm², 47 – 50 psi) at curb idle

- (12) Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.
(13) Racing the engine repeatedly, hold the fuel return hose lightly with fingers to feel that fuel pressure is present in the return hose.

NOTE

If the fuel flowrate is low, there will be no fuel pressure in the return hose.

- (14) If any of fuel pressure measured in steps (9) to (12) is out of specification, troubleshoot and repair according to the table below.

Symptom	Probable cause	Remedy
- Fuel pressure too low - Fuel pressure drops after racing - No fuel pressure in fuel return hose	Clogged fuel filter	Replace fuel filter
	Fuel leaking to return side due to poor fuel regulator valve seating or settled spring	Replace fuel pressure regulator
	Low fuel pump delivery pressure	Replace fuel pump
Fuel pressure too high	Binding valve in fuel pressure regulator	Replace fuel pressure regulator
	Clogged fuel return hose or pipe	Clean or replace hose or pipe
Same fuel pressure when vacuum hose is connected and when disconnected	Damaged vacuum hose or clogged nipple	Replace vacuum hose or clean nipple

- (15) Stop the engine and check change of fuel pressure gauge reading. Normal if the reading does not drop within 2 minutes. If it does, observe the rate of drop and troubleshoot and repair according to the table below.

Symptom	Probable cause	Remedy
Fuel pressure drops gradually after engine is stopped	Leaky injector	Replace injector
	Leaky fuel regulator valve seat	Replace fuel pressure regulator
Fuel pressure drops sharply immediately after engine is stopped	Check valve in fuel pump is held open	Replace fuel pump

- (16) Release residual pressure from the fuel pipe line. (Refer to P.13-56.)

- (17) Remove the fuel pressure gauge and special tool from the delivery pipe.

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.

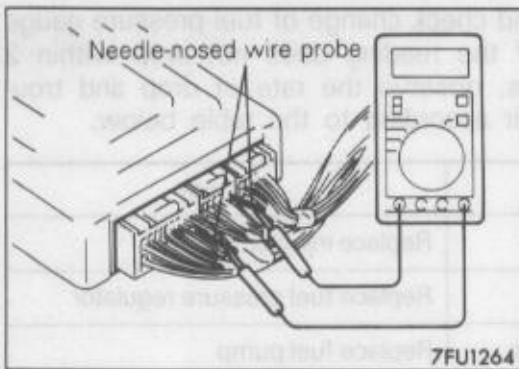
- (18) Replace the O-ring at the end of the fuel high pressure hose with a new one.

- (19) Fit the fuel high pressure hose over the delivery pipe and tighten the bolt to specified torque.

Tightening torque: 5 Nm (0.56 kgm, 3.6 ft.lbs.)

- (20) Check for fuel leaks.

- ① Apply the battery voltage to the fuel pump drive terminal to drive the fuel pump.
- ② Under fuel pressure, check the fuel line for leaks.



ENGINE CONTROL UNIT TERMINAL VOLTAGE CHECK

- (1) Connect a needle-nosed wire probe (test harness: MB991223 or paper clip) to a voltmeter probe.
- (2) Insert the needle-nosed wire probe into each of the engine control unit connector terminals from the wire side, and measure the voltage while referring to the check chart.

NOTE

1. Make the voltage measurement with the engine control unit connectors connected.
2. Make the voltage measurement between terminal No. 26 (earth terminal) and each terminal.
3. You may find it convenient to pull out the engine control unit to make it easier to reach the connector terminals.
4. The checks can be carried out off the order given in the chart.

Caution

Short-circuiting the positive (+) probe between a connector terminal and earth could damage the vehicle wiring, the sensor, engine control unit, or all there. Use care to prevent this!

- (3) If voltmeter shows any division from standard value, check the corresponding sensor, actuator and related electrical wiring, then repair or replace.
- (4) After repair or replacement, recheck with the voltmeter to confirm that the repair has corrected the problem.

TERMINAL VOLTAGE CHECK CHART

Engine Control Unit Terminal Arrangement

Engine control unit connector

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
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Terminal No.	Check item	Check condition (Engine condition)		Standard value
60	Backup power supply	Ignition switch: OFF		SV
12	Power supply	Ignition switch: ON		SV
25				
8	Control relay (Fuel pump)	Ignition switch: ON		SV
		Engine: Idle speed		0–3V
61	Sensor impressed voltage	Ignition switch: ON		4.5–5.5V
52	Intake air temperature sensor	Ignition switch: ON	When intake air temperature is 0°C (32°F)	3.2–3.8V
			When intake air temperature is 20°C (68°F)	2.3–2.9V
			When intake air temperature is 40°C (104°F)	1.5–2.1V
			When intake air temperature is 80°C (176°F)	0.4–1.0V
70	Vacuum sensor (Manifold absolute pressure sensor)	Ignition switch: ON	When altitude is 0 m	3.7–4.3V
			When altitude is 1,200 m (3,937 ft.)	3.2–3.8V
		Engine: Idle speed		0.9–1.5V
		While engine is idling after having warmed up, suddenly depress the accelerator pedal		From 0.9–1.5V, momentarily increases
63	Coolant temperature sensor	Ignition switch: ON	When coolant temperature is 0°C (32°F)	3.2–3.8V
			When coolant temperature is 20°C (68°F)	2.3–2.9V
			When coolant temperature is 40°C (104°F)	1.3–1.9V
			When coolant temperature is 80°C (176°F)	0.3–0.9V
64	Throttle position sensor	Ignition switch: ON	Set throttle valve to idle position	0.3–1.0V
			Fully open throttle valve	4.5–5.5V
67	Idle position switch	Ignition switch: ON	Set throttle valve to idle position	0–1V
			Slightly open throttle valve	4V or more

Terminal No.	Check item	Check condition (Engine condition)		Standard value
68	Top dead centre sensor	Engine: Cranking		0.2–3.0V
		Engine: Idle speed		
69	Crank angle sensor	Engine: Cranking		0.2–3.0V
		Engine: Idle speed		
51	Ignition switch-ST	Engine: Cranking		8V or more
66	Vehicle speed sensor	Ignition switch: ON Move the vehicle slowly forward		0↔5V (Changes repeatedly)
37	Power steering fluid pressure switch	Engine: Idling after warming up	When stationary	SV
			When being turned	0–3V
45	Air conditioner switch	Engine: Idle speed	Turn the air conditioner switch OFF	0–3V
			Turn the air conditioner switch ON (Air conditioner compressor is operating)	SV
22	Air conditioner relay	Engine: Idle speed Air conditioner switch: OFF→ON Turn the air conditioner switch ON (Air conditioner compressor is operating)		SV or temporarily 6V or more ↓ 0–3V
56	Oxygen sensor	Engine: Running at 2,000 r/min. after having warmed up. (Check using a digital type voltmeter.)		0↔0.8V (Changes repeatedly)
1	No. 1 injector	While engine is idling after having warmed up, suddenly depress the accelerator pedal		From 11–14V, momentarily drops slightly
14	No. 2 injector			
2	No. 3 injector			
15	No. 4 injector			
10	Power transistor unit	Engine r/min.: 3,000 r/min.		0.3–3.0V
9	Purge control solenoid valve	Ignition switch: ON		SV
		Running at 3,000 r/min. while engine is warmed up after having been started.		0–3V
34	Ignition timing adjustment terminal	Ignition switch: ON	Earth the ignition timing adjustment terminal	0–1V
			Remove the earth connection from the ignition timing adjustment terminal.	4.0–5.5V
36	Engine warning lamp	Ignition switch: OFF→ON		0–3V ↓ 9–13V (After several seconds have elapsed)

Terminal No.	Check item	Check condition (Engine condition)	Standard value
35	Oxygen sensor heater	Engine: Idling after warming up	0–3V
		Engine r/min.: 5,000 r/min.	SV
5	Idle speed control servo valve position sensor No. 1	Ignition switch: Immediately after turning ON	1.5–4V (Momentarily) ↓ 0–1V or 4.5–5.5V
18	Idle speed control servo valve position sensor No. 2	Ignition switch: Immediately after turning ON	1.5–4V (Momentarily) ↓ 0–1V or 4.5–5.5V
4	Idle speed control motor (Closed)	Ignition switch: Immediately after turning ON	2V or more (Momentarily) ↓ 0–1V
17	Idle speed control motor (Open)	Ignition switch: Immediately after turning ON	4V or more (Momentarily) ↓ 0–1V

SERVICE ADJUSTMENT PROCEDURES <4G92, 4G93-MPI – Vehicles built from June 1992>

GENERAL INSPECTION

ACCELERATOR CABLE INSPECTION AND ADJUSTMENT

Refer to P.13-123-44.

FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE THE FUEL PRESSURE)

Refer to P.13-56.

FUEL FILTER REPLACEMENT

Refer to P.13-57.

Standard value	Engine condition		
0-3V	Engine idling	Oxygen sensor heater	25
0V			
1.5-4V (Maximum)	Turning ON	Idle speed control servo valve position sensor	9
0-1V or 4.5-5.5V			
1.5-4V (Maximum)	Turning ON	Idle speed control servo valve position sensor	18
0-1V or 4.5-5.5V			
2V or more (Maximum)	Ignition switch: immediately after turning ON	Idle speed control motor (Closed)	4
0-1V			
4V or more (Maximum)	Ignition switch: immediately after turning ON	Idle speed control motor (Open)	17
0-1V			