FUEL

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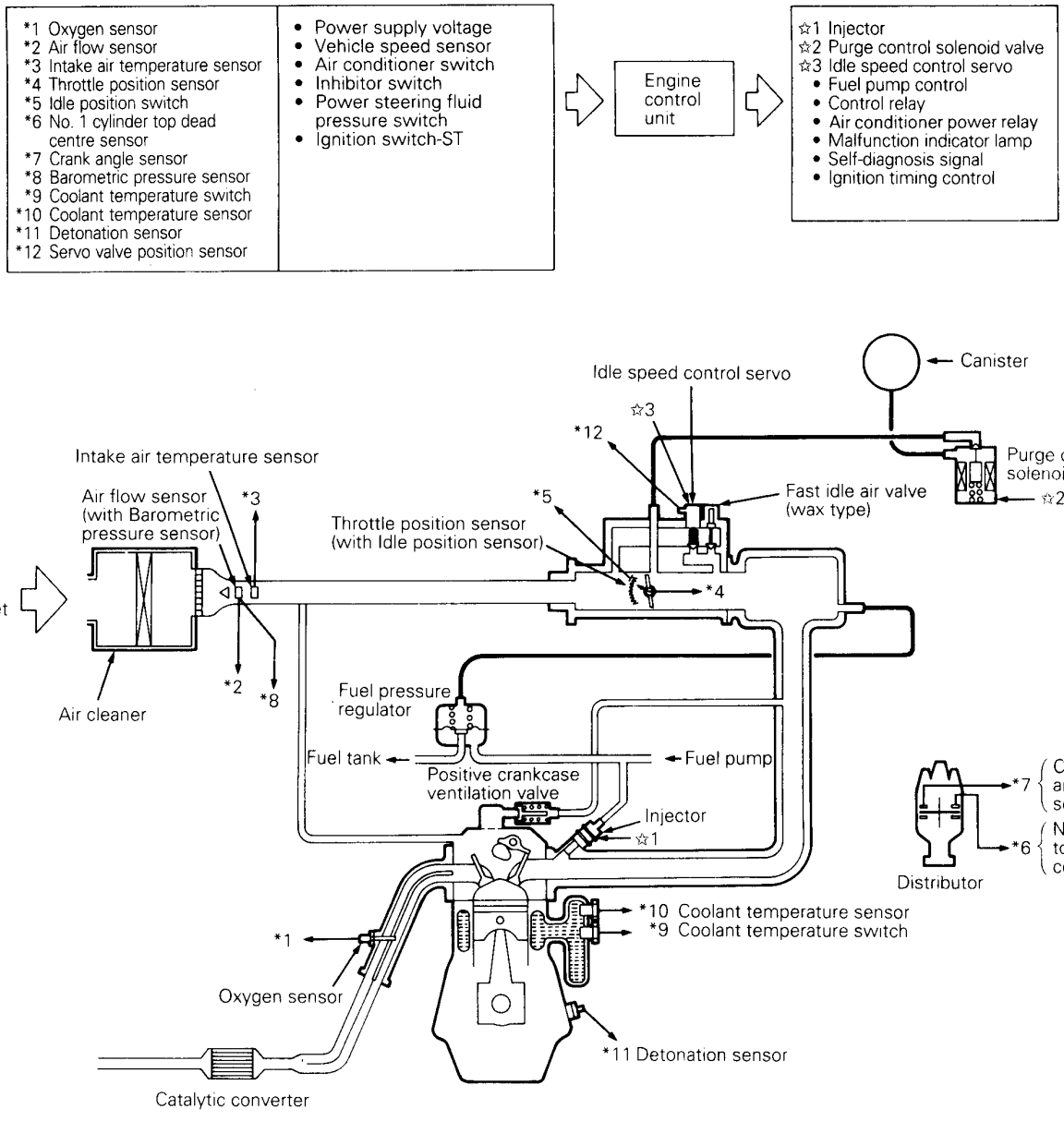
FUEL SYSTEM <4G93>

GENERAL INFORMATION

E13BBAJ

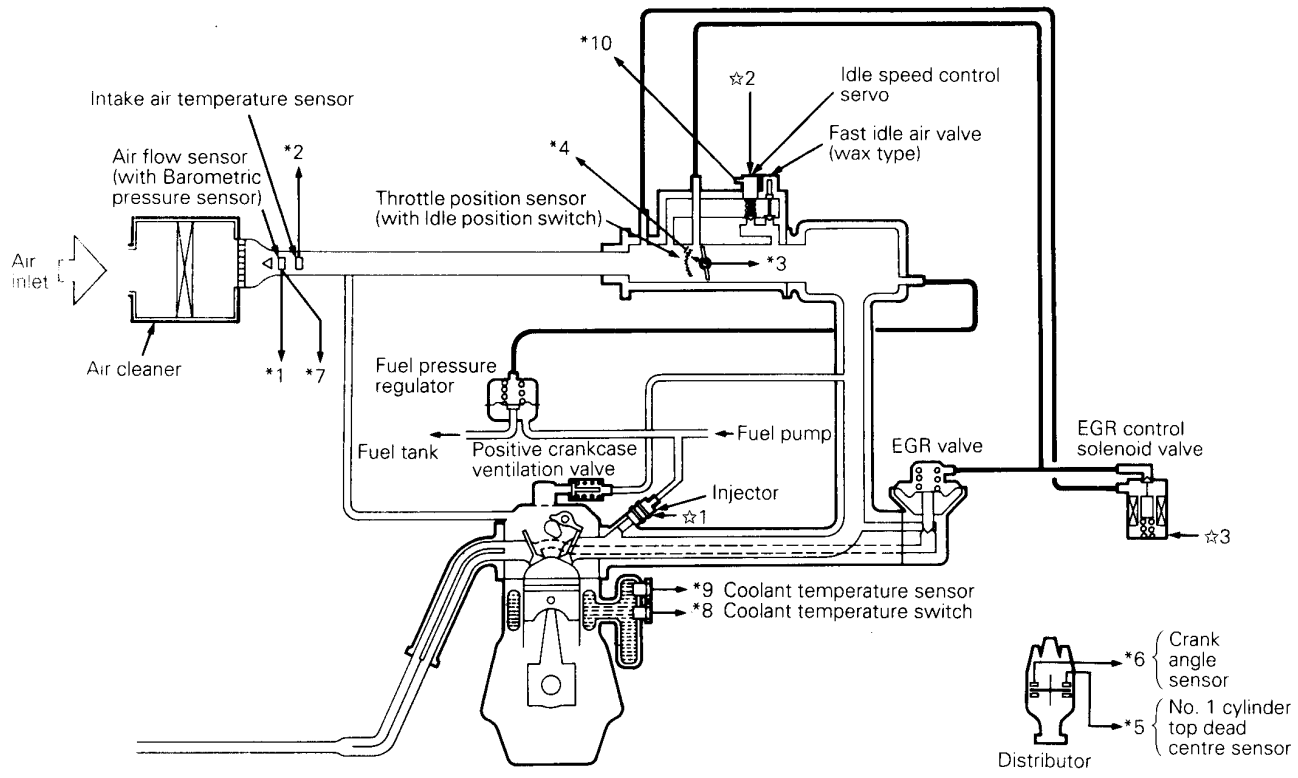
MULTI POINT INJECTION SYSTEM DIAGRAM

<Vehicles with Catalytic Converter>



<Vehicles without Catalytic Converter>

*1 Air flow sensor *2 Intake air temperature sensor *3 Throttle position sensor *4 Idle position switch *5 No. 1 cylinder top dead centre sensor *6 Crank angle sensor *7 Barometric pressure sensor *8 Coolant temperature switch *9 Coolant temperature sensor *10 Servo valve position sensor	• Power supply voltage • Vehicle speed sensor • Air conditioner switch • Inhibitor switch • Power steering fluid pressure switch • Ignition switch-ST • Mixture adjusting screw (Variable resistor)	Engine control unit	☆1 Injector ☆2 Idle speed control servo ☆3 EGR control solenoid valve • Fuel pump control • Control relay • Air conditioner power relay • Self-diagnosis signal • Ignition timing control



9FU0046

SPECIFICATIONS

GENERAL SPECIFICATIONS

E13CA-A

Items	Specifications
Fuel	
Tank capacity dm³ (U.S. gal., Imp. gal.)	55 (14.5, 12.1) <SPACE RUNNER> 60 (15.9, 13.2) <SPACE WAGON>
Fuel pump	
Type	Electrical, in-tank type
Throttle body	
Throttle bore mm (in.)	50 (1.97)
Throttle position sensor	Variable resistor type
Idle speed control servo	DC motor type DC motor type by-pass air control system with the Fast Idle Air Valve (FIAV)
Idle position switch	Rotary contact type, within throttle position sensor
Servo valve position sensor	Hall element type
Mixture adjusting screw (variable resistor)*2	Variable resistor type
Engine control unit	
Identification model No.	
2WD	E2T37680*1, *3 E2T61585*4 E2T37682*2
4WD	E2T37681*3 E2T61585*5
Sensors	
Air flow sensor	Karman vortex type
Barometric pressure sensor	Semiconductor type
Intake air temperature sensor	Thermistor type
Engine coolant temperature sensor	Thermistor type
Oxygen sensor*1	Zirconia type
Vehicle speed sensor	Reed switch type
Inhibitor switch	Contact switch type
No. 1 cylinder top dead centre sensor	Hall element type
Crank angle sensor	Hall element type
Detonation sensor	Piezoelectric type
Power steering fluid pressure switch	Contact switch type
Actuators	
Control relay type	Contact switch type
Injector type and number	Electromagnetic type, 4
Injector identification mark	MDH210
EGR control solenoid valve*2	ON/OFF type solenoid valve
Purge control solenoid valve*1	ON/OFF type solenoid valve
Fuel pressure regulator	
Regulating pressure kPa (kg/cm², psi)	335 (3.35, 47.6)

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter
*3: Vehicles built up to April, 1993
*4: Vehicles with catalytic converter built from May, 1993
*5: Vehicles built from May, 1993

SERVICE SPECIFICATIONS

E13CB-A

Items		Specifications
Standard value		
Accelerator cable play	mm (in.)	
<M/T>		1–2 (0.04–0.08)
<A/T>		3–5 (0.12–0.20)
Basic ignition timing		5° ±2° BTDC at curb idle
Curb idle speed	r/min.	800±100*1
		700±100*2
Idle speed when air conditioner is ON	r/min.	830 at neutral position
Basic idle speed	r/min.	800±50*1
		700±50*2
Throttle position sensor adjusting voltage	mV	400–1000
Throttle position sensor resistance	kΩ	3.5–6.5
Intake air temperature sensor resistance	kΩ	2.7 [at 20°C (68°F)]
Mixture adjusting screw total resistance	kΩ	4-6*2
Engine coolant temperature sensor resistance	kΩ	
20°C (68°F)		2.4
80°C (176°F)		0.3
Oxygen sensor output voltage	V	0.6–1.0*1
Fuel pressure	kPa (kg/cm², psi)	
Vacuum hose disconnection		330–350 (3.3-3.5, 47-50) at curb idle
Vacuum hose connection		Approx. 270 (2.7, 38) at curb idle
Injector coil resistance	Ω	13–16 [at 20°C (68°F)]
EGR control solenoid valve coil resistance	Ω	36–44 [at 20°C (68°F)]*2
Purge control solenoid valve coil resistance	Ω	36–44 [at 20°C (68°F)]*1

NOTE
*1 : Vehicles with catalytic converter
*2 : Vehicles without catalytic converter

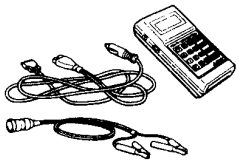
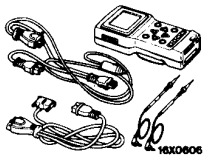
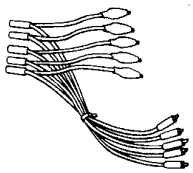
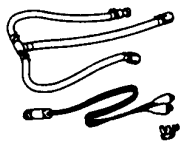
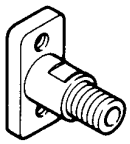
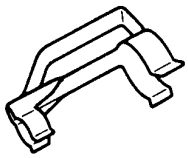
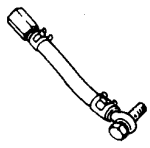
SEALANT

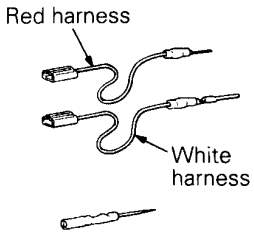
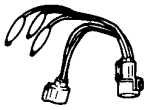
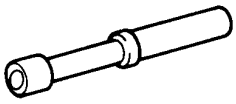
E13CE--

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

SPECIAL TOOLS

E13DA-A

Tool	Number	Name	Use
	MB991341	Multi-use tester (MUT) sub assembly	<Up to 1993 models> • Reading diagnosis code • MPI system inspection
	For the number, refer to GROUP 00-Precautions Before Service.	ROM pack	
	MB991502	MUT-II sub assembly	<All models> • Reading diagnosis code • MPI system inspection
 16X0607		ROM pack	
	MB991348	Test harness set	• Adjustment of idle position switch and throttle position sensor • Inspection using an analyzer
	MD998706	Injector test set	Checking the spray condition of injectors
	MD998741	Injector test adapter	
	MD998746	Clip	
	MD998709	Adapter hose	Measurement of fuel pressure

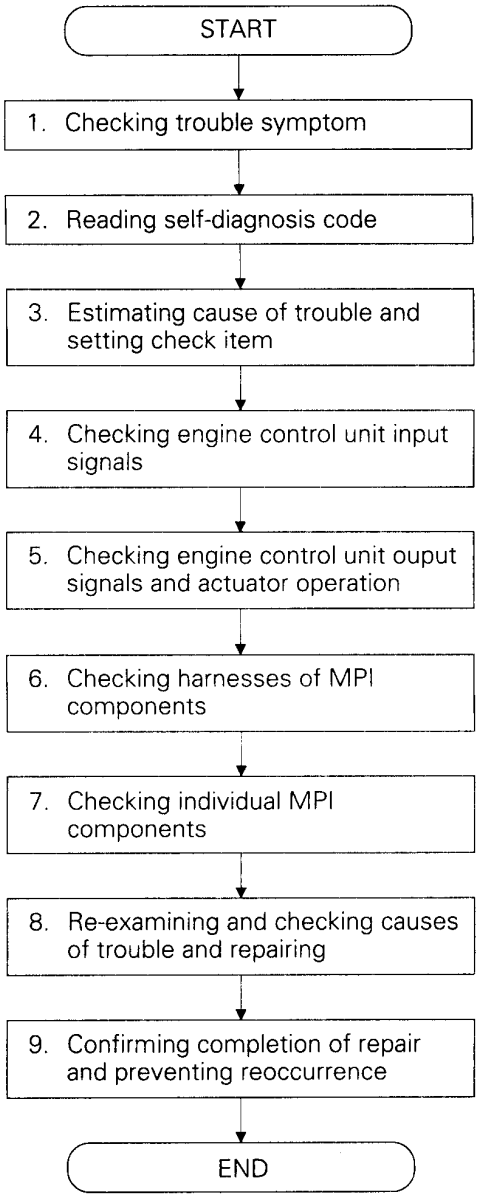
Tool	Number	Name	Use
	MD998742	Hose adaptor	Measurement of fuel pressure
	MB991223	Inspection test harness set • Pin contact pressure inspection harness • Market tester contact probe (for general connectors)	Measurement of terminal voltage
	MD998478	Test harness (3 pin, triangle)	• Mixture adjusting screw (variable resistor) inspection
	MD998299	MAS driver	• Mixture adjusting screw (variable resistor) adjustment

TROUBLESHOOTING

E13EFAM

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 multi-use tester (MUT), MUT-II 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.

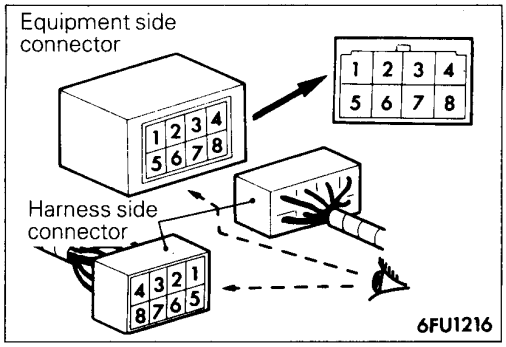
(5) Checking engine control unit output signals and actuator operation
- Use the multi-use tester (MUT) or MUT-II to check the signals output from the engine control unit. Also, force-drive the actuator using the actuator test function to check the actuator operation.
- Use an analyzer to check the signals 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.

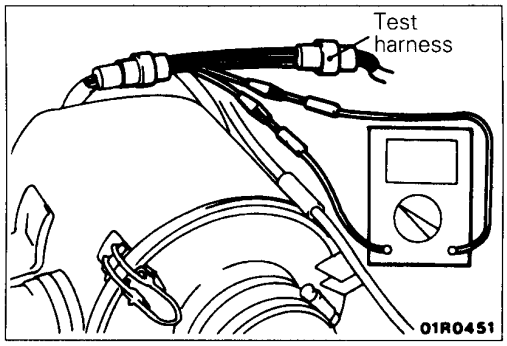
(8) Re-examining and checking causes of trouble and repairing
- If the results of the harness check and individual component check are normal but the input and output signals for the engine control unit are still abnormal, re-examine the causes of the trouble, referring to the troubleshooting hints. 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.

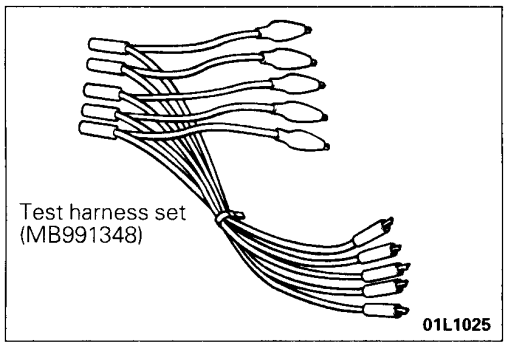


EXPLANATION AND CAUTIONS FOR CIRCUIT CHECKING

- 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.

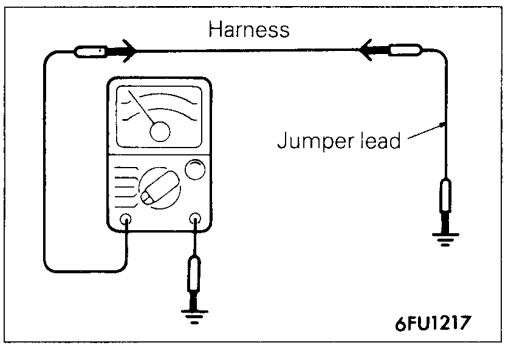


- When checking a waterproof connector with the circuit in a live state, be sure to use the special tool (test harness).
  Inserting the test probe from the harness side should never be done, as it will adversely affect waterproof performance, which may lead to corrosion.
  Furthermore, the test harness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

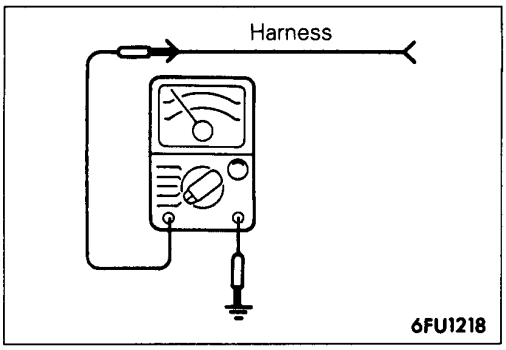


- In addition, if there is no test harness for the appropriate connector, the test harness set (MB991348) which can be connected directly between the terminals can be used.

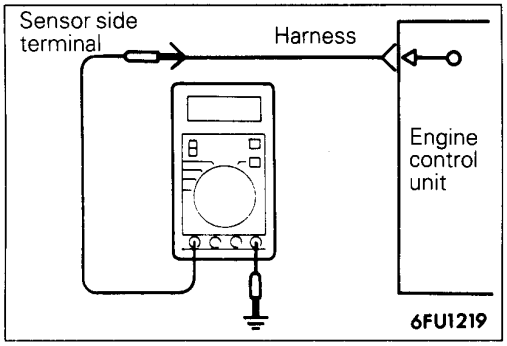
- When checking the terminal voltage, etc., with the connectors disconnected, do not insert the test probe if the check terminal has female pins. Use the special tool (inspection harness set MB991223) instead.
  Forcing the test probe into such a terminal can cause poor contact.



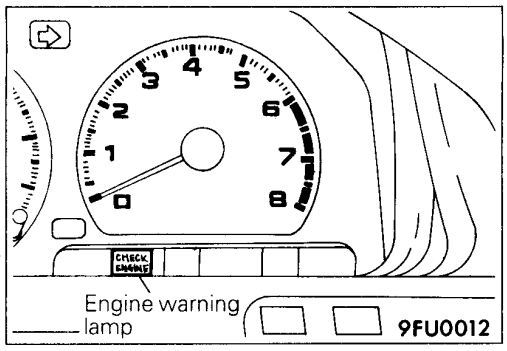
- When checking for a open circuit in a harness with both ends of the harness separated physically, use a jumper lead to earth one end and check continuity between the other end and the earth. This enables checking for a open circuit in the harness to be made. If there is no continuity, repair the harness.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



- 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.



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*
Air flow sensor
Intake air temperature sensor
Throttle position sensor
Engine coolant temperature sensor
Crank angle sensor
Top dead centre sensor (No. 1 cylinder top dead centre)
Barometric pressure sensor
Detonation 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.

NOTE
*: Vehicles with catalytic converter.

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 occured, memorizes the malfunction code, and outputs the signal to the self-diagnosis output terminal.
There are 15 diagnosis items, including the normal state, and the diagnosis results can be read out with a multi-use tester (MUT) or MUT-II. Moreover, since memorization of the malfunction codes is backed up directly by the battery, the diagnosis results are memorized even if the ignition key is turned off. The malfunction codes will, however, be erased when the battery terminal or the engine control unit connector is disconnected.
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 or MUT-II 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 or MUT-II to the engine control unit and the diagnosis memory will be erased.

The 15 diagnosis items are provided as follows, and if plural items are activated, they are all indicated sequentially from the smallest code number.

Caution
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)
		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	Air flow sensor	12	Retained	• Harness and connector (If harness and connector are normal, replace air flow sensor assembly.)
4	Intake air temperature sensor	13	Retained	• Harness and connector • Intake air temperature sensor
5	Throttle position sensor	14	Retained	• Harness and connector • Throttle position sensor • Idle position switch
6	Engine coolant temperature sensor	21	Retained	• Harness and connector • Engine coolant temperature sensor
7	Crank angle sensor	22	Retained	• Harness and connector (If harness and connector are normal, replace distributor assembly.)
8	No. 1 cylinder top dead centre sensor	23	Retained	• Harness and connector (If harness and connector are normal, replace distributor assembly.)

Output preference order	Diagnosis item	Malfunction code		Check item (Remedy)
		No.	Memory	
9	Vehicle speed sensor (reed switch)	24	Retained	• Harness and connector • Vehicle speed sensor (reed switch)
10	Barometric pressure sensor	25	Retained	• Harness and connector (If harness and connector are normal, replace barometric pressure sensor assembly)
11	Detonation sensor*	31	Retained	• Harness and connector (If harness and connector are normal, replace detonation sensor)
12	Ignition timing adjustment signal	36	–	• Harness and connector
13	Injector	41	Retained	• Harness and connector • Injector coil resistance
14	Servo valve position sensor	55	Retained	• Harness and connector • Servo valve position sensor • Idle speed control servo (DC motor)
15	Normal state	—	—	–

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. * : Vehicles with catalytic converter.
3. The code numbers will be displayed in order, starting from the lowest.

PROBLEM DIAGNOSIS CONTENT CHART

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remark (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 (6) Engine control unit malfunction	• Reduction in exhaust gas purification * • Poor starting • Unstable idling • Poor acceleration
12	Air flow sensor	Frequency of air flow sensor signal is 10Hz or less, even though engine is running.	(1) Air flow sensor malfunction (2) Open circuit or short circuit in air flow sensor, or connector contact is defective. (3) Engine control unit malfunction.	• Poor acceleration * • Inappropriate idle speed * • Unstable idling *
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 (3) Engine control unit malfunction	• 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 (5) Engine control unit malfunction	• Engine stalls • Racing is impossible

NOTE
*: Fail-Safe/backup function is operating.

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remark (Trouble symptom, etc.)
21	Engine coolant temperature sensor	(1) Voltage of engine coolant temperature sensor signal is 4.6V or more. (2) Voltage of engine coolant temperature sensor signal is 0.11V or less. (3) While engine is warming up, engine coolant temperature sensor signal shows a drop in engine coolant temperature.	(1) Engine coolant temperature malfunction (2) Open circuit or short circuit in engine coolant temperature sensor, or connector contact is defective (3) Engine control unit malfunction	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 (3) Engine control unit malfunction	• 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 (3) Engine control unit malfunction	• 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 3000 r/min or more.	(1) Vehicle speed sensor malfunction (2) Open circuit or short circuit in vehicle speed sensor, or connector contact is defective (3) Engine control unit malfunction	Engine stalls when vehicle stops after decelerating

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remark (Trouble symptom, etc.)
25	Barometric pressure sensor	(1) Voltage of barometric pressure sensor signal is 4.5V or more. (2) Voltage of barometric pressure sensor signal is 0.2V or less	(1) Barometric pressure sensor malfunction (2) Open circuit or short circuit in barometric pressure sensor, or connector contact is defective (3) Engine control unit malfunction	• Reduction in exhaust gas purification efficiency * • Poor starting • Unstable idling • Poor acceleration
31	Detonation sensor	Detonation sensor signal voltage is abnormal.	(1) Detonation sensor malfunction (2) Open circuit or short circuit in detonation sensor, or connector contact is defective (3) Engine control unit malfunction	• Poor acceleration *
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 (2) Engine control unit malfunction	• 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 (3) Engine control unit malfunction	• Reduction in exhaust gas purification efficiency * • 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 (5) Engine control unit is defective	• Inappropriate idle speed * • Engine stops * • Unstable idling *

FAIL-SAFE/BACKUP FUNCTION TABLE

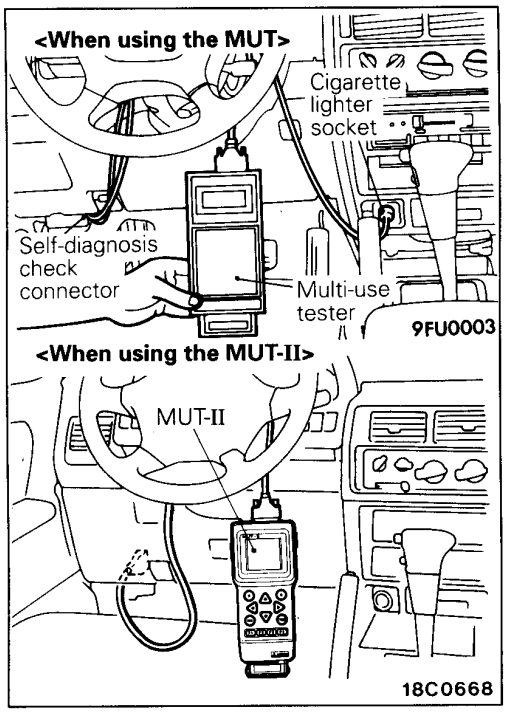
When the main sensor malfunctions are detected by the self-diagnosis function, the vehicle is controlled by means of the pre-set control logic to maintain safe conditions for driving.

Malfunctioning item	Control contents during malfunction
Air flow 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 25°C (77°F).
Throttle position sensor (TPS)	No increase in fuel injection amount during acceleration due to the throttle position sensor signal.
Engine coolant temperature sensor	Controls as if the engine 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.)
Barometric pressure sensor	Controls as if the barometric pressure is 101kPa (760mmHg, 30 in.Hg).
Detonation sensor	Retards the ignition timing from normal ignition timing to timing where knocking doesn't occur.
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 multi-use tester (MUT) or MUT-II should always be made with the ignition switch in the OFF position.



READING PROCEDURE–USING MULTI-USE TESTER (MUT) <Up to 1993 models> OR MUT-II <All models>

(1) Connect the MUT or MUT-II to the diagnosis connector.

NOTE
When connecting the MUT-II to vehicles built up to 1993, use the adaptor harness which is supplied as an accessory to the MUT-II sub-assembly.

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

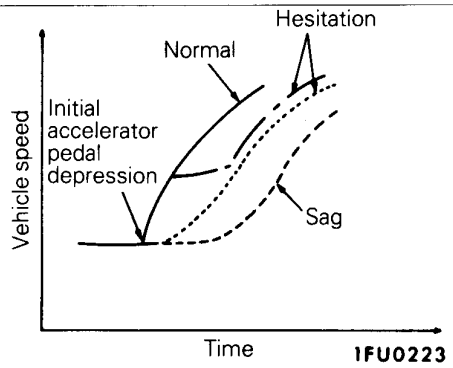
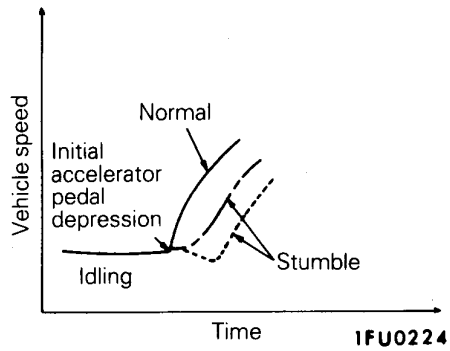
CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

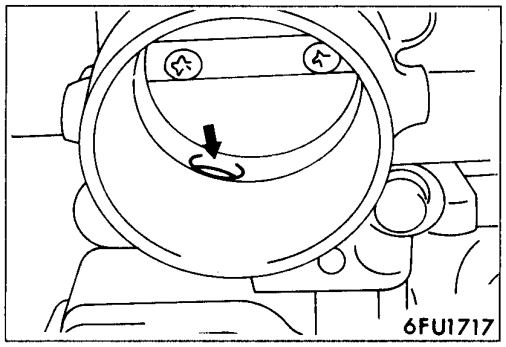
Problem symptoms / Check items	Starting		Idling stability			Driving						Stopping	Reference page
	Will not start	Starting problem	Idling instability (Rough idling)	Incorrect idling speed	Improper idling continuity	Hesitation, sag	Poor acceleration	Stumble	Shock	Surge	Knocking	Run-on (Dieseling)	
Power supply	① 1												P.13-34
Engine control unit power earth	② 2												P.13-37
Fuel pump	③ 3	① 1			① 1	① 1	① 1						P.13-38
Air flow sensor					⑫ 10	⑨ 9		⑤ 5	⑥ 6		④ 4		P.13-41
Intake air temperature sensor			⑥			⑤ 5	④ 4				② 2		P.13-45
Barometric pressure sensor			⑧			⑧ 8	⑥ 6				③ 3		P.13-48
Engine coolant temperature sensor		3	⑦ 6	① 1	⑥ 6	⑦ 7	⑤ 5	④ 4		③ 3			P.13-50
Throttle position sensor						⑥ 6		③ 3	④ 4				P.13-53
Idle position switch			④ 4	② 2	⑤ 5								P.13-56
Servo valve position sensor			③ 3	⑥ 3	④				⑤ 5				P.13-58
Top dead centre sensor	⑤ 5	⑥ 7			⑨ 8				② 2				P.13-61
Crank angle sensor	⑥ 6	⑦ 8			⑩ 9				③ 3				P.13-65
Ignition switch-ST <M/T>	④ 4	③ 4											P.13-69
Ignition switch-ST and inhibitor switch <A/T>	④ 4	③ 4		⑤									P.13-70
Vehicle speed sensor					⑦				⑦				P.13-72
Power steering fluid pressure switch				③									P.13-74
Mixture adjusting screw*2			⑪										P.13-76
Air conditioner switch and power relay				④									P.13-78
Detonation sensor*1											① 1		P.13-80
Oxygen sensor*1			⑩										P.13-82
Injectors	⑧ 8	② 2	② 2		③ 3	② 2	② 2	① 1		① 1		①	P.13-85
Idle speed control servo (DC motor)		④ 5	① 1	⑦ 4	② 2				⑨ 7				P.13-91
Ignition coil and power transistor	⑦ 7				⑪ 10		⑦ 7		① 1		⑤ 5		P.13-93
Purge control solenoid valve*1			⑨										P.13-98
EGR control solenoid valve*2						④ 4		⑥ 6		④ 4			P.13-100
Anti-skid brake signal <4WD-M/T>*3									⑧				P.13-102
Fuel pressure		⑤ 6	⑤ 5		⑧ 7	③ 3	③ 3	② 2		② 2			P.13-103

○ : Warm engine (number inside indicates check order)
□ : Cold engine (number inside indicates check order)

NOTE
*1 : Vehicles with catalytic converter
*2 : Vehicles without catalytic converter
*3 : Vehicles built up to May, 1992

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, ajudgement 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 accelator 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 (engine r/min) that occurs when the accelerator is depressed in order to accelerate from the speed at which the vehicle is now traveling, or a temporary drop in vehicle speed (engine r/min) during such acceleration. Serious hesistation is called "sag". 
	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. 
	Shock	The feeling of a comparativley large impact or vibration when the engine is accelerated or decelerated.
	Surge	This is repeated surging ahead during constant speed travel or during variable speed travel.
	Knocking	A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving.
Stopping	Run on ("dieseling")	The condition in which the engine continues to run after the ignition switch is turned to OFF. Also called "dieseling".



SERVICE ADJUSTMENT PROCEDURES

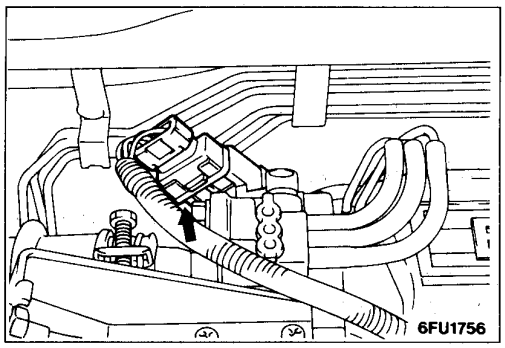
THROTTLE BODY (THROTTLE VALVE AREA) CLEANING E13HAJD

(1) Start the engine and warm it up until the engine 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.

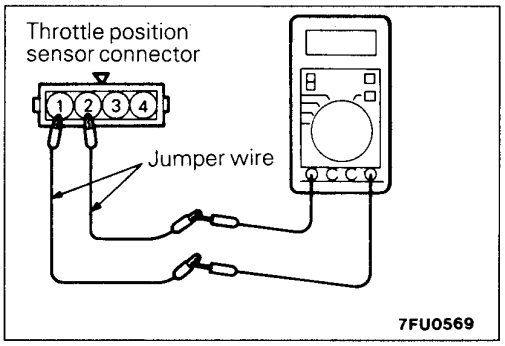
(4) Spray cleaning solvent into the valve through the throttle body intake port and leave it for about 5 minutes.
(5) Start the engine, race it several times and idle it for about 1 minute. If the idling speed becomes unstable (or if the engine stalls) due to the bypass passage being plugged, slightly 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 multi-use tester (MUT) or MUT-II to erase the self-diagnosis code.
(10) Adjust the basic idle speed. (Refer to P.13-25)

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

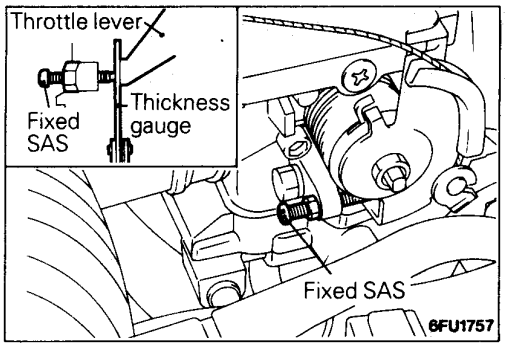


IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT E13HAKG

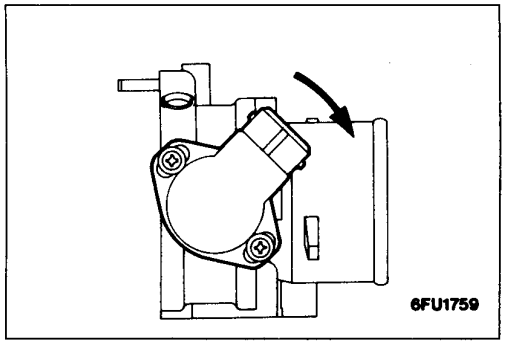
(1) Disconnect the connector of the throttle position sensor.



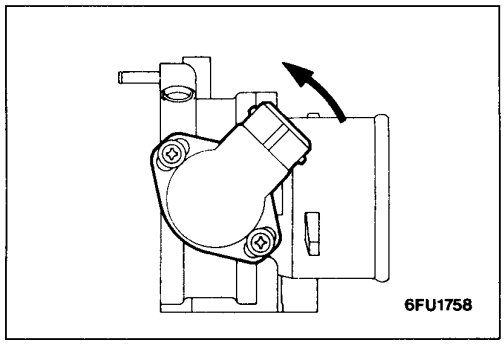
(2) Connect an ohmmeter between terminal ② (Idle position switch) and ① (sensor earth) by using jumper wires.



(3) Insert a feeler gauge with a thickness of 0.65 mm (.0256 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 clockwise.
(5) In this condition, check for continuity between terminals ① and ②.

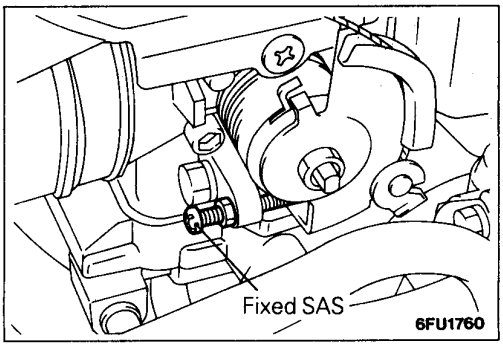


(6) Slowly turn the throttle position sensor in the counter clockwise direction until the point at which continuity between terminals ① and ② changes to non-continuity is found. Tighten the throttle position sensor installation bolt at that position.
(7) Connect the connector of the throttle position sensor.

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

Standard value: 400 – 1000 mV

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



FIXED SAS ADJUSTMENT E13HAMD

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 anti-clockwise 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.13-23)

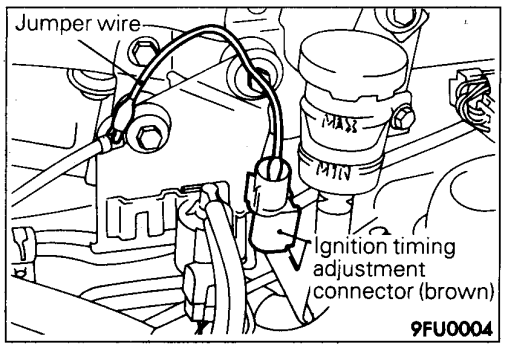
BASIC IDLE SPEED ADJUSTMENT E13HANF

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 multi-use tester (MUT) or MUT-II to the diagnosis connector.

NOTE
When the MUT or MUT-II is connected, the diagnosis control terminal should be earthed.



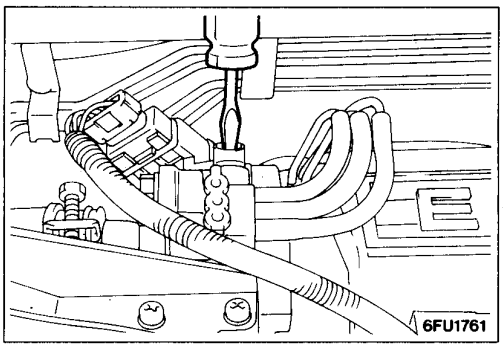
(3) Remove the waterproof female connector from the ignition timing adjustment connector.
(4) Use a jumper wire to earth the ignition timing adjustment terminal.

(5) Start the engine and run at idle.
(6) Select item No. 22 and read the idle speed.

Standard value:

Vehicles with catalytic converter	**800 ±50 r/min.**
Vehicles without catalytic converter	**700 ±50 r/min.**

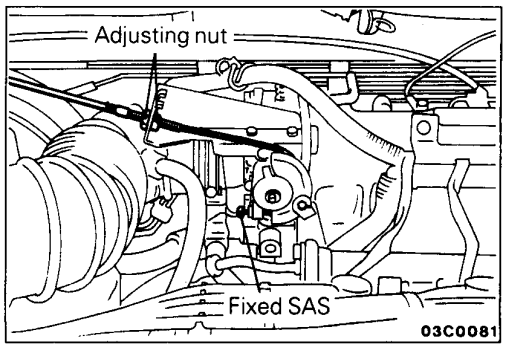
NOTE
1. The engine speed may be 20 to 100 r/min. lower than indicated above for a new vehicle (driven approximately 500 km (300 miles) or less), but no adjustment is necessary.
2. If the engine stalls or the rpm is low even though the vehicle has been driven approximately 500 km (300 miles) or more, it is probable that deposits are adhered to the throttle valve, so clean it. (Refer to P.13-23)



(7) 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.

(8) Switch OFF the ignition switch.
(9) Disconnect the jumper wire from the ignition timing adjustment terminal and return the connector to its original condition.
(10) 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.

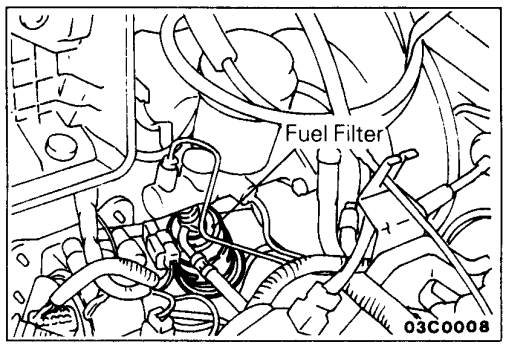


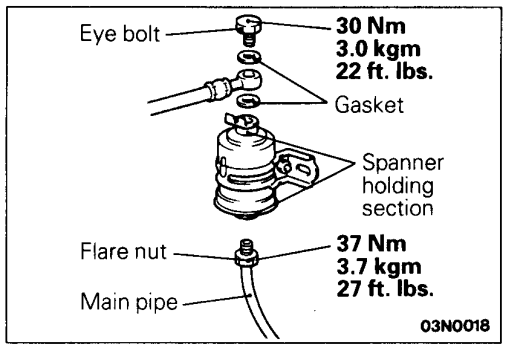
ACCELERATOR CABLE INSPECTION AND ADJUSTMENT E13FCBC

(1) Check to be sure that there are no sharp bends in the accelerator cable.
(2) Check to be sure that the throttle lever is touching the fixed SAS.
(3) Check to see if the inner cable play is at the standard value.

Standard value: 1 – 2 mm (0.04 – 0.08 in.) <M/T>
3 – 5 mm (0.12 – 0.20 in.) <A/T>

(4) If the play is outside the standard value, adjust by sliding the adjusting nut so that the inner cable play is brought to the standard value, and then tighten the nut.



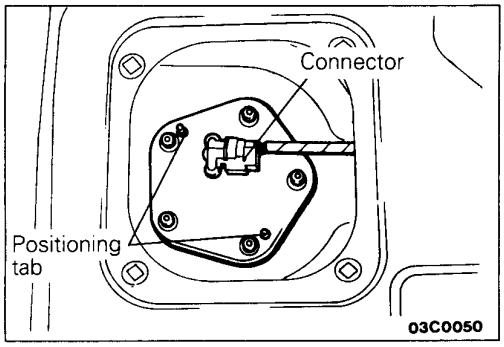


FUEL FILTER REPLACEMENT E13FZAO

(1) Bleed the residual pressure from inside the fuel line.
(2) Remove the air cleaner and air intake hose.
(3) Hold the fuel filter with a spanner and remove the eye bolt. Then remove the high-pressure fuel hose.

Caution
As there will be some pressure remaining in the fuel pipe line, cover it with a rag to prevent fuel from spraying out.

(4) Hold the fuel filter with a spanner and loosen the flare nut. Then disconnect the fuel main pipe connection.
(5) Remove the fuel filter.
(6) When installing the fuel filter, use a new gasket, and tighten the flare nut of the high-pressure fuel hose and the fuel main pipe to the specified torque.
(7) After installation, check that there are no fuel leaks.
  ① Apply battery voltage to the fuel pump drive terminal to operate the fuel pump. (Refer to P.13-29.)
  ② Check for leaks when fuel pressure is applied.



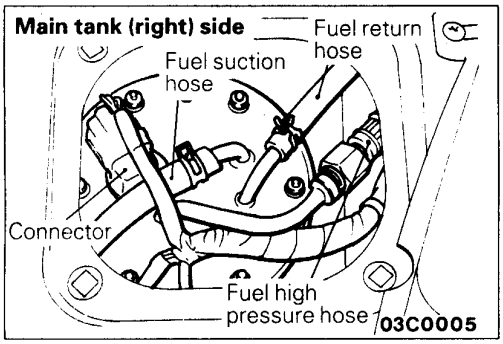
FUEL GAUGE UNIT REPLACEMENT E13FDAE

<2WD>

(1) Remove the rear seat.
(2) Remove the hole cover at the lower section of the rear seat.
(3) Remove the connector from the fuel gauge unit and remove the fuel gauge unit.
(4) When installing, align the positioning tabs on the packing with the holes in the fuel gauge unit.
(5) Install the hole cover.

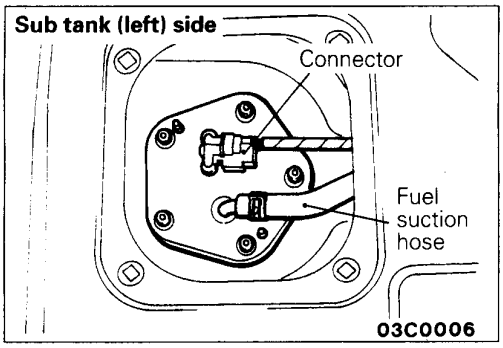
<4WD>

(1) Take the necessary measures to prevent fuel from flowing out. (Refer to P.13-29.)
(2) Remove the rear seat.
(3) Remove the hole covers at the lower section of the rear seat from both the main tank and sub tank.



MAIN TANK SIDE

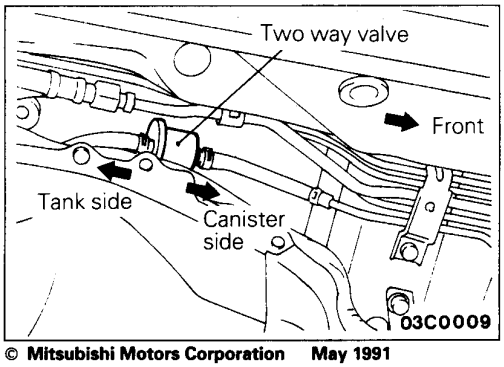
① Disconnect the high-pressure fuel hose connection.
② Remove the fuel return hose and fuel suction hose connections and connectors, and then remove the fuel gauge and pump assembly.



SUB TANK SIDE

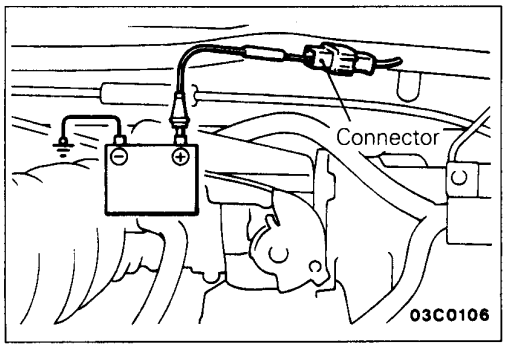
Remove the fuel suction hose and connector, and then remove the fuel gauge unit.

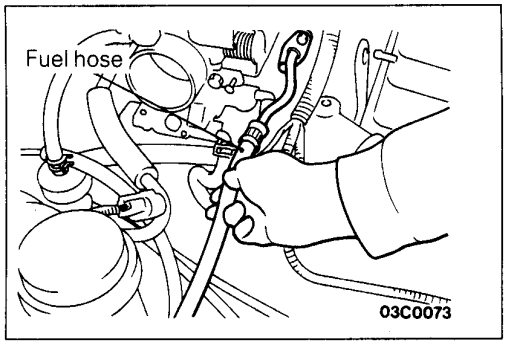
(4) After installation, check that there are no fuel leaks.
① Apply battery voltage to the fuel pump drive terminal to operate the fuel pump. (Refer to P.13-29.)
② Check for leaks when fuel pressure is applied.
(5) Install both hole covers.



TWO-WAY VALVE REPLACEMENT E13FFAE

(1) Remove the two-way valve.
(2) Install so that the installation direction of the two-way valve is correct.





FUEL PUMP OPERATION CHECK E13FGCD

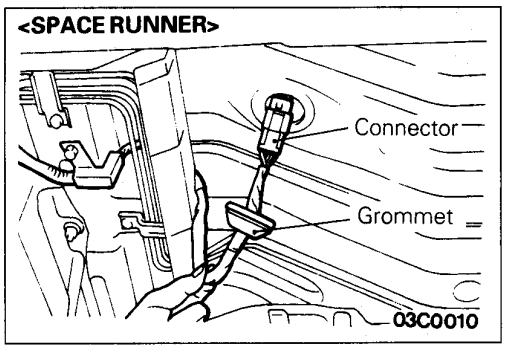
(1) Check the operation of the fuel pump by using the multi-use tester to force-drive the fuel pump.
(2) If the fuel pump will not operate, check by using the following procedure, and if it is normal, check the drive circuit.
   ① Turn the ignition switch to OFF.
   ② When the fuel pump drive connector (black) is attached directly to the battery, check if the sound of the fuel pump operation can be heard.

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

   ③ Check the fuel pressure by pinching the fuel hose with the fingertips.

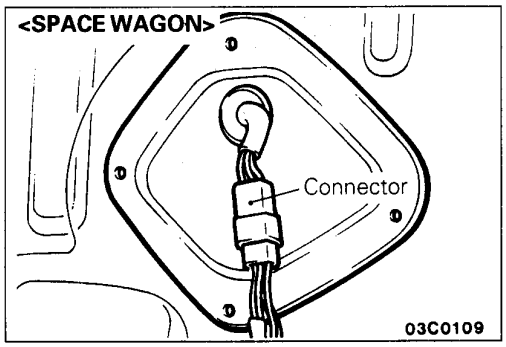
FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE THE FUEL PRESSURE) E13HABI

When removing the fuel pipe, hose, etc., since fuel pressure in the fuel pipe line is high, do the following operation so as to release fuel pressure in the line and prevent fuel from running out.



<SPACE RUNNER>

(1) Remove the grommet below the floor, and disconnect the fuel pump connector.
(2) After starting the engine and then letting it stop naturally, turn the ignition switch OFF.
(3) Connect the fuel pump connector.



<SPACE WAGON>

(1) Remove the rear seat and disconnect the fuel pump connector below the rear seat.
(2) After starting the engine and then letting it stop naturally, turn the ignition switch OFF.
(3) Connect the fuel pump connector.

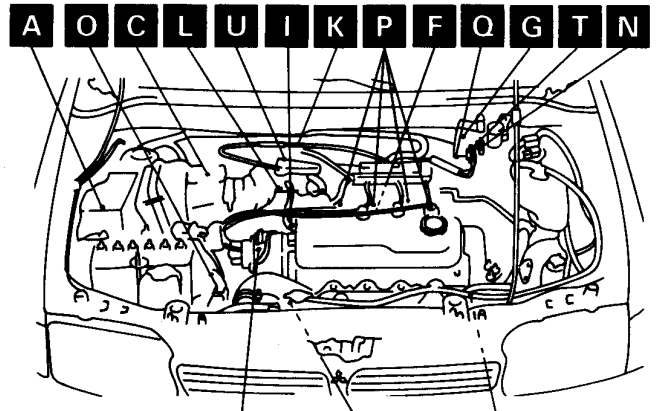
ON VEHICLE INSPECTION OF MPI COMPONENTS

E13QAAF

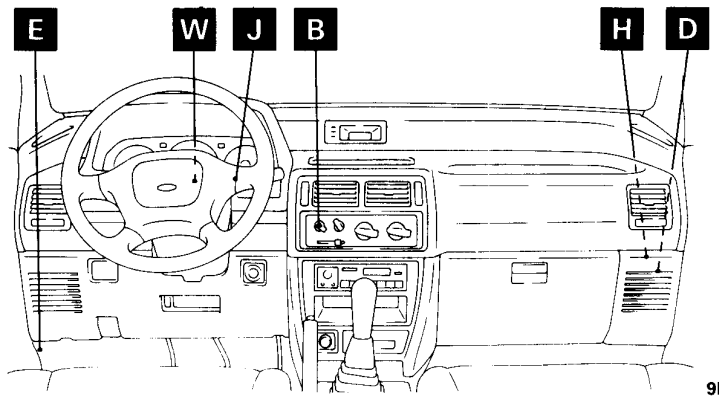
COMPONENTS LOCATION

Name	Symbol	Name	Symbol
Air conditioner relay	A	Idle speed control servo	L
Air conditioner switch	B	Ignition coil (power transistor)	M
Air flow sensor (with incorporated intake air temperature sensor and barometric pressure sensor)	C	Ignition timing adjustment terminal	N
		Inhibitor switch (A/T)	O
Control relay	D	Injector	P
Diagnosis connector	E*1	Mixture adjusting screw (variable resistor)	Q*2
Detonation sensor	F	Oxygen sensor	R*1
EGR control solenoid valve	G*2	Power steering fluid pressure switch	S
Engine control unit	H	Purge control solenoid valve	T*1
Engine coolant temperature sensor	I	Throttle position sensor (with idle position switch)	U
Engine warning lamp (check engine lamp)	J	Top dead centre sensor and crank angle sensoror	V
Fuel pump check terminal	K	Vehicle speed sensor (reed switch)	W

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter



9FU0005



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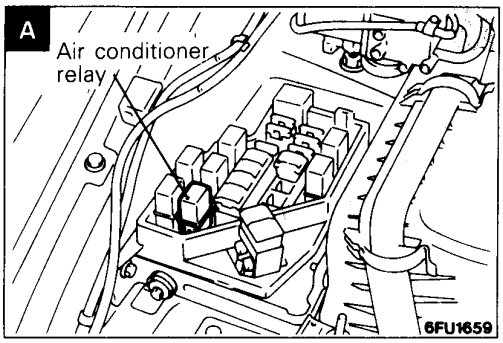

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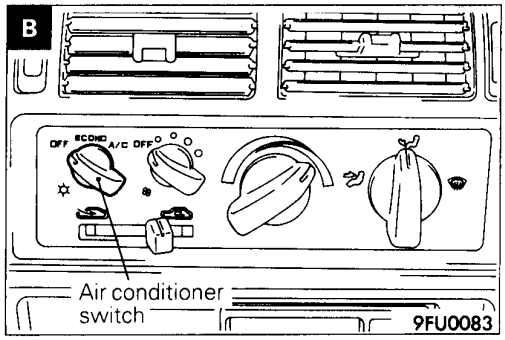

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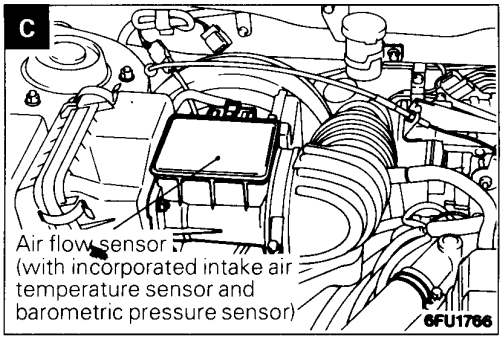

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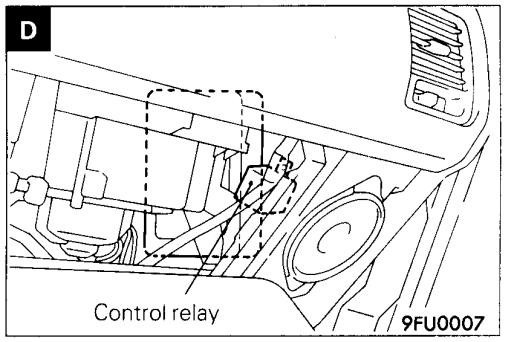

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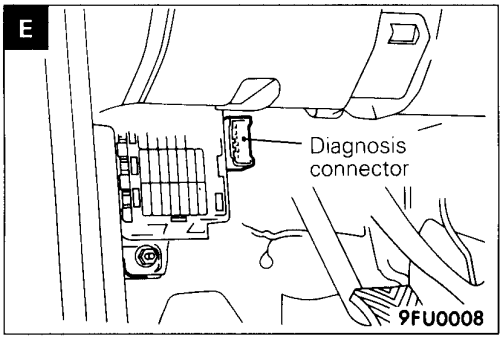

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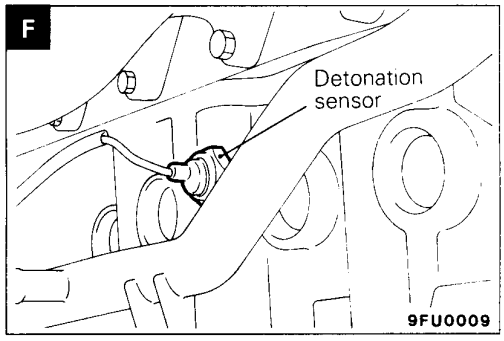

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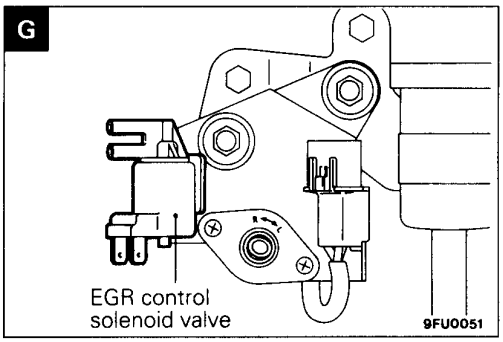

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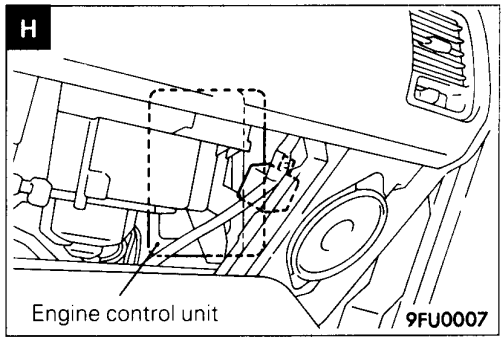

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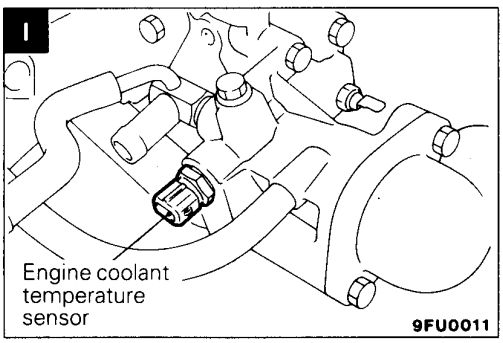

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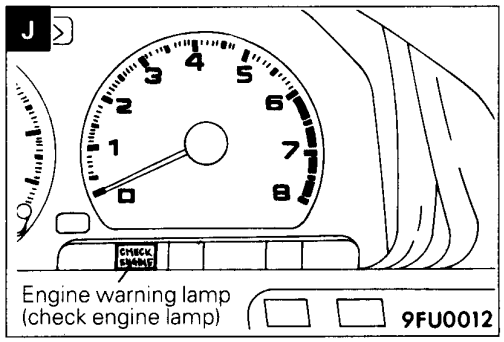

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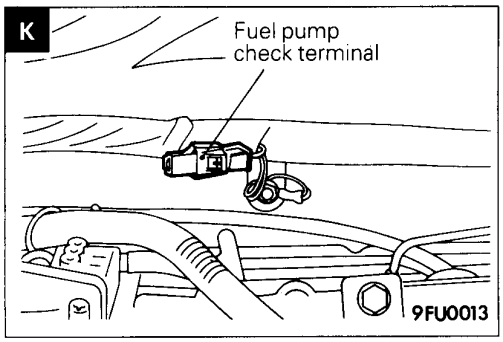

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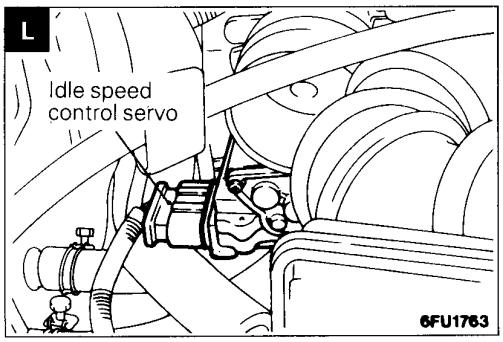

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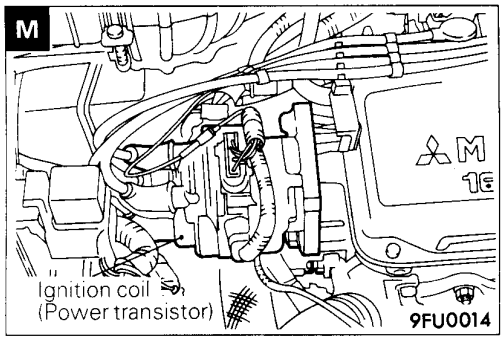

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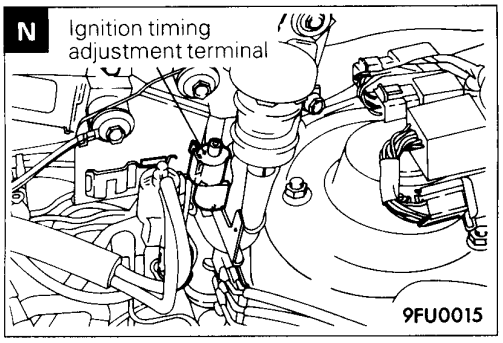

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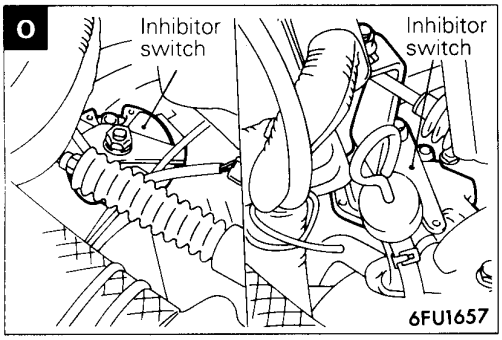

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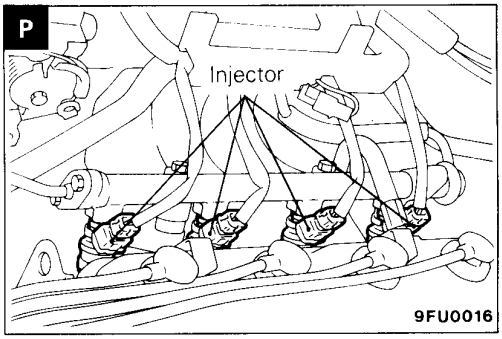

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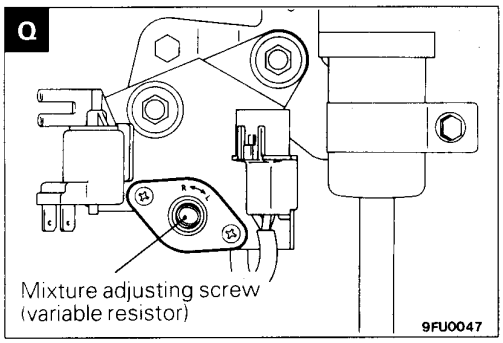

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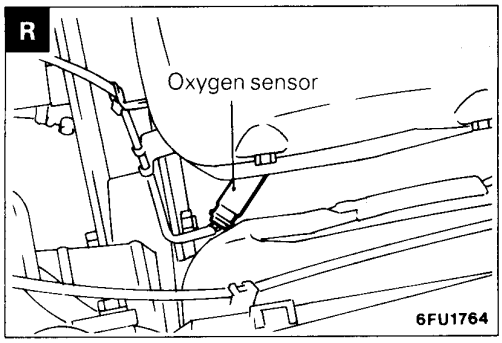

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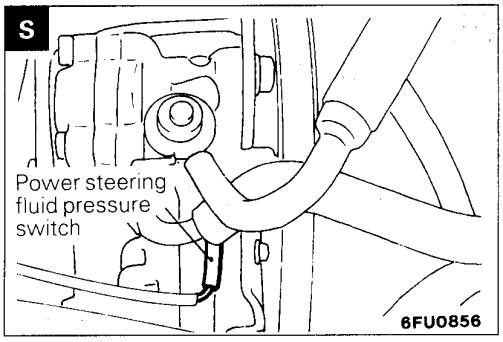

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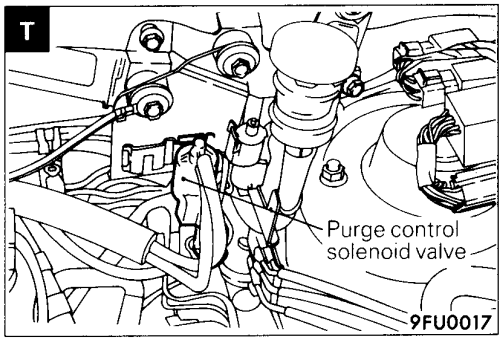
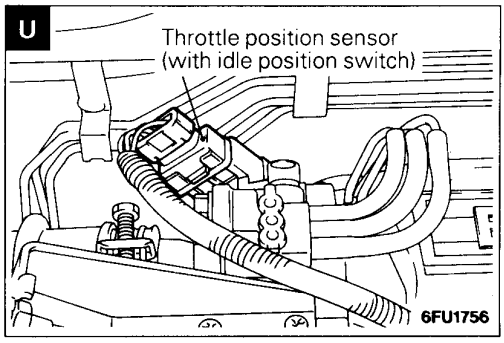
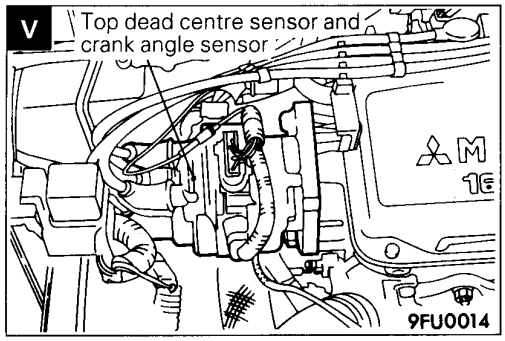
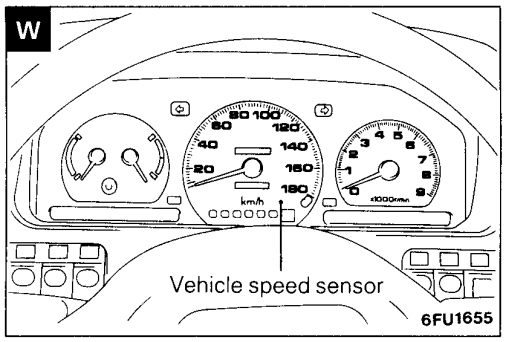
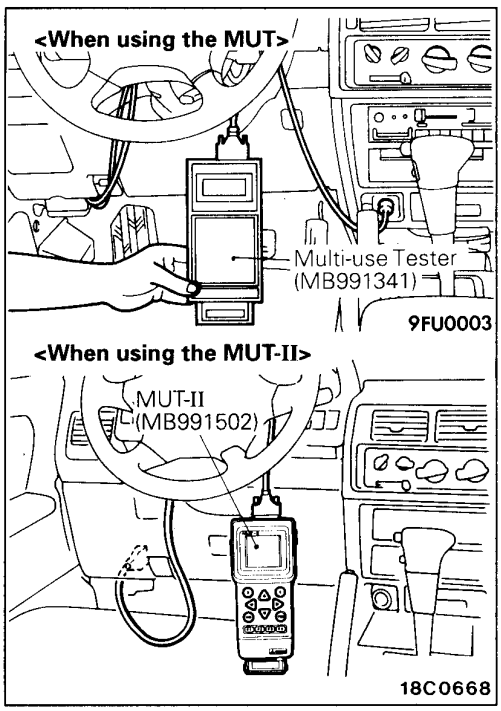










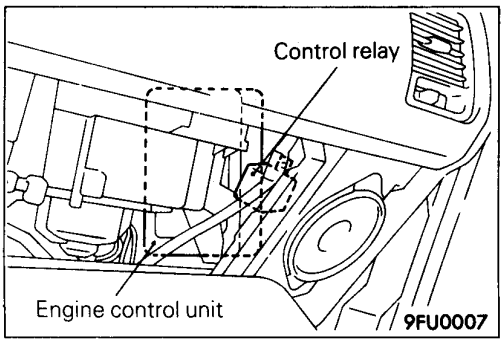
INSPECTION PROCEDURE USING THE MULTI-USE TESTER (MUT) <Up to 1993 models> OR MUT-II <All models>

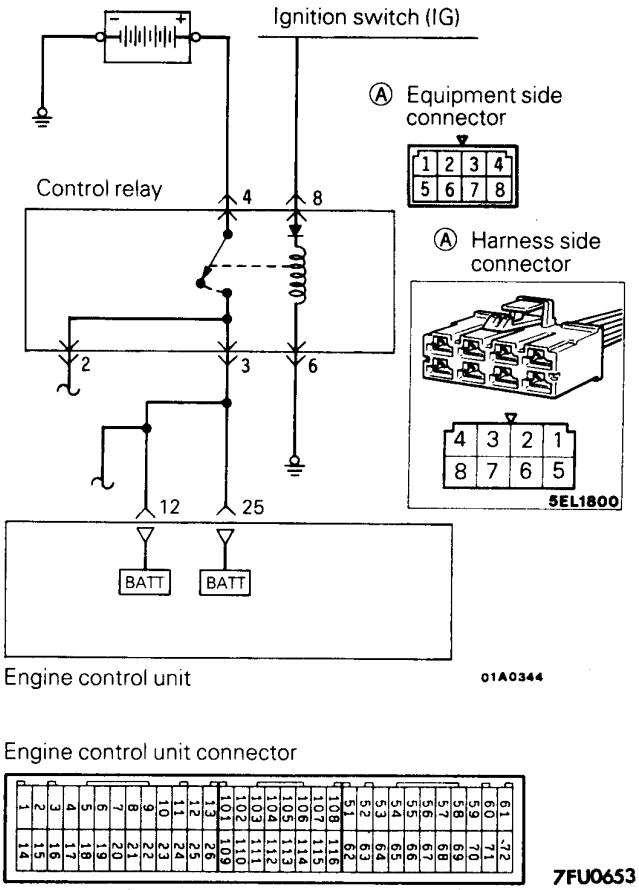
(1) Connect the MUT or MUT-II to the diagnosis connector.

NOTE
When connecting the MUT-II to vehicles built up to 1993, use the adaptor harness which is supplied as an accessory to the MUT-II sub-assembly.

(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 or MUT-II 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 or MUT-II.
(6) Start the engine and perform running test, etc. to make sure that the troubles have been corrected.

POWER SUPPLY





Engine control unit connector

OPERATION

- While the ignition switch is ON, battery power is supplied to the engine control unit, the injector, the air flow sensor, etc.
- When the ignition switch is turned ON, 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.

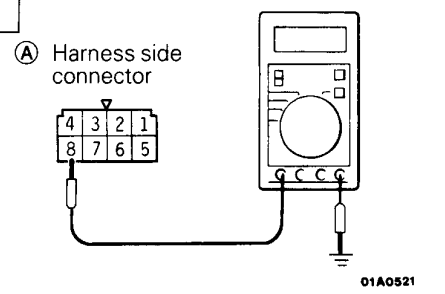
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

HARNESS INSPECTION

1

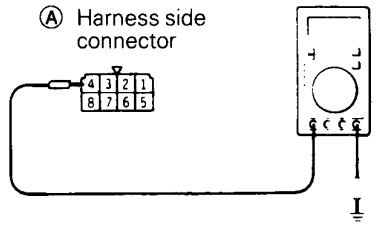


Measure the power supply voltage of the control relay.
- Control relay connector: Disconnected

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

OK → 2
Repair the harness. (Ignition switch – Ⓐ8) or check the Ignition switch.

2

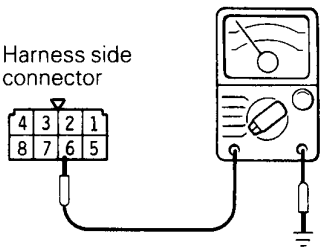


Measure the power supply voltage of the control relay.
- Control relay connector: Disconnected

Voltage (V)
SV

OK → 3
Repair the harness. (Battery – Ⓐ4)

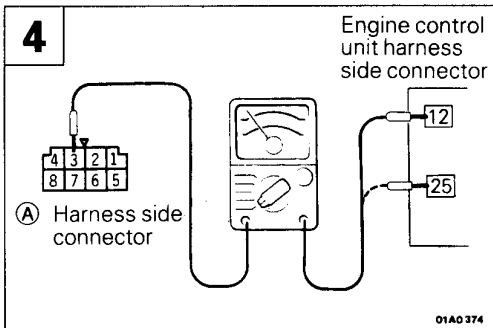
3



Check for continuity of the earth circuit.
- Control relay connector: Disconnected

OK → 4
Repair the harness. (Ⓐ6 – Earth)

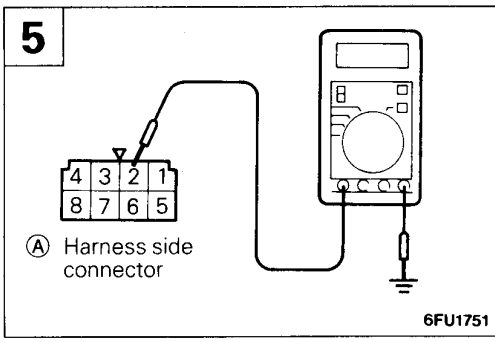
4



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 – Ⓐ3) (25 – Ⓐ3)

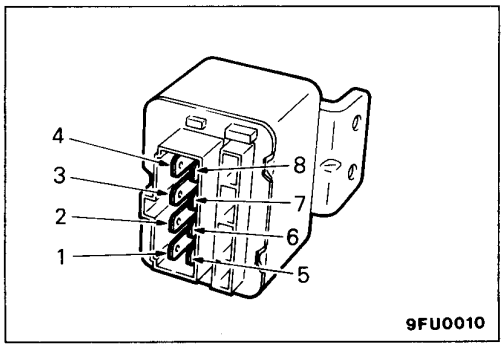
5



Measure the power voltage to the actuator.
- Control relay connector: Connected
- ECU connector: Connected

Engine	Voltage [V]
Cranking	8V or more
Racing	SV

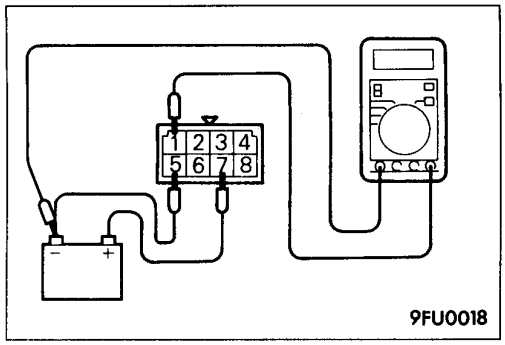
OK → STOP
Replace the control relay.



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

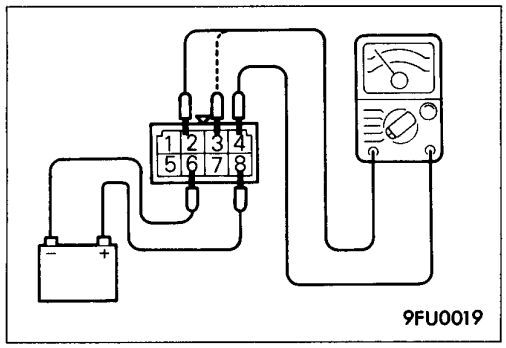


(3) Use jumper leads to connect control relay terminal ⑦ to the battery (+) terminal and terminal ⑤ to the battery (–) terminal.

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

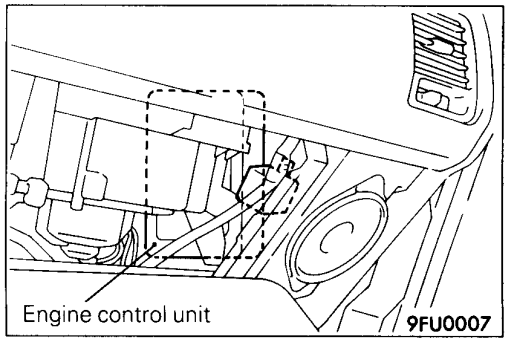


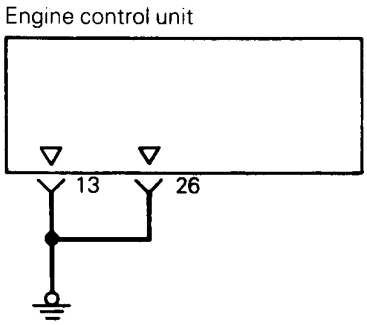
(5) Use the jumper leads to connect control relay terminal ⑧ to the battery (+) terminal and terminal ⑥ to the battery (–) terminal.
(6) Check the continuity between control relay terminals ② – ④ and terminals ③ – ④ while connecting and disconnecting the jumper lead at the battery (–) terminal.

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





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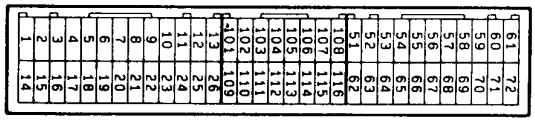
Engine control unit connector



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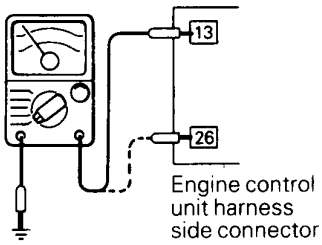
OPERATION

Earth the engine control unit

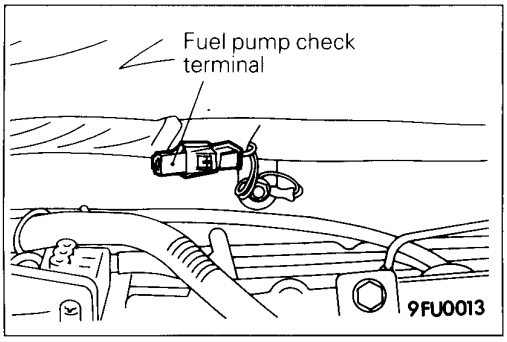
TROUBLESHOOTING HINTS

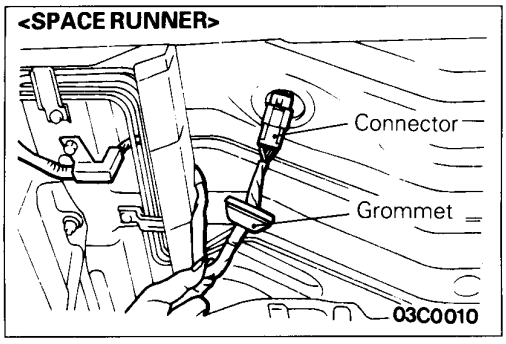
If the earth wire of the engine control unit is not connected securely to earth, the unit will not operate correctly.

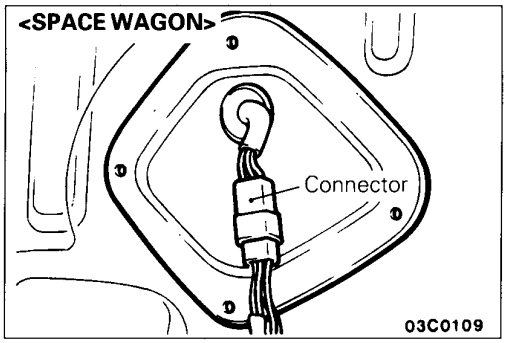
HARNESS INSPECTION

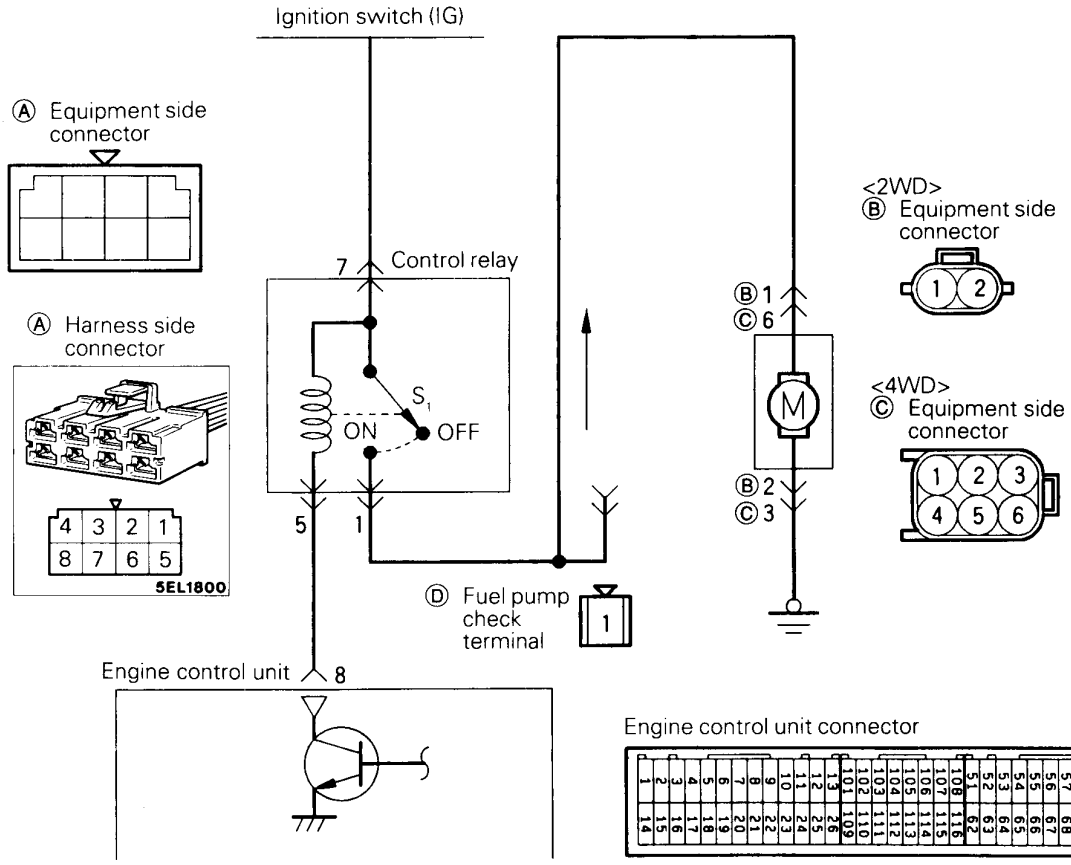
1	 01P0180	Check for continuity of the earth circuit. • Connector: Disconnected	OK → STOP NG → Repair the harness. (13 – Earth) (26 – Earth)

FUEL PUMP









9FU0386

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.

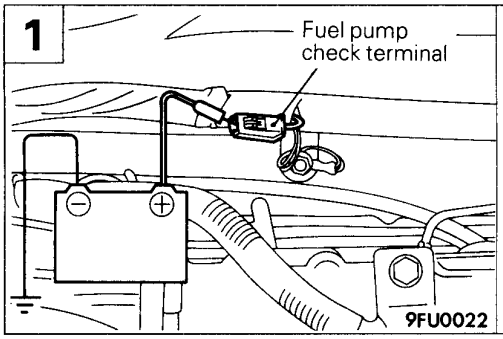
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

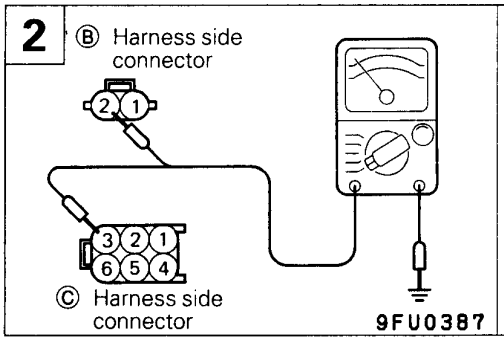


Check the fuel pump.
- Apply battery voltage to the checking terminal and operate the pump.

OK → 4

NG → 2

2

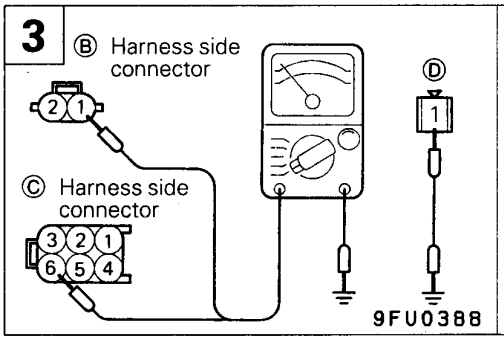


Check for continuity of the fuel pump earthing line.
- Fuel pump connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓑ2 – Earth) (Ⓒ3 – Earth)

3

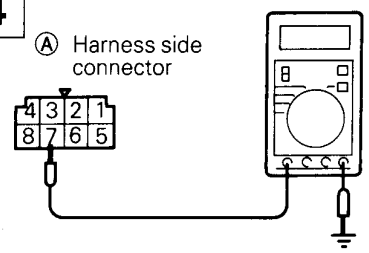


Check for open-circuit or short circuit between the fuel pump and the fuel pump drive terminal.
- Fuel pump connector: Disconnected
- Control relay connector: Disconnected

OK → 4

NG → Repair the harness. (Ⓑ1 – Ⓓ1) (Ⓒ6 – Ⓓ1)

4



Measure the power supply voltage of the control relay.

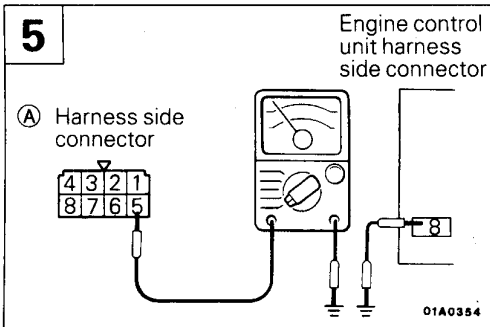
- Control relay connector: Disconnected

Ignition switch	Voltage (V)
OFF	0
START	8V or more

OK → 5

Repair the harness. (Ignition switch – Ⓐ7) or check for ignition switch.

5



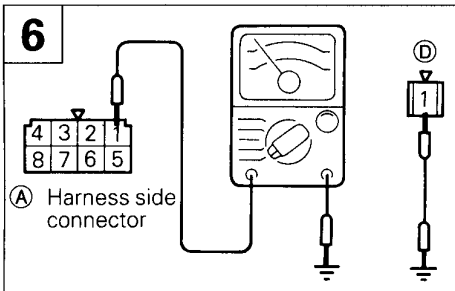
Check for an open-circuit, or a short-circuit to earth between the control relay and the engine control unit.

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

OK → 6

Repair the harness. (Ⓐ5 – 8)

6



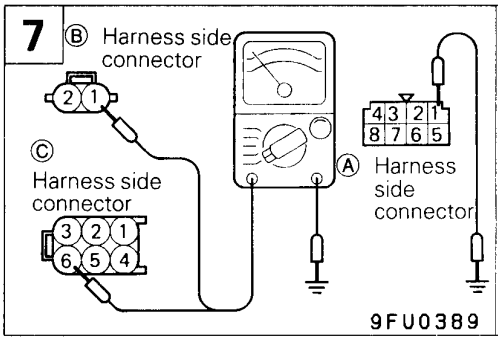
Check for continuity between the fuel pump checking terminal and between the control relay terminals.

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

OK → 7

Repair the harness. (Ⓐ1 – Ⓓ1)

7



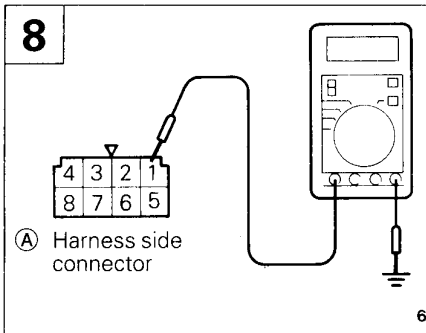
Check for an open-circuit, or short-circuit to earth between the control relay and the fuel pump.

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

OK → 8

Repair the harnes. (Ⓐ1 – Ⓑ1) (Ⓐ1 – Ⓒ6)

8



Measure the power supply voltage of the fuel pump.

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

Engine	Voltage [V]
Cranking	8V or more
Racing	SV

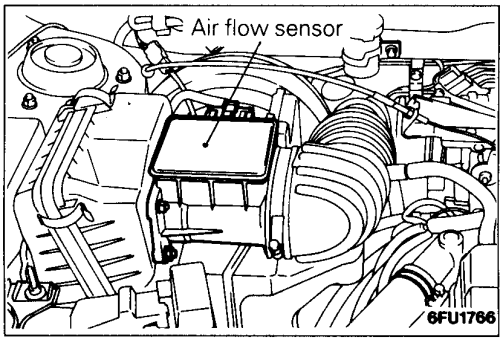
OK → STOP

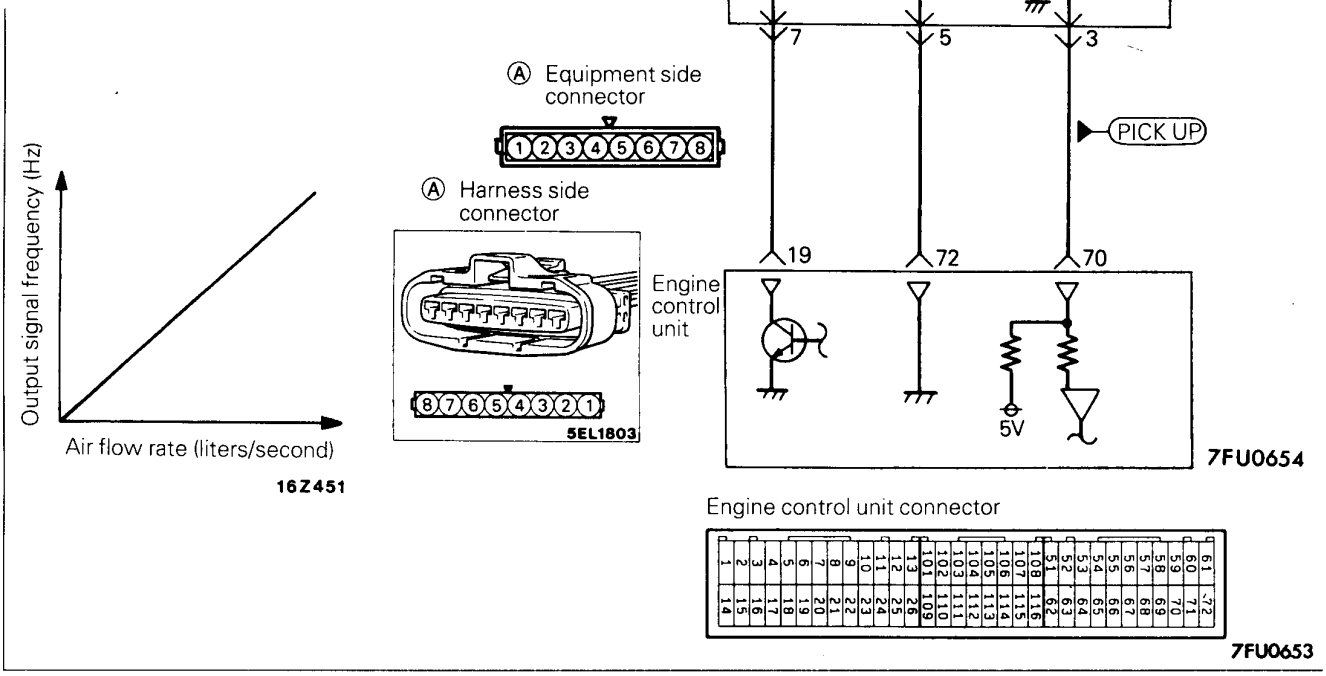
Control relay or engine control unit is defective.

CONTROL RELAY INSPECTION

Refer to P.13-36

AIR FLOW SENSOR





OPERATION

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

TROUBLESHOOTING HINTS

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

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

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

[Examples]

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

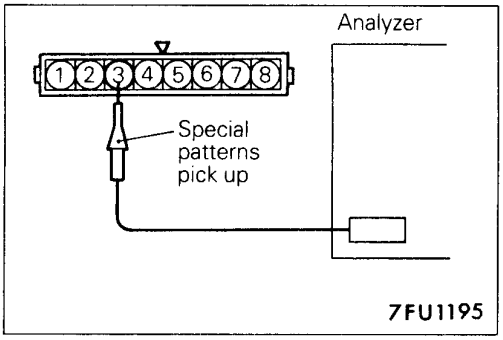
INSPECTION

Using Multi-use Tester (MUT) or MUT-II
<Air Flow sensor>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	12	Sensor air volume (frequency)	• Engine coolant temperature: 80 to 95°C (176 to 203°F) • Lamps, electric cooling fan, accessories: OFF • Transmission: Neutral (P range for A/T) • Steering wheel: Neutral	800 r/min.*1 700 r/min.*2 (Idle)	27 – 53 Hz
				2,000 r/min.	55 – 95 Hz
				Racing	Frequency increases with racing

NOTE
1. When the vehicle is new [within initial operation of about 500 km (300 miles)], the air flow sensor output frequency may be about 10% higher.
2. *1: Vehicles with catalytic converter
   *2: Vehicles without catalytic converter

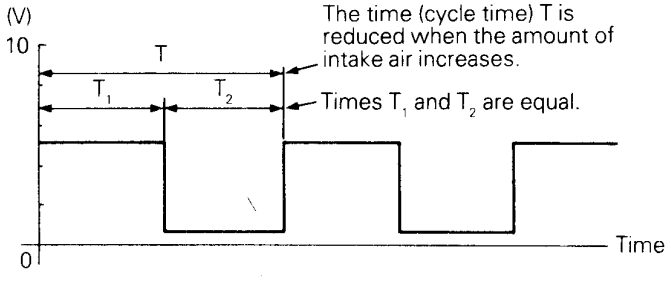
Wave Pattern Inspection Using an Analyzer



Measurement Method

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

Standard wave pattern

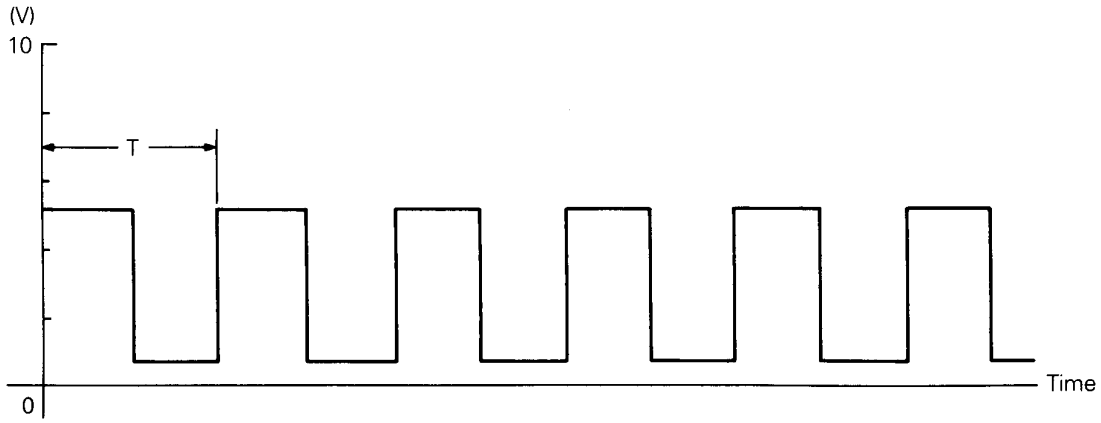


Observation conditions

Function	Special patterns
Pattern height	Low
Pattern Selector	Display
Engine r/min	Idle speed (800 r/min.*1 / 700 r/min.*2)

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter

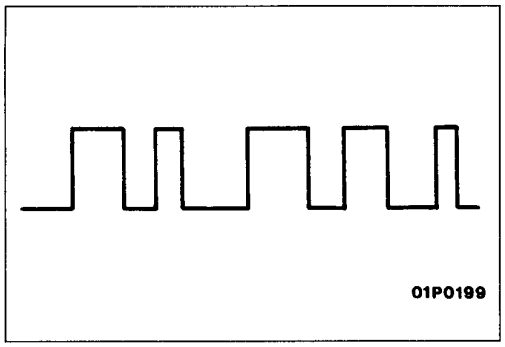
Observation conditons (from conditions above engine speed is increased by racing.)



7FU0880

Wave pattern observation points

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



Examples of abnormal wave patterns

- Example 1

  Cause of problem

  Sensor interface malfunction

  Wave pattern characteristics

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

- Example 2

  Cause of problem

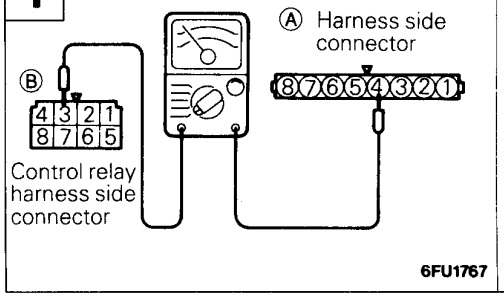
  Damaged rectifier or vortex generation column

  Wave pattern characteristics

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

HARNESS INSPECTION

1



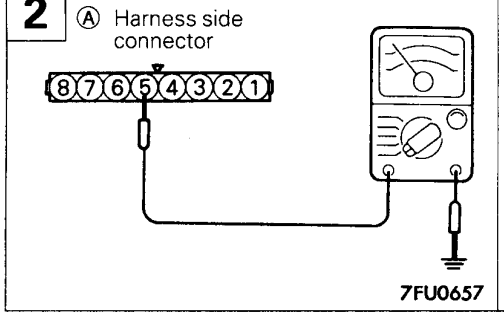
Check for continuity between air flow sensor and control relay.
- Control relay connector: Disconnected
- Air flow sensor connector: Disconnected

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

OK → 2

NO → Repair the harness (Ⓐ4 – Ⓑ3)

2

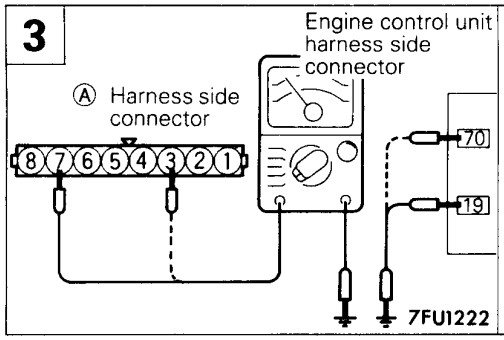


Check for continuity of the earth circuit.
- Air flow sensor connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ5 – 72)

3

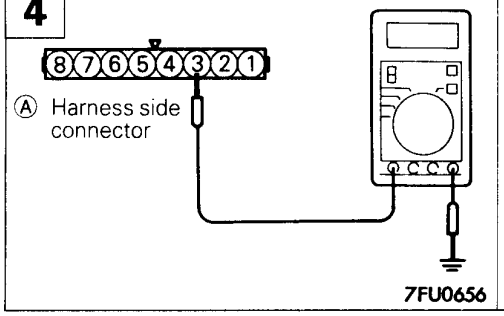


Check for broken wire or short-circuit to earth, between air flow sensor and engine control unit.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 4

NO → Repair the harness. (Ⓐ3 – 70) (Ⓐ7 – 19)

4



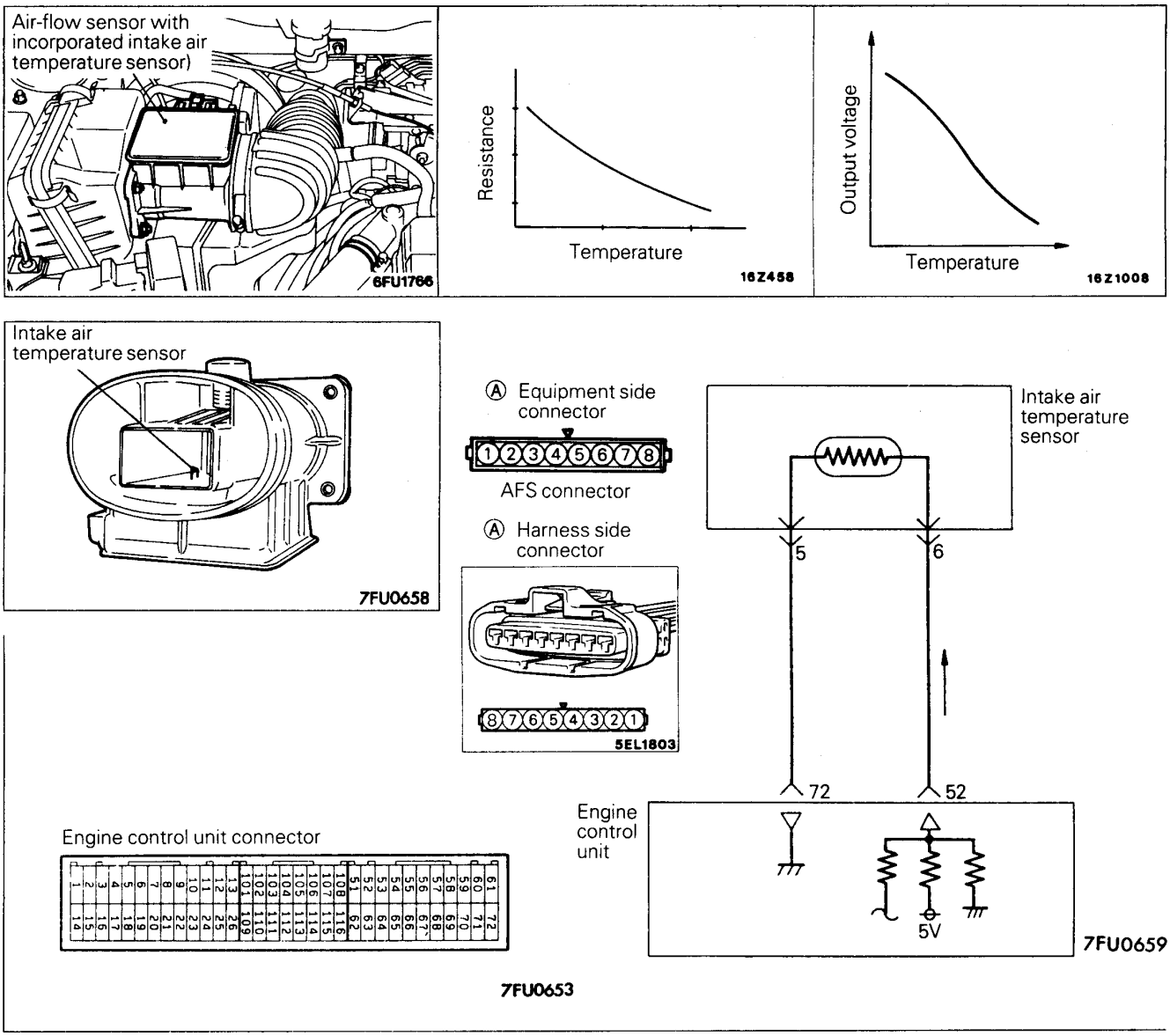
Measure the impressed voltage.
- Airflow sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.8 – 5.2

OK → STOP

NO → Replace the engine control unit.

INTAKE AIR TEMPERATURE SENSOR



OPERATION

- The intake air temperature sensor converts the engine intake air temperature into a voltage and inputs it to the engine control unit, which then corrects the fuel injection rate, etc. based on the input signal.
- The 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 cleaner so that it may indicate a temperature different from outside temperature depending on engine operating state.

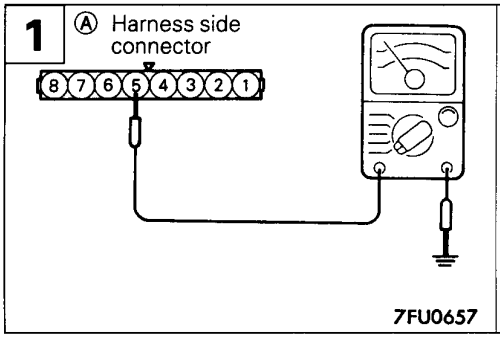
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

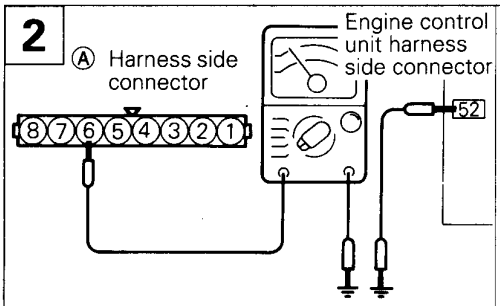


Check for continuity of the earth circuit.
- Air flow sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ5 – 72)

2

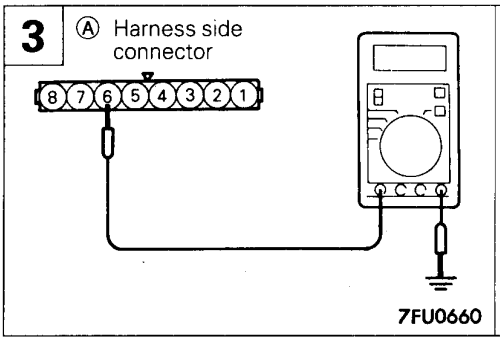


Check for open circuit or short-circuit to earth, between intake air temperature sensor and engine control unit.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ6 – 52)

3

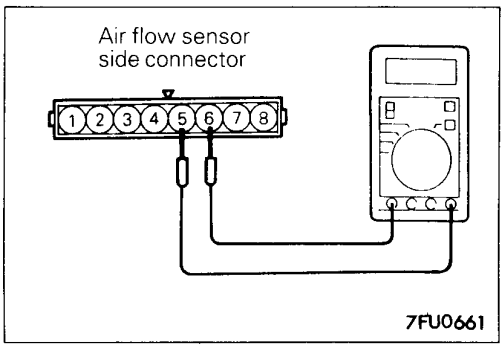


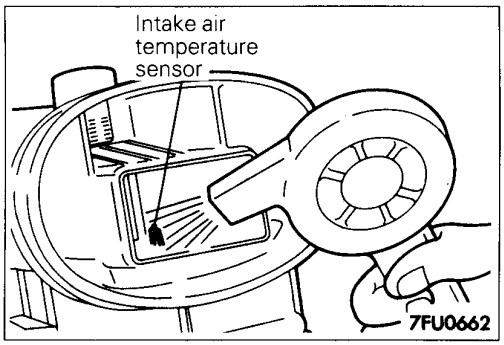
Measure the impressed voltage.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.5 – 4.9

OK → STOP

NG → Replace the engine control unit.





SENSOR INSPECTION

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

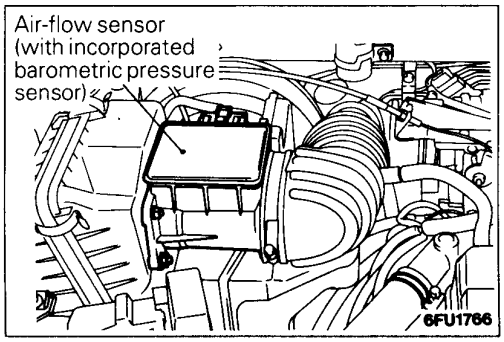
Temperature [°C (°F)]	Resistance (kΩ)
0 (32)	6.0
20 (68)	2.7
80 (176)	0.4

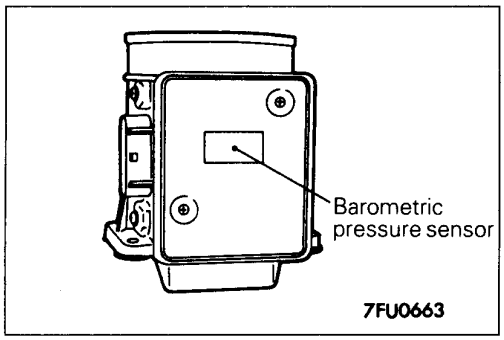
(3) Measure resistance while heating the sensor using a hair drier.

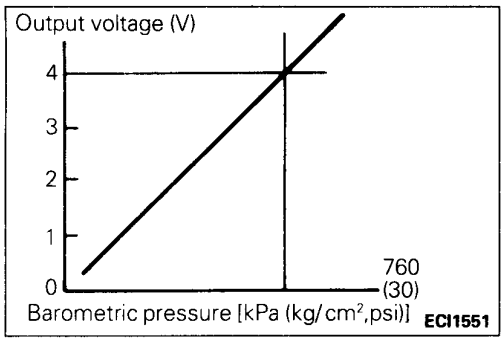
Temperature [°C (°F)]	Resistance (kΩ)
Higher	Smaller

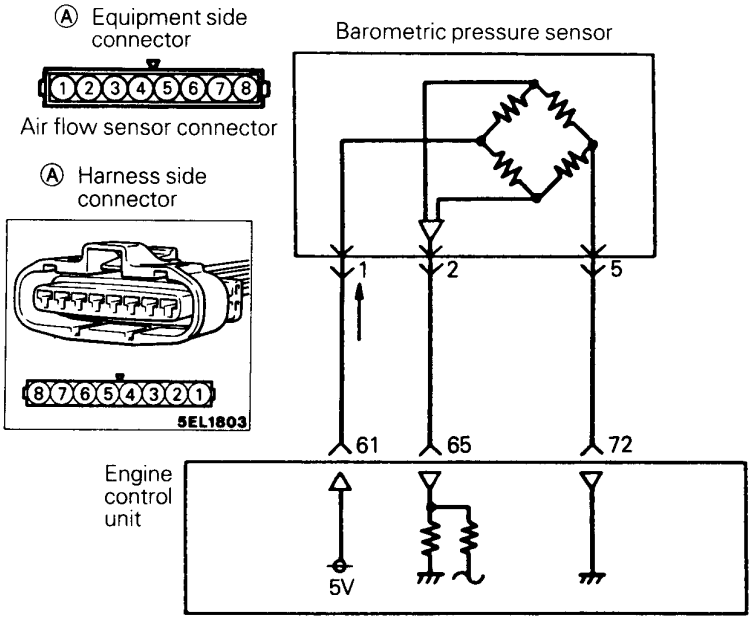
(4) If the value deviates from the standard value or the resistance remains unchanged, replace the air flow sensor assembly.

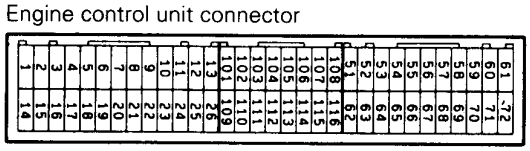
BAROMETRIC PRESSURE SENSOR











OPERATION

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

TROUBLESHOOTING HINTS

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

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

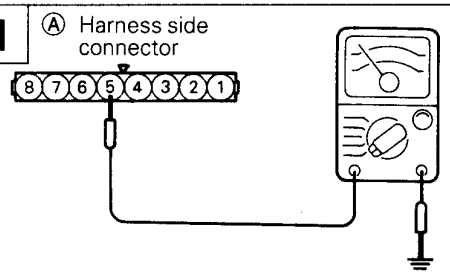
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

HARNESS INSPECTION

1 Ⓐ Harness side connector



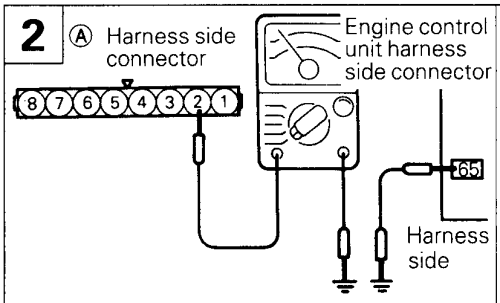
7FU0657

Check for continuity of the earth circuit.
- Air flow sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ5 – 72)

2 Ⓐ Harness side connector



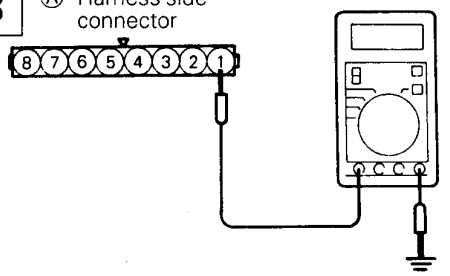
7FU0666

Check for an open-circuit, or a short-circuit to earth between the engine control unit and the barometric pressure sensor.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ2 – 65)

3 Ⓐ Harness side connector



7FU0665

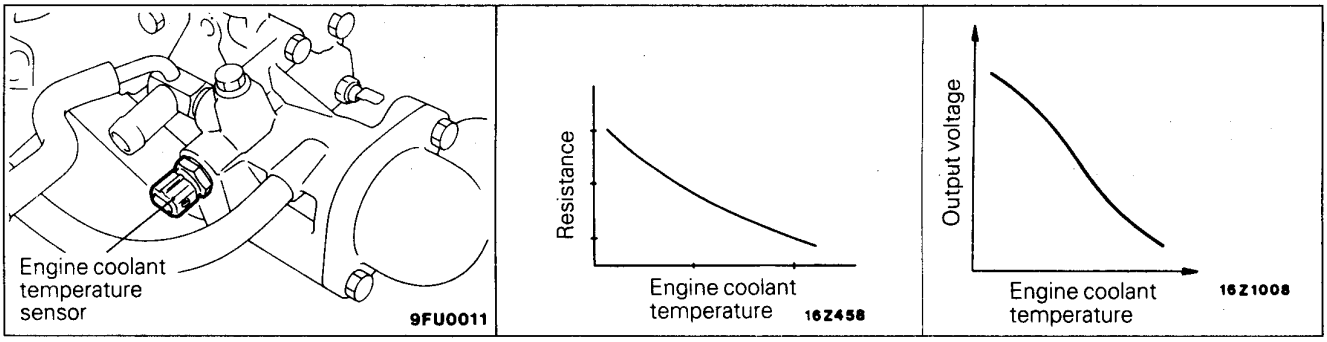
Measure the impressed voltage of the barometric pressure sensor.
- Air flow sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

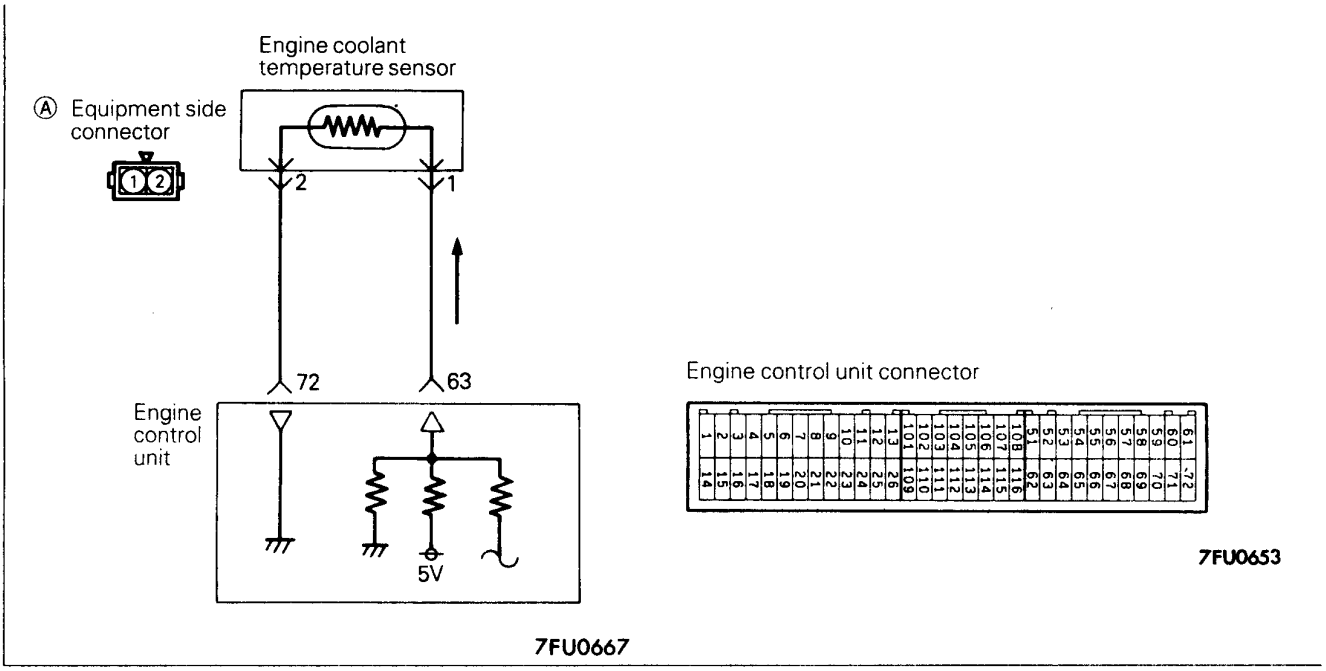
Voltage (V)
4.8 – 5.2

OK → STOP

NG → Replace the engine control unit.

ENGINE COOLANT TEMPERATURE SENSOR





OPERATION

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

TROUBLESHOOTING HINTS

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

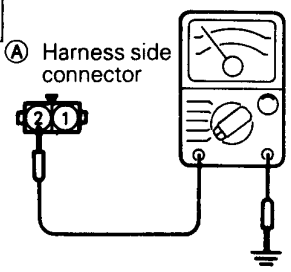
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Coolant temperature	Standard value
Data reading	21	Sensor temperature	Ignition switch: ON or engine operating	–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



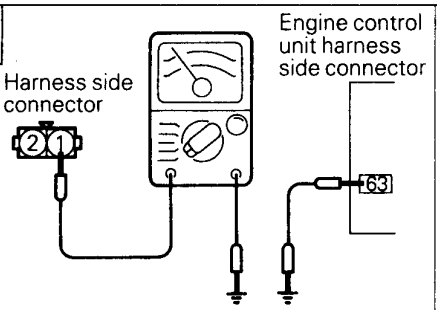
7FU0668

Check for continuity of the earth circuit.
- Engine coolant temperature sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ2 – 72)

2



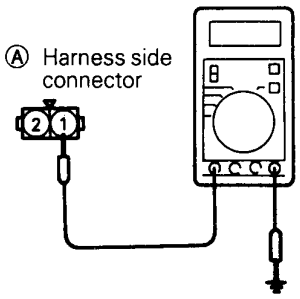
7FU1225

Check for open circuit, or short-circuit to earth, between engine coolant temperature and engine control unit.
- Engine coolant temperature connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ1 – 63)

3



7FU0669

Measure the impressed voltage.
- Engine coolant temperature sensor connector: Disconnected
- Engine control unit connector: connected
- Ignition switch: ON

Voltage (V)
4.5 – 4.9

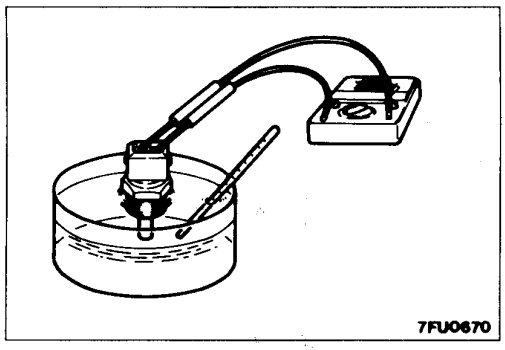
OK → STOP

NG → Replace the engine control unit.

SENSOR INSPECTION

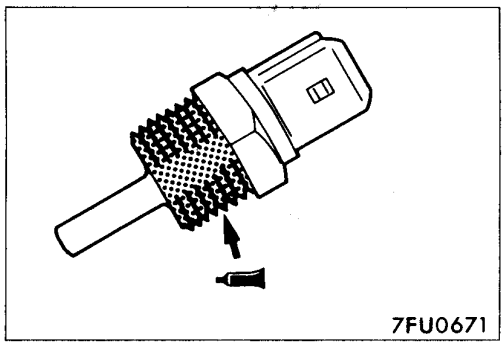
Caution
Be careful not to touch the tool against the connector (resin section) when removing and installing.

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



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

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



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

INSTALLATION

(1) Apply sealant to threaded portion.

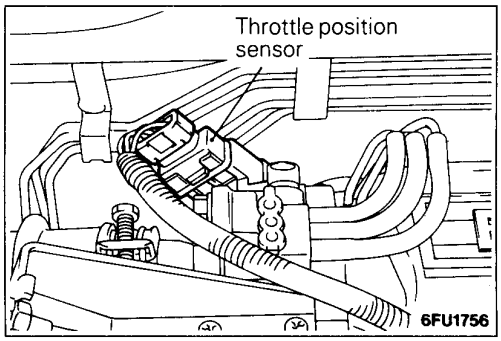
Specified sealant: 3M NUT locking Part No. 4171 or equivalent

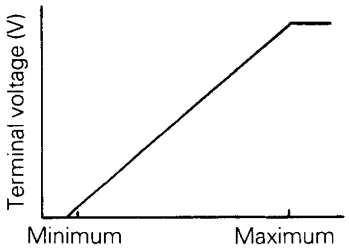
(2) Install engine coolant temperature sensor and tighten it to specified torque.

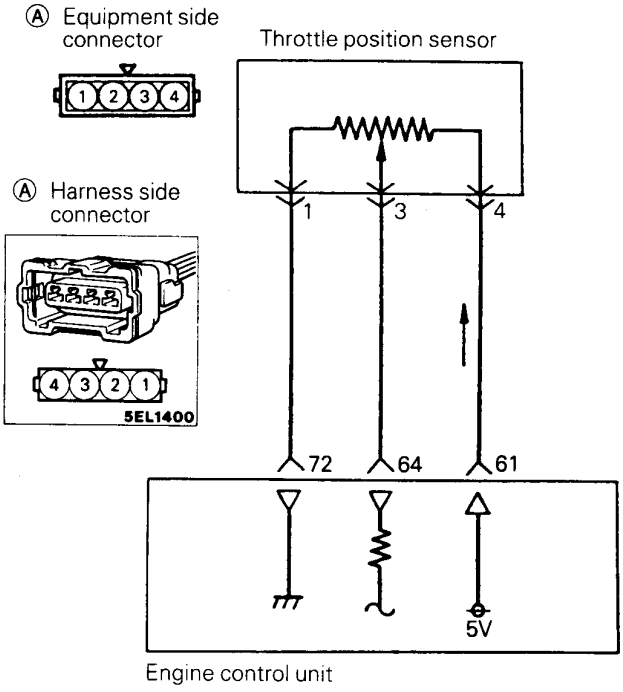
Sensor tightening torque: 30 Nm (3 kgm, 22 ft. lbs.)

(3) Fasten harness connectors securely.

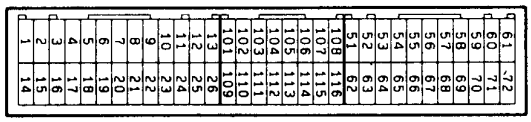
THROTTLE POSITION SENSOR







Engine control unit connector



7FU0653

7FU0672

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.

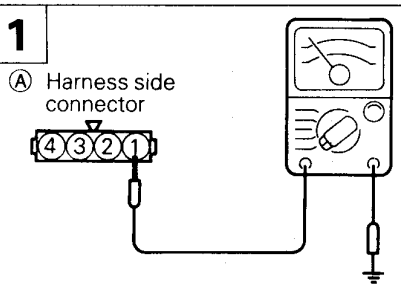
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Throttle valve	Standard value
Data reading	14	Sensor voltage	Ignition switch: Held ON for 15 sec. or more	At idle position	300 – 1000 mV
				Open slowly	Increases with valve opening
				Open widely	4,500 – 5,500 mV

HARNESS INSPECTION

1



6FU1671

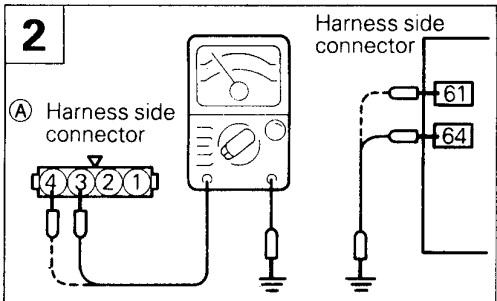
Check for continuity of the earth circuit.

- Throttle position sensor connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ1 – 72)

2



6FU1773

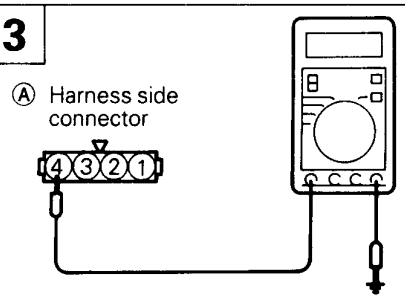
Check for an open-circuit, or a short-circuit to earth between the engine control unit and the throttle position sensor.

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

OK → 3

NG → Repair the harness. (Ⓐ3 – 64) (Ⓐ4 – 61)

3



6FU1670

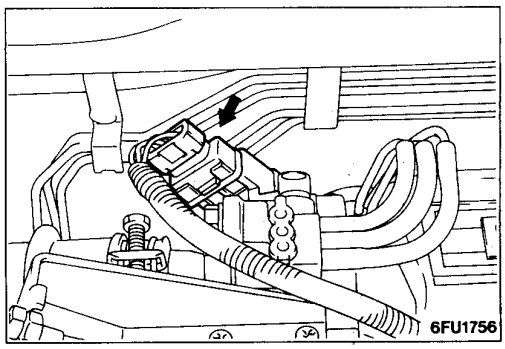
Measure the impressed voltage of the throttle position sensor.

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

Voltage (V)
4.8 – 5.2

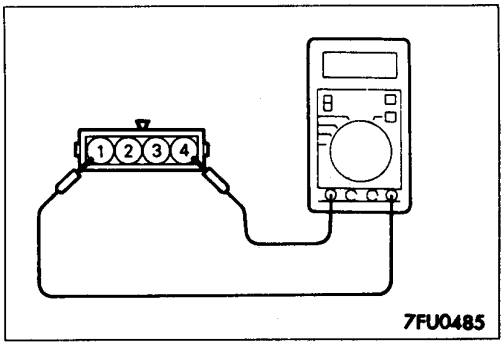
OK → STOP

NG → Replace the engine control unit.



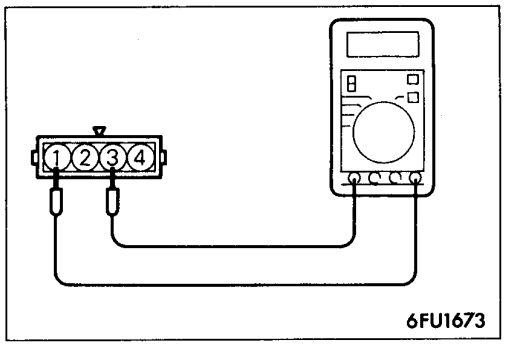
SENSOR INSPECTION

(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



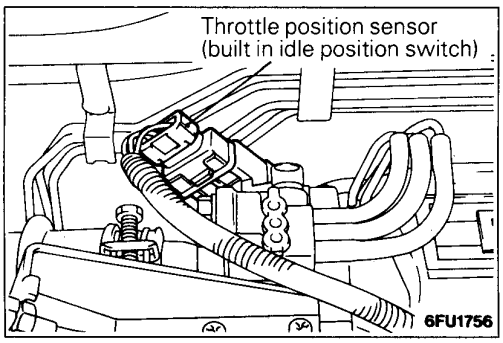
(3) Measure the resistance between the throttle position sensor side connector terminal ① and terminal ③.

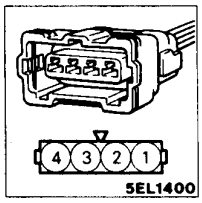
Throttle valve slowly opens until fully open from the idle position	Changes smoothly in proportion to the opening angle of the throttle valve

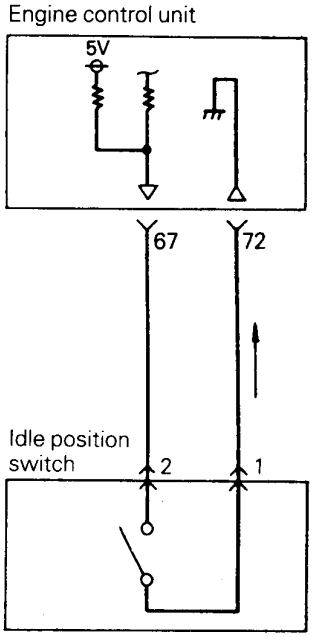
(4) If the resistance is outside the standard value, or if it doesn't change smoothly, replace the throttle position sensor.

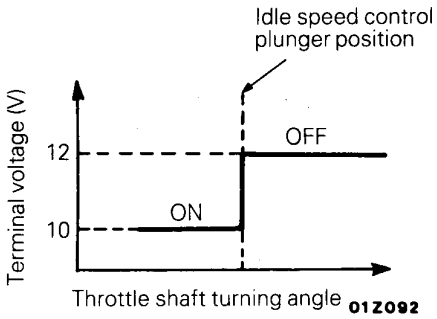
NOTE
For the throttle position sensor adjustment procedure, refer to P.13-23.

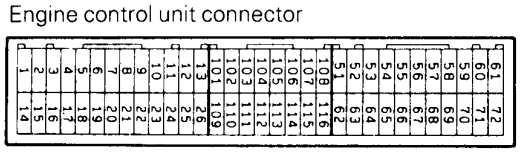
IDLE POSITION SWITCH











OPERATION

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

TROUBLESHOOTING HINTS

If the idle position switch harness and individual check results are normal but the idle position switch output is abnormal, the following troubles are suspected.
(1) Poorly adjusted accelerator cable
(2) Poorly adjusted fixed SAS

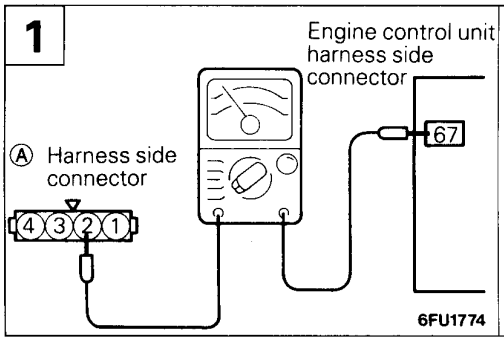
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

HARNESS INSPECTION

1

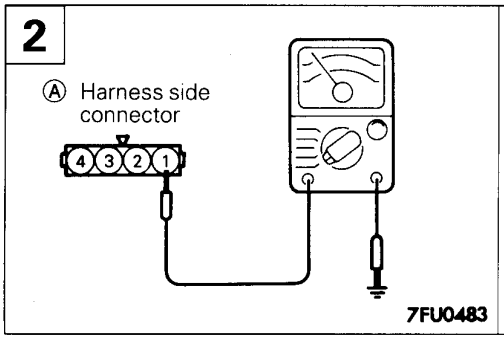


Check for open-circuit, or short-circuit to earth, between idle position switch and engine control unit.
- Engine control unit connector: Disconnected
- Idle position switch connector: Disconnected

OK → 2

NG → Repair the harness. (Ⓐ2 – 67)

2

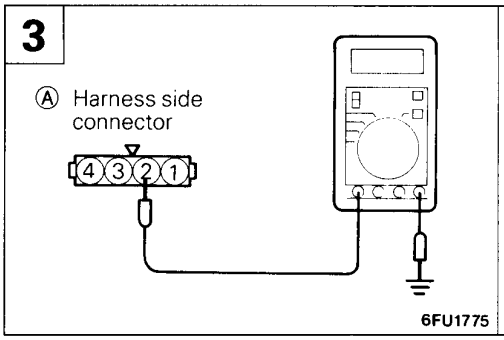


Check for continuity of the earth circuit.
- Idle position switch connector: Disconnected

OK → 3

NG → Repair the harness. (Ⓐ1 – 72)

3

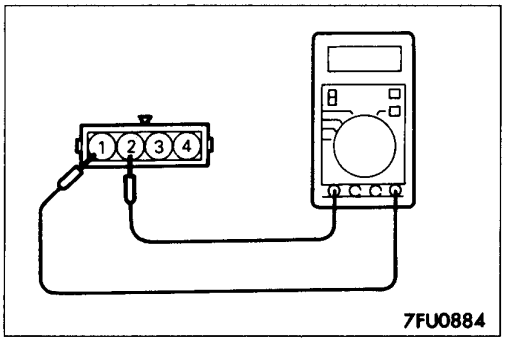


Measure the impressed voltage of the idle position switch.
- Connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4 or more

OK → STOP

NG → Replace the engine control unit.



SENSOR INSPECTION

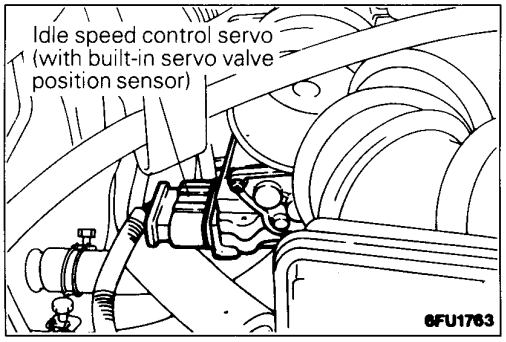
(1) Disconnect the throttle position sensor connector.
(2) Check the continuity between the throttle position sensor connector side terminal ① and terminal ②.

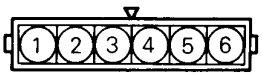
Accelerator pedal	Continuity
Depressed	Non-conductive (∞ Ω)
Released	Conductive (0 Ω)

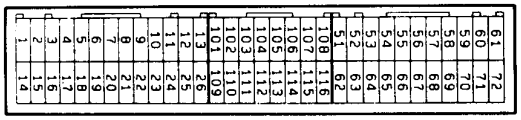
(3) If out of specification, replace the throttle position sensor.

NOTE
After replacement, the throttle position sensor and idle position switch should be adjusted. (Refer to P.13-23.)

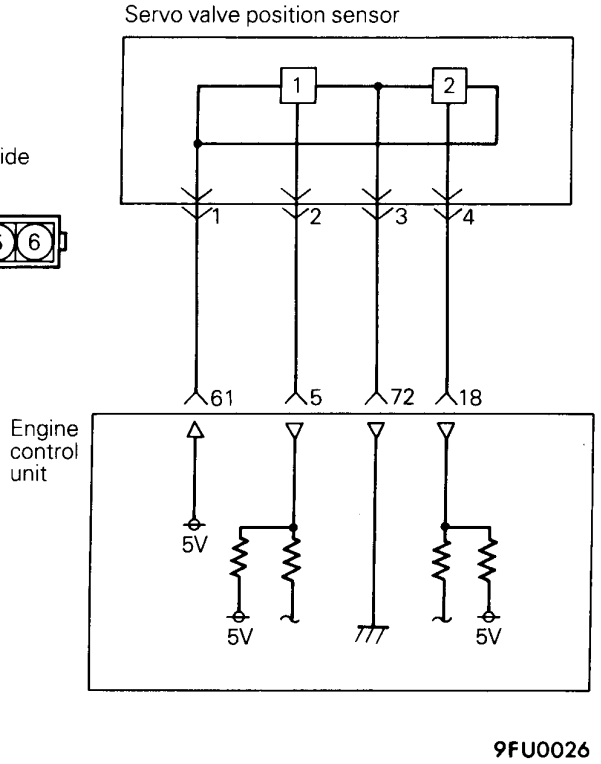
SERVO VALVE POSITION SENSOR







7FU0653



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 Multi-use Tester (MUT) or MUT-II

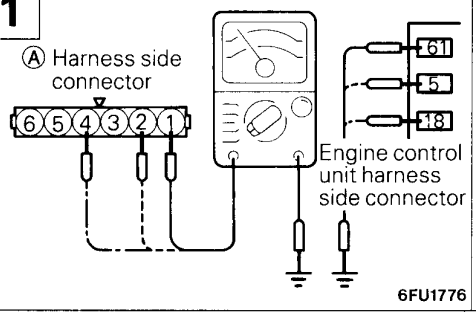
Function	Item No.	Data display	Check condition	Load state	Standard value
Data reading	55	Servo valve position step	• Engine coolant temperature: 80 to 95°C (176 to 203°F) • Lamps, electric cooling fan, accessories: OFF • Transmission: Neutral • Idle position switch: ON • Engine: At idle (Compressor clutch 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

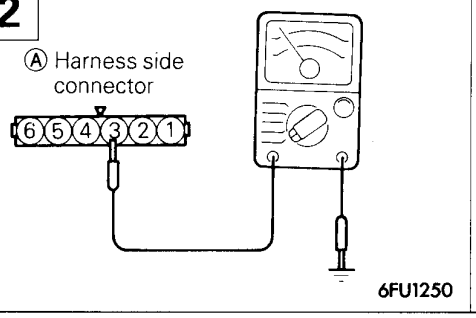


Check for open circuit, or short-circuit to earth, between engine control unit and servo valve position sensor.
- Engine control unit connector: Disconnected
- Servo valve position sensor connector: Disconnected

OK → 2

NO → Repair the harness (Ⓐ1 – 61) (Ⓐ2 – 5) (Ⓐ4 – 18)

2



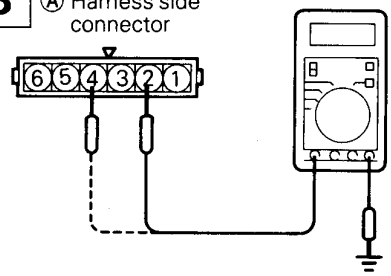
Check for continuity of the earth circuit.
- Servo valve position sensor connector: Disconnected

OK → 3

NO → Repair the harness (Ⓐ3 – 72)

3

Ⓐ Harness side connector



6FU1724

Measure the impressed voltage.

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

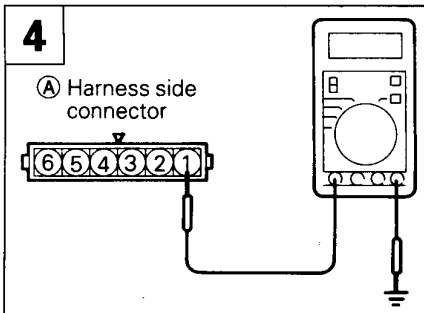
Voltage (V)
4.8 – 5.2

OK → 4

NG → Replace the engine control unit

4

Ⓐ Harness side connector



6FU1723

Measure the impressed voltage.

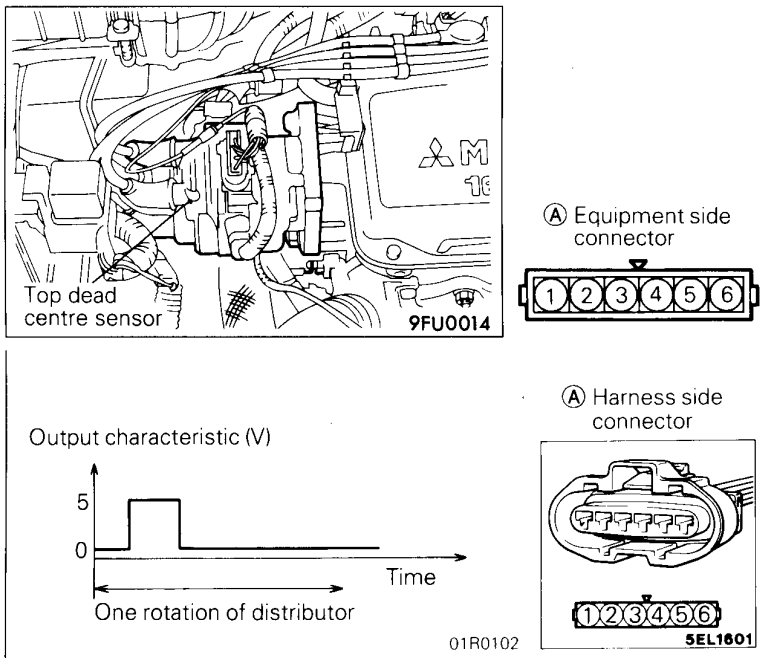
- Servo valve position sensor connector
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.8 – 5.2

OK → STOP

NG → Replace the engine control unit

TOP DEAD CENTRE SENSOR



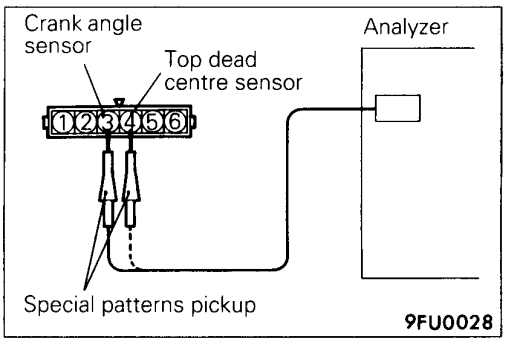
OPERATION

- 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 the earth is located in the engine control unit. A 5V voltage is applied from the engine control unit to the top dead centre sensor output terminal, and the top dead centre sensor generates a pulse signal as it switches from OPEN to SHORT (power transistor inside the sensor switches ON/OFF) between the output terminal and the 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

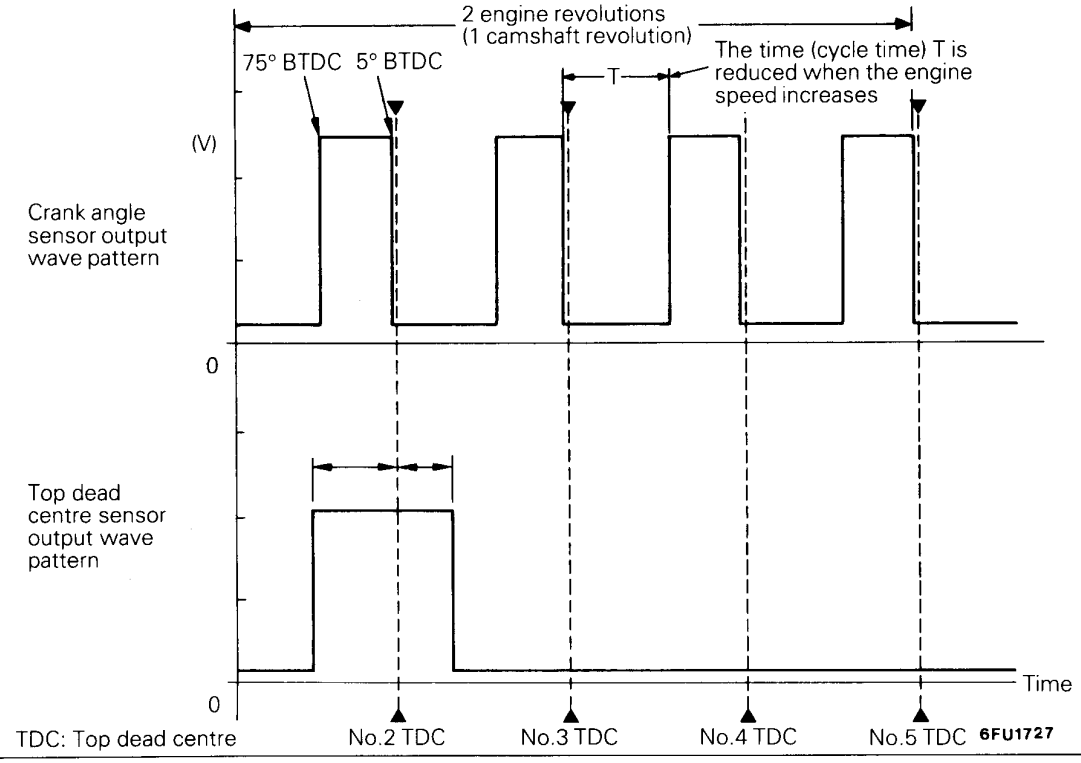
(1) Disconnect the crank angle sensor connector and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
(2) Connect the analyzer special patterns pickup to crank angle sensor terminal ④. (When checking the top dead centre sensor signal wave pattern)
(3) Connect the analyzer special patterns pickup to crank angle sensor connector terminal ③. (When inspecting the crank angle sensor signal wave pattern.)

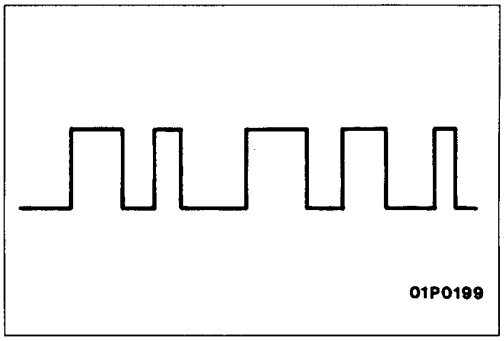
Standard wave pattern

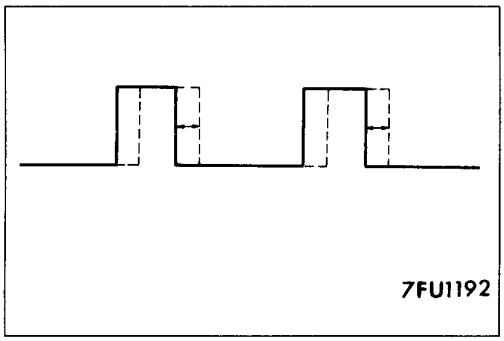
Observation conditions

FUNCTION	SPECIAL PATTERNS
PATTERN HEIGHT	LOW
PATTERN SELECTOR	DISPLAY
Engine r/min.	Idle speed (800r/min. *1) (700r/min. *2)

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter







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

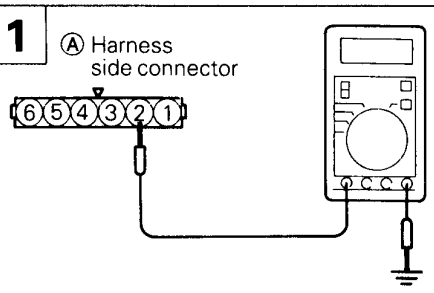
  Loose timing belt
  Abnormality in sensor disk

  Wave pattern characteristics

  Wave pattern is displaced to the left or right.

HARNESS INSPECTION

1



Measure the power supply voltage.

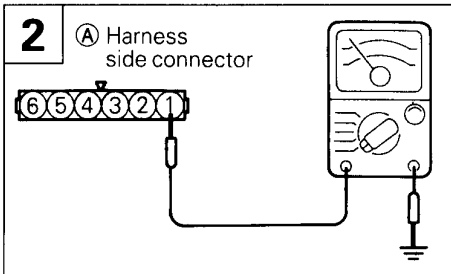
- Crank angle sensor connector: Disconnected
- Ignition switch: ON

Voltage (V)
5V

OK → 2

NG → Repair the harness (Ⓐ2 – Ignitionswitch) or check the ignition switch

2



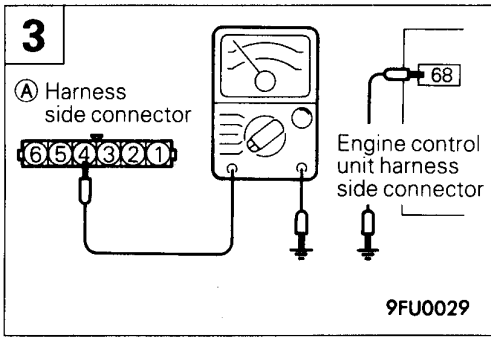
Check for continuity of the earth circuit.

- Crank angle sensor connector: Disconnected

OK → 3

NG → Repair the harness (Ⓐ1 – Earth)

3



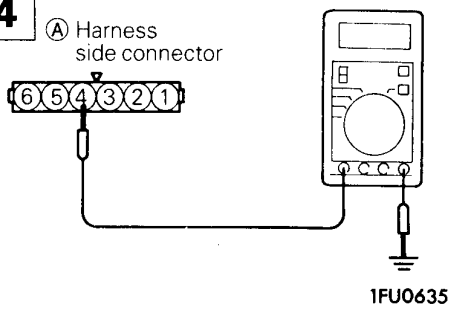
Check for open circuit or short-circuit to earth, between top dead centre sensor and engine control unit.

- Engine control unit connector: Disconnected
- Crank angle sensor connector: Disconnected

OK → 4

NG → Repair the harness (Ⓐ4 – 68)

4



Measure the impressed voltage.

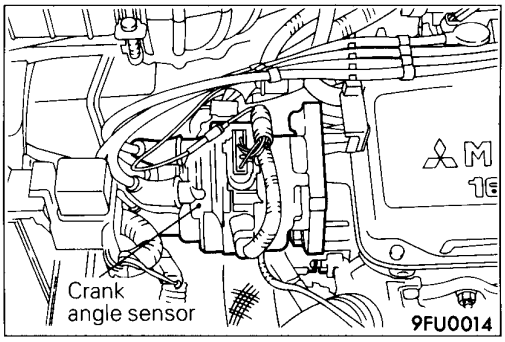
- Crank angle sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.8 – 5.2

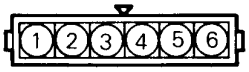
OK → STOP

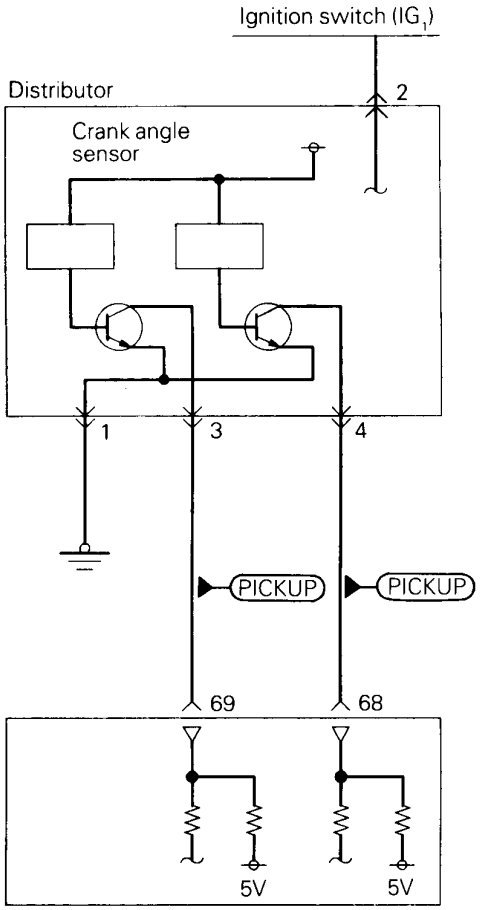
NOT OK → Replace the engine control unit

CRANK ANGLE SENSOR

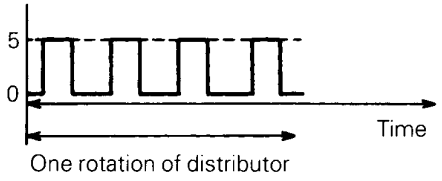


Ⓐ Equipment side connector



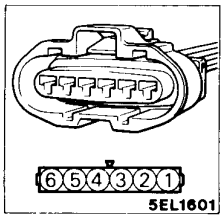


Output characteristic (V)

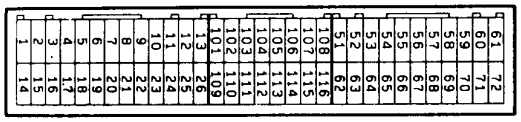


01R0103

Ⓐ Harness side connector



Engine control unit connector



7FU0653

9FU0390

OPERATION

- The crank angle sensor detects the crank angle (piston position) of each cylinder, converts it to a pulse signal and inputs it to the engine control unit. The engine control unit computes the engine speed and the intake air amount for one stroke and outputs the injector drive signal and injection command signal based on this signal.
- Power to the crank angle sensor is supplied from the ignition switch (IG), and the earth is located in the engine control unit. A 5V voltage is applied from the engine control unit to the crank angle sensor output terminal, and the crank angle sensor generates a pulse signal as it switches from OPEN to SHORT (power transistor inside the sensor switches ON/OFF) between the output terminal and the earth.

TROUBLESHOOTING HINTS

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

Hint 2: If the crank angle sensor outputs a pulse signal when the ignition switch is turned 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 water temperature sensor
(2) Faulty idle speed control servo
(3) Poorly adjusted basic idle speed

INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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 or MUT-II reading	Indicated speed to agree

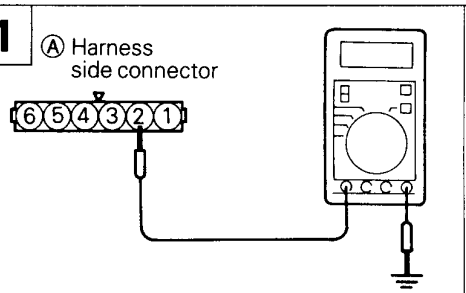
Function	Item No.	Data display	Check condition	Check content	Normal state
Data reading	22	Idle speed	• Engine: Idling • Idle position switch: ON	–20°C (–4°F)	1350 – 1600 r/min.
				0°C (32°F)	1350 – 1500 r/min.
				20°C (68°F)	1250 – 1450 r/min.
				40°C (104°F)	1000 – 1200 r/min.
				80°C (176°F)	700 – 900 r/min.*1 600 – 800 r/min.*2

Wave Pattern Inspection Using an Analyzer
(Refer to P.13-62.)

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter

HARNESS INSPECTION

1



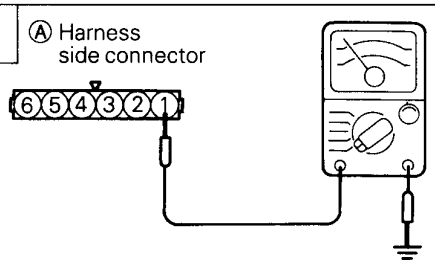
Measure the power supply voltage.
- Crank angle sensor connector: Disconnected
- Ignition switch: ON

Voltage (V)
SV

OK → 2

NG → Repair the hahrness (Ⓐ2 – Ignition switch) or check the ignition switch

2

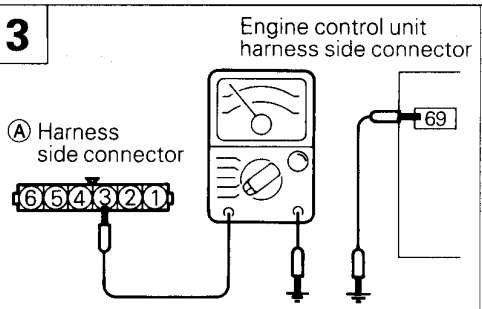


Check for continuity of the earth circuit.
- Crank angle sensor connector: Disconnected

OK → 3

NG → Repair the harness (Ⓐ1 – Earth)

3

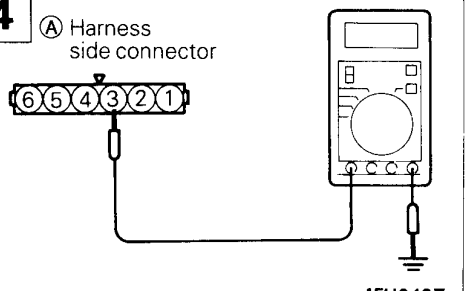


Check for open circuit, or short-circuit to earth, between crank angle sensor and engine control unit.
- Engine control unit connector: Disconnected
- Crank angle sensor connector: Disconnected

OK → 4

NG → Repair the harness (Ⓐ3 – 69)

4



Measure the impressed voltage.
- Crank angle sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

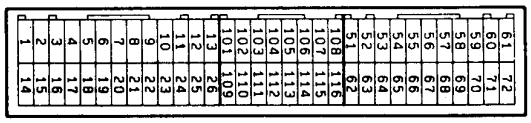
Voltage (V)
4.8 – 5.2

OK → STOP

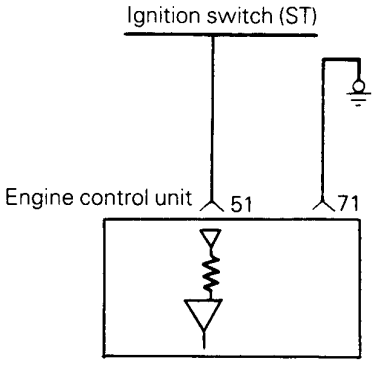
NG → Replace the engine control unit

IGNITION SWITCH-ST <M/T>

Engine control unit connector



7FU0653



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.

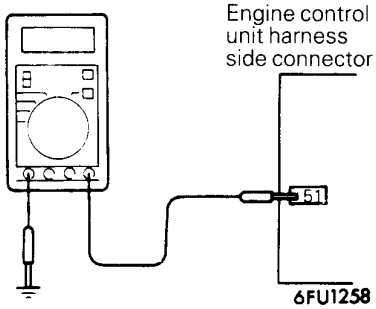
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

HARNESS INSPECTION

1



6FU1258

Measure the input voltage to the engine control unit.

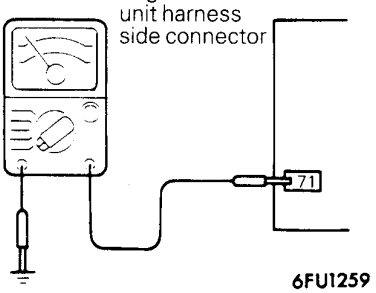
- Engine control unit connector: Disconnected
- Ignition switch: START

Voltage (V)
8 or more

OK → 2

NG → Repair the harness (51 – Ignition switch) or check the ignition switch

2



6FU1259

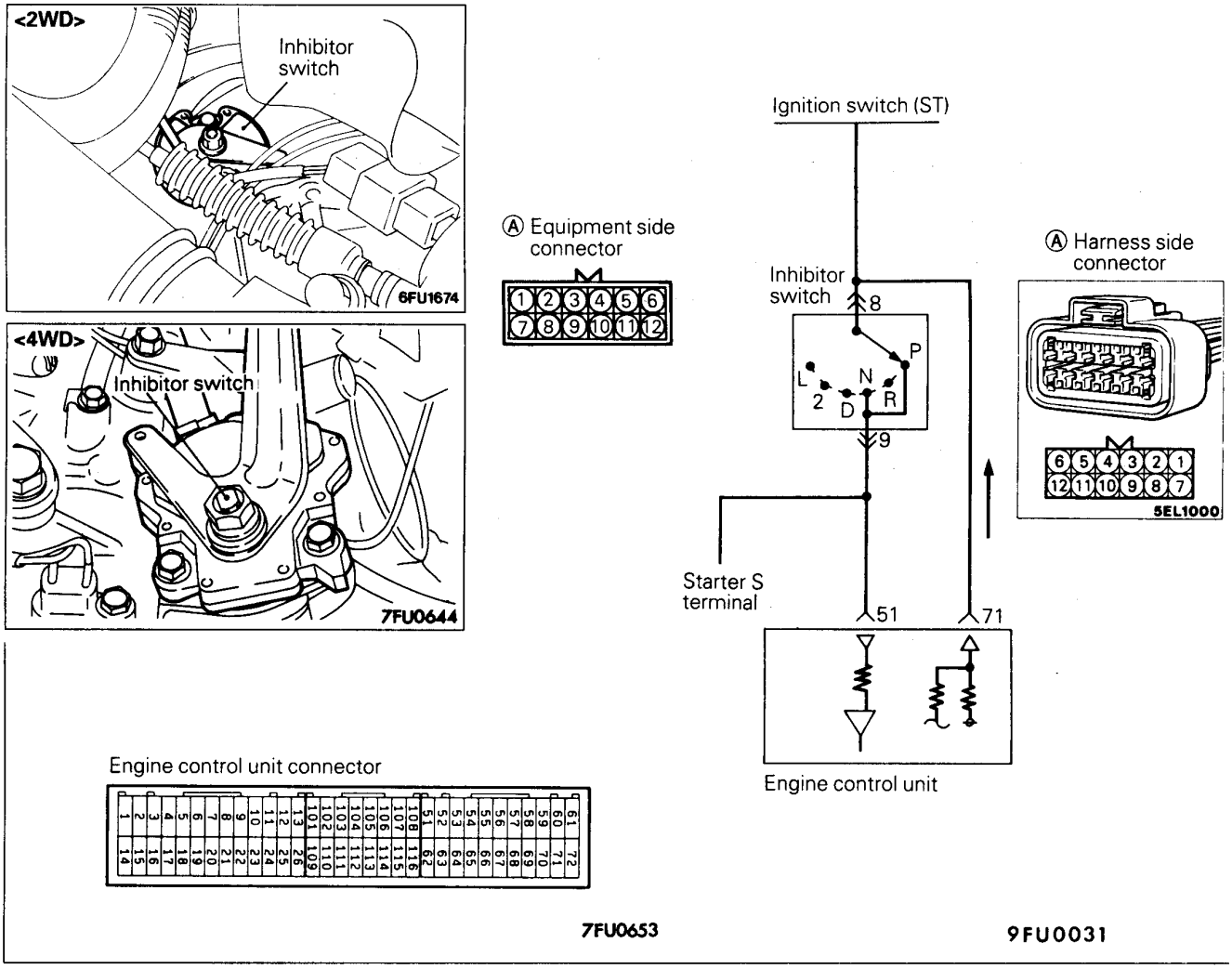
Check for continuity of the earth circuit.

- Engine control unit connector: Disconnected

OK → STOP

NG → Repair the harness (71 – Earth)

IGNITION SWITCH-ST AND INHIBITOR SWITCH <A/T–Vehicles built up to May, 1992>



OPERATION

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

TROUBLESHOOTING HINTS

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

INSPECTION

Using Multi-use Tester (MUT) or MUT-II

IGNITION SWITCH-ST

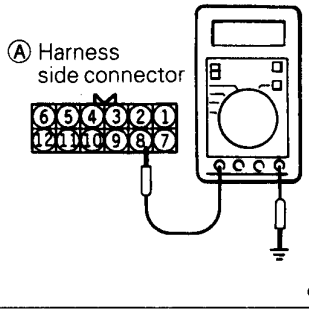
Function	Item No.	Data display	Check condition	Engine	Normal indication
Data reading	18	Switch state	Ignition switch: ON	Stop	OFF
				Cranking	ON

INHIBITOR SWITCH

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

HARNESS INSPECTION

1



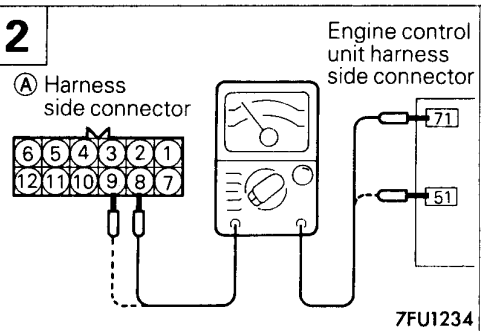
Measure the power supply voltage of the inhibitor switch.
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected
- Ignition switch: START

Voltage (V)
SV

OK → 2

NG → Check the power supply circuit

2



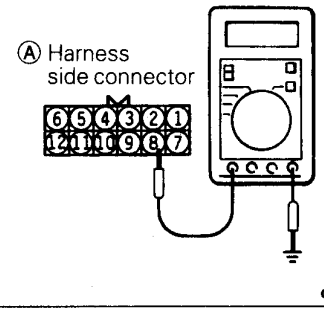
Check for continuity between inhibitor switch and engine control unit.
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected

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

OK → 3

NG → Repair the harness (Ⓐ8 – 71) (Ⓐ9 – 51)

3



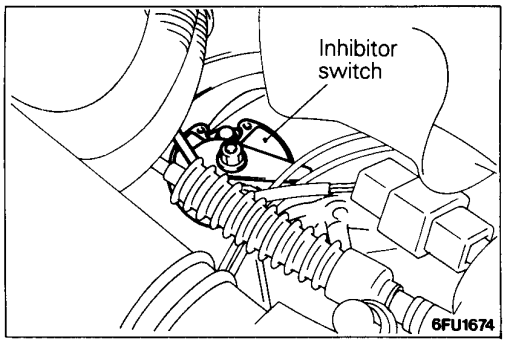
Measure the impressed voltage to inhibitor switch terminal
- Engine control unit connector: Connected
- Inhibitor switch connector: Disconnected
- Ignition switch: ON

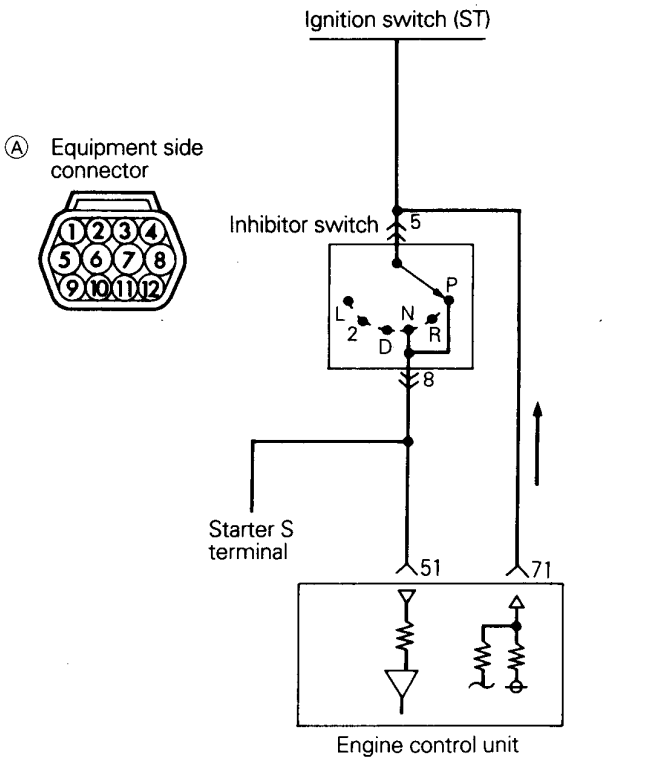
Voltage (V)
SV

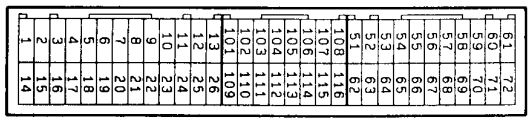
OK → STOP

NG → Replace the engine control unit

IGNITION SWITCH-ST AND INHIBITOR SWITCH <A/T–Vehicles built from June, 1992>





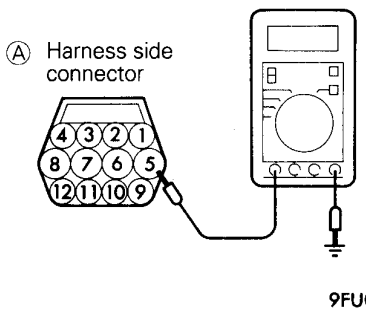


OPERATION
Refer to P.13 – 70.

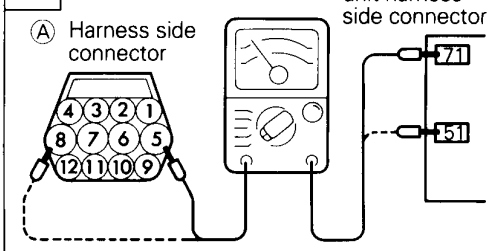
TROUBLESHOOTING HINTS
Refer to P.13 – 70.

INSPECTION
Refer to P.13 – 71.

HARNESS INSPECTION

1  	Measure the power supply voltage of the inhibitor switch. • Engine control unit connector: Disconnected • Inhibitor switch connector: Disconnected • Ignition switch: START Voltage (V): SV	OK →	2
		NG →	Check the power supply circuit.

2



9FU0267

Check for continuity between inhibitor switch and engine control unit.

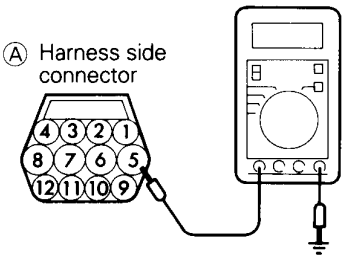
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected

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

OK → 3

NG → Repair the harness.
(Ⓐ5 – 71)
(Ⓐ8 – 51)

3



9FU0266

Measure the impressed voltage to inhibitor switch terminal.

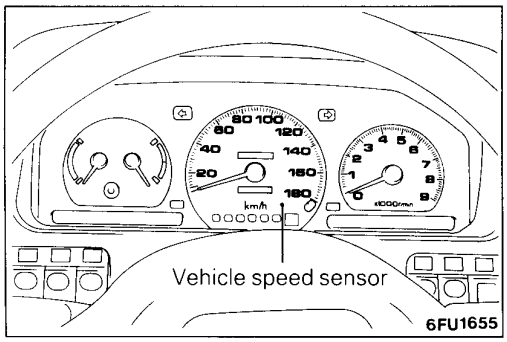
- Engine control unit connector: Connected
- Inhibitor switch connector: Disconnected
- Ignition switch: ON

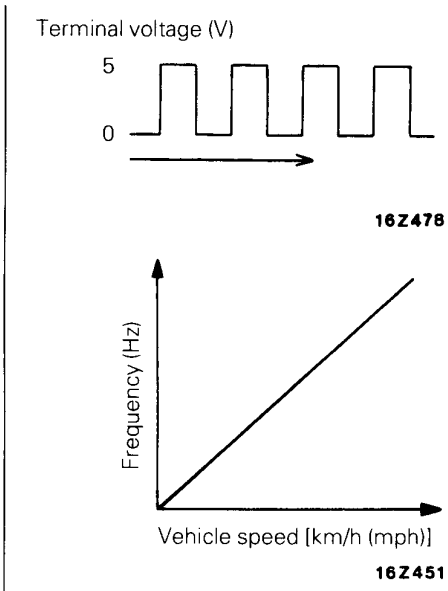
Voltage (V)
5V

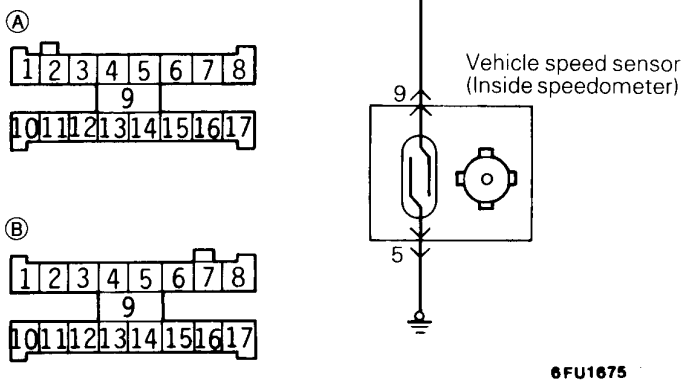
OK → STOP

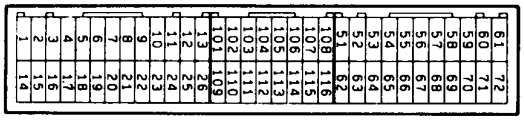
NG → Replace the engine control unit.

VEHICLE SPEED SENSOR









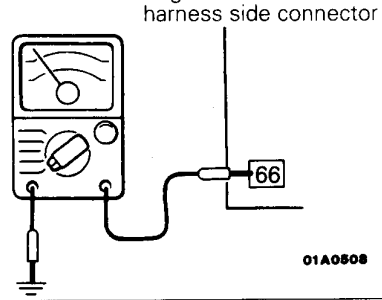
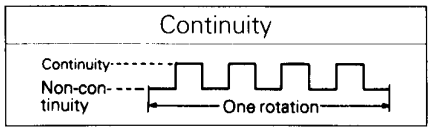
OPERATION

- 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 5 V applied from the engine control unit and earth using a reed switch.

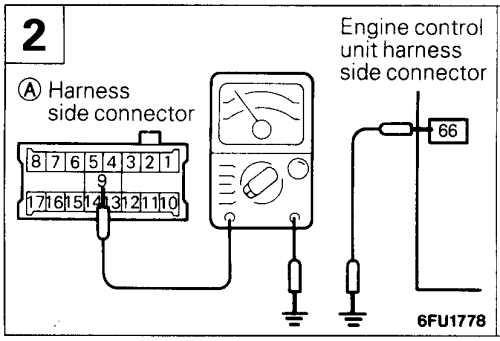
TROUBLESHOOTING HINTS

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		Check the vehicle speed sensor output circuit for continuity. • Engine control unit connector: Disconnected • Move the vehicle. 	OK → 4 NG → 2

2



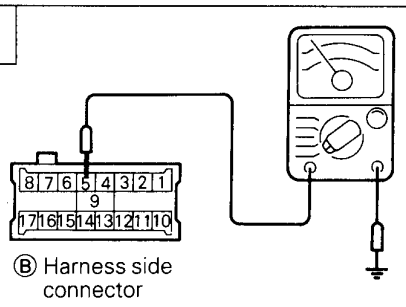
Check for open circuit or short-circuit to earth between engine control unit and vehicle speed sensor.

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

OK → 3

OK → Repair the harness (Ⓐ9 – 66)

3



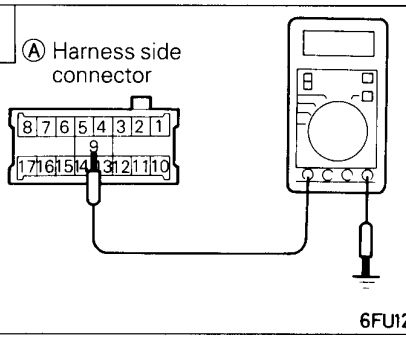
Check for continuity of the earth circuit.

- Vehicle speed sensor: Disconnected

OK → 4

OK → Repair the harness (Ⓑ5 – Earth)

4



Measure the impressed voltage.

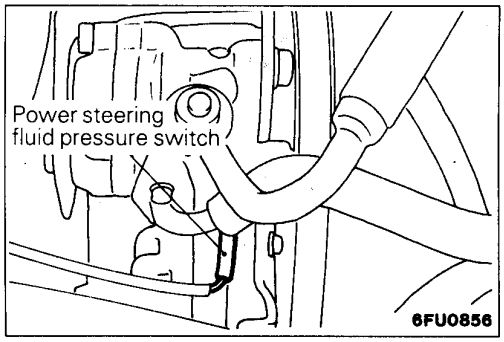
- Vehicle speed sensor connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

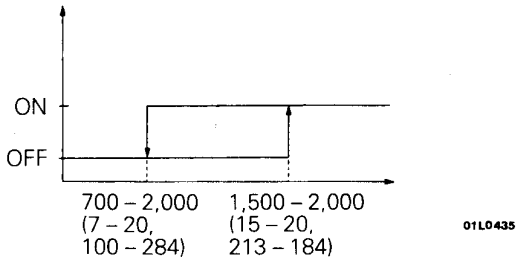
Voltage (V)
4.5 – 4.9

OK → STOP

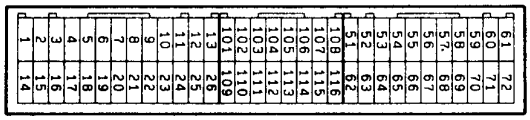
OK → Replace the engine control unit

POWER STEERING FLUID PRESSURE SWITCH

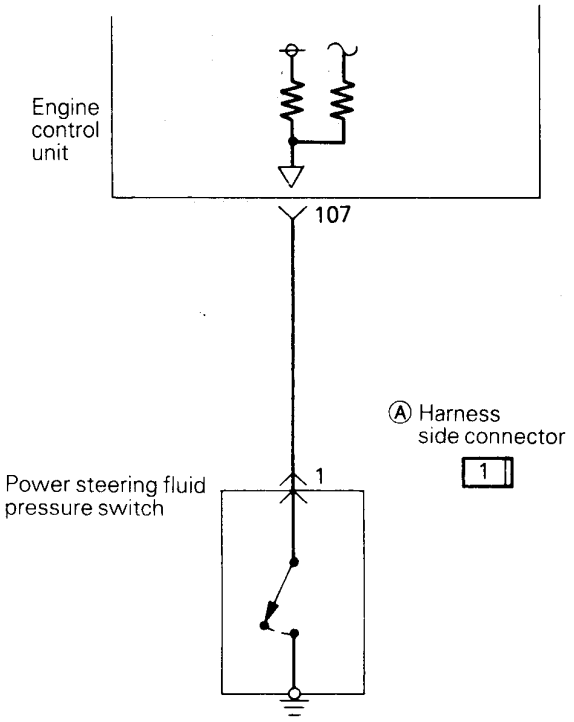




Engine control unit connector



7FU0653



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.

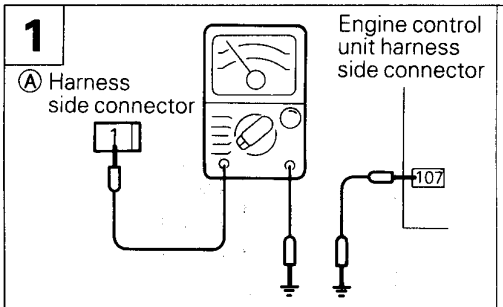
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

HARNESS INSPECTION

1



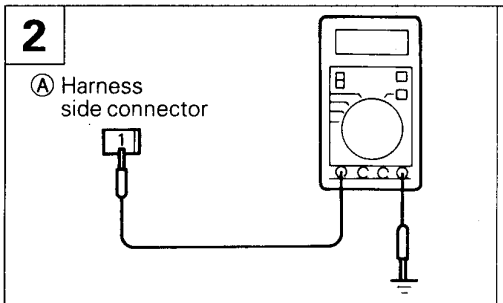
Check for open circuit or short-circuit to earth, between engine control unit and power steering fluid pressure switch.

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

OK → 2

NOT OK → Repair the harness (Ⓐ1 – 107)

2



Measure the impressed voltage.

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

Voltage (V)
SV

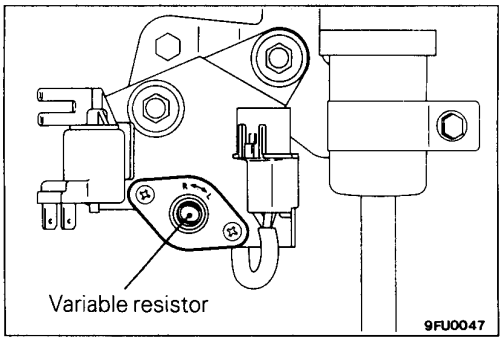
OK → STOP

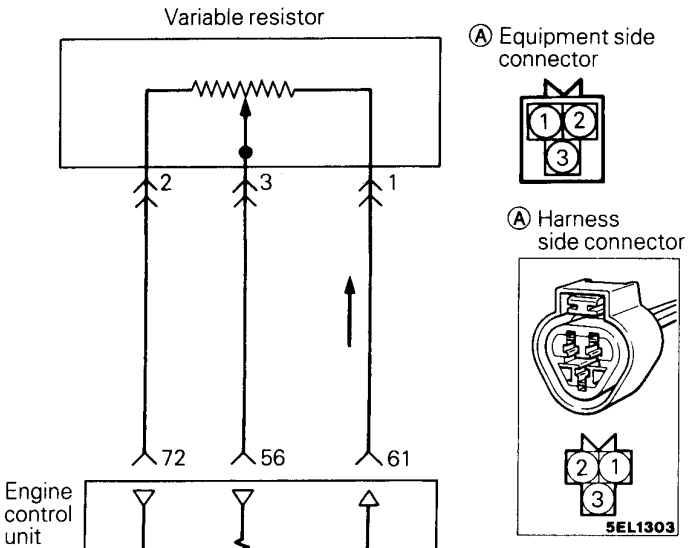
NOT OK → Replace the engine control unit

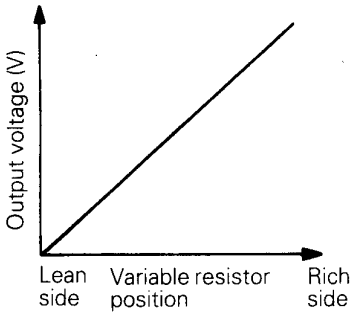
SENSOR INSPECTION

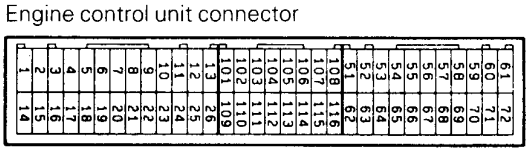
Refer to GROUP 37 – Service Adjustment Procedures.

MIXTURE ADJUSTING SCREW (Variable Resistor) <Vehicles without catalytic converter>









OPERATION

- The mixture adjusting screw (variable resistor) is a variable resistor for adjusting idle mixture manually.
- The 5 V power in the engine control unit is supplied to the mixture adjusting screw (variable resistor) and is then earthed in the engine control unit through a resistor.
- Turning the shaft of the mixture adjusting screw (variable resistor) changes the resistance between the variable resistor and earth terminal. As a result, the variable resistor terminal voltage of this screw changes according to the shaft rotation.
- The engine control unit controls the injector so that the idle mixture will become rich as the variable resistor terminal voltage increases.

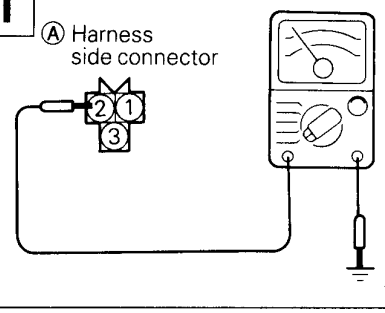
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Standard value
Data reading	17	Adjusting voltage	Ignition switch: ON	1000 – 4000 mV

HARNESS INSPECTION

1

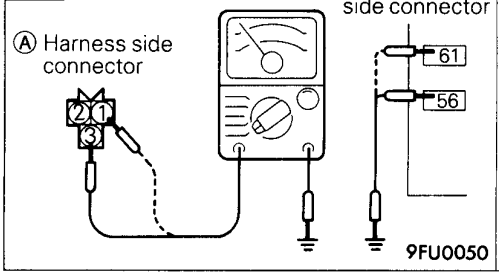


Check for continuity of the earth circuit.
- Variable resistor connector: Disconnected

OK → 2

NG → Repair the harness (Ⓐ2 – 72)

2

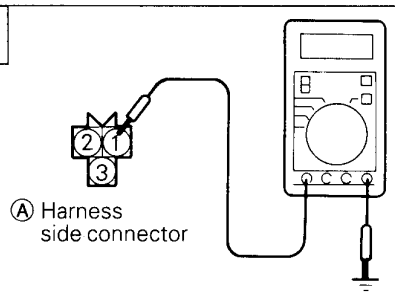


Check for an open-circuit, or a short circuit to earth between the engine control unit and the variable resistor.
- Variable resistor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness (Ⓐ3 – 56) (Ⓐ1 – 61)

3

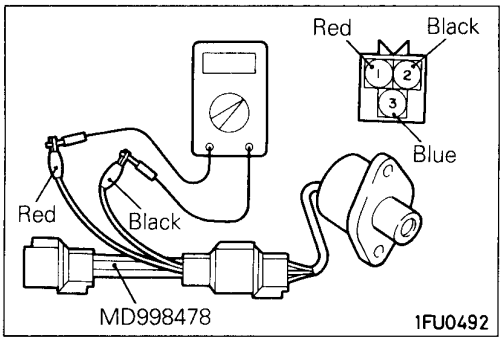


Measure the impressed voltage of the variable resistor.
- Connector: Disconnected
- Ignition switch: ON

Voltage (V)
4.8 – 5.2

OK → STOP

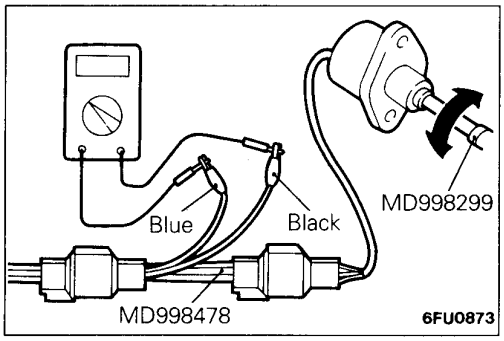
NG → Replace the engine control unit



SENSOR INSPECTION

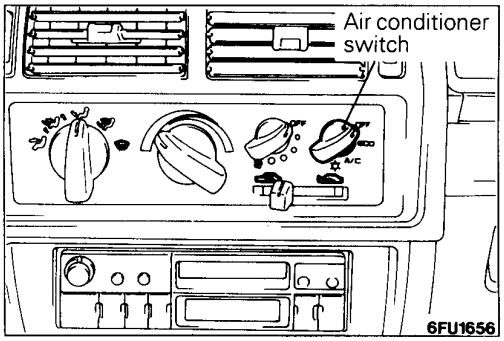
(1) Disconnect the variable resistor connector and connect the special tool (test harness).
(2) Use a circuit tester to measure the resistance between terminal ① (red clip of the special tool) and terminal ② (black clip of the special tool) of the throttle position sensor connector.

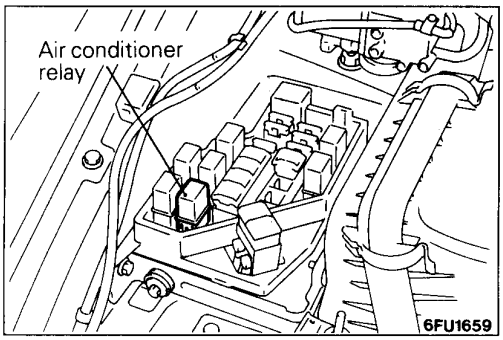
Standard value: 4–6 kΩ

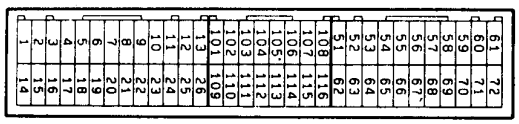


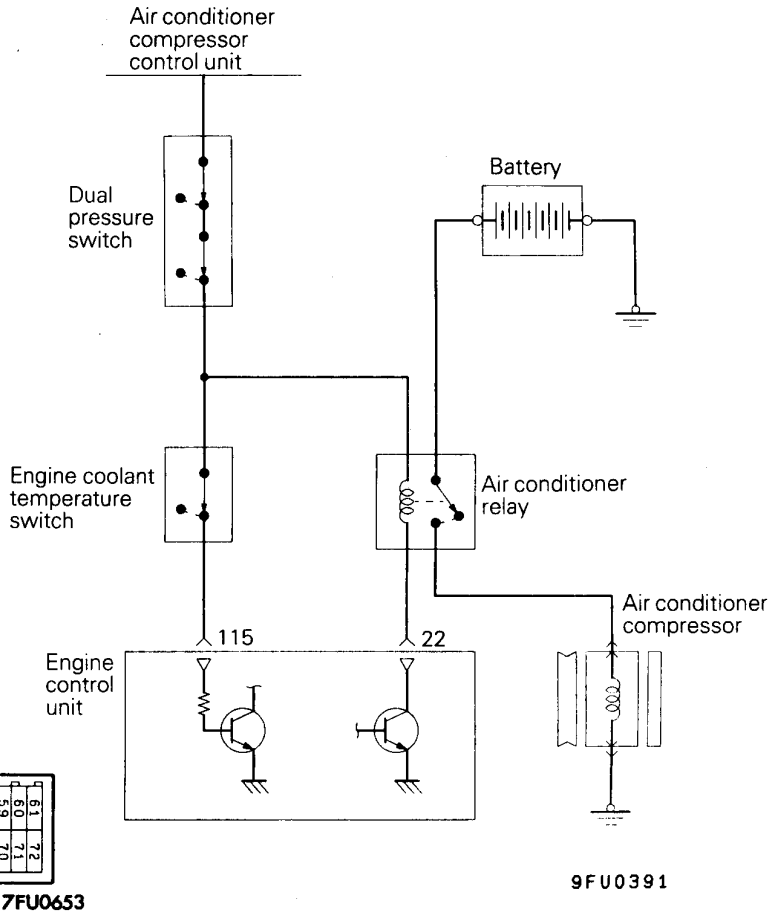
(3) Next, connect the circuit tester between terminal ③ (blue clip of the special tool) and terminal ② (black clip of the special tool).
(4) Check if the resistance changes smoothly when the adjusting screw is rotated by the special tool (MAS driver).
(5) Inspect the body for cracks or other damage.
(6) If any defect is found, replace the throttle position sensor and variable resistor as an assembly.

AIR CONDITIONER SWITCH AND POWER RELAY









OPERATION

- The air conditioner switch applies the battery voltage to the engine control unit when the air conditioner is turned on.
- When the air conditioner ON signal is input, the engine control unit drives the idle speed control servo and turns ON the power transistor. As a result, the air conditioner compressor power relay coil is energized to turn ON the relay switch, which activates the air compressor magnet clutch.

TROUBLESHOOTING HINTS

If the air compressor magnet clutch is not activated when the air conditioner switch is turned ON during idling, faulty air conditioner control system is suspected.

INSPECTION

Using Multi-use Tester (MUT) or MUT-II

AIR CONDITIONER SWITCH

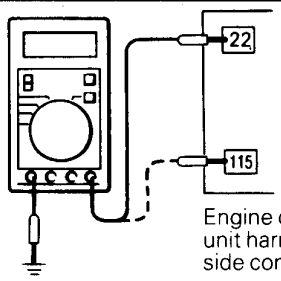
Function	Item No.	Data display	Check condition	Air conditioner switch	Normal indication
Data reading	28	Switch state	Engine: Idling (air compressor to be running when air conditioner switch is ON)	OFF	OFF
				ON	ON

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



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

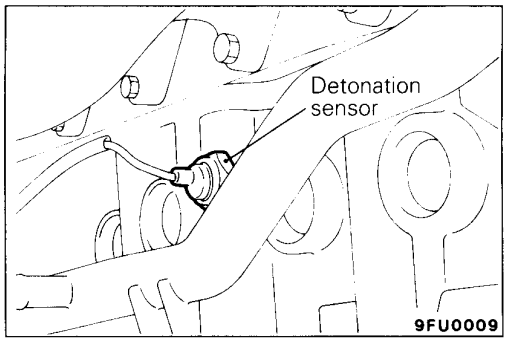
OK → STOP

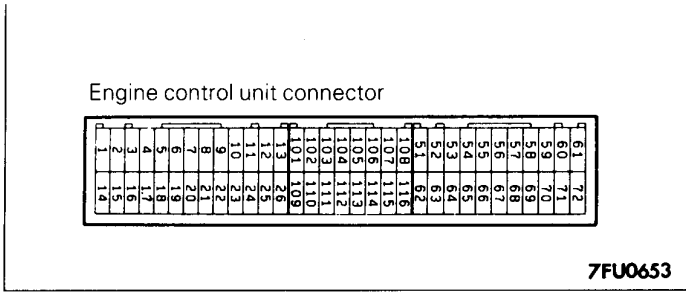
NG → Check the air conditioner circuit

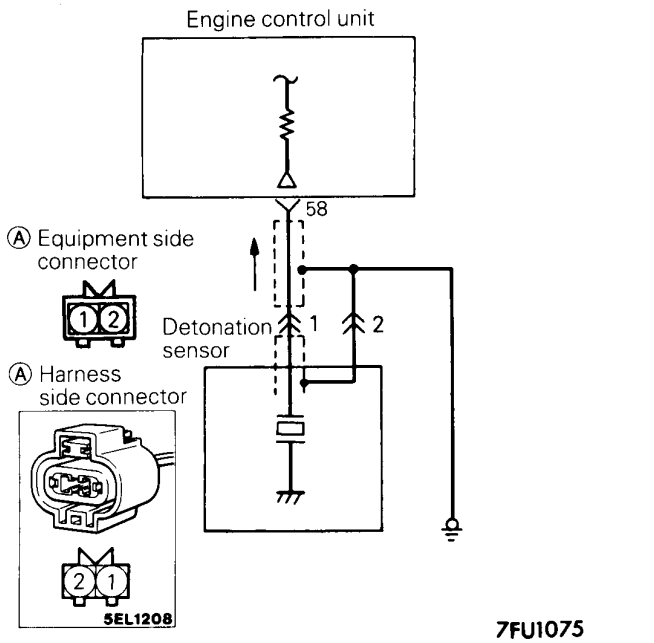
AIR CONDITIONER INSPECTION

Refer to GROUP 55 – Service Adjustment Procedures.

DETONATION SENSOR <Vehicles with catalytic converter>







OPERATION

- The detonation sensor converts cylinder block vibration caused by detonation into a voltage that is proportional to intensity of vibration and inputs it to the engine control unit, which then provides delay control of the ignition timing based on this signal.

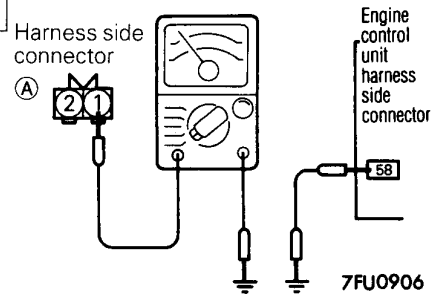
TROUBLESHOOTING HINTS

If detonation is caused while driving with high load, following as well as the detonation sensor may be responsible.

(1) Incorrect heating value of the spark plug
(2) Use of inadequate fuel
(3) Poorly adjusted reference ignition timing

HARNESS INSPECTION

1



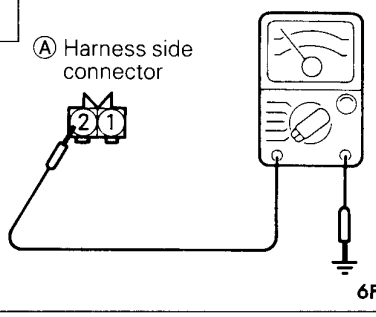
Check for open circuit, or short-circuit to earth, between detonation sensor and engine control unit.

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

OK → 2

NG → Repair the harness (Ⓐ1 – 58)

2



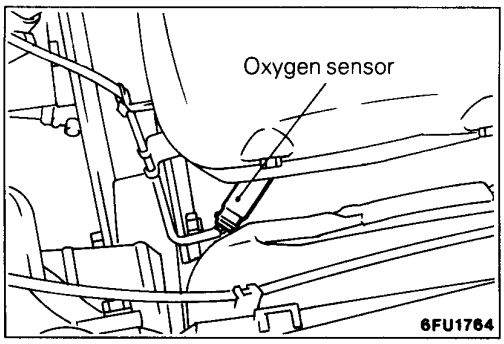
Check for continuity of the earth circuit.

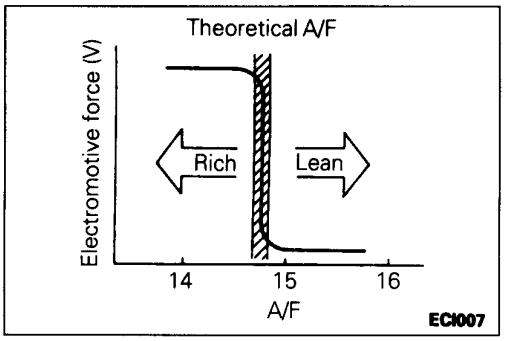
- Detonation sensor connector: Disconnected

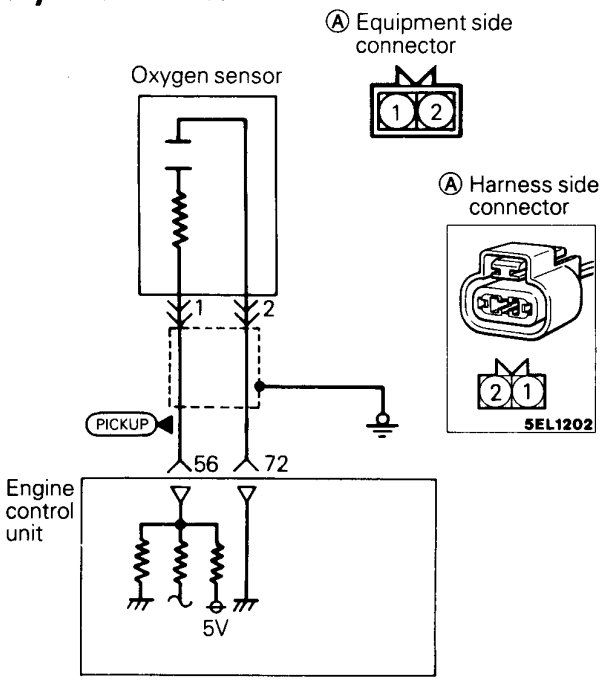
OK → STOP

NG → Repair the harness (Ⓐ2 – Earth)

OXYGEN SENSOR <Vehicles with catalytic converter>

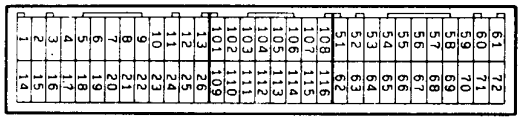






9FU0032

Engine control unit connector



7FU0653

OPERATION

- The oxygen sensor senses the oxygen concentration in exhaust gas, converts it into a voltage and inputs it to the engine control unit.
- The oxygen sensor outputs about 1 V when the air fuel ratio is richer than the theoretical ratio and outputs about 0 V when the ratio is leaner (higher oxygen concentration in exhaust gas).
- The engine control unit controls the fuel injection ratio based on this signal so that the air fuel ratio may be kept at the theoretical ratio.

TROUBLESHOOTING HINTS

Hint 1: Poor cleaning of exhaust gas will result if the oxygen sensor fails.

Hint 2: If the oxygen sensor check has resulted normal but the sensor output voltage is out of specification, troubles of parts related to air fuel ratio control system are suspected.
[Examples]
(1) Faulty injector
(2) Air leaking into the intake manifold through gasket gap, etc.
(3) Faulty air flow sensor, intake air temperature sensor, barometric pressure sensor, water temperature sensor

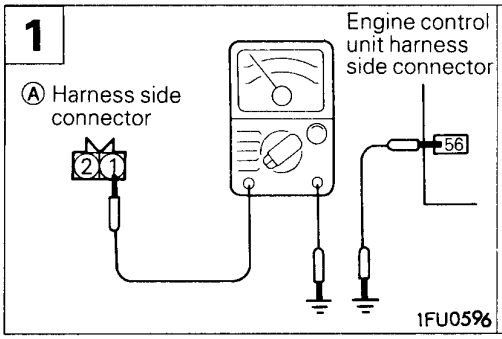
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Select lever position	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.	200 mV or lower
				When eingie 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)	800 r/min. (Idle)	400 mV or lower ↕ (changes) 600–1,000 mV
				2,000 r/min.	

HARNESS INSPECTION

1



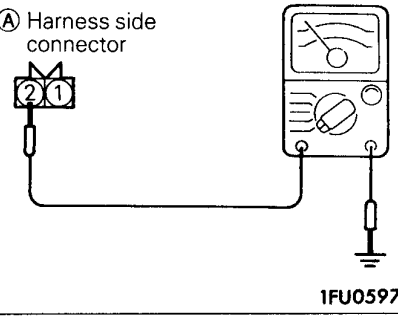
Check for an open-circuit, or a short circuit to earth between the engine control unit and the oxygen sensor.

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

OK → 2

NG → Repair the harness (Ⓐ1 – 56)

2

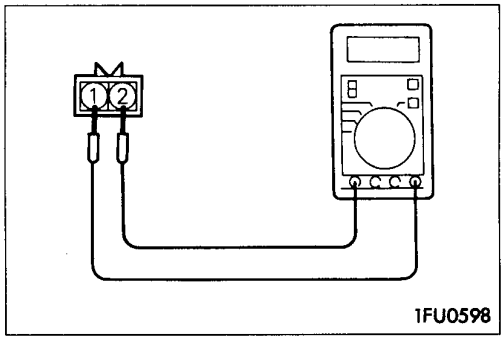


Check for continuity of the earth circuit.

- Oxygen sensor connector: Disconnected

OK → STOP

NG → Repair the harness (Ⓐ2 – 72)



SENSOR INSPECTION

(1) Warm the engine and check to be sure that the engine coolant temperature is 80 – 95°C (176 – 203°F).
(2) Disconnect the oxygen sensor connector and connect a digital voltmeter.

Caution
When disconnecting the oxygen sensor connector, do not pull the connector or lead wire too strongly.

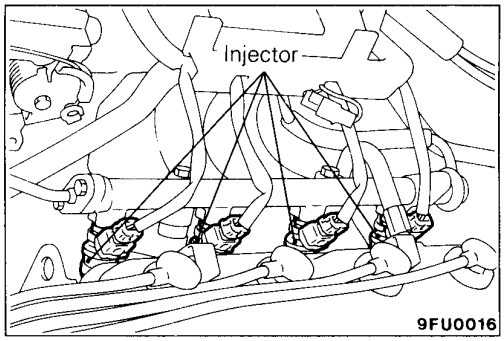
(3) Race the engine repeatedly and measure the oxygen sensor output voltage.

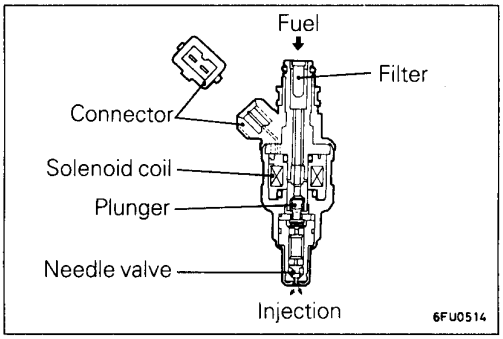
Engine	Sensor output voltage	Remark
When racing the engine	0.6 – 1.0 V	When the air/fuel mixture ratio is enriched by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6 – 1.0V.

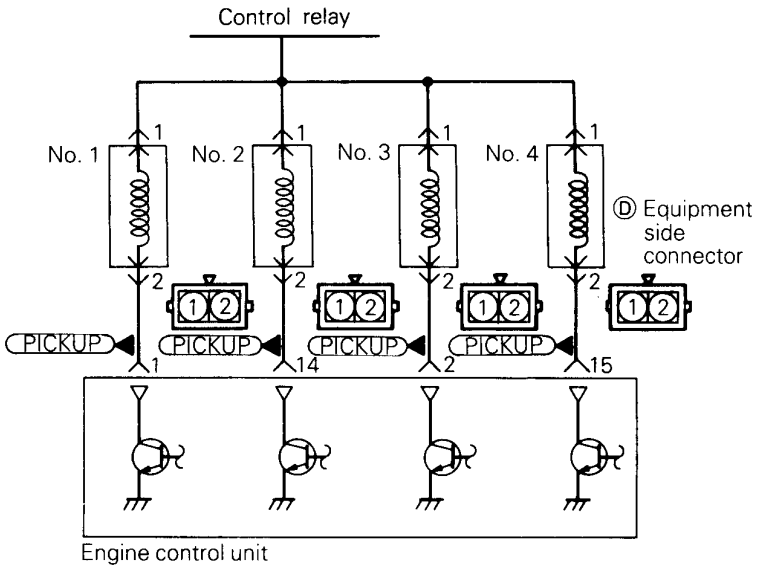
(4) If the sensor is defective, replace the oxygen sensor.

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

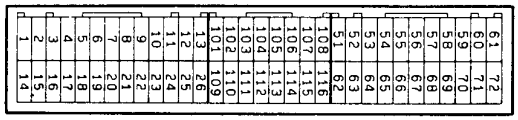
INJECTORS







Engine control unit connector



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 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.

Hint 2: If the injector does not 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 high tension 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

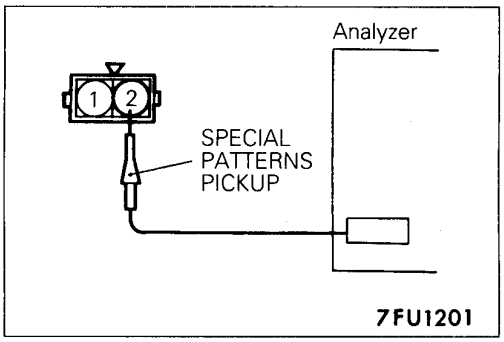
Using Multi-use Tester (MUT) or MUT-II

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. 19 ms
				20°C (68°F)	Approx. 40 ms
				80°C (176°F)	Approx. 10 ms

Function	Item No.	Data display	Check condition	Coolant temperature	Standard value
Data reading	41	Drive time *3	• Engine coolant temperature: 80 to 95°C (176 to 203°F) • Lamps, electric cooling fan, accessories: OFF • Transmission: Neutral (P range for A/T) • Steering wheel: Neutral	800 r/min. *4 700 r/min. *5 (Idle)	2.3 – 3.5 ms
				2,00 r/min.	2.6 – 3.8 ms
				When sharp racing is made	To increase

NOTE
*1: The injector drive time refers to when the supply voltage is 11 V and the cranking speed is less than 250 r/min.
*2: When engine 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.
*4: Vehicles with catalytic converter
*5: Vehicles without catalytic converter

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		

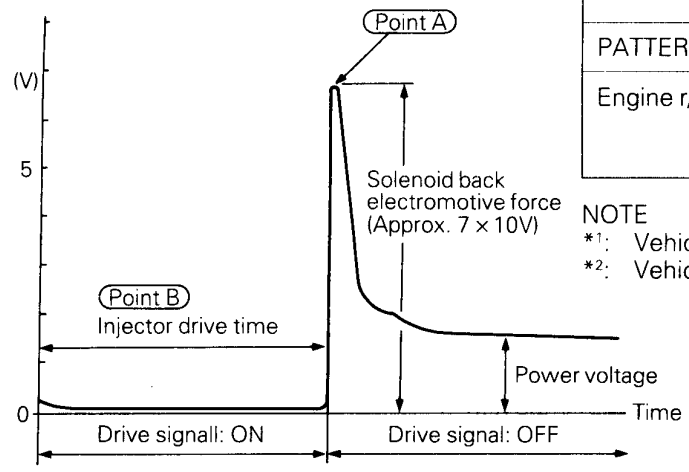


Wave Pattern Inspection Using an Analyzer

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 (800 r/min. *1 / 700 r/min. *2)

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter

Explanation of Wave Pattern

Normally the power voltage is displayed, but when an injector drive "ON" signal is output by the engine control unit, voltage drops to around 0V for the duration of this "ON" signal only. When the drive signal from the engine control unit becomes "OFF", a voltage peak appears due to the coil back electromotive force, and after this, it returns to power voltage.

Injector drive time: The fuel injection time computed by the engine control unit from the output values from each sensor such as the air flow sensor
Injector drive time = effective injection time + ineffective injection time
(Ineffective injection time: compensates for retarded injector operation due to the drop in power source voltage.)

Solenoid back electromotive force: When the injector drive signal from the engine control unit is turned OFF, a back electromagnetic force is generated in the injector coil (Approx. 65 - 75V).

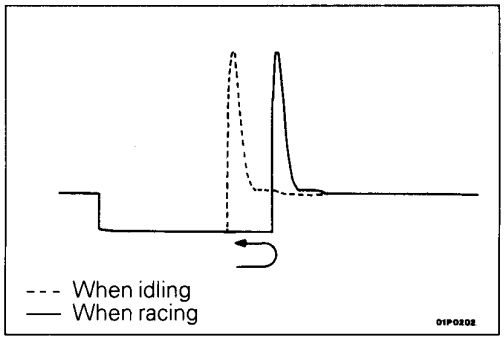
Power source voltage: When there is no "ON" signal from the engine control unit, power supply voltage is displayed. When this power supply voltage is low, the ineffective injection time is long and injector drive time also is long.

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

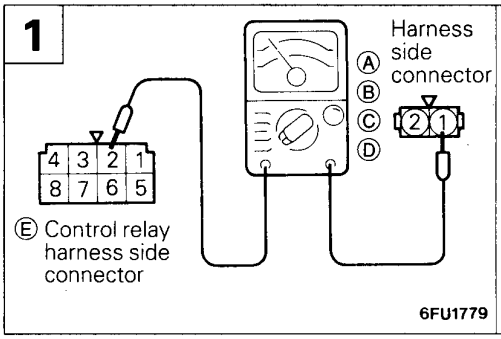
(Point B): Injector drive time



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

HARNESS INSPECTION

1



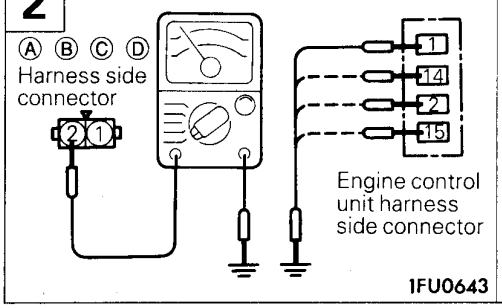
Check for continuity between injector and control relay.
- Injector connector: Disconnected
- Control relay connector: Disconnected

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

OK → 2

NG → Repair the harness (ABCD1 – E2)

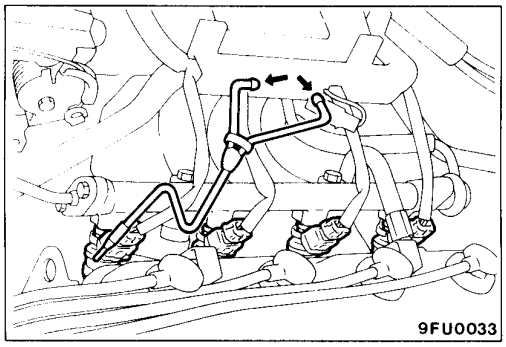
2



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

OK → STOP

NG → Repair the harness (ABCD 2 – 1. 14. 2. 15)



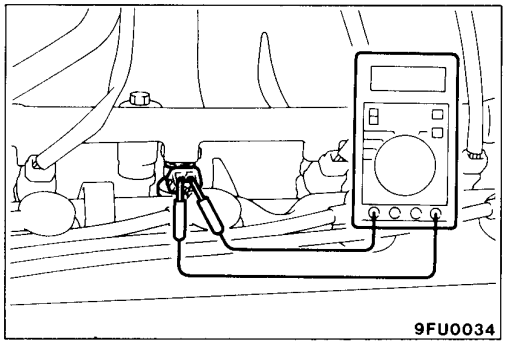
ACTUATOR INSPECTION

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 circut, a defective injector or engine control unit is suspected.



Measurement of Resistance between Terminals

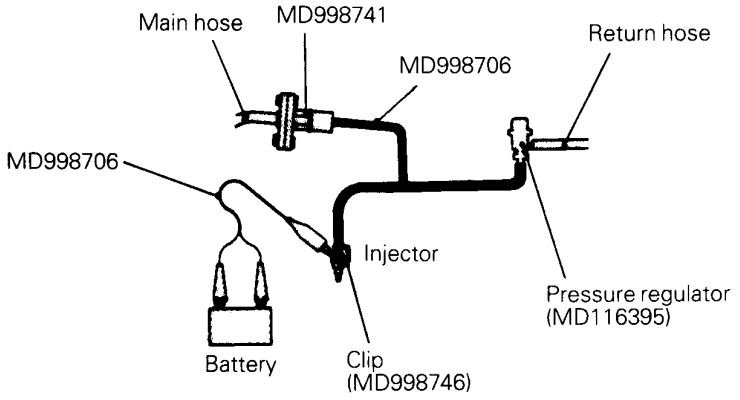
(1) Remove the injector connector.
(2) Measure the resistance between terminals.

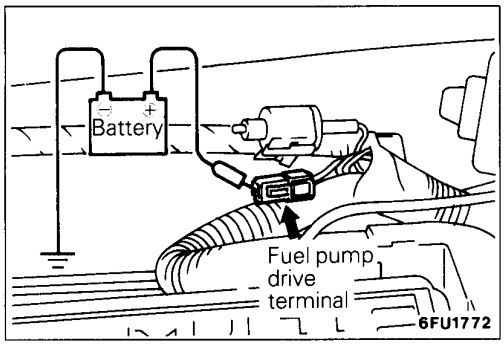
Standard value: 13 – 16 Ω [at 20°C (68°F)]

(3) Install the injector connector.

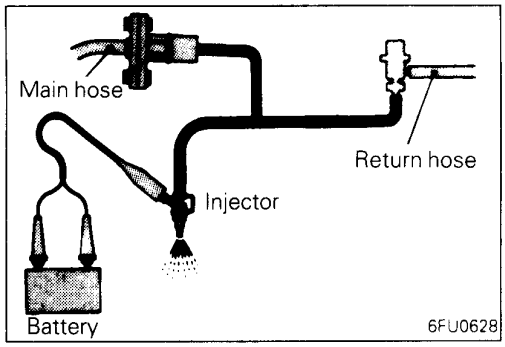
Checking the Injection Condition

(1) Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel. (Refer to P. 13-29)
(2) Remove the injector.
(3) Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.

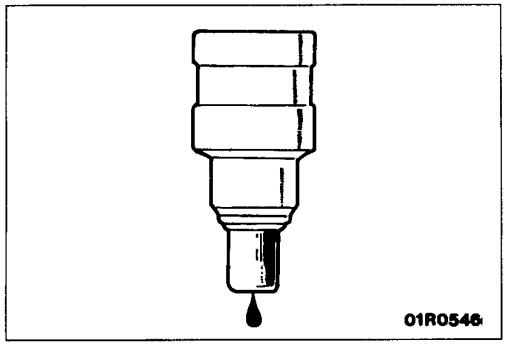




(4) Connect the battery's negative (–) terminal.
(5) Apply battery voltage to the fuel pump drive terminal and activate the fuel pump.



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

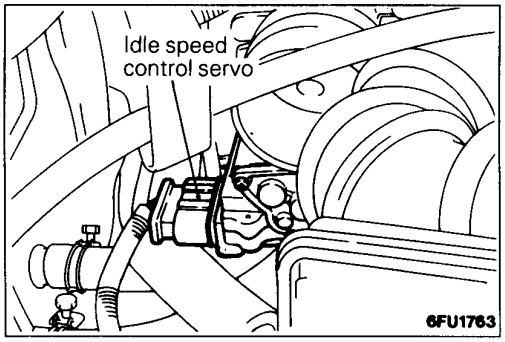


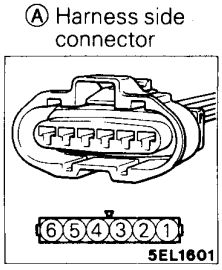
(7) Stop the actuation of the injector, and check for leakage from the injector's nozzle.

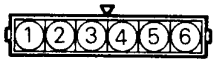
Standard value: 1 drop or less per minute

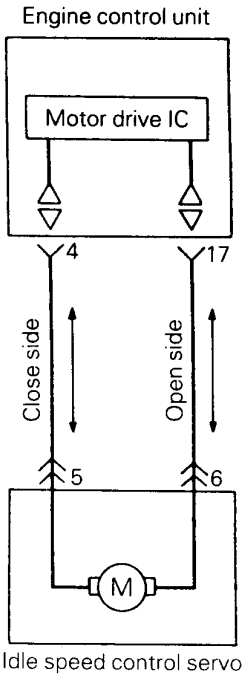
(8) Activate the injector without activating the fuel pump; then, when the spray emission of fuel from the injector stops, disconnect the special tool and restore it to its original condition.

IDLE SPEED CONTROL SERVO (DC MOTOR)



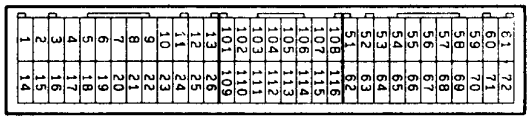






6FU1734

Engine control unit connector



7FU0653

OPERATION

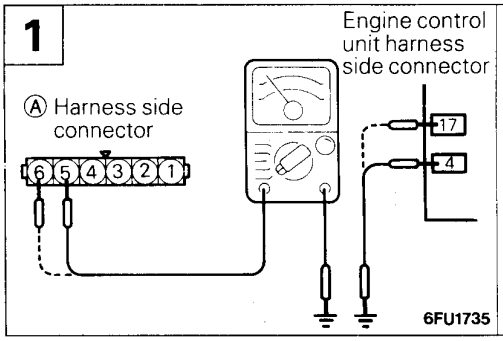
- The volume of intake air during engine idling is controlled by the opening and closing of the servo valve for bypassing the throttle valve, located at the air intake port.
- The servo valve opens and closes depending on whether the DC motor inside the idle speed control servo is turning clockwise or 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 to 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

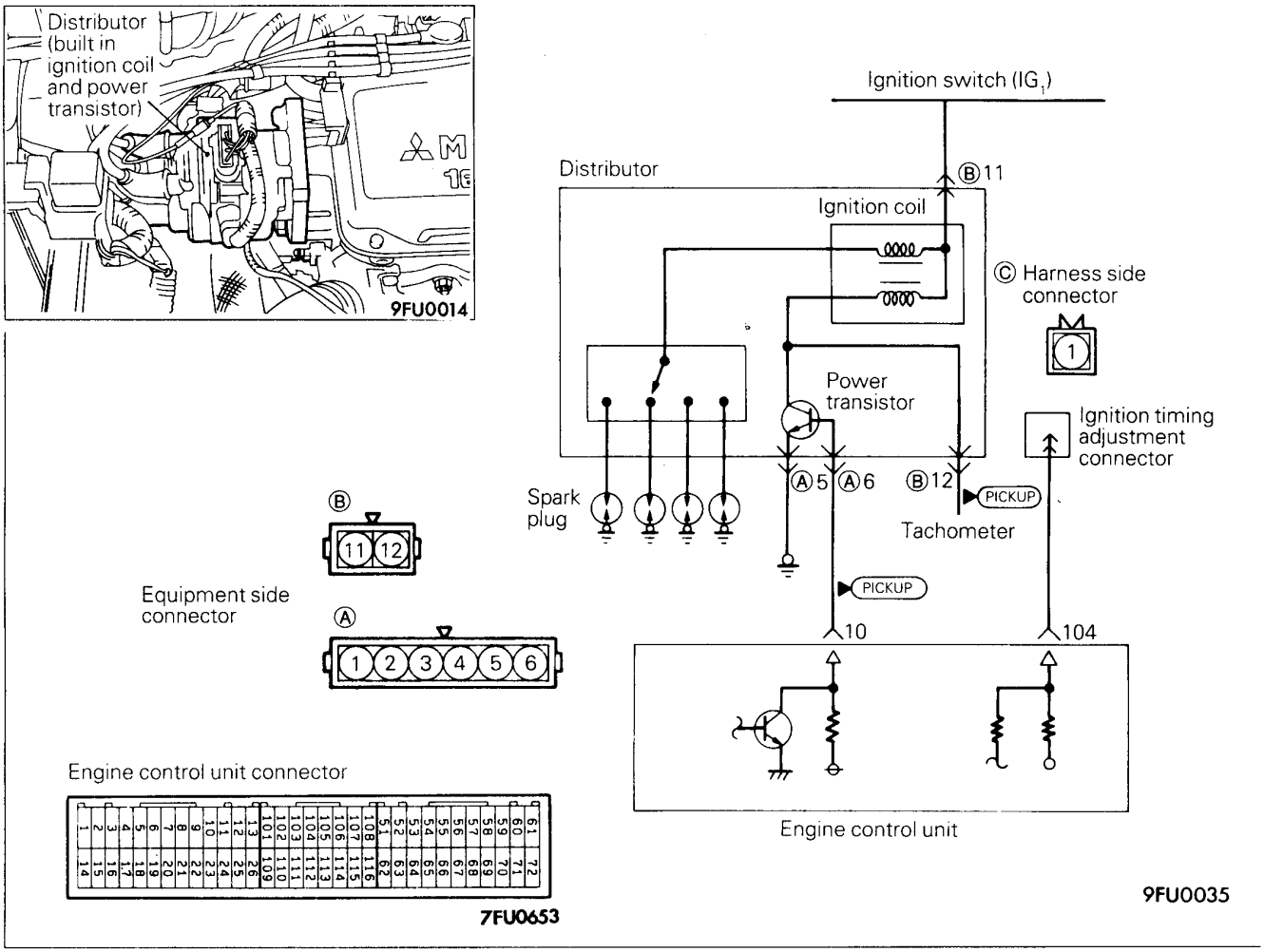
1 	Check for open circuit, or short-circuit to earth, between idle speed control servo and engine control unit. • Idle speed control servo connector: Disconnected • Engine control unit connector: Disconnected	OK →	STOP
		NO →	Repair the harness (Ⓐ5 – 4) (Ⓐ6 – 17)

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.

IGNITION COIL AND POWER TRANSISTOR



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 trnasistor 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.

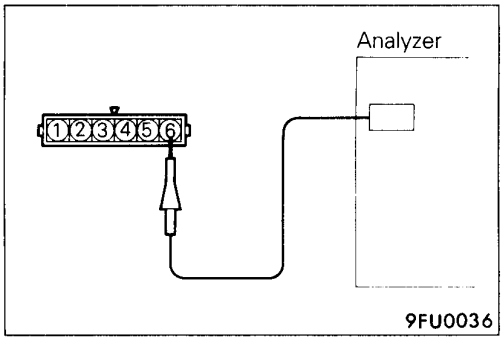
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Spark advance value

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	44	Ignition advance	• Engine: Warming up • Timing lamp: Set (set timing lamp to check actual ignition timing)	800 r/min. *1 700 r/min. *2 (Idle)	2 – 18 °BTDC*1 3 °ATDC – 13 °BTDC
				2,000 r/min.	9 – 29 °BTDC*1 16 – 36 °BTDC*2

NOTE
*1: Vehicles with catalytic converter
*2: Vehicles without catalytic converter



Wave Pattern Inspection Using an Analyzer

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

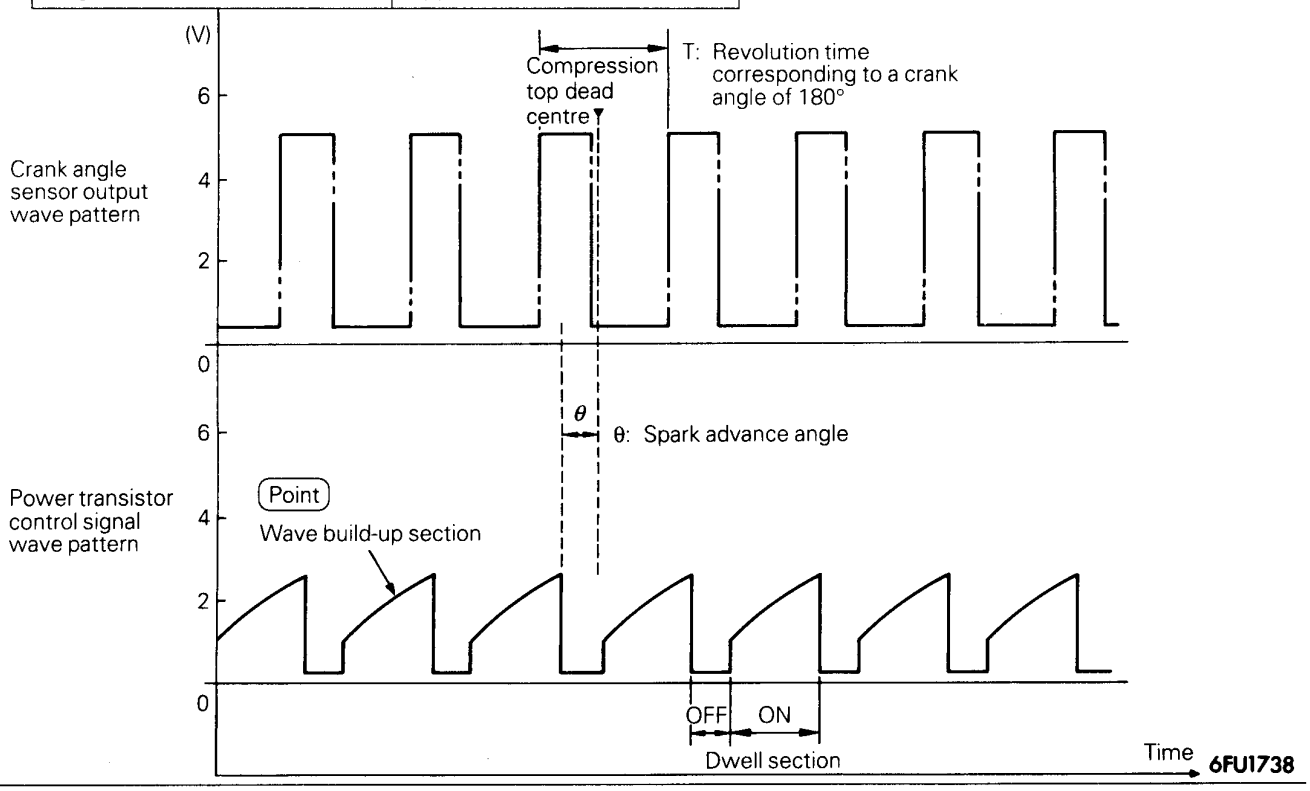
Measurement method

(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

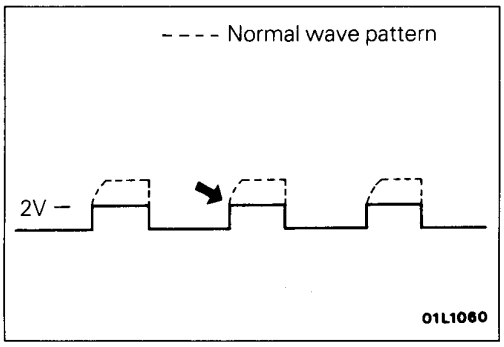
FUNCTION	SPECIAL PATTERNS
PATTERN HEIGHT	LOW
PATTERN SELECTOR	DISPLAY
Engine r/min.	Approx. 1200 r/min.

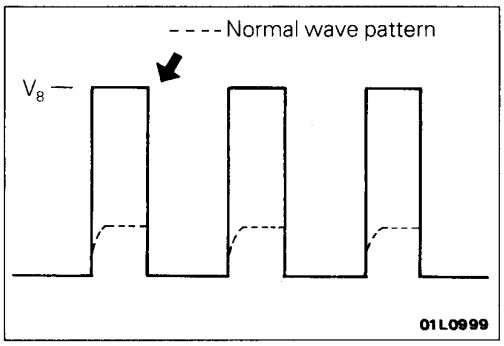


Wave Pattern Observation Points

(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

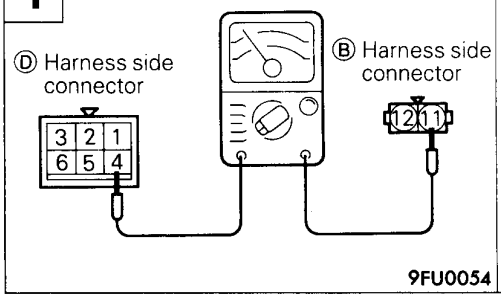
  Malfunction in power transistor

  Wave pattern characteristics

  Power voltage results when the power transistor is ON.

HARNESS INSPECTION

1



9FU0054

Check for continuity between ignition coil and ignition switch [IG].
- Ignition switch [IG] connector: Disconnected
- Ignition coil connector: Disconnected

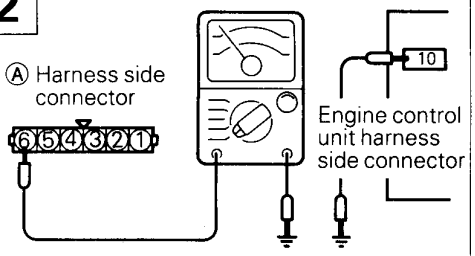
NOTE

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

OK → 2

NO → Repair the harness (Ⓑ11 – Ⓓ4)

2



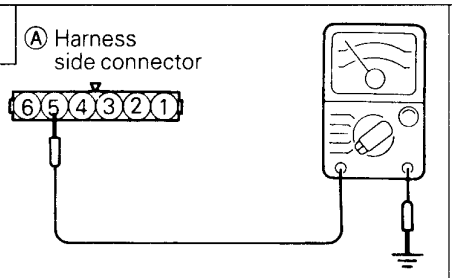
9FU0037

Check for open-circuit, or short-circuit to earth, between power transistor and engine control unit.
- Power transistor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NO → Repair the harness (Ⓐ6 – 10)

3



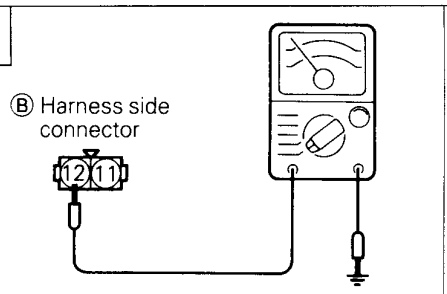
1FU0649

Check for continuity of the earth circuit of a power transistor.
- Power transistor connector: Disconnected

OK → 4

NO → Repair the harness (Ⓐ5 – Earth)

4



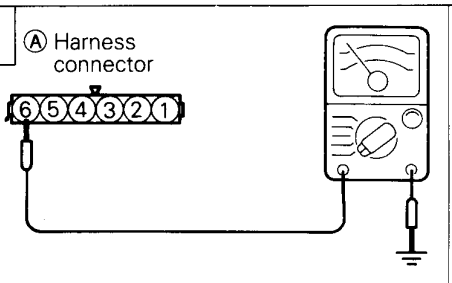
9FU0038

Check to be sure that there is no continuity between the ignition coil and the earth.
- Ignition coil connector: Disconnected

OK → 5

NO → Check for short in the ignition coil primary circuit

5



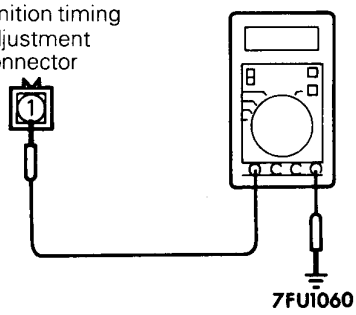
1FU0650

Measure the voltage of the control signal circuit of the power transistor.
- Power transistor connector: Disconnected
- Ignition switch: START

Voltage (V)
2 – 6

OK → 6

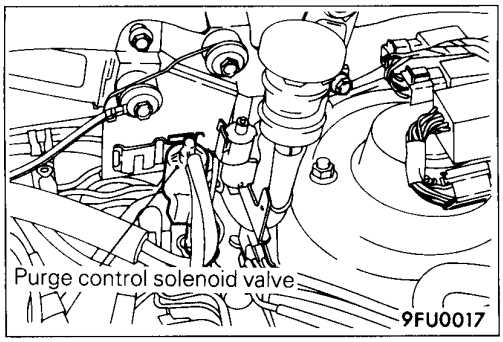
NO → Repair the harness (Ⓐ6 – 10)

6	© Ignition timing adjustment connector  	Measure the voltage of the ignition timing adjustment terminal. • Ignition switch: ON Voltage (V): 4.0 – 5.2	OK → STOP NG → Repair the harness (©1 – 104)

ACTUATOR INSPECTION

Refer to GROUP 16 – Ignition System.

PURGE CONTROL SOLENOID VALVE <Vehicles with catalytic converter>



OPERATION

- The purge control solenoid valve is an ON-OFF type of one which controls introduction of purge air from the canister into the intake air plenum.
- 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.

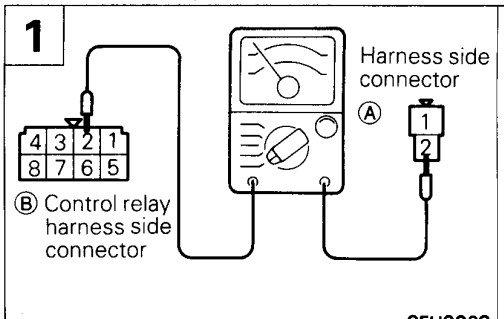
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

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

HARNESS INSPECTION

1



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

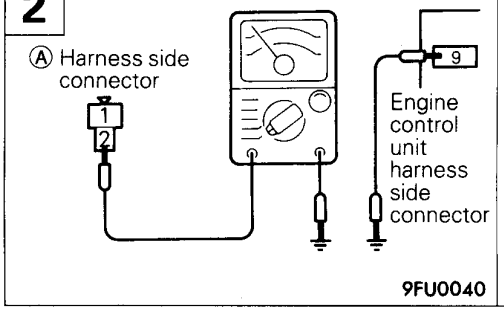
- Purge control solenoid valve connector: Disconnected
- Control relay connector: Disconnected

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

OK → 2

NG → Repair the harness (Ⓐ2 – Ⓑ2)

2



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

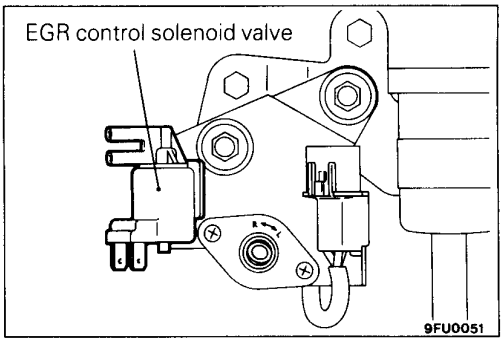
OK → STOP

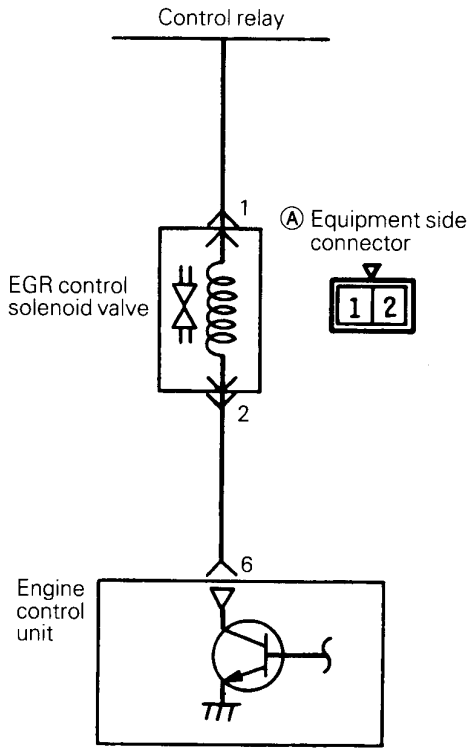
NG → Repair the harness (Ⓐ1 – 9)

ACTUATOR INSPECTION

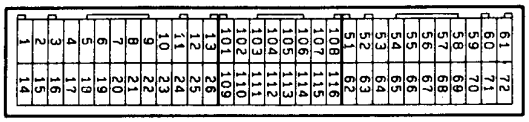
Refer to GROUP 17 – Evaporative Emission Control System.

EGR CONTROL SOLENOID VALVE <Vehicles without catalytic converter>





Engine control unit connector



7FU0653

01W857

OPERATION

- The EGR control solenoid valve is ON-OFF type solenoid valve. It makes control by leaking EGR valve operating negative pressure to the throttle body A port.
- Power supply from the battery is sent through the control relay to the EGR control solenoid valve. When the engine control unit turns off the power transistor inside the unit, current no more flows through the coil and EGR valve operating negative pressure leaks.

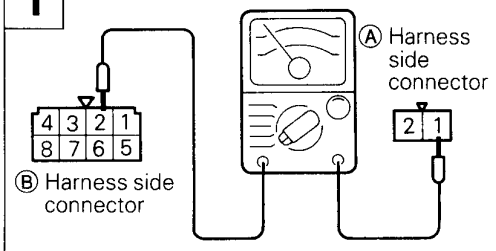
INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Function	Item No.	Drive content	Check condition	Normal state
Actuator test	10	Change solenoid valve from OFF to ON state	Ignition switch: ON	Operating sound is heard when driven

HARNESS INSPECTION

1



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

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

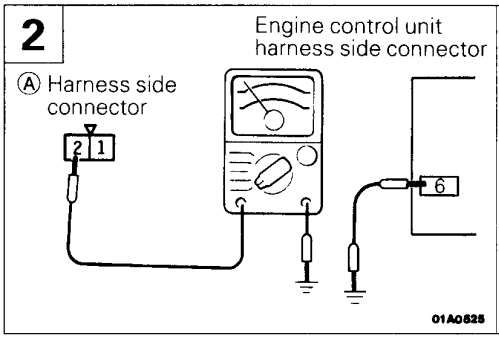
NOTE

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

OK → 2

NO → Repair the harness (Ⓐ1 – Ⓑ2)

2



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

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

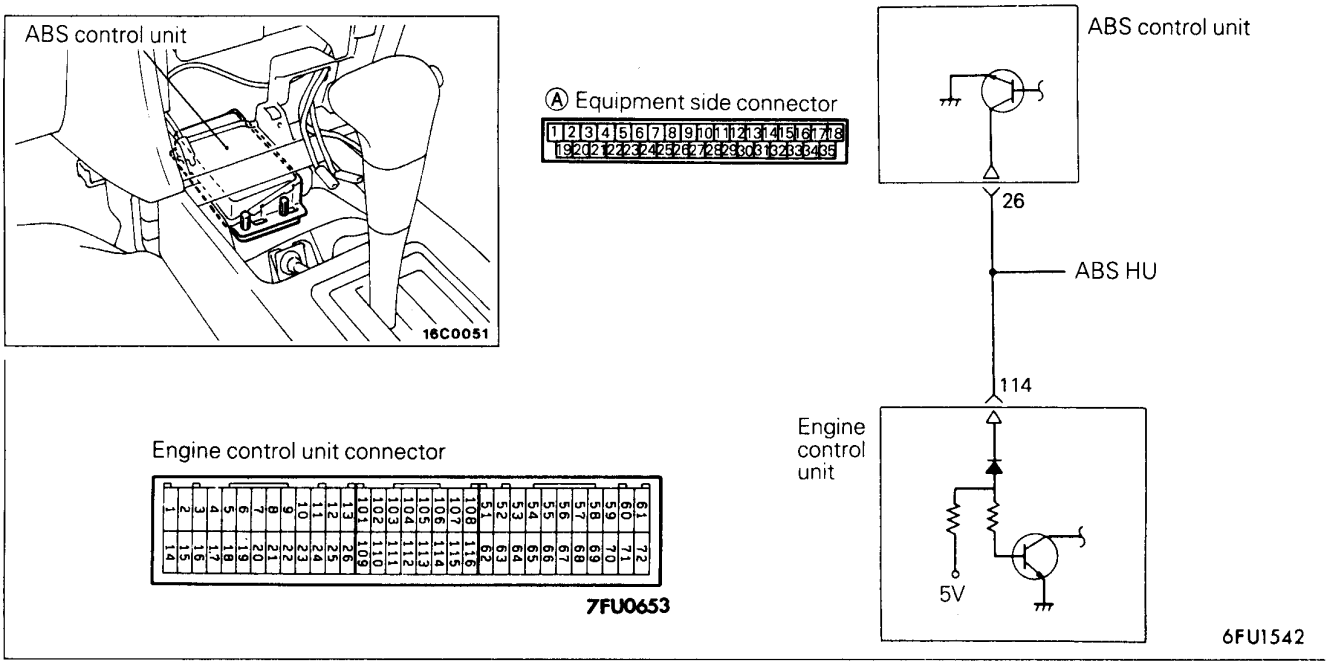
OK → STOP

NO → Repair the harness (Ⓐ2 – 6)

ACTUATOR INSPECTION

Refer to GROUP 17 – Exhaust Gas Recirculation (EGR) System.

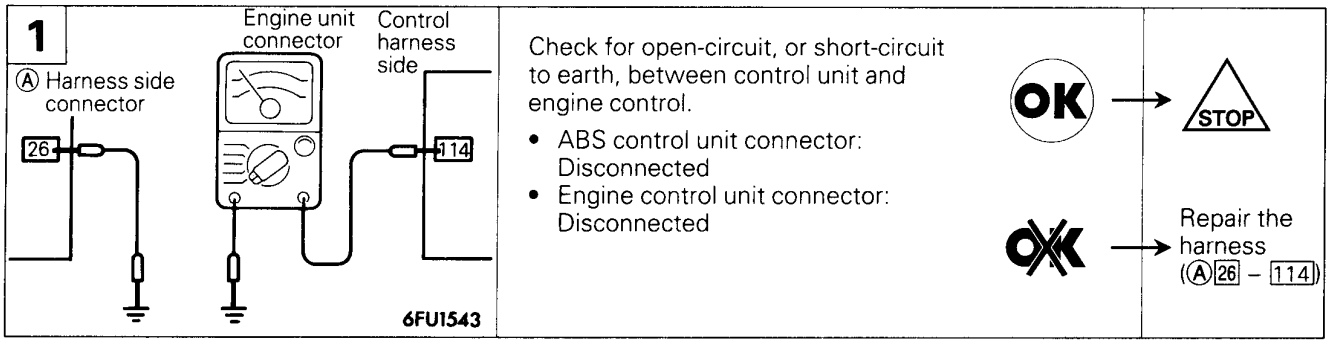
ANTI-SKID BRAKE SIGNAL <4WD-M/T–Vehicles built up to May, 1992>

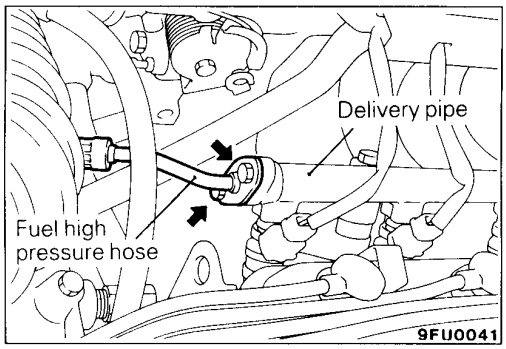


OPERATION

- The anti-skid brake signal is output by the anti-skid brake system (ABS) control unit to the engine control unit as a signal to indicate whether the motor relay is being driven or not. The engine control unit controls the idle speed control servo by means of this signal, and to give accurate anti-skid brake effectiveness.
- The ABS control unit turns the power transistor ON when the motor relay is being driven, and the output terminal which has battery voltage applied is shorted to the earth. This causes the anti-skid brake signal to change from HIGH to LOW.

HARNESS INSPECTION

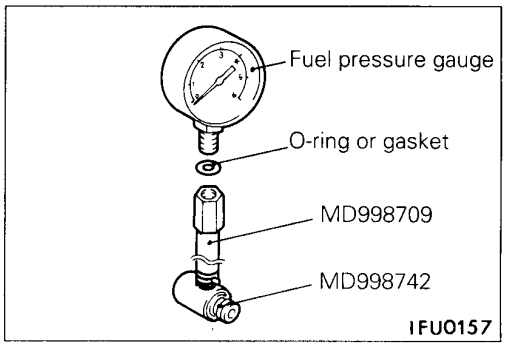




FUEL PRESSURE TEST

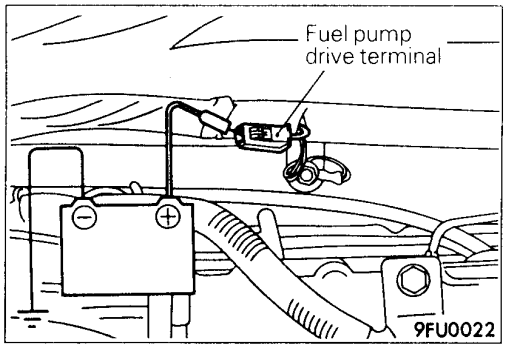
(1) Release residual pressure from the fuel pipe line to prevent fuel gush out. (Refer to P.13-29.)
(2) Disconnect the fuel high pressure hose at the delivery pipe side.

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.

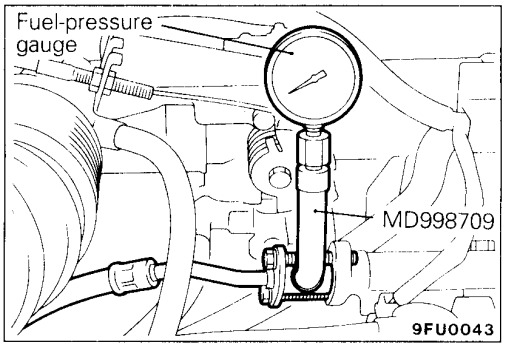


(3) Remove the union joint and bolt from the special tool (adapter hose MD998709) and instead attach the special tool (hose adapter MD998742) to the adapter hose.

(4) Install a fuel pressure gauge on the adapter hose that was set up in setp (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.

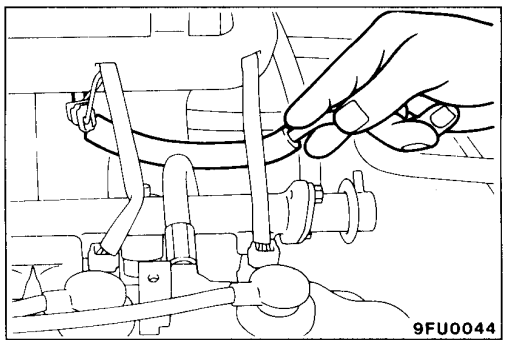


(7) Connect the fuel pump drive terminal with the battery (+) terminal using a jumper wire and drive the fuel pump. Under fuel pressure, check the fuel pressure gauge and special tool connections for leaks.
(8) Disconnect the jumper wire from the fuel pump drive terminal to stop the fuel pump.
(9) Start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

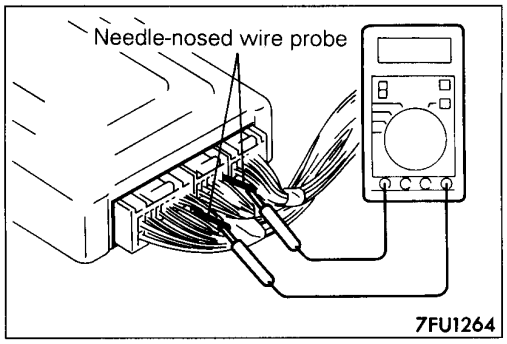
(16) Release residual pressure from the fuel pipe line. (Refer to P.13-29.)
(17) Remove the fuel pressure gauge and special tool from the delivery pipe.

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: 5Nm (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.

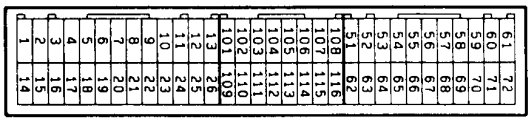
Caution
Short-circuiting the positive (+) probe between a connecter terminal and earth could damage the vehicle wiring, the sensor, engine control unit, or all there. Use care to prevent this!

(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 volt-meter to confirm that the repair has corrected the problem.

TERMINAL VOLTAGE CHECK CHART

Engine Control Unit Terminal Arrangement

Engine control unit connector



7FU0653

Terminal No.	Check Item	Check Condition (Engine Condition)		Standard value
60	Backup power supply	Ignition: OFF		SV
12	Power supply	Ignition: 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
70	Air flow sensor	Engine: Idle speed		2.2-3.2V
		Engine r/min.: 2000r/min.		
19	Air flow sensor reset signal	Engine: Idle speed		0-1V
		Engine r/min.: 3000r/min.		6-9V
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
65	Barometric 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
63	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C (32°F)	3.2-3.8V
			When engine coolant temperature is 20°C (68°F)	2.3-2.9V
			When engine coolant temperature is 40°C (104°F)	1.3-1.9V
			When engine coolant temperature is 80°C (176°F)	0.3-0.9V

Terminal No.	Check Item	Check Condition (Engine Condition)		Standard value
64	Throttle position sensor	Ignition switch: Kept in ON position for 15 seconds or more	Set throttle valve to idle position.	0.3-0.6V
			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
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
71	Inhibitor switch	Ignition switch: ON	Set selector lever to P or N.	0-3V
			Set selector lever to D, 2, L or R.	8-14V
66	Vehicle speed sensor	Ignition switch: ON Move the vehicle slowly forward.		0↔5V (Changes repeatedly)
107	Power steering fluid pressure switch	Engine: Idling after warming up	Set the steering wheel to the straight forward position.	SV
			Half turn the steering wheel.	0-3V
115	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*1	Oxygen sensor	Engine: Running at 2000 r/min after having warmed up. (Check using a digital type voltmeter.)		0↔0.8V (Changes repeatedly)
56*2	Mixture adjusting screw	Ignition switch: ON		1-4V
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			

Terminal No.	Check Item	Check Condition (Engine Condition)		Standard value
10	Power transistor unit	Engine r/min.: 3000r/min.		0.3-3.0V
9*1	Purge control solenoid valve	Ignition switch: ON		SV
		Running at 3000 r/min. after having warmed up.		0-3V
104	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
106	Engine warning lamp	Air conditioner switch: OFF→ON		0-3V ↓ 9-13V (After several seconds have elapsed)
6*2	EGR control solenoid valve	Ignition switch: ON		SV
		Engine: Idling when engine coolant temperature is 60°C (140°F) or lower.		0-3V
114	Anti-skid brake signal	Engine: Idle speed		SV
		• When vehicle first starts to move after turning the ignition switch to ON • Vehicle speed: 0 →10 km/h (0.6 mph)		13-15V ↓ 0-13V (Tempo-rarily)
5	Idle speed control servo valve position sensor No.1	Ignition switch: Immediately after turning ON		1.5-4V (Momen-tarily) 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 (Momen-tarily) ↓ 0-1V or 4.5-5.5V
4	Idle speed control motor (closed)	Ignition switch: Immediately after turning ON		2V or more (Momen-tarily) ↓ 0-1V
17	Idle speed control motor (open)	Ignition switch: Immediately after turning ON		4V or more (Momen-tarily) ↓ 0-1V

OTE
: Vehicles with catalytic converter
: Vehicles without catalytic converter

FUEL SYSTEM <4G63, 4G64>

GENERAL INFORMATION

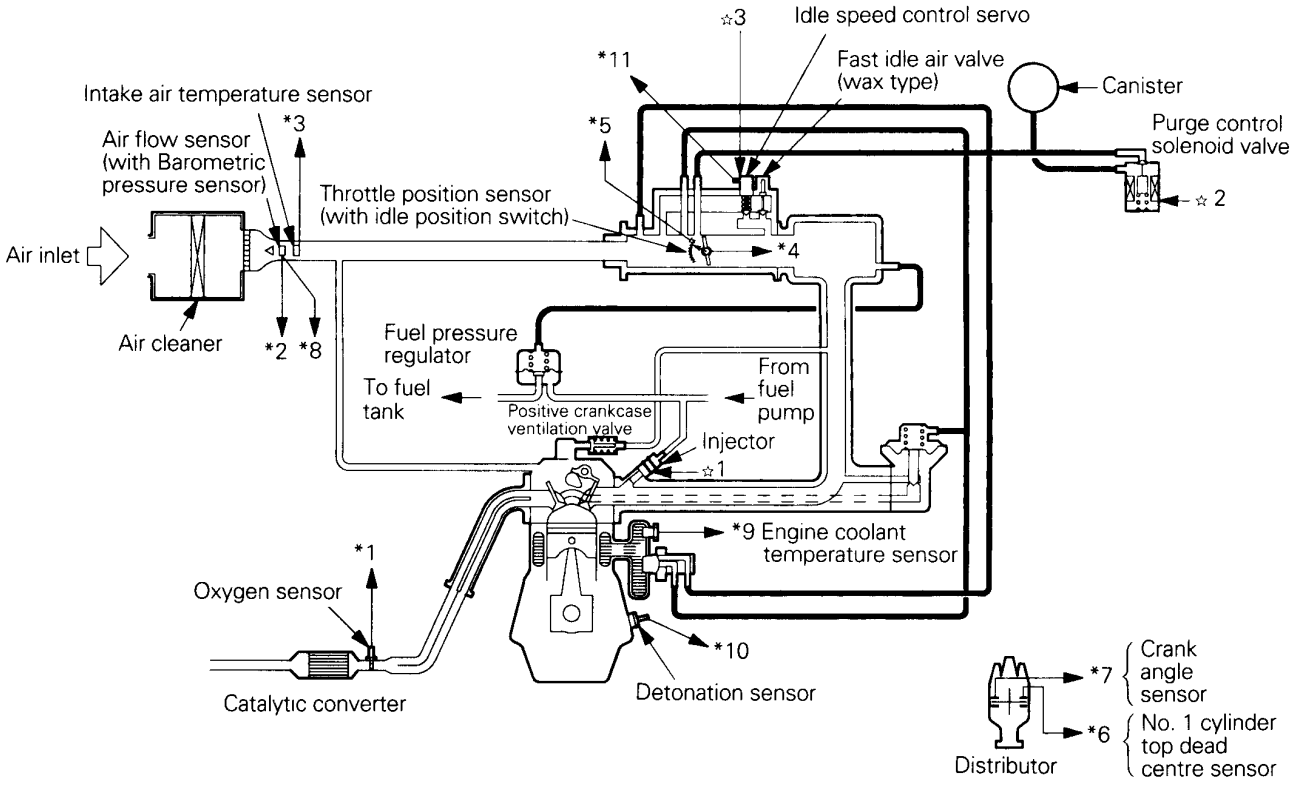
E13BBAJa

MULTI POINT INJECTION SYSTEM DIAGRAM

<4G63>

*1 Oxygen sensor *2 Air flow sensor *3 Intake air temperature sensor *4 Throttle position sensor *5 Idle position switch *6 No. 1 cylinder top dead centre sensor *7 Crank angle sensor *8 Barometric pressure sensor *9 Engine coolant temperature sensor *10 Detonation sensor *11 Servo valve position sensor	• Power supply voltage • Vehicle speed sensor • Air conditioner switch • Inhibitor switch • Power steering fluid pressure switch • Ignition switch-ST	⇨ Engine control unit ⇨

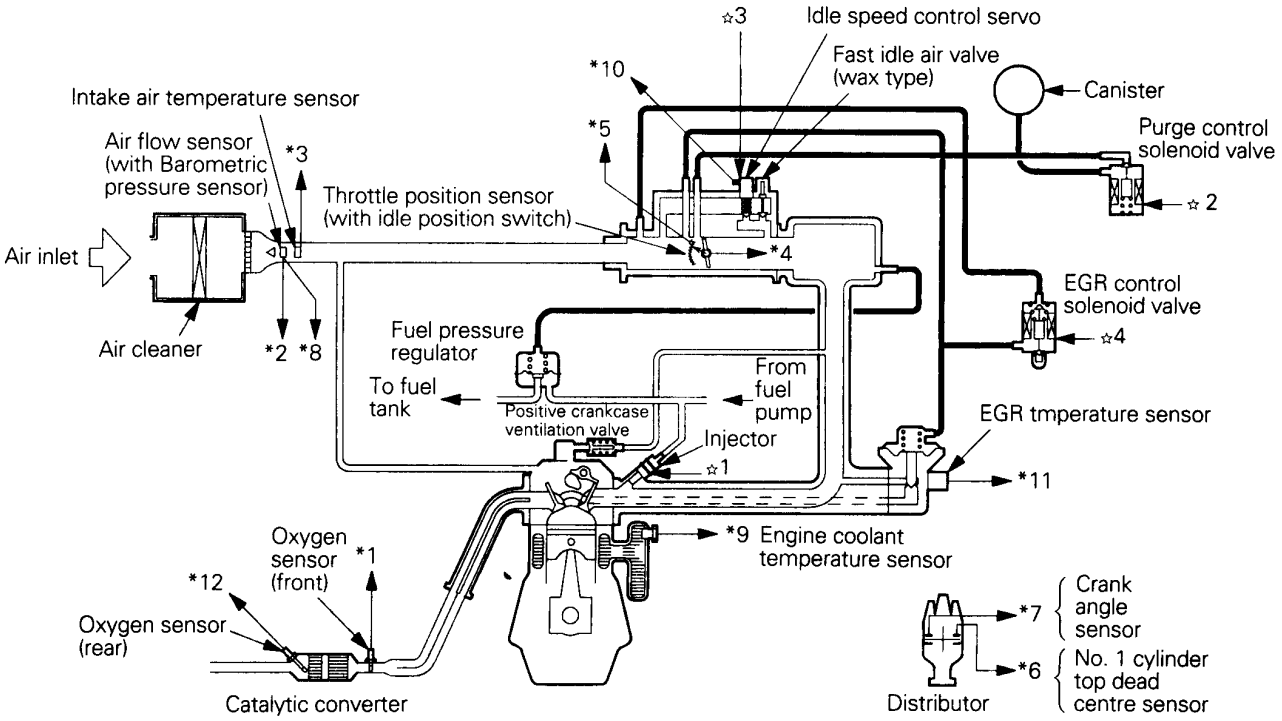
☆1 Injector
☆2 Purge control solenoid valve
☆3 Idle speed control servo
• Fuel pump control
• Control relay
• Air conditioner power relay
• Malfunction indicator lamp
• Self-diagnosis signal
• Ignition timing control



6FU1990

<4G64>

*1 Oxygen sensor (front) *2 Air flow sensor *3 Intake air temperature sensor *4 Throttle position sensor *5 Idle position switch *6 No. 1 cylinder top dead centre sensor *7 Crank angle sensor *8 Barometric pressure sensor *9 Engine coolant temperature sensor *10 Servo valve position sensor *11 EGR temperature sensor *12 Oxygen sensor (rear)	• Power supply voltage • Vehicle speed sensor • Air conditioner switch • Inhibitor switch • Power steering fluid pressure switch • Ignition switch-ST	⇨ Engine control unit ⇨	☆1 Injector ☆2 Purge control solenoid valve ☆3 Idle speed control servo ☆4 EGR control solenoid valve • Fuel pump control • Control relay • Air conditioner power relay • Malfunction indicator lamp • Self-diagnosis signal • Ignition timing control



6FU1991

SPECIFICATIONS

GENERAL SPECIFICATIONS

E13CA--

Items	Specifications
Fuel Tank capacity dm³ (U.S. gal., Imp. gal.)	60 (15.9, 13.2)
Fuel pump Type	Electrical, in-tank type
Throttle body Throttle bore mm (in.) Throttle position sensor Idle speed control servo Idle position switch Servo valve position sensor	 54 (1.97) Variable resistor type DC motor type DC motor type by-pass air control system with the Fast Idle Air Valve (FIAV) Rotary contact type, within throttle position sensor Hall element type
Engine control unit Identification model No. <4G63-2WD> <4G63-4WD> <4G64>	 E2T60575*1 E2T61586*2 E2T60576*1 E2T61587*2 E2T60572*1 E2T61578*2
Sensors Air flow sensor Barometric pressure sensor Intake air temperature sensor Engine coolant temperature sensor Oxygen sensor Vehicle speed sensor Inhibitor switch No. 1 cylinder top dead centre sensor Crank angle sensor Detonation sensor <4G63> Power steering fluid pressure switch	 Karman vortex type Semiconductor type Thermistor type Thermistor type Zirconia type Reed switch type Contact switch type Hall element type Hall element type Piezoelectric type Contact switch type
Actuators Control relay type Injector type and number Injector identification mark <4G63> <4G64> EGR control solenoid valve <4G64> Purge control solenoid valve	 Contact switch type Electromagnetic type, 4 MDH240 MDH275 Duty type solenoid valve ON/OFF type solenoid valve
Fuel pressure regulator Regulator pressure kPa (kg/cm², psi)	 335 (3.35, 47.6)

NOTE
*1: Vehicles built up to April, 1993
*2: Vehicles built from May, 1993

SERVICE SPECIFICATIONS

E13CB --

Items		Specifications
Basic ignition timing		5° ± 2° BTDC at curb idle
Curb idle speed	r/min.	750 ± 100
Idle speed when air conditioner is ON	r/min.	850 at neutral position
Basic idle speed	r/min.	750 ± 50
Throttle position sensor adjusting voltage	mV	400 – 1000
Throttle position sensor resistance	kΩ	3.5 – 6.5
Intake air temperature sensor resistance	kΩ	2.7 [at 20°C (68°F)]
Engine coolant temperature sensor resistance	kΩ	
20°C (68°F)		2.4
80°C (176°F)		0.3
Oxygen sensor output voltage	V	0.6 – 1.0
Fuel pressure	kPa (kg/cm², psi)	
Vacuum hose disconnection		330 – 350 (3.3–3.5, 47–50) at curb idle
Vacuum hose connection		Approx. 270 (2.7, 38) at curb idle
Injector coil resistance	Ω	13 – 16 [at 20°C (68°F)]
EGR control solenoid valve coil resistance	Ω	36 – 44 [at 20°C (68°F)]
Purge control solenoid valve coil resistance	Ω	36 – 44 [at 20°C (68°F)]

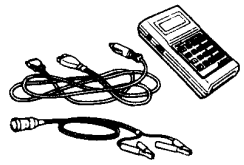
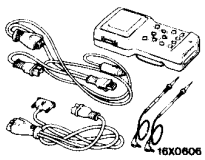
SEALANT

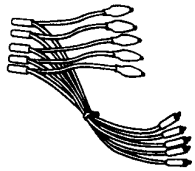
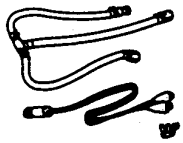
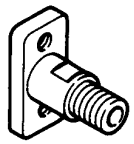
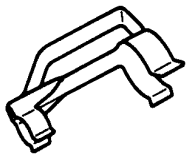
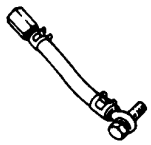
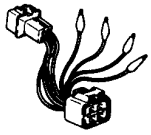
E13CE --

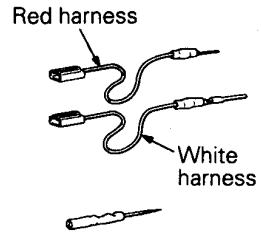
Items	Specified sealant	Characteristics
Engine coolant temperature sensor threaded portion	3M Nut Locking Part No. 4171 or equivalent	Drying sealant

SPECIAL TOOLS

E13DA --

Tool	Number	Name	Use
	MB991341	Multi-use tester (MUT) sub assembly	<Up to 1993 models> • Reading diagnosis code • MPI system inspection
	For the number, refer to GROUP 00 – Precaution Before Service.	ROM pack	
	MB991502	MUT-II sub assembly	<All models> • Reading diagnosis code • MPI system inspection
		ROM pack	

Tool	Number	Name	Use
	MB991348	Test harness set	• Adjustment of idle position switch and throttle position sensor • Inspection using an analyzer.
	MD998706	Injector test set	Checking the spray condition of injectors.
	MD998741	Injector test adapter	
	MD998746	Clip	
	MD998709	Adapter hose	Measurement of fuel pressure
	MD998742	Hose adapter	
	MD998464	Test harness (4 pin, square)	Checking the oxygen sensor (front)

Tool	Number	Name	Use
	MB991223	Inspection test harness set • Pin contact pressure inspection harness • Market tester contact probe (for general connectors	Measurement of terminal voltage

TROUBLESHOOTING

E13EFAMa

EXPLANATION OF TROUBLESHOOTING PROCEDURES

Refer to P.13-9

EXPLANATION AND CAUTIONS FOR CIRCUIT CHECKING

Refer to P.13 – 10

ENGINE WARNING LAMP (CHECK ENGINE LAMP)

Refer to P.13 – 12

ITEMS INDICATED BY THE ENGINE WARNING LAMP

Engine control unit
Oxygen sensor <4G63>
Oxygen sensor (front) <4G64>
Air flow sensor
Intake air temperature sensor
Throttle position sensor
Engine coolant temperature sensor
Crank angle sensor
Top dead centre sensor (No. 1 cylinder top dead centre)
Barometric pressure sensor
Detonation sensor <4G63>
Ignition timing adjustment signal
Injector
EGR system <4G64>
Oxygen sensor (rear) <4G64>

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
Refer to P.13 – 13

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 occured, memorizes the malfunction code, and outputs the signal to the self-diagnosis output terminal.
There are 17 diagnosis items, including the normal state, and the diagnosis results can be read out with a multi-use tester (MUT) or MUT-II.
Moreover, since memorization of the malfunction codes is backed up directly by the battery, the diagnosis results are memorized even if the ignition key is turned off. The malfunction codes will, however, be erased when the battery terminal or the engine control unit connector is disconnected.
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 or MUT-II 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 or MUT-II to the engine control unit and the diagnosis memory will be erased.

The 17 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)
		No.	Memory	
1	Engine control unit	–	–	(Replace engine control unit)
2	Oxygen sensor <4G63> Oxygen sensor (front) <4G64>	11	Retained	• Harness and connector • Fuel pressure • Injectors (Replace if defective.) • Intake air leaks • Oxygen sensor
3	Air flow sensor	12	Retained	• Harness and connector (If harness and connector are normal, replace air flow sensor assembly.)
4	Intake air temperature sensor	13	Retained	• Harness and connector • Intake air temperature sensor
5	Throttle position sensor	14	Retained	• Harness and connector • Throttle position sensor • Idle position switch
6	Engine coolant temperature sensor	21	Retained	• Harness and connector • Engine coolant temperature sensor
7	Crank angle sensor	22	Retained	• Harness and connector (If harness and connector are normal, replace distributor assembly.)
8	No. 1 cylinder top dead centre sensor	23	Retained	• Harness and connector (If harness and connector are normal, replace distributor assembly.)

Output preference order	Diagnosis item	Malfunction code		Check item (Remedy)
		No.	Memory	
9	Vehicle speed sensor (reed switch)	24	Retained	• Harness and connector • Vehicle speed sensor (reed switch)
10	Barometric pressure sensor	25	Retained	• Harness and connector (If harness and connector are normal, replace barometric pressure sensor assembly)
11	Detonation sensor <4G63>	31	Retained	• Harness and connector (If harness and connector are normal, replace detonation sensor)
12	Ignition timing adjustment signal	36	—	• Harness and connector
13	Injector	41	Retained	• Harness and connector • Injector coil resistance
14	EGR <4G64>	43	Retained	• Harness and connector • EGR valve • EGR control solenoid valve • EGR valve control vacuum • EGR temperature sensor
15	Servo valve position sensor	55	Retained	• Harness and connector • Servo valve position sensor • Idle speed control servo (DC motor)
16	Oxygen sensor (rear) <4G64>	59	Retained	• Harness and connector • Oxygen sensor
17	Normal state	—	—	—

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	Remark (Trouble symptom, etc.)
—	Engine control unit	Abnormality in engine control unit	—	• Engine stalls • Starting is impossible
11	Oxygen sensor <4G63> Oxygen sensor (front) <4G64>	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 (6) Engine control unit malfunction	• Reduction in exhaust gas purification* • Poor starting • Unstable idling • Poor acceleration
12	Air flow sensor	Frequency of air flow sensor signal is 10Hz or less, even though engine is running.	(1) Air flow sensor malfunction (2) Open circuit or short circuit in air flow sensor, or connector contact is defective. (3) Engine control unit malfunction.	• Poor acceleration* • Inappropriate idle speed* • Unstable idling*
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 (3) Engine control unit malfunction	• 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 (5) Engine control unit malfunction	• Engine stalls • Racing is impossible

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remark (Trouble symptom, etc.)
21	Engine coolant temperature sensor	(1) Voltage of engine coolant temperature sensor signal is 4.6V or more. (2) Voltage of engine coolant temperature sensor signal is 0.11V or less. (3) While engine is warming up, engine coolant temperature sensor signal shows a drop in engine coolant temperature.	(1) Engine coolant temperature malfunction (2) Open circuit or short circuit in engine coolant temperature sensor, or connector contact is defective (3) Engine control unit malfunction	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 (3) Engine control unit malfunction	• 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 (3) Engine control unit malfunction	• 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 3000 r/min or more.	(1) Vehicle speed sensor malfunction (2) Open circuit or short circuit in vehicle speed sensor, or connector contact is defective (3) Engine control unit malfunction	Engine stalls when vehicle stops after decelerating

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remark (Trouble symptom, etc.)
25	Barometric pressure sensor	(1) Voltage of barometric pressure sensor signal is 4.5 V or more. (2) Voltage of barometric pressure sensor signal is 0.2V or less	(1) Barometric pressure sensor malfunction (2) Open circuit or short circuit in barometric pressure sensor, or connector contact is defective (3) Engine control unit malfunction	• Reduction in exhaust gas purification efficiency* • Poor starting • Unstable idling • Poor acceleration
31	Detonation sensor <4G63>	Detonation sensor signal voltage is abnormal.	(1) Detonation sensor malfunction (2) Open circuit or short circuit in detonation sensor, or connector contact is defective (3) Engine control unit malfunction	• Poor acceleration*
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 (2) Engine control unit malfunction	• 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 (3) Engine control unit malfunction	• Reduction in exhaust gas purification efficiency* • Poor starting • Unstable idling • Poor acceleration
43	EGR <4G64>	During driving after engine warm-up; (1) Volume of EGR is scarce. (EGR temperature sensor signal voltage is too high.) (2) EGR temperature sensor signal voltage is below 0.1V.	(1) EGR valve does not open. (2) EGR valve control negative pressure is too low. (3) EGR control solenoid valve is defective. (4) EGR temperature sensor is defective. (5) EGR temperature sensor circuit is broken, short-circuited or poor contact of connector. (6) Engine control unit malfunction	• Reduction in exhaust gas purification efficiency

Malfunction code No.	Diagnosis item	Diagnosis contents	Probable cause	Remark (Trouble symptom, etc.)
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 (5) Engine control unit is malfunction	• Inappropriate idle speed* • Engine stops* • Unstable idling*
59	Oxygen sensor (rear) <4G64>	Voltage of oxygen sensor signal is not 0.1 V or more even though engine has been warmed up.	(1) Oxygen sensor malfunction. (2) Open circuit or short circuit in oxygen sensor circuit, or connector contact is defective. (3) Engine control unit is malfunction.	• Reduction in exhaust gas purification efficiency

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
Air flow 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 25°C (77°F).
Throttle position sensor (TPS)	No increase in fuel injection amount during acceleration due to the throttle position sensor signal.
Engine coolant temperature sensor	Controls as if the engine 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.)
Barometric pressure sensor	Controls as if the barometric pressure is 101kPa (760 mmHg, 30 in.Hg).
Detonation sensor	Retards the ignition timing from normal ignition timing to timing where knocking doesn't occur.
Servo valve position sensor	Idle speed control is not performed.
Oxygen sensor <4G63> Oxygen sensor (front) <4G64>	Air/fuel ratio feedback control (closed loop control) is not performed.
Oxygen sensor (rear) <4G64>	Installed at the front side of the catalytic converter. Air/fuel ratio feedback control (closed loop control) is performed using only oxygen sensor (front) signal.

READ OUT OF MALFUNCTION CODE

Refer to P.13 – 20

CHECK CHART CLASSIFIED BY PROBLEM SYMPTOMS

Problem symptoms / Check items	Starting		Idling Stability			Driving						Stopping	Reference page
	Will not start	Starting problem	Idling instability (Rough idling)	Incorrect idling speed	Improper idling continuity	Hesitation, sag	Poor acceleration	Stumble	Shock	Surge	Knocking	Run-on (Dieseling)	
Power supply	①1												P.13-34
Engine control unit power earth	②2												P.13-37
Fuel pump	③3	①1			①1	①1	①1						P.13-38
Air flow sensor					⑫⑩	⑨9		⑤5	⑥6		④4		P.13-109-21
Intake air temperature sensor			⑥			⑤5	④4				②2		P.13-4
Barometric pressure sensor			⑧			⑧8	⑥6				③3		P.13-48
Engine coolant temperature sensor		3	⑦6	①1	⑥6	⑦7	⑤5	④4		③3			P.13-23
Throttle position sensor						⑥6		③3	④4				P.13-53
Idle position switch			④4	②2	⑤5								P.13-56
Servo valve position sensor			③3	⑦3	④				⑤5				P.13-58
Top dead centre sensor	⑤5	⑥7			⑨8				②2				P.13-61
Crank angle sensor	⑥6	⑦8			⑩9				③3				P.13-109-26
Ignition switch-ST <M/T>	④4	③4											P.13-69
Ignition switch-ST and inhibitor switch <A/T>	④4	③4		⑥									P.13-71-1
Vehicle speed sensor					⑦				⑦				P.13-72
Power steering fluid pressure switch				③									P.13-74
Air conditioner switch and power relay				④									P.13-78
Fan motor relay and air conditioning refrigerant middle pressure switch <From May, 1993>				⑤									P.13-109-27-3
Detonation sensor <4G63>											①1		P.13-80
Oxygen sensor			⑩										P.13-109-30 <4G63> P.13-109-33 <4G64>
Injectors	⑧8	②2	②2		③3	②2	②2	①1		①1		①	P.13-109-36
Idle speed control servo (DC motor)		④5	①1	⑧4	②2				⑨7				P.13-91
Ignition coil and power transistor	⑦7				⑪⑩		⑦7		①1		⑤5		P.13-109-38
Purge control solenoid valve			⑨										P.13-98
EGR control solenoid valve <4G64>						④4		⑥6		④4			P.13-109-39
Anti-skid brake signal <4WD-M/T>									⑧				P.13-102
Fuel pressure		⑤6	⑤5		⑧7	③3	③3	②2		②2			P.13-103

○ : Warm engine (number inside indicates check order)
□ : Cold engine (number inside indicates check order)

PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

Refer to P.13–22

SERVICE ADJUSTMENT PROCEDURES

THROTTLE BODY (THROTTLE VALVE AREA) CLEANING E13HAJDa

Refer to P.13 – 23

IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT E13HAKGa

Refer to P.13 – 23

FIXED SAS ADJUSTMENT E13HAMDa

Refer to P.13 – 25

BASIC IDLE SPEED ADJUSTMENT E13HANFa

Refer to P.13 – 25

Standard value: 750 ± 50 r/min.

ACCELERATOR CABLE INSPECTION AND ADJUSTMENT

Refer to P.13 – 27

E13FCBCa

FUEL FILTER REPLACEMENT

Refer to P.13 – 27

E13FZAOa

FUEL GAUGE UNIT REPLACEMENT

Refer to P.13 – 28

E13FDAEa

TWO-WAY VALVE REPLACEMENT

Refer to P.13 – 28

E13FFAEa

FUEL PUMP OPERATION CHECK

Refer to P.13 – 29

E13FGCDa

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

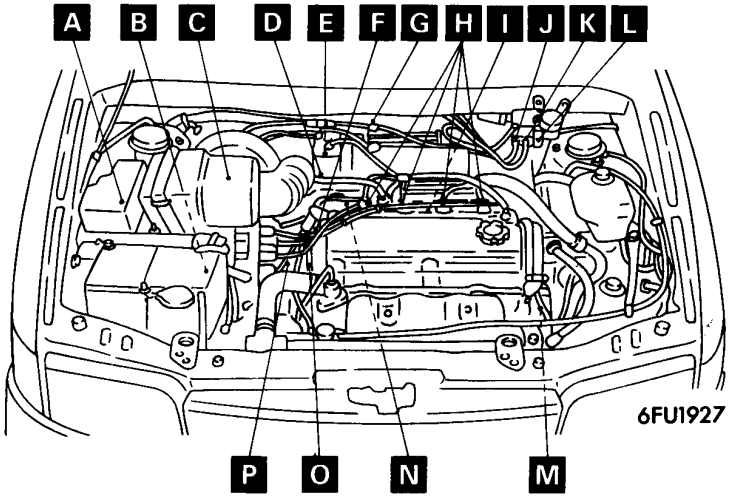
Refer to P.13 – 29

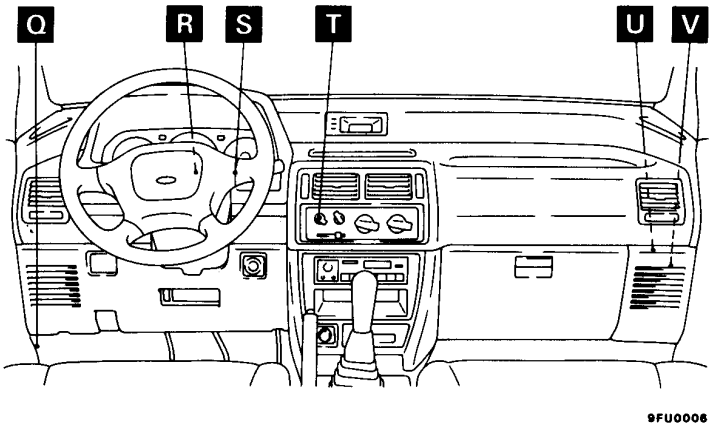
E13HABIa

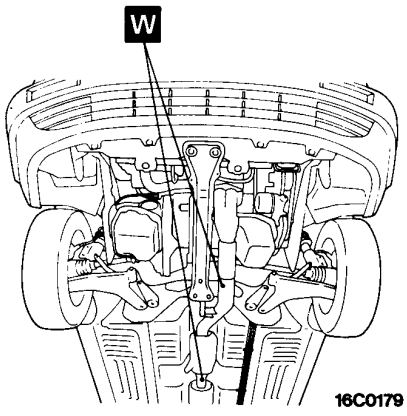
ON VEHICLE INSPECTION OF MPI COMPONENTS

COMPONENTS LOCATION

Name	Symbol	Name	Symbol
Air conditioner relay	A	Fuel pump check terminal	G
Air conditioner switch	T	Idle speed control servo	E
Air flow sensor (with incorporated intake air temperature sensor and barometric pressure sensor)	C	Ignition coil (power transistor unit)	P
		Ignition timing adjustment terminal	L
Control relay	V	Inhibitor switch (A/T)	B
Diagnosis connector	Q	Injector	H
Detonation sensor <4G63>	I	Oxygen sensor	W
EGR control solenoid valve <4G64>	J	Power steering fluid pressure switch	M
EGR temperature sensor <4G64>	N	Purge control solenoid valve	K
Engine control unit	U	Throttle position sensor (with idle position switch)	D
Engine coolant temperature sensor	F	Top dead centre sensor and crank angle sensor	O
Engine warning lamp (check engine lamp)	S	Vehicle speed sensor (reed switch)	R







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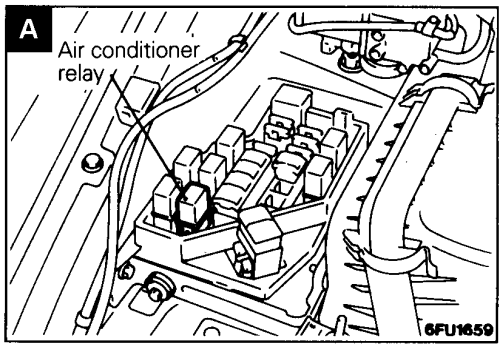
Air conditioner relay
6FU1659

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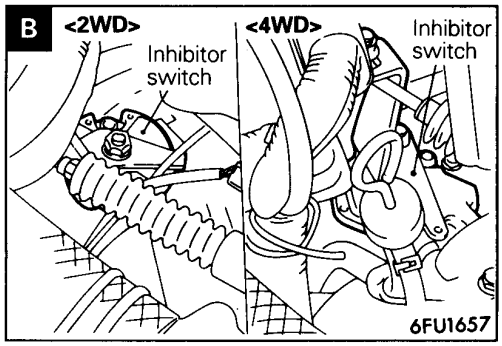
<2WD>
Inhibitor switch
<4WD>
Inhibitor switch
6FU1657

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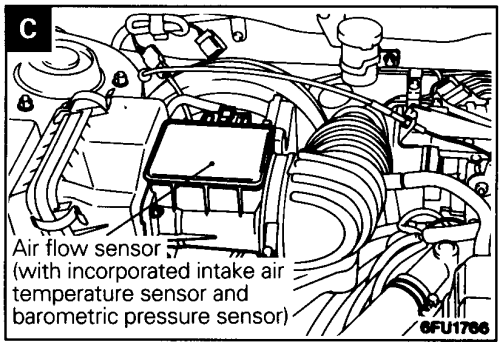
Air flow sensor (with incorporated intake air temperature sensor and barometric pressure sensor)
6FU1766

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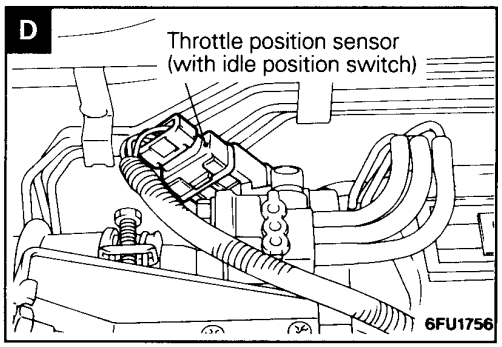
Throttle position sensor (with idle position switch)
6FU1756

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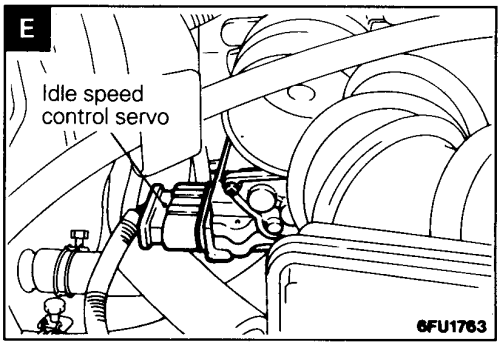
Idle speed control servo
6FU1763

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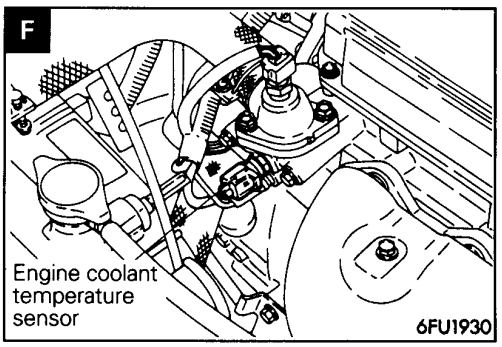
Engine coolant temperature sensor
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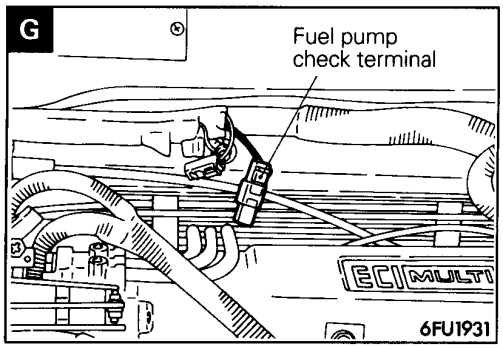
Fuel pump check terminal
ECI MULTI
6FU1931

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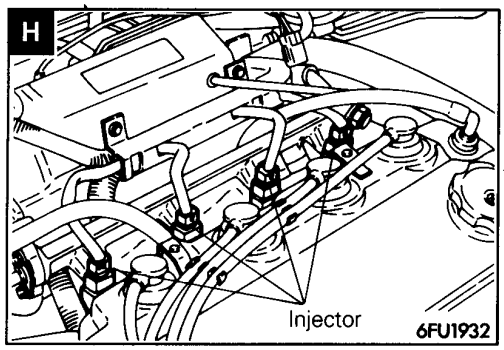
Injector
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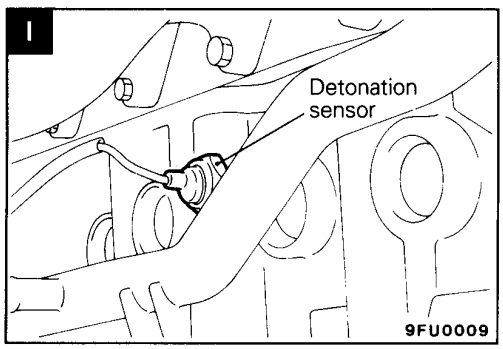
Detonation sensor
9FU0009

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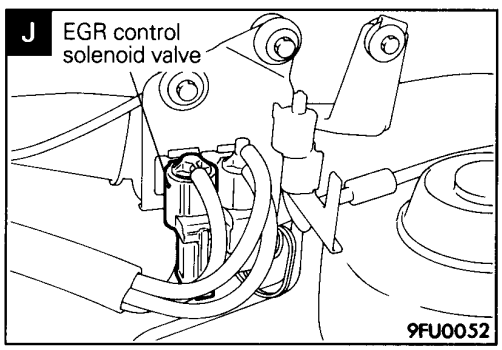
EGR control solenoid valve
9FU0052

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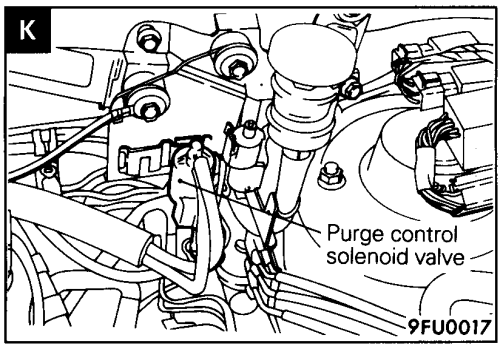

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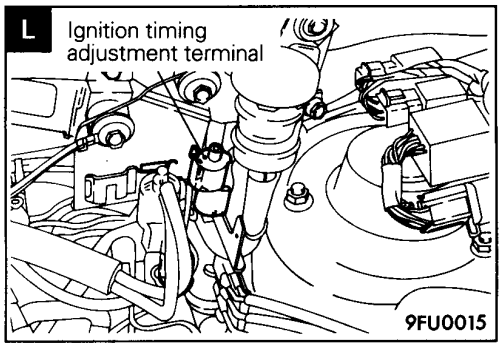

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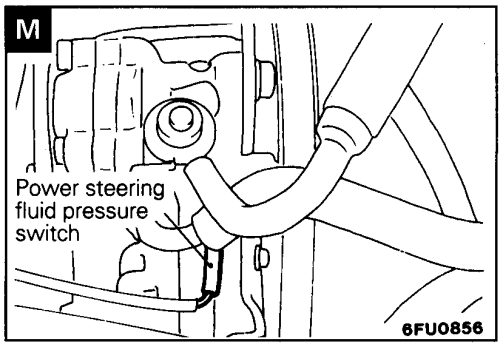

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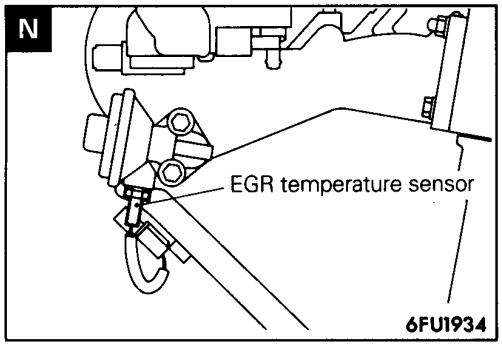

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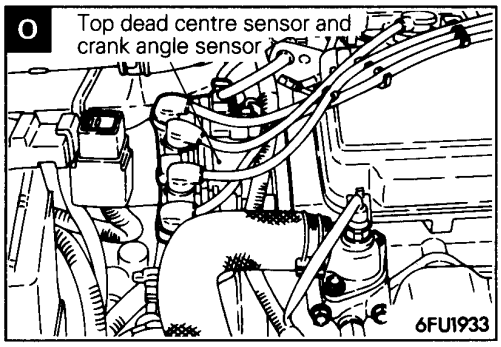

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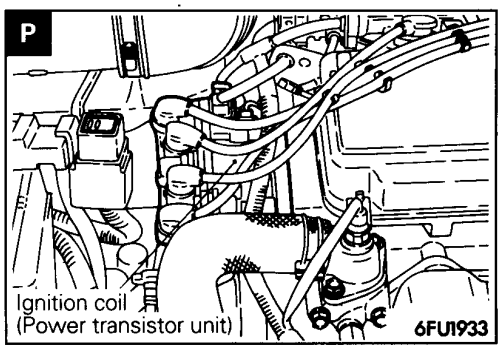

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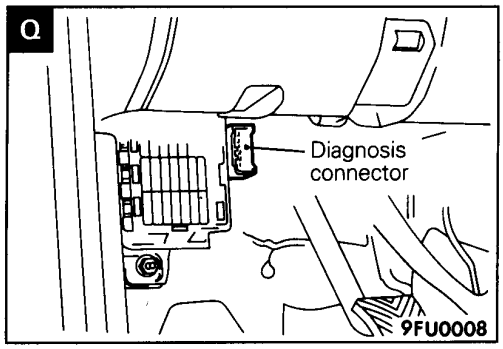

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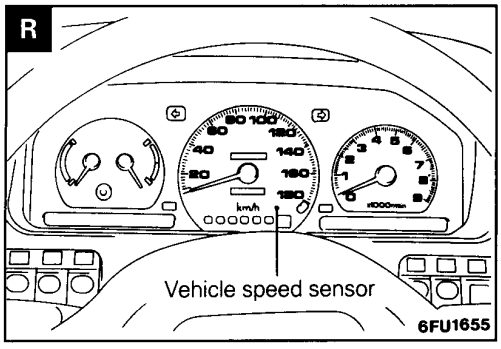

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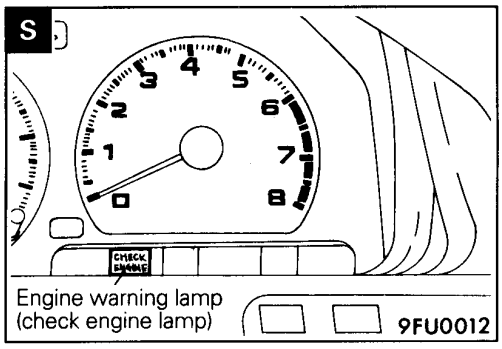

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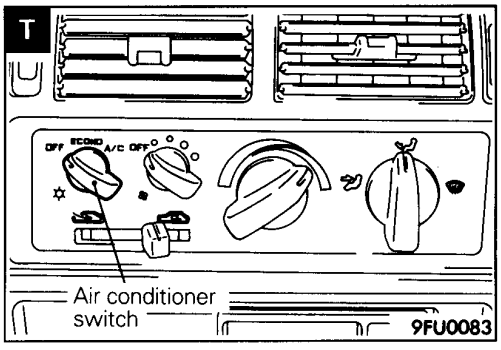

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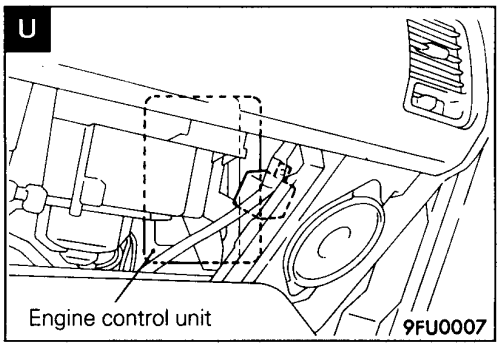
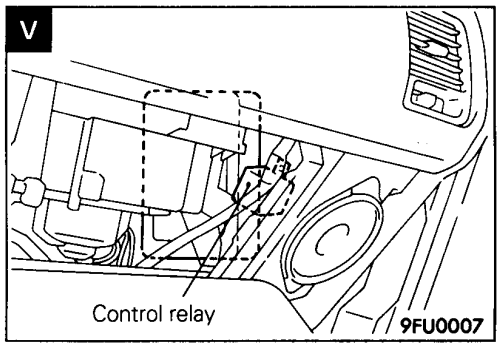
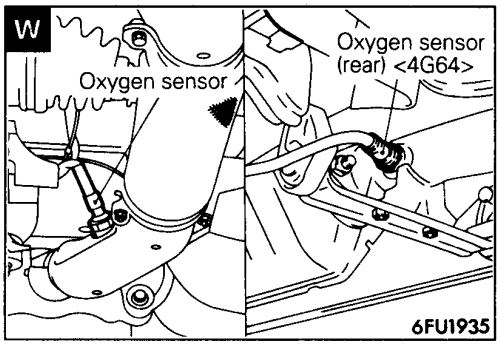






INSPECTION PROCEDURE USING THE MULTI-USE TESTER (MUT) OR MUT-II

Refer to P.13–33

POWER SUPPLY

Refer to P.13 – 34

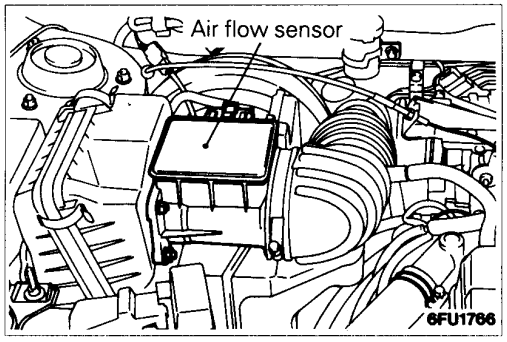
ENGINE CONTROL UNIT POWER EARTH

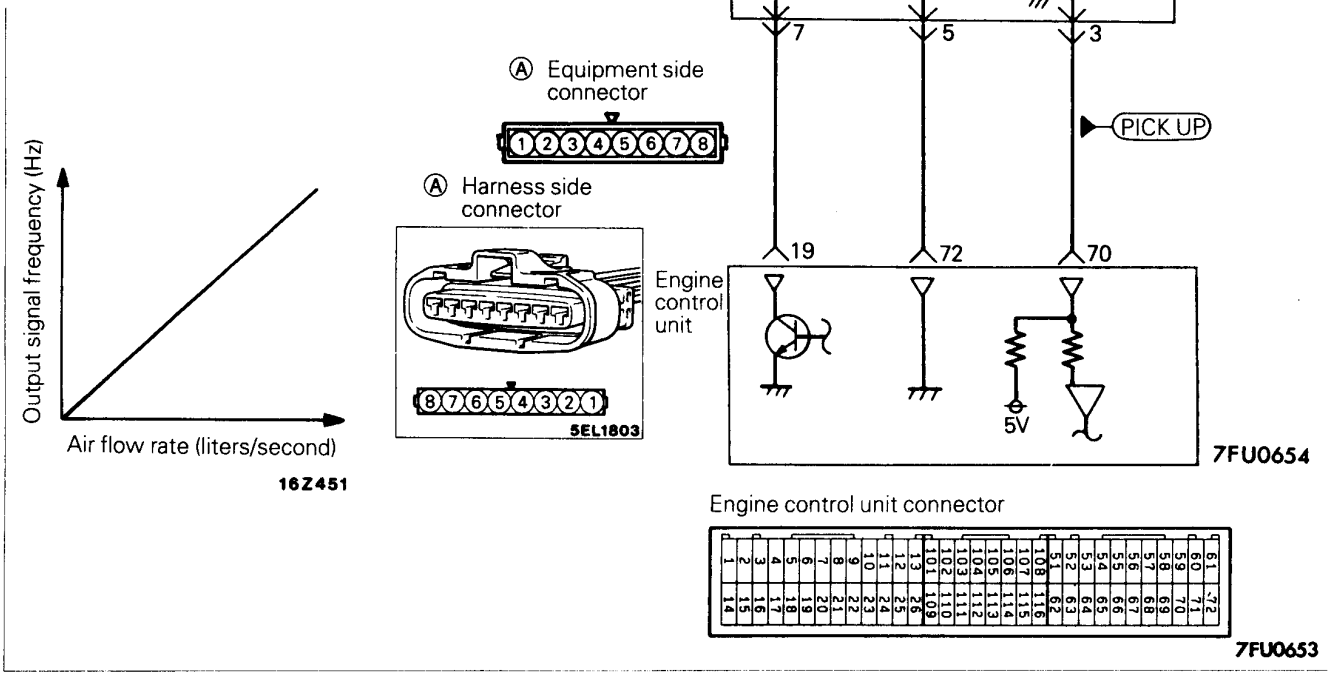
Refer to P.13 – 37

FUEL PUMP

Refer to P.13 – 38

AIR FLOW SENSOR





OPERATION

Refer to P.13 – 41

TROUBLESHOOTING HINTS

Refer to P.13 – 41

INSPECTION

Using Multi-use Tester (MUT) or MUT-II

<Air Flow sensor>

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	12	Sensor air volume (frequency)	• Engine coolant temperature: 80 to 95°C (176 to 203°F) • Lamps, electric cooling fan, accessories: OFF • Transmission: Neutral (P range for A/T) • Steering wheel: Neutral	Idle	19– 45 Hz <4G63> 18– 44 Hz <4G64>
				2,000 r/min.	50– 90 Hz <4G63> 43– 83 Hz <4G64>
				Racing	Frequency increases with racing

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

Wave Pattern Inspection Using an Analyzer

Refer to P.13 – 42

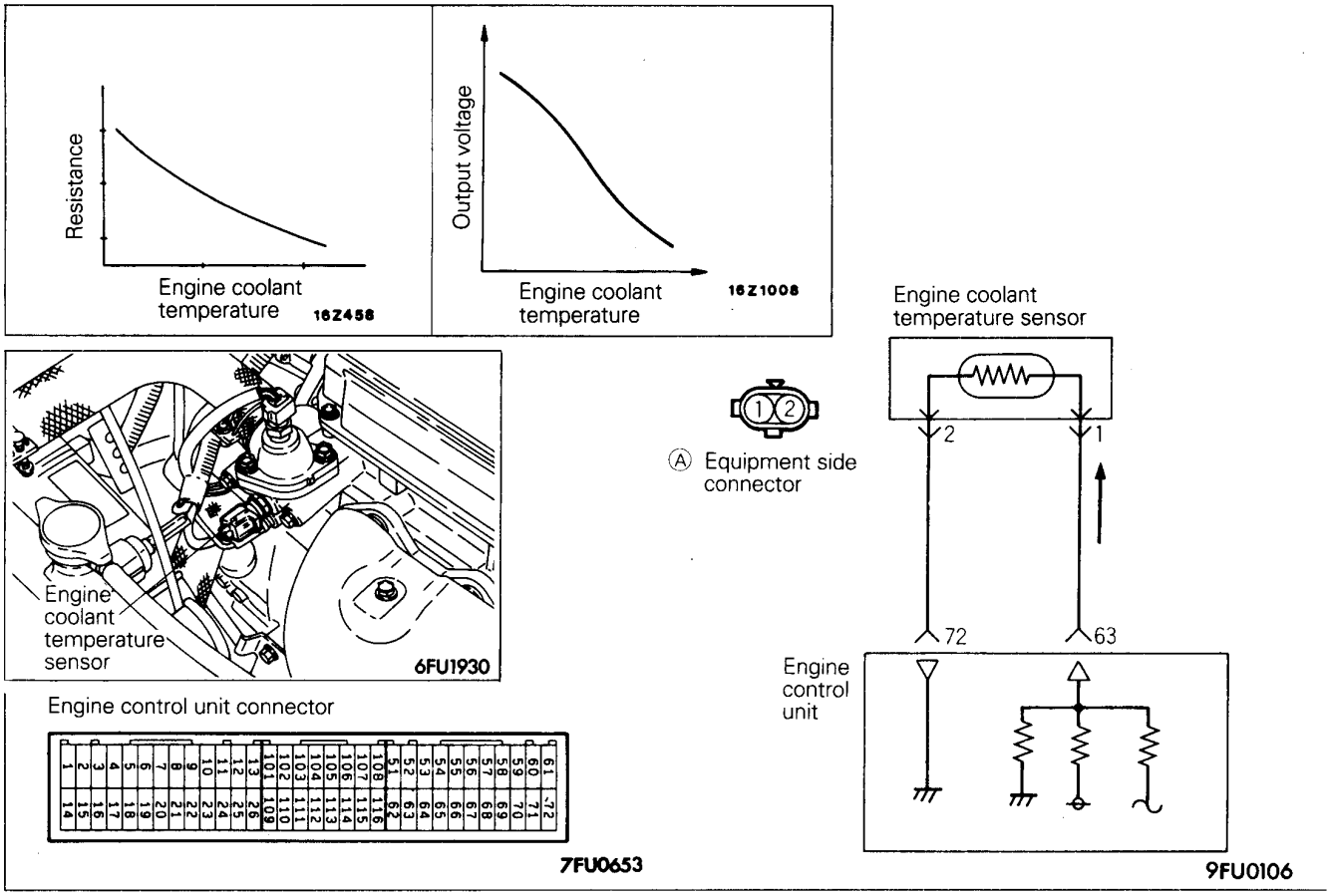
INTAKE AIR TEMPERATURE SENSOR

Refer to P.13 – 45

BAROMETRIC PRESSURE SENSOR

Refer to P.13 – 48

ENGINE COOLANT TEMPERATURE SENSOR



OPERATION

Refer to P.13 – 50

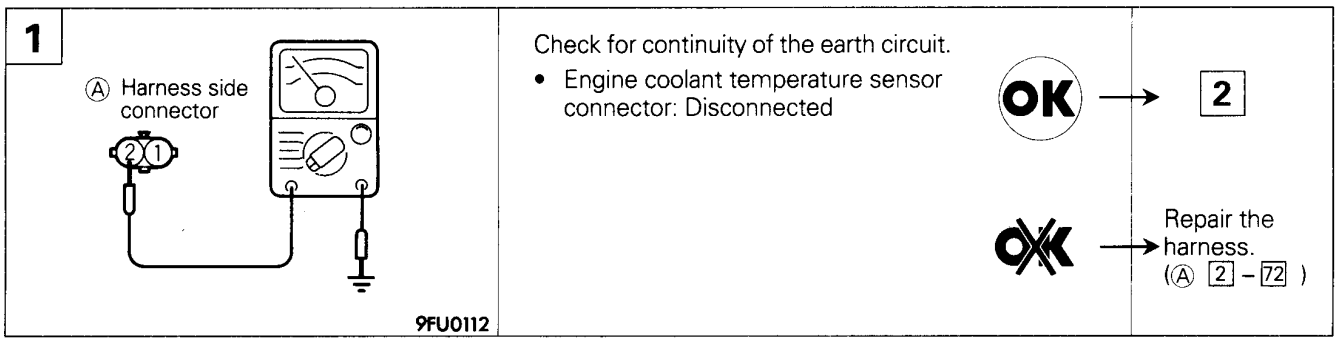
TROUBLESHOOTING HINTS

Refer to P.13 – 50

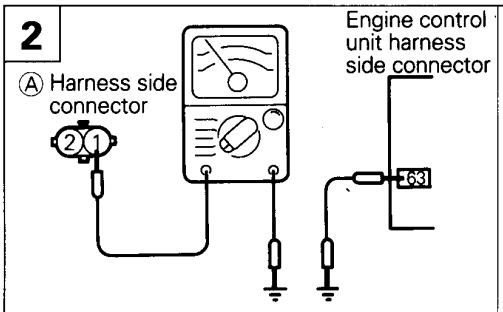
INSPECTION

Refer to P.13 – 51

HARNESS INSPECTION



2



9FU0113

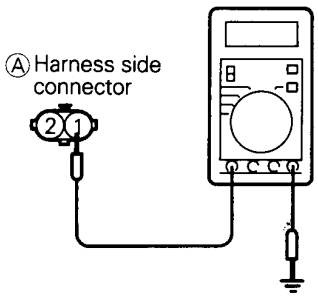
Check for open circuit, or short-circuit to earth, between engine coolant temperature and engine control unit.

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

OK → 3

NG → Repair the harness. (Ⓐ1 – 63)

3



9FU0114

Measure the impressed voltage.

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

Voltage (V)
4.5 – 4.9

OK → STOP

NG → Replace the engine control unit.

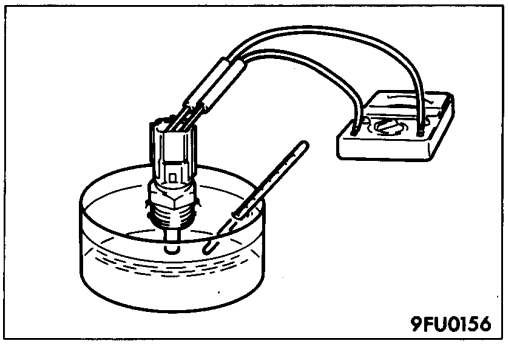
SENSOR INSPECTION

Caution

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

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

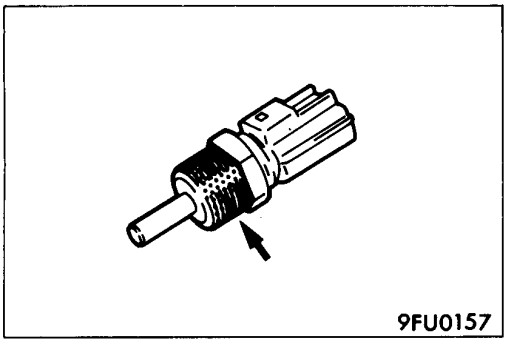
(2) With temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.



9FU0156

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

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



9FU0157

INSTALLATION

(1) Apply sealant to threaded portion.

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

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

Sensor tightening torque: 30 Nm (3kgm, 22ft.lbs.)

(3) Fasten harness connectors securely.

THROTTLE POSITION SENSOR

Refer to P. 13 – 53.

IDLE POSITION SWITCH

Refer to P. 13 – 56

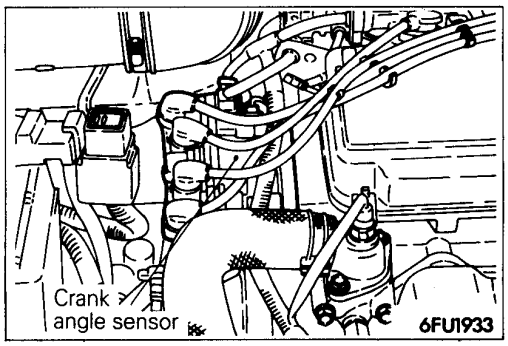
SERVO VALVE POSITION SENSOR

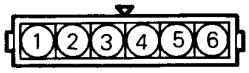
Refer to P.13 – 58

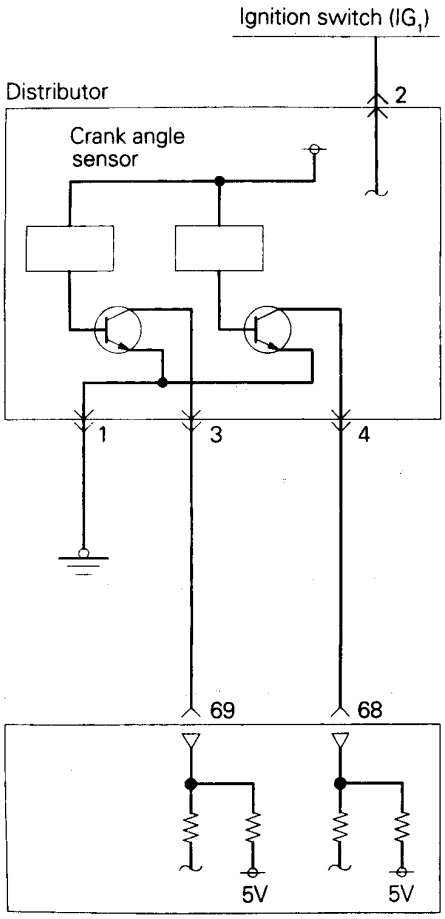
TOP DEAD CENTRE SENSOR

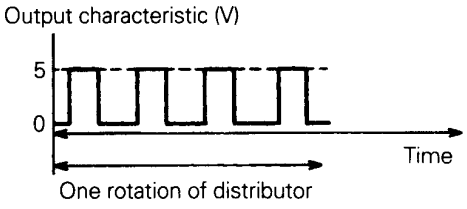
Refer to P.13 – 61

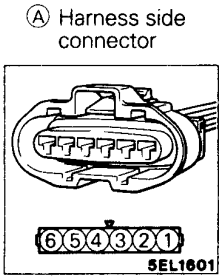
CRANK ANGLE SENSOR

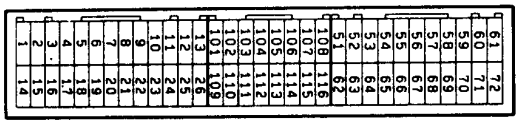












7FU0653

9FU0390

OPERATION

Refer to P.13 – 66

TROUBLESHOOTING HINTS

Refer to P.13 – 66

INSPECTION

Using Multi-use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Check content	Normal states
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 multi-use tester 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)	1275–1475 rpm <4G63> 1300–1500 rpm <4G64>
				0°C (32°F)	1220–1420 rpm <4G63> 1300–1500 rpm <4G64>
				20°C (68°F)	1100–1300 rpm <4G63> 1150–1350 rpm <4G64>
				40°C (104°F)	950–1150 rpm
				80°C (176°F)	650–850 rpm

Wave Pattern Inspection Using an Analyzer

Refer to P.13 – 62

HARNESS INSPECTION

Refer to P.13 – 68

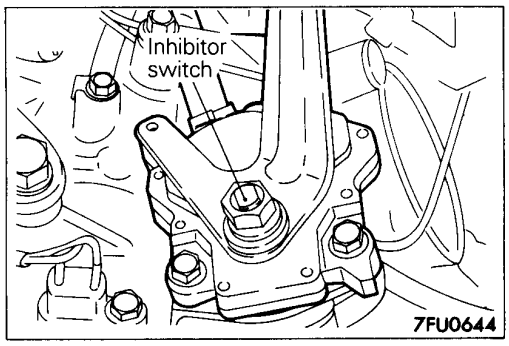
IGNITION SWITCH-ST <M/T>

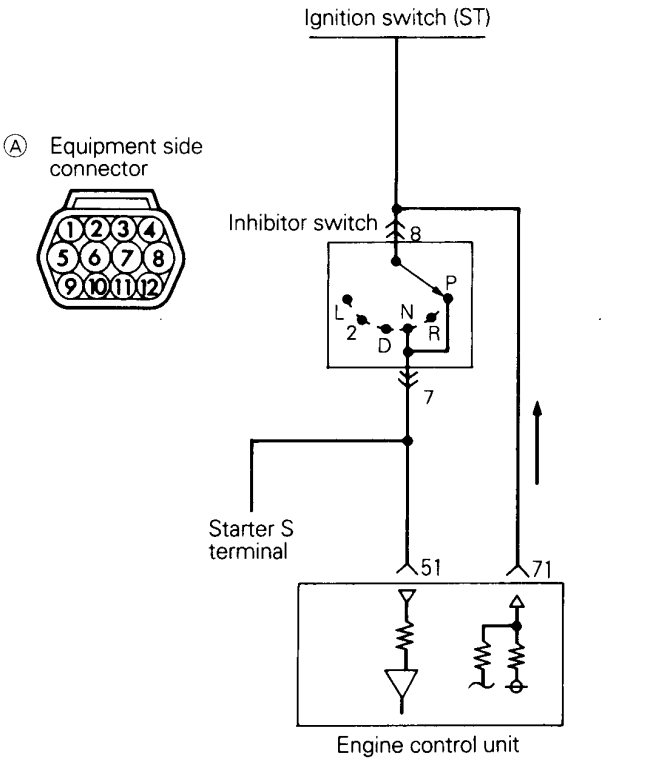
Refer to P.13 – 69

IGNITION SWITCH-ST AND INHIBITOR SWITCH <A/T–except 4WD vehicles built from June, 1992>

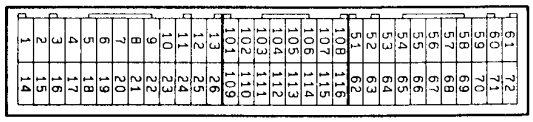
Refer to P.13 – 71 – 1

IGNITION SWITCH-ST AND INHIBITOR SWITCH <A/T–4WD vehicles built from June, 1992>





Engine control unit connector



7FU0653

OPERATION
Refer to P.13 – 70.

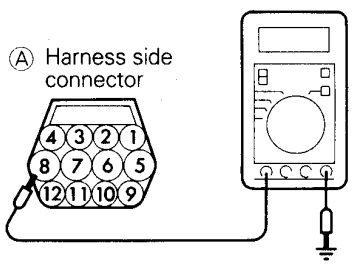
TROUBLESHOOTING HINTS
Refer to P.13 – 70.

INSPECTION
Refer to P.13 – 71.

HARNESS INSPECTION

1

Ⓐ Harness side connector



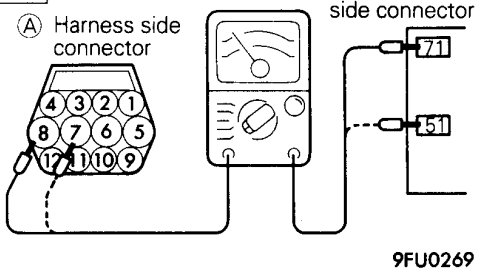
Measure the power supply voltage of the inhibitor switch.
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected
- Ignition switch: START

Voltage (V)
SV

OK → 2

NG → Check the power supply circuit

2



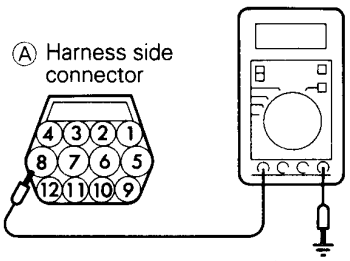
Check for continuity between inhibitor switch and engine control unit.
- Engine control unit connector: Disconnected
- Inhibitor switch connector: Disconnected

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

OK → 3

NG → Repair the harness. (Ⓐ8 – 71) (Ⓐ7 – 51)

3



Measure the impressed voltage to inhibitor switch terminal
- Engine control unit connector: Connected
- Inhibitor switch connector: Disconnected
- Ignition switch: ON

Voltage (V)
SV

OK → STOP

NG → Replace the engine control unit.

VEHICLE SPEED SENSOR

Refer to P.13 – 72

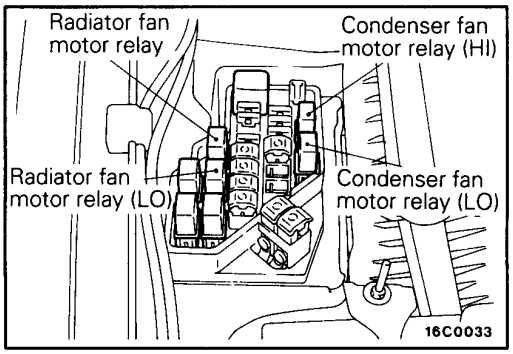
POWER STEERING FLUID PRESSURE SWITCH

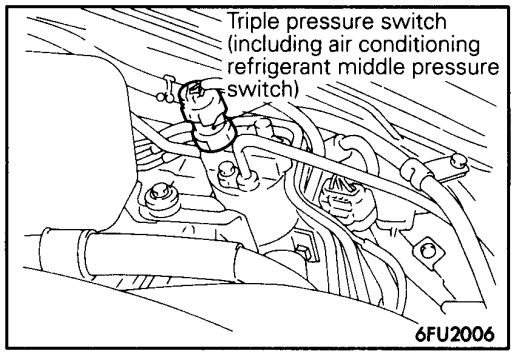
Refer to P.13 – 74

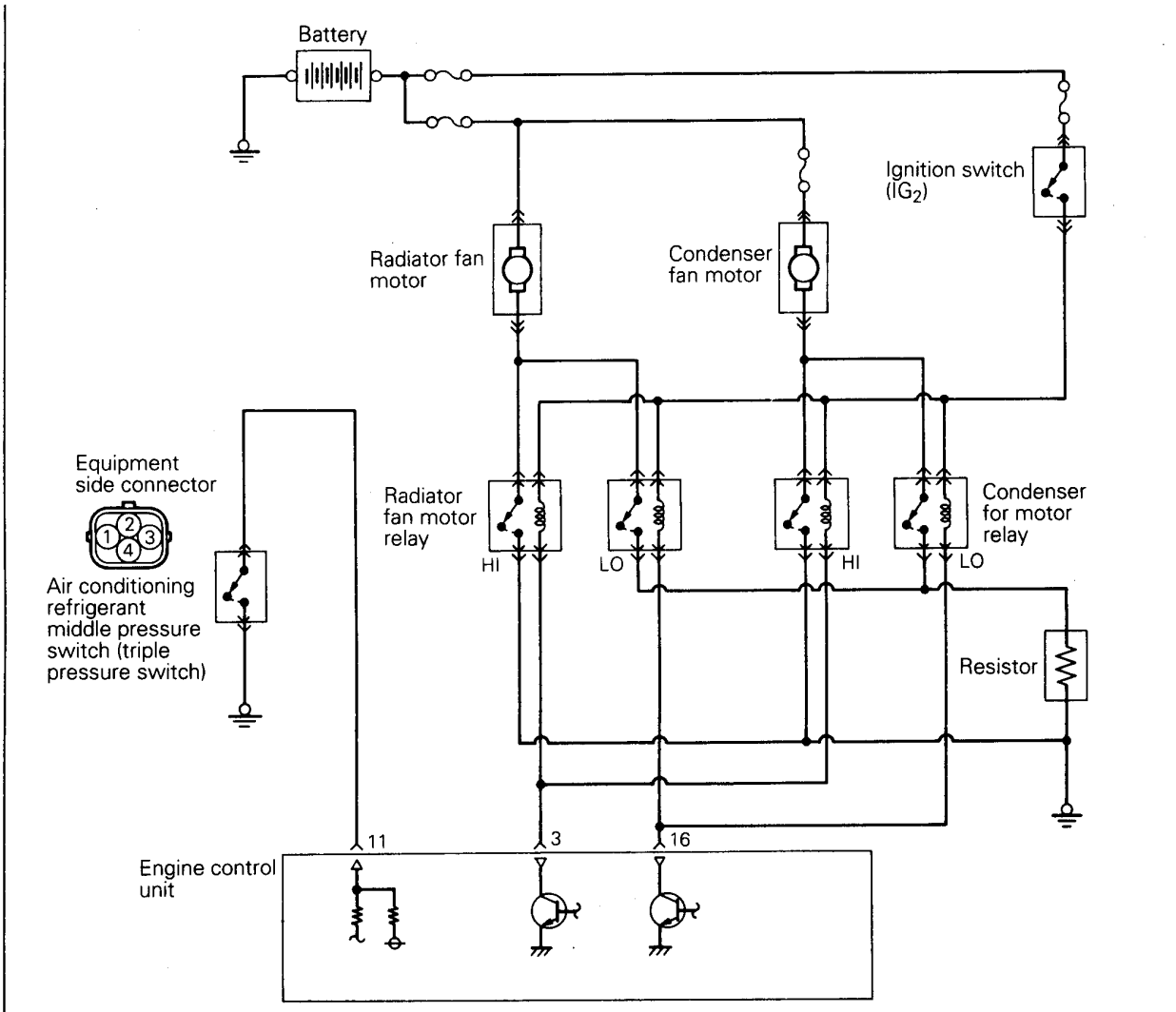
AIR CONDITIONER SWITCH AND POWER RELAY

Refer to P.13 – 78

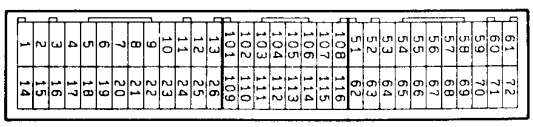
FAN MOTOR RELAY AND AIR CONDITIONING REFRIGERANT MIDDLE PRESSURE SWITCH <Vehicles built from May, 1993>







Engine control unit connector



OPERATION

- The engine control unit controls the operation speed of the radiator fan motor and condenser fan motor in accordance with the engine coolant temperature and vehicle speed by controlling the power transistors (low-speed side and high-speed side) inside the engine control unit.
- When the engine control unit turns the low-speed side power transistor inside the engine control unit ON, the radiator fan motor relay (LO) operates and current for driving the radiator fan motor (low-speed operation) is supplied from the battery to the engine control unit.
  When current flows to the fan motor relay coil, the relay switch turns ON, and the motor drive voltage (for low speed operation) is supplied from the battery to the radiator fan motor and condenser fan motor via the respective relay switches.
- When the engine control unit turns the high-speed side power transistor inside the engine control unit ON, the radiator fan motor relay (HI) and condenser fan motor relay (HI) operate and current for driving the radiator fan motor and condenser fan motor (high-speed operation) is supplied from the battery to the radiator fan motor and condenser fan motor.
  When the A/C switch and middle pressure switch are both ON, the radiator fan motor and condenser fan motor will both operate at high speed irrespective of the vehicle speed and the engine coolant temperature.

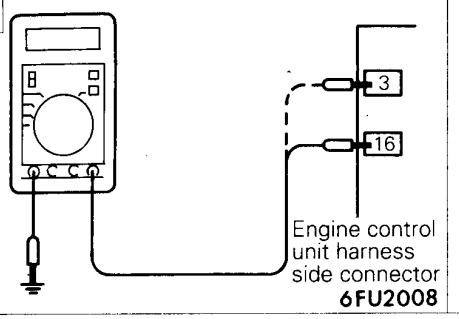
INSPECTION

Using Multi-Use Tester (MUT) or MUT-II

Function	Item No.	Check content	Check condition	Normal state
Actuator test	20	Drive the radiator fan motor and the condenser fan motor at high speed	Ignition switch: ON	The radiator fan motor and the condenser fan motor turn at high speed
	21	Drive the radiator fan motor and the condenser fan motor at low speed	Ignition switch: ON	The radiator fan motor and the condenser fan motor turn at low speed

HARNESS INSPECTION

1



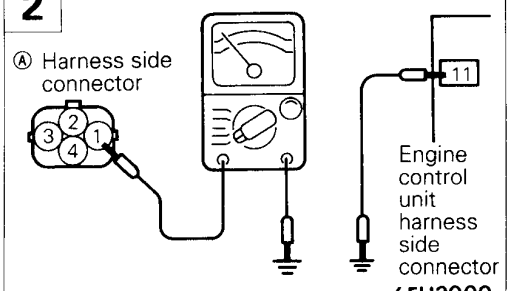
Measure the input voltage to the engine control unit
- Engine control unit connector: Disconnected
- Ignition switch: ON

Voltage (V)
System voltage

OK → **2**

OK → Check the fan motor relay circuit

2

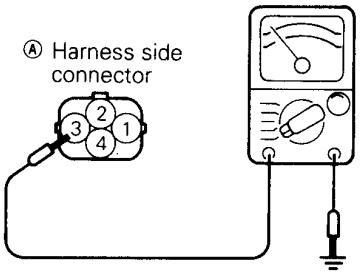


Check for an open-circuit, or a short circuit to earth between the engine control unit and the refrigerant middle pressure switch.
- Refrigerant middle pressure switch connector: Disconnected
- Engine control unit connector: Disconnected

OK → **3**

OK → Repair the harness. (Ⓐ–1–11)

3



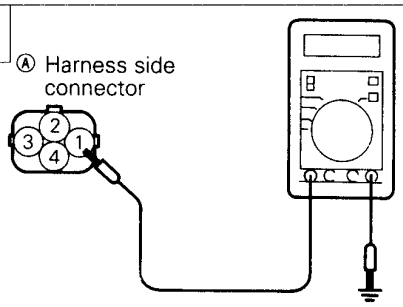
6FU2010

Check for continuity of the earth circuit
- Triple pressure switch connector: Disconnected

OK → 4

OK → Repair the harness. (Ⓐ–3 – earth)

4



6FU2011

Measure the impressed voltage.
- Triple pressure switch connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON
- Air conditioning switch: ON

Voltage (V)
System voltage

OK → STOP

OK → Check the triple pressure switch

FAN MOTOR RELAY

Refer to GROUP 14 – Radiator.

TRIPLE PRESSURE SWITCH

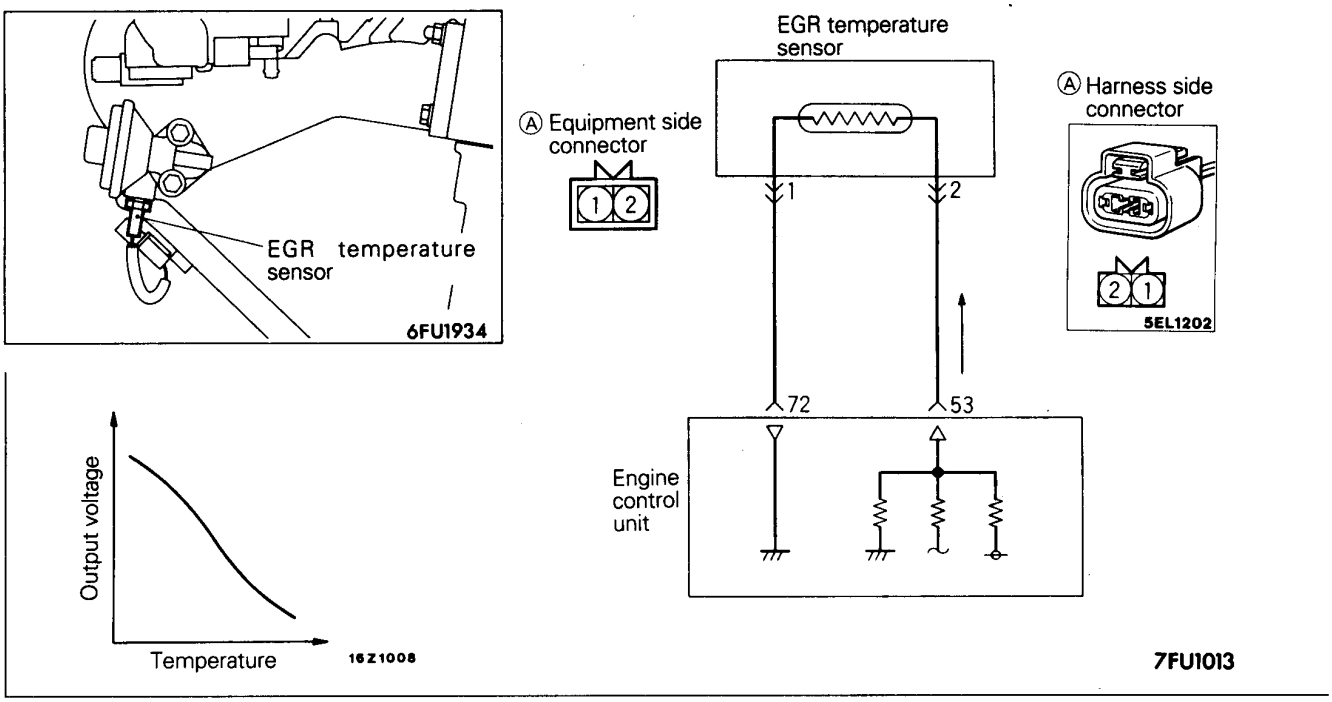
Refer to GROUP 55 – Service Adjustment Procedures.

DETONATION SENSOR <4G63>

Refer to P.13-80.

NOTES

EGR TEMPERATURE SENSOR <4G64>



OPERATION

- The EGR temperature sensor converts the temperature of EGR gas downstream from the EGR valve to voltage and inputs it to the engine control unit. The engine control unit judges the condition of the EGR by this signal. If there is abnormal condition, the engine warning lamp is turned on to notify the driver.
- Five volt power supply in the engine control unit is applied to the EGR temperature sensor through the resistance in the unit. This power supply further passes through the EGR temperature sensor, which is a kind of a resistor, and is earthed at the engine control unit. The resistance of the EGR temperature sensor is characterized by a decrease in resistance with an increase of EGR temperature due to increase in quantity of EGR.
- EGR temperature sensor terminal voltage increases or decreases with EGR temperature sensor resistance. Therefore, EGR temperature sensor terminal voltage changes with EGR gas temperature. The higher the EGR gas temperature, the lower the EGR temperature sensor terminal voltage.

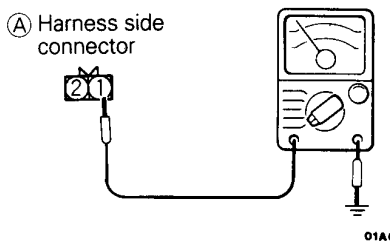
INSPECTION

Using Multi-Use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	43	Sensor temperature	Engine: Warmed up Engine is maintained in a constant state for 2 minutes or more.	Idle	70°C (158°F) or less
				3,500 r/min.	70°C (158°F) or more

HARNESS INSPECTION

1

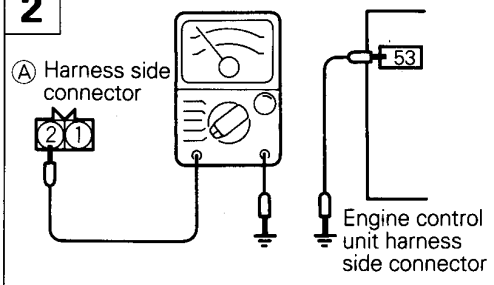


Check for continuity of the earth circuit.
- EGR temperature sensor connector: Disconnected

OK → 2

NO → Repair the harness. (Ⓐ1 – 72)

2

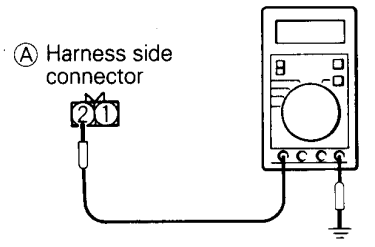


Check for an open circuit, or a short-circuit to earth, between the engine control unit and the EGR temperature sensor.
- EGR temperature sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ2 – 53)

3



Measure the impressed voltage.
- Connector: Disconnected
- Engine control unit connector: Connected
- Ignition switch: ON

Voltage (V)
4.3 – 4.7

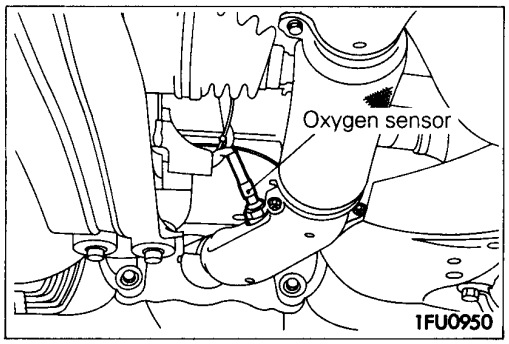
OK → STOP

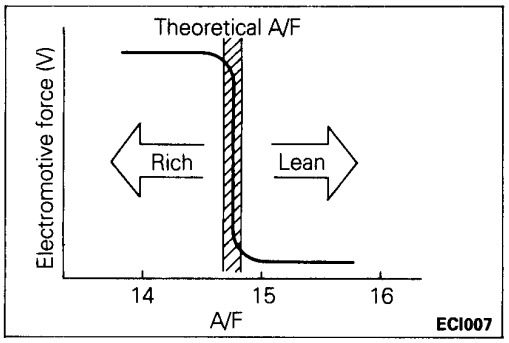
NO → Replace engine control unit.

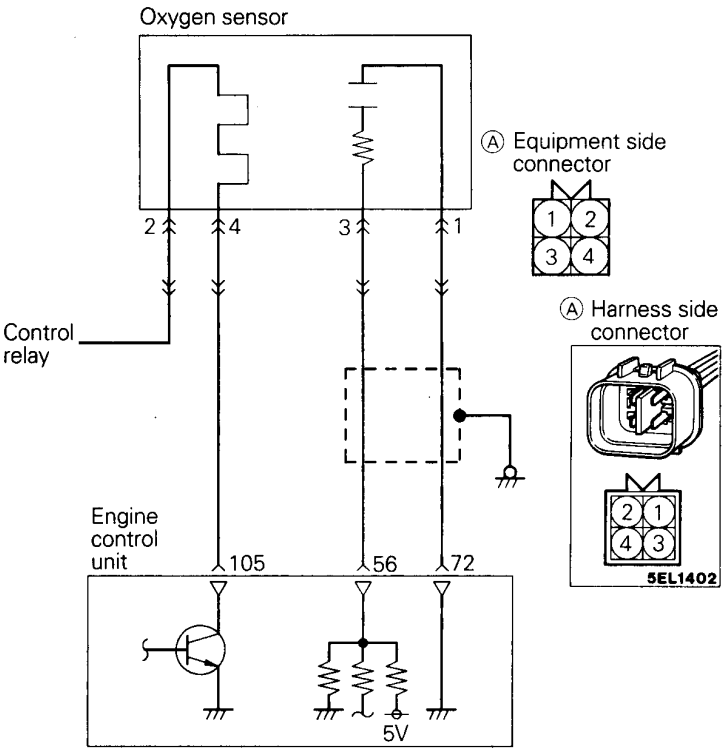
SENSOR INSPECTION

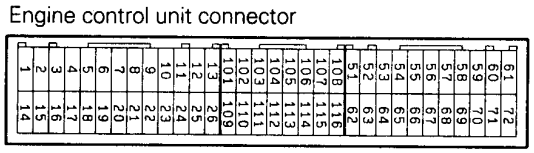
Refer to GROUP 17 – Exhaust Gas Recirculation (EGR) System.

OXYGEN SENSOR <4G63>









6FU1992

7FU0653

OPERATION

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

TROUBLESHOOTING HINTS

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

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

[Examples]

(1) Malfunction of an injector.

(2) Air leakage into the intake manifold from a leaking gasket.

(3) Malfunction of the air-flow sensor, the intake air temperature sensor, the barometric- pressure sensor, or the coolant temperature sensor.

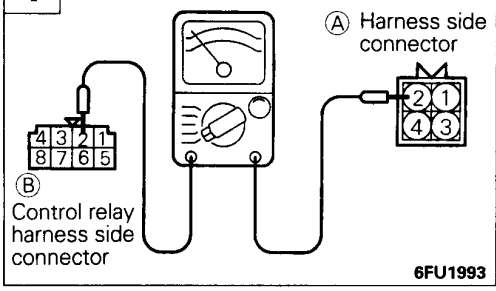
INSPECTION

Using Multi-Use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Select lever positon	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.	200 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)	Idle	400 mV or lower ↕ (changes) 600 – 1,000 mV
				2,000 r/min.	

HARNESS INSPECTION

1



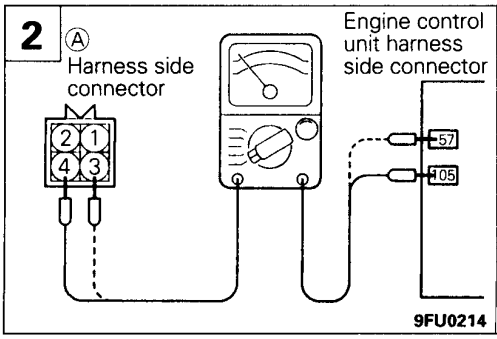
Check for continuity between oxygen sensor and control relay.
- Oxygen sensor connector: Disconnected
- Control relay connector: Disconnected

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

OK → 2

NO → Repair the harness. (Ⓐ2 – Ⓑ2)

2

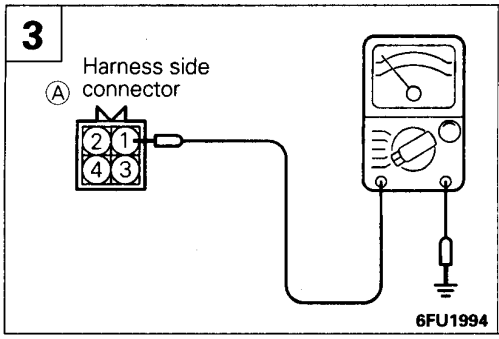


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the oxygen sensor.
- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NO → Repair the harness. (Ⓐ3 – 56) (Ⓐ4 – 105)

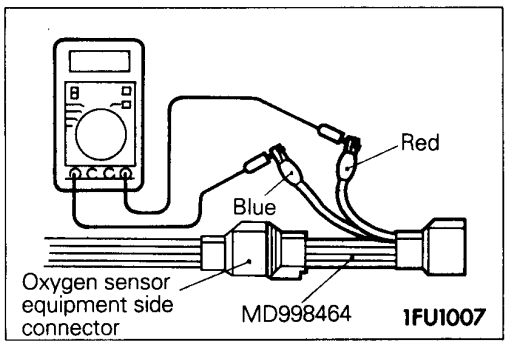
3

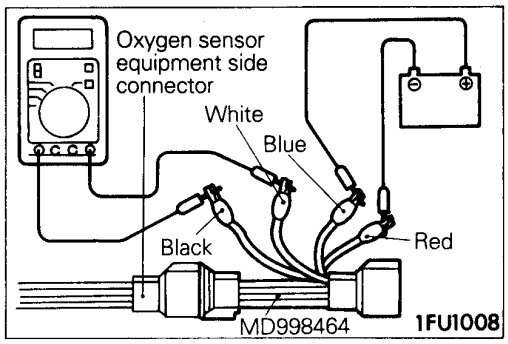


Check for continuity of the earth circuit.
- Oxygen sensor connector: Disconnected

OK → STOP

NO → Repair the harness. (Ⓐ1 – 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 Ω at 20°C (68°F)] between terminal ② (red clip of the special tool) and terminal ④ (blue clip) 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 (red clip) (connect to (+) terminal) and terminal ④ (blue clip) (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 (black clip) and terminal ③ (white clip).

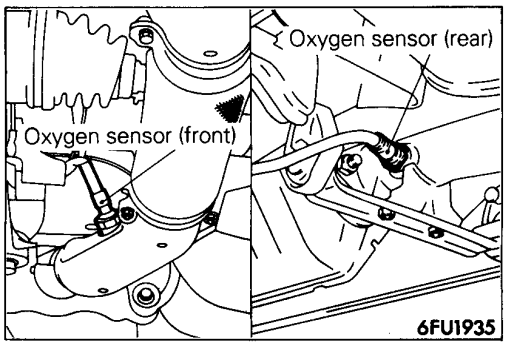
(7) While repeatedly racing the engine, measure the oxygen sensor output voltage.

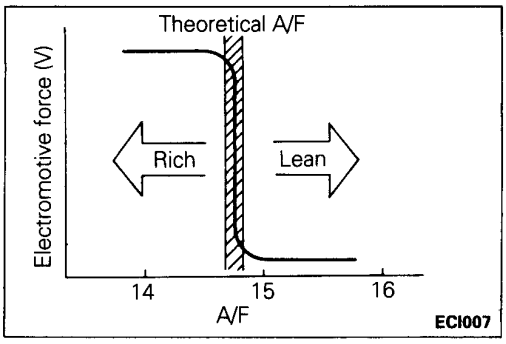
Engine	Oxygen sensor output voltage	Remarks
When racing engine	0.6 – 1.0 V	If you make the air/fuel ratio rich by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6–1.0 V.

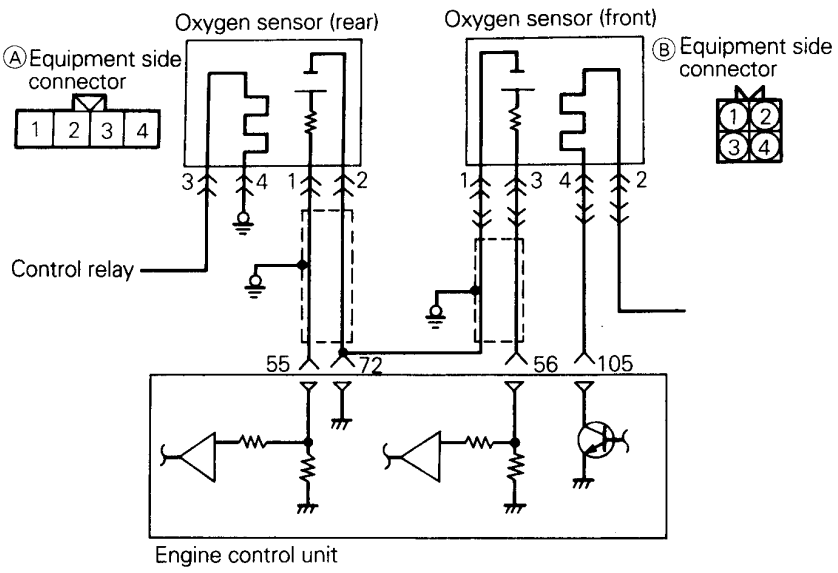
(8) If the sensor is defective, replace the oxygen sensor.

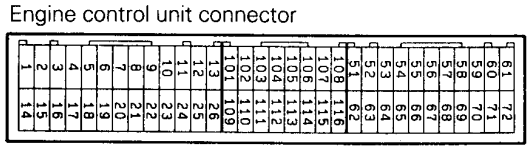
NOTE
For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe and Main Muffler.

OXYGEN SENSOR <4G64>









OPERATION

Refer to P.13 – 109–30

TROUBLESHOOTING HINTS

Refer to P.13 – 109–30

INSPECTION

Using Multi-Use Tester (MUT) or MUT-II <Oxygen Sensor (front)>

Function	Item No.	Data display	Check condition	Select lever positon	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.	200 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)	Idle	400 mV or lower ↕ (changes) 600 – 1,000 mV
				2,000 r/min.	

<Oxygen Sensor (rear)>

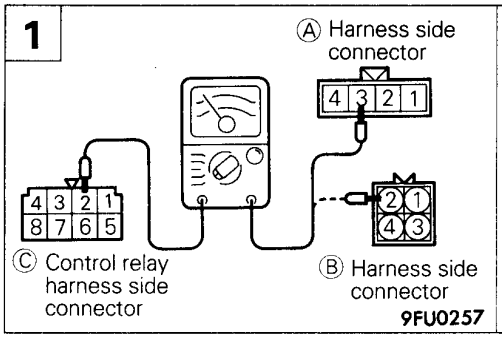
Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	59	Sensor voltage	• Transmission: 2nd (M/T), L range (A/T) • Run at full throttle speed.	3,500 r/min.	600–1,000 mV

<Oxygen Sensor Heater (front, rear)>

Function	Item No.	Data display	Check condition	Engine state	Normal indication
Data reading	48	Heater	Engine: Warm -up	Idle	ON
				5,000 r/min.	OFF

HARNESS INSPECTION

1



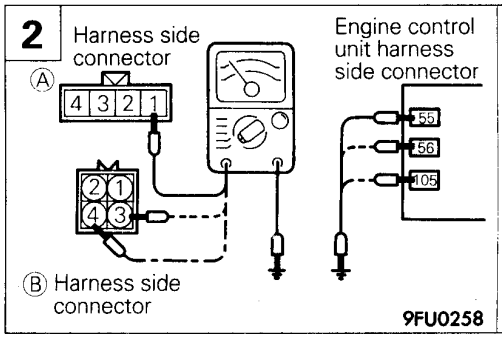
Check for continuity between oxygen sensor and control relay.
- Oxygen sensor connector: Disconnected
- Control relay connector: Disconnected

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

OK → 2

NG → Repair the harness.
(Ⓐ3 – Ⓒ2)
(Ⓑ2 – Ⓒ2)

2

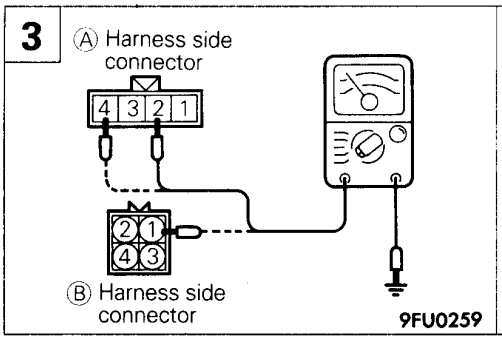


Check for an open-circuit, or a short-circuit to earth, between the engine control unit and the oxygen sensor.
- Oxygen sensor connector: Disconnected
- Engine control unit connector: Disconnected

OK → 3

NG → Repair the harness.
(Ⓐ1 – 55)
(Ⓑ3 – 56)
(Ⓑ4 – 105)

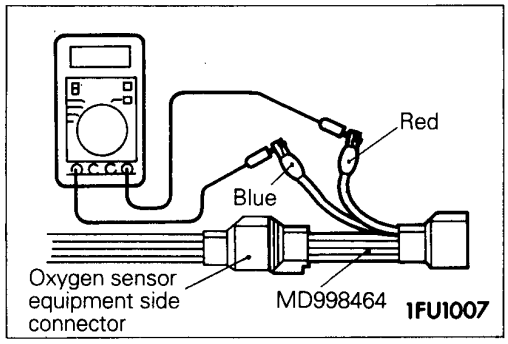
3

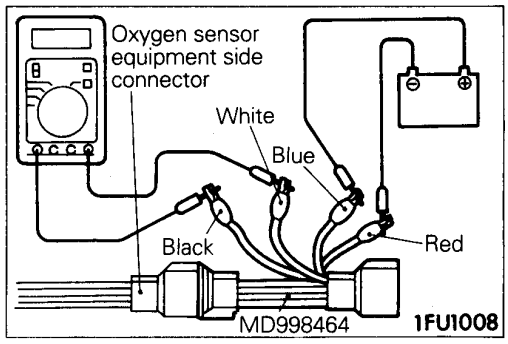


Check for continuity of the earth circuit.
- Oxygen sensor connector: Disconnected

OK → STOP

NG → Repair the harness.
(Ⓐ2 – 72)
(Ⓐ4 – Earth)
(Ⓑ1 – 72)





SENSOR INSPECTION

<Oxygen sensor (front)>

(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. 20Ω at 20°C (68°F)] between terminal ② (red clip of the special tool) and terminal ④ (blue clip) 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 (red clip) (connect to (+) terminal) and terminal ④ (blue clip) (connect to (–) terminal) with the battery (+) terminal and (–) terminal.

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

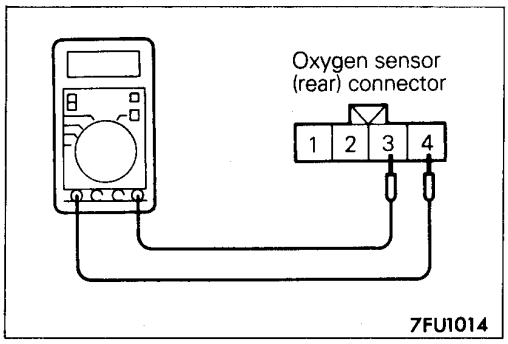
(6) Connect a digital voltage meter between terminal ① (black clip) and terminal ③ (white clip).

(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 Pipe and Main Muffler.



<Oxygen sensor (rear)>

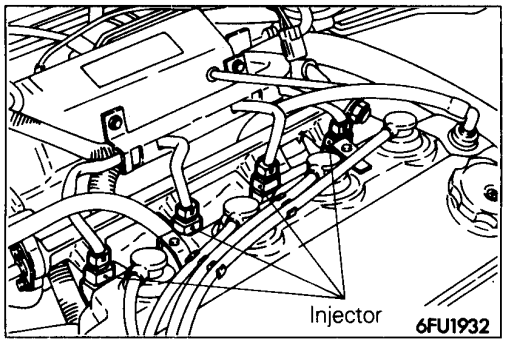
(1) Disconnect the oxygen sensor (rear) connector.

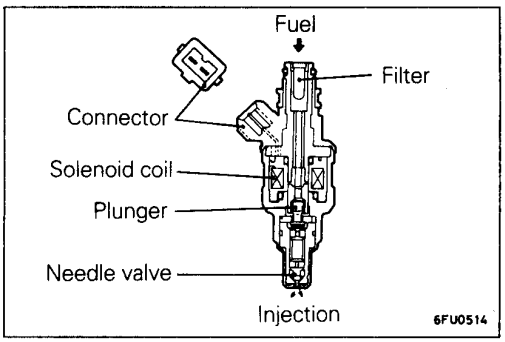
(2) Make sure that there is a continuity [Approx. 20Ω at 20°C (68°F)] between terminal ③ and terminal ④ on the oxygen sensor (rear) connector.

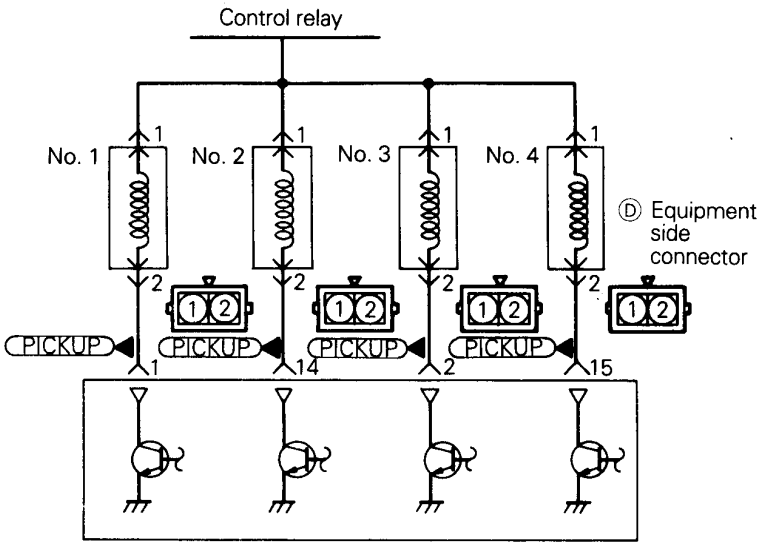
(3) If there is no continuity, replace the oxygen sensor (rear).

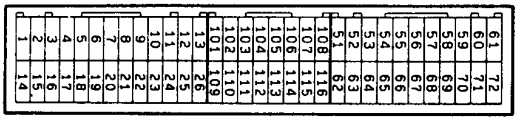
NOTE
1. If the MUT or MUT-II does not indicate the standard value even though the results of the above continuity check and harness inspection are normal, replace the oxygen sensor (rear).
2. For removal and installation of the oxygen sensor (rear), refer to GROUP 15 – Exhaust Pipe and Main Muffler.

INJECTOR









1FU0642

7FU0653

OPERATION

Refer to P.13 – 85

TROUBLESHOOTING HINTS

Refer to P.13 – 85

INSPECTION

Using Multi-Use Tester (MUT) or MUT-II

Function	Item No.	Data display	Check condition	Coolant temperature	Standard value
Data reading	41	Drive time*1	Engine: Cranking	0°C (32°C)*2	Approx. 18 ms <4G63> 19 ms <4G64>
				20°C (68°F)	Approx. 32 ms <4G63> 39 ms <4G64>
				80°C (176°F)	Approx. 9.8 ms <4G63> 9.6 ms <4G64>

Function	Item No.	Data display	Check condition	Coolant temperature	Standard value
Data reading	41	Drive time*3	• Engine coolant temperature:80 to 95°C (176 to 203°F) • Lamps, electric cooling fan, accessories: OFF • Transmission: Neutral (P range for A/T) • Steering wheel: Neutral	Idle	2.0 – 3.2 ms
				2,000r/min.	1.8 – 3.0 ms
				When sharp racing is made	To increase

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

Wave Pattern Inspection Using an Analyzer

Refer to P.13 – 87

HARNESS INSPECTION

Refer to P.13 – 88

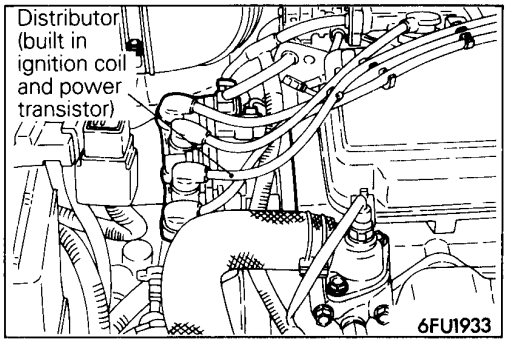
ACTUATOR INSPECTION

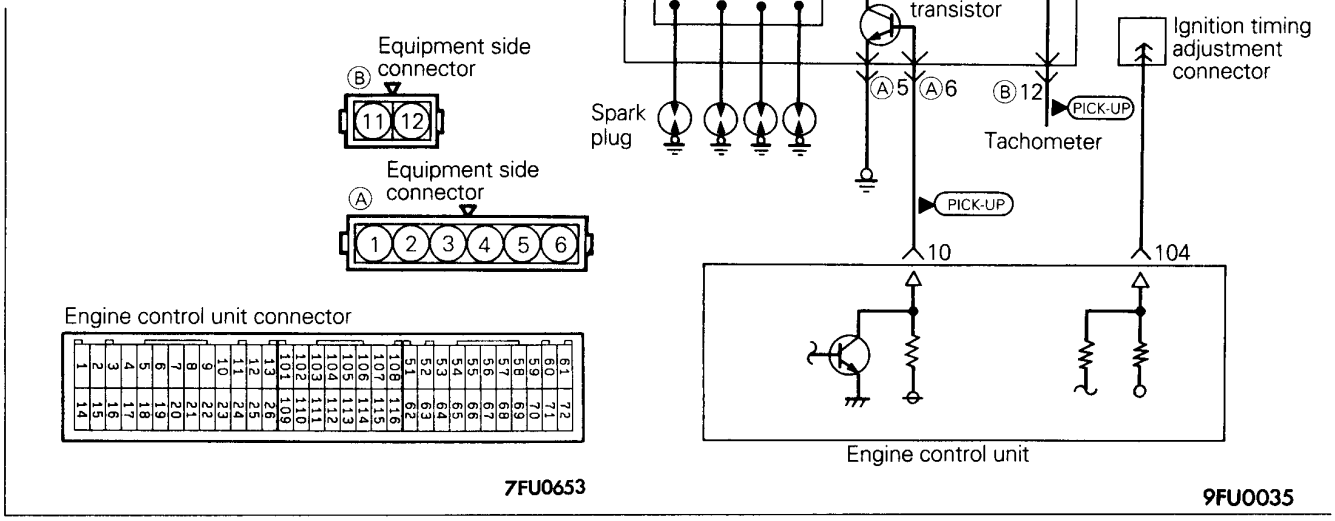
Refer to P.13 – 89

IDLE SPEED CONTROL SERVO (DC MOTOR)

Refer to P.13 – 91

IGNITION COIL AND POWER TRANSISTOR





OPERATION

Refer to P.13 – 93

INSPECTION

Using Multi-Use Tester (MUT) or MUT-II

Spark advance value

Function	Item No.	Data display	Check condition	Engine state	Standard value
Data reading	44	Ignition advance	• Engine: Warming up • Timing lamp: Set (set timing lamp to check actual ignition timing)	Idle	2 – 18°BTDC
				2,000 r/min.	20 – 40°BTDC <4G63> 24 – 44°BTDC <4G64>

Wave Pattern Inspection Using an Analyzer

Refer to P.13 – 94

HARNESS INSPECTION

Refer to P.13 – 96

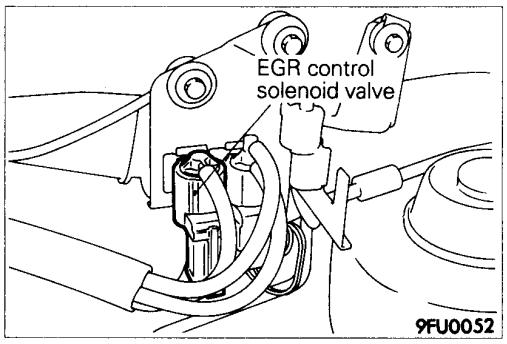
ACTUATOR INSPECTION

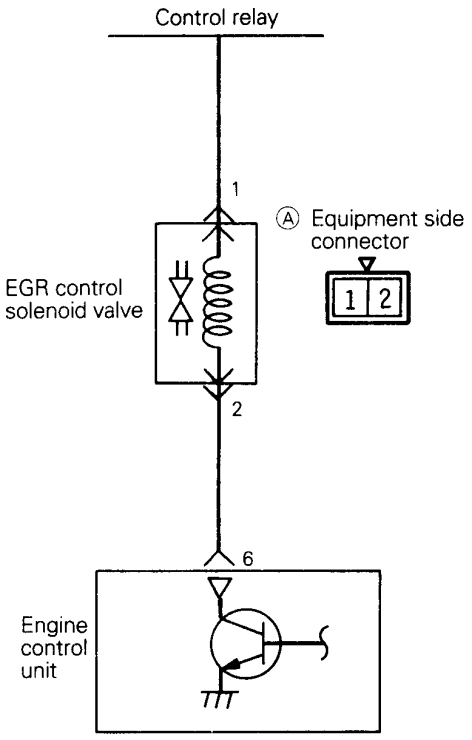
Refer to GROUP 16 – Ignition System

PURGE CONTROL SOLENOID VALVE

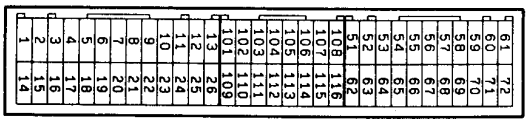
Refer to P.13 – 98

EGR CONTROL SOLENOID VALVE <4G64>





Engine control unit connector



7FU0653

OPERATION

- The EGR control solenoid valve is duty control type solenoid valve. It makes control by leaking EGR valve operating negative pressure to the throttle body A port.
- Power supply from the battery is sent through the control relay to the EGR control solenoid valve. When the engine control unit turns off the power transistor inside the unit, current no more flows through the coil and EGR valve operating negative pressure leaks.

INSPECTION

Refer to P.13 – 100

HARNESS INSPECTION

Refer to P.13 – 100

ACTUATOR INSPECTION

Refer to GROUP 17 – Exhaust Gas Recirculation (EGR) System.

ANTI-SKID BRAKE SIGNAL <4WD–M/T>

Refer to P.13 – 102

FUEL PRESSURE TEST

Refer to P.13 – 103

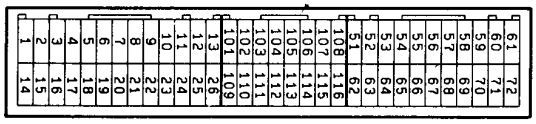
ENGINE CONTROL UNIT TERMINAL VOLTAGE CHECK

Refer to P.13 – 106

TERMINAL VOLTAGE CHECK CHART

Engine Control Unit Terminal Arrangement

Engine control unit connector



7FU0653

Terminal No.	Check Item	Check Condition (Engine Condition)		Standard value
60	Backup power supply	Ignition: OFF		SV
12	Power supply	Ignition: 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
70	Air flow sensor	Engine: Idle speed		2.2-3.2V
		Engine r/min.: 2,000 r/min.		
19	Air flow sensor reset signal	Engine: Idle speed		0-1V
		Engine r/min.: 3,000 r/min.		6-9V
52	Intake air temperature sensor	Ingition 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
65	Barometric 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

Terminal No.	Check Item	Check Condition (Engine Conditions)		Standard value
63	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C (32°F)	3.2–3.8V
			When engine coolant temperature is 20°C (68°F)	2.3–2.9V
			When engine coolant temperature is 40°C (104°F)	1.3–1.9V
			When engine 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
68	Top dead centre sensor	Engine: Cranking		0.4–3.0V
		Engine: Idle speed		0.5–2.0V
69	Crank angle sensor	Engine: Cranking		0.4–4.0V
		Engine: Idle speed		1.5–2.5V
51	Ignition switch-ST	Engine: Cranking		8V or more
71	Inhibitor switch	Ignition switch: ON	Set selector lever to P or N.	0–3V
			Set selector lever to D, 2, L or R.	8-14V
66	Vehicle speed sensor	Ignition switch: ON Move the vehicle slowly forward.		0↔5V (Changes repeatedly)
107	Power steering fluid pressure switch	Engine: Idling after warming up	Set the steering wheel to the straight forward position.	SV
			Half turn the steering wheel.	0–3V
115	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 A conditioner switch: OFF→ ON Turn the air conditioner switch ON. (Air conditioner compressor is operating)		SV or temporarily 6V or more ↓ 0–3V

Terminal No.	Check Item	Check Condition (Engine Conditions)		Standard value
56	Oxygen sensor <4G63> Oxygen sensor (front) <4G64>	Engine: Running at 2000 r/min. after having warmed up. (Check using a digital type voltmeter.)		0↔0.8V (Changes repeatedly)
55	Oxygen sensor (rear) <4G64>	• Transmission: 2nd (M/T), L range (A/T) • Run at full throttle speed. • Engine r/min. :3500r/min. or higher (Check using a digital type speedometer)		0.6–1.0V
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.: 3000 r/min.		0.3–3.0V
9	Purge control solenoid valve	Ignition switch: ON		SV
		Running at 3000 r/min. after having warmed up.		0–3V
104	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
106	Engine warning lamp	Air conditioner switch: OFF→ON		0–3V ↓ 9–13V (After several seconds have elapsed)
6	EGR control solenoid valve <4G64>	Ignition switch: ON		SV
		While engine is idling, suddenly depress the accelerator pedal.		From SV momentarily drops slightly.
53	EGR temperature sensor <4G64>	Ignition switch: ON	When sensor temperature is 50°C (122°F)	3.6–4.4V
			When sensor temperature is 100° (212°F)	2.2–3.0V
105	Oxygen sensor heater	Engine : Idling		0–3V
		Engine r/min. : 5000 r/min.		SV
114	Anti-skid brake signal <4WD-M/T>	Engine: Idle speed		SV
		• When vehicle first starts to move after turning the ignition switch to ON • Vehicle speed: 0→10 km/h (0.6 mph)		13–15V ↓ 0–13V (Temporarily)

Terminal No.	Check Item	Check Condition (Engine Conditions)	Standard value
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

NOTES

FUEL SYSTEM <4D65, 4D68>

SPECIFICATIONS

GENERAL SPECIFICATIONS

E13CA-B

Items		Specifications
Fuel		
Tank capacity	dm^3 (U.S. gal., Imp gal.)	55 (14.5, 12.1) <SPACE RUNNER> 60 (15.9, 13.2) <SPACE WAGON>
Fuel injection pump		
Type		Distributor type
Rotation direction		Clockwise (viewed from driving side)
Injection sequence		1-3-4-2
Cam lift	mm (in.)	2.2 (0.087)
Plunger diameter	mm (in.)	
4D65		9 (0.35)
4D68		10 (0.39)
Governor type		Half all speed
Feed pump type		Vane type
Fast idle system		Wax type
Injection nozzle		
Nozzle type		Throttling type
Holder type		Screw-in type

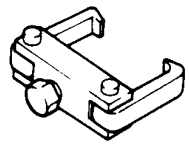
SERVICE SPECIFICATIONS

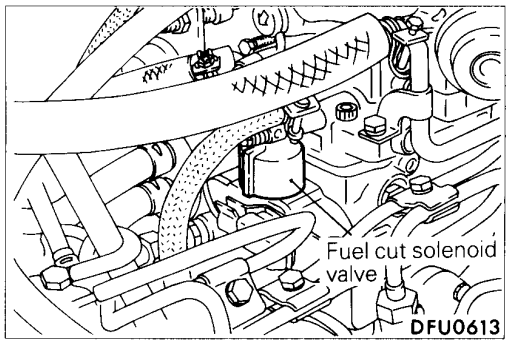
E13CB-B

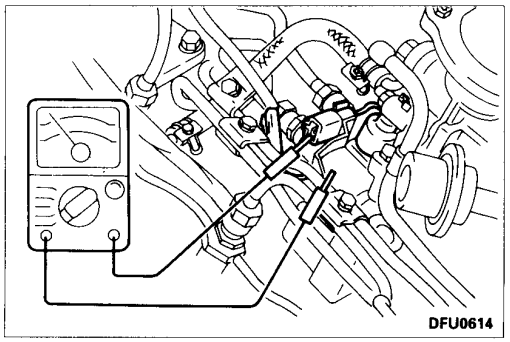
Items		Specifications
Standard value		
Fuel cut solenoid valve resistance	Ω	9–12 [at 20°C (68°F)]
Injection nozzlebreaking pressure	kPa (kg/cm^2, psi)	12000–13000(120–130, 1707–1849)
Speed sensor resistance	kΩ	1.2 –1.7 [at 20°C (68°F)]

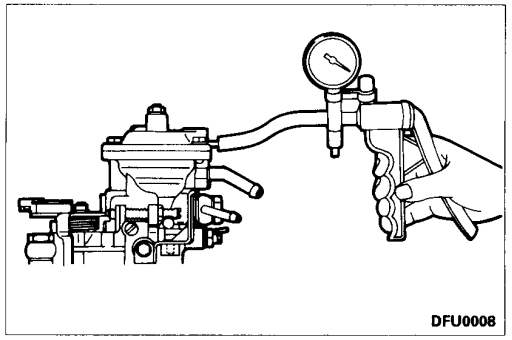
SPECIAL TOOL

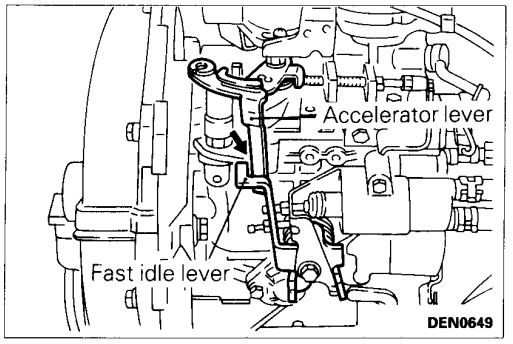
E13DA-B

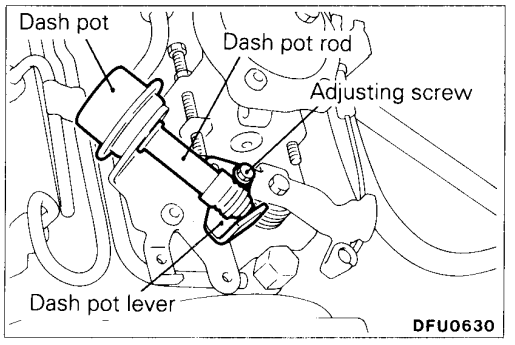
Tool	Number	Name	Use
	MD998388	Sprocket puller	Removal of fuel injection pump sprocket











SERVICE ADJUSTMENT PROCEDURES

FUEL CUT SOLENOID VALVE INSPECTION E13HBCA

Operation inspection

(1) Hold a sound scope against the fuel cut solenoid valve to check if the sound of the valve operating can be heard when the ignition switch is turned to "ON".

Measurement of resistance of coil

(1) Measure the resistance between the fuel cut solenoid valve terminal and the injection pump body.
Standard value: 9–12Ω [at 20°C (68°F)]

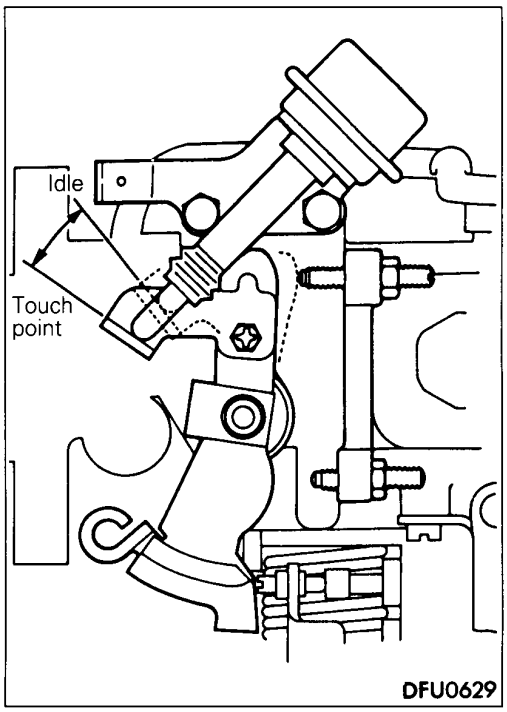
BOOST COMPENSATOR INSPECTION E13HBDA

(1) Connect a hand pump (pressurization type) to the nipple of the boost compensator.
(2) Apply 30 kPa (0.3 kg/cm^2, 4.3 psi.) of pressure and check to be sure that the pressure is maintained.

DASH POT INSPECTION AND ADJUSTMENT <4D65> E13HBEA

(1) After the engine has warmed up, check to be sure that the fast idle lever is separated from the accelerator lever.

(2) Open the accelerator lever until the dash pot rod is at the full stoke extension.



(3) When the accelerator lever is gradually closed, find the point where the dash pot lever touches the dash pot rod (point where dash pot rod starts to compress).
(4) When the accelerator lever is released at the point where the dash pot lever touches the dash pot rod, check to be sure that the accelerator lever closes to the idle position.
(5) Measure the turning angle of the accelerator lever from the touching point to the idle position.

Standard value: 10° [corresponding to a dash pot stroke of 9 mm (0.35 in.)]

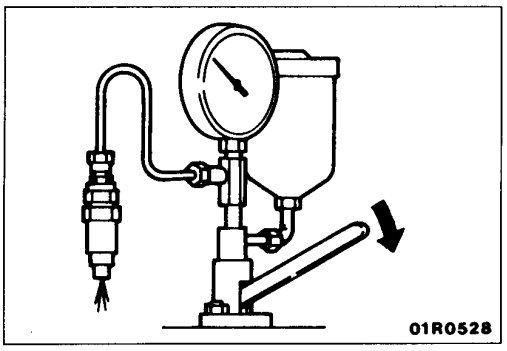
(6) If the angle is outside the standard value, loosen the adjusting screw and adjust with the dash pot lever.

INJECTION NOZZLE INSPECTION AND ADJUSTMENT

E13FOAH

Caution
Never touch the spray that is injected from the nozzle.

BREAKING PRESSURE TESTING AND ADJUSTMENT

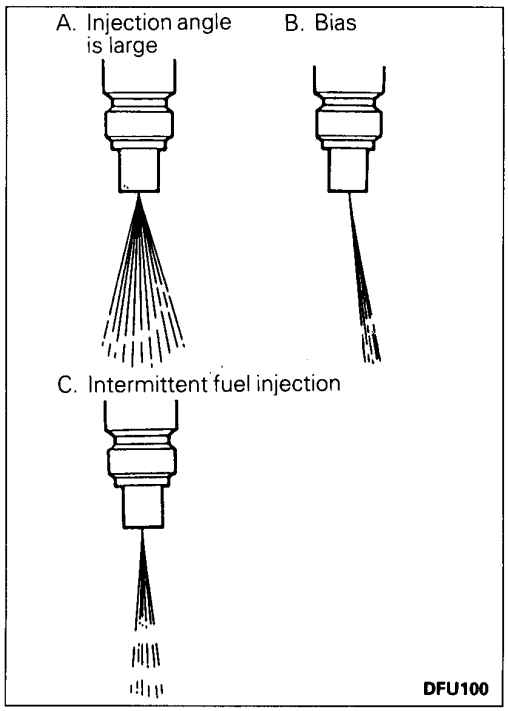


(1) Set injection nozzle in nozzle tester.
(2) Inject fuel 2 - 3 times to bleed the air.
(3) Gently press down the lever of the nozzle tester, and take a reading of the maximum indication value (fuel injection initial pressure) on the pressure gauge.

Standard value: 12,000 – 13,000 kPa (120 – 130 kg/cm², 1,707 – 1,849 psi)

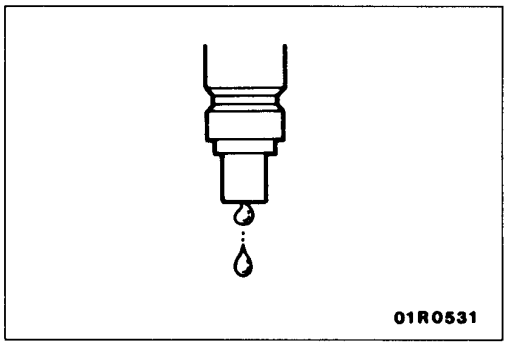
(4) If the fuel injection initial pressure is outside the standard value, disassemble the nozzle holder to clean it, and then change the thickness of the shim to adjust the fuel injection initial pressure.

NOTE
1. For disassembly and reassembly of the nozzle holder, refer to the Engine Workshop Manual (Pub. No. PWEE9079).
2. There are 11 shims for adjustment, with thicknesses in the range 1.20 – 1.70 mm (0.0472 – 0.0669 in.).
3. When the shim thickness is increased by 0.1mm (0.004 in.), the fuel injection initial pressure increases in the following manner:
   4D65 engine: 2400kPa (24kg/cm²,341psi)
   4D68 engine: 1500kPa (15kg/cm²,213psi)

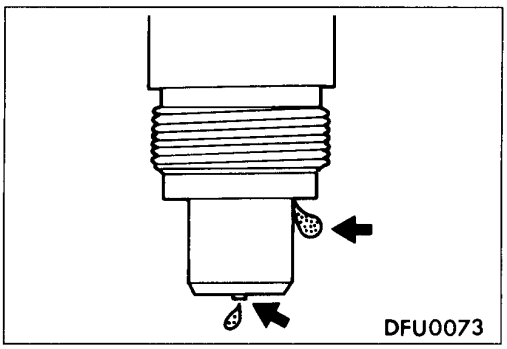


INJECTION TESTING

(1) Move the lever of the nozzle tester rapidly (4 – 6 times per second) to eject the fuel continuously.
(2) Check that the injection spray comes out evenly in a straight, thin line (angle of spray is zero). <4D65>
Check that the injection spray comes out evenly in a straight, thin line (angle of spray is 15°). <4D68>
The injection spray patterns shown in the illustration at left are wrong.

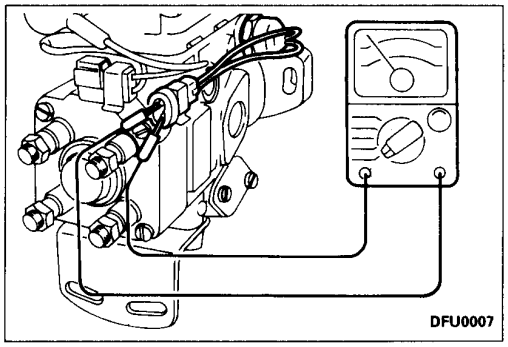


(3) Check that no fuel drips after injection is completed.
(4) If there are any drips, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.



LEAKAGE TESTING

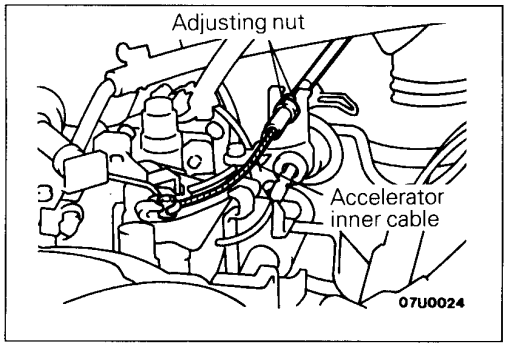
(1) Gently press down the lever of the nozzle tester until the pressure inside the nozzle becomes 10,000 – 11,000 kPa (100 – 110 kg/cm^2, 1,422 – 1,565 psi.), and after holding this pressure for approximately 10 seconds, check that there are no fuel leaks from the nozzle.
(2) If there are any drips, disassemble the nozzle, clean it and re-inspect, or replace the nozzle.



SPEED SENSOR INSPECTION E13HBFA

(1) Using a circuit tester, measure the resistance of the speed sensor.

Standard value: 1.2–1.7 kΩ [at 20°C (68°F)]

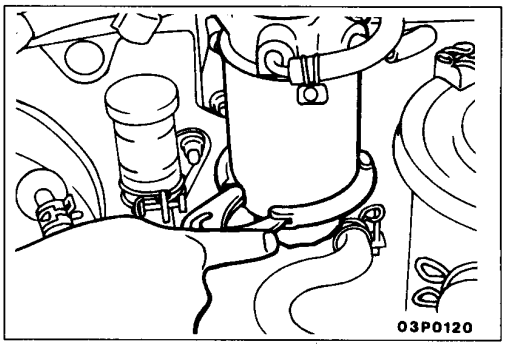


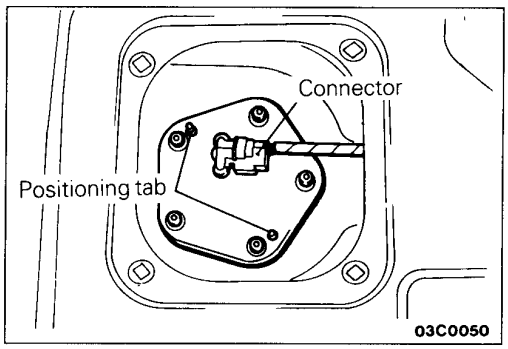
ACCELERATOR CABLE INSPECTION AND ADJUSTMENT E13FCBD

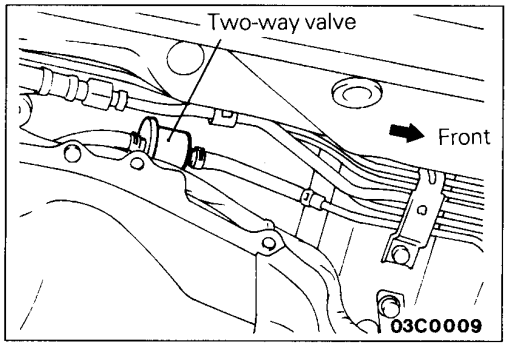
(1) Warm up the engine until it stabilizes at idle.
(2) Confirm that the idle speed is at the prescribed rpm.
(3) Stop the engine (ignition switch OFF).
(4) Confirm that there are no sharp bends in the accelerator cable
(5) Check to see if the inner cable play is at the standard value.

Standard value: 1 – 2 mm (0.04 – 0.08 in.) <M/T>
3 – 5 mm (0.12 – 0.20 in) <A/T>

(6) If the play is outside the standard value, adjust by sliding the adjusting nut so that the inner cable play is brought to the standard value, and then tighten the nut.







FUEL FILTER REPLACEMENT E13FZAI

(1) Remove the fuel tank cap and release the pressure from the fuel tank.
(2) Disconnect the water level sensor connector.
(3) Using an oil filter wrench, remove the fuel filter cartridge from the fuel filter pump body.

Caution
Cover the fuel filter with a shop towel to prevent fuel from splashing out.

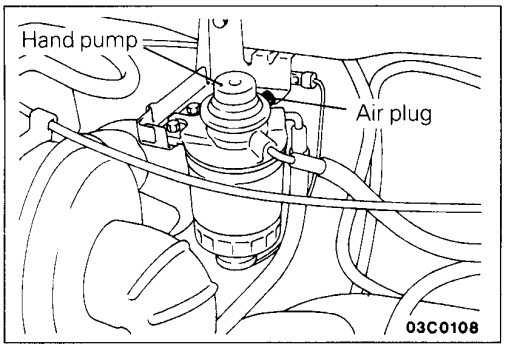
(4) Install a new fuel filter, and then bleed the fuel line. (Refer to P.13-115.)
(5) Start the engine, and check for fuel leaks.

FUEL GAUGE UNIT REPLACEMENT E13FDAF

(1) Remove the rear seat.
(2) Remove the hole cover at the lower section of the rear seat.
(3) Remove the connector from the fuel gauge unit and remove the fuel gauge unit.
(4) When installing, align the positioning tabs on the packing with the holes in the fuel gauge unit.
(5) Install the hole cover.

TWO-WAY VALVE REPLACEMENT E13FFAE

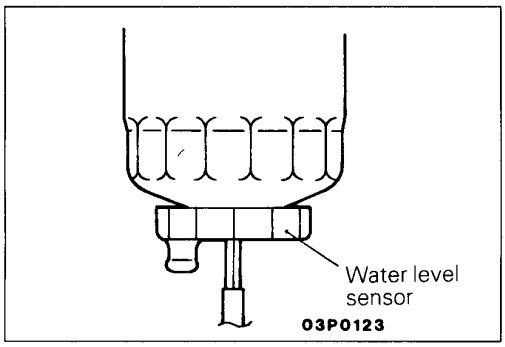
(1) Remove the two-way valve.
(2) Install so that the installation direction of the two-way valve is correct.



AIR BLEED FROM FUEL LINE E13FSAC

Remove air after performing the following operations:
- When fuel is drained and refilled.
- When the fuel filter is replaced.
- When the main fuel line is removed.

(1) Loosen the fuel filter air plug.
(2) Place shop towels around air plug hole. Operate the hand pump repeatedly until no bubbles come fro m the plug hole. Tighten the air plug.
(3) Repeat until the hand pump operation becomes stiff.



WATER BLEED FROM FUEL FILTER E13FVAC

Water is in the filter when the fuel filter indicator lights up. Drain water by the following procedures.
(1) Loosen water level sensor.
(2) Place shop towels around the water level sensor. Drain the water with a hand pump. Finger-tighten the water level sensor.

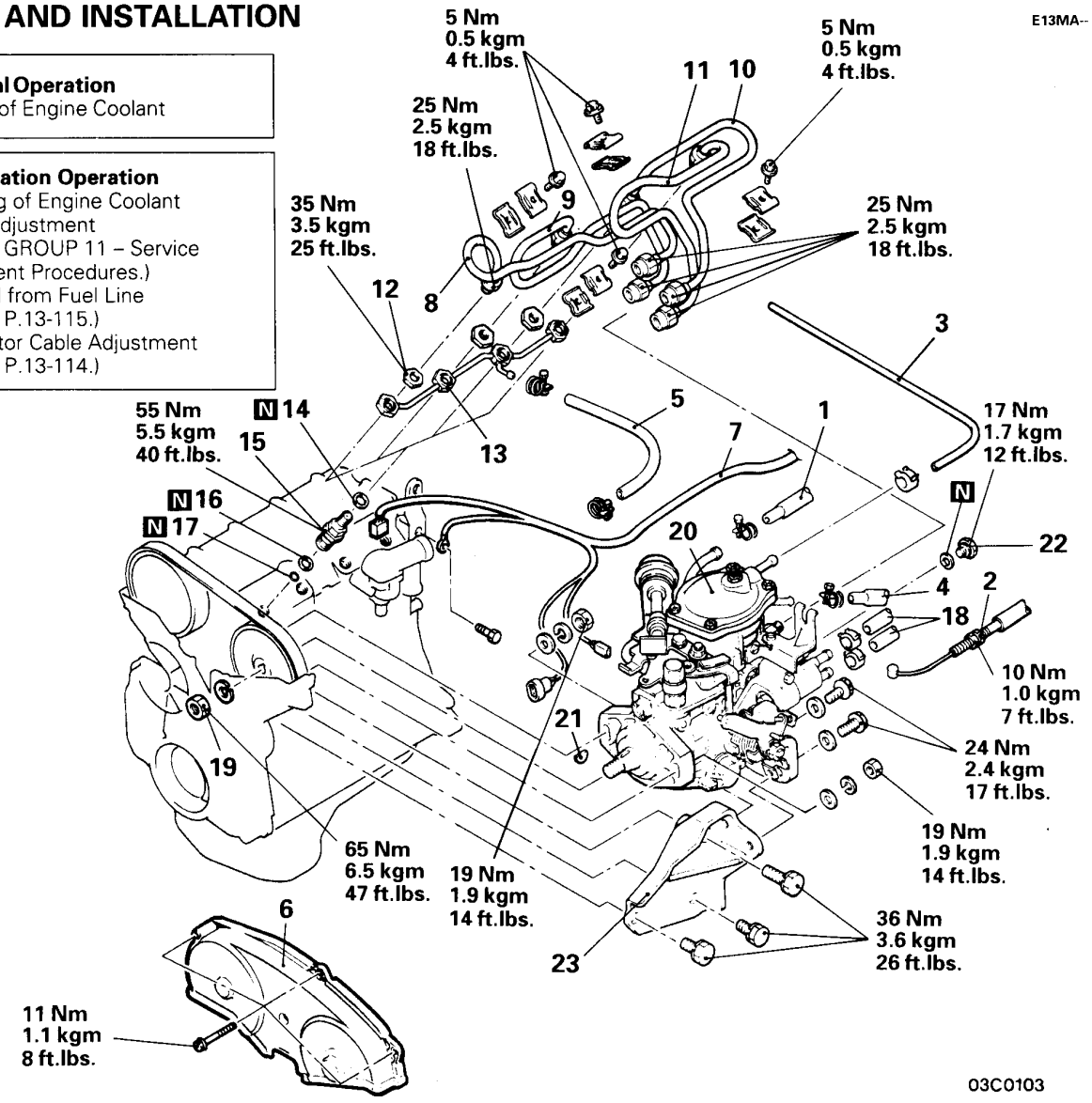
FUEL SYSTEM

FUEL INJECTION PUMP <4D65>

REMOVAL AND INSTALLATION

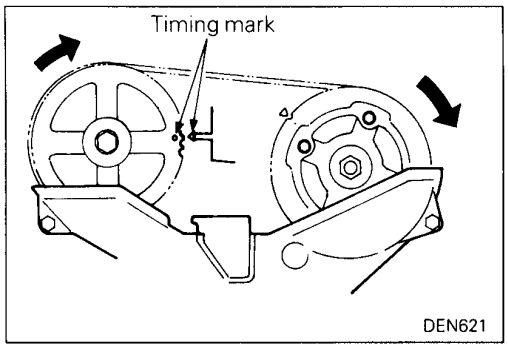
Pre-removal Operation
- Draining of Engine Coolant

Post-installation Operation
- Supplying of Engine Coolant
- Engine Adjustment (Refer to GROUP 11 – Service Adjustment Procedures.)
- Air Bleed from Fuel Line (Refer to P.13-115.)
- Accelerator Cable Adjustment (Refer to P.13-114.)



Removal steps

1. Fuel main hose
2. Accelerator cable
3. Boost hose
4. Fuel return hose
5. Fuel return hose
6. Timing belt front upper cover
7. Fuel injection pump harness
8. Fuel injection pipe No. 1
9. Fuel injection pipe No. 2
10. Fuel injection pipe No. 3
11. Fuel injection pipe No. 4
12. Nut
13. Fuel return pipe
14. Fuel return pipe gasket
15. Fuel injection nozzle
16. Holder gasket
17. Nozzle gasket
18. Water hose
19. Nut
20. Fuel injection pump
21. Key
22. Timing check plug
23. Fuel injection pump bracket

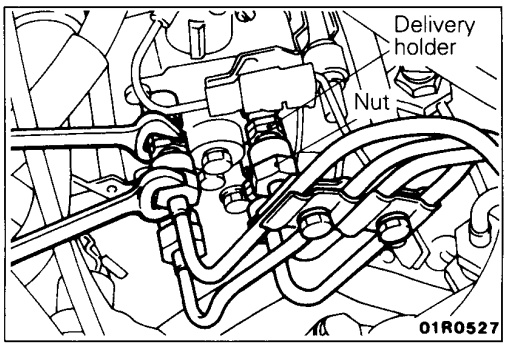


SERVICE POINTS OF REMOVAL E13MBAH

6. REMOVAL OF TIMING BELT FRONT UPPER COVER

Turn the crankshaft clockwise and aling the timing marks.

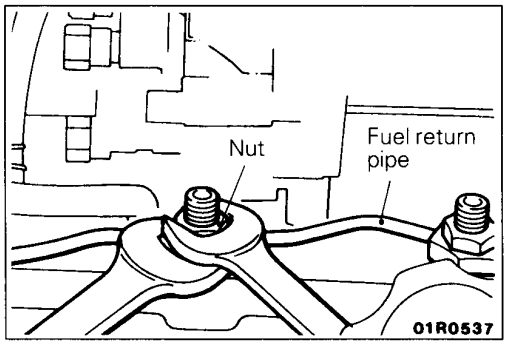
Caution
The crankshaft must always be turned clockwise



8./9./10./11. REMOVAL OF FUEL INJECTION PIPES

When loosening the nuts at both ends of the fuel injection pipe, use a spanner or similar tool to hold the connected component: the delivery holder (at the pump end) or the nozzle holder (at the nozzle end).

Caution
After disconnecting the injection pipe, be sure to plug it so that foreign material, etc. does not get into the pump.

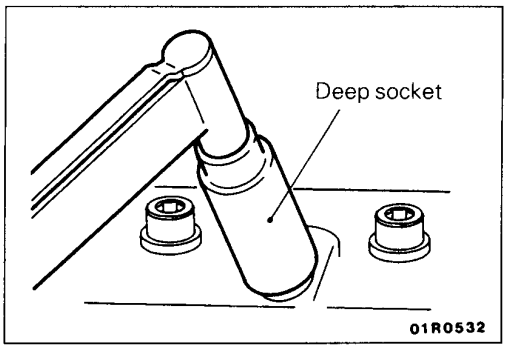


12. REMOVAL OF NUT/13. FUEL RETURN PIPE

(1) While using a spanner or similar tool to hold the hexagonal nut of the fuel return pipe, remove the nut.

Caution
If an attempt is made to loosen the nut without first holding the fuel return pipe, the pipe may be broken or otherwise damaged.

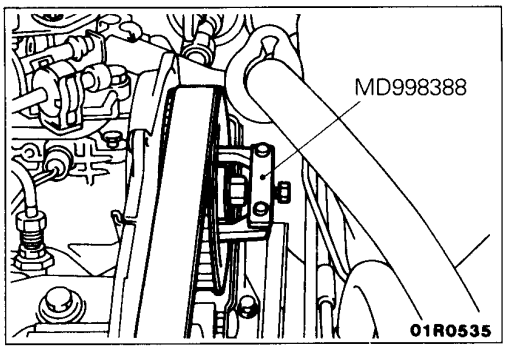
(2) Disconnect the fuel return pipe.



15. REMOVAL OF FUEL INJECTION NOZZLE

Using a deep socket wrench, remove the injection nozzle.

Caution
1. **Make a mark on the removed injection nozzle (the cylinder No.).**
2. **Use a cap to prevent foreign material, etc. from entering the injection nozzle hole.**



19. REMOVAL OF NUT/20. FUEL INJECTION PUMP

(1) After removing the nut, install the special tool on the injection pump sprocket.
(2) Pull the injection pump sprocket off from the pump's drive shaft.
(3) Place the injection pump sprocket (with the timing belt attached) inside the timing belt front lower cover.

Caution
1. **When removing the sprocket, care must be taken not to subject the pump drive shaft to an impact.**
2. **Take care not to apply excessive or unnecessary force (such as excessive twisting, bending, etc.) to the timing belt.**
3. **After removal, the crankshaft should not be turned.**
4. **When holding the injection pump, do not hold the accelerator lever or the fast idle lever.**
   Also, do not attempt to remove these levers: doing so will result in a malfunction of the injection pump.

FUEL TANK

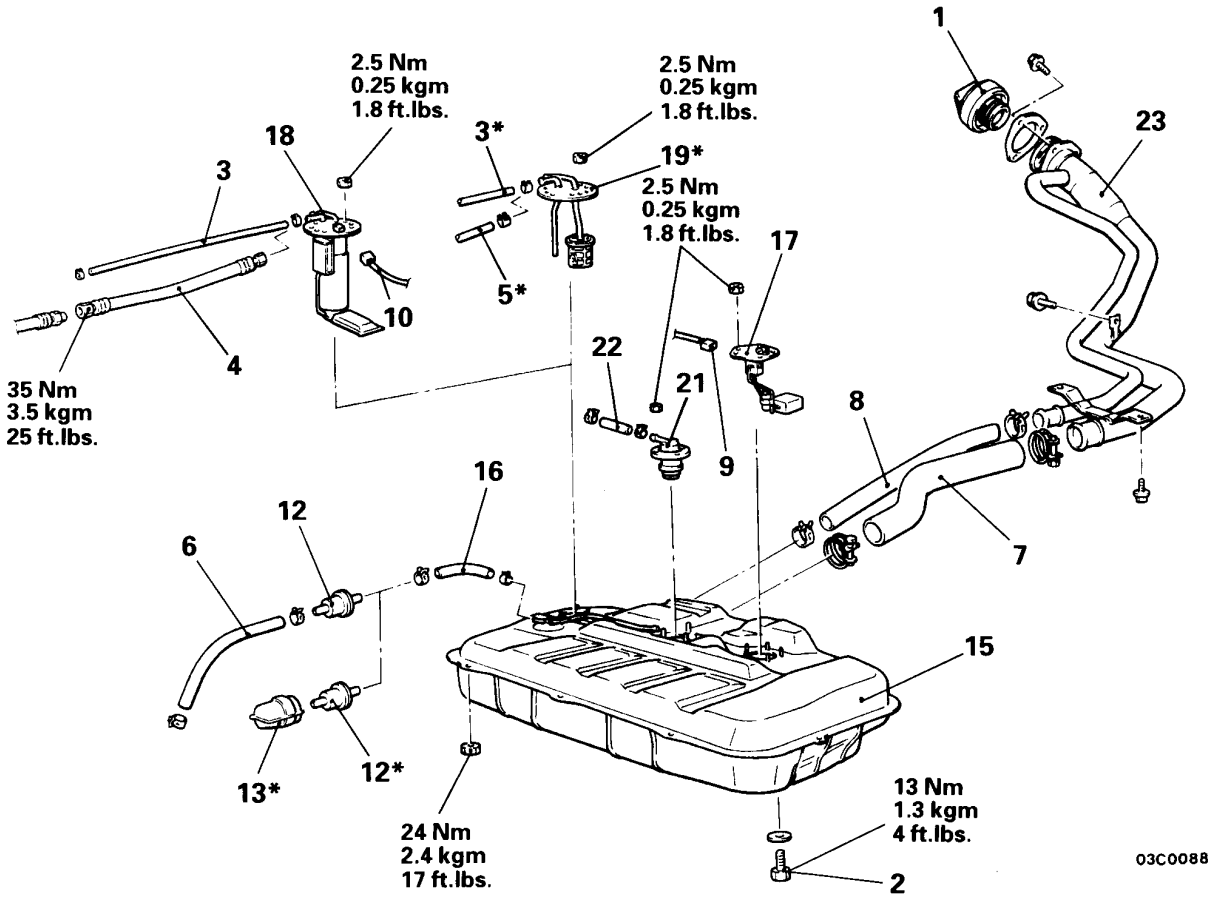
E13GA--

REMOVAL AND INSTALLATION

Pre-removal Operation
- Draining the Fuel.
- Reduce the Inner Pressure of Fuel Line and Hose (Refer to P.13-29.)

Post-installation Operation
- Refilling the Fuel.
- Checking for Fuel Leaks.

<2WD>



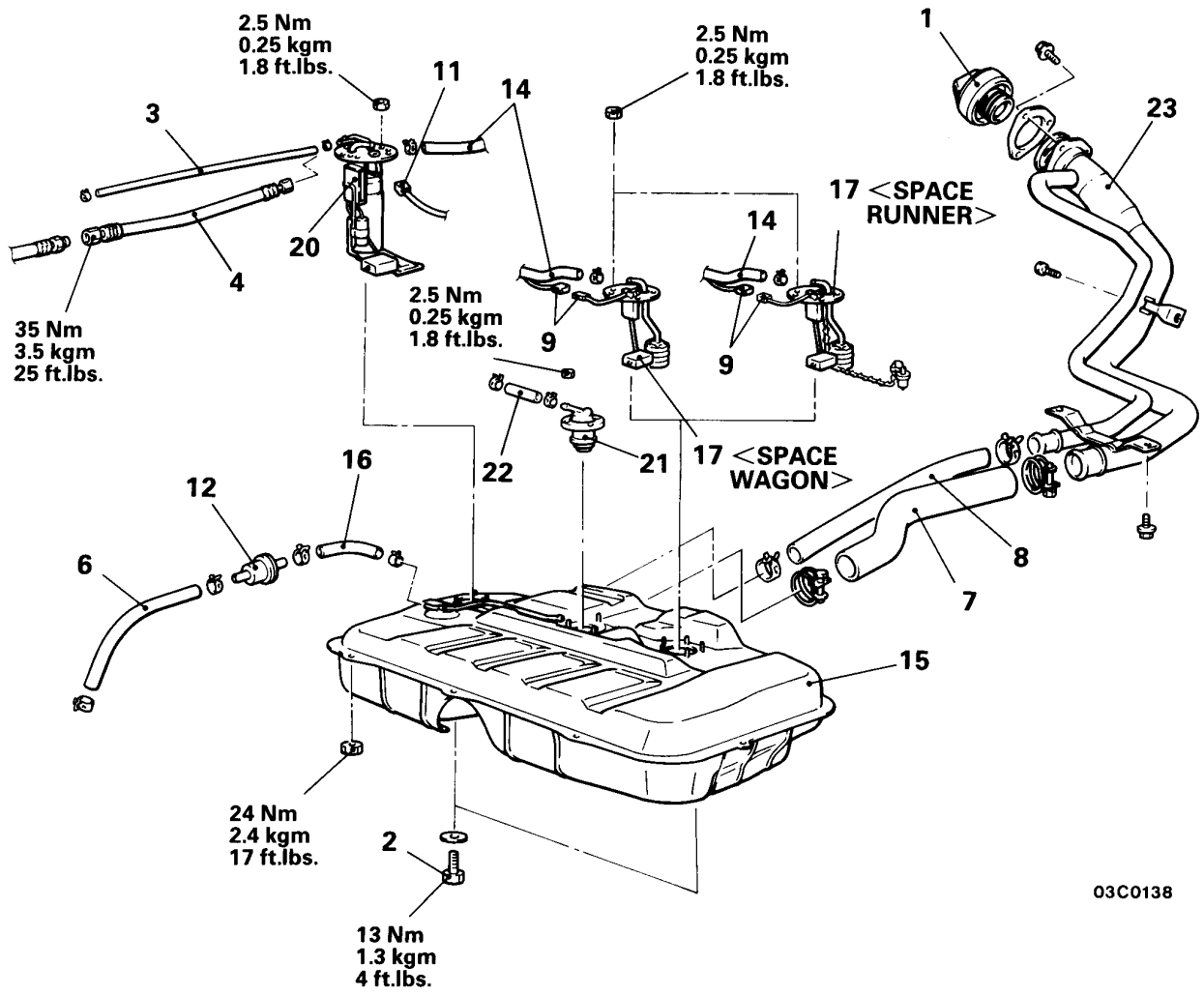
Removal steps

1. Fuel tank cap
2. Drain plug
3. ➡⬅ Return hose
4. Fuel high-pressure hose
5. ➡⬅ Main hose
6. ➡⬅ Vapor hose
7. ➡⬅ Filler hose
8. ➡⬅ Vapor hose
9. Fuel gauge unit connector
10. Fuel pump connector
12. ➡⬅ Two-way valve
13. Breather case
15. Fuel tank
16. ➡⬅ Vapor hose
17. Fuel gauge unit
18. Fuel pump
19. Pipe assembly
21. Fuel cut off valve
22. ➡⬅ Vapor hose
23. Filler neck

NOTE
1. * : Diesel-powered vehicles
2. When removing the fuel gauge unit, fuel pump or pipe assembly only, it is possible to work from the service holes inside the passenger compartment without having to remove the fuel tank. (Refer to P.13-28, 109-16, 114.)

<4WD>

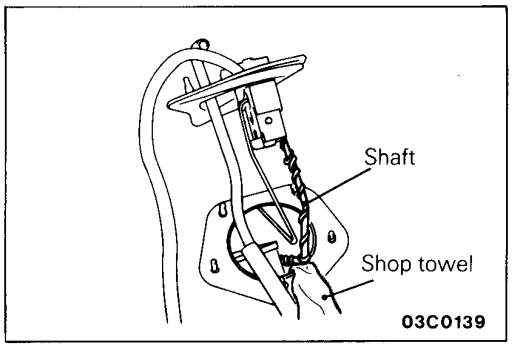
Pre-removal and Post-installation Operation
- Removal and Installation of Propeller Shaft (Refer to GROUP 25 – Propeller Shaft.)



Removal steps

1. Fuel tank cap
2. Drain plug
3. Return hose
4. Fuel high-pressure hose
6. Vapor hose
7. Filler hose
8. Vapor hose
9. Fuel gauge unit connector
11. Fuel gauge and pump assembly connector
12. Two-way valve
14. Suction hose
15. Fuel tank
16. Vapor hose
17. Fuel gauge unit
20. Fuel gauge and pump assembly
21. Fuel cut off valve
22. Vapor hose
23. Filler neck

NOTE
When removing the fuel gauge unit, fuel gauge and pump assembly only, it is possible to work from the service holes inside the passenger compartment without having to remove the fuel tank. (Refer to P.13-28, 109-16, 114.)

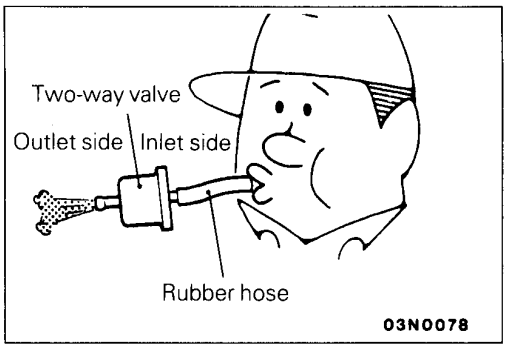


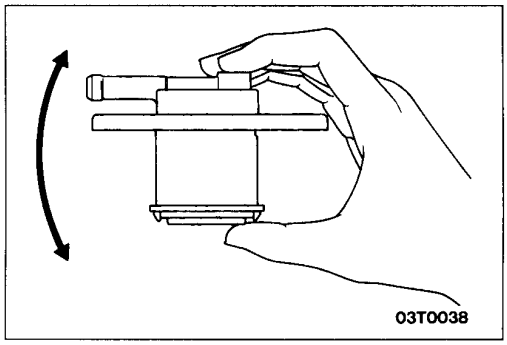
SERVICE POINTS OF REMOVAL

17. REMOVAL OF FUEL GAUGE UNIT <SPACE RUNNER–4WD>
(Vehicles built up to September 1991)

(1) Cover the fuel tank opening with a shop towel or similar so as not to damage the level switch harness.
(2) Push the shaft towards the centre of the fuel tank opening, and then while bending it within its range of elasticity, remove the fuel gauge unit.

NOTES





INSPECTION E13GCAO

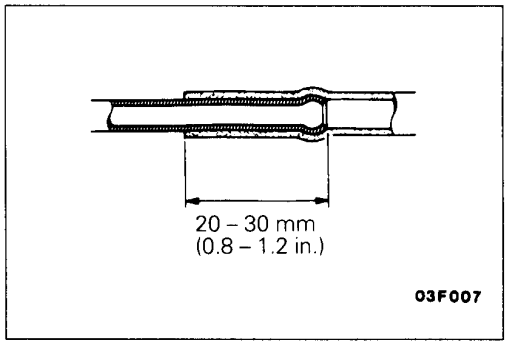
SIMPLE CHECKING OF THE TWO-WAY VALVE

Attach a clean hose and check the operation of the two-way valve.

Inspection procedure	Normal condition
Lightly blow from inlet side (fuel tank side).	Air passes through with a slight feeling of resistance.
Lightly blow from outlet side (canister side).	Air passes through.

FUEL CUT OFF VALVE

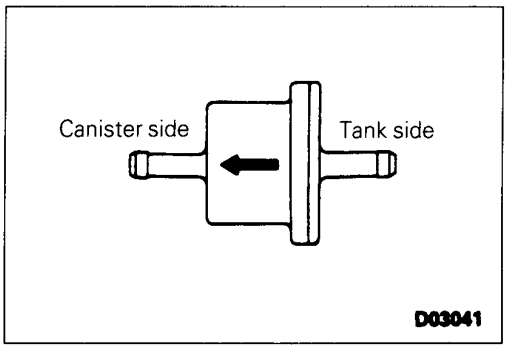
If the sound of the float valve moving (knocking sound) can be heard when the valve assembly is gently shaken up and down, then the valve is okay.



SERVICE POINTS OF INSTALLATION E13GDBD

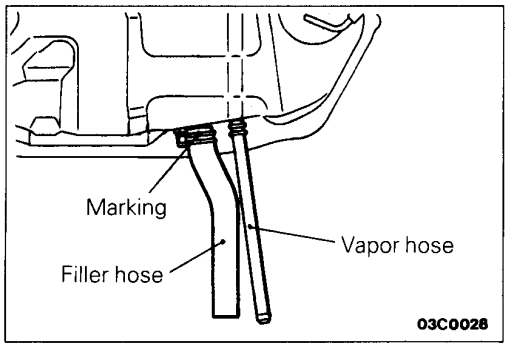
22.16.6. INSTALLATION OF VAPOR HOSE/5. MAIN HOSE/ 3. RETURN HOSE.

If the pipe has a stepped part, connect securely up to the stepped part. If the pipe has no stepped part, insert so that the inserted portion is 20 – 30 mm (0.8 – x1.2 in.) long.



12. INSTALLATION OF TWO-WAY VALVE

Install so that the installation direction of the two-way valve is correct.



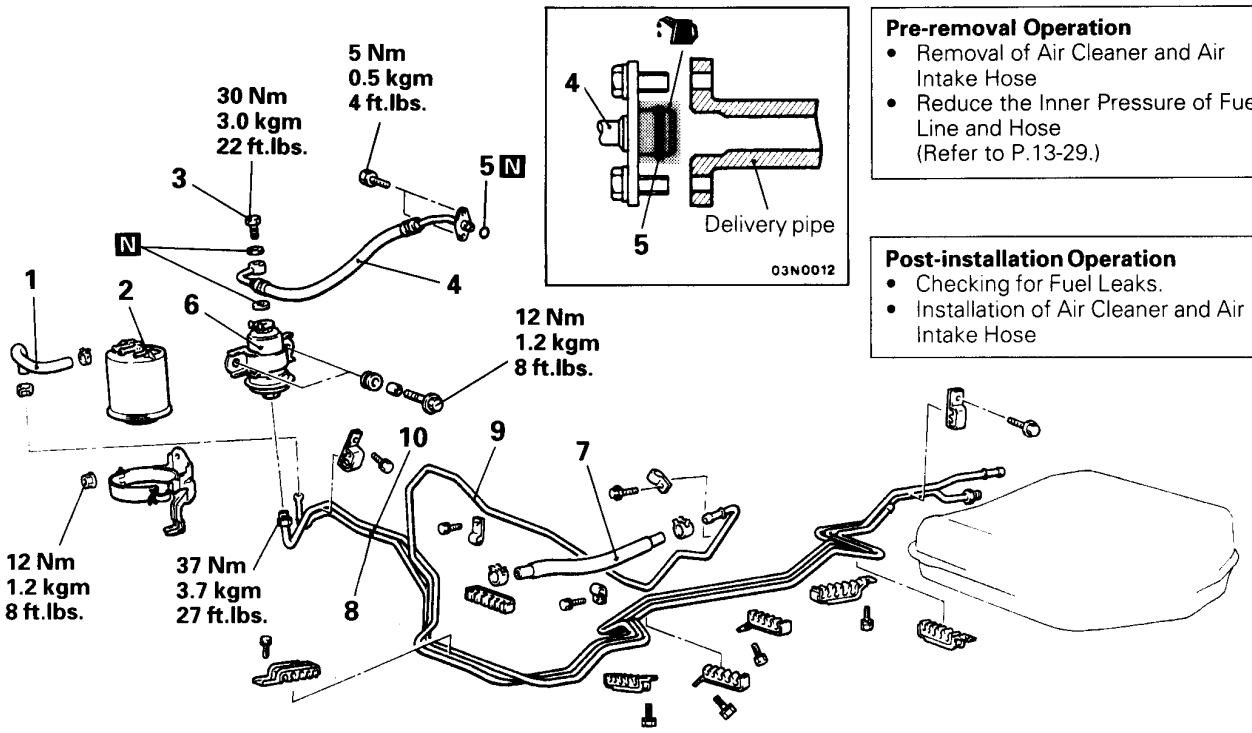
8. INSTALLATION OF VAPOR HOSE/7. FILLER HOSE

(1) Install the filler hose to the tank side in the direction of the marking, and face it towards the top of the tank. <SPACE RUNNER>
(2) Insert both the filler hose and vapor hose so that they touch the tank on the tank side, and so that they are connected up to the stepped part on the fuel filler neck side.

FUEL LINE AND VAPOR LINE

REMOVAL AND INSTALLATION <PETROL-POWERED VEHICLES>

E13KA-A



Pre-removal Operation
- Removal of Air Cleaner and Air Intake Hose
- Reduce the Inner Pressure of Fuel Line and Hose (Refer to P.13-29.)

Post-installation Operation
- Checking for Fuel Leaks.
- Installation of Air Cleaner and Air Intake Hose

Removal steps

1. Vapor hose
2. Canister
3. Eye bolt
4. Fuel high pressure hose
5. O-ring
6. Fuel filter
7. Return hose
8. Fuel vapor pipe
9. Fuel return pipe
10. Fuel main pipe

SERVICE POINT OF REMOVAL

E13KBAQ

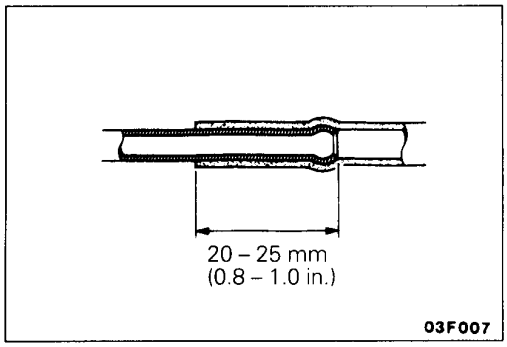
4. REMOVAL OF HIGH PRESSURE FUEL HOSE

After reducing the fuel pressure by taking the necessary measures to prevent fuel from flowing out, cover it with a rag to prevent fuel from spraying out, as there will be some pressure remaining in the fuel pipe line.

SERVICE POINTS OF INSTALLATION

E13KDBD

7. INSTALLATION OF RETURN HOSE/1. VAPOR HOSE



If the pipe has a stepped part, connect securely up to the stepped part. If the pipe has no stepped part, insert so that the inserted portion is 20 – 25 mm (0.8 – 1.0 in.) long.

4. INSTALLATION OF FUEL HIGH PRESSURE HOSE

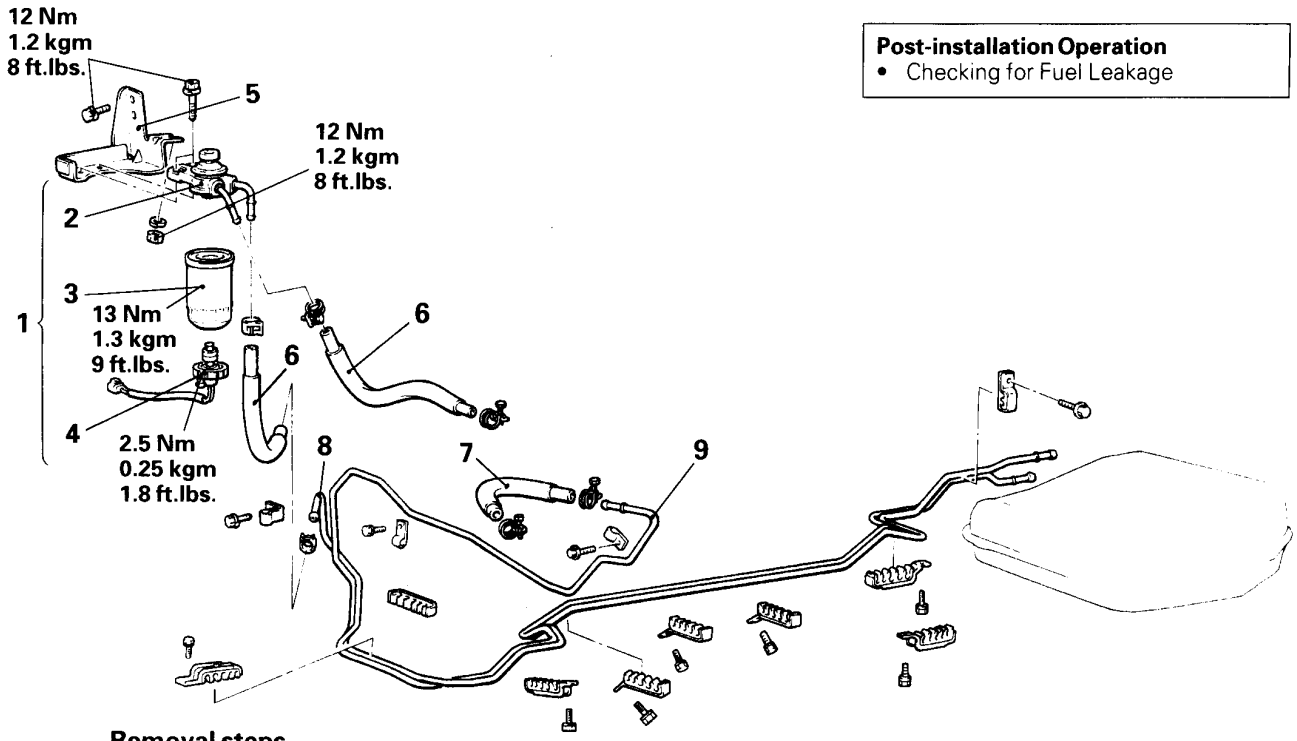
Insert the hose, being careful not to damage the O-ring, and tighten securely.

NOTE

Be sure to tighten securely to prevent fuel leaks so that there will be high pressure between the fuel pump and the delivery pipe.

REMOVAL AND INSTALLATION <DIESEL-POWERED VEHICLES>

E13KA-B



Post-installation Operation
- Checking for Fuel Leakage

Removal steps

1. Fuel filter assembly
2. Fuel filter body
3. Fuel filter cartridge
4. Water level sensor
5. Filter bracket
6. Fuel main hose
7. Fuel return hose
8. Fuel main pipe
9. Fuel return pipe

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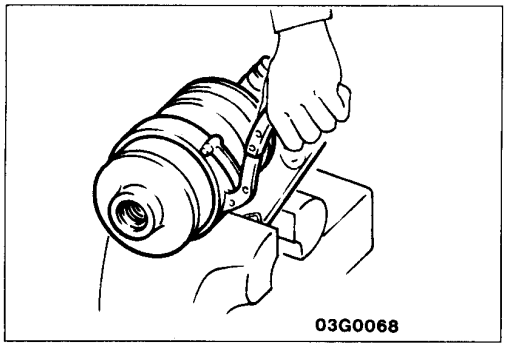
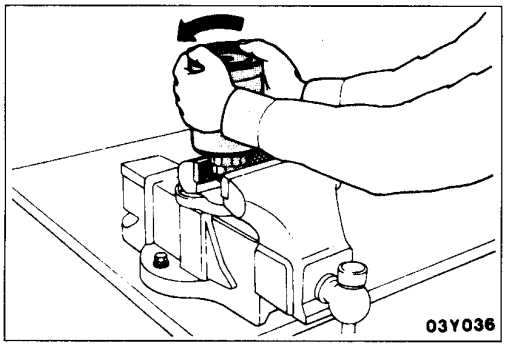


SERVICE POINTS OF REMOVAL

E13KBAI

3. REMOVAL OF FUEL FILTER CARTRIDGE

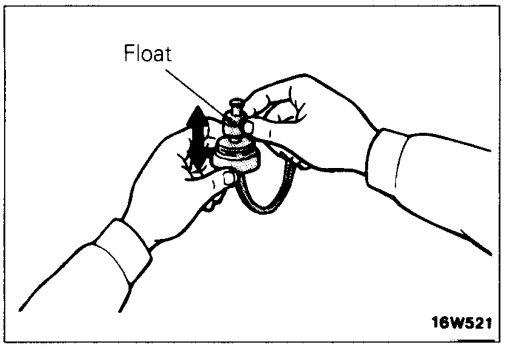
Hold fuel filter pump in vice. Remove fuel fillter cartridge with oil filter wrench.



4. REMOVAL OF WATER LEVEL SENSOR

Hold water level sensor in vice. Remove fuel filter cartridge by hand.

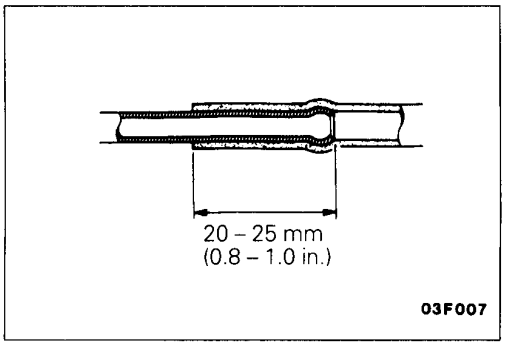
Caution
Never grip the water level sensor with too great a force in the vice; the water level sensor is a plastic part.



INSPECTION E13KCAT

WATER LEVEL SENSOR

Connect the circuit tester to the water level sensor connector. The water level sensor is operating correctly if there is continuity when the float is raised and no continuity when it is lowered.



SERVICE POINTS OF INSTALLATION E13KDBE

7. INSTALLATION OF FUEL RETURN HOSE/6. FUEL MAIN HOSE

If the pipe has a stepped part, connect securely up to the stepped part. If the pipe has no stepped part, insert so that the inserted portion is 20 – 25 mm (0.8 – 1.0 in.) long.

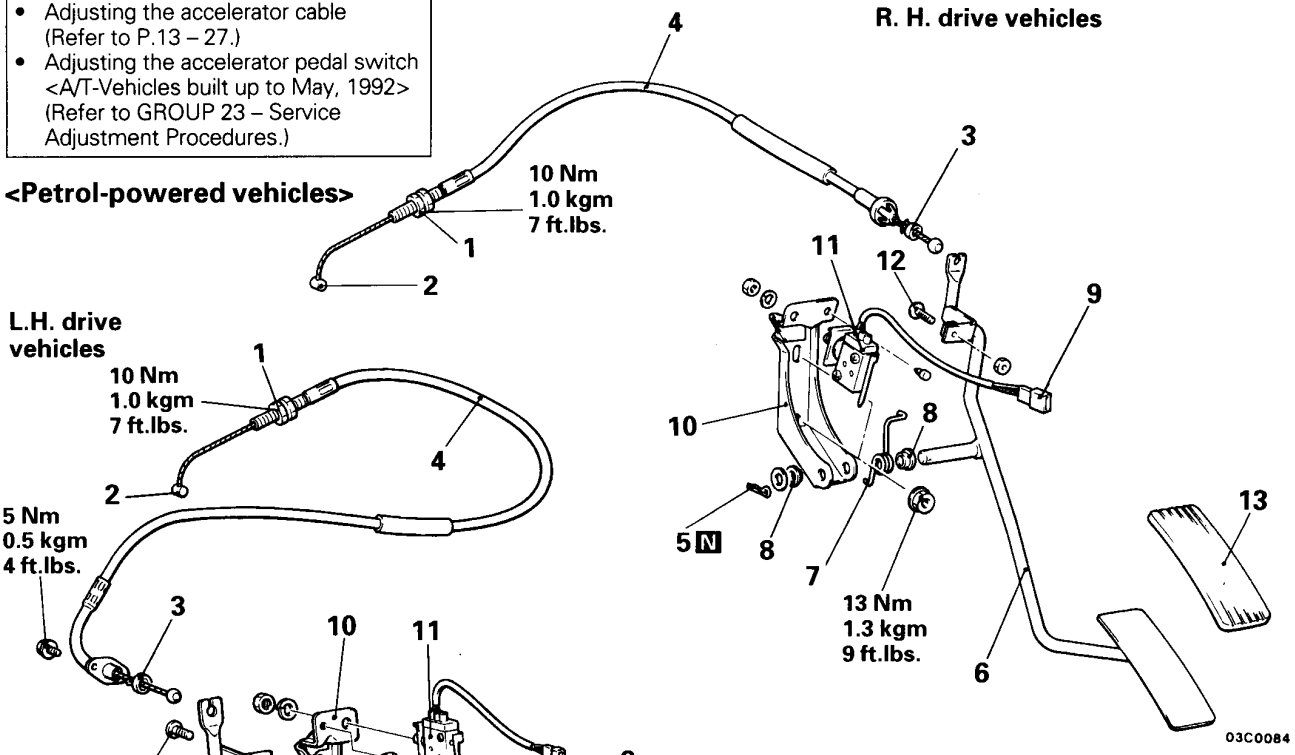
ACCELERATOR CABLE AND PEDAL

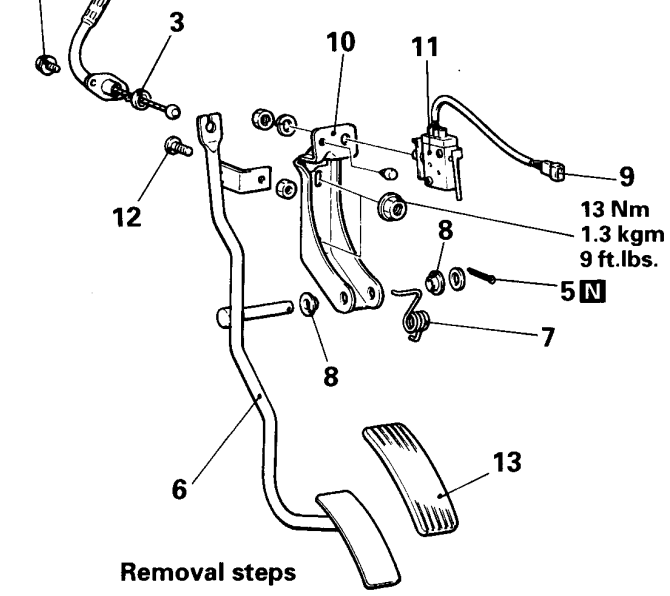
REMOVAL AND INSTALLATION

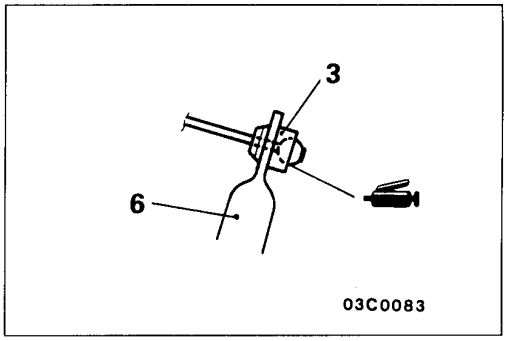
E13OA--

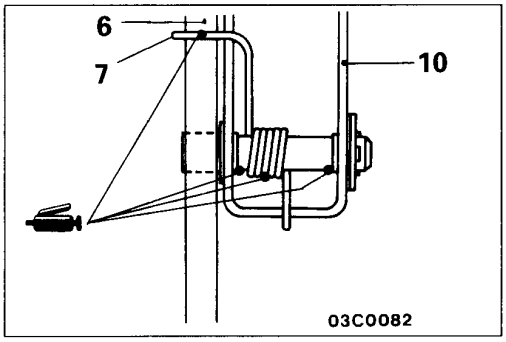
Post-installation Operation
- Adjusting the accelerator cable (Refer to P.13 – 27.)
- Adjusting the accelerator pedal switch <A/T-Vehicles built up to May, 1992> (Refer to GROUP 23 – Service Adjustment Procedures.)

<Petrol-powered vehicles>







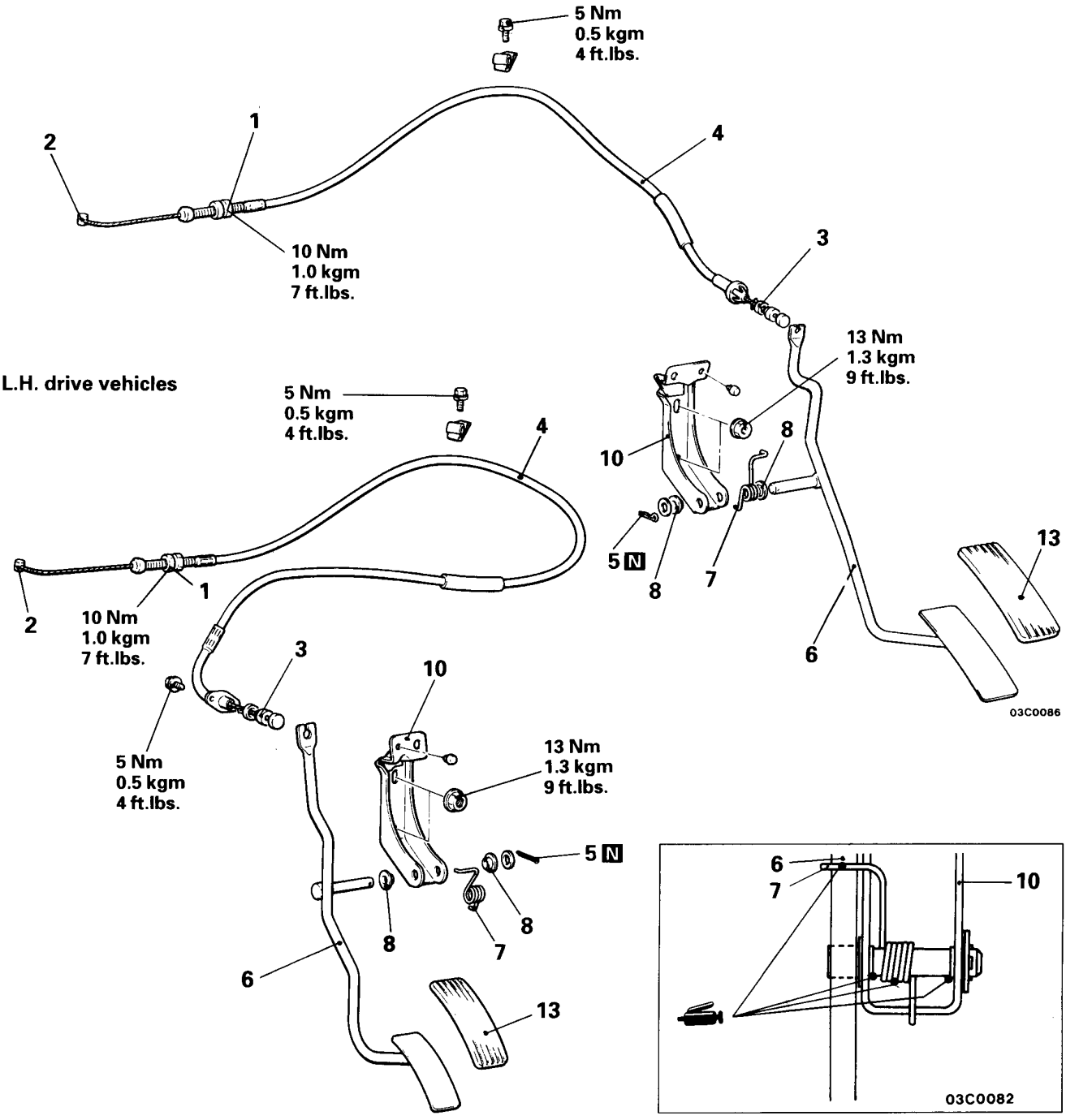


Removal steps
1. Adjusting nut
2. Inner cable connection
3. Bush connection
4. Accelerator cable
5. Split pin
6. Accelerator arm
7. Return spring
8. Bushing
9. Accelerator pedal switch connector <A/T-Vehicles built up to May, 1992>
10. Accelerator arm bracket
11. Accelerator pedal switch <A/T–Vehicles built up to May, 1992>
12. Adjusting bolt <A/T–Vehicles built up to May, 1992>
13. Accelerator pedal

<Diesel-powered vehicles>

R.H. drive vehicles

L.H. drive vehicles



Removal steps

1. Adjusting nut
2. Inner cable connection
3. Bushing connection
4. Accelerator cable
5. Split pin
6. Accelerator arm
7. Return spring
8. Bushing
10. Accelerator arm bracket
13. Accelerator pedal