
FUEL

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GASOLINE DIRECT INJECTION (GDI)

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GENERAL INFORMATION

The Gasoline Direct 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 for each cylinder is mounted at the cylinder head. The fuel is sent under pressure from the fuel tank to the fuel pressure regulator (low pressure) by the fuel pump (low pressure). The pressure is regulated by the fuel pressure regulator (low pressure) and the fuel regulated is then sent to the fuel pump (high pressure). The fuel under increased pressure generated by the fuel pump (high pressure) is then regulated by the fuel pressure regulator (high pressure) and is then distributed to each of the injectors via the delivery pipes.

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.

When the engine is cold or under a severe load, the "open-loop" control keeps the air/fuel ratio at a richer than usual level to maintain driveability. When the engine is under low or medium loads, the air/fuel ratio becomes leaner to reduce fuel consumption. When the engine is running at medium or high loads after having warmed up, the "closed-loop" control uses the signal from the oxygen sensor to keep the air/fuel ratio at the optimum theoretical level.

THROTTLE VALVE OPENING ANGLE CONTROL

This system controls throttle valve opening angle electronically. The engine-ECU determines how deeply the accelerator pedal is depressed by means of the accelerator position sensor (APS). Then the engine-ECU sends a

target value of the throttle valve opening angle to the throttle valve controller. The throttle valve control servo operates the throttle valve so that it reaches the target opening angle.

IDLE SPEED CONTROL

This system maintains engine idle speed at a predetermined condition by controlling the air flow that passes through the throttle valve according to engine idling condition and engine loads at idling.

The engine-ECU operates the throttle valve control servo so that engine speed is maintained within a map value. The map value is predetermined according to engine coolant temperature and air-conditioning load.

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, atmospheric pressure and injection timing (intake stroke or compression stroke).

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 Motor Control
The revolutions of the radiator fan and

condenser fan are controlled in response to the engine coolant temperature and vehicle speed.

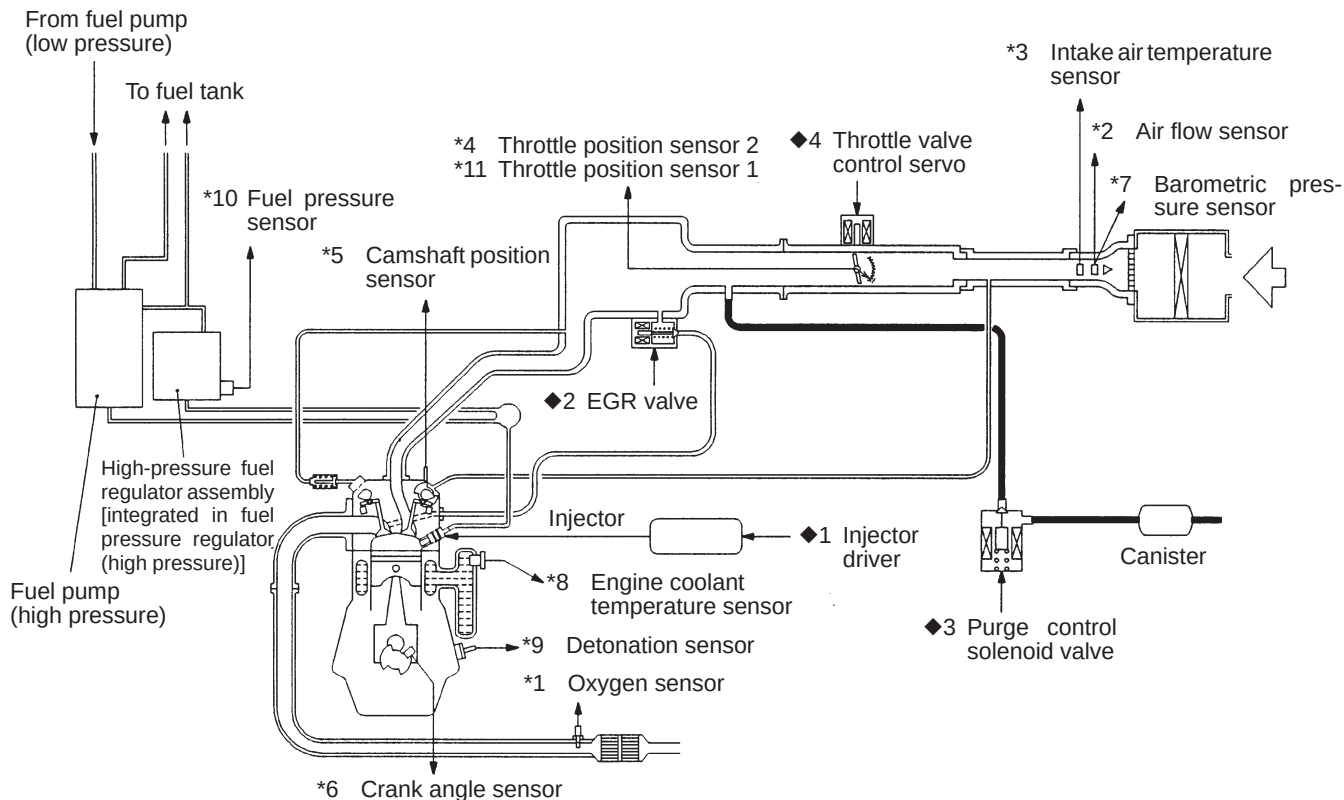
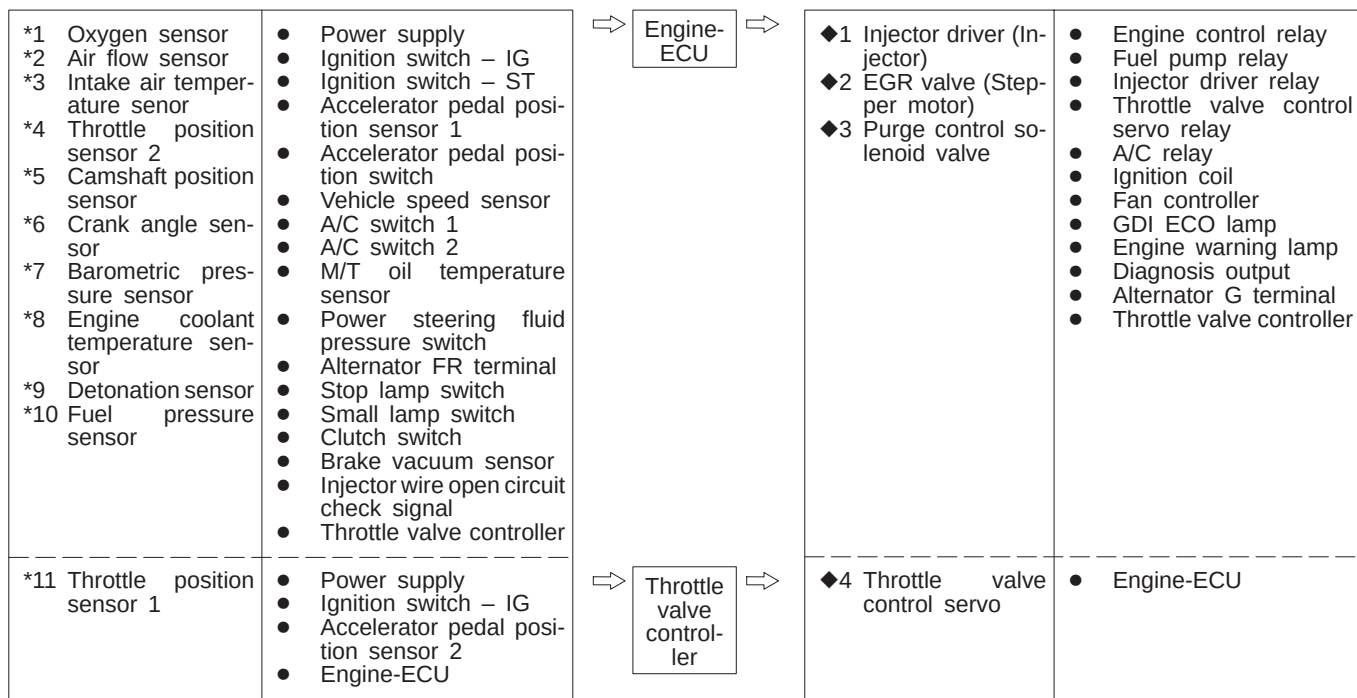
4. Purge Control Solenoid Valve Control
Refer to GROUP 17.
5. EGR valve Control
Refer to GROUP 17.

GENERAL SPECIFICATIONS

Items			Specifications
Throttle body	Throttle bore mm		60
	Throttle position sensor		Variable resistor type
	Throttle valve control servo		Torque motor type
Engine-ECU	Identification model No.	Except vehicles for Germany	E2T72671
		Vehicles for Germany	E2T72672
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
	Accelerator pedal position sensor		Variable resistor type
	Accelerator pedal position switch		Rotary contact type, within accelerator pedal position sensor
	Vehicle speed sensor		Magnetic resistive element type
	Camshaft position sensor		Hall element type
	Crank angle sensor		Hall element type
	Detonation sensor		Piezoelectric type
	Fuel pressure sensor		Metallic membrane type
	Power steering fluid pressure switch		Contact switch type

Items		Specifications
Actuators	Engine control relay type	Contact switch type
	Fuel pump relay type	Contact switch type
	Injector driver control relay	Contact switch type
	Injector type and number	Electromagnetic type, 4
	Injector identification mark	DIM 1000G
	Throttle valve control servo relay	Contact switch type
	Throttle valve control servo	Torque motor type
	EGR valve	Stepper motor type
	Purge control solenoid valve	Duty cycle type solenoid valve
Fuel pressure regulator (low pressure)	Regulator pressure kPa	329
Fuel pressure regulator (high pressure)	Regulator pressure MPa	5

GASOLINE DIRECT INJECTION SYSTEM DIAGRAM



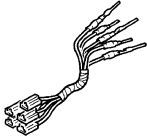
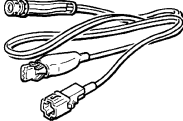
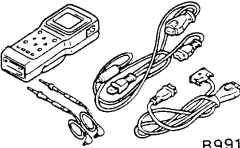
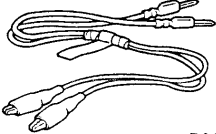
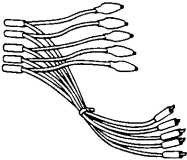
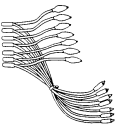
SERVICE SPECIFICATIONS

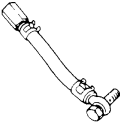
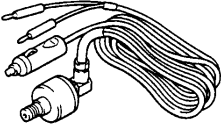
Item		Standard value
Adjustment voltage of throttle position sensor (1st channel) V		0.4 – 0.6
Adjustment voltage of throttle position sensor (2nd channel) V		4.2 – 4.8
Resistance of throttle position sensor k Ω		3.5 – 6.5
Adjustment voltage of accelerator pedal position sensor (1st and 2nd channels) V		0.4 – 0.9
Resistance of throttle position sensor (1st and 2nd channels) k Ω		3.5 – 6.5
Intake air temperature sensor resistance k Ω	at 20°C	2.3 – 3.0
	at 80°C	0.30 – 0.42
Engine coolant temperature sensor resistance k Ω	at 20°C	2.1 – 2.7
	at 80°C	0.26 – 0.36
Fuel pressure	High-pressure side kPa (kgf/cm ²)	4 – 7
	Low-pressure side kPa (kgf/cm ²)	324 – 343
Injector coil resistance Ω		0.9 – 1.1
Oxygen sensor output voltage V		0.6 – 1.0
Oxygen sensor heater resistance Ω		11 – 18
Throttle valve control servo resistance Ω		1.35 – 1.65

SEALANT

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

SPECIAL TOOLS

Tool	Number	Name	Use
A  B  C  D  D  C991223	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: Power circuit inspection C: Power circuit inspection D: Commercial tester connection
 B991502	MB991502	MUT-II sub assembly	- Reading diagnosis code - GDI system inspection
 B991529	MB991529	Diagnose code check harness	Reading diagnosis code
	MB991348, MB991658	Test harness set	- Measurement of voltage during troubleshooting - Inspection using an analyzer
 MB991709	MB991709	Test harness	
	MB991519	Alternator harness connector	Measurement of voltage during troubleshooting
	MD998478	Test harness (3-pin, triangle)	- Measurement of voltage during troubleshooting - Inspection using an analyzer

Tool	Number	Name	Use
	MD998709	Adaptor hose	Measurement of fuel pressure
	MD998742	Hose adaptor	
 B991637	MB991637	Fuel pressure gauge set	

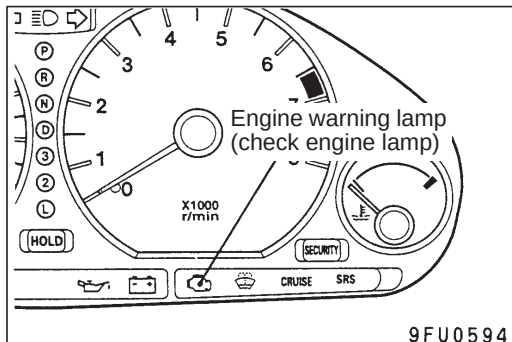
TROUBLESHOOTING

DIAGNOSIS TROUBLESHOOTING FLOW

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

NOTE

If the engine-ECU is replaced, the immobilizer-ECU and ignition key should be replaced together with it.



DIAGNOSIS FUNCTION

ENGINE WARNING LAMP (CHECK ENGINE LAMP)

If an abnormality occurs in any of the following items related to the Gasoline Direct Injection (GDI) 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 (1st channel)
Throttle position sensor (2nd channel)
Engine coolant temperature sensor
Crank angle sensor
Camshaft position sensor
Barometric pressure sensor
Detonation sensor
Injector
Abnormal combustion
Immobilizer system
Abnormal fuel pressure
Brake vacuum sensor
Fuel system malfunction
Accelerator pedal position sensor (1st channel)
Accelerator pedal position sensor (2nd channel)
Electronic-controlled throttle valve system
Throttle valve control servo
Throttle valve controller

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 TESTING

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 problem has disappeared.

FAIL-SAFE FUNCTION REFERENCE TABLE

If the diagnosis system detects any sensor malfunction, the vehicle can be driven safely by using a default control logic instead of the faulty sensors.

Defective part or function	What to do when a sensor is defective
Air flow sensor	(1) Disables lean-mixture combustion. (2) Determines injector basic operating time and basic ignition timing according to map value, which has been predetermined by throttle position sensor and crank angle sensor signals.
Intake air temperature sensor	Controls as the intake air temperature is 25°C.
Throttle position sensor (1st channel)	(1) Disables lean-mixture combustion. (2) Controls throttle valve opening angle by closed loop control by using the throttle position sensor (2nd channel) signal. (3) Disables the throttle valve opening angle control when the throttle position sensor (2nd channel) signal is also defective.
Throttle position sensor (2nd channel)	(1) Disables lean-mixture combustion. (2) Controls throttle valve opening angle by closed loop control by using the throttle position sensor (1st channel) signal. (3) Disables the throttle valve opening angle control when the throttle position sensor (1st channel) signal is also defective.
Engine coolant temperature sensor	Controls as if the engine coolant temperature is 80°C. (Note that this control will continue until the ignition switch is turned off even if the sensor signal return to normal.)
Camshaft position sensor	Controls according to the conditions before a failure is detected.
Vehicle speed sensor	(1) Disables lean-mixture combustion. However, if a predetermined time elapses at an engine speed of 1,500 r/min or more, the lean-mixture combustion will return to normal. (2) Disables lean-mixture combustion during engine idling.
Barometric pressure sensor	Controls as if the barometric pressure is 101 kPa.
Detonation sensor	Holds the ignition timing at that for regular gasoline.
Injector	(1) Disables lean-mixture combustion. (2) Shuts down exhaust gas recirculation.
Abnormal combustion	Disables lean-mixture combustion.
Alternator FR terminal	Disables inhibition control of the alternator output according to electrical load (treats the alternator as if it is conventional one).
Fuel pressure sensor	(1) Controls as if the fuel pressure is 5 MPa (if there is open or short circuit). (2) Turns off the fuel pump relay (if the fuel pressure is excessively high). (3) Shuts off the fuel injection (If an excessively low pressure is detected or the engine speed exceeds 3,000 r/min).
Accelerator pedal position sensor (1st channel)	(1) Disables lean-mixture combustion. (2) Controls the throttle valve position by using the accelerator pedal position sensor (2nd channel) signal. (3) Disables the electronic-controlled throttle valve system if the accelerator pedal position sensor (2nd channel) signal is also defective, and holds the throttle valve at a predetermined angle where the vehicle can be driven safely although its performance is reduced.

Defective part or function	What to do when a sensor is defective
Accelerator pedal position sensor (2nd channel)	(1) Disables lean-mixture combustion. (2) Controls the throttle valve position by using the accelerator pedal position sensor (1st channel) signal. (3) Disables the electronic-controlled throttle valve system if the accelerator pedal position sensor (1st channel) signal is also defective.
Electronic-controlled throttle valve system	(1) Disables the electronic-controlled throttle valve system. (2) Disables lean-mixture combustion. (3) Disables engine idle speed feedback control.
Throttle valve position feedback	(1) Disables the electronic-controlled throttle valve system. (2) Disables lean-mixture combustion. (3) Disables engine idle speed feedback control.
Throttle valve control servo motor malfunction (1st phase)	(1) Disables lean-mixture combustion.
Throttle valve control servo motor malfunction (2nd phase)	(1) Disables the electronic-controlled throttle valve system. (2) Disables lean-mixture combustion. (3) Disables engine idle speed feedback control.
Communication line with the throttle valve controller	(1) Error in communication between the throttle valve controller and engine-ECU • Disables lean-mixture combustion. • Shuts off fuel supply when engine speed exceeds 3,000 r/min. (1) Error in communication between the throttle valve controller and engine-ECU • Disables lean-mixture combustion. • Shuts off fuel supply when engine speed exceeds 3,000 r/min. • The throttle valve controller controls the throttle valve opening angle by using the accelerator pedal position sensor (2nd channel) signal.

INSPECTION CHART FOR DIAGNOSIS CODES

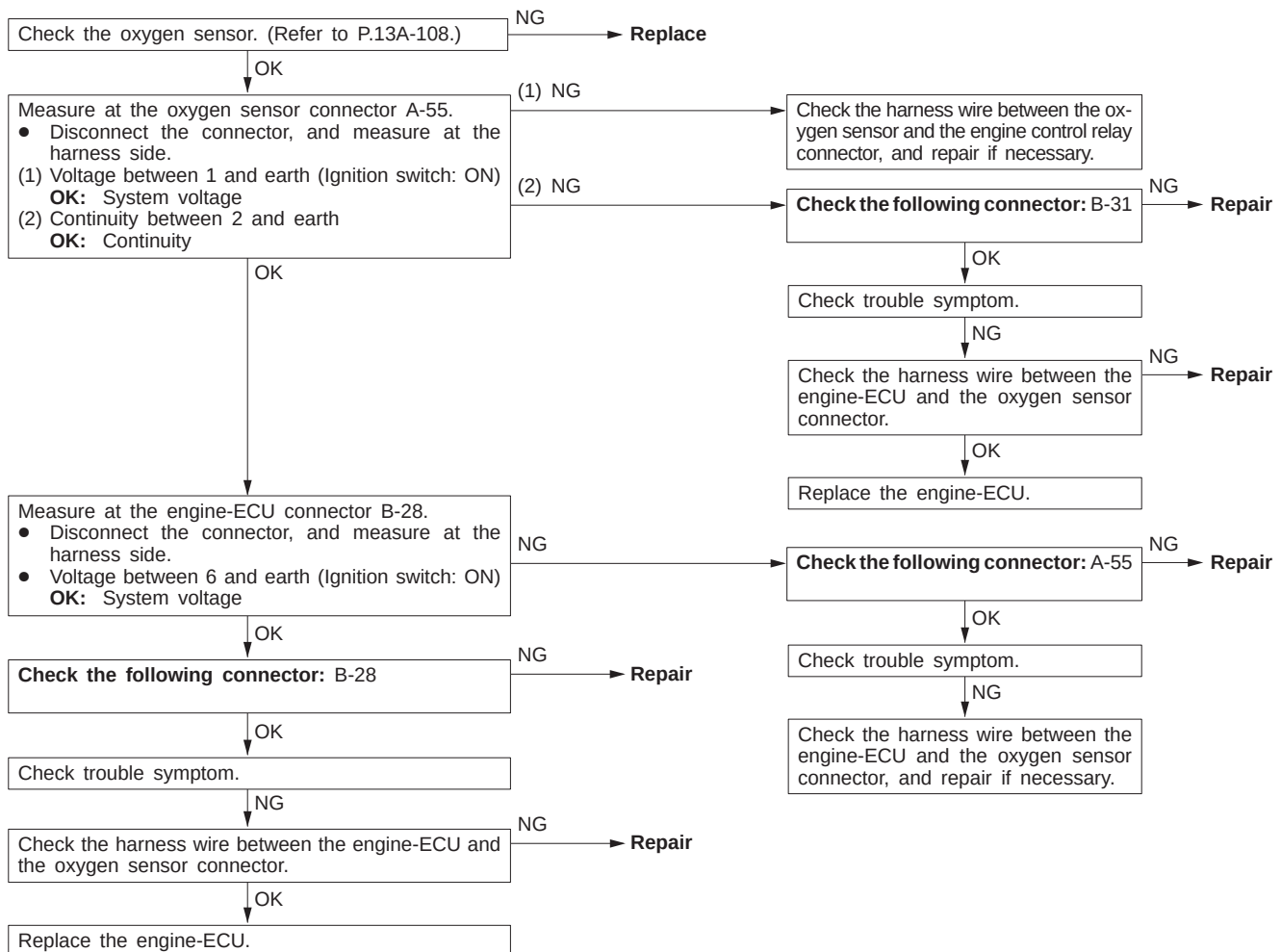
Code No.	Diagnosis item	Reference page
11	Oxygen sensor system	13A-14
12	Air flow sensor system	13A-15
13	Intake air temperature sensor system	13A-16
14	Throttle position sensor (2nd channel) system	13A-17
21	Engine coolant temperature sensor system	13A-18
22	Crank angle sensor system	13A-19
23	Camshaft position sensor system	13A-20
24	Vehicle speed sensor system	13A-21
25	Barometric pressure sensor system	13A-22
31	Detonation sensor system	13A-23
41	Injector system	13A-24
44	Abnormal combustion	13A-26
54	Immobilizer system	13A-27
56	Abnormal fuel pressure system	13A-28
64	Alternator FR terminal system	13A-30
66	Brake vacuum sensor system	13A-31
77	Accelerator pedal position sensor (2nd channel) system	13A-32
78	Accelerator pedal position sensor (1st channel) system	13A-33
79	Throttle position sensor (1st channel) system	13A-34
89	Abnormal fuel system	13A-35
91	Electronic-controlled throttle valve system	13A-36
92	Throttle valve position feedback system	13A-36
94	Communication line system with throttle valve controller	13A-37
95	Malfunction in throttle valve control servo motor system (1st phase)	13A-37
99	Malfunction in throttle valve control servo motor system (2nd phase)	13A-38

NOTE

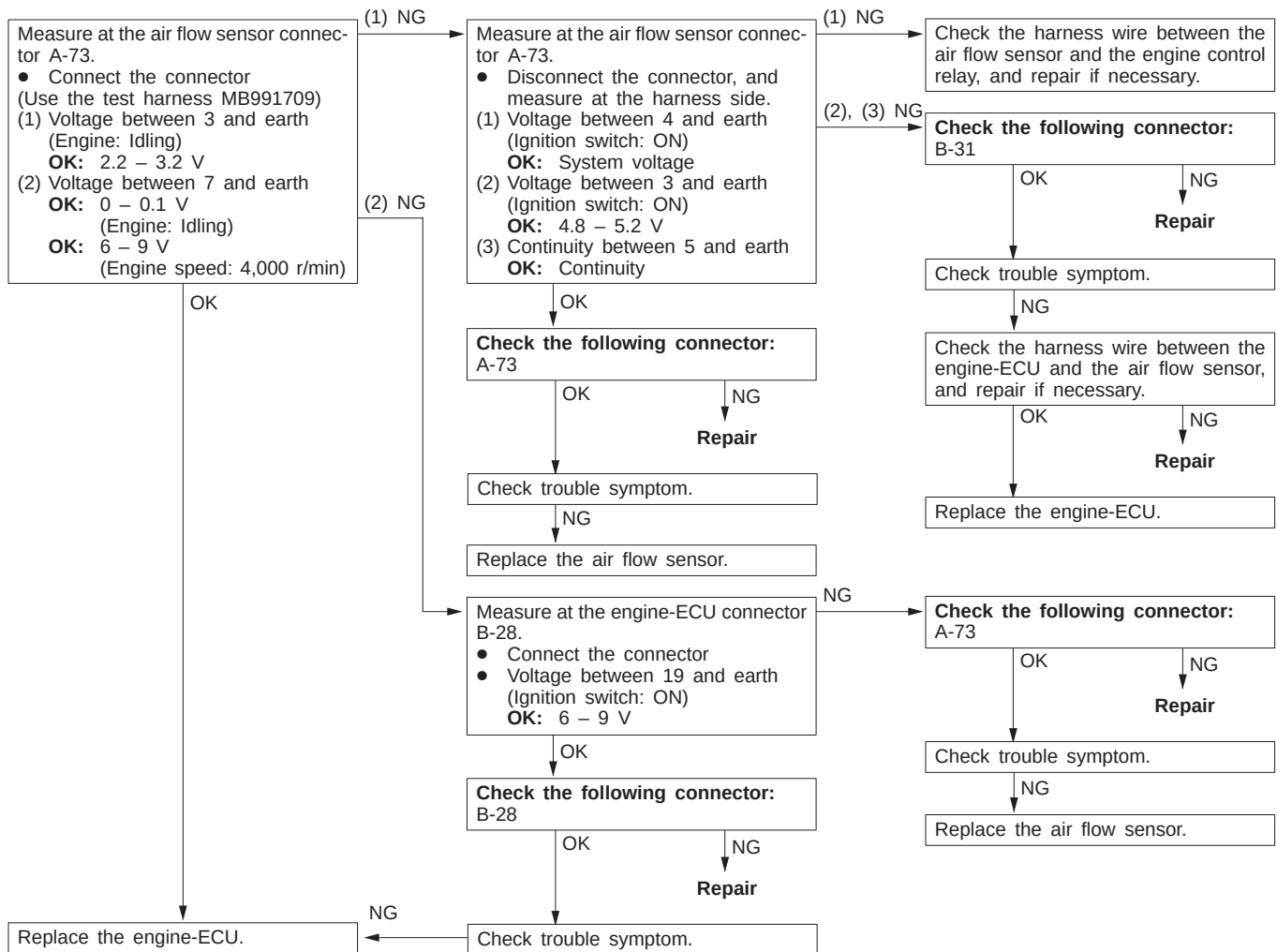
Code No. 56 may be also output when air is sucked in high-pressure fuel line due to no fuel supply.

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

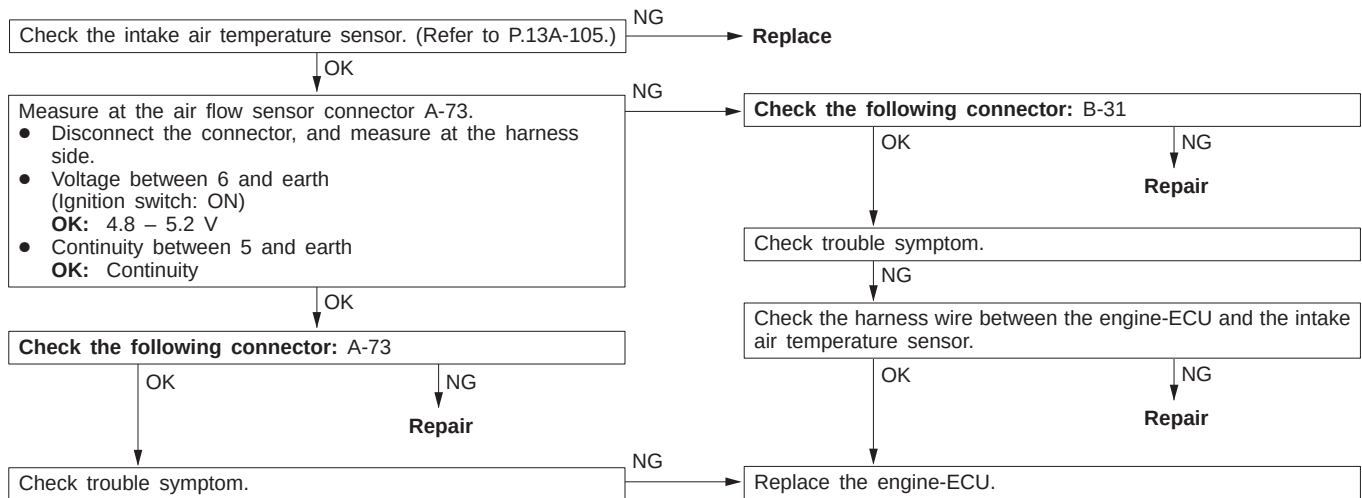
Code No. 11 Oxygen sensor system	Probable cause
Range of check 3 minutes have passed after engine was started. - Engine coolant temperature is approx. 80°C or more. - Intake air temperature is 20–50°C. - Engine speed is approx. 2,000–3,000 r/min - Vehicle is moving at constant speed on a flat, level 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



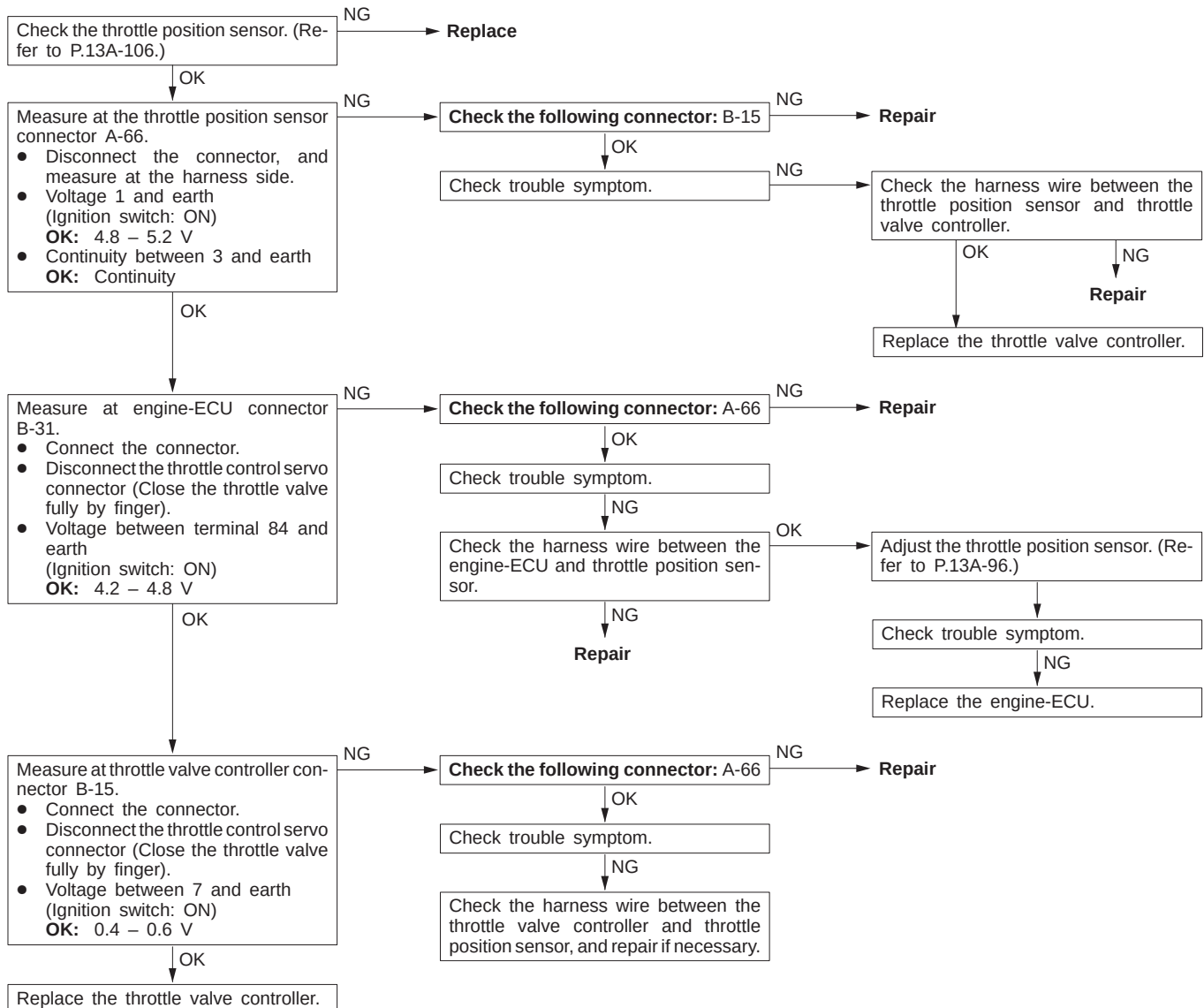
Code No.12 Air flow sensor system	Probable cause
Range of check • Engine speed is 500 r/min or more. Set conditions • Sensor output frequency is 3.3 Hz or less for 4 seconds.	• Malfunction of the air flow sensor • Open circuit or short-circuited harness wire of air flow sensor circuit • Malfunction of the engine-ECU



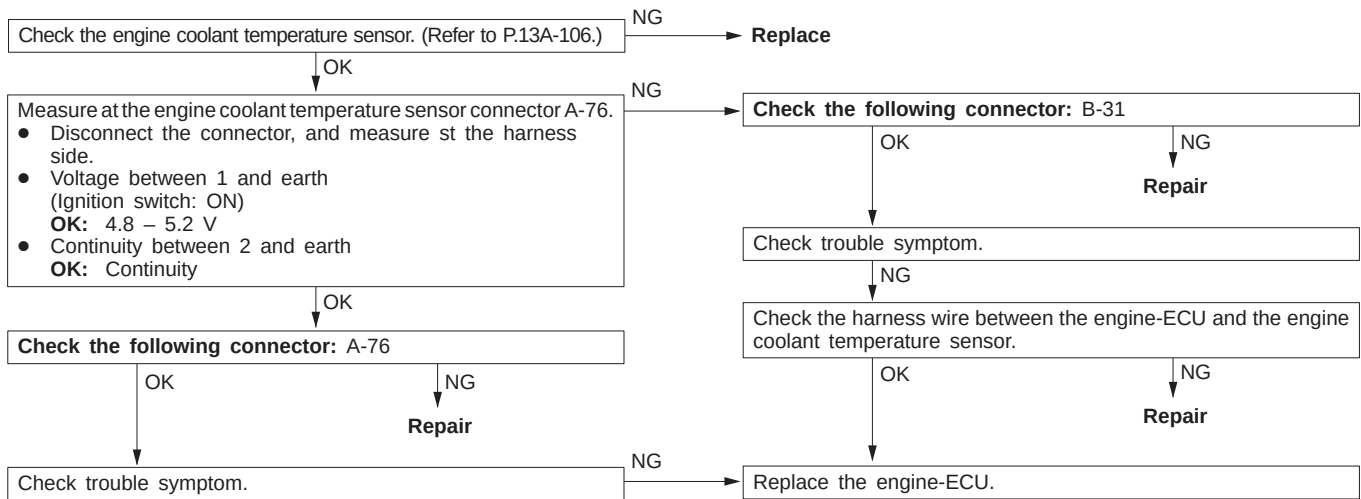
Code No.13 Intake air temperature sensor system	Probable cause
Range of check - After 60 seconds have passed since the engine have started Set conditions - Sensor resistance is 0.14 kΩ or less for 4 seconds. or - Sensor resistance is 50 kΩ or more for 4 seconds.	- Malfunction of the intake air temperature sensor - Open circuit or short-circuited harness wire of the intake air temperature sensor circuit - Malfunction of the engine-ECU



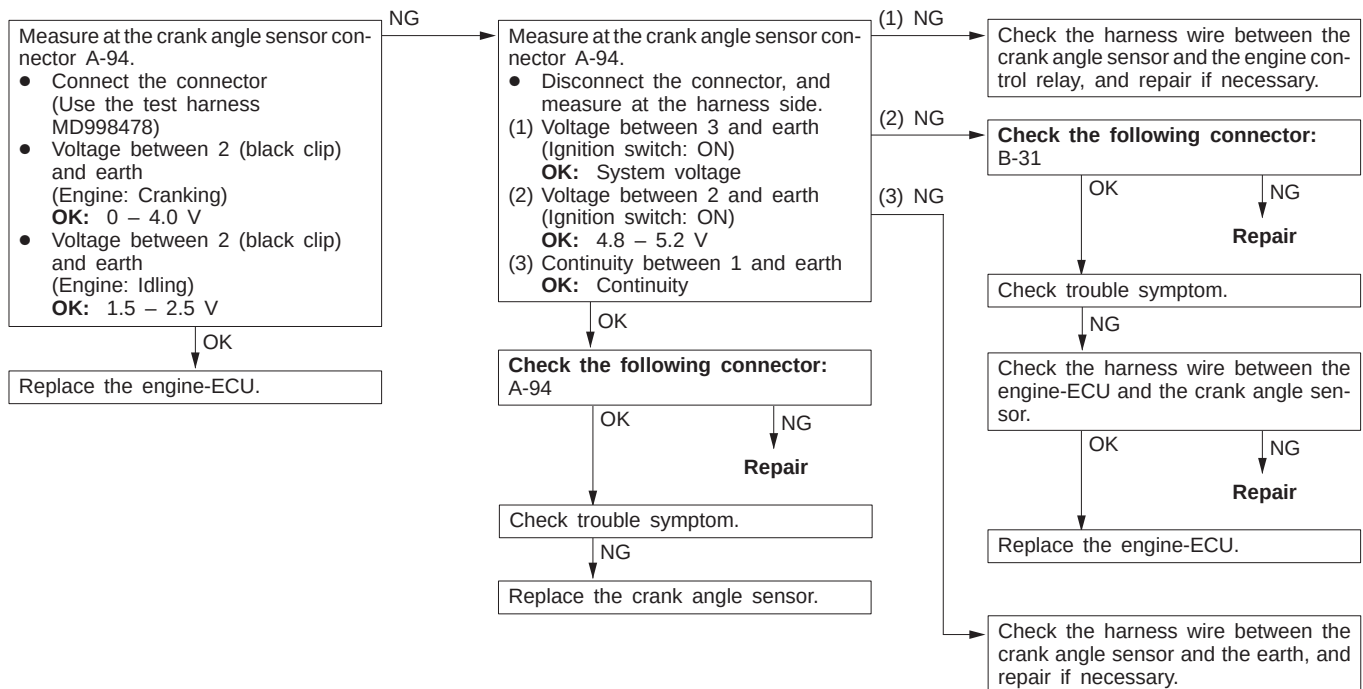
Code No.14 Throttle position sensor system (2nd channel)	Probable cause
The throttle valve controller determines whether a failure is present or not, and sends a signal indicating its result to the engine-ECU. Range of check - Ignition switch: ON - Throttle position sensor (1st channel) is normal Set conditions - The throttle position sensor (1st channel) output voltage is 1.24 V or more, and the (2nd channel) output voltage is 4.6 V or more for one second. or - The throttle position sensor (1st channel) output voltage is 3.53 V or less, and the (2nd channel) output voltage is 0.2 V or less for one second. or - Throttle position sensor (1st and 2nd channels) output voltages are outside 4 to 6 V.	- Malfunction of throttle position sensor (2nd channel) - Open circuit or short-circuited harness wire in throttle position sensor (2nd channel) or poor connector contact - Faulty throttle valve controller - Malfunction of the engine-ECU



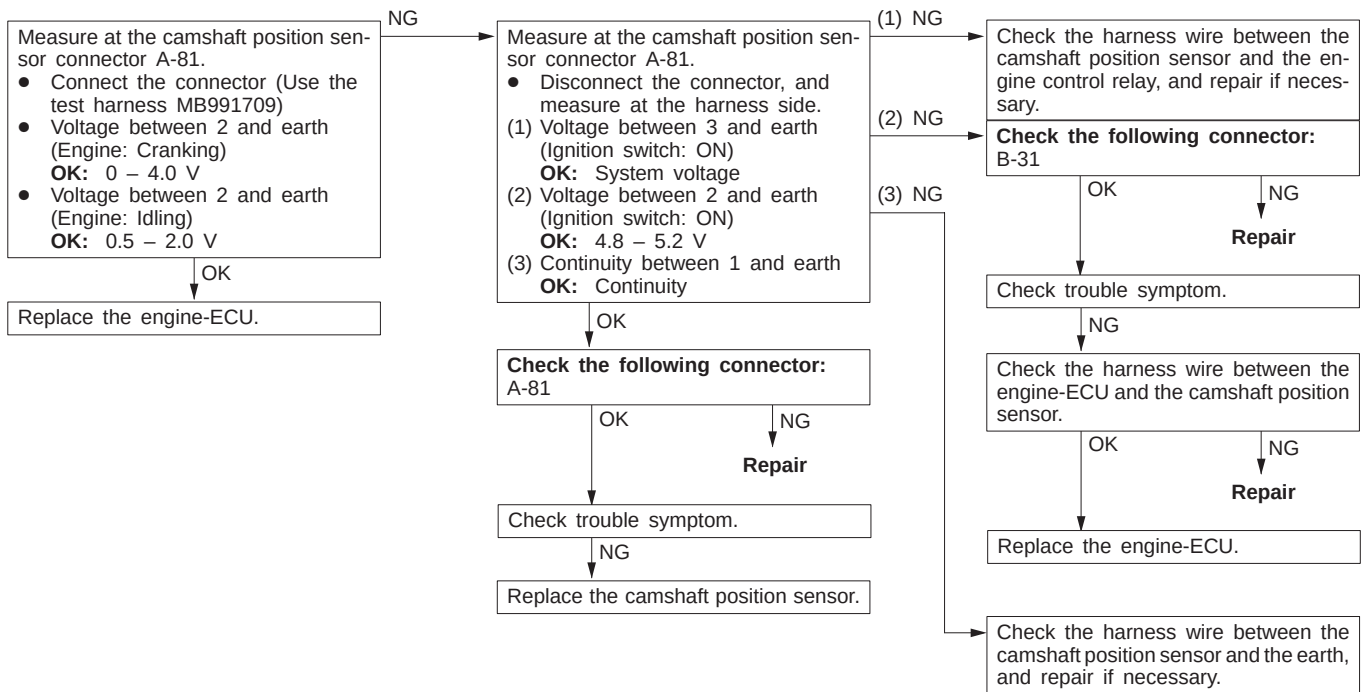
Code No.21 Engine coolant temperature sensor system	Probable cause
Range of check - After 60 seconds have passed since the engine have started Set conditions - Sensor resistance is 50 Ω or less for 4 seconds. or - Sensor resistance is 72 kΩ or more for 4 seconds.	- Malfunction of the engine coolant temperature sensor - Open circuit or short-circuited harness wire of the engine coolant temperature sensor circuit - Malfunction of the engine-ECU
Range of check - After engine starts Set conditions - After 5 minutes or more have passed since the engine coolant temperature after filtering has dropped from 40°C or more to less than this temperature	



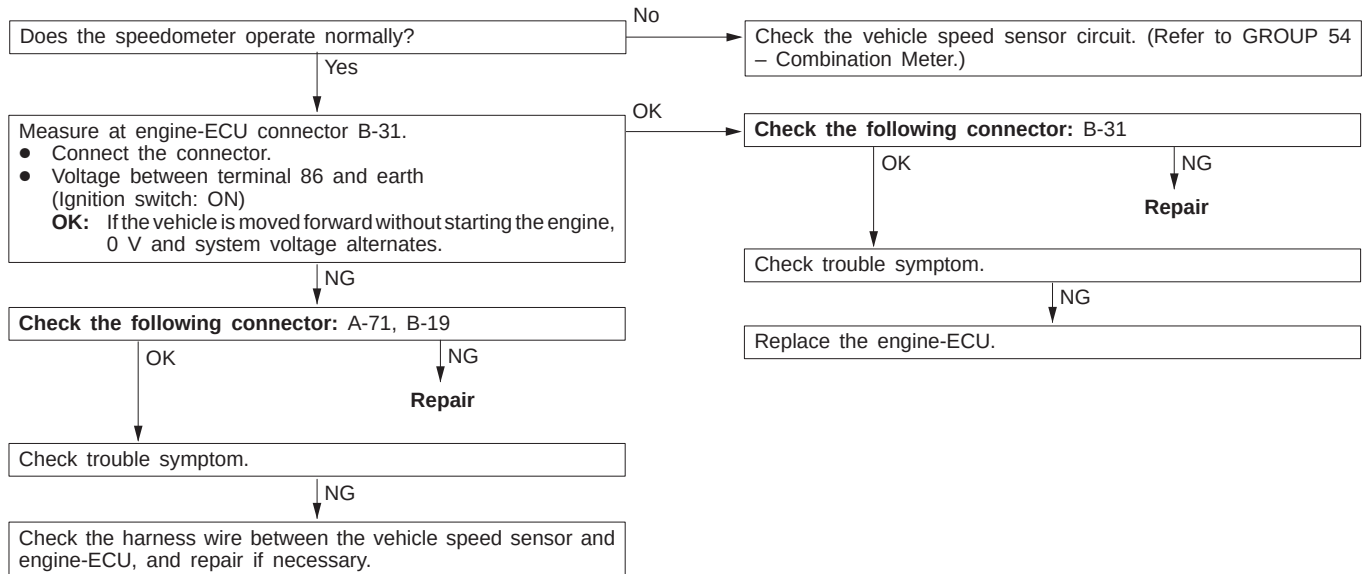
Code No.22 Crank angle sensor system	Probable cause
Range of check • Engine: During cranking Set conditions • Sensor output voltage does not change for 4 seconds (no pulse signal is being input).	• Malfunction of the crank angle sensor • Open circuit or short-circuited harness wire of the crank angle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



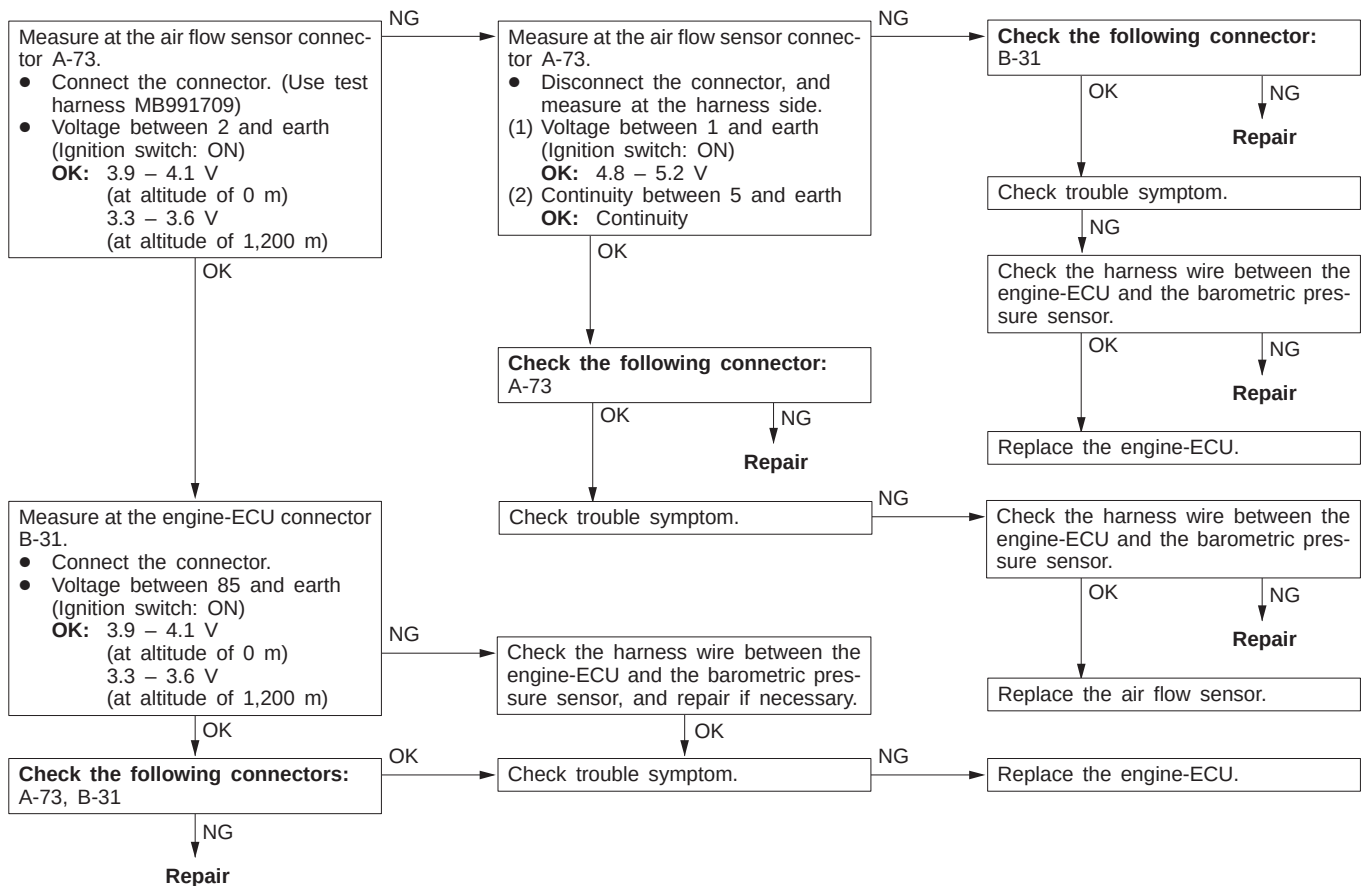
Code No.23 Camshaft position sensor system	Probable cause
Range of check - While engine is cranking or running Set conditions - Sensor output voltage does not change for 4 seconds (no pulse signal is being input). or - Abnormal pulse signal pattern is output.	- Malfunction of the camshaft position sensor - Open circuit or short-circuited harness wire of the camshaft position sensor - Malfunction of the engine-ECU



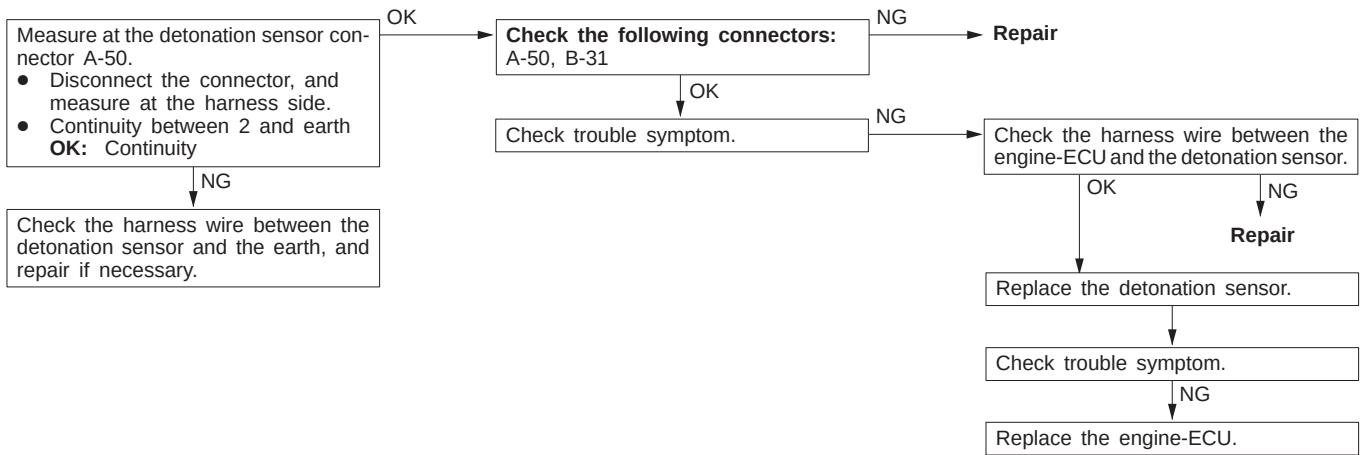
Code No. 24 Vehicles speed sensor system	Probable cause
Range of check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. - Engine speed is 3,000 r/min or more. - Driving under high engine load conditions. Set conditions - Sensor 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



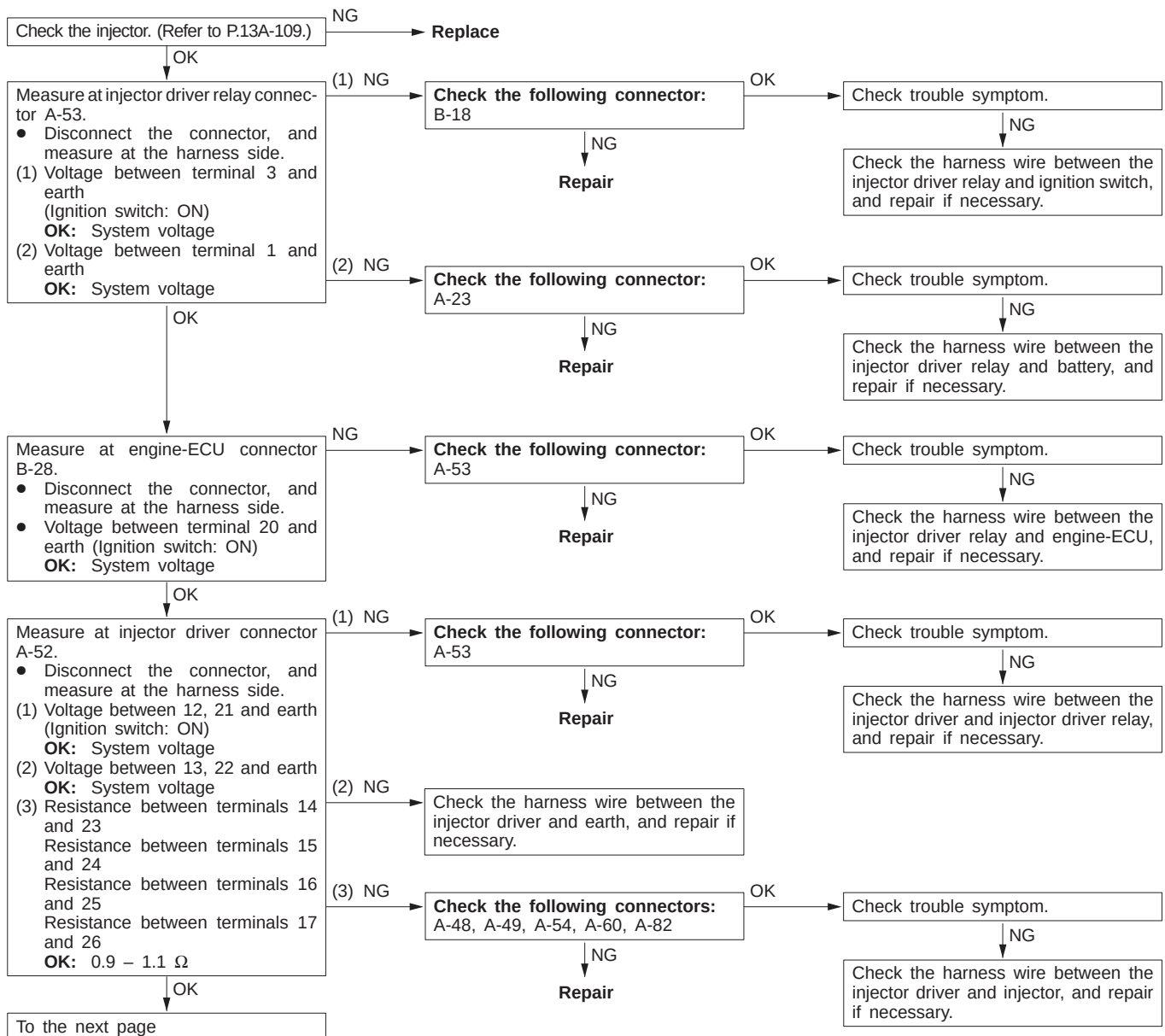
Code No.25 Barometric pressure sensor system	Probable cause
Range of check - After 60 seconds have passed since the engine have started - Battery voltage is 8 V or more. Set conditions - Sensor output voltage is 0.2 V or less for 4 seconds. or - Sensor output voltage is 4.5 V or more for 4 seconds.	- Malfunction of the barometric pressure sensor - Open circuit or short-circuited harness wire of the barometric pressure sensor - Malfunction of the engine-ECU

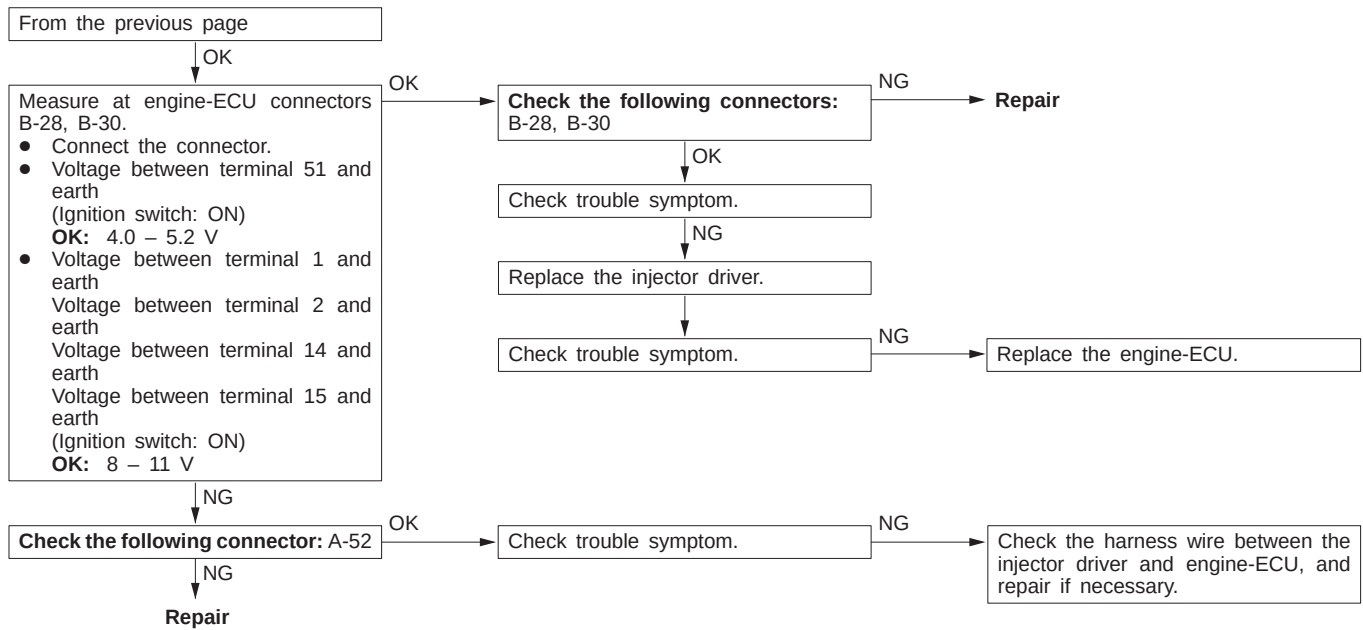


Code No.31 Detonation sensor system	Probable cause
Range of check • After 60 seconds have passed since the engine have started Set conditions • Amount of change in the sensor output voltage (detonation sensor peak voltage for each half rotation of the crankshaft) is 0.06 V or less for 200 continuous times.	• Malfunction of the detonation sensor • Open circuit or short-circuited harness wire of the detonation sensor • Malfunction of the engine-ECU

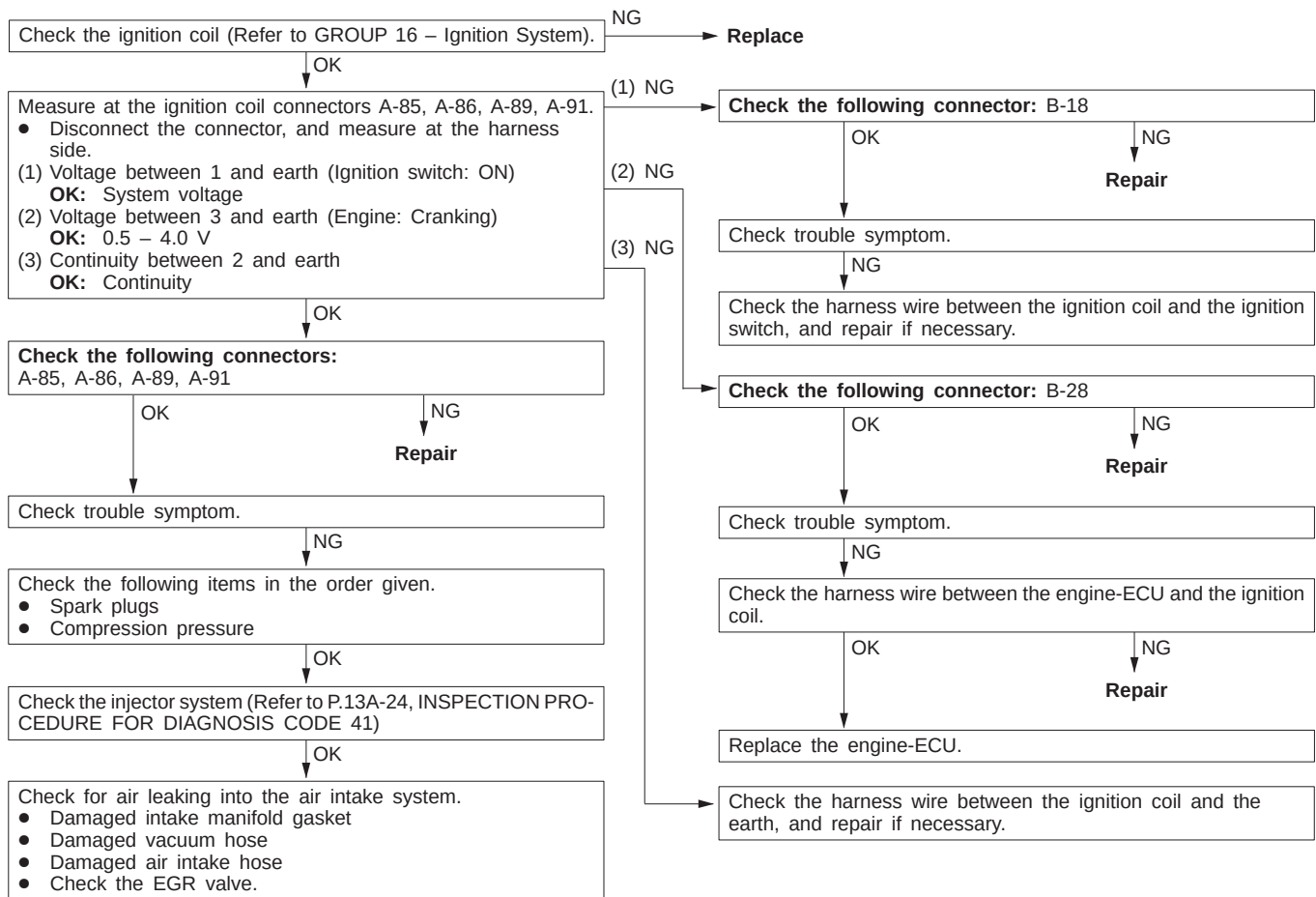


Code No.41 Injector system	Probable cause
Range of check - Engine: while cranking, or running - Engine speed: 4,000 r/min or less - System voltage: 10 V or more - Fuel shut off, or forcible activating of injector (actuator test) is not in operation. Set conditions - Injector open circuit check signal is not output from the injector driver predetermined time(s).	- Malfunction of the injector - Faulty injector driver relay - Faulty injector driver - Open circuit or short-circuited harness wire in the injector drive circuit, or poor connector contact - Malfunction of the engine-ECU





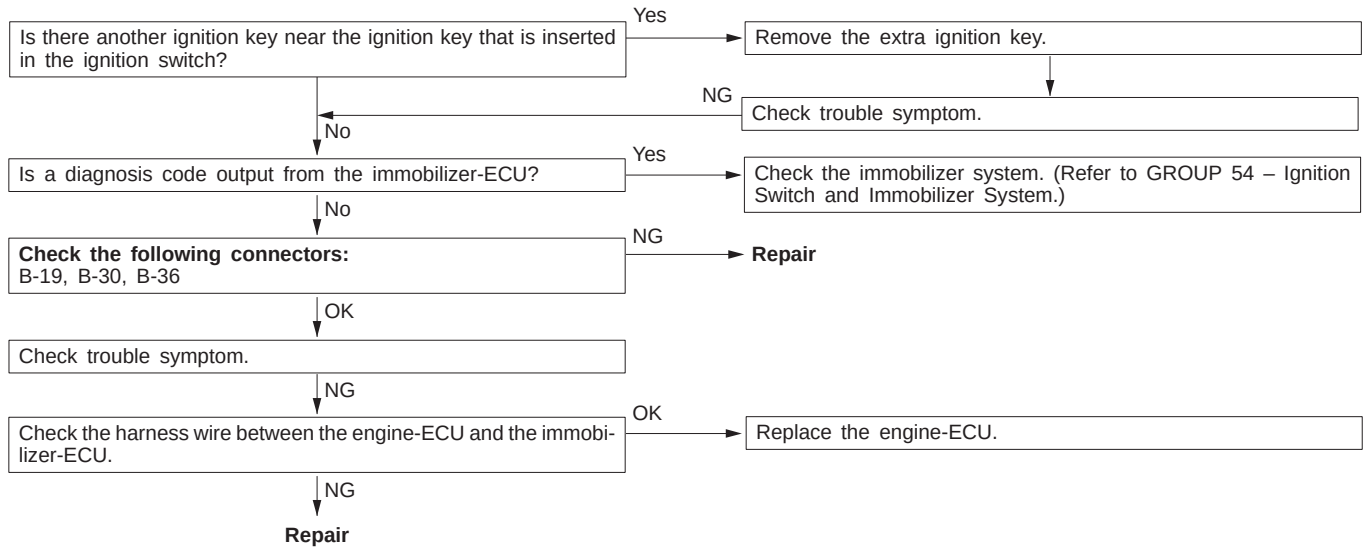
Code No.44 Abnormal combustion	Probable cause
Range of check - While engine is running during lean fuel combustion Set conditions - Abnormal engine speed due to mis-firing is detected by the crank angle sensor	- Malfunction of the ignition coil - Malfunction of the spark plug - Malfunction of the EGR valve - Open circuit or short-circuit in ignition primary circuit - Malfunction of the injector system - Malfunction of the engine-ECU



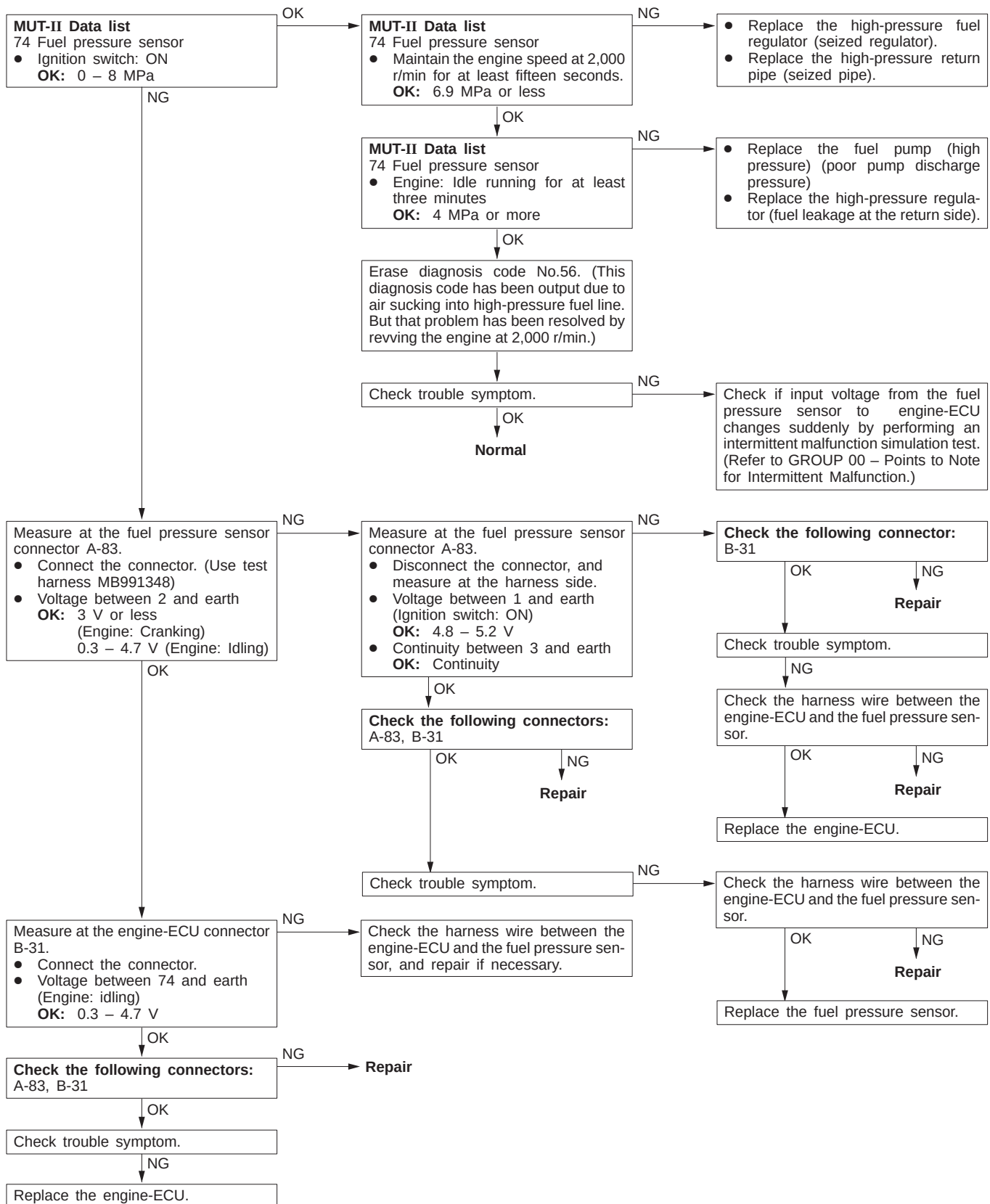
Code No.54 Immobilizer system	Probable cause
Range of Check • Ignition switch: ON Set Conditions • Improper communication between the engine-ECU and immobilizer-ECU	• Radio interference of ID codes • Incorrect ID code • Malfunction of harness or connector • Malfunction of immobilizer-ECU • Malfunction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

NOTE

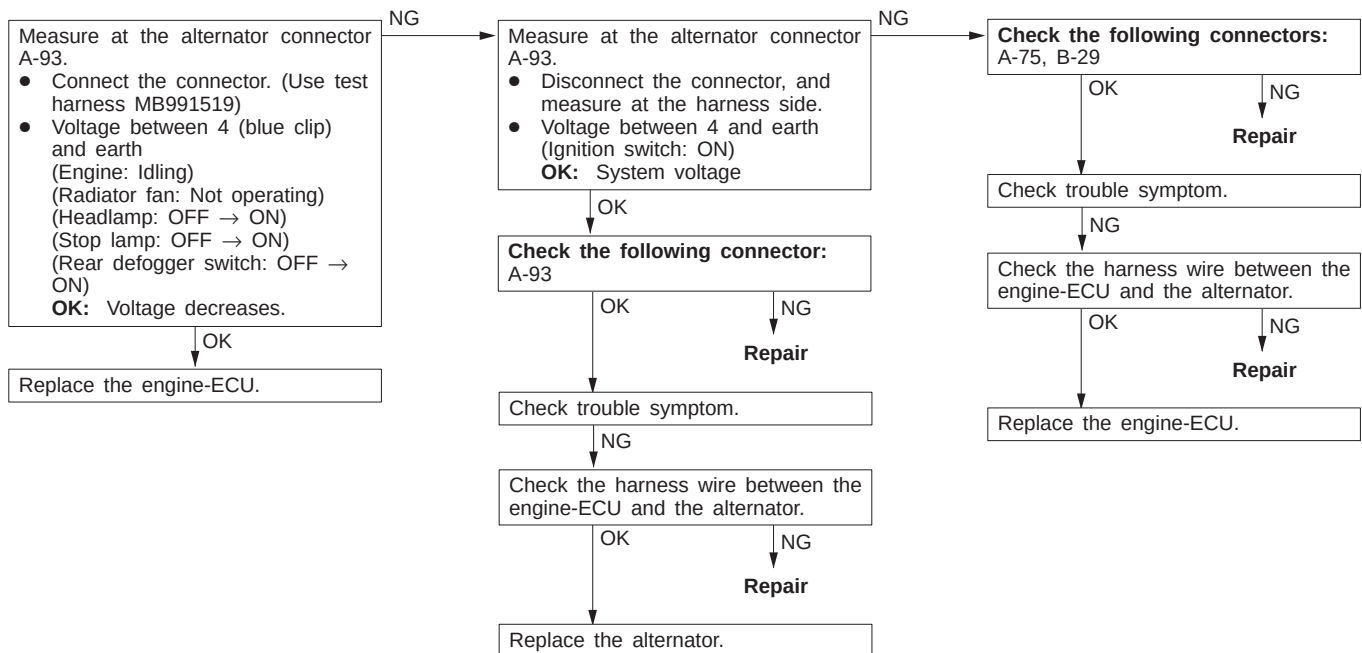
- (1) If the ignition switches are close each other when starting the engine, radio interference may cause this code to be displayed.
- (2) This code may be displayed when registering the key ID code.



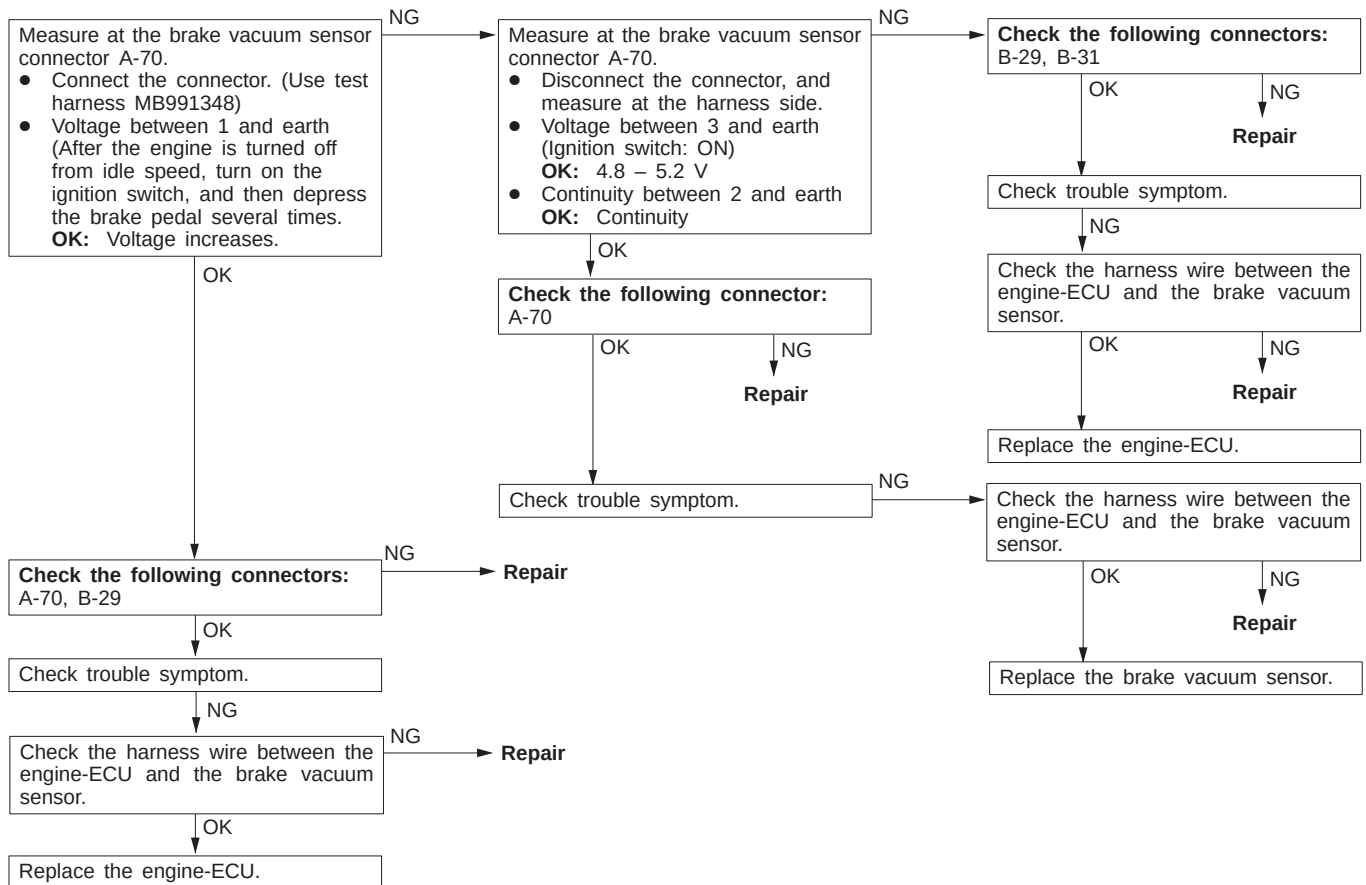
Code No.56 Abnormal fuel pressure system	Probable cause
Range of check ● Ignition switch: ON Set conditions ● Sensor output voltage is 4.8 V or more for four seconds. or ● Sensor output voltage is 0.2 V or less for four seconds. Range of check ● After the engine is started, the following conditions have been detected: (1) Engine speed: 1,000 r/min or more (2) Fuel pressure: 2 MPa or more ● While engine is running Set conditions ● Fuel pressure is 6.9 MPa or more for four seconds. or ● Fuel pressure is 2 MPa or less for four seconds.	● Malfunction of the fuel pressure sensor ● Open circuit or short-circuited harness wire of the fuel pressure sensor ● Malfunction of the engine-ECU ● Malfunction of the fuel pump (high pressure) ● Malfunction of the fuel pressure regulator (high pressure) ● Clogged high-pressure fuel line
This diagnosis code is also output when air is sucked in high-pressure fuel line due to no fuel supply. In this case, air can be bled by letting the engine run at 2,000 r/min for at least fifteen seconds. After the air bleeding, the diagnosis code must be erased by the MUT-II.	● Air sucking due to no fuel supply



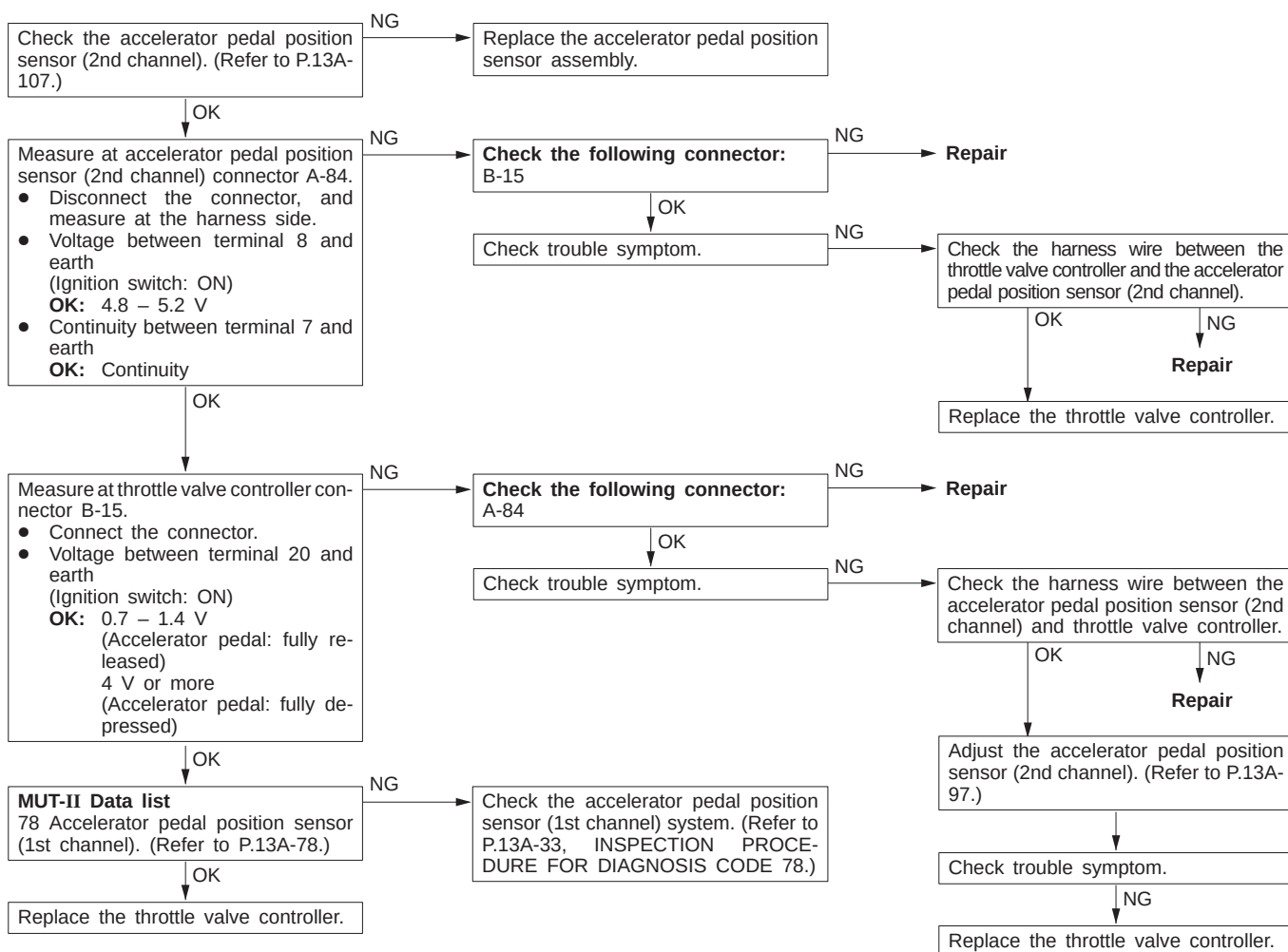
Code No.64 Alternator FR terminal system	Probable cause
Range of check • Engine speed is 50 r/min or more. Set conditions • Input voltage from the alternator FR terminal is system voltage for 20 seconds.	• Open circuit in alternator FR terminal circuit • Malfunction of the engine-ECU



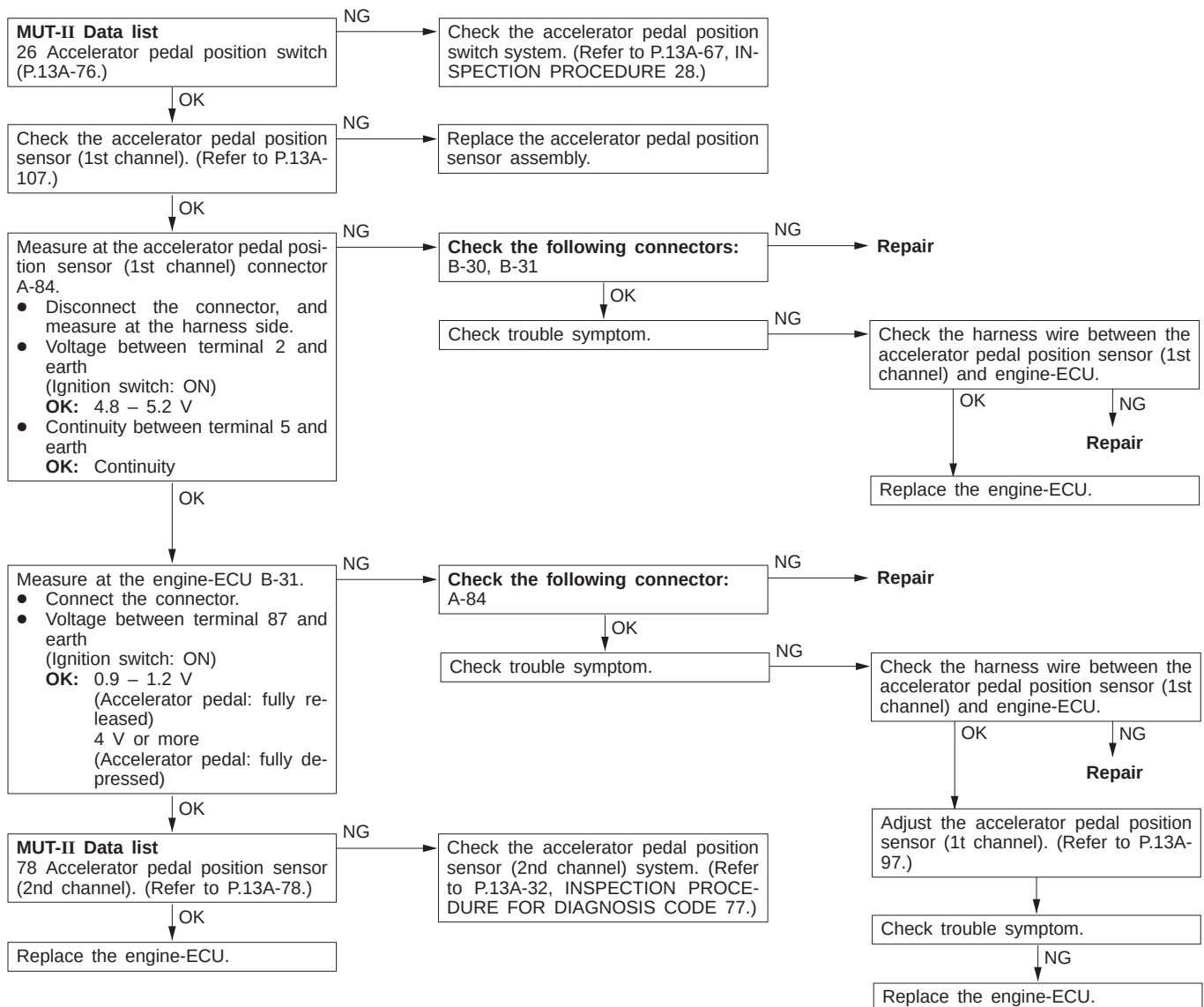
Code No.66 Brake vacuum sensor system	Probable cause
Range of check • Ignition switch: ON Set conditions • Sensor output voltage is 4.8 V or more. or • Sensor output voltage is 0.2 V or less.	• Malfunction of the brake vacuum sensor • Improper connector contact, open circuit or short-circuited harness wire of the brake vacuum sensor • Malfunction of the engine-ECU



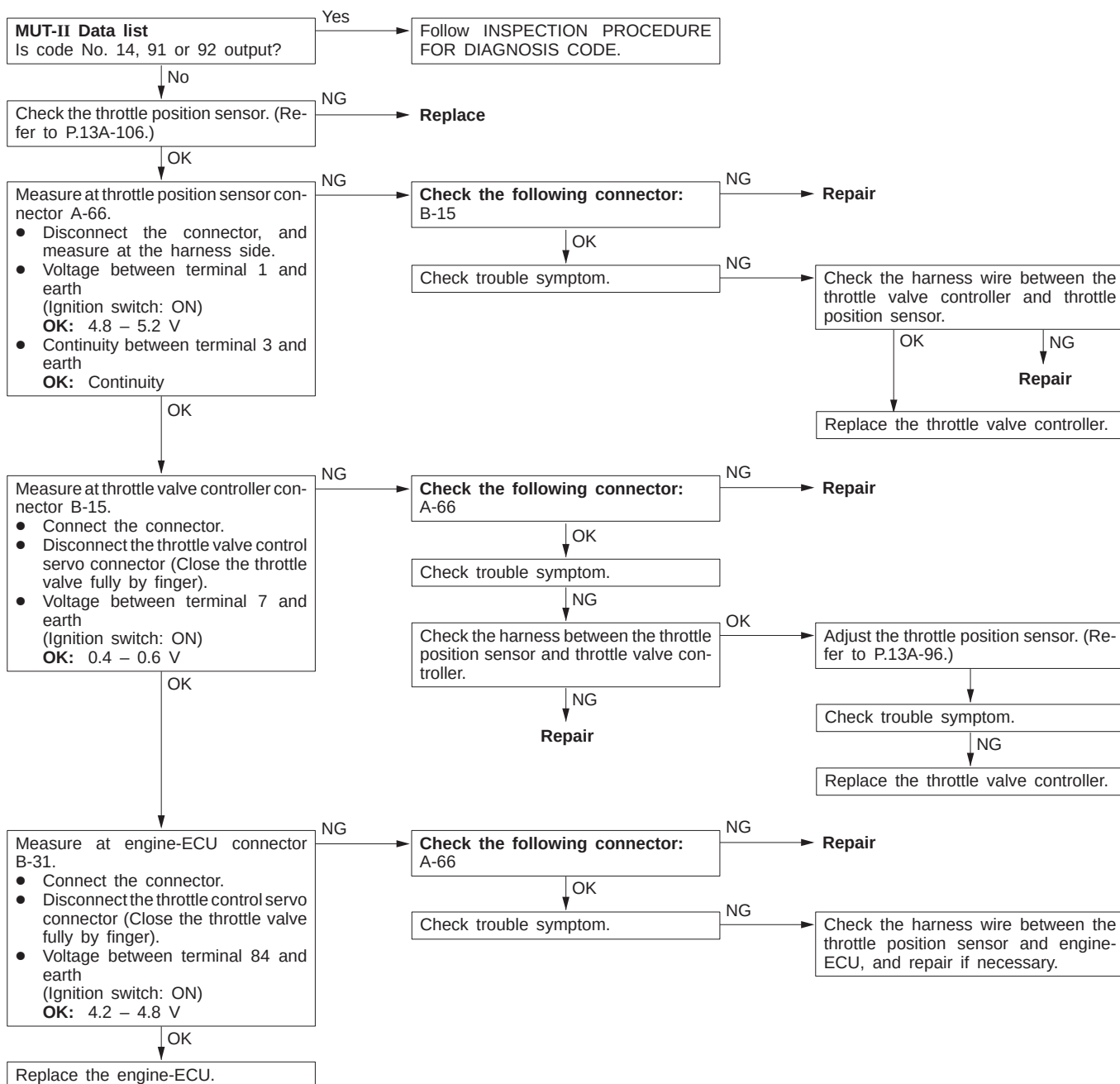
Code No.77 Accelerator pedal position sensor (2nd channel) system	Probable cause
Range of check - Accelerator pedal position sensor (1st channel) system is normal. - Communication between the engine-ECU and throttle valve controller is normal. Set conditions - Output voltage of accelerator position sensor (2nd channel) system is 0.2 V or less for one second. or - Output voltage of the accelerator pedal position sensor (1st channel) is 2.5 V or less, and output voltage of the accelerator pedal position sensor (2nd channel) is 4.5 V or more for one second. or - Difference between the accelerator pedal position sensor output voltages (1st and 2nd channels) exceeds 1.0 V (i.e. when the throttle valve opening angle changes slightly).	- Malfunction of the accelerator pedal position sensor (2nd channel) - Open circuit or short-circuited harness wire in the accelerator pedal position sensor (2nd channel) system, or poor connector contact - Malfunction of the throttle valve controller - Malfunction of the engine-ECU



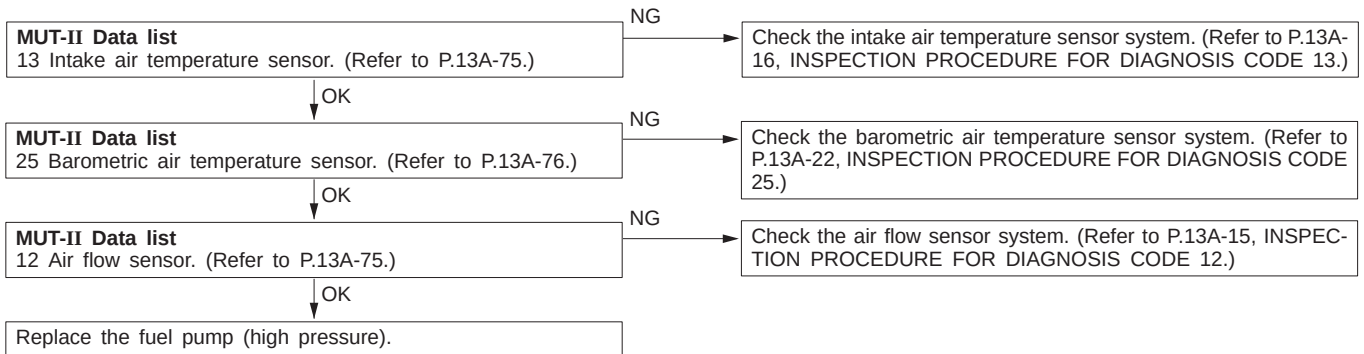
Code No.78 Accelerator pedal position sensor (1st channel) system	Probable cause
Range of check - Accelerator pedal position sensor (2nd channel) system is normal. - Communication between the engine-ECU and throttle valve controller is normal. Set conditions - Output voltage of accelerator position sensor (1st channel) system is 0.2 V or less for one second. or - Output voltage of the accelerator pedal position sensor (2nd channel) is 2.5 V or less, and (1st channel) output voltage of the accelerator pedal position sensor is 4.5 V or more for one second. or - Difference between the accelerator pedal position sensor (1st and 2nd channels) output voltages exceeds 1.0 V (i.e. when the throttle valve opening angle changes slightly). or - Although the accelerator pedal position switch is on, 1st-channel output voltage of the accelerator pedal position sensor exceeds 1.1 V for one second.	- Malfunction of the accelerator pedal position sensor (1st channel) - Open circuit or short-circuited harness wire in the accelerator pedal position sensor (1st channel) system, or poor connector contact - ON-seizure of the accelerator pedal position switch - Malfunction of the throttle valve controller - Malfunction of the engine-ECU



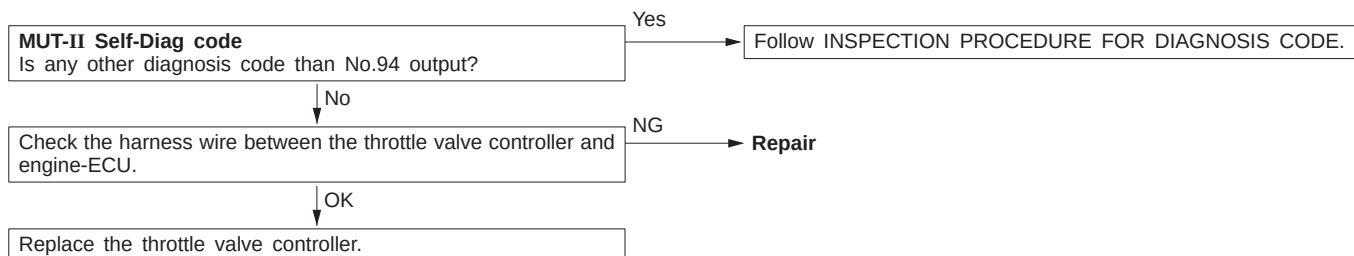
Code No.79 Throttle position sensor (1st channel) system	Probable cause
The throttle valve controller determines a failure, and sends its result to the engine-ECU. Range of check - Ignition switch: ON - System voltage: 8 V or more Set conditions - Output voltage of the sensor remains 0.2 V for one second. or - Output voltage of the sensor remains 4.9 V for one second. or - Output voltage of the throttle position sensor (1st and 2nd channels) remains outside 4 – 6 V for four seconds.	- Malfunction of the throttle position sensor (1st channel) - Open circuit or short-circuited harness wire in the throttle position sensor (1st channel), or poor connector contact - Malfunction of the throttle valve controller - Malfunction of the engine-ECU



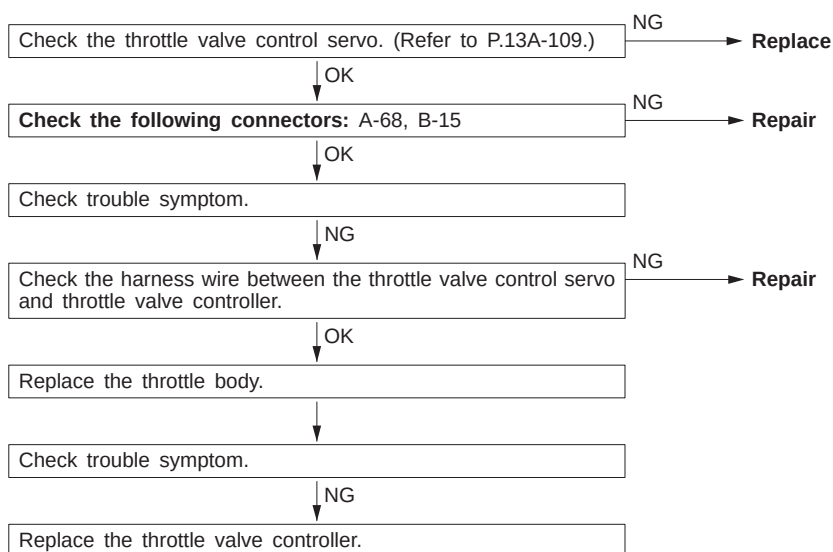
Code No.89 Abnormal fuel system	Probable cause
Range of check • Engine: Idling (during stoichio-feedback operation) Set conditions • Fuel injection correction value remains excessively low for ten seconds or more. or • Fuel injection correction value remains excessively high for ten seconds or more.	• Malfunction of the fuel pump (high pressure) • Malfunction of the intake air temperature sensor • Malfunction of the barometric pressure sensor • Malfunction of the air flow sensor • Malfunction of the engine-ECU



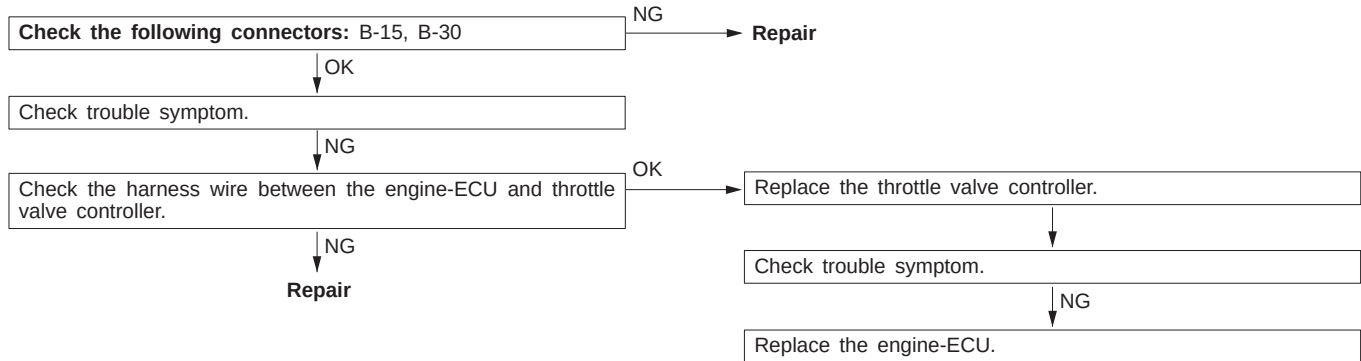
Code No.91 Electronic-controlled throttle valve system	Probable cause
Range of check - Ignition switch: ON - Error in communication between the engine-ECU and throttle valve controller Set conditions - Output voltage of the throttle position sensor (2nd channel) fluctuates significantly (approx. 1 V or more) from an expected value. Range of check - Ignition switch: ON - Error in communication between the throttle valve controller and engine-ECU Set conditions - The throttle valve opening angle (voltage) which the engine-ECU requested of the throttle valve controller is significantly different from output voltage of the (2nd channel) throttle position sensor (approx. one volt).	- Short in communication line - Malfunction of the engine-ECU - Malfunction of the throttle valve controller



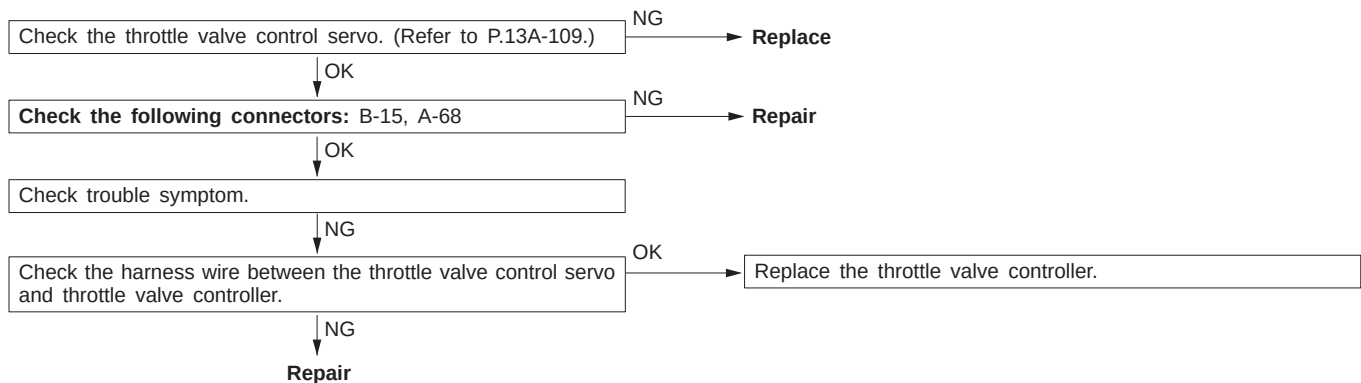
Code No.92 Throttle valve position feedback system	Probable cause
The throttle valve controller determines if a failure is present, and sends its result to the engine-ECU. Range of check - Ignition switch: ON - System voltage: 8 V or more Set condition - Motor position feedback system is defective (System detects a motor overcurrent, or that actual and projected opening angles of the throttle position sensor (1st channel) are different by 1.0 V or more.	- Malfunction of the throttle position sensor (1st channel) - Open circuit or short-circuited harness wire in the throttle position sensor system (1st channel), or poor connector contact - Malfunction of the throttle valve controller



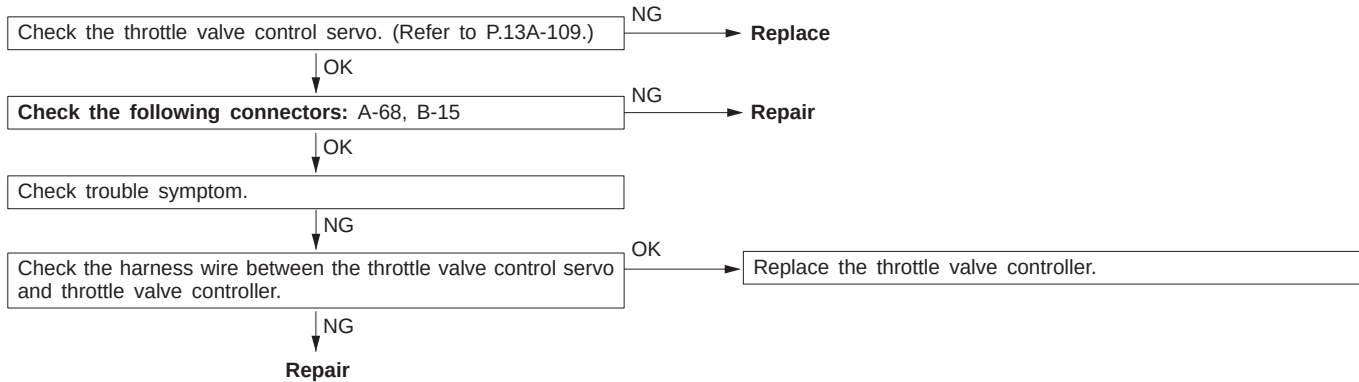
Code No.94 Communication line system with throttle valve controller	Probable cause
Range of check - Ignition switch: ON - System voltage: 8 V or more - Engine: not cranking Set condition - System detects an error in communication line between the engine-ECU and throttle valve controller.	- Short circuit in communication line - Malfunction of the engine-ECU - Malfunction of the throttle valve controller



Code No.95 Malfunction in throttle valve control servo motor system (1st phase)	Probable cause
Range of check - Throttle valve control servo relay: ON - System voltage: 8 V or more Set conditions - Throttle valve control servo drive circuit is shorted to earth. - Other power source interferences with throttle valve control servo drive circuit. - Throttle valve control servo drive circuit is open circuit.	- Malfunction of the throttle valve control servo - Open circuit or short-circuited harness wire in throttle valve control servo system, or poor connector contact - Malfunction of the throttle valve controller



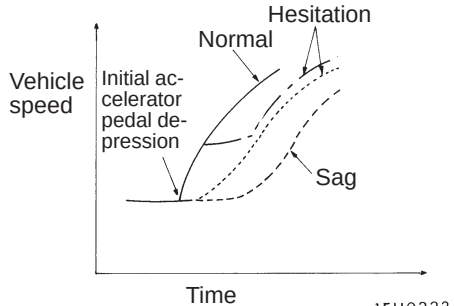
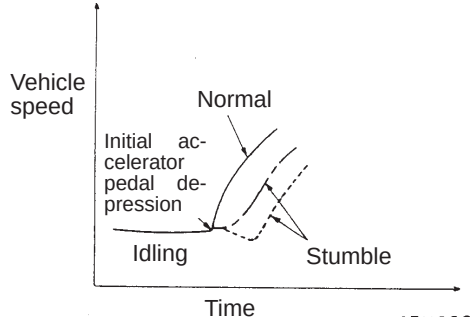
Code No.99 Malfunction in throttle valve control servo motor system (2nd phase)	Probable cause
Range of check - Throttle valve control servo relay: ON - System voltage: 8V or more Set conditions - Throttle valve control servo drive circuit is shorted to earth. - Other power source interferes with throttle valve control servo drive circuit. - Throttle valve control servo drive circuit is open-circuited.	- Malfunction of the throttle valve control servo - Open circuit or short-circuited harness wire in the throttle valve control servo system, or poor connector contact - Malfunction of the throttle valve controller



INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is impossible.	Communication with all systems is not possible.	1	13A-41
	Communication with engine-ECU only is not possible.	2	13A-42
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-43
	The engine warning lamp remains illuminating and never goes out.	4	13A-43
Starting	No initial combustion (starting impossible)	5	13A-44
	Initial combustion but no complete combustion (starting impossible)	6	13A-46
	Long time to start (improper starting)		
Idling stability (Improper idling)	Unstable idling (Rough idling, hunting)	7	13A-48
	Idling speed is high. (Improper idling speed)	8	13A-50
	Idling speed is low. (Improper idling speed)		
Idling stability (Engine stalls)	When the engine is cold, it stalls at idling. (Die out)	9	13A-51
	When the engine is hot, it stalls at idling. (Die out)	10	13A-52
	The engine stalls when starting the car. (Pass out)	11	13A-54
	The engine stalls when decelerating.	12	13A-55
Driving	Hesitation, sag or stumble	13	13A-56
	Poor acceleration		
	Surge		
	The feeling of impact or vibration when accelerating	14	13A-57
	The feeling of impact or vibration when decelerating	15	13A-58
	Knocking	16	13A-58
Dieseling		17	13A-58
Too high CO and HC concentration when idling		18	13A-59
Low alternator output voltage (approx. 12.3 V)		19	13A-61
Engine idle speed is incorrect while the A/C is on.		20	13A-61
Fans (radiator fan, A/C condenser fan) are inoperative		21	13A-62
GDI ECO lamp system	The GDI ECO lamp does not illuminate.	22	13A-63
	The GDI ECO lamp remains on (does not extinguish).	23	13A-64
Malfunction of the clutch switch system		24	13A-64

PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

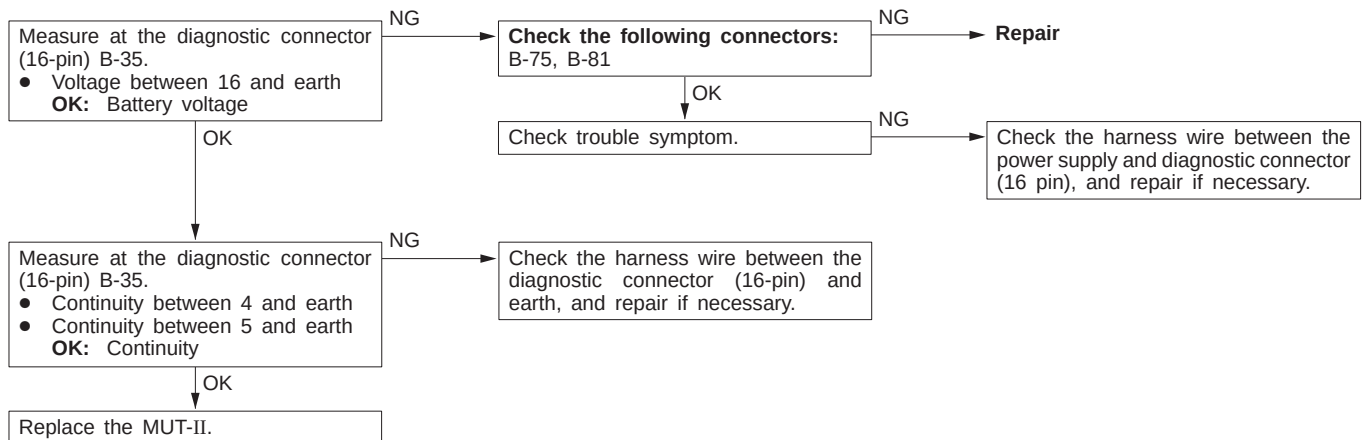
Items		Symptom
Starting	Won't start	The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start.
	Fires up and dies	There is combustion within the cylinders, but then the engine soon stalls.
	Hard starting	Engine starts after cranking a while.
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".  1FU0223
	Poor acceleration	Poor acceleration is inability to obtain an acceleration corresponding to the degree of throttle opening, even though acceleration is smooth, or the inability to reach maximum speed.
	Stumble	Engine speed increase is delayed when the accelerator pedal is initially depressed for acceleration.  1FU0224

Items		Symptom
Driving	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 FOR TROUBLE SYMPTOMS

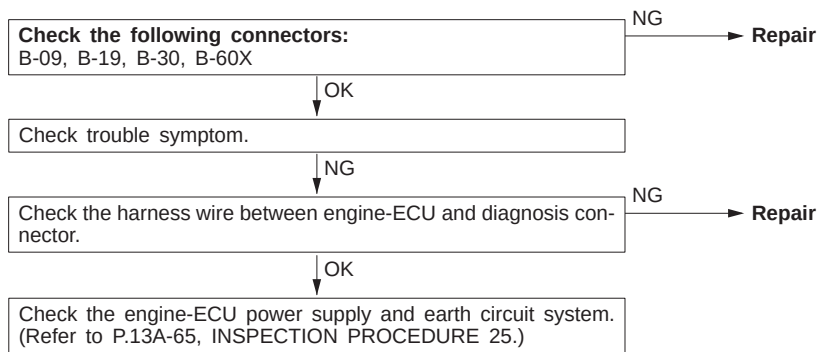
INSPECTION PROCEDURE 1

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	• Malfunction of engine-ECU power supply circuit • Malfunction of engine-ECU • Open circuit between the engine-ECU and diagnosis connector

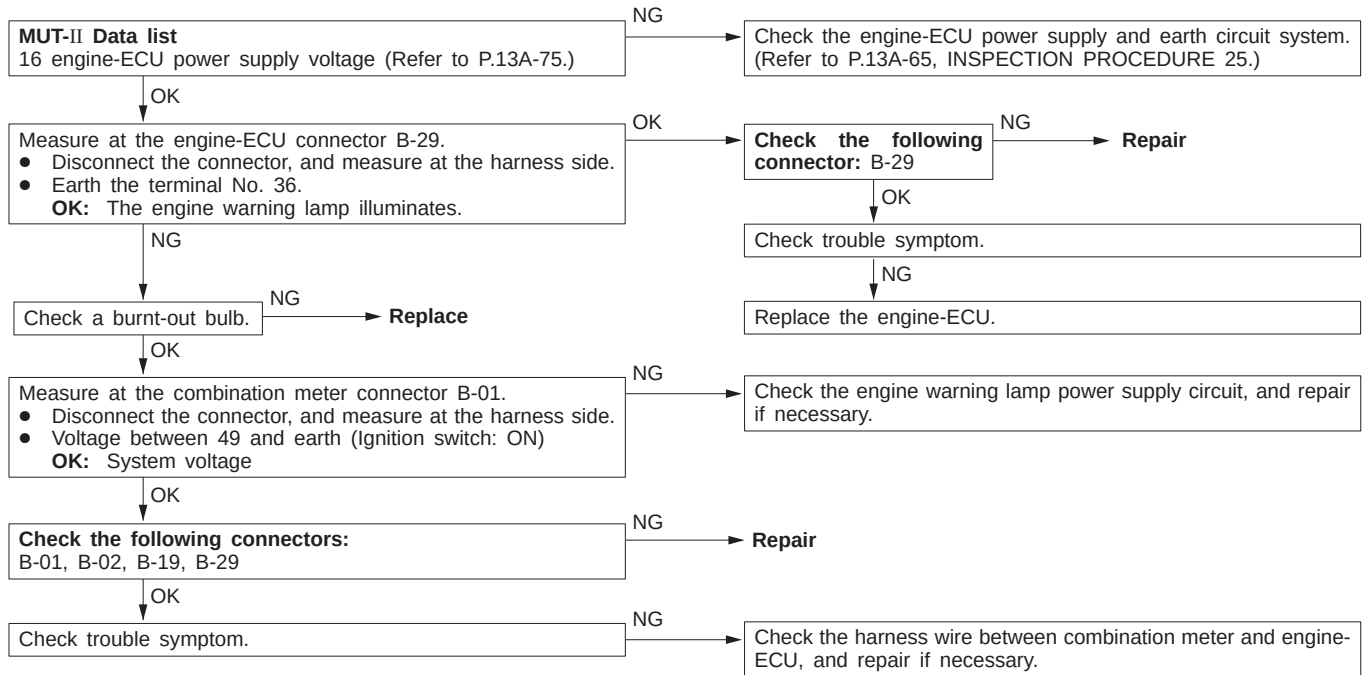


NOTE

On vehicles with the multi-center display, if a malfunction cannot be resolved after the procedure above, check the multi-center display and replace if necessary. (Refer to GROUP 54 – Multi-center display.)

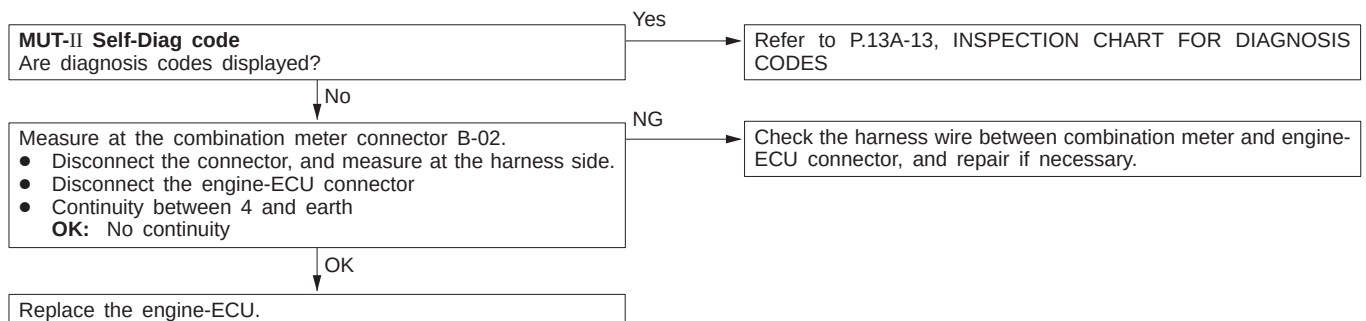
INSPECTION PROCEDURE 3

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



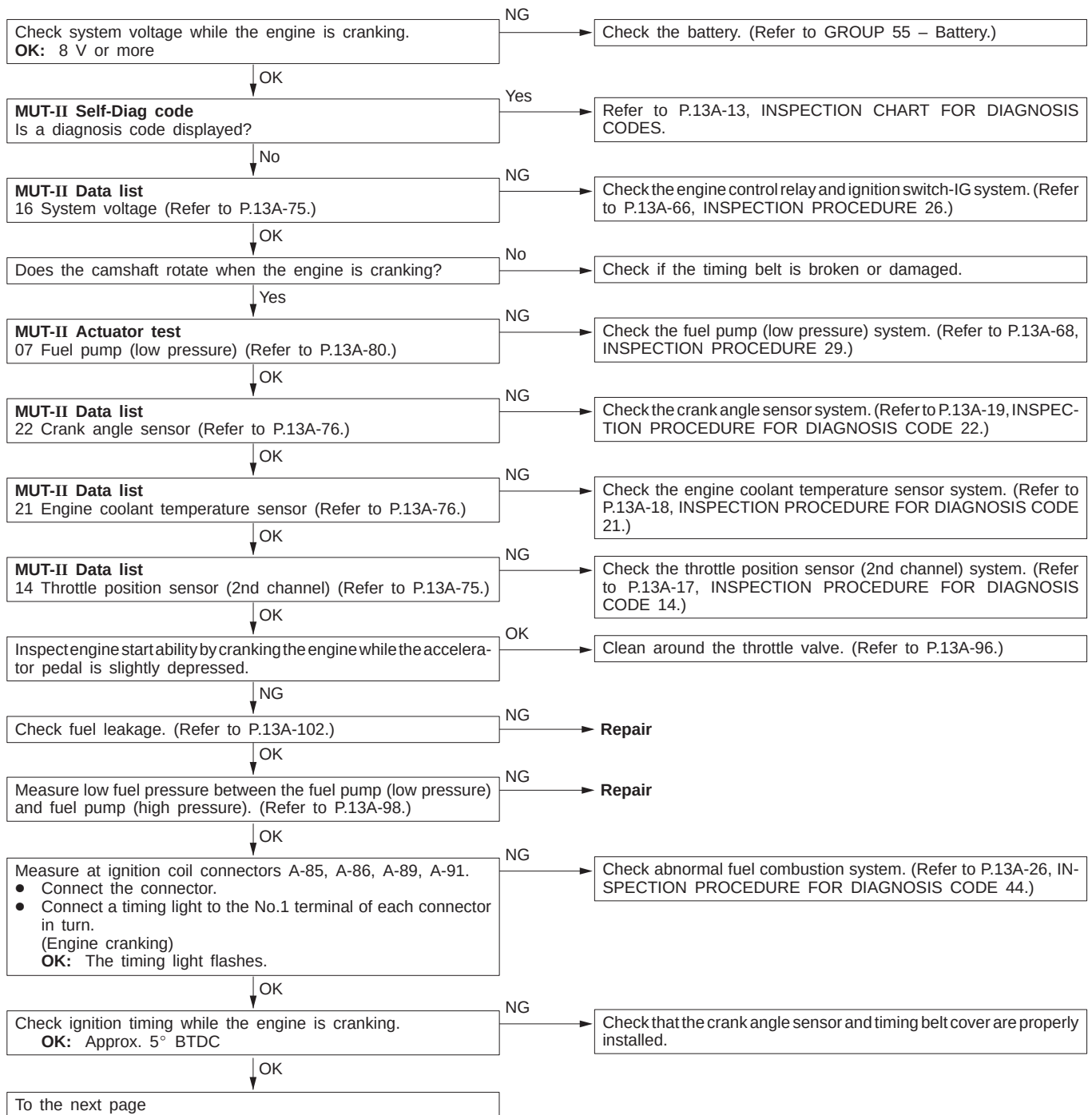
INSPECTION PROCEDURE 4

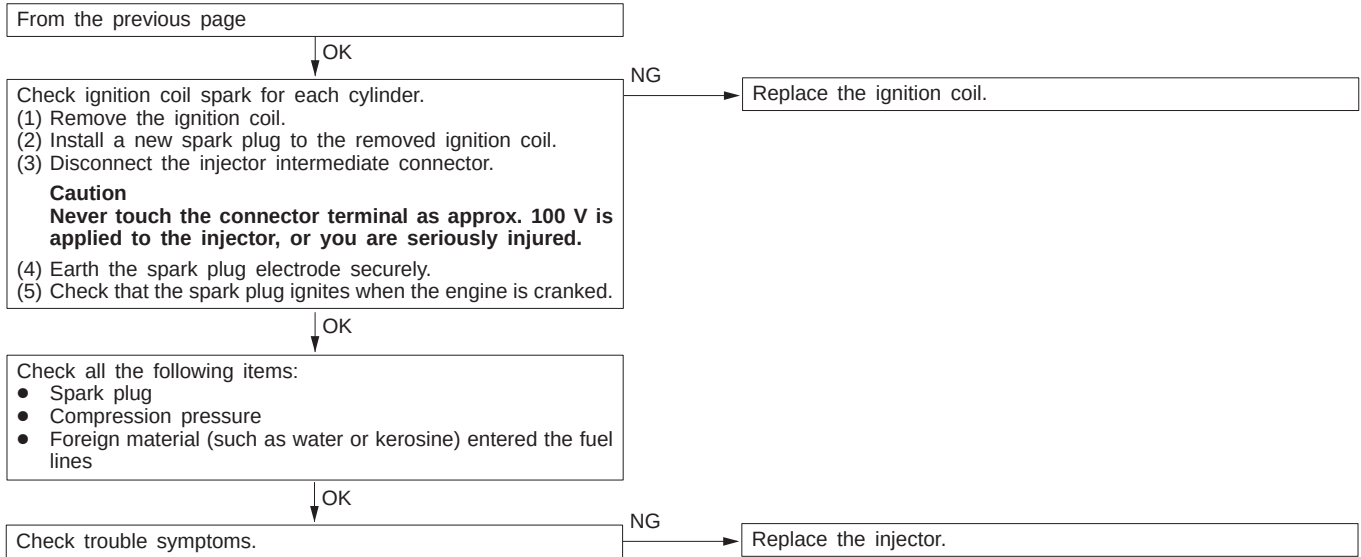
The engine warning lamp remains illuminating and never goes out.	Probable cause
In cases such as the above, the cause is probably that the engine-ECU is detecting a problem in a sensor or actuator, or that one of the malfunctions listed at right has occurred.	- Short-circuit between the engine warning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



INSPECTION PROCEDURE 5

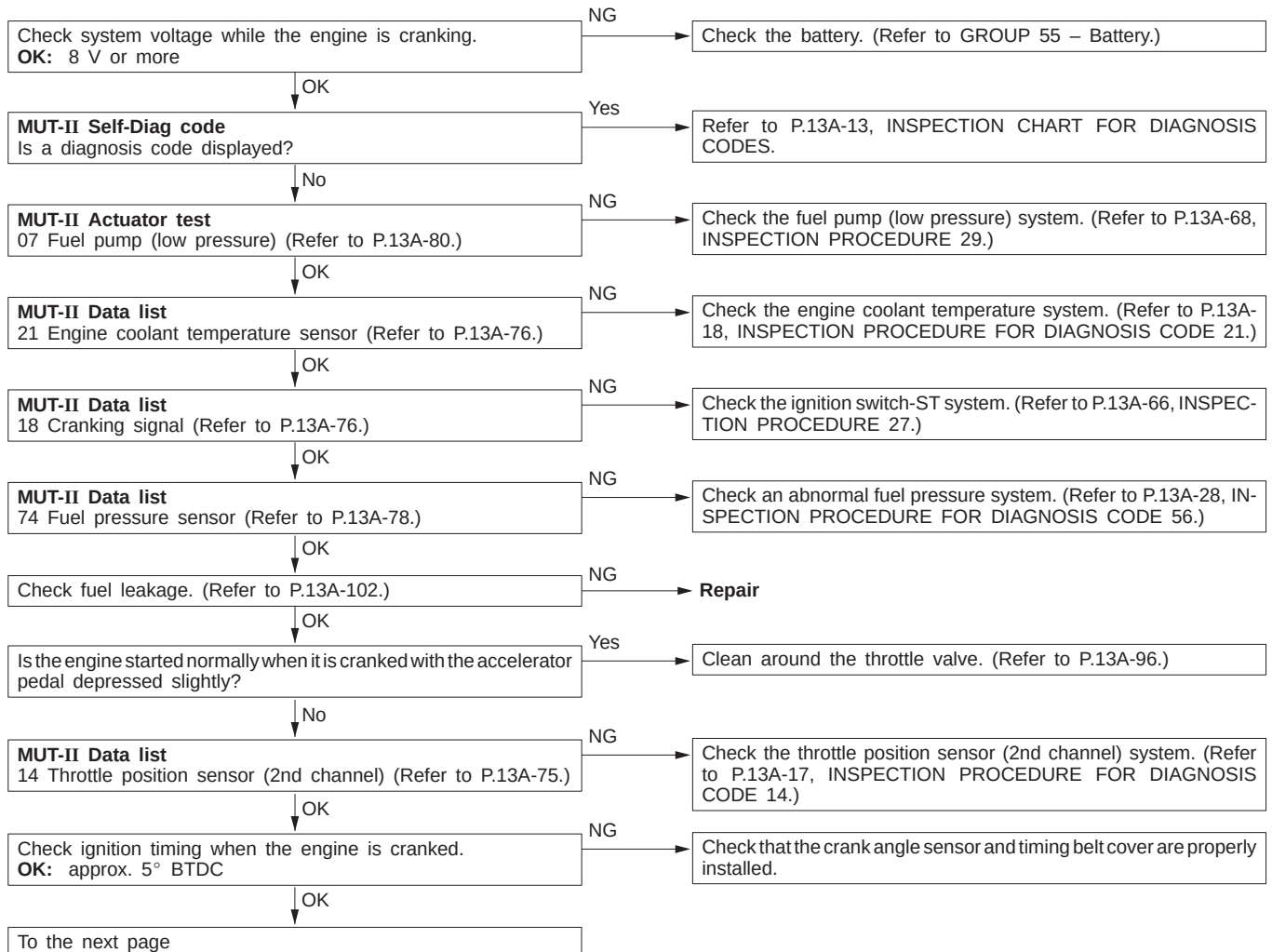
No initial combustion (starting impossible)	Probable cause
This is caused by incorrect fuel supply into the combustion chamber, and improper ignition circuit. Besides that, foreign material may be contaminated in fuel.	● Malfunction of the fuel supply system ● Malfunction of the ignition system ● Malfunction of the engine-ECU

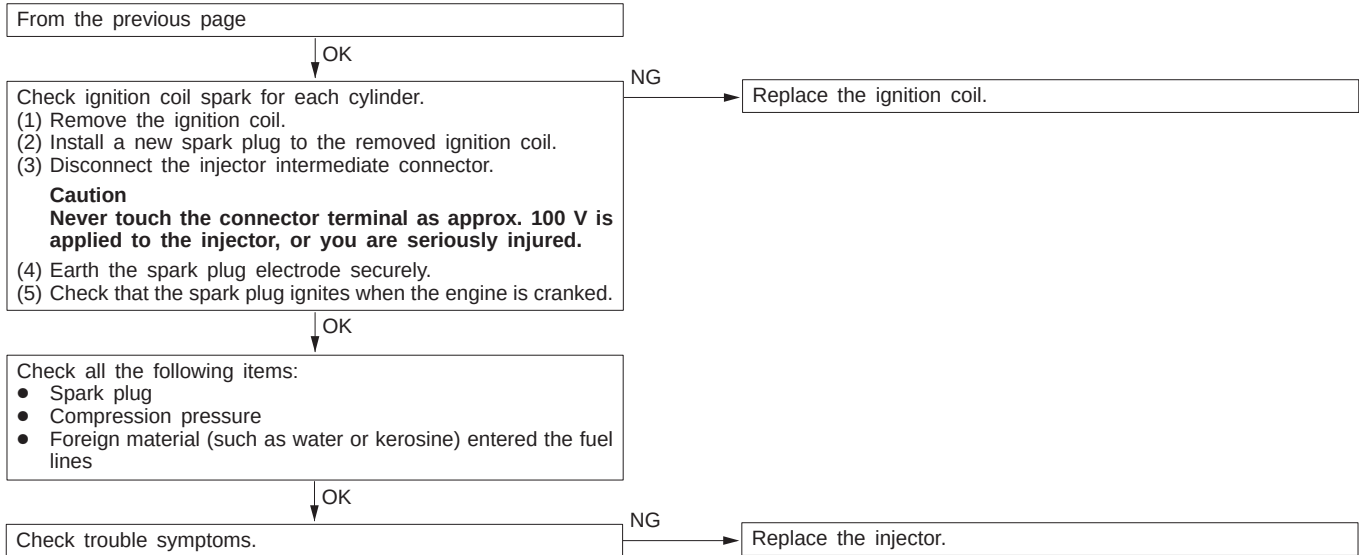




INSPECTION PROCEDURE 6

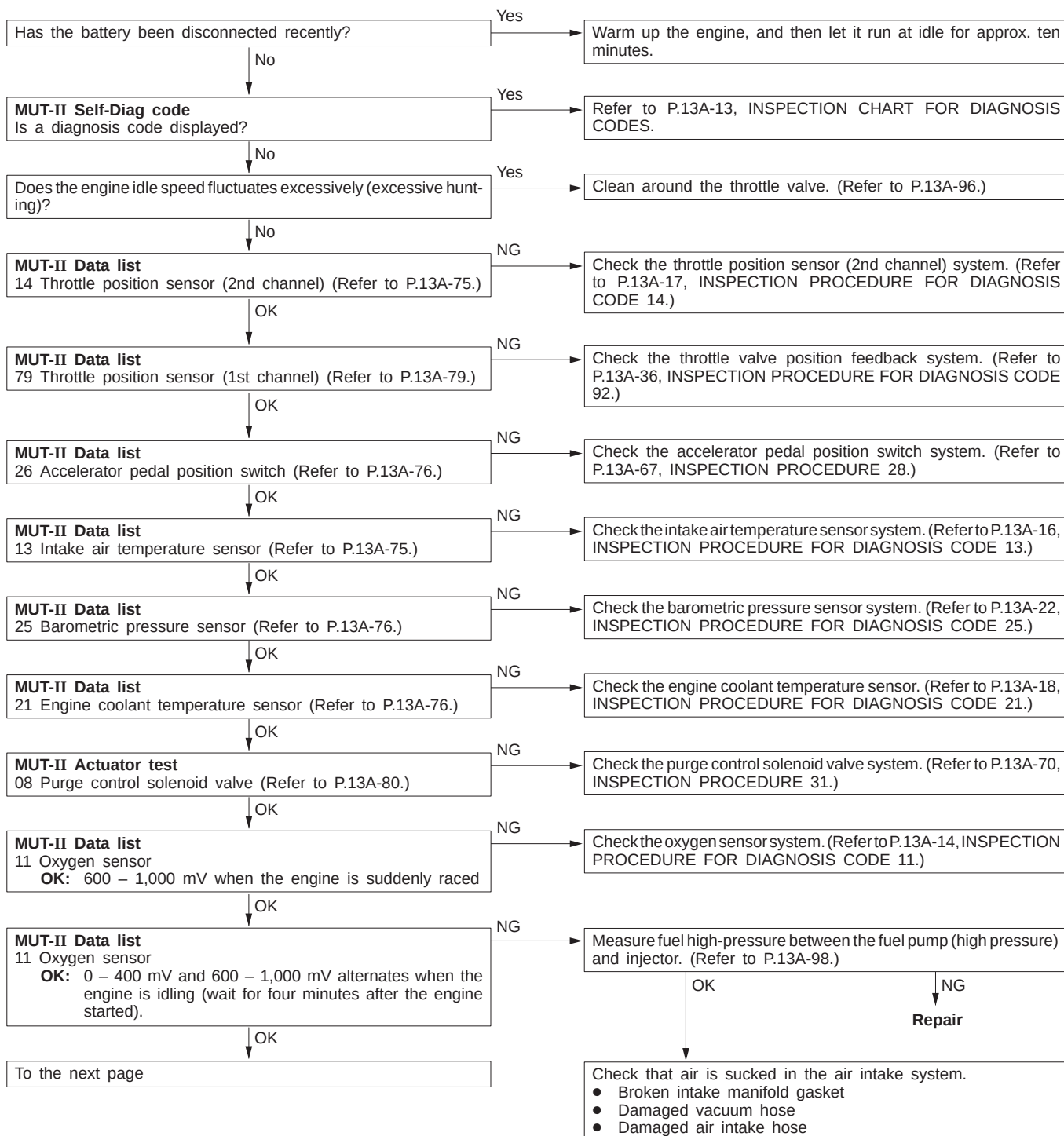
Initial combustion takes place, but does not complete (start impossible), too long time to start (poor start)	Probable cause
This may be caused by improper spark plug ignition (poor spark), improper mixture during engine cranking, improper fuel pressure.	• Malfunction of the fuel supply system • Malfunction of the fuel pressure sensor • Malfunction of the ignition system • Malfunction of the electronic-controlled throttle valve system • Malfunction of the engine-ECU

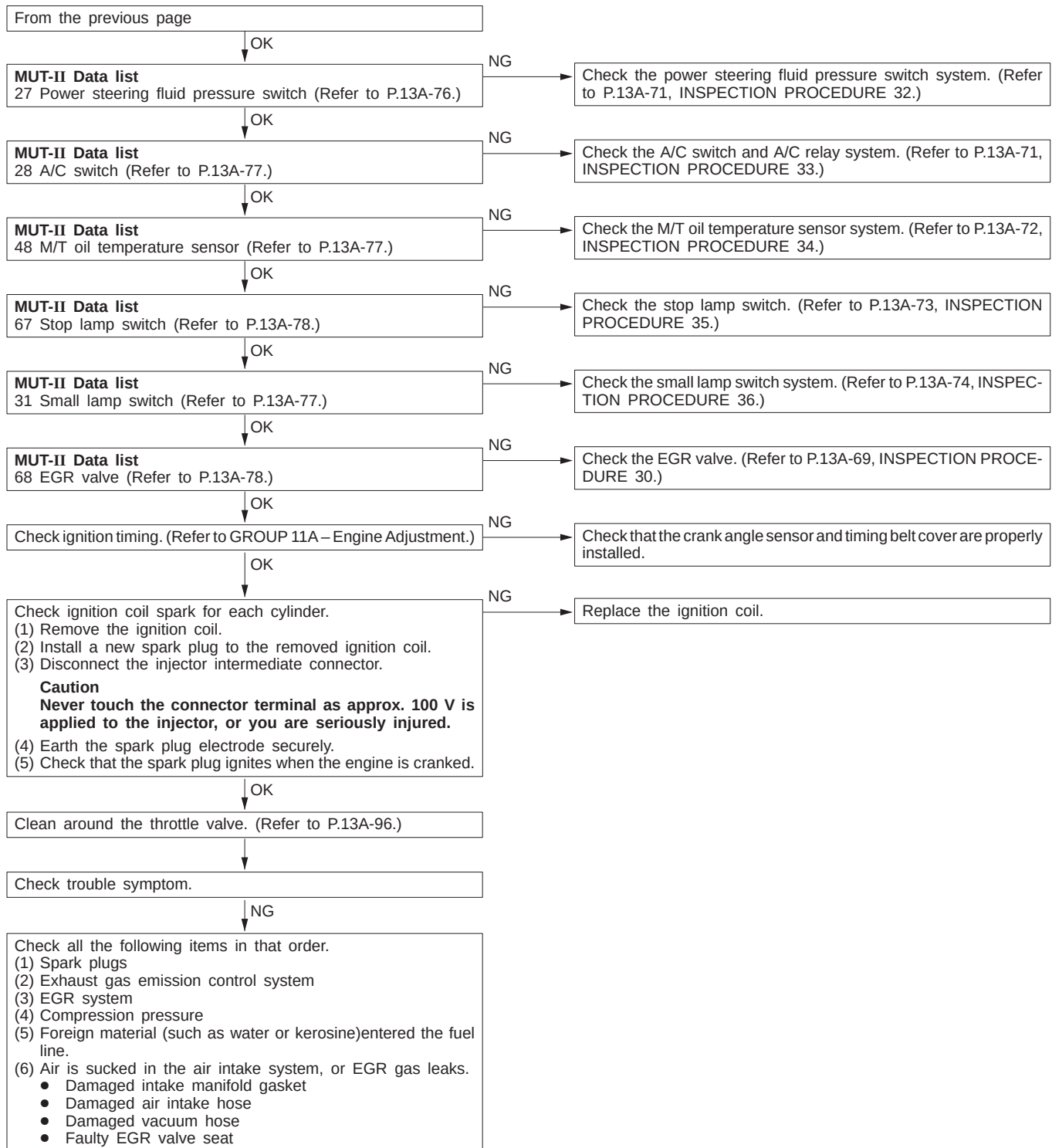




INSPECTION PROCEDURE 7

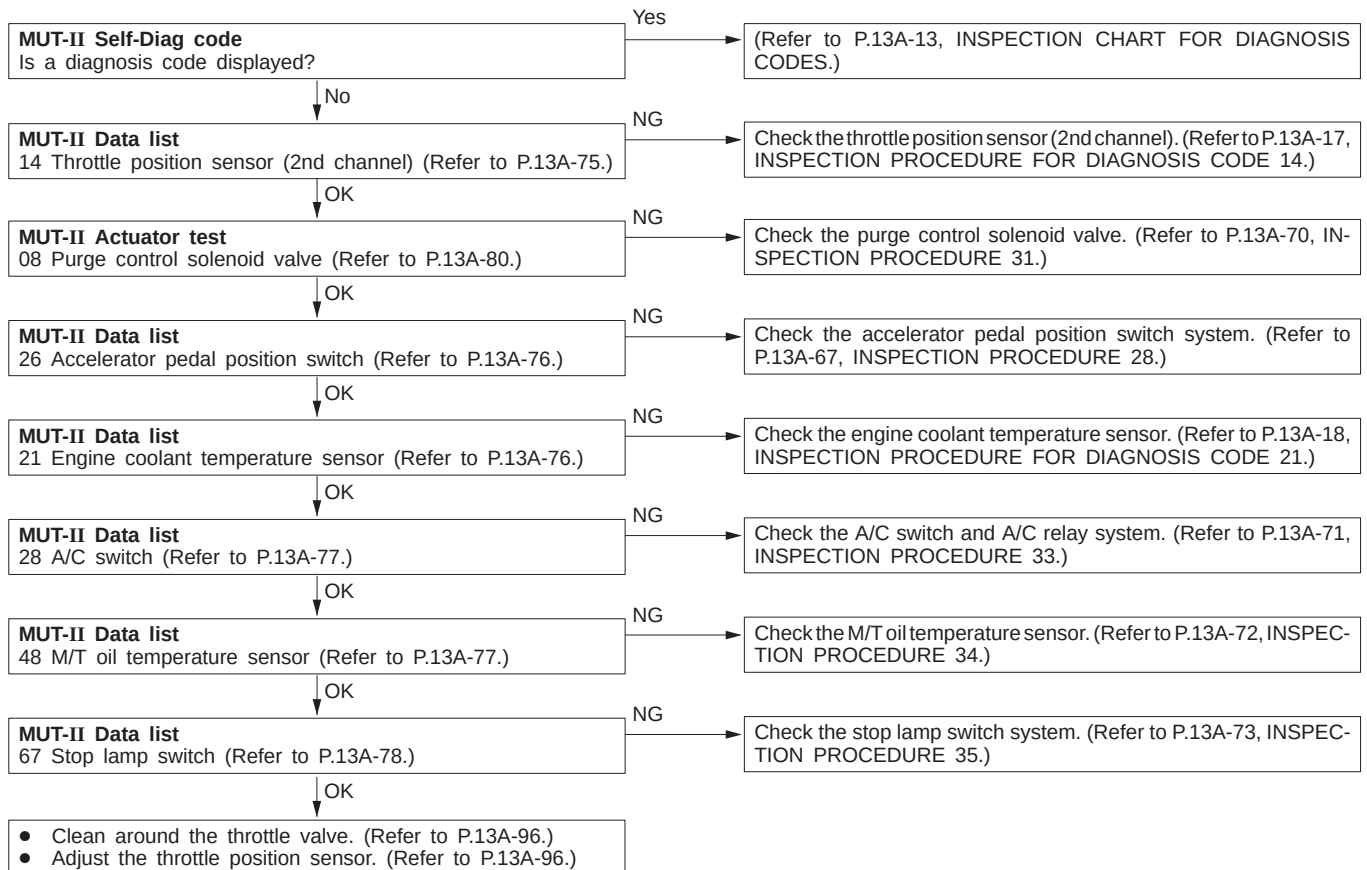
Unstable idling (rough idle, hunting)	Probable cause
This malfunction is probably caused by a faulty ignition system, improper air/fuel ratio, a faulty electronic-controlled throttle valve system, improper compression pressure, etc. As many causes can be suspected, diagnose from easier items.	● Malfunction of the ignition system ● Malfunction of the air/fuel ratio control system ● Malfunction of the electronic-control throttle valve system ● Improper compression pressure ● Air sucking into the air intake system





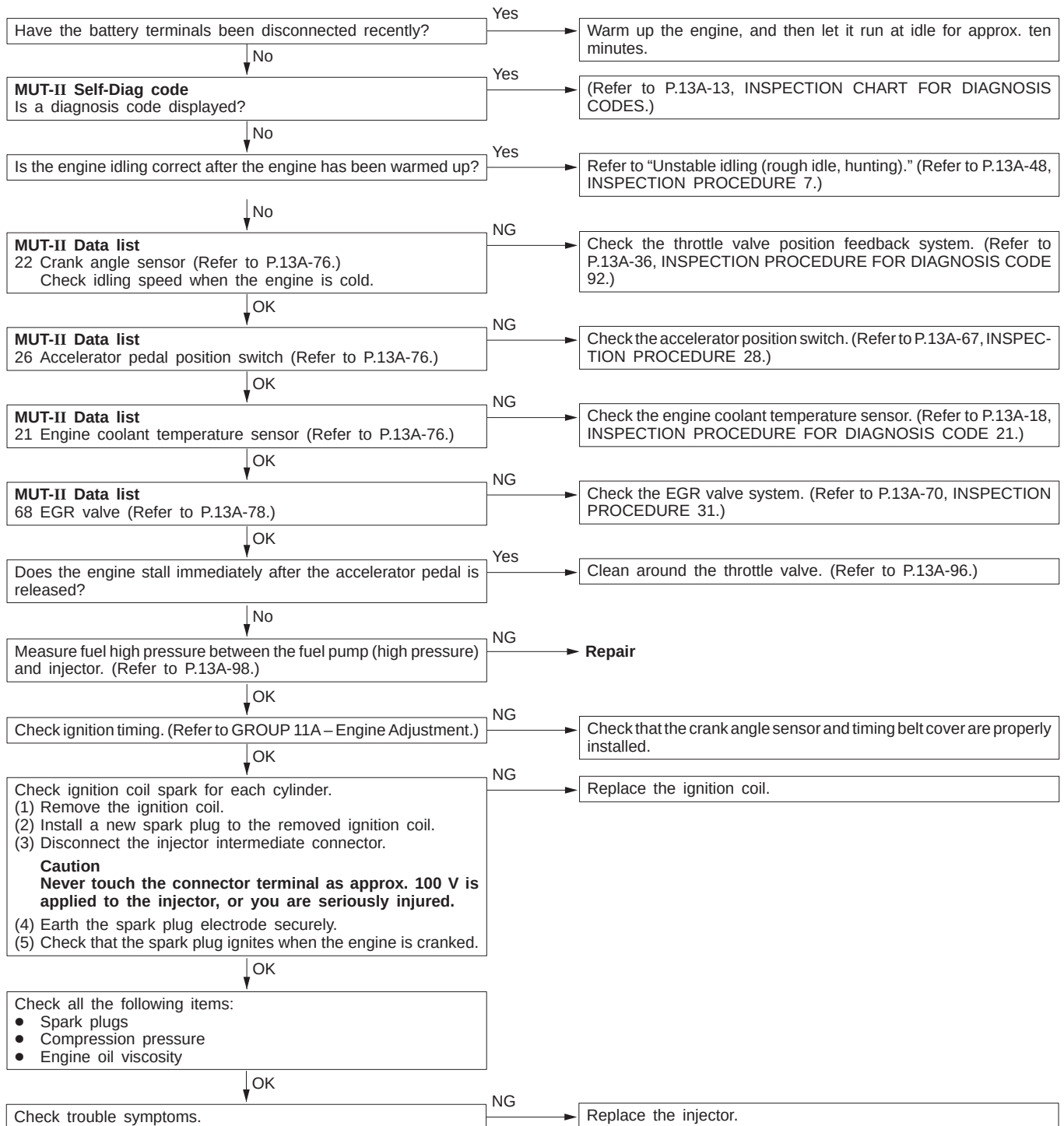
INSPECTION PROCEDURE 8

Idle speed is high or low (Improper idling)	Probable cause
The cause is probably that the intake air amount during idling is too great or too small.	- Malfunction of the electronic-controlled throttle valve system - Malfunction of the throttle body



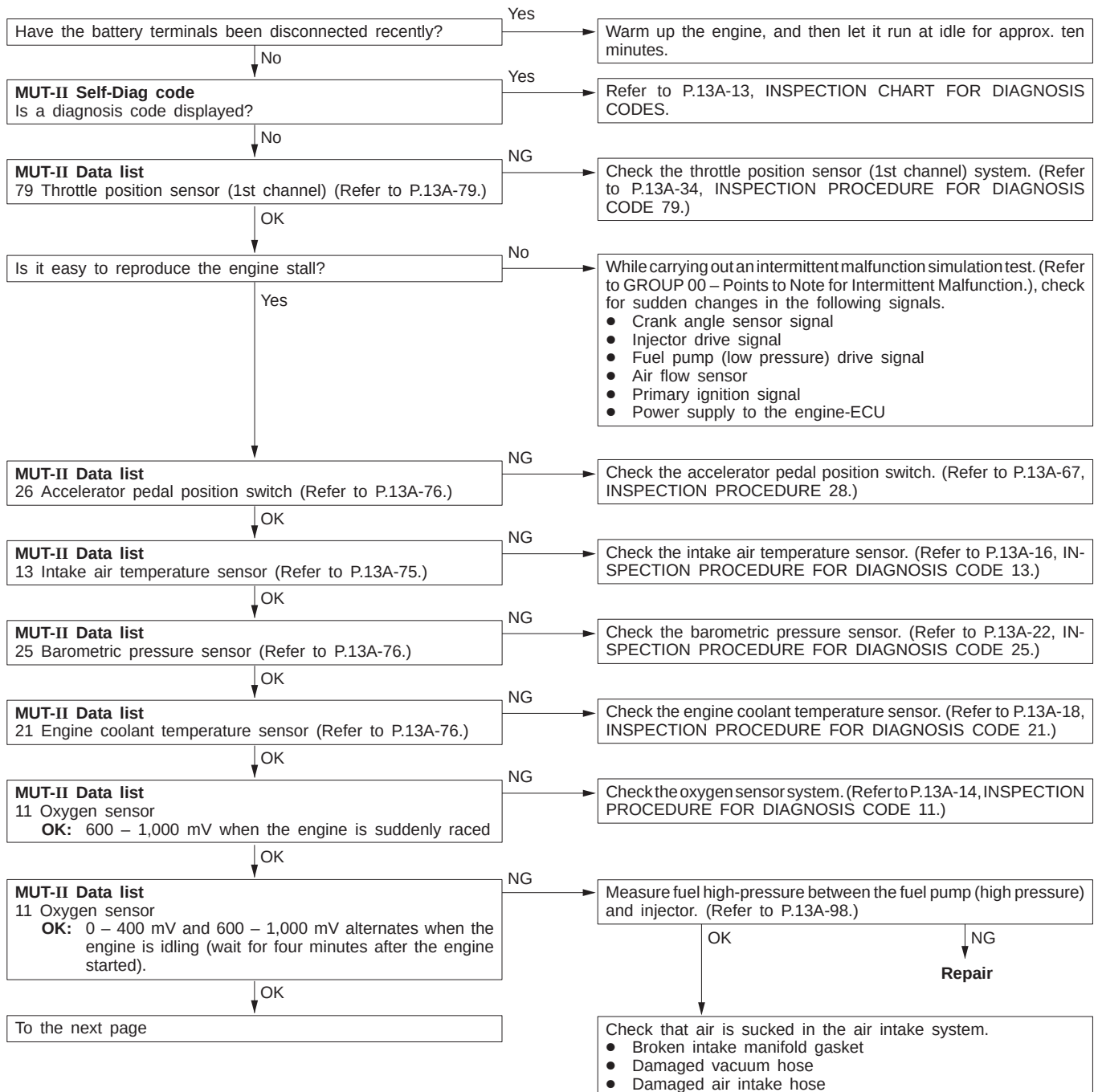
INSPECTION PROCEDURE 9

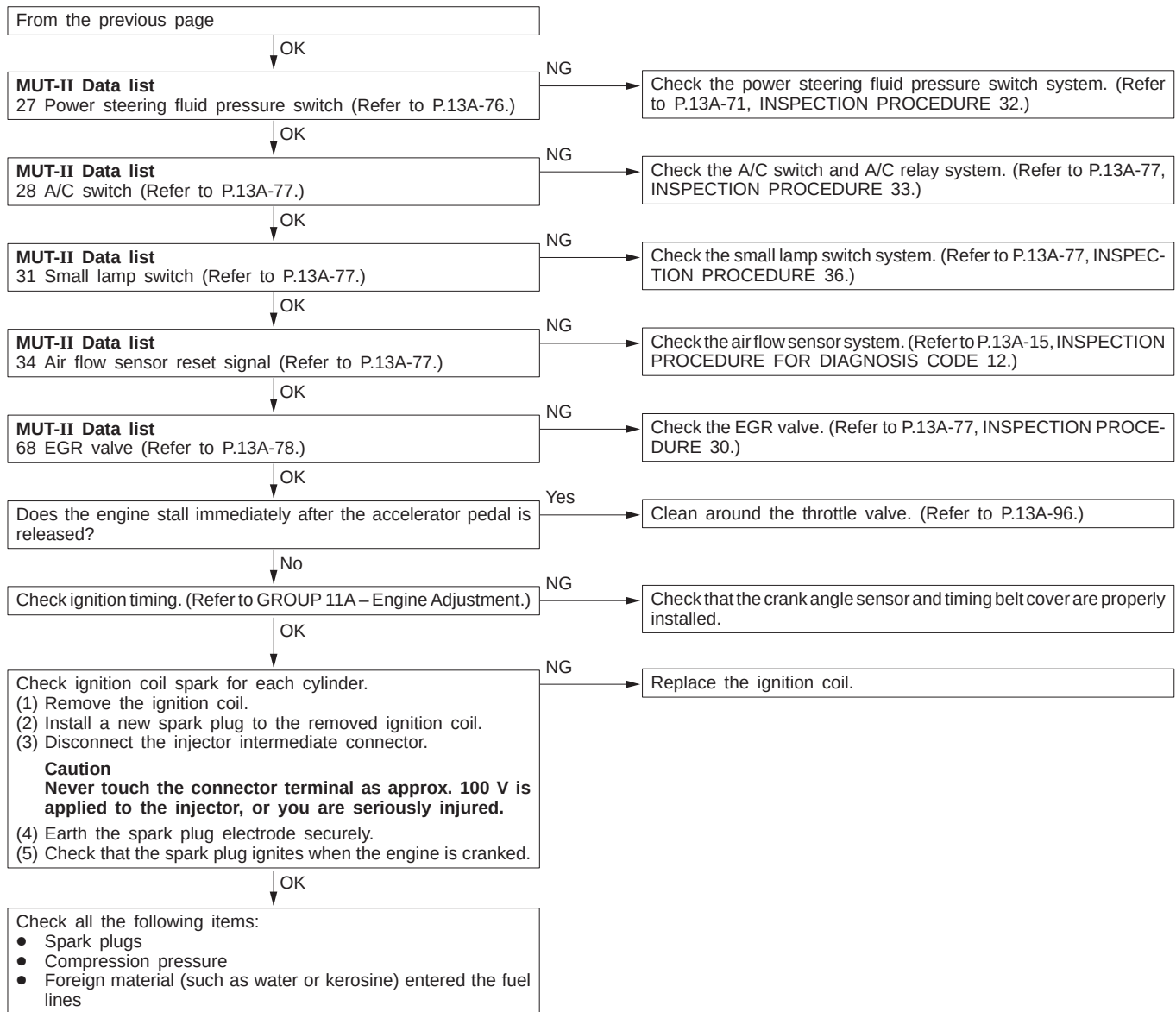
When the engine is cold, it stalls at idling. (Die out)	Probable cause
The cause is probably an incorrect air/fuel ratio or poor intake air amount when the engine is cold.	- Malfunction of the electronic-control throttle valve system - Malfunction of the throttle body



INSPECTION PROCEDURE 10

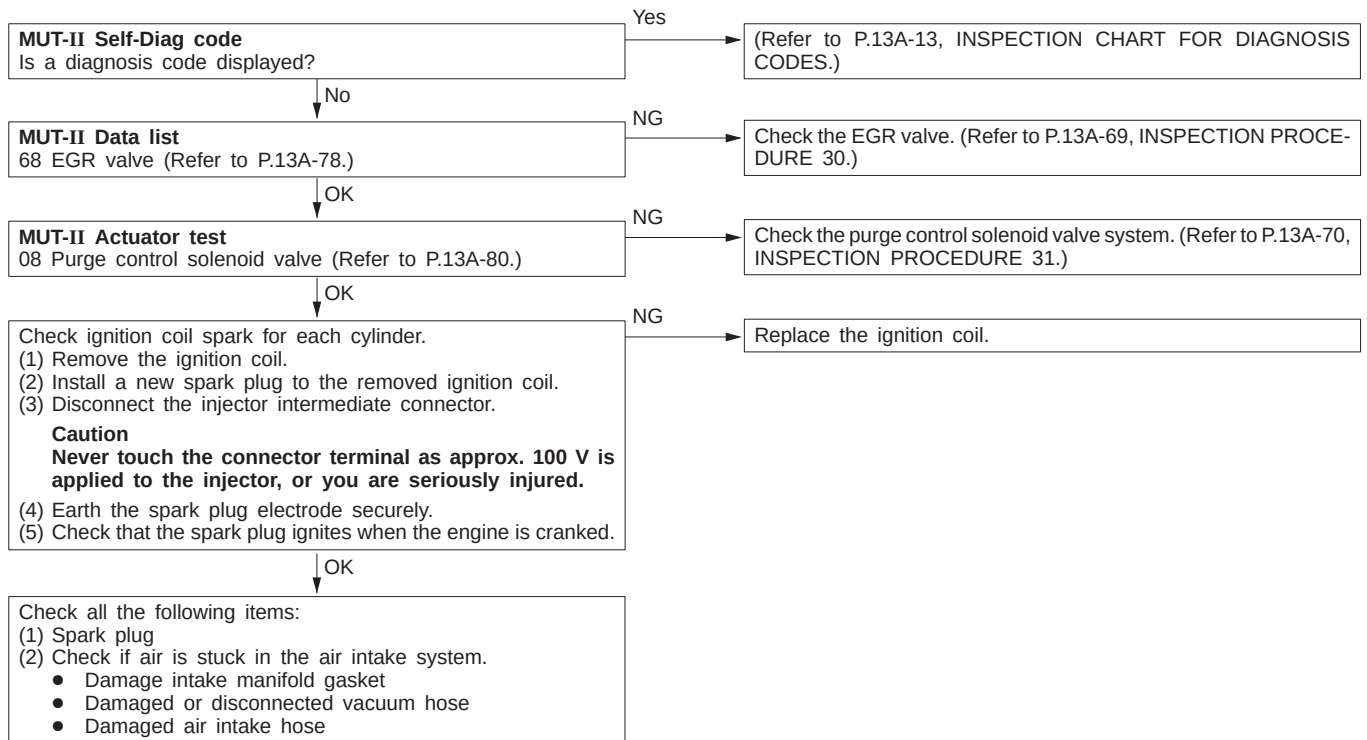
When the engine is hot, it stalls at idling. (Die out)	Probable cause
The cause is probably an improper air/fuel ratio, faulty electronic-controlled throttle valve system, compression pressure. In addition, if the engine stalls suddenly, another possible cause might be a poor connector contact.	● Malfunction of the ignition system ● Malfunction of the air/fuel ratio control system ● Malfunction of the electronic-controlled throttle valve system ● Malfunction of the throttle body ● Poor connector contact ● Improper compression pressure ● Air stuck in the air intake system





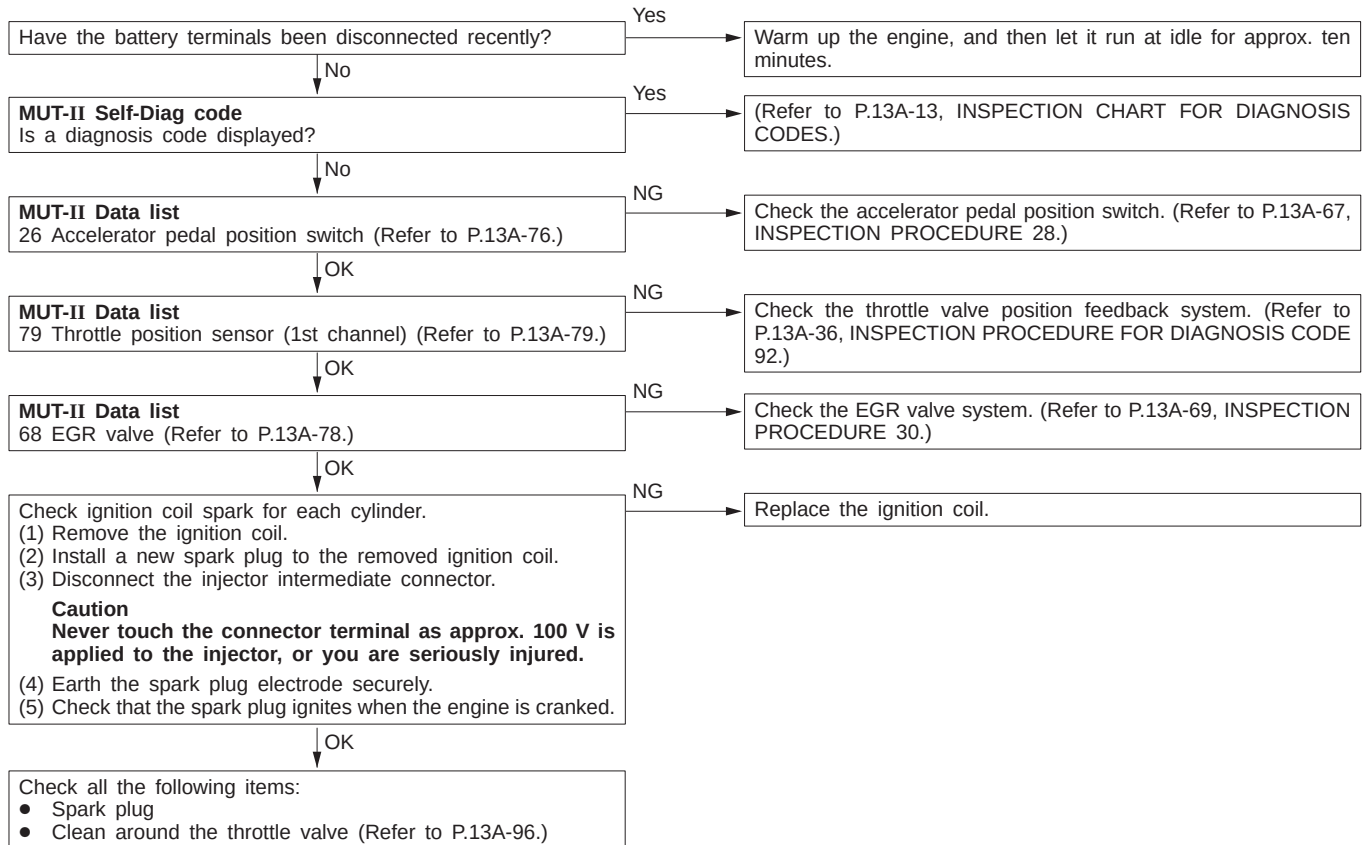
INSPECTION PROCEDURE 11

The engine stalls when starting the car. (Pass out)	Probable cause
The cause is probably poor ignition due to a malfunctioning spark plug (weak spark), or an incorrect air/fuel ratio when the accelerator is depressed.	• Malfunction of the ignition system • Malfunction of the EGR valve • Air stuck in the air intake system



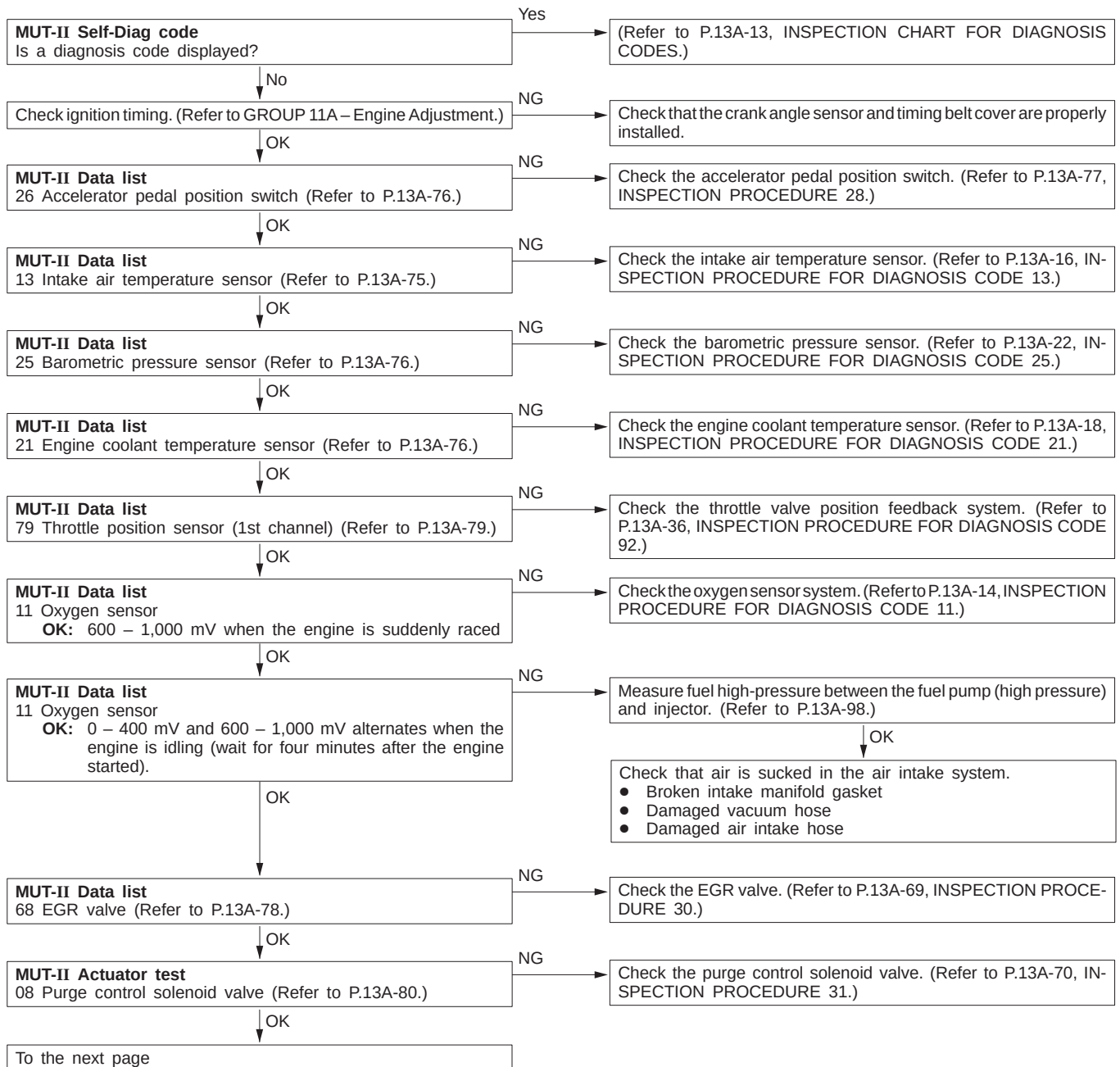
INSPECTION PROCEDURE 12

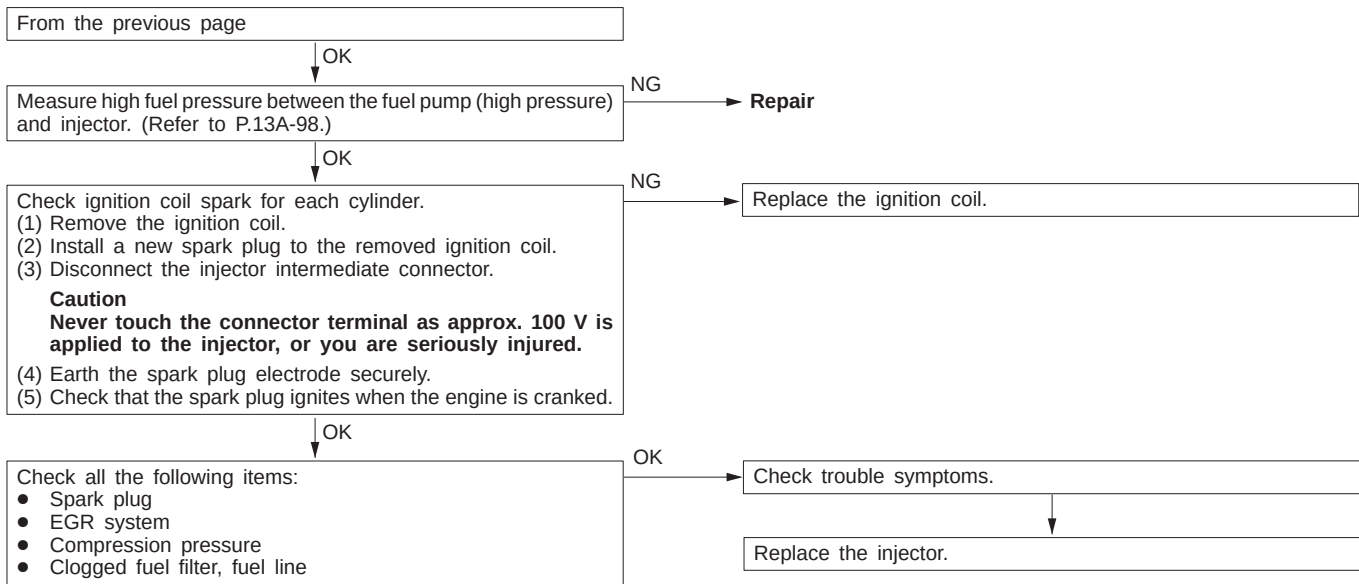
The engine stalls when decelerating.	Probable cause
The cause is probably an improper air/fuel ratio due to a faulty EGR system, or poor intake air volume due to a faulty electronic-controlled throttle valve system.	- Malfunction of the electronic-controlled throttle valve system - Malfunction of the EGR valve



INSPECTION PROCEDURE 13

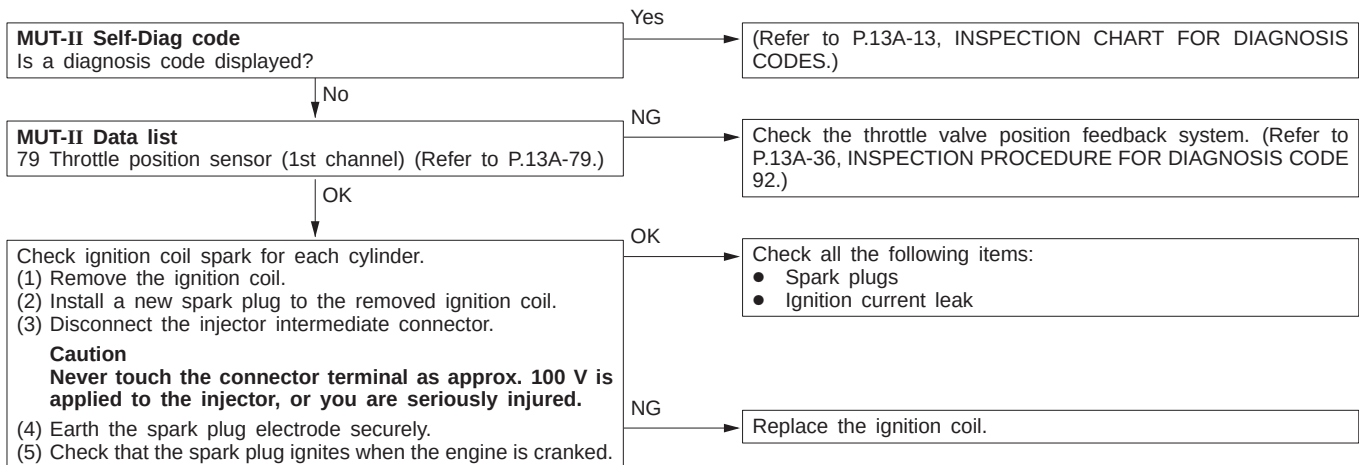
Hesitation, sag, stumble, poor acceleration or surge	Probable cause
The cause is probably a malfunction of the ignition system, electronic-controlled throttle valve system, compression pressure, etc.	• Malfunction of the ignition system • Malfunction of the air/fuel ratio control system • Malfunction of the electronic-controlled throttle valve system • Improper compression pressure • Air stuck in the air intake system





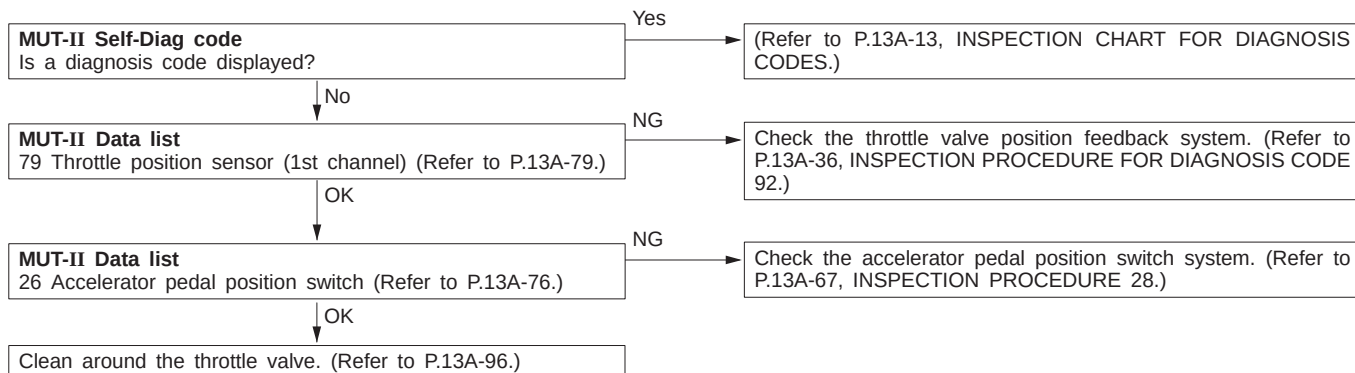
INSPECTION PROCEDURE 14

The feeling of impact when accelerating	Probable cause
The cause is probably an ignition leak being generated in line with an increase in the spark plug request voltage during acceleration.	• Malfunction of the ignition system



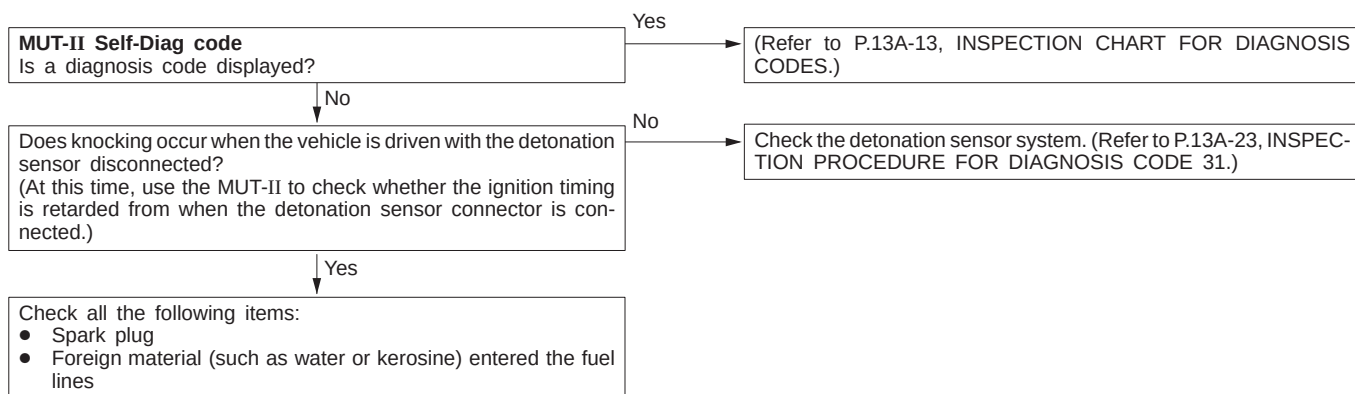
INSPECTION PROCEDURE 15

The feeling of impact when decelerating	Probable cause
The cause is probably insufficient intake air due to a faulty electronic-controlled throttle valve system.	Malfunction of the electronic-controlled throttle valve system



INSPECTION PROCEDURE 16

Knocking	Probable cause
The cause is probably incorrect detonation control or improper heat range of the spark plugs.	- Malfunction of the detonation sensor - Improper heat range of the spark plugs



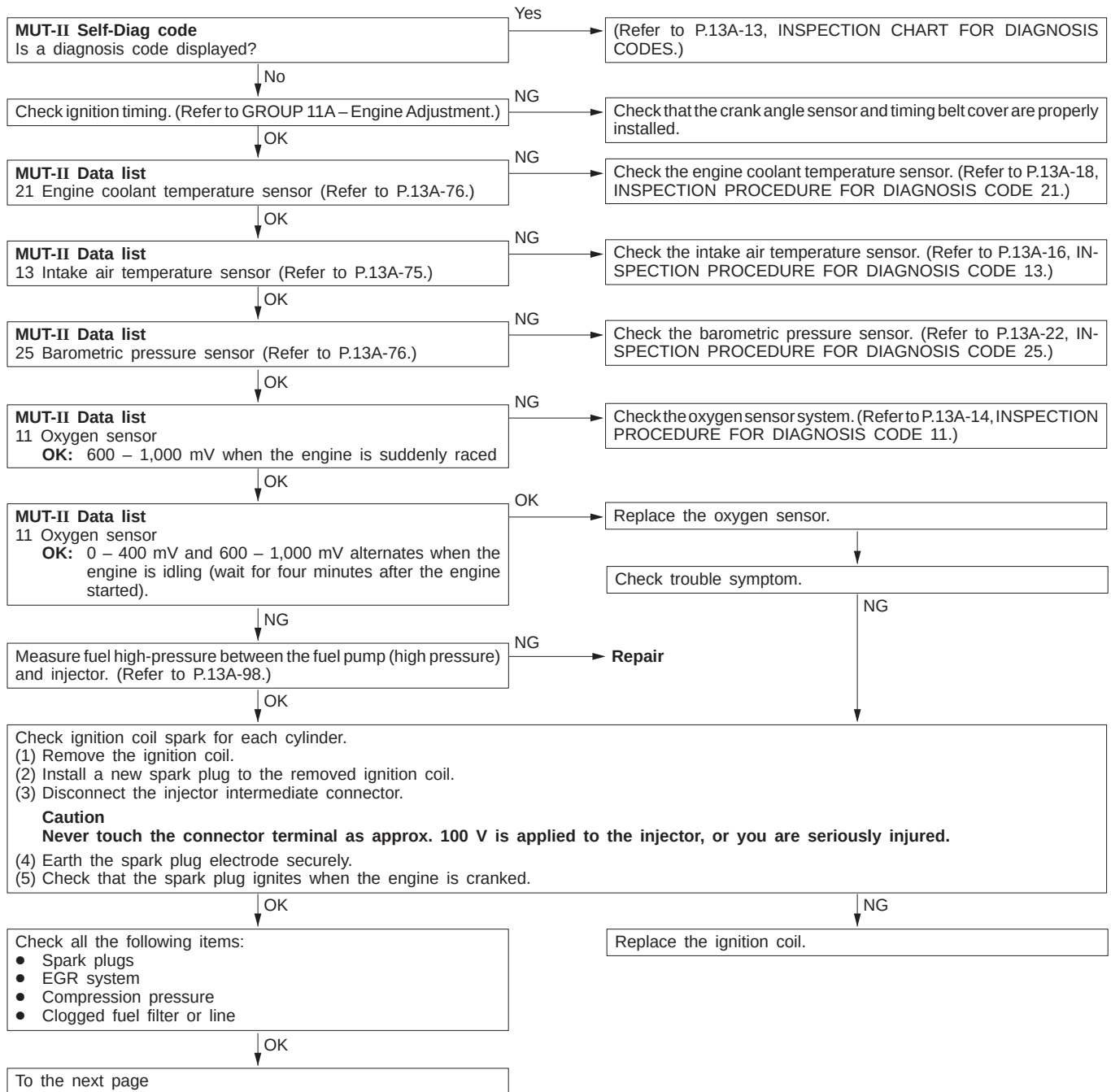
INSPECTION PROCEDURE 17

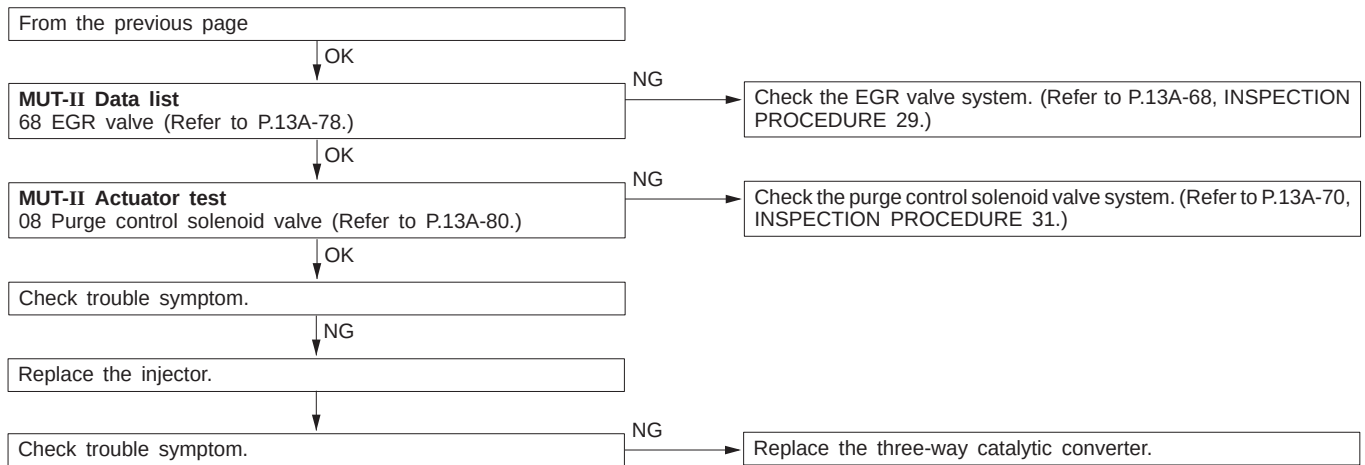
Run-on (dieseling)	Probable cause
The cause is probably fuel leak from injector(s)	Malfunction of the injector

Replace the injector.

INSPECTION PROCEDURE 18

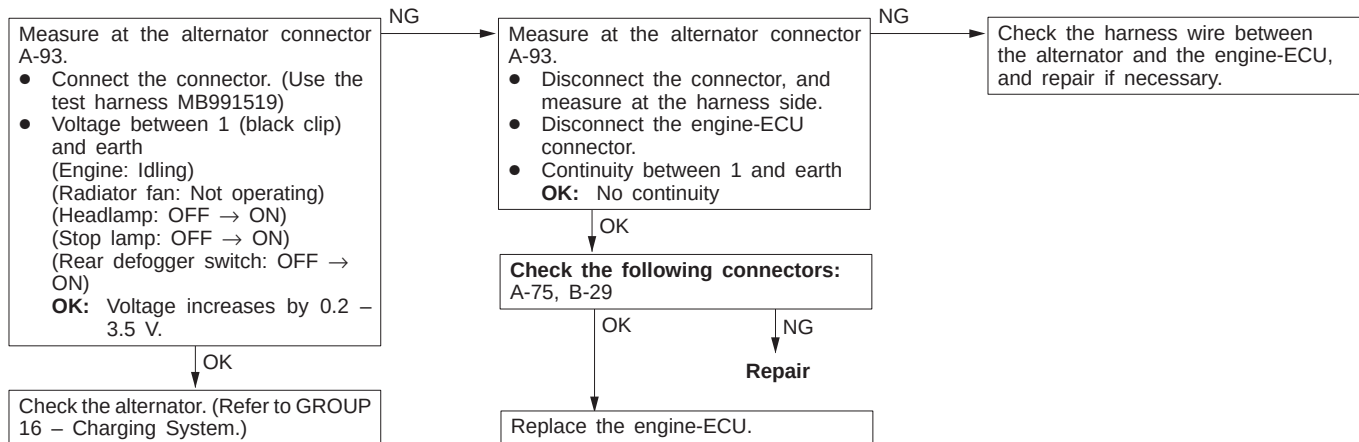
To high CO and HC concentration when idling	Probable cause
The cause is probably an incorrect air/fuel ratio	- Malfunction of the air/fuel ratio control system - Deterioration of the catalyst





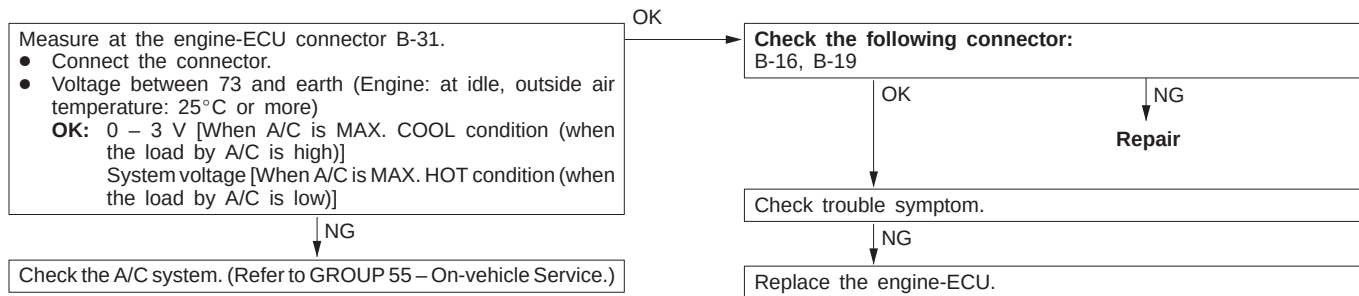
INSPECTION PROCEDURE 19

Low alternator output voltage (approx. 12.3 V)	Probable cause
The cause is probably a malfunction of the alternator or one of the problems listed at right.	- Malfunction of the charging system - Open circuit between the alternator G terminal and the engine-ECU - Malfunction of the engine-ECU



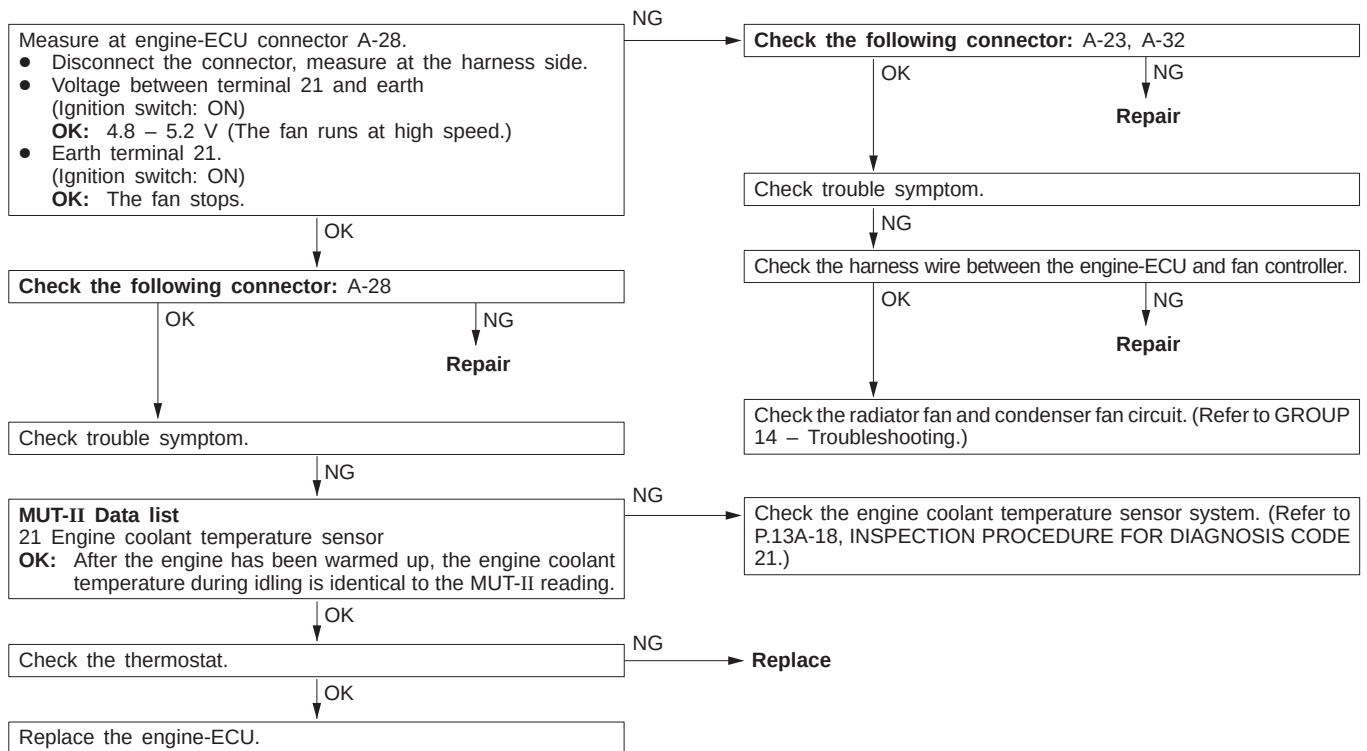
INSPECTION PROCEDURE 20

Idling speed is improper when A/C is operating	Probable cause
If the engine-ECU detects that the air conditioner is on, it activates the idle speed control (ISC) servo to control idle-up operation. The A/C-ECU judges if the load caused by air conditioner operation is high or low, and converts it to voltage signal (high or low voltage) and inputs the signal to the engine-ECU. Based on this voltage signal, the engine-ECU controls the idle-up speed (for high or low load).	- Malfunction of the A/C control system - Improper connector contact, open circuit or short-circuited harness wire - Malfunction of the engine-ECU



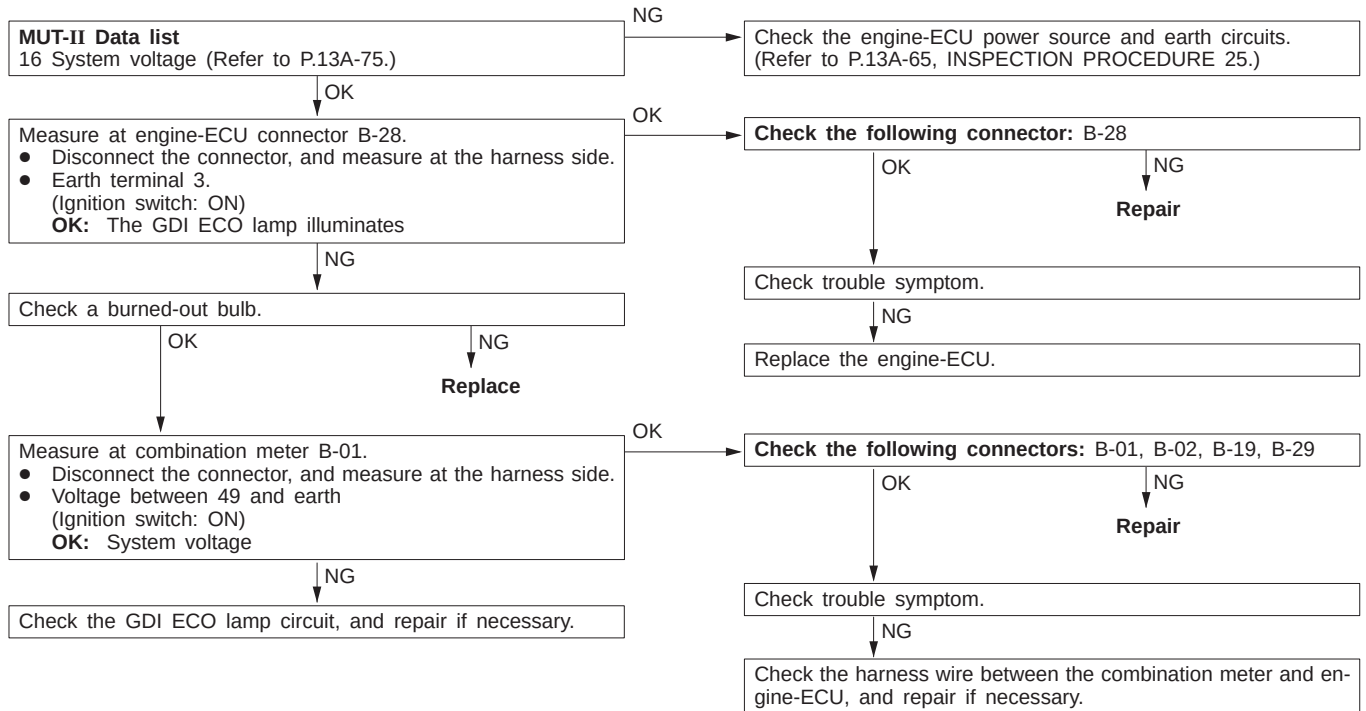
INSPECTION PROCEDURE 21

Fans (radiator fan, A/C condenser fan) are inoperative.	Probable cause
The engine-ECU sends a duty signal to the fan controller according to engine coolant temperature, vehicle speed, or A/C switch load. The fan controller controls radiator fan and condenser fan speeds, based on this signal. (The closer the terminal voltage comes to 5 V, the higher the fan speed becomes.)	● Malfunction of the fan motor relay ● Malfunction of the fan motor ● Malfunction of the fan controller ● Open or short circuit, or poor connector contact ● Malfunction of the engine-ECU



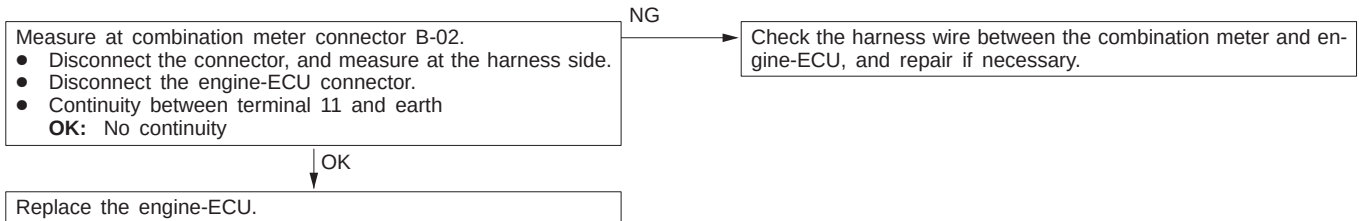
INSPECTION PROCEDURE 22

The GDI ECO lamp does not illuminate.	Probable cause
If the GDI ECO lamp does not illuminate after turning on the ignition switch, the causes listed in the right column are suspected.	● Burned-out GDI ECO lamp bulb ● Open circuit or short-circuited harness wire in the GDI ECO lamp circuit ● Malfunction of the engine-ECU



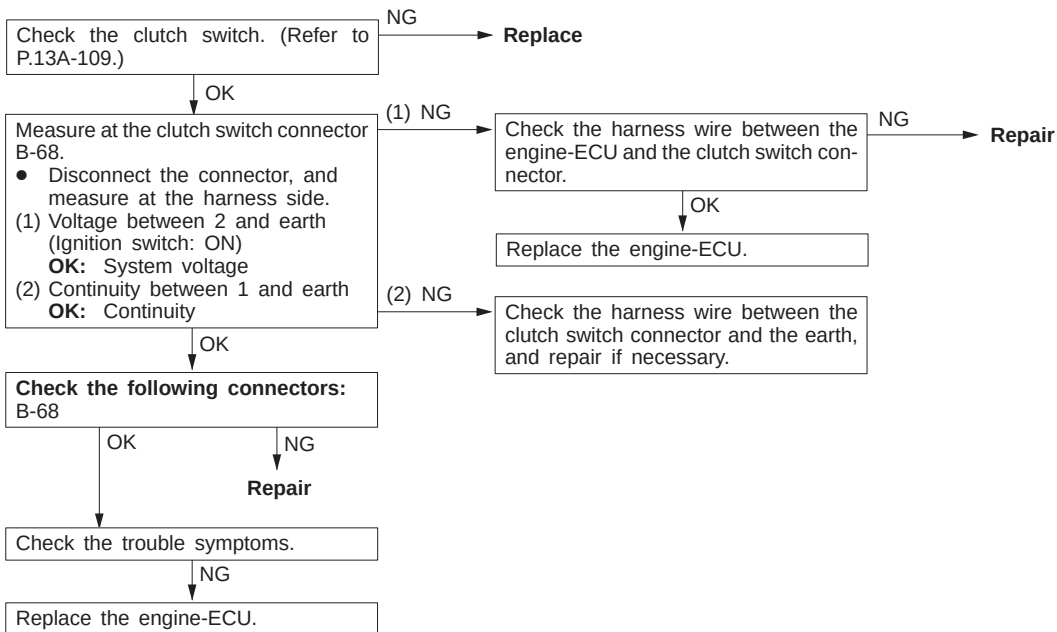
INSPECTION PROCEDURE 23

The GDI ECO lamp remains on (does not extinguish).	Probable cause
If the GDI ECO lamp does not extinguish during high load operation, the causes listed in the right column are suspected.	- Short circuit between the GDI ECO lamp and engine-ECU - Malfunction of the engine-ECU



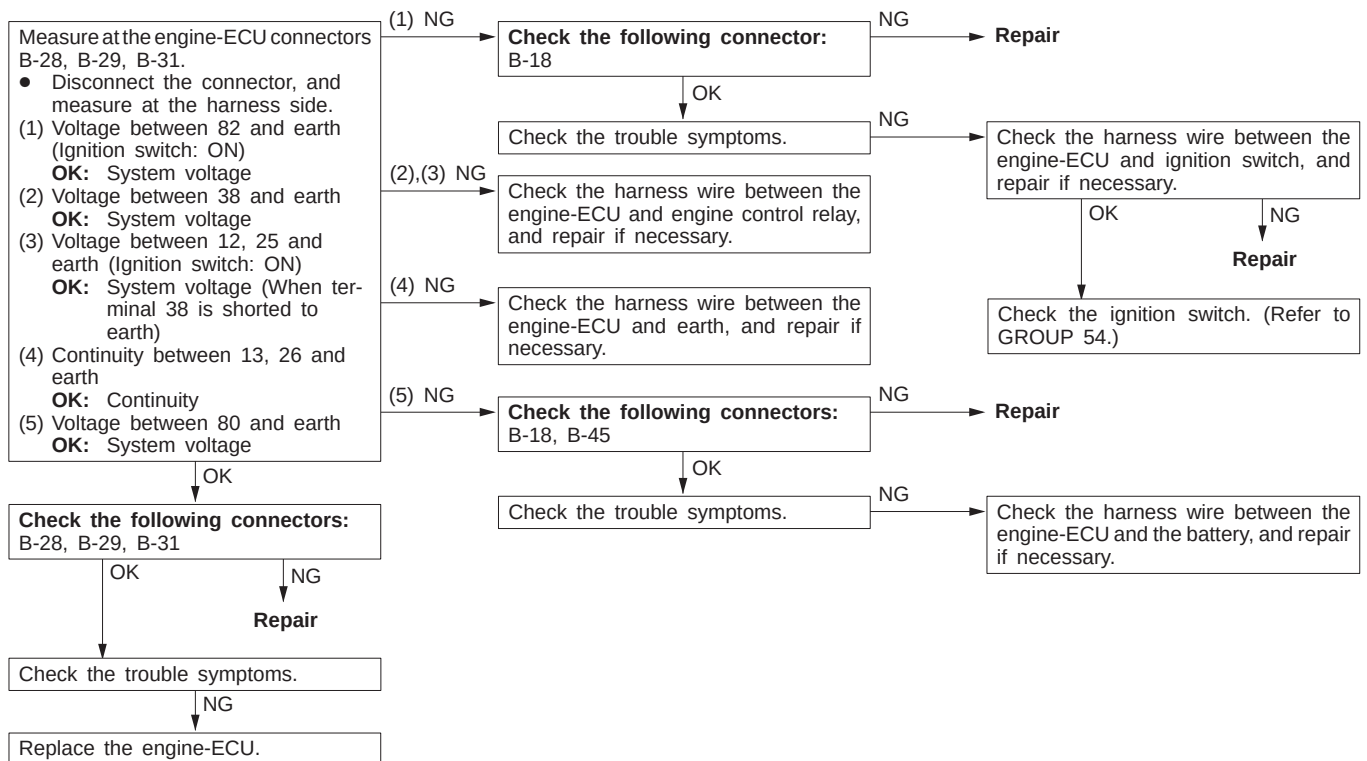
INSPECTION PROCEDURE 24

Malfunction of the clutch switch system	Probable cause
When the clutch pedal is depressed, the clutch switch sends a signal to the engine-ECU, and the engine-ECU controls the fuel injection properly based on this signal. Due to this, engine speed fluctuation is reduced at shifting.	- Malfunction of the clutch switch - Open circuit or short-circuited harness wire in the clutch switch circuit - Malfunction of the engine-ECU



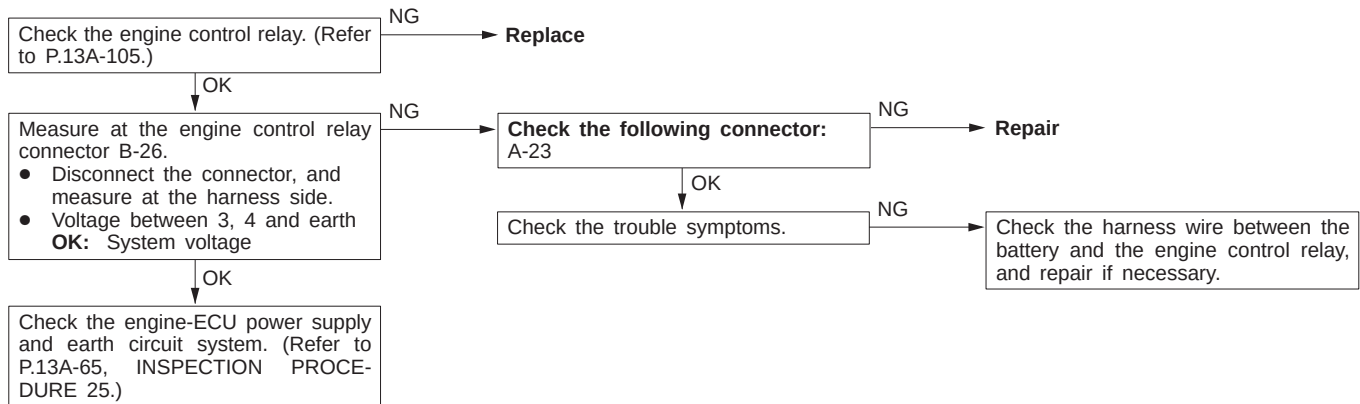
INSPECTION PROCEDURE 25

Engine-ECU power supply and earth circuit system	Probable cause
The cause is probably a malfunction of the engine-ECU or one of the problems listed at right.	- Open circuit or short-circuited harness wire in the engine-ECU power supply circuit - Open circuit or short-circuited harness wire in the engine-ECU earth circuit - Malfunction of the engine-ECU



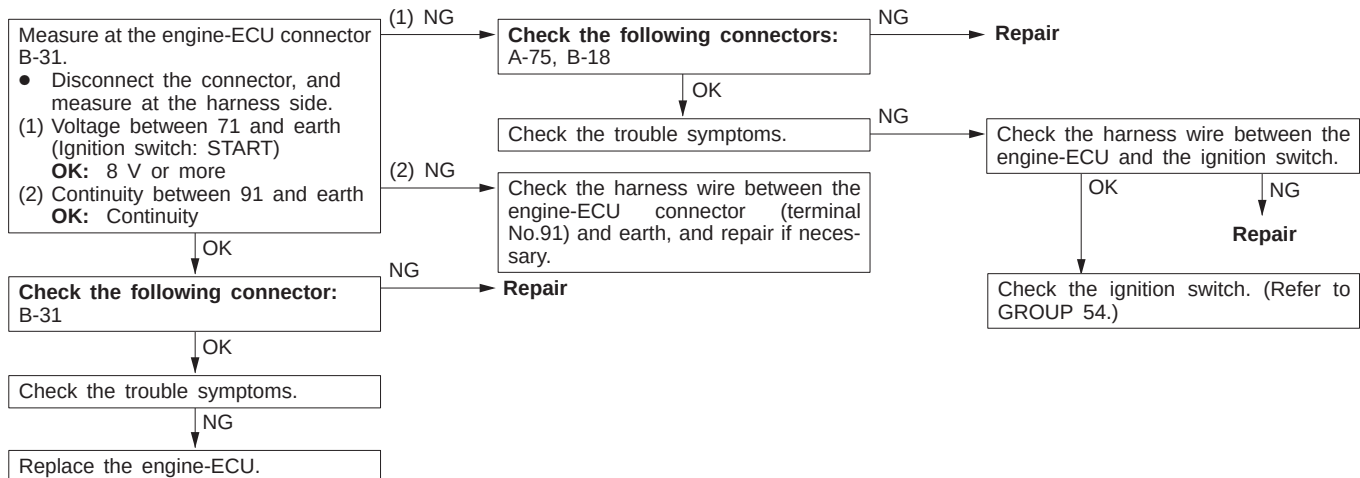
INSPECTION PROCEDURE 26

Engine control relay and ignition switch-IG system	Probable cause
When the ignition switch ON signal is input to the engine-ECU, the engine-ECU turns on the engine control relay. This causes system voltage to be supplied to the engine-ECU and to the sensors and actuators.	● Malfunction of the ignition switch ● Malfunction of the engine control relay ● Open circuit or short-circuited harness wire of the engine control relay circuit ● Malfunction of the engine-ECU



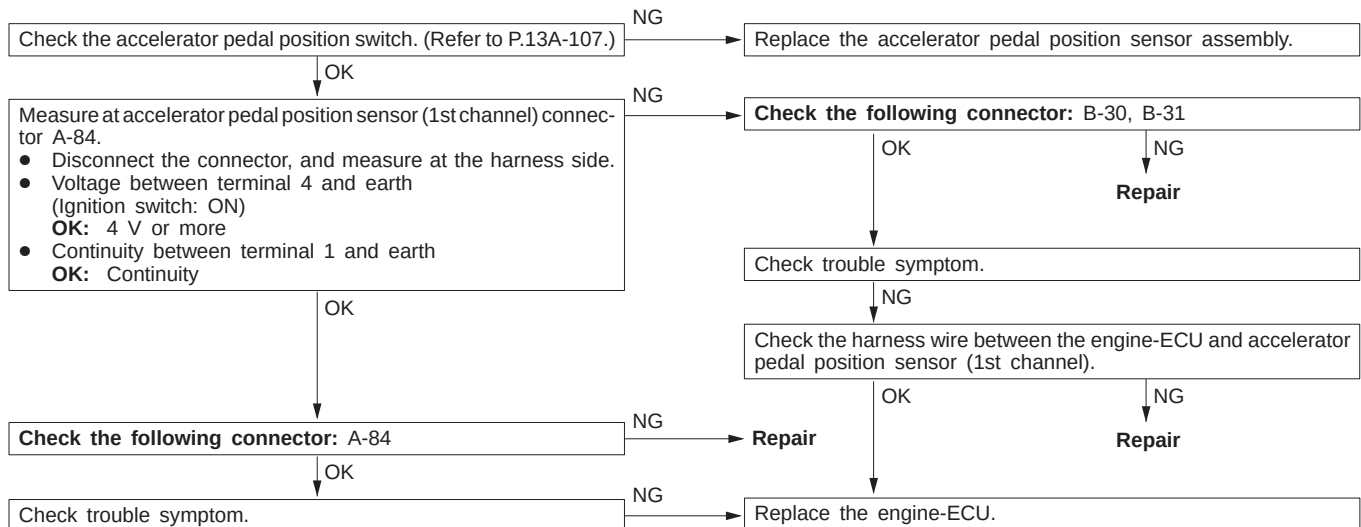
INSPECTION PROCEDURE 27

Ignition switch-ST system	Probable cause
The ignition switch-ST outputs a HIGH signal to the engine-ECU while the engine is cranking. The engine-ECU uses this signal to carry out functions such as fuel injection control during starting.	● Malfunction of the ignition switch ● Open circuit or short-circuited harness wire of the ignition switch circuit ● Malfunction of the engine-ECU



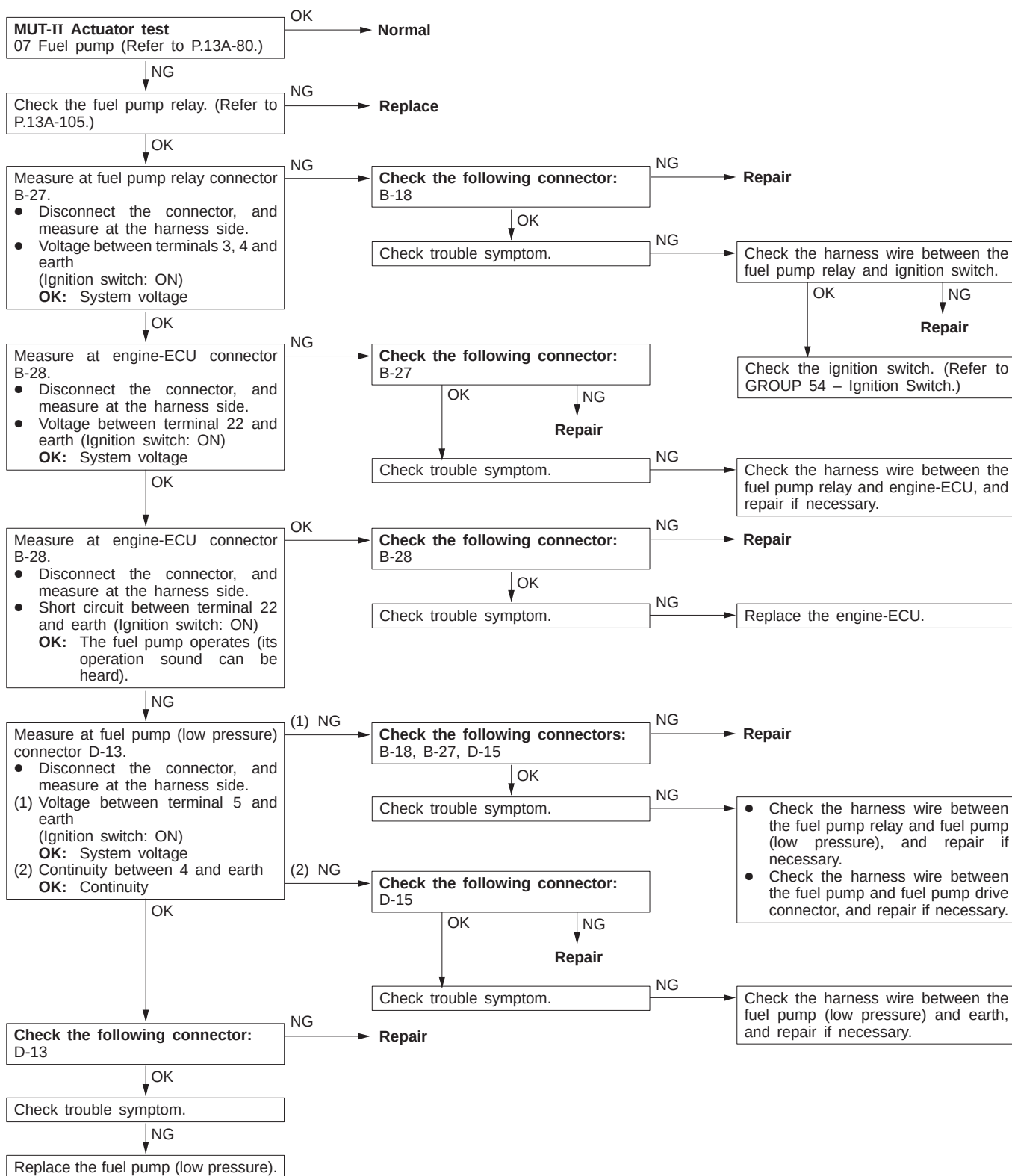
INSPECTION PROCEDURE 28

Accelerator pedal position switch system	Probable cause
The accelerator pedal position switch detects that the accelerator pedal is fully closed, and sends a signal to the engine-ECU. The engine-ECU judges if the accelerator pedal position sensor is faulty, based on this signal.	- Maladjustment of the accelerator cable - Maladjustment of the accelerator pedal position switch - Open circuit or short-circuited harness wire in the accelerator pedal position switch system, or poor connector contact - Malfunction of the engine-ECU



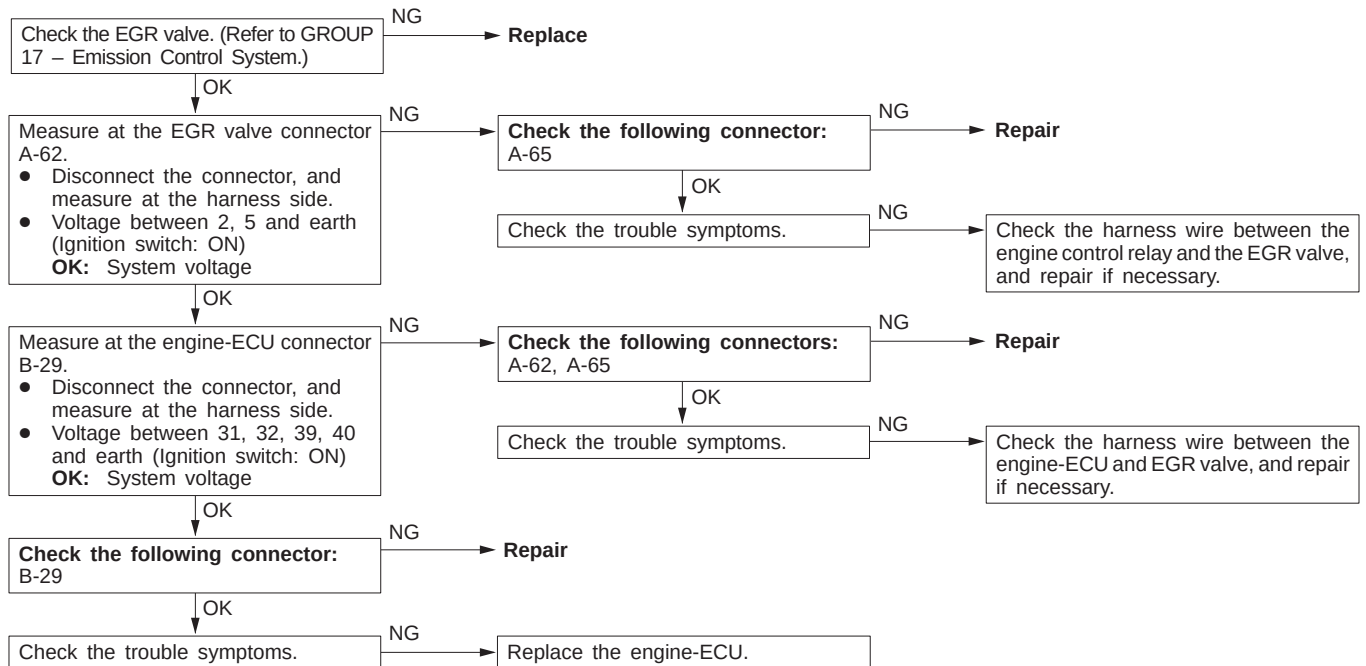
INSPECTION PROCEDURE 29

Fuel pump (low pressure) system	Probable cause
The engine-ECU turns on the fuel pump relay while the engine is cranking or running, and supplies power source to the fuel pump (low pressure).	• Malfunction of the fuel pump relay • Malfunction of the fuel pump (low pressure) • Open circuit or short-circuited harness wire in the fuel pump (low pressure) circuit, or poor connector contact • Malfunction of the engine-ECU



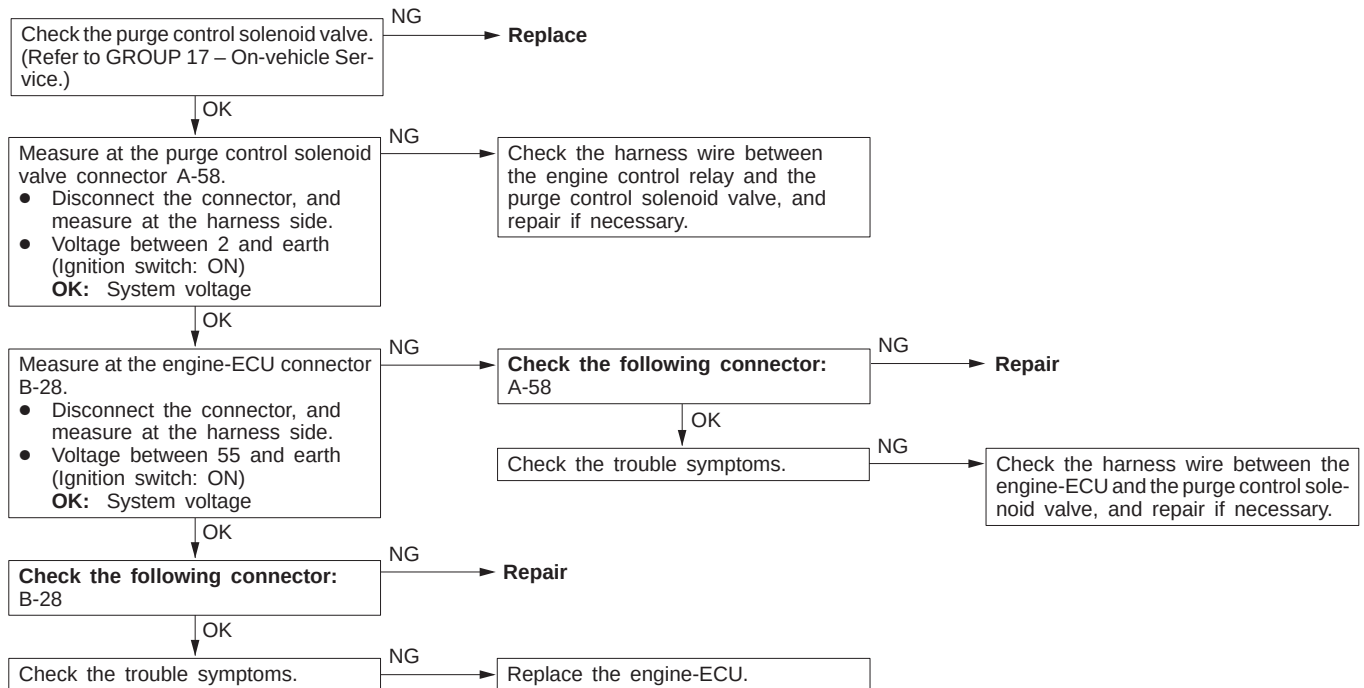
INSPECTION PROCEDURE 30

EGR valve (stepper motor) system	Probable cause
The engine-ECU controls the EGR valve (stepper motor) in order to control the amount of exhaust gas mixed in the intake air.	● Malfunction of the EGR valve ● Open circuit or short-circuited harness wire in the EGR valve circuit ● Malfunction of the engine-ECU



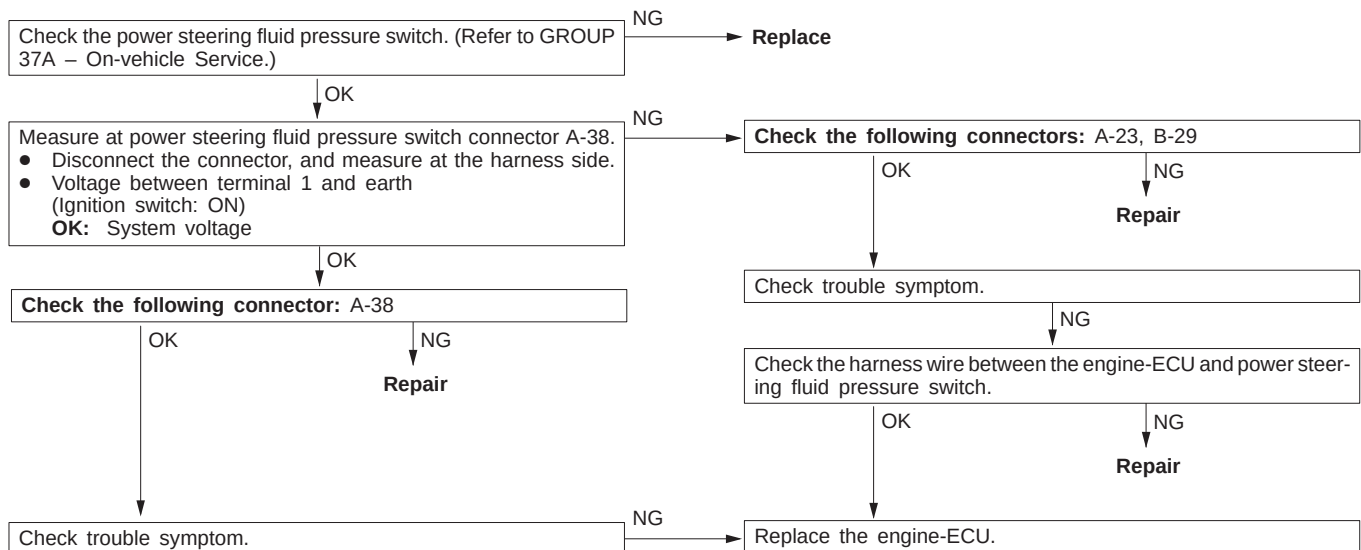
INSPECTION PROCEDURE 31

Purge control solenoid valve system	Probable cause
The engine-ECU controls the purge control solenoid valve in order to control the purge air coming from the canister.	- Malfunction of the purge control solenoid valve - Open circuit or short-circuited harness wire in the purge control solenoid valve circuit - Malfunction of the engine-ECU



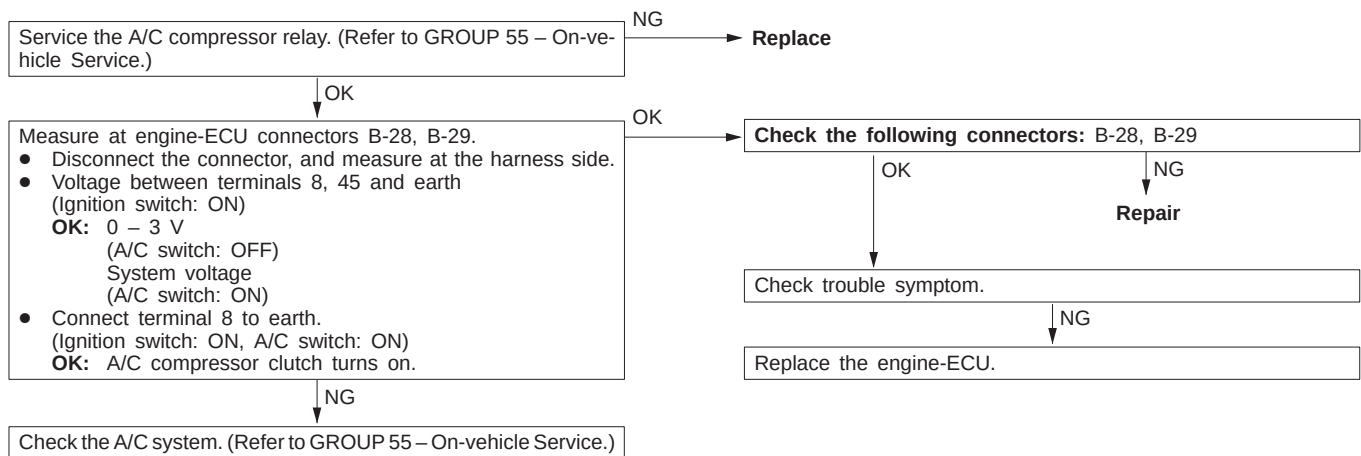
INSPECTION PROCEDURE 32

Power steering fluid pressure switch system	Probable cause
The power steering fluid pressure switch sends a signal to the engine-ECU according to power steering load. Based on this signal, the engine-ECU controls the throttle control servo so that idle speed increases when the power steering is in operation.	- Malfunction of the power steering fluid pressure switch - Open circuit or short-circuited harness wire in the power steering fluid pressure switch circuit, or poor connector contact - Malfunction of the engine-ECU



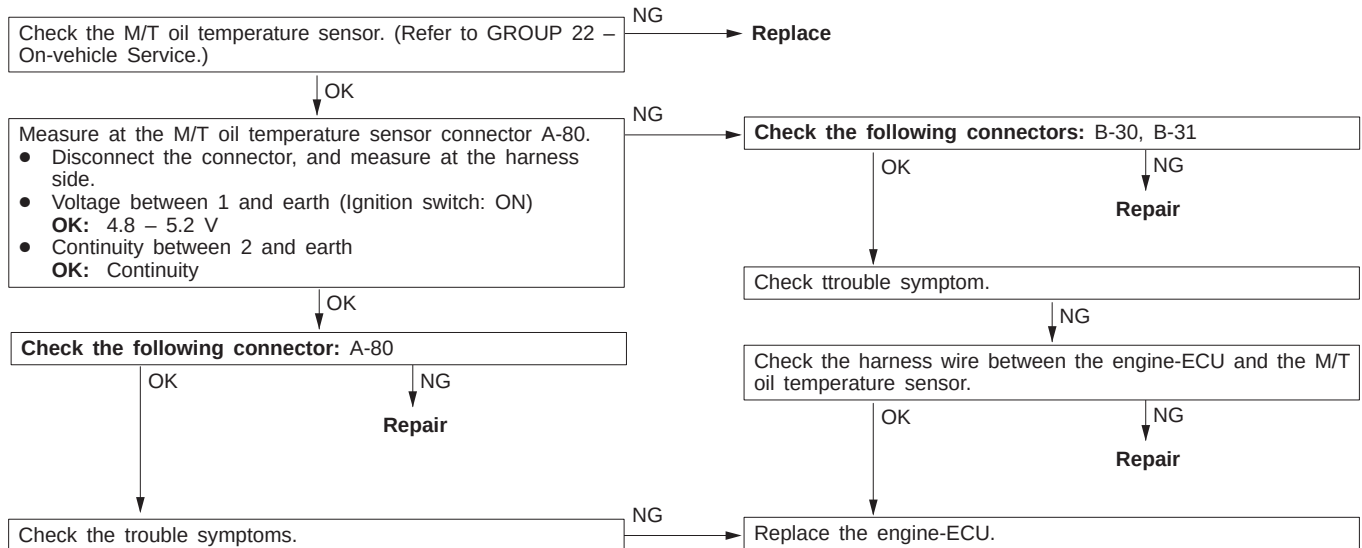
INSPECTION PROCEDURE 33

A/C switch and A/C relay system	Probable cause
If the engine-ECU receives a 'A/C on' signal, it operates the throttle control servo and A/C compressor magnetic clutch so that idle speed increases.	- Malfunction of the A/C control system - Malfunction of the A/C switch - Open circuit or short-circuited harness wire in the A/C switch circuit, or poor connector contact - Malfunction of the engine-ECU



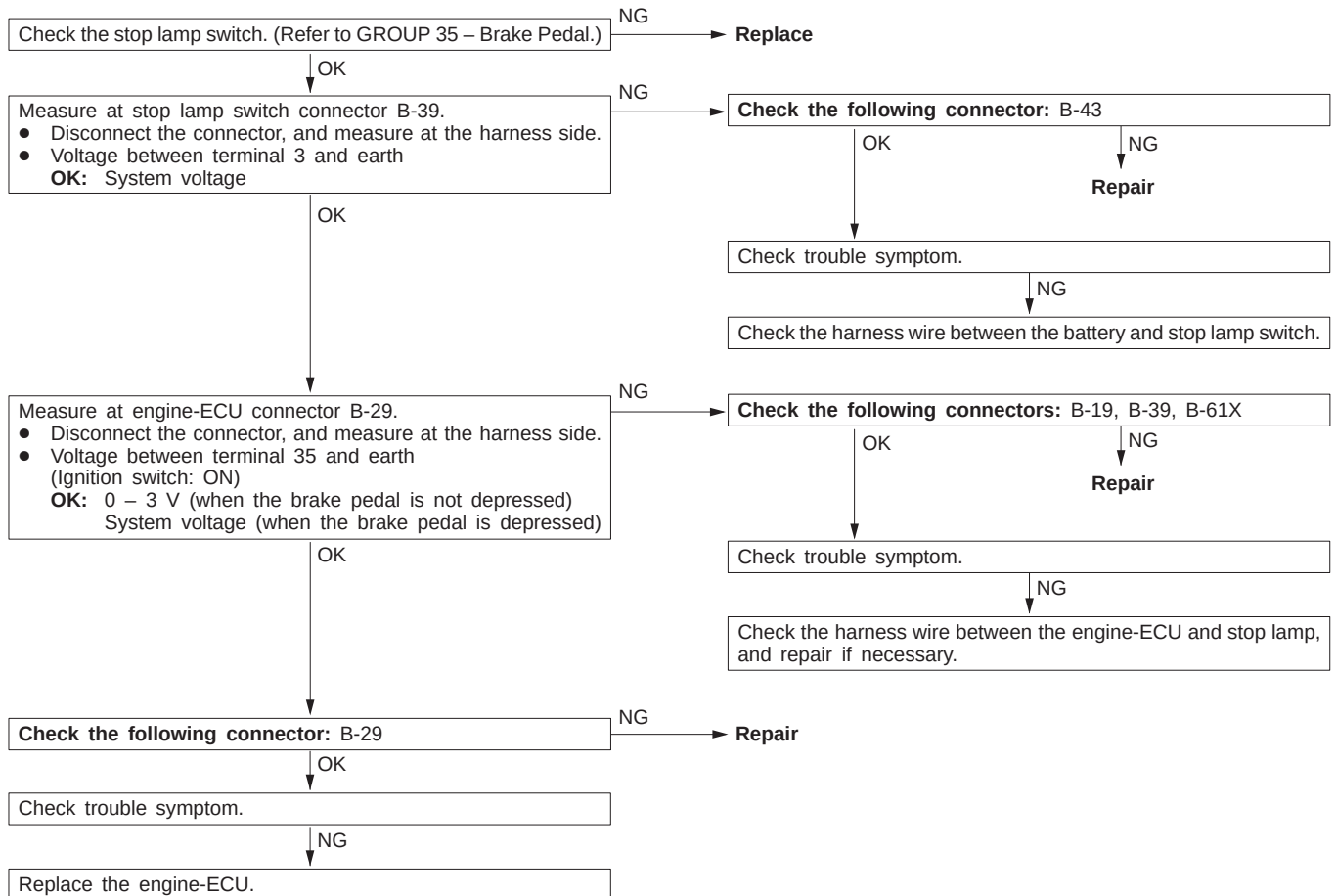
INSPECTION PROCEDURE 34

M/T oil temperature sensor system	Probable cause
This sensor inputs the manual transmission oil temperature to the engine-ECU. The engine-ECU uses this input to control the idle speed control servo so that the idle speed is increased when the manual transmission oil temperature becomes low.	- Malfunction of the M/T oil temperature sensor - Open circuit or short-circuited harness wire in the M/T oil temperature sensor circuit - Malfunction of the engine-ECU



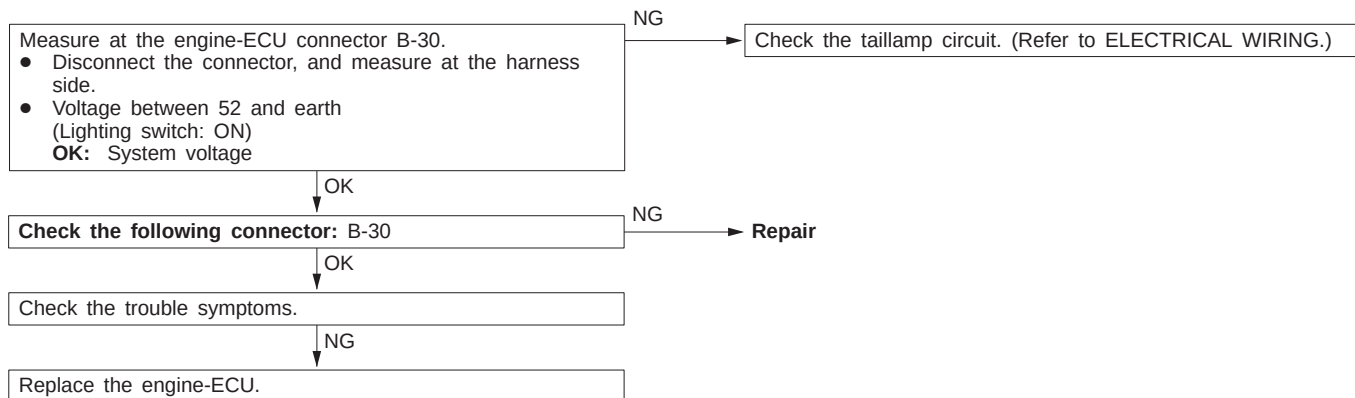
INSPECTION PROCEDURE 35

Stop lamp switch system	Probable cause
The engine-ECU determines whether the brake pedal is depressed or not, by means of the stop lamp switch input signal.	- Malfunction of the stop lamp switch - Open circuit or short-circuited harness wire in the stop lamp circuit, or poor connector contact - Malfunction of the engine-ECU



INSPECTION PROCEDURE 36

Small lamp switch	Probable cause
The engine-ECU determines whether the small lamp switch is on or off. According to that information, the engine-ECU controls alternator output current when the vehicle is started.	- Improper connector contact, open circuit or short-circuited harness wire in the taillamp circuit - Malfunction of the engine-ECU



DATA LIST REFERENCE TABLE

Caution

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

NOTE

*1: Within four minutes after starting the engine

*2: In a new vehicle [driven approximately 500 km or less], the injector drive time is sometimes 10% longer than the standard time.

*3: The accelerator pedal position switch normally turns off when the voltage of the accelerator pedal position sensor (1st channel) is 50 – 100 mV higher than the voltage at the idle position. If the accelerator pedal position switch turns back on after the accelerator pedal position sensor voltage has risen by 100 mV and the throttle valve has opened, the accelerator pedal position switch and the accelerator pedal position sensor (1st channel) need to be adjusted.

Item No.	Check items	Requirements	Normal condition	Inspection procedure No.	Reference page
11	Oxygen sensor	Engine: After warm-up	Idling	0 mV	Code No.11 13A-14
			Sudden racing	600 – 1,000 mV	
			2,500 r/min	400 mV or less and 600 – 1,000 mV alternates.	
12	Air flow sensor	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral	Idling	20 – 55 Hz	Code No.12 13A-15
			2,500 r/min	65 – 85 Hz	
			Racing	Frequency increases in response to racing.	
13	Intake air temperature sensor	Ignition switch: ON	Intake air temperature: –20°C	–20°C	Code No.13 13A-16
			Intake air temperature: 0°C	0°C	
			Intake air temperature: 20°C	20°C	
			Intake air temperature: 40°C	40°C	
			Intake air temperature: 80°C	80°C	
14	Throttle position sensor (2nd channel)	- Engine coolant temperature: 80 – 95°C - Ignition switch: ON (Engine stopped)	Release the accelerator pedal.	4,200 – 4,800 mV	Code No.14 13A-17
			Depress the accelerator pedal gradually.	Voltage decreases in response to the pedal depression.	
			Depress the accelerator pedal fully.	200 – 900 mV	
16	Power supply voltage	Ignition switch: ON	System voltage	Procedure No.25	13A-65

Item No.	Check items	Requirements	Normal condition	Inspection procedure No.	Reference page
18	Cranking signal (Ignition switch – ST)	Transmission: Neutral	Engine: Stopped Engine: Cranking	OFF ON	Procedure No.27 13A-66
21	Engine coolant temperature sensor	Ignition switch: ON	Intake air temperature: –20°C Intake air temperature: 0°C Intake air temperature: 20°C Intake air temperature: 40°C Intake air temperature: 80°C	–20°C 0°C 20°C 40°C 80°C	Code No.21 13A-18
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-19
		- Engine: Idling - Accelerator pedal position switch: ON	Engine coolant temperature: –20°C Engine coolant temperature: 0°C Engine coolant temperature: 20°C Engine coolant temperature: 40°C Engine coolant temperature: 80°C	1,200 – 1,400 r/min 1,100 – 1,300 r/min 1,000 – 1,200 r/min 900 – 1,100 r/min 500 – 700 r/min*1	
25	Barometric pressure sensor	Ignition switch: ON	Altitude: 0 m Altitude: 600 m Altitude: 1,200 m Altitude: 1,800 m	101 kPa 95 kPa 88 kPa 81 kPa	Code No.25 13A-22
26	Accelerator pedal position switch	Ignition switch: ON (Depress and release the accelerator pedal several times)	Release the accelerator pedal. Depress the accelerator pedal slightly.	ON OFF	Procedure No.28 13A-67
27	Power steering fluid pressure switch	Engine: Idling	Steering wheel stationary Steering wheel turning	OFF ON	Procedure No.32 13A-71

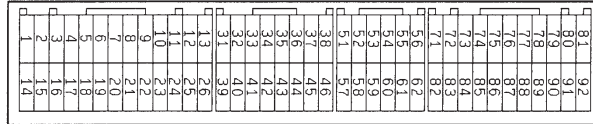
Item No.	Check items	Requirements		Normal condition	Inspection procedure No.	Reference page
28	A/C switch	Engine: Idling (The A/C compressor is running when the A/C switch is on.)	A/C switch: OFF	OFF	Procedure No.33	13A-71
			A/C switch: ON	ON		
31	Small lamp switch	Engine: Idling	Lighting switch: OFF	OFF	Procedure No.36	13A-74
			Lighting switch: ON	ON		
34	Air flow sensor reset signal	Engine: After having warmed up	Engine is idling	ON	Code No.12	13A-15
			3,000 r/min	OFF		
37	Volumetric efficiency	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral	Engine is idling	15 – 35%	–	–
			2,500 r/min	15 – 35%		
			Engine is suddenly raced	Volumetric efficiency increases in response to racing		
38	Crank angle sensor	- Engine: Cranking [reading is possible at 2,000 r/min or less] - Tachometer: Connected		Engine speeds displayed on the MUT-II and tachometer are identical.	–	–
41	Injector drive time *2	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral	Idling*1	0.5 – 0.7 ms*1	Code No.41	13A-24
			2,500 r/min	0.6 – 0.8 ms		
			Sudden racing	Increases		
44	Ignition advance	- Engine: After warm-up - Set a timing light.	Idling*1	12 – 20° BTDC *2	Code No.44	13A-26
			2,500 r/min	20 – 40° BTDC		
48	M/T oil temperature sensor	Drive after the engine has warmed up.	Drive for 15 minutes or more.	Gradually increases to 50 – 90°C.	Procedure No.34	13A-72
49	A/C relay	Engine: After warm-up, idling	A/C switch: OFF	OFF (compressor clutch is not operating)	Procedure No.33	13A-71
			A/C switch: ON	ON (compressor clutch is operating)		

Item No.	Check items	Requirements		Normal condition	Inspection procedure No.	Reference page
66	Brake vacuum sensor	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral	Stop the engine from idling speed, and then depress the brake pedal several times with the ignition switch on.	Displayed pressure increases.	Code No.66	13A-31
67	Stop switch lamp	Ignition switch: ON	Brake pedal: De-pressed	OFF	Procedure No.33	13A-71
			Brake pedal: Re-leased	ON		
68	EGR valve	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral	Idling	5 – 15 STEP	Procedure No.30	13A-69
			2,500 r/min	0 – 5 STEP		
74	Fuel pressure sensor	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral	Engine: Idling	4 – 7 MPa	–	–
77	Accelerator pedal position sensor (2nd channel)	Ignition switch: ON	Release the accelerator pedal.	400 – 900 mV	Code No.77	13A-32
			Depress the accelerator pedal gradually.	Increases in response to the pedal depression stroke.		
			Depress the accelerator pedal fully.	4,500 – 5,000 mV		
78	Accelerator pedal position sensor (1st channel) *3	Ignition switch: ON	Release the accelerator pedal.	400 – 900 mV	Code No.78	13A-33
			Depress the accelerator pedal gradually.	Increases in response to pedal depression stroke.		
			Depress the accelerator pedal fully.	4,500 – 5,000 mV		

Item No.	Check items	Requirements		Normal condition	Inspection procedure No.	Reference page
79	Throttle position sensor (1st channel)	- Engine coolant temperature: 80 – 95°C - Ignition switch: ON (Engine stopped)	Release the accelerator pedal.	400 – 600 mV	Code No.79	13A-34
			Depress the accelerator pedal gradually.	Increases in response to pedal depression stroke.		
			Depress the accelerator pedal fully.	3,900 – 4,900 mV		
		Engine: After warm-up, idling	No load	450 – 1,000 mV		
			A/C switch: OFF → ON	Increases by 100 – 600 mV.		
			Selector lever: N → D range	Increases by 0 – 200 mV.		
99	Fuel injection mode	Engine: After warm up	Idling (for several minutes after engine start)	Lean compression	–	–
			2,500 r/min	Stoichio metric feedback		
			Sudden racing after idle position	Open loop		

ACTUATOR TEST REFERENCE TABLE

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-24
02		Cut fuel to No. 2 injector				
03		Cut fuel to No. 3 injector				
04		Cut fuel to No. 4 injector				
07	Fuel pump (low pressure)	Fuel pump operates and fuel is recirculated.	Ignition switch: ON	Sound of operation is heard.	Procedure No. 29	13A-68
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. 31	13A-70
17	Basic ignition timing	Set the engine-ECU to ignition timing adjustment mode	Idling after engine warm up	5° BTDC	—	—
21	Fan controller	Drive the fan motor	Ignition switch: ON	The fan motor operates	Procedure No.21	13A-62
34	Electronic-controlled throttle valve system	Close the throttle valve fully	Ignition switch: ON	Operation sound can be heard	Code No.91	13A-36

CHECK AT THE ENGINE-ECU TERMINALS**TERMINAL VOLTAGE CHECK CHART****Engine-ECU Connector Terminal Arrangement**

9FU0393

Terminal No.	Check item	Check requirements (engine condition)		Normal condition
1	No.1 injector	Engine: Warm up, and then depress the accelerator pedal suddenly from the idle speed.		decreases slightly for short time from 9 – 13 V.
14	No.2 injector			
2	No.3 injector			
15	No.4 injector			
3	GDI ECO lamp	Constant speed driving at 40 km/h		0 – 3 V
		Engine: Depress the accelerator pedal suddenly from the idle speed.		System voltage
5	Purge control solenoid valve	- Engine coolant temperature: 80 – 95°C - Ignition switch: ON	Engine: stopped	System voltage
			Engine: Start the engine, and then increase engine speed up to 3,500 r/min.	Voltage decreases.
6	Oxygen sensor heater	Engine: idling		0 – 3 V
		Engine: 3,500 r/min		System voltage
8	A/C relay	- Engine: idling - A/C switch: OFF → ON (Compressor is operating)		System voltage, or changes from momentarily 6 V or more to 0 → 3 V
10	No.1 ignition coil	Engine: 3,000 r/min		0.1 – 2.0 V
11	No.2 ignition coil			
23	No.3 ignition coil			
24	No.4 ignition coil			
12	Power supply	Ignition switch: ON		System voltage
25				
16	Throttle valve control servo relay	Ignition switch: OFF		0 – 0.3 V
		Ignition switch: ON		0.5 – 1.0 V
19	Air flow sensor reset signal	Engine: idling		0 – 1 V
		Engine: 3,000 r/min		6 – 9 V

Terminal No.	Check item	Check requirements (engine condition)		Normal condition
20	Injector driver relay	Ignition switch: OFF		0 – 0.1 V
		Ignition switch: ON		0.5 – 1.0 V
21	Fan controller	Radiator and condenser fans are not operating.		0 – 0.3 V
		Radiator and condenser fans are operating.		0.7 V or more
22	Fuel pump relay	Ignition switch: ON	Engine: stopped	System voltage
			Engine: Idling	0 – 3 V
31	EGR valve (C)	Ignition switch: immediately after turning ON		5 – 8 V (fluctuates for approx. three seconds)
32	EGR valve (D)			
39	EGR valve (A)			
40	EGR valve (B)			
33	Alternator G terminal	- Engine: Warm up, and then idling - Radiator fan: not operating - Headlamp: OFF → ON - Stop lamp: OFF → ON - Rear defogger switch: OFF → ON		Voltage increases by 0.2 – 3.5 V
41	Alternator FR terminal	- Engine: Warm up, and then idling - Radiator fan: not operating - Headlamp: OFF → ON - Stop lamp: OFF → ON - Rear defogger: OFF → ON		Voltage decreases
35	Stop lamp switch	Depress the brake pedal.		System voltage
		Release the brake pedal.		0 – 3 V
36	Engine warning lamp	Ignition switch: OFF → ON		0 – 3 V → system voltage (after several seconds)
37	Power steering fluid pressure switch	Engine: Warm up, and then idling	Steering wheel stationary	System voltage
			Steering wheel turning	0 – 3 V
38	Engine control relay	Ignition switch: OFF		0 – 3 V
		Ignition switch: ON		System voltage
42	Brake vacuum sensor	Engine: Stop the engine from idle speed, turn the ignition switch ON, and then depress the brake pedal several times.		Voltage increases
44	Clutch switch	Depress the clutch pedal.		0 – 3 V
		Release the clutch pedal.		System voltage

Terminal No.	Check item	Check requirements (engine condition)		Normal condition
45	A/C switch (1st channel)	Engine: idling	A/C switch: OFF	0 – 3 V
			A/C switch: ON (Compressor is operating)	System voltage
51	Injector open circuit check signal	Engine: Increase engine speed from idle speed to 4,000 r/min.		Decreases slightly (approx.0.7 V) from 4.5 V – 5.0 V.
52	Small lamp switch	Lighting switch: OFF		0 – 3 V
		Lighting switch: ON (Taillamp: ON)		System voltage
57	Accelerator pedal position switch	Ignition switch: ON	Release the accelerator pedal.	0 – 1 V
			Depress the accelerator pedal slightly.	4 V or more
58	Tachometer output	Engine: 3,000 r/min		2.0 – 9.0 V
71	Ignition switch – ST	Engine: cranking		8 V or more
72	Intake air temperature sensor	Ignition switch: ON	Intake air temperature: 0°C	3.2 – 3.8 V
			Intake air temperature: 20°C	2.3 – 2.9 V
			Intake air temperature: 40°C	1.5 – 2.1 V
			Intake air temperature: 80°C	0.4 – 1.0 V
73	A/C switch (2nd channel)	Refer to GROUP 55 – Troubleshooting “Check at the A/C-ECU terminals, engine-ECU output terminals.”		
74	Fuel pressure sensor	Engine: idling		0.3 – 4.7 V
75	M/T oil temperature sensor	M/T oil temperature: 25°C		2.4 – 2.7 V
		M/T oil temperature: 80°C		0.5 – 0.8 V
76	Oxygen sensor	Engine: Warm up, and then hold the engine speed at 2,500 r/min (Use a digital voltmeter).		0 and 0.8 V alternates.
77	Sensor power supply	Ignition switch: ON		4.5 – 5.5 V
81	Power supply to accelerator pedal position sensor (1st channel)	Ignition switch: ON		4.5 – 5.5 V
80	Back-up power source	Ignition switch: OFF		System voltage
82	Ignition switch – IG	Ignition switch: ON		System voltage

Terminal No.	Check item	Check requirements (engine condition)		Normal condition
83	Engine coolant temperature sensor	Ignition switch: ON	Engine coolant temperature: 0°C	3.2 – 3.8 V
			Engine coolant temperature: 20°C	2.3 – 2.9 V
			Engine coolant temperature: 40°C	1.3 – 1.9 V
			Engine coolant temperature: 80°C	0.3 – 0.9 V
84	Throttle position sensor (2nd channel)	Ignition switch: ON	Release the accelerator pedal.	4.2 – 4.8 V
			Depress the accelerator pedal fully.	0.2 – 0.9 V
85	Barometric pressure sensor	Ignition switch: ON	Altitude: 0 m	3.7 – 4.3 V
			Altitude: 1,200 m	3.2 – 3.8 V
86	Vehicle speed sensor	- Ignition switch: ON - Move the vehicle forward.		0 V and system voltage alternates.
87	Accelerator pedal position sensor (1st channel)	Ignition switch: ON	Release the accelerator pedal.	0.4 – 0.9 V
			Depress the accelerator pedal fully.	4.5 V or more
88	Camshaft position sensor	Engine: Cranking		0.3 – 3.0 V
		Engine: Idling		0.5 – 3.5 V
89	Crank angle sensor	Engine: Cranking		0.4 – 4.0 V
		Engine: Idling		1.5 – 2.5 V
90	Air flow sensor	Engine: Idling		2.2 – 3.2 V
		Engine: 2,500 r/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.

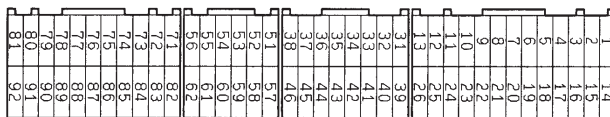
Caution

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!

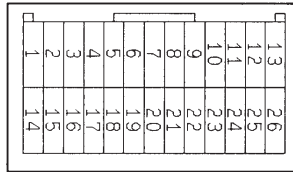
4. If the ohmmeter shows any deviation from the standard value, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
5. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.

Engine-ECU Harness Side Connector Terminal Arrangement



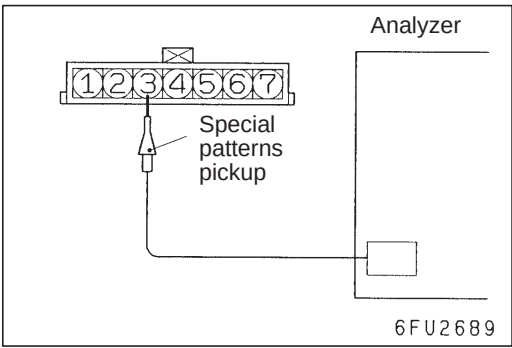
9FU0392

Terminal No.	Check item	Standard value, normal condition (check requirements)
5 – 12	Purge control solenoid valve	36 – 44 Ω (at 20°C)
6 – 12	Oxygen sensor heater control	11 – 18 Ω (at 20°C)
13 – Body earth	Earth	Continuity (0 Ω)
26 – Body earth		
31 – 12	EGR valve (C)	15 – 20 Ω (at 20°C)
32 – 12	EGR valve (D)	
39 – 12	EGR valve (A)	
40 – 12	EGR valve (B)	
57 – 92	Accelerator pedal position switch	Continuity (when the accelerator pedal is released)
		No continuity (when the accelerator pedal is slightly depressed)
72 – 53	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 – 53	Engine coolant temperature sensor	5.1 – 6.5 k Ω (when engine coolant temperature is 0°C)
		2.1 – 2.7 k Ω (when engine coolant temperature is 20°C)
		0.9 – 1.3 k Ω (when engine coolant temperature is 40°C)
		0.26 – 0.36 k Ω (when engine coolant temperature is 80°C)

CHECK AT THE THROTTLE VALVE CONTROLLER TERMINALS**TERMINAL VOLTAGE CHECK CHART****Throttle Valve Controller Terminal Arrangement**

7FU2121

Terminal No.	Check items	Requirements		Normal value
1	Throttle valve control servo (A+)	● Ignition switch: ON ● Accelerator pedal: Fully opened → fully closed		Decreases slightly from system voltage.
9	Throttle valve control servo (B+)			
14	Throttle valve control servo (A−)	● Ignition switch: ON ● Accelerator pedal: Fully closed → fully opened		Decreases slightly (approx. 2 V) from system voltage.
15	Throttle valve control servo (B−)			
2	Power supply to throttle valve control servo	Ignition switch: ON		System voltage
19				
5	Power supply	Ignition switch: ON		System voltage
6	Sensor voltage	Ignition switch: ON		4.5 – 5.5 V
7	Throttle position sensor (1st channel)	Ignition switch: ON	Release the accelerator pedal.	0.4 – 0.6 V
			Depress the accelerator pedal fully.	3.9 – 4.9 V
20	Accelerator pedal position sensor (2nd channel)	Ignition switch: ON	Release the accelerator pedal.	0.4 – 0.9 V
			Depress the accelerator pedal fully.	4.5 V or more
22	Ignition switch – IG	Ignition switch: ON		System voltage



INSPECTION PROCEDURE USING AN ANALYZER
AIR FLOW SENSOR (AFS)

Measurement Method

1. Disconnect the air flow sensor connector, and connect the special tool (test harness: MB991709) 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)

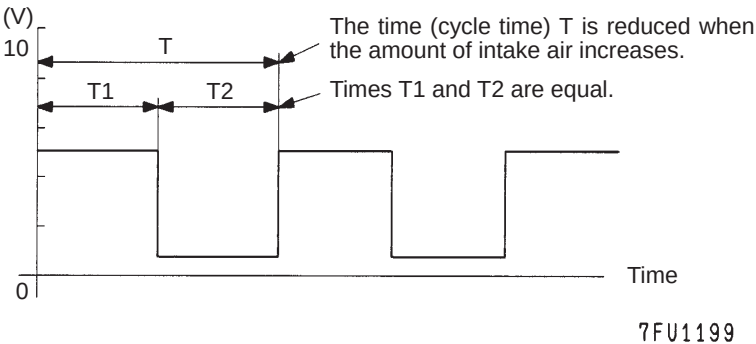
1. Connect the analyzer special patterns pickup to engine-ECU terminal 90.

Standard Wave Pattern

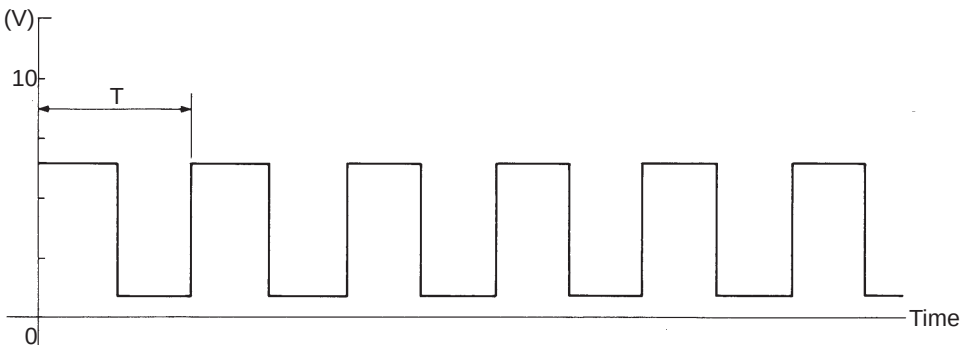
Observation conditions

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

Standard wave pattern

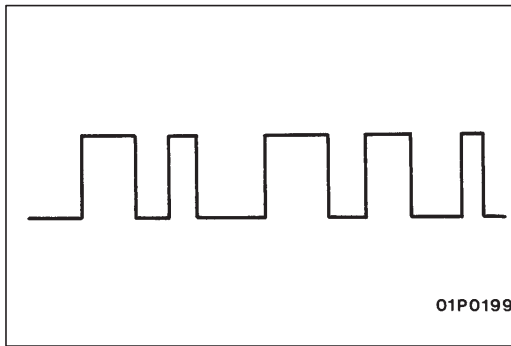


Observation conditions (from conditions above engine speed is increased by racing.)



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.

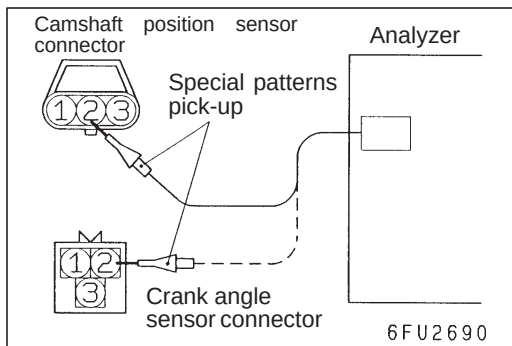
● Example 2

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: MB991709) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns 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 patterns pickup to crank angle sensor terminal 2.

Alternate Method (Test harness not available)

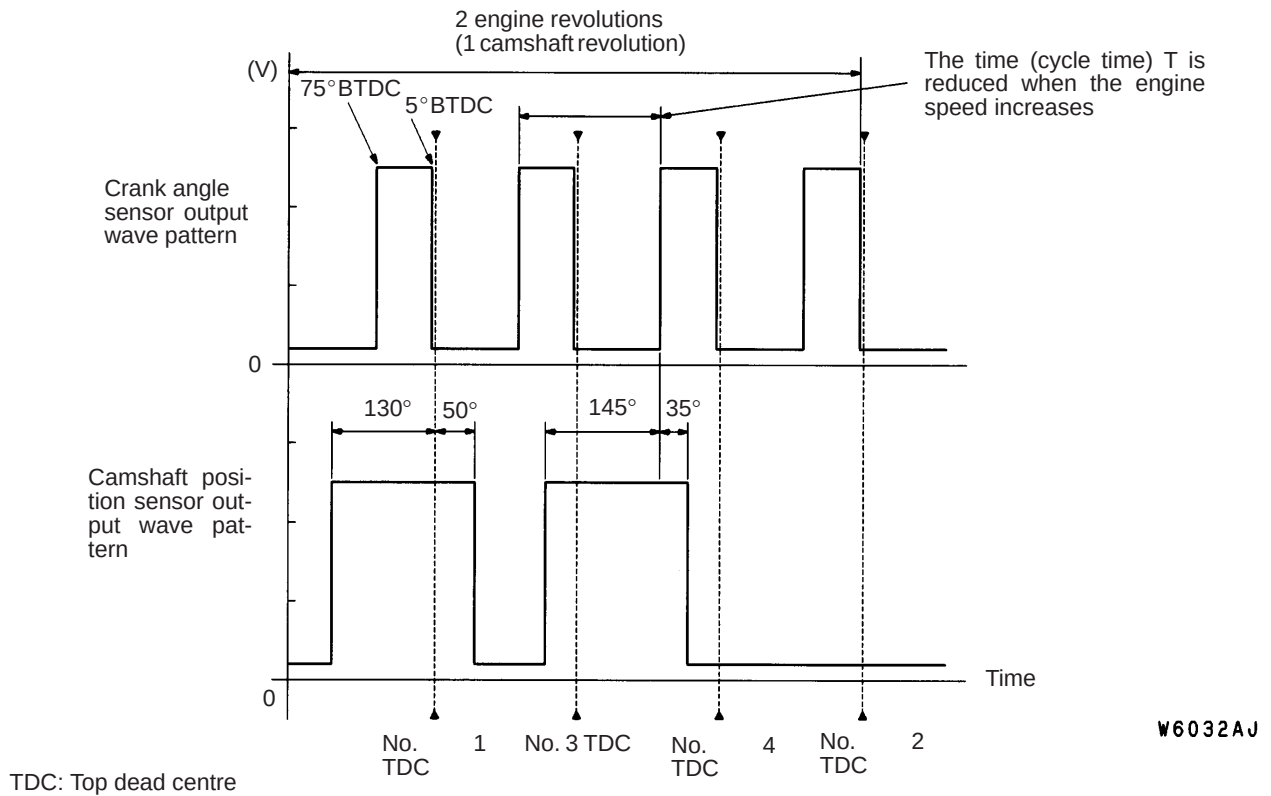
1. Connect the analyzer special patterns pickup to engine-ECU terminal 88. (When checking the camshaft position sensor signal wave pattern.)
2. Connect the analyzer special patterns pickup to engine-ECU terminal 89. (When checking the crank angle sensor signal wave pattern.)

Standard Wave Pattern

Observation conditions

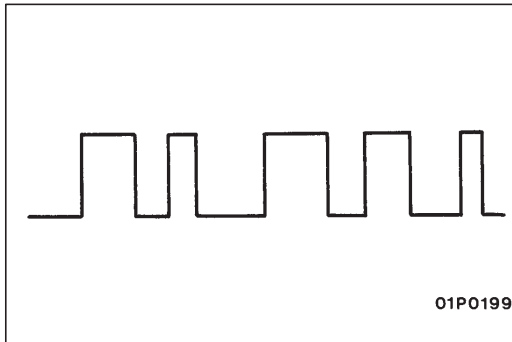
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern



Wave Pattern Observation Points

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



Examples of Abnormal Wave Patterns

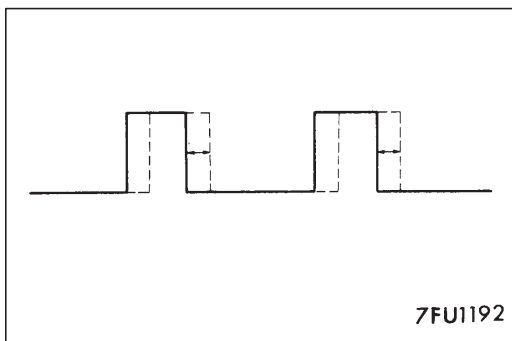
- Example 1

Cause of problem

Sensor interface malfunction

Wave pattern characteristics

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



- Example 2

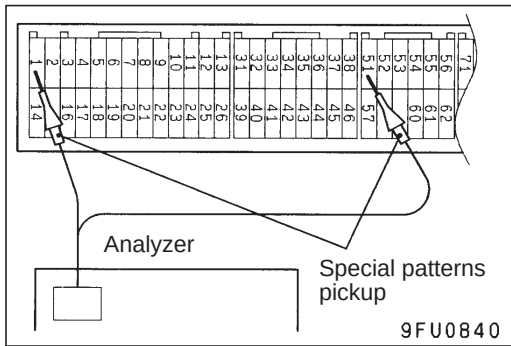
Cause of problem

Loose timing belt

Abnormality in sensor disk

Wave pattern characteristics

Wave pattern is displaced to the left or right.



INJECTORS AND INJECTOR OPEN CIRCUIT CHECK SIGNAL

Measurement Method

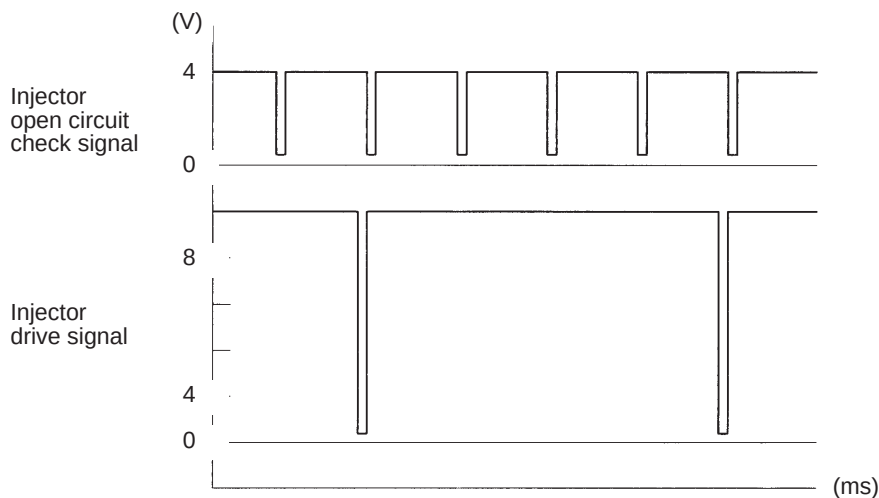
1. Connect the analyzer special patterns pickup to terminal 1 (No.1 injector) of the engine-ECU connector.
2. Connect the analyzer special patterns pickup to terminal 51 (injector open circuit check signal) of the engine-ECU connector.
3. After checking terminal 1, check terminal 14 (No.2 injector), terminal 2 (No.3 injector) and terminal 15 (No.4 injector).

Standard Wave Pattern

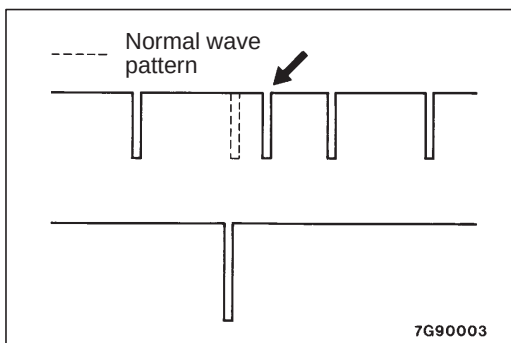
Observation conditions

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

Standard wave pattern

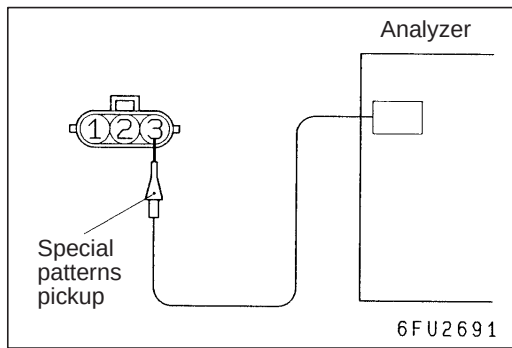


9FU0841



Wave Pattern Observation Points

- Check that the injector drive time is identical to the time displayed on the MUT-II.
- Check that the injector signals become greatly extended but soon return to their normal wave length when the engine is suddenly raced.
- Check that the injector open circuit check signal is synchronized with each rising portion of the injector drive signal.



IGNITION COIL AND POWER TRANSISTOR

Power transistor control signal

Measurement Method

1. Disconnect the ignition coil connector, and connect the special tool (test harness: MB991658) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to terminal 3 of each ignition coil connector in turn.

Alternate Method (Test harness not available)

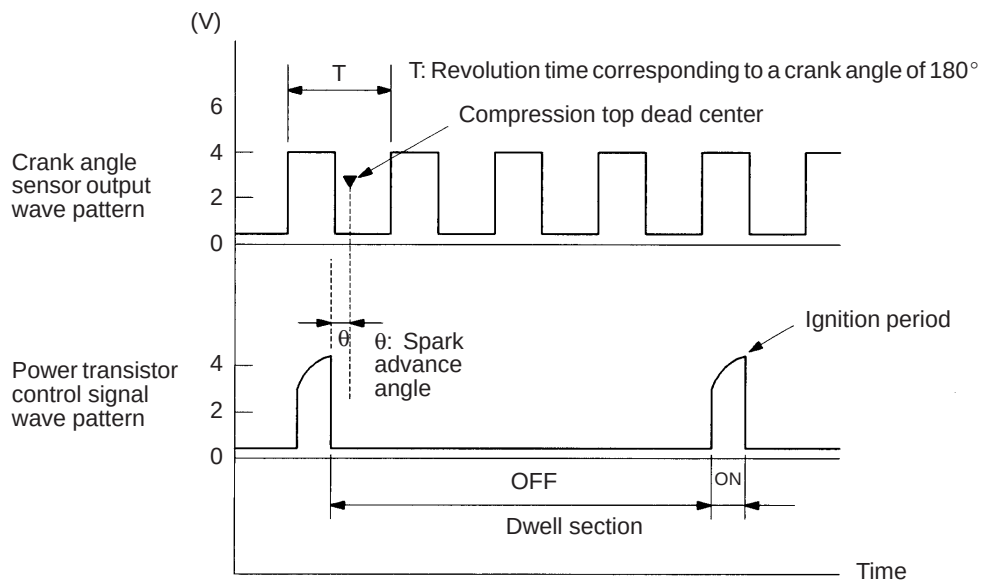
1. Connect the analyzer special patterns pickup to engine-ECU terminal 10 (No. 1 ignition coil), terminal 11 (No. 2 ignition coil), terminal 23 (No. 3 ignition coil), terminal 24 (No. 4 ignition coil) respectively.

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

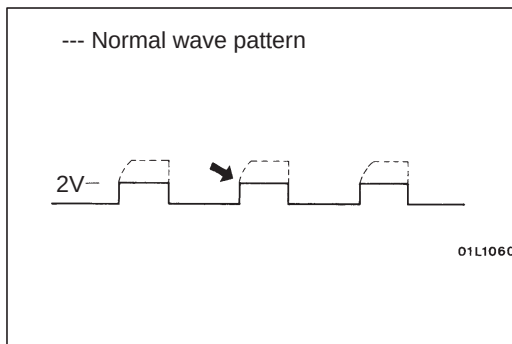


9FU0842

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

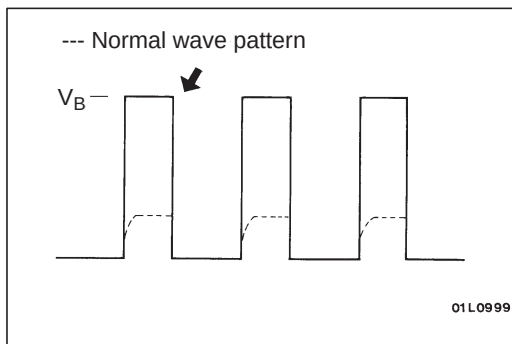
Wave pattern during engine cranking

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

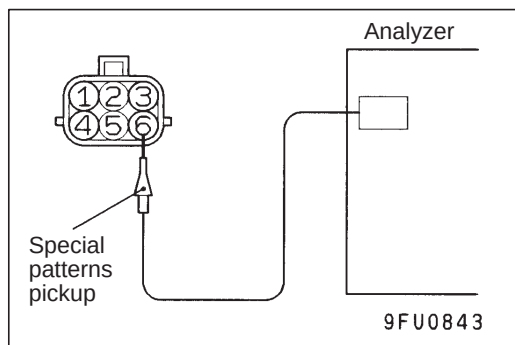
Wave pattern during engine cranking

Cause of problem

Malfunction in power transistor

Wave pattern characteristics

Power voltage results when the power transistor is ON.



EGR VALVE (STEPPER MOTOR)

Measurement Method

1. Disconnect the EGR valve connector, and connect the special tool (test harness: MB991658) in between.
2. Connect the analyzer special patterns pickup to the EGR valve-side connector terminal 1, terminal 3, terminal 4 and terminal 6 respectively.

Alternate Method (Test harness not available)

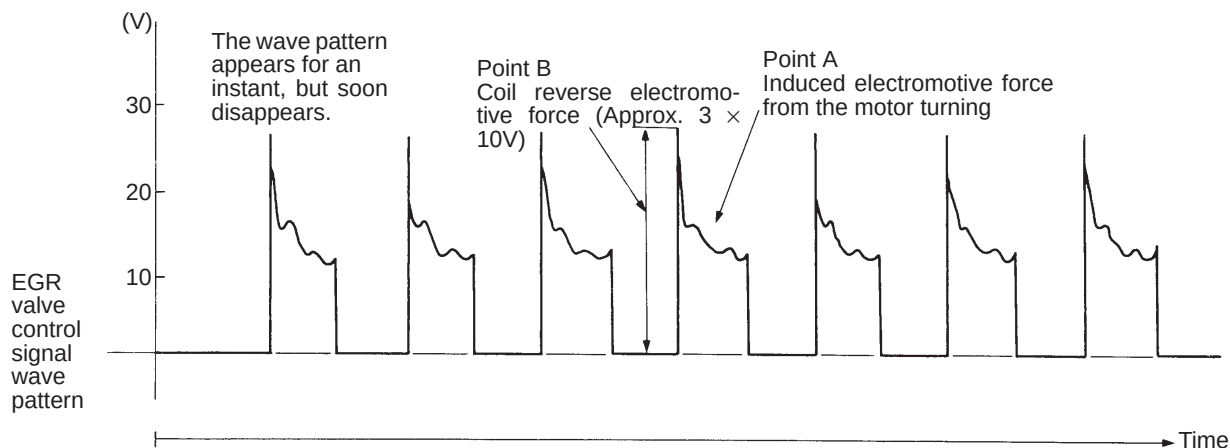
1. Connect the analyzer special patterns pickup to engine-ECU terminal 39, connection terminal 40, connection terminal 31, and connection terminal 32 respectively.

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



Wave Pattern Observation Points

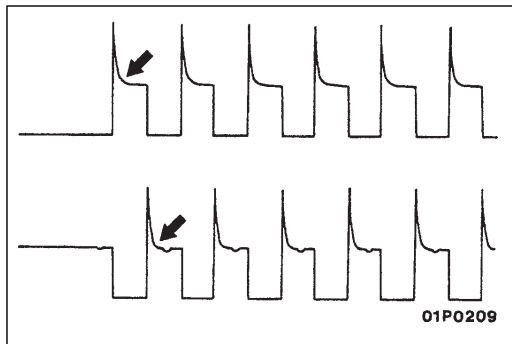
Check that the standard wave pattern appears when the EGR control servo is operating.

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 operating.)

Wave pattern characteristics

Induced electromotive force from the motor turning does not appear.

- Example 2

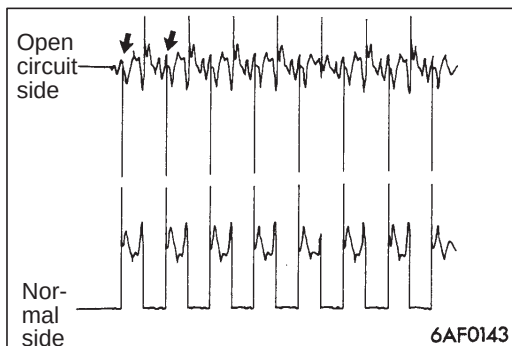
Cause of problem

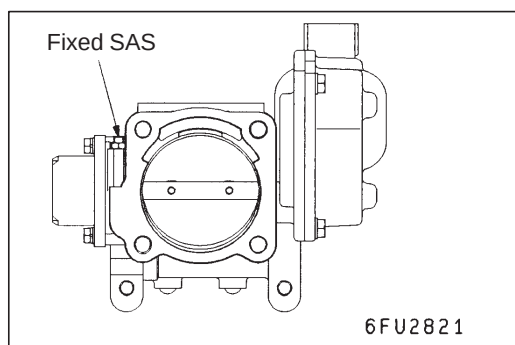
Open circuit in the line between the EGR valve and the engine-ECU

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.





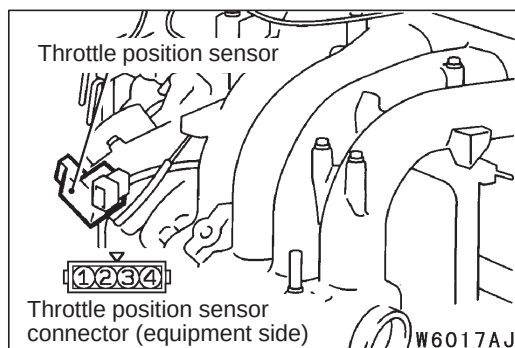
ON-VEHICLE SERVICE

Caution

1. Never attempt to tamper the fixed SAS. The fixed SAS is precisely adjusted at factory.
2. Should it be tampered, the full closed position of the throttle valve will be changed. This causes the engine-ECU to learn a wrong position of the throttle valve.

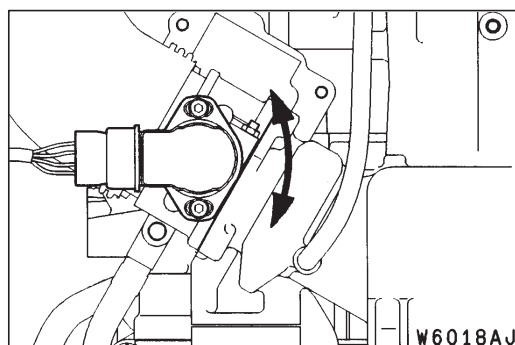
THROTTLE BODY (THROTTLE VALVE ARE) CLEANING

1. Start the engine, and warm it up until engine coolant temperature reaches 80°C. Then stop the engine.
2. Remove the air intake hose at the throttle body side.
3. Apply cleaning agent to the throttle valve through the intake port of the throttle valve, and then leave it for approx. five minutes.
4. Start the engine, race it several times, and then let it run at idle for approx. one minute.
5. If carbon deposits are not removed from the throttle valve area, repeat steps (3) and (4).
6. Install the air intake hose.
7. Use the MUT-II or disconnect the negative battery cable from the battery terminal in order to erase a diagnosis code. Wait for at least ten seconds, and then let the engine run at idle again for approx. ten minutes.



THROTTLE POSITION SENSOR ADJUSTMENT

1. Connect the MUT-II to the diagnosis connector.
2. Disconnect the throttle valve control servo connector.
3. Turn on the ignition switch (but do not start the engine).



4. Check the output voltage of the throttle position sensor (1st channel) when the throttle valve is fully closed by your finger.

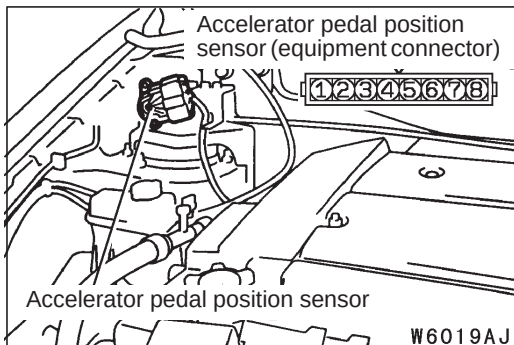
Standard value: 0.4 – 0.6 V

5. If not within the standard value, loosen the throttle position sensor mounting bolts. Then rotate the sensor body to adjust.

6. Check the output voltage of the throttle position sensor (2nd channel) when the throttle valve is fully closed by your finger.

Standard value: 4.2 – 4.8 V

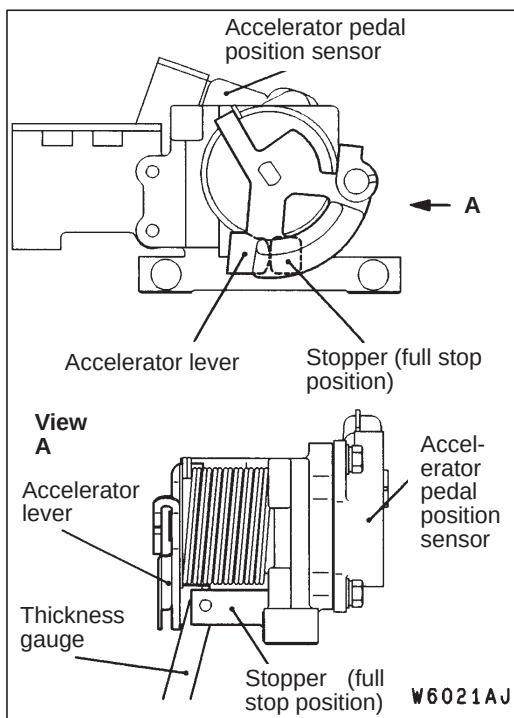
7. If not within the standard value, replace the throttle position sensor.
8. Turn off the ignition switch.
9. Reconnect the throttle valve control servo connector.
10. Remove the MUT-II.
11. If a diagnosis code is displayed, erase the diagnosis code by using the MUT-II or disconnect the negative battery cable from the battery terminal and then leave it for at least ten seconds. After that, reconnect the battery cable.
12. Turn on the ignition switch, wait for at least 10 seconds, and then off again. In addition, if the battery cable is disconnected at step 11, let the engine run at idle for approx. ten minutes.

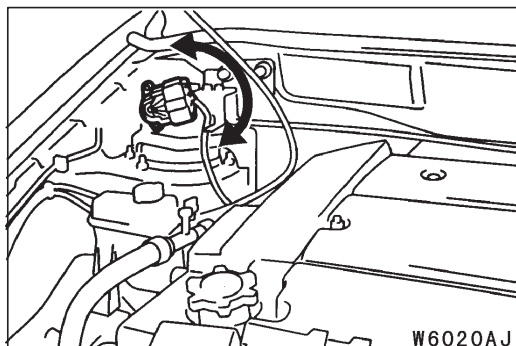


ACCELERATOR PEDAL POSITION SWITCH AND ACCELERATOR PEDAL POSITION SENSOR ADJUSTMENT

Caution

1. **Never attempt to tamper the accelerator pedal position sensor. The sensor position is precisely adjusted at factory.**
2. **Should it be tampered, follow the procedure below:**
 1. Connect the MUT-II to the diagnosis connector.
 2. Remove the two accelerator pedal position sensor assembly mounting bolts, and then insert a 0.60 mm of thickness gauge blade between the accelerator lever and stopper.
 3. Turn on the ignition switch (but do not start the engine).

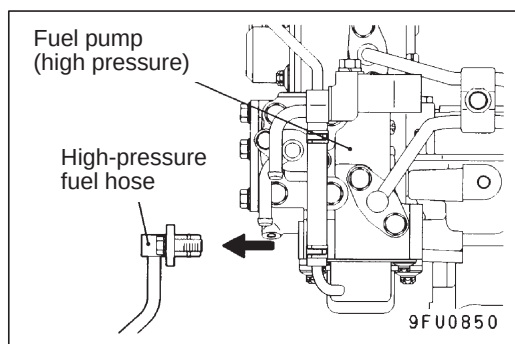




4. Loosen the accelerator pedal position sensor mounting bolts, and then rotate it fully anticlockwise.
5. Check that the accelerator pedal position switch is on (there should be continuity between terminals).
6. Slowly rotate the accelerator pedal position sensor clockwise, and find the pint where the accelerator pedal position switch is turned off (there will be no continuity). At this point, tighten the accelerator pedal position sensor mounting bolts securely.
7. Check output voltage of the accelerator pedal position sensor (1st and 2nd channels).

Standard value: 0.4 – 0.9 V

8. If not within the standard value, check the accelerator pedal position sensor (1st and 2nd channels) and its related wiring harness.



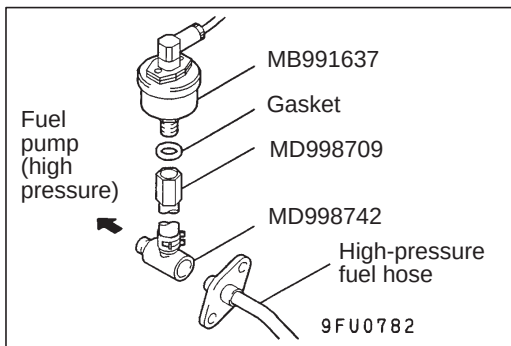
FUEL PRESSURE TEST

MEASUREMENT OF FUEL LOW PRESSURE BETWEEN FUEL PUMP (LOW PRESSURE) AND FUEL PUMP (HIGH PRESSURE)

1. Release residual pressure from the fuel pipe line to prevent fuel gush out. (Refer to P.13A-102.)
2. Disconnect the high-pressure fuel hose at the fuel pump (high pressure) side.

Caution

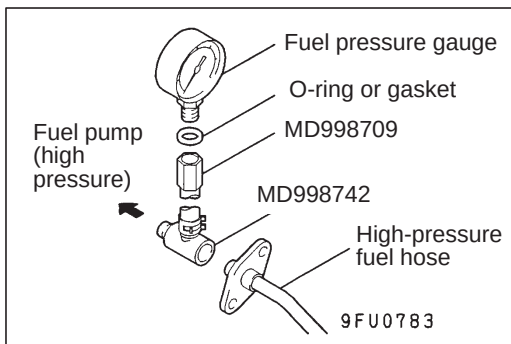
Cover the hose connection with rags to prevent splash of fuel that could be caused by some residual pressure in the fuel pipe line.



3. Remove the union joint and bolt from the special tool (adapter hose) and instead attach the special tool (hose adapter) to the adapter hose.
4. Install the special tool (for measuring the fuel pressure) that was set up in step 3.

<When using the fuel pressure gauge set (special tool)>

- (1) Install the special tool (for measuring the fuel pressure) between the high-pressure fuel hose and the fuel pump (high pressure).
- (2) Install the fuel pressure gauge set (special tool) on the special tool (for measuring the fuel pressure) putting the gasket between them.
- (3) Connect the lead wire of the fuel pressure gauge set (special tool) to the power supply (cigarette lighter socket) and to the MUT-II.



<When using the fuel pressure gauge>

- (1) Install the fuel pressure gauge on the special tool (for measuring the fuel pressure) putting a suitable O-ring or gasket between them.
 - (2) Install the special tool which was set up in step (1) between the high-pressure fuel hose and the fuel pump (high pressure).
5. Connect the MUT-II to the diagnosis connector.
 6. Turn the ignition switch to ON. (But do not start the engine.)
 7. Select "Item No.07" from the MUT-II Actuator test to drive the fuel pump (low pressure) at the fuel tank side. Check that there are no fuel leaks from any parts.
 8. Finish the actuator test or turn the ignition switch to OFF.
 9. Start the engine and run at idle.
 10. Measure fuel pressure while the engine is running at idle.

Standard value: 324 – 343 kPa

11. Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.
12. If fuel pressure is out of the standard value, troubleshoot and repair according to the table below.

Symptom	Probable cause	Remedy
- Fuel pressure too low - Fuel pressure drops after racing	Clogged fuel filter	Replace fuel filter
	Fuel leaking to return side due to poor fuel pressure regulator (low pressure) valve seating or settled spring	Replace fuel pressure regulator (low pressure)
	Low fuel pump (low pressure) delivery pressure	Replace the fuel pump (low pressure)
Fuel pressure too high	Binding valve in fuel pressure regulator (low pressure)	Replace fuel pressure regulator (low pressure)
	Clogged fuel return hose or pipe	Clean or replace hose or pipe

13. 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.

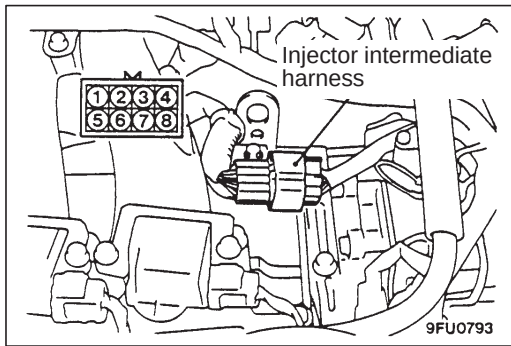
Symptom	Probable cause	Remedy
Fuel pressure drops gradually after engine is stopped	Leaky fuel pressure regulator (low pressure) valve seat	Replace fuel pressure regulator (low pressure)
Fuel pressure drops sharply immediately after engine is stopped	Check valve in fuel pump (low pressure) is held open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

14. Release residual pressure from the fuel pipe line. (Refer to P.13A-102.)
15. Remove the fuel pressure gauge and special tools from the fuel pump (high pressure).

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.

16. 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.
17. Fit the high-pressure fuel hose to the fuel pump (high pressure) and tighten the mounting bolt to specified torque.
18. Check for any fuel leaks by following the procedure in step 7.
19. Disconnect the MUT-II.



MEASUREMENT OF FUEL HIGH PRESSURE BETWEEN FUEL PUMP (HIGH PRESSURE) AND INJECTORS

NOTE

Measurement of the fuel pressure between the fuel pump (high pressure) and the injectors should be carried out after checking that the fuel pressure between the fuel pump (low pressure) and the fuel pump (high pressure) is normal.

1. Connect the MUT-II to the diagnosis connector.
2. Disconnect the injector intermediate harness connector.
3. Turn the ignition switch to ON.
4. Select "Item No.74" from the MUT-II Data list.
5. Crank the engine continuously for 2 seconds or more, and visually check that there are no fuel leaks from any parts.

Caution

If any fuel leaks appear, stop cranking immediately and repair the source of the leak.

6. Check if the fuel pressure is more than 1 MPa immediately after 20 seconds have passed since cranking was finished.
7. If the fuel pressure is lower than 1 MPa, it means that there is likely to be a leak in the high-pressure fuel system, so this system should be checked.

Caution

If the fuel pressure drops by more than 1 MPa, it means that there is likely to be a leak in the high-pressure fuel system, so this system should be checked.

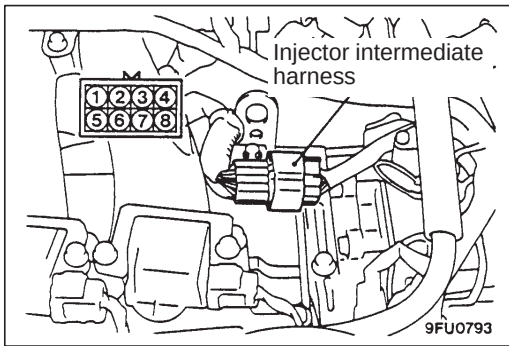
8. Turn the ignition switch to OFF.
9. Connect the injector intermediate harness connector.
10. Start the engine and run at idle.
11. Measure fuel pressure while the engine is running at idle.

Standard value: 4 – 7 MPa

12. Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.
13. If fuel pressure is out of the standard value, troubleshoot and repair according to the table below.

Symptom	Probable cause	Remedy
● Fuel pressure too low ● Fuel pressure drops after racing	Fuel leaking to return side due to poor fuel pressure regulator (high pressure) valve seating or settled spring	Replace fuel pressure regulator (high pressure)
	Low fuel pump (high pressure) delivery pressure	Replace the fuel pump (high pressure)
Fuel pressure too high	Binding valve in fuel pressure regulator (high pressure)	Replace fuel pressure regulator (high pressure)
	Clogged fuel return hose or pipe	Clean or replace hose or pipe

14. Stop the engine and turn the ignition switch to OFF.
15. Disconnect the MUT-II.



FUEL LEAK CHECK

1. Connect the MUT-II to the diagnosis connector.
2. Disconnect the injector intermediate harness connector.
3. Turn the ignition switch to ON.
4. Select "Item No.74" from the MUT-II Data list.
5. Crank the engine continuously for 2 seconds or more, and visually check that there are no fuel leaks from any parts.

Caution

If any fuel leaks appear, stop cranking immediately and repair the source of the leak.

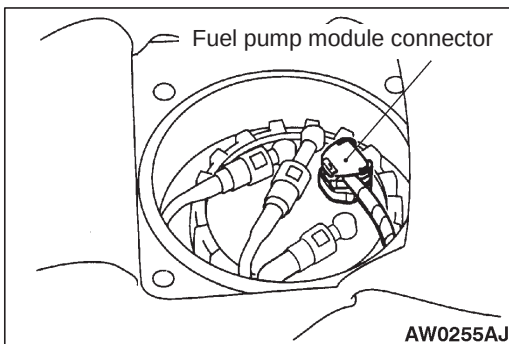
6. Stop cranking and measure fuel pressure immediately after 20 seconds.

Limit: Minimum 1 MPa

Caution

If the fuel pressure is less than 1 MPa, there may be a partial fuel leak in the high-pressure fuel system. Check this system.

7. Turn off the ignition switch.
8. Reconnect the injector intermediate connector.
9. Remove the MUT-II.



FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE FUEL PRESSURE)

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 assembly. (Refer to GROUP 52A.)
- (2) Remove the protector.
- (3) Disconnect the fuel pump module connector.
- (4) Connect the MUT-II to the diagnosis connector.

Caution

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

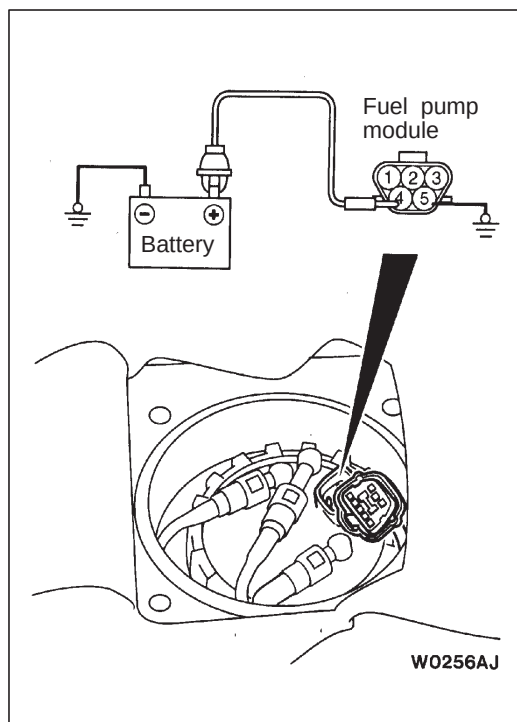
- (5) Turn off the ignition switch.
- (6) Select "Item No.74" from the MUT-II Data list.
- (7) Crank the engine for at least two seconds.
- (8) If the engine is not be started, use the MUT-II to make sure that the fuel pressure is 0.5 MPa or less. Then turn off the ignition switch.

- (9) If the engine is started, release fuel pressure by the following procedure:
 - 1) Turn off the ignition switch, and then stop the engine.
 - 2) Disconnect one of the ignition coil connectors.
 - 3) Crank the engine for at least two seconds.
 - 4) If the engine can not be started, use the MUT-II to make sure that the fuel pressure is 0.5 MPa or less. Then turn off the ignition switch.
 - 5) If the engine is started, stop it by racing and use the MUT-II to make sure that the fuel pressure is 0.5 MPa or less. Then turn off the ignition switch.
 - 6) Reconnect the ignition coil connector.

Caution

Clean the spark plug which corresponds to the disconnected ignition coil connector.

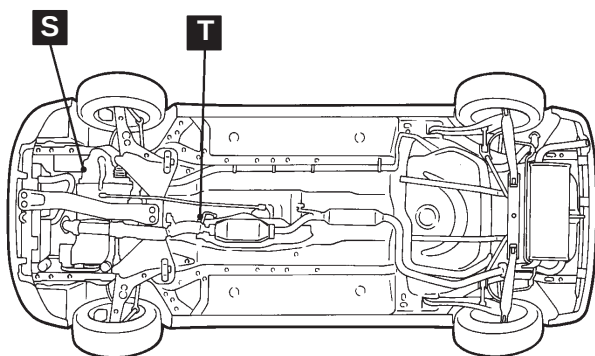
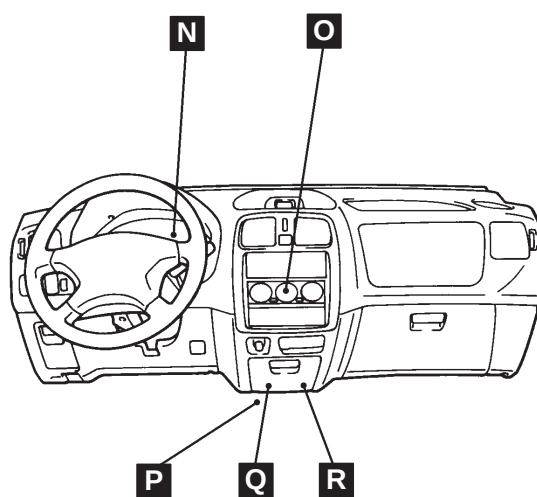
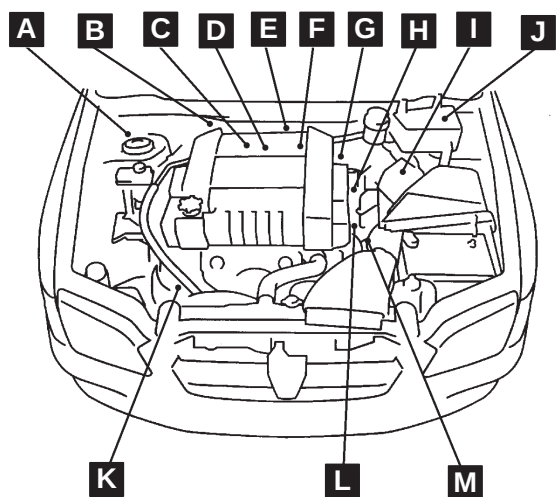
- (10) Remove the MUT-II.
- (11) Reconnect the fuel pump module connector.
- (12) Install the protector and rear seat assembly.

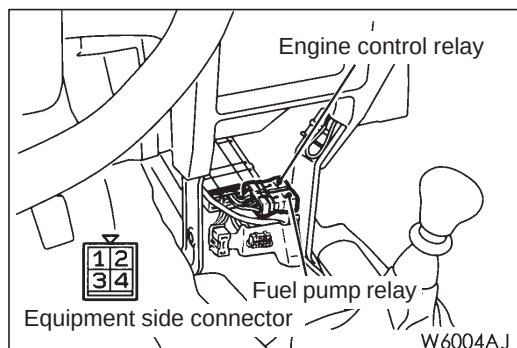
**FUEL PUMP OPERATION CHECK**

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, and if it is normal, check the drive circuit.
 - (1) Turn the ignition switch to OFF.
 - (2) Remove the rear seat assembly. (Refer to GROUP 52A.)
 - (3) Remove the protector.
 - (4) Disconnect the fuel pump module connector. Listen to a fuel pump operation sound while connecting battery voltage to No.4 terminal of the fuel pump module, and No.5 terminal to earth.
 - (5) Check fuel pressure by pinching the fuel hose with your finger.
 - (6) Connect the fuel pump module connector.
 - (7) Install the protector and rear seat assembly.

COMPONENT LOCATION

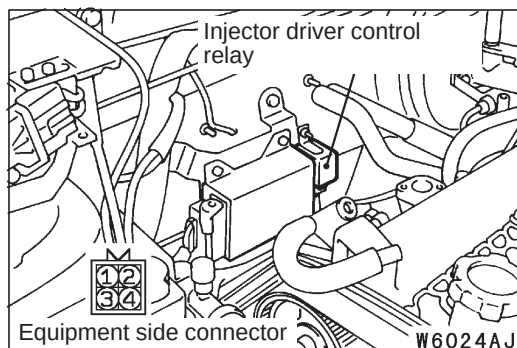
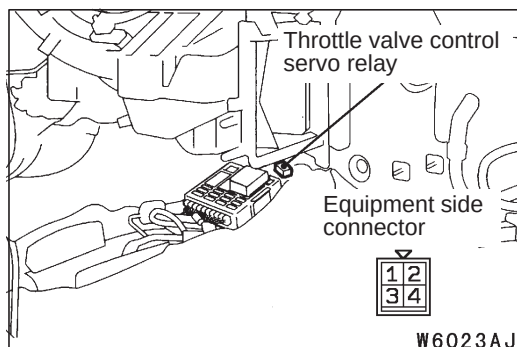
Name	Symbol	Name	Symbol
A/C relay	J	Fuel pressure sensor	L
A/C switch	O	Fuel pump relay	R
Accelerator pedal position sensors	A	Ignition coil	C
Air flow sensor (with intake air temperature sensor and barometric pressure sensor)	I	Injectors	D
		Injector driver	B
Camshaft position sensor	L	Injector driver relay	B
		M/T oil temperature sensor	S
Crank angle sensor	M	Oxygen sensor	T
Detonation sensor	E	Power steering fluid pressure switch	K
Diagnosis connector	P	Purge control solenoid valve	G
EGR valve	F	Throttle position sensor	G
Engine control relay	R	Throttle valve controller	Q
Engine coolant temperature sensor	L	Throttle valve control servo	G
Engine-ECU	Q	Throttle valve control servo relay	Q
Engine warning lamp (CHECK ENGINE lamp)	N	Vehicle speed sensor	H





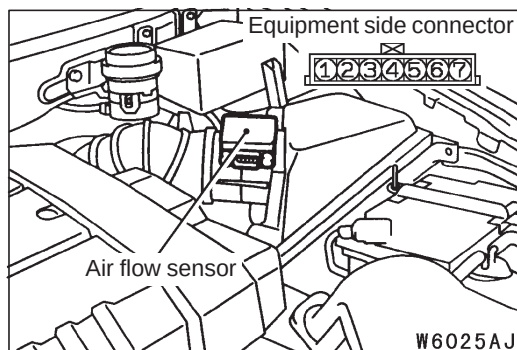
ENGINE CONTROL RELAY, FUEL PUMP RELAY AND THROTTLE VALVE CONTROL SERVO RELAY CONTINUITY CHECK

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



INJECTOR DRIVER CONTROL RELAY CONTINUITY CHECK

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



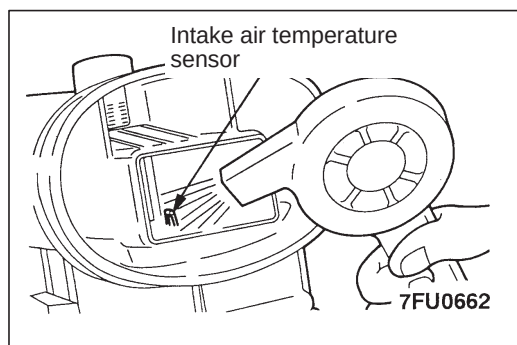
INTAKE AIR TEMPERATURE SENSOR CHECK

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

Standard value:

2.3 – 3.0 k Ω (at 20°C)

0.30 – 0.42 k Ω (at 80°C)

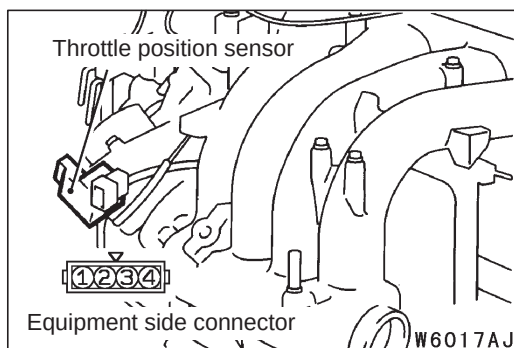
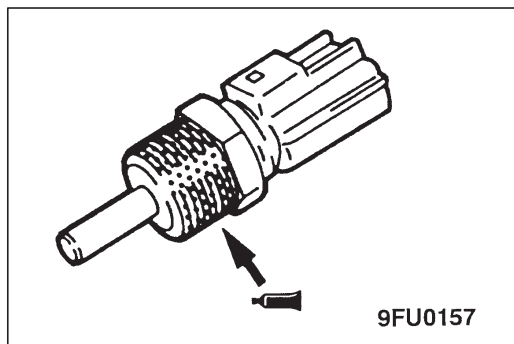
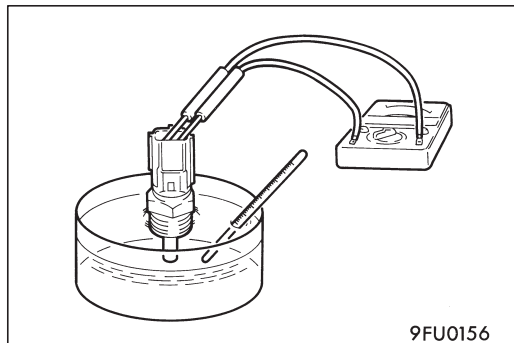
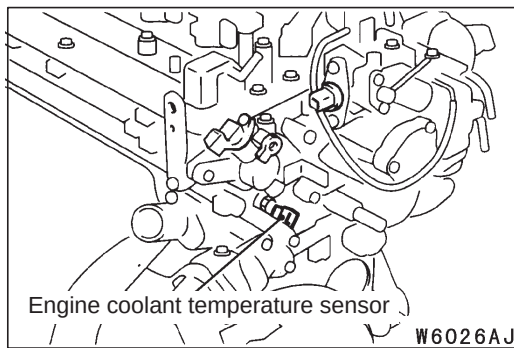


3. Measure resistance while heating the sensor using a hair drier.

Normal condition:

Temperature (°C)	Resistance (k Ω)
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

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 engine coolant temperature sensor immersed in hot water, check resistance.
- Standard value:**
 2.1 – 2.7 k Ω (at 20°C)
 0.26 – 0.36 k Ω (at 80°C)
3. If the resistance deviates from the standard value greatly, replace the sensor.

4. Apply sealant to 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.

Tightening torque: 29 Nm

THROTTLE POSITION SENSOR CHECK

1. Disconnect the throttle position sensor connector.
2. Measure the resistance between throttle position sensor side connector terminal 1 and terminal 3.

Standard value: 3.5 – 6.5 k Ω

3. Measure resistance between terminal Nos. 1 and 2 as well as 1 and 4 of the throttle position sensor connector, respectively.

Normal condition:

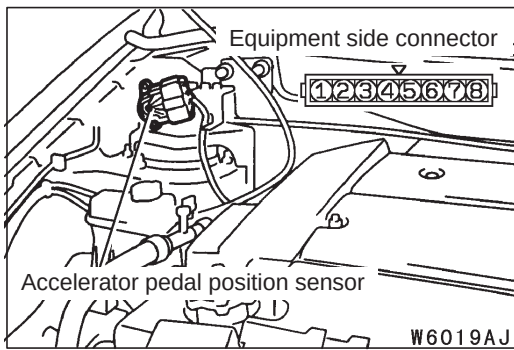
Throttle valve slowly open until fully open from the idle position

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-96.



ACCELERATOR PEDAL POSITION SENSOR CHECK

1. Disconnect the accelerator pedal position sensor connector.
2. Measure resistance between terminal Nos.2 and 1 as well as Nos.8 and 7 of the sensor connector.

Standard value: 3.5 – 6.5 k Ω

3. Measure resistance between terminal Nos.2 and 3 as well as 8 and 6 of the accelerator pedal position sensor connector, respectively.

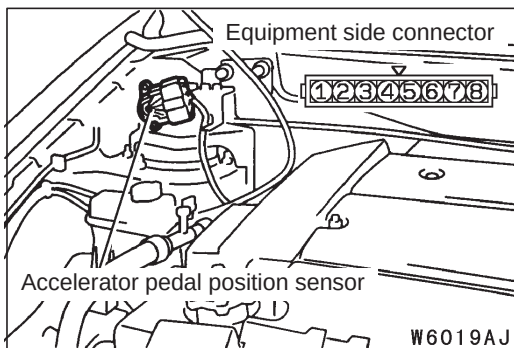
Normal condition:

Depress the accelerator pedal slowly.	Resistance value changes in accordance with the accelerator pedal depression smoothly.
---------------------------------------	--

4. If not within the standard value, or resistance value does not change smoothly, replace the accelerator pedal position sensor assembly.

NOTE

After replacement, adjust the accelerator pedal position sensor. (Refer to P.13A-97.)



ACCELERATOR PEDAL POSITION SWITCH CHECK

1. Disconnect the accelerator pedal position sensor connector.
2. Check continuity between terminal Nos. 4 (accelerator pedal position switch) and 5 (sensor earth) of the accelerator pedal position sensor.

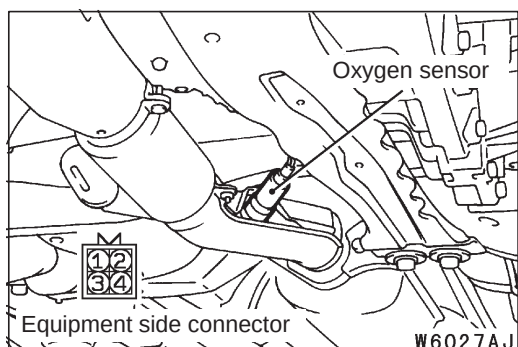
Normal condition

Accelerator pedal	Continuity
Depress	No continuity
Release	Continuity

3. If defective, replace the accelerator pedal position sensor assembly.

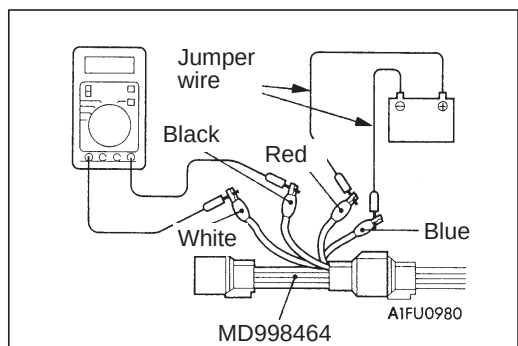
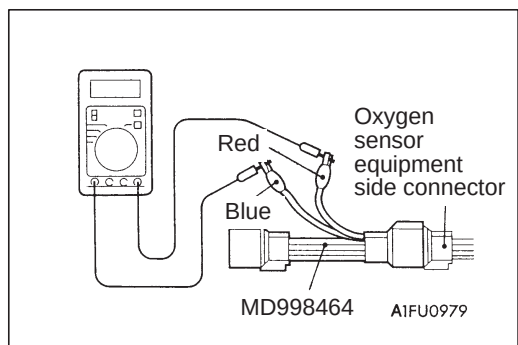
NOTE

After replacement, adjust the accelerator pedal position sensor and switch. (Refer to P.13A-97.)



OXYGEN SENSOR CHECK

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 ($11 - 18 \Omega$ at 20°C) between terminal 1 (red clip of special tool) and terminal 3 (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 a jumper wire to connect terminal 1 (red clip) of the oxygen sensor connector to the battery (+) terminal and terminal 3 (blue clip) to the battery (-) terminal.

Caution

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

6. Connect a digital voltage meter between terminal 2 (black clip) and terminal 4 (white clip).
7. While repeatedly racing the engine, measure the oxygen sensor output voltage.

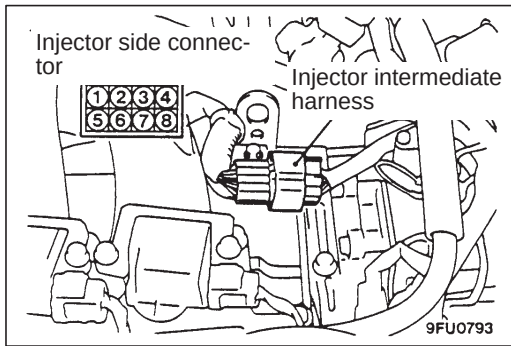
Standard value:

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

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

NOTE

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



INJECTOR CHECK

1. Disconnect the injector intermediate harness connector.
2. Measure the resistance between each of the terminals.

Standard value: 0.9 – 1.1 Ω (at 20°C)

Injector	Measurement terminal
No.1 cylinder	1 – 2
No.2 cylinder	3 – 4
No.3 cylinder	5 – 6
No.4 cylinder	7 – 8

3. Connect the injector intermediate harness connector.

THROTTLE VALVE CONTROL SERVO CHECK

Operation Check

1. Disconnect the air intake hose from the throttle body.
2. Turn on the ignition switch.
3. Check that the throttle valve opens or closes in response to the accelerator pedal depression.

Check of Coil Resistance

1. Disconnect the throttle valve control servo connector.
2. Measure resistance between the throttle valve control servo connector terminals.

Standard value:

Terminals to be measured	Resistance value (Ω)
1 – 3	1.35 – 1.65 (at 20°C)
2 – 4	

3. Check that there is no continuity between the terminals and body.

CLUTCH SWITCH CHECK

1. Disconnect the connector.
2. Check for continuity between the terminals of the switch.

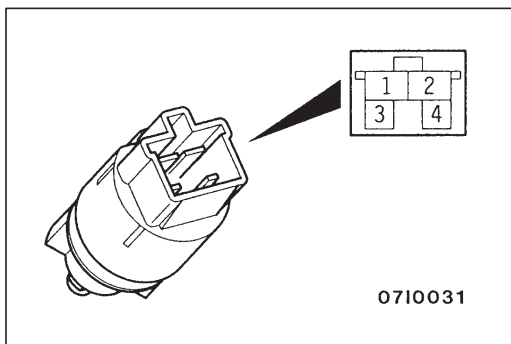
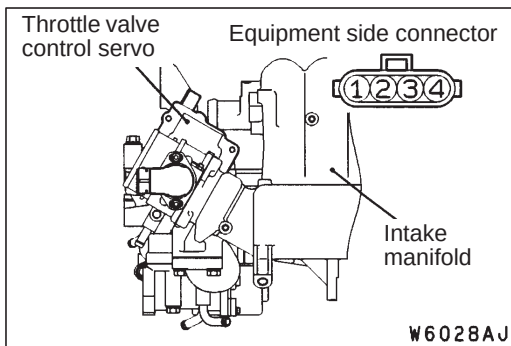
Measurement conditions	Terminal No.	
	1	2
When clutch pedal is depressed.	○ — ○	○ — ○
When clutch pedal is not depressed.		

PURGE CONTROL SOLENOID VALVE CHECK

Refer to GROUP 17 – Emission Control System.

EGR VALVE CHECK

Refer to GROUP 17 – Emission Control System.

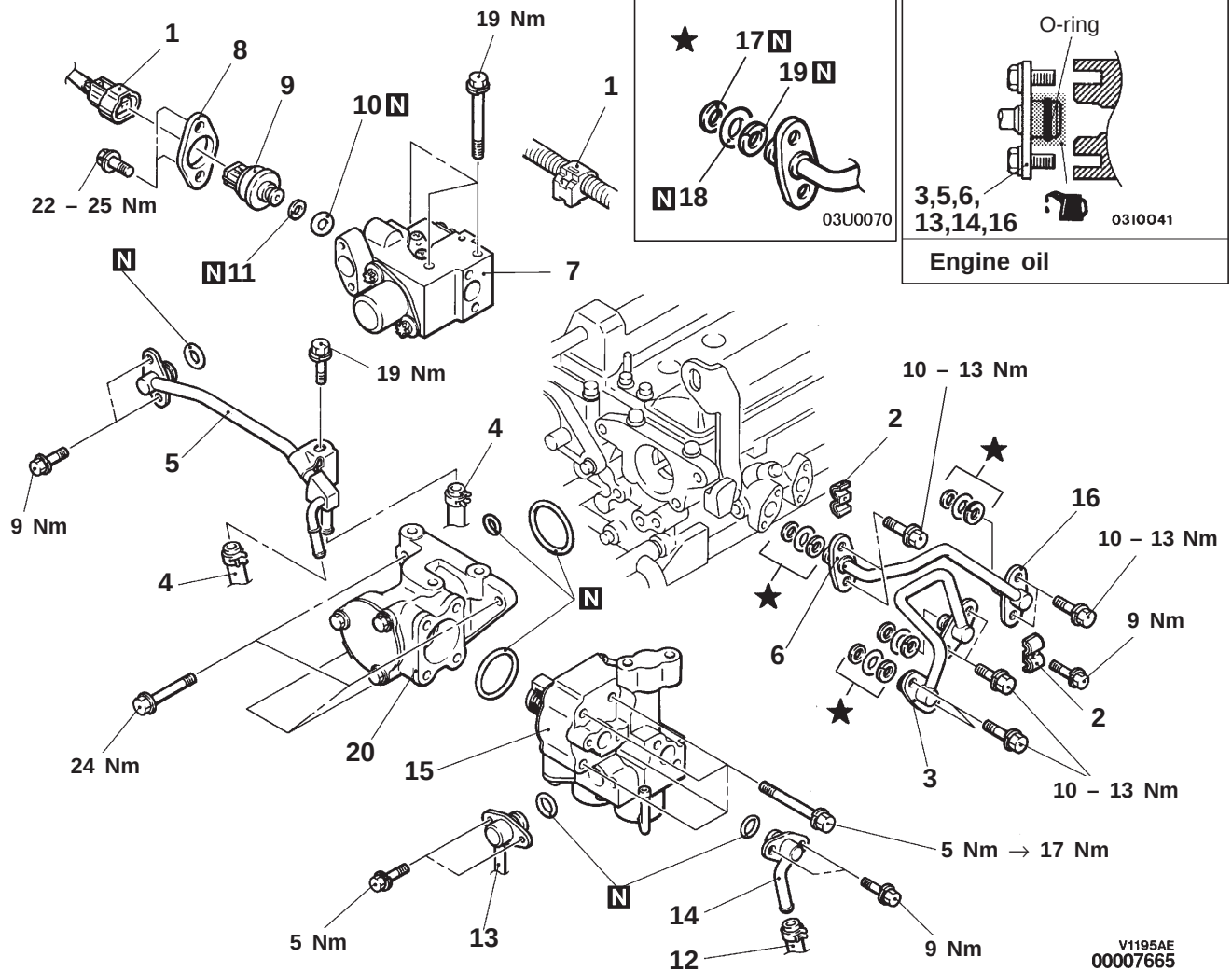


FUEL PUMP (HIGH PRESSURE)

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Prevention of Fuel Discharge <before removal only>
(Refer to P.13A-102.)
- Engine Cover Removal and Installation
- Air Cleaner Assembly Removal and Installation
- Fuel Leak Check <after Installation only.>
(Refer to P.13A-102.)



Fuel pressure regulator (high pressure) removal steps

- H◄ • Air-bleeding of fuel pump (high pressure)

1. Harness connector and clamp
4. Fuel return hose connection

- C◄ 5. Fuel low-pressure pipe

- C◄ 6. Fuel return pipe connection

7. Fuel pressure regulator (high pressure) assembly

- ◄A► ►G◄ 8. Flange

- G◄ 9. Fuel pressure sensor

- F◄ 10. O-ring

- F◄ 11. Back-up ring

- ◄B► ►B◄ 17. Back-up ring A

- B◄ 18. O-ring

- B◄ 19. Back-up ring B

Fuel pump (high pressure) removal steps

- Throttle body (Refer to P.13A-118.)

- C◄ 2. Fuel pipe clamp

- C◄ 3. Fuel feed pipe

- C◄ 5. Fuel low-pressure pipe

- E◄ 12. Fuel return hose connection

- C◄ 13. Fuel pressure hose connection

- D◄ 14. Fuel nipple assembly

- B◄ 15. Fuel pump (high pressure)

- ◄B► ►B◄ 17. Back-up ring A

- B◄ 18. O-ring

- B◄ 19. Back-up ring B

Pump camshaft case assembly removal steps

7. Fuel pressure regulator (high pressure) assembly

- D◄ 15. Fuel pump (high pressure)

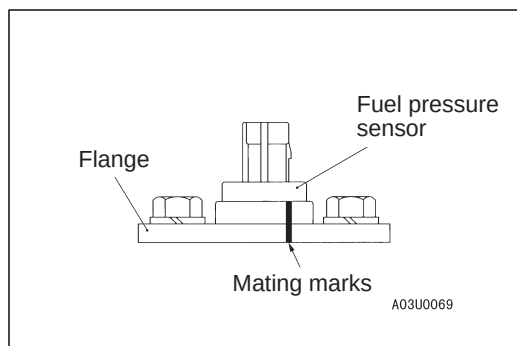
- B◄ 16. Fuel return pipe

- B◄ 17. Back-up ring A

- B◄ 18. O-ring

- B◄ 19. Back-up ring B

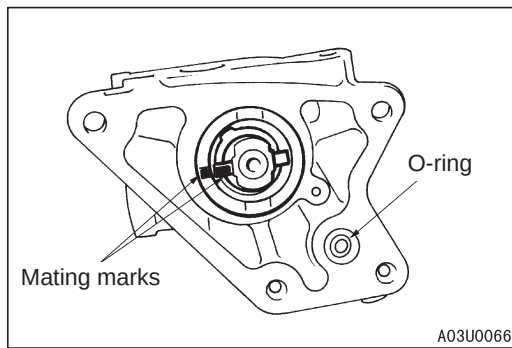
- ◄B► ►A◄ 20. Pump camshaft case assembly

**REMOVAL SERVICE POINT****◄A► FLANGE REMOVAL**

If reusing the fuel pressure sensor, make the mating marks on the sensor and the flange before removing the flange.

NOTE

The flange will be bent when it is installed to the engine. Because of this, the sealing condition and installation condition of the fuel pressure sensor will be maintained in good condition. Therefore, the mating marks should be made in order to install the flange in the original condition. If replacing the fuel pressure sensor with a new part, the sensor and flange should be replaced together.



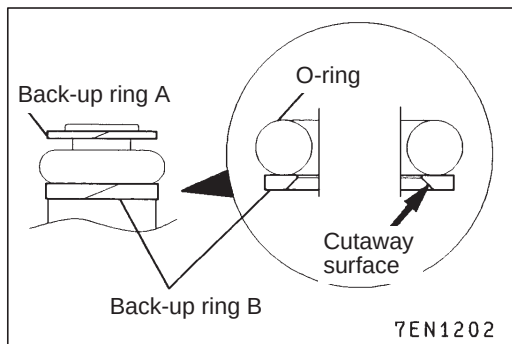
INSTALLATION SERVICE POINTS

►A◄ PUMP CAMSHAFT CASE ASSEMBLY INSTALLATION

1. Set the No.1 cylinder to the compression top dead centre position.
2. Align the mating mark on the housing of the pump camshaft case assembly with the mating mark on the coupling, and then install the pump camshaft case assembly to the engine.

Caution

Be careful not to drop the O-ring.



►B◄ BACK-UP RING B/O-RING/BACK-UP RING A INSTALLATION

Install the back-up rings and the O-ring as shown in the illustration.

Caution

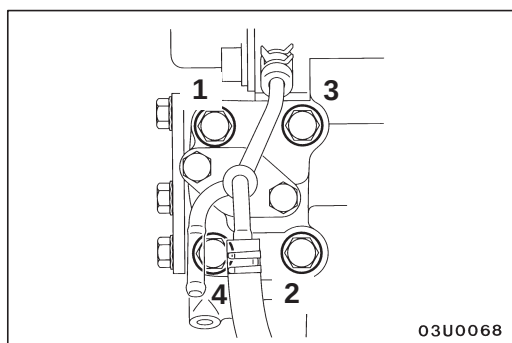
1. Install the back-up ring B facing its cutaway surface toward the opposite side of the O-ring as shown in the illustration.
2. Confirm the outer diameter of the back-up ring A. Take care not to install the back-up ring for the fuel pressure sensor by mistake. (Outer diameter of the back-up ring A: 14.8 mm)

►C◄ FUEL RETURN PIPE/FUEL LOW-PRESSURE PIPE/FUEL FEED PIPE INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution

Take care not to let any of the engine oil get inside the fuel pump (high pressure), fuel pressure regulator (high pressure) or the delivery pipe assembly.



►D◄ FUEL PUMP (HIGH PRESSURE) INSTALLATION

Use a torque wrench with a precision of 0.5 Nm to tighten the fuel pump mounting bolts according to the following procedure.

1. Tighten the bolts to 5 Nm in the order shown in the illustration.
2. Tighten the bolts to 17 Nm in the order shown in the illustration. The overall difference in tightening torque between the four bolts should be within 2 Nm.

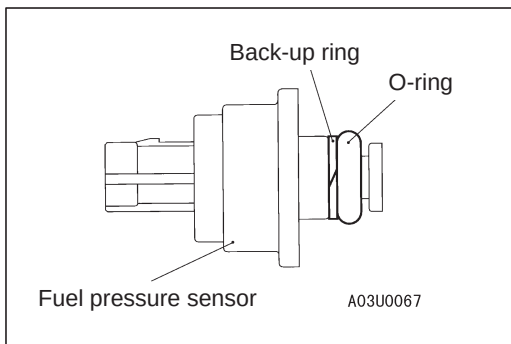
►E◄ FUEL PRESSURE HOSE INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

Caution

Take care not to let any of the engine oil get inside the fuel pump (high pressure).

2. While being careful not to damage the O-ring, turn the high-pressure fuel hose to the left and right and connect it to the fuel pump (high pressure). After connecting, check that the hose turns smoothly.
3. If the hose does not turn smoothly, the cause may be that the O-ring is getting caught. Disconnect the hose, check the O-ring for damage and re-connect the hose to the fuel pump (high pressure) and then re-check.

**►F◄ BACK-UP RING/O-RING INSTALLATION**

Install the back-up ring and the O-ring as shown in the illustration.

Caution

Take care not to install the back-up ring A for the injector, fuel feed pipe or fuel return pipe by mistake. (Outer diameter of the back-up ring for the fuel pressure sensor: 15.1 mm)

►G◄ FUEL PRESSURE SENSOR/FLANGE INSTALLATION

1. Apply a small amount of fresh engine oil to the O-ring.

Caution

Take care not to let any of the engine oil get inside the fuel pressure regulator (high pressure) assembly.

2. Align the mating marks which were made at the time of removal, and then install the fuel pressure sensor and flange to the fuel pressure regulator (high pressure) assembly.

Caution

If replacing the fuel pressure sensor with a new part, the sensor and flange should be replaced together.

►H◄ FUEL PUMP (HIGH PRESSURE) AIR-BLEEDING

1. Drive the engine at 2,000 r/min for at least 15 seconds, and bleed the pump.

NOTE

Air may enter the fuel pump when it is removed. If air has entered, diagnosis code No.56 is displayed due to an abnormal fuel pressure.

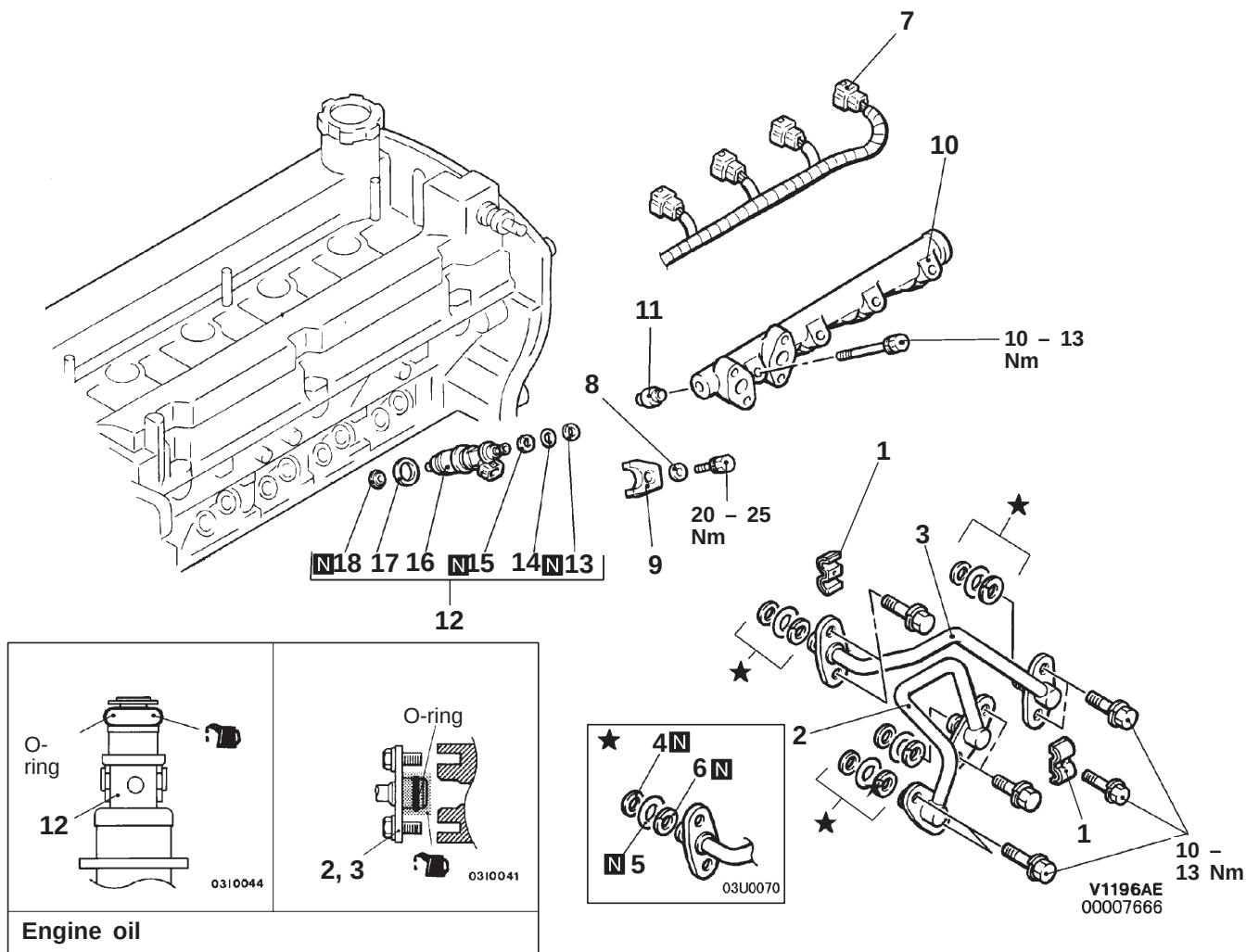
2. Then confirm the diagnosis code by the MUT-II. If diagnosis code No.56 (indicating a malfunction of the fuel pressure sensor system) is displayed, erase it.

INJECTOR

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Prevention of Fuel Discharge <before removal only> (Refer to P.13A-102.)
- Engine Cover Removal and Installation
- Air Cleaner Assembly Removal and Installation
- Intake Manifold Removal and Installation (Refer to GROUP 15.)
- Fuel Leak Check <after installation only> (Refer to P.13A-102.)



Removal steps

1. Fuel pipe clamp
2. Fuel feed pipe
3. Fuel return pipe
4. Back-up ring A
5. O-ring
6. Back-up ring B
7. Injector harness connector
8. Washer
9. Injector holder

10. Delivery pipe assembly
11. Insulator
12. Fuel injector assembly
13. Back-up ring
14. O-ring
15. Back-up ring
16. Fuel injector
17. Gasket
18. Corrugated washer

REMOVAL SERVICE POINTS**◀A▶ INJECTOR HARNESS CONNECTOR
DISCONNECTION****Caution**

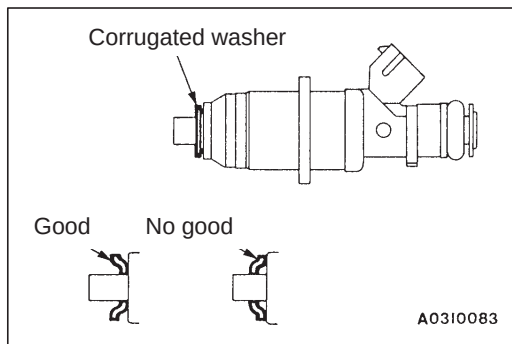
Disconnect the negative battery cable from its terminal before carrying out this operation.

**◀B▶ DELIVERY PIPE ASSEMBLY/FUEL INJECTOR
ASSEMBLY REMOVAL**

Remove the delivery pipe assembly with the fuel injector assembly still attached.

Caution

Be careful not to drop the fuel injector assembly when removing the delivery pipe assembly.

**INSTALLATION SERVICE POINTS****▶A▶ CORRUGATED WASHER INSTALLATION****Caution**

1. The corrugated washer should always be replaced with a new part.
2. There should be no scratches or foreign particles on the corrugated washer mounting surface of the injector.
3. Be careful not to mistake the corrugated washer installation direction.

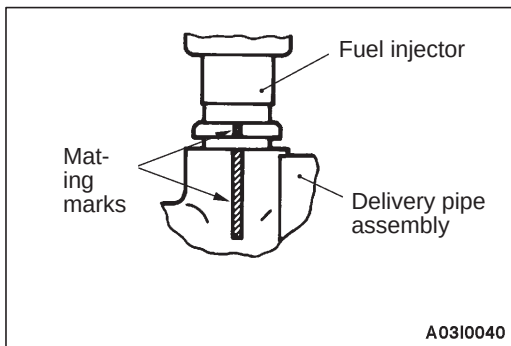
**▶B▶ FUEL INJECTOR ASSEMBLY/DELIVERY PIPE
ASSEMBLY INSTALLATION**

1. Apply a small amount of fresh engine oil to the O-ring.

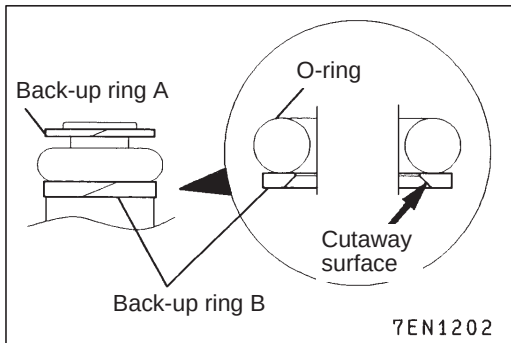
Caution

Take care not to let any of the engine oil get inside the delivery pipe assembly.

2. While being careful not to damage the O-ring, turn the fuel injector assembly to the left and right and connect it to the delivery pipe assembly. After connecting, check that the fuel injector turns smoothly.
3. If the fuel injector does not turn smoothly, the cause may be that the O-ring is getting caught. Remove the fuel injector, check the O-ring for damage and re-connect the fuel injector to the delivery pipe assembly and then re-check.



4. Align the mating marks on the delivery pipe assembly and the fuel injector, and then install the delivery pipe assembly with the injector assembly still attached.



►C◄ BACK-UP RING B/O-RING/BACK-UP RING A INSTALLATION

Install the back-up rings and the O-ring as shown in the illustration.

Caution

1. Install the back-up ring B facing its cutaway surface toward the opposite side of the O-ring as shown in the illustration.
2. Confirm the outer diameter of the back-up ring A. Take care not to install the back-up ring for the fuel pressure sensor by mistake. (Outer diameter of the back-up ring A: 14.8 mm)

►D◄ FUEL RETURN PIPE/FUEL FEED PIPE INSTALLATION

Apply a small amount of fresh engine oil to the O-ring.

Caution

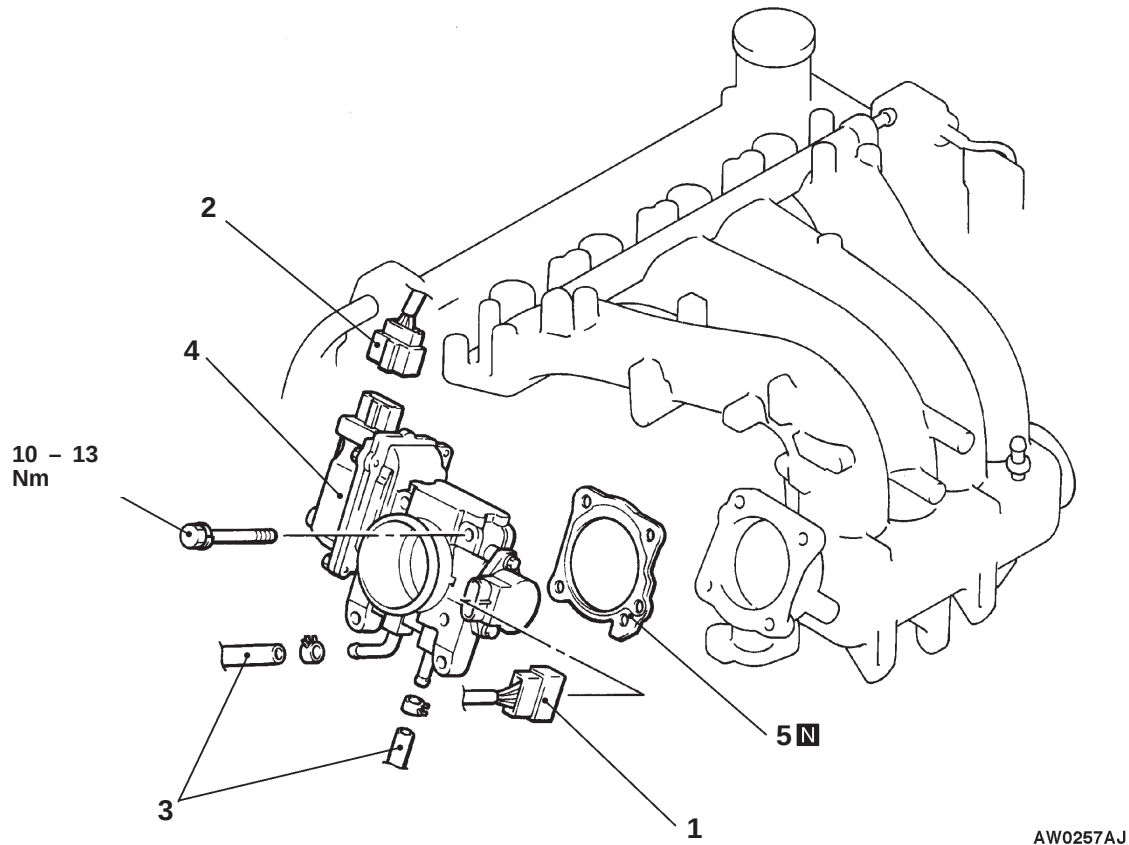
Take care not to let any of the engine oil get inside the fuel pump (high pressure), fuel pressure regulator (high pressure) or the delivery pipe assembly.

THROTTLE BODY

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying (Refer to GROUP 14 – On-vehicle Service.)
- Engine Cover Removal and Installation
- Air Intake Hose Removal and Installation



Removal steps

1. Throttle valve control servo connector
2. Throttle position sensor connector

- ▶A◀
3. Water hose connection
 4. Throttle body
 5. Throttle body gasket

INSTALLATION SERVICE POINT

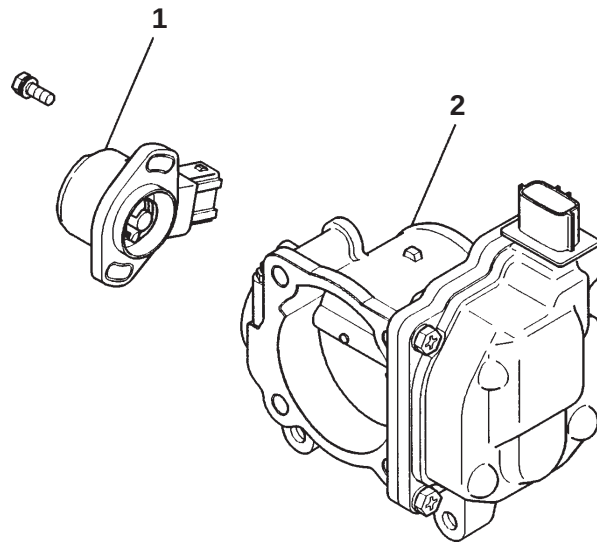
▶A◀ THROTTLE BODY INSTALLATION

If the throttle body is replaced, initialize the electronic-controlled throttle valve system.

Initialization

Turn on the ignition switch, and turn off it within one second. Then leave it for at least ten seconds with the ignition switch off.

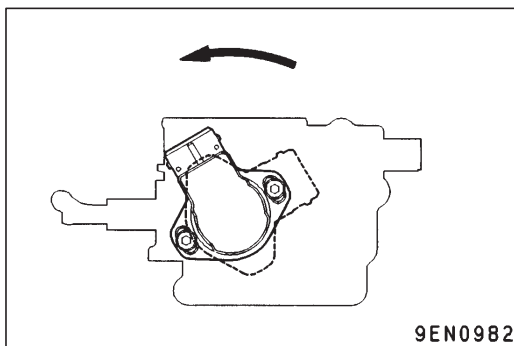
DISASSEMBLY AND REASSEMBLY



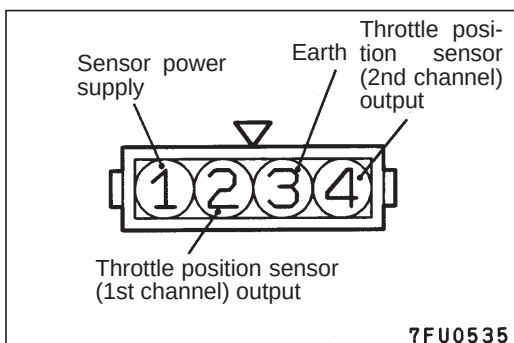
9EN0981

Disassembly steps

- A◄
1. Throttle position sensor
 2. Throttle body



9EN0982



7FU0535

REASSEMBLY SERVICE POINTS**►A◄ THROTTLE POSITION SENSOR**

- (1) Position the throttle position sensor on the throttle body along the dotted line as shown in the illustration.
- (2) Rotate the throttle position sensor anticlockwise as shown in the illustration, and then tighten the screws.
- (3) Measure resistance value between terminal Nos. 1(sensor power supply) and 2(throttle position sensor 1st-channel output) as well as 1(sensor power supply) and 4(throttle position sensor 2nd-channel output).

Normal condition

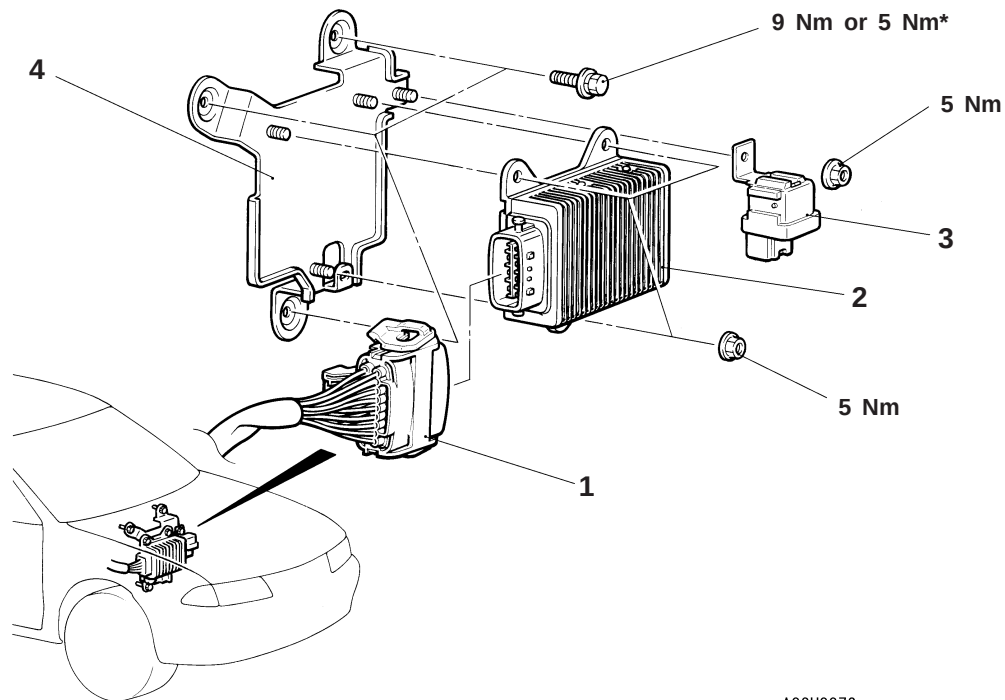
Open the throttle valve slowly from the idle position to full-open position.

Resistance value changes smoothly in response to throttle valve opening angle.

- (4) If the resistance value does not change smoothly, replace the throttle position sensor.

INJECTOR DRIVER

REMOVAL AND INSTALLATION



A03U0072

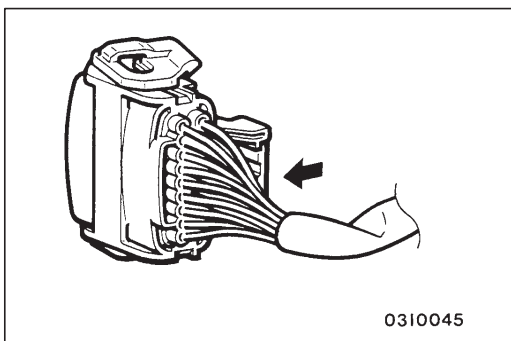
Removal steps



1. Injector driver connector
2. Injector driver
3. Injector driver control relay
4. Bracket

NOTE

Tightening torque marked with * is for earth bolts (head marking: E).



0310045

REMOVAL SERVICE POINTS

◀A▶ INJECTOR DRIVER CONNECTOR DISCONNECTION

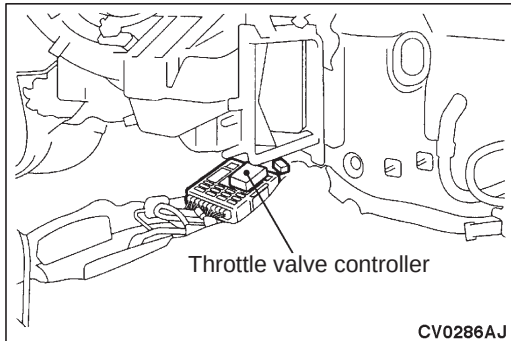
Press the injector driver connector in the place shown in the illustration to disconnect the injector driver connector.

Caution

Disconnect the negative battery cable from its terminal before carrying out this operation.

◀B▶ INJECTOR DRIVER REMOVAL**Caution**

The injector driver will become hot after the vehicle has been driven, so take care when handling it.

**THROTTLE VALVE CONTROLLER****INSTALLATION SERVICE POINT**

If the throttle valve controller is replaced, initialize the electronic-controlled throttle valve system.

Initialization

Turn on the ignition switch, and turn off it within one second. Then leave it for at least ten seconds with the ignition switch off.

NOTES

MULTIPOINT FUEL INJECTION (MPI)

CONTENTS

13109000577

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GENERAL INFORMATION

13100010647

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.

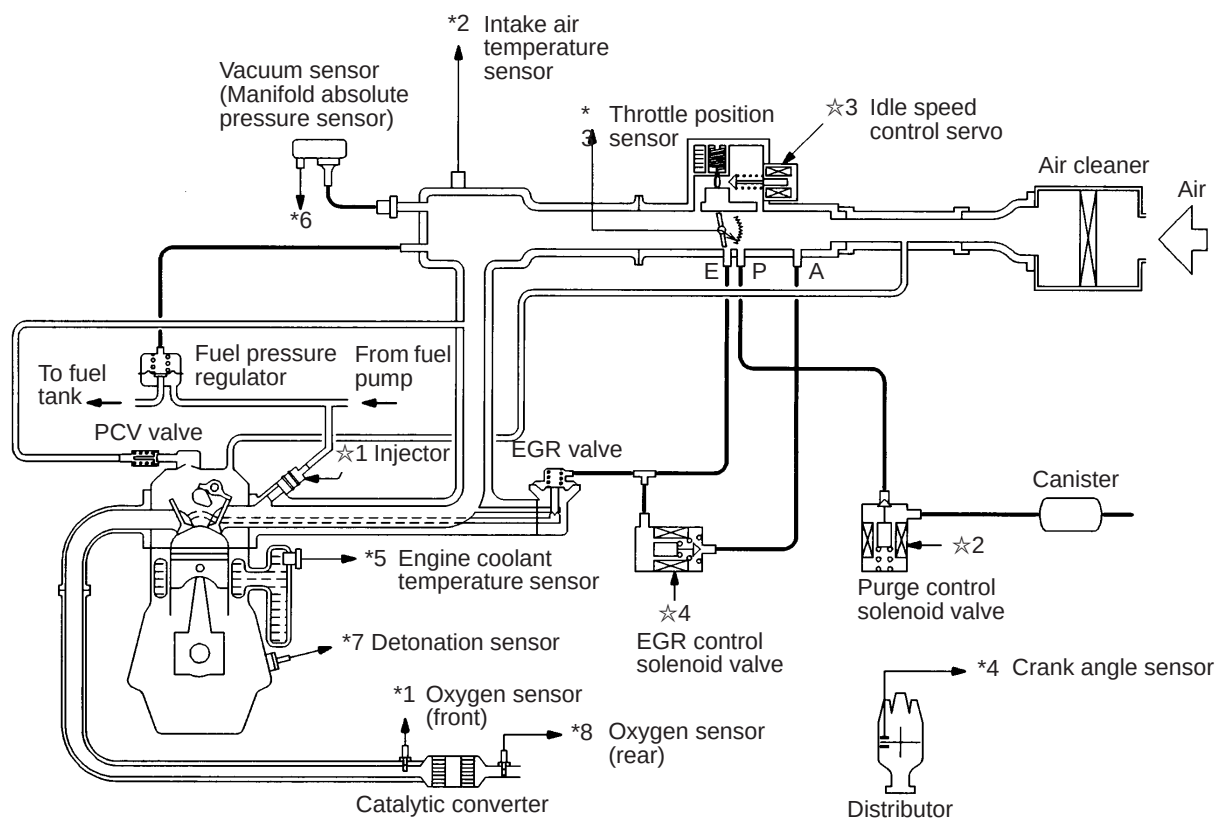
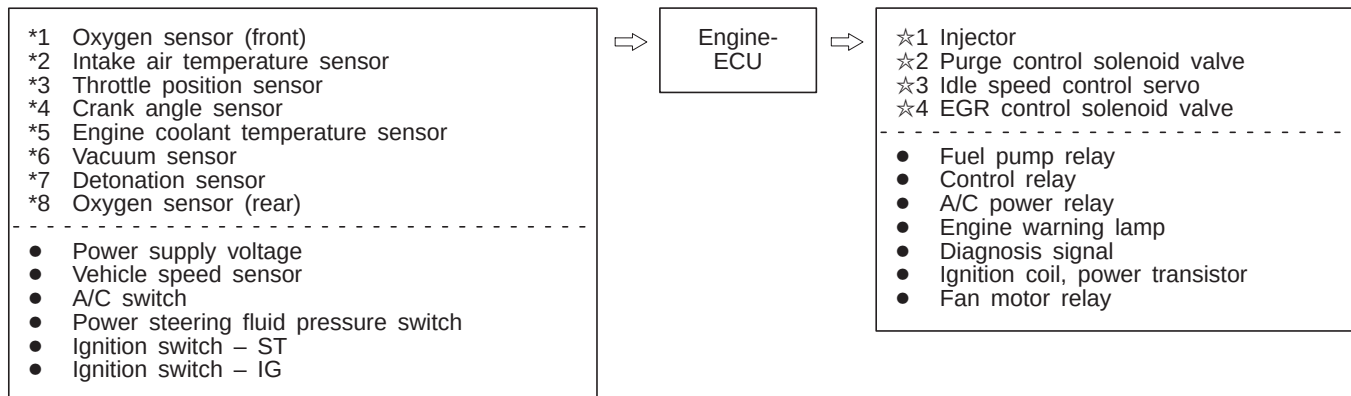
OTHER CONTROL FUNCTIONS

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	46
	Throttle position sensor	Variable resistor type
	Idle speed control servo	Stepper motor type (Stepper motor type by-pass air control system with the air volume limiter)
Engine-ECU	Identification model No.	E2T71272 <Except vehicles for Germany> E2T71275 <Vehicles for Germany>
Sensors	Vacuum sensor (Manifold absolute 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
	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	CDH166
	EGR control solenoid valve	ON/OFF 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



W6001AJ

SERVICE SPECIFICATIONS

13100030469

Items		Specifications
Basic idle speed r/min		750±50
Idle speed when A/C is ON r/min		850 at neutral position
Throttle position sensor adjusting voltage mV		530 – 740
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)

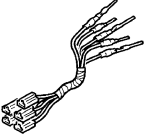
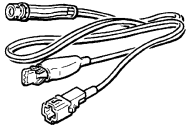
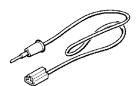
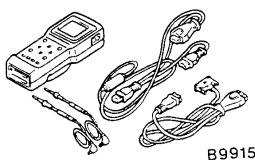
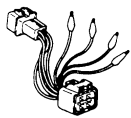
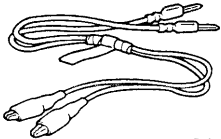
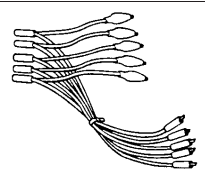
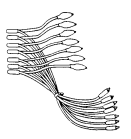
SEALANT

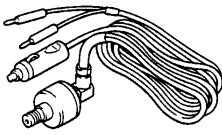
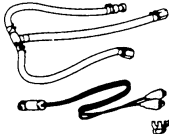
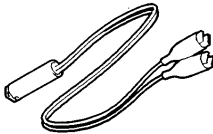
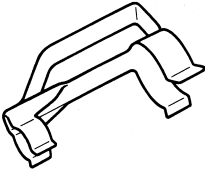
13100050038

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

SPECIAL TOOLS

13100060444

Tool	Number	Name	Use
A  B  C  D  C991223	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: Power circuit inspection C: Power circuit inspection D: Commercial tester connection
 B991502	MB991502	MUT-II sub assembly	- Reading diagnosis code - MPI system inspection
	MB998464	Test harness (4-pin, square)	Inspection of oxygen sensor
 B991529	MB991529	Diagnosis code check harness	Reading diagnosis code
	MB991348	Test harness set	- Measurement of voltage during trouble-shooting - Inspection using an analyzer
 MB991709	MB991709	Test harness	- Inspection of idle speed control servo - Measurement of voltage during trouble-shooting - Inspection using an analyzer

Tool	Number	Name	Use
	MD998709	Adaptor hose	Measurement of fuel pressure
	MD998742	Hose adaptor	
 B991637	MB991637	Fuel pressure gauge set	
	MD998706	Injector test set	Checking the spray condition of injectors
 MB991607	MB991607	Injector test harness	
 MD998741	MD998741	Injector test adaptor	
	MB991608	Clip	

TROUBLESHOOTING

13100850409

DIAGNOSIS TROUBLESHOOTING FLOW

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

NOTE

If the engine-ECU is replaced, immobilizer-ECU and ignition key should be also replaced.

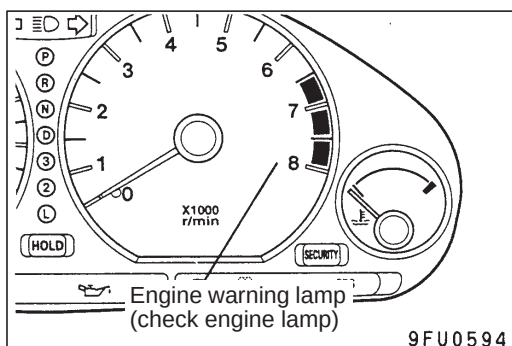
DIAGNOSIS FUNCTION

13100860594

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
Vacuum sensor
Intake air temperature sensor
Throttle position sensor
Engine coolant temperature sensor
Crank angle sensor
Detonation sensor
Ignition timing adjustment signal
Injector
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 TESTING

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 problem has disappeared.

FAIL-SAFE FUNCTION REFERENCE TABLE

13100910398

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
Vacuum sensor	1. Uses the throttle position sensor signal and engine speed signal (crank angle sensor signal) to take reading of the basic injector drive time 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 45°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.
Detonation sensor	Switches the ignition timing from ignition timing for super petrol to ignition timing for standard petrol.
Oxygen sensor (front)	Air/fuel ratio feedback control (closed loop control) is not performed.
Oxygen sensor (rear)	Performs the feedback control (closed loop control) of the air/fuel ratio by using only the signal of the oxygen sensor (front) installed on the front of the catalytic converter.

INSPECTION CHART FOR DIAGNOSIS CODES

13100870672

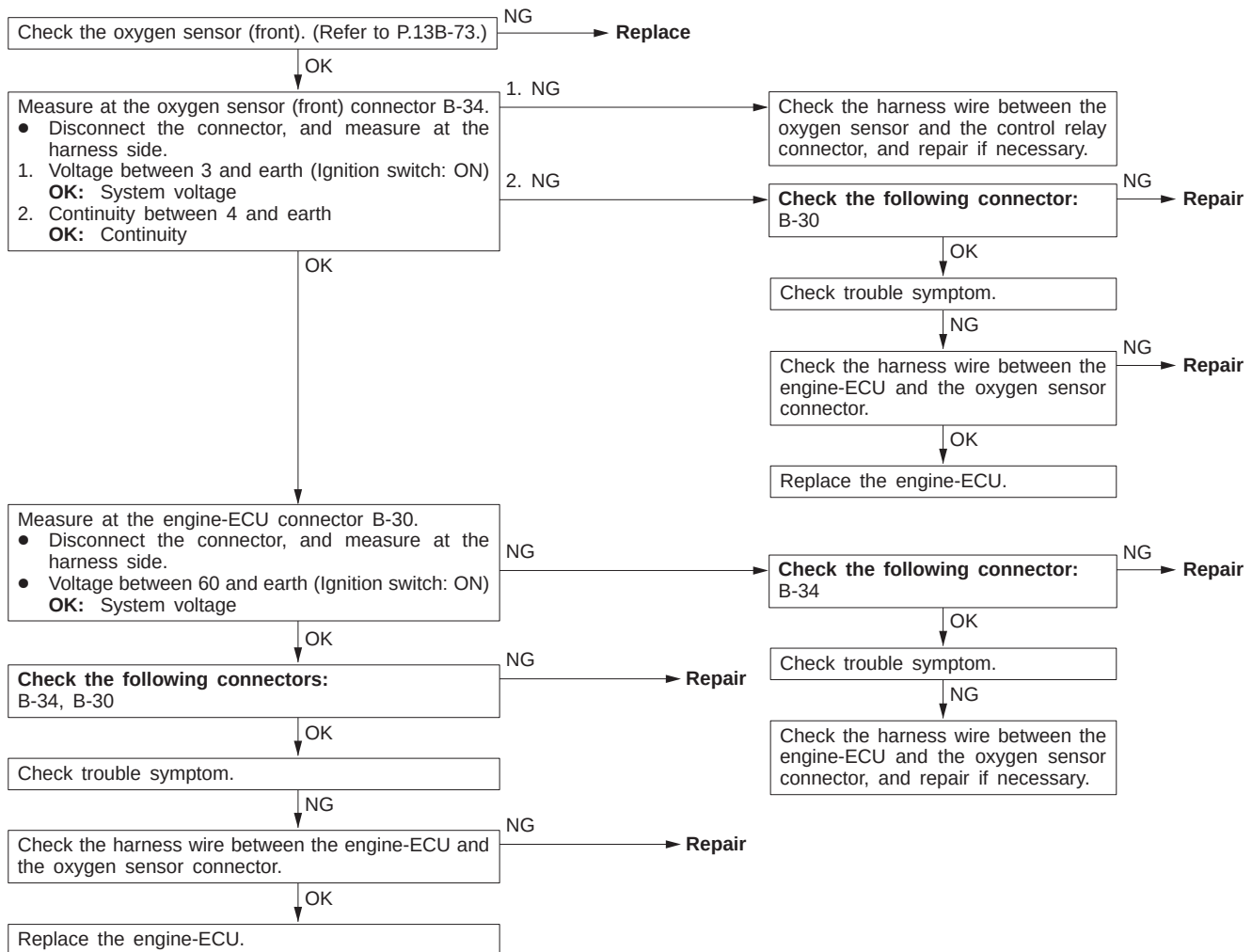
Code No.	Diagnosis item	Reference page
11	Oxygen sensor (front) system	13B-10
13	Intake air temperature sensor system	13B-11
14	Throttle position sensor system	13B-12
21	Engine coolant temperature sensor system	13B-13
22	Crank angle sensor system	13B-14
24	Vehicle speed sensor system	13B-14
31	Detonation sensor system	13B-15
32	Vacuum sensor system	13B-16
36*	Ignition timing adjustment signal system	13B-17
41	Injector system	13B-17
54	Immobilizer system	13B-18
59	Oxygen sensor (rear) system	13B-19

NOTE

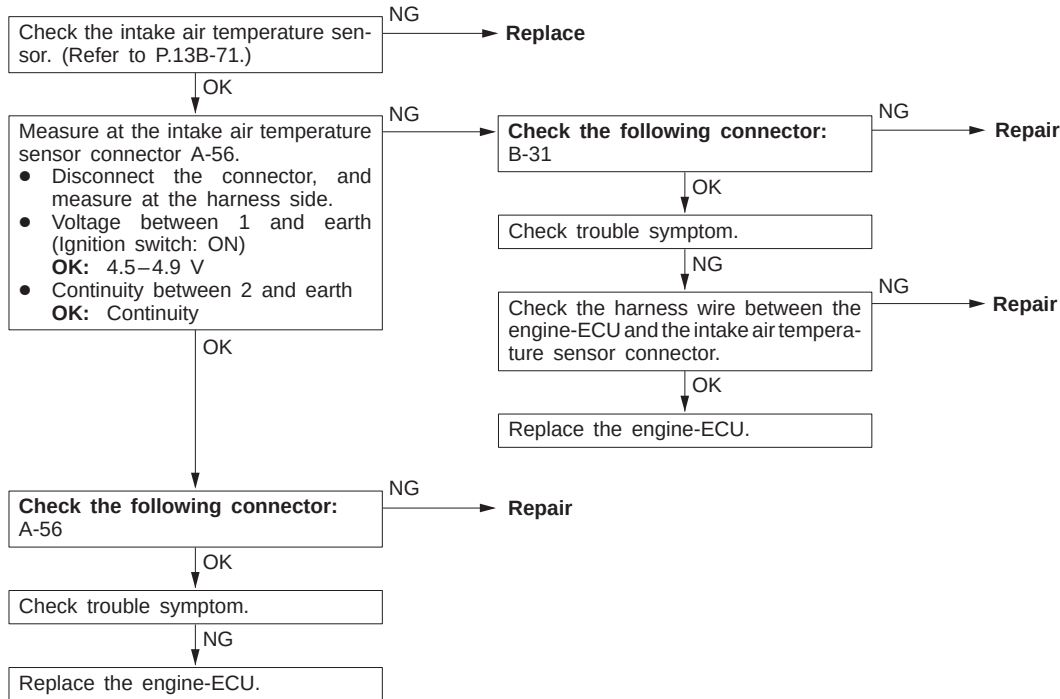
*: Malfunction code No. 36 is not memorized.

INSPECTION PROCEDURE FOR DIAGNOSIS CODES

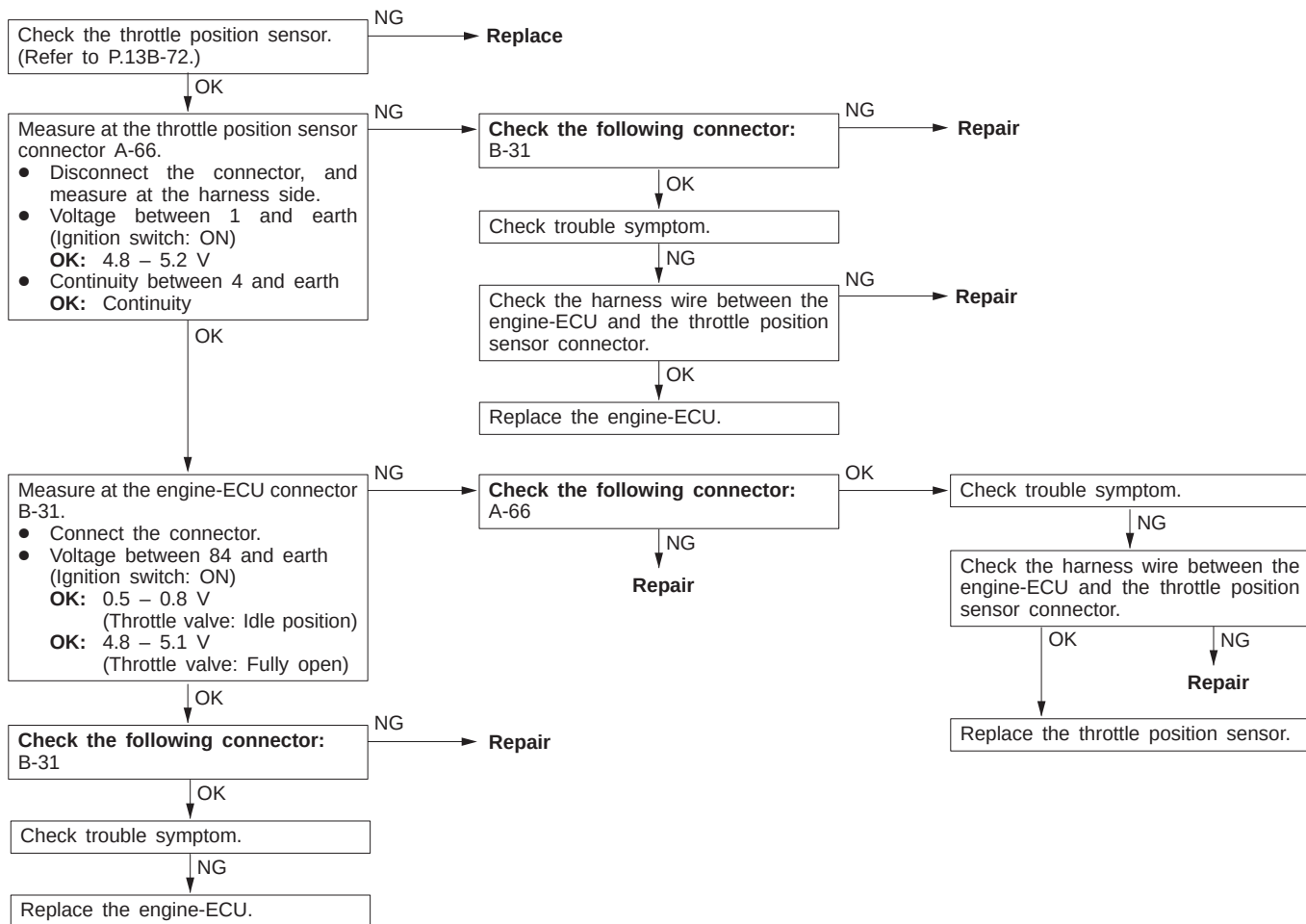
Code No. 11 Oxygen sensor (front) system	Probable cause
Range of Check 3 minutes have passed after engine was started. - Engine coolant temperature is approx. 80°C or more. - Intake air temperature is 20–50°C. - Engine speed is approx. 2,000–3,000 r/min - Vehicle is moving at constant speed on a flat, level road surface Set conditions - The oxygen sensor (front) 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 (front) - Improper connector contact, open circuit or short-circuited harness wire - Malfunction of the engine-ECU



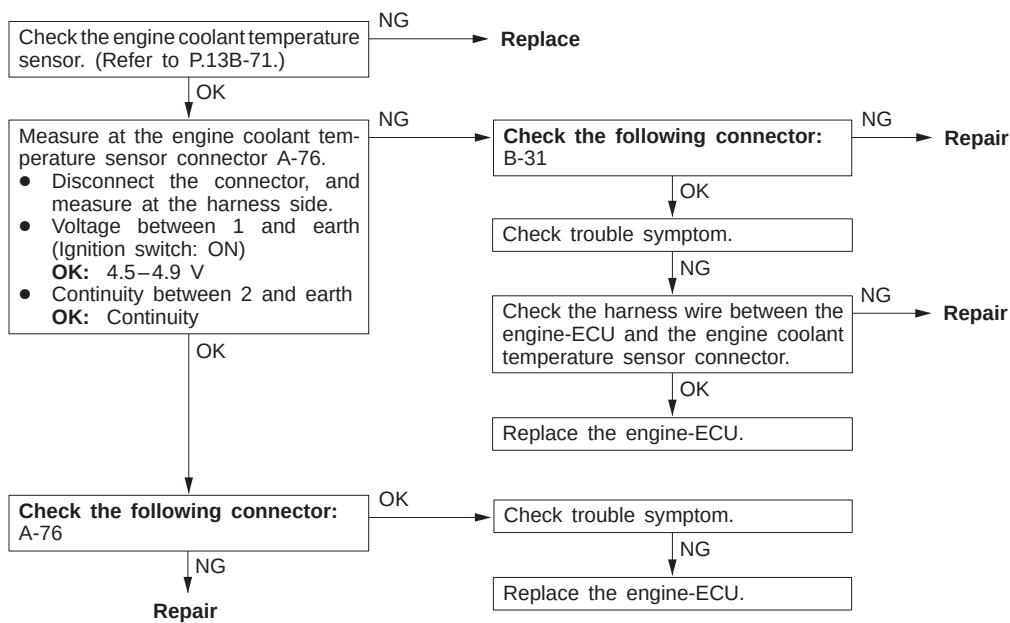
Code No. 13 Intake air temperature sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. Set conditions - Sensor output voltage is 4.6 V or more (corresponding to an intake air temperature 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



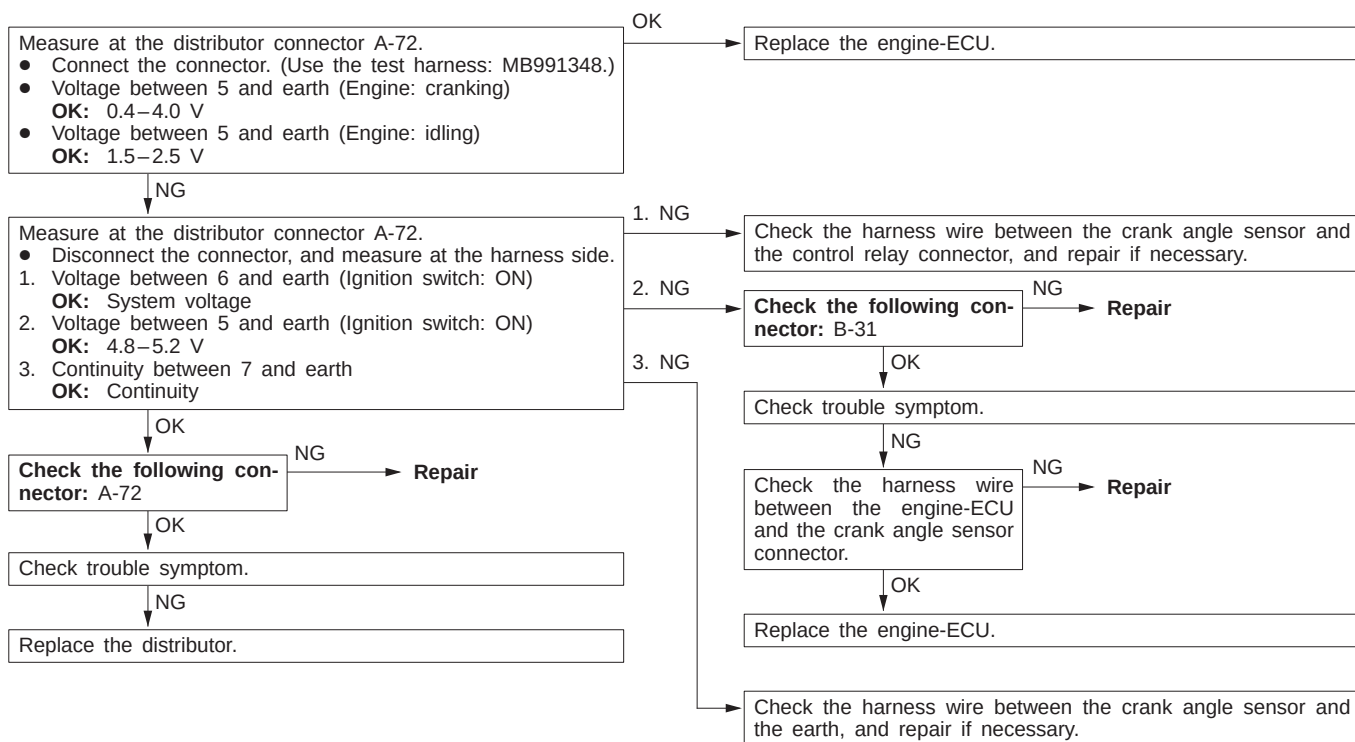
Code No.14 Throttle position sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. Set conditions - Engine speed is 3,000 r/min or less, and volumetric efficiency is 30% or less, TPS output voltage is 4.6 V or more for 4 seconds. or - Engine speed is 2,000 r/min or more, and volumetric efficiency is 60% or more, TPS output voltage is 0.8 V or less for 4 seconds.	- Malfunction of the throttle position sensor - Improper connector contact, open circuit or short-circuited harness wire of the throttle position sensor circuit - Malfunction of the engine-ECU



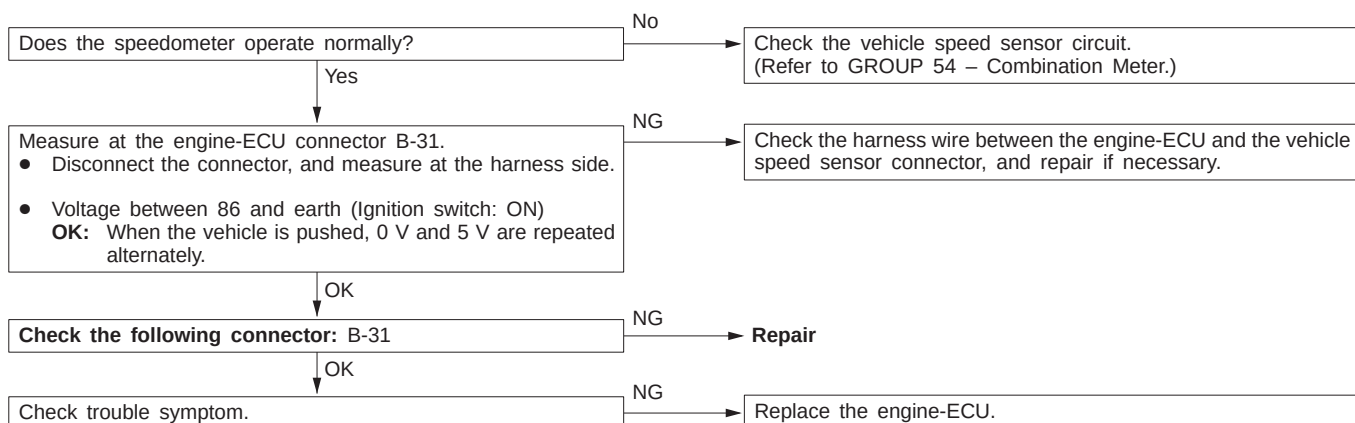
Code No. 21 Engine coolant temperature sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. Set conditions - Sensor output voltage is 4.6 V or more (corresponding to an engine coolant 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.	



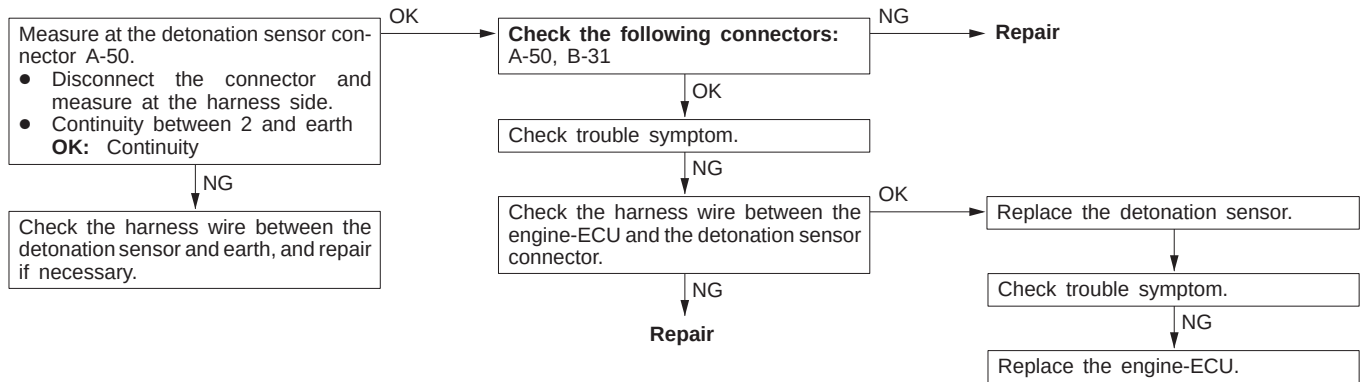
Code No. 22 Crank angle sensor system	Probable cause
Range of Check - Engine is cranking. Set conditions - Sensor output voltage does not change for 4 seconds (no pulse signal input.)	- Malfunction of the crank angle sensor - Improper connector contact, open circuit or short-circuited harness wire of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



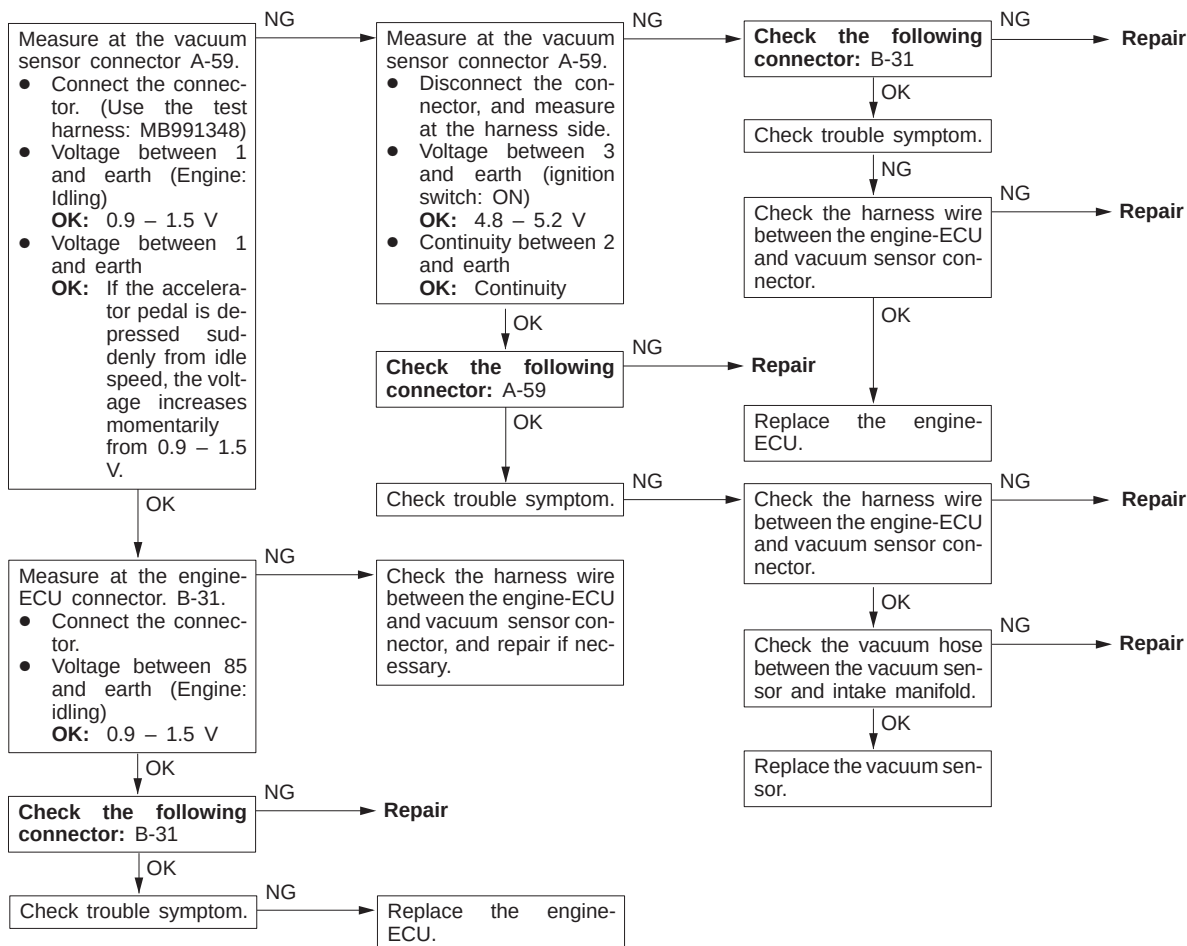
Code No. 24 Vehicles speed sensor system	Probable cause
Range of check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. - Idle position switch: OFF - Engine speed is 3,000 r/min or more. - Driving under high engine load conditions. 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



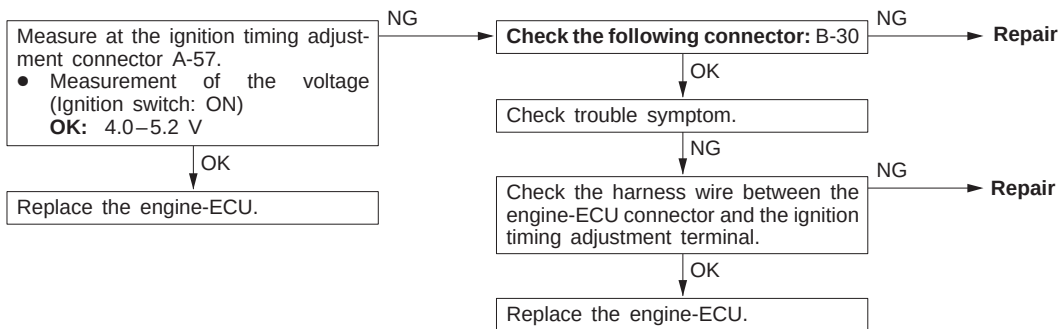
Code No. 31 Detonation sensor system	Probable cause
Range of Check - Ignition switch: ON - Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts. - Engine speed is approx. 5,000 r/min or more Set conditions The change in the detonation sensor output voltage (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



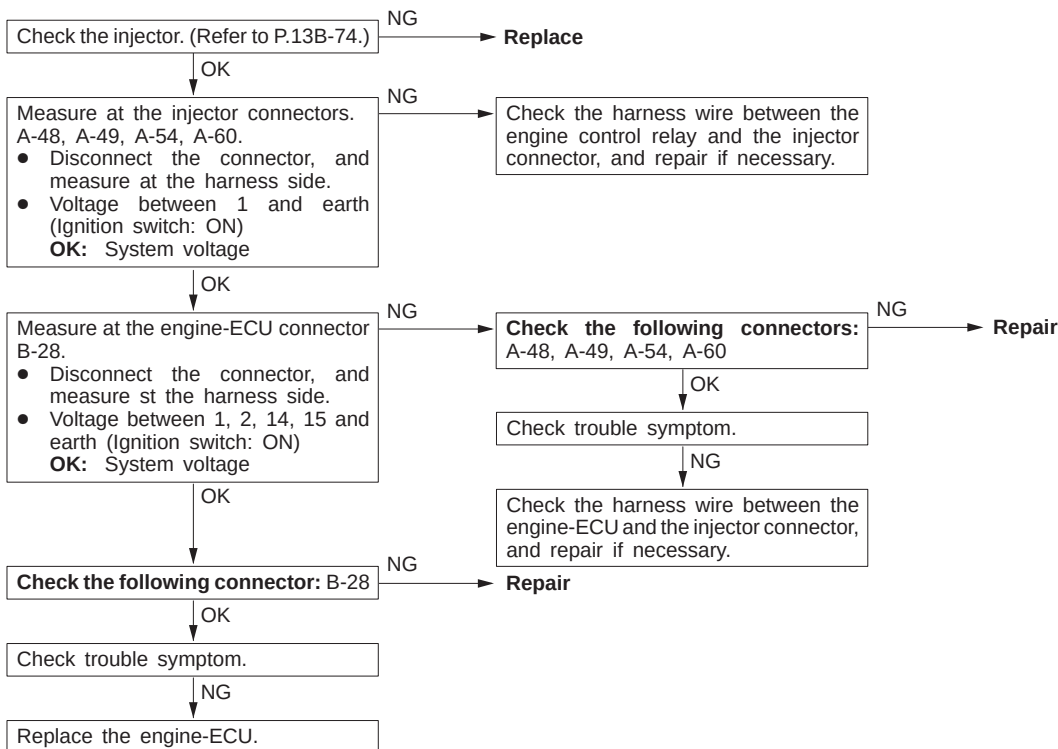
Code No.32 Vacuum sensor system	Range of Check
Range of Check • Ignition switch: ON Set Conditions • The output voltage of the vacuum sensor is 4.5 V or more for 4 seconds. (This corresponds to the absolute manifold pressure of 115 kPa or more.)	• Malfunction of the vacuum sensor • Improper connector contact, open circuit or short-circuited harness • Malfunction of the engine-ECU
Range of Check • The output voltage of the throttle position sensor is 1.25 V or more. or • The vehicle is stationary. Set Conditions • The output voltage of the vacuum sensor is 0.2 V or less for 4 seconds. (This corresponds to the absolute manifold pressure of 4.9 kPa or less.)	



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



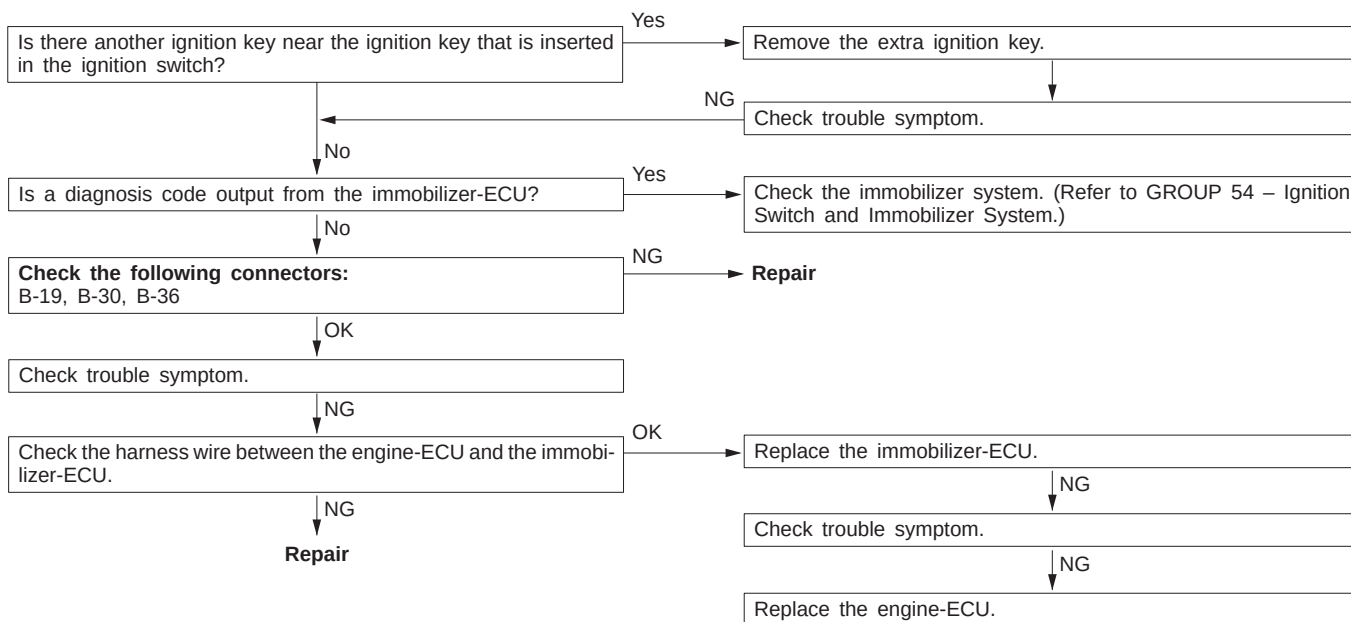
Code No. 41 Injector system	Probable cause
Range of Check • Engine speed is approx. 50–1,000 r/min • The throttle position sensor output voltage is 1.15 V or less. • Actuator test by MUT-II is not carried out. Set conditions • Surge voltage of injector coil is not detected for 4 seconds.	• Malfunction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



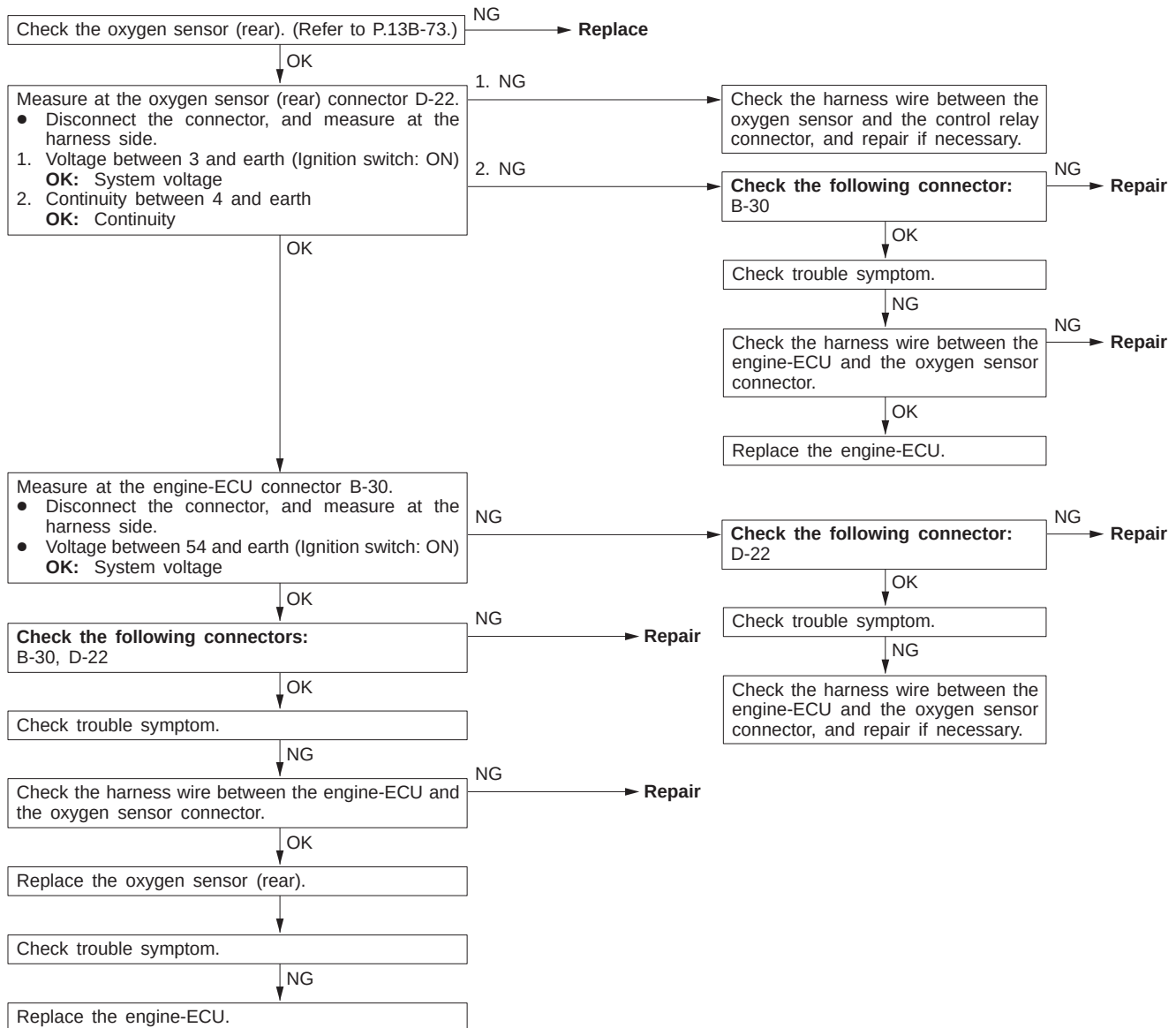
Code No.54 Immobilizer system	Probable cause
Range of Check • Ignition switch: ON Set Conditions • Improper communication between the engine-ECU and immobilizer-ECU	• Radio interference of ID codes • Incorrect ID code • Malfunction of harness or connector • Malfunction of immobilizer-ECU • Malfunction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

NOTE

- (1) If the ignition switches are close each other when starting the engine, radio interference may cause this code to be displayed.
- (2) This code may be displayed when registering the key ID code.



Code No. 59 Oxygen sensor (rear) system	Probable cause
Range of Check 3 minutes have passed after engine was started. - Engine coolant temperature is approx. 80°C or more. - Idle position switch: OFF - The throttle position sensor output voltage is 4.1 V or more. - Open loop control in operation 20 seconds have passed after deceleration finished. Set conditions - The oxygen sensor (rear) output voltage is 0.1 V or less. - The difference in the maximum and minimum values for the oxygen sensor (rear) output voltage is 0.08 V or less. - The oxygen sensor (rear) output voltage is 0.5 V or more. - The above conditions continue for a continuous period of 5 seconds.	- Malfunction of the oxygen sensor (rear) - Improper connector contact, open circuit or short-circuited harness wire - Malfunction of the engine-ECU



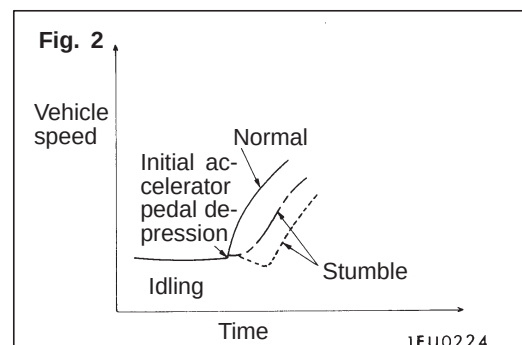
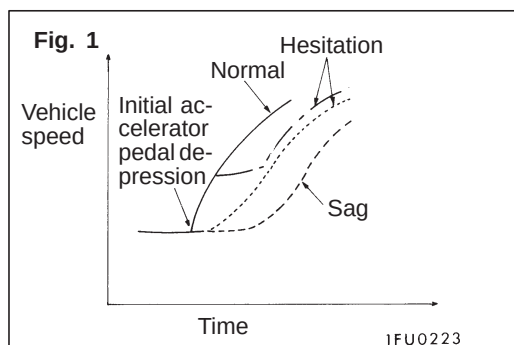
INSPECTION CHART FOR TROUBLE SYMPTOMS

13100880590

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is impossible.	Communication with all systems is not possible.	1	13B-22
	Communication with engine-ECU only is not possible.	2	13B-22
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	13B-23
	The engine warning lamp remains illuminating and never goes out.	4	13B-23
Starting	No initial combustion (starting impossible)	5	13B-24
	Initial combustion but no complete combustion (starting impossible)	6	13B-25
	Long time to start (improper starting)	7	13B-26
Idling stability (Improper idling)	Unstable idling (Rough idling, hunting)	8	13B-27
	Idling speed is high. (Improper idling speed)	9	13B-29
	Idling speed is low. (Improper idling speed)	10	13B-29
Idling stability (Engine stalls)	When the engine is cold, it stalls at idling. (Die out)	11	13B-30
	When the engine becomes hot, it stalls at idling. (Die out)	12	13B-31
	The engine stalls when starting the car. (Pass out)	13	13B-33
	The engine stalls when decelerating.	14	13B-33
Driving	Hesitation, sag or stumble	15	13B-34
	The feeling of impact or vibration when accelerating	16	13B-35
	The feeling of impact or vibration when decelerating	17	13B-35
	Poor acceleration	18	13B-36
	Surge	19	13B-37
	Knocking	20	13B-38
Dieseling		21	13B-38
Too high CO and HC concentration when idling		22	13B-39
Fans (radiator fan, A/C condenser fan) are inoperative		23	13B-40

PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)

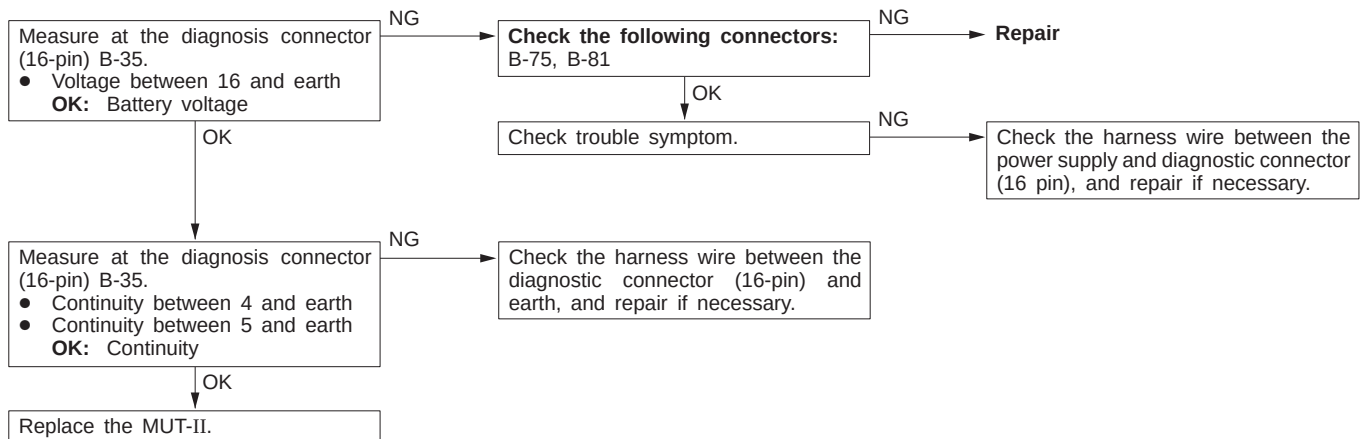
Items		Symptom
Starting	Won't start	The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start.
	Fires up and dies	There is combustion within the cylinders, but then the engine soon stalls.
	Hard starting	Engine starts after cranking a while.
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 FOR TROUBLE SYMPTOMS

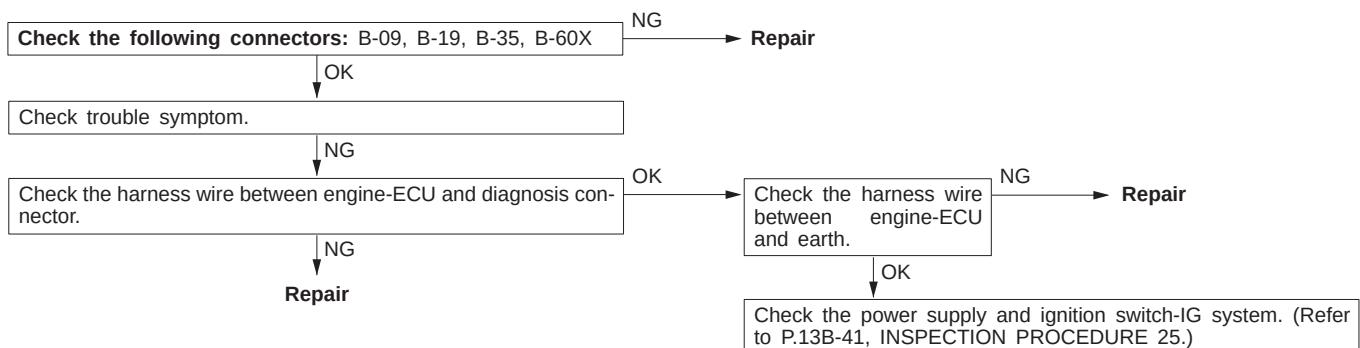
INSPECTION PROCEDURE 1

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	• Malfunction of engine-ECU power supply circuit • Malfunction of engine-ECU • Open circuit between engine-ECU and diagnosis connector

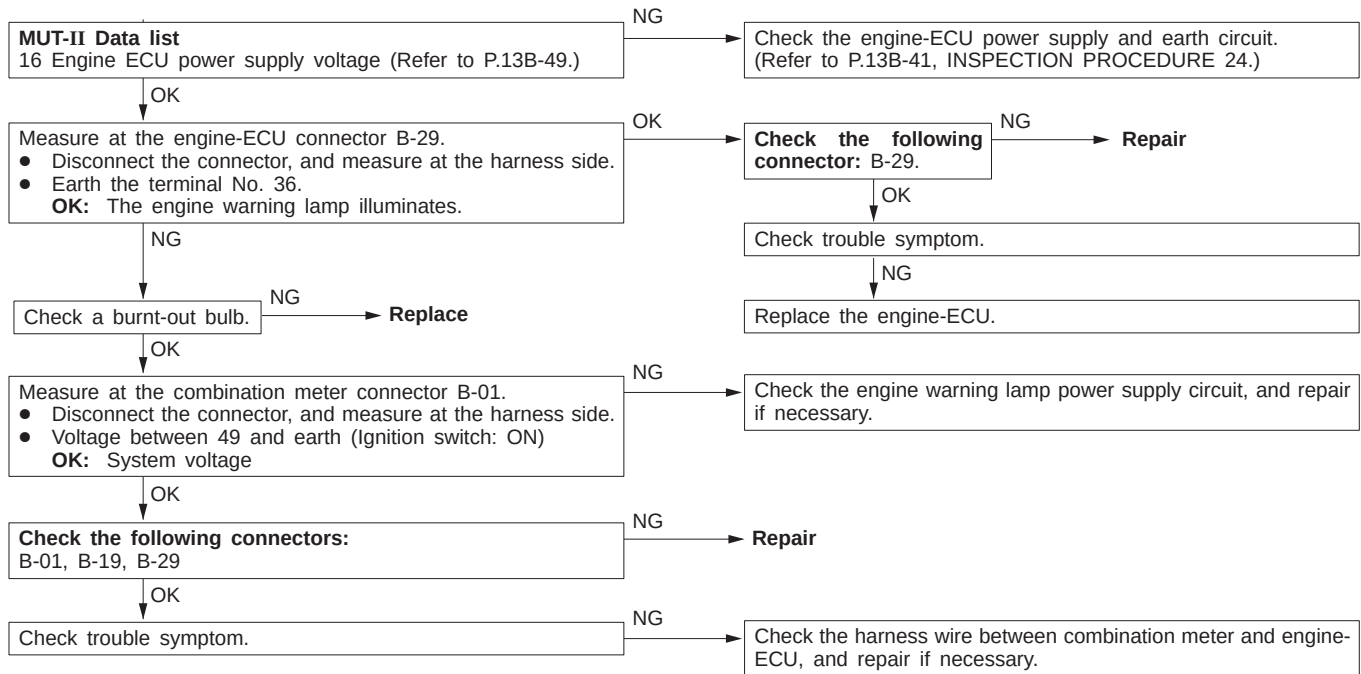


NOTE

Though the above inspection has been performed, if trouble symptom does not disappear, check the multi center display, and replace it if necessary.

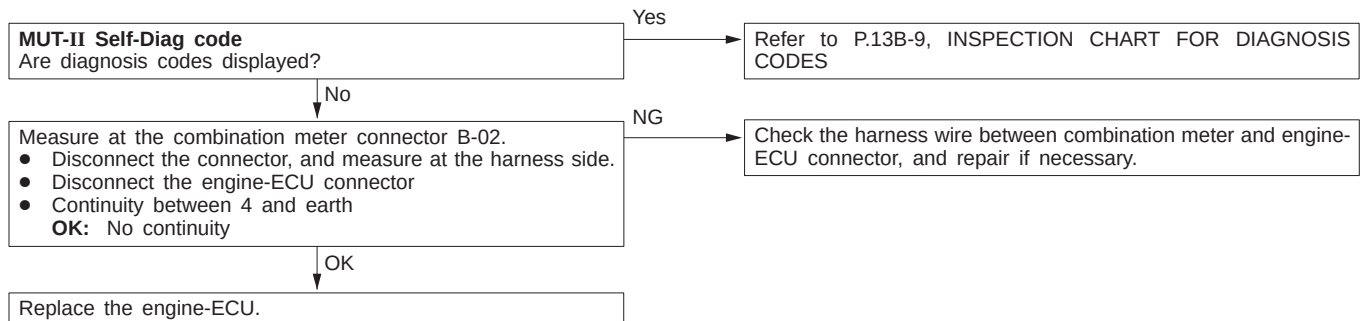
INSPECTION PROCEDURE 3

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



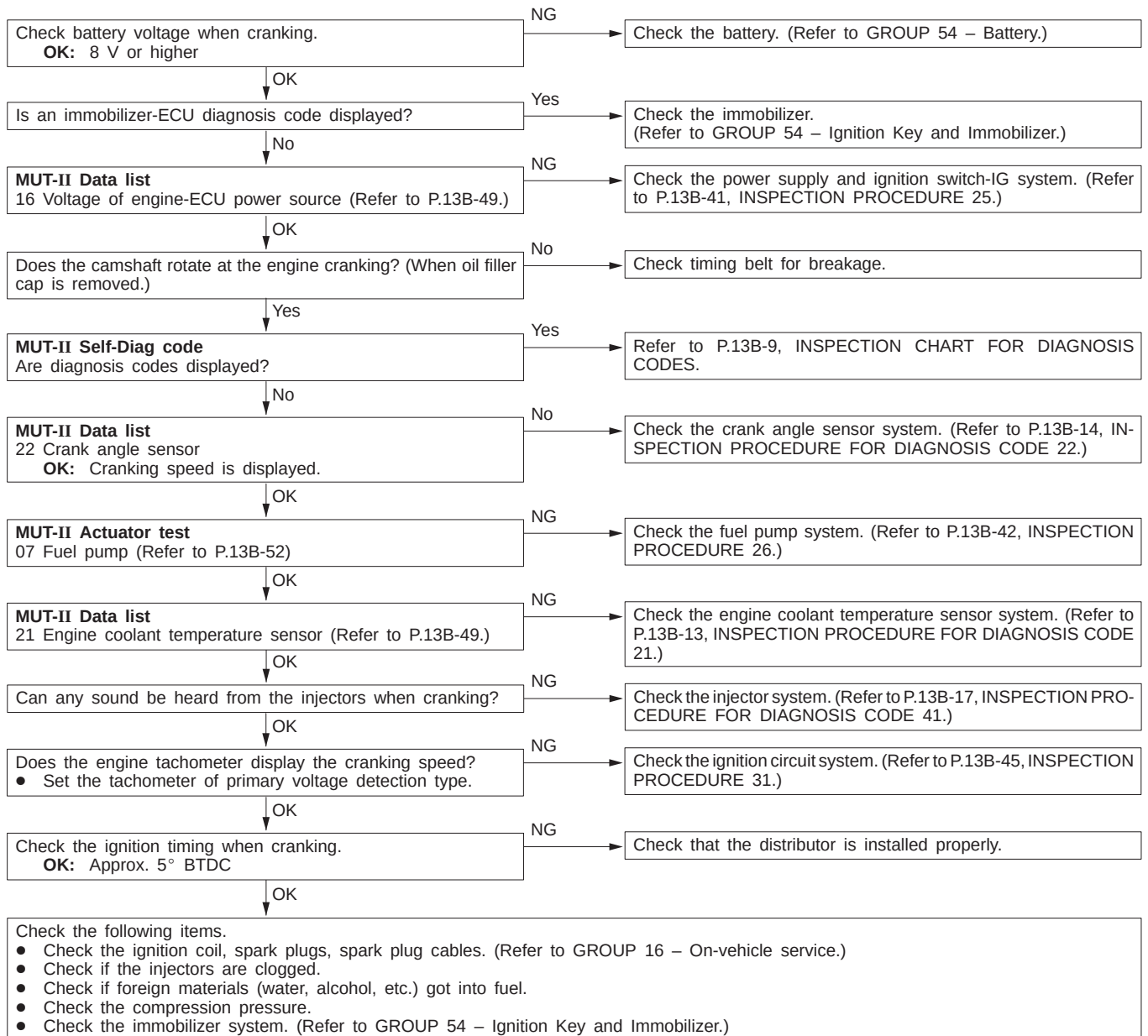
INSPECTION PROCEDURE 4

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



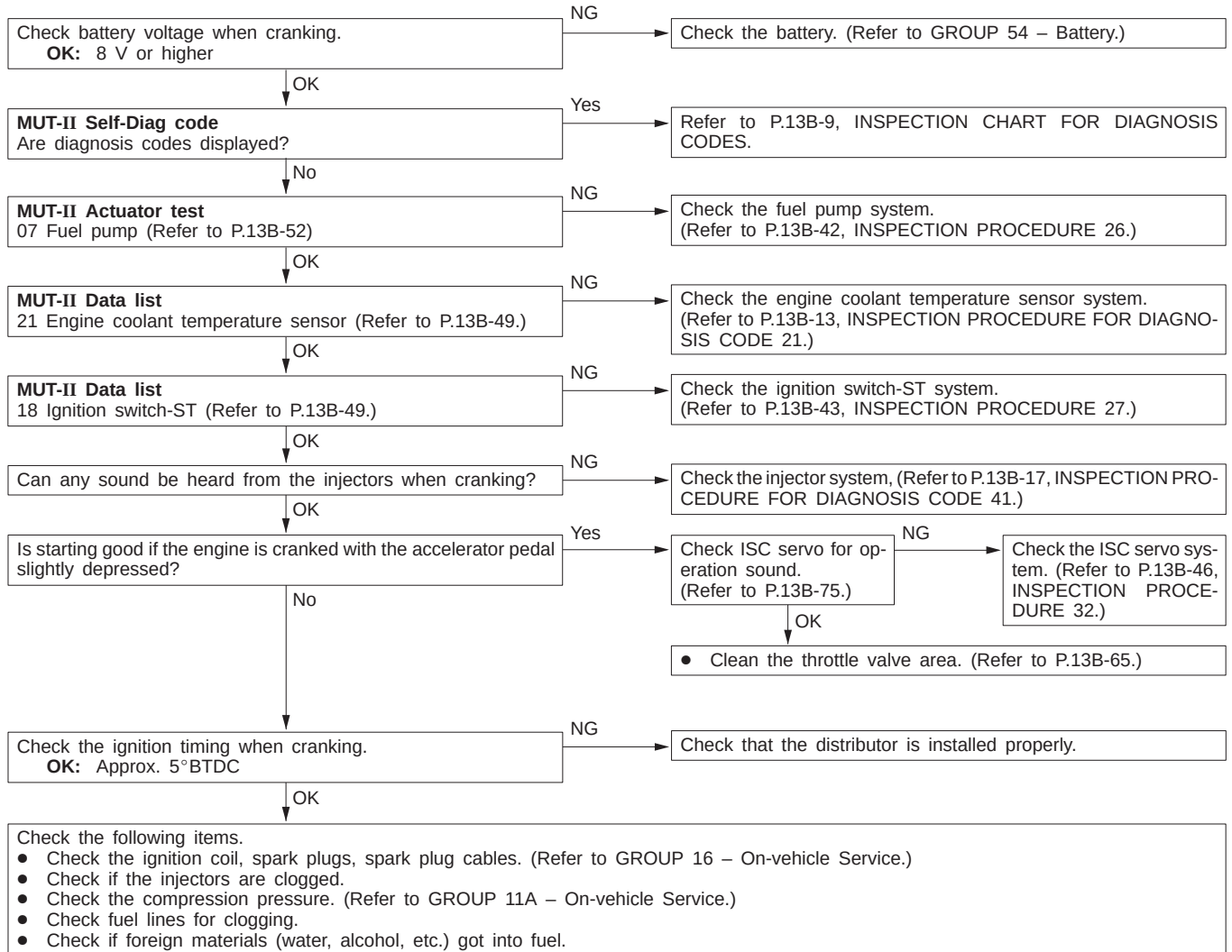
INSPECTION PROCEDURE 5

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 ● Foreign materials in fuel



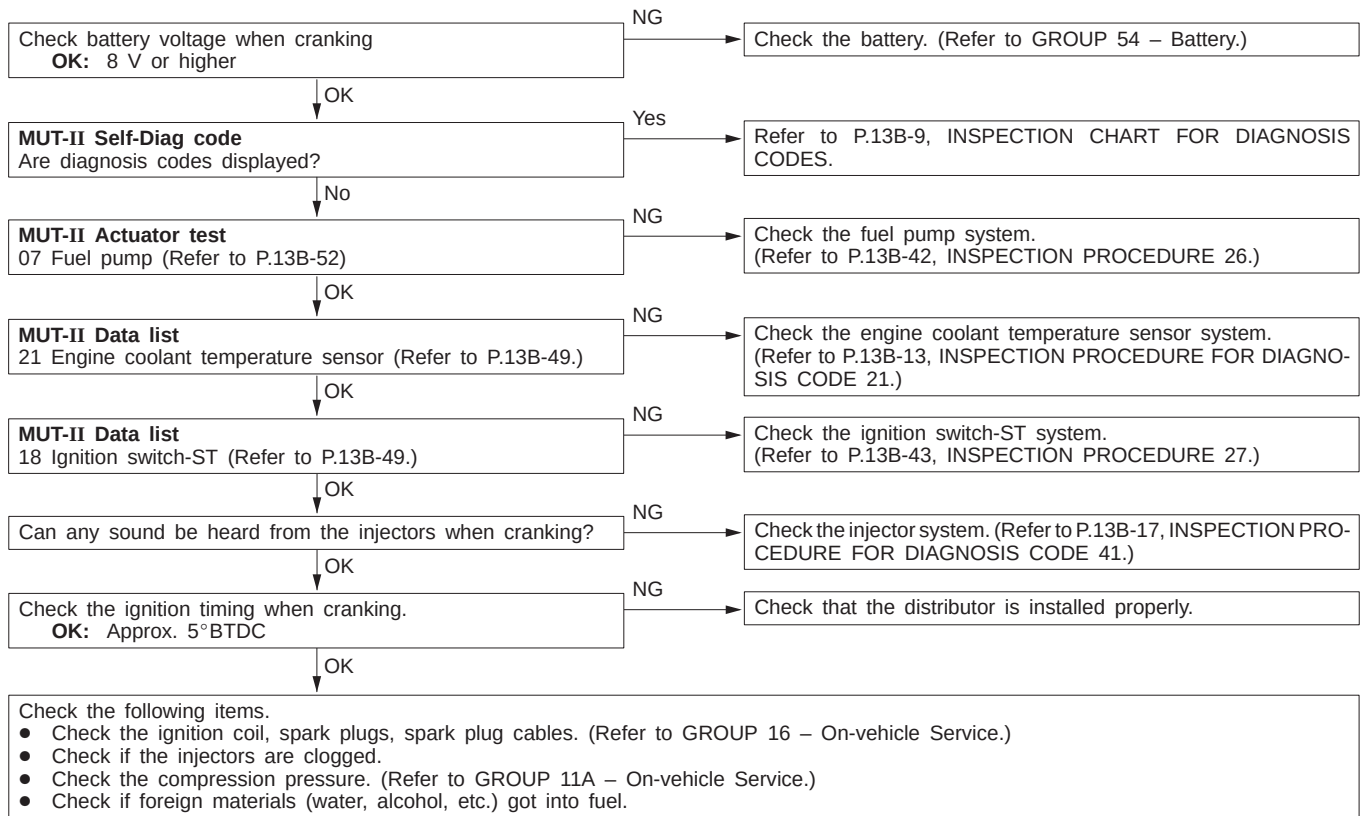
INSPECTION PROCEDURE 6

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



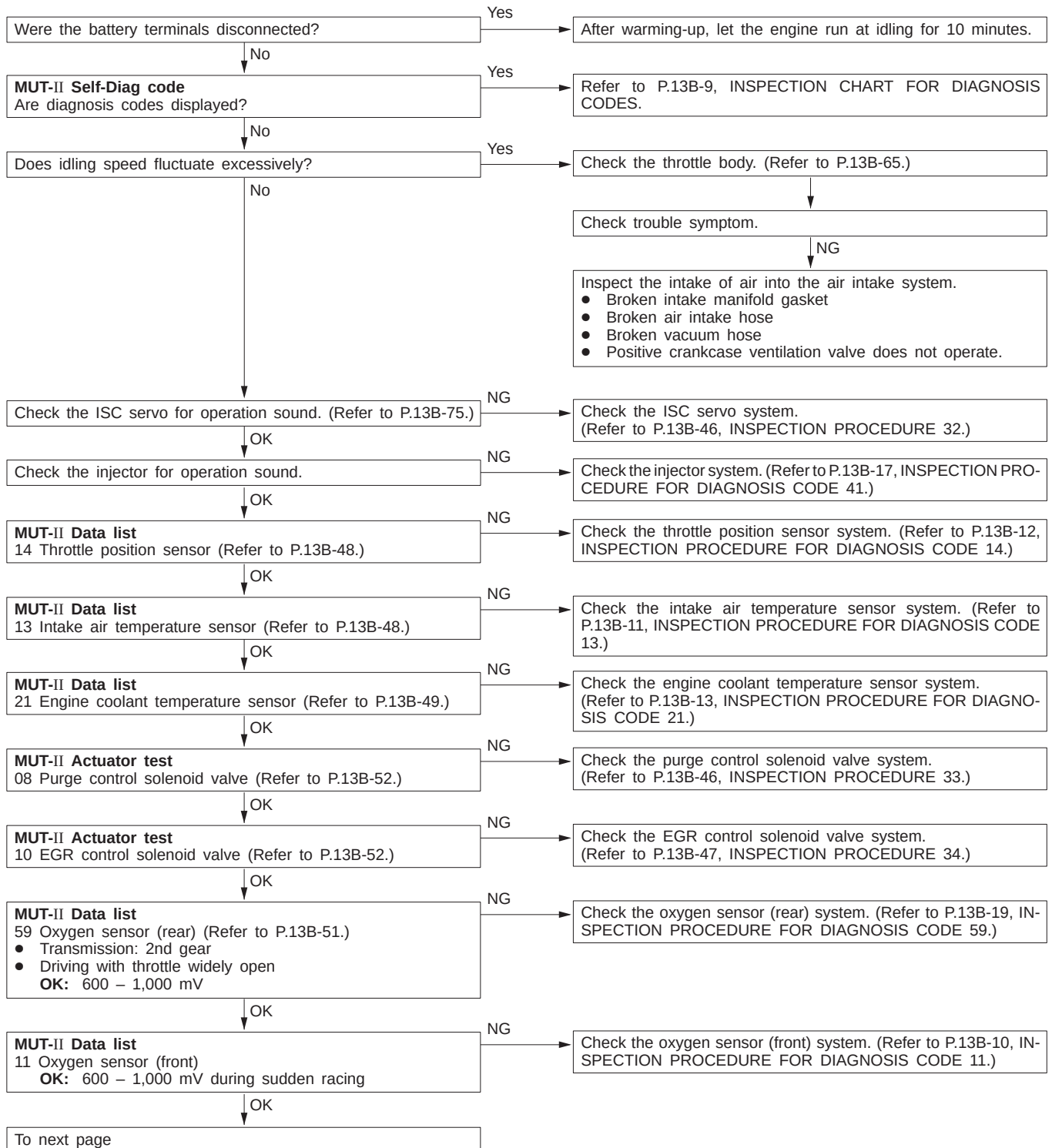
INSPECTION PROCEDURE 7

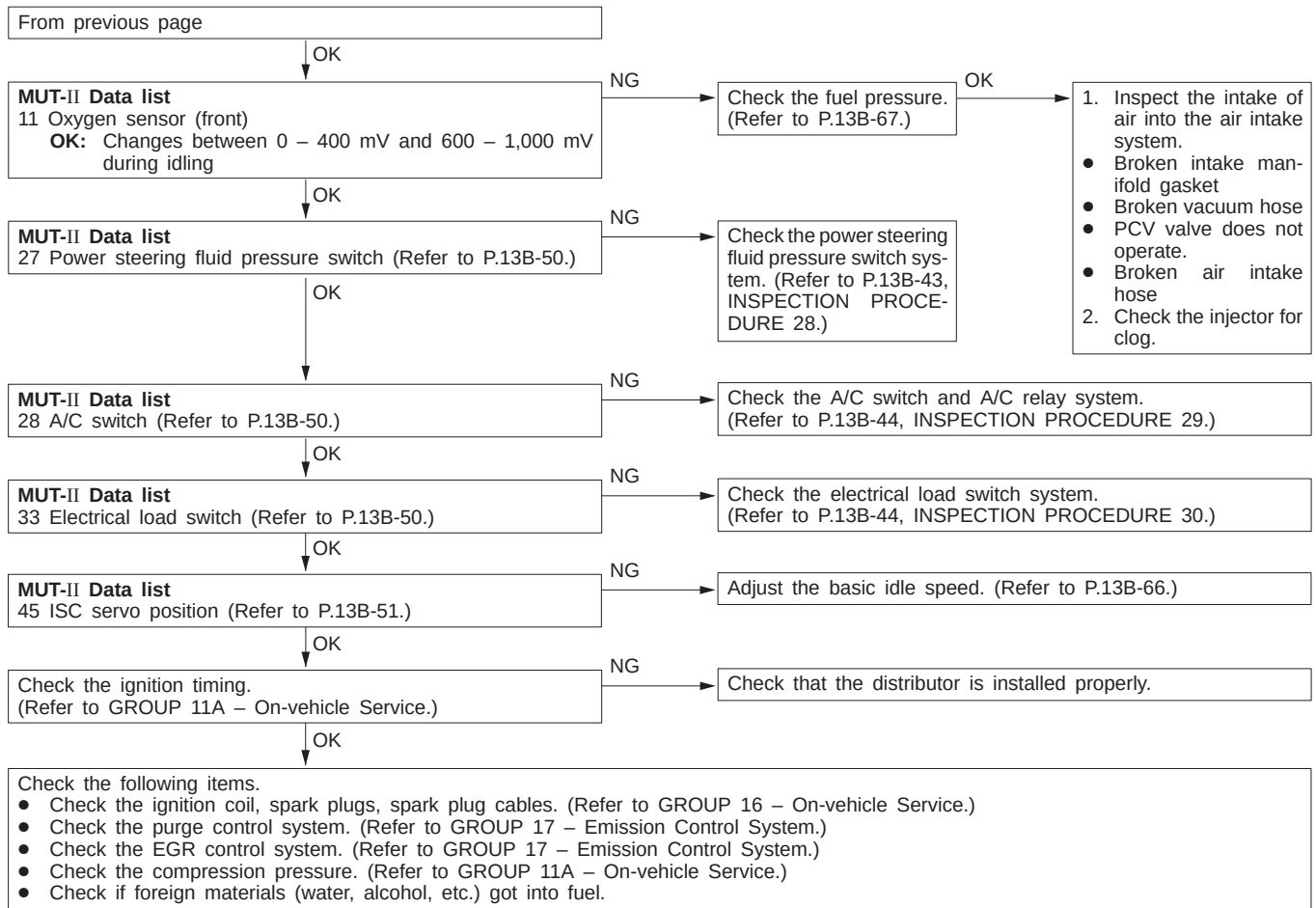
In takes too long time to start. (Incorrect starting)	Probable cause
In cases such as the above, the cause is probably that the spark is weak and ignition is difficult, the initial mixture for starting is not appropriate, or sufficient compression pressure is not being obtained.	● Malfunction of the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



INSPECTION PROCEDURE 8

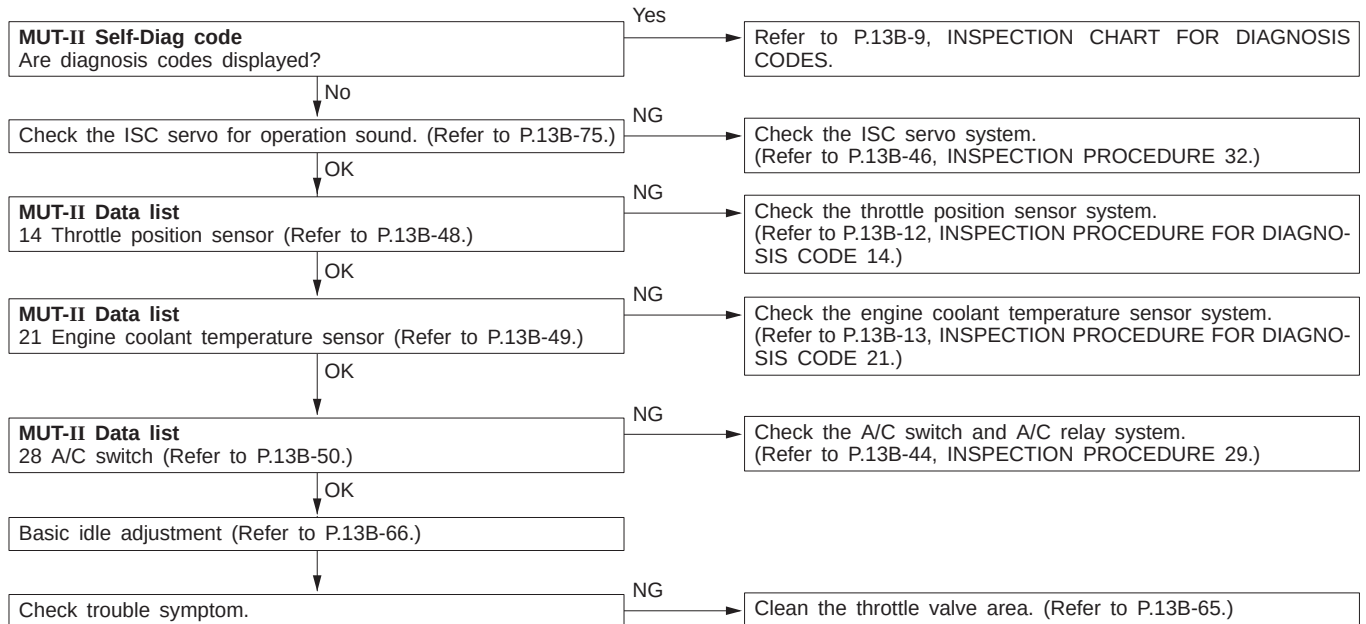
Unstable idling (Rough idling, hunting)	Probable cause
In cases as the above, the cause is probably that the ignition system, air/fuel mixture, idle speed control (ISC) or compression pressure is defective. Because the range of possible causes is broad, inspection is narrowed down to simple items.	● 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





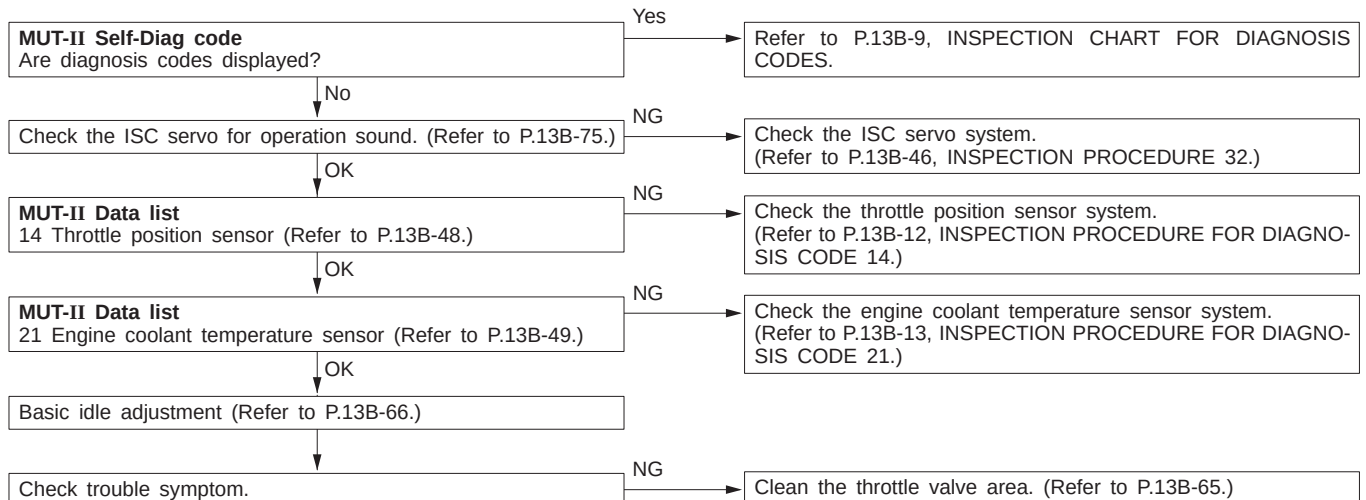
INSPECTION PROCEDURE 9

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



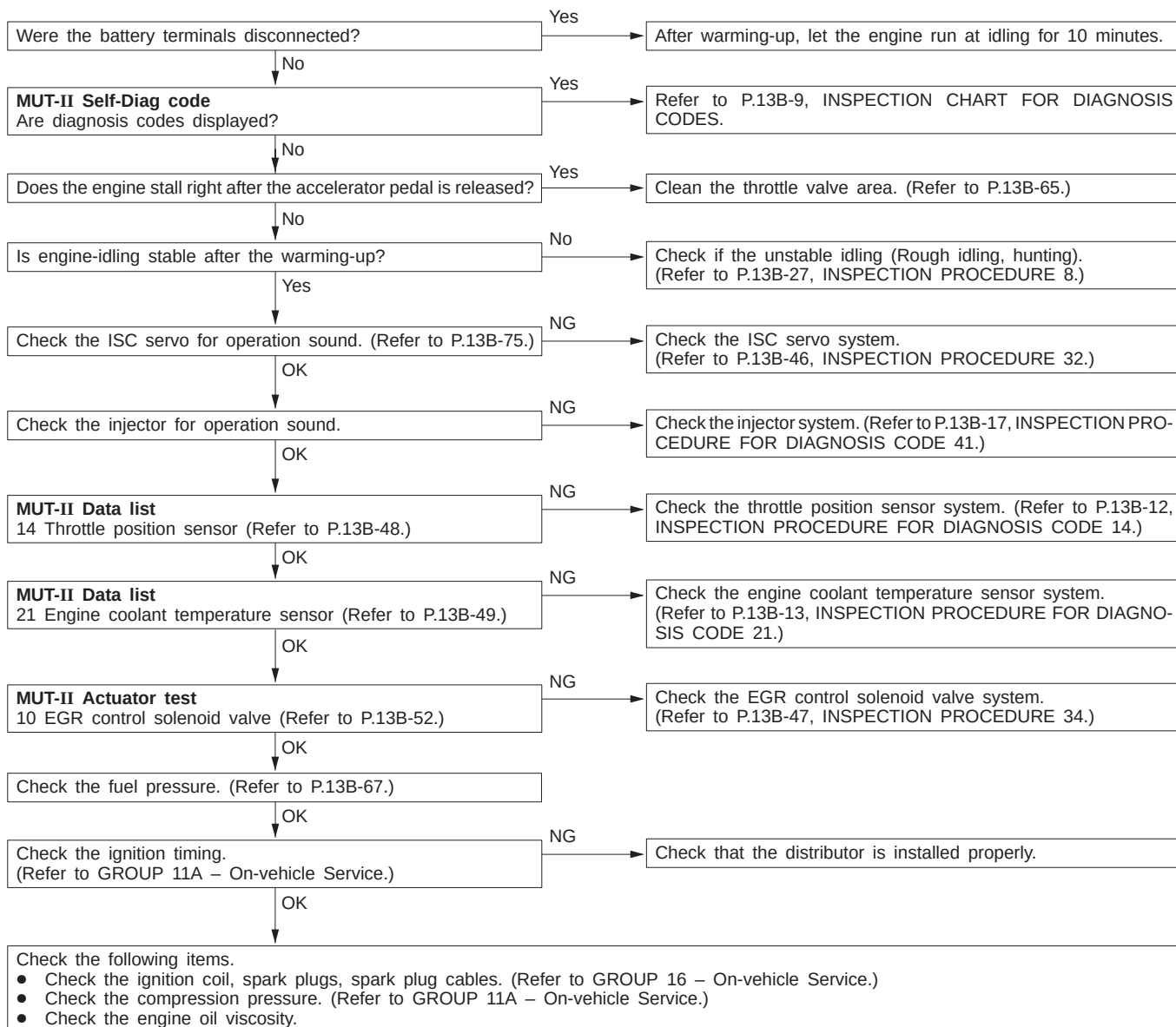
INSPECTION PROCEDURE 10

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



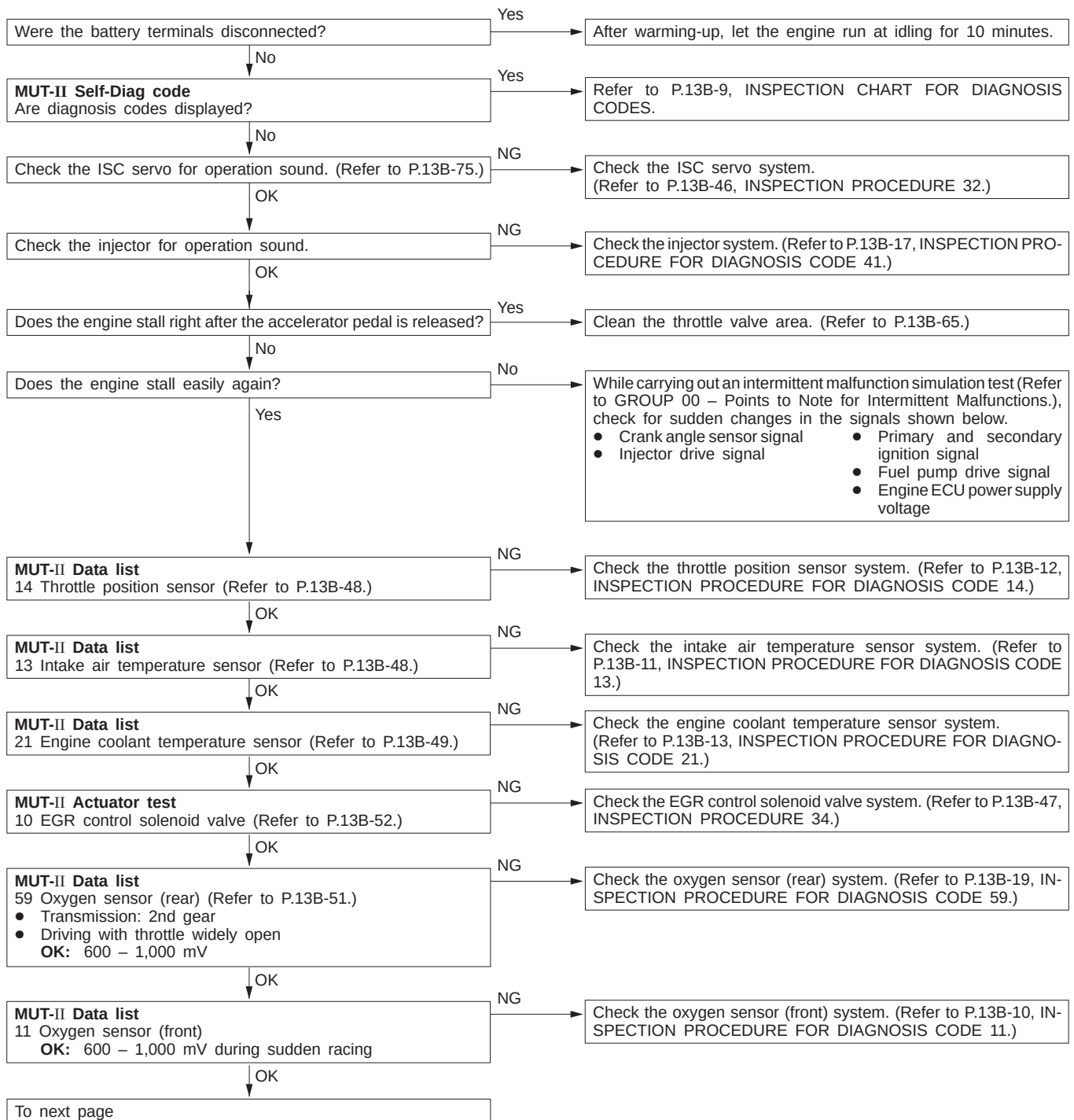
INSPECTION PROCEDURE 11

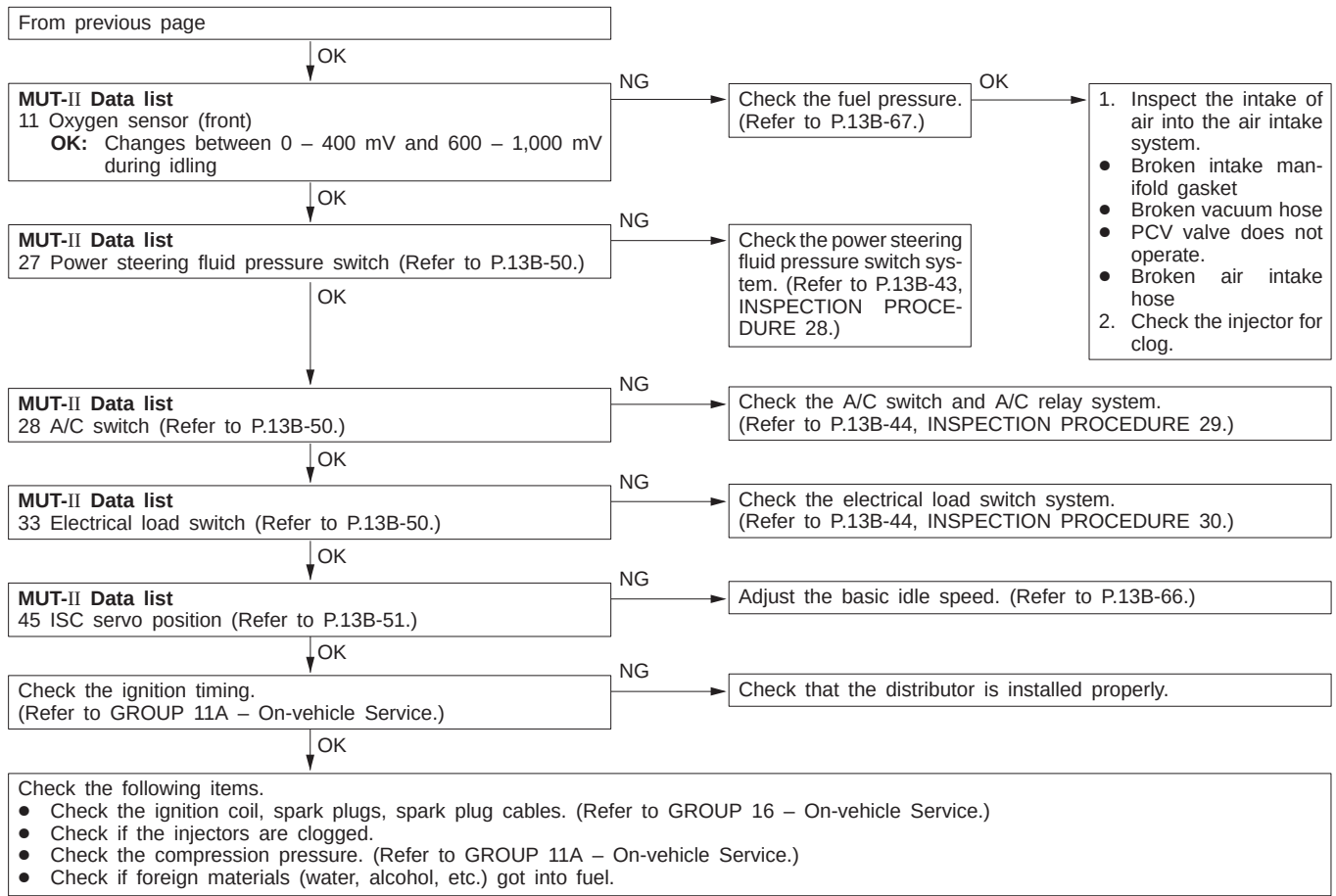
When the engine is cold, it stalls at idling. (Die out)	Probable cause
In such cases as the above, the cause is probably that the air/fuel mixture is inappropriate when the engine is cold, or that the intake air volume is insufficient.	● Malfunction of the ISC servo system ● Malfunction of the throttle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



INSPECTION PROCEDURE 12

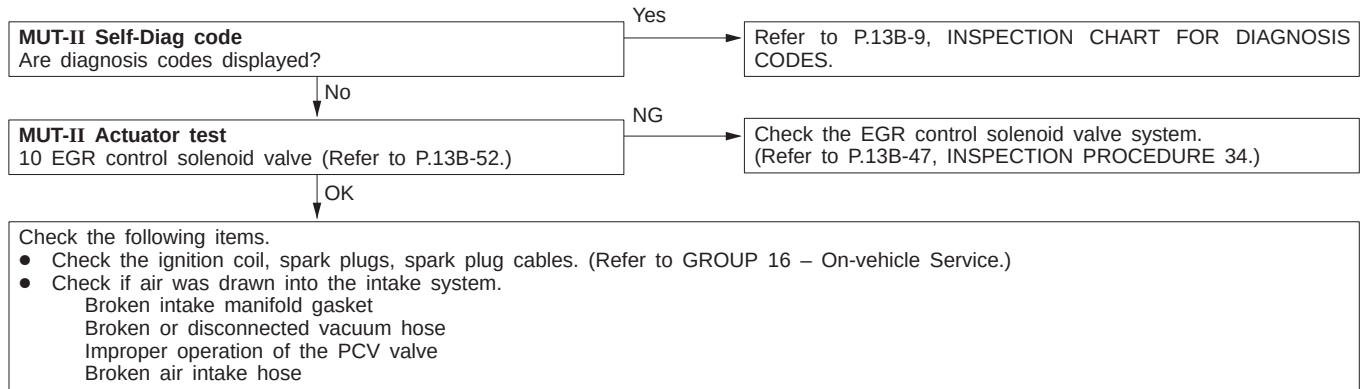
When the engine is hot, it stalls at idling. (Die out)	Probable cause
In such cases as the above, the cause is probably that ignition system, air/fuel mixture, idle speed control (ISC) or compression pressure is defective. In addition, if the engine suddenly stalls, the cause may also be a defective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





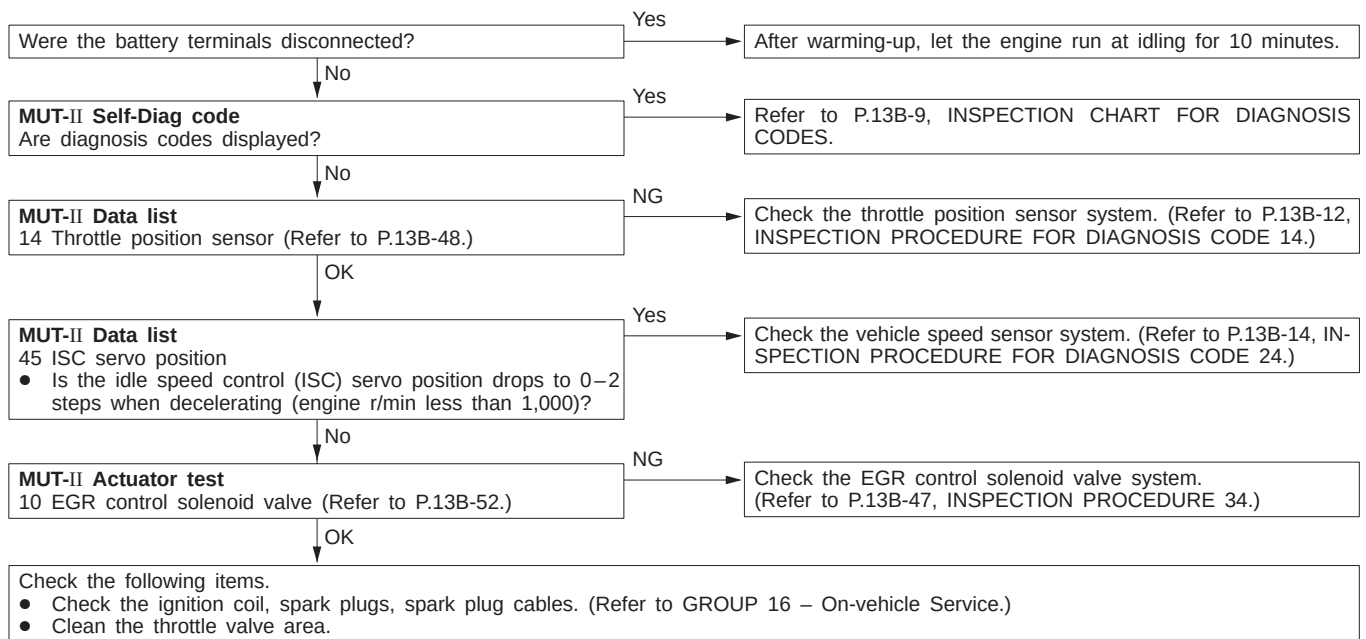
INSPECTION PROCEDURE 13

The engine stalls when starting the car. (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



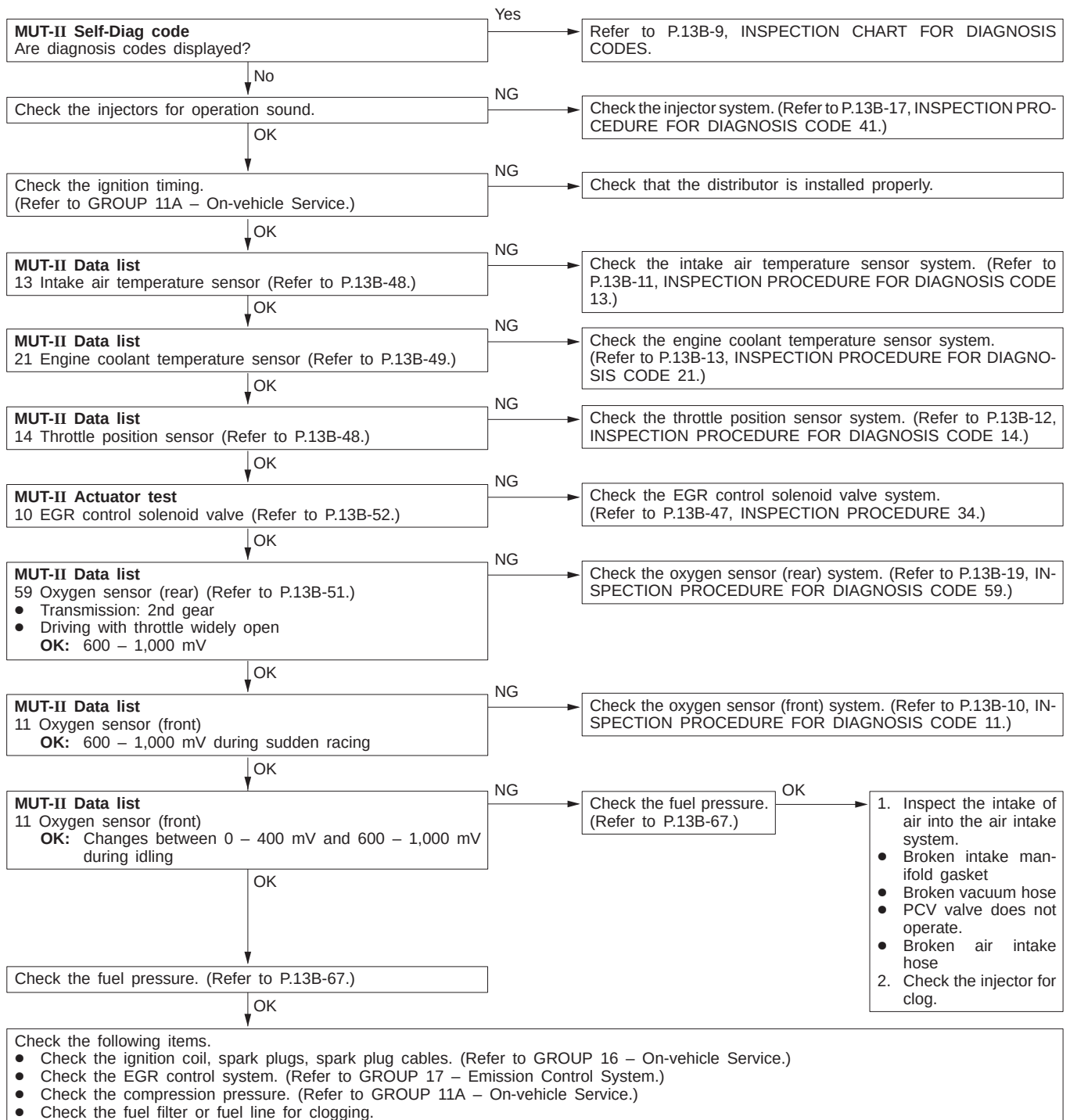
INSPECTION PROCEDURE 14

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



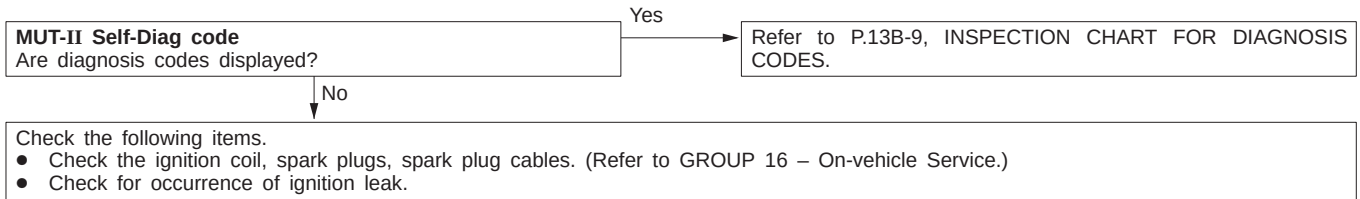
INSPECTION PROCEDURE 15

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



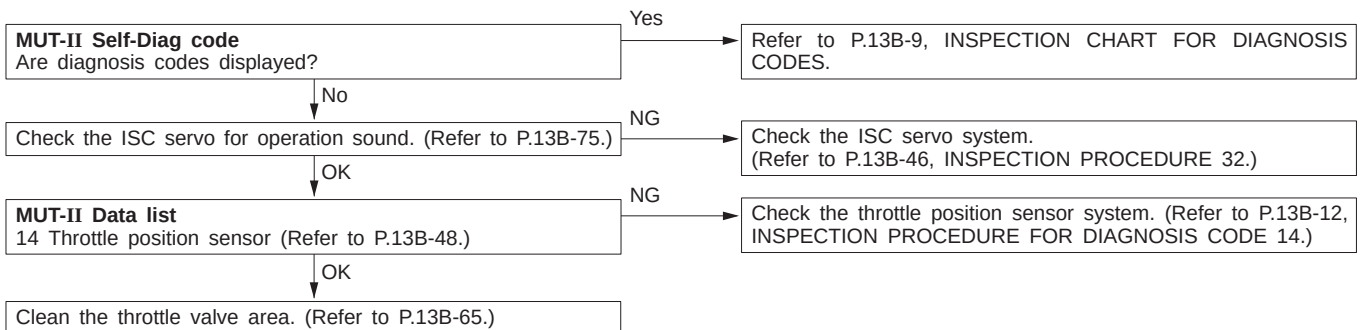
INSPECTION PROCEDURE 16

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



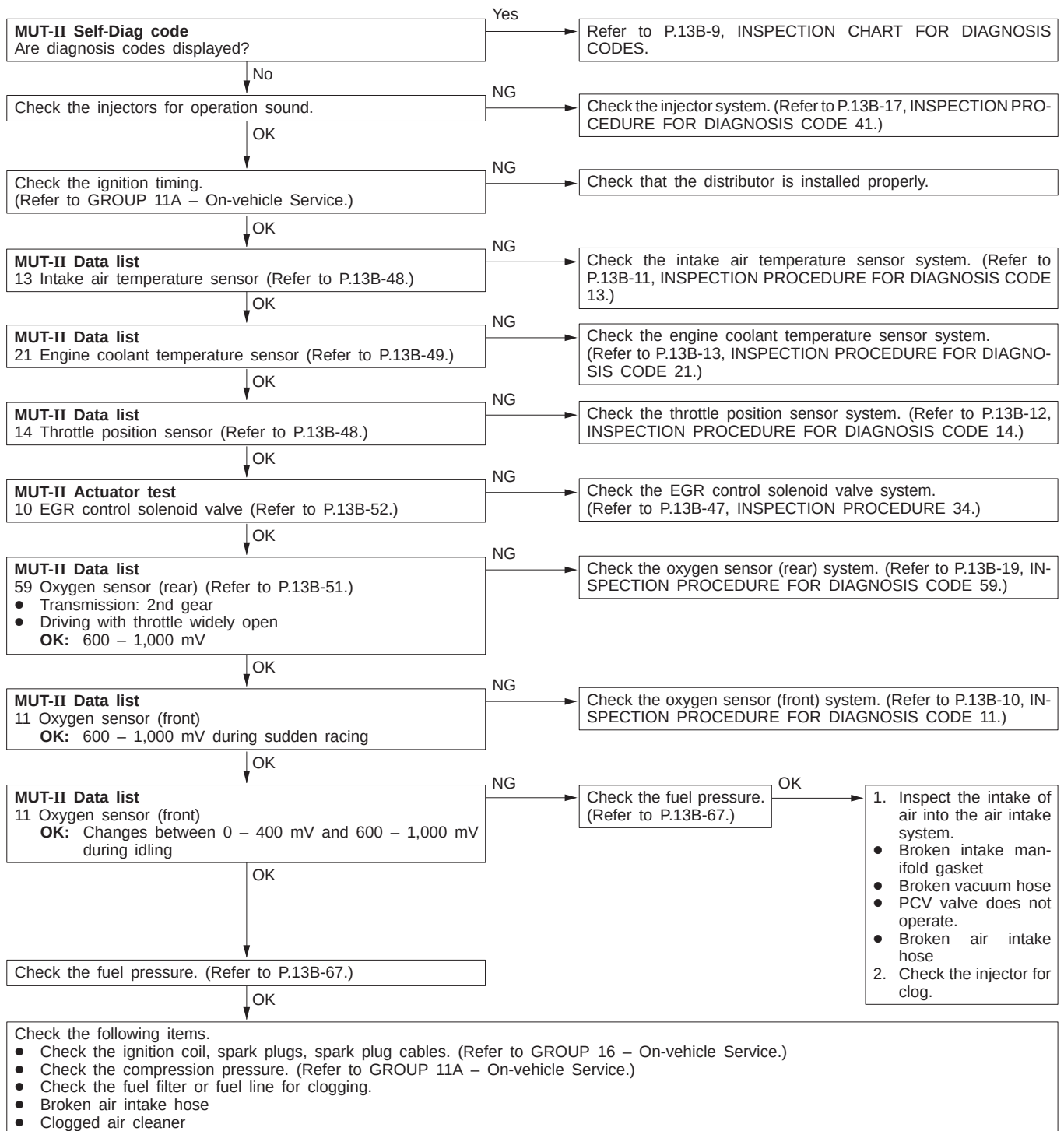
INSPECTION PROCEDURE 17

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



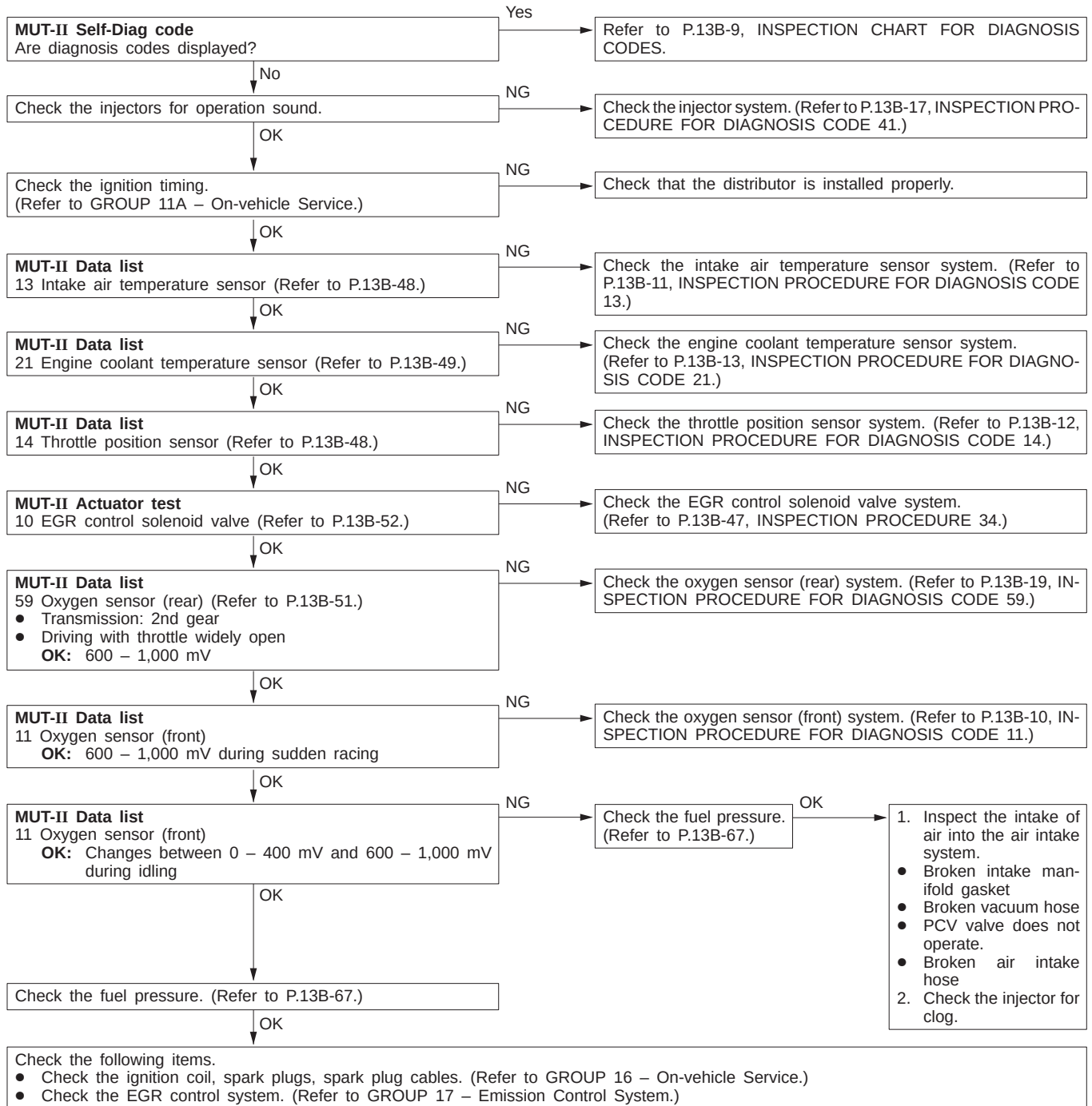
INSPECTION PROCEDURE 18

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



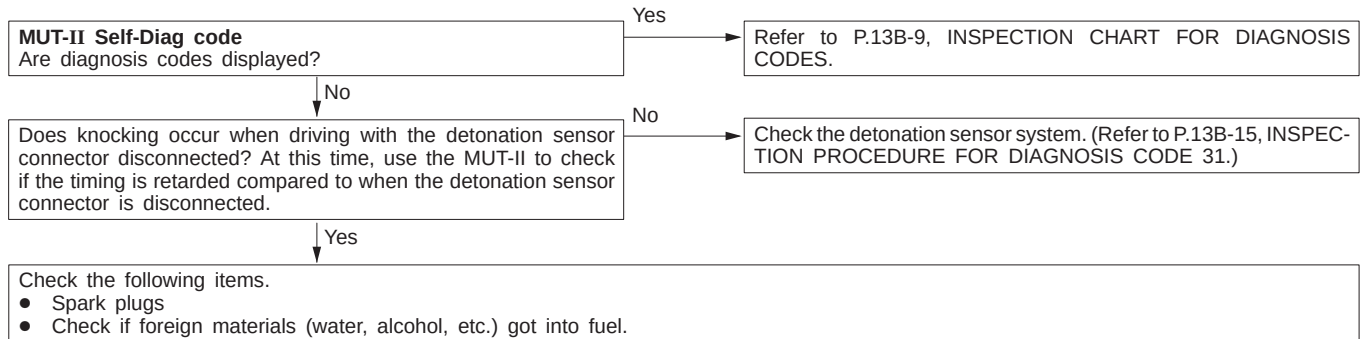
INSPECTION PROCEDURE 19

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



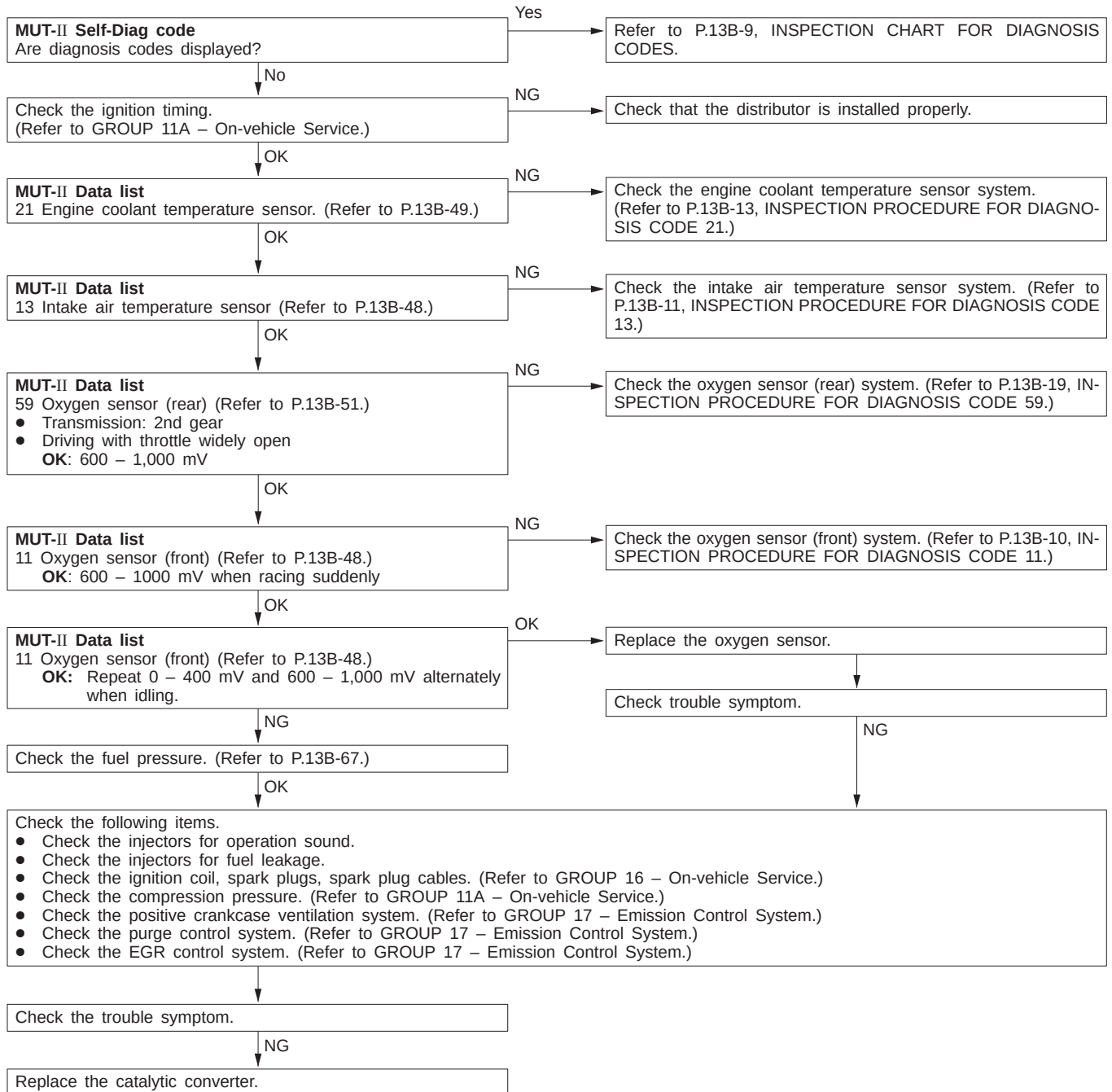
INSPECTION PROCEDURE 21

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

Check the injectors for fuel leakage.

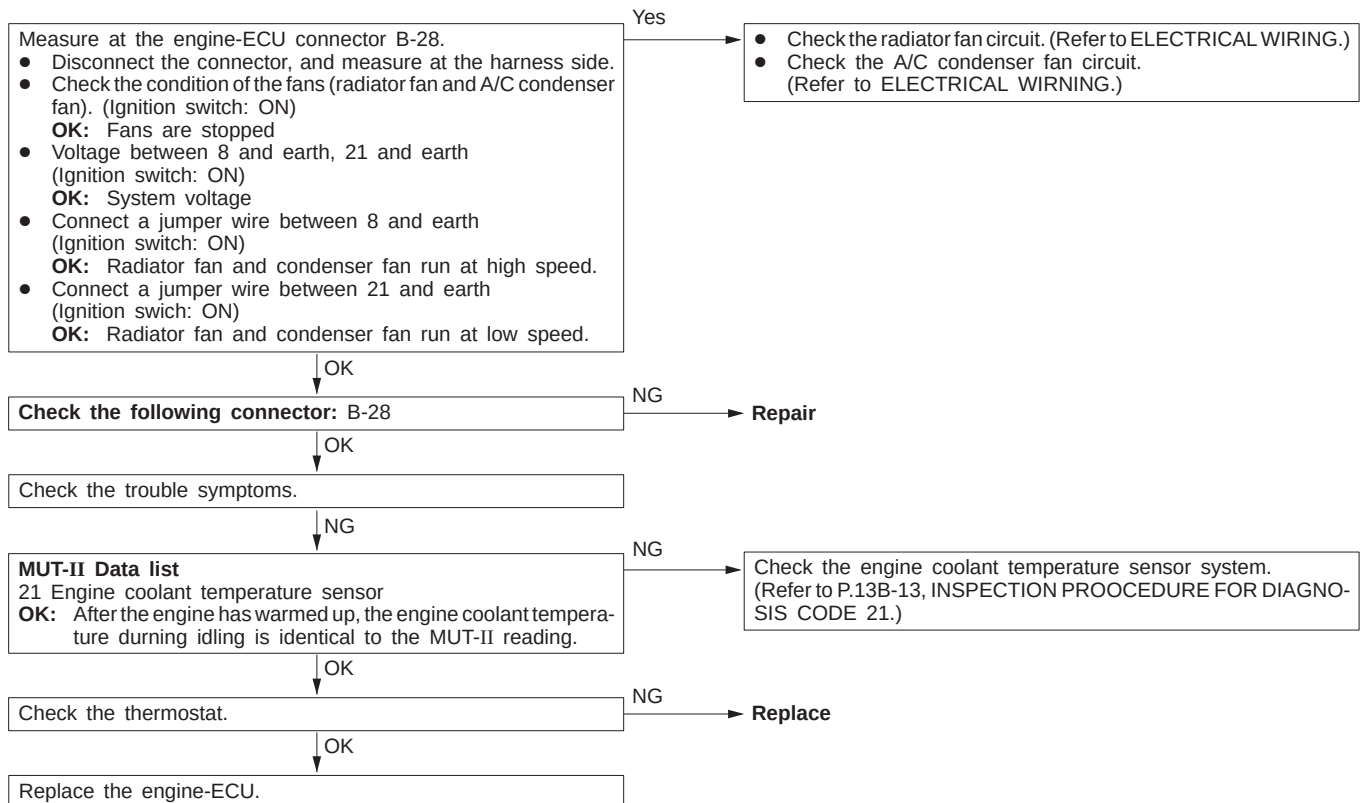
INSPECTION PROCEDURE 22

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



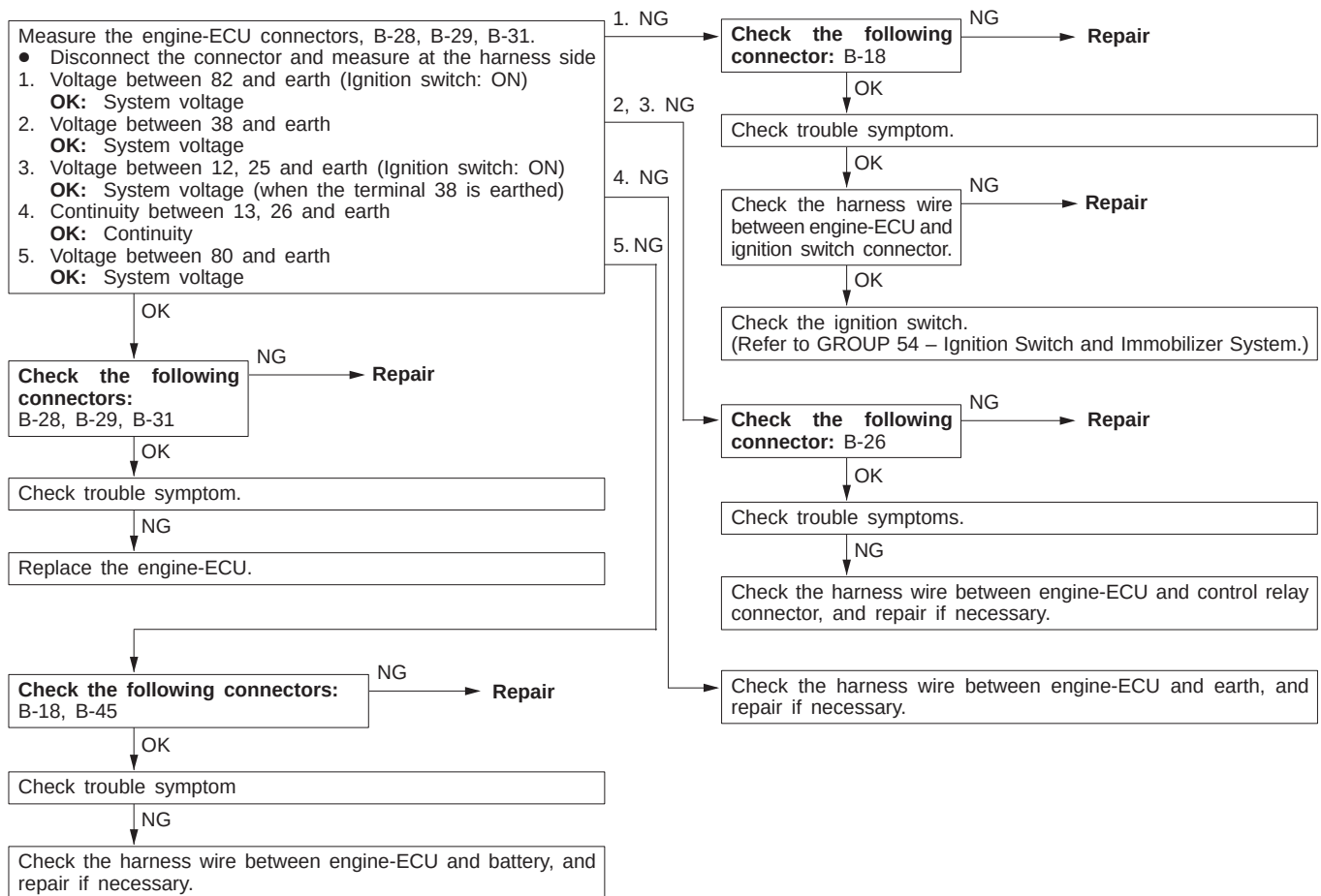
INSPECTION PROCEDURE 23

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



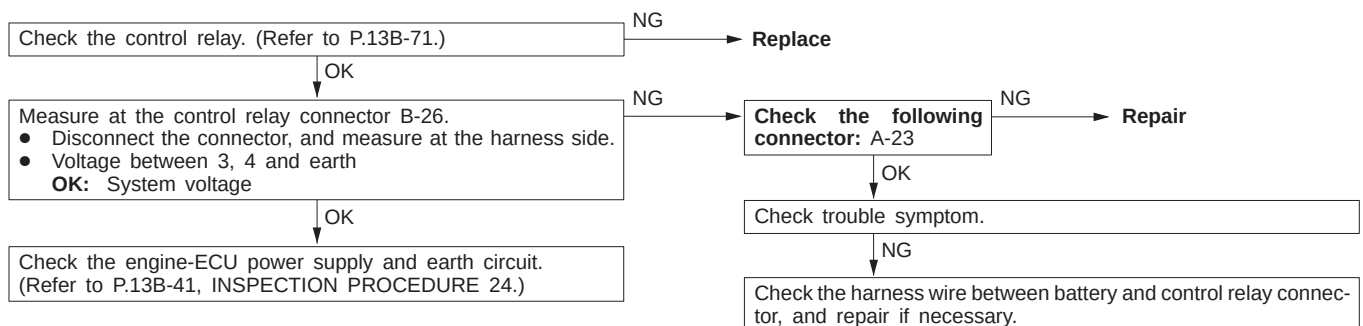
INSPECTION PROCEDURE 24

Check the engine-ECU power supply and earth circuit.



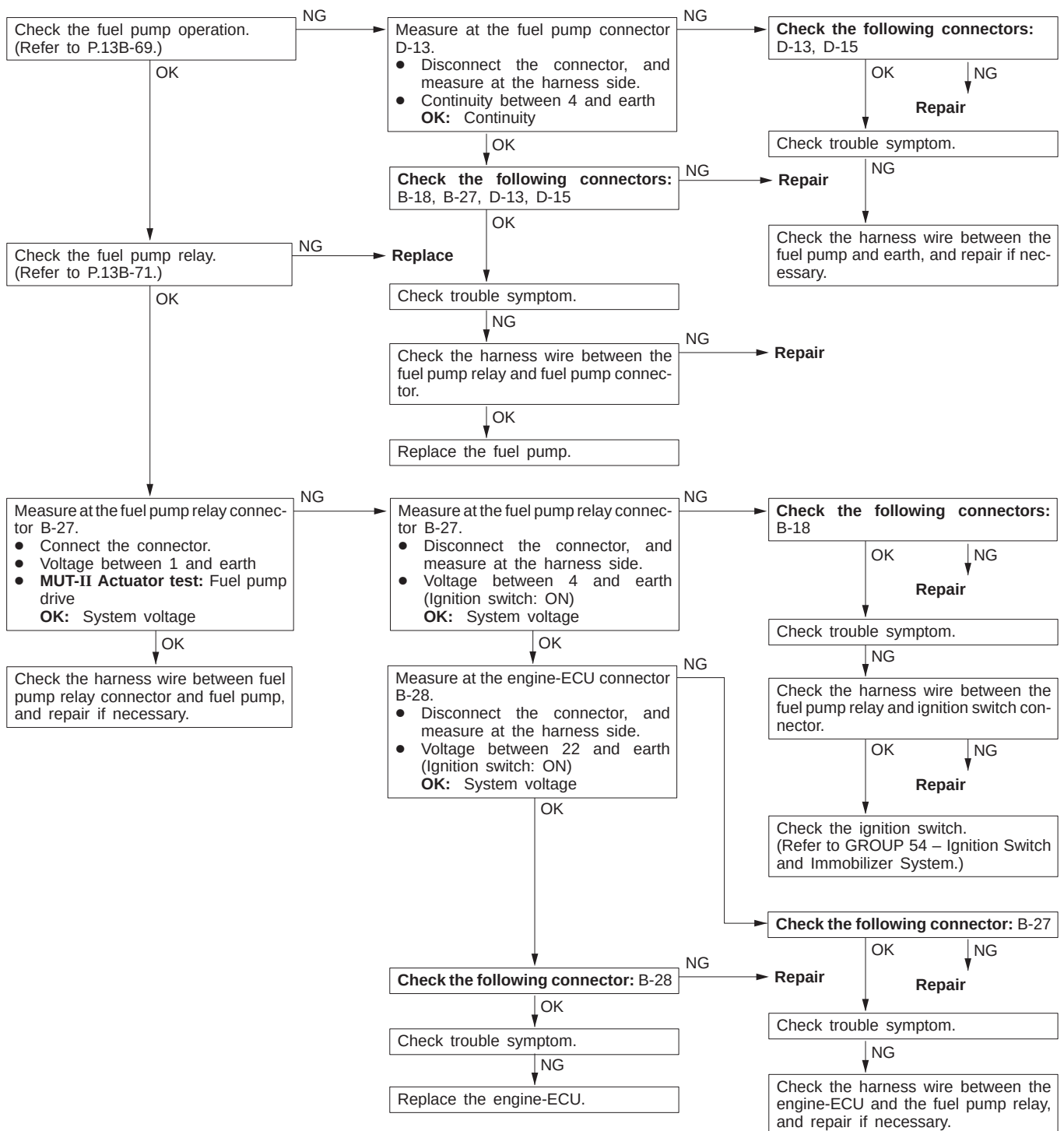
INSPECTION PROCEDURE 25

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



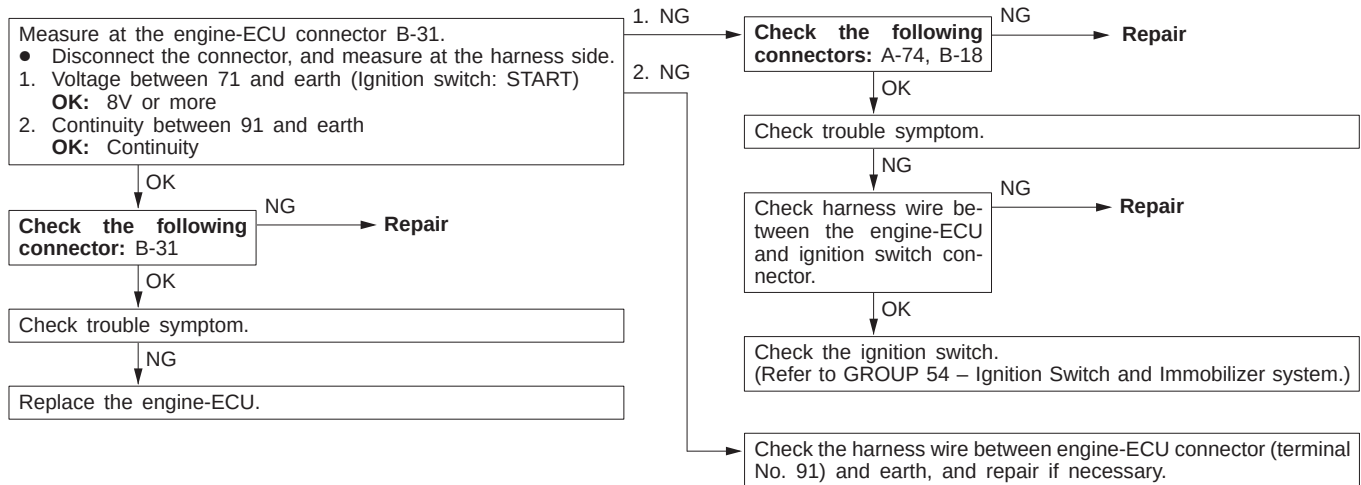
INSPECTION PROCEDURE 26

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



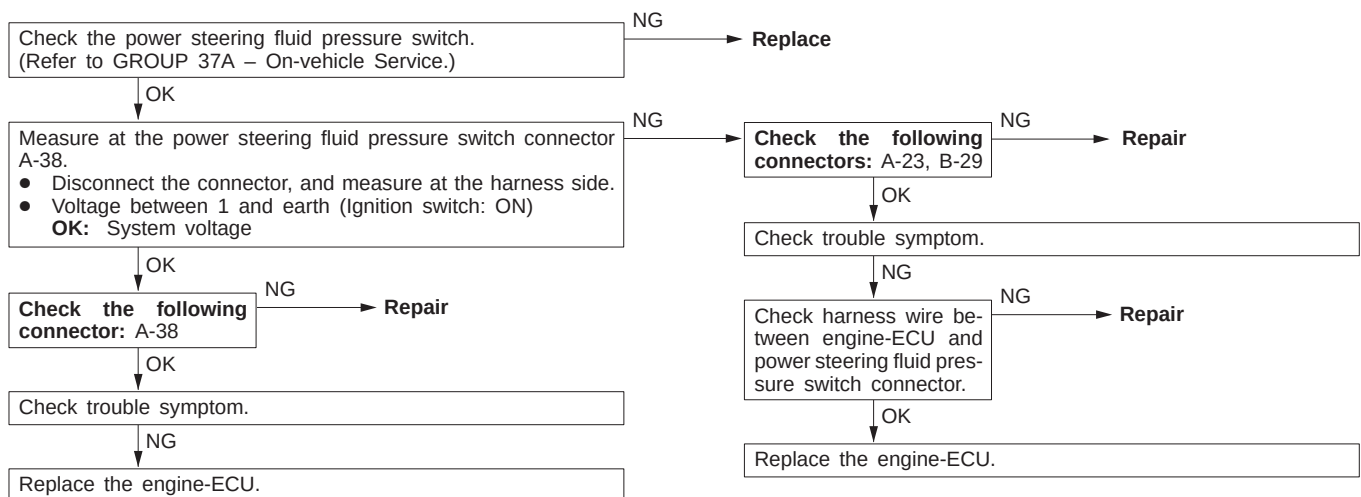
INSPECTION PROCEDURE 27

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



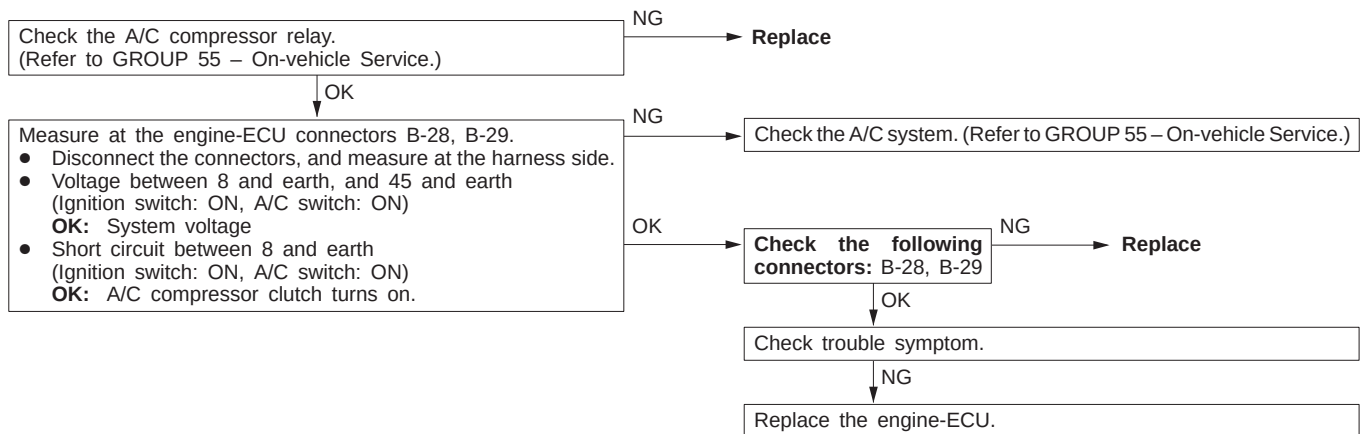
INSPECTION PROCEDURE 28

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



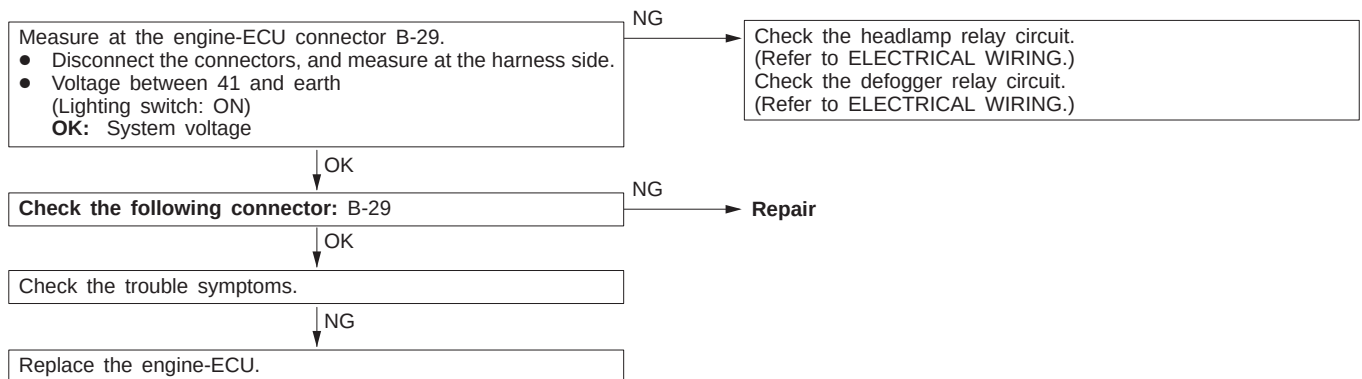
INSPECTION PROCEDURE 29

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



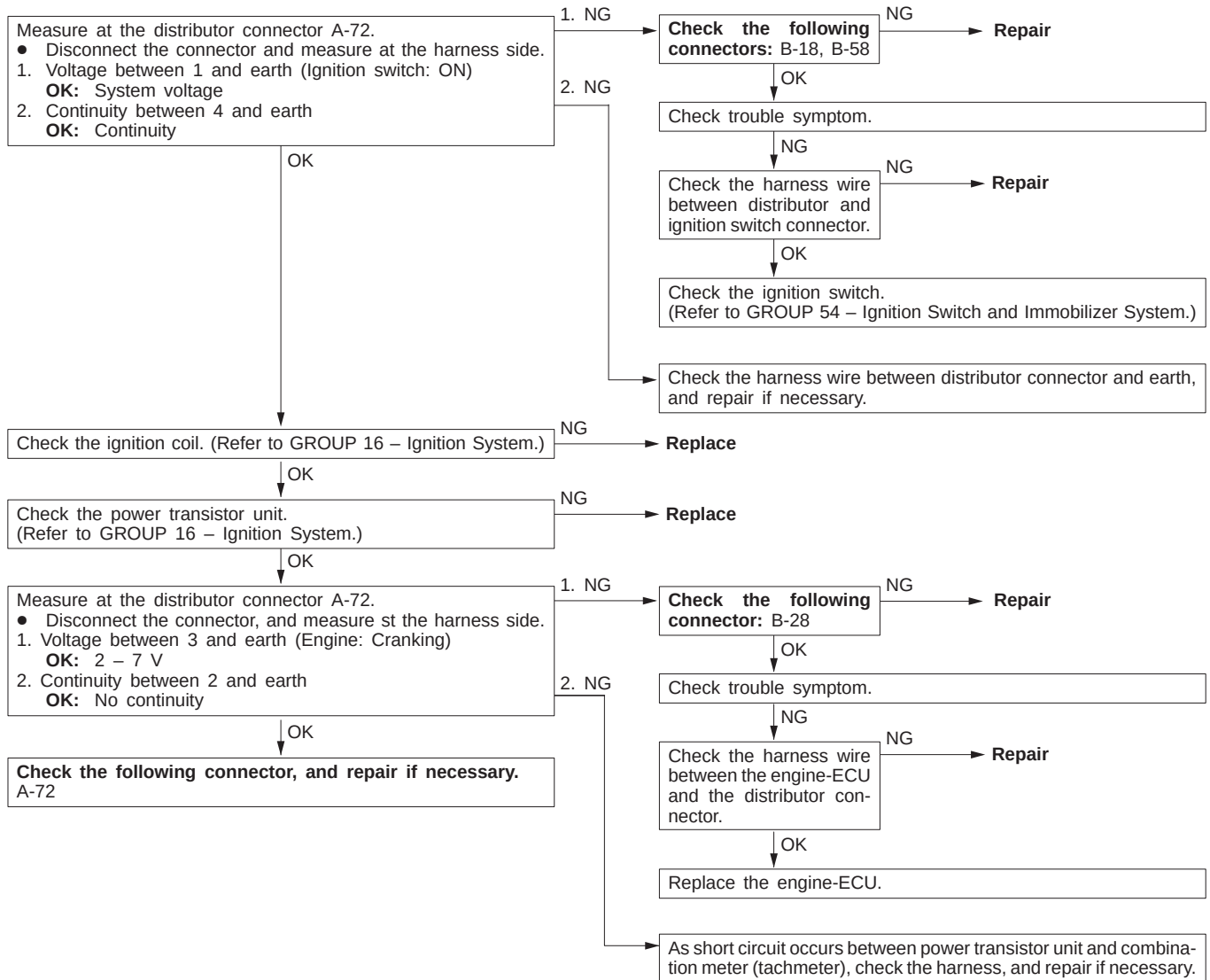
INSPECTION PROCEDURE 30

Electrical load switch	Probable cause
During idling, the ON/OFF condition of switches is equipment which have a large electrical load is input to the engine-ECU. The engine-ECU controls the idle speed control servo on this input.	• Improper connector contact, open circuit or short-circuited harness wire in the headlamp relay circuit • Improper connector contact, open circuit or short-circuited harness wire in the defogger relay circuit. • Malfunction of the engine-ECU



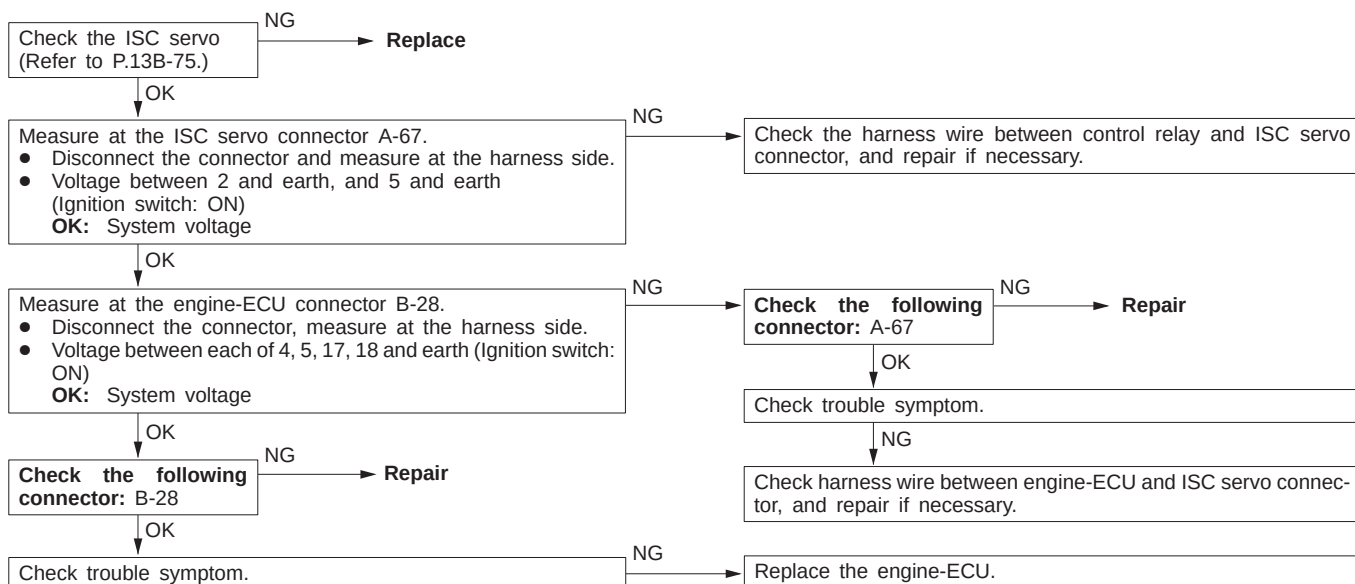
INSPECTION PROCEDURE 31

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 - Improper connector contact, open circuit or short-circuited harness wire - Malfunction of the engine-ECU



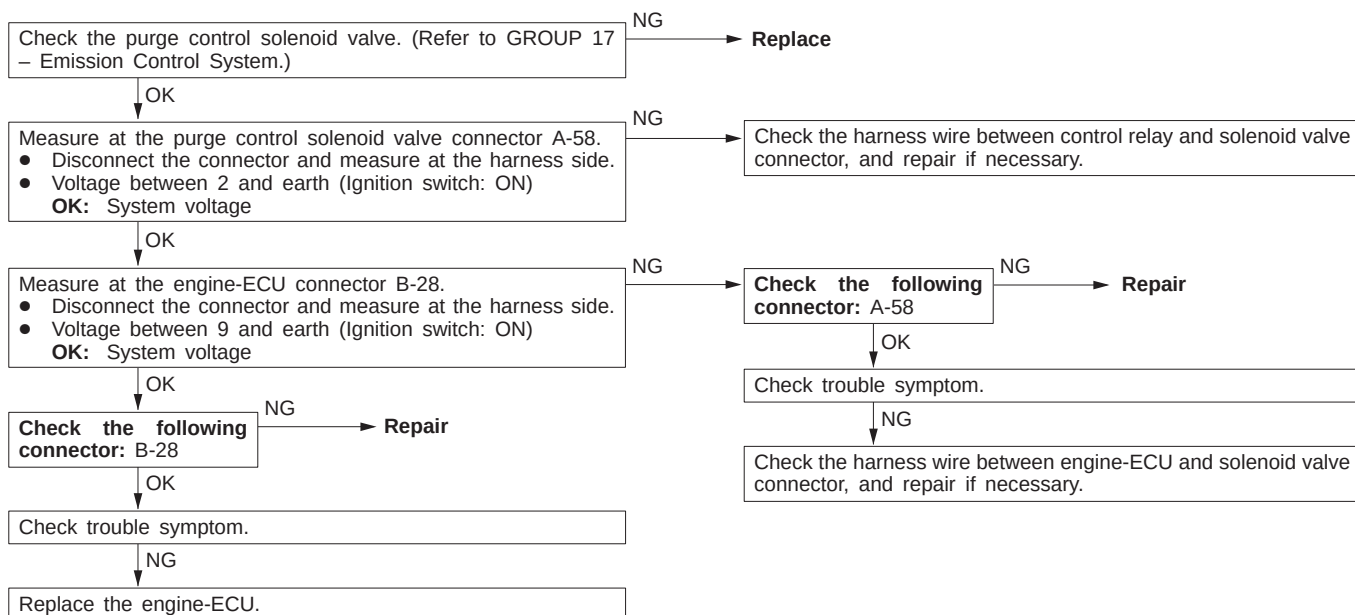
INSPECTION PROCEDURE 32

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



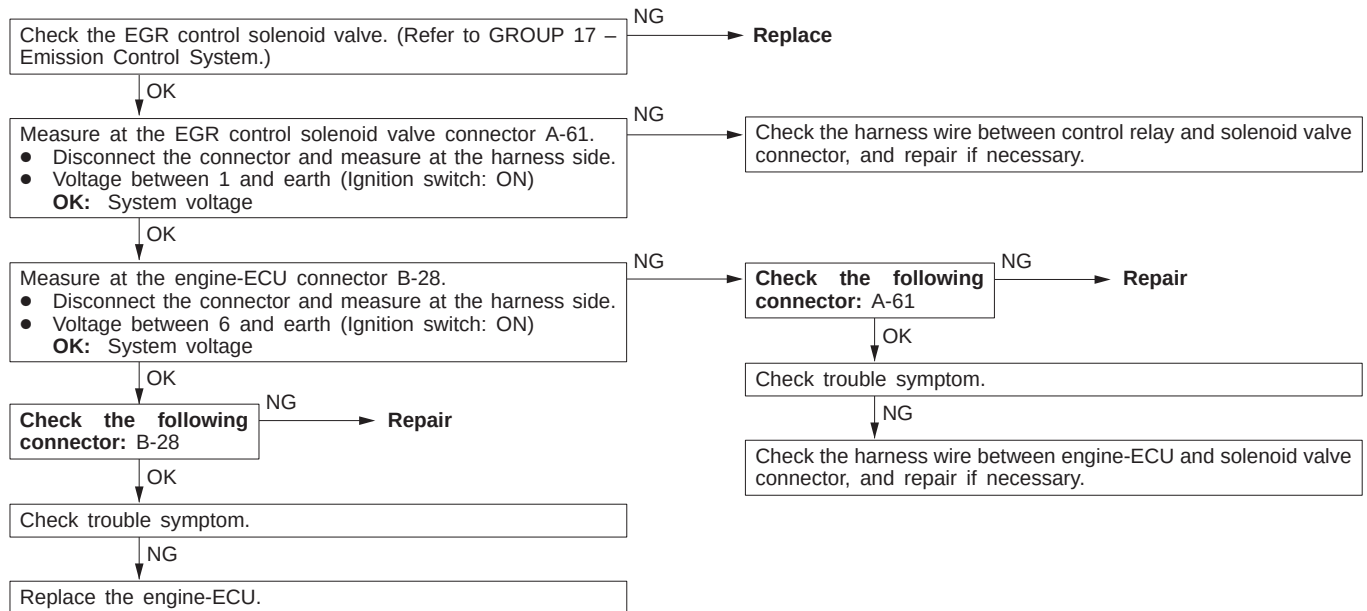
INSPECTION PROCEDURE 33

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



DATA LIST REFERENCE TABLE

13100890500

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 intake plenum pressure is sometimes 10% higher than the standard pressure.
- *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.

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
11	Oxygen sensor (front)	Engine:After having warmed up Air/fuel mixture is made leaner when de- celerating, and is made richer when racing.	When at 4,000 r/min, engine is suddenly decelerated	200 mV or less	Code No. 11	13B-10
			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) 600–1,000 mV		
			2,500 r/min			
13	Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is –20°C	–20°C	Code No. 13	13B-11
			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	13B-12
			Gradually open	Increases in proportion to throttle opening angle		
			Open fully	4,500–5,500 mV		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
16	Power supply voltage	Ignition switch: ON		System voltage	Procedure No. 25	13B-41
18	Cranking signal (ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF	Procedure No. 27	13B-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	13B-13
			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	13B-14
		- Engine: Idling - Idle position switch: ON	When engine coolant temperature is -20°C	1,475–1,675 r/min		
			When engine coolant temperature is 0°C	1,345–1,545 r/min		
			When engine coolant temperature is 20°C	1,300–1,500 r/min		
			When engine coolant temperature is 40°C	1,160–1,360 r/min		
			When engine coolant temperature is 80°C	650–850 r/min		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
27	Power steering fluid pressure switch	Engine: Idling	Steering wheel stationary	OFF	Procedure No. 28	13B-43
			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. 29	13B-44
			A/C switch: ON	ON		
32	Vacuum sensor*1	- Engine coolant temperature: 80 – 95°C - Lamps, electric cooling fan and all accessories: OFF - Transmission: Neutral (P range for A/T) - Ignition switch: ON	Engine: Stopped (At altitude of 0 m)	101 kPa	Code No. 32	13B-16
			Engine: Stopped (At altitude of 600 m)	95 kPa		
			Engine: Stopped (At altitude of 1,200 m)	88 kPa		
			Engine: Stopped (At altitude of 1,800 m)	81 kPa		
			Engine: Idling	24.3 – 37.7 kPa		
			When engine is suddenly raced	Increases		
33	Electrical load switch	All accessories: OFF	Lighting switch only: OFF → ON	OFF → ON	Procedure No.30	13B-44
36	Ignition timing adjustment mode	Engine: Idling	Ignition timing adjustment terminal is earthed	ON	Code No. 36	13B-17
			Ignition timing adjustment terminal is disconnected from earth	OFF		
41	Injectors *2	Engine: Cranking	When engine coolant temperature is 0°C (injection is carried out for all cylinders simultaneously)	19–29 ms	–	–
			When engine coolant temperature is 20°C	39–59 ms		
			When engine coolant temperature is 80°C	8.8–13.2 ms		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
41	Injectors*3	● Engine coolant temperature: 80–95°C ● Lamps, electric cooling fan and all accessories: OFF ● Transmission: Neutral (A/T : P range)	Engine is idling	1.7–2.9 ms	–	–
			2,500 r/min	1.4–2.6 ms		
			When engine is suddenly raced	Increases		
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	2–18 °BTDC	–	–
			2,500 r/min	25–45 °BTDC		
45	ISC (stepper) motor position *4	● Engine coolant temperature: 80–95°C ● Lamps, electric cooling fan and all accessories: OFF ● Transmission: Neutral (A/T : P range) ● 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		
			● A/C switch: OFF ● Select lever: N range → D range	Increases by 5–50 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. 29	13B-44
			A/C switch: ON	ON (Compressor clutch is operating)		
59	Oxygen sensor (rear)	● Transmission: 2nd gear <M/T>, L range <A/T> ● Drive with throttle widely open	3,500 r/min	600 – 1,000 mV	Code No. 59	13B-19

ACTUATOR TEST REFERENCE TABLE

13100900579

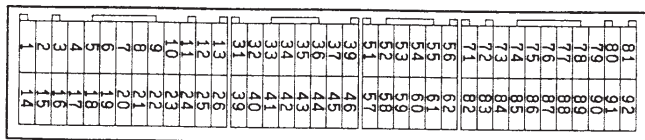
Item No.	Inspection item	Drive contents	Inspection contents		Normal condition	Inspection procedure No.	Reference page
01	Injectors	Cut fuel to No. 1 injector	Engine: After having warmed up/Engine is idling (Cut the fuel supply to each injector in turn and check cylinders which don't affect idling.)		Idling condition becomes different (becomes unstable).	Code No. 41	13B-17
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. Listen near the fuel tank for the sound of fuel pump operation.	Pulse is felt. Sound of operation is heard.	Procedure No. 26	13B-42
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	13B-46
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	13B-47
20	Condenser fan	Drive the fan motors (condenser)	- Ignition switch: ON - A/C switch: ON		Fan motor runs	Procedure No. 23	13B-40
21	Radiator fan	Drive the fan motors (radiator)	Ignition switch: ON		Fan motor runs	Procedure No. 23	13B-40

CHECK AT THE ENGINE-ECU TERMINALS

13100920506

TERMINAL VOLTAGE CHECK CHART

Engine-ECU Connector Terminal Arrangement



9FU0393

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		
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
8	A/C relay	- Engine: Idle speed - A/C switch: OFF → ON (A/C compressor runs)	System voltage or momentarily 6 V or more → 0–3 V
9	Purge control solenoid valve	Ignition switch: ON	System voltage
		Running at 3,000r/min while engine is warming up after having been started.	0–3 V
10	Power transistor unit	Engine r/min: 3,000 r/min	0.3–3.0 V
12	Power supply	Ignition switch: ON	System voltage
25			

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
20	Condenser fan motor relay	Condenser fan is not operating (Engine coolant temperature is 90°C or less)		System voltage
		Condenser fan is operating (Engine coolant temperature is 105°C or more)		0 – 3 V
21	Radiator fan motor relay	Radiator fan is not operating (Engine coolant temperature is 90°C or less)		System voltage
		Radiator fan is operating (Engine coolant temperature is 90 – 105°C)		0 – 3 V
22	Fuel pump relay	Ignition switch: ON		System voltage
		Engine: Idle speed		0–3 V
36	Engine warning lamp	Ignition switch: OFF → ON		0–3 V → 9–13 V (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	0–3 V
38	Control relay (Power supply)	Ignition switch: OFF		System voltage
		Ignition switch: ON		0–3 V
41	Electrical load switch	Engine: Idling	Turn off the lighting switch	0 – 3 V
			Turn on the lighting switch	System voltage
45	A/C switch	Engine: Idle speed	Turn the A/C switch OFF	0–3 V
			Turn the A/C switch ON (A/C compressor is operating)	System voltage
52	Ignition timing adjustment terminal	Ignition switch: ON	Earth the ignition timing adjustment terminal	0–1 V
			Remove the earth connection from the ignition timing adjustment terminal	4.0–5.5 V
54	Oxygen sensor heater (rear)	Engine: Idling after warming up		0 – 3 V
		Engine r/min: 5,000 r/min		System voltage
60	Oxygen sensor heater (front)	Engine: Idling after warming up		0–3 V
		Engine r/min: 5,000r/min		System voltage
71	Ignition switch – ST	Engine: Cranking		8V or more

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
72	Intake air temperature sensor	Ignition switch: ON	When intake air temperature is 0°C	3.2–3.8 V
			When intake air temperature is 20°C	2.3–2.9 V
			When intake air temperature is 40°C	1.5–2.1 V
			When intake air temperature is 80°C	0.4–1.0 V
75	Oxygen sensor (rear)	• Transmission: 2nd gear • Engine r/min: 3,500 r/min or more • Driving with the throttle valve widely open		0.6 – 1.0 V
76	Oxygen sensor (front)	Engine: Running at 2,500 r/min after warmed up (Check using a digital type voltmeter)		0 – 0.8 V (Changes repeatedly)
80	Backup power supply	Ignition switch: OFF		System voltage
81	Sensor impressed voltage	Ignition switch: ON		4.5–5.5 V
82	Ignition switch – IG	Ignition switch: ON		System voltage
83	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C	3.2–3.8 V
			When engine coolant temperature is 20°C	2.3–2.9 V
			When engine coolant temperature is 40°C	1.3–1.9 V
			When engine coolant temperature is 80°C	0.3–0.9 V
84	Throttle position sensor	Ignition switch: ON	Set throttle valve to idle position	0.3–1.0 V
			Fully open throttle valve	4.5–5.5 V
85	Vacuum sensor (Manifold absolute pressure sensor)	Ignition switch: ON (when altitude is 0 m)		3.7 – 4.3 V
		Ignition switch: ON (when altitude is 1,200 m)		3.2 – 3.8 V
		Engine: Idle speed		0.9 – 1.5 V
		While engine is idling after having warmed up, suddenly depress the accelerator pedal		From 0.9 – 1.5 V, momentarily increases
86	Vehicle speed sensor	• Ignition switch: ON • Move the vehicle slowly forward		0 – 5 V (Changes repeatedly)
89	Crank angle sensor	Engine: Cranking		0.4–4.0 V
		Engine: Idle speed		1.5–2.5 V

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.

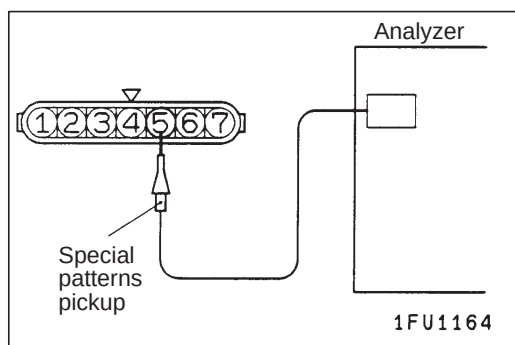
Engine-ECU Harness Side Connector Terminal Arrangement



9FU0392

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	
54–12	Oxygen sensor heater (rear)	2.5 – 5.0 Ω (At 20°C)
60–12	Oxygen sensor heater (front)	2.5 – 5.0 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)



INSPECTION PROCEDURE USING AN ANALYZER

13100930363

CRANK ANGLE SENSOR

Measurement Method

1. Disconnect the distributor (crank angle sensor) connector and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to distributor connector terminal 5.

Alternate Method (Test harness not available)

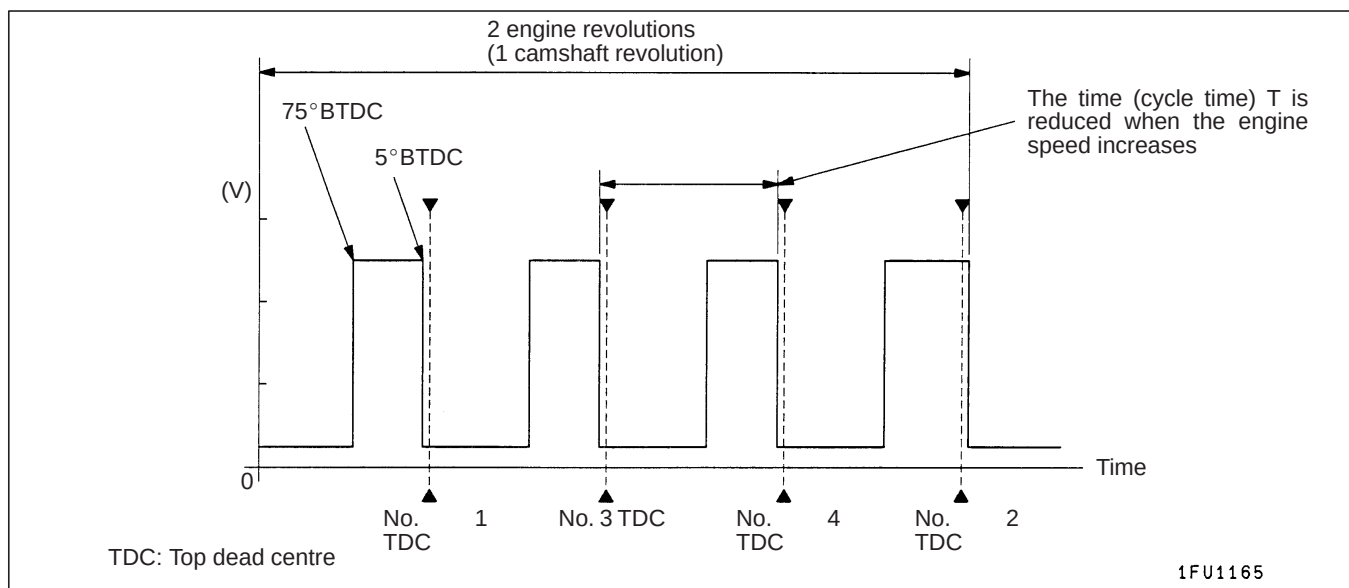
1. Connect the analyzer special patterns pickup to engine-ECU terminal 89.

Standard Wave Pattern

Observation conditions

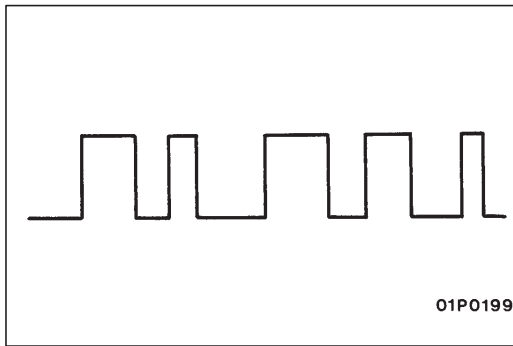
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern



Wave Pattern Observation Points

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

**Examples of Abnormal Wave Patterns**

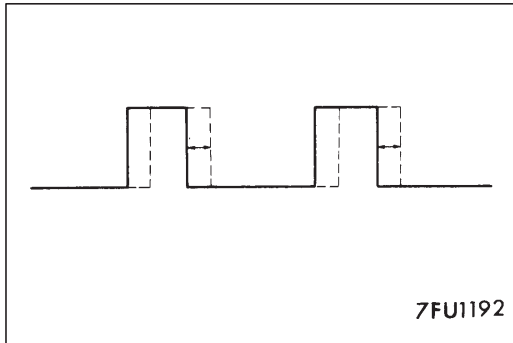
● Example 1

Cause of problem

Sensor interface malfunction

Wave pattern characteristics

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



● Example 2

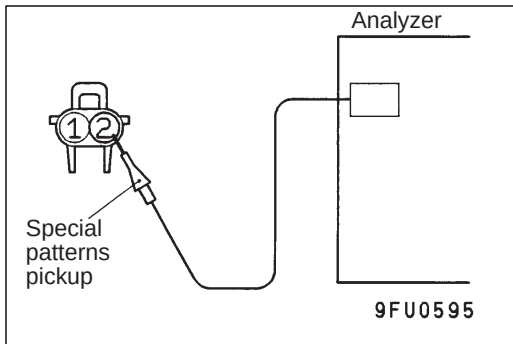
Cause of problem

Loose timing belt

Abnormality in sensor disk

Wave pattern characteristics

Wave pattern is displaced to the left or right.

**INJECTOR****Measurement Method**

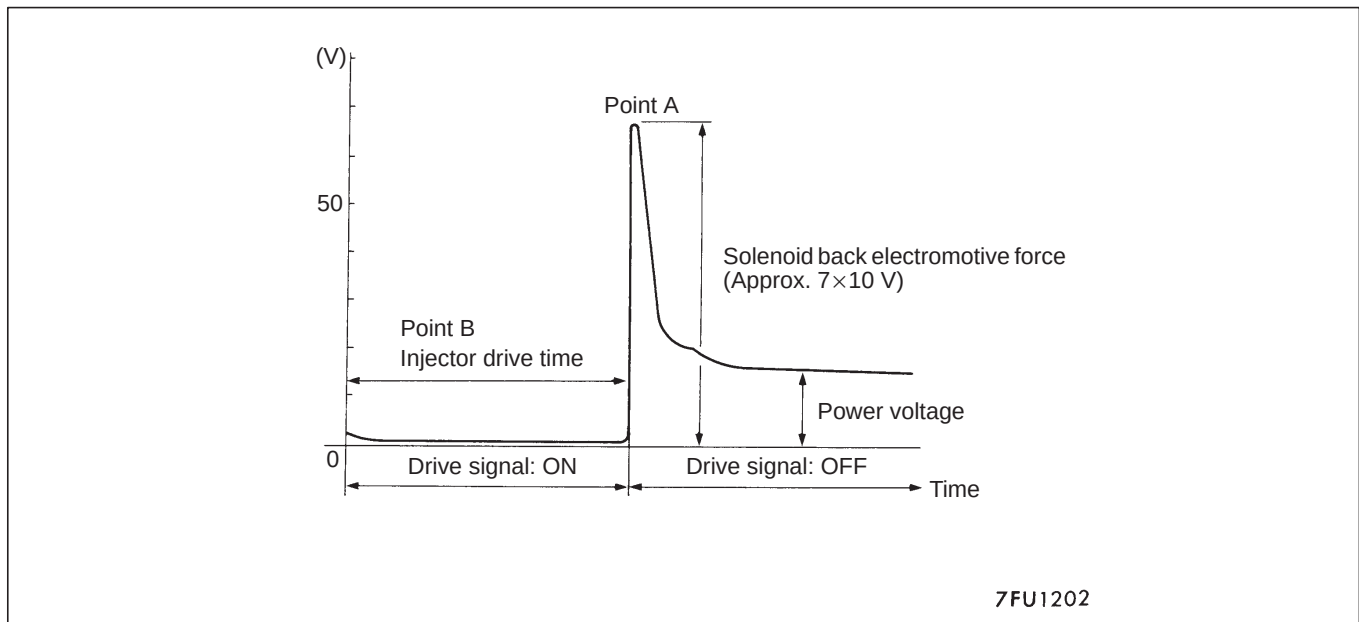
1. Disconnect the injector connector, and then connect the special tool (test harness: MB991348) in between. (Both the power supply side and engine-ECU side should be connected.)
2. Connect the analyzer special patterns pickup to terminal 2 of the injector connector.

Alternate Method (Test harness not available)

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

Standard Wave Pattern**Observation conditions**

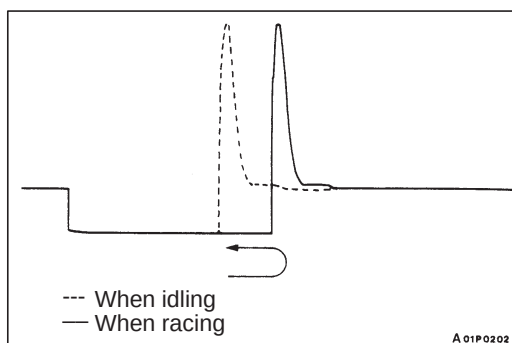
Function	Special patterns
Pattern height	Variable
Variable knob	Adjust while viewing the wave pattern
Pattern selector	Display
Engine r/min	Idle speed

Standard wave pattern**Wave Pattern Observation Points**

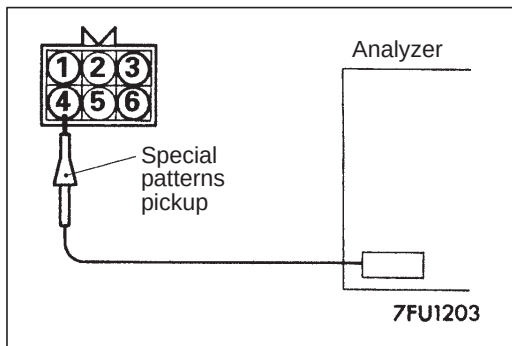
Point A: Height of solenoid back electromotive force

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

Point B: Injector drive time



- The injector drive time will be synchronized with the MUT-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.



IDLE SPEED CONTROL (ISC) SERVO (STEPPER MOTOR)

Measurement Method

1. Disconnect the ISC servo connector, and connect the special tool (test harness: MD998463) in between.
2. Connect the analyzer special patterns pickup to the ISC servo-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)

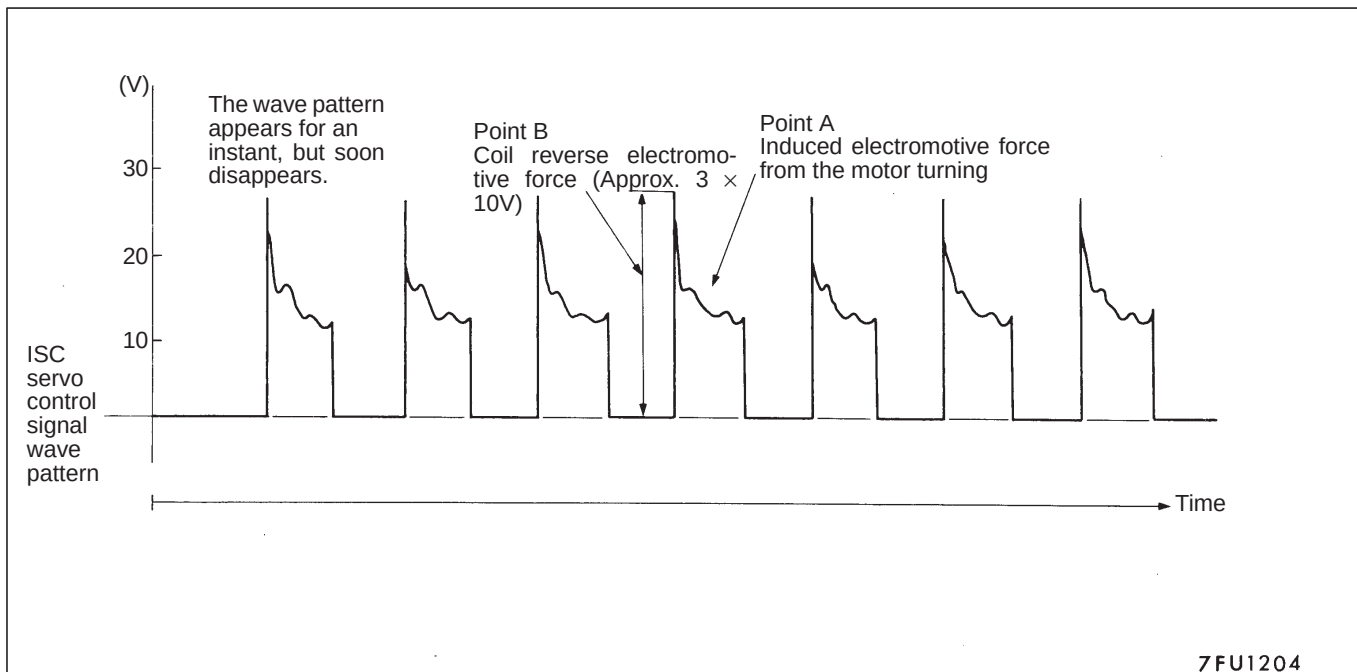
1. Connect the analyzer special patterns pickup to engine-ECU terminal 4, connection terminal 5, connection terminal 17, and connection terminal 18 respectively.

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

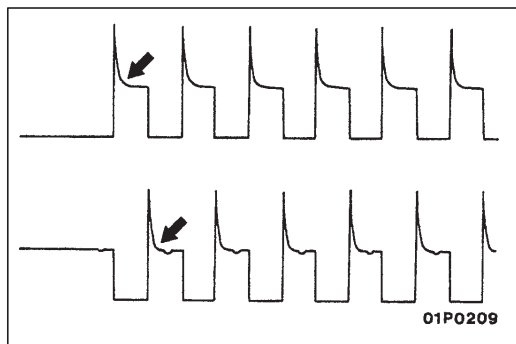
Check that the standard wave pattern appears when the ISC servo is operating.

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 operating.)

Wave pattern characteristics

Induced electromotive force from the motor turning does not appear.

- Example 2

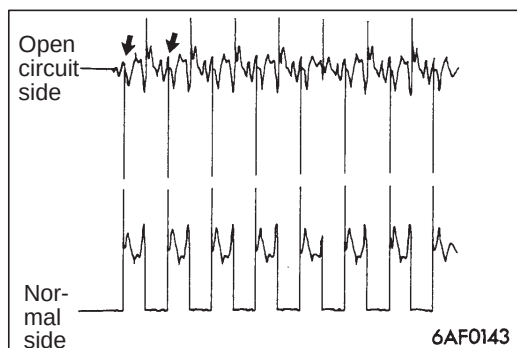
Cause of problem

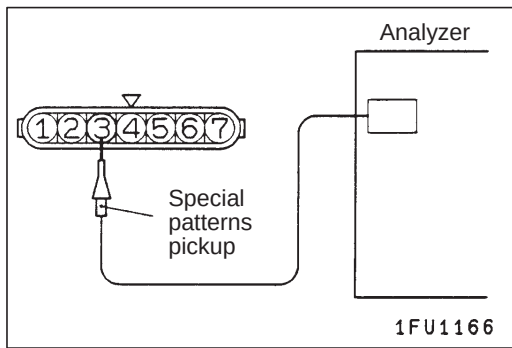
Open circuit in the line between the ISC servo and the engine-ECU.

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

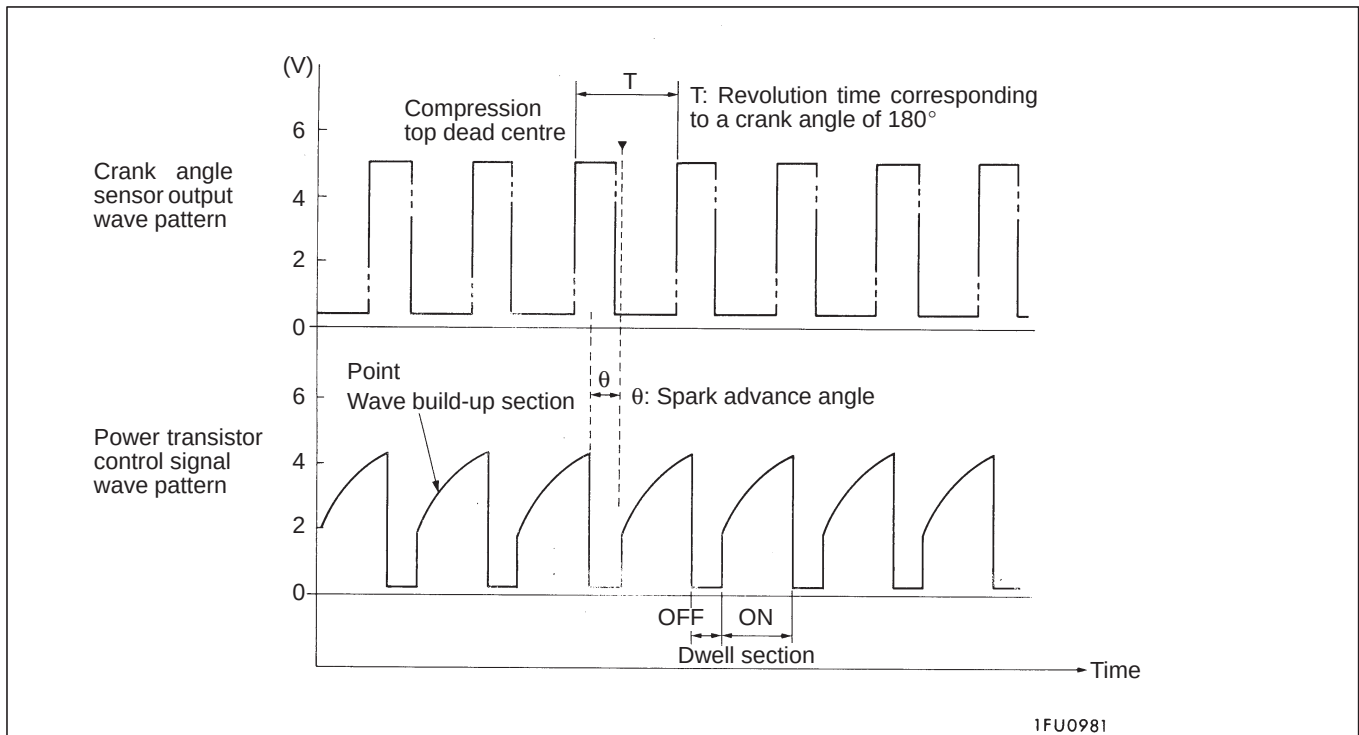
1. Disconnect the distributor connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to distributor connector terminal 3.

Alternate Method (Test harness not available)

1. Connect the analyzer special patterns pickup to engine-ECU terminal 10.

Standard Wave Pattern**Observation condition**

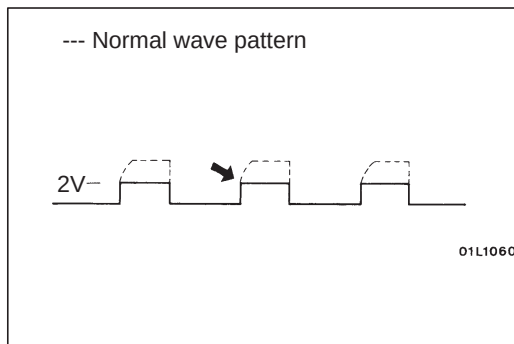
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Approx. 1,200 r/min

Standard wave pattern

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

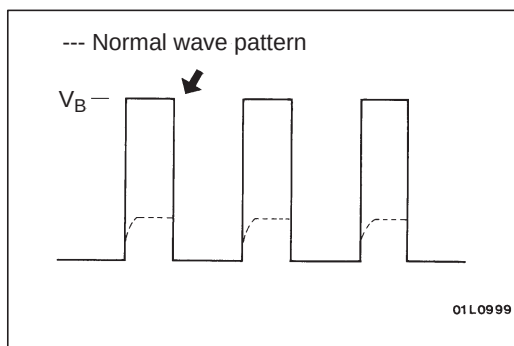
Wave pattern during engine cranking

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

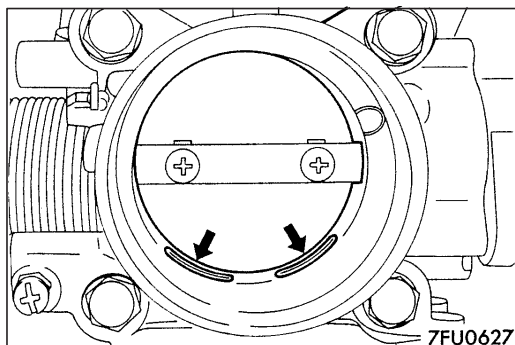
Power voltage results when the power transistor is ON.

ON-VEHICLE SERVICE

13100100450

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 self-diagnosis code.
10. Adjust the basic idle speed. (Refer to P.13B-66.)

NOTE

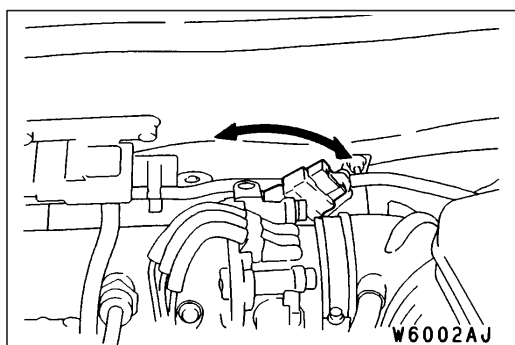
If the engine hunts while idling after adjustment of the basic idle speed, disconnect the (–) cable from the battery for 10 seconds or more, and then reconnect it and run the engine at idle for about 10 minutes.

THROTTLE POSITION SENSOR ADJUSTMENT

13100110071

1. Connect the MUT-II to the diagnosis connector.
2. Turn the ignition switch to ON (but do not start the engine).
3. Check the throttle position sensor output voltage.

Standard value: 530 – 740 mV



4. If the voltage is outside the standard value, adjust by loosening the throttle position sensor mounting bolts and turning the throttle position sensor body. After adjusting, tighten the bolts securely.
5. Turn the ignition switch to OFF.
6. If a diagnosis code is output while adjusting the throttle position sensor, use the MUT-II to erase the diagnosis code.

BASIC IDLE SPEED ADJUSTMENT

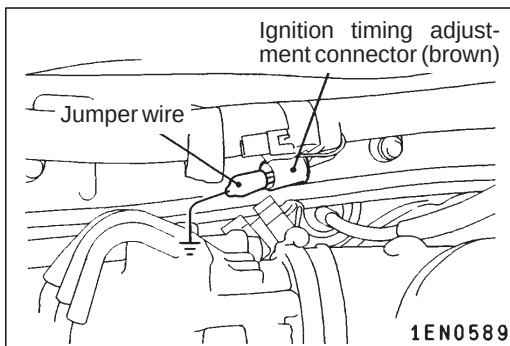
13100180508

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.



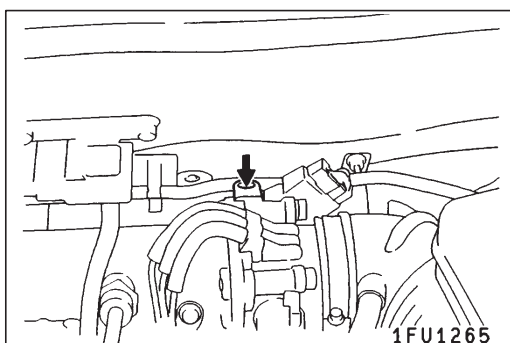
3. Remove the waterproof female connector from the ignition timing adjustment connector.
4. Use a jumper wire to earth the ignition timing adjustment terminal.

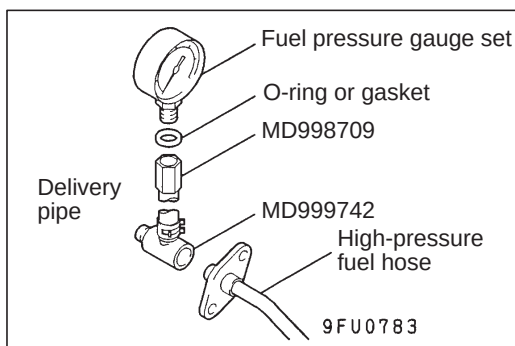
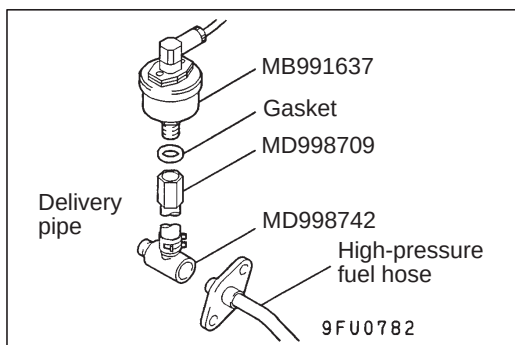
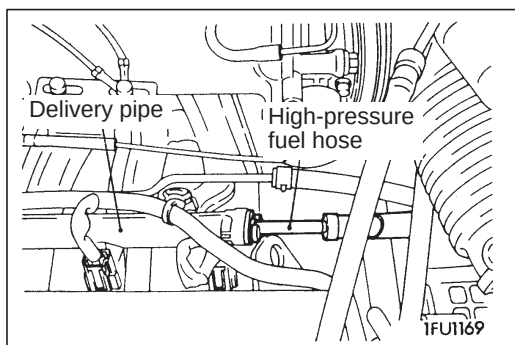
5. Start the engine and run at idle.
6. Check the idle speed.

Standard value: 750 ± 50 r/min

NOTE

- (1) The engine speed may be 20 to 100 r/min lower than indicated above for a new vehicle [driven approximately 500 km 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.13B-65.)
7. If not within the standard value range, turn the speed adjusting screw (SAS) to make the necessary adjustment.
 8. Switch OFF the ignition switch.
 9. Disconnect the jumper wire from the ignition timing adjustment terminal and return the connector to its original condition.
 10. Disconnect the MUT-II.
 11. 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

13100190440

1. Release residual pressure from the fuel pipe line to prevent fuel gush out. (Refer to P.13B-69.)
2. Disconnect the high-pressure fuel 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) and instead attach the special tool (hose adapter) to the adapter hose.
4. Install the special tool (for measuring the fuel pressure) that was set up in step 3.

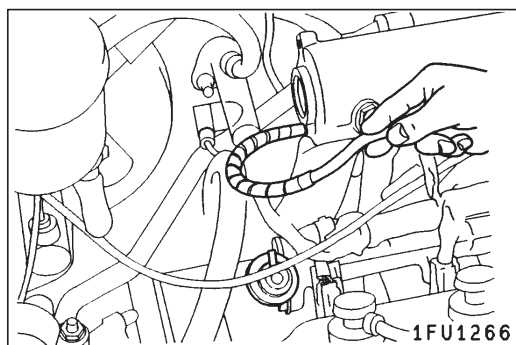
<When using the fuel pressure gauge set (special tool)>

- (1) Install the special tool (for measuring the fuel pressure) between the high-pressure fuel hose and the delivery pipe.
- (2) Install the fuel pressure gauge set (special tool) on the special tool (for measuring the fuel pressure) putting the gasket between them.
- (3) Connect the lead wire of the fuel pressure gauge set (special tool) to the power supply (cigarette lighter socket) and to the MUT-II.

<When using the fuel pressure gauge>

- (1) Install the fuel pressure gauge on the special tool (for measuring the fuel pressure) putting a suitable O-ring or gasket between them.
- (2) Install the special tool which was set up in step (1) between the high-pressure fuel hose and the delivery pipe.
5. Connect the MUT-II to the diagnosis connector.
6. Turn the ignition switch to ON. (But do not start the engine.)
7. Select "Item No.07" from the MUT-II Actuator test to drive the fuel pump. Check that there are no fuel leaks from any parts.
8. Finish the actuator test or turn the ignition switch to OFF.
9. Start the engine and run at idle.
10. Measure fuel pressure while the engine is running at idle.

Standard value: Approx. 265 kPa at kerb idle



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

Standard value:

324–343 kPa at kerb idle

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

NOTE

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

14. If any of fuel pressure measured in steps 10 to 13 is out of specification, troubleshoot and repair according to the table below.

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

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

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

16. Release residual pressure from the fuel pipe line. (Refer to P.13B-69.)
17. Remove the fuel pressure gauge and special tool from the delivery pipe.

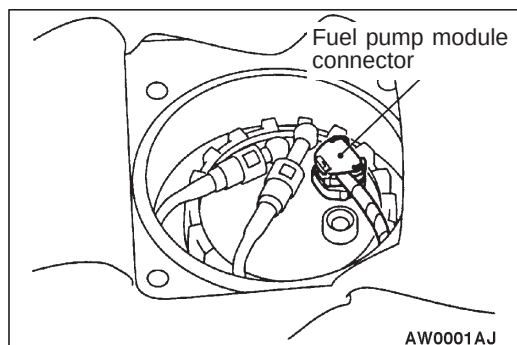
Caution

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

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

Tightening torque: 5 Nm

20. Check for any fuel leaks by following the procedure in step 7.
21. Disconnect the MUT-II.

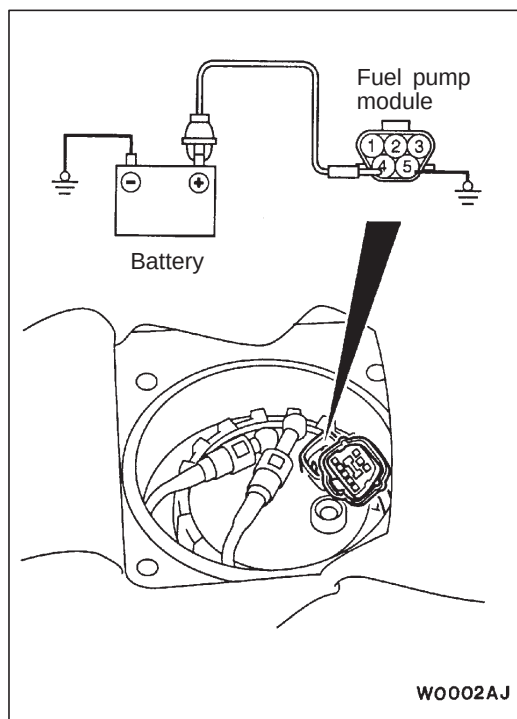


FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE THE FUEL PRESSURE)

13100090320

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 the fuel pressure in the line and prevent fuel from running out.

- (1) Remove the rear seat assembly. (Refer to GROUP 52A.)
- (2) Remove the protector.
- (3) Disconnect the fuel pump module connector.
- (4) After starting the engine and letting it run until it stops naturally, turn the ignition switch to OFF.
- (5) Connect the fuel pump module connector.
- (6) Install the protector and rear seat assembly.



FUEL PUMP OPERATION CHECK

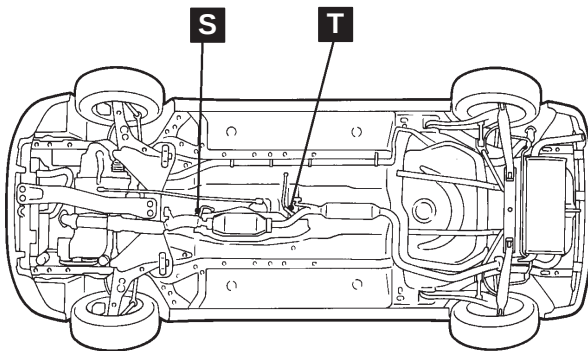
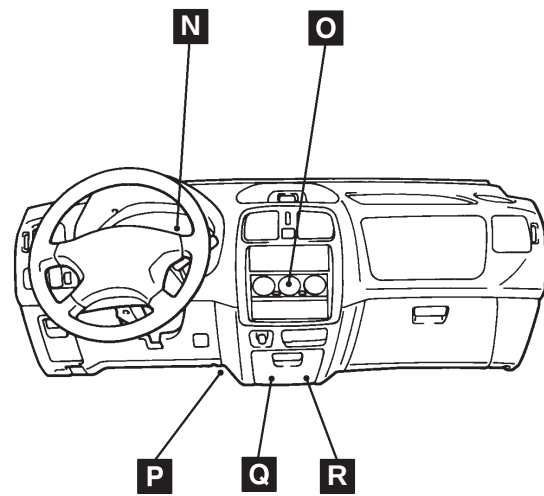
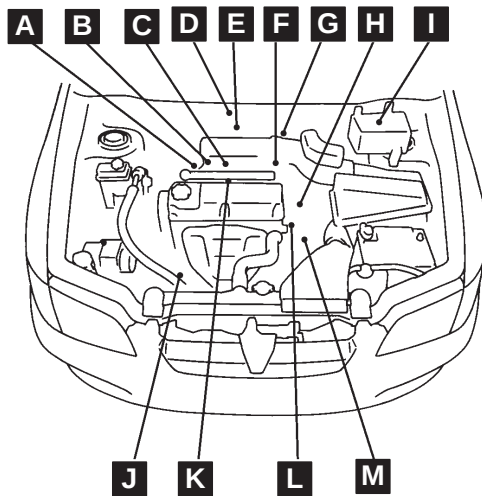
13100200303

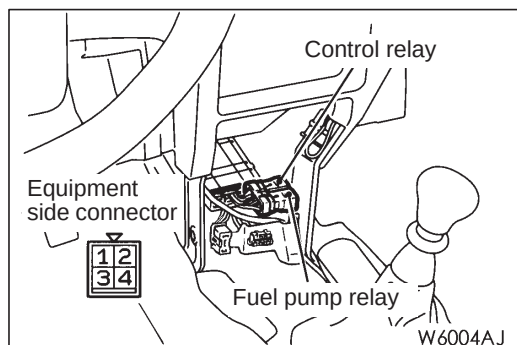
1. Check the operation of the fuel pump by using the MUT-II to force-drive the fuel pump.
2. If the fuel pump will not operate, check by using the following procedure, and if it is normal, check the drive circuit.
 - (1) Turn the ignition switch to OFF.
 - (2) Remove the rear seat assembly. (Refer to GROUP 52A.)
 - (3) Remove the protector.
 - (4) Disconnect the fuel pump module connector. Apply a battery voltage to the terminal No.4 of the fuel pump module connector and connect the terminal No.5 to earth, and check that the fuel pump operation sound can be heard.
 - (5) Check the fuel pressure by pinching the fuel hose with the fingertip.
 - (6) Connect the fuel pump module connector.
 - (7) Install the protector and rear seat assembly.

COMPONENT LOCATION

13100210566

Name	Symbol	Name	Symbol
A/C relay	I	Idle speed control servo	F
A/C switch	O	Ignition timing adjustment terminal	E
Control relay and fuel pump relay	R	Injectors	K
Detonation sensor	A	Intake air temperature sensor	B
Diagnosis connector	P	Oxygen sensor (front)	S
Distributor (with ignition coil and crank angle sensor)	H	Oxygen sensor (rear)	T
		Power steering fluid pressure switch	J
EGR control solenoid valve	C	Purge control solenoid valve	C
Engine coolant temperature sensor	L	Throttle position sensor	G
Engine-ECU	Q	Vacuum sensor	D
Engine warning lamp (check engine lamp)	N	Vehicle speed sensor	M

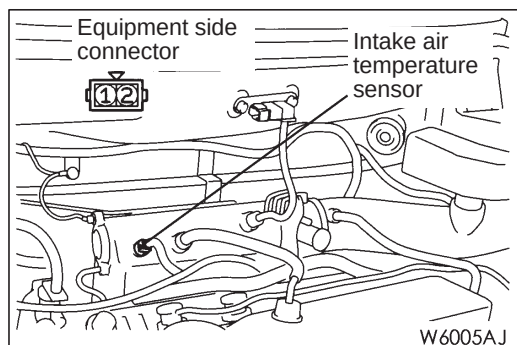




CONTROL RELAY AND FUEL PUMP RELAY CONTINUITY CHECK

13100990248

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



INTAKE AIR TEMPERATURE SENSOR CHECK

13100280314

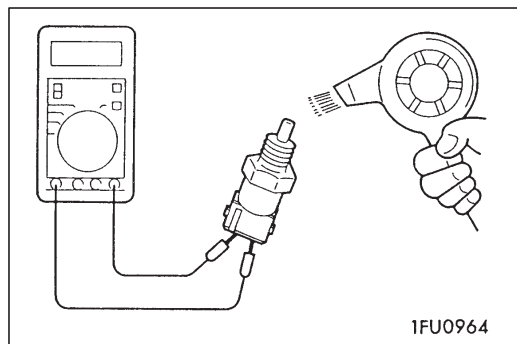
1. Disconnect the intake air temperature sensor connector.
2. Measure resistance between terminals 1 and 2.

Standard value:

2.3 – 3.0 kΩ (at 20°C)

0.30 – 0.42 kΩ (at 80°C)

3. Remove the intake air temperature sensor.



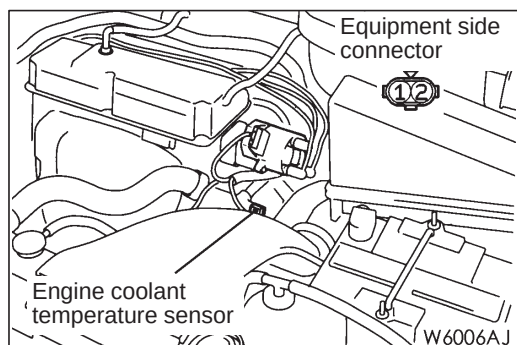
4. Measure resistance while heating the sensor using a hair drier.

Normal condition:

Temperature (°C)	Resistance (kΩ)
Higher	Smaller

5. If the value deviates from the standard value or the resistance remains unchanged, replace the intake air temperature sensor.
6. Install the intake air temperature sensor and tighten it to the specified torque.

Tightening torque: 12 – 15 Nm



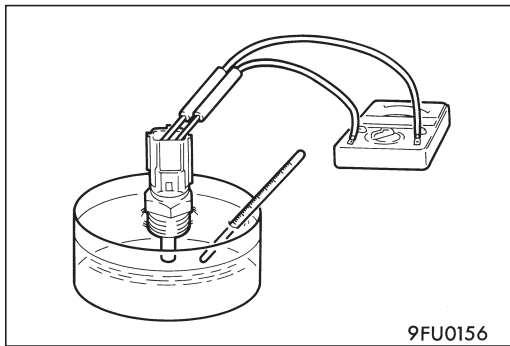
ENGINE COOLANT TEMPERATURE SENSOR CHECK

13100310303

Caution

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

1. Remove the engine coolant temperature sensor.



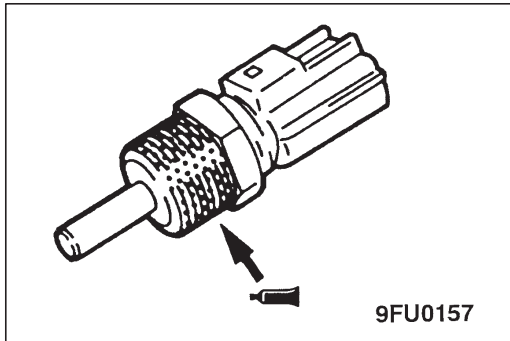
2. With temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.

Standard value:

2.1 – 2.7 k Ω (at 20°C)

0.26 – 0.36 k Ω (at 80°C)

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



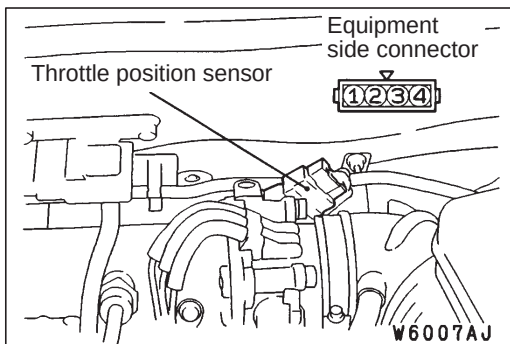
4. Apply sealant to threaded portion.

Specified sealant:

3M NUT Locking Part No.4171 or equivalent

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

Tightening torque: 29 Nm



THROTTLE POSITION SENSOR CHECK 13100320412

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 k Ω

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

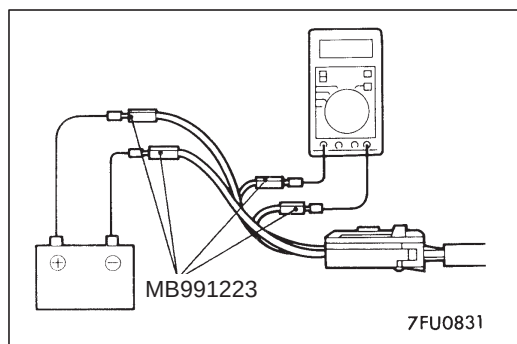
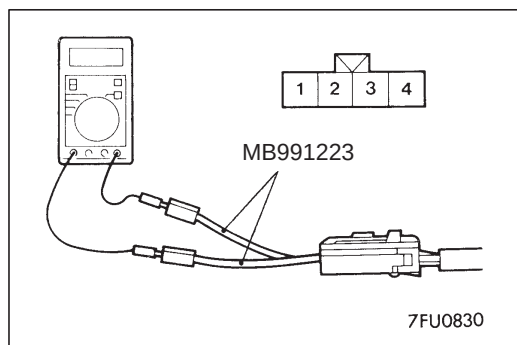
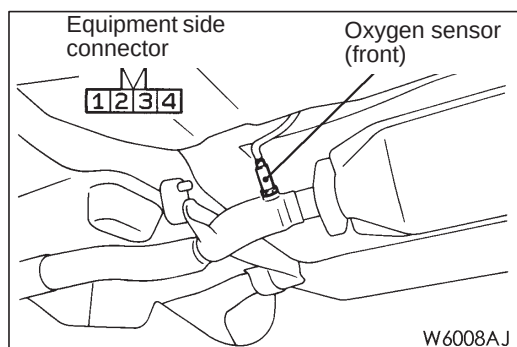
Normal condition:

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.13B-65.



OXYGEN SENSOR CHECK

13100510222

<Oxygen sensor (front)>

1. Disconnect the oxygen sensor connector and connect the special tool (test harness) to the connector on the oxygen sensor side.
2. Make sure that there is continuity ($2.5 - 5.0 \Omega$ at 20°C) between terminal 3 and terminal 4 on the oxygen sensor connector.
3. If there is no continuity, replace the oxygen sensor.
4. Warm up the engine until engine coolant is 80°C or higher.
5. Use the jumper wire to connect terminal 3 of the oxygen sensor connector to the battery (+) terminal and terminal 4 to the battery (-) terminal.
6. Connect a digital voltage meter between terminal 1 and terminal 2.
7. While repeatedly racing the engine, measure the oxygen sensor output voltage.

Caution

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

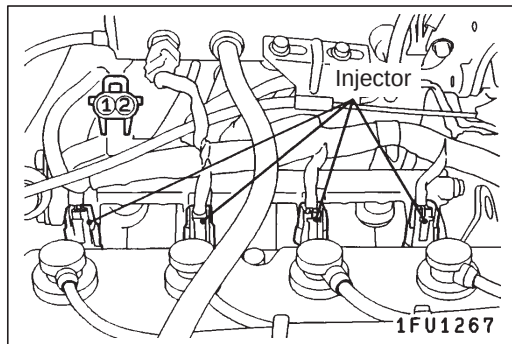
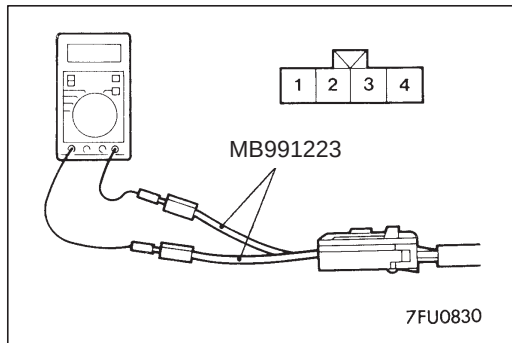
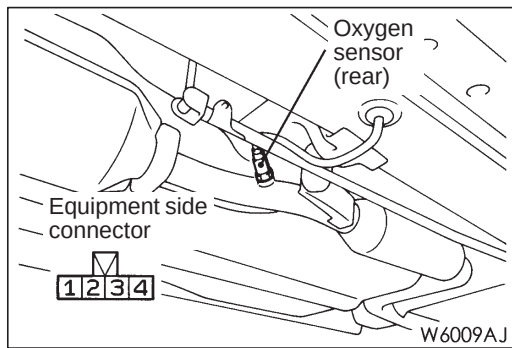
Standard value:

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

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

NOTE

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



<Oxygen sensor (rear)>

1. Disconnect the oxygen sensor connector and connect the special tool (test harness set) to the connector on the oxygen sensor side.
2. Make sure that there is continuity ($2.5 - 5.0 \Omega$ at 20°C) between terminal 3 and terminal 4 on the oxygen sensor connector.
3. If there is no continuity, replace the oxygen sensor.

NOTE

- (1) If the MUT-II does not display the standard value although no abnormality is found by the above mentioned continuity test and harness check, replace the oxygen sensor (rear).
- (2) For removal and installation of the oxygen sensor, refer to GROUP 15 – Exhaust Pipe and Main Muffler.

INJECTOR CHECK

13100520409

Measurement of Resistance between Terminals

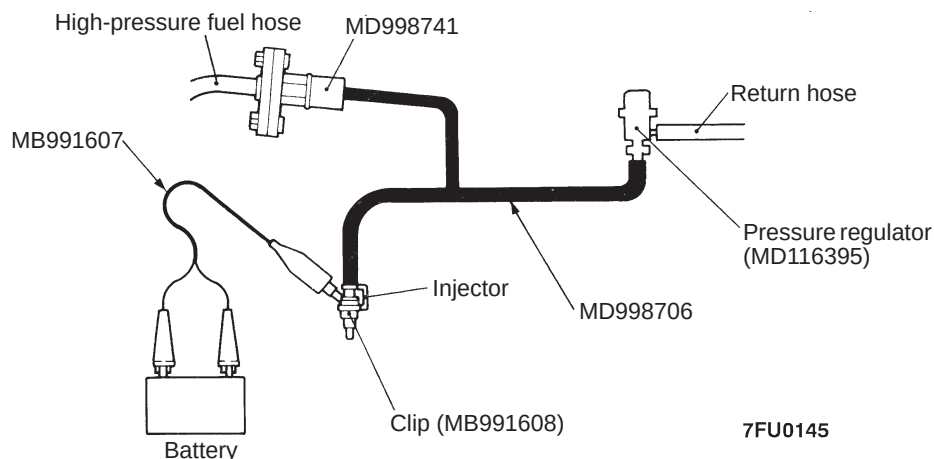
1. Remove the injector connector.
2. Measure the resistance between terminals.

Standard value: $13 - 16 \Omega$ (at 20°C)

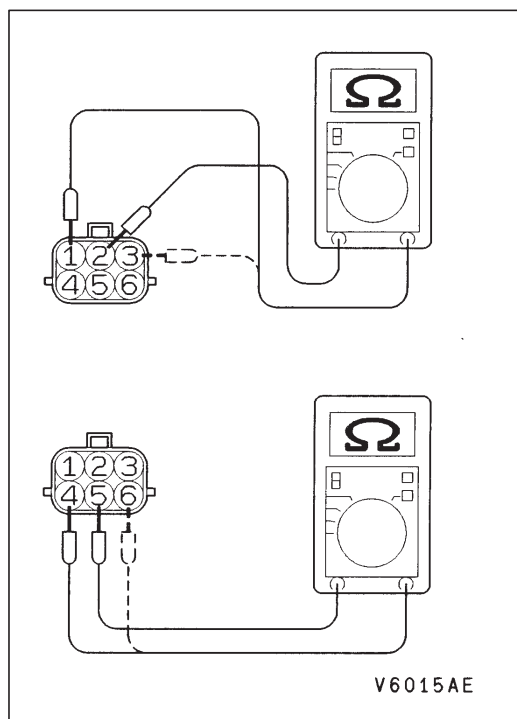
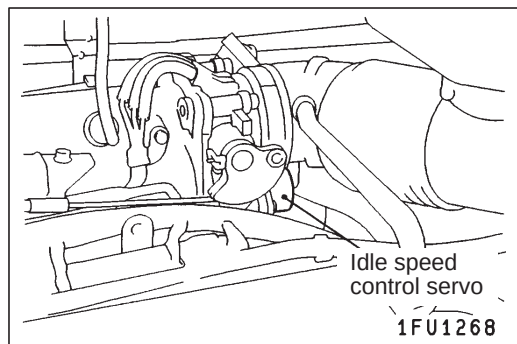
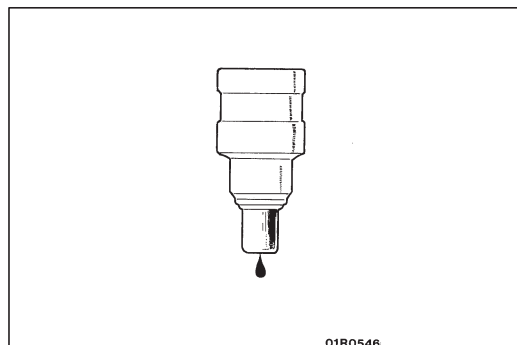
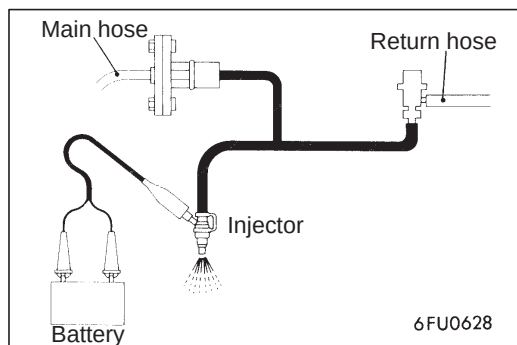
3. Install the injector connector.

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.13B-69.)
2. Remove the injector.
3. Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.



4. Connect the MUT-II to the diagnosis connector.
5. Turn the ignition switch to ON. (But do not start the engine.)
6. Select "Item No.07" from the MUT-II Actuator test to drive the fuel pump.



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

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

Standard value: 1 drop or less per minute

9. 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.
10. Disconnect the MUT-II.

IDLE SPEED CONTROL (ISC) SERVO (STEPPER MOTOR) CHECK

13100540344

Checking the Operation Sound

1. Check that the 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.

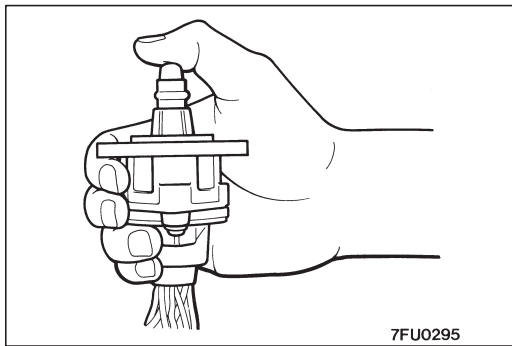
Checking the Coil Resistance

1. Disconnect the idle speed control servo connector.
2. Measure the resistance between terminal 2 and either terminal 1 or terminal 3 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 and either terminal 6 or terminal 4 of the connector at the idle speed control servo side.

Standard value: 28–33 Ω (at 20°C)

**Operation Check**

1. Remove the throttle body.
2. Remove the idle speed control servo.
3. Connect the special tool (test harness set: MB991709) to the idle speed control servo connector.
4. Connect the positive (+) terminal of a power supply (approx. 6 V) to the terminals No.2 and No.5.
5. Hold the ISC servo as shown in the illustration. Connect the negative (–) terminal of the power supply to each clip as described in the following steps, and check whether or not a vibrating feeling (a feeling of very slight vibration of the stepper motor) is generated as a result of the activation of the stepper motor.
 - (1) Connect the negative (–) terminal of the power supply to the terminals No.1 and No.4.
 - (2) Connect the negative (–) terminal of the power supply to the terminals No.3 and No.4.
 - (3) Connect the negative (–) terminal of the power supply to the terminals No.3 and No.6.
 - (4) Connect the negative (–) terminal of the power supply to the terminals No.1 and No.6.
 - (5) Connect the negative (–) terminal of the power supply to the terminals No.1 and No.4.
 - (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

13100560357

Refer to GROUP 17 – Emission Control System.

EGR CONTROL SOLENOID VALVE CHECK

13100570268

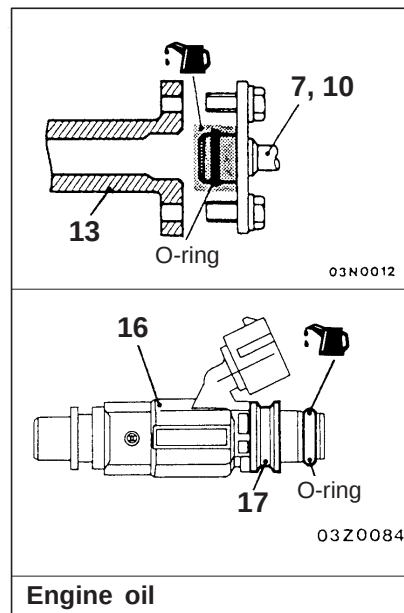
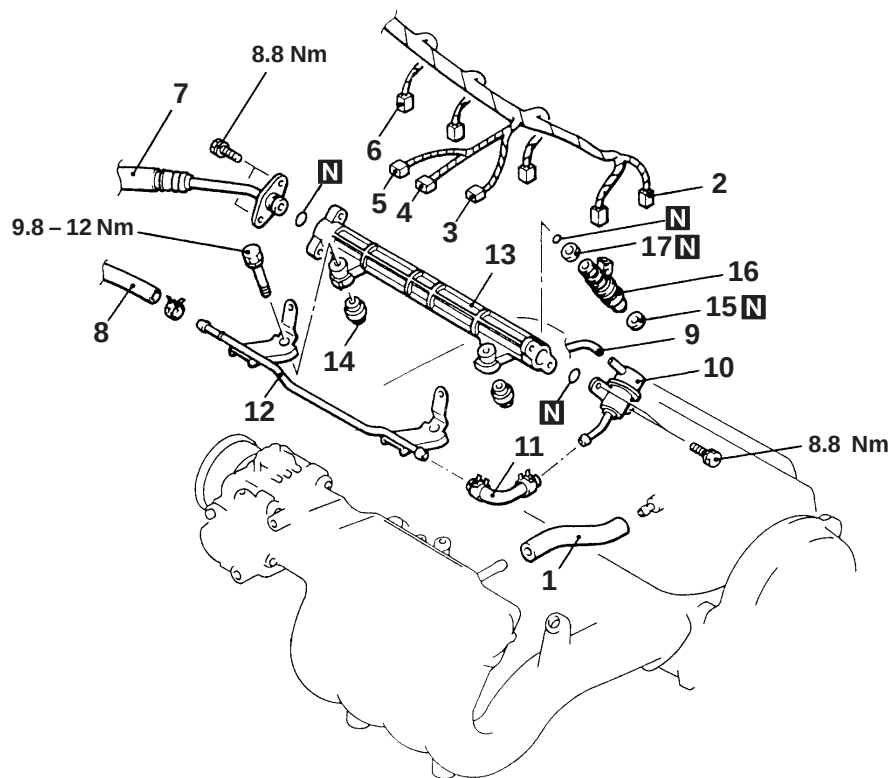
Refer to GROUP 17 – Emission Control System.

INJECTOR

REMOVAL AND INSTALLATION

Pre-removal Operation

- Fuel Discharge Prevention (Refer to P.13B-69.)



03M0019 00008034

Removal steps

- | | | |
|--|---------|---------------------------------|
| 1. PCV hose | | 9. Vacuum hose connection |
| 2. Detonation sensor connector | | ▶A◀ 10. Fuel pressure regulator |
| 3. Intake air temperature sensor connector | | 11. Fuel hose |
| 4. Purge control solenoid valve connector | ◀A▶ | 12. Fuel return pipe |
| 5. EGR solenoid valve connector | | 13. Delivery pipe |
| 6. Injector connector | | 14. Insulator |
| ▶A◀ 7. High-pressure fuel hose connection | ◀A▶ ▶A◀ | 15. Insulator |
| 8. Fuel return hose connection | | 16. Injector |
| | | 17. Grommet |

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 enter the delivery pipe.

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

Tightening torque:

8.8 Nm (Fuel pressure regulator)

THROTTLE BODY

13100770439

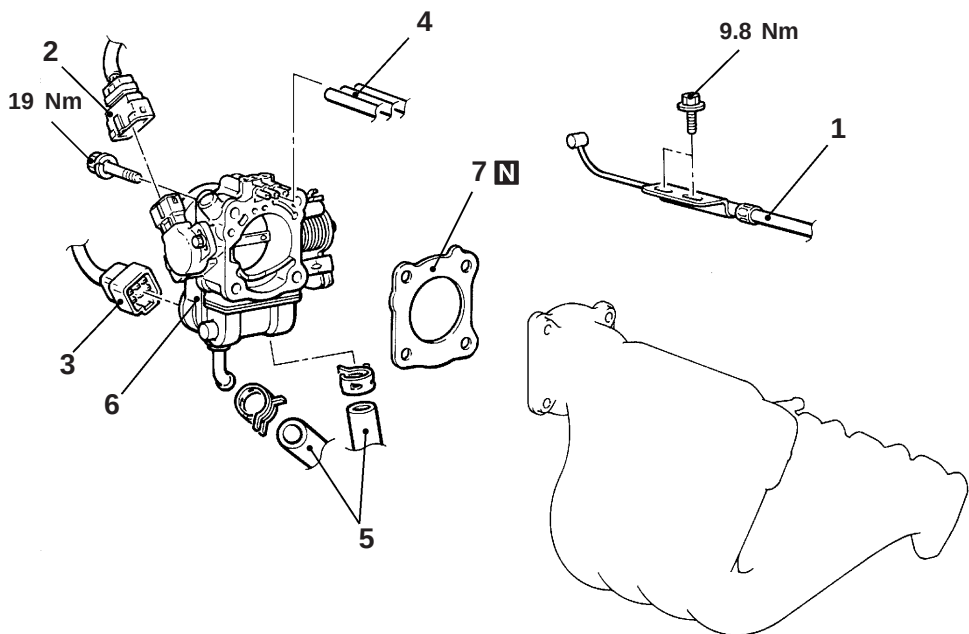
REMOVAL AND INSTALLATION

Pre-removal Operation

- Engine Coolant Draining
(Refer to GROUP 14 – On-vehicle Service.)
- Air Cleaner Removal

Post-installation Operation

- Air Cleaner Installation
- Engine Coolant Supplying
(Refer to GROUP 14 – On-vehicle Service.)
- Accelerator Cable Adjustment
(Refer to GROUP 17 – On-vehicle Service.)

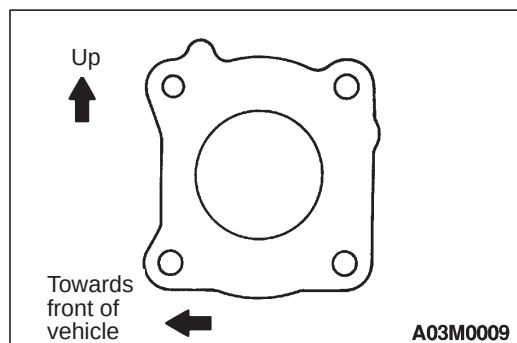


AW0003AJ

Removal steps

1. Accelerator cable connection
2. Throttle position sensor connector
3. Idle speed control servo connector
4. Vacuum hose connection

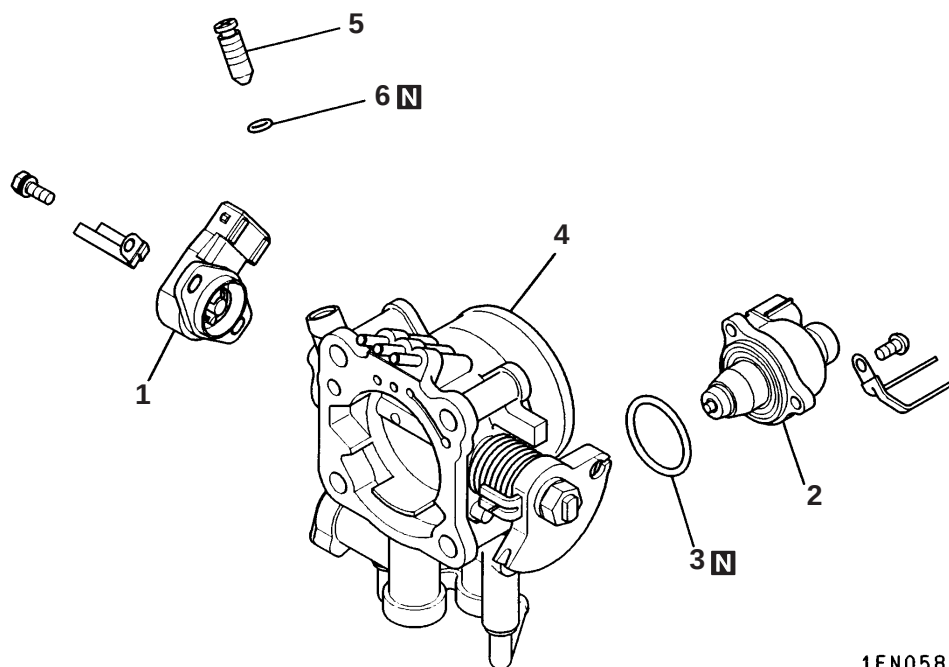
5. Water hose connection
6. Throttle body
7. Throttle body gasket

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

Place the gasket so that the projecting part is positioned as shown in the illustration, and then install it between the intake manifold and the throttle body.

DISASSEMBLY AND REASSEMBLY

13100970525



1EN0586

Disassembly steps

1. Throttle position sensor (TPS)
2. Idle speed control servo
3. O-ring

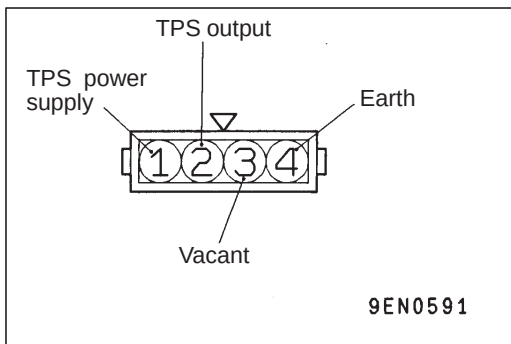
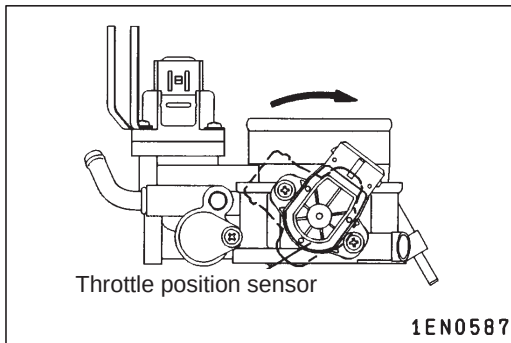
4. Throttle body
5. Speed adjusting screw
6. O-ring

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 servo assemblyIf 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 POINT**►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 circuit tester between terminal No.1 (TPS power supply) and terminal No.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.



NOTES

FUEL SUPPLY

CONTENTS

13509000272

GENERAL INFORMATION	2	FUEL TANK	3
SPECIAL TOOL	2	Fuel Pump Module	6

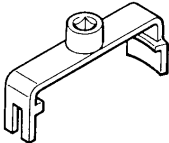
GENERAL INFORMATION

13500010182

1. The fuel tank is located under the floor of the rear seats to provide increased safety and a wider luggage space.
2. A valve assembly (rollover valve) has been adopted to prevent fuel from leaking out in the event of a collision.
3. A plastic fuel tank has been adopted to reduce weight, and improve anti-corrosion effectiveness.

SPECIAL TOOL

13500060132

Tool	Number	Name	Use
	MB996009	Tank cap wrench	Removal and installation of tank cap

FUEL TANK

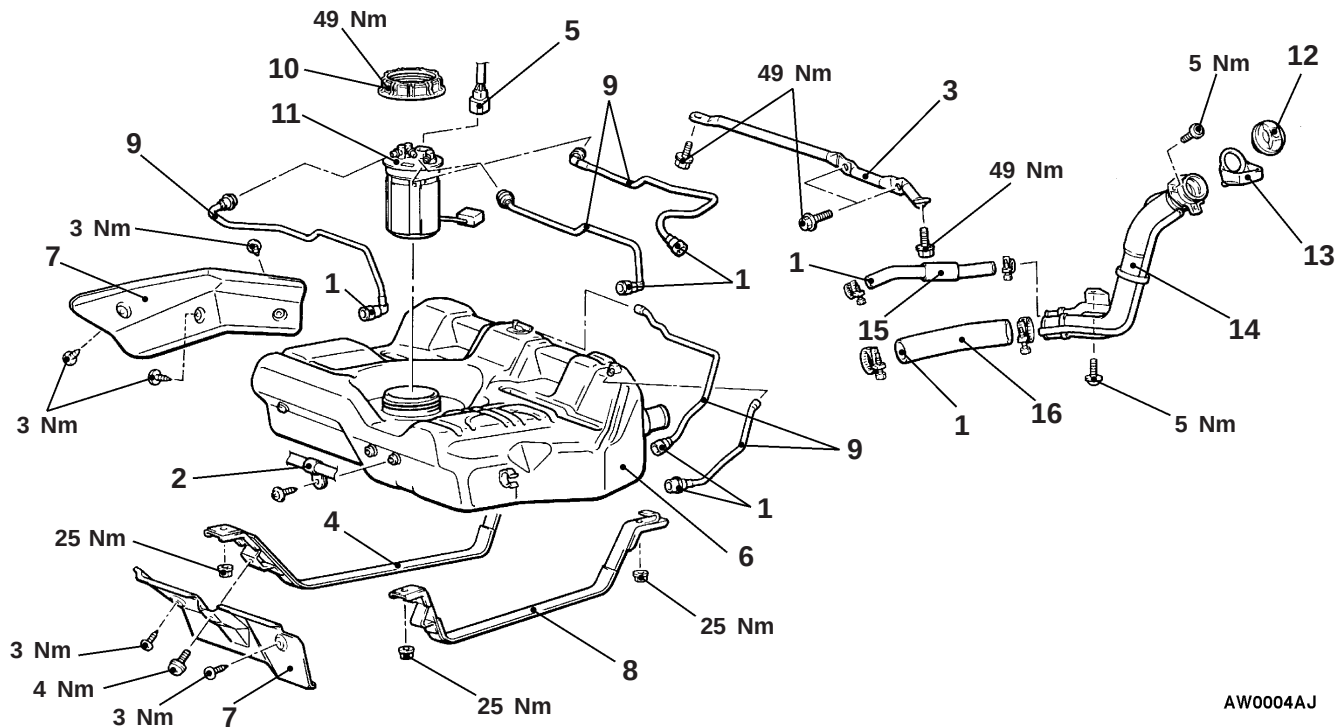
REMOVAL AND INSTALLATION

Pre-removal Operation

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

Post-installation Operation

- Refilling the Fuel.
- Checking for Fuel Leaks.

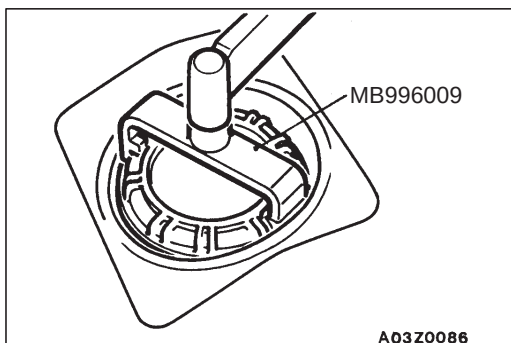


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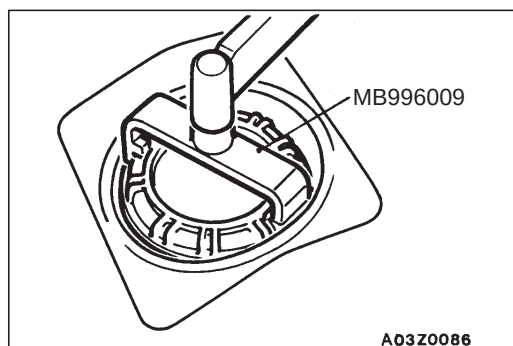
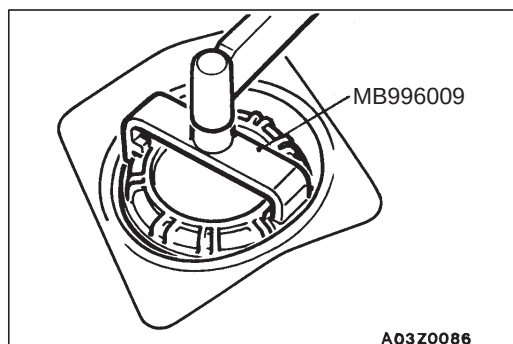
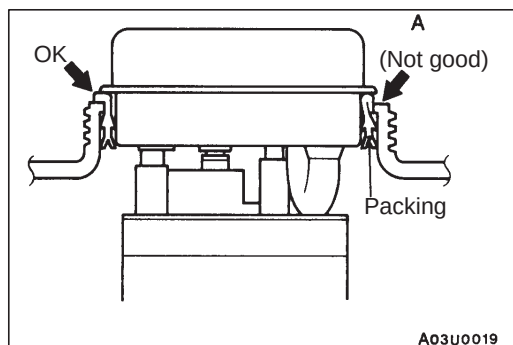
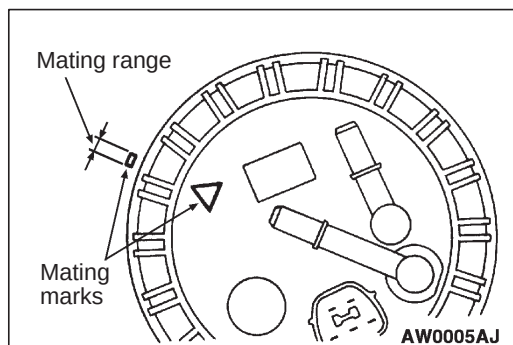
Removal steps

1. Fuel hoses connection
2. Harassment clamp
3. Toe control link support bar
4. Band (RH)
5. Fuel pump module connector
6. Fuel tank assembly
7. Heat protector
8. Band (LH)

- ◀A▶ ▶B▶
▶A▶
9. Fuel hoses
 10. Cap
 11. Fuel pump module
 12. Fuel filler cap
 13. Fuel rubber drain
 14. Filler neck assembly
 15. Leveling hose
 16. Filler hose

**REMOVAL SERVICE POINT**

◀A▶ CAP REMOVAL



INSTALLATION SERVICE POINTS

►A◄ FUEL PUMP MODULE INSTALLATION

1. Check to be sure that the fuel tank packing is not damaged or deformed, and then securely install the packing to the fuel tank.

Caution

If the packing is installed to the fuel pump module, packing lip will be damaged when installing the fuel pump module to the fuel tank and the fuel leak will result.

NOTE

If the packing is damaged or deformed, replace the defective packing with a new packing.

2. Apply soapy water to the inside of the packing. Align the mating marks on the fuel tank and fuel pump module as shown in the illustration, and then install the fuel pump module to the fuel tank.

Caution

- (1) Do not tilt the fuel pump module when installing.
- (2) The packing should not be folded over as shown by (A) in the illustration.

►B◄ CAP INSTALLATION

Apply soapy water to the cap thread, and then use the special tool as the same manner as for removal to tighten the cap to the specified torque.

Tightening torque: 49 Nm

Caution

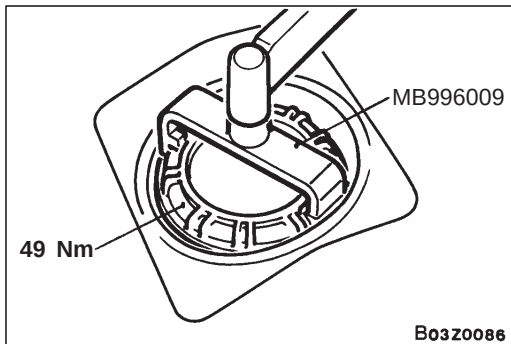
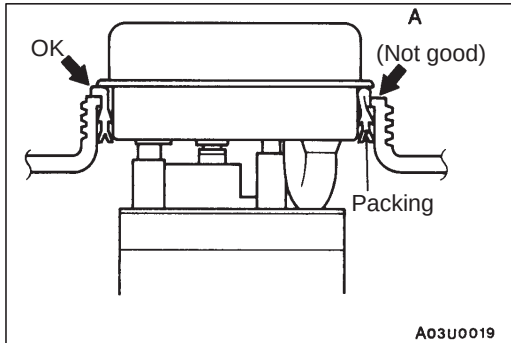
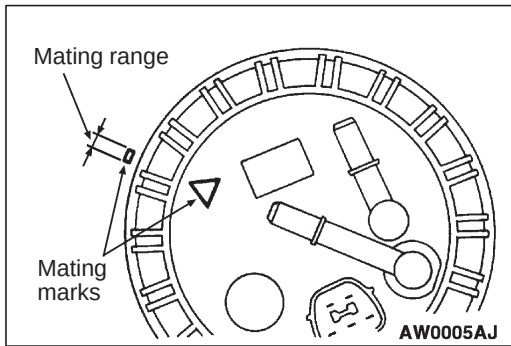
Prevent the fuel pump module from turning with the cap when tightening the cap.

INSPECTION

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FUEL PUMP MODULE REPLACEMENT

1. Bleed the residual pressure from inside the fuel pipe line to prevent the fuel from spraying out. (Refer to GROUP 13 – On-vehicle Service.)
2. Disconnect the fuel hoses.
3. Use the special tool to remove the cap, and then remove the fuel pump module.



4. Check to be sure that the fuel tank packing is not damaged or deformed, and then securely install the packing to the fuel tank.

Caution

If the packing is installed to the fuel pump module, packing lip will be damaged when installing the fuel pump module to the fuel tank and the fuel leak will result.

NOTE

If the packing is damaged or deformed, replace the defective packing with a new packing.

5. Apply soapy water to the inside of the packing. Align the mating marks on the fuel tank and fuel pump module as shown in the illustration, and then install the fuel pump module to the fuel tank.

Caution

- (1) Do not tilt the fuel pump module when installing.
- (2) The packing should not be folded over as shown by (A) in the illustration.

6. Use the special tool to tighten the cap to the specified torque.

Tightening torque: 49 Nm

7. Check for leaks from the installation section of the fuel pump module by the following procedure.
 - (1) Apply soapy water to the circumference of the cap.
 - (2) Choke the vapor hose and main hose, apply an internal pressure of 10 kPa or less from the return hose and check to be sure that no bubbles form in the soapy water.

FUEL GAUGE CHECK

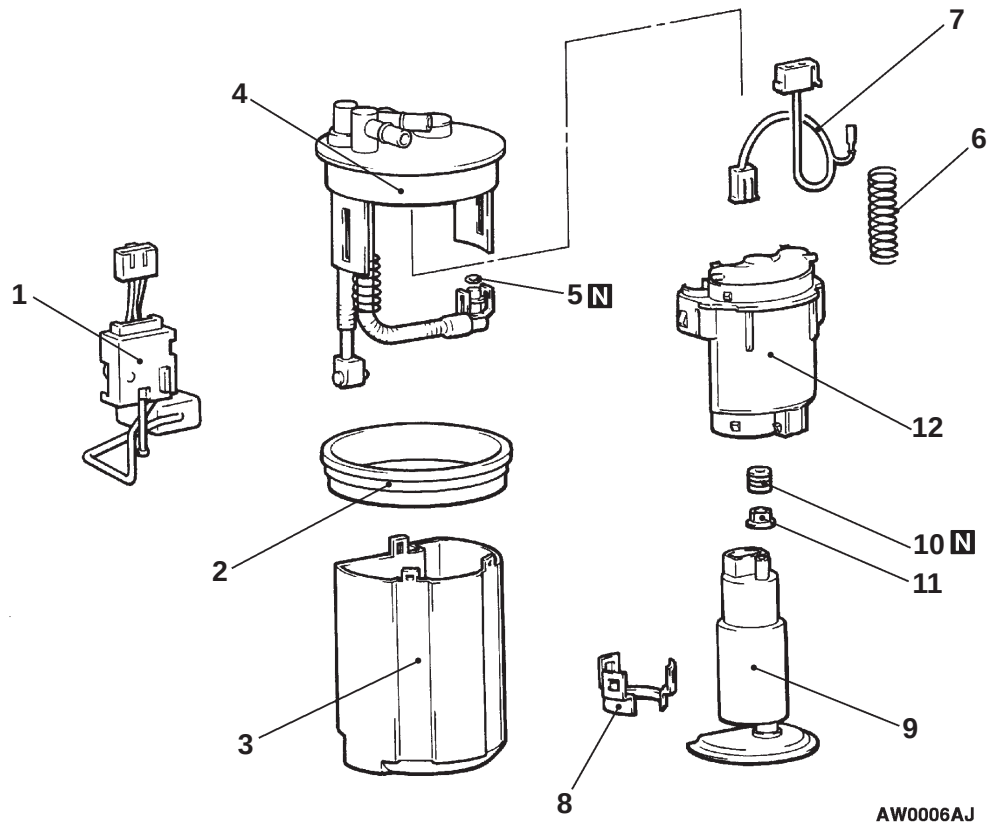
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Refer to GROUP 54 – Combination Meter.

DISASSEMBLY AND REASSEMBLY

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FUEL PUMP MODULE



Disassembly steps

1. Fuel gauge unit
2. Packing
3. Reservoir cup
4. Pump support bracket assembly
5. O-ring
6. Spring



7. Pump harness
8. Lock bracket
9. Fuel pump
10. Grommet
11. Spacer
12. Fuel filter



REASSEMBLY SERVICE POINT

►A◄ GROMMET/O-RING INSTALLATION

Apply a unleaded petrol to the grommet and O-ring before installing them in order to prevent damage.