

FUEL

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13109000171

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NOTE
THE GROUPS MARKED BY  ARE NOT IN THIS MANUAL

MULTIPOINT FUEL INJECTION (MPI)

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GENERAL INFORMATION

13100010135

The Multipoint Fuel Injection System consists of sensors which detect the engine conditions, the engine-ECU which controls the system based on signals from these sensors, and actuators which operate under the control of the engine-ECU. The engine-ECU carries out

activities such as fuel injection control, idle speed control and ignition timing control. In addition, the engine-ECU is equipped with several diagnosis modes which simplify troubleshooting when a problem develops.

FUEL INJECTION CONTROL

The injector drive times and injector timing are controlled so that the optimum air/fuel mixture is supplied to the engine to correspond to the continually-changing engine operation conditions.

A single injector is mounted at the intake port of each cylinder. Fuel is sent under pressure from the fuel tank by the fuel pump, with the pressure being regulated by the fuel pressure regulator. The fuel thus regulated is distributed to each of the injectors.

Fuel injection is normally carried out once for each cylinder for every two rotations of the crankshaft. The firing order is 1-3-4-2. This is

called sequential fuel injection. The engine-ECU provides a richer air/fuel mixture by carrying out "open-loop" control when the engine is cold or operating under high load conditions in order to maintain engine performance. In addition, when the engine is warm or operating under normal conditions, the engine-ECU controls the air/fuel mixture by using the oxygen sensor signal to carry out "closed-loop" control in order to obtain the theoretical air/fuel mixture ratio that provides the maximum cleaning performance from the three way catalyst.

IDLE AIR CONTROL

The idle speed is kept at the optimum speed by controlling the amount of air that bypasses the throttle valve in accordance with changes in idling conditions and engine load during idling. The engine-ECU drives the idle speed control (ISC) motor to keep the engine running at the pre-set idle target speed in accordance with the engine coolant temperature and air

conditioner load. In addition, when the air conditioner switch is turned off and on while the engine is idling, the ISC motor operates to adjust the throttle valve bypass air amount in accordance with the engine load conditions in order to avoid fluctuations in the engine speed.

IGNITION TIMING CONTROL

The power transistor located in the ignition primary circuit turns ON and OFF to control the primary current flow to the ignition coil. This controls the ignition timing in order to provide the optimum ignition timing with respect to the

engine operating conditions. The ignition timing is determined by the engine-ECU from the engine speed, intake air volume, engine coolant temperature and atmospheric pressure.

SELF-DIAGNOSIS FUNCTION

- When an abnormality is detected in one of the sensors or actuators related to emission control, the engine warning lamp (check engine lamp) illuminates as a warning to the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnosis code corresponding to the abnormality is output.
- The RAM data inside the ENGINE-ECU that is related to the sensors and actuators can be read by means of the MUT-II. In addition, the actuators can be force-driven under certain circumstances.

OTHER CONTROL FUNCTIONS

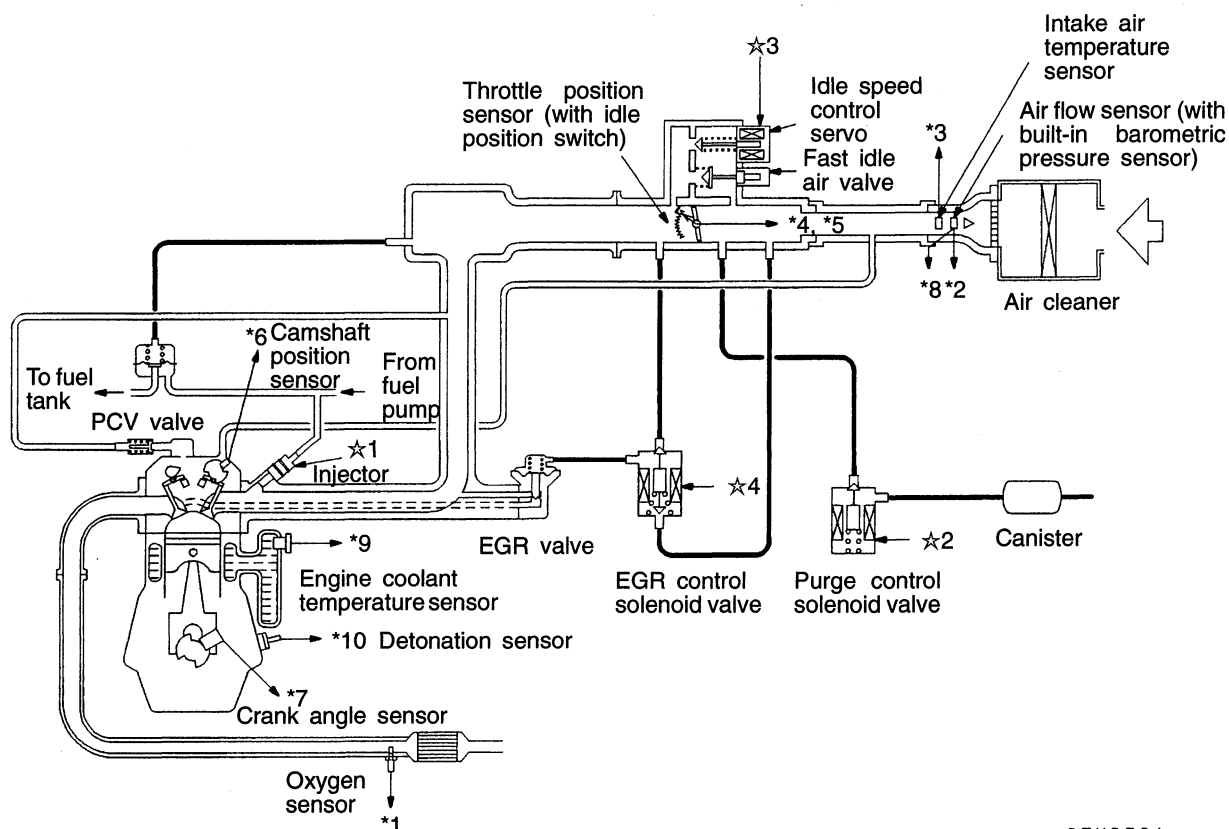
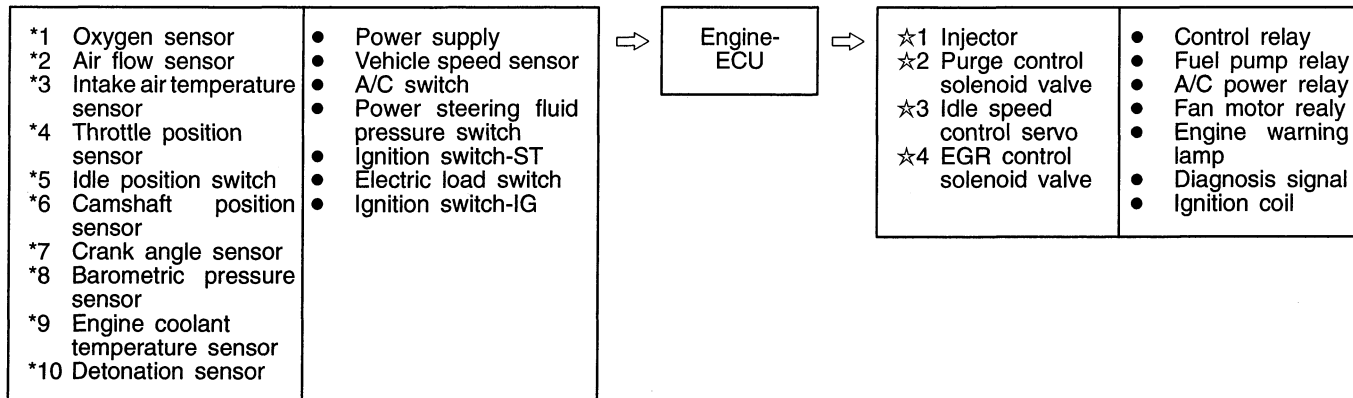
1. Fuel Pump Control
Turns the fuel pump relay ON so that current is supplied to the fuel pump while the engine is cranking or running.
2. A/C Relay Control
Turns the compressor clutch of the A/C ON and OFF.
3. Fan Relay Control
The revolutions of the radiator fan and condenser fan are controlled in response to the engine coolant temperature and vehicle speed.
4. Purge Control Solenoid Valve Control
Refer to GROUP 17.
5. EGR Control Solenoid Valve Control
Refer to GROUP 17.

GENERAL SPECIFICATIONS

Items		Specifications
Throttle body	Throttle bore mm	54
	Throttle position sensor	Variable resistor type
	Idle speed control servo	Stepper motor type (Stepper motor type by-pass air control system with the fast idle air valve)
	Idle position switch	Rotary contact type, within throttle position sensor

Items		Specifications
Engine-ECU	Identification model No.	E2T61679 <vehicles without immobilizer> E2T61680 <vehicles with immobilizer>
Sensors	Air flow sensor	Karman vortex type
	Barometric pressure sensor	Semiconductor type
	Intake air temperature sensor	Thermistor type
	Engine coolant temperature sensor	Thermistor type
	Oxygen sensor	Zirconia type
	Vehicle speed sensor	Magnetic resistive element type
	Camshaft position 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
	Fuel pump relay type	Contact switch type
	Injector type and number	Electromagnetic type, 4
	Injector identification mark	MDH240
	EGR control solenoid valve	Duty cycle type solenoid valve
	Purge control solenoid valve	ON/OFF type solenoid valve
Fuel pressure regulator	Regulator pressure kPa	329

MULTI POINT FUEL INJECTION SYSTEM DIAGRAM



6FU2521

SERVICE SPECIFICATIONS

13100030124

Items		Specifications
Basic idle speed r/min		850±50
Idle speed when A/C is ON r/min		850 at neutral position
Throttle position sensor adjusting voltage mV		400–1,000
Throttle position sensor resistance kΩ		3.5–6.5
Idle speed control servo coil resistance Ω		28–33 (at 20°C)
Intake air temperature sensor resistance kΩ	20°C	2.3–3.0
	80°C	0.30–0.42
Engine coolant temperature sensor resistance kΩ	20°C	2.1–2.7
	80°C	0.26–0.36
Oxygen sensor output voltage V		0.6–1.0
Fuel pressure kPa	Vacuum hose disconnection	324–343 at curb idle
	Vacuum hose connection	Approx. 265 at curb idle
Injector coil resistance Ω		13–16 (at 20°C)

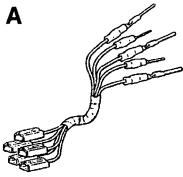
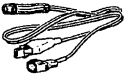
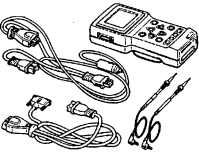
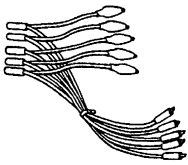
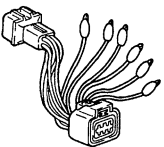
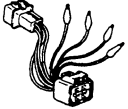
SEALANT

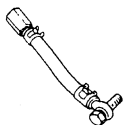
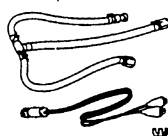
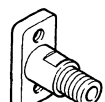
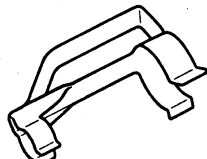
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Item	Specified sealant	Remark
Engine coolant temperature sensor threaded portion	3M Nut Locking Part No. 4171 or equivalent	Drying sealant

SPECIAL TOOLS

13100060116

Tool	Number	Name	Use
A  B  C  D 	MB991223 A: MB991219 B: MB991220 C: MB991221 D: MB991222	Harness set A: Test harness B: LED harness C: LED harness adapter D: Probe	- Fuel gauge simple inspection - A: Connector pin contact pressure inspection - B, C: Power circuit inspection - D: Commercial tester connection
	MB991502	MUT-II sub assembly	- Reading diagnosis code - MPI system inspection
	MB991348	Test harness set	Inspection using an analyzer
	MD998463	Test harness (6-pin, square)	- Inspection of idle speed control servo - Inspection using an analyzer
	MD998478	Test harness (3-pin, triangle)	Inspection using an analyzer
	MB998464	Test harness (4 pin, square)	Oxygen sensor check

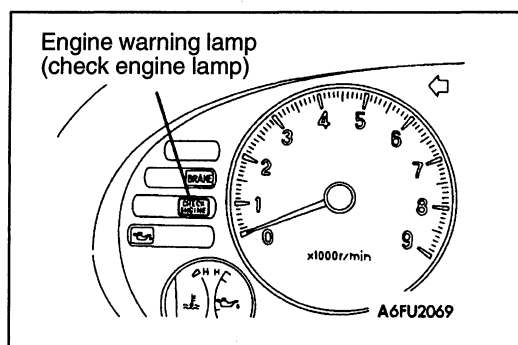
Tool	Number	Name	Use
	MD998709	Adaptor hose	Fuel pressure measurement
	MD998742	Hose adaptor	
	MD998706	Injector test set	Checking the spray condition of injectors
 MD998741	MD998741	Injector test adaptor	
	MD998746	Clip	

TROUBLESHOOTING

13100850119

DIAGNOSIS TROUBLESHOOTING FLOW

Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.



DIAGNOSIS FUNCTION

13100860112

ENGINE WARNING LAMP (CHECK ENGINE LAMP)

If an abnormality occurs in any of the following items related to the Multipoint Fuel Injection (MPI) system, the engine warning lamp will illuminate.

If the lamp remains illuminated or if the lamp illuminates while the engine is running, check the diagnosis code output.

Engine warning lamp inspection items

Engine-ECU
Oxygen sensor
Air flow sensor
Intake air temperature sensor
Throttle position sensor
Engine coolant temperature sensor
Crank angle sensor
Camshaft position sensor
Barometric pressure sensor
Detonation sensor
Ignition timing adjustment signal
Injector
Ignition coil, power transistor
Immobilizer system

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.

METHOD OF READING AND ERASING DIAGNOSIS CODES

Refer to GROUP 00 – How to Use Troubleshooting/Inspection Service Points.

INSPECTION USING MUT-II DATA LIST AND ACTUATOR TEST

1. Carry out inspection by means of the data list and the actuator test function.
If there is an abnormality, check and repair the chassis harnesses and components.
2. After repairing, re-check using the MUT-II and check that the abnormal input and output have returned to normal as a result of the repairs.
3. Erase the diagnosis code memory.
4. Remove the MUT-II.
5. Start the engine again and carry out a road test to confirm that the malfunction has disappeared.

FAIL-SAFE FUNCTION REFERENCE TABLE

13100910114

When the main sensor malfunctions are detected by the 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. Uses the throttle position sensor signal and engine speed signal (crank angle sensor signal) to take readings of the basic injector drive timing and basic ignition timing from the pre-set mapping. 2. Fixes the ISC servo in the appointed position so idle control is not performed.
Intake air temperature sensor	Controls as if the intake air temperature is 25°C.
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.
Camshaft position sensor	1. Injects fuel into the cylinders in the order 1-3-4-2 with irregular timing. (However, after the ignition switch is turned to ON, the No. 1 cylinder top dead centre is not detected at all.) 2. Cuts off the fuel supply 4 seconds after a problem is detected. (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 101 kPa.
Detonation sensor	Switches the ignition timing from ignition timing for super petrol to ignition timing for standard petrol.
Ignition coil, power transistor	Cuts off the fuel supply to cylinders with an abnormal ignition signal.
Oxygen sensor	Air/fuel ratio feedback control (closed loop control) is not performed.

INSPECTION CHART FOR DIAGNOSIS CODES

13100870115

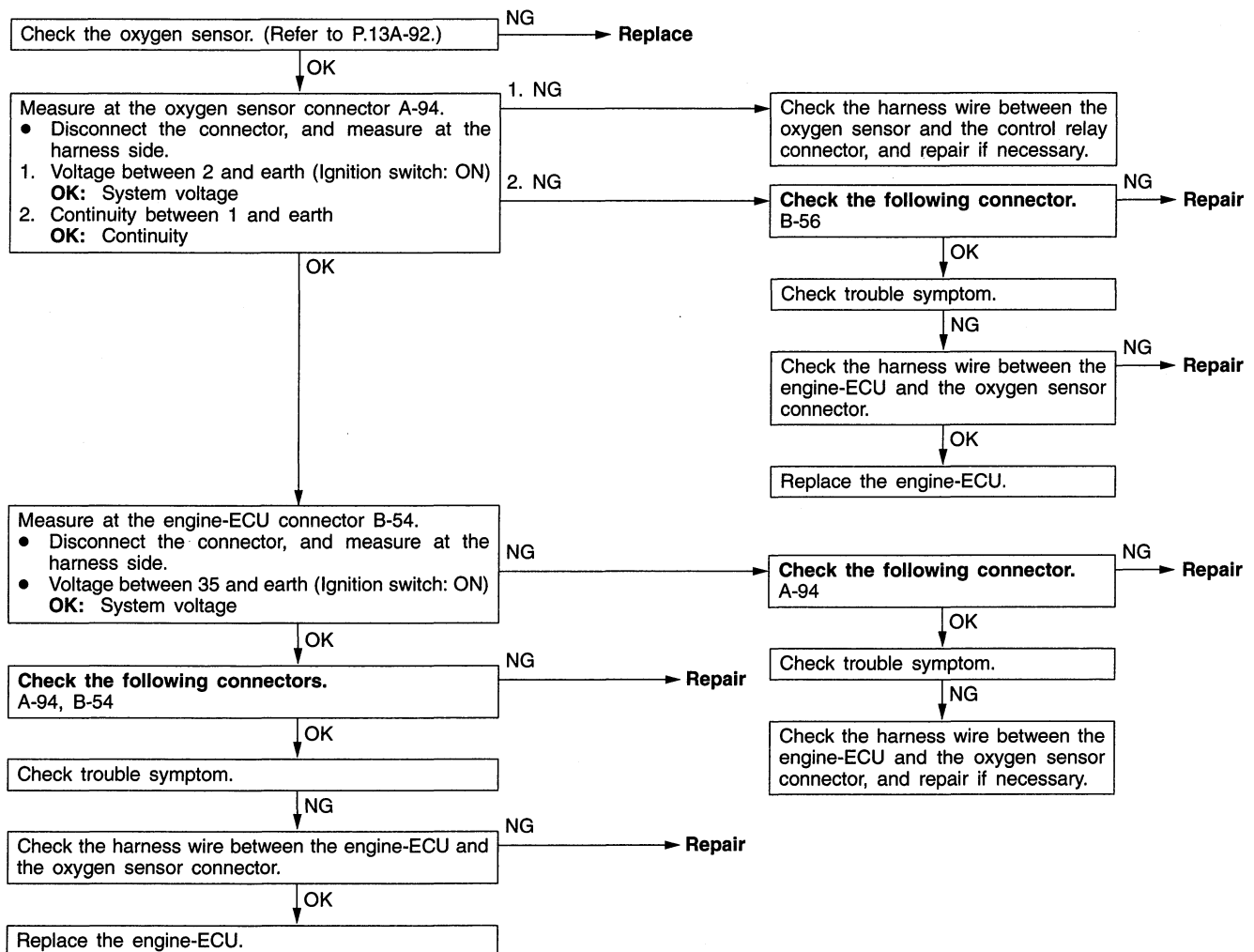
Code No.	Diagnosis item	Reference page
11	Oxygen sensor system	13A-13
12	Air flow sensor system	13A-14
13	Intake air temperature sensor system	13A-14
14	Throttle position sensor system	13A-15
21	Engine coolant temperature sensor system	13A-16
22	Crank angle sensor system	13A-17
23	Camshaft position sensor	13A-18
24	Vehicle speed sensor system	13A-19
25	Barometric pressure sensor system	13A-20
31	Detonation sensor system	13A-21
36*1	Ignition timing adjustment signal system	13A-21
41	Injector system	13A-22
44	Ignition coil and power transistor unit system	13A-22
54	Immobilizer system	13A-23

NOTE

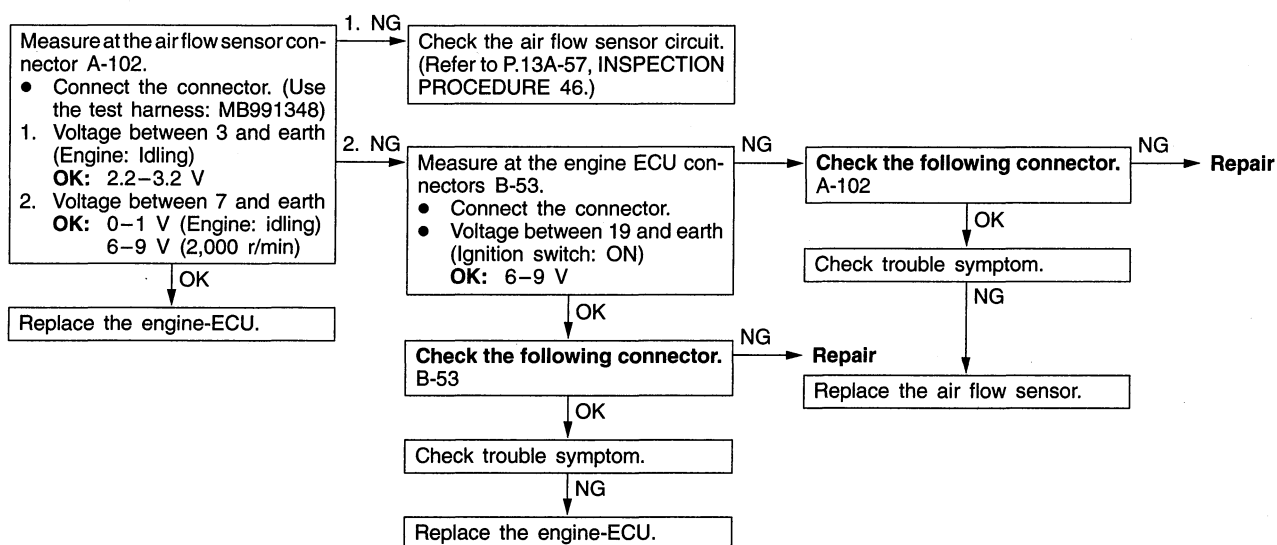
*1: Malfunction code No. 36 is not memorized.

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

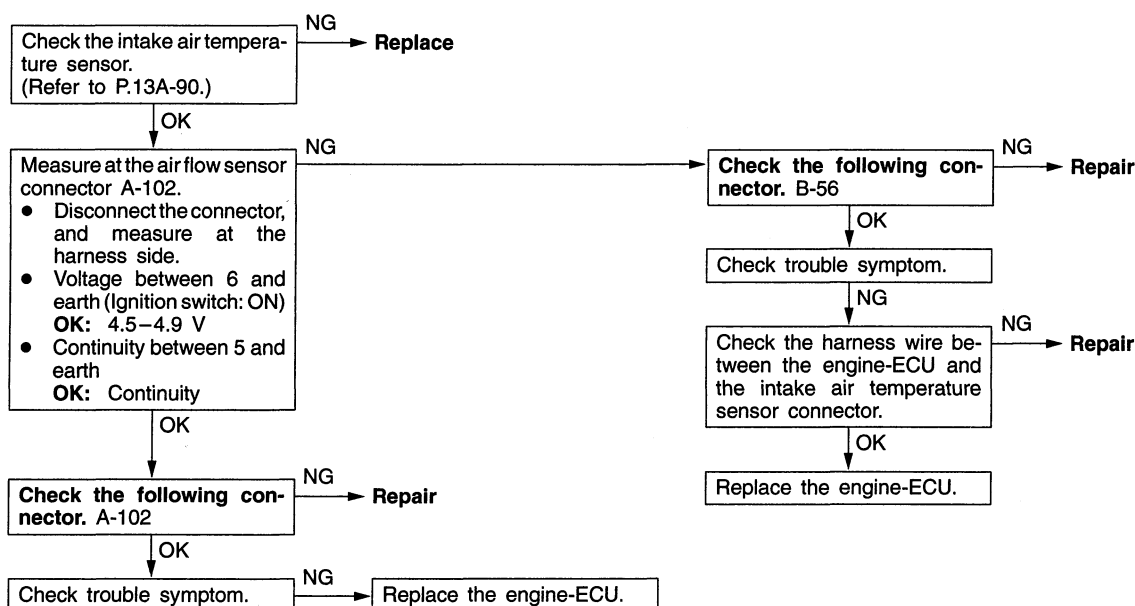
Code No. 11 Oxygen sensor system	Probable cause
Range of Check • 3 minutes have passed after engine was started. • Engine coolant temperature is approx. 80°C or more. • Intake air temperature is 20–50°C. • Engine speed is approx. 2,000–3,000 r/min • Vehicle is moving at constant speed on a flat, level road surface Set conditions • The oxygen sensor output voltage is around 0.6 V for 30 seconds (does not cross 0.6 V for 30 seconds). • When the range of check operations given above which accompany starting of the engine are carried out four time in succession, a problem is detected after each operation.	• Malfunction of the oxygen sensor • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



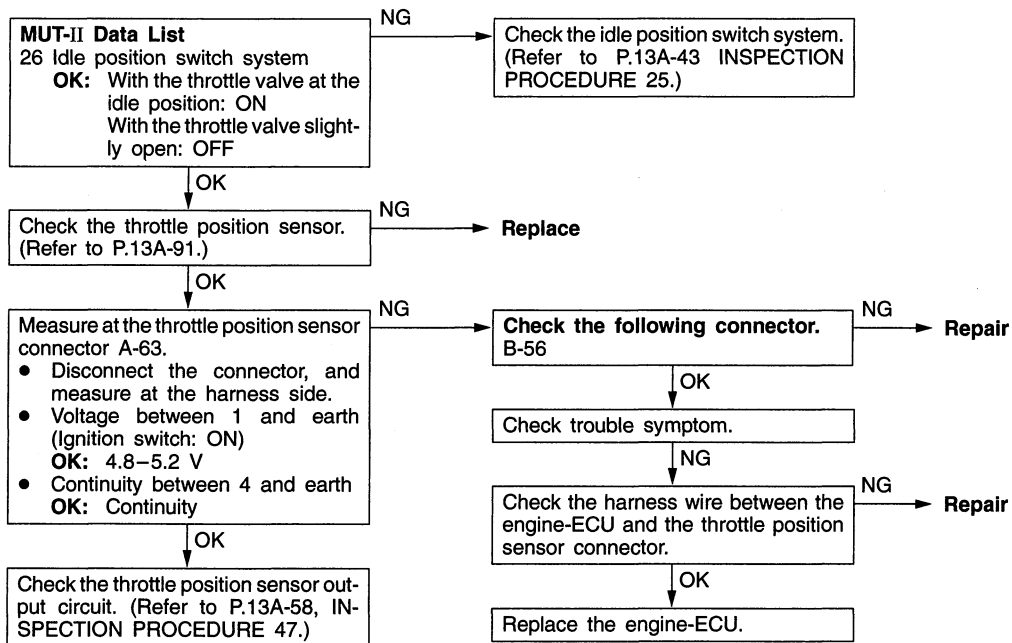
Code No. 12 Air flow sensor system	Probable cause
Range of Check • Engine speed is 500 r/min or more. Set conditions • Sensor output frequency is 3 Hz or less for 4 seconds.	• Malfunction of the air flow sensor • Improper connector contact, open circuit or short-circuited harness wire of the air flow sensor • Malfunction of the engine-ECU



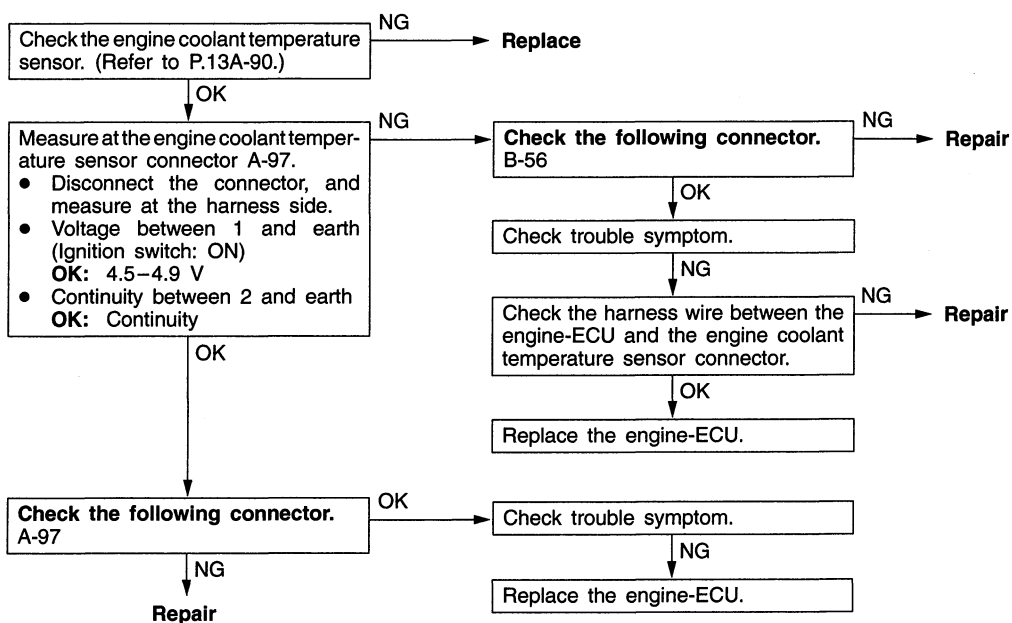
Code No. 13 Intake air temperature sensor system	Probable cause
Range of Check • Ignition switch: ON • Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. Set conditions • Sensor output voltage is 4.6 V or more (corresponding to an intake air temperature of -45°C or less) for 4 seconds. or • Sensor output voltage is 0.2V or less (corresponding to an intake air temperature of 125°C or more) for 4 seconds.	• Malfunction of the intake air temperature sensor • Improper connector contact, open circuit or short-circuited harness wire of the intake air temperature sensor circuit • Malfunction of the engine-ECU



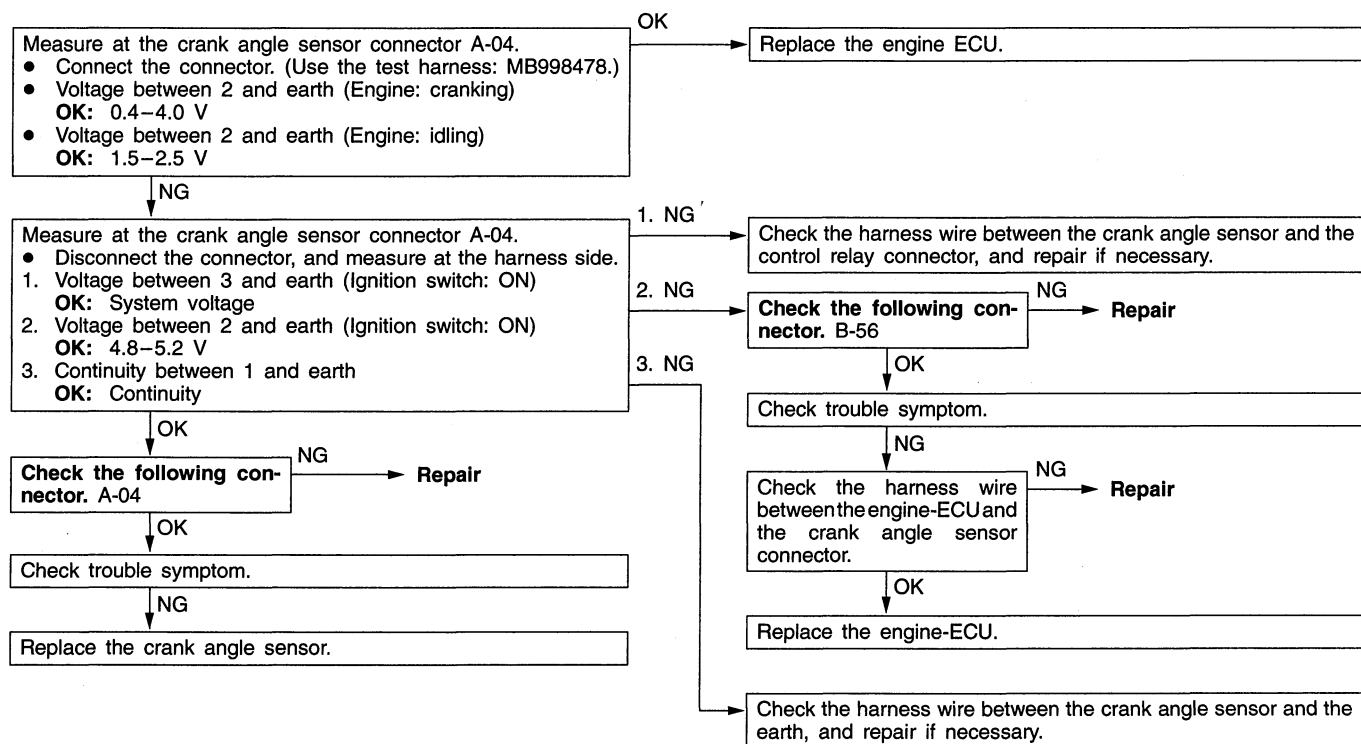
Code No. 14 Throttle position sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. Set conditions - When the idle position switch is ON, the sensor output voltage is 2 V or more for 4 seconds. or - The sensor output voltage is 0.2 V or less for 4 seconds.	- Malfunction of the throttle position sensor or maladjustment - Improper connector contact, open circuit or short-circuited harness wire of the throttle position sensor circuit - Improper "ON" state of idle position switch - Short circuit of the idle position switch signal line - Malfunction of the engine-ECU



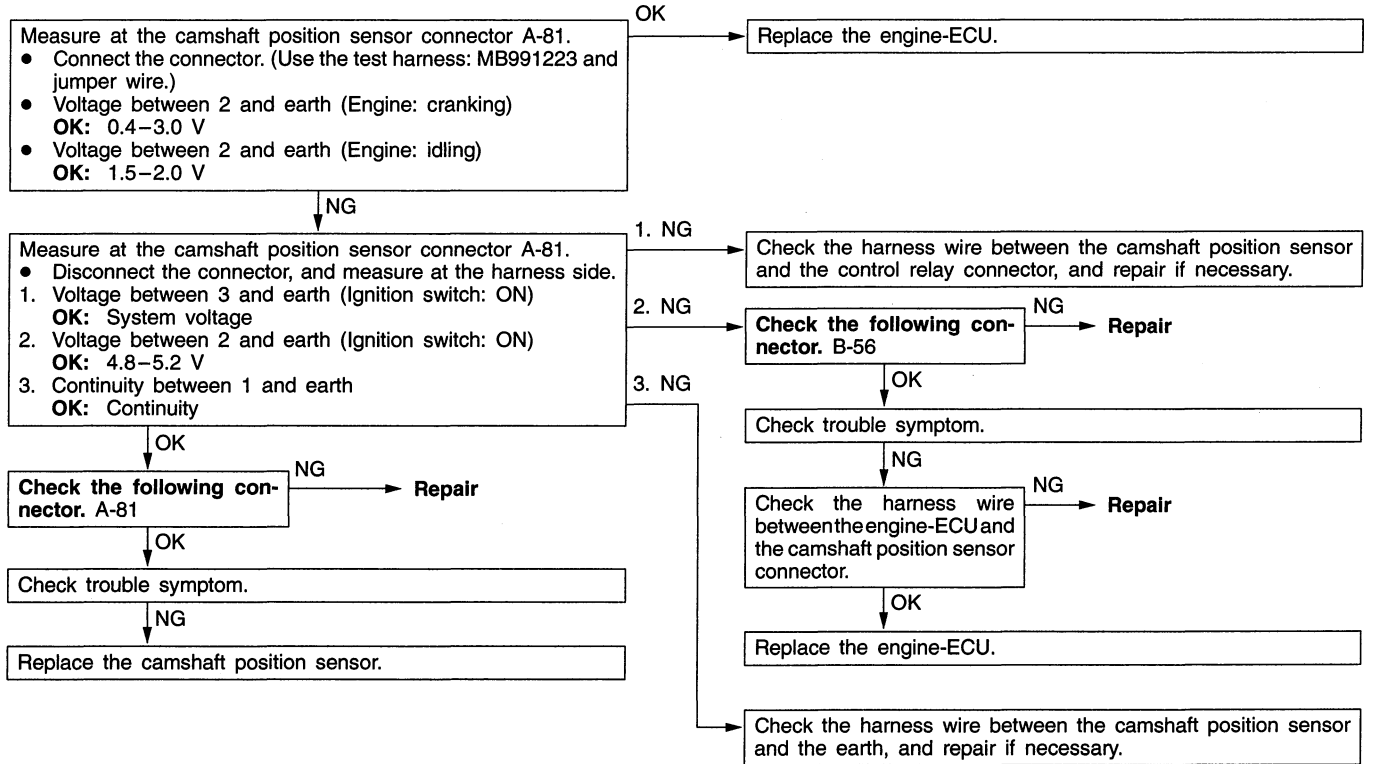
Code No. 21 Engine coolant temperature sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. Set conditions - Sensor output voltage is 4.6 V or more (corresponding to an engine coolant temperature of -45°C or less) for 4 seconds. or - Sensor output voltage is 0.1 V or less (corresponding to an engine coolant temperature of 140°C or more) for 4 seconds.	- Malfunction of the engine coolant temperature sensor - Improper connector contact, open circuit or short-circuited harness wire of the engine coolant temperature sensor circuit - Malfunction of the engine-ECU
Range of Check - Ignition switch: ON - Engine speed is approx. 50 r/min or more Set conditions - The sensor output voltage increases from 1.6 V or less (corresponding to an engine coolant temperature of 40°C or more) to 1.6 V or more (corresponding to an engine coolant temperature of 40°C or less). - After this, the sensor output voltage is 1.6 V or more for 5 minutes.	



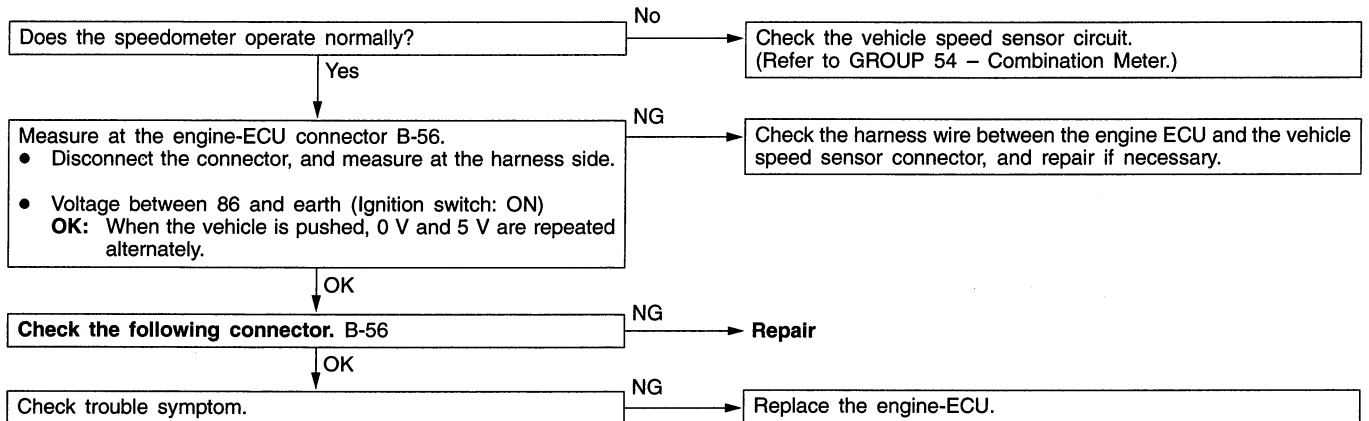
Code No. 22 Crank angle sensor system	Probable cause
Range of Check • Engine is cranking. Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal input.)	• Malfunction of the crank angle sensor • Improper connector contact, open circuit or short-circuited harness wire of the crank angle sensor circuit • Malfunction of the engine-ECU



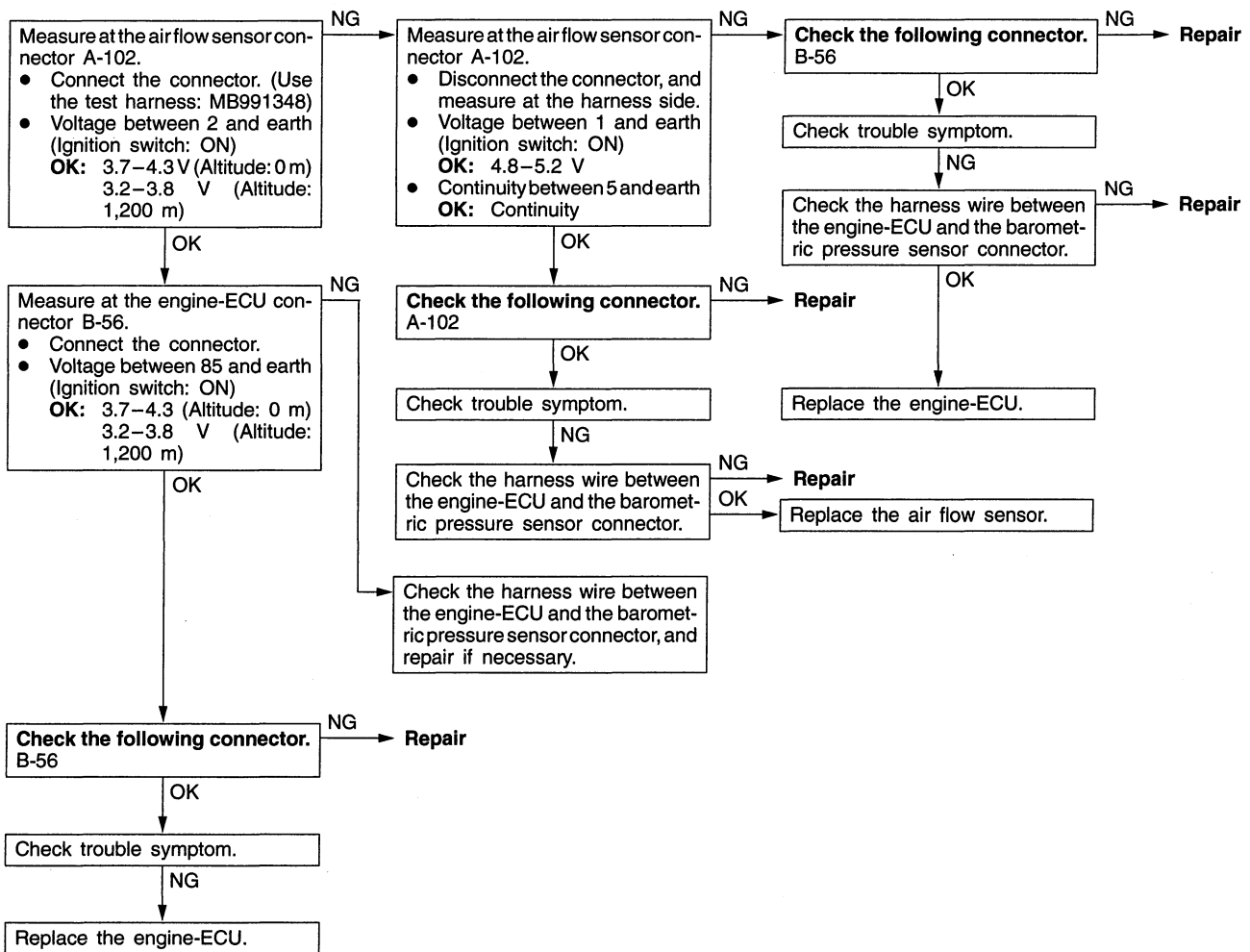
Code No. 23 Camshaft position sensor system	Probable cause
Range of Check • Ignition switch: ON • Engine speed is approx. 50 r/min or more. Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal input.)	• Malfunction of the top dead centre sensor • Improper connector contact, open circuit or short-circuited harness wire of the top dead centre sensor circuit • Malfunction of the engine-ECU



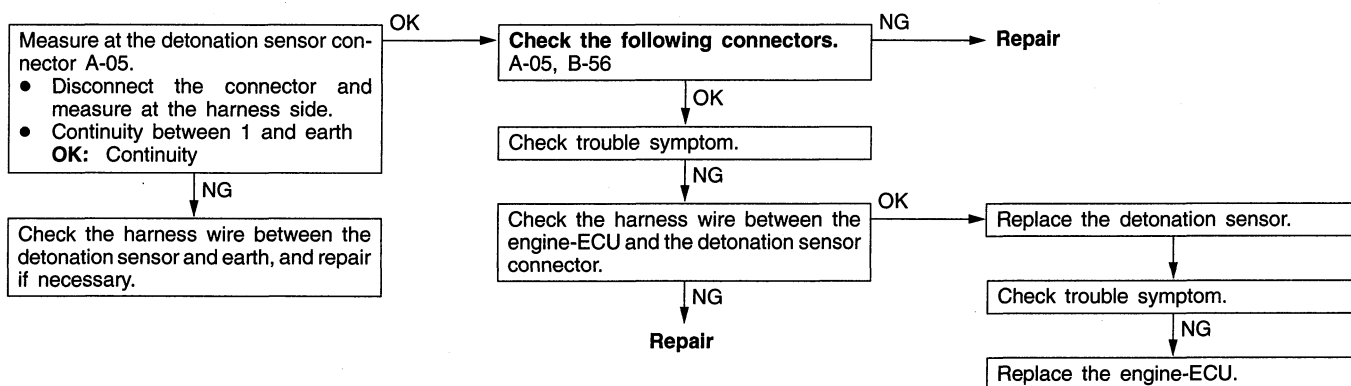
Code No. 24 Vehicles speed sensor system	Probable cause
Range of check • Ignition switch: ON • Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. • Idle position switch: OFF • Engine speed is 3,000 r/min or more. • Driving under high engine load conditions. Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal input).	• Malfunction of the vehicle speed sensor • Improper connector contact, open circuit or short-circuited harness wire of the vehicle speed sensor circuit • Malfunction of the engine-ECU



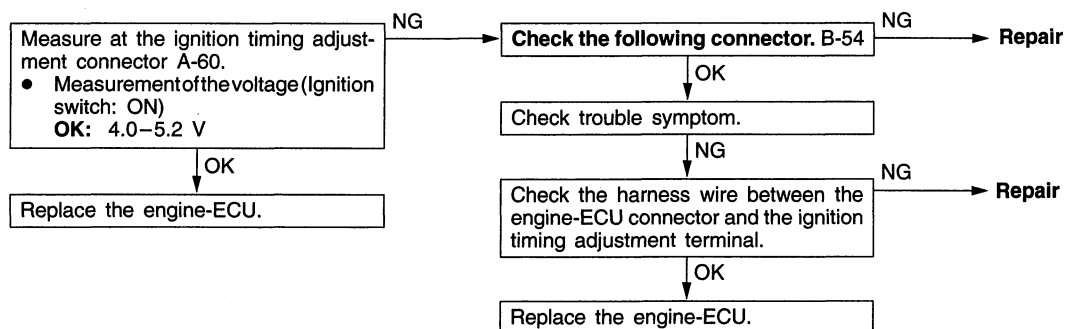
Code No. 25 Barometric pressure sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. - Battery voltage is 8 V or more. Set conditions - Sensor output voltage is 4.5 V or more (corresponding to a barometric pressure of 114 kPa or more) for 4 seconds. or - Sensor output voltage is 0.2 V or less (corresponding to a barometric pressure of 5.33 kPa or less) for 4 seconds.	- Malfunction of the barometric pressure sensor - Improper connector contact, open circuit or short-circuited harness wire of the barometric pressure sensor circuit - Malfunction of the engine-ECU



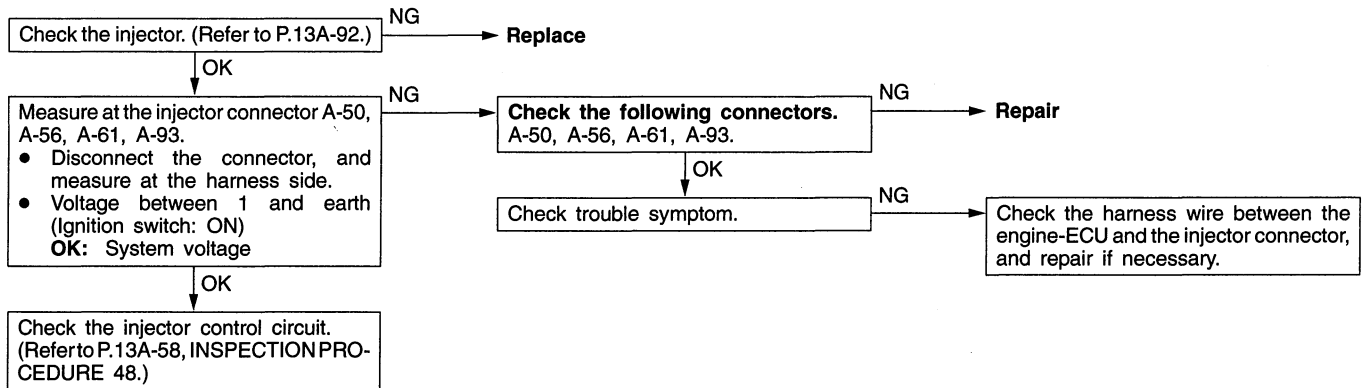
Code No. 31 Detonation sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. - Engine speed is approx. 5,000 r/min or more Set conditions The change in the detonation sensor output voltage (detonation sensor peak voltage at each 1/2 revolution of the crankshaft) is less than 0.06 V for 200 times in succession.	- Malfunction of the detonation sensor - Improper connector contact, open circuit or short-circuited harness wire of the detonation sensor circuit - Malfunction of the engine-ECU



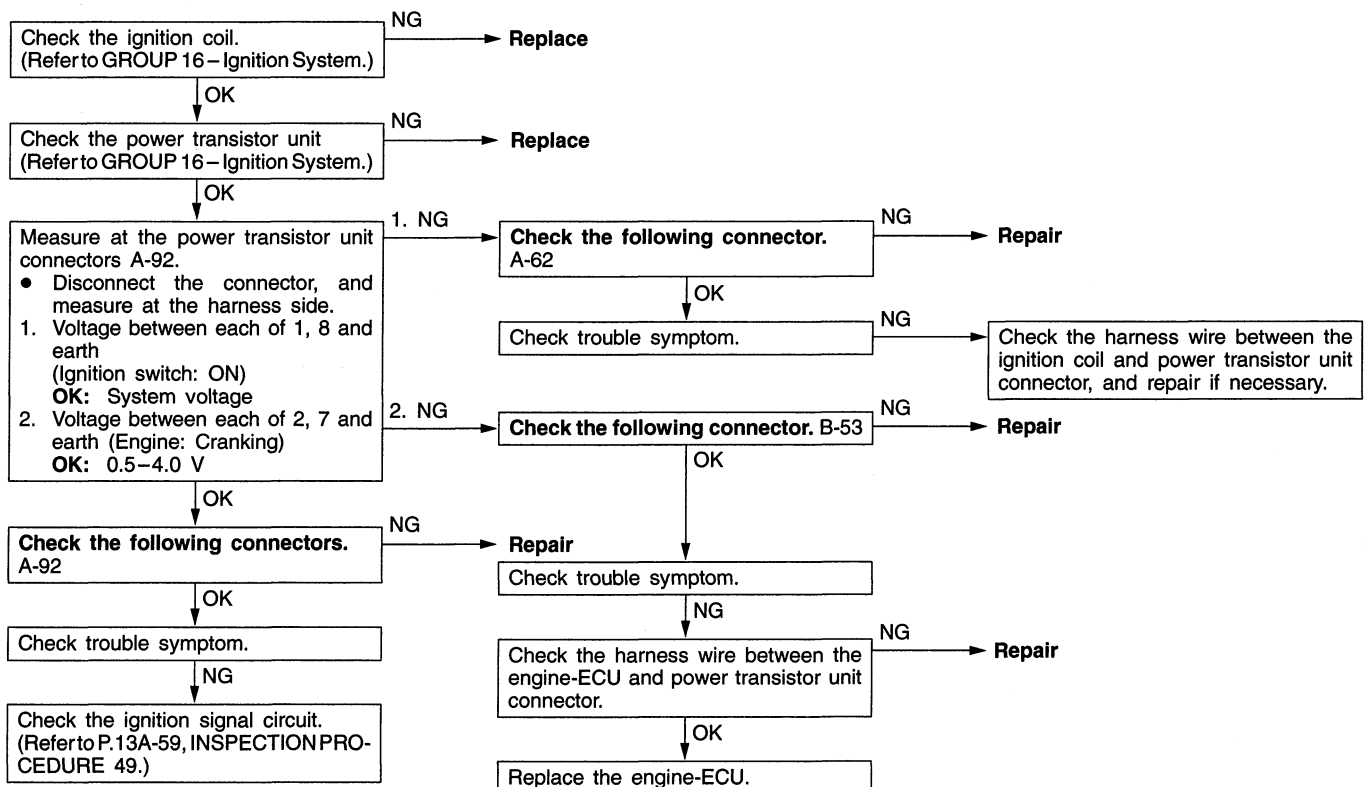
Code No. 36 Ignition timing adjustment signal system	Probable cause
Range of Check - Ignition switch: ON Set conditions - The ignition timing adjusting signal wire is shorted to the earth.	- Short circuit to earth of the ignition timing adjustment signal line - Malfunction of the engine-ECU



Code No. 41 Injector system	Probable cause
Range of Check - Engine speed is approx. 50–1,000 r/min - The throttle position sensor output voltage is 1.15 V or less. - Actuator test by MUT-II is not carried out. Set conditions - Surge voltage of injector coil is not detected for 4 seconds.	- Malfunction of the injector - Improper connector contact, open circuit or short-circuited harness wire of the injector circuit - Malfunction of the engine-ECU



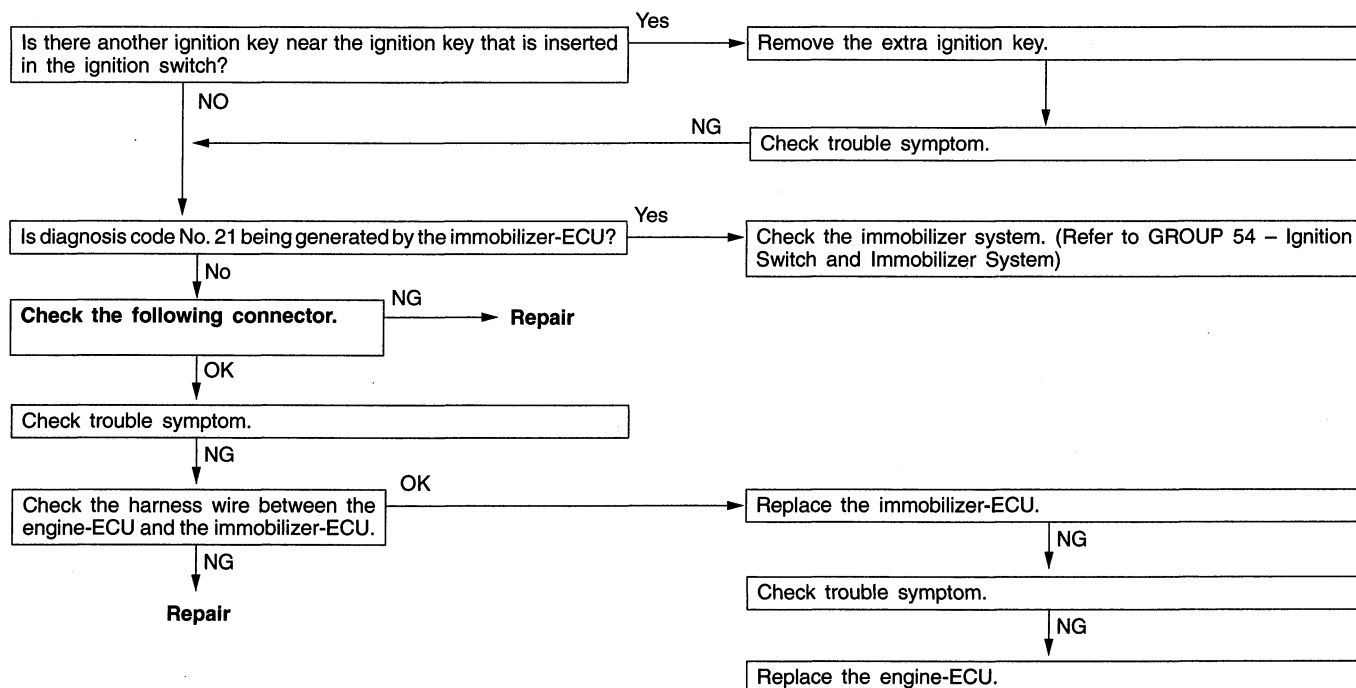
Code No. 44 Ignition coil and power transistor unit system	Probable cause
Range of Check - Engine speed is approx. 50–4,000 r/min - Engine is not cranking. Set conditions - The ignition signal from the same coil is not input for 4 seconds. However, this excludes cases where no ignition signal is input from any coils.	- Malfunction of the ignition coil - Improper connector contact, open circuit or short-circuited harness wire of the ignition primary circuit - Malfunction of the power transistor unit - Malfunction of the engine-ECU



Code No. 54 Immobilizer system	Probable cause
Range of Check • Ignition switch: ON Set Conditions • There is a problem with communication between the engine-ECU and the immobilizer-ECU.	• Radio interference with ID codes • Incorrect ID code • Malfunction of harness or connector • Malfunction of the immobilizer-ECU • Malfunction of the engine-ECU

NOTE

- When starting the engine, one ignition key's ID code interferes with another ignition key's code.
- This diagnosis code may be displayed when an ID-code is registered.



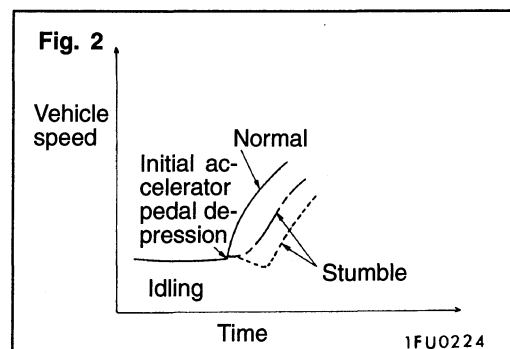
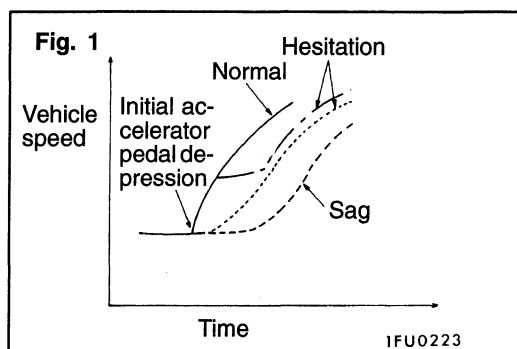
INSPECTION CHART FOR TROUBLE SYMPTOMS

13100880118

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is impossible.	Communication with all systems is not possible.	1	13A-26
	Communication with engine-ECU only is not possible.	2	13A-27
Engine warning lamp and related parts	The engine warning lamp does not illuminate right after the ignition switch is turned to the ON position.	3	13A-28
	The engine warning lamp remains illuminating and never goes out.	4	13A-28
Starting	No initial combustion (starting impossible)	5	13A-29
	Initial combustion but no complete combustion (starting impossible)	6	13A-30
	It take too long time to start (improper starting)	7	13A-31
Idling stability (Improper idling)	Unstable idling (Rough idling, hunting)	8	13A-32
	Idling speed is high. (Improper idling speed)	9	13A-33
	Idling speed is low. (Improper idling speed)	10	13A-34
Idling stability (Engine stalls)	When the engine is cold, it stalls at idling. (Die out)	11	13A-35
	When the engine becomes hot, it stalls at idling. (Die out)	12	13A-36
	The engine stalls when the vehicle starts. (Pass out)	13	13A-37
	The engine stalls when decelerating.	14	13A-37
Driving	Hesitation, sag or stumble	15	13A-38
	The feeling of impact or vibration when accelerating	16	13A-38
	The feeling of impact or vibration when decelerating	17	13A-39
	Poor acceleration	18	13A-39
	Surge	19	13A-40
	Knocking	20	13A-40
Dieseling		21	13A-40
Too high CO and HC concentration when idling		22	13A-41

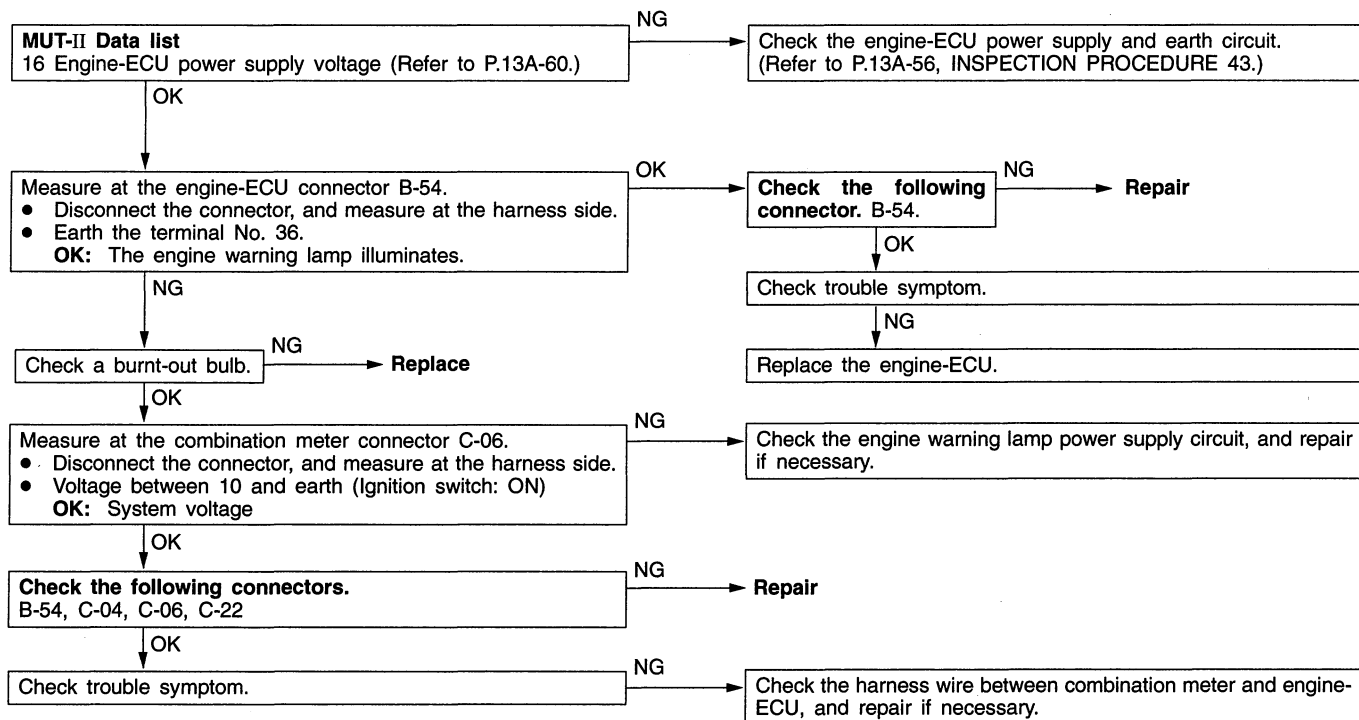
PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

Items		Symptom
Starting	Won't start	The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start.
	Fires up and dies	There is combustion within the cylinders, but then the engine soon stalls.
	Hard starting	Engine starts after cranking a while.
Idling stability	Hunting	Engine speed doesn't remain constant; changes at idle.
	Rough idle	Usually, a judgement can be based upon the movement of the tachometer pointer, and the vibration transmitted to the steering wheel, shift lever, body, etc. This is called rough idle.
	Incorrect idle speed	The engine doesn't idle at the usual correct speed.
	Engine stall (Die out)	The engine stalls when the foot is taken from the accelerator pedal, regardless of whether the vehicles is moving or not.
	Engine stall (Pass out)	The engine stalls when the accelerator pedal is depressed or while it is being used.
Driving	Hesitation Sag	"Hesitation" is the delay in response of the vehicle speed (engine speed) 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 speed) during such acceleration. Serious hesitation is called "sag". (Refer to Fig. 1)
	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 speed increase is delayed when the accelerator pedal is initially depressed for acceleration. (Refer to Fig. 2)
	Shock	The feeling of a comparatively large impact or vibration when the engine is accelerated or decelerated.
	Surge	This is repeated surging ahead during constant speed travel or during variable speed travel.
	Knocking	A sharp sound like a hammer striking the cylinder walls during driving and which adversely affects driving.
Stopping	Run on ("Dieseling")	The condition in which the engine continues to run after the ignition switch is turned to OFF. Also called "Dieseling".



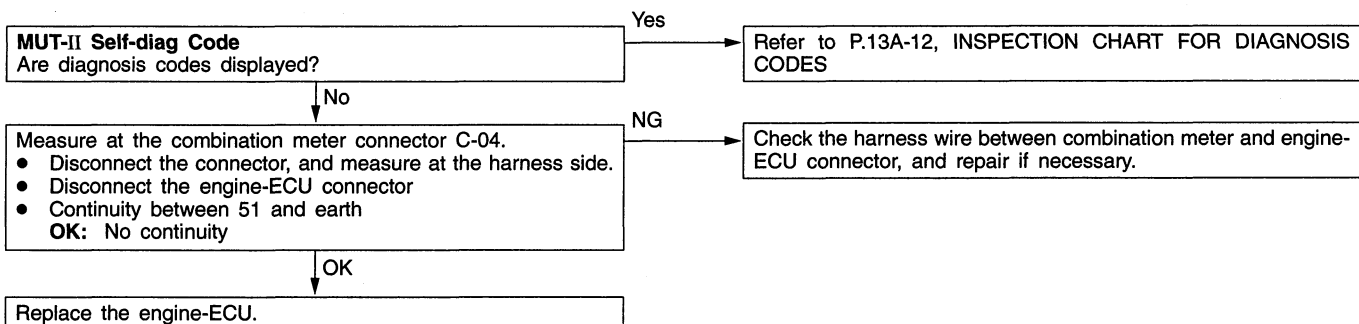
INSPECTION PROCEDURE 3

The engine warning lamp does not illuminate right after the ignition switch is turned to the ON position.	Probable cause
Because there is a burnt-out bulb, the engine ECU causes the engine warning lamp to illuminate for five seconds immediately after the ignition switch is turned to ON. If the engine warning lamp does not illuminate immediately after the ignition switch is turned to ON, one of the malfunctions listed at right has probably occurred.	- Burnt-out bulb - Defective warning lamp circuit - Malfunction of the engine ECU



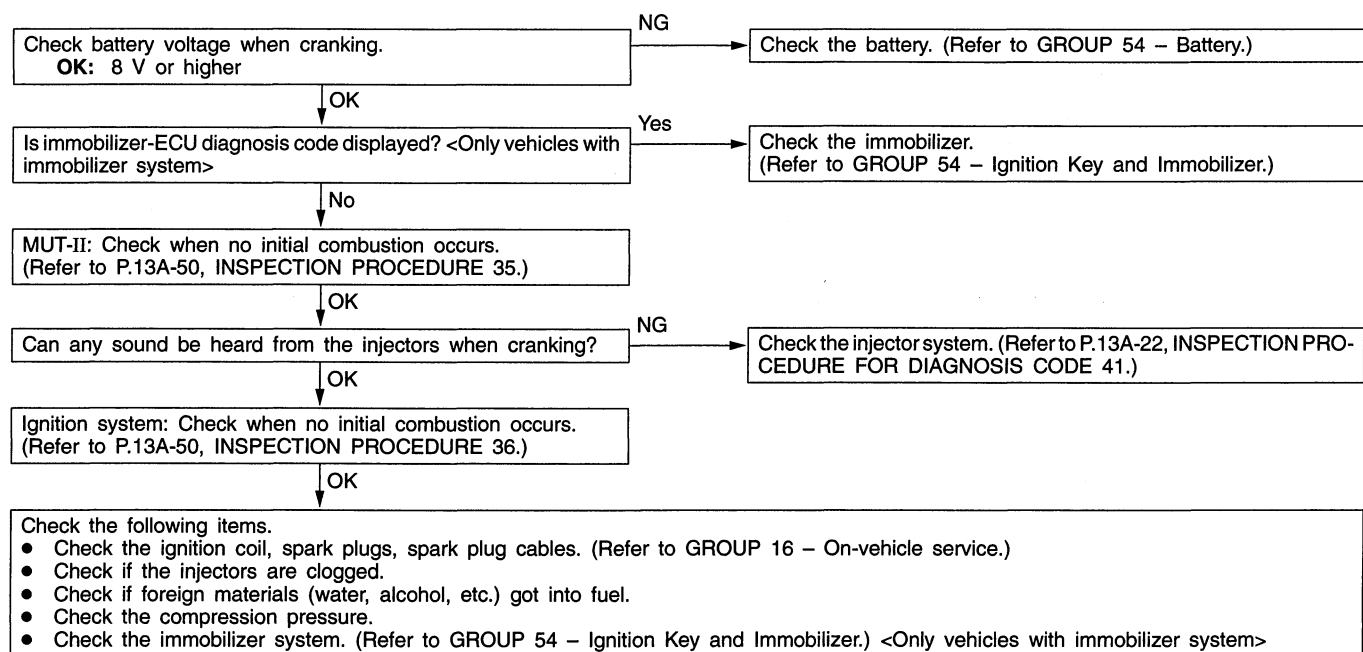
INSPECTION PROCEDURE 4

The engine warning lamp remains illuminating and never goes out.	Probable cause
In cases such as the above, the cause is probably that the engine-ECU is detecting a problem in a sensor or actuator, or that one of the malfunctions listed at right has occurred.	- Short-circuit between the engine warning lamp and engine-ECU - Malfunction of the engine-ECU



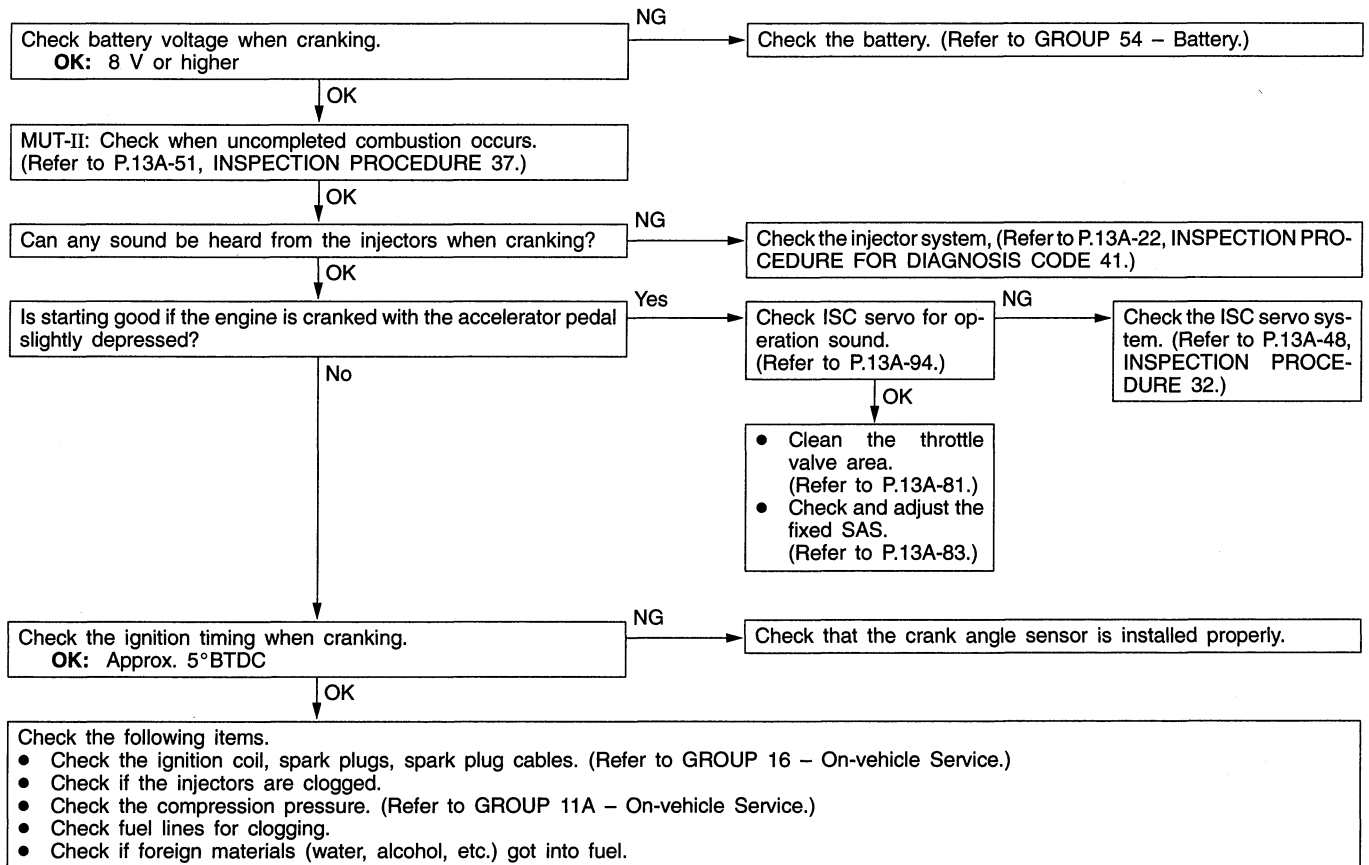
INSPECTION PROCEDURE 5

No initial combustion (starting impossible)	Probable cause
In cases such as the above, the cause is probably that a spark plug is defective, or that the supply of fuel to the combustion chamber is defective. In addition, foreign materials (water, kerosene, etc.) may be mixed with the fuel.	• Malfunction of the ignition system • Malfunction of the fuel pump system • Malfunction of the injectors • Malfunction of the engine-ECU • Malfunction of the immobilizer system <Only vehicles with immobilizer system> • Foreign materials in fuel



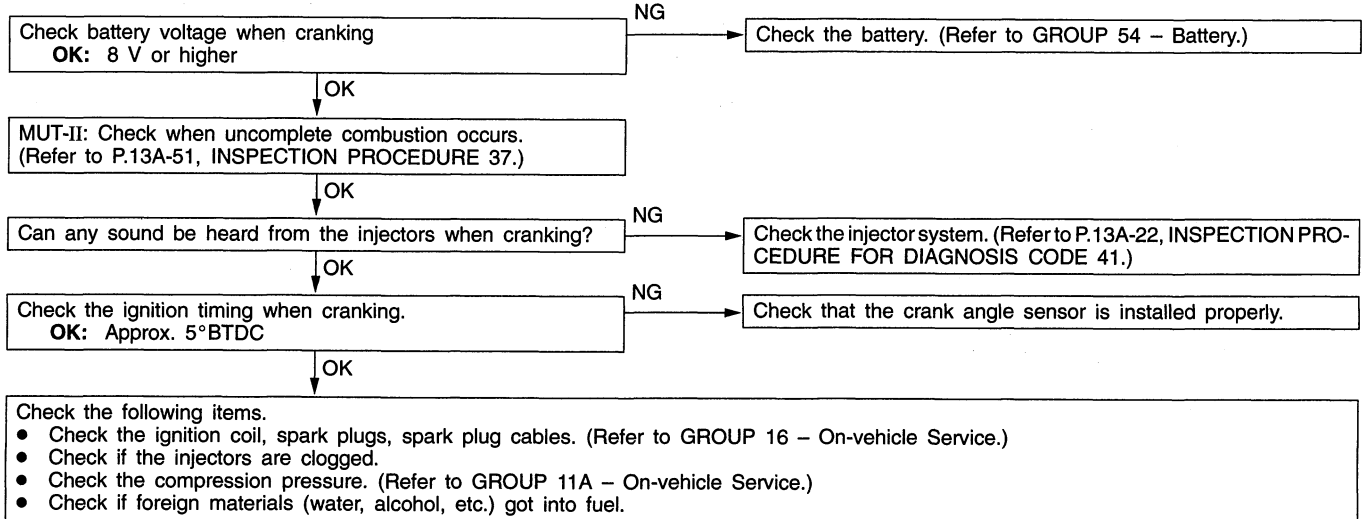
INSPECTION PROCEDURE 6

Initial combustion but no complete combustion (starting impossible)	Probable cause
In such cases as the above, the cause is probably that the spark plugs are generating sparks but the sparks are weak, or the initial mixture for starting is not appropriate.	• Malfunction of the ignition system • Malfunction of the injector system • Foreign materials in fuel • Poor compression • Malfunction of the engine-ECU



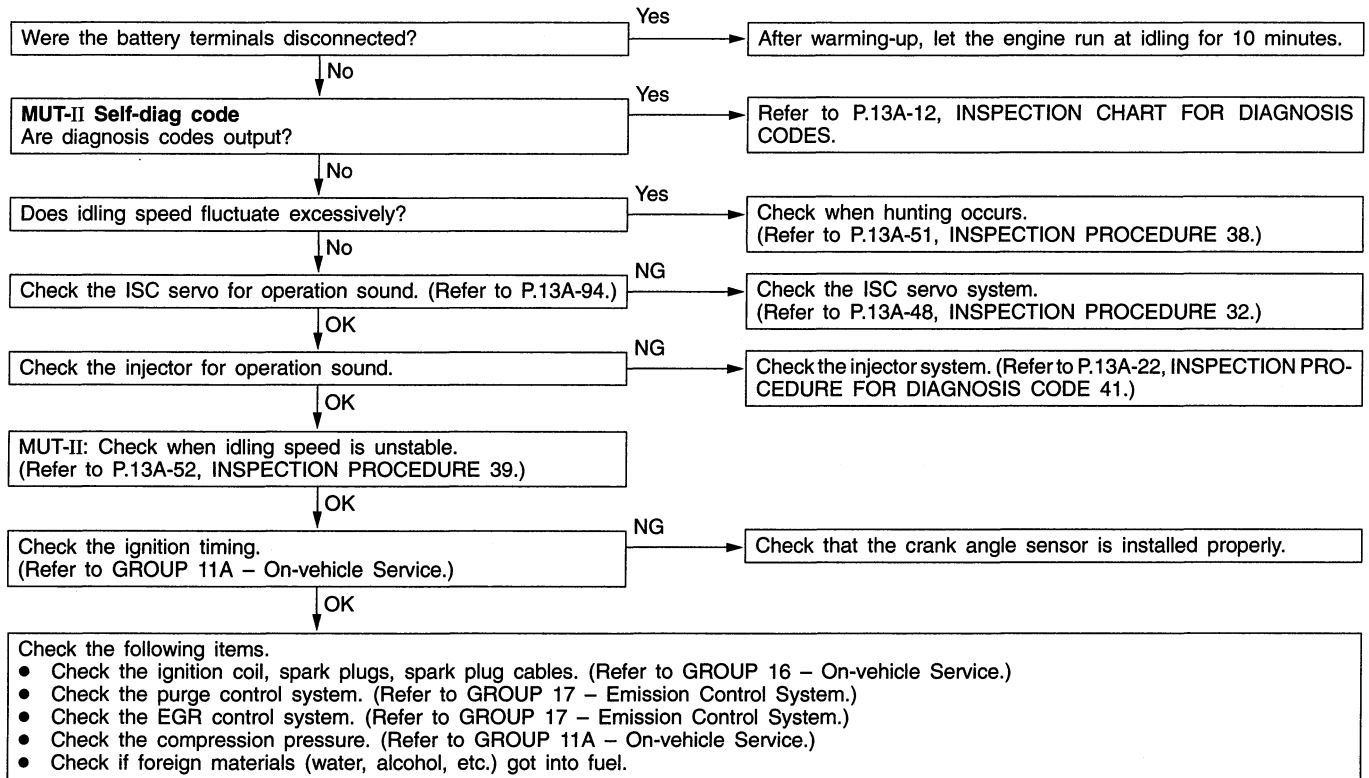
INSPECTION PROCEDURE 7

It takes too long time to start. (Incorrect starting)	Probable cause
In cases such as the above, the cause is probably that the spark is weak and ignition is difficult, the initial mixture for starting is not appropriate, or sufficient compression pressure is not being obtained.	• Malfunction of the ignition system • Malfunction of the injector system • Inappropriate gasoline use • Poor compression



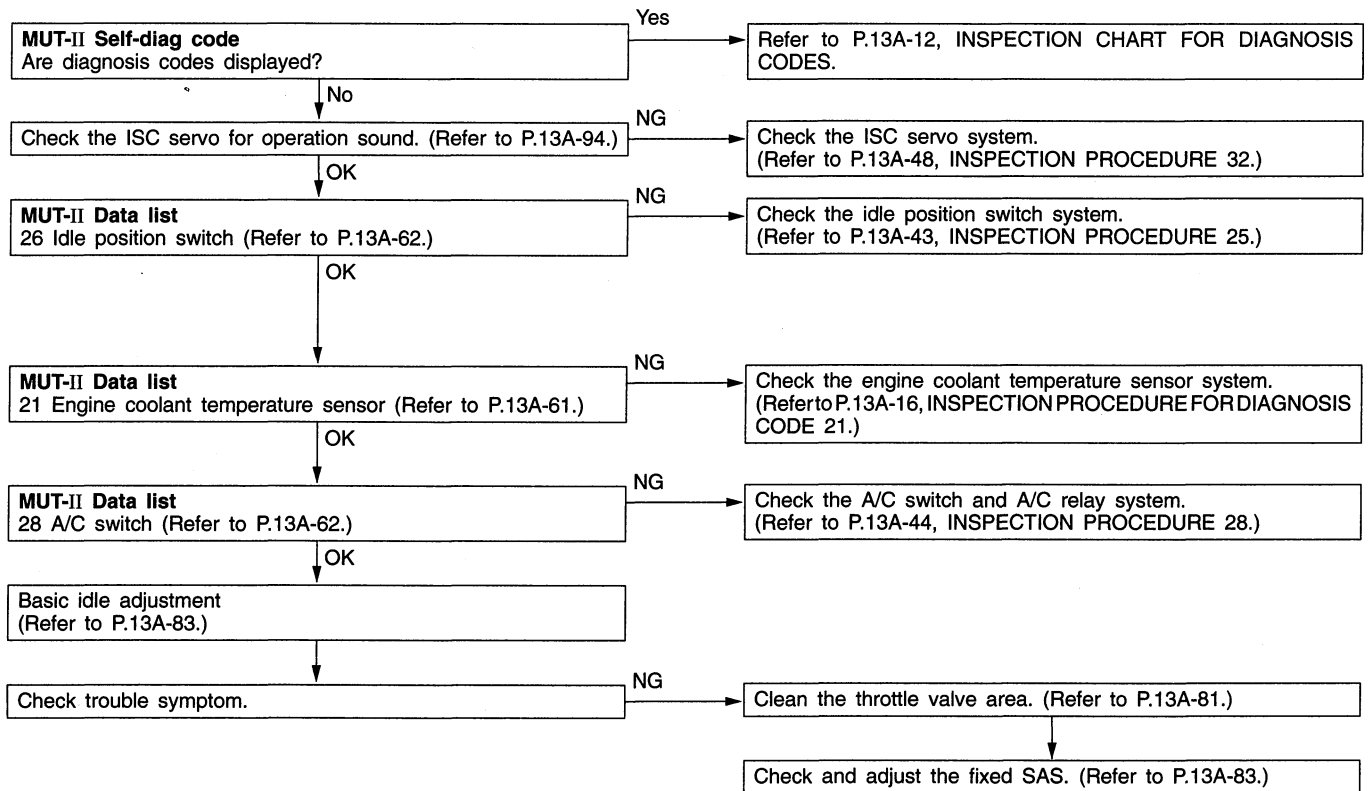
INSPECTION PROCEDURE 8

Idling is unstable (Rough idling, hunting)	Probable cause
In cases as the above, the cause is probably that the ignition system, air/fuel mixture, idle speed control (ISC) or compression pressure is defective. Because the range of possible causes is broad, inspection is narrowed down to simple items.	• Malfunction of the ignition system • Malfunction of air-fuel ratio control system • Malfunction of the ISC system • Malfunction of the purge control solenoid valve system • Malfunction of the EGR solenoid valve system • Poor compression • Drawing air into exhaust system



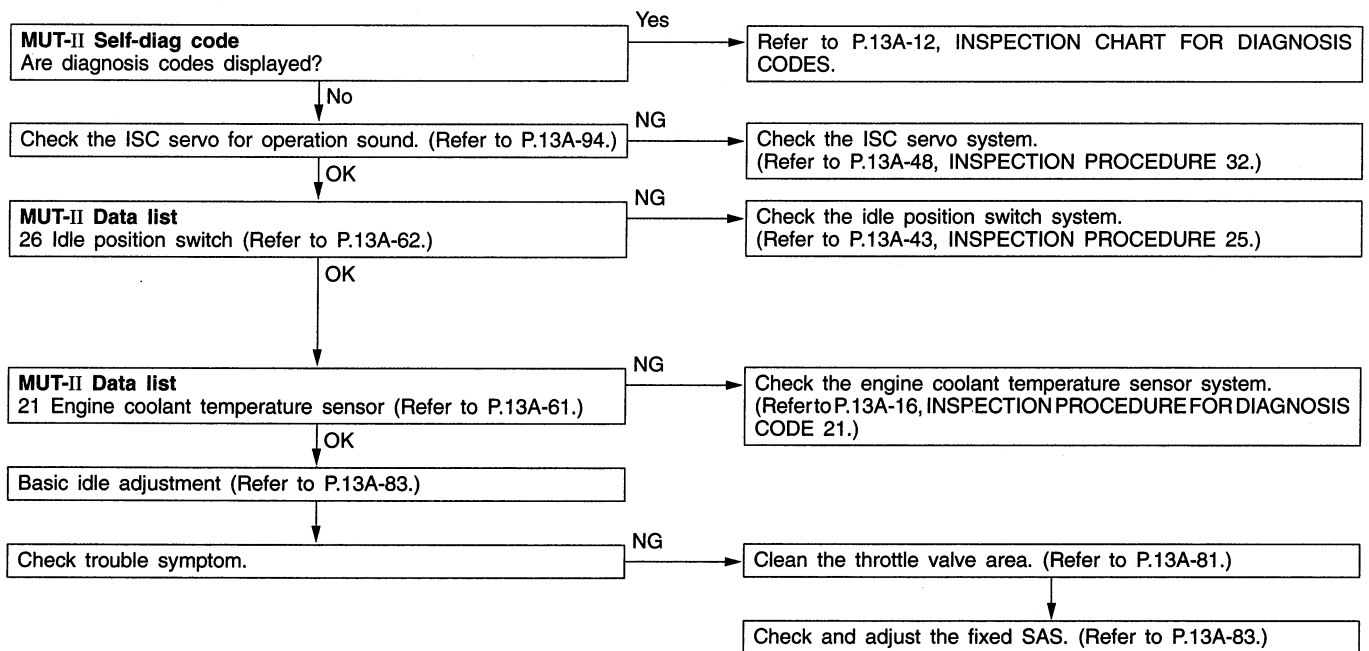
INSPECTION PROCEDURE 9

Idling speed is high. (Improper idling speed)	Probable cause
In such cases as the above, the cause is probably that the intake air volume during idling is too great.	• Malfunction of the ISC servo system • Malfunction of the throttle body



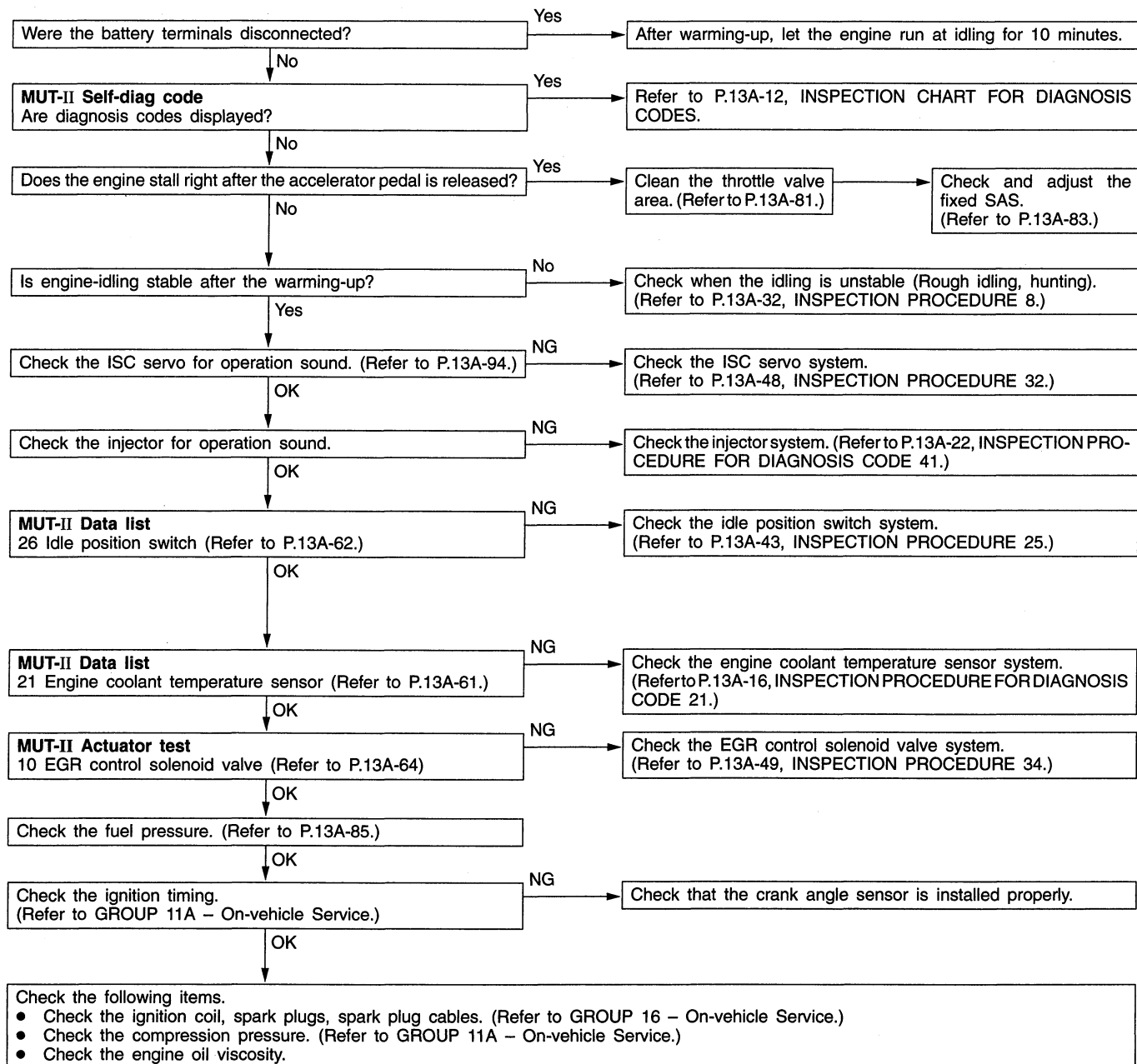
INSPECTION PROCEDURE 10

Idling speed is low. (Improper idling speed)	Probable cause
In cases such as the above, the cause is probably that the intake air volume during idling is too small.	• Malfunction of the ISC servo system • Malfunction of the throttle body



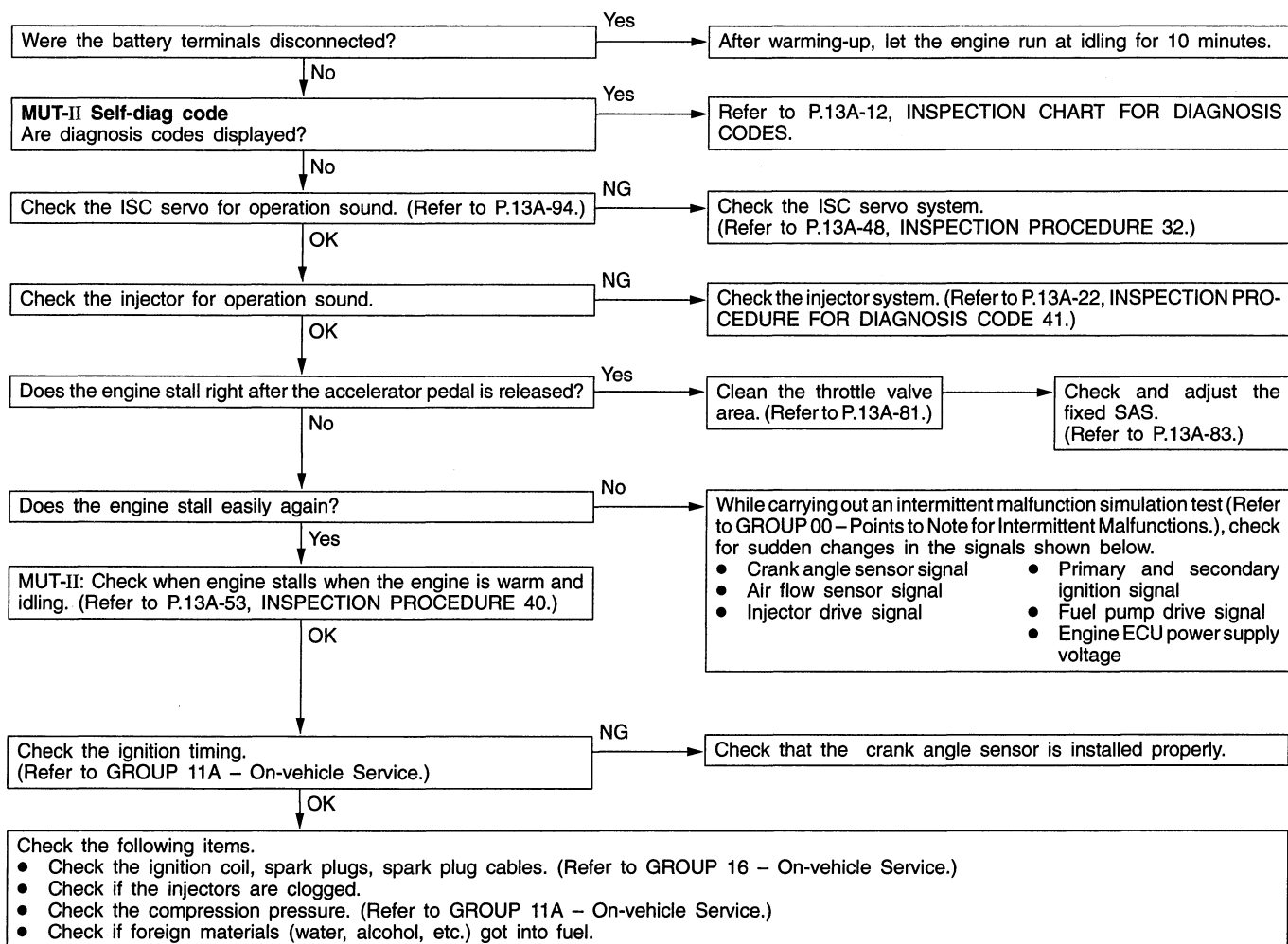
INSPECTION PROCEDURE 11

When the engine is cold, it stalls at idling. (Die out)	Probable cause
In such cases as the above, the cause is probably that the air/fuel mixture is inappropriate when the engine is cold, or that the intake air volume is insufficient.	• Malfunction of the ISC servo system • Malfunction of the throttle body • Malfunction of the injector system • Malfunction of the ignition system



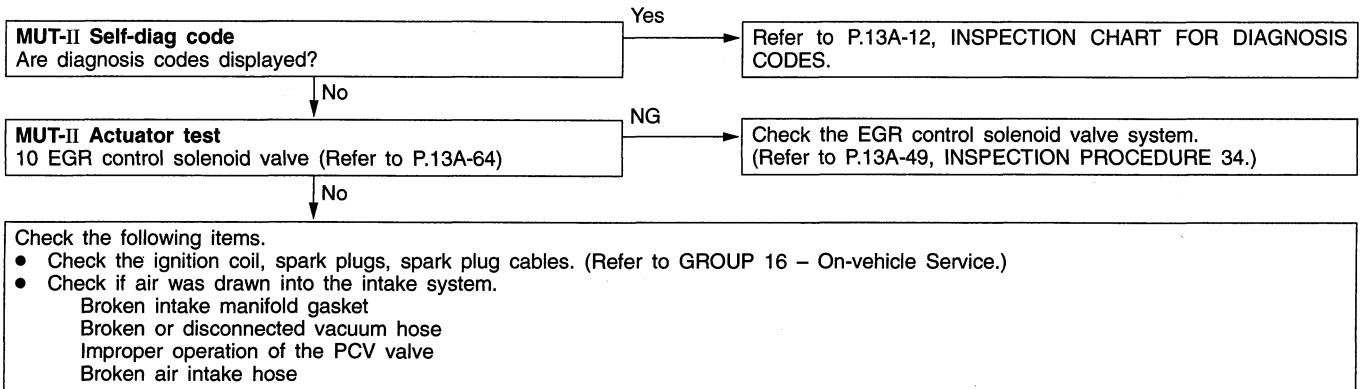
INSPECTION PROCEDURE 12

When the engine is hot, it stalls at idling. (Die out)	Probable cause
In such cases as the above, the cause is probably that ignition system, air/fuel mixture, idle speed control (ISC) or compression pressure is defective. In addition, if the engine suddenly stalls, the cause may also be a defective connector contact.	• Malfunction of the ignition system • Malfunction of air-fuel ratio control system • Malfunction of the ISC system • Drawing air into intake system • Improper connector contact



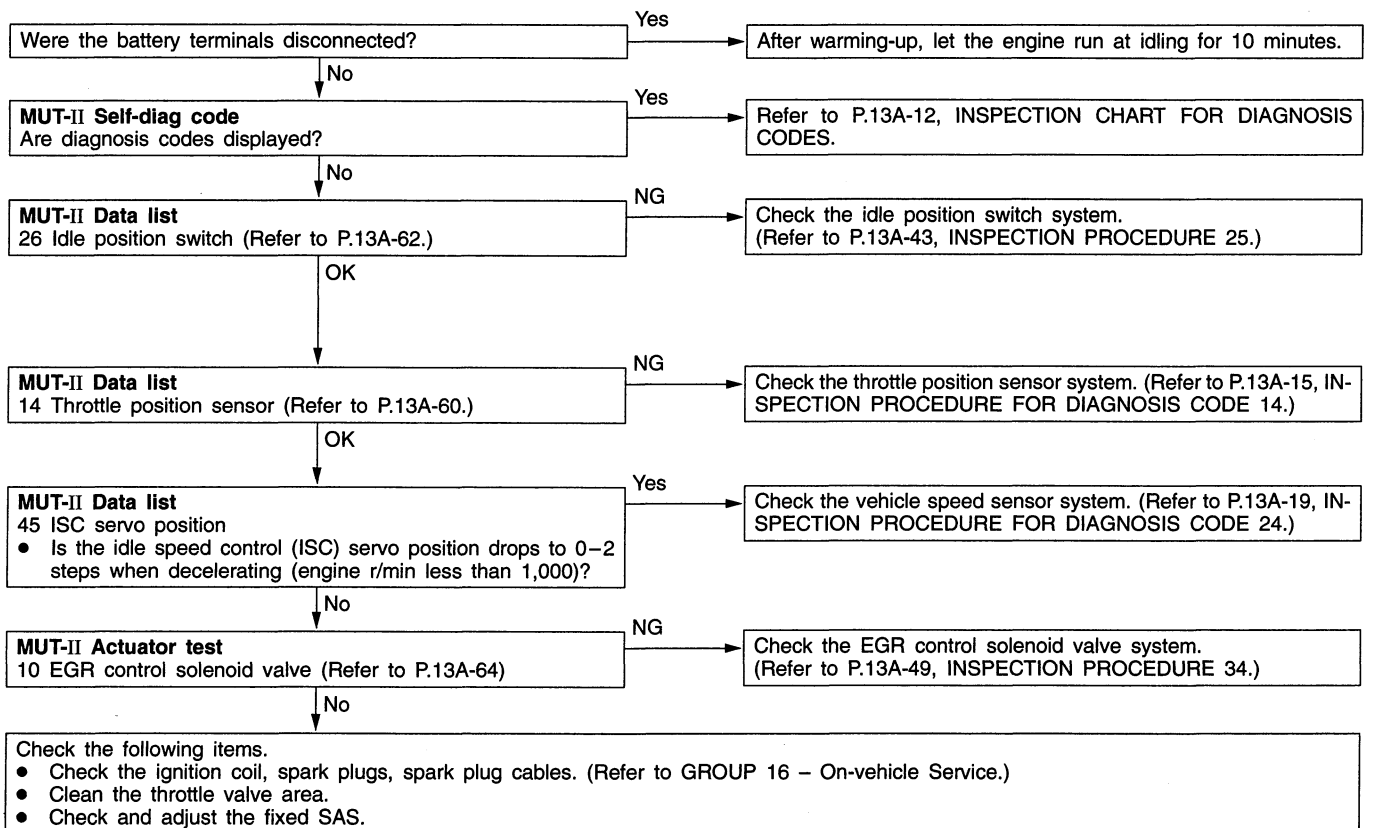
INSPECTION PROCEDURE 13

The engine stalls when the vehicle starts. (Pass out)	Probable cause
In cases such as the above, the cause is probably misfiring due to a weak spark, or an inappropriate air/fuel mixture when the accelerator pedal is depressed.	• Drawing air into intake system • Malfunction of the ignition system



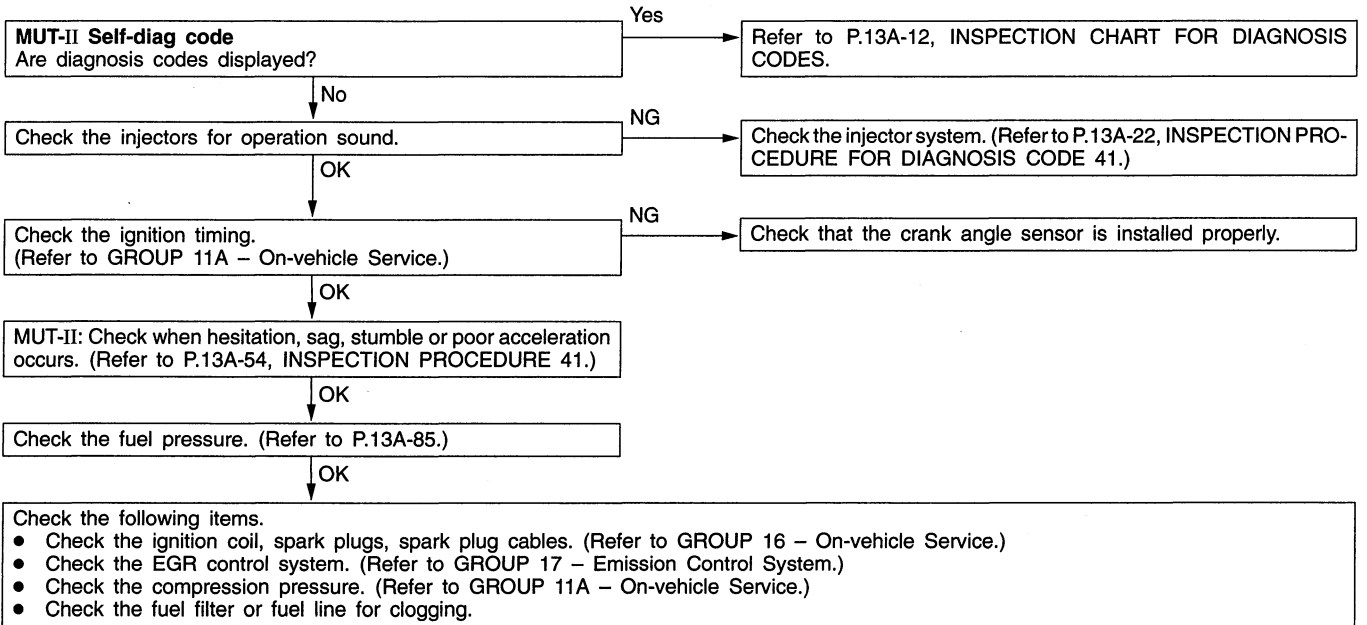
INSPECTION PROCEDURE 14

The engine stalls when decelerating.	Probable cause
In cases such as the above, the cause is probably that the intake air volume is insufficient due to a defective idle speed control (ISC) servo system.	• Malfunction of the ISC system



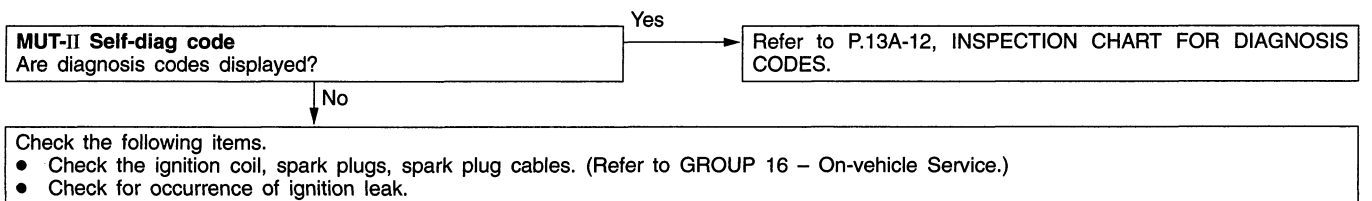
INSPECTION PROCEDURE 15

Hesitation, sag or stumble	Probable cause
In cases such as the above, the cause is probably that ignition system, air/fuel mixture or compression pressure is defective.	• Malfunction of the ignition system • Malfunction of air-fuel ratio control system • Malfunction of the fuel supply system • Malfunction of the EGR control solenoid valve system • Poor compression



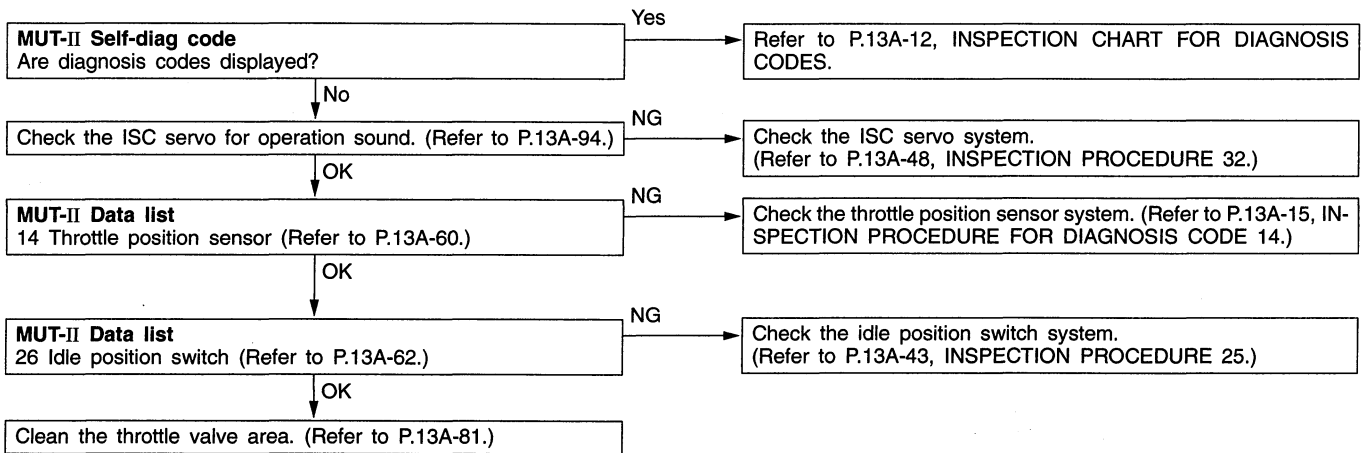
INSPECTION PROCEDURE 16

The feeling of impact or vibration when accelerating	Probable cause
In cases such as the above, the cause is probably that there is an ignition leak accompanying the increase in the spark plug demand voltage during acceleration.	• Malfunction of the ignition system



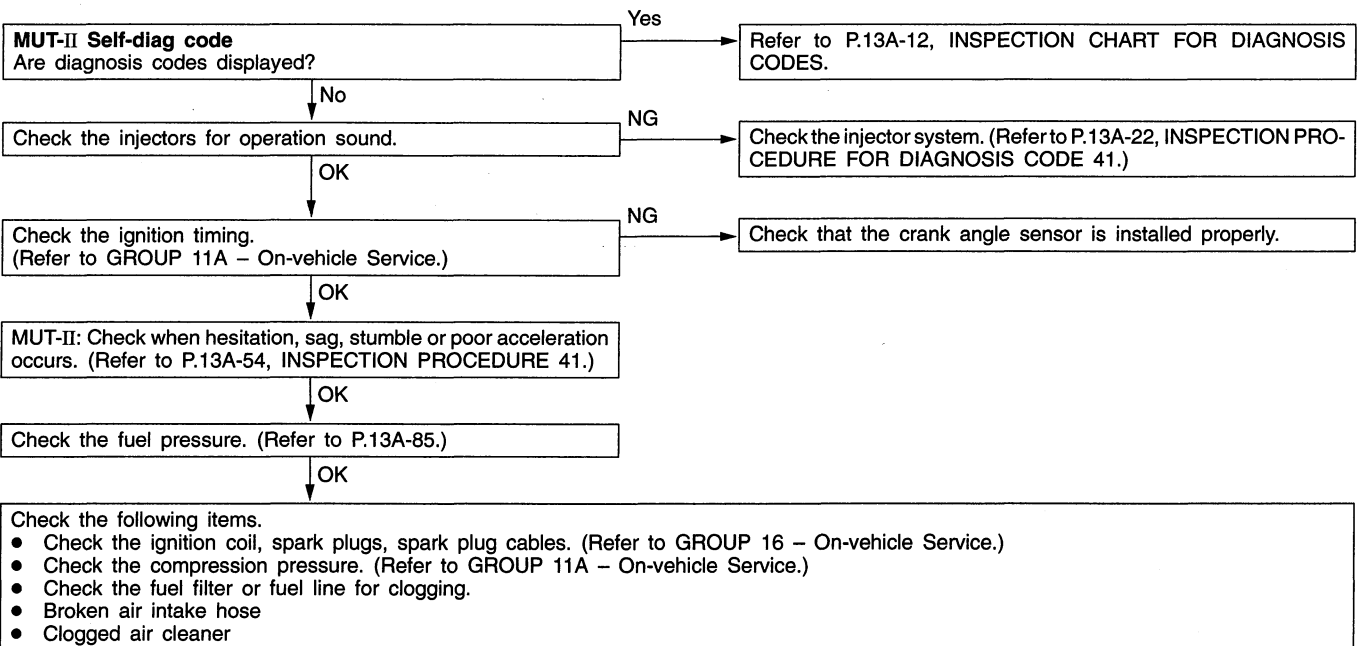
INSPECTION PROCEDURE 17

The feeling of impact or vibration when decelerating.	Probable cause
Malfunction of the ISC system is suspected.	Malfunction of the ISC system



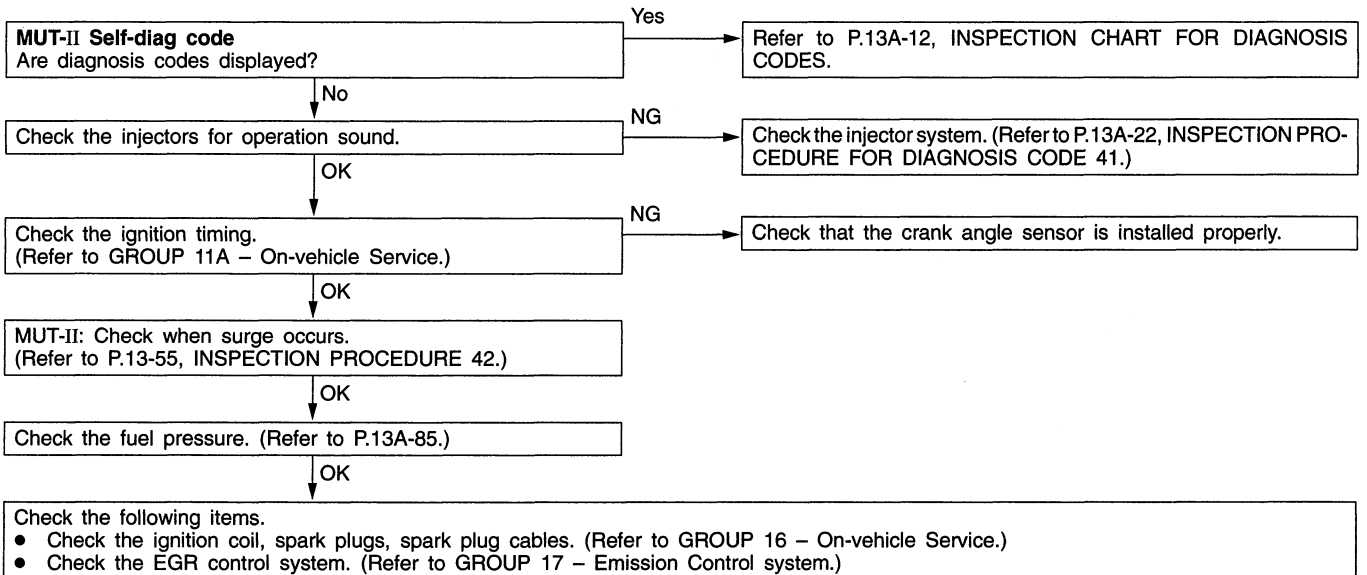
INSPECTION PROCEDURE 18

Poor acceleration	Probable cause
Defective ignition system, abnormal air-fuel ratio, poor compression pressure, etc. are suspected.	- Malfunction of the ignition system - Malfunction of air-fuel ratio control system - Malfunction of the fuel supply system - Poor compression pressure - Clogged exhaust system



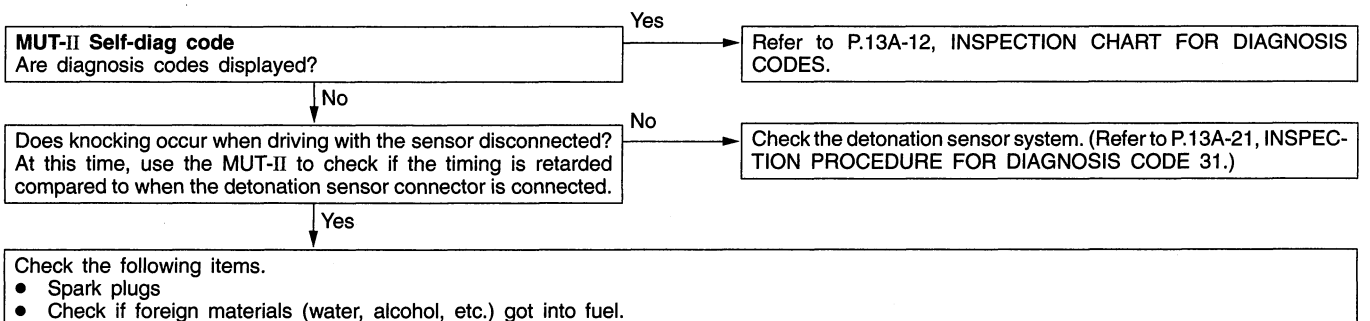
INSPECTION PROCEDURE 19

Surge	Probable cause
Defective ignition system, abnormal air-fuel ratio, etc. are suspected.	• Malfunction of the ignition system • Malfunction of air-fuel ratio control system • Malfunction of the EGR control solenoid valve system



INSPECTION PROCEDURE 20

Knocking	Probable cause
In cases as the above, the cause is probably that the detonation control is defective or the heat value of the spark plug is inappropriate.	• Defective detonation sensor • Inappropriate heat value of the spark plug



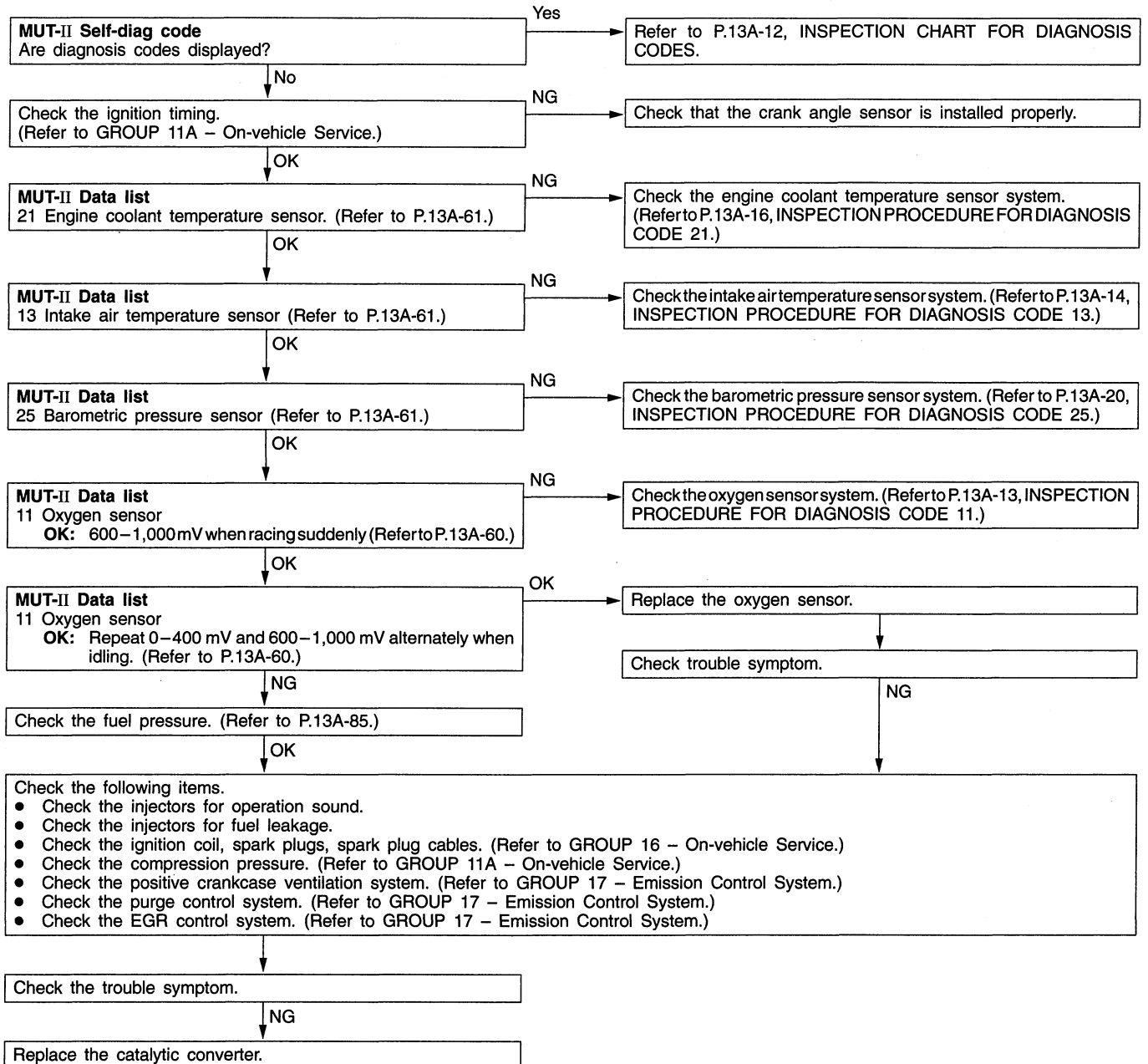
INSPECTION PROCEDURE 21

Dieseling	Probable cause
Fuel leakage from injectors is suspected.	• Fuel leakage from injectors

Check the injectors for fuel leakage.

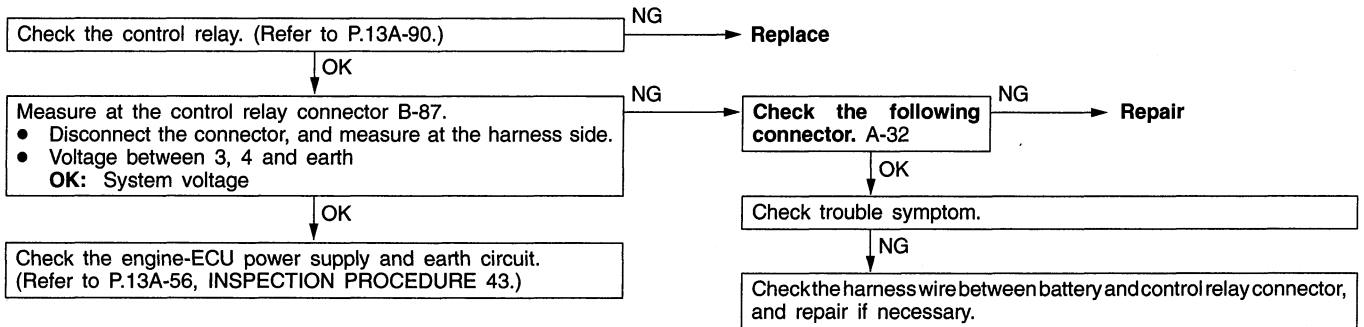
INSPECTION PROCEDURE 22

Too high CO and HC concentration when idling	Probable cause
Abnormal air-fuel ratio is suspected.	- Malfunction of the air-fuel ratio control system - Deteriorated catalyst



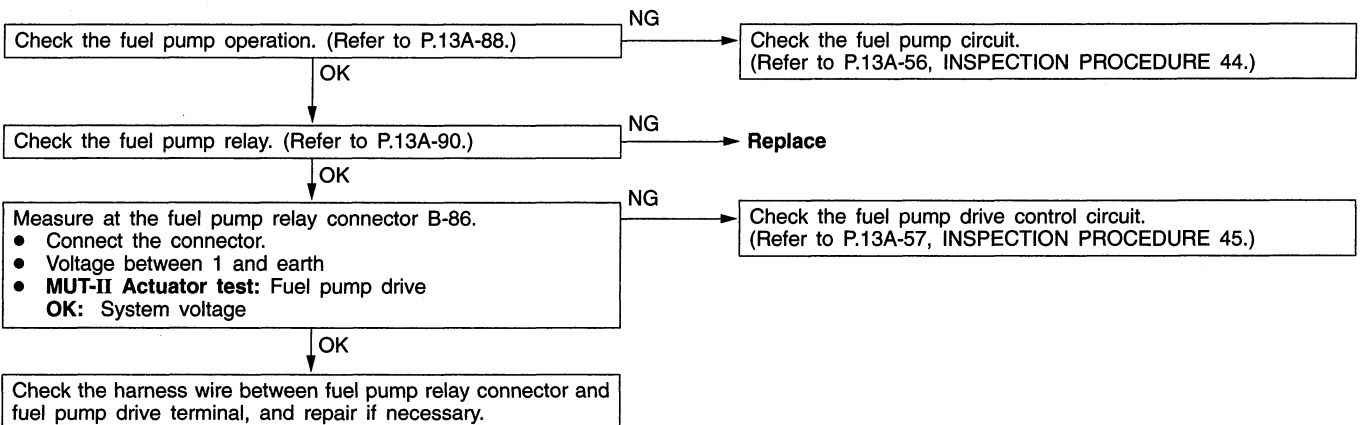
INSPECTION PROCEDURE 23

Power supply system and ignition switch-IG system	Probable cause
When an ignition switch ON signal is input to the engine-ECU, the engine-ECU turns the control relay ON. This causes battery voltage to be supplied to the engine-ECU, injectors and air flow sensor.	• Malfunction of the ignition switch • Malfunction of the control relay • Improper connector contact, open circuit or short-circuited harness wire • Disconnected engine-ECU earth wire • Malfunction of the engine-ECU



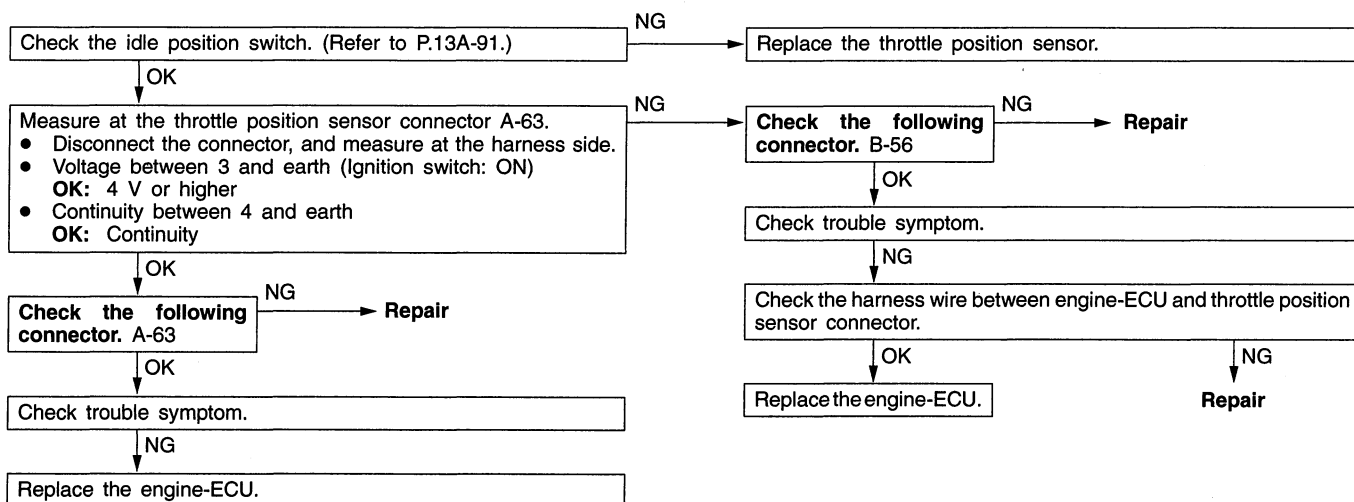
INSPECTION PROCEDURE 24

Fuel pump system	Probable cause
The engine-ECU turns the fuel pump relay ON when the engine is cranking or running, and this supplies power to drive the fuel pump.	• Malfunction of the fuel pump relay • Malfunction of the fuel pump • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



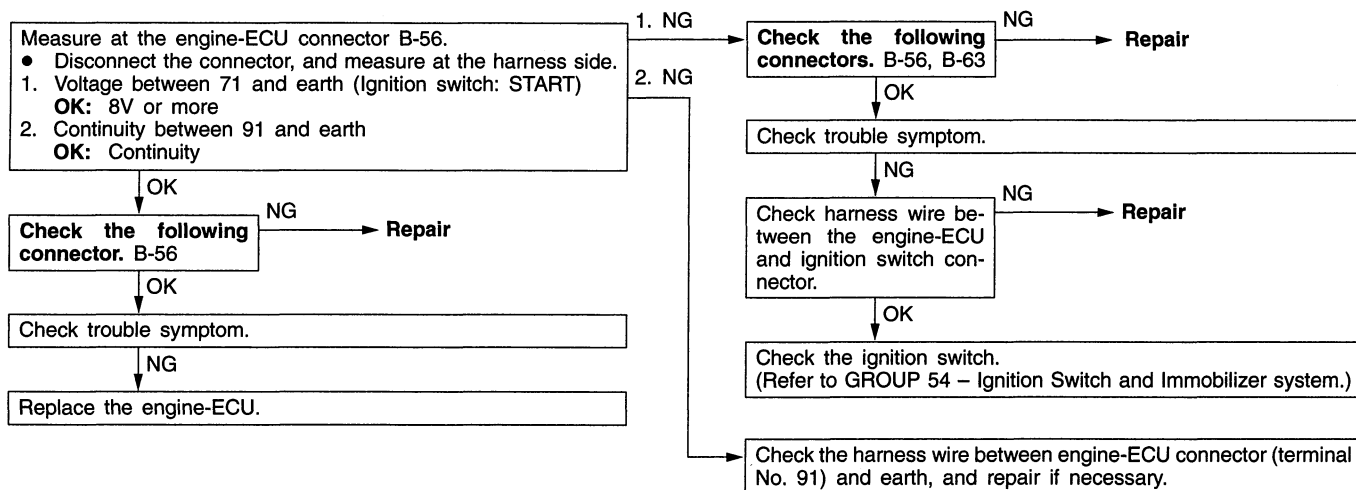
INSPECTION PROCEDURE 25

Idle position switch system	Probable cause
The idle position switch inputs the condition of the accelerator pedal, i.e. whether it is depressed or released (HIGH/LOW), to the engine-ECU. The engine-ECU controls the idle speed control servo based on this input.	• Maladjustment of the accelerator pedal • Maladjustment of the fixed SAS • Maladjustment of the idle position switch and throttle position sensor • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



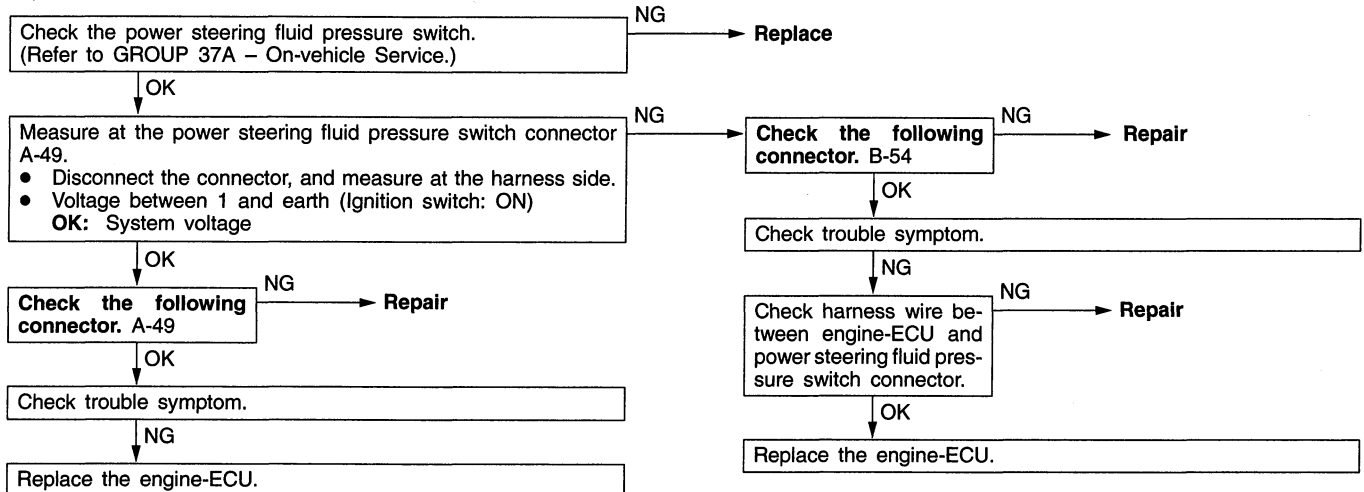
INSPECTION PROCEDURE 26

Ignition switch-ST system	Probable cause
The ignition switch-ST inputs a HIGH signal to the engine-ECU while the engine is cranking. The engine-ECU controls fuel injection, etc. during starting based on this input.	• Malfunction of ignition switch • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



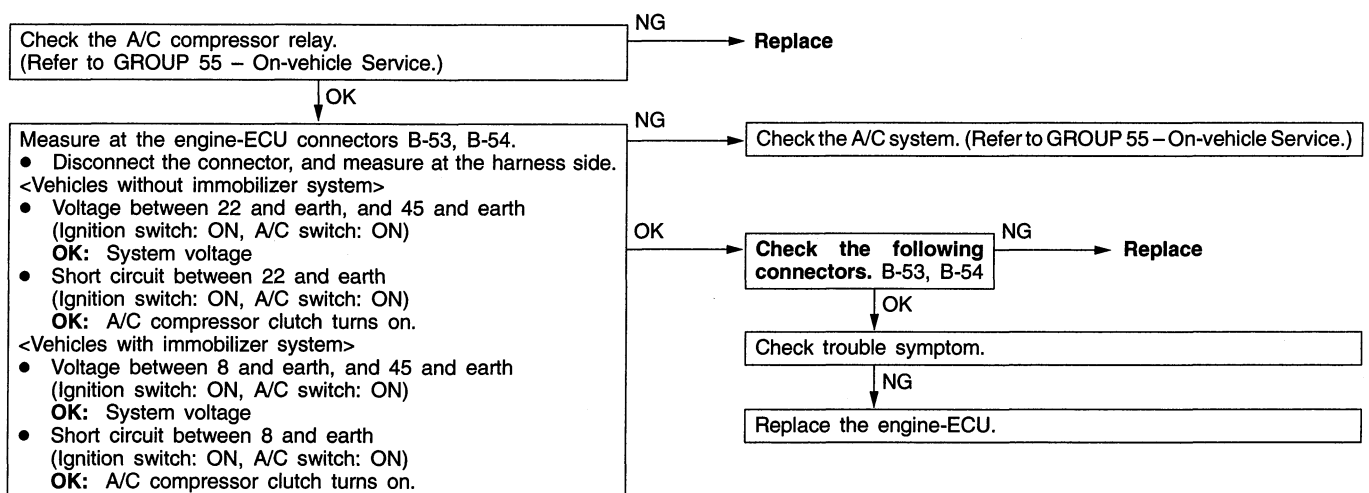
INSPECTION PROCEDURE 27

Power steering fluid pressure switch system	Probable cause
The presence or absence of power steering load is input to the engine-ECU. The engine-ECU controls the idle speed control (ISC) servo based on this input.	• Malfunction of power steering fluid pressure switch • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



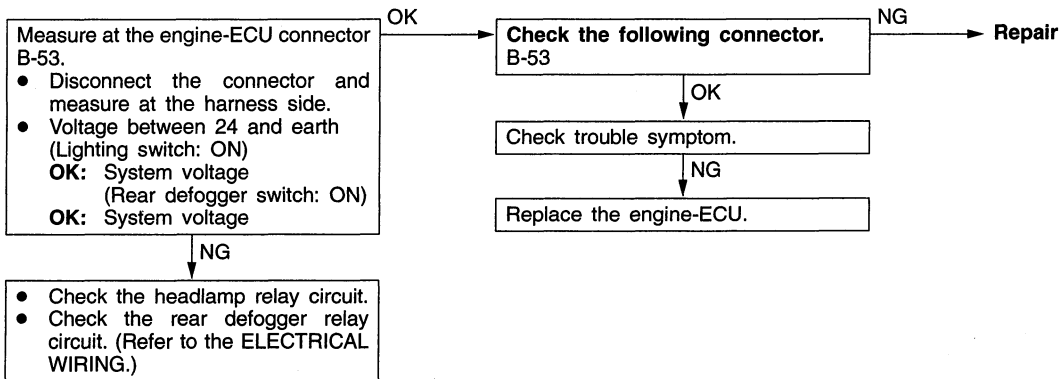
INSPECTION PROCEDURE 28

A/C switch and A/C relay system	Probable cause
When an A/C ON signal is input to the engine-ECU, the engine-ECU carries out control of the idle speed control (ISC) servo, and also operates the A/C compressor magnetic clutch.	• Malfunction of A/C control system • Malfunction of A/C switch • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



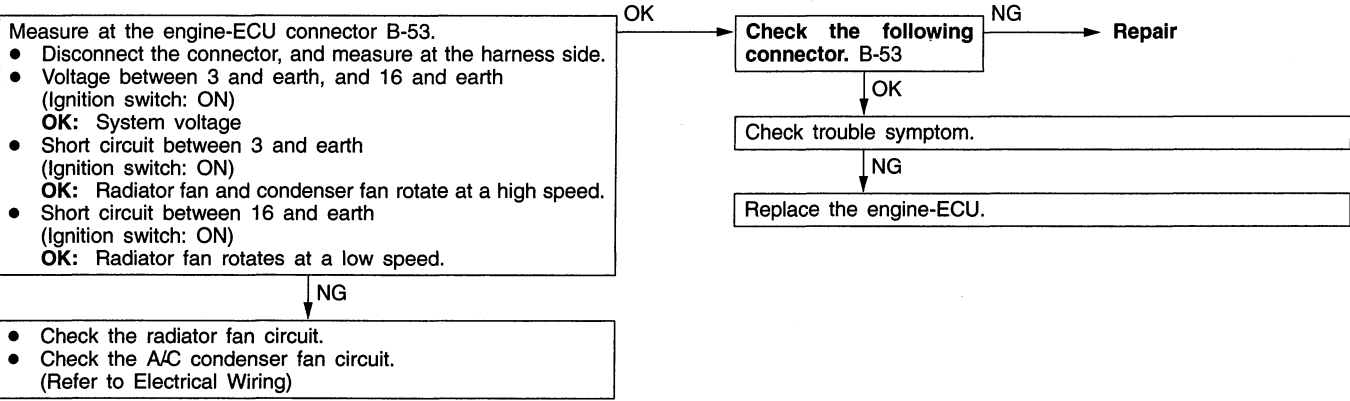
INSPECTION PROCEDURE 29

Electrical load switch system	Probable cause
The electrical load switch inputs ON/OFF state of the switch of equipment that consumes much power during idling, namely with a large electrical load, to the engine-ECU. Based on this signal the engine-ECU controls idle speed control servo.	• Improper connector contact, open circuit or short-circuited harness wire of the headlamp relay • Improper connector contact, open circuit or short-circuited harness wire of the rear defogger relay. • Malfunction of the engine-ECU



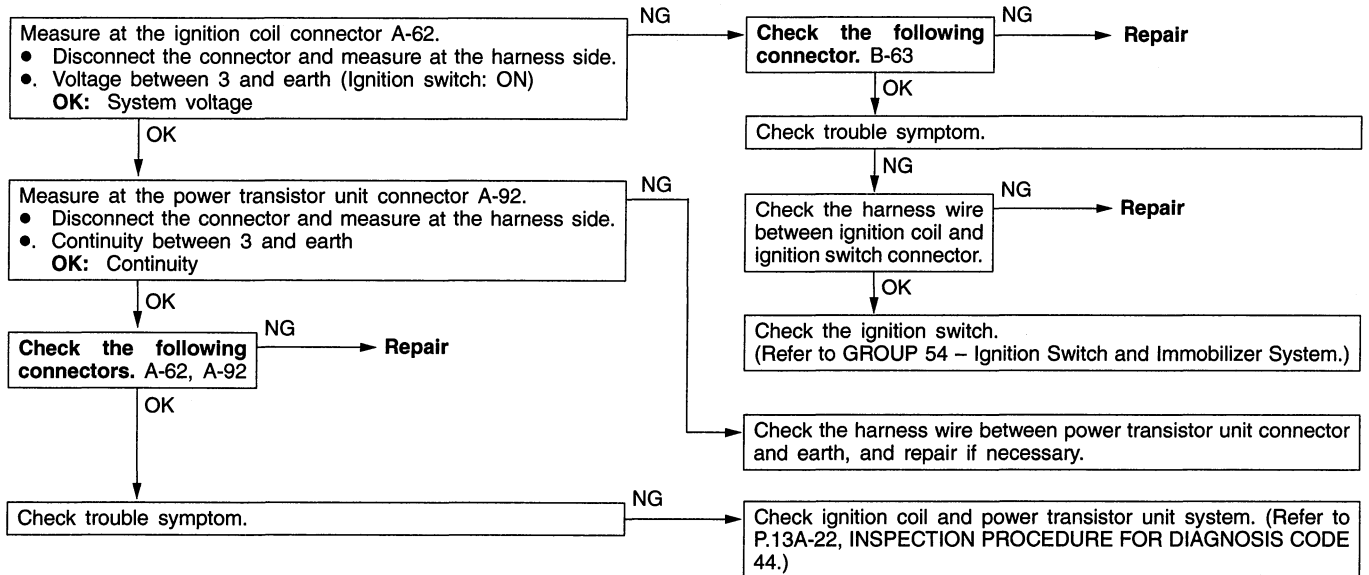
INSPECTION PROCEDURE 30

Fan motor relay system (Radiator fan, A/C condenser fan)	Probable cause
The fan motor relay is controlled by the power transistor inside the engine-ECU turning ON and OFF.	• Malfunction of fan motor relay • Malfunction of fan motor • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of engine-ECU



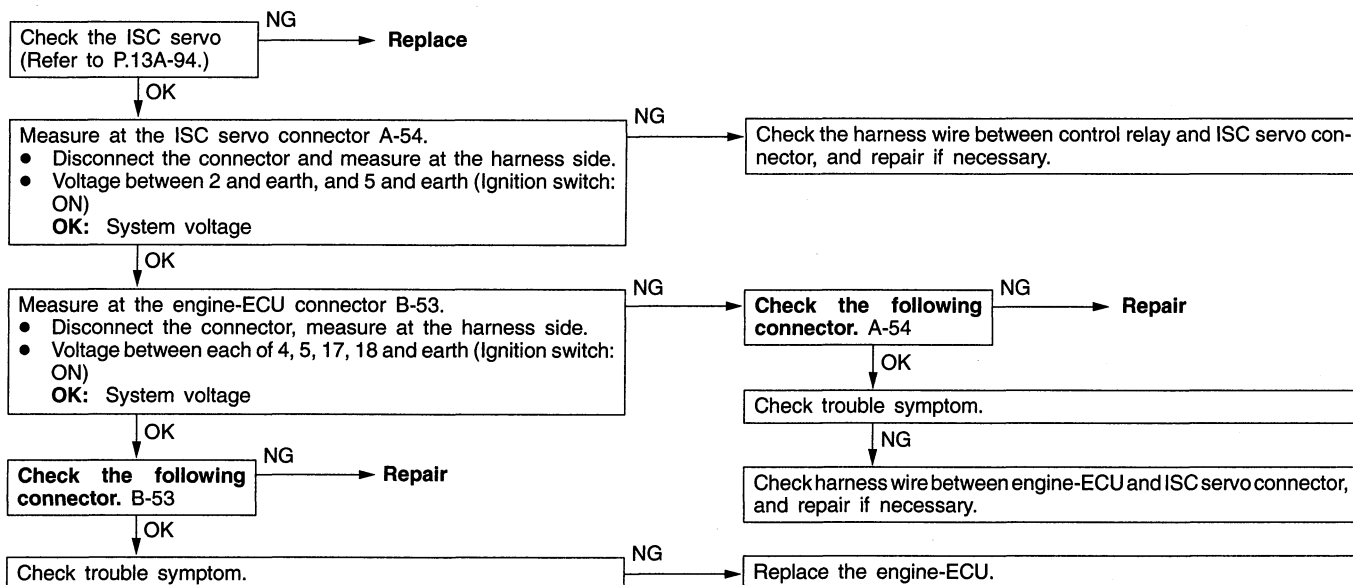
INSPECTION PROCEDURE 31

Ignition circuit system	Probable cause
The engine-ECU interrupts the ignition coil primary current by turning the power transistor inside the engine-ECU ON and OFF.	• Malfunction of ignition switch. • Malfunction of power transistor unit • Improper connector contact, open circuit or short-circuited harness wire • Malfunction of the engine-ECU



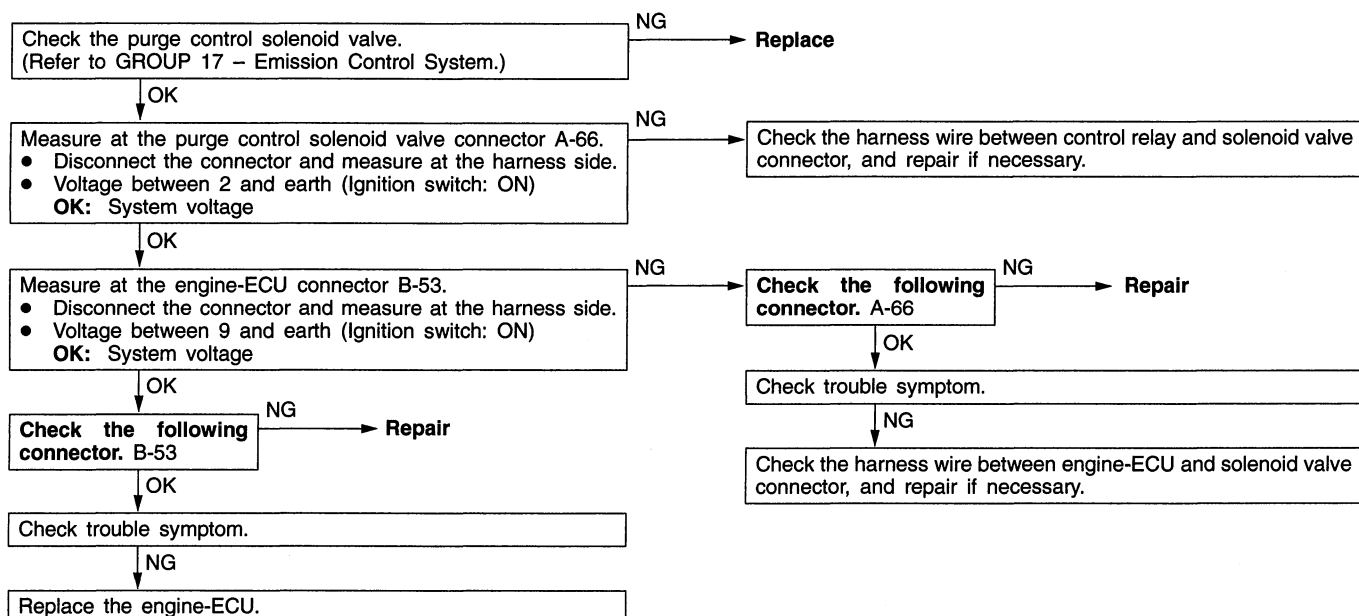
INSPECTION PROCEDURE 32

Idle speed control (ISC) servo (Stepper motor) system	Probable cause
The engine-ECU controls the intake air volume during idling by opening and closing the servo valve located in the bypass air passage.	- Malfunction of ISC servo - Improper connector contact, open circuit or short-circuited harness wire - Malfunction of the engine-ECU



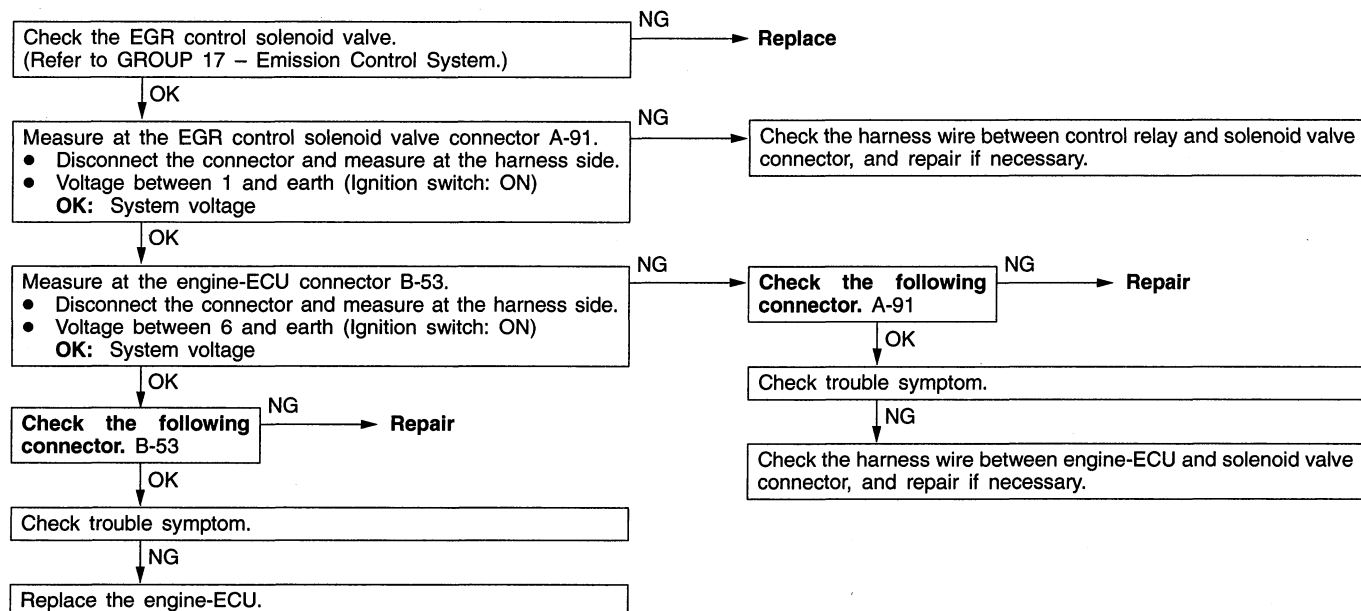
INSPECTION PROCEDURE 33

Purge control solenoid valve system	Probable cause
The purge control solenoid valve controls the purging of air from the canister located inside the intake manifold.	- Malfunction of solenoid valve - Improper connector contact, open circuit or short-circuited harness wire. - Malfunction of the engine-ECU

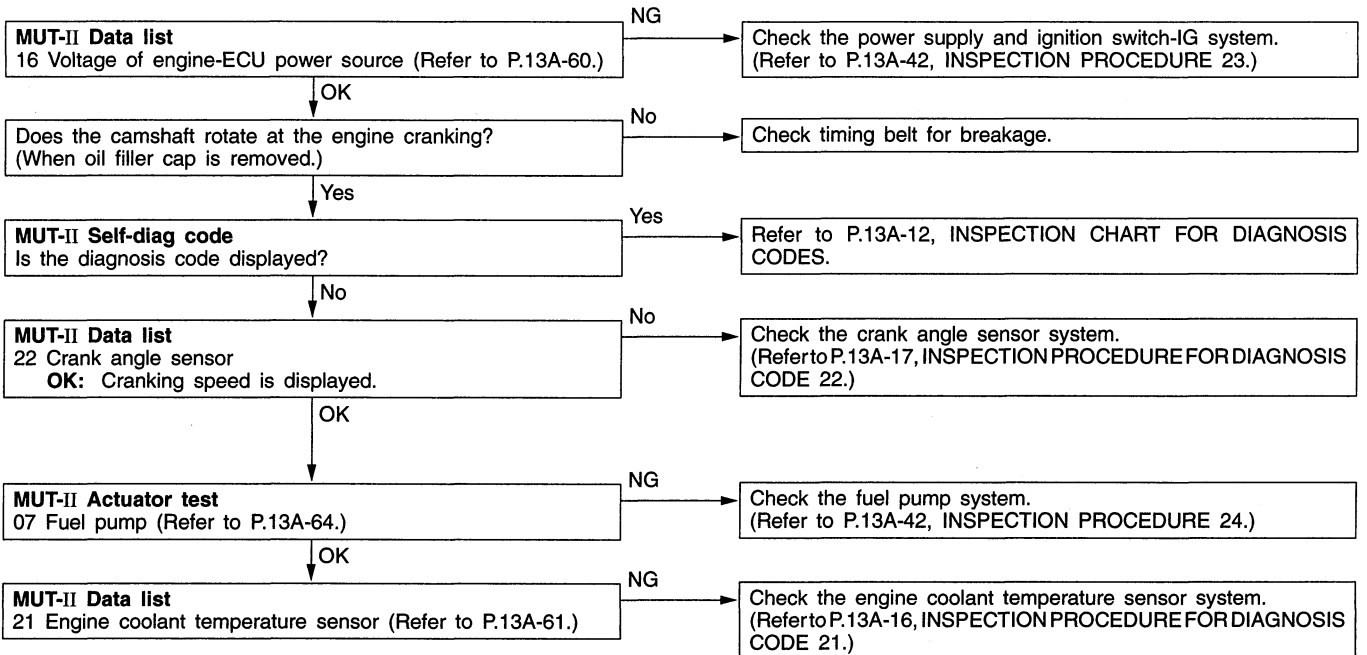


INSPECTION PROCEDURE 34

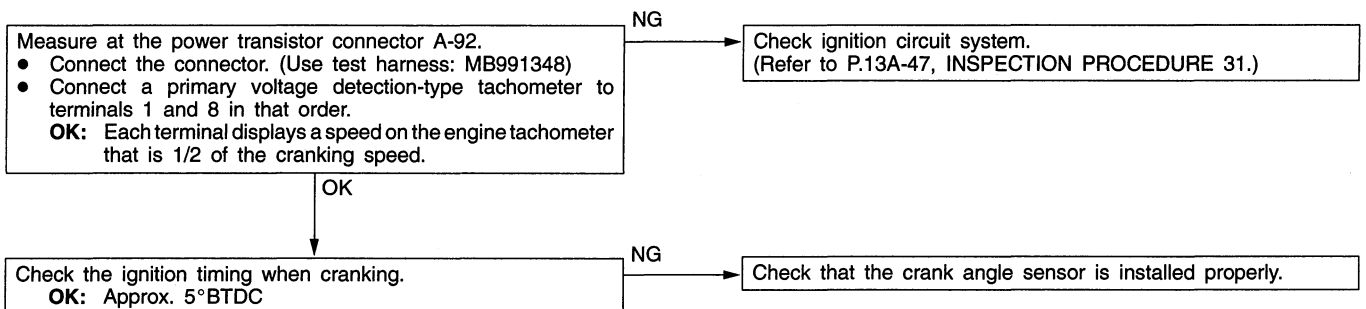
EGR control solenoid valve system	Probable cause
The EGR control solenoid valve is controlled by the negative pressure resulting from EGR operation leaking to port "A" of the throttle body.	- Malfunction of solenoid valve - Improper connector contact, open circuit or short-circuited harness wire. - Malfunction of the engine-ECU



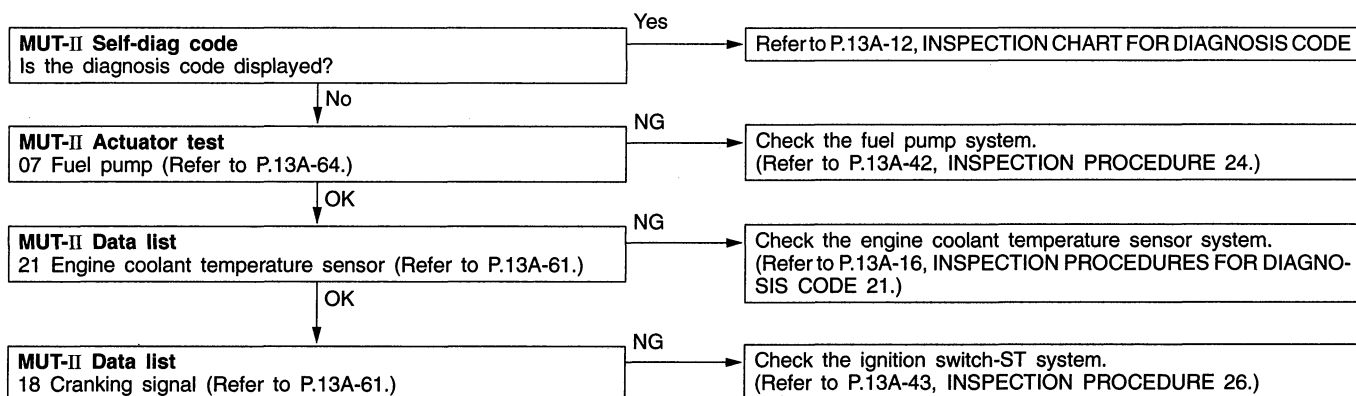
INSPECTION PROCEDURE 35

MUT-II: Check when no initial combustion occurs.

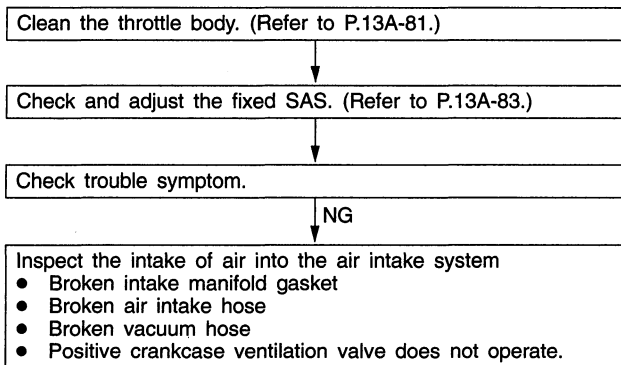
INSPECTION PROCEDURE 36

Ignition system: Check when no initial combustion occurs.

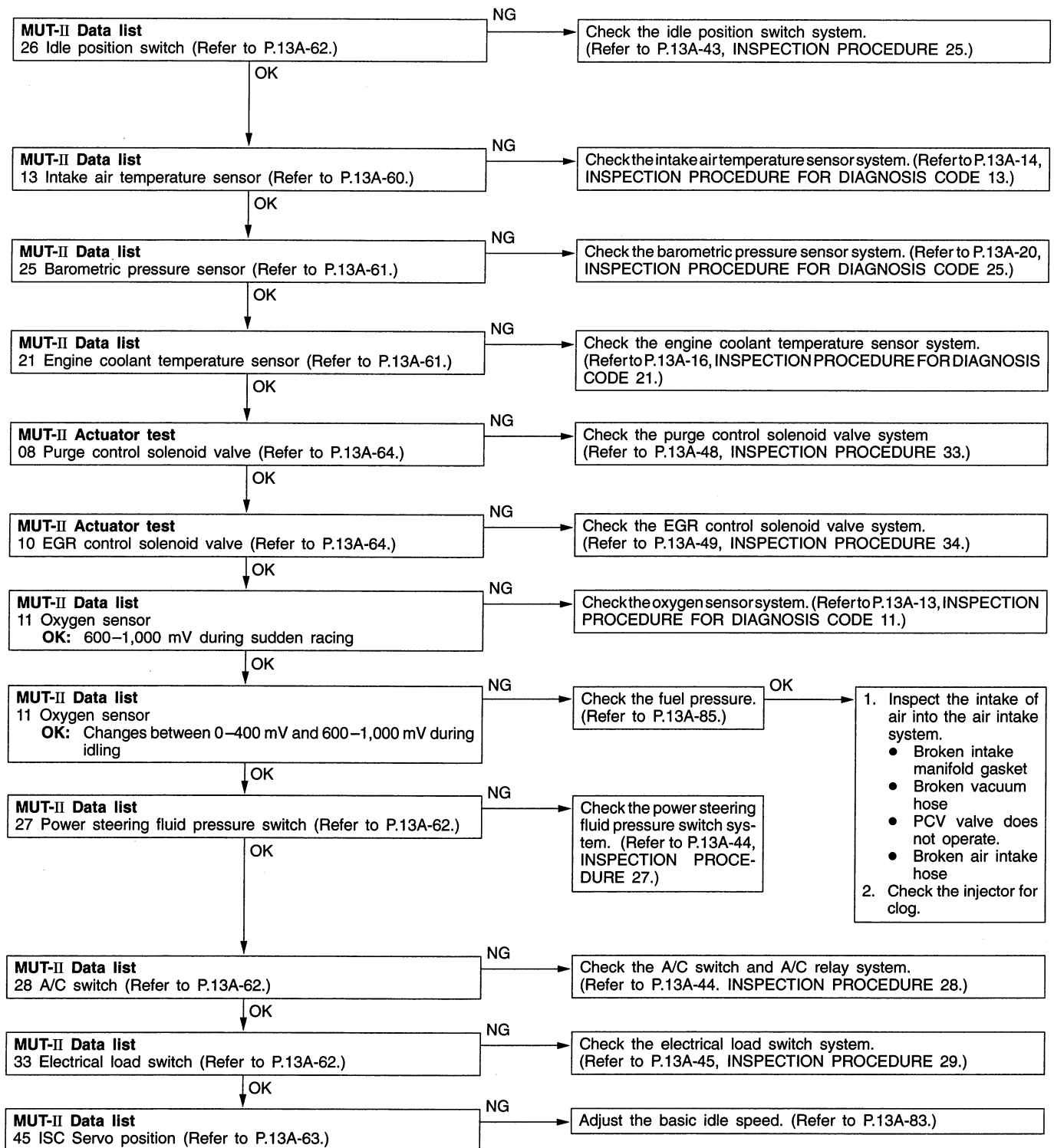
INSPECTION PROCEDURE 37

MUT-II: Check when uncomplete combustion occurs.

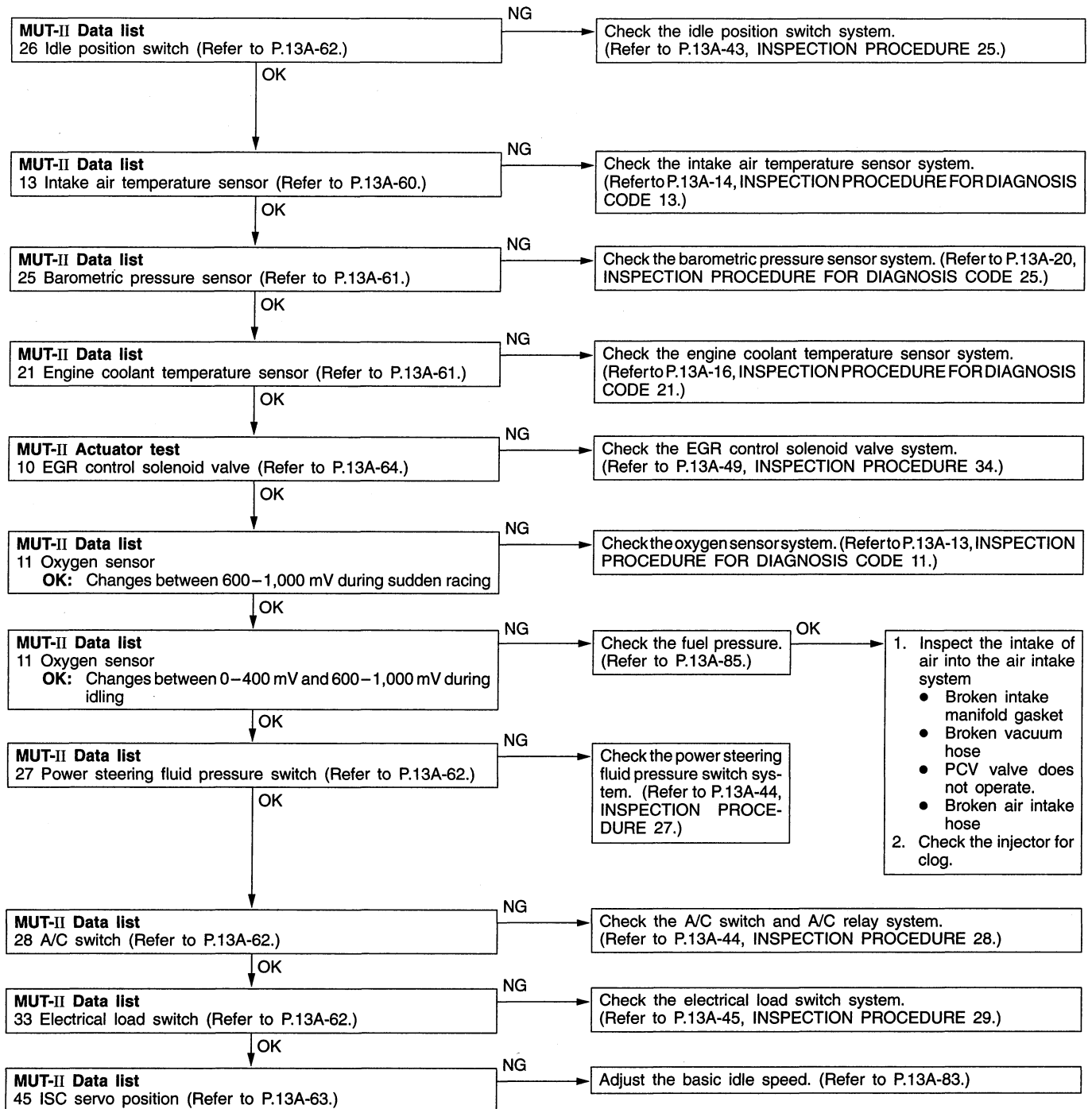
INSPECTION PROCEDURE 38

Check when hunting occurs.

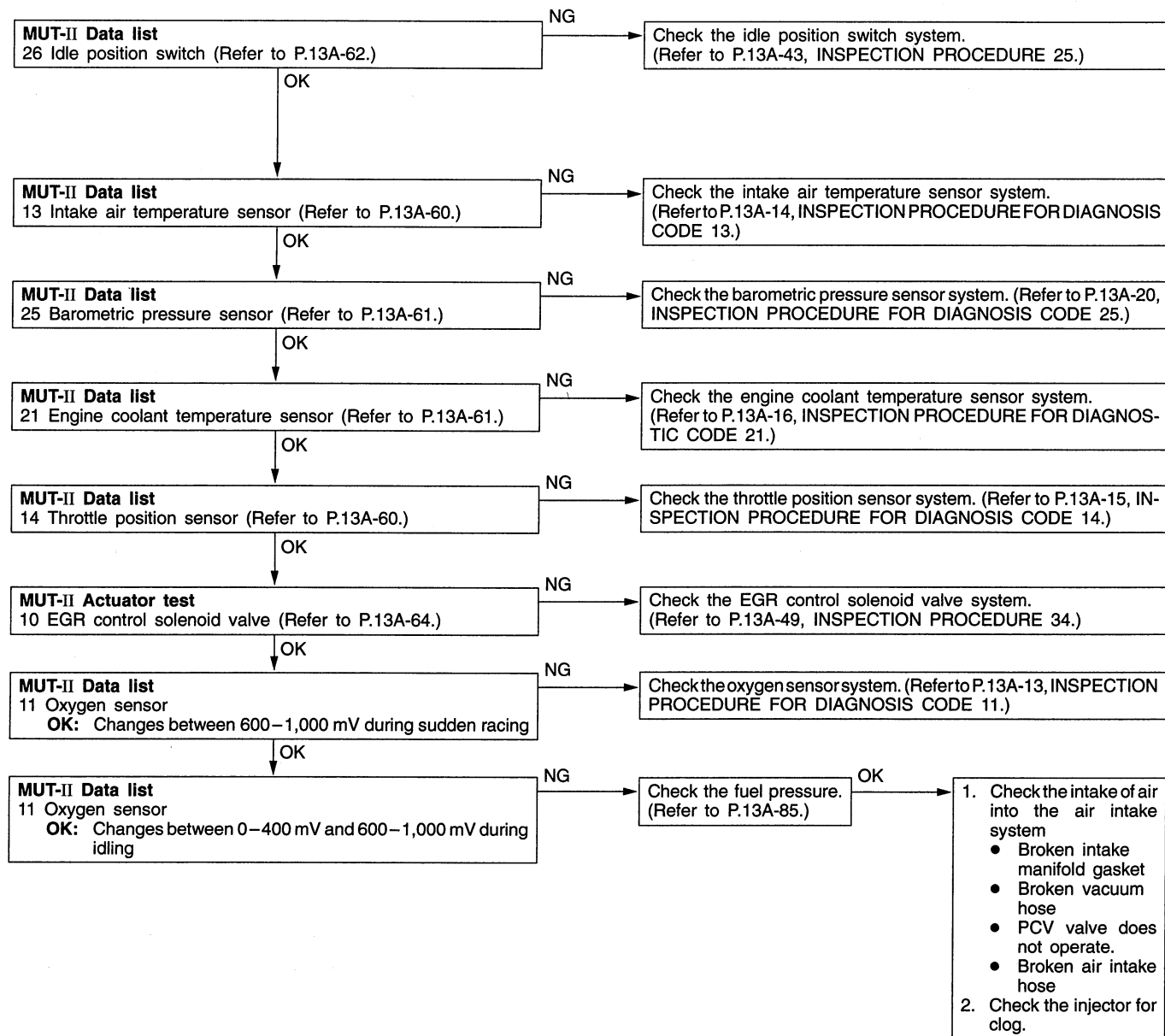
INSPECTION PROCEDURE 39

MUT-II: Check when idling speed is unstable.

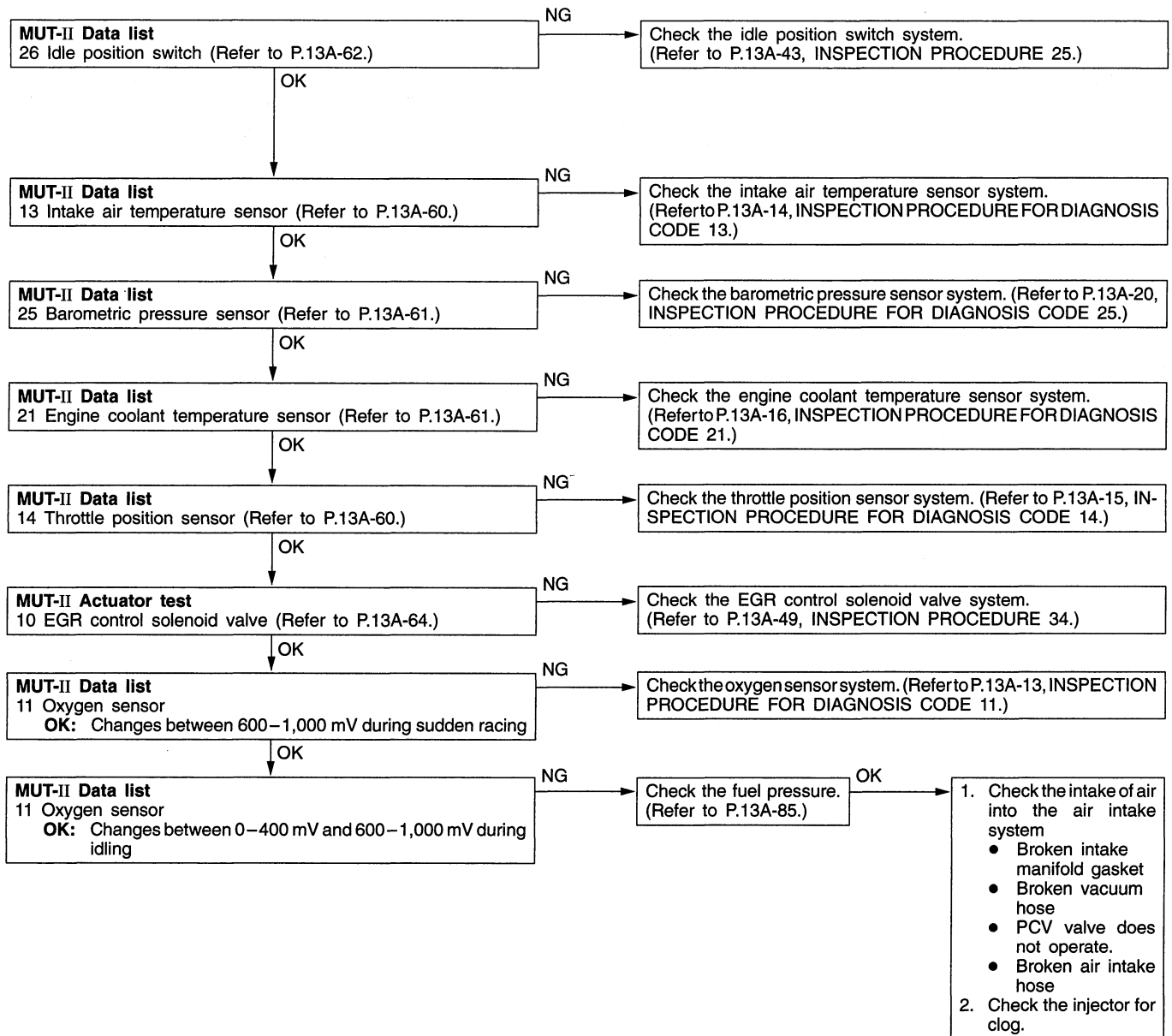
INSPECTION PROCEDURE 40

MUT-II: Check when engine stalls when the engine is warmed up and idling.

INSPECTION PROCEDURE 41

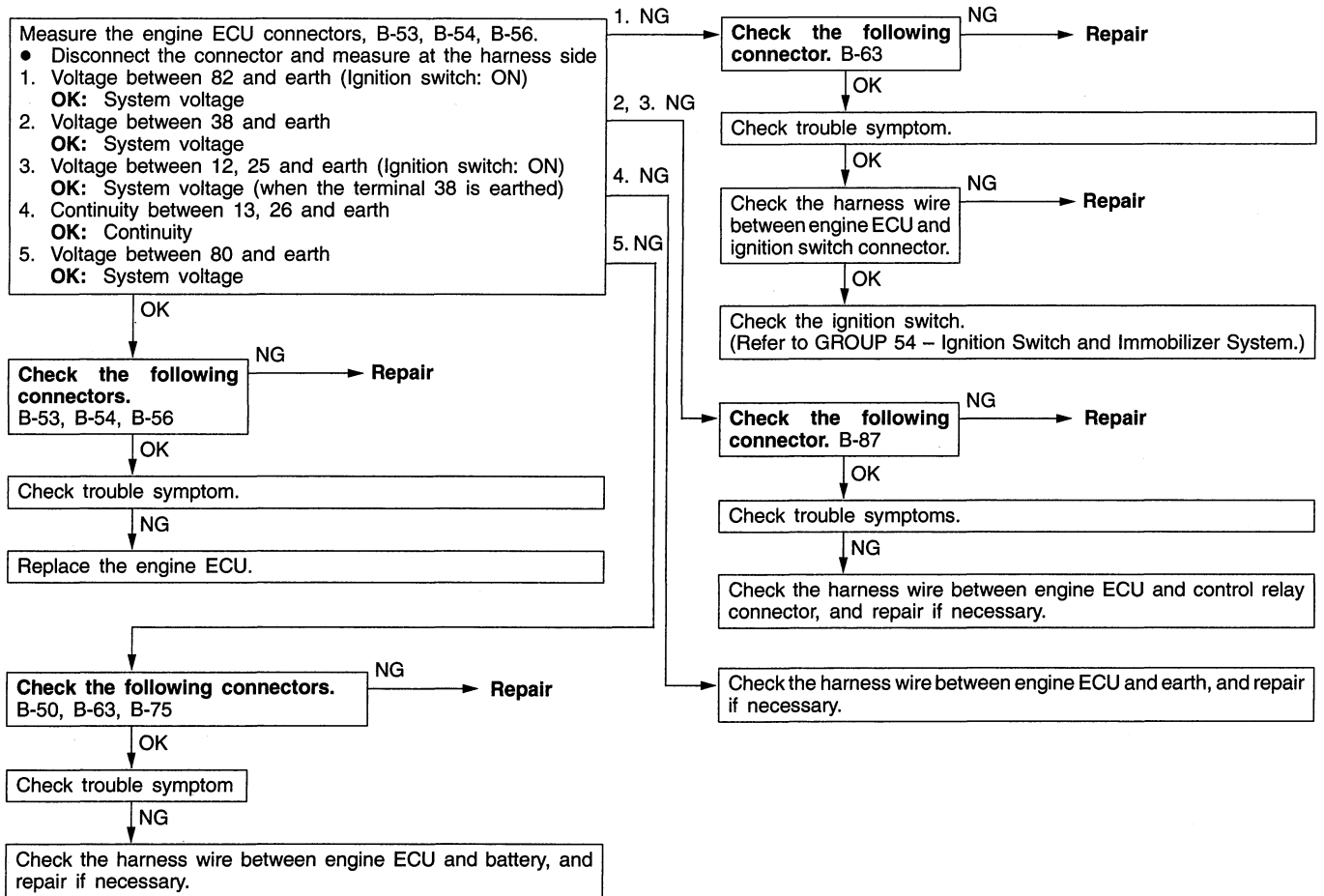
MUT-II: Check when hesitation, sag, stumble or poor acceleration occurs.

INSPECTION PROCEDURE 42

MUT-II Check when surge occurs.

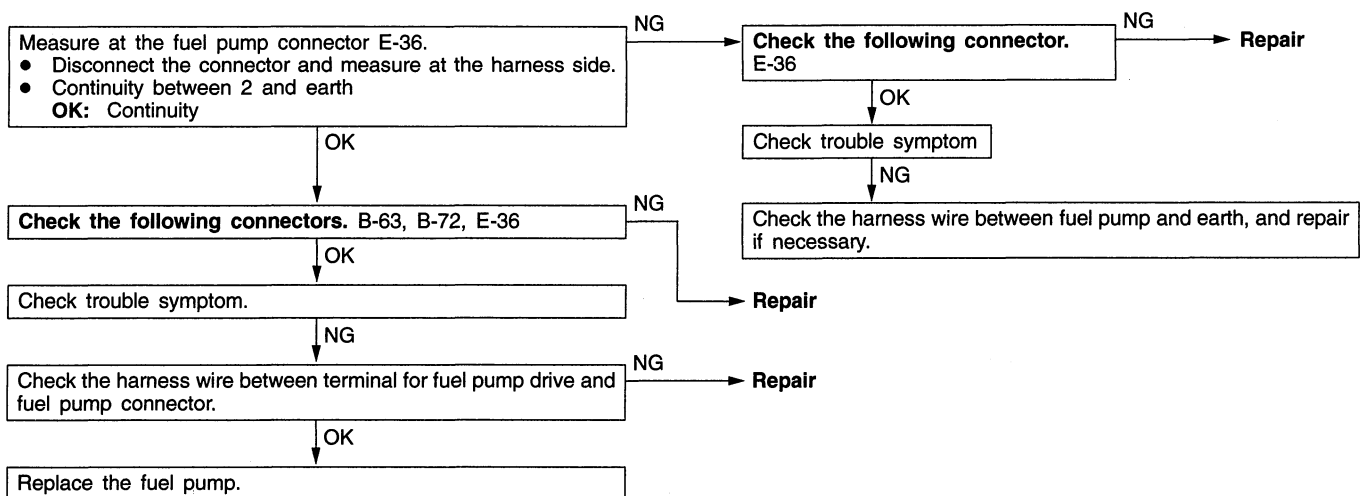
INSPECTION PROCEDURE 43

Check the engine ECU power supply and earth circuit.



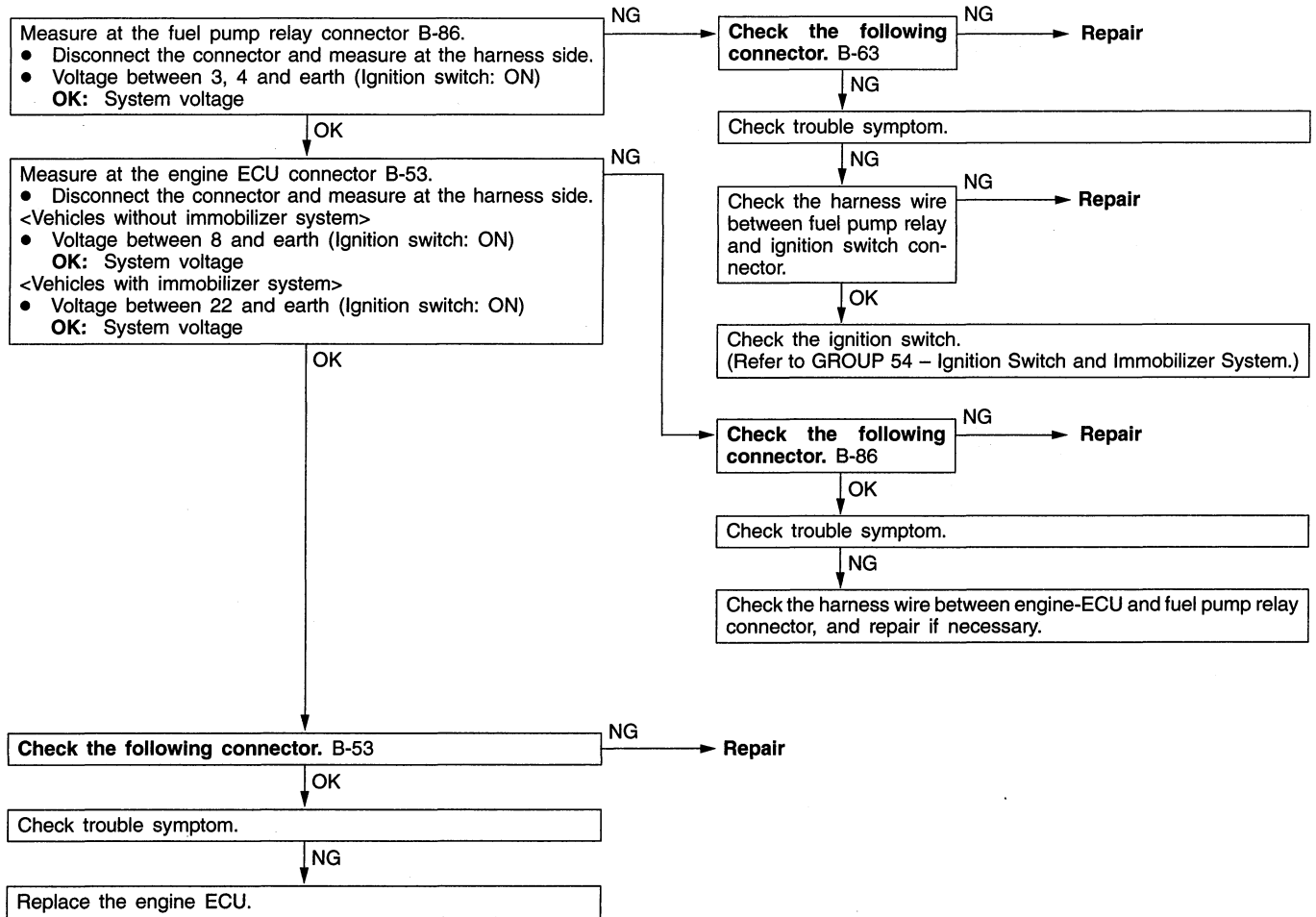
INSPECTION PROCEDURE 44

Check the fuel pump circuit.



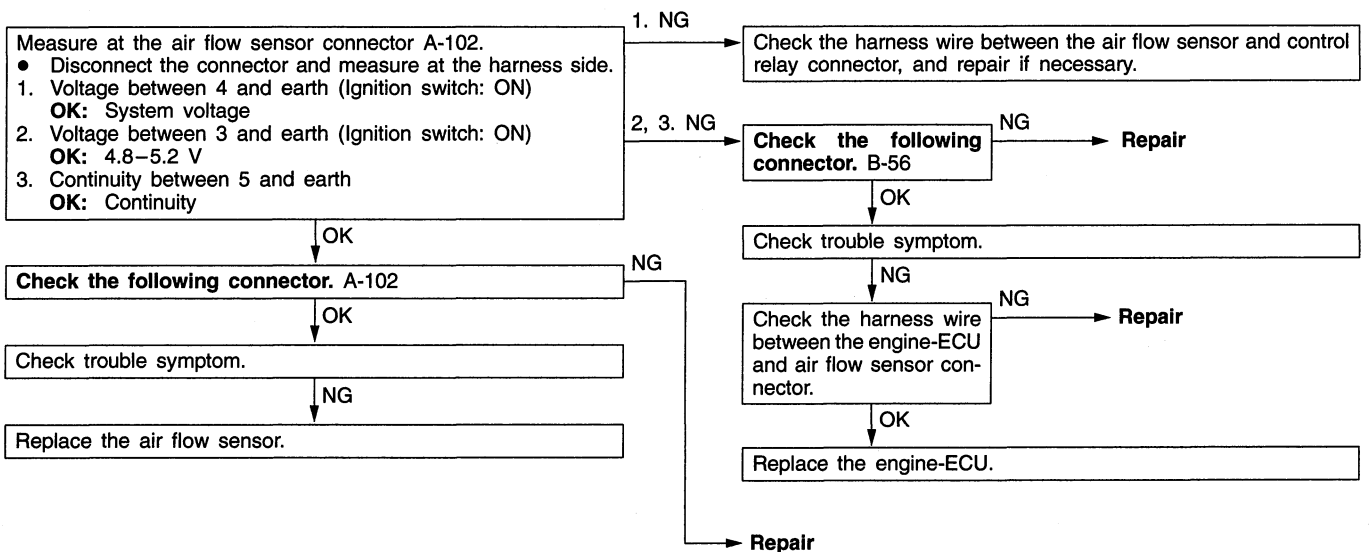
INSPECTION PROCEDURE 45

Check the fuel pump drive control circuit.



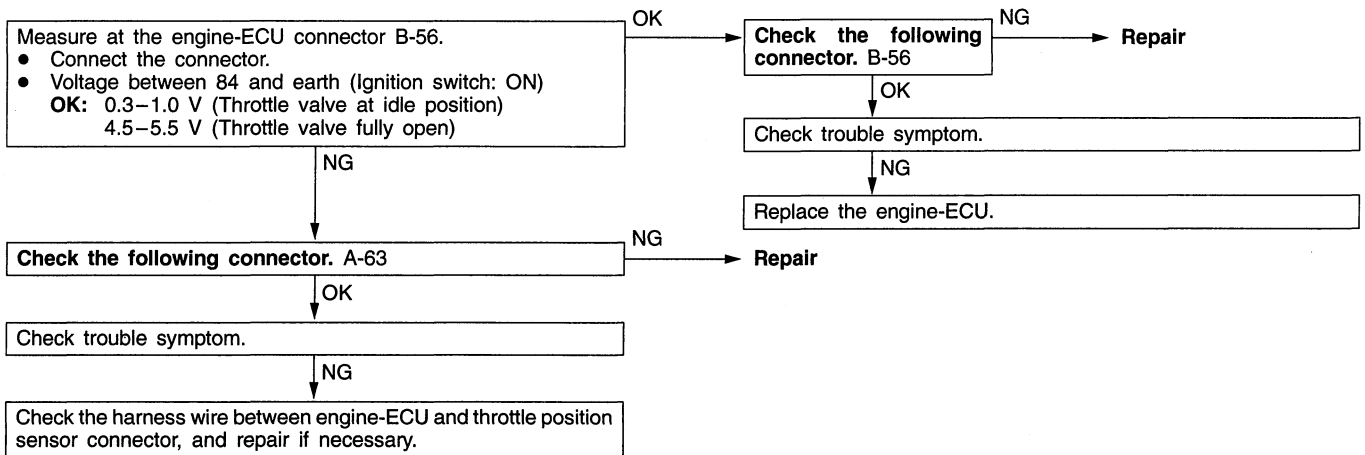
INSPECTION PROCEDURE 46

Check air flow sensor (AFS) control circuit.



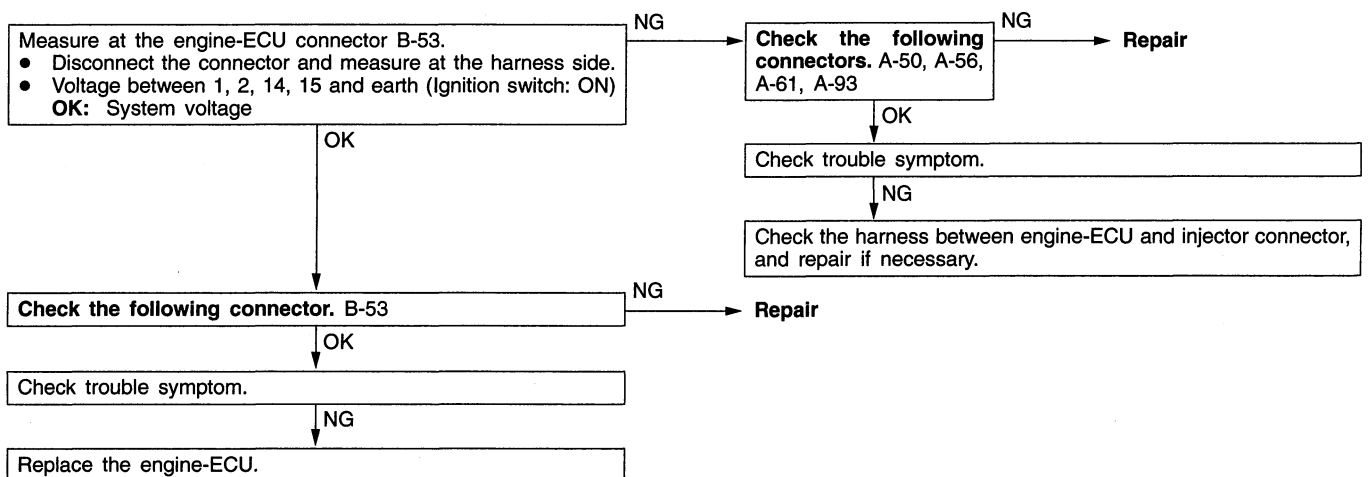
INSPECTION PROCEDURE 47

Check throttle position sensor (TPS) output circuit.



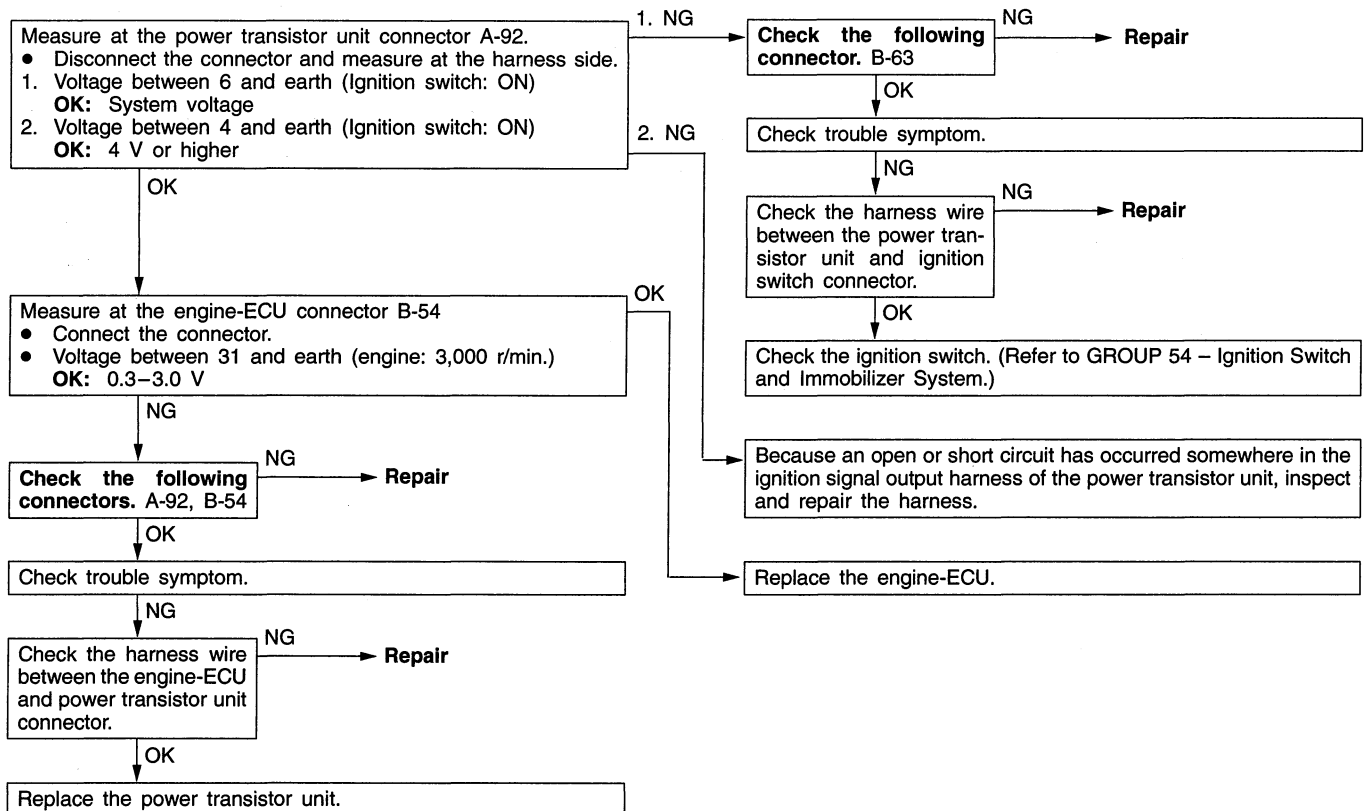
INSPECTION PROCEDURE 48

Check injector control circuit



INSPECTION PROCEDURE 49

Check the ignition signal circuit.



DATA LIST REFERENCE TABLE

13100890081

Caution

When shifting the select lever to D range, the brakes should be applied so that the vehicle does not move forward.

NOTE

- *1. In a new vehicle [driven approximately 500 km or less], the air flow sensor output frequency is sometimes 10% higher than the standard frequency.
- *2. The injector drive time represents the time when the cranking speed is at 250 r/min or below when the power supply voltage is 11 V.
- *3. In a new vehicle [driven approximately 500 km or less], the injector drive time is sometimes 10% longer than the standard time.
- *4. In a new vehicle [driven approximately 500 km or less], the step of the stepper motor is sometimes 30 steps greater than the standard value.
- *5. The idle position switch normally turns off when the voltage of the throttle position sensor is 50–100 mV higher than the voltage at the idle position. If the throttle position switch turns back on after the throttle position sensor voltage has risen by 100 mV and the throttle valve has opened, the idle position switch and the throttle position sensor need to be adjusted.

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
11	Oxygen sensor	Engine: After having warmed up Air/fuel mixture is made leaner when decelerating, and is made richer when racing.	When at 4,000 r/min, engine is suddenly decelerated	200 mV or less	Code No. 11	13A-13
			When engine is suddenly raced	600–1,000 mV		
		Engine: After having warmed up The oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the ECU.	Engine is idling	400 mV or less (Changes)		
			2,500 r/min	600–1,000 mV		
12	Air flow sensor*1	- Engine coolant temperature: 80–95°C - Lamps and all accessories: OFF - Transmission: Neutral	Engine is idling	25–51 Hz	–	–
			2,500 r/min	49–89		
			Engine is raced	Frequency increases in response to racing		
13	Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is –20°C	–20°C	Code No. 13	13A-14
			When intake air temperature is 0°C	0°C		
			When intake air temperature is 20°C	20°C		
			When intake air temperature is 40°C	40°C		
			When intake air temperature is 80°C	80°C		
14	Throttle position sensor	Ignition switch: ON	Set to idle position	300–1,000 mV	Code No. 14	13A-46
			Gradually open	Increases in proportion to throttle opening angle		
			Open fully	4,500–5,500 mV		
16	Power supply voltage	Ignition switch: ON		System voltage	Procedure No. 23	13A-46

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
18	Cranking signal (ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF	Procedure No. 26	13A-43
			Engine: Cranking	ON		
21	Engine coolant temperature sensor	Ignition switch: ON or with engine running	When engine coolant temperature is -20°C	-20°C	Code No. 21	13A-16
			When engine coolant temperature is 0°C	0°C		
			When engine coolant temperature is 20°C	20°C		
			When engine coolant temperature is 40°C	40°C		
			When engine coolant temperature is 80°C	80°C		
22	Crank angle sensor	- Engine: Cranking - Tachometer: Connected	Compare the engine speed readings on the tachometer and the MUT-II.	Accord	Code No. 22	13A-17
		- Engine: Idling - Idle position switch: ON	When engine coolant temperature is -20°C	1,300–1,500 rpm		
			When engine coolant temperature is 0°C	1,200–1,400 rpm		
			When engine coolant temperature is 20°C	1,100–1,300 rpm		
			When engine coolant temperature is 40°C	950–1,150 rpm		
			When engine coolant temperature is 80°C	750–950 rpm		
25	Barometric pressure sensor	Ignition switch: ON	At altitude of 0 m	101 kPa	Code No. 25	13A-20
			At altitude of 600 m	95 kPa		
			At altitude of 1,200 m	88 kPa		
			At altitude of 1,800 m	81 kPa		

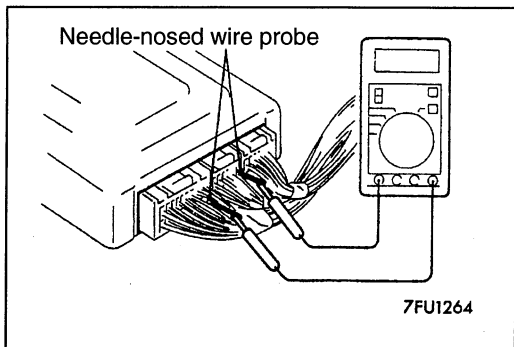
Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
26	Idle position switch	Ignition switch: ON Check by operating accelerator pedal repeatedly	Throttle valve: Set to idle position	ON	Procedure No. 25	13A-43
			Throttle valve: Slightly open	OFF*5		
27	Power steering fluid pressure switch	Engine: Idling	Steering wheel stationary	OFF	Procedure No. 27	13A-44
			Steering wheel turning	ON		
28	A/C switch	Engine: Idling (when A/C switch is ON, A/C compressor should be operating.)	A/C switch: OFF	OFF	Procedure No. 28	13A-44
			A/C switch: ON	ON		
33	Electrical load switch	All accessories: OFF	Lighting switch only: OFF → ON	OFF → ON	Procedure No. 29	13A-45
			Rear defogger switch only: OFF → ON	OFF → ON		
41	Injectors *2	Engine: Cranking	When engine coolant temperature is 0°C (injection is carried out for all cylinders simultaneously)	15–23 ms	–	–
			When engine coolant temperature is 20°C	32–47 ms		
			When engine coolant temperature is 80°C	7.4–11.0 ms		
	Injectors*3	- Engine coolant temperature: 80–95°C - Lamps and all accessories: OFF - Transmission: Neutral	Engine is idling	2.2–3.4 ms		
			2,500 r/min	1.7–2.9 ms		
			When engine is suddenly raced	Increases		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
44	Ignition coils and power transistors	- Engine: After having warmed up - Timing lamp is set. (The timing lamp is set in order to check actual ignition timing.)	Engine is idling	0–13 °BTDC		
			2,500 r/min	23–43 °BTDC		
45	ISC (stepper) motor position *4	- Engine coolant temperature: 80–95°C - Lamps and all accessories: OFF - Transmission: Neutral - Idle position switch: ON - Engine: Idling - When A/C switch is ON, A/C compressor should be operating	A/C switch: OFF	2–25 STEP	–	–
			A/C switch: OFF ON	Increases by 10–70 steps		
49	A/C relay	Engine: After having warmed up/Engine is idling	A/C switch: OFF	OFF (Compressor clutch is not operating)	Procedure No. 28	13A-44
			A/C switch: ON	ON (Compressor clutch is operating)		

ACTUATOR TEST REFERENCE TABLE

13100900111

Item No.	Inspection item	Drive contents	Inspection contents		Normal condition	Inspection procedure No.	Reference page
01	Injectors	Cut fuel to No. 1 injector	Engine: After having warmed up/Engine is idling (Cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)		Idling condition becomes different (becomes unstable).	Code No. 41	13A-22
02		Cut fuel to No. 2 injector					
03		Cut fuel to No. 3 injector					
04		Cut fuel to No. 4 injector					
07	Fuel pump	Fuel pump operates and fuel is recirculated.	- Engine: Cranking - Fuel pump: Forced driving Inspect according to both the above conditions.	Pinch the return hose with fingers to feel the pulse of the fuel being recirculated.	Pulse is felt.	Procedure No. 24	13A-42
				Listen near the fuel tank for the sound of fuel pump operation.	Sound of operation is heard.		
08	Purge control solenoid valve	Solenoid valve turns from OFF to ON.	Ignition switch: ON		Sound of operation can be heard when solenoid valve is driven.	Procedure No. 33	13A-48
10	EGR control solenoid valve	Solenoid valve turns from OFF to ON.	Ignition switch: ON		Sound of operation can be heard when solenoid valve is driven.	Procedure No. 34	13A-49
20	Radiator fan (Hi) Condenser fan (Hi)	Drive the fan motors (radiator and condenser).	Ignition switch: ON A/C switch: ON		Fan motor operates at high speed	Procedure No. 30	13A-46
21	Radiator fan (Lo)	Drive the radiator fan motor	Ignition switch: ON A/C switch: ON		Fan motor operates at low speed.	Procedure No. 30	13A-46



CHECK AT THE ENGINE ECU TERMINALS

13100920087

TERMINAL VOLTAGE CHECK CHART

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 ECU 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 ECU connectors connected.
2. You may find it convenient to pull out the engine ECU to make it easier to reach the connector terminals.
3. The checks can be carried out off the order given in the chart.

Caution

Short-circuiting the positive (+) probe between a connector terminal and earth could damage the vehicle wiring, the sensor, engine ECU or all of them. Be careful to prevent this!

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

Engine-ECU Connector Terminal Arrangement

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

*: Vehicles with immobilizer system

Terminal No.	Check item	Check condition (Engine condition)	Normal condition
1	No. 1 injector	While engine is idling after having warmed up, suddenly depress the accelerator pedal.	From 11–14 V, momentarily drops slightly
14	No. 2 injector		
2	No. 3 injector		
15	No. 4 injector		
3	Fan motor relay (High)	Radiator fan is not running (engine coolant temperature is 90°C or less)	System Voltage
		Radiator fan is running at high speed (engine coolant temperature is 105°C or more)	0–3V
16	Fan motor relay (Low)	Radiator fan is not running (engine coolant temperature is 90°C or less)	System Voltage
		Radiator fan is running at low speed (engine coolant temperature is 90–105°C or more)	0–3V
4	Stepper motor coil <A1>	Engine: Soon after the warmed up engine is started	System voltage ↔ 0 V (Changes repeatedly)
17	Stepper motor coil <A2>		
5	Stepper motor coil <B1>		
18	Stepper motor coil <B2>		
6	EGR control solenoid valve	Ignition switch: ON	System Voltage
		While engine is idling, suddenly depress the accelerator pedal.	From system voltage, momentarily drops

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
8 or 22*	Fuel pump relay	Ignition switch: ON		System voltage
		Engine: Idle speed		0–3V
9	Purge control solenoid valve	Ignition switch: ON		System voltage
		Running at 3,000r/min while engine is warming up after having been started.		0–3V
10	Power transistor unit A	Engine r/min: 3,000 r/min		0.3–3.0V
23	Power transistor unit B			
12	Power supply	Ignition switch: ON		System voltage
25				
19	Air flow sensor reset signal	Engine: Idle speed		0–1V
		Engine r/min: 3,000 r/min		6–9V
22 or 8*	A/C relay	- Engine: Idle speed - A/C switch: OFF ON (A/C compressor is running)		System voltage or momentarily 6V or more 0–3V
24	Electric load switch	Engine: Idle speed	Turn OFF the lighting switch	0–3V
			Turn ON the lighting switch	System voltage
31	Engine ignition signal	Engine r/min: 3,000 r/min		0.3–3.0V
34	Ignition timing adjustment terminal	Ignition switch: ON	Earth the ignition timing adjustment terminal	0–1V
			Remove the earth connection from the ignition timing adjustment terminal	4.0–5.5V
35	Oxygen sensor heater	Engine: Idling after warming up		0–3V
		Engine r/min: 5,000r/min.		System voltage
36	Engine warning lamp	Ignition switch: OFF ON		0–3V 9–13V (After several seconds have elapsed)
37	Power steering fluid pressure switch	Engine: Idling after warming up	When steering wheel is stationary	System voltage
			When steering wheel is turned	0–3V
38	Control relay (Power supply)	Ignition switch: OFF		System voltage
		Ignition switch: ON		0–3V

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
45	A/C switch	Engine: Idle speed	Turn the A/C switch OFF	0–3V
			Turn the A/C switch ON (A/C compressor is operating)	System voltage
71	Ignition switch – ST	Engine: Cranking		8V or more
72	Intake air temperature sensor	Ignition switch: ON	When intake air temperature is 0°C	3.2–3.8V
			When intake air temperature is 20°C	2.3–2.9V
			When intake air temperature is 40°C	1.5–2.1V
			When intake air temperature is 80°C	0.4–1.0V
76	Oxygen sensor	Engine: Running at 2,500 r/min after warmed up (Check using a digital type voltmeter)		0 ↔ 0.8V (Changes repeatedly)
80	Backup power supply	Ignition switch: OFF		System voltage
81	Sensor impressed voltage	Ignition switch: ON		4.5–5.5V
82	Ignition switch – IG	Ignition switch: ON		System voltage
83	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C	3.2–3.8V
			When engine coolant temperature is 20°C	2.3–2.9V
			When engine coolant temperature is 40°C	1.3–1.9V
			When engine coolant temperature is 80°C	0.3–0.9V
84	Throttle position sensor	Ignition switch: ON	Set throttle valve to idle position	0.3–1.0V
			Fully open throttle valve	4.5–5.5V
85	Barometric pressure sensor	Ignition switch: ON	When altitude is 0m	3.7–4.3V
			When altitude is 1,200m	3.2–3.8V
86	Vehicle speed sensor	- Ignition switch: ON - Move the vehicle slowly forward		0 ↔ 5V (Changes repeatedly)

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
87	Idle position switch	Ignition switch: ON	Set throttle valve to idle position	0–1V
			Slightly open throttle valve	4V or more
88	Camshaft position sensor	Engine: Cranking		0.4–3.0V
		Engine: Idle speed		0.5–2.0V
89	Crank angle sensor	Engine: Cranking		0.4–4.0V
		Engine: Idle speed		1.5–2.5V
90	Air flow sensor	Engine: Idle speed		2.2–3.2V
		Engine r/min: 2,500r/min		

CHECK CHART FOR RESISTANCE AND CONTINUITY BETWEEN TERMINALS

1. Turn the ignition switch to OFF.
2. Disconnect the engine-ECU connector.
3. Measure the resistance and check for continuity between the terminals of the engine-ECU harness-side connector while referring to the check chart.

NOTE

1. When measuring resistance and checking continuity, a harness for checking contact pin pressure should be used instead of inserting a test probe.
2. Checking need not be carried out in the order given in the chart.

Caution

If the terminals that should be checked are mistaken, or if connector terminals are not correctly shorted to earth, damage may be caused to the vehicle wiring, sensors, engine-ECU and/or ohmmeter.

Be careful to prevent this!

4. If the ohmmeter shows any deviation from the standard value, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
5. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.

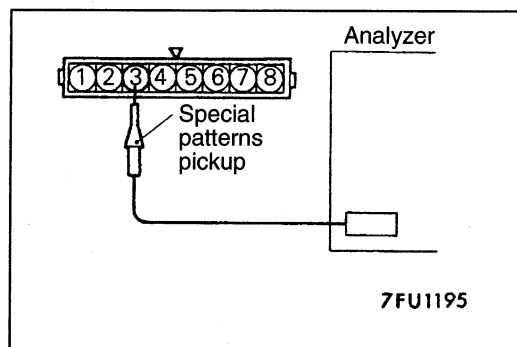
Engine-ECU Harness Side Connector Terminal Arrangement

61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
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Terminal No.	Inspection item	Normal condition (Check condition)
1-12	No. 1 injector	13-16 Ω (At 20°C)
14-12	No. 2 injector	
2-12	No. 3 injector	
15-12	No. 4 injector	

Terminal No.	Inspection item	Normal condition (Check condition)
4-12	Stepper motor coil (A1)	28-33 Ω (At 20°C)
17-12	Stepper motor coil (A2)	
5-12	Stepper motor coil (B1)	
18-12	Stepper motor coil (B2)	
6-12	EGR control solenoid valve	36-44 Ω (At 20°C)
9-12	Purge control solenoid valve	36-44 Ω (At 20°C)
13-Body earth	Engine-ECU earth	Continuity (0 Ω)
26-Body earth	Engine-ECU earth	
35-12	Oxygen sensor heater	7-40 Ω (At 20°C)
72-92	Intake air temperature sensor	5.3-6.7 k Ω (When intake air temperature is 0°C)
		2.3-3.0 k Ω (When intake air temperature is 20°C)
		1.0-1.5 k Ω (When intake air temperature is 40°C)
		0.30-0.42 k Ω (When intake air temperature is 80°C)
83-92	Engine coolant temperature sensor	5.1-6.5 k Ω (When coolant temperature is 0°C)
		2.1-2.7 k Ω (When coolant temperature is 20°C)
		0.9-1.3 k Ω (When coolant temperature is 40°C)
		0.26-0.36 k Ω (When coolant temperature is 80°C)
87-92	Idle position switch	Continuity (when throttle valve is at idle position)
		No continuity (when throttle valve is slightly open)



INSPECTION PROCEDURE USING AN ANALYZER

13100930080

AIR FLOW SENSOR (AFS)

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.

Alternate Method (Test harness not available)

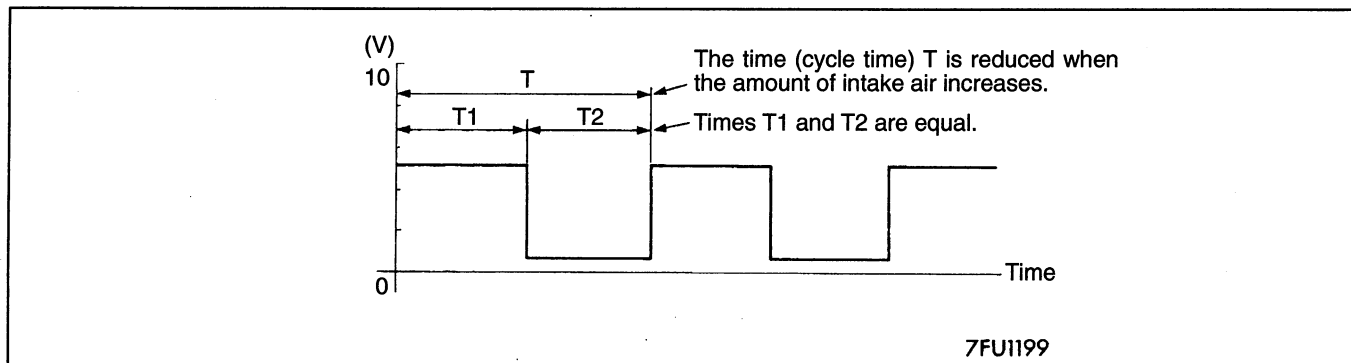
1. Connect the analyzer special patterns pickup to engine-ECU terminal 90.

Standard Wave Pattern

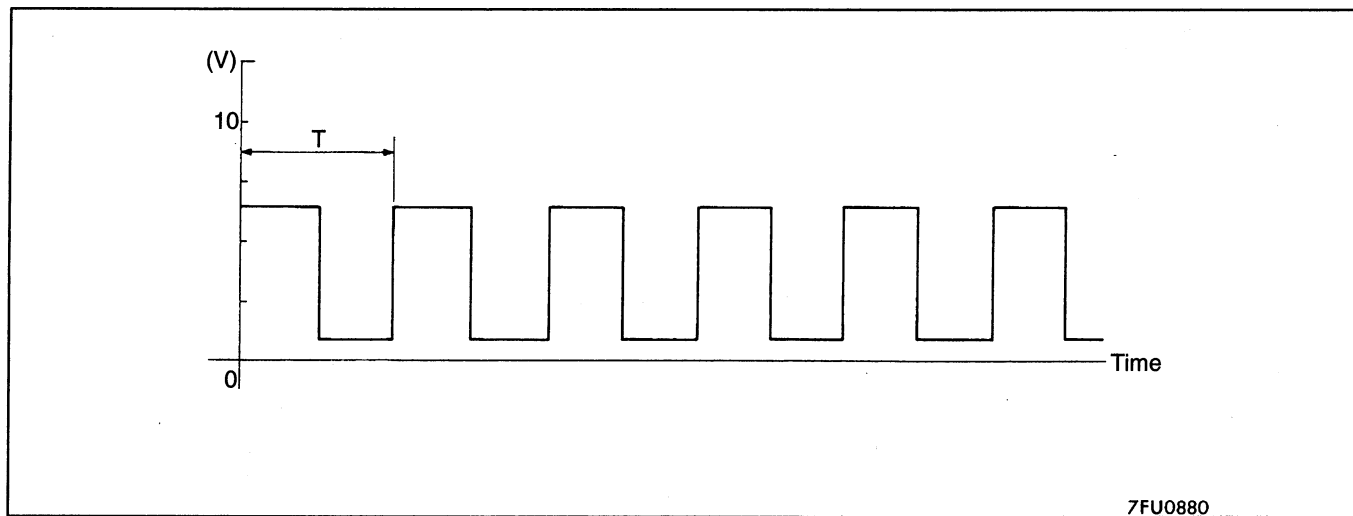
Observation conditions

Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern

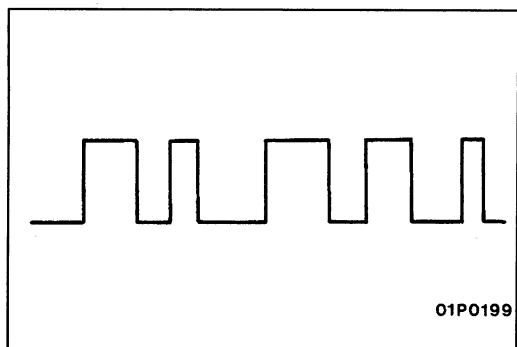


Observation conditions (from conditions above engine speed is increased by racing.)



Wave Pattern Observation Points

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

**Examples of Abnormal Wave Patterns**

- Example 1

Cause of problem

Sensor interface malfunction

Wave pattern characteristics

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

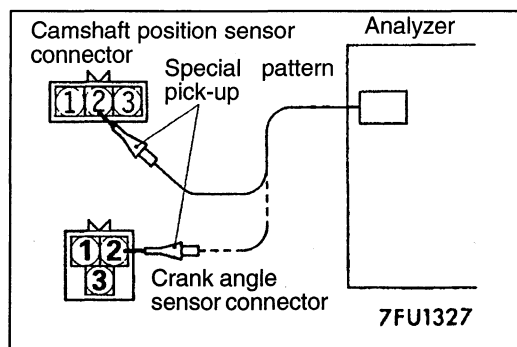
- Example 2

Cause of problem

Damaged rectifier or vortex generation column

Wave pattern characteristics

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



CAMSHAFT POSITION SENSOR AND CRANK ANGLE SENSOR

Measurement Method

1. Disconnect the camshaft position sensor connector and connect the special tool (test harness: MB991223) and jumper wire in between. (All terminals should be connected.)
2. Connect the analyzer special pattern pickup to camshaft position sensor terminal 2.
3. Disconnect the crank angle sensor connector and connect the special tool (test harness: MD998478) in between.
4. Connect the analyzer special pattern pickup to crank angle sensor terminal 2.

Alternate Method (Test harness not available)

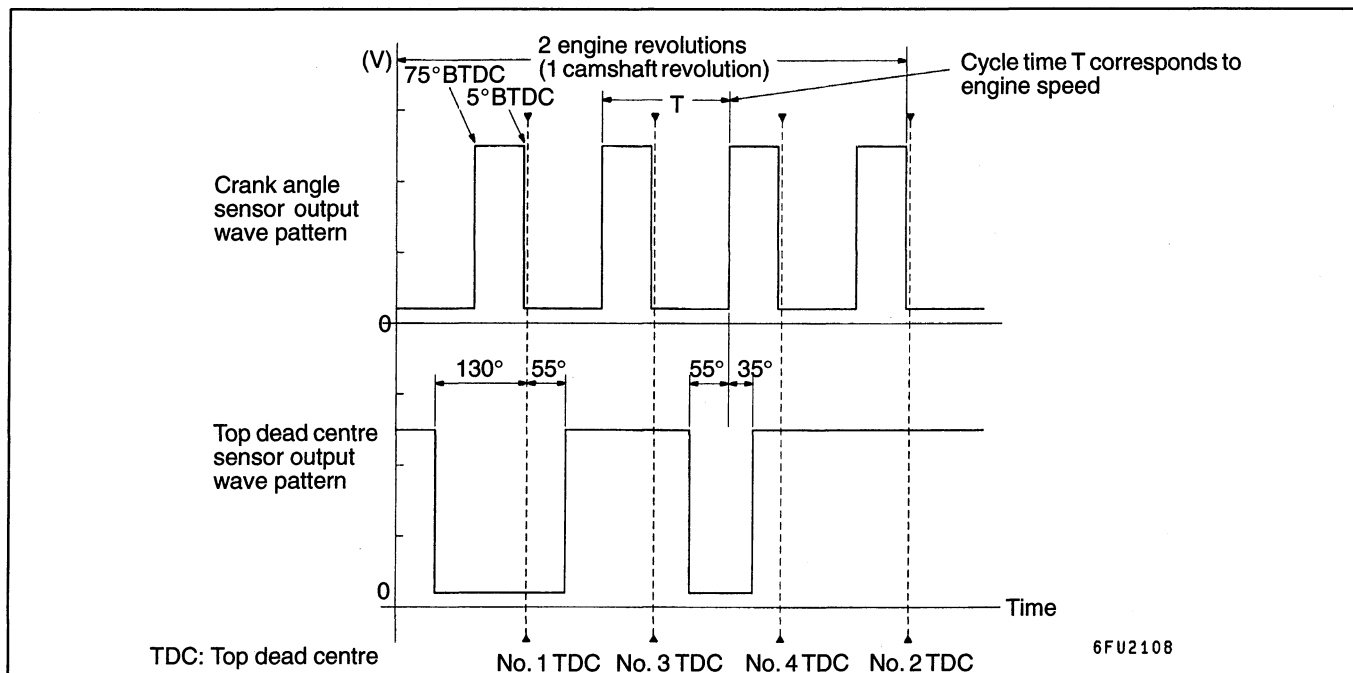
1. Connect the analyzer special pattern pickup to engine-ECU terminal 88. (When checking the camshaft position sensor signal wave pattern.)
2. Connect the analyzer special pattern pickup to engine-ECU terminal 89. (When checking the crank angle sensor signal wave pattern.)

Standard Wave Pattern

Observation conditions

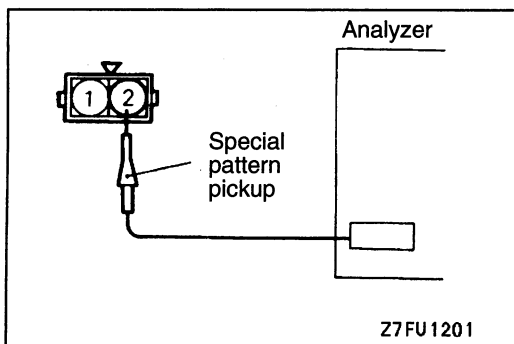
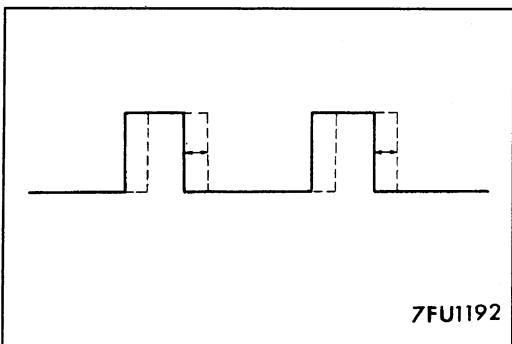
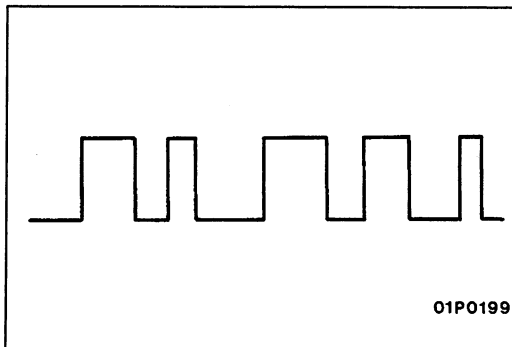
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern



Wave Pattern Observation Points

Check 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 disc

Wave pattern characteristics

Wave pattern is displaced to the left or right.

INJECTOR

Measurement method

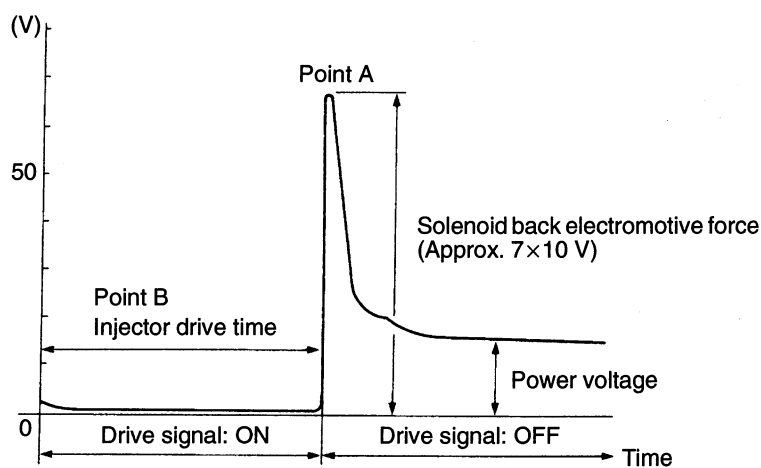
1. Disconnect the injector connector and connect the special tool (test harness: MB991348) in between. (Both the power supply side and engine-ECU side should be connected.)
2. Connect the analyzer special pattern pickup to terminal 2 of the injector connector.

Alternate Method (Test harness not available)

1. Connect the analyzer special pattern pickup to engine-ECU terminal 1. (When checking the No. 1 cylinder.)
2. Connect the analyzer special pattern pickup to engine-ECU terminal 14. (When checking the No. 2 cylinder.)
3. Connect the analyzer special pattern pickup to engine-ECU terminal 2. (When checking the No. 3 cylinder.)
4. Connect the analyzer special pattern pickup to engine-ECU terminal 15. (When checking the No. 4 cylinder.)

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

Standard wave pattern

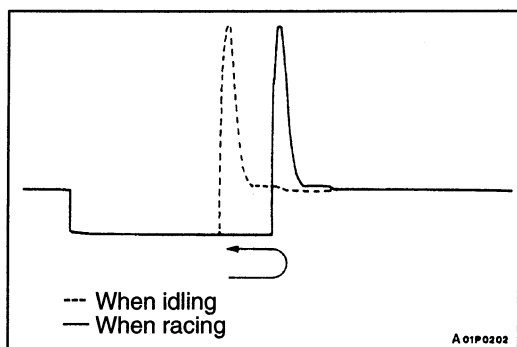
7FU1202

Wave Pattern Observation Points**Explanation of Wave Pattern**

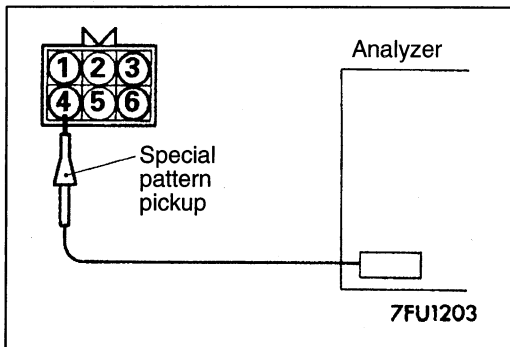
Point A: Height of solenoid back electromotive force

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-II tester display.
- When the engine is suddenly raced, the drive time will be greatly extended at first, but the drive time will soon match the engine speed.



STEPPER MOTOR

Measurement Method

1. Disconnect the stepper motor connector, and connect the special tool (test harness: MD998463) in between.
2. Connect the analyzer special pattern pickup to the stepper motor-side connector terminal 1 (red clip of special tool), terminal 3 (blue clip), terminal 4 (black clip) and terminal 6 (yellow clip) respectively.

Alternate Method (Test harness not available)

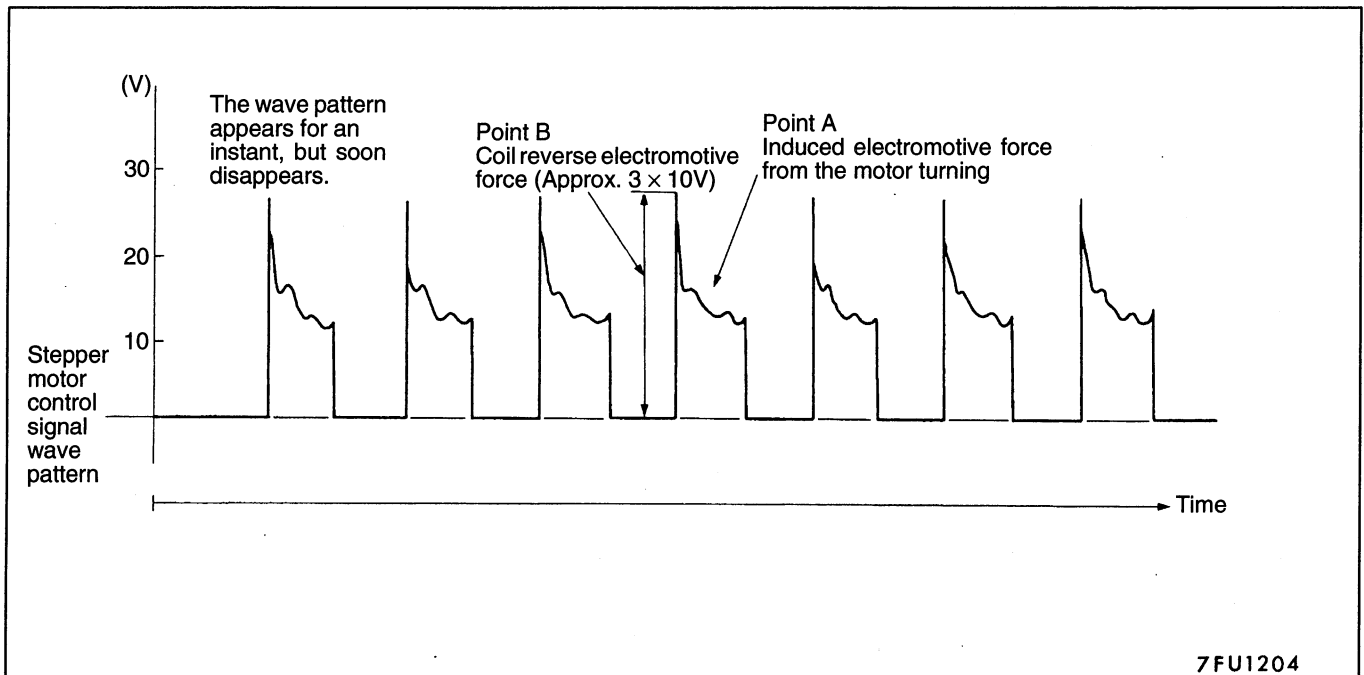
1. Connect the analyzer special pattern pickup to ECU terminal 4, connection terminal 5, connection terminal 17, and connection terminal 18 respectively.

Standard Wave Pattern

Observation conditions

Function	Special patterns
Pattern height	High
Pattern selector	Display
Engine condition	When the engine coolant temperature is 20°C or below, turn the ignition switch from OFF to ON (without starting the engine).
	While the engine is idling, turn the A/C switch to ON.
	Immediately after starting the warm engine

Standard wave pattern



7FU1204

Wave Pattern Observation Points

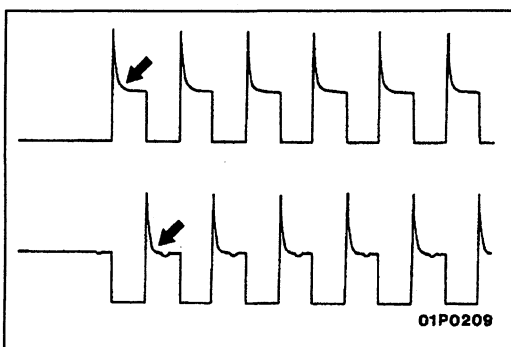
Check that the standard wave pattern appears when the stepper motor is operating.

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

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

Point B: Height of coil reverse electromotive force

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

**Examples of Abnormal Wave Pattern**

- Example 1

Cause of problem

Motor is malfunctioning. (Motor is not running.)

Wave pattern characteristics

Induced electromotive force from the motor turning does not appear.

- Example 2

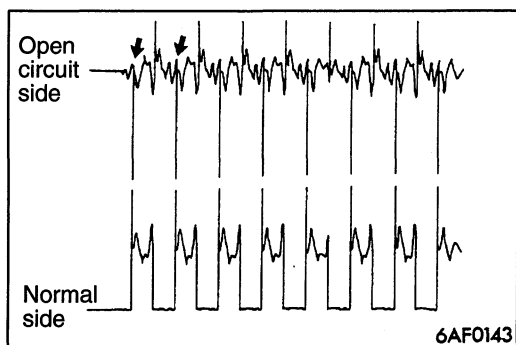
Cause of problem

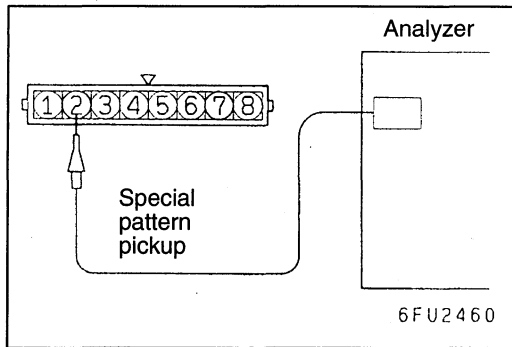
Open circuit in the line between the stepper motor and the engine-ECU.

Wave pattern characteristics

Current is not supplied to the motor coil on the open circuit side. (Voltage does not drop to 0 V.)

Furthermore, the induced electromotive force waveform at the normal side is slightly different from the normal waveform.



**IGNITION COIL AND POWER TRANSISTOR**

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

Measurement Method

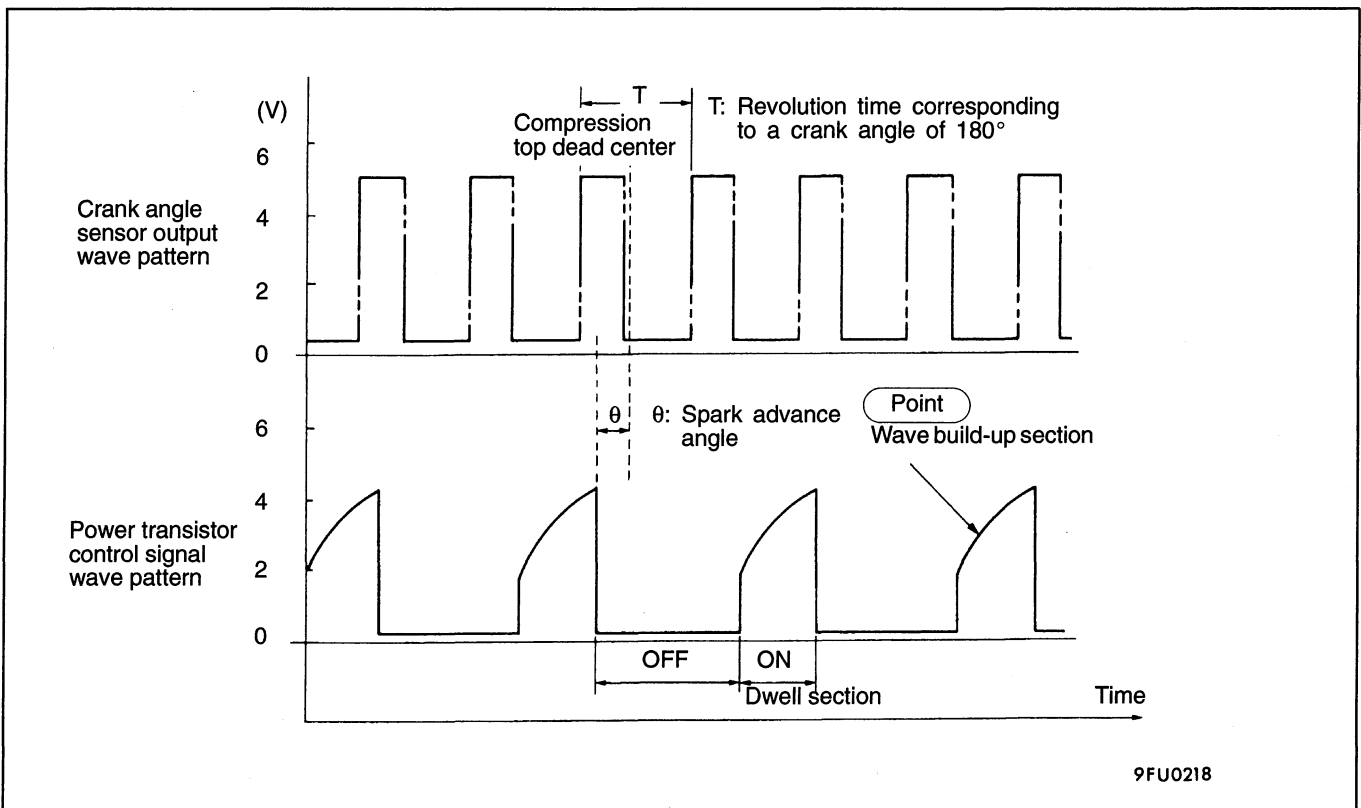
1. Disconnect the power transistor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
2. Connect the analyzer special pattern pickup to the power transistor connector terminal 2 (No. 2–No. 3) and terminal 7 (No. 1–No.4) respectively.

Alternate Method (Test harness not available)

1. Connector the analyzer special pattern pickup to engine ECU terminal 10 (No. 1 – No. 4), terminal 23 (No. 2 – No. 3) respectively.

Standard Wave Pattern**Observation condition**

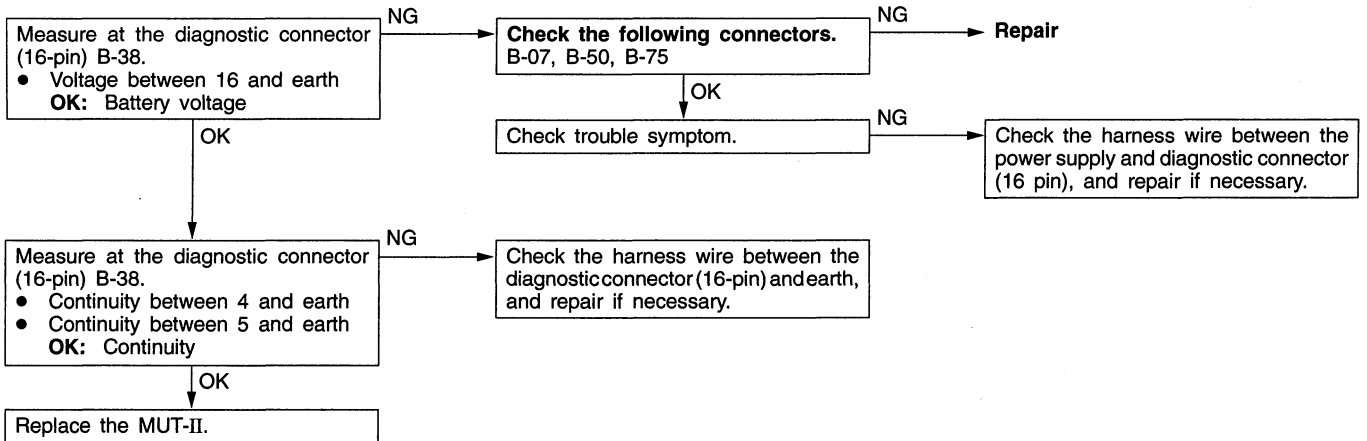
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Approx. 1,200 r/min

Standard wave pattern

INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

INSPECTION PROCEDURE 1

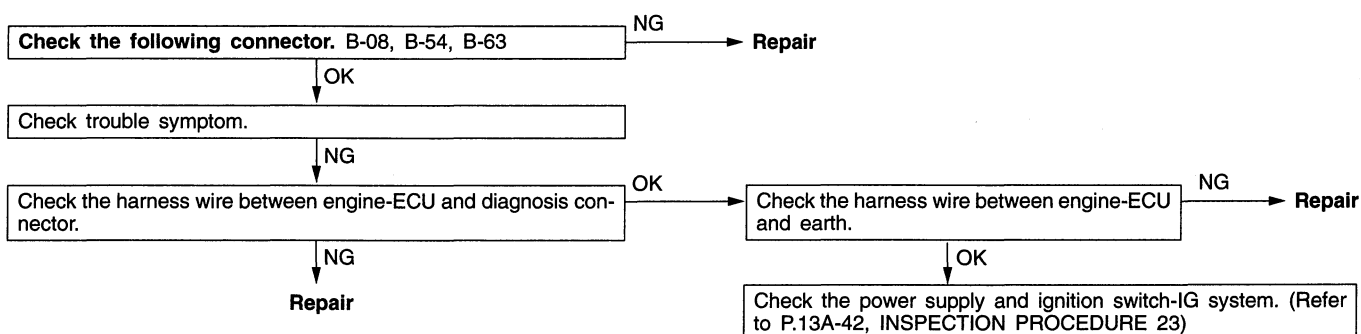
Communication with MUT-II is not possible. (Communication with all systems is not possible.)	Probable cause
The cause is probably a defect in the power supply system (including earth) for the diagnosis line.	• Malfunction of the connector • Malfunction of the harness wire



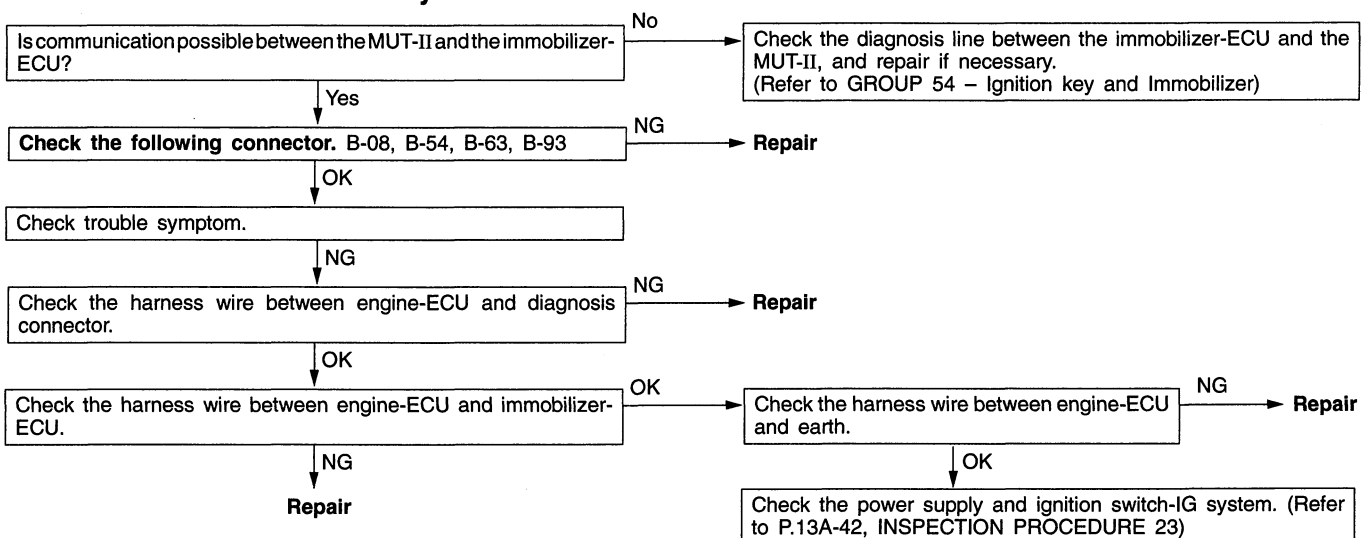
INSPECTION PROCEDURE 2

MUT-II communication with engine-ECU is impossible.	Probable cause
One of the following causes may be suspected. • No power supply to engine-ECU • Defective earth circuit of engine-ECU • Defective engine-ECU • Improper communication line between engine-ECU and MUT-II	<Vehicles without immobilizer system> • Malfunction of engine-ECU power supply circuit • Malfunction of the engine-ECU • Open circuit between engine-ECU and diagnosis connector <Vehicles with immobilizer system> • Malfunction of engine-ECU power supply circuit • Malfunction of the engine-ECU • Malfunction of the immobilizer-ECU • Open circuit between immobilizer-ECU and diagnosis connector • Open circuit between engine-ECU and immobilizer-ECU

<Vehicles without immobilizer system>



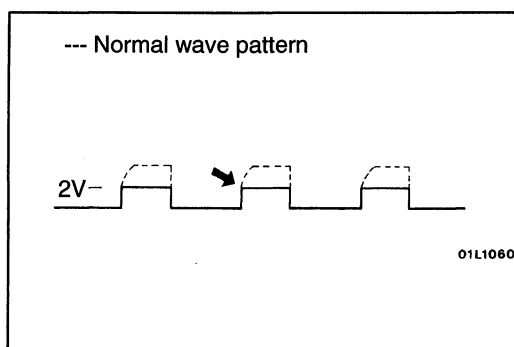
<Vehicles with immobilizer system>



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

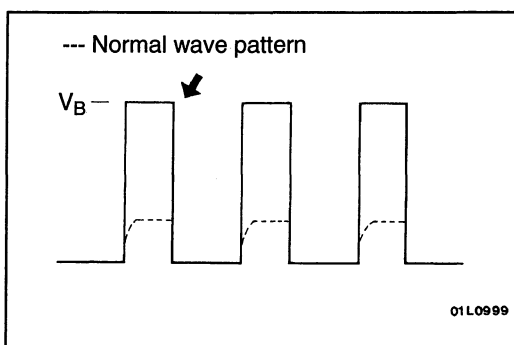
Wave pattern during engine cranking

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

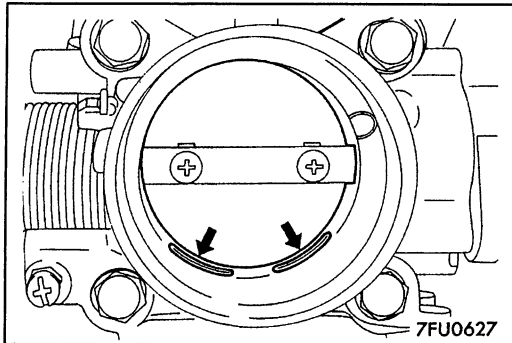
Power voltage results when the power transistor is ON.

ON-VEHICLE SERVICE

13100100108

THROTTLE BODY (THROTTLE VALVE AREA) CLEANING

1. Start the engine and warm it up until the coolant is heated to 80°C or higher and then stop the engine.
2. Remove the air intake hose from the throttle body.



3. Plug the bypass passage inlet of the throttle body.

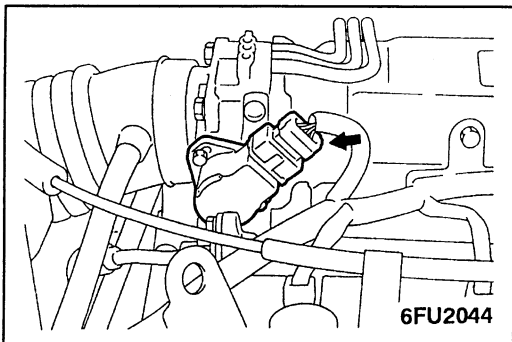
Caution

Do not allow cleaning solvent to enter the bypass passage.

4. Spray cleaning solvent into the valve through the throttle body intake port and leave it for about 5 minutes.
5. Start the engine, race it several times and idle it for about 1 minute. If the idling speed becomes unstable (or if the engine stalls) due to the bypass passage being plugged, slightly open the throttle valve to keep the engine running.
6. If the throttle valve deposits are not removed, repeat steps 4 and 5.
7. Unplug the bypass passage inlet.
8. Attach the air intake hose.
9. Use the MUT-II to erase the diagnosis code.
10. Adjust the basic idle speed. (Refer to P.13A-83.)

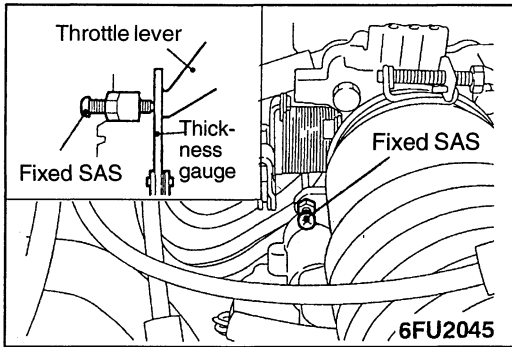
NOTE

If the engine hunts while idling after adjustment of the basic idle speed, disconnect the (-) cable from the battery for 10 seconds or more, and then reconnect it and run the engine at idle for about 10 minutes.

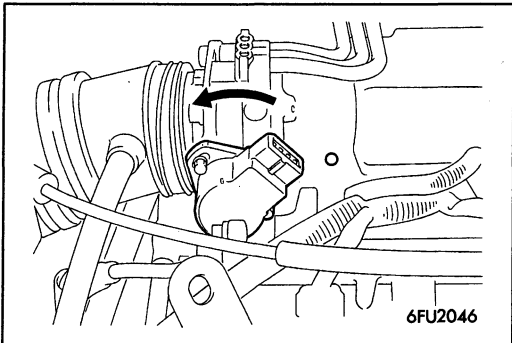
**IDLE POSITION SWITCH AND THROTTLE POSITION SENSOR ADJUSTMENT**

13100130091

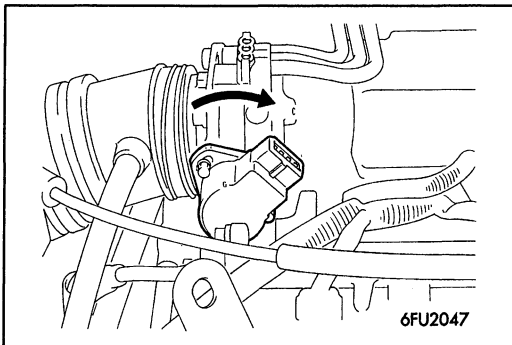
1. Connect the MUT-II to the diagnosis connector.



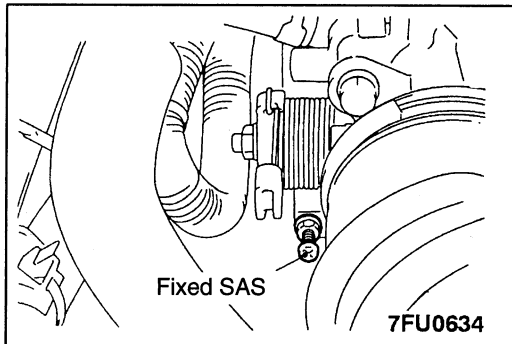
2. Insert a thickness gauge with a thickness of 0.65 mm between the fixed SAS and the throttle lever.
3. Turn the ignition switch to ON (but do not start the engine).



4. Loosen the throttle position sensor mounting bolt, and then turn the throttle position sensor anti-clockwise as far as it will go.
5. Check that the idle position switch is on at this position.
6. Slowly turn the throttle position sensor clockwise and find the point where the idle position switch turns off. Securely tighten the throttle position sensor mounting bolt at this point.



7. Check the throttle position sensor output voltage.
Standard value: 400–1,000 mV
8. If there is a deviation from the standard value, check the throttle position sensor and the related harness.
9. Remove the thickness gauge.
10. Turn the ignition switch to OFF.
11. Disconnect the MUT-II.



FIXED SAS ADJUSTMENT

13100150103

NOTE

1. The fixed SAS should not be moved unnecessarily; it has been precisely adjusted by the manufacturer.
2. If the adjustment is disturbed for any reason, readjust as follows.

1. Loosen the tension of the accelerator cable sufficiently.
2. Back out the fixed SAS lock nut.
3. Turn the fixed SAS counterclockwise until it is sufficiently backed out, and fully close the throttle valve.
4. Tighten the fixed SAS until the point where the throttle lever is touched (i.e., the point at which the throttle valve begins to open) is found.
From that point, tighten the fixed SAS 1-1/4 turn.
5. While holding the fixed SAS so that it doesn't move, tighten the lock nut securely.
6. Adjust the tension of the accelerator cable.
7. Adjust the basic idling speed.
8. Adjust the idle position switch and the throttle position sensor (P.13A-81).

BASIC IDLE SPEED ADJUSTMENT

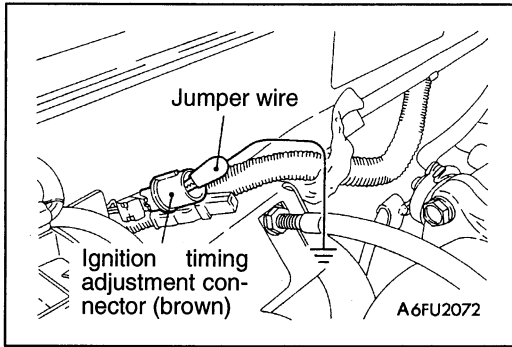
13100180102

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. If the adjustment has been changed by mistake, the idle speed may become too high or the idle speed may drop too low when loads from components such as the A/C are placed on the engine. If this occurs, adjust by the following procedure.
 3. 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. Before inspection and adjustment, set the vehicle to the pre-inspection condition.
 2. Connect the MUT-II to the diagnosis connector (16-pin).

NOTE

When the 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. Check the idle speed.

Standard value: 850±50 r/min

NOTE

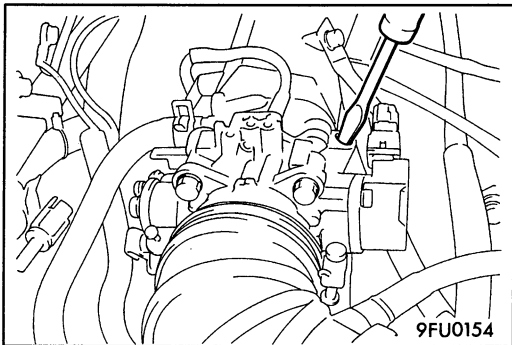
1. The engine speed may be 20 to 100 r/min lower than indicated above for a new vehicle [driven approximately 500 km or less], but no adjustment is necessary.
2. If the engine stalls or the engine speed is low even though the vehicle has been driven approximately 500 km or more, it is probable that deposits are adhered to the throttle valve, so clean it. (Refer to P.13A-81.)

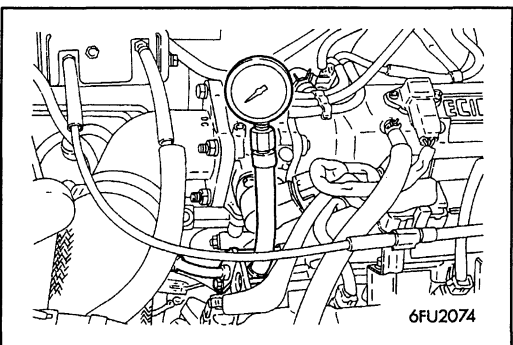
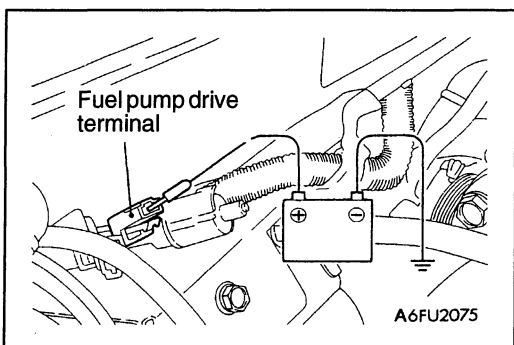
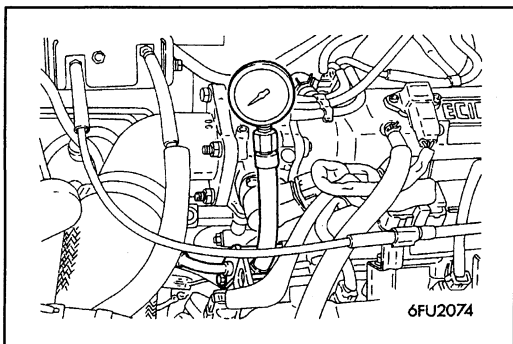
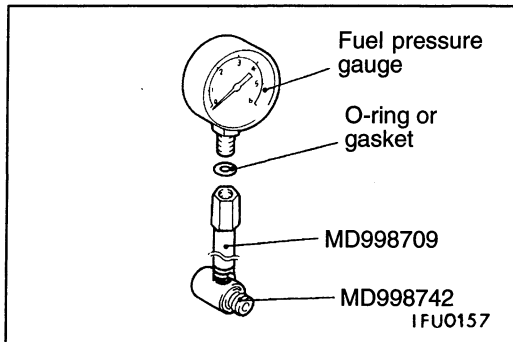
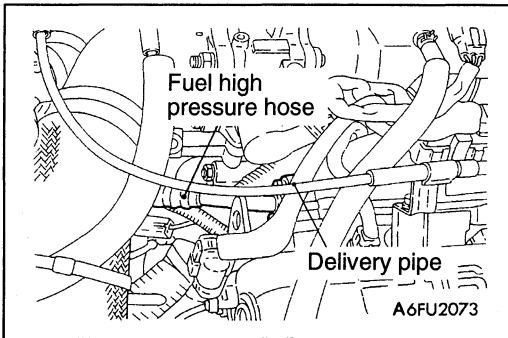
7. If not within the standard value range, turn the speed adjusting screw (SAS) to make the necessary adjustment.

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.

8. Turn 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 10 minutes; check that the idling condition is normal.





FUEL PRESSURE TEST

13100190105

1. Release residual pressure from the fuel pipe line to prevent fuel gush out. (Refer to P.13A-88.)
2. Disconnect the fuel high pressure hose at the delivery pipe side.

Caution

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

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

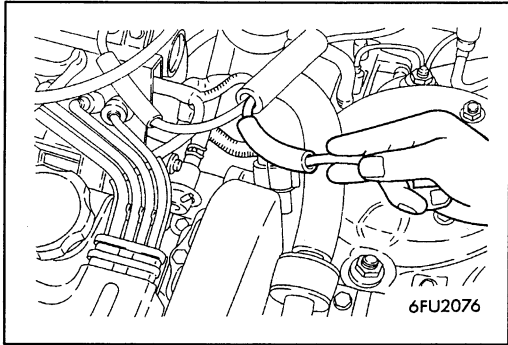
5. Install the special tool, which was set in place in steps 3 and 4 between the delivery pipe and the high pressure hose.

6. Connect the 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.
7. Disconnect the jumper wire from the fuel pump drive terminal to stop the fuel pump.
8. Start the engine and run at idle.

9. Measure fuel pressure while the engine is running at idle.

Standard value:

Approx. 265 kPa at curb idle



10. Disconnect the vacuum hose from the fuel pressure regulator and measure fuel pressure with the hose end closed by a finger.

Standard value: 324–343 kPa at curb idle

11. Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.
12. 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 flow rate is low, there will be no fuel pressure in the return hose.

13. 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

14. 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

15. Release residual pressure from the fuel pipe line. (Refer to P.13A-88.)
16. Remove the fuel pressure gauge and special tool from the delivery pipe.

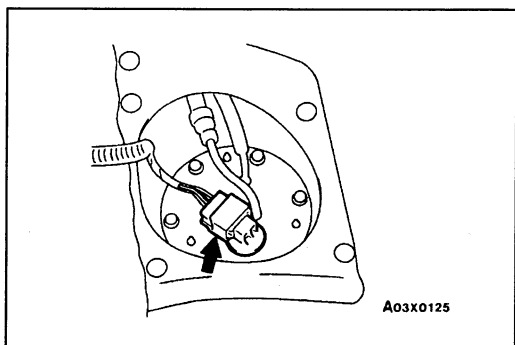
Caution

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

17. Replace the O-ring at the end of the high-pressure fuel hose with a new one. Furthermore, apply engine oil to the new O-ring before replacement.
18. Fit the high-pressure fuel hose over the delivery pipe and tighten the bolt to specified torque.

Tightening torque: 5 Nm

19. 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.

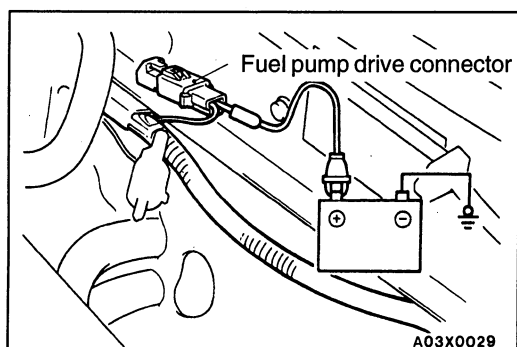


FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE FUEL LINE PRESSURE)

13100090139

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.

1. Remove the rear seat cushion. (Refer to GROUP 52A.)
2. Remove the protector to disconnect the fuel pump connector.
3. Start the engine and let it run until it stops naturally, turn the ignition switch to OFF.
4. Connect the fuel pump connector to install the protector.
5. Install the rear seat cushion.



FUEL PUMP OPERATION CHECK

13100200099

1. Check the operation of the fuel pump by using the MUT-II to force-drive the fuel pump.
2. If the fuel pump will not operate, check by using the following procedure. If normal, check the fuel pump 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

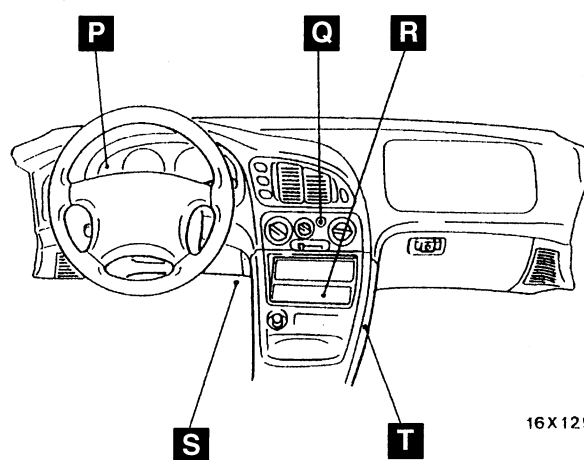
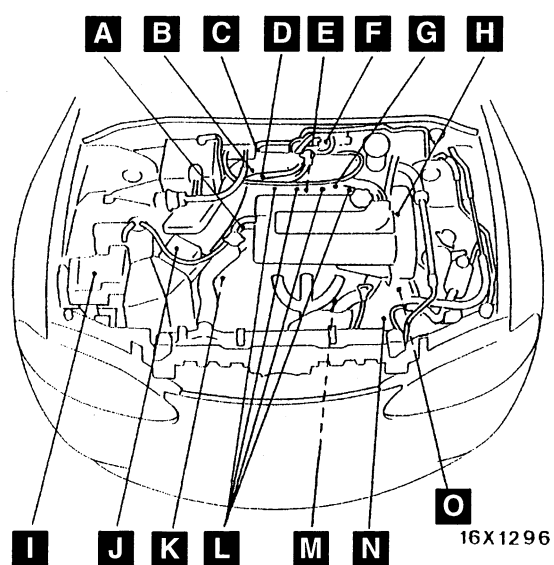
As the fuel pump is an in-tank type, the fuel pump sound is hard to hear, so remove the fuel tank filler tube cap and check from the tank inlet.

- (3) Check the fuel pressure by pinching the fuel hose with the fingertips.

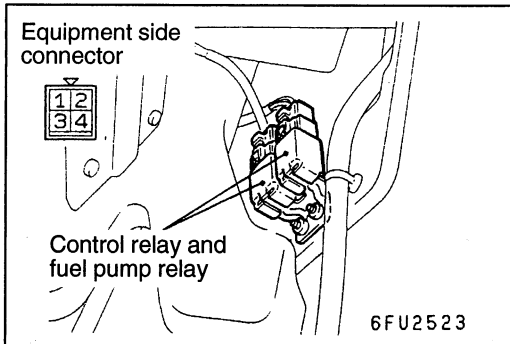
COMPONENT LOCATION

13100210146

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



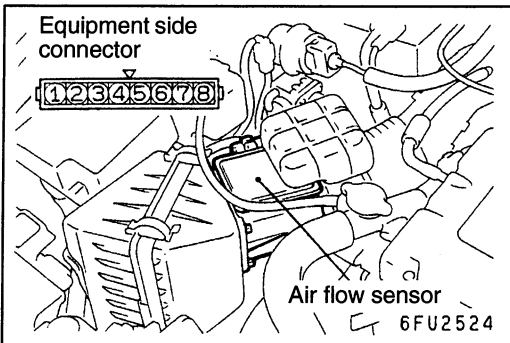
6FU2529



CONTROL RELAY AND FUEL PUMP RELAY CONTINUITY CHECK

13100800060

Battery voltage	Terminal No.			
	1	2	3	4
Not supplied		○	—	○
Supplied	○	—	○	⊕



INTAKE AIR TEMPERATURE SENSOR CHECK

13100280093

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

Standard value:

2.3–3.0 kΩ (at 20°C)

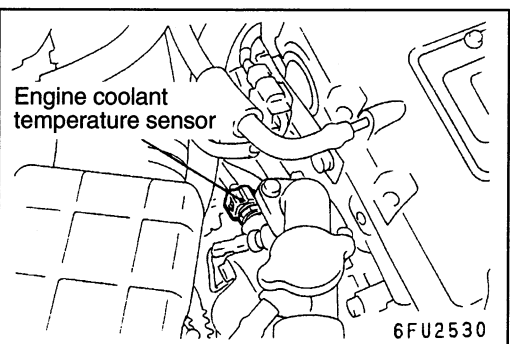
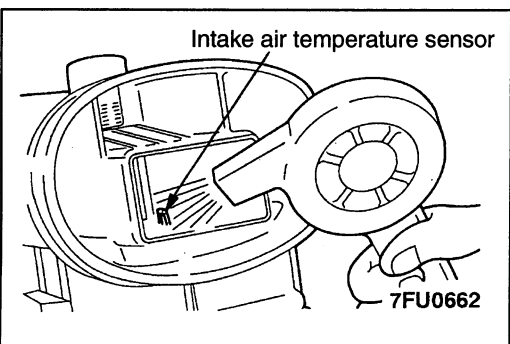
0.30–0.42 kΩ (at 80°C)

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

Normal condition:

Temperature (°C)	Resistance (kΩ)
Higher	Smaller

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



ENGINE COOLANT TEMPERATURE SENSOR CHECK

13100310099

Caution

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

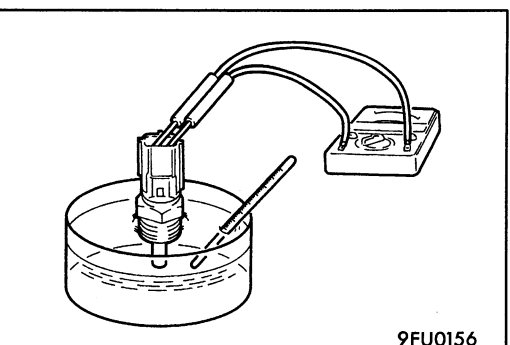
1. Remove the engine coolant temperature sensor.
2. With temperature sensing portion of the engine coolant temperature sensor immersed in hot water, check resistance.

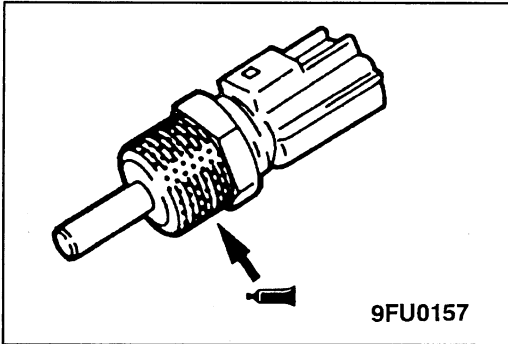
Standard value:

2.1–2.7 kΩ (at 20°C)

0.26–0.36 kΩ (at 80°C)

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





4. Apply sealant to the threaded portion.

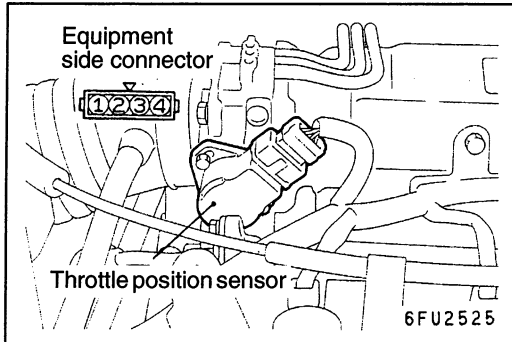
Specified sealant:

3M NUT locking Part No. 4171 or equivalent

5. Install the engine coolant temperature sensor and tighten it to the specified torque.

Sensor tightening torque: 30 Nm

6. Fasten the harness connectors securely.



THROTTLE POSITION SENSOR CHECK 13100320092

1. Disconnect the throttle position sensor connector.
2. Measure the resistance between the throttle position sensor side connector terminal 1 and terminal 4.

Standard value: 3.5–6.5 kΩ

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

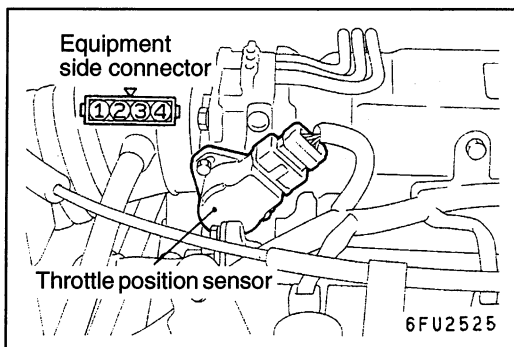
Normal condition:

Throttle valve slowly open 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.13A-81.



IDLE POSITION SWITCH CHECK 13100330101

1. Disconnect the throttle position sensor connector.
2. Check the continuity between the throttle position sensor connector side terminal 3 and terminal 4.

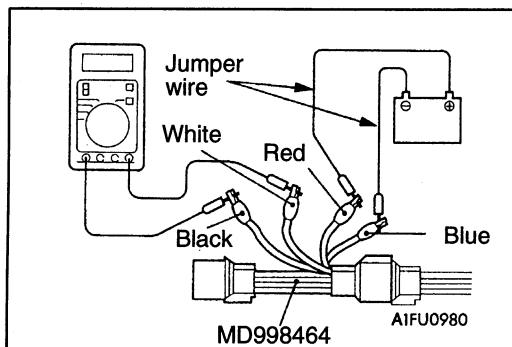
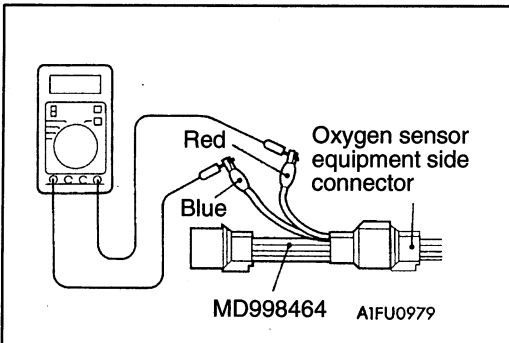
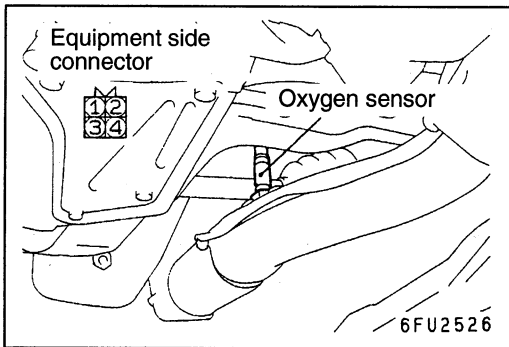
Normal condition:

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

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

NOTE

After replacement, the idle position switch and throttle position sensor should be adjusted. (Refer to P.13A-81.)



OXYGEN SENSOR CHECK

13100510031

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 [7–40 Ω at 20°C] between terminal 2 (red clip of special tool) and terminal 4 (blue clip of special tool) 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 or higher.
5. Use the jumper wires to connect terminal 2 (red clip) of the oxygen sensor connector to the battery (+) terminal and terminal 4 (blue clip) to the battery (-) terminal.

Caution

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

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

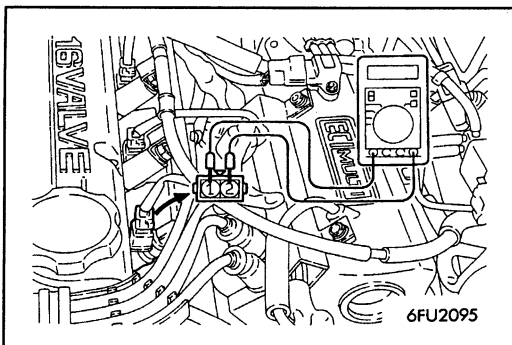
Normal condition:

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

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, Main Muffler.



INJECTOR CHECK

13100520096

Measurement of Resistance between Terminals

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

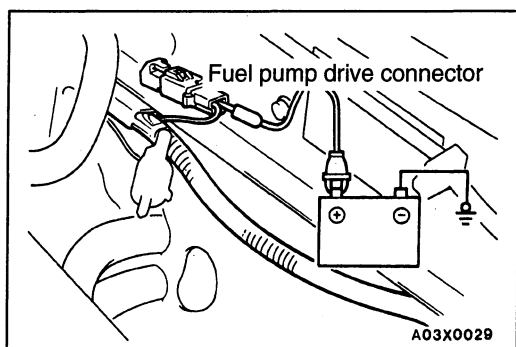
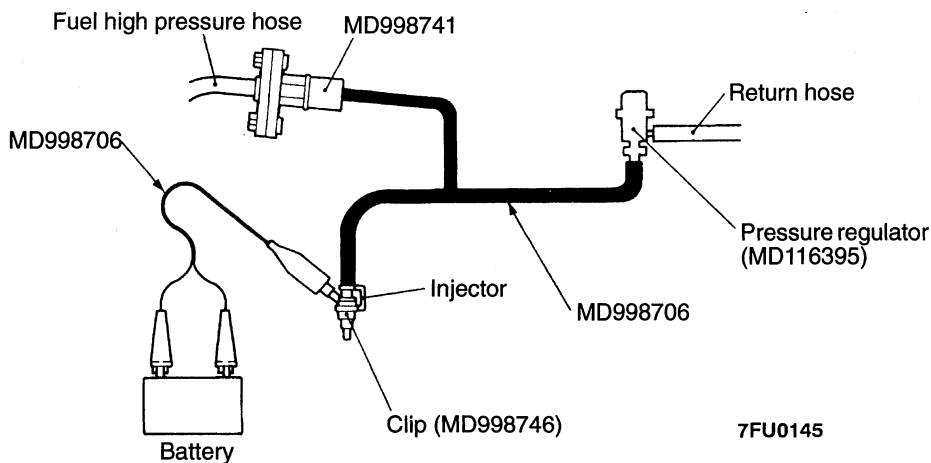
Standard value: 13–16 Ω (at 20°C)

3. Install the injector connector.

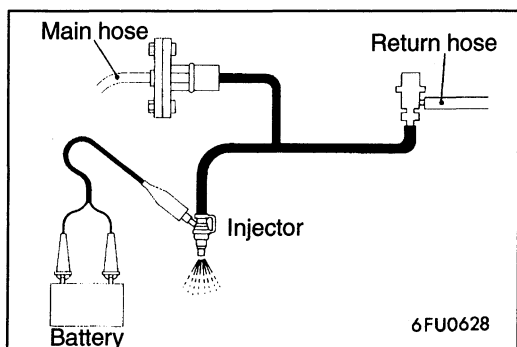
Checking the Injection Condition

1. Following the steps below, bleed out the residual pressure within the fuel pipe line to prevent flow of the fuel. (Refer to P.13-88.)
2. Remove the injector.

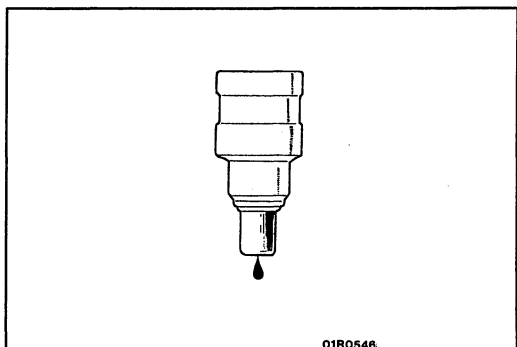
3. Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.



4. Apply battery voltage to the fuel pump drive terminal (black) and activate the fuel pump.



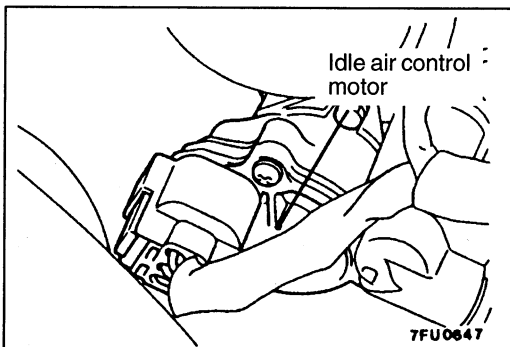
5. Activate the injector and check the atomized spray condition of the fuel. The condition can be considered satisfactory unless it is extremely poor.



6. Stop the actuation of the injector, and check for leakage from the injector's nozzle.

Standard value: 1 drop or less per minute

7. 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 (ISC) SERVO (STEPPER MOTOR) CHECK

13100540139

Checking the Operation Sound

1. Check that engine coolant temperature is 20°C or below.

NOTE

Disconnecting the engine coolant temperature sensor connector and connecting the harness-side of the connector to another engine coolant temperature sensor that is at 20°C or below is also okay.

2. Check that the operation sound of the stepper motor can be heard after the ignition is switched ON. (but without starting the motor.)
3. If the operation sound cannot be heard, check the stepper motor's activation circuit.
If the circuit is normal, it is probable that there is a malfunction of the stepper motor or of the engine control unit.

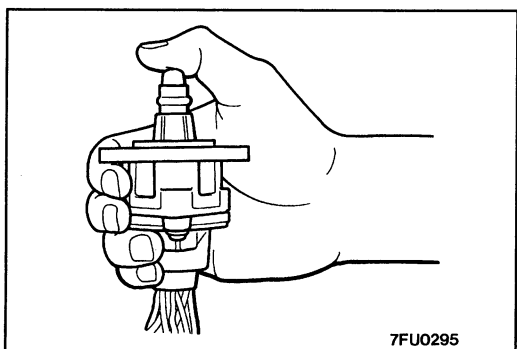
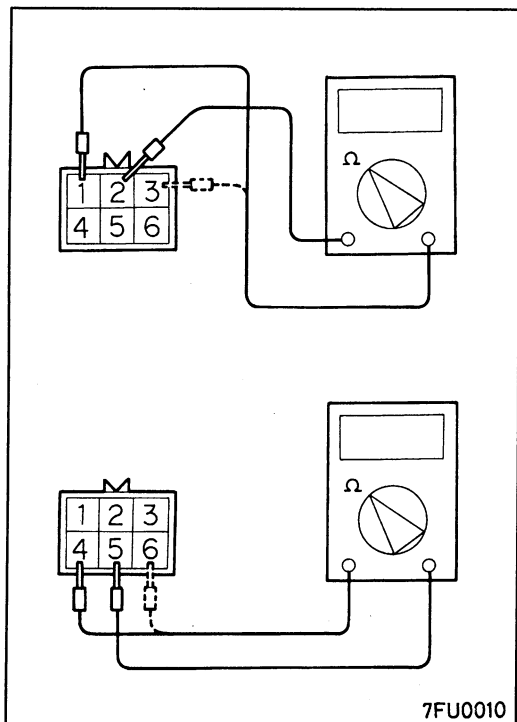
Checking the Coil Resistance

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

Standard value: 28–33 Ω (at 20°C)

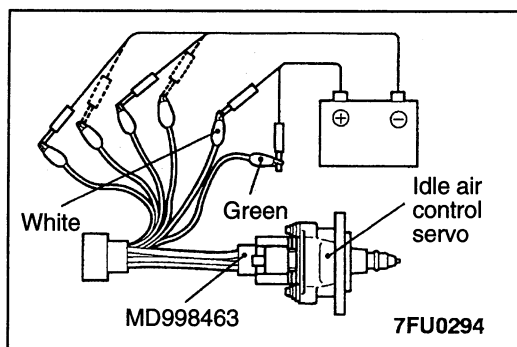
3. Measure the resistance between terminal 5 (green clip of the special tool) and either terminal 6 (yellow clip) or terminal 4 (black clip) of the connector at the idle speed control servo side.

Standard value: 28–33 Ω (at 20°C)



Operational Check

1. Remove the throttle body.
2. Remove the stepper motor.
3. Connect the special tool (test harness) to the idle speed control servo connector.
4. Connect the positive (+) terminal of a power supply (approx. 6V) to the white clip and the green clip.
5. With the idle air control motor as shown in the illustration, connect the negative (–) terminal of the power supply to each clip as described in the following steps, and check whether or not a vibrating feeling (a feeling of very slight vibration of the stepper motor) is generated as a result of the activation of the stepper motor.
 - (1) Connect the negative (–) terminal of the power supply to the red and black clip.
 - (2) Connect the negative (–) terminal of the power supply to the blue and black clip.
 - (3) Connect the negative (–) terminal of the power supply to the blue and yellow clip.
 - (4) Connect the negative (–) terminal of the power supply to the red and yellow clip.



- (5) Connect the negative (–) terminal of the power supply to the red and black clip.
- (6) Repeat the tests in sequence from (5) to (1).
- 6. If, as a result of these tests, vibration is detected, the stepper motor can be considered to be normal.

PURGE CONTROL SOLENOID VALVE CHECK

13100560104

Refer to GROUP 17 – Emission Control System.

EGR CONTROL SOLENOID VALVE CHECK

13100570091

Refer to GROUP 17 – Emission Control System.

INJECTOR

13100710134

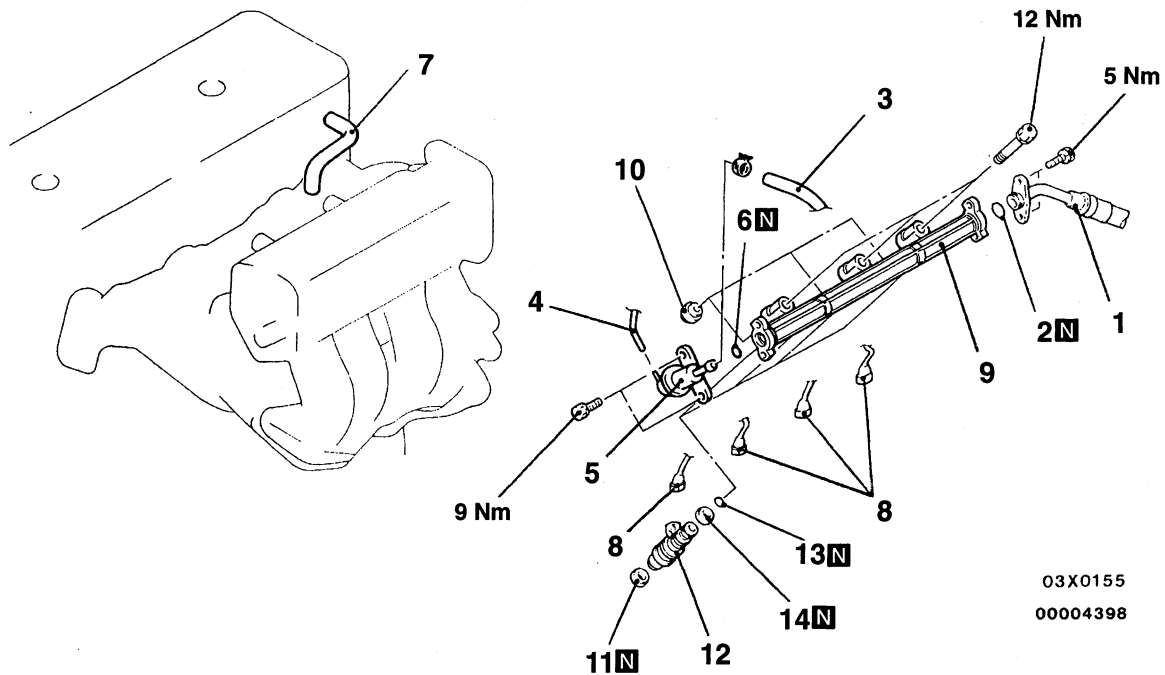
REMOVAL AND INSTALLATION

Pre-removal Operation

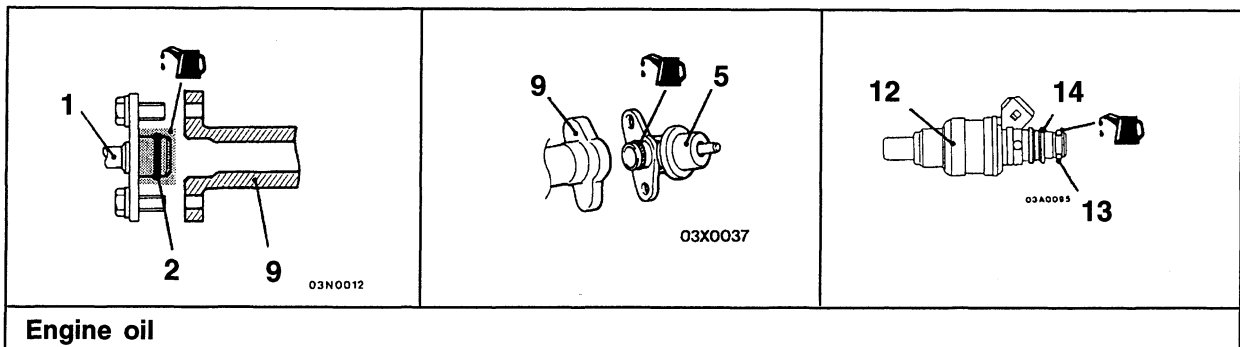
- (1) Fuel Discharge Prevention (Refer to P.13-88.)
- (2) Spark Plug Cable Removal

Post-installation Operation

- (1) Spark Plug Cable Installation
- (2) Fuel Leakage Inspection



03X0155
00004398



Engine oil

Removal steps

- ▶◀ 1. High-pressure fuel hose connection
 2. O-ring
 3. Fuel return hose connection
 4. Vacuum hose connection
 ▶◀ 5. Fuel pressure regulator
 6. O-ring
 7. PCV hose

- ◀▶ 8. Injector connectors
 9. Delivery pipe
 10. Insulators
 11. Insulators
 ▶◀ ▶◀ 12. Injectors
 13. O-rings
 14. Grommets

REMOVAL SERVICE POINT**◀A▶ DELIVERY PIPE INJECTOR REMOVAL**

Remove the delivery pipe (with the injectors attached to it.)

Caution

Care must be taken, when removing the delivery pipe, not to drop the injector.

INSTALLATION SERVICE POINT**▶A◀ INJECTOR/FUEL PRESSURE REGULATOR/HIGH-PRESSURE FUEL HOSE INSTALLATION**

- (1) Apply a drop of new engine oil to the O-ring.

Caution

Be sure not to let engine oil in the delivery pipe.

- (2) While turning the injector, high-pressure fuel hose and fuel pressure regulator to the right and left, install to the delivery pipe, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
- (3) Check to be sure that the fuel pressure regulator turns smoothly. If it does not turn smoothly, the O-ring may be trapped, remove the fuel pressure regulator and then re-insert it into the delivery pipe and check once again.
- (4) Tighten the high pressure fuel hose to the standard torque, and tighten the fuel pressure regulator to the specified torque.

Tightening torque:

9 Nm (Fuel pressure regulator)

THROTTLE BODY

13100770118

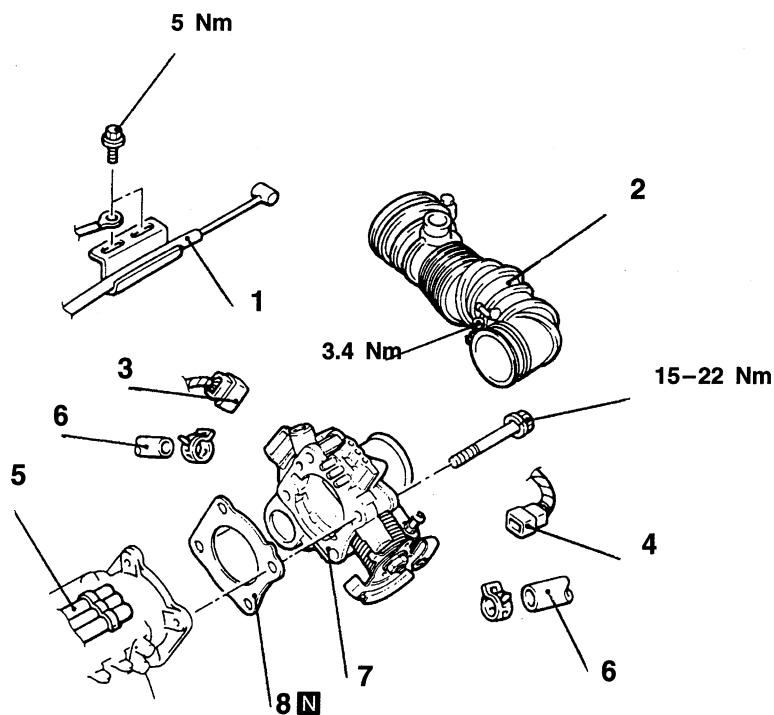
REMOVAL AND INSTALLATION

Pre-removal Operation

- (1) Engine Coolant Draining
- (2) Battery Removal

Post-installation Operation

- (1) Battery Installation
- (2) Engine Coolant Supplying
- (3) Accelerator Cable Adjustment (Refer to GROUP 17 – On-vehicle Service.)

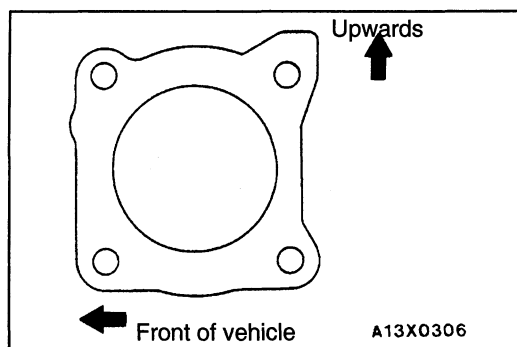


A03X0218

Removal steps

1. Accelerator cable connection
2. Air intake hose
3. TPS connector
4. ISC connector

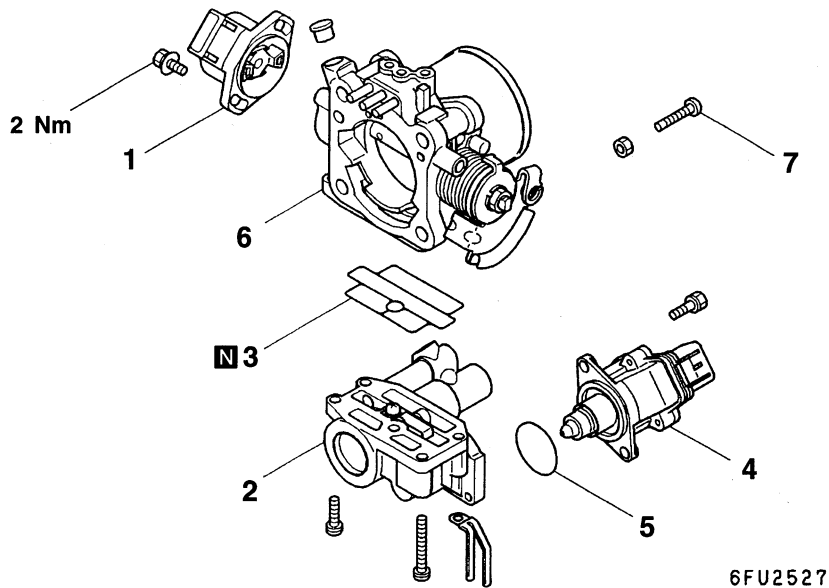
5. Vacuum hose connection
6. Water hose connection
7. Throttle body
8. Gasket

**INSTALLATION SERVICE POINT****►A◄ THROTTLE BODY GASKET INSTALLATION**

Install the gasket between the intake manifold and the throttle body with its protrusion facing upwards.

DISASSEMBLY AND REASSEMBLY

13100970099

**Disassembly steps**

- A◄
1. Throttle position sensor
 2. Idle speed control body assembly
 3. O-ring
 4. Idle speed control servo
 5. O-ring
 6. Throttle body
 7. Fixed SAS

NOTE

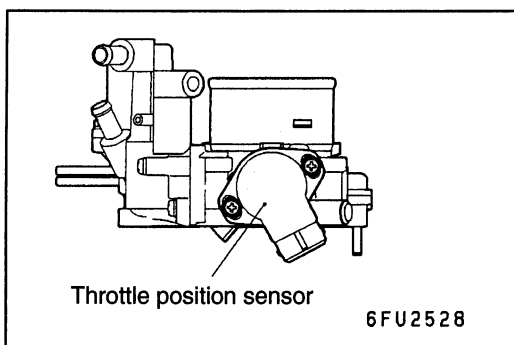
1. The fixed SAS is correctly adjusted at the factory and should not be removed.
2. If the fixed SAS should happen to have been removed, carry out fixed SAS adjustment. (Refer to page 13A-83.)

CLEANING THROTTLE BODY PARTS

- (1) Clean all throttle body parts.
Do not use solvent to clean the following parts:
 - Throttle position sensor
 - Accelerator pedal position sensor
 - Idle speed control body assembly
 If these parts are immersed in solvent, their insulation will deteriorate.
Wipe them with cloth only.
- (2) Check if the vacuum port or passage is clogged. Use compressed air to clean the vacuum passage.

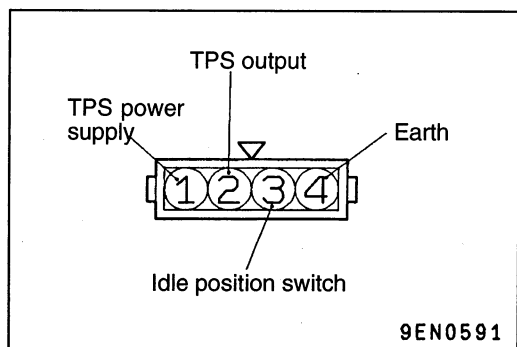
REASSEMBLY SERVICE POINTS**►A◄ THROTTLE POSITION SENSOR (TPS) INSTALLATION**

- (1) Install the TPS so that it faces as shown in the illustration, and then tighten it with the screw.
- (2) Connect a multimeter between terminal (1) (TPS power supply) and terminal (2) (TPS output) of the TPS connector, and check that the resistance increases gradually as the throttle valve is opened slowly to the fully-open position.



Throttle position sensor

6FU2528



- (3) Check the continuity between terminal (3) (idle position switch) and terminal (4) (earth) of the TPS connector when the throttle valve is fully closed and fully open.

Normal condition:

Throttle valve condition	Continuity
Fully closed	Continuity
Fully open	No continuity

If there is no continuity when the throttle valve is fully closed, turn the TPS body anticlockwise and then check again.

- (4) If there is an abnormality, replace the TPS.

FUEL SUPPLY

CONTENTS

13509000081

FUEL TANK	2	FUEL TANK	2
GENERAL INFORMATION	2	FUEL FILTER	4

FUEL TANK

13500010069

GENERAL INFORMATION

(1) The fuel tank is located under the floor of the rear seats to provide increased safety.

(2) A fuel cut-off valve has been adopted to prevent fuel from leaking out in the event of a collision.

FUEL TANK

13500190114

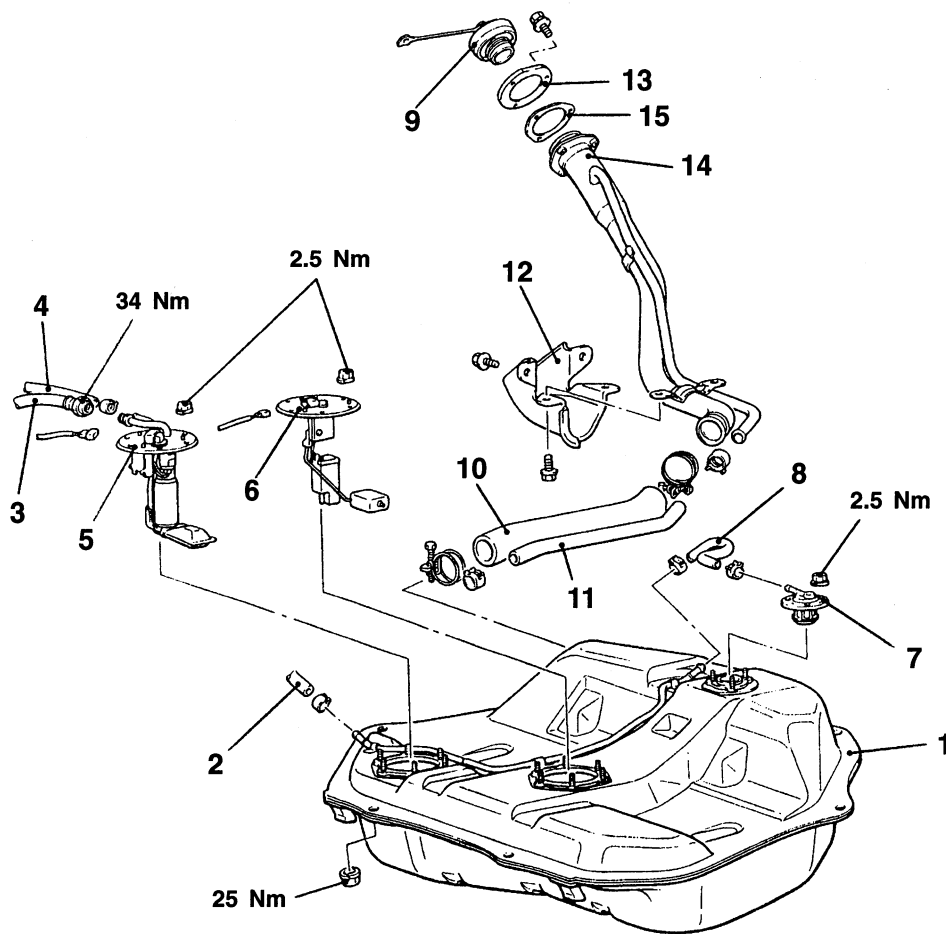
REMOVAL AND INSTALLATION

Pre-removal Operation

- (1) Fuel Draining
- (2) Reduce the Inner Pressure of Fuel Line and Hose.
(Refer to GROUP 13A - On-vehicle Service.)

Post-Installation Operation

- (1) Fuel Refilling
- (2) Checking for Fuel Leaks



B03X0130

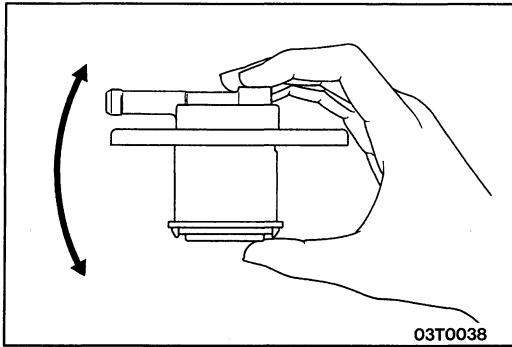
Removal steps

1. Fuel tank
2. Vapour hose
3. High-pressure fuel hose
4. Return hose
5. Fuel pump assembly
6. Fuel gauge unit
7. Fuel cut-off valve assembly
8. Vapour hose
9. Fuel filler cap
10. Filler hose
11. Vapour hose

12. Fuel tank filler tube protector
13. Reinforcement
14. Fuel tank filler tube assembly
15. Packing

NOTE

When replacing the fuel pump assembly or the fuel gauge unit only, it is possible to work from the service holes underneath the rear seat cushion without having to remove the fuel tank. (Refer to P.13F-3.)

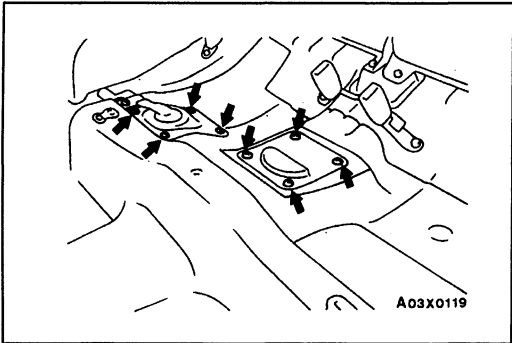
**INSPECTION****FUEL CUT OFF VALVE CHECK**

13500300050

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.

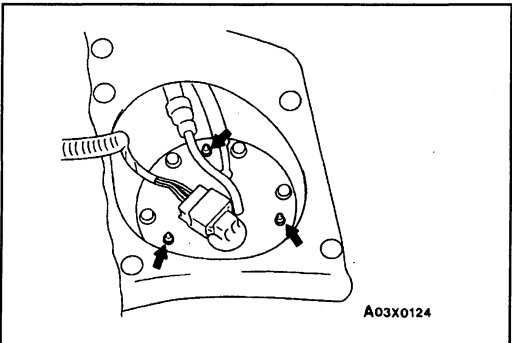
FUEL GAUGE UNIT CHECK

Refer to GROUP 54 – Combination Meters.

**FUEL GAUGE UNIT AND PUMP ASSEMBLY REPLACEMENT**

13500160085

- (1) Remove the rear seat cushion. (Refer to GROUP 52A – Rear Seat.)
- (2) Remove the protector.



- (3) Disconnect the hoses and connectors to remove the fuel pump assembly or fuel gauge unit.
- (4) Align the packing positioning projections with the holes in the fuel pump assembly.

FUEL FILTER

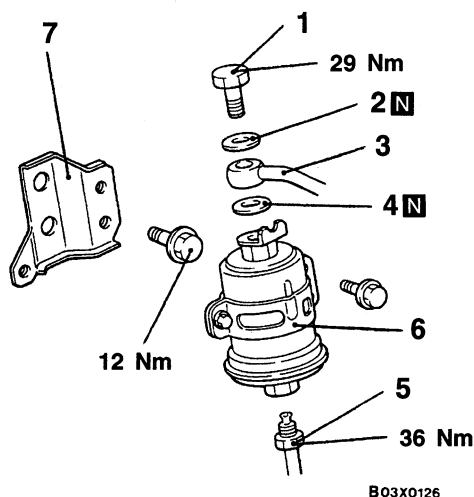
REMOVAL AND INSTALLATION

Pre-removal Operation

- (1) Reduce Residual Pressure from High-Pressure Fuel Hose (Refer to GROUP 13A - On-vehicle Service.)
- (2) Battery Removal
- (3) Air Intake Hose Removal

Post-installation Operation

- (1) Air Intake Hose Installation
- (2) Battery Installation
- (3) Fuel Pressure Measurement
(Refer to GROUP 13A - On-vehicle Service.)



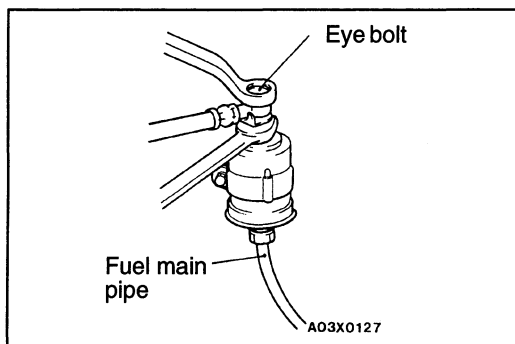
Removal steps

◀A▶

1. Eye bolt
2. Gasket
3. High-pressure fuel hose connection
4. Gasket

◀B▶

5. Fuel main pipe connection
6. Fuel filter
7. Fuel filter bracket



REMOVAL SERVICE POINTS

◀A▶ EYE BOLT REMOVAL

Hold the fuel filter with a spanner and remove the eye bolt.

Caution

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

◀B▶ FUEL MAIN PIPE DISCONNECTION

Hold the fuel filter with a spanner and loosen the flare nut. Then disconnect the fuel main pipe.

