

# FUEL

## CONTENTS

13109000195

MULTIPOINT FUEL INJECTION (MPI) .....	13A
ELECTRONIC CONTROL TYPE CARBURETTOR .....	13B
CONVENTIONAL TYPE CARBURETTOR .....	13C
VARIABLE VENTURI TYPE CARBURETTOR .....	13D
DIESEL FUEL .....	13E
FUEL SUPPLY .....	13F
AUTO-CRUISE CONTROL SYSTEM .....	Refer to GROUP 17
TRACTION CONTROL SYSTEM (TCL) .....	13H

### NOTE

THE GROUPS MARKED BY ■ ARE NOT IN THIS MANUAL

# MULTIPOINT FUEL INJECTION (MPI)

## CONTENTS

13109000409

### MULTIPOINT FUEL INJECTION <4G6>

<b>GENERAL INFORMATION</b> .....	<b>4</b>
<b>SERVICE SPECIFICATIONS</b> .....	<b>7</b>
<b>SEALANT</b> .....	<b>7</b>
<b>SPECIAL TOOLS</b> .....	<b>8</b>
<b>TROUBLESHOOTING</b> .....	<b>9</b>
<b>ON-VEHICLE SERVICE</b> .....	<b>81</b>
Throttle Body (Throttle Valve Area) Cleaning .....	81
Idle Position Switch and Throttle Position Sensor Adjustment .....	81
Fixed SAS Adjustment .....	83
Basic Idle Speed Adjustment .....	83
Fuel Pressure Test .....	85
Fuel Pump Connector Disconnection (How to Reduce the Fuel Pressure) .....	88
Fuel Pump Operation Check .....	88
Component Location .....	89
Control Relay and Fuel Pump Relay Continuity Check .....	90
Intake Air Temperature Sensor Check .....	90
Engine Coolant Temperature Sensor Check .....	90
Throttle Position Sensor Check .....	91
Idle Position Switch Check .....	91
Oxygen Sensor Check .....	92
Injector Check .....	93

Idle Speed Control (ISC) Servo (Stepper Motor) Check .....	95
Purge Control Solenoid Valve Check .....	95
EGR Control Solenoid Valve Check .....	95

<b>INJECTOR</b> .....	<b>96</b>
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<b>THROTTLE BODY</b> .....	<b>98</b>
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### MULTIPOINT FUEL INJECTION <6A1>

<b>GENERAL INFORMATION</b> .....	<b>102</b>
<b>SERVICE SPECIFICATIONS</b> .....	<b>106</b>
<b>SEALANT</b> .....	<b>106</b>
<b>SPECIAL TOOLS</b> .....	<b>107</b>
<b>TROUBLESHOOTING</b> .....	<b>108</b>
<b>ON-VEHICLE SERVICE</b> .....	<b>184</b>

Throttle Body (Throttle Valve Area) Cleaning .....	184
Idle Position Switch and Throttle Position Sensor Adjustment <Vehicles without TCL> .....	184
Throttle Position Sensor Adjustment <Vehicles with TCL> .....	186
Idle Position Switch and Accelerator Pedal Position Sensor Adjustment <Vehicles with TCL> .....	186
Fixed SAS Adjustment .....	187
Basic Idle Speed Adjustment .....	188

CONTINUED ON NEXT PAGE

Fuel Pressure Test .....	189	Purge Control Solenoid Valve Check .....	200
Fuel Pump Connector Disconnection (How to Reduce the Fuel Pressure) .....	191	EGR Control Solenoid Valve Check .....	200
Fuel Pump Operation Check .....	191	Ventilation Control Solenoid Valve Check <Vehicles with TCL> .....	201
Component Location .....	192	Vacuum Control Solenoid Valve Check <Vehicles with TCL> .....	201
Control Relay and Fuel Pump Relay Continuity Check .....	193	Vacuum Tank Check <Vehicles with TCL> .....	202
Intake Air Temperature Sensor Check .....	193	Vacuum Actuator Check <Vehicles with TCL> .....	202
Engine Coolant Temperature Sensor Check .....	193	Throttle Valve Operation Check <Vehicles with TCL> .....	202
Throttle Position Sensor Check .....	194	Negative Pressure Check during Traction Control Operation <Vehicles with TCL> ...	203
Accelerator Pedal Position Sensor Check <Vehicles with TCL> .....	194	Power Steering Air Control Valve Operation Check .....	203
Idle Position Switch Check <Vehicles without TCL> .....	195	<b>INJECTOR .....</b>	<b>204</b>
Idle Position Switch Check <Vehicles with TCL> .....	195	<b>THROTTLE BODY .....</b>	<b>207</b>
Oxygen Sensor Check .....	196		
Injector Check .....	197		
Idle Speed Control (ISC) Servo (Stepper Motor) Check .....	199		

# MULTIPOINT FUEL INJECTION (MPI) <4G6>

13100010449

## GENERAL INFORMATION

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

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

## FUEL INJECTION CONTROL

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

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

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

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

## IDLE AIR CONTROL

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

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

## IGNITION TIMING CONTROL

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

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

## SELF-DIAGNOSIS FUNCTION

- When an abnormality is detected in one of the sensors or actuators related to emission control, the engine warning lamp (check engine lamp) illuminates as a warning to the driver.
- When an abnormality is detected in one of the sensors or actuators, a diagnosis

code corresponding to the abnormality is output.

- The RAM data inside the engine-ECU that is related to the sensors and actuators can be read by means of the MUT-II. In addition, the actuators can be force-driven under certain circumstances.

**OTHER CONTROL FUNCTIONS**

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

**GENERAL SPECIFICATIONS**

Items		Specifications
Throttle body	Throttle bore mm	54
	Throttle position sensor	Variable resistor type
	Idle speed control servo	Stepper motor type (Stepper motor type by-pass air control system with the air volume limiter)
	Idle position switch	Rotary contact type, within throttle position sensor
Engine-ECU	Identification model No.	E2T67673
Sensors	Air flow sensor	Karman vortex type
	Barometric pressure sensor	Semiconductor type
	Intake air temperature sensor	Thermistor type
	Engine coolant temperature sensor	Thermistor type
	Oxygen sensor	Zirconia type
	Vehicle speed sensor	Magnetic resistive element type
	Inhibitor switch	Contact switch type
	Camshaft position sensor	Hall element type
	Crank angle sensor	Hall element type
	Detonation sensor	Piezoelectric type
	Power steering fluid pressure switch	Contact switch type
Actuators	Control relay type	Contact switch type
	Fuel pump relay type	Contact switch type
	Injector type and number	Electromagnetic type, 4
	Injector identification mark	CDH275
	EGR control solenoid valve	Duty cycle type solenoid valve
	Purge control solenoid valve	ON/OFF type solenoid valve
Fuel pressure regulator	Regulator pressure kPa	329

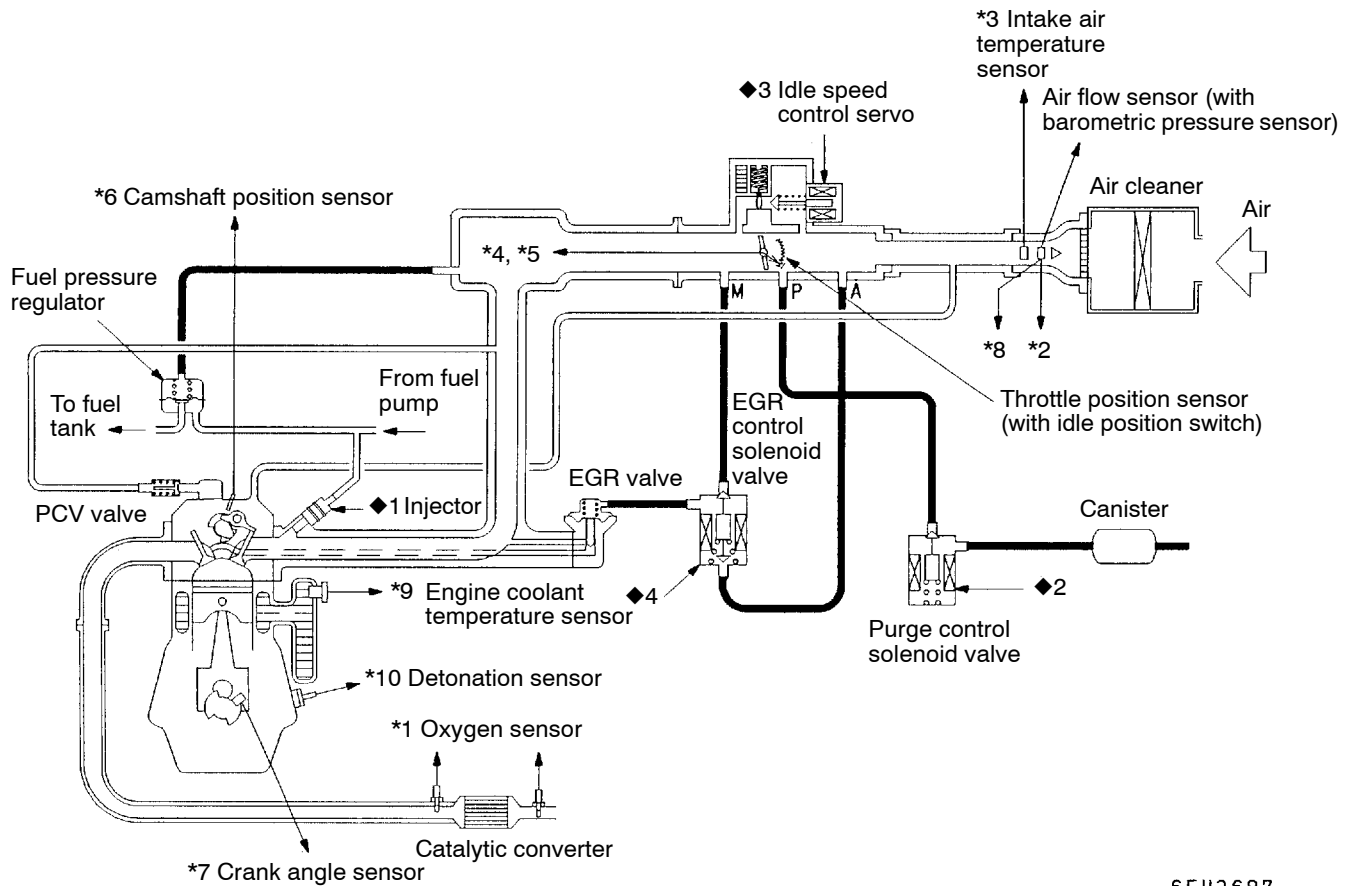
## MULTIPOINT FUEL INJECTION SYSTEM DIAGRAM

- \*1 Oxygen sensor (front)
  - \*2 Air flow sensor
  - \*3 Intake air temperature sensor
  - \*4 Throttle position sensor
  - \*5 Idle position switch
  - \*6 Camshaft position sensor
  - \*7 Crank angle sensor
  - \*8 Barometric pressure sensor
  - \*9 Engine coolant temperature sensor
  - \*10 Detonation sensor
  - \*11 Oxygen sensor (rear)
- 
- Power supply voltage
  - Vehicle speed sensor
  - A/C switch 1, 2
  - Inhibitor switch
  - Power steering fluid pressure switch
  - Ignition switch - ST
  - Ignition switch - IG
  - Alternator FR terminal
  - A/T-ECU

⇒ Engine-ECU ⇒

- ◆1 Injector
- ◆2 Purge control solenoid valve
- ◆3 Idle speed control servo
- ◆4 EGR control solenoid valve

- 
- Fuel pump relay
  - Control relay
  - A/C power relay
  - Engine warning lamp
  - Diagnosis signal
  - Ignition coil, power transistor
  - Fan controller
  - Alternator G terminal
  - A/T-ECU



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## SERVICE SPECIFICATIONS

13100030339

Items		Specifications
Basic idle speed r/min		750±50
Throttle position sensor adjusting voltage mV		400 - 1,000
Throttle position sensor resistance kΩ		3.5 - 6.5
Idle speed control servo coil resistance Ω		28 - 33 (at 20°C)
Intake air temperature sensor resistance kΩ	20°C	2.3 - 3.0
	80°C	0.30 - 0.42
Engine coolant temperature sensor resistance kΩ	20°C	2.1 - 2.7
	80°C	0.26 - 0.36
Oxygen sensor output voltage V		0.6 - 1.0
Fuel pressure kPa	Vacuum hose disconnection	324 - 343 at kerb idle
	Vacuum hose connection	Approx. 265 at kerb idle
Injector coil resistance Ω		13 - 16 (at 20°C)

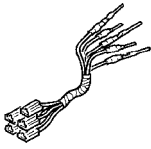
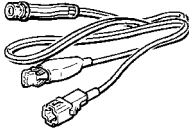
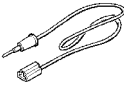

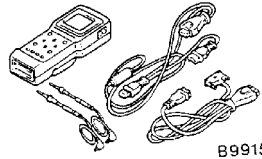
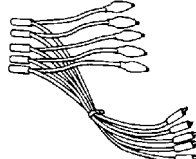
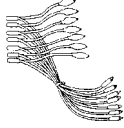

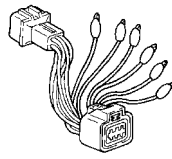
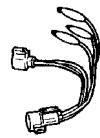
## SEALANT

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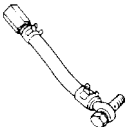

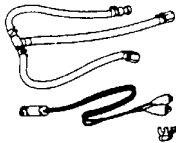
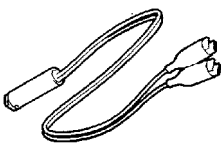
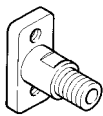
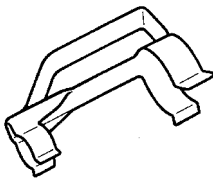
Item	Specified sealant	Remark
Engine coolant temperature sensor threaded portion	3M Nut Locking Part No. 4171 or equivalent	Drying sealant

## SPECIAL TOOLS

13100060338

Tool	Number	Name	Use
<p><b>A</b></p>  <p><b>B</b></p>  <p><b>C</b></p>  <p><b>D</b></p>  <p>C991223</p>	<p>MB991223</p> <p>A: MB991219</p> <p>B: MB991220</p> <p>C: MB991221</p> <p>D: MB991222</p>	<p>Harness set</p> <p>A: Test harness</p> <p>B: LED harness</p> <p>C: LED harness adapter</p> <p>D: Probe</p>	<ul style="list-style-type: none"> <li>Fuel gauge simple inspection</li> <li>Connector pin contact pressure inspection</li> <li>Power circuit inspection</li> <li>Power circuit inspection</li> <li>Commercial tester connection</li> </ul>
 <p>B991502</p>	MB991502	MUT-II sub assembly	<ul style="list-style-type: none"> <li>Reading diagnosis code</li> <li>MPI system inspection</li> </ul>
	MB991348	Test harness set	<ul style="list-style-type: none"> <li>Measurement of voltage during troubleshooting</li> <li>Inspection using an analyzer</li> </ul>
 <p>MB991709</p>	MB991709	Test harness	
	MB991519	Alternator harness connector	Measurement of voltage during troubleshooting
	MD998463	Test harness (6-pin, square)	<ul style="list-style-type: none"> <li>Inspection of idle speed control servo</li> <li>Inspection using an analyzer</li> </ul>
	MD998478	Test harness (3-pin, triangle)	<ul style="list-style-type: none"> <li>Measurement of voltage during troubleshooting</li> <li>Inspection using an analyzer</li> </ul>



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

## TROUBLESHOOTING

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### DIAGNOSIS TROUBLESHOOTING FLOW

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

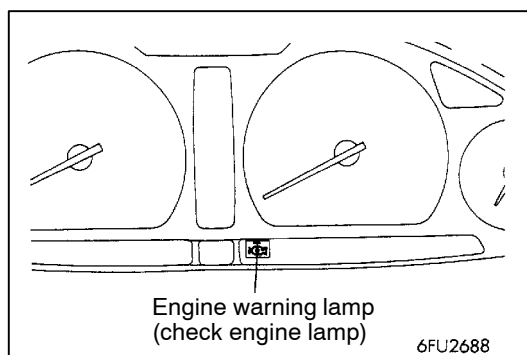
### DIAGNOSIS FUNCTION

13100860358

#### ENGINE WARNING LAMP (CHECK ENGINE LAMP)

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

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



**Engine warning lamp inspection items**

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

**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**

13100910299

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

Malfunctioning item	Control contents during malfunction
Air flow sensor	<ol style="list-style-type: none"> <li>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.</li> <li>2. Fixes the ISC servo in the appointed position so idle control is not performed.</li> </ol>
Intake air temperature sensor	Controls as if the intake air temperature is 25°C.
Throttle position sensor (TPS)	No increase in fuel injection amount during acceleration due to the throttle position sensor signal.
Engine coolant temperature sensor	Controls as if the engine coolant temperature is 80°C.
Camshaft position sensor	Injects fuel to all cylinders simultaneously. (However, after the ignition switch is turned to ON, the No. 1 cylinder top dead centre is not detected at all.)
Barometric pressure sensor	Controls as if the barometric pressure is 101 kPa.
Detonation sensor	Switches the ignition timing from ignition timing for super petrol to ignition timing for standard petrol.
Ignition coil, power transistor	Cuts off the fuel supply to cylinders with an abnormal ignition.
Oxygen sensor	Air/fuel ratio feedback control (closed loop control) is not performed.
Communication wire with transmission control unit <A/T>	Ignition timing is not retarded during transmission gear shifting (overall engine and transmission control).
Alternator FR terminal	Does not control the output of the alternator according to an electrical load. (works as a normal alternator)

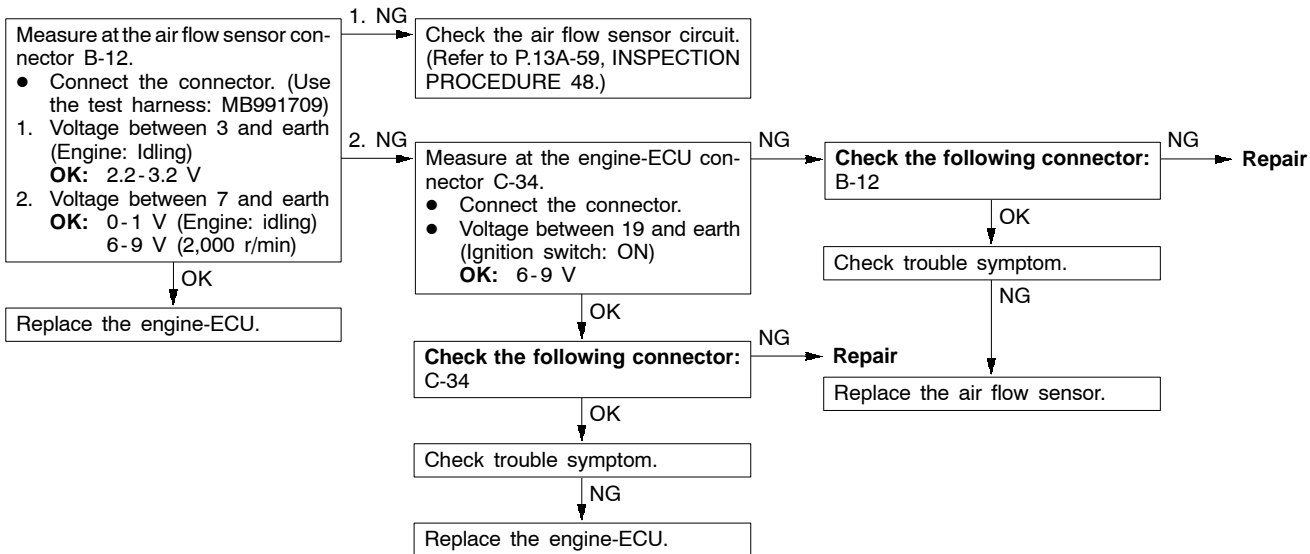
## INSPECTION CHART FOR DIAGNOSIS CODES

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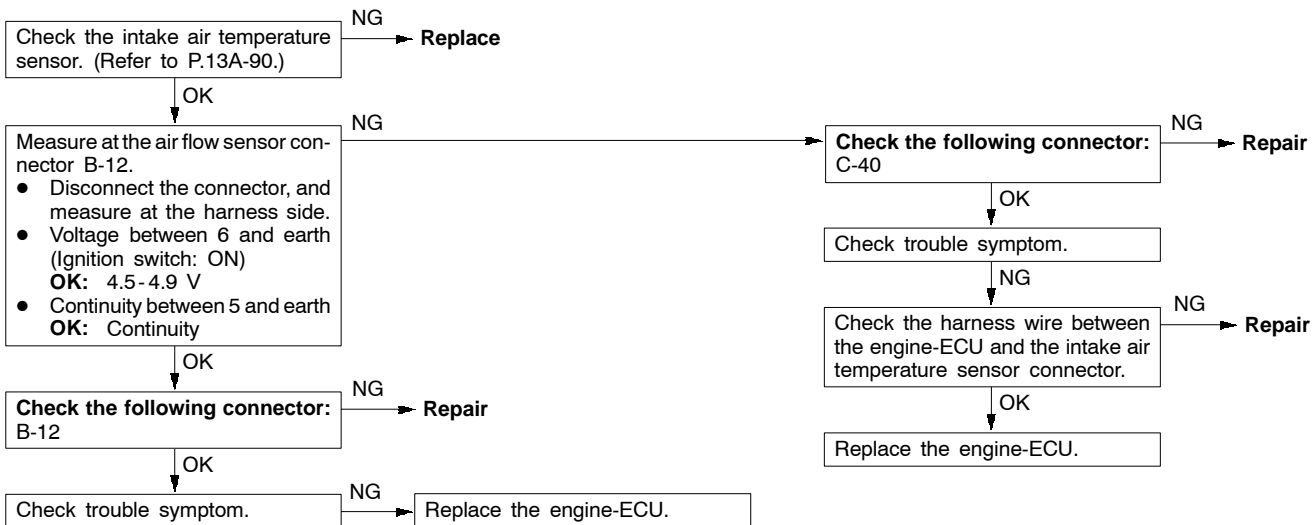
Code No.	Diagnosis item	Reference page
11	Oxygen sensor (front) system	13A-13
12	Air flow sensor system	13A-14
13	Intake air temperature sensor system	13A-14
14	Throttle position sensor system	13A-15
21	Engine coolant temperature sensor system	13A-16
22	Crank angle sensor system	13A-17
23	Camshaft position sensor	13A-18
24	Vehicle speed sensor system	13A-19
25	Barometric pressure sensor system	13A-20
31	Detonation sensor system	13A-21
41	Injector system	13A-21
44	Ignition coil system	13A-22
54	Immobilizer system	13A-23
59	Oxygen sensor (rear) system	13A-24
61	Communication wire with A/T-ECU system <A/T>	13A-25
64	Alternator FR terminal system	13A-25



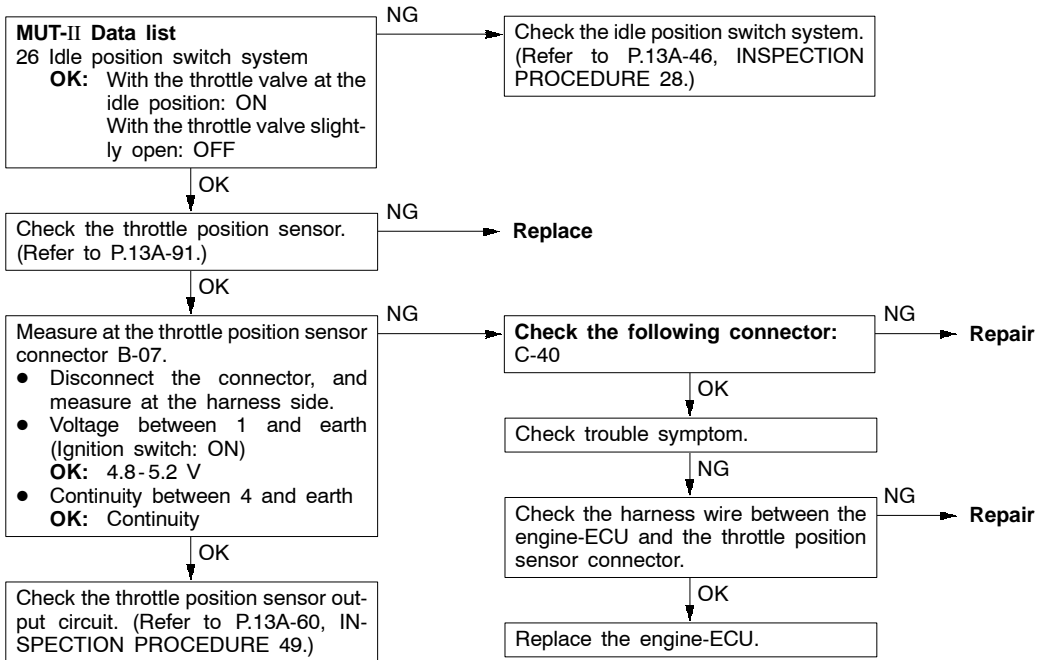
Code No. 12 Air flow sensor system	Probable cause
Range of Check <ul style="list-style-type: none"> <li>Engine speed is 500 r/min or more.</li> </ul> Set conditions <ul style="list-style-type: none"> <li>Sensor output frequency is 3 Hz or less for 4 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the air flow sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the air flow sensor</li> <li>Malfunction of the engine-ECU</li> </ul>



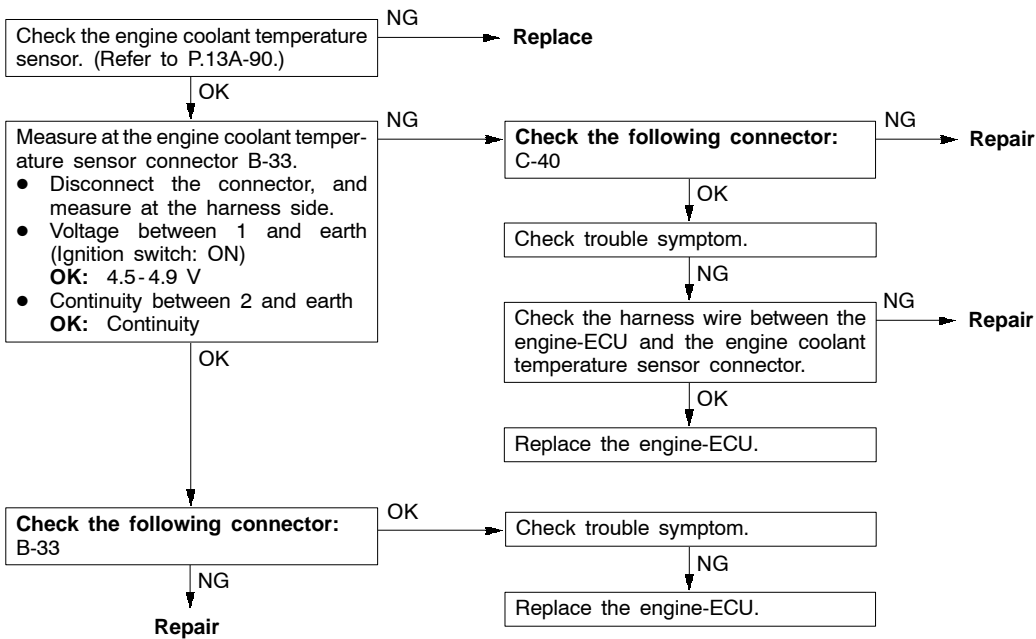
Code No. 13 Intake air temperature sensor system	Probable cause
Range of Check <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts.</li> </ul> Set conditions <ul style="list-style-type: none"> <li>Sensor output voltage is 4.6 V or more (corresponding to an intake air temperature of -45°C or less) for 4 seconds.</li> </ul> or <ul style="list-style-type: none"> <li>Sensor output voltage is 0.2V or less (corresponding to an intake air temperature of 125°C or more) for 4 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the intake air temperature sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the intake air temperature sensor circuit</li> <li>Malfunction of the engine-ECU</li> </ul>



Code No. 14 Throttle position sensor system	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts.</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>When the idle position switch is ON, the sensor output voltage is 2 V or more for 4 seconds.</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>The sensor output voltage is 0.2 V or less for 4 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the throttle position sensor or maladjustment</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the throttle position sensor circuit</li> <li>Improper "ON" state of idle position switch</li> <li>Short circuit of the idle position switch signal line</li> <li>Malfunction of the engine-ECU</li> </ul>

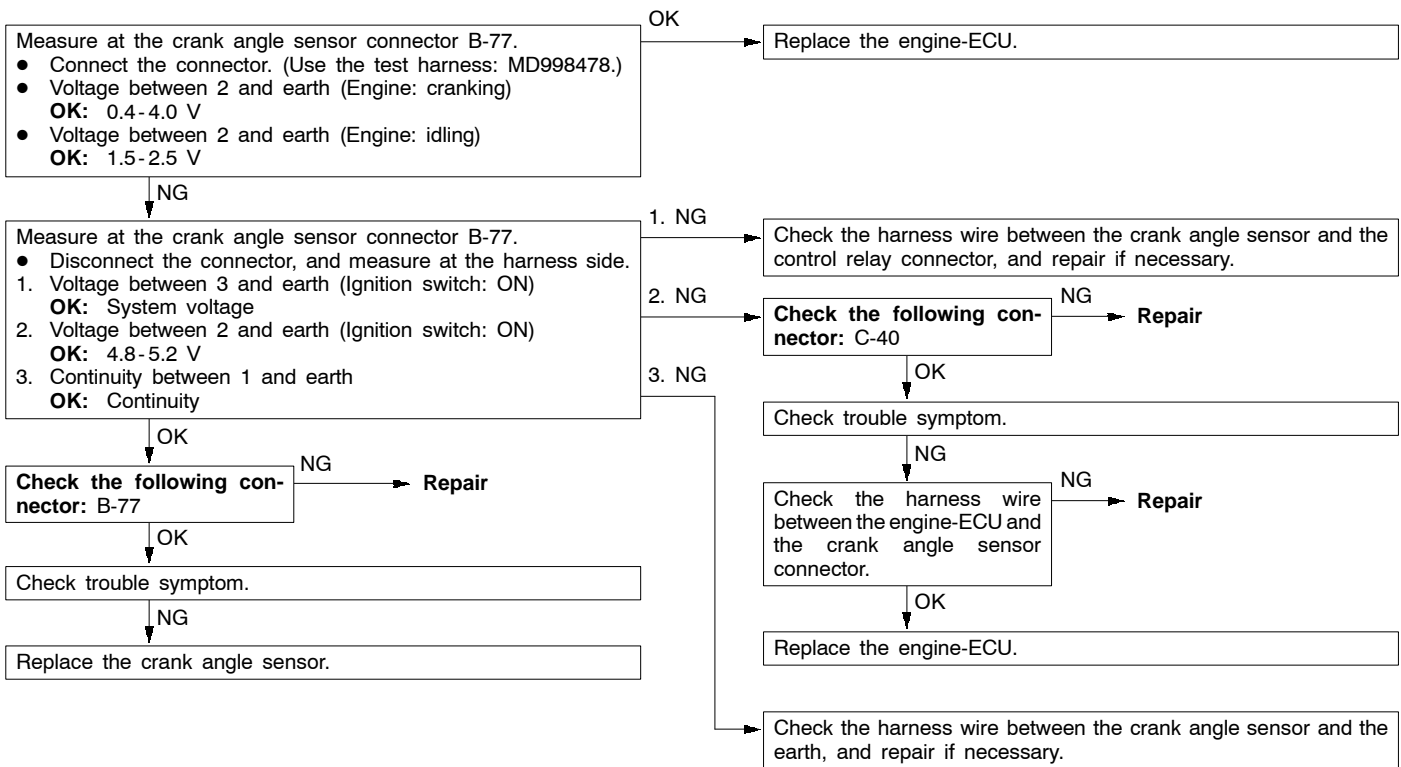


Code No. 21 Engine coolant temperature sensor system	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts.</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>Sensor output voltage is 4.6 V or more (corresponding to an engine coolant temperature of -45°C or less) for 4 seconds.</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>Sensor output voltage is 0.1 V or less (corresponding to an engine coolant temperature of 140°C or more) for 4 seconds.</li> </ul> <p>Range of Check</p> <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Engine speed is approx. 50 r/min or more</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>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).</li> <li>After this, the sensor output voltage is 1.6 V or more for 5 minutes.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the engine coolant temperature sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the engine coolant temperature sensor circuit</li> <li>Malfunction of the engine-ECU</li> </ul>

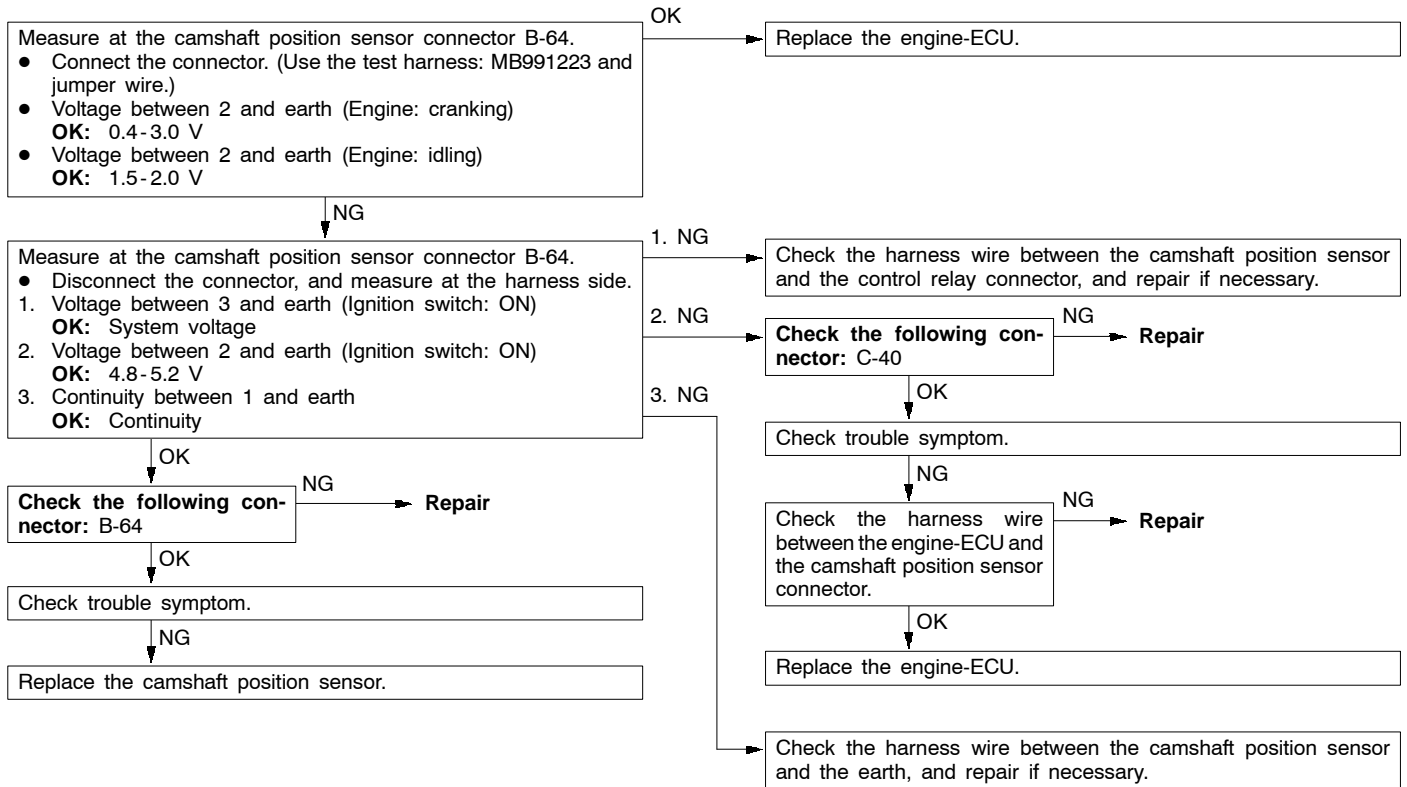




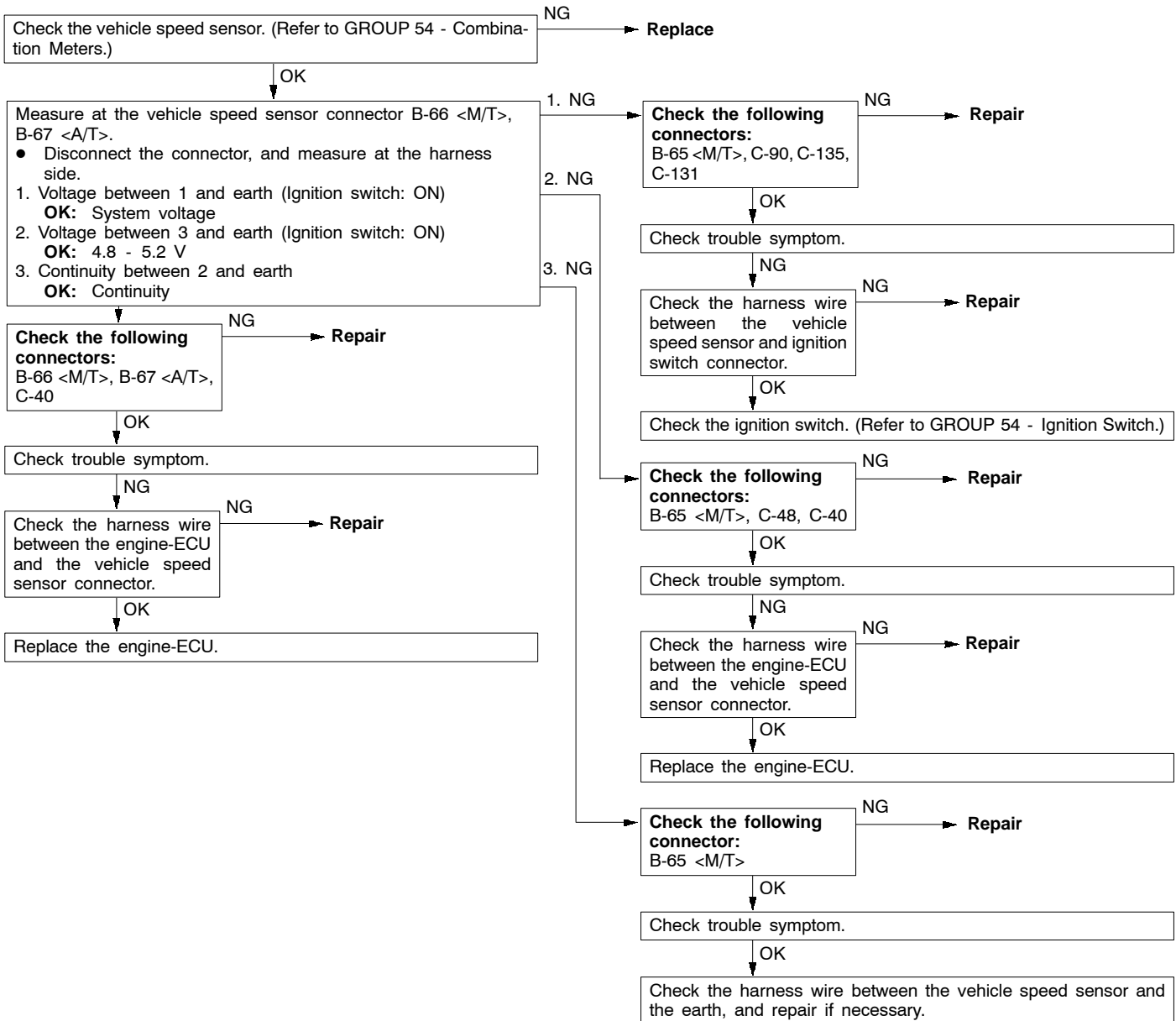
Code No. 22 Crank angle sensor system	Probable cause
Range of Check <ul style="list-style-type: none"> <li>Engine is cranking.</li> </ul> Set conditions <ul style="list-style-type: none"> <li>Sensor output voltage does not change for 4 seconds (no pulse signal input.)</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the crank angle sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the crank angle sensor</li> <li>Malfunction of the engine-ECU</li> </ul>



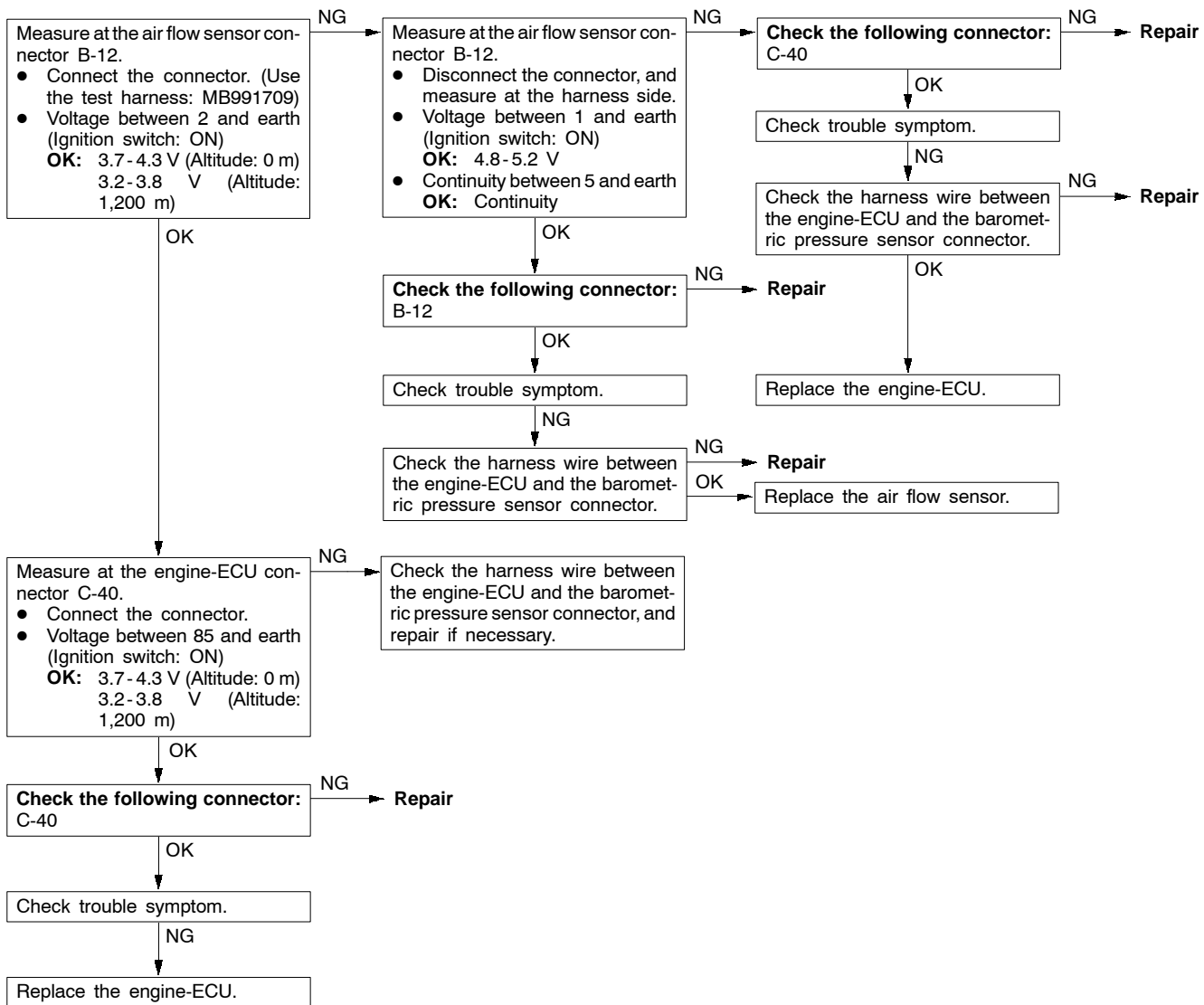
Code No. 23 Camshaft position sensor system	Probable cause
Range of Check <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Engine speed is approx. 50 r/min or more.</li> </ul> Set conditions <ul style="list-style-type: none"> <li>Sensor output voltage does not change for 4 seconds (no pulse signal input.)</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the camshaft position sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the camshaft position sensor circuit</li> <li>Malfunction of the engine-ECU</li> </ul>



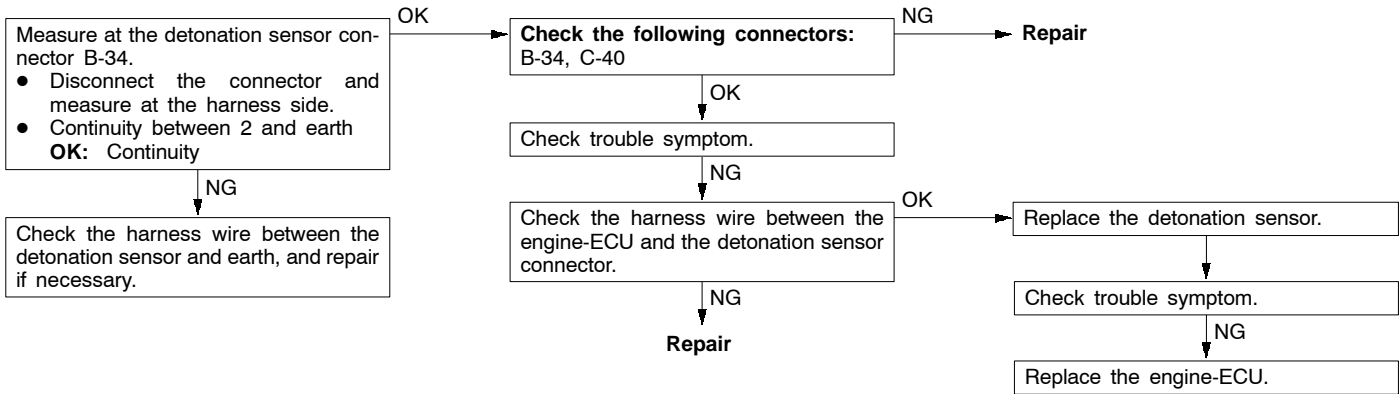
Code No. 24 Vehicles speed sensor system	Probable cause
<p>Range of check</p> <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts.</li> <li>Idle position switch: OFF</li> <li>Engine speed is 3,000 r/min or more.</li> <li>Driving under high engine load conditions.</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>Sensor output voltage does not change for 4 seconds (no pulse signal input).</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the vehicle speed sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the vehicle speed sensor circuit</li> <li>Malfunction of the engine-ECU</li> </ul>



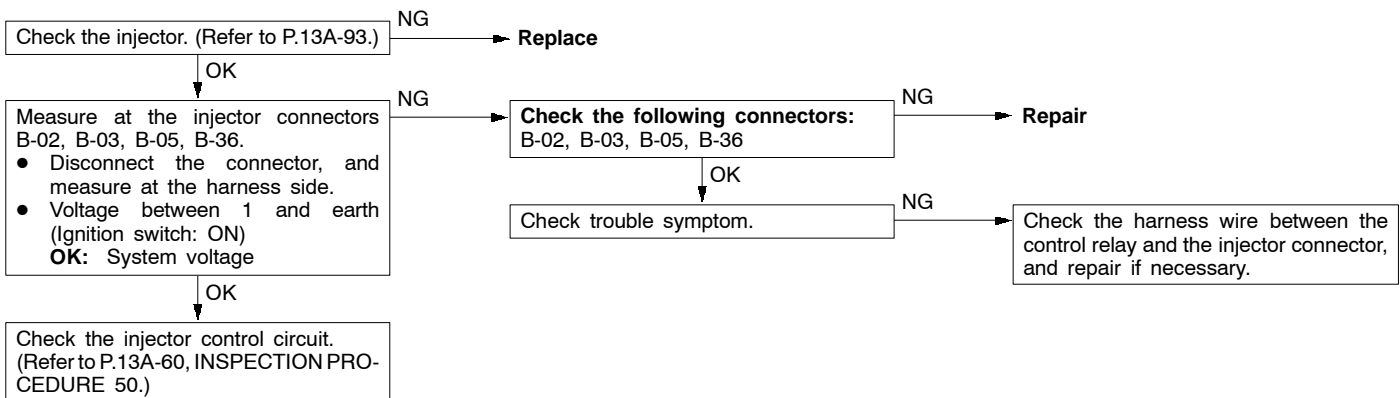
Code No. 25 Barometric pressure sensor system	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>● Ignition switch: ON</li> <li>● Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts.</li> <li>● Battery voltage is 8 V or more.</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>● Sensor output voltage is 4.5 V or more (corresponding to a barometric pressure of 114 kPa or more) for 4 seconds.</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>● Sensor output voltage is 0.2 V or less (corresponding to a barometric pressure of 5.33 kPa or less) for 4 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>● Malfunction of the barometric pressure sensor</li> <li>● Improper connector contact, open circuit or short-circuited harness wire of the barometric pressure sensor circuit</li> <li>● Malfunction of the engine-ECU</li> </ul>



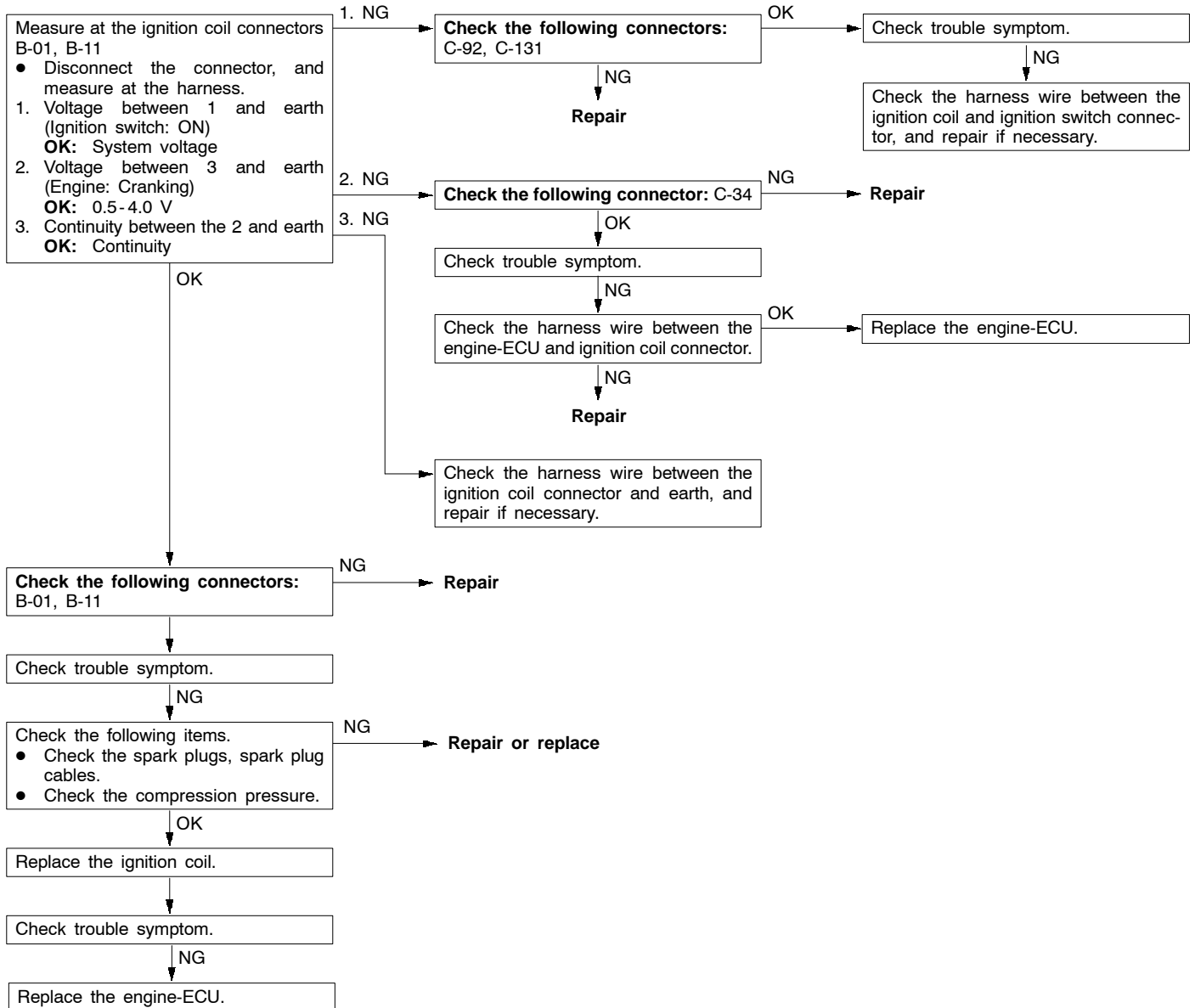
Code No. 31 Detonation sensor system	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>Ignition switch: ON</li> <li>Excluding 60 seconds after the ignition switch is turned to ON or immediately after the engine starts.</li> <li>Engine speed is approx. 5,000 r/min or more</li> </ul> <p>Set conditions</p> <p>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.</p>	<ul style="list-style-type: none"> <li>Malfunction of the detonation sensor</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the detonation sensor circuit</li> <li>Malfunction of the engine-ECU</li> </ul>



Code No. 41 Injector system	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>Engine speed is approx. 50-1,000 r/min</li> <li>The throttle position sensor output voltage is 1.15 V or less.</li> <li>Actuator test by MUT-II is not carried out.</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>Surge voltage of injector coil is not detected for 4 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the injector</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the injector circuit</li> <li>Malfunction of the engine-ECU</li> </ul>



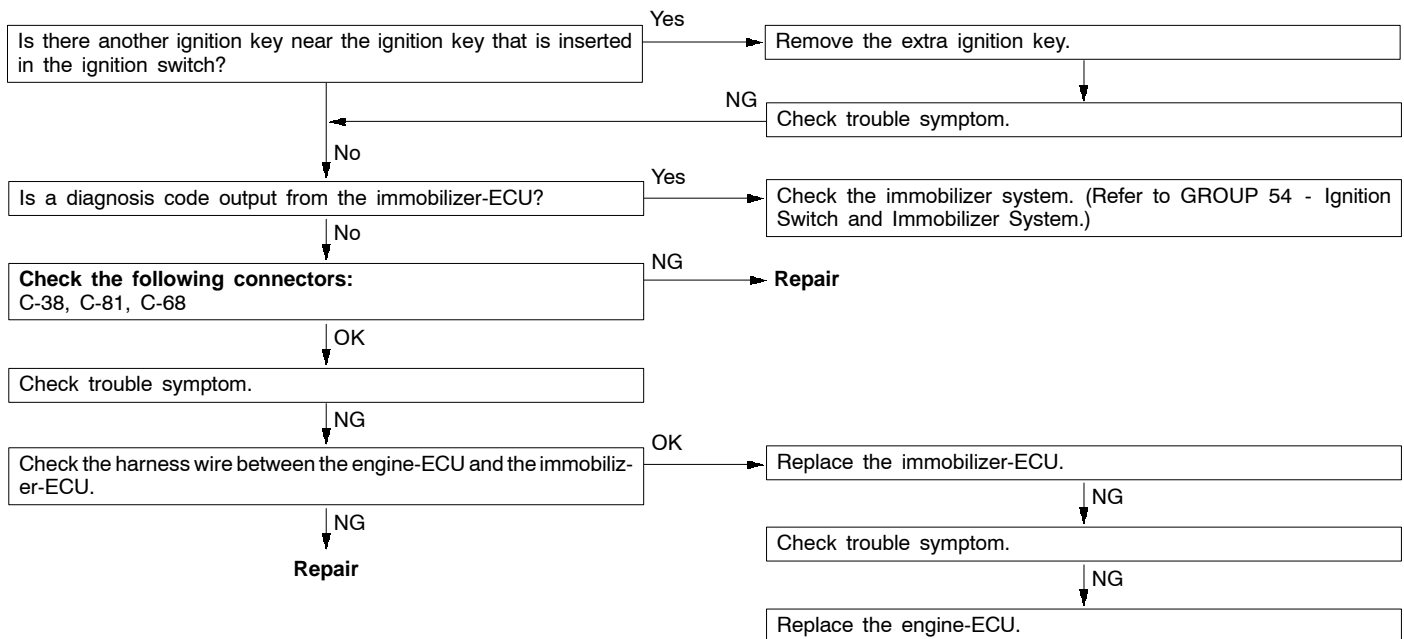
Code No. 44 Ignition coil system	Probable cause
Range of Check <ul style="list-style-type: none"> <li>Engine speed is approx. 50-4,000 r/min</li> <li>Excluding deceleration driving and sudden acceleration or deceleration driving</li> </ul> Set conditions <ul style="list-style-type: none"> <li>Misfire occurs in No.1 and No.4 cylinders or No.2 and No.3 cylinders more than predetermined times per 1,000 r/min.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the ignition coil</li> <li>Improper connector contact, open circuit or short-circuited harness wire of the ignition primary circuit</li> <li>Malfunction of the spark plug and spark plug cable</li> <li>Improper compression pressure</li> <li>Malfunction of the engine-ECU</li> </ul>



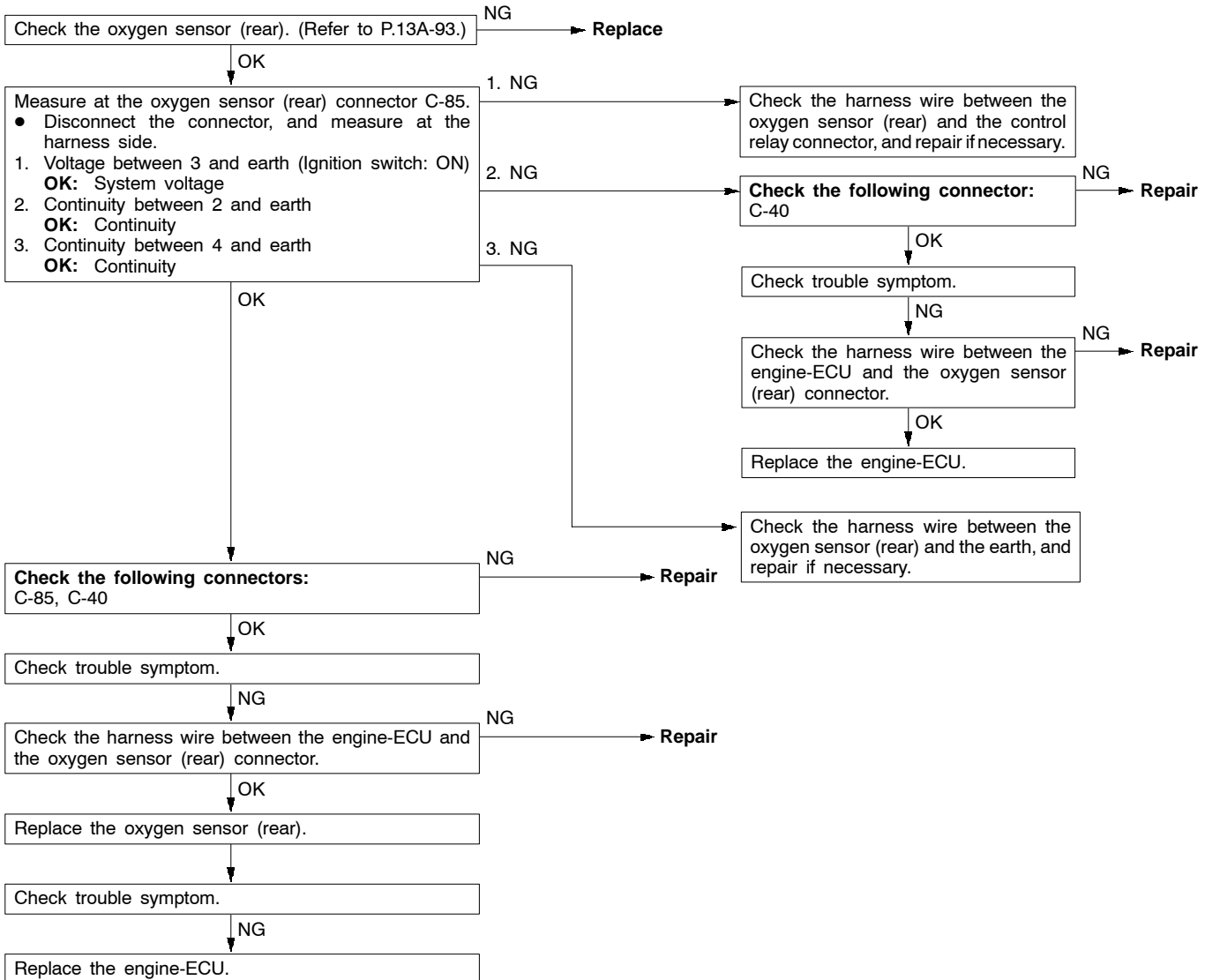
Code No.54 Immobilizer system	Probable cause
Range of Check <ul style="list-style-type: none"> <li>Ignition switch: ON</li> </ul> Set Conditions <ul style="list-style-type: none"> <li>Improper communication between the engine-ECU and immobilizer-ECU</li> </ul>	<ul style="list-style-type: none"> <li>Radio interference of ID codes</li> <li>Incorrect ID code</li> <li>Malfunction of harness or connector</li> <li>Malfunction of immobilizer-ECU</li> <li>Malfunction of engine-ECU</li> </ul>

## 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.

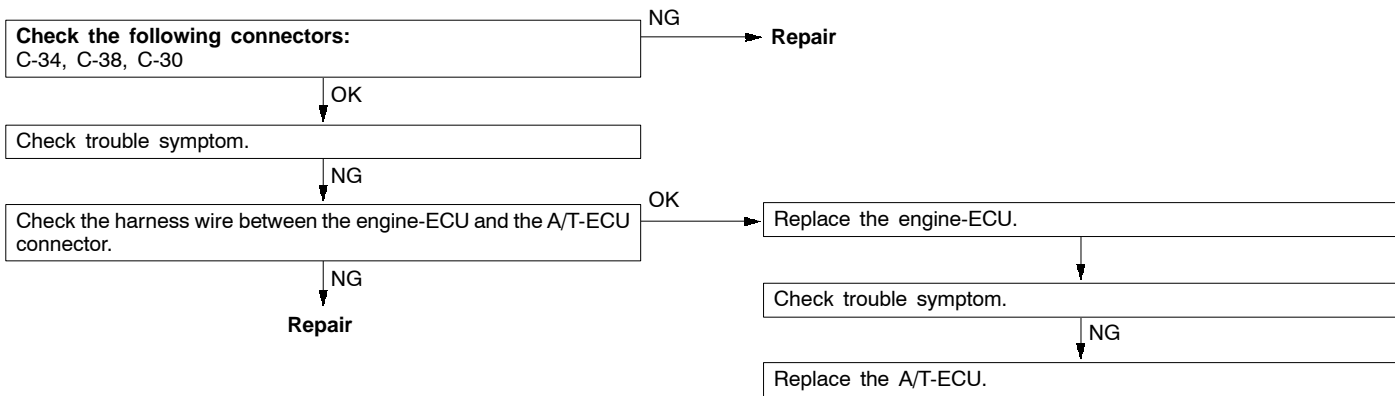


Code No. 59 Oxygen sensor (rear) system	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>3 minutes have passed after engine was started.</li> <li>Engine coolant temperature is approx. 80°C or more.</li> <li>Idle position switch: OFF</li> <li>The throttle position sensor output voltage is 4.1 V or more.</li> <li>Open loop control in operation</li> <li>20 seconds have passed after deceleration finished.</li> </ul> <p>Set conditions</p> <ul style="list-style-type: none"> <li>The oxygen sensor (rear) output voltage is 0.1 V or less.</li> <li>The difference in the maximum and minimum values for the oxygen sensor (rear) output voltage is 0.08 V or less.</li> <li>The oxygen sensor (rear) output voltage is 0.5 V or more.</li> <li>The above conditions continue for a continuous period of 5 seconds.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the oxygen sensor (rear)</li> <li>Improper connector contact, open circuit or short-circuited harness wire</li> <li>Malfunction of the engine-ECU</li> </ul>

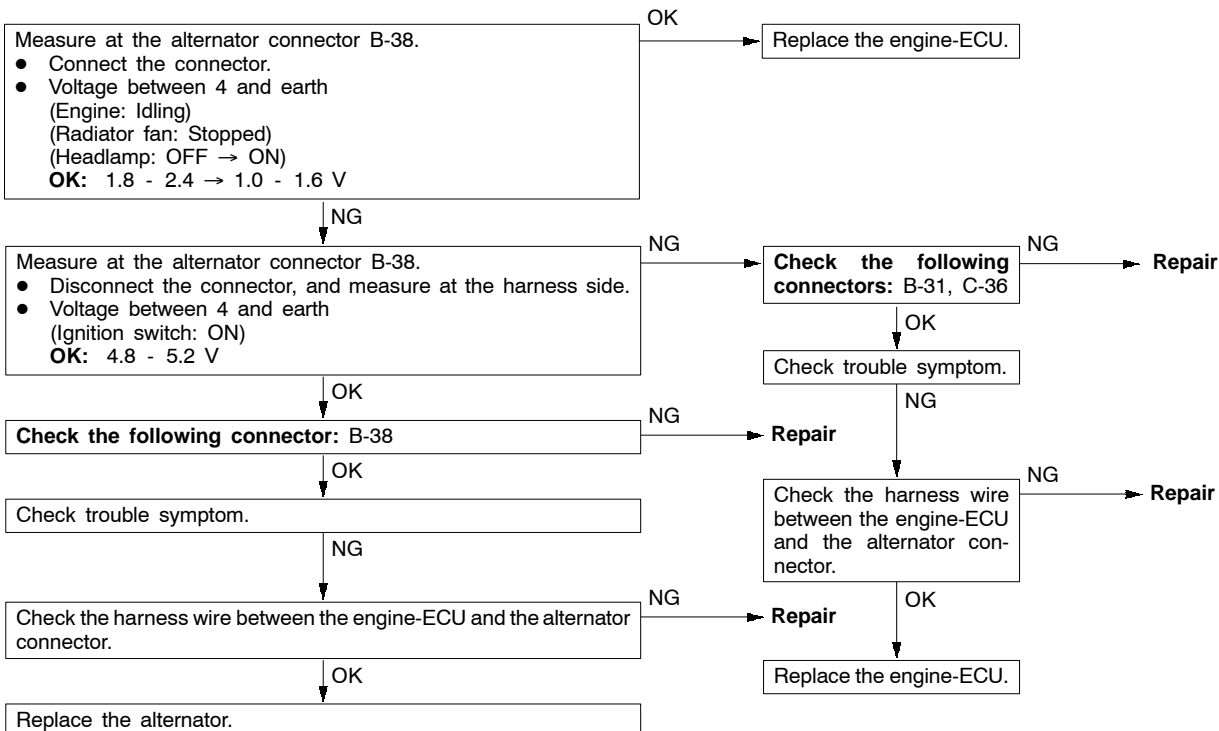




Code No. 61 Communication wire with A/T-ECU system <A/T>	Probable cause
<p>Range of Check</p> <ul style="list-style-type: none"> <li>60 seconds or more have passed immediately after engine was started.</li> <li>Engine speed is approx. 50 r/min or more</li> </ul> <p>Set conditions</p> <p>The voltage of the torque reduction request signal from the A/T-ECU is LOW for 1.5 seconds or more.</p>	<ul style="list-style-type: none"> <li>Malfunction of the harness wire and the connector</li> <li>Malfunction of the engine-ECU</li> <li>Malfunction of the A/T-ECU</li> </ul>



Code No. 64 Alternator FR Terminal System	Probable cause
<p>Range of Check, Set Conditions</p> <ul style="list-style-type: none"> <li>The alternator FR terminal signal voltage remains high for approximately 20 seconds while the engine is running.</li> </ul>	<ul style="list-style-type: none"> <li>Open circuit in alternator FR terminal circuit</li> <li>Malfunction of the engine-ECU</li> </ul>

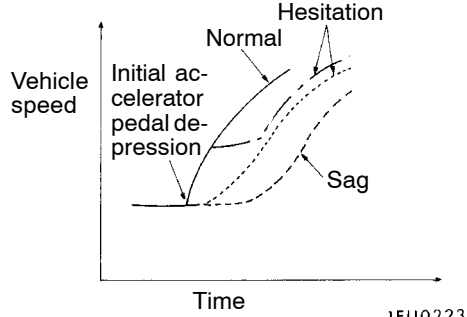
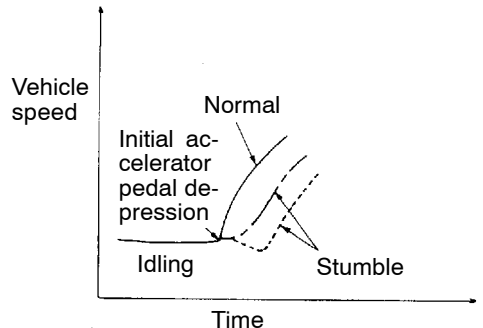


## INSPECTION CHART FOR TROUBLE SYMPTOMS

13100880354

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is impossible.	Communication with all systems is not possible.	1	13A-28
	Communication with engine-ECU only is not possible.	2	13A-29
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-30
	The engine warning lamp remains illuminating and never goes out.	4	13A-30
Starting	No initial combustion (starting impossible)	5	13A-31
	Initial combustion but no complete combustion (starting impossible)	6	13A-32
	Long time to start (improper starting)	7	13A-33
Idling stability (Improper idling)	Unstable idling (Rough idling, hunting)	8	13A-34
	Idling speed is high. (Improper idling speed)	9	13A-35
	Idling speed is low. (Improper idling speed)	10	13A-36
Idling stability (Engine stalls)	When the engine is cold, it stalls at idling. (Die out)	11	13A-37
	When the engine becomes hot, it stalls at idling. (Die out)	12	13A-38
	The engine stalls when starting the car. (Pass out)	13	13A-39
	The engine stalls when decelerating.	14	13A-39
Driving	Hesitation, sag or stumble	15	13A-40
	The feeling of impact or vibration when accelerating	16	13A-40
	The feeling of impact or vibration when decelerating	17	13A-41
	Poor acceleration	18	13A-41
	Surge	19	13A-42
	Knocking	20	13A-42
Dieseling		21	13A-42
Too high CO and HC concentration when idling		22	13A-43
Low alternator output voltage (approx. 12.3 V)		23	13A-44
Idling speed is improper when A/C is operating		24	13A-44
Fans (radiator fan, A/C condensor fan) are inoperative		25	13A-45

**PROBLEM SYMPTOMS TABLE (FOR YOUR INFORMATION)**

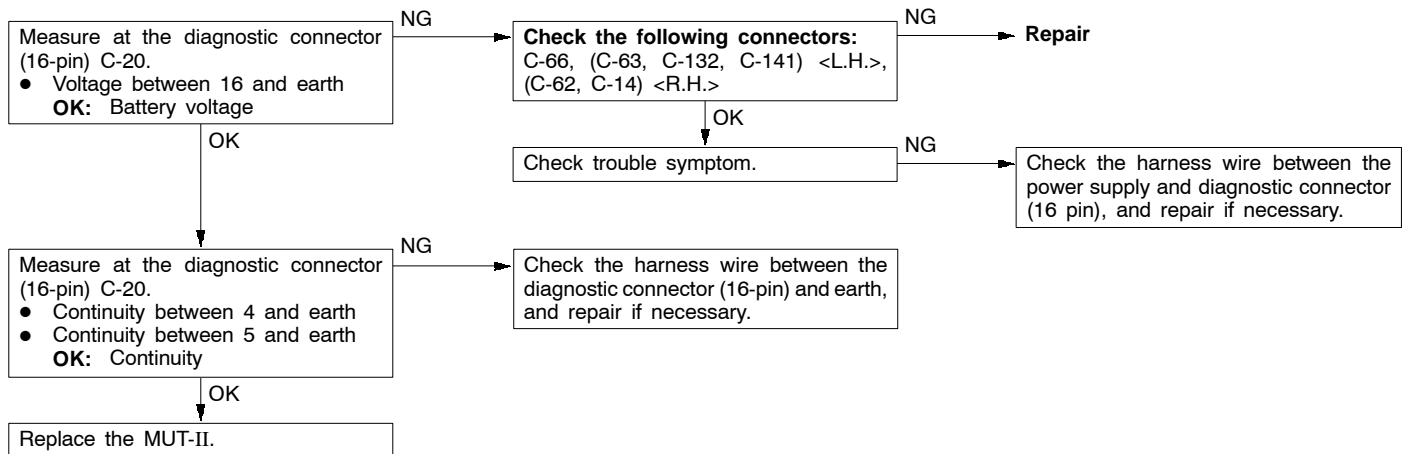
Items		Symptom
Starting	Won't start	The starter is used to crank the engine, but there is no combustion within the cylinders, and the engine won't start.
	Fires up and dies	There is combustion within the cylinders, but then the engine soon stalls.
	Hard starting	Engine starts after cranking a while.
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	<p>"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".</p>  <p style="text-align: right;">1FU0223</p>
	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	<p>Engine speed increase is delayed when the accelerator pedal is initially depressed for acceleration.</p>  <p style="text-align: right;">1FU0224</p>

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

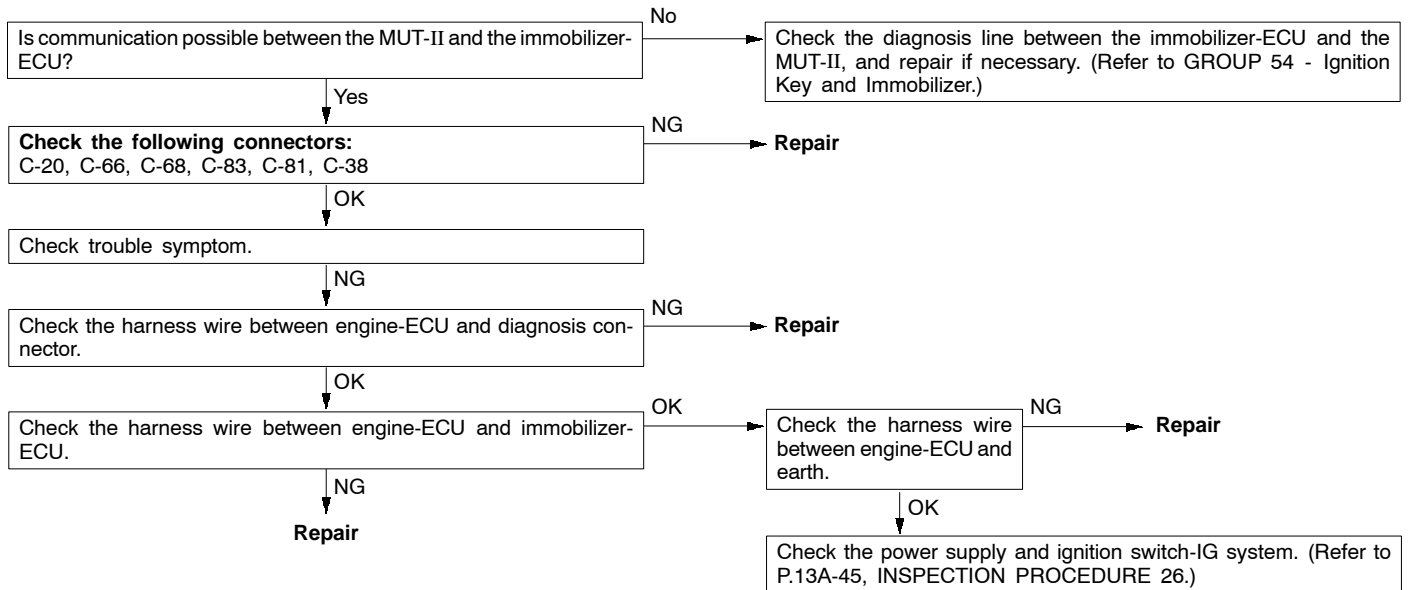
### INSPECTION PROCEDURE 1

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.	<ul style="list-style-type: none"> <li>Malfunction of the connector</li> <li>Malfunction of the harness wire</li> </ul>



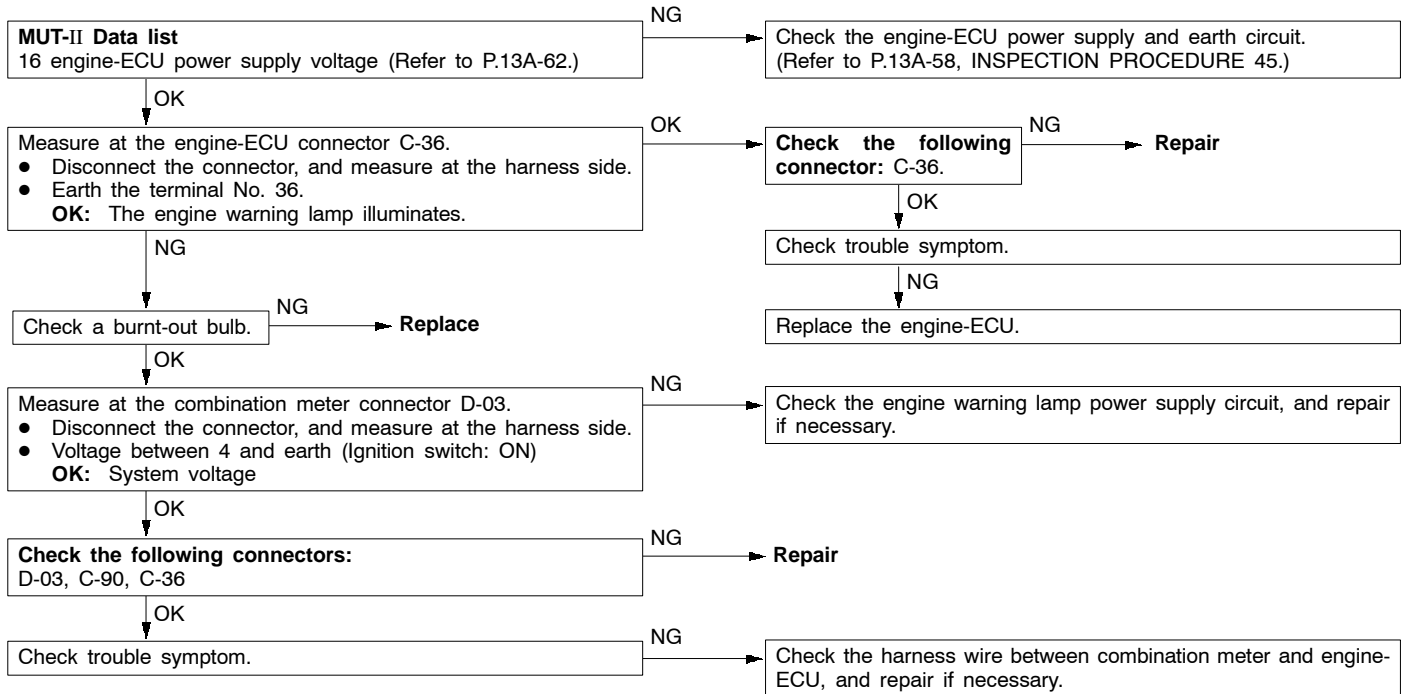
## INSPECTION PROCEDURE 2

MUT-II communication with engine-ECU is impossible.	Probable cause
One of the following causes may be suspected. <ul style="list-style-type: none"> <li>• No power supply to engine-ECU.</li> <li>• Defective earth circuit of engine-ECU.</li> <li>• Defective engine-ECU.</li> <li>• Improper communication line between engine-ECU and MUT-II</li> </ul>	<ul style="list-style-type: none"> <li>• Malfunction of engine-ECU power supply circuit</li> <li>• Malfunction of engine-ECU</li> <li>• Malfunction of immobilizer-ECU</li> <li>• Open circuit between immobilizer-ECU and diagnosis connector</li> <li>• Open circuit between engine-ECU and immobilizer-ECU</li> </ul>



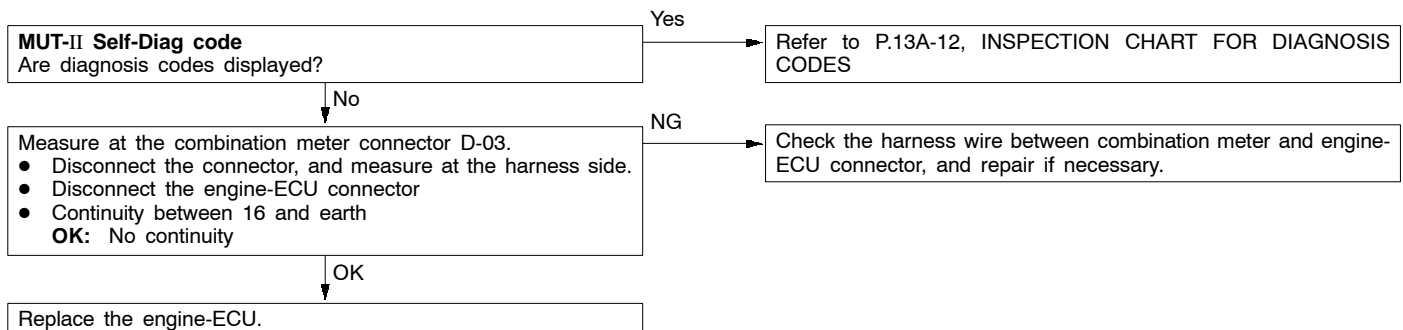
## INSPECTION PROCEDURE 3

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.	<ul style="list-style-type: none"> <li>Burnt-out bulb</li> <li>Defective warning lamp circuit</li> <li>Malfunction of the engine-ECU</li> </ul>



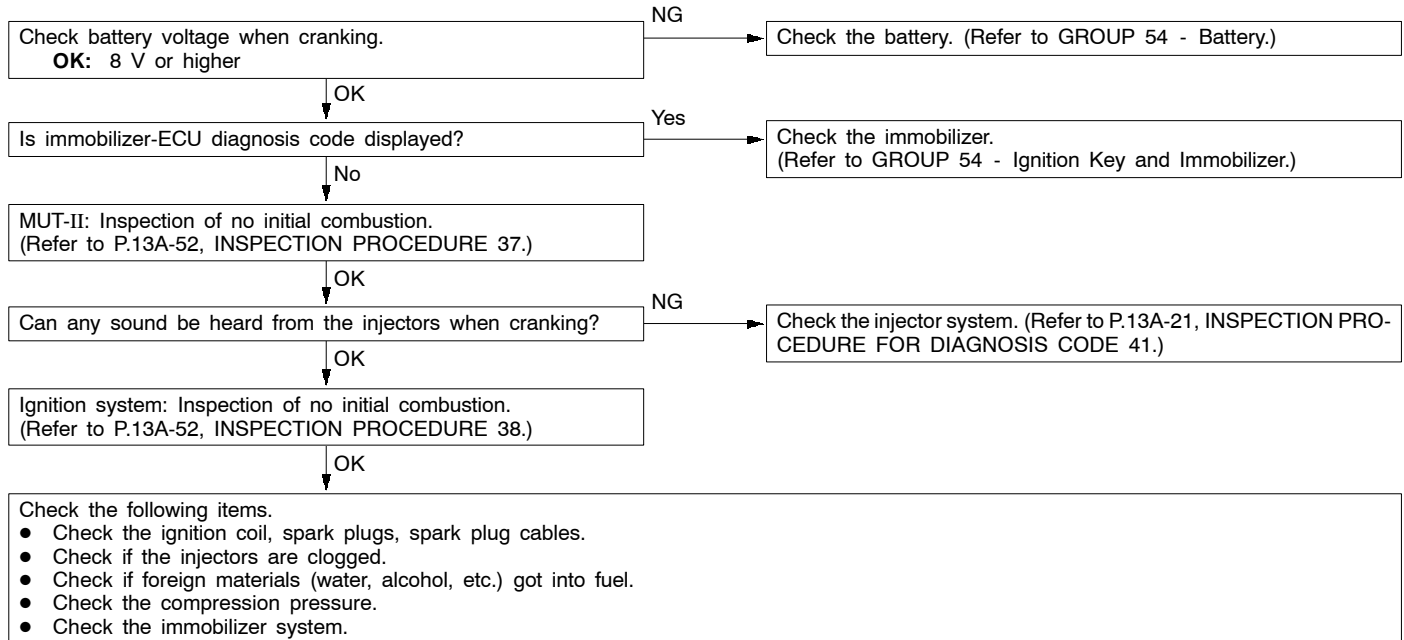
## INSPECTION PROCEDURE 4

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.	<ul style="list-style-type: none"> <li>Short-circuit between the engine warning lamp and engine-ECU</li> <li>Malfunction of the engine-ECU</li> </ul>



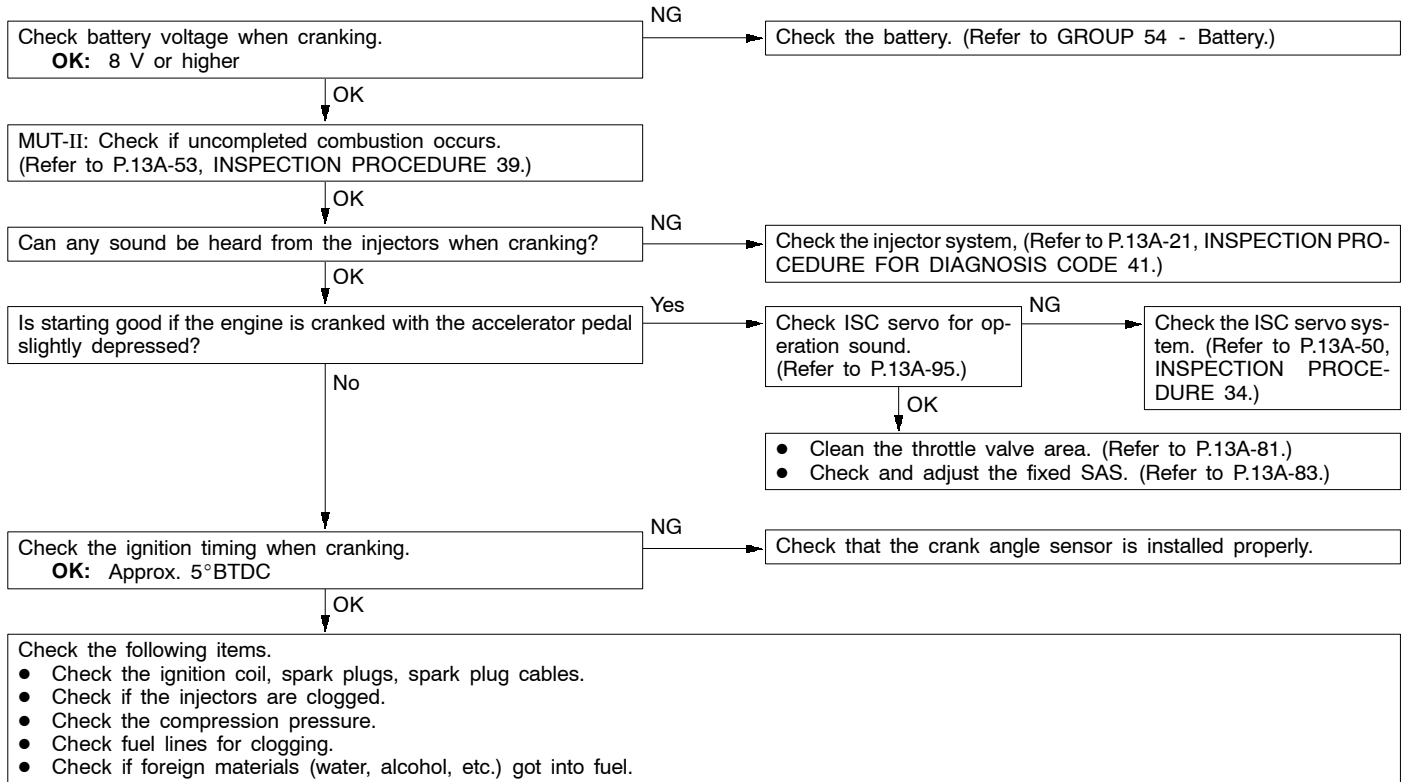
## INSPECTION PROCEDURE 5

No initial combustion (starting impossible)	Probable cause
<p>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.</p> <p>In addition, foreign materials (water, kerosene, etc.) may be mixed with the fuel.</p>	<ul style="list-style-type: none"> <li>● Malfunction of the ignition system</li> <li>● Malfunction of the fuel pump system</li> <li>● Malfunction of the injectors</li> <li>● Malfunction of the engine-ECU</li> <li>● Malfunction of the immobilizer system</li> <li>● Foreign materials in fuel</li> </ul>



## INSPECTION PROCEDURE 6

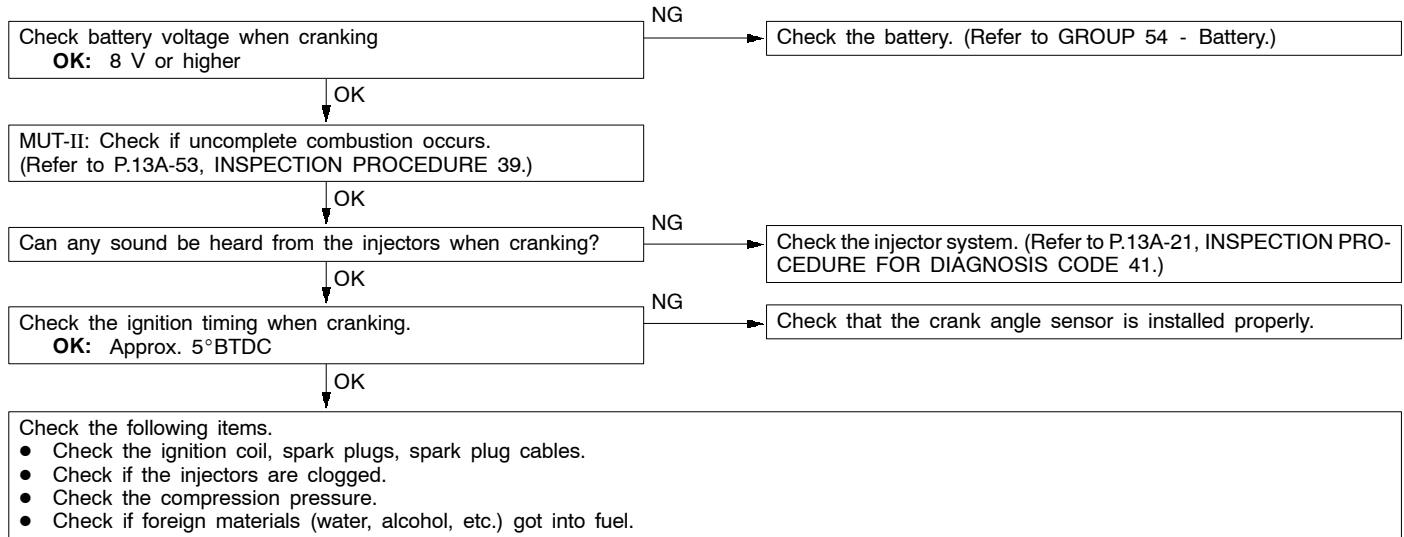
Initial combustion but no complete combustion (starting impossible)	Probable cause
In such cases as the above, the cause is probably that the spark plugs are generating sparks but the sparks are weak, or the initial mixture for starting is not appropriate.	<ul style="list-style-type: none"> <li>● Malfunction of the ignition system</li> <li>● Malfunction of the injector system</li> <li>● Foreign materials in fuel</li> <li>● Poor compression</li> <li>● Malfunction of the engine-ECU</li> </ul>





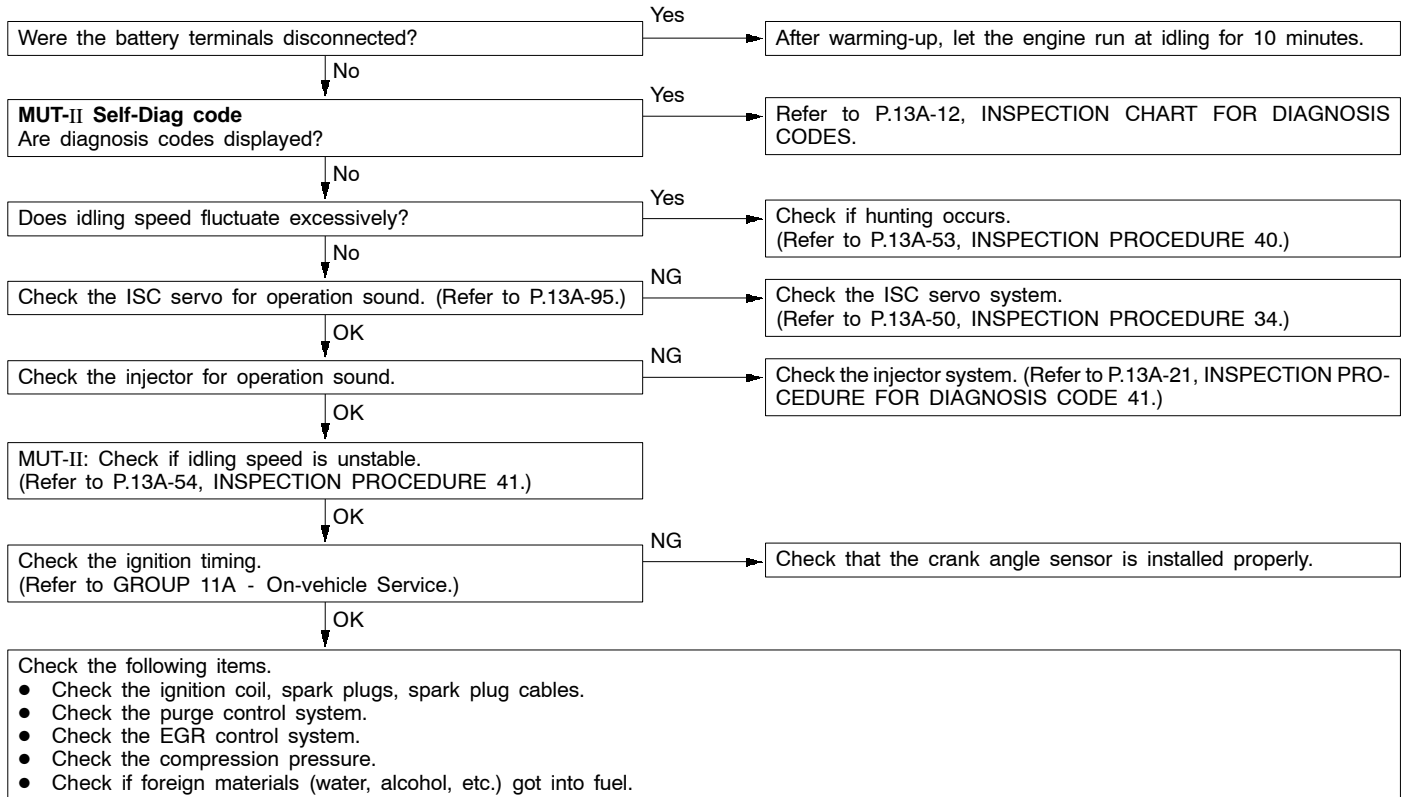
## INSPECTION PROCEDURE 7

It takes too long time to start. (Incorrect starting)	Probable cause
In cases such as the above, the cause is probably that the spark is weak and ignition is difficult, the initial mixture for starting is not appropriate, or sufficient compression pressure is not being obtained.	<ul style="list-style-type: none"> <li>• Malfunction of the ignition system</li> <li>• Malfunction of the injector system</li> <li>• Inappropriate gasoline use</li> <li>• Poor compression</li> </ul>



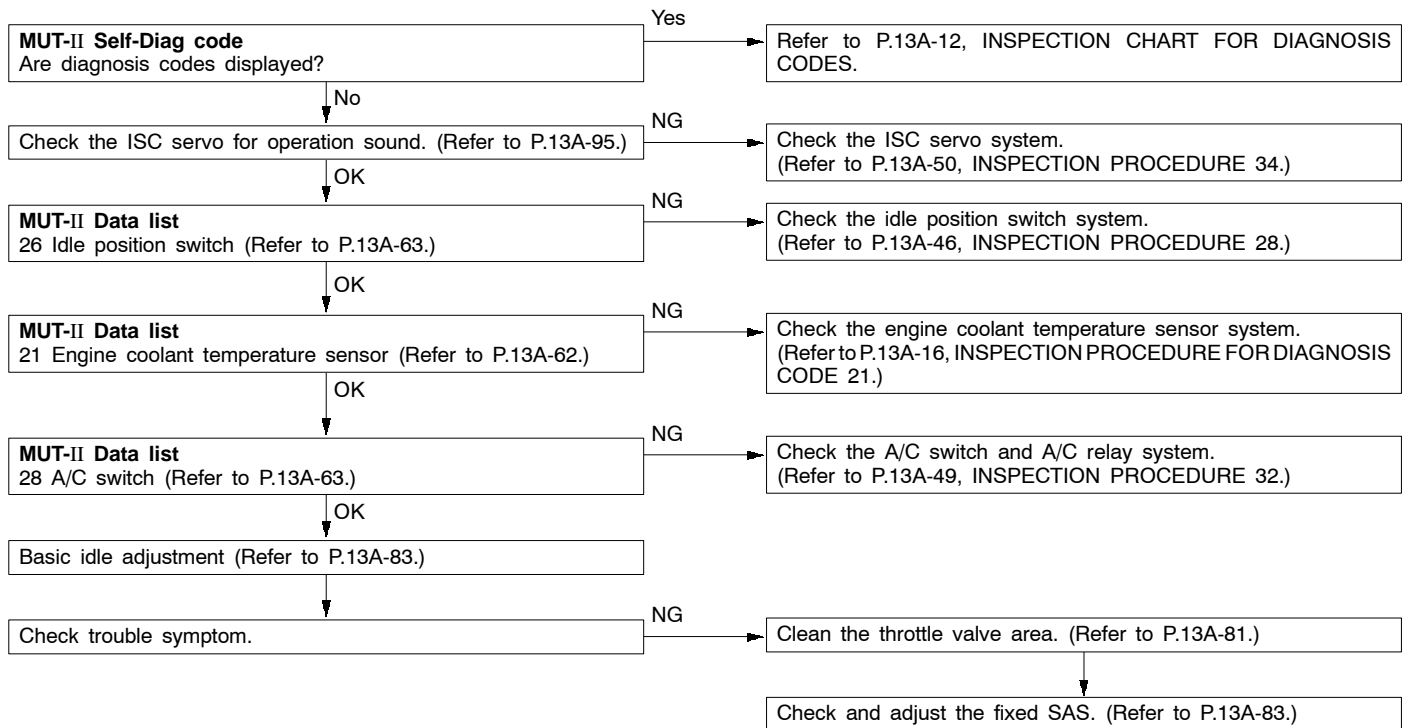
## INSPECTION PROCEDURE 8

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.	<ul style="list-style-type: none"> <li>● Malfunction of the ignition system</li> <li>● Malfunction of air-fuel ratio control system</li> <li>● Malfunction of the ISC system</li> <li>● Malfunction of the purge control solenoid valve system</li> <li>● Malfunction of the EGR solenoid valve system</li> <li>● Poor compression</li> <li>● Drawing air into exhaust system</li> </ul>



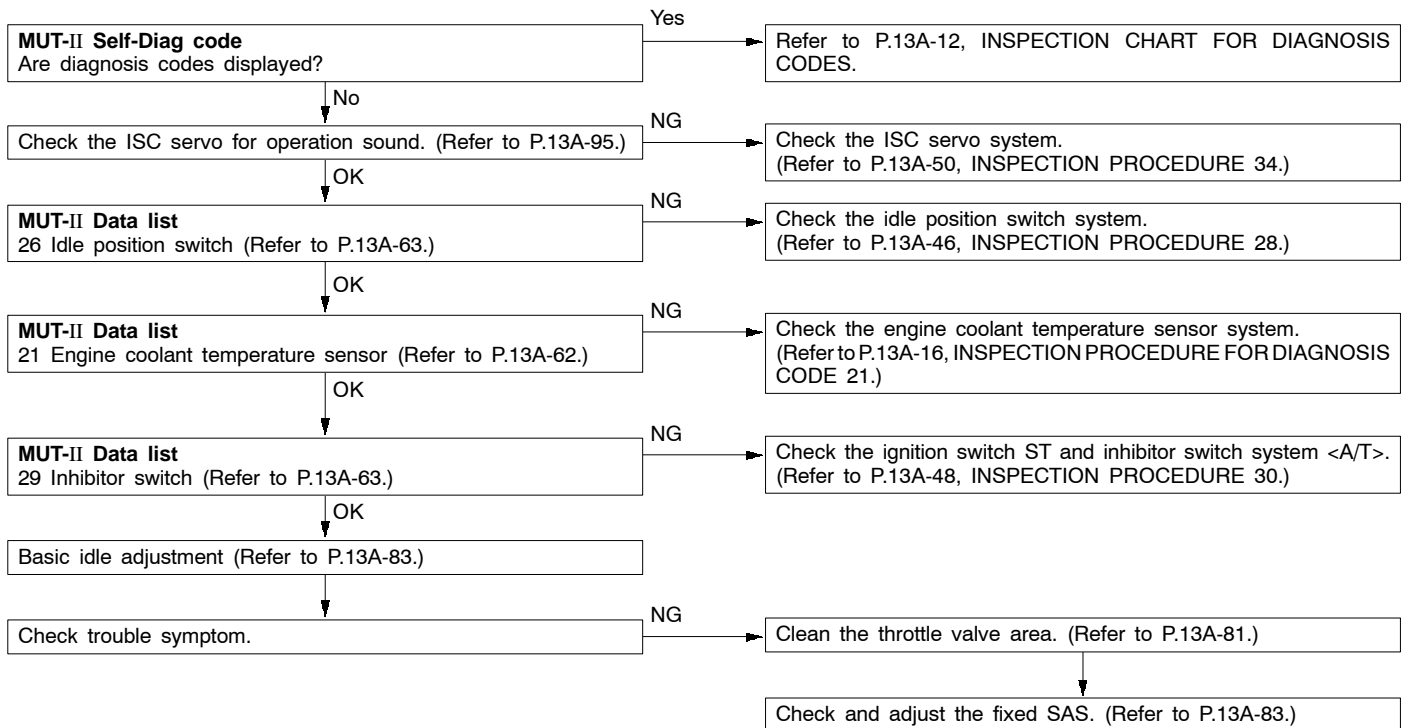
## INSPECTION PROCEDURE 9

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.	<ul style="list-style-type: none"> <li>• Malfunction of the ISC servo system</li> <li>• Malfunction of the throttle body</li> </ul>



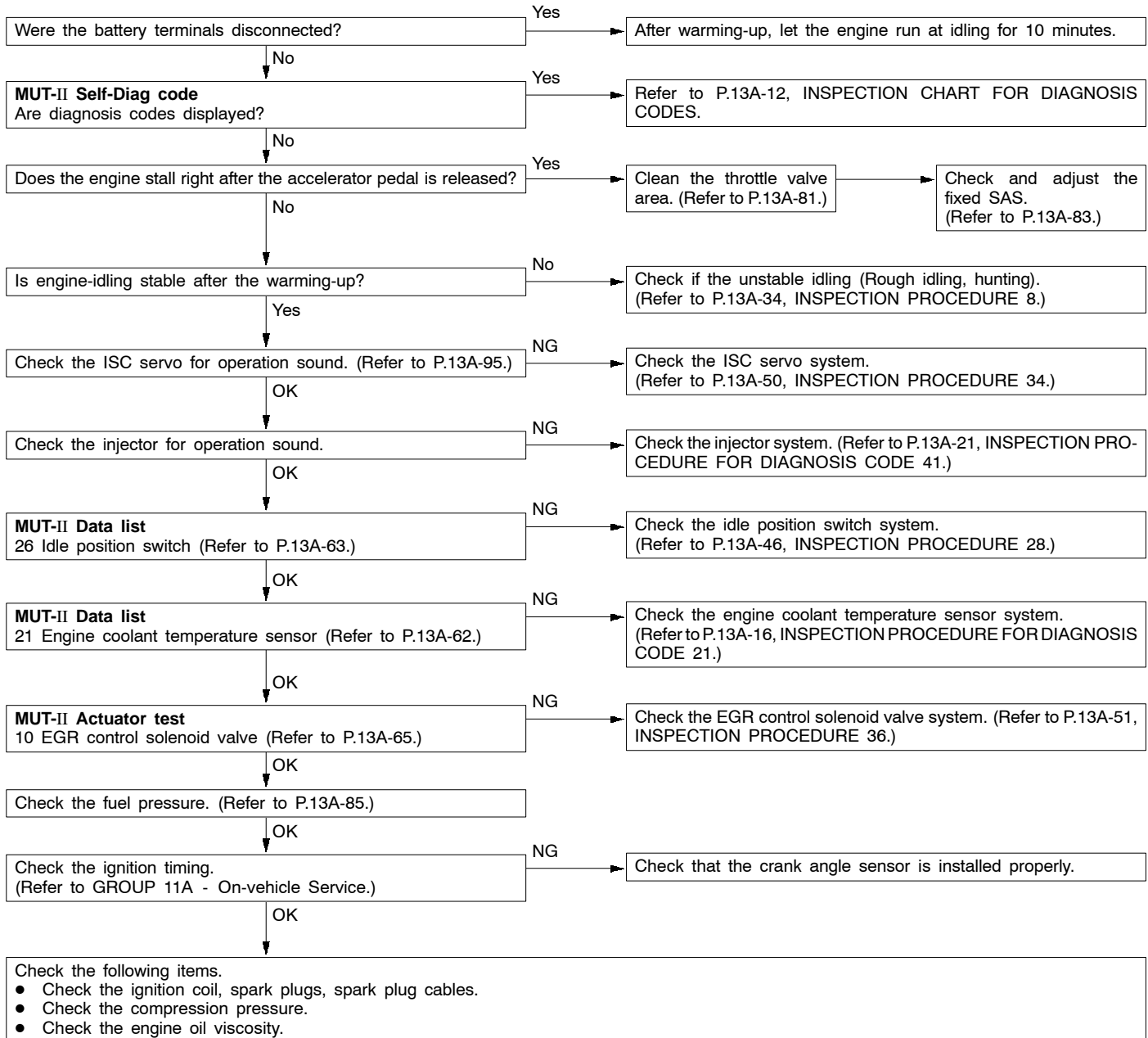
## INSPECTION PROCEDURE 10

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.	<ul style="list-style-type: none"> <li>• Malfunction of the ISC servo system</li> <li>• Malfunction of the throttle body</li> </ul>



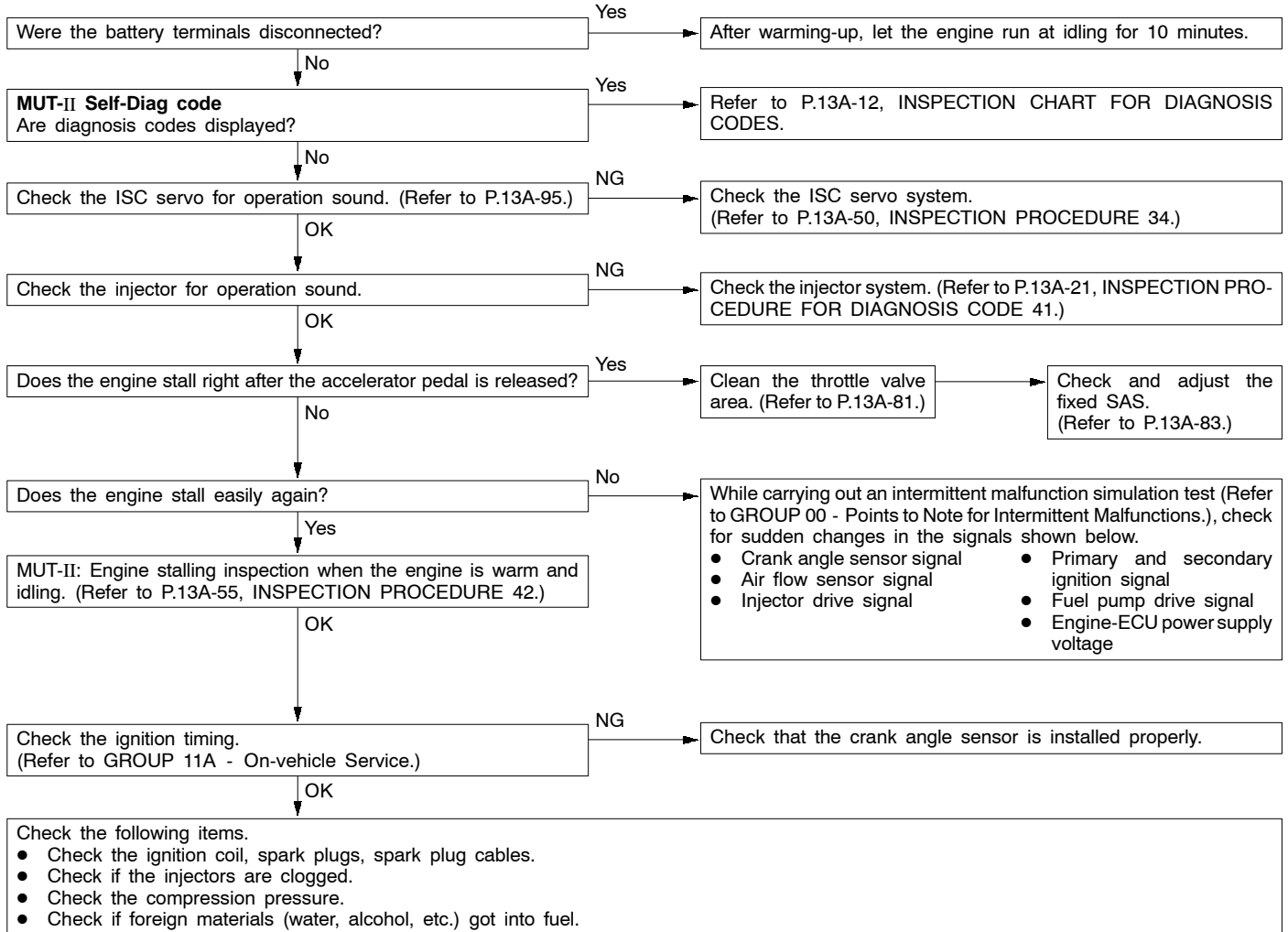
## INSPECTION PROCEDURE 11

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.	<ul style="list-style-type: none"> <li>• Malfunction of the ISC servo system</li> <li>• Malfunction of the throttle body</li> <li>• Malfunction of the injector system</li> <li>• Malfunction of the ignition system</li> </ul>



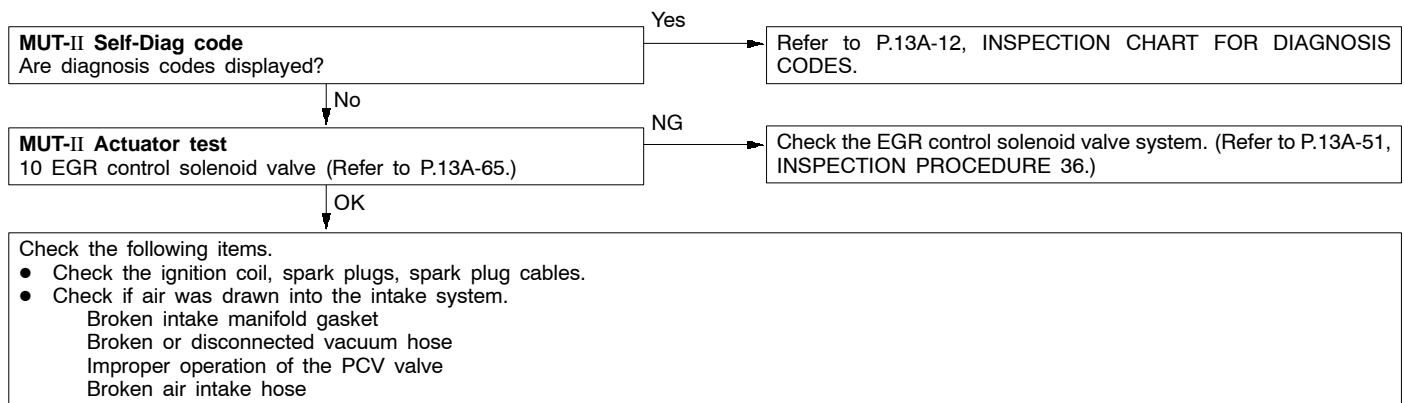
## INSPECTION PROCEDURE 12

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.	<ul style="list-style-type: none"> <li>● Malfunction of the ignition system</li> <li>● Malfunction of air-fuel ratio control system</li> <li>● Malfunction of the ISC system</li> <li>● Drawing air into intake system</li> <li>● Improper connector contact</li> </ul>



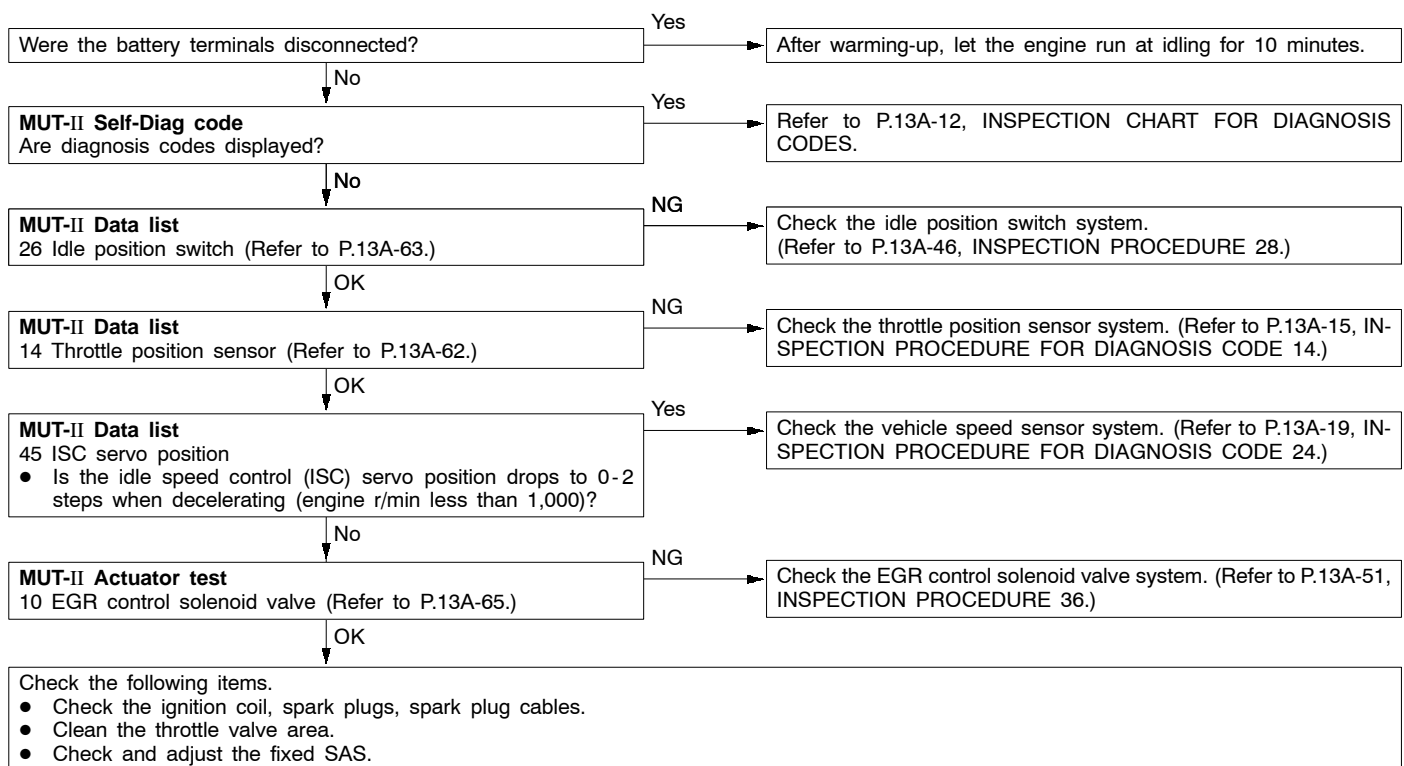
## INSPECTION PROCEDURE 13

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.	<ul style="list-style-type: none"> <li>Drawing air into intake system</li> <li>Malfunction of the ignition system</li> </ul>



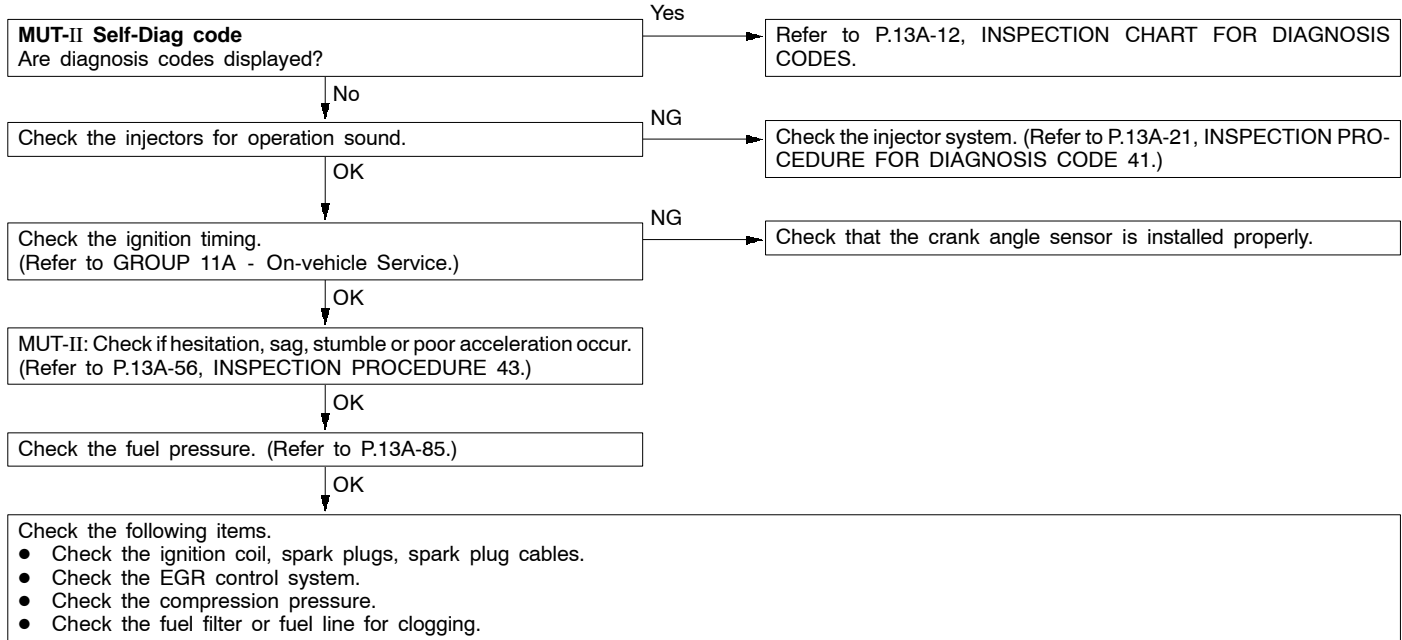
## INSPECTION PROCEDURE 14

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.	<ul style="list-style-type: none"> <li>Malfunction of the ISC system</li> </ul>



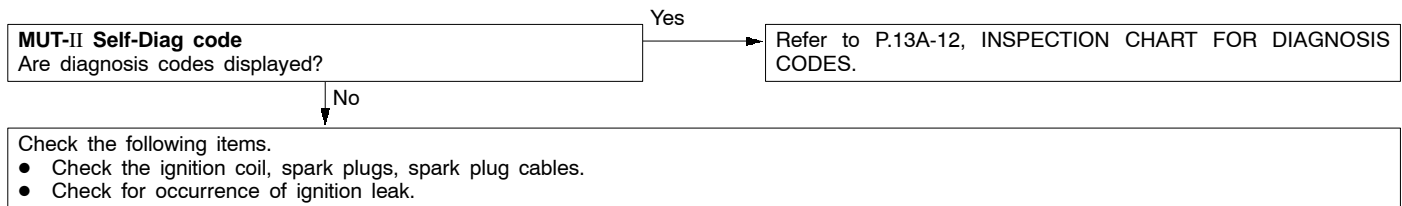
## INSPECTION PROCEDURE 15

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.	<ul style="list-style-type: none"> <li>• Malfunction of the ignition system</li> <li>• Malfunction of air-fuel ratio control system</li> <li>• Malfunction of the fuel supply system</li> <li>• Malfunction of the EGR control solenoid valve system</li> <li>• Poor compression</li> </ul>



## INSPECTION PROCEDURE 16

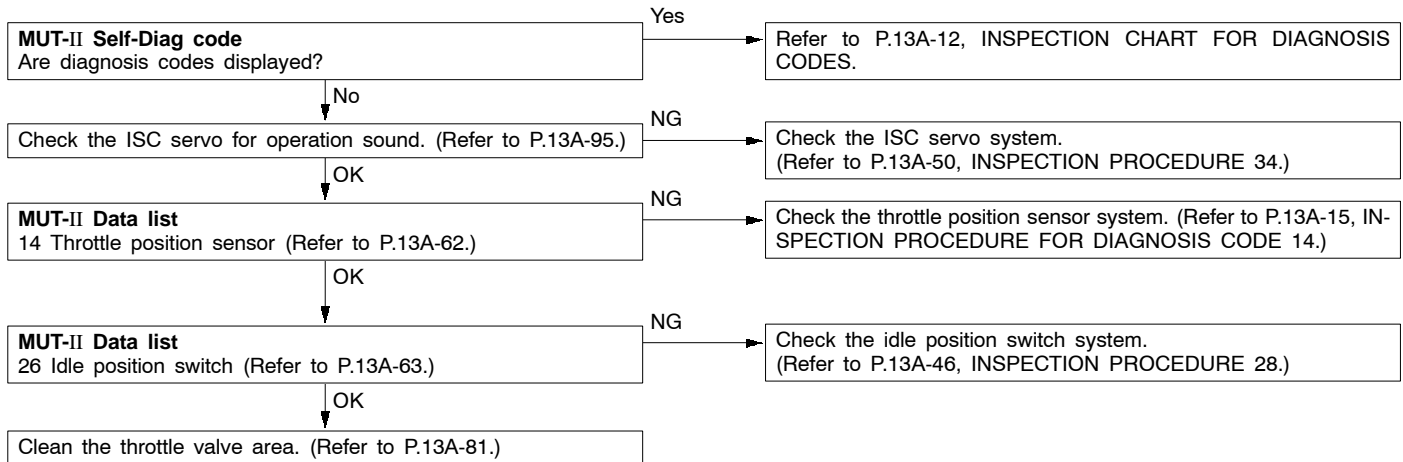
The feeling of impact or vibration when accelerating	Probable cause
In cases such as the above, the cause is probably that there is an ignition leak accompanying the increase in the spark plug demand voltage during acceleration.	<ul style="list-style-type: none"> <li>• Malfunction of the ignition system</li> </ul>





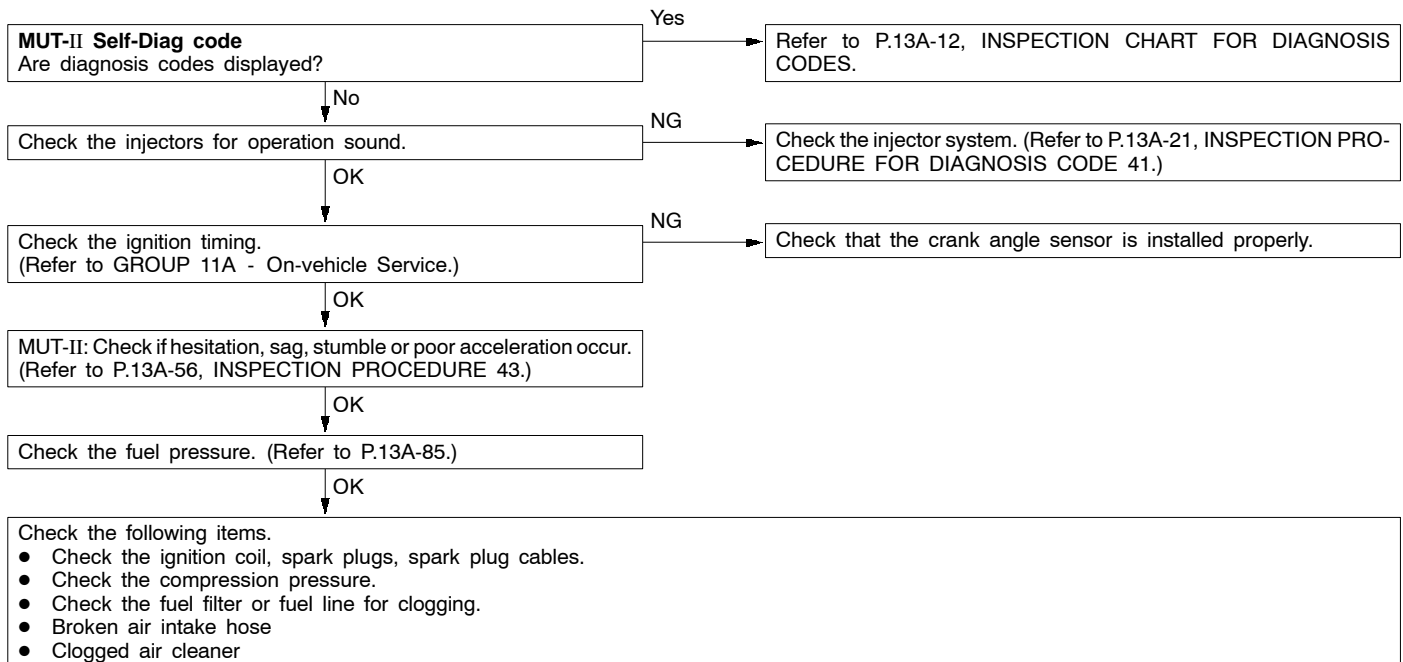
## INSPECTION PROCEDURE 17

The feeling of impact or vibration when decelerating.	Probable cause
Malfunction of the ISC system is suspected.	<ul style="list-style-type: none"> <li>Malfunction of the ISC system</li> </ul>



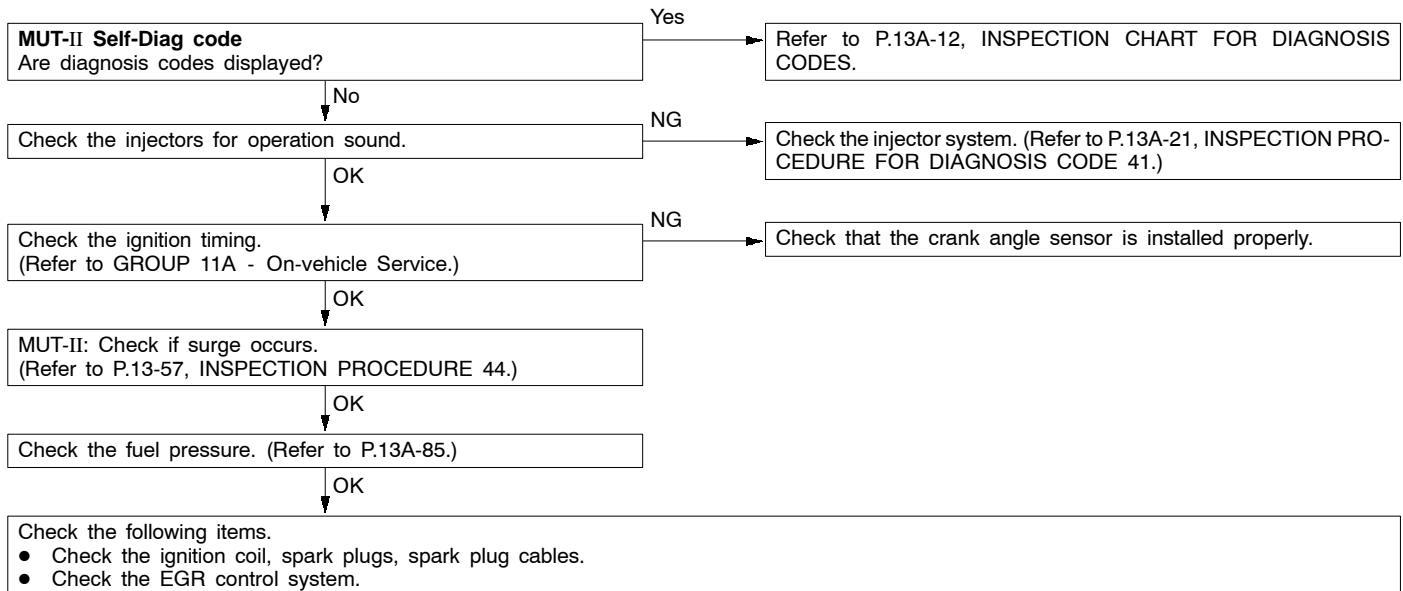
## INSPECTION PROCEDURE 18

Poor acceleration	Probable cause
Defective ignition system, abnormal air-fuel ratio, poor compression pressure, etc. are suspected.	<ul style="list-style-type: none"> <li>Malfunction of the ignition system</li> <li>Malfunction of air-fuel ratio control system</li> <li>Malfunction of the fuel supply system</li> <li>Poor compression pressure</li> <li>Clogged exhaust system</li> </ul>



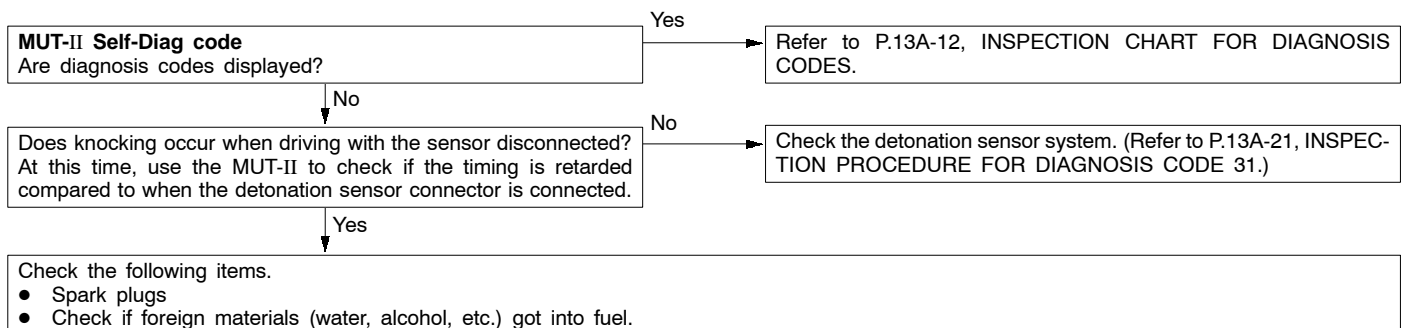
## INSPECTION PROCEDURE 19

Surge	Probable cause
Defective ignition system, abnormal air-fuel ratio, etc. are suspected.	<ul style="list-style-type: none"> <li>• Malfunction of the ignition system</li> <li>• Malfunction of air-fuel ratio control system</li> <li>• Malfunction of the EGR control solenoid valve system</li> </ul>



## 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.	<ul style="list-style-type: none"> <li>• Defective detonation sensor</li> <li>• Inappropriate heat value of the spark plug</li> </ul>



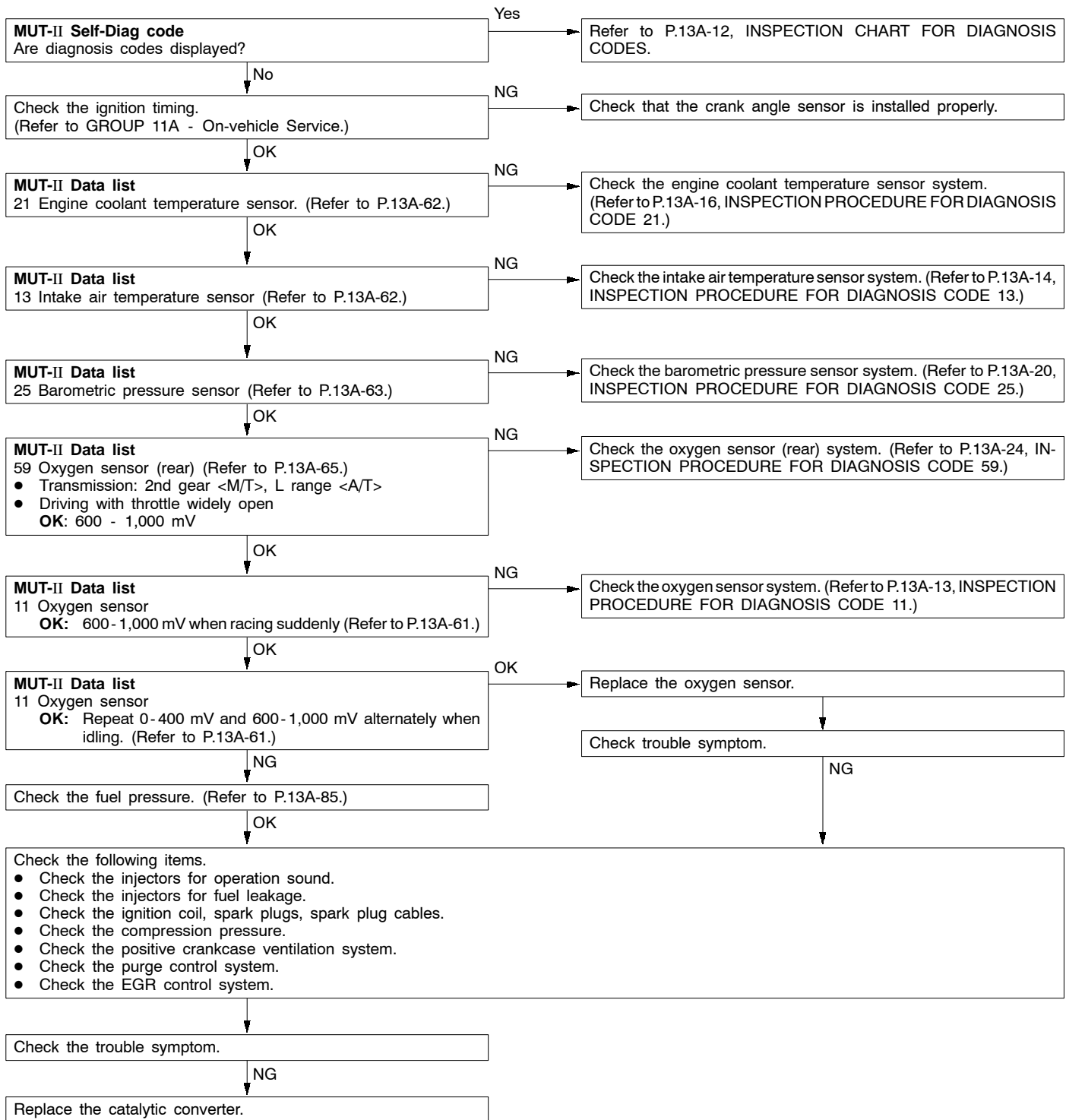
## INSPECTION PROCEDURE 21

Dieseling	Probable cause
Fuel leakage from injectors is suspected.	<ul style="list-style-type: none"> <li>• Fuel leakage from injectors</li> </ul>

Check the injectors for fuel leakage.

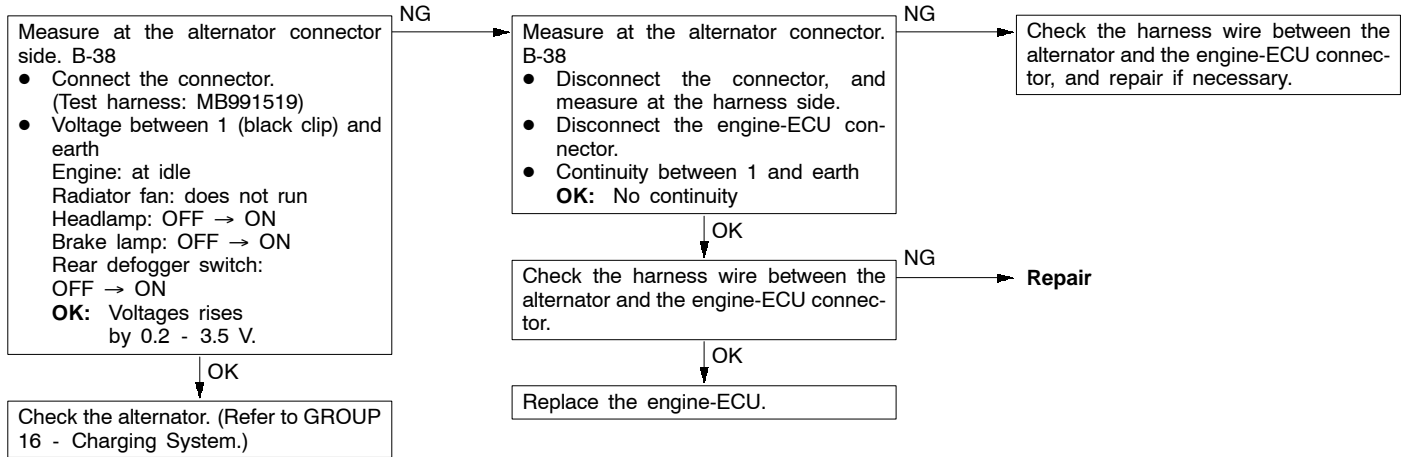
## INSPECTION PROCEDURE 22

Too high CO and HC concentration when idling	Probable cause
Abnormal air-fuel ratio is suspected.	<ul style="list-style-type: none"> <li>Malfunction of the air-fuel ratio control system</li> <li>Deteriorated catalyst</li> </ul>



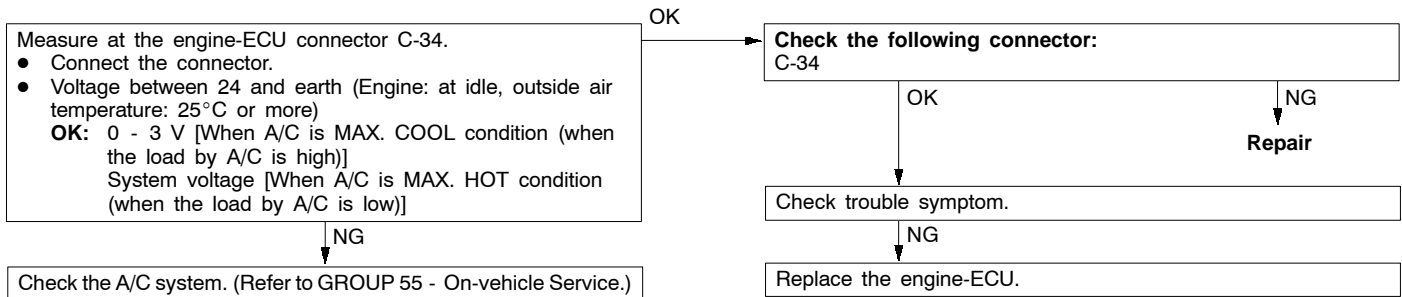
## INSPECTION PROCEDURE 23

Low alternator output voltage (approx. 12.3 V)	Probable cause
The alternator may be defective, or malfunctions, which are listed in the right column, may be suspected.	<ul style="list-style-type: none"> <li>Malfunction of charging system</li> <li>Short circuit in harness between alternator G terminal and engine-ECU</li> <li>Malfunction of engine-ECU</li> </ul>



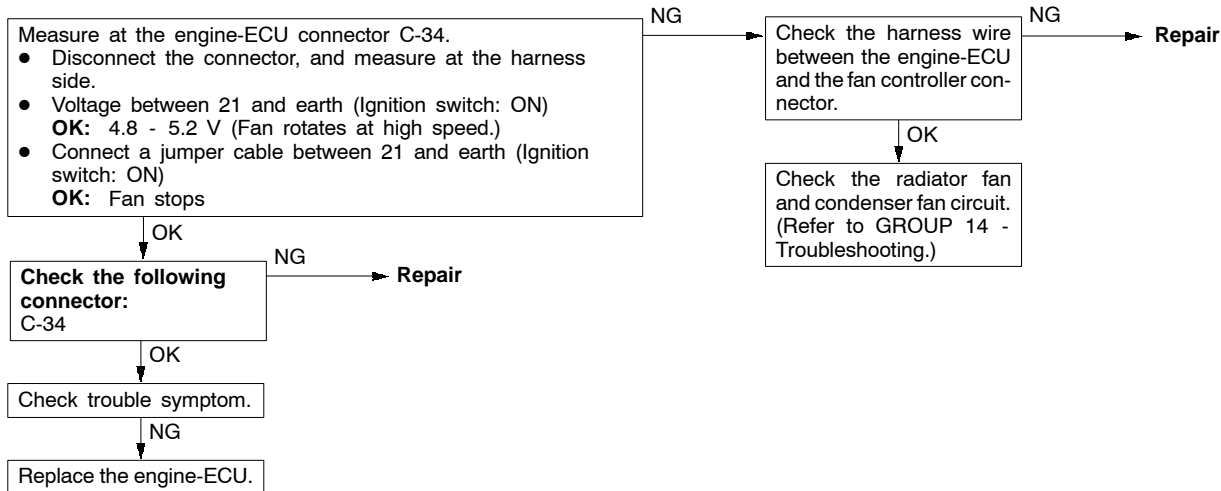
## INSPECTION PROCEDURE 24

Idling speed is improper when A/C is operating	Probable cause
<p>If the engine-ECU detects that the air conditioner is on, it activates the idle speed control (ISC) servo to control idle-up operation.</p> <p>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.</p> <p>Based on this voltage signal, the engine-ECU controls the idle-up speed (for high or low load).</p>	<ul style="list-style-type: none"> <li>Malfunction of the A/C control system</li> <li>Improper connector contact, open circuit or short-circuited harness wire</li> <li>Malfunction of the engine-ECU</li> </ul>



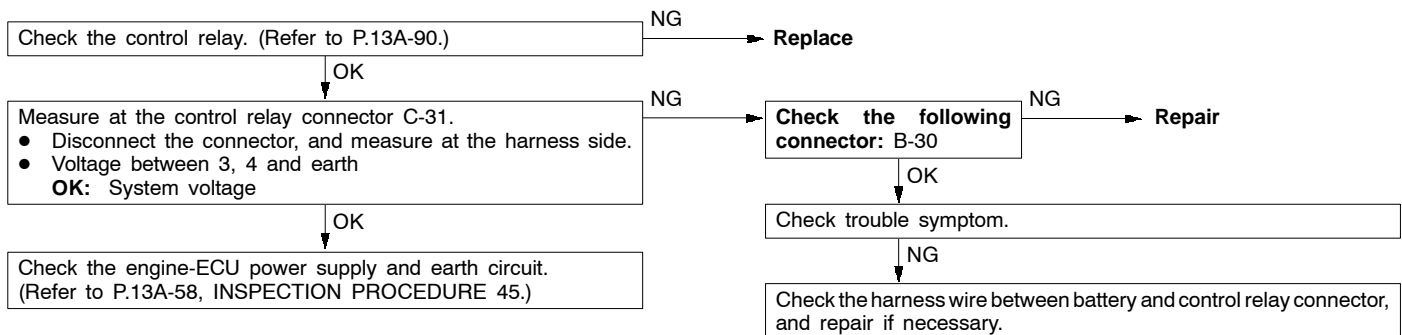
## INSPECTION PROCEDURE 25

Fans (radiator fan, A/C condenser fan) are inoperative	Probable cause
<p>The engine-ECU outputs a duty signal to the fan controller depending on the engine coolant temperature, vehicle speed, and air conditioner switch condition. Based on this signal, the fan controller controls the radiator fan and condenser fan speeds (The more the average voltage at the terminal approaches 5 V, the higher the fan speed become.)</p>	<ul style="list-style-type: none"> <li>• Malfunction of the fan motor relay</li> <li>• Malfunction of the fan motor</li> <li>• Malfunction of the fan controller</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



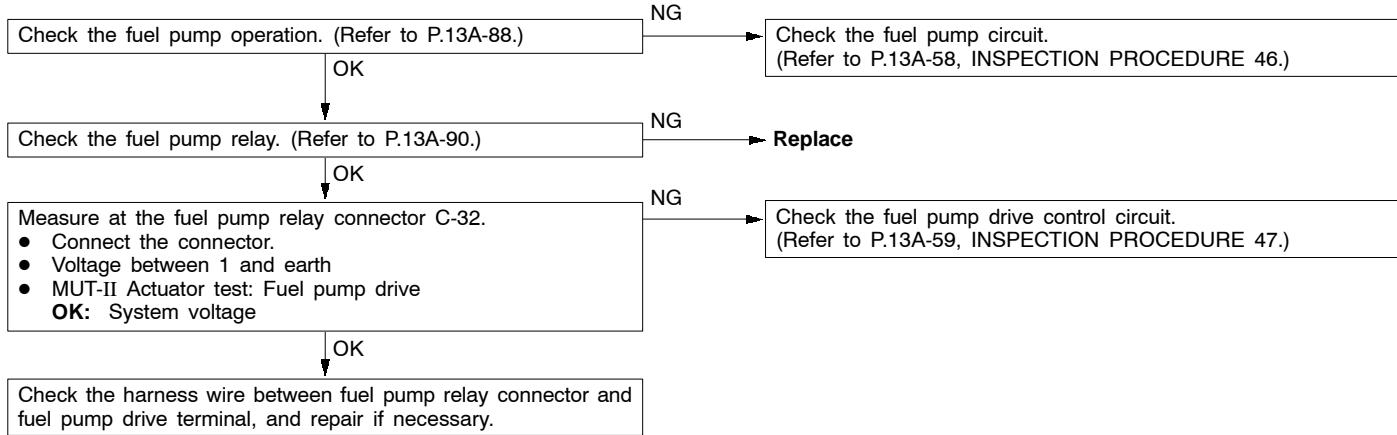
## INSPECTION PROCEDURE 26

Power supply system and ignition switch-IG system	Probable cause
<p>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.</p>	<ul style="list-style-type: none"> <li>• Malfunction of the ignition switch</li> <li>• Malfunction of the control relay</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Disconnected engine-ECU earth wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



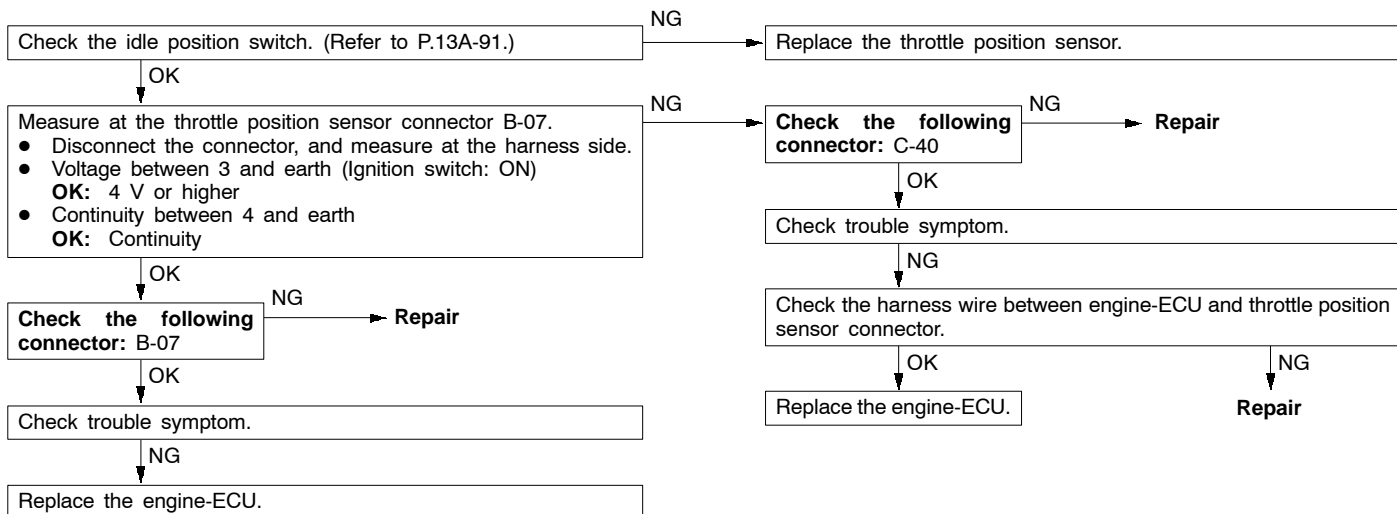
## INSPECTION PROCEDURE 27

Fuel pump system	Probable cause
The engine-ECU turns the control relay ON when the engine is cranking or running, and this supplies power to drive the fuel pump.	<ul style="list-style-type: none"> <li>• Malfunction of the fuel pump relay</li> <li>• Malfunction of the fuel pump</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



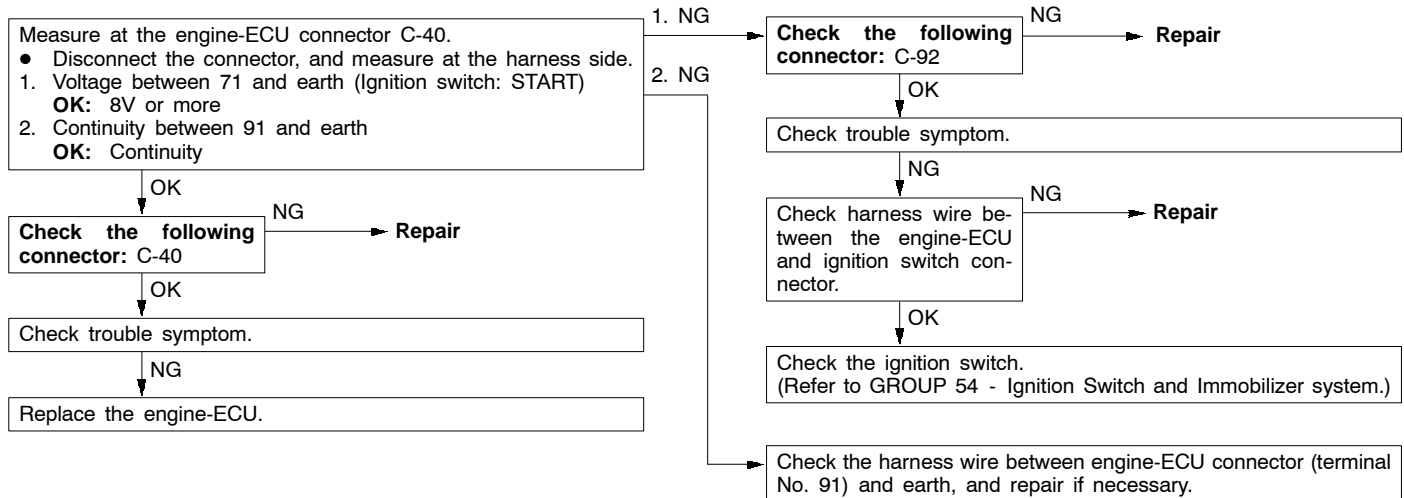
## INSPECTION PROCEDURE 28

Idle position switch system	Probable cause
The idle position switch inputs the condition of the accelerator pedal, i.e. whether it is depressed or released (HIGH/LOW), to the engine-ECU. The engine-ECU controls the idle speed control servo based on this input.	<ul style="list-style-type: none"> <li>• Maladjustment of the accelerator pedal</li> <li>• Maladjustment of the fixed SAS</li> <li>• Maladjustment of the idle position switch and throttle position sensor</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



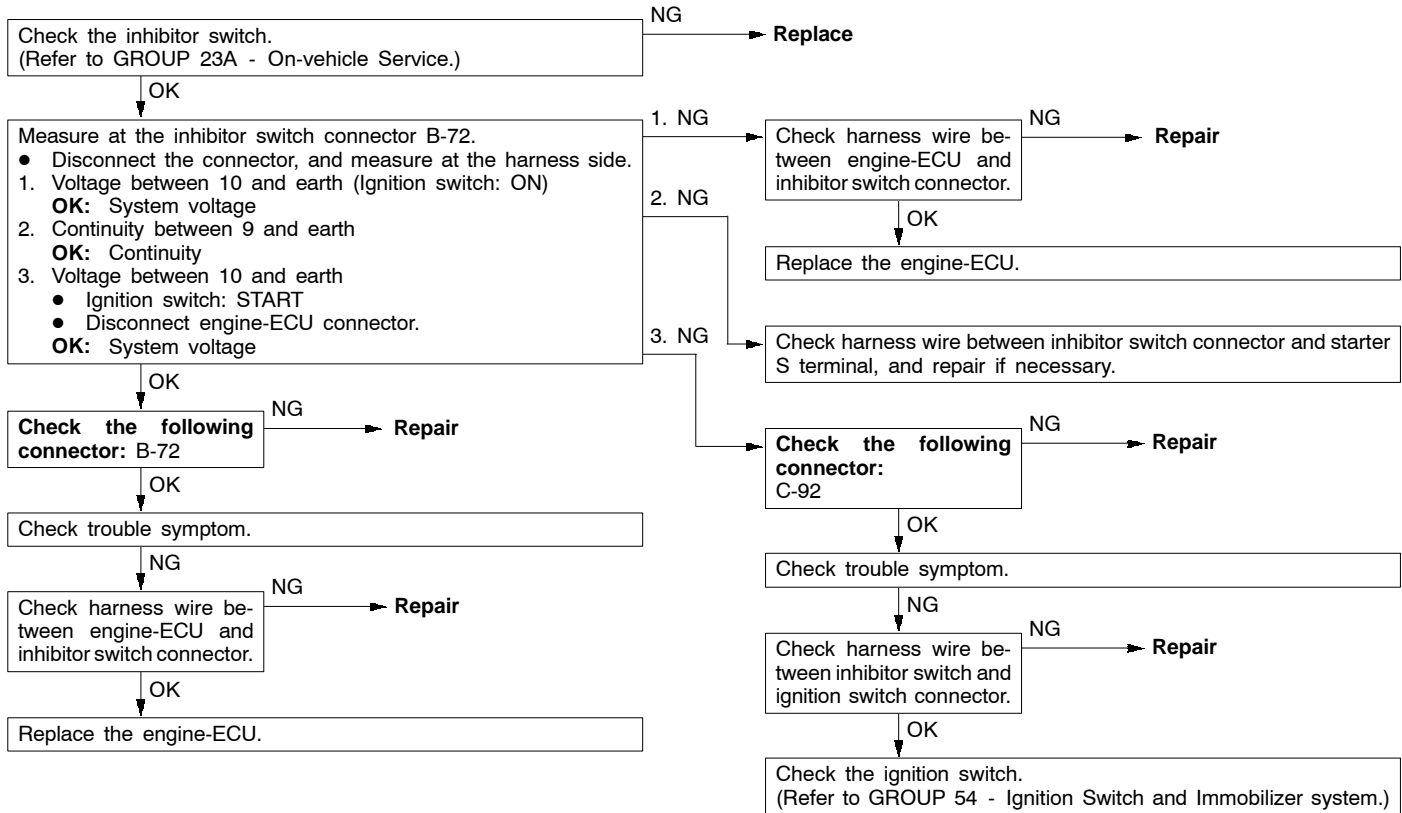
## INSPECTION PROCEDURE 29

Ignition switch-ST system <M/T>	Probable cause
<p>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.</p>	<ul style="list-style-type: none"> <li>• Malfunction of ignition switch</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



## INSPECTION PROCEDURE 30

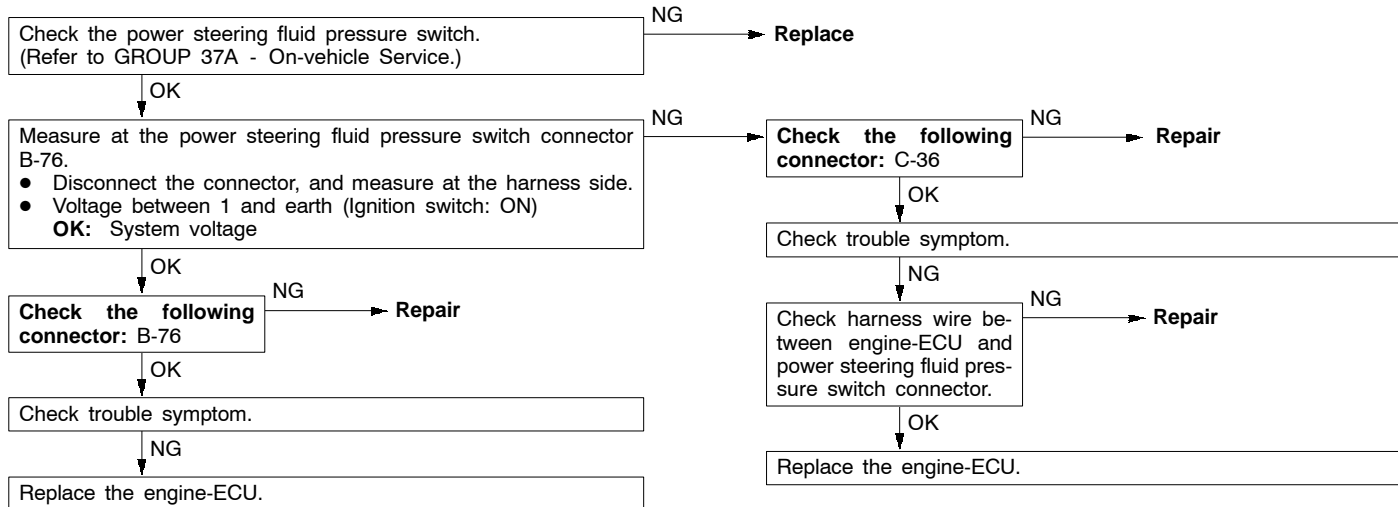
Ignition switch-ST and inhibitor switch system <A/T>	Probable cause
<ul style="list-style-type: none"> <li>The ignition switch-ST inputs a HIGH signal to the engine-ECU while the engine is cranking. The engine-ECU controls fuel injection, etc. during starting based on this input.</li> <li>The inhibitor switch inputs the condition of the select lever, i.e. whether it is in P or N range or in some other range, to the engine-ECU. The engine-ECU controls the idle speed control (ISC) servo based on this input.</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of ignition switch</li> <li>Malfunction of inhibitor switch</li> <li>Improper connector contact, open circuit or short-circuited harness wire</li> <li>Malfunction of the engine-ECU.</li> </ul>





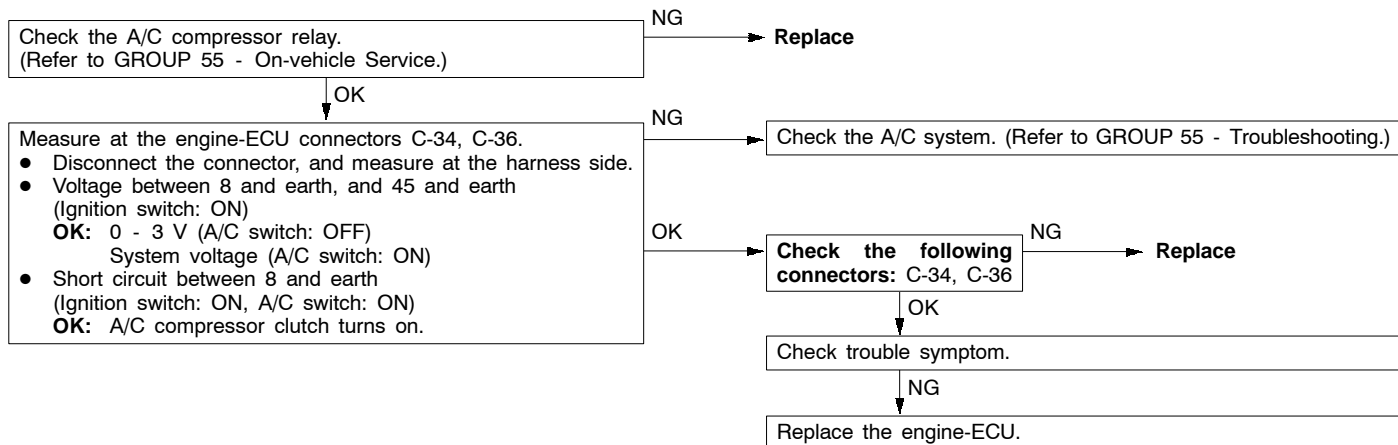
## INSPECTION PROCEDURE 31

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.	<ul style="list-style-type: none"> <li>• Malfunction of power steering fluid pressure switch</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



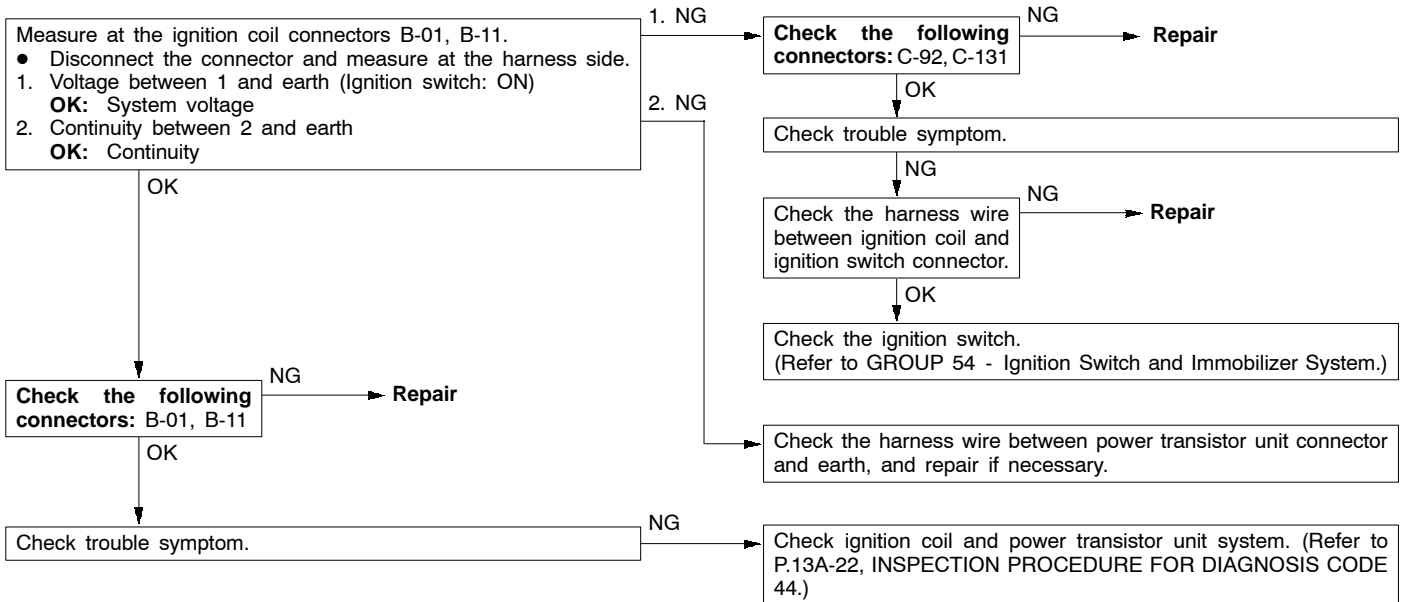
## INSPECTION PROCEDURE 32

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.	<ul style="list-style-type: none"> <li>• Malfunction of A/C control system</li> <li>• Malfunction of A/C switch</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



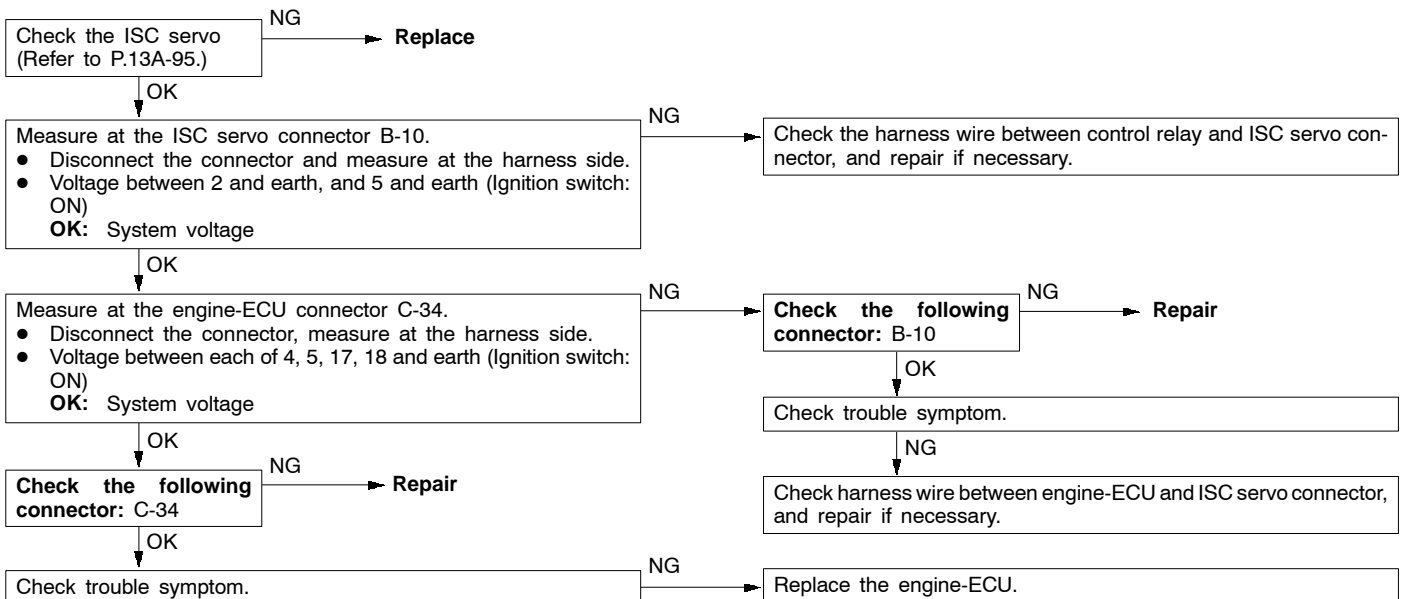
## INSPECTION PROCEDURE 33

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.	<ul style="list-style-type: none"> <li>• Malfunction of ignition switch.</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



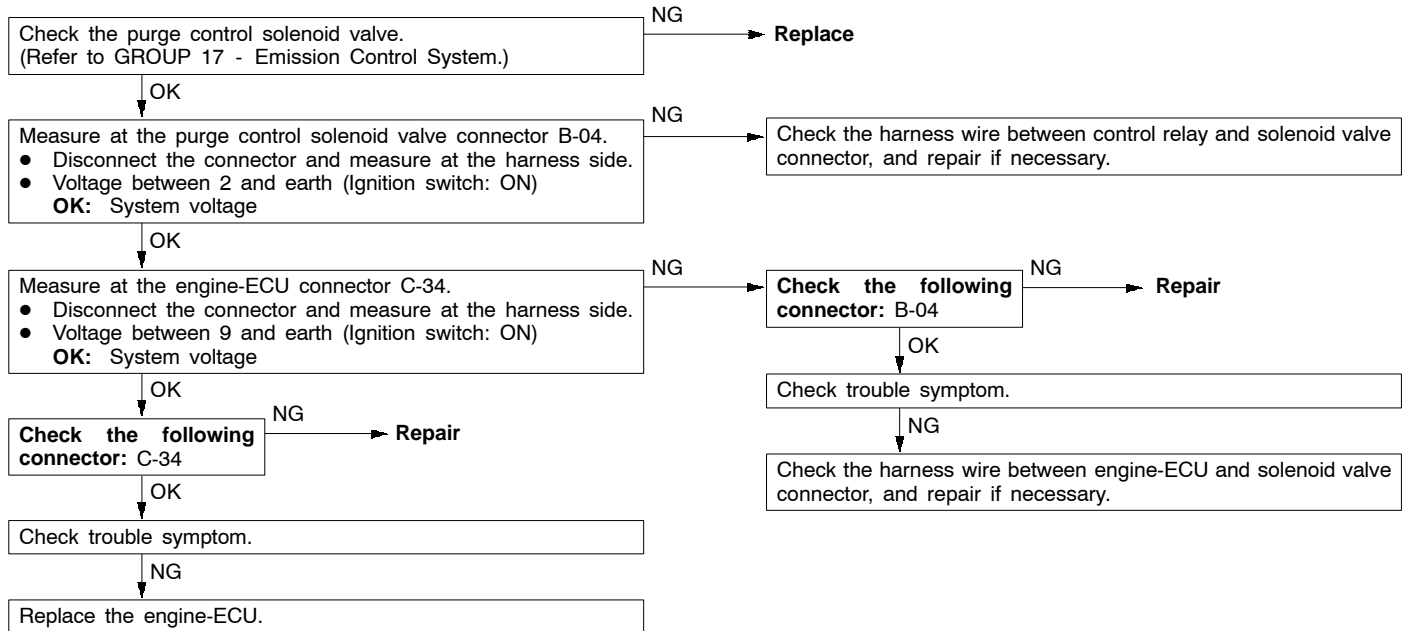
## INSPECTION PROCEDURE 34

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.	<ul style="list-style-type: none"> <li>• Malfunction of ISC servo</li> <li>• Improper connector contact, open circuit or short-circuited harness wire</li> <li>• Malfunction of the engine-ECU</li> </ul>



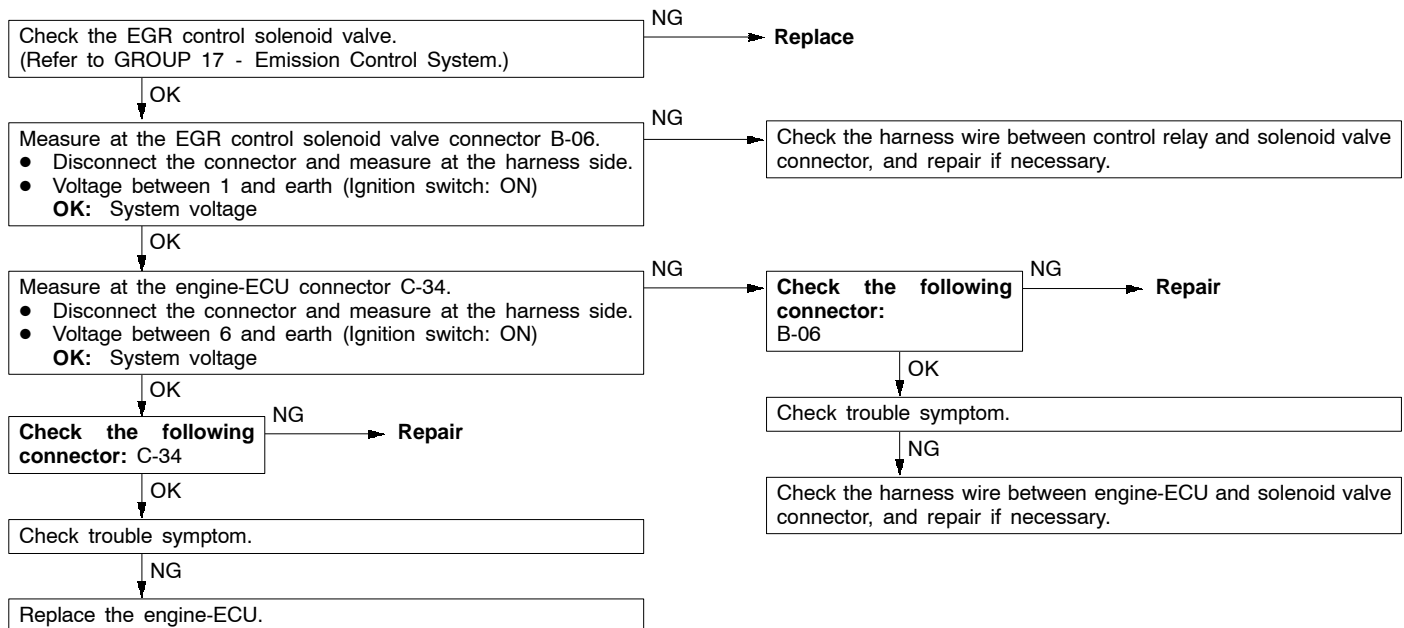
## INSPECTION PROCEDURE 35

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.	<ul style="list-style-type: none"> <li>• Malfunction of solenoid valve</li> <li>• Improper connector contact, open circuit or short-circuited harness wire.</li> <li>• Malfunction of the engine-ECU</li> </ul>



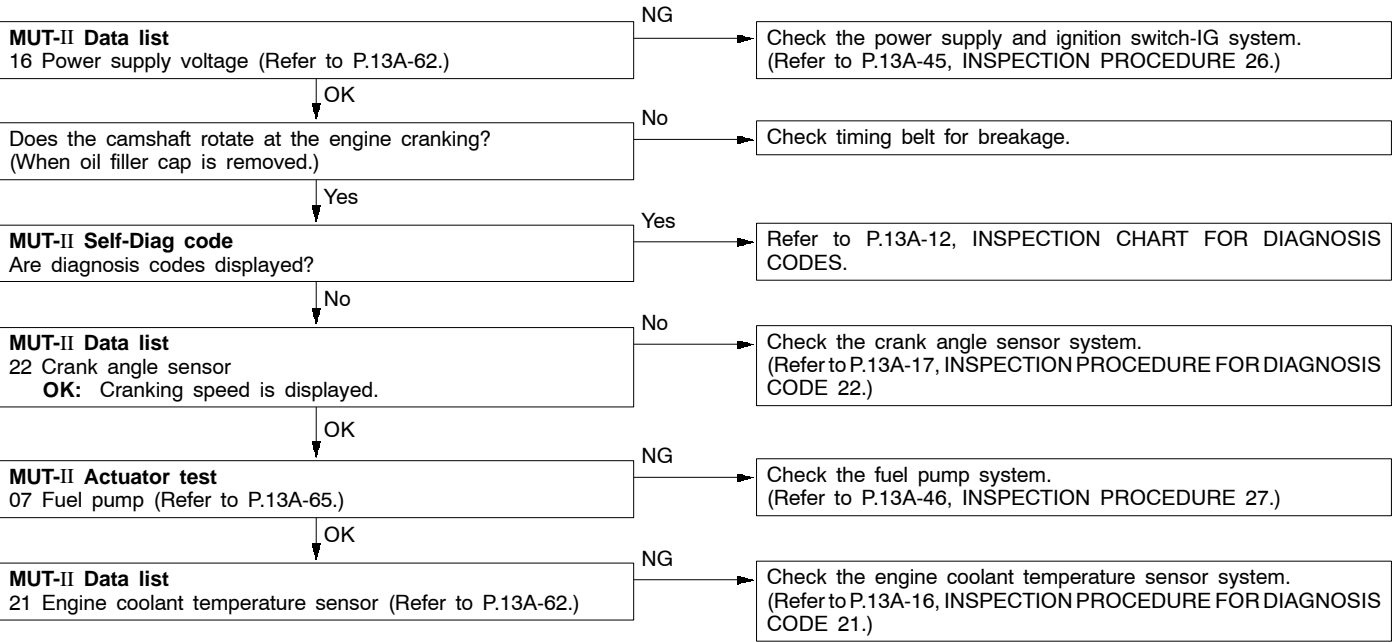
## INSPECTION PROCEDURE 36

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.	<ul style="list-style-type: none"> <li>• Malfunction of solenoid valve</li> <li>• Improper connector contact, open circuit or short-circuited harness wire.</li> <li>• Malfunction of the engine-ECU</li> </ul>



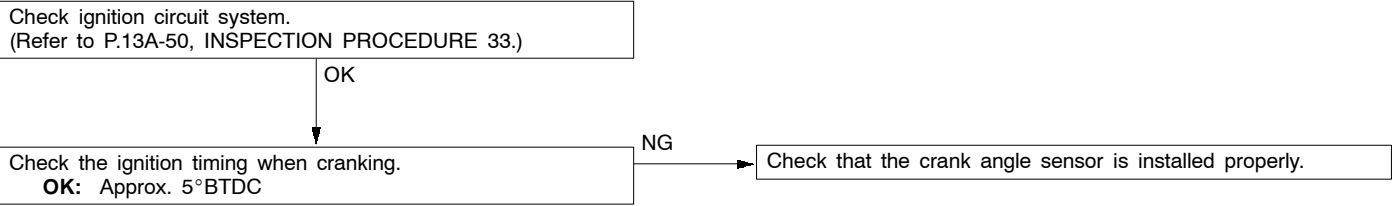
INSPECTION PROCEDURE 37

MUT-II: Inspection of no initial combustion

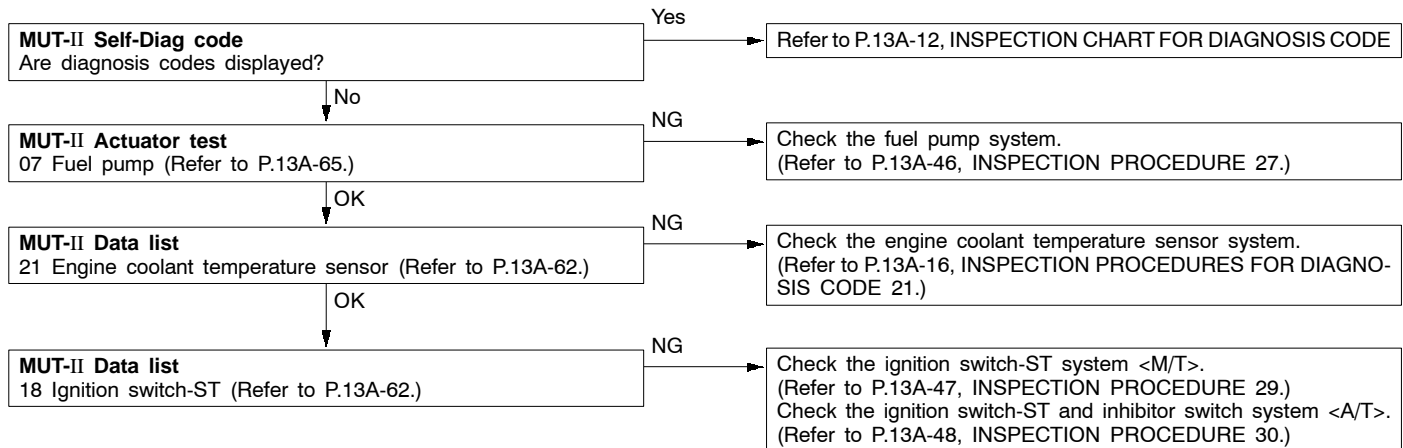


INSPECTION PROCEDURE 38

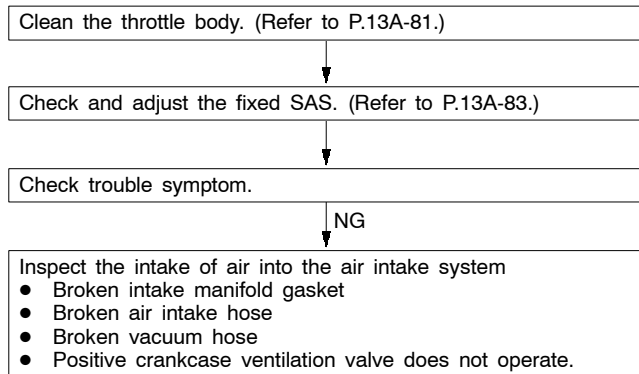
Ignition system: Inspection of no initial combustion.



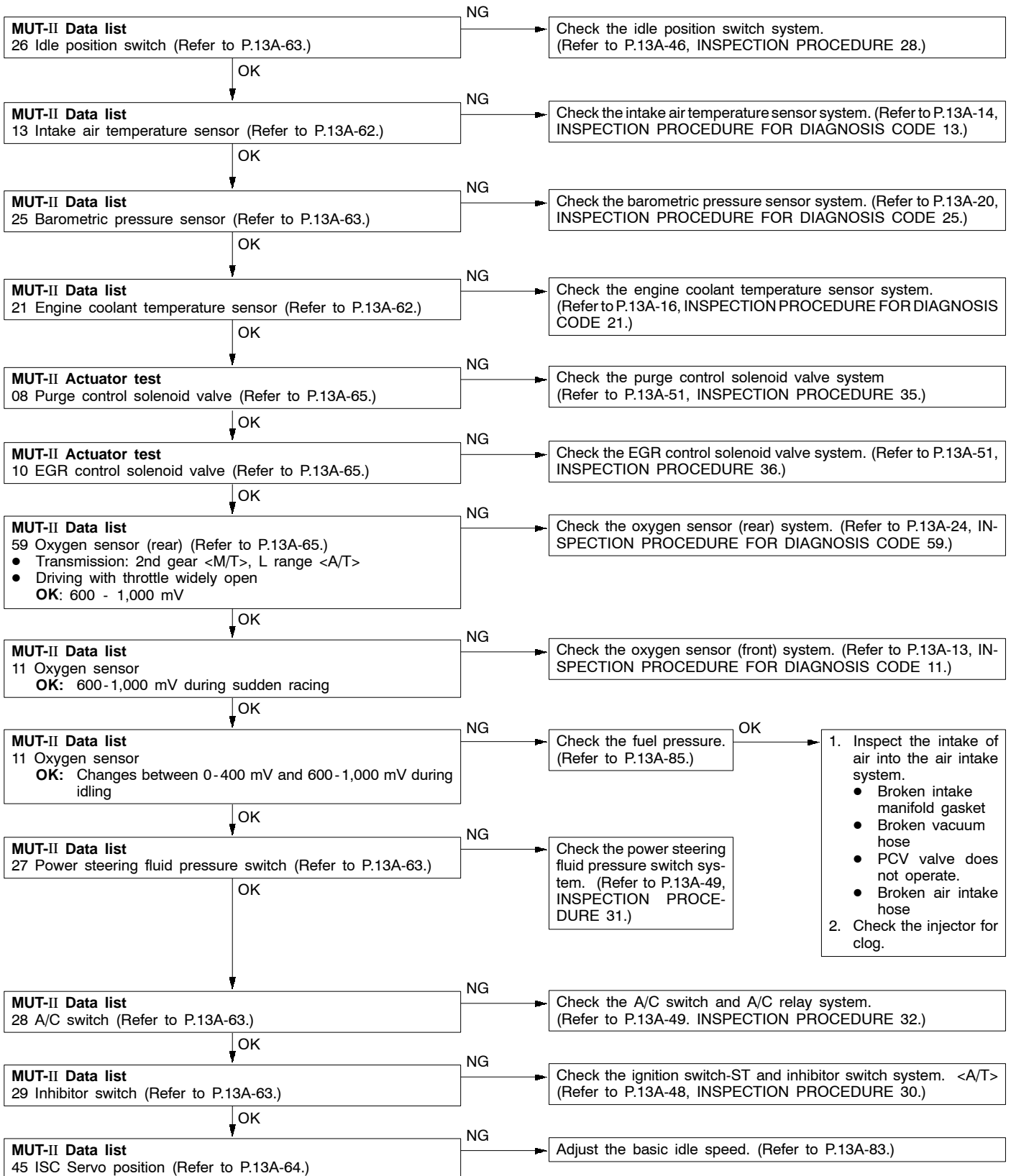
## INSPECTION PROCEDURE 39

**MUT-II: Check if incomplete combustion occurs.**

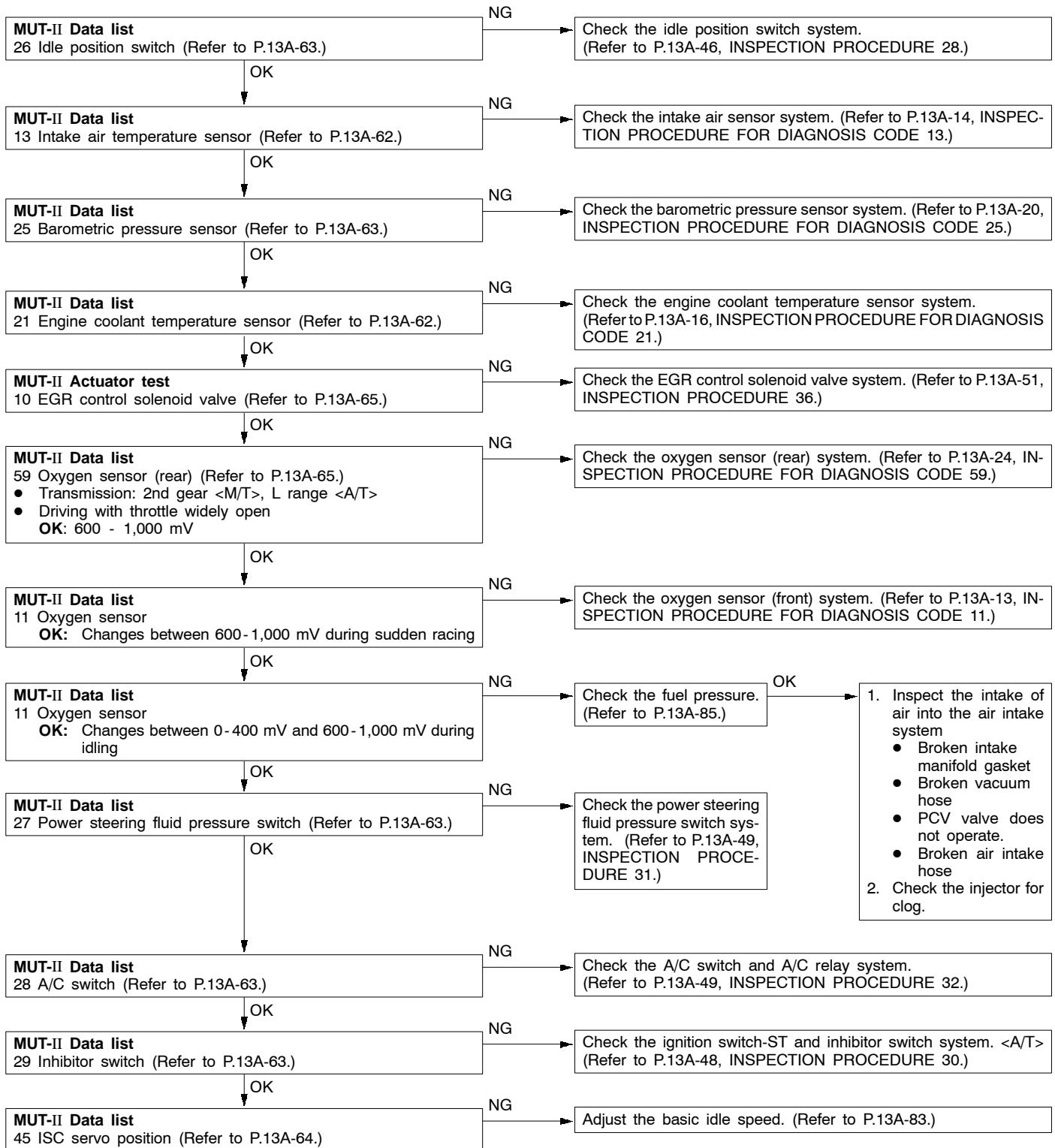
## INSPECTION PROCEDURE 40

**Check if hunting occurs.**

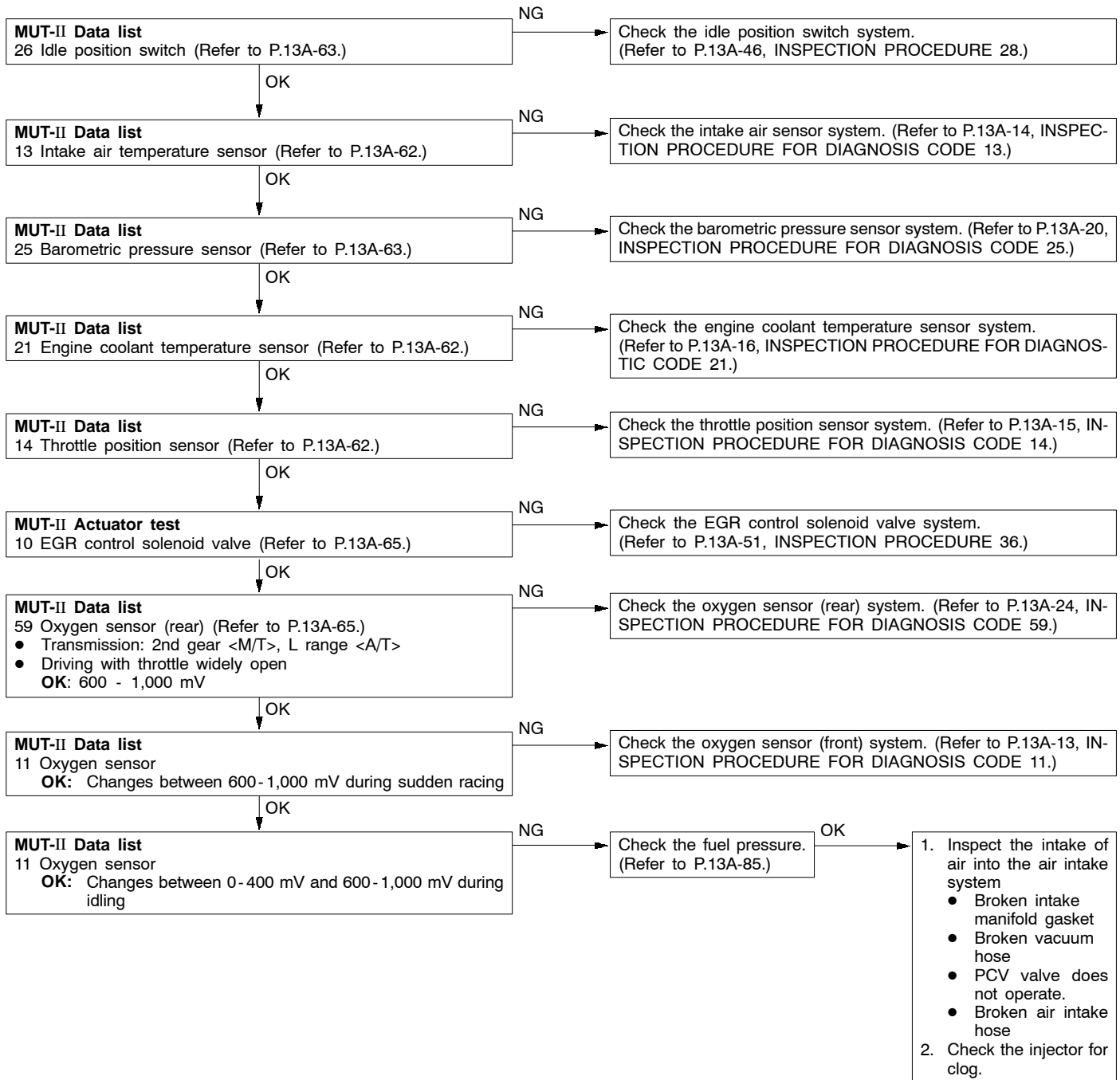
## INSPECTION PROCEDURE 41

**MUT-II: Check if idling speed is unstable.**

## INSPECTION PROCEDURE 42

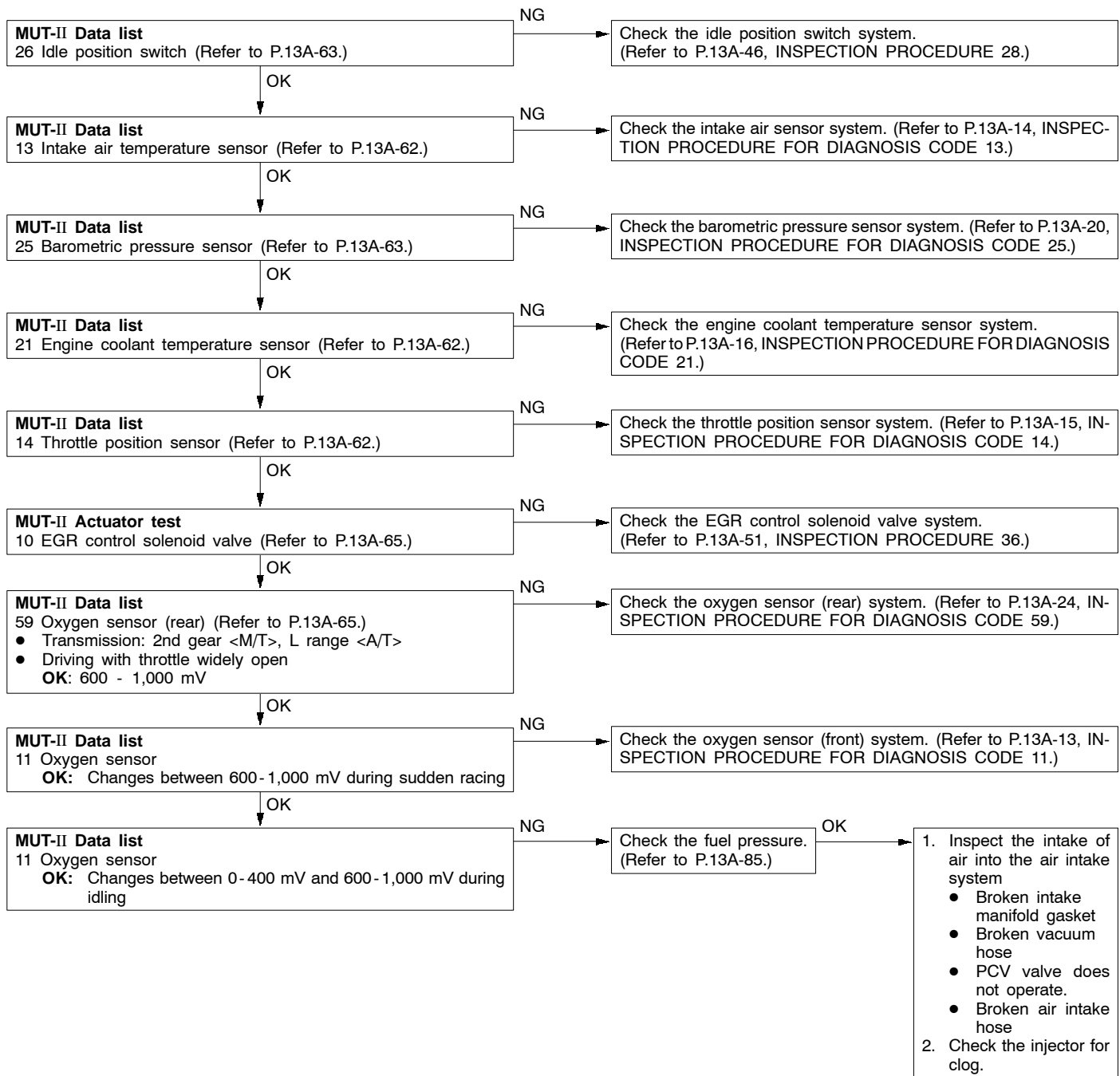
**MUT-II: Engine stalling inspection when the engine is warmed up and idling.**

## INSPECTION PROCEDURE 43

**MUT-II: Check if hesitation, sug, stumble or poor acceleration occurs.**

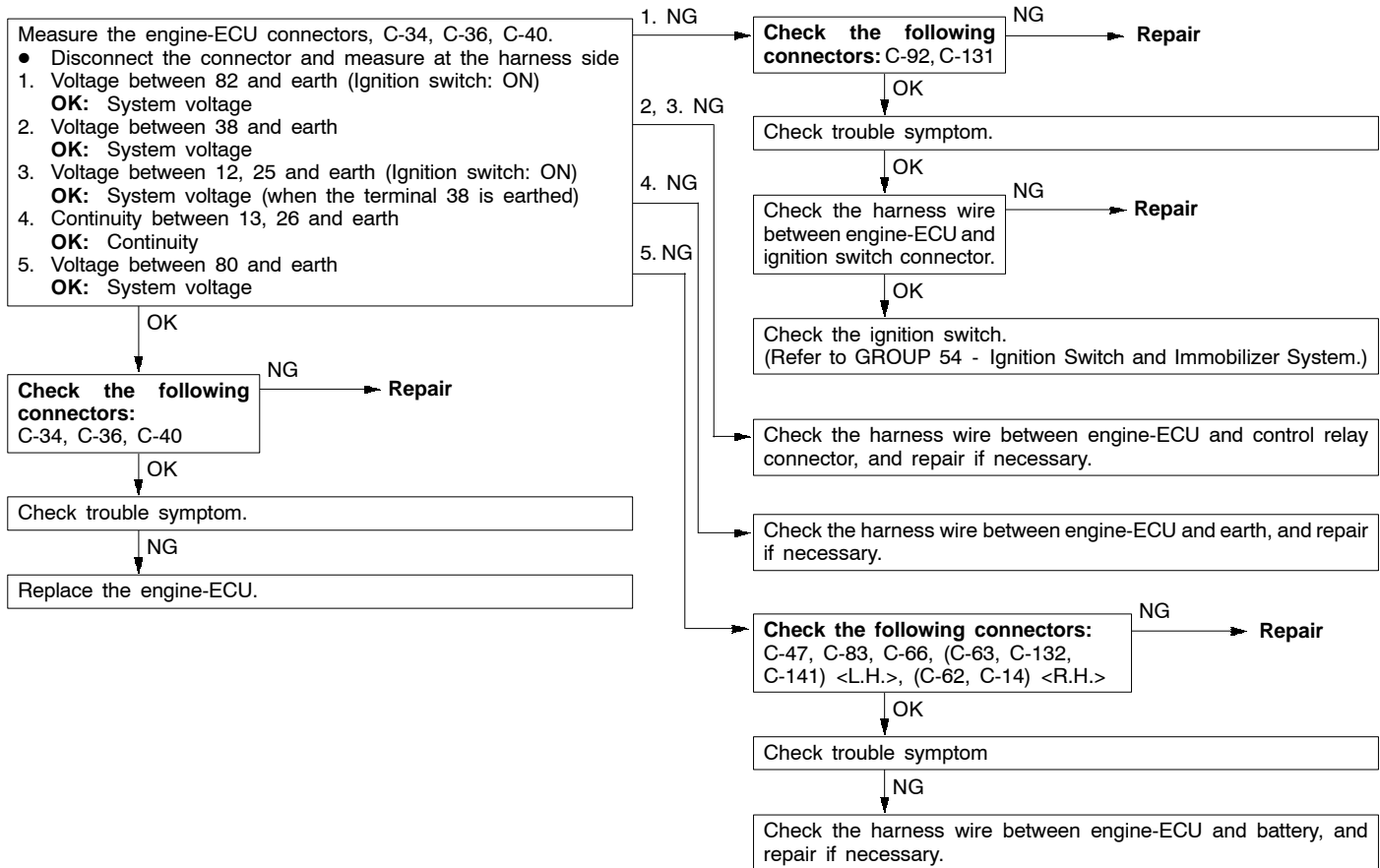


## INSPECTION PROCEDURE 44

**MUT-II: Check if surge occurs.**

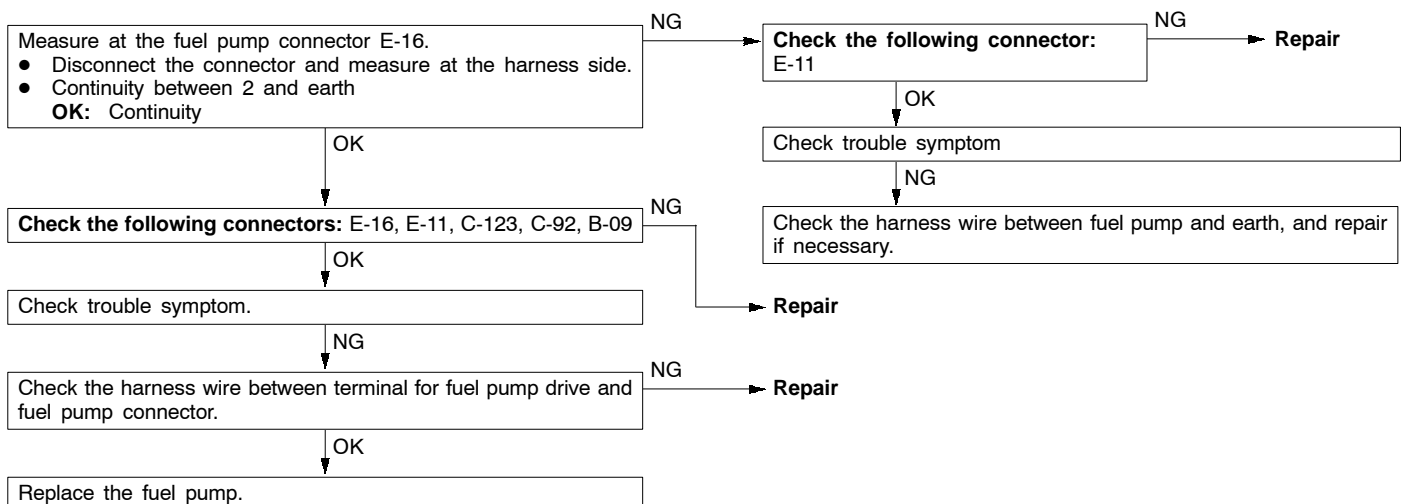
## INSPECTION PROCEDURE 45

## Check the engine-ECU power supply and earth circuit.



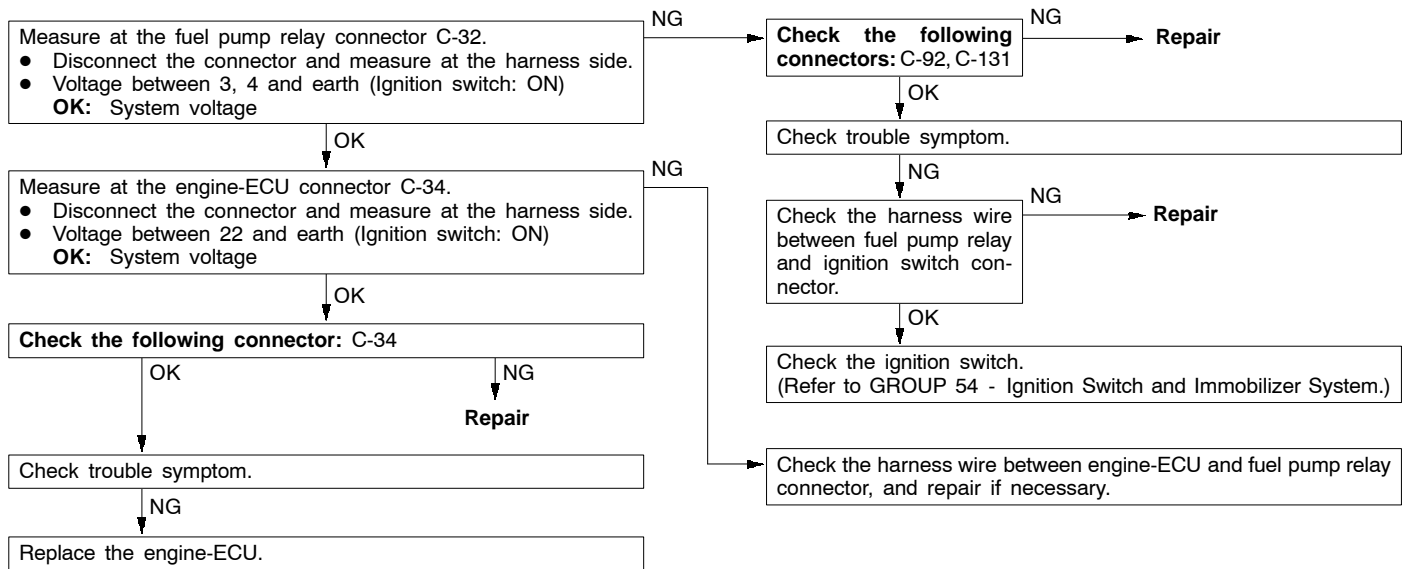
## INSPECTION PROCEDURE 46

## Check fuel pump circuit.



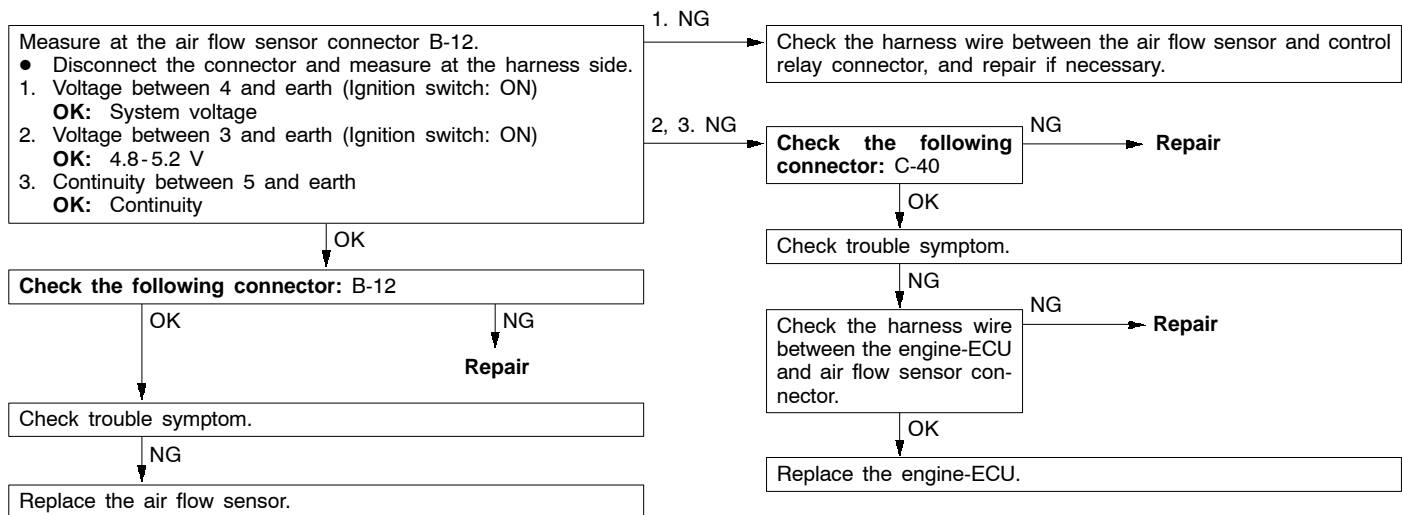
## INSPECTION PROCEDURE 47

## Check the fuel pump drive control circuit.



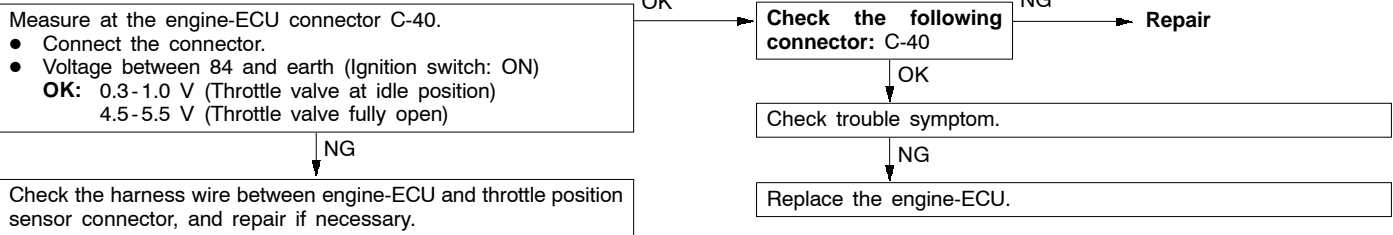
## INSPECTION PROCEDURE 48

## Check air flow sensor (AFS) control circuit.



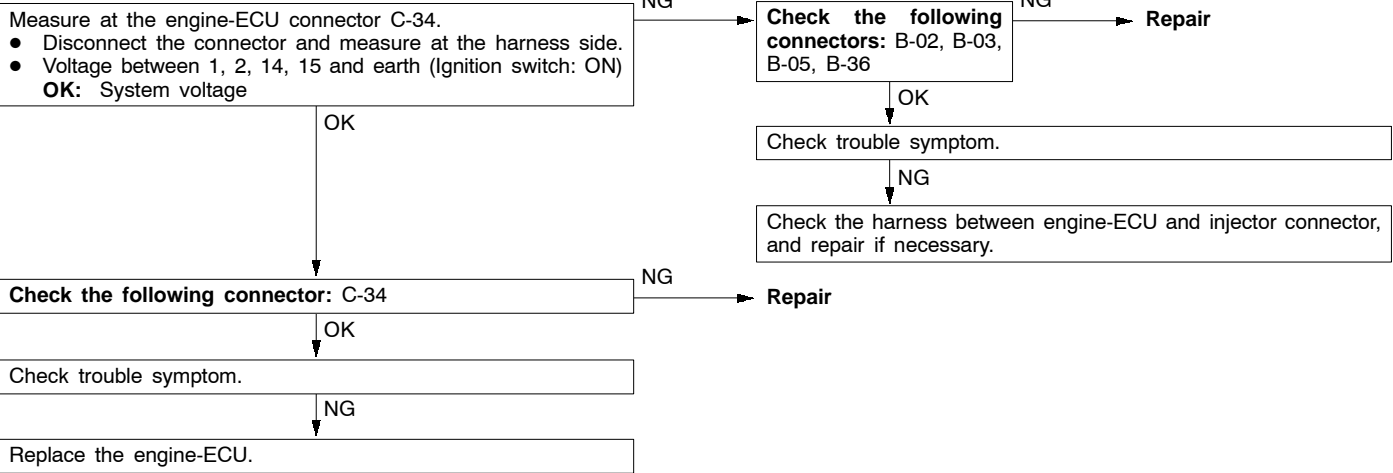
INSPECTION PROCEDURE 49

Check throttle position sensor (TPS) output circuit.



INSPECTION PROCEDURE 50

Check injector control circuit



## DATA LIST REFERENCE TABLE

13100890289

**Caution**

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

**NOTE**

- \*1. In a new vehicle [driven approximately 500 km or less], the air flow sensor output frequency is sometimes 10% higher than the standard frequency.
- \*2. The idle position switch normally turns off when the voltage of the throttle position sensor is 50 - 100 mV higher than the voltage at the idle position. If the throttle position switch turns back on after the throttle position sensor voltage has risen by 100 mV and the throttle valve has opened, the idle position switch and the throttle position sensor need to be adjusted.
- \*3. 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.
- \*4. In a new vehicle [driven approximately 500 km or less], the injector drive time is sometimes 10% longer than the standard time.
- \*5. 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 decelerating, and is made richer when racing.	When at 4,000 r/min, engine is suddenly decelerated	200 mV or less	Code No. 11	13A-13
			When engine is suddenly raced	600 - 1,000 mV		
		Engine:After having warmed up The oxygen sensor signal is used to check the air/fuel mixture ratio, and control condition is also checked by the ECU.	Engine is idling	400 mV or less (Changes)		
			2,500 r/min	600 - 1,000 mV		
12	Air flow sensor*1	<ul style="list-style-type: none"> <li>● Engine coolant temperature: 80 - 95°C</li> <li>● Lamps, electric cooling fan and all accessories: OFF</li> <li>● Transmission: Neutral (A/T: P range)</li> </ul>	Engine is idling	17 - 43 Hz	-	-
			2,500 r/min	70 - 110 Hz		
			Engine is raced	Frequency increases in response to racing		
13	Intake air temperature sensor	Ignition switch: ON or with engine running	When intake air temperature is -20°C	-20°C	Code No. 13	13A-14
			When intake air temperature is 0°C	0°C		
			When intake air temperature is 20°C	20°C		
			When intake air temperature is 40°C	40°C		
			When intake air temperature is 80°C	80°C		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
14	Throttle position sensor	Ignition switch: ON	Set to idle position	300 - 1,000 mV	Code No. 14	13A-15
			Gradually open	Increases in proportion to throttle opening angle		
			Open fully	4,500 - 5,500 mV		
16	Power supply voltage	Ignition switch: ON		System voltage	Procedure No. 26	13A-45
18	Cranking signal (ignition switch-ST)	Ignition switch: ON	Engine: Stopped	OFF	Procedure No. 29 <M/T>	13A-47 <M/T> 13A-48 <M/T>
			Engine: Cranking	ON	Procedure No. 30 <A/T>	
21	Engine coolant temperature sensor	Ignition switch: ON or with engine running	When engine coolant temperature is -20°C	-20°C	Code No. 21	13A-16
			When engine coolant temperature is 0°C	0°C		
			When engine coolant temperature is 20°C	20°C		
			When engine coolant temperature is 40°C	40°C		
			When engine coolant temperature is 80°C	80°C		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
22	Crank angle sensor	<ul style="list-style-type: none"> <li>Engine: Cranking</li> <li>Tachometer: Connected</li> </ul>	Compare the engine speed readings on the tachometer and the MUT-II.	Accord	Code No. 22	13A-17
		<ul style="list-style-type: none"> <li>Engine: Idling</li> <li>Idle position switch: ON</li> </ul>	When engine coolant temperature is -20°C	1,275 - 1,475 rpm		
			When engine coolant temperature is 0°C	1,225 - 1,425 rpm		
			When engine coolant temperature is 20°C	1,100 - 1,300 rpm		
			When engine coolant temperature is 40°C	950 - 1,150 rpm		
			When engine coolant temperature is 80°C	650 - 850 rpm		
25	Barometric pressure sensor	Ignition switch: ON	At altitude of 0 m	101 kPa	Code No. 25	13A-20
			At altitude of 600 m	95 kPa		
			At altitude of 1,200 m	88 kPa		
			At altitude of 1,800 m	81 kPa		
26	Idle position switch	Ignition switch: ON Check by operating accelerator pedal repeatedly	Throttle valve: Set to idle position	ON	Procedure No. 28	13A-46
			Throttle valve: Slightly open	OFF*2		
27	Power steering fluid pressure switch	Engine: Idling	Steering wheel stationary	OFF	Procedure No. 31	13A-49
			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. 32	13A-49
			A/C switch: ON	ON		
29	Inhibitor switch <A/T>	Ignition switch: ON	P or N	P or N	Procedure No. 30	13A-48
			D, 2, L or R	D, 2, L or R		

Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
41	Injectors * <sup>3</sup>	Engine: Cranking	When engine coolant temperature is 0°C (injection is carried out for all cylinders simultaneously)	12 - 19 ms	-	-
			When engine coolant temperature is 20°C	26 - 40 ms		
			When engine coolant temperature is 80°C	6.0 - 9.1 ms		
	Injectors* <sup>4</sup>	<ul style="list-style-type: none"> <li>Engine coolant temperature: 80–95°C</li> <li>Lamps, electric cooling fan and all accessories: OFF</li> <li>Transmission: Neutral (A/T : P range)</li> </ul>	Engine is idling	1.6 - 2.8 ms		
			2,500 r/min	1.4 - 2.6 ms		
			When engine is suddenly raced	Increases		
44	Ignition coils and power transistors	<ul style="list-style-type: none"> <li>Engine: After having warmed up</li> <li>Timing lamp is set. (The timing lamp is set in order to check actual ignition timing.)</li> </ul>	Engine is idling	2 - 18° BTDC	-	-
			2,500 r/min	18 - 38° BTDC		
45	ISC (stepper) motor position * <sup>5</sup>	<ul style="list-style-type: none"> <li>Engine coolant temperature: 80 - 95°C</li> <li>Lamps, electric cooling fan and all accessories: OFF</li> <li>Transmission: Neutral (A/T : P range)</li> <li>Idle position switch: ON</li> <li>Engine: Idling</li> <li>When A/C switch is ON, A/C compressor should be operating</li> </ul>	A/C switch: OFF	2 - 25 STEP	-	-
			A/C switch: OFF → ON	Increases by 10 - 70 steps		
			<ul style="list-style-type: none"> <li>A/C switch: OFF</li> <li>Select lever: N range → D range</li> </ul>	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. 32	13A-49
			A/C switch: ON	ON (Compressor clutch is operating)		

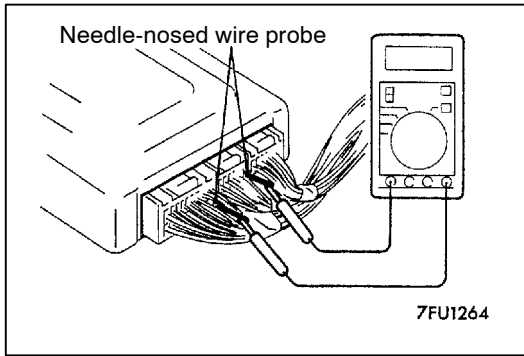


Item No.	Inspection item	Inspection contents		Normal condition	Inspection procedure No.	Reference page
59	Oxygen sensor (rear)	<ul style="list-style-type: none"> <li>Transmission: 2nd gear &lt;M/T&gt;, L range &lt;A/T&gt;</li> <li>Drive with throttle widely open</li> </ul>	3,500 r/min	600 - 1,000 mV	Code No. 59	13A-24

**ACTUATOR TEST REFERENCE TABLE**

13100900357

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-21
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.	<ul style="list-style-type: none"> <li>Engine: Cranking</li> <li>Fuel pump: Forced driving</li> </ul> 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. 27	13A-46
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. 35	13A-51
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. 36	13A-51
17	Basic ignition timing	Set to ignition timing adjustment mode	Engine: Idling Timing light is set		5° BTDC	-	-
21	Fan controller	Drive the fan motor	Ignition switch: ON		Radiator fan and condenser fan operate at high speed	Procedure No. 25	13A-45



## CHECK AT THE ENGINE-ECU TERMINALS

13100920285

### TERMINAL VOLTAGE CHECK CHART

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

#### NOTE

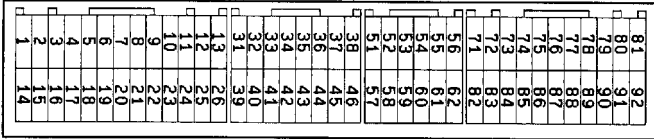
- (1) Make the voltage measurement with the engine-ECU connectors connected.
- (2) You may find it convenient to pull out the engine-ECU to make it easier to reach the connector terminals.
- (3) The checks can be carried out off the order given in the chart.

#### Caution

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

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

## Engine-ECU Connector Terminal Arrangement



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	<ul style="list-style-type: none"> <li>Engine: Idle speed</li> <li>A/C switch: OFF → ON (A/C compressor is operating)</li> </ul>	System voltage or momentarily 6V or more → 0 - 3V
9	Purge control solenoid valve	Ignition switch: ON	System voltage
		Running at 3,000r/min while engine is warming up after having been started.	0 - 3V
10	Ignition coil - No. 1, No. 4 (power transistor)	Engine r/min: 3,000 r/min	0.3 - 3.0V
23	Ignition coil - No. 2, No. 3 (power transistor)		
12	Power supply	Ignition switch: ON	System voltage
25			
19	Air flow sensor reset signal	Engine: Idle speed	0 - 1V
		Engine r/min: 3,000 r/min	6 - 9V
21	Fan controller	Radiator fan and condenser fan are not operating	0 - 0.3 V
		Radiator fan and condenser fan are operating	0.7 V or more

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
22	Fuel pump relay	Ignition switch: ON		System voltage
		Engine: Idle speed		0 - 3V
24	A/C switch 2	<ul style="list-style-type: none"> <li>Engine: Idling</li> <li>Outside air temperature: 25°C or more</li> </ul>	When A/C is MAX. COOL condition (when the load by A/C is high)	0 - 3 V
			(When A/C is MAX. HOT condition (when the load by A/C is low))	System voltage
33	Alternator G terminal	<ul style="list-style-type: none"> <li>Engine: Warm, idle (radiator fan: OFF)</li> <li>Headlamp: OFF to ON</li> <li>Rear defogger switch: OFF to ON</li> <li>Brake lamp: ON</li> </ul>		Voltage rises by 0.2 - 3.5 V.
41	Alternator FR terminal	<ul style="list-style-type: none"> <li>Engine: Warm, idle (radiator fan: OFF)</li> <li>Headlamp: OFF to ON</li> <li>Rear defogger switch: OFF to ON</li> <li>Brake lamp: ON</li> </ul>		Voltage drops by 0.2 - 3.5 V.
36	Engine warning lamp	Ignition switch: OFF → ON		0 - 3V → 9 - 13V (After several seconds have elapsed)
37	Power steering fluid pressure switch	Engine: Idling after warming up	When steering wheel is stationary	System voltage
			When steering wheel is turned	0 - 3V
38	Control relay (Power supply)	Ignition switch: OFF		System voltage
		Ignition switch: ON		0 - 3V
45	A/C switch 1	Engine: Idle speed	Turn the A/C switch OFF	0 - 3V
			Turn the A/C switch ON (A/C compressor is operating)	System voltage
58	Tachometer signal	Engine r/min: 3,000 r/min		0.3 - 3.0V
60	Oxygen sensor heater	Engine: Idling after warming up		0 - 3V
		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 - 3.8V
			When intake air temperature is 20°C	2.3 - 2.9V
			When intake air temperature is 40°C	1.5 - 2.1V
			When intake air temperature is 80°C	0.4 - 1.0V
75	Oxygen sensor (rear)	<ul style="list-style-type: none"> <li>• Transmission: 2nd gear &lt;M/T&gt;, L range &lt;A/T&gt;</li> <li>• Engine r/min: 3,500 r/min or more</li> <li>• Driving with the throttle valve widely open</li> </ul>		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 ↔ 0.8V (Changes repeatedly)
80	Backup power supply	Ignition switch: OFF		System voltage
81	Sensor impressed voltage	Ignition switch: ON		4.5 - 5.5V
82	Ignition switch - IG	Ignition switch: ON		System voltage
83	Engine coolant temperature sensor	Ignition switch: ON	When engine coolant temperature is 0°C	3.2 - 3.8V
			When engine coolant temperature is 20°C	2.3 - 2.9V
			When engine coolant temperature is 40°C	1.3 - 1.9V
			When engine coolant temperature is 80°C	0.3 - 0.9V
84	Throttle position sensor	Ignition switch: ON	Set throttle valve to idle position	0.3 - 1.0V
			Fully open throttle valve	4.5 - 5.5V
85	Barometric pressure sensor	Ignition switch: ON	When altitude is 0m	3.7 - 4.3V
			When altitude is 1,200m	3.2 - 3.8V
86	Vehicle speed sensor	<ul style="list-style-type: none"> <li>• Ignition switch: ON</li> <li>• Move the vehicle slowly forward</li> </ul>		0 ↔ 5V (Changes repeatedly)

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
87	Idle position switch	Ignition switch: ON	Set throttle valve to idle position	0 - 1V
			Slightly open throttle valve	4V or more
88	Camshaft position sensor	Engine: Cranking		0.4 - 3.0V
		Engine: Idle speed		0.5 - 2.0V
89	Crank angle sensor	Engine: Cranking		0.4 - 4.0V
		Engine: Idle speed		1.5 - 2.5V
90	Air flow sensor	Engine: Idle speed		2.2 - 3.2V
		Engine r/min: 2,500r/min		
91	Inhibitor switch <A/T>	Ignition switch: ON	Set selector lever to P or N	0 - 3V
			Set selector lever to Other than P or N	8 - 14V

#### 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.

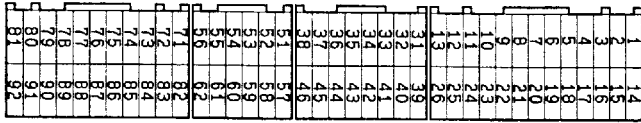
#### Caution

**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!**

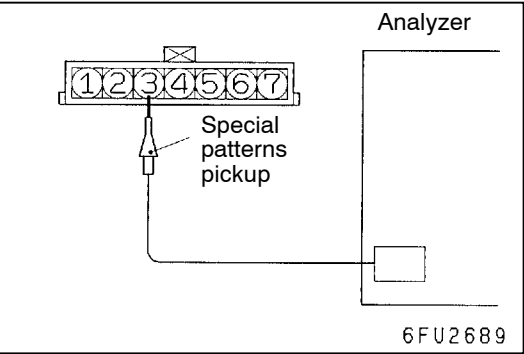
4. If the ohmmeter shows any deviation from the standard value, check the corresponding sensor, actuator and related electrical wiring, and then repair or replace.
5. After repair or replacement, recheck with the ohmmeter to confirm that the repair or replacement has corrected the problem.

## Engine-ECU Harness Side Connector Terminal Arrangement



9FU0392

Terminal No.	Inspection item	Normal condition (Check condition)
1 - 12	No. 1 injector	13 - 16 $\Omega$ (At 20°C)
14 - 12	No. 2 injector	
2 - 12	No. 3 injector	
15 - 12	No. 4 injector	
4 - 12	Stepper motor coil (A1)	28 - 33 $\Omega$ (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 $\Omega$ (At 20°C)
9 - 12	Purge control solenoid valve	36 - 44 $\Omega$ (At 20°C)
13 - Body earth	Engine-ECU earth	Continuity (0 $\Omega$ )
26 - Body earth	Engine-ECU earth	
60 - 12	Oxygen sensor heater	11 - 18 $\Omega$ (At 20°C)
72 - 92	Intake air temperature sensor	5.3 - 6.7 k $\Omega$ (When intake air temperature is 0°C)
		2.3 - 3.0 k $\Omega$ (When intake air temperature is 20°C)
		1.0 - 1.5 k $\Omega$ (When intake air temperature is 40°C)
		0.30 - 0.42 k $\Omega$ (When intake air temperature is 80°C)
83 - 92	Engine coolant temperature sensor	5.1 - 6.5 k $\Omega$ (When coolant temperature is 0°C)
		2.1 - 2.7 k $\Omega$ (When coolant temperature is 20°C)
		0.9 - 1.3 k $\Omega$ (When coolant temperature is 40°C)
		0.26 - 0.36 k $\Omega$ (When coolant temperature is 80°C)
87 - 92	Idle position switch	Continuity (when throttle valve is at idle position)
		No continuity (when throttle valve is slightly open)
91 - Body earth	Inhibitor switch <A/T>	Continuity (when select lever is at P or N)
		No continuity (when select lever is at D, 2, L or R)



INSPECTION PROCEDURE USING AN ANALYZER

13100930219

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)

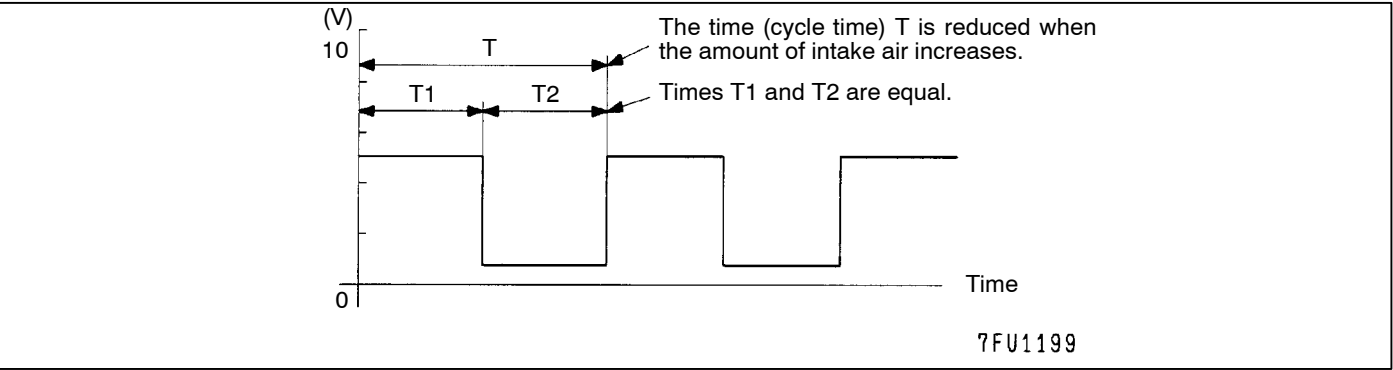
1. Connect the analyzer special patterns pickup to engine-ECU terminal 90.

Standard Wave Pattern

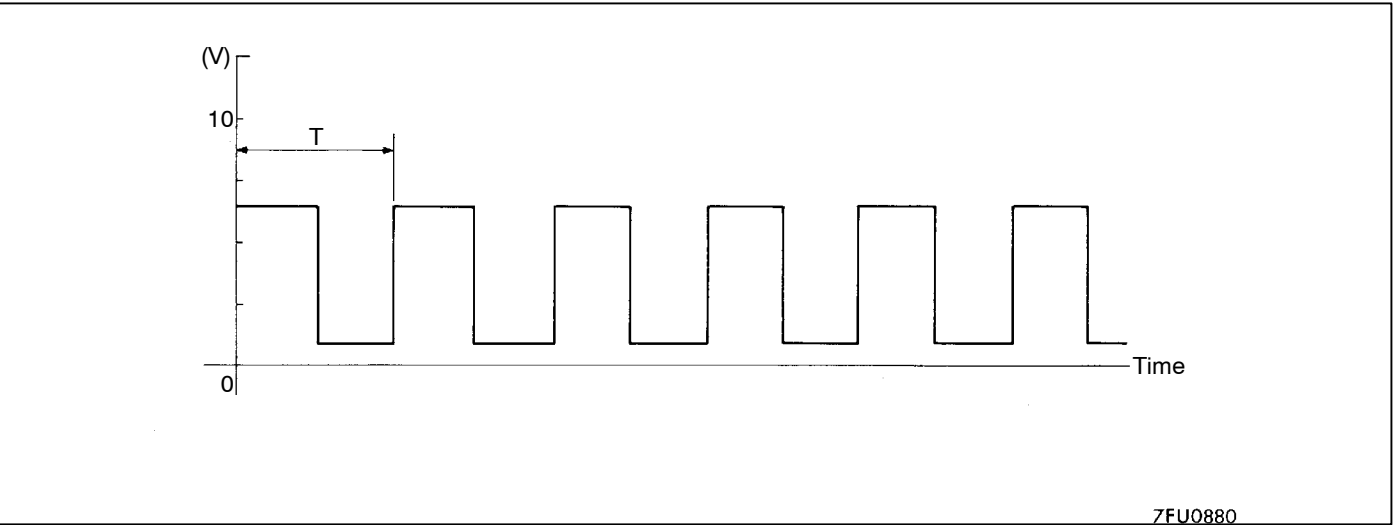
Observation conditions

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

Standard wave pattern



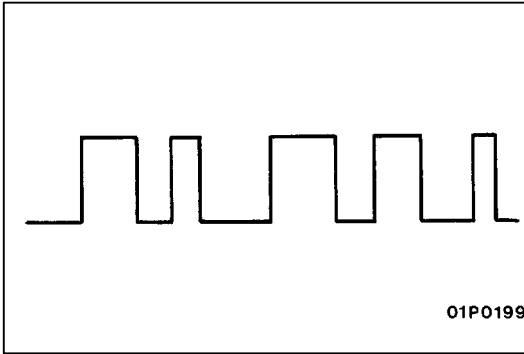
Observation conditions (from conditions above engine speed is increased by racing.)



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.

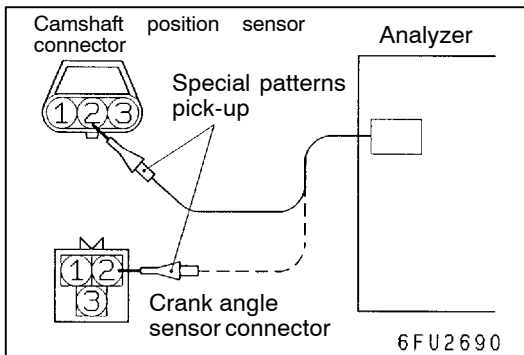
#### • Example 2

##### 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: MB991223) and jumper wire 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)

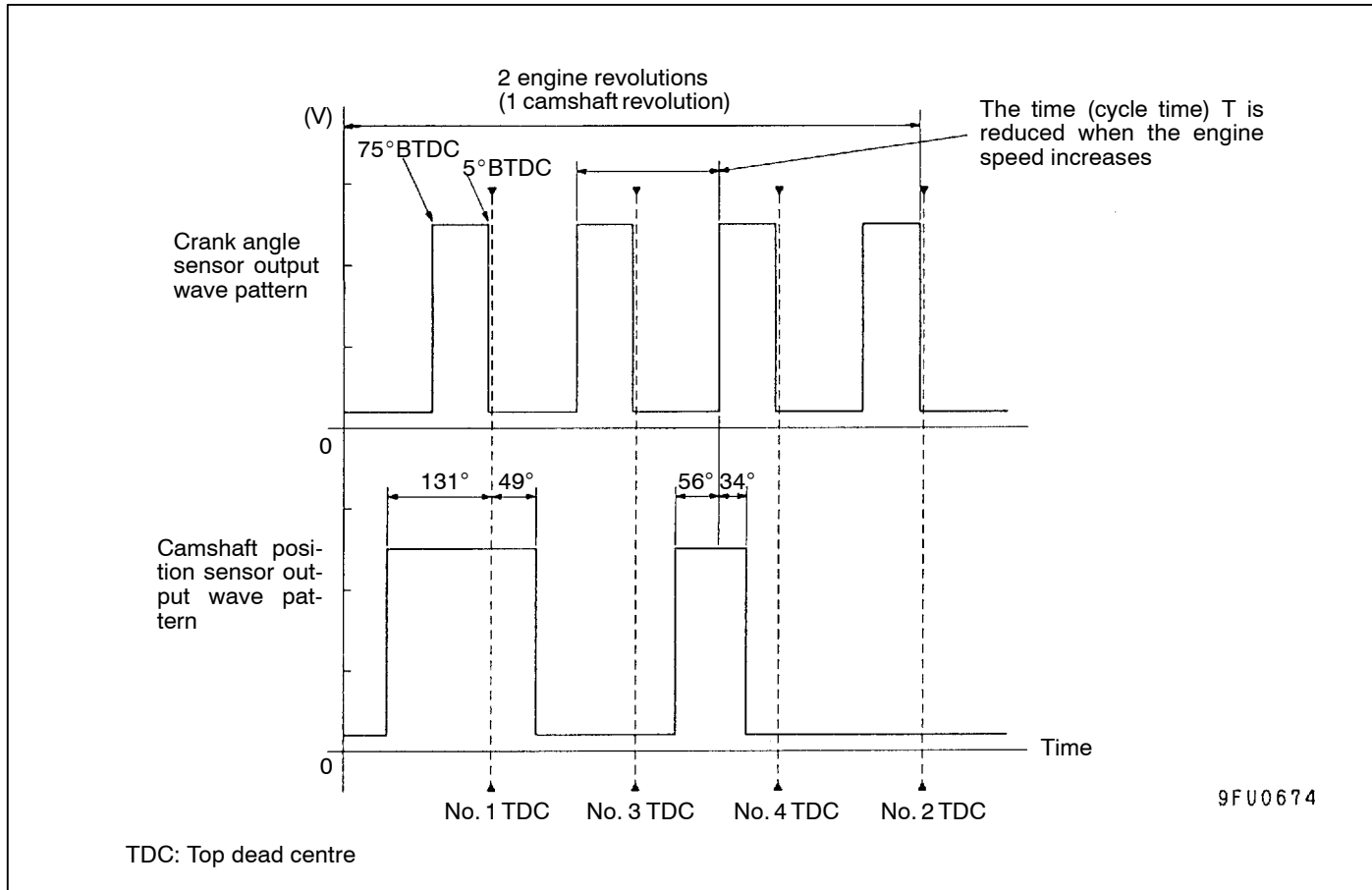
1. Connect the analyzer special patterns pickup to engine-ECU terminal 88. (When checking the camshaft position sensor signal wave pattern.)
2. Connect the analyzer special patterns pickup to engine-ECU terminal 89. (When checking the crank angle sensor signal wave pattern.)

### Standard Wave Pattern

#### Observation conditions

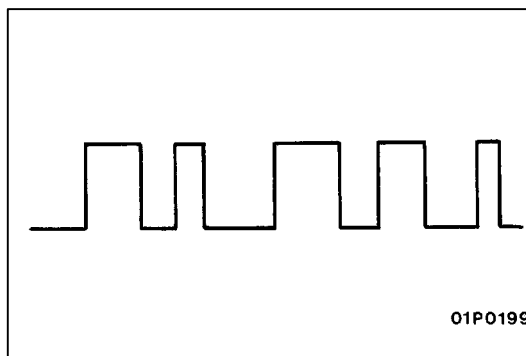
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Idle speed

## Standard wave pattern



## Wave Pattern Observation Points

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



## Examples of Abnormal Wave Patterns

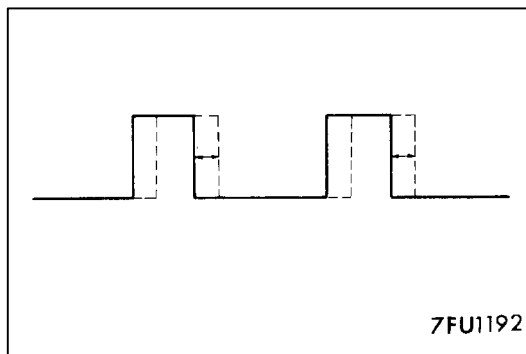
## • Example 1

**Cause of problem**

Sensor interface malfunction

**Wave pattern characteristics**

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



## • Example 2

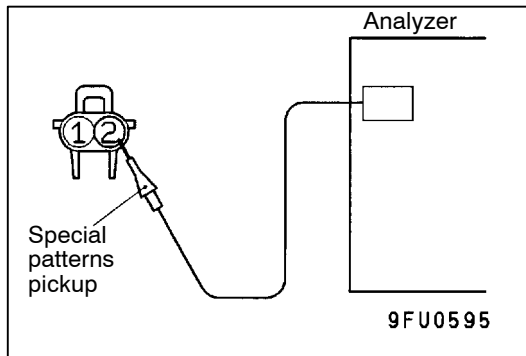
**Cause of problem**

Loose timing belt

Abnormality in sensor disk

**Wave pattern characteristics**

Wave pattern is displaced to the left or right.



## 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)

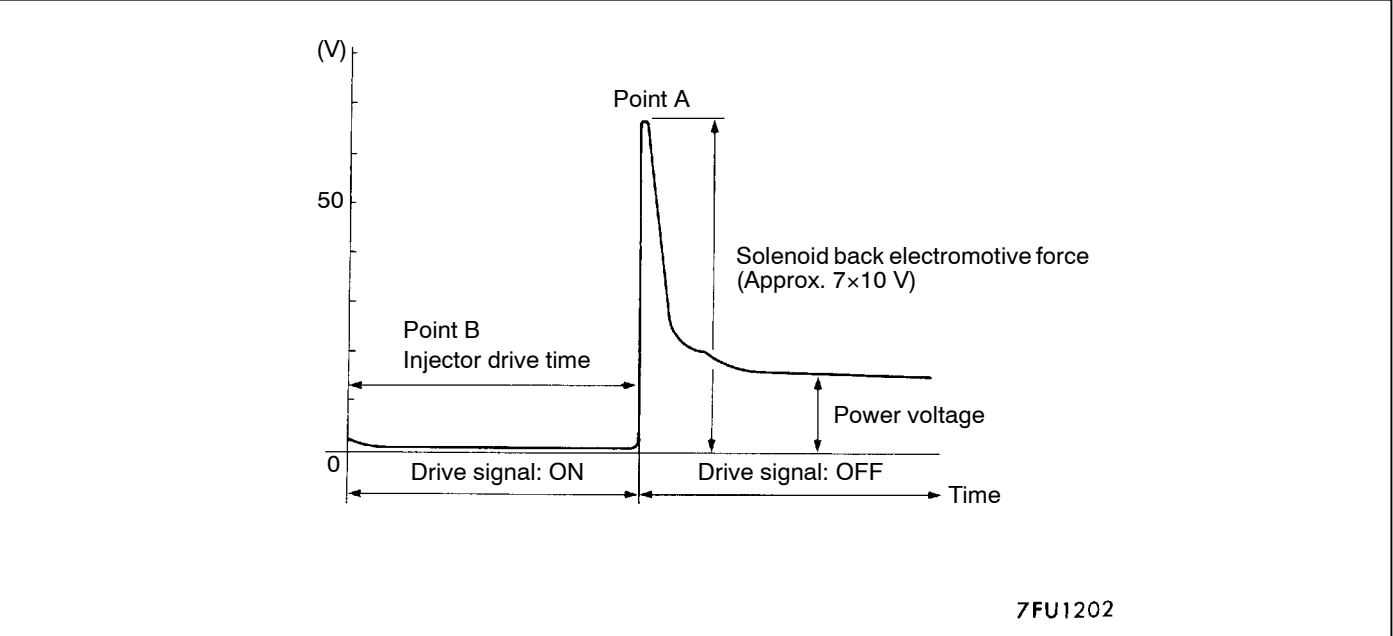
1. Connect the analyzer special patterns pickup to engine-ECU terminal 1. (When checking the No. 1 cylinder.)
2. Connect the analyzer special patterns pickup to engine-ECU terminal 14. (When checking the No. 2 cylinder.)
3. Connect the analyzer special patterns pickup to engine-ECU terminal 2. (When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

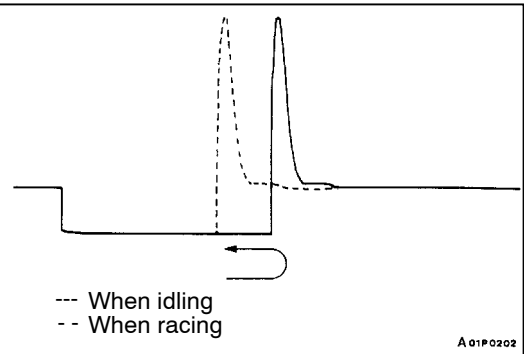


Wave Pattern Observation Points

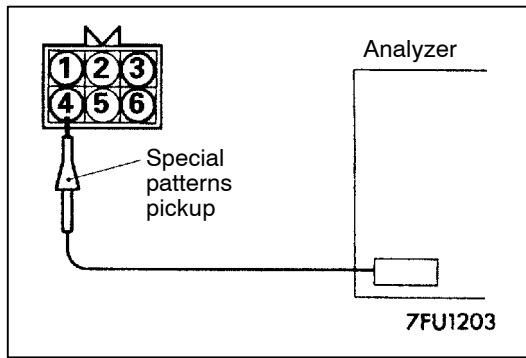
Point A: Height of solenoid back electromotive force

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.



## STEPPER MOTOR

### Measurement Method

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

### Alternate Method (Test harness not available)

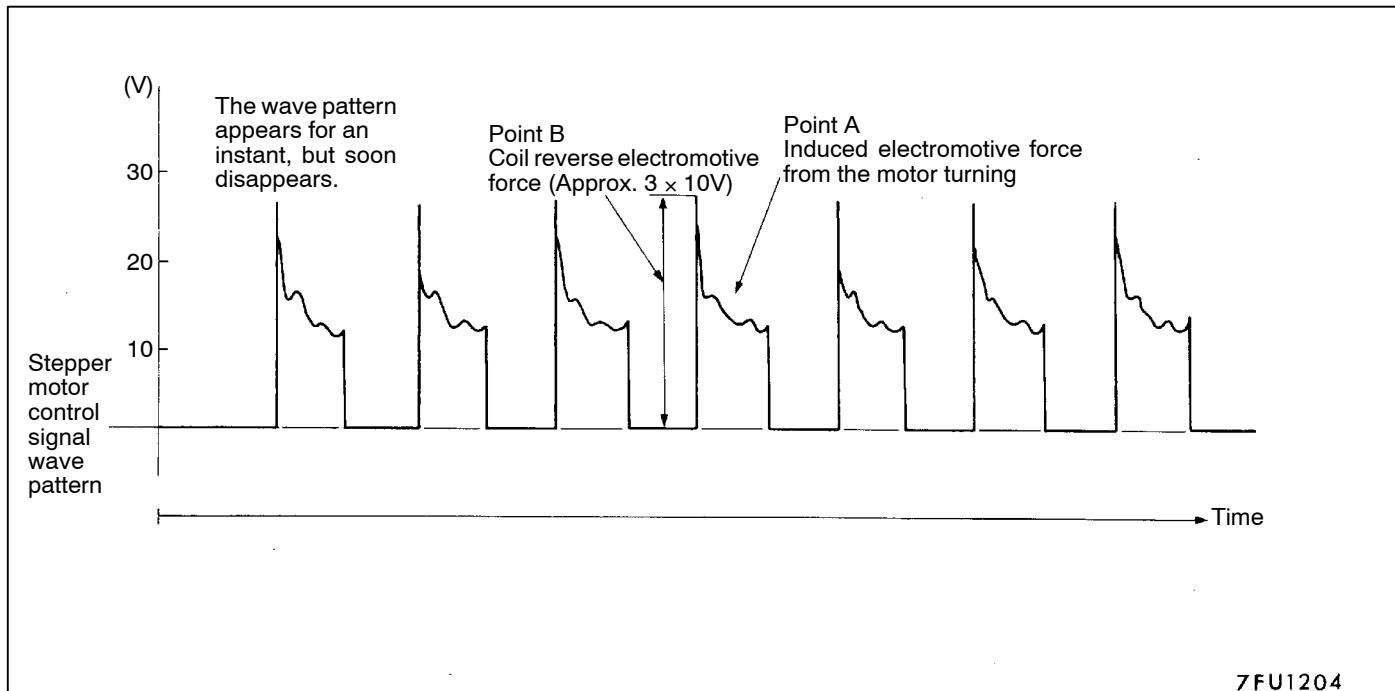
1. Connect the analyzer special patterns pickup to engine-ECU terminal 4, connection terminal 5, connection terminal 17, and connection terminal 18 respectively.

## 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



**Wave Pattern Observation Points**

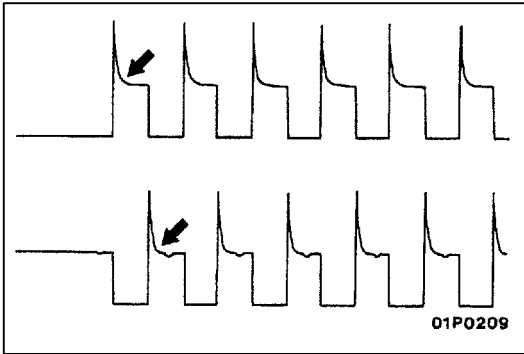
Check that the standard wave pattern appears when the stepper motor is operating.

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

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

Point B: Height of coil reverse electromotive force

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

**Examples of Abnormal Wave Pattern**

- Example 1

**Cause of problem**

Motor is malfunctioning. (Motor is not operating.)

**Wave pattern characteristics**

Induced electromotive force from the motor turning does not appear.

- Example 2

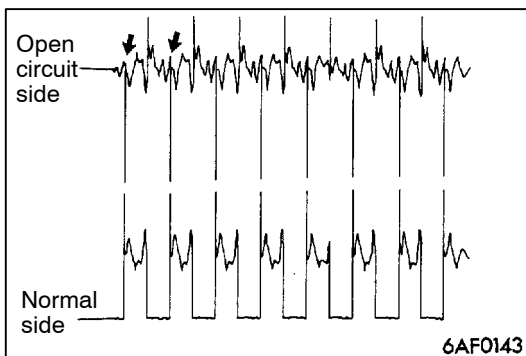
**Cause of problem**

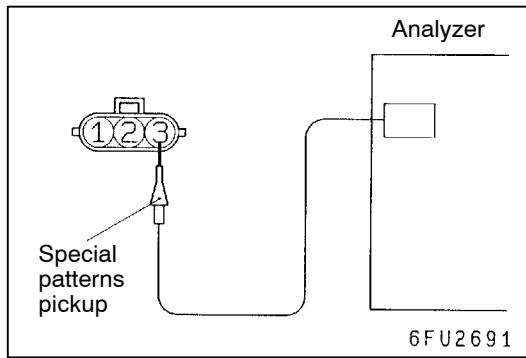
Open circuit in the line between the stepper motor and the engine-ECU.

**Wave pattern characteristics**

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

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



**IGNITION COIL AND POWER TRANSISTOR**

Power transistor control signal

**Measurement Method**

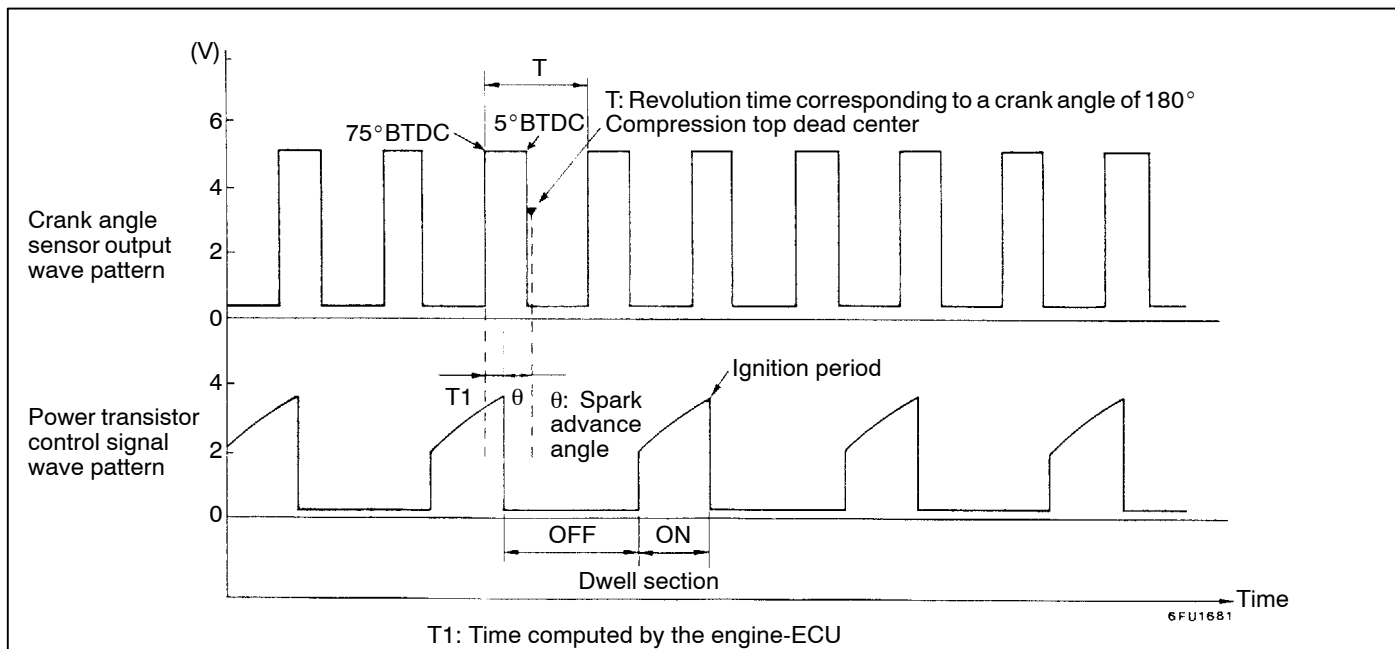
1. Disconnect the ignition coil connector, and connect the special tool (test harness: MB991348) in between. (All terminals should be connected.)
2. Connect the analyzer special patterns pickup to terminal 3 of each ignition coil connector in turn.

**Alternate Method (Test harness not available)**

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

**Standard Wave Pattern****Observation condition**

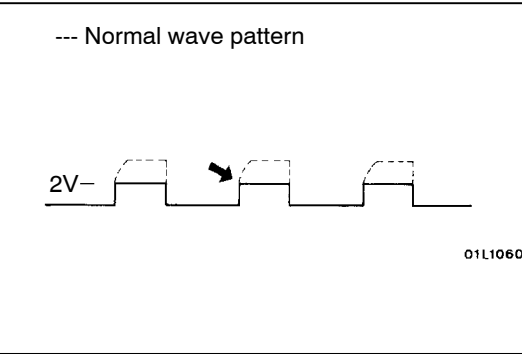
Function	Special patterns
Pattern height	Low
Pattern selector	Display
Engine r/min	Approx. 1,200 r/min

**Standard wave pattern**

Wave Pattern Observation Points

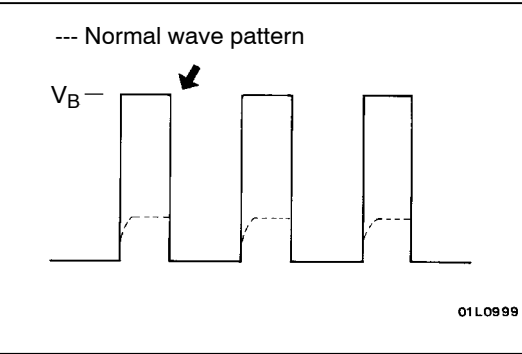
Point: Condition of wave pattern build-up section and maximum voltage (Refer to abnormal wave pattern examples 1 and 2.)

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**

13100100306

**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**

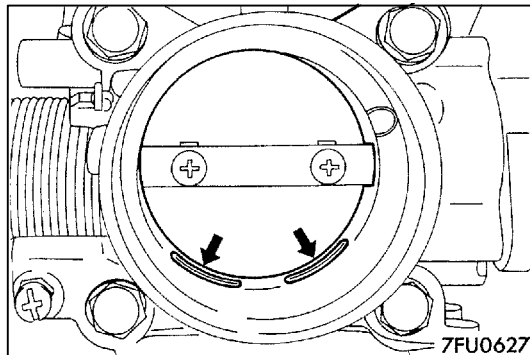
**Do not allow cleaning solvent to enter the bypass passage.**

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.13A-83.)

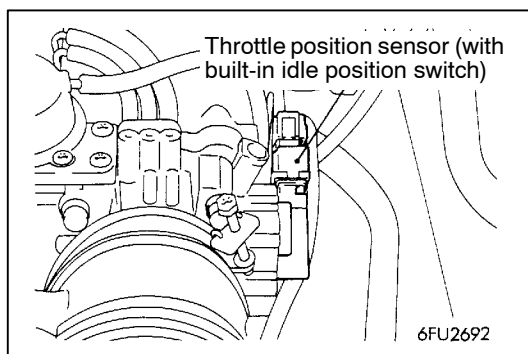
**NOTE**

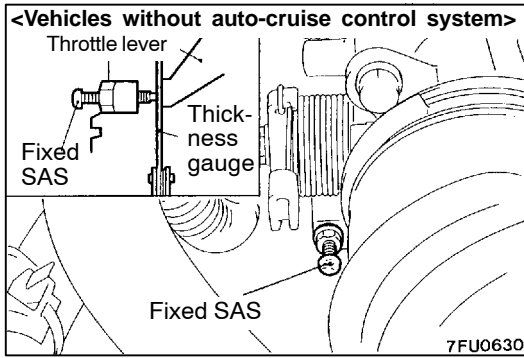
If the engine hunts while idling after adjustment of the basic idle speed, disconnect the (–) cable from the battery for 10 seconds or more, and then reconnect it and run the engine at idle for about 10 minutes.

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

13100130268

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

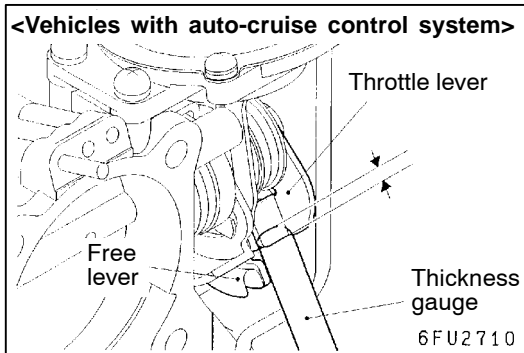




2. Insert a thickness gauge as follows:

**<Vehicles without auto-cruise control system>**

Insert a thickness gauge with a thickness of 0.45 mm between the fixed SAS and the throttle lever.



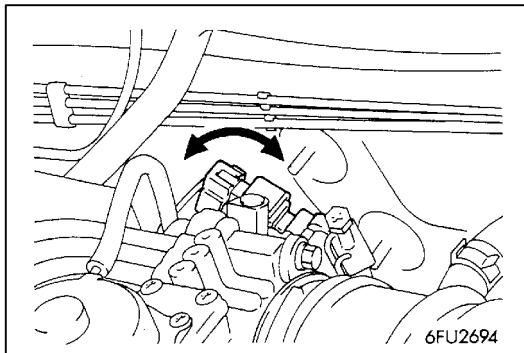
**<Vehicles with auto-cruise control system>**

Insert a 1.4-mm thick thickness gauge up to approx. 3 mm between the levers shown in the figure.

**NOTE**

Do not insert the thickness gauge 3 mm or more. If doing that, the throttle lever opening angle becomes larger than the predetermined angle, causing maladjustment.

3. Turn the ignition switch to ON (but do not start the engine).

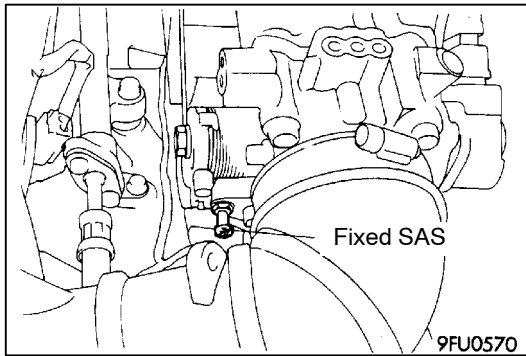


4. Loosen the throttle position sensor mounting bolt, and then turn the throttle position sensor anti-clockwise as far as it will go.
5. Check that the idle position switch is ON at this position.
6. Slowly turn the throttle position sensor clockwise and find the point where the idle position switch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

7. Check the throttle position sensor output voltage.

**Standard value: 400 - 1,000 mV**

8. If there is a deviation from the standard value, check the throttle position sensor and the related harness.
9. Remove the thickness gauge.
10. Turn the ignition switch to OFF.
11. Disconnect the MUT-II.

**FIXED SAS ADJUSTMENT**

13100150301

**NOTE**

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

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

**BASIC IDLE SPEED ADJUSTMENT**

13100180348

**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. Start the engine and run at idle.

4. Select the item No.30 of the MUT-II Actuator test.

**NOTE**

This holds the ISC servo at the basic step to adjust the basic idle speed.

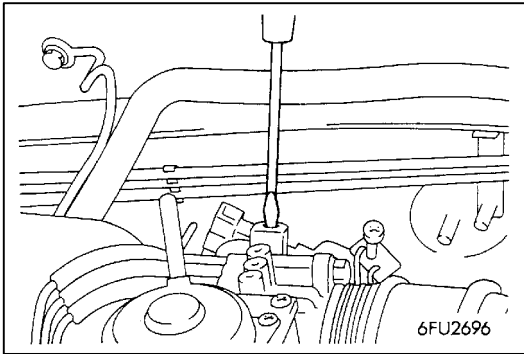
5. Check the idle speed.

**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.13A-81.)



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

**NOTE**

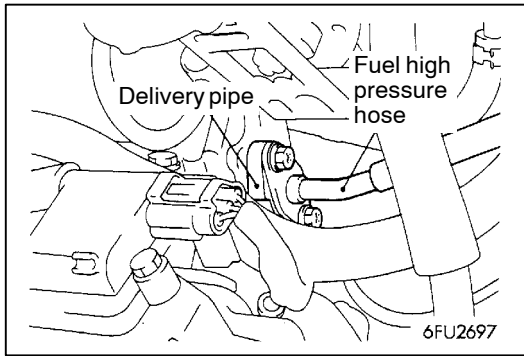
If the idling speed is higher than the standard value range even when the SAS is fully closed, check whether or not there is any indication that the fixed SAS has been moved. If there is an indication that it has been moved, adjust the fixed SAS.

7. Press the MUT-II clear key, and release the ISC servo from the Actuator test mode.

**NOTE**

Unless the ISC servo is released, the Actuator test mode will continue 27 minutes.

8. Switch OFF the ignition switch.
9. Disconnect the MUT-II.
10. Start the engine again and let it run at idle speed for about 10 minutes; check that the idling condition is normal.

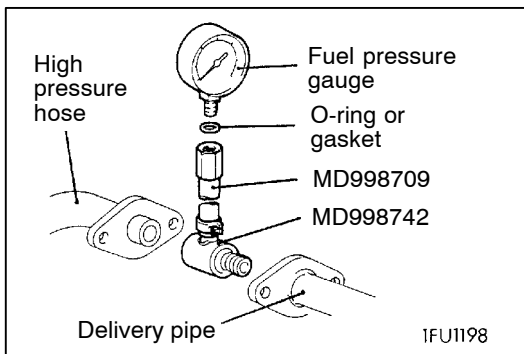
**FUEL PRESSURE TEST**

13100190303

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

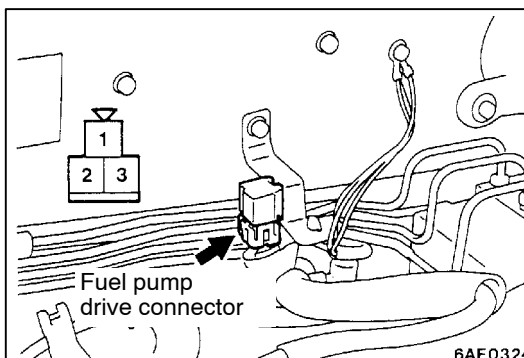
**Caution**

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



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

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

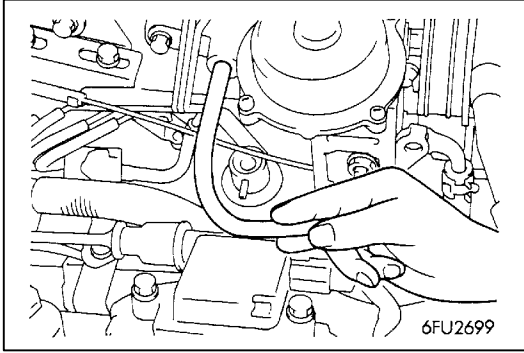


6. Connect the No. 2 terminal of 3 pin connector (fuel pump drive terminal) shown in the figure at left to the battery (+) terminal using a jumper wire and drive the fuel pump. Under fuel pressure, check the fuel pressure gauge and special tool connections for leaks.

7. Disconnect the jumper wire from the fuel pump drive terminal to stop the fuel pump.
8. Start the engine and run at idle.
9. Measure fuel pressure while the engine is running at idle.

**Standard value:**

**Approx. 265 kPa at kerb idle**



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

**Standard value:**

**324 - 343 kPa at kerb idle**

11. Check to see that fuel pressure at idle does not drop even after the engine has been raced several times.

12. Racing the engine repeatedly, hold the fuel return hose lightly with fingers to feel that fuel pressure is present in the return hose.

**NOTE**

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

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

Symptom	Probable cause	Remedy
<ul style="list-style-type: none"> <li>Fuel pressure too low</li> <li>Fuel pressure drops after racing</li> <li>No fuel pressure in fuel return hose</li> </ul>	Clogged fuel filter	Replace fuel filter
	Fuel leaking to return side due to poor fuel regulator valve seating or settled spring	Replace fuel pressure regulator
	Low fuel pump delivery pressure	Replace fuel pump
Fuel pressure too high	Binding valve in fuel pressure regulator	Replace fuel pressure regulator
	Clogged fuel return hose or pipe	Clean or replace hose or pipe
Same fuel pressure when vacuum hose is connected and when disconnected	Damaged vacuum hose or clogged nipple	Replace vacuum hose or clean nipple

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

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

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

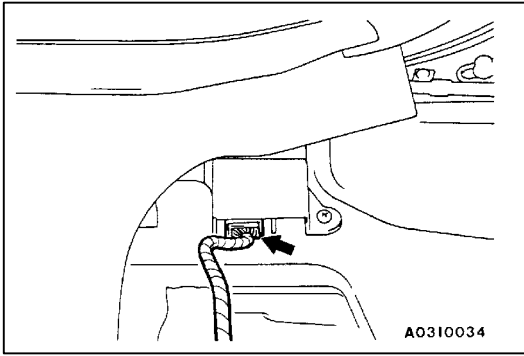
**Caution**

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

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

**Tightening torque: 5 Nm**

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

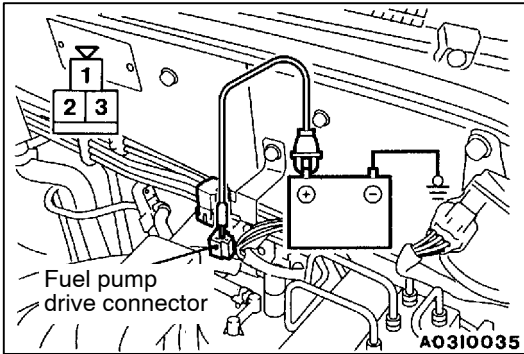


## FUEL PUMP CONNECTOR DISCONNECTION (HOW TO REDUCE THE FUEL PRESSURE)

13100090252

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. Raise the rear seat cushion.
2. Disconnect the floor wiring harness and fuel wiring harness under the floor carpet.
3. After starting the engine and letting it run until it stops naturally, turn the ignition switch to OFF.
4. Connect the fuel wiring harness and floor wiring harness.
5. Install the rear seat cushion.



## FUEL PUMP OPERATION CHECK

13100200105

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) When the fuel pump drive connector (black) is attached directly to the battery, check if the sound of the fuel pump operation can be heard.

### NOTE

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

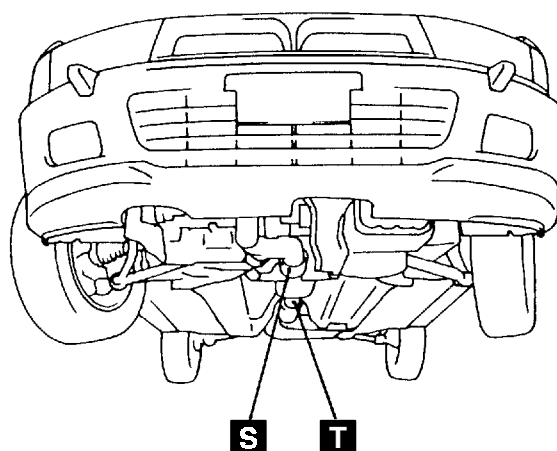
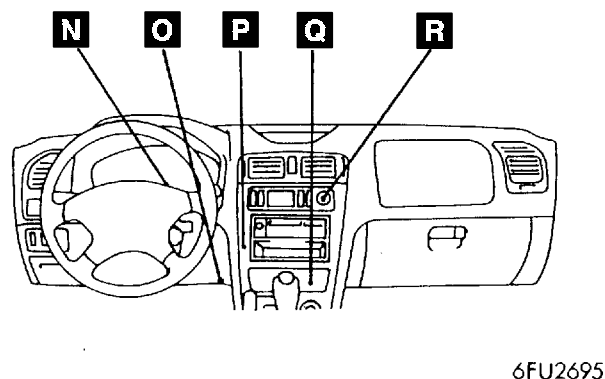
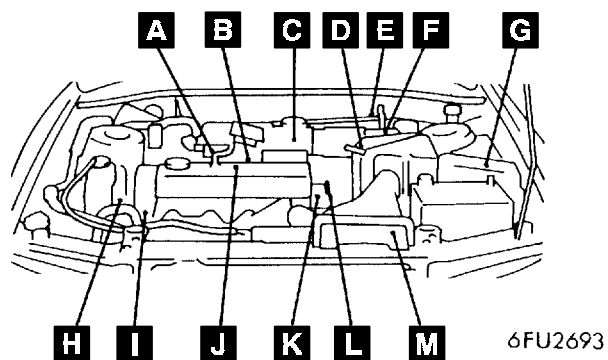
- (3) Check the fuel pressure by pinching the fuel hose with the fingertips.



## COMPONENT LOCATION

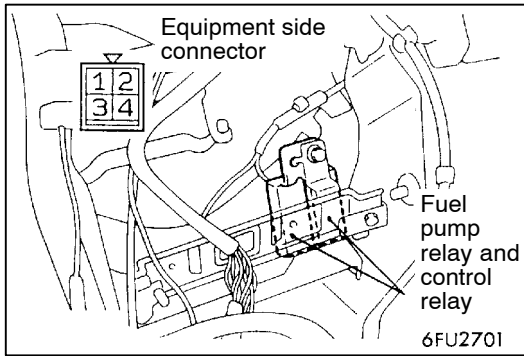
13100210368

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



6FU2698

6FU2700



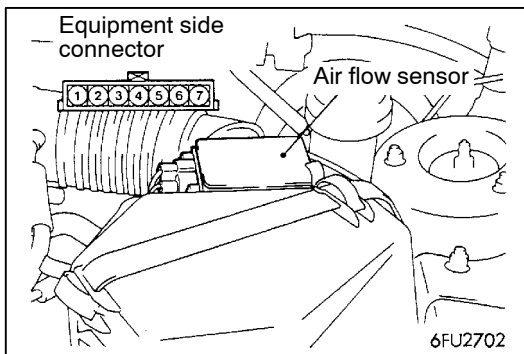
## CONTROL RELAY AND FUEL PUMP RELAY CONTINUITY CHECK

13100990170

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

## INTAKE AIR TEMPERATURE SENSOR CHECK

13100280239

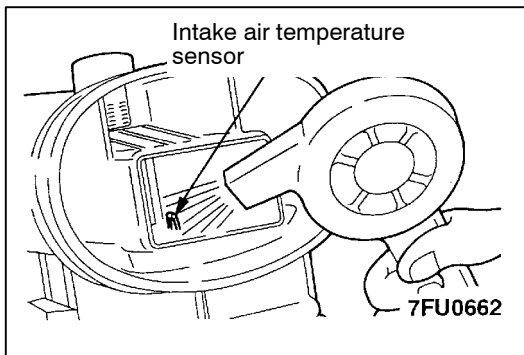


1. Disconnect the air flow sensor connector.
2. Measure resistance between terminals 5 and 6.

### Standard value:

2.3 - 3.0 kΩ (at 20°C)

0.30 - 0.42 kΩ (at 80°C)



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

### Normal condition:

Temperature (°C)	Resistance (kΩ)
Higher	Smaller

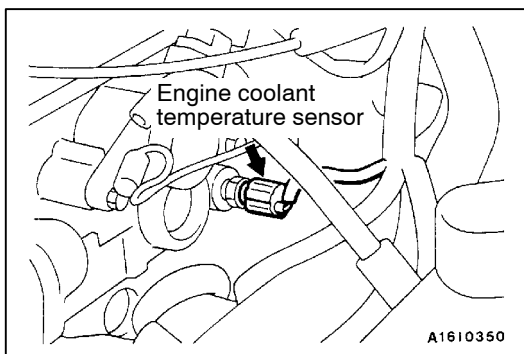
4. If the value deviates from the standard value or the resistance remains unchanged, replace the air flow sensor assembly.

## ENGINE COOLANT TEMPERATURE SENSOR CHECK

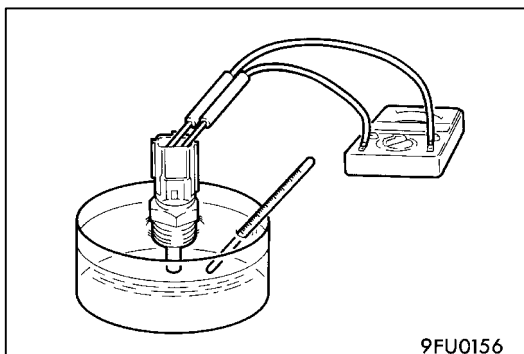
13100310242

### Caution

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



1. Remove the engine coolant temperature sensor.



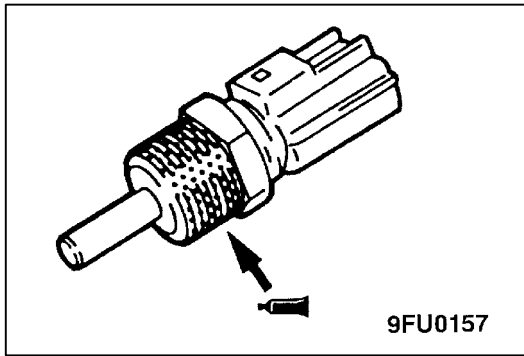
2. With temperature sensing portion of engine coolant temperature sensor immersed in hot water, check resistance.

### Standard value:

2.1 - 2.7 kΩ (at 20°C)

0.26 - 0.36 kΩ (at 80°C)

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



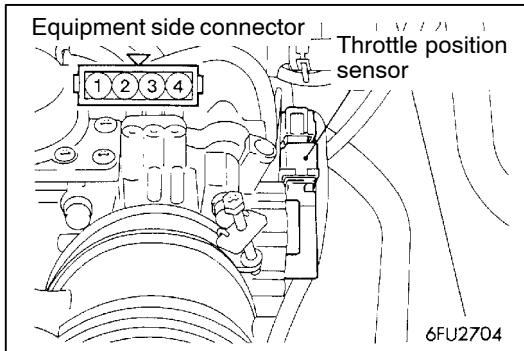
4. Apply sealant to threaded portion.

**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 13100320276

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

**Standard value: 3.5 - 6.5 kΩ**

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

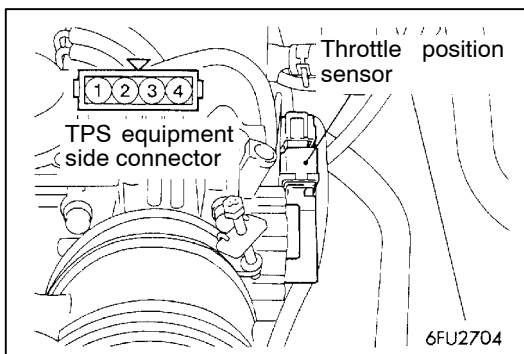
**Normal condition:**

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

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

### NOTE

For the throttle position sensor adjustment procedure, refer to P.13A-81.



## IDLE POSITION SWITCH CHECK 13100330262

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

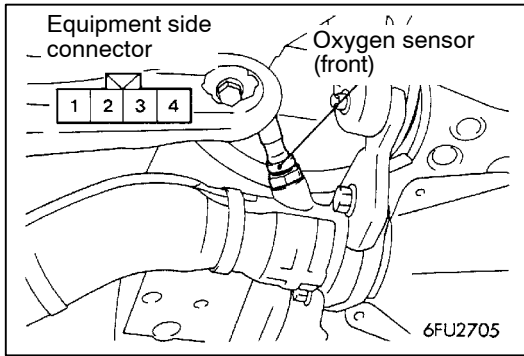
**Normal condition:**

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

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

### NOTE

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

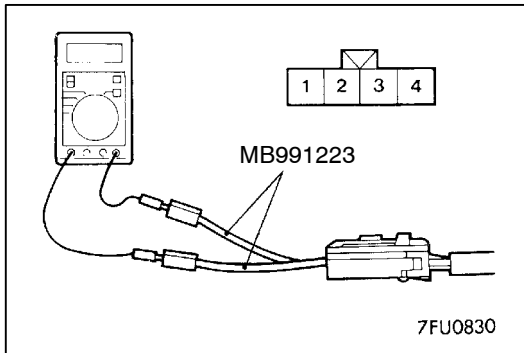


## OXYGEN SENSOR CHECK

13100510161

### <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 ( $11 - 18 \Omega$  at  $20^\circ\text{C}$ ) 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  $80^\circ\text{C}$  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.

### Caution

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

6. Connect a digital voltage meter between terminal 1 and terminal 2.
7. While repeatedly racing the engine, measure the oxygen sensor output voltage.

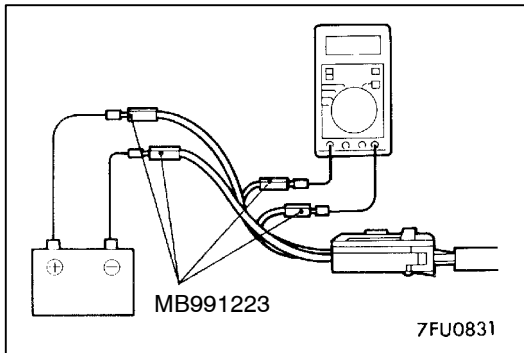
### Standard value:

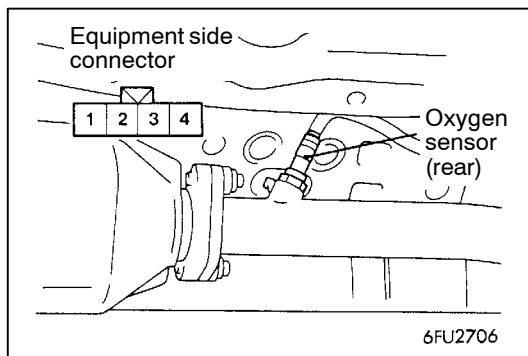
Engine	Oxygen sensor output voltage	Remarks
When racing the engine	0.6 - 1.0 V	If you make the air/fuel ratio rich by racing the engine repeatedly, a normal oxygen sensor will output a voltage of 0.6 - 1.0 V.

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.

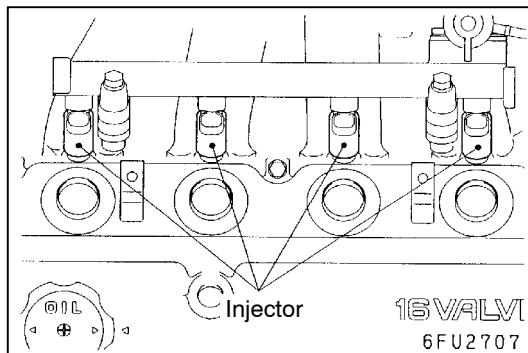
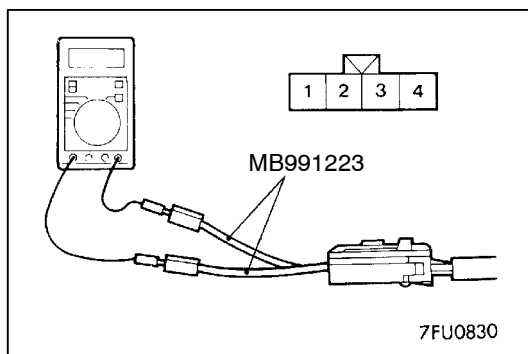


**<Oxygen sensor (rear)>**

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 ( $11 - 18 \Omega$  at  $20^\circ\text{C}$ ) 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**

13100520287

**Measurement of Resistance between Terminals**

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

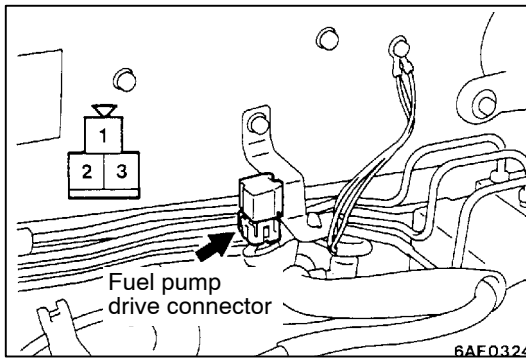
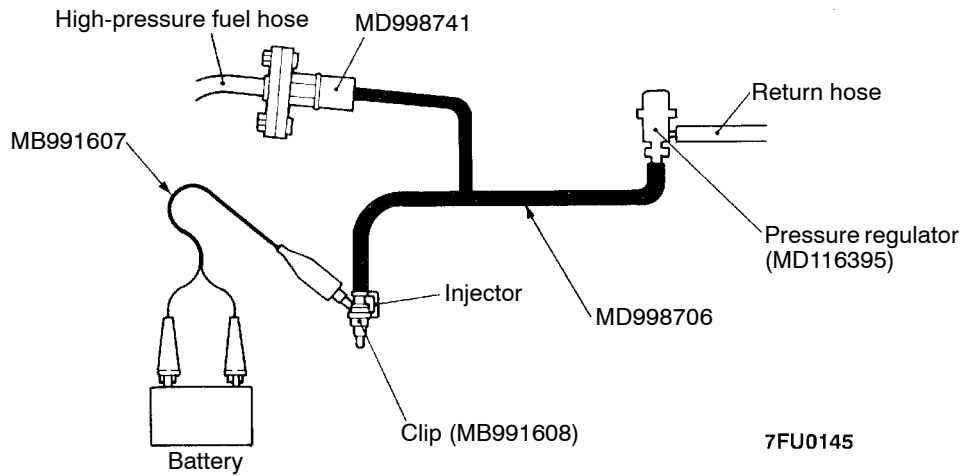
**Standard value:  $13 - 16 \Omega$  (at  $20^\circ\text{C}$ )**

3. Install the injector connector.

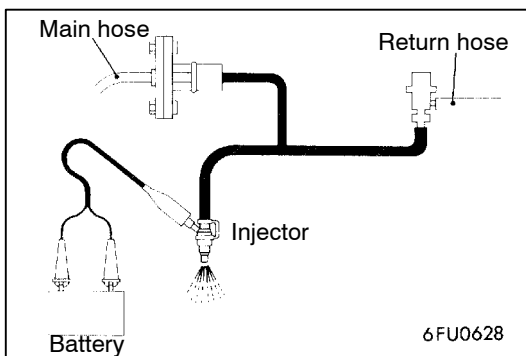
**Checking the Injection Condition**

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

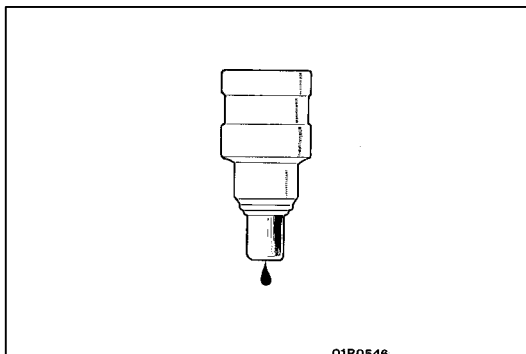
3. Arrange the special tool (injector test set), adaptor, fuel pressure regulator and clips as shown in the illustration below.



4. Apply battery voltage to the No. 2 terminal of 3 pin connector (fuel pump drive connector) shown in the figure at left and drive the fuel pump.



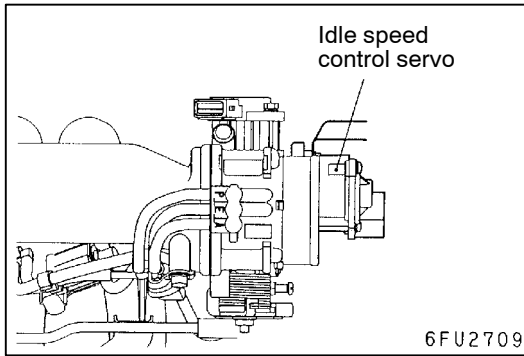
5. Activate the injector and check the atomized spray condition of the fuel. The condition can be considered satisfactory unless it is extremely poor.



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

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

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



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

13100540238

### 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.

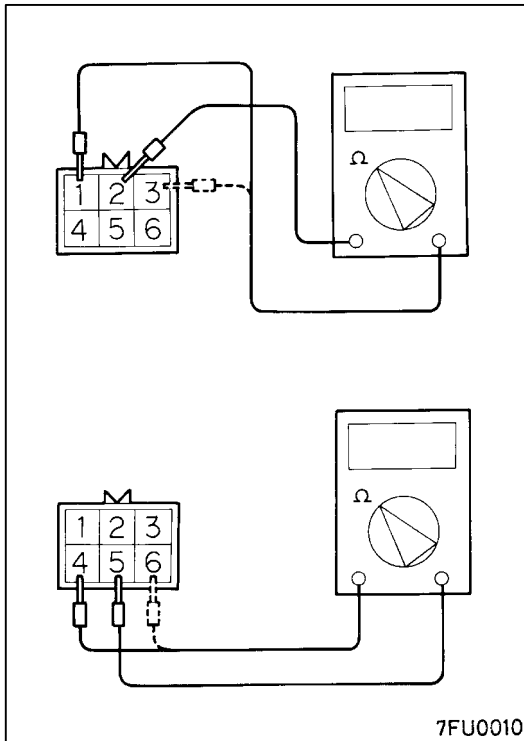
### Checking the Coil Resistance

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

**Standard value: 28 - 33 Ω (at 20°C)**

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

**Standard value: 28 - 33 Ω (at 20°C)**



## PURGE CONTROL SOLENOID VALVE CHECK

13100560241

Refer to GROUP 17 - Emission Control System.

## EGR CONTROL SOLENOID VALVE CHECK

13100570206

Refer to GROUP 17 - Emission Control System.