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# ENGINE AND EMISSION CONTROL

Click on the applicable bookmark to selected the required model year.

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# ENGINE AND EMISSION CONTROL

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# ENGINE CONTROL SYSTEM

## GENERAL INFORMATION

On vehicles with 6G7 and 4M4 engines, an electronic-controlled throttle valve system has been used instead of a conventional cable-type accelerator mechanism.

On 4D5 engine, a cable-type accelerator mechanism and a suspended-type pedal have been used.

## SERVICE SPECIFICATIONS

Items		Standard value
Accelerator cable play mm		1 - 2
Engine idle speed r/min	4D5	750 $\pm$ 100

## ON-VEHICLE SERVICE

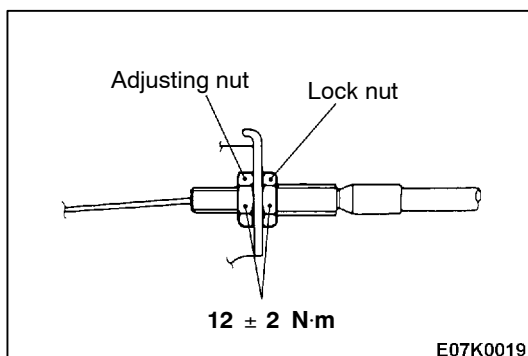
### ACCELERATOR CABLE CHECK AND ADJUSTMENT <4D5>

1. Turn A/C and lamps OFF.  
Inspect and adjust at no load.
2. Warm engine until stabilized at idle.
3. Confirm idle speed is at prescribed value.

**Standard value: 750  $\pm$  100 r/min**

4. Stop engine (ignition switch OFF).
5. Confirm there are no sharp bends in accelerator cable.
6. Check inner cable for correct slack.

**Standard value: 1 - 2 mm**



7. If there is too much slack or no slack, adjust play by the following procedures.
  - (1) Loosen the lock nut and fully close the throttle lever.
  - (2) Tighten the adjusting nut until immediately before the throttle lever starts to move.
  - (3) By loosening the adjusting nut one turn, the accelerator cable play will be brought to the standard value.
  - (4) Fix the adjusting nut with the lock nut.
  - (5) After adjusting, check that the throttle lever is touching the stopper.

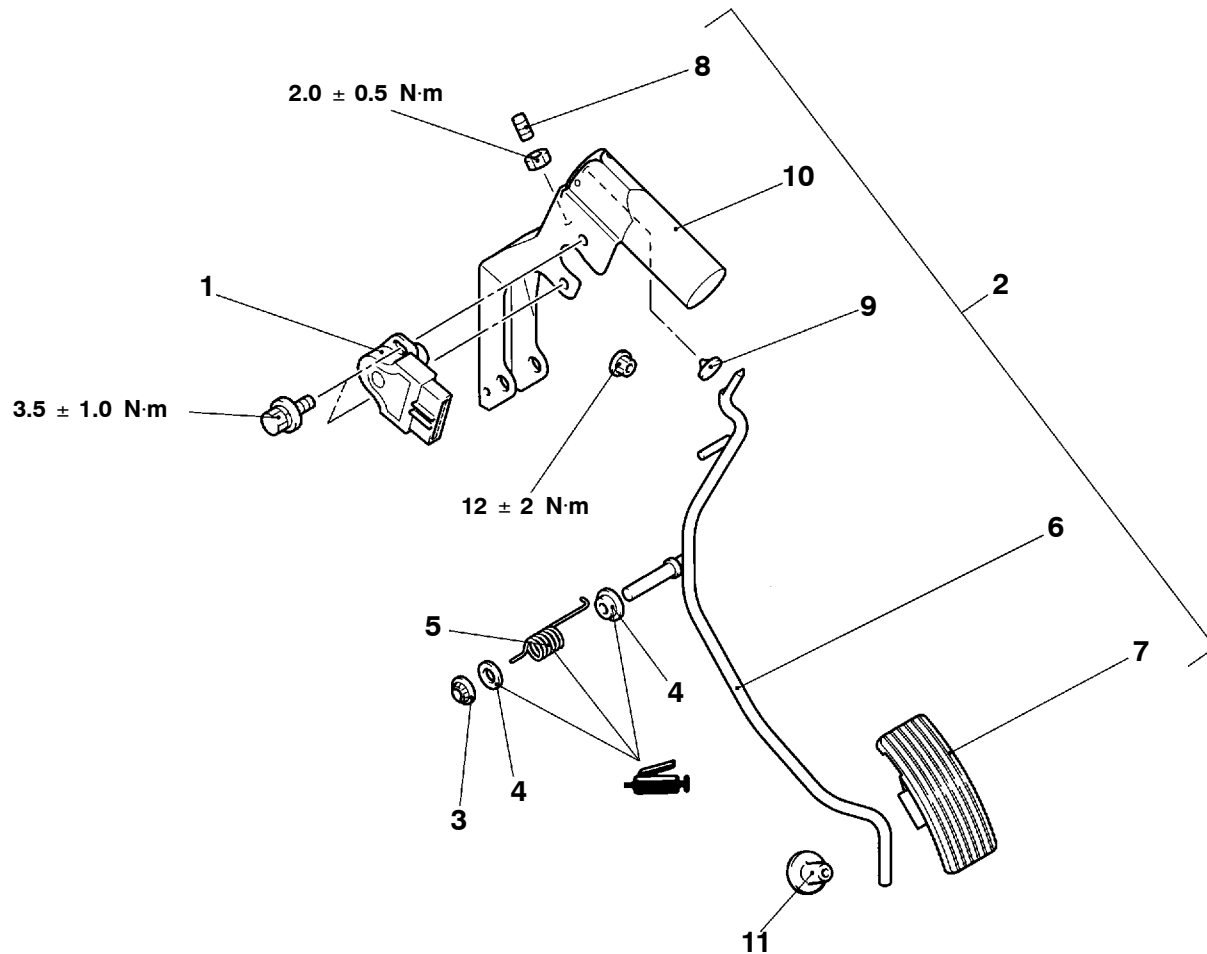
# ACCELERATOR CABLE AND PEDAL

## REMOVAL AND INSTALLATION

<6G7, 4M4>

### Post-installation Operation

Check and Adjustment of the Accelerator Pedal Position Sensor (Refer to GROUP 13A, C - On-vehicle Service.)



AX0520CA

### Removal steps

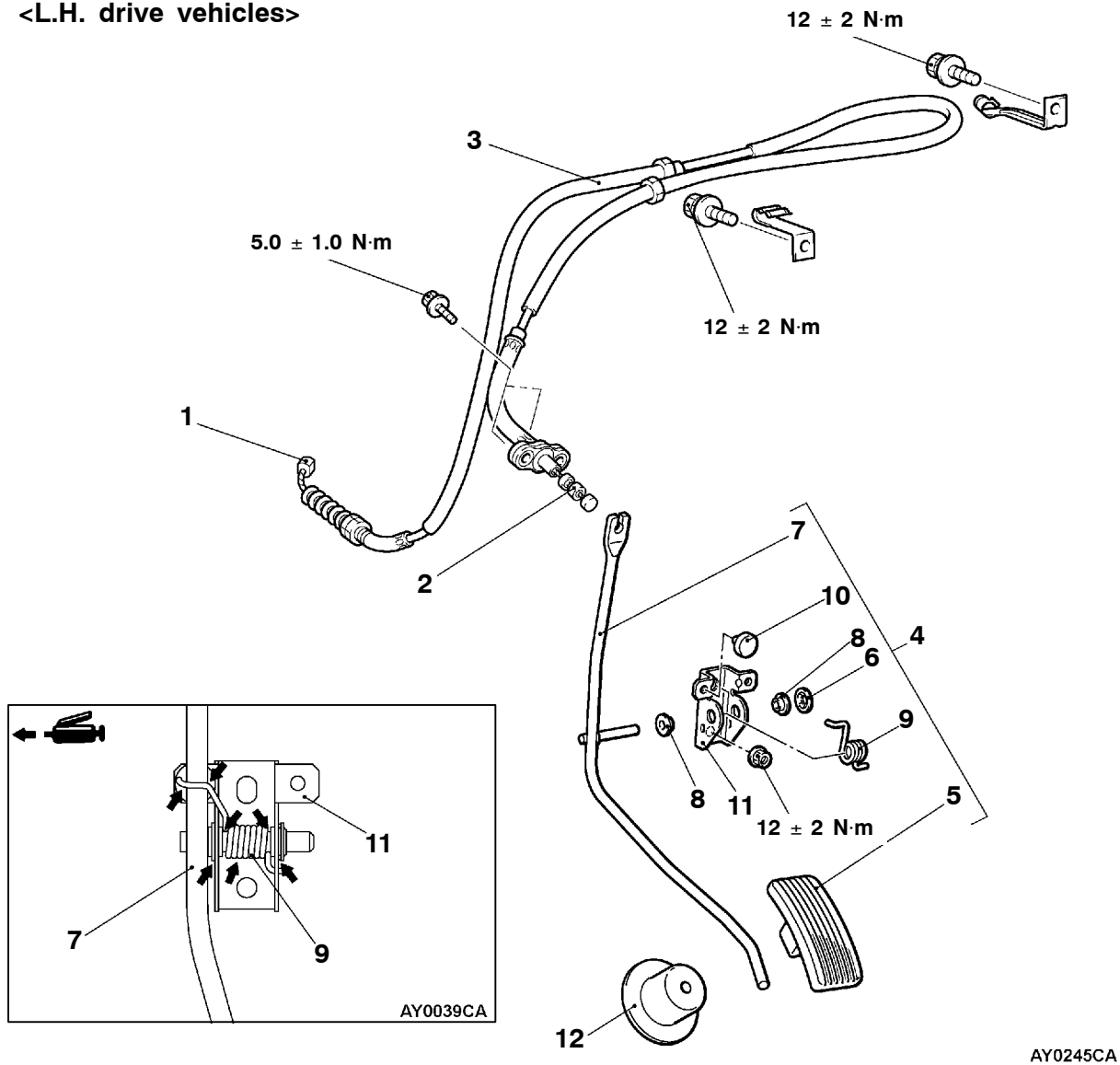
- |                                      |                                       |
|--------------------------------------|---------------------------------------|
| 1. Accelerator pedal position sensor | 7. Accelerator pedal pad              |
| 2. Accelerator pedal assembly        | 8. Adjusting screw                    |
| 3. Push-on spring nut                | 9. Stopper                            |
| 4. Bushing                           | 10. Accelerator pedal bracket         |
| 5. Return spring                     | 11. Stopper <R.H. drive vehicles-M/T> |
| 6. Accelerator pedal                 |                                       |

&lt;4D5&gt;

**Post-installation Operation**

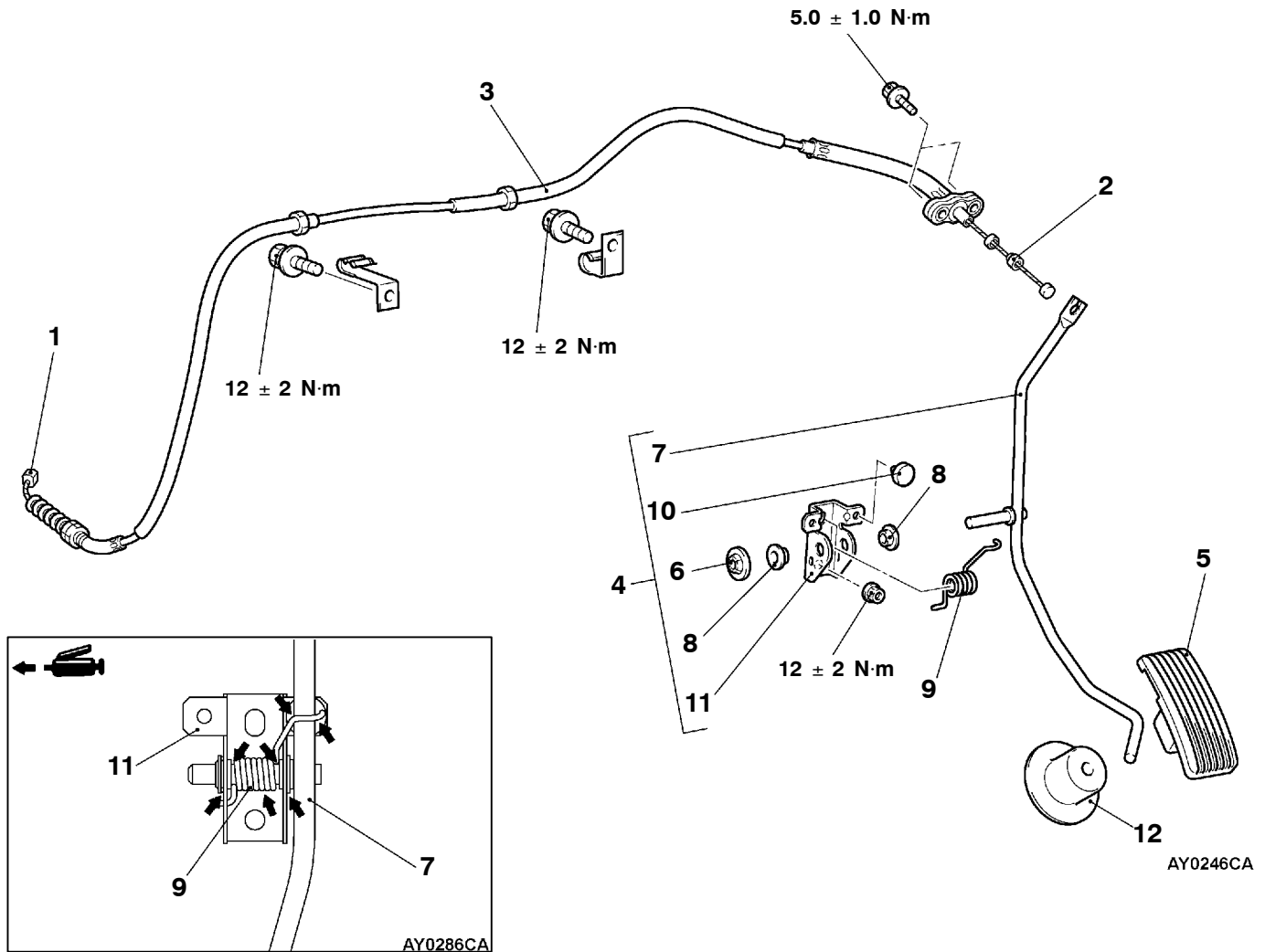
Adjusting the Accelerator Cable (Refer to P.17-3.)

&lt;L.H. drive vehicles&gt;

**Removal steps**

- |   |                               |
|---|-------------------------------|
| 1. Inner cable connection<br>(Throttle body side)     | 6. Push-on spring nut         |
| 2. Inner cable connection<br>(Accelerator pedal side) | 7. Accelerator arm            |
| 3. Accelerator cable                                  | 8. Bushing                    |
| 4. Accelerator pedal assembly                         | 9. Spring                     |
| 5. Accelerator pedal pad                              | 10. Stopper                   |
|   | 11. Accelerator pedal bracket |
|   | 12. Accelerator pedal stopper |

&lt;R.H. drive vehicles&gt;

**Removal steps**

1. Inner cable connection (Throttle body side)
2. Inner cable connection (Accelerator pedal side)
3. Accelerator cable
4. Accelerator pedal assembly
5. Accelerator pedal pad
6. Push-on spring nut
7. Accelerator arm
8. Bushing
9. Spring
10. Stopper
11. Accelerator pedal bracket
12. Accelerator pedal stopper

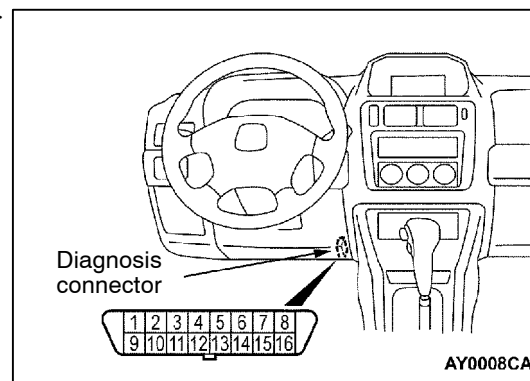
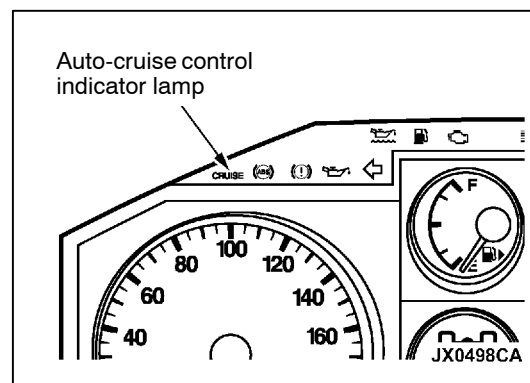
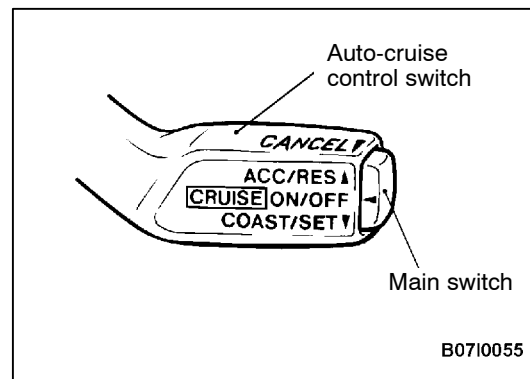
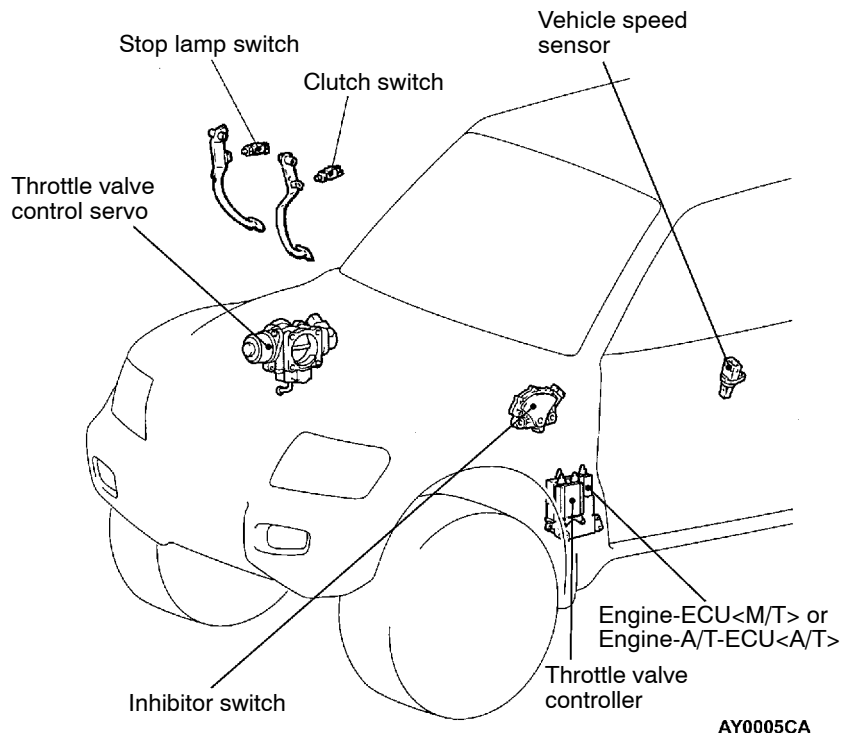
# AUTO-CRUISE CONTROL SYSTEM

## GENERAL INFORMATION

By using the auto-cruise control, the driver can drive at the speed he/she likes (in a range of

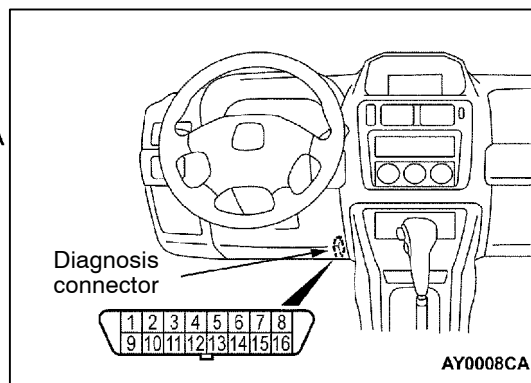
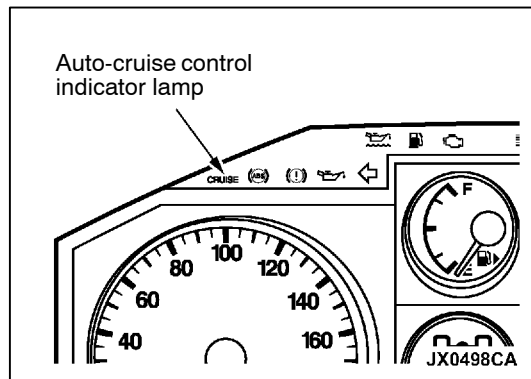
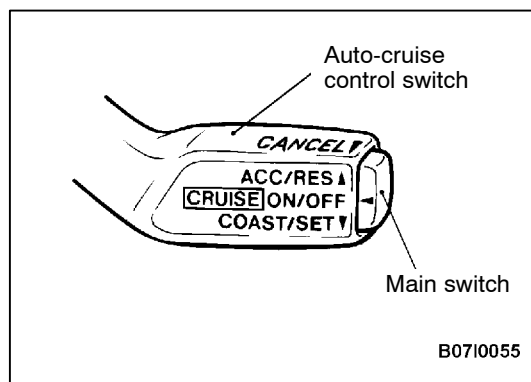
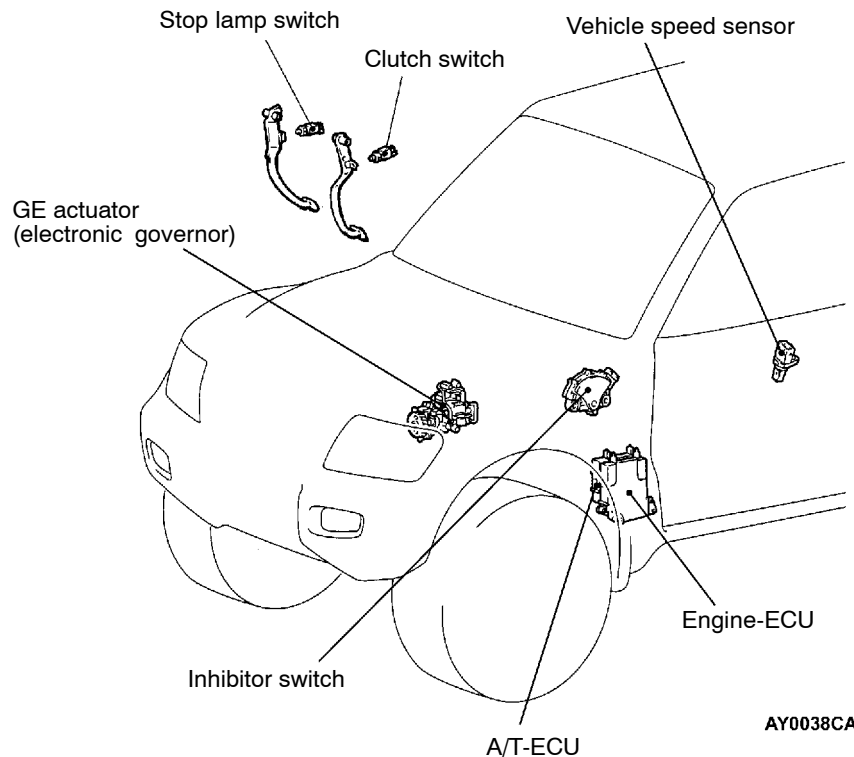
approximately 40-200 km/h) without depressing the accelerator pedal.

<6G7>





<4M4>



## SPECIAL TOOL

Tool	Number	Name	Use
<p>B991502</p>	MB991502	MUT-II sub assembly	<ul style="list-style-type: none"> <li>Reading diagnosis codes</li> <li>Auto-cruise control system check</li> </ul>

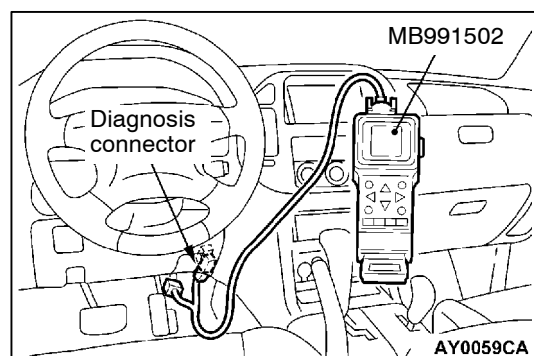
## TROUBLESHOOTING

### STANDARD FLOW OF DIAGNOSIS TROUBLESHOOTING

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

#### NOTE

Check that the vacuum hose is connected correctly and is not damaged, and then carry out the diagnosis.



### DIAGNOSIS FUNCTION

#### METHOD OF READING THE DIAGNOSIS CODES

##### Using the MUT-II

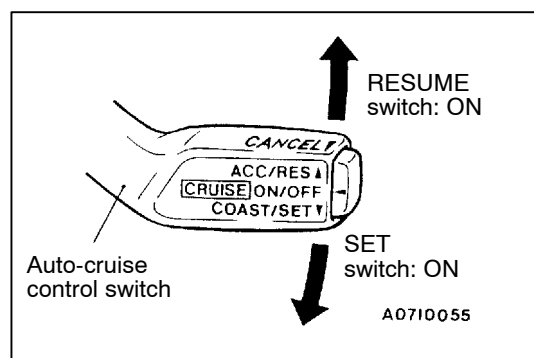
1. Connect the MUT-II to the diagnosis connector (16-pin) under the instrument under cover.
2. With the ignition switch in the ON position, take a reading of the diagnosis codes.

#### Caution

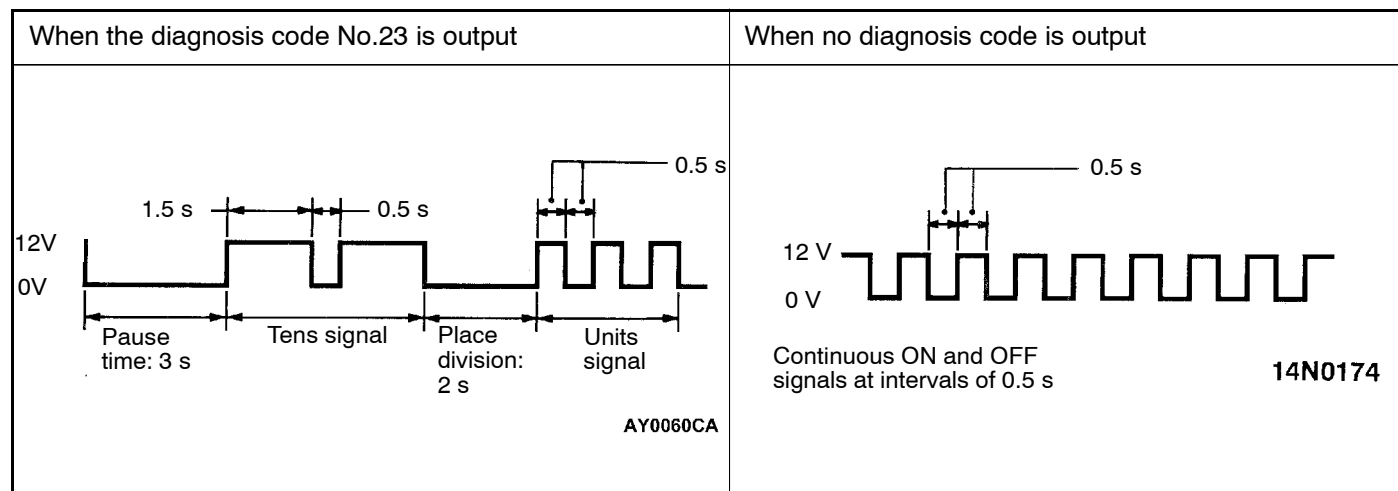
Turn off the ignition switch before connecting or disconnecting the MUT-II.

##### Using a Auto-cruise Control Indicator Lamp

1. Turn the ignition switch ON with the SET switch on. Then, turn the RESUME switch ON within 1 second.
2. Read a diagnosis code by observing the flash display pattern of the auto-cruise control indicator lamp in the combination meter.



### Indication of diagnosis code by auto-cruise control indicator lamp



#### NOTE

Other on-board diagnostic items are also output as voltage waveforms corresponding to diagnosis code numbers.

## METHOD OF ERASING THE DIAGNOSIS CODES

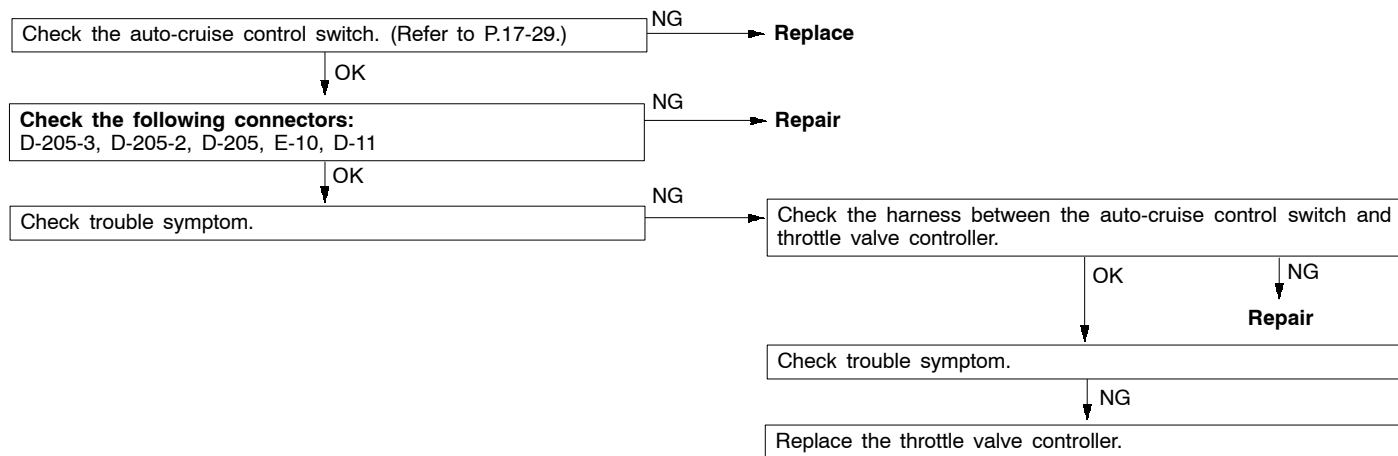
Refer to GROUP 00 - How to Use Troubleshooting/Inspection Service Points.

### INSPECTION CHART FOR DIAGNOSIS CODES <6G7>

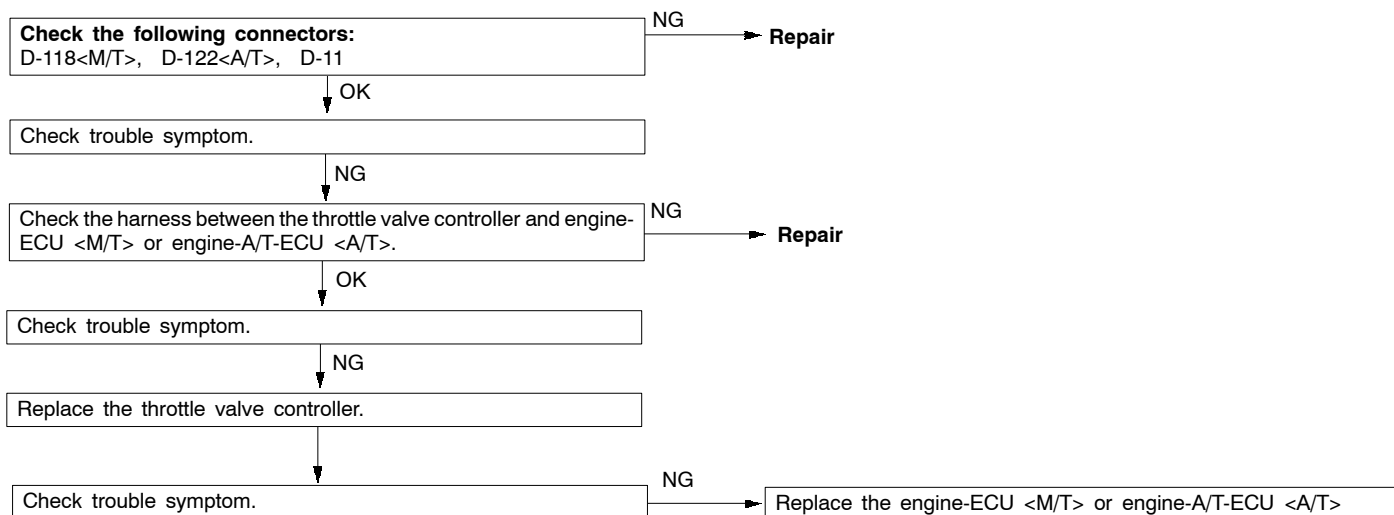
Code No.	Diagnosis item	Reference page
15	Auto-cruise control switch system	17-10
21	Cancel latch signal system	17-11
22	Stop lamp switch system	17-11
23	Engine-ECU <M/T> or engine-A/T-ECU <A/T> system	17-12

### INSPECTION PROCEDURE FOR DIAGNOSIS CODES <6G7>

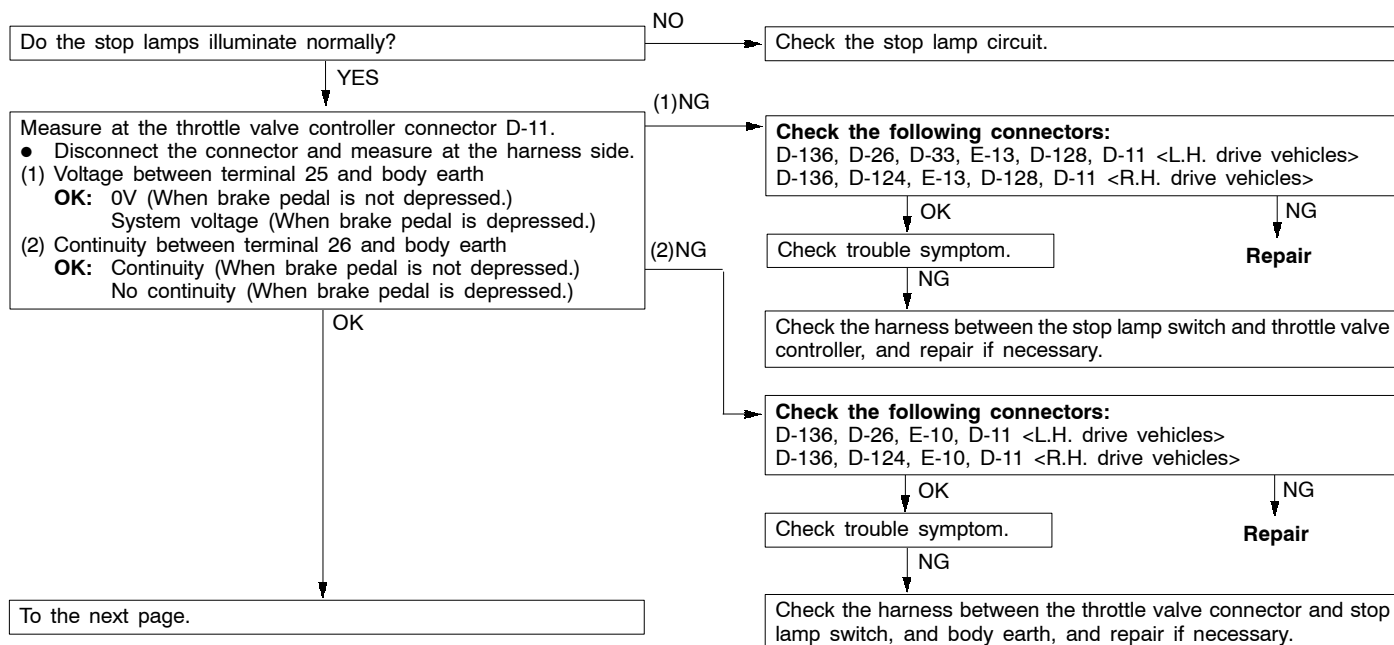
Code No. 15 Auto-cruise control switch system	Probable cause
This diagnosis code is output if the RESUME and SET switches of the auto-cruise control switch remain on.	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the throttle valve controller</li> </ul>

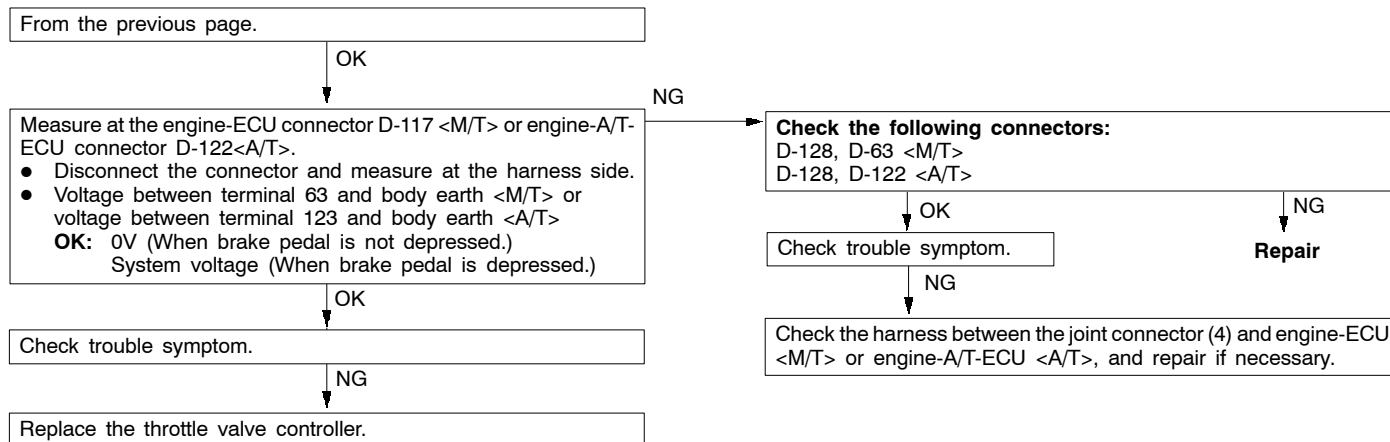


Code No. 21 Cancel latch signal system	Probable cause
<p>The throttle valve controller and engine-ECU &lt;M/T&gt; or engine-A/T-ECU &lt;A/T&gt; send a cancel holding information to the engine-ECU &lt;M/T&gt; or engine-A/T-ECU &lt;A/T&gt; via a cancel latch signal line and the serial communication line.</p> <p>This diagnosis code is output if there is a failure in the cancel latch signal line, or a disaccord in the communication data.</p>	<ul style="list-style-type: none"> <li>● Malfunction of the connector</li> <li>● Malfunction of the harness</li> <li>● Malfunction of the throttle valve controller</li> <li>● Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>● Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> </ul>

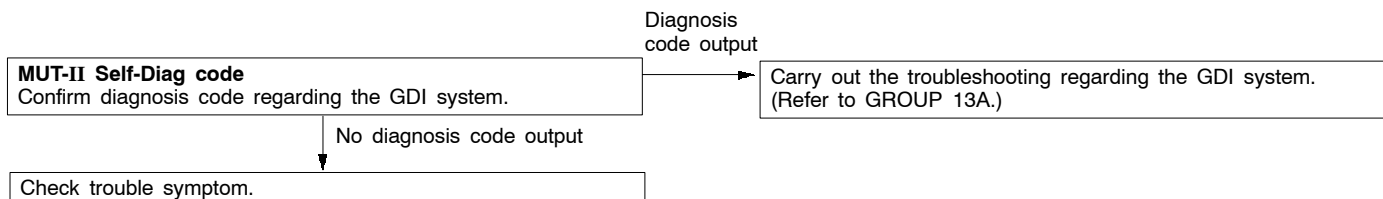


Code No. 22 Stop lamp switch system	Probable cause
<p>This diagnosis code is output when the throttle valve controller detects a failure in the stop lamp switch output.</p>	<ul style="list-style-type: none"> <li>● Malfunction of the stop lamp switch</li> <li>● Malfunction of the connector</li> <li>● Malfunction of the harness</li> <li>● Malfunction of the throttle valve controller</li> </ul>





Code No. 23 Engine-ECU <M/T> or engine-A/T-ECU <A/T> system	Probable cause
<p>This diagnosis code is output if the engine-ECU &lt;M/T&gt; or engine-A/T-ECU &lt;A/T&gt; system is defective as follows:</p> <ul style="list-style-type: none"> <li>Communication error between the throttle valve controller and the engine-ECU &lt;M/T&gt;</li> <li>Communication error between the throttle valve controller and the engine-A/T-ECU &lt;A/T&gt;</li> <li>Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> <li>Malfunction of the throttle position sensor</li> <li>Malfunction of the accelerator pedal position sensor</li> <li>Malfunction of the throttle control servo</li> <li>Malfunction of the vehicle speed sensor</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> </ul>

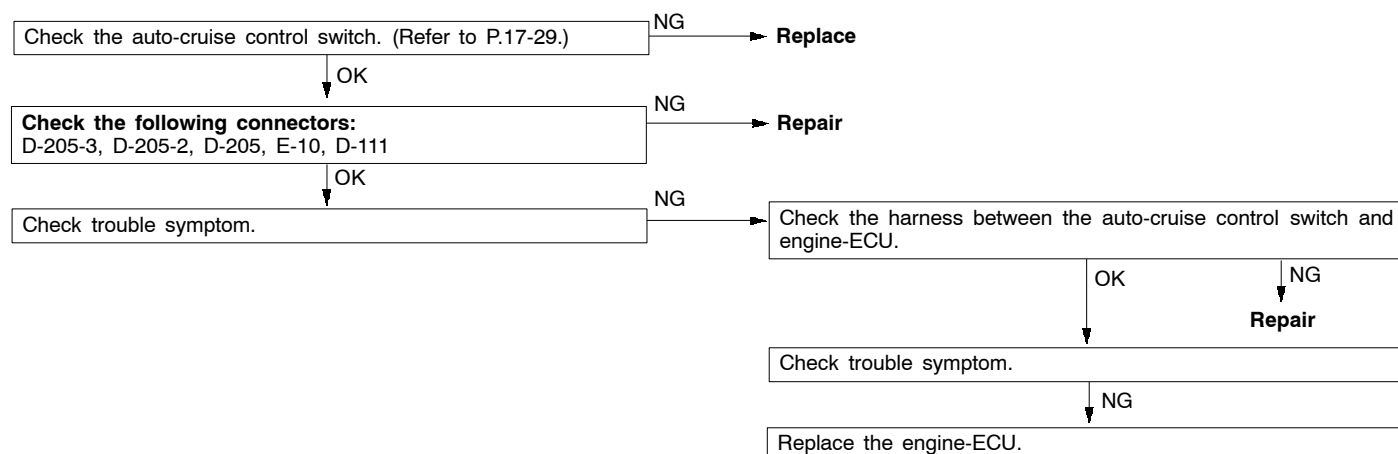


# INSPECTION CHART FOR DIAGNOSIS CODES <4M4>

Code No.	Diagnosis item	Reference page
15	Auto-cruise control switch system	17-13
22	Stop lamp switch system	17-14
23	Engine-ECU system	17-14

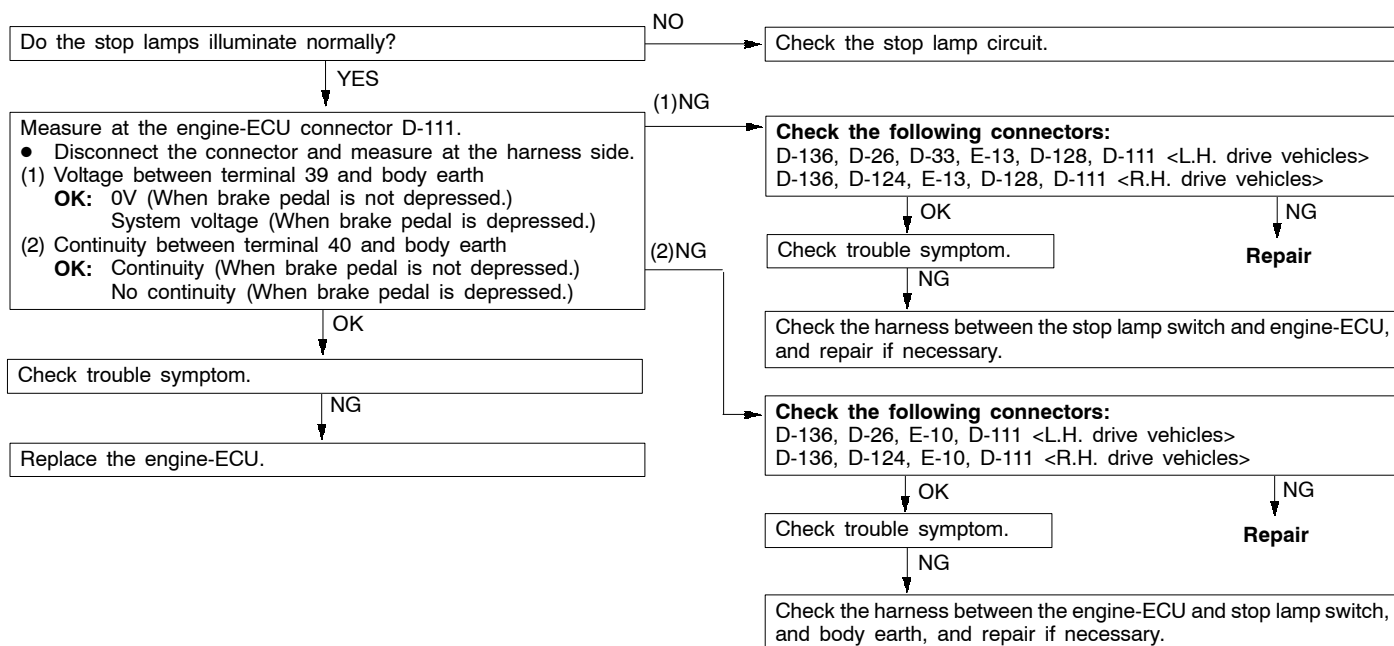
## INSPECTION PROCEDURE FOR DIAGNOSIS CODES <4M4>

Code No. 15 Auto-cruise control switch system	Probable cause
This diagnosis code is output if the RESUME and SET switches of the auto-cruise control switch remain on.	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the engine-ECU</li> </ul>

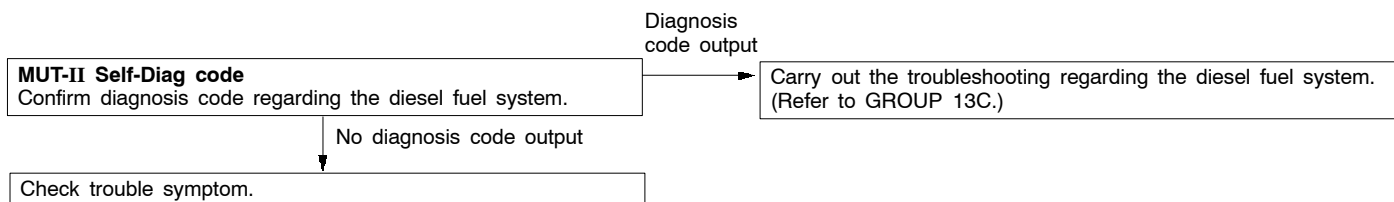


# 17-14 ENGINE AND EMISSION CONTROL - Auto-cruise Control System

Code No. 22 Stop lamp switch system	Probable cause
This diagnosis code is output when the engine-ECU detects a failure in the stop lamp switch output.	<ul style="list-style-type: none"> <li>Malfunction of the stop lamp switch</li> <li>Malfunction of the connector</li> <li>Malfunction of the harness</li> <li>Malfunction of the engine-ECU</li> </ul>



Code No. 23 Engine-ECU system	Probable cause
This diagnosis code is output if the engine-ECU system is defective as follows: <ul style="list-style-type: none"> <li>Malfunction of the engine-ECU</li> <li>Malfunction of the accelerator pedal position sensor</li> <li>Malfunction of the GE actuator (electronic governor)</li> <li>Malfunction of the vehicle speed sensor</li> </ul>	<ul style="list-style-type: none"> <li>Malfunction of the engine-ECU</li> </ul>



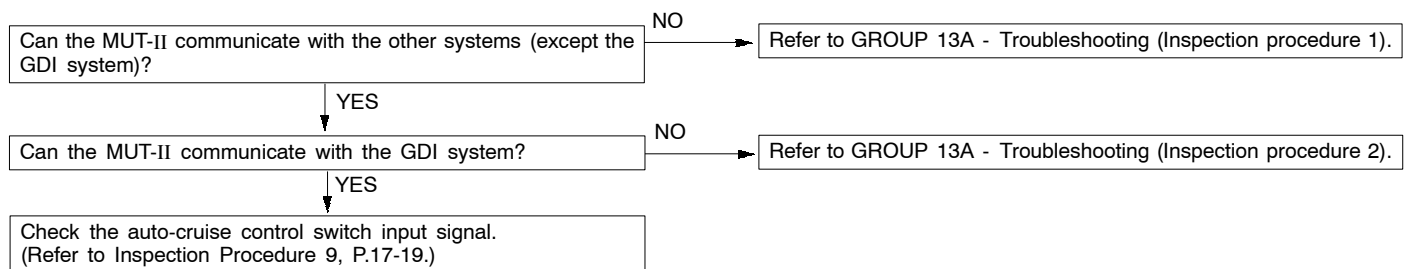
## INSPECTION CHART FOR TROUBLE SYMPTOMS <6G7>

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.		1	17-15
Auto-cruise control is not cancelled.	Even if brake pedal is depressed	2	17-16
	Even if clutch pedal is depressed <M/T>	3	17-16
	Even if select lever is set to N range <A/T>	4	17-17
	Even if CANCEL switch is set to ON	5	17-17
Auto-cruise control cannot be set.		6	17-17
Hunting (repeated acceleration and deceleration) occurs at the set vehicle speed.		7	17-18
When the MAIN switch of the auto-cruise control switch is turned ON, the auto-cruise control indicator lamp does not illuminate. (However, the auto-cruise control system is normal.)		8	17-18

## INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS <6G7>

### Inspection Procedure 1

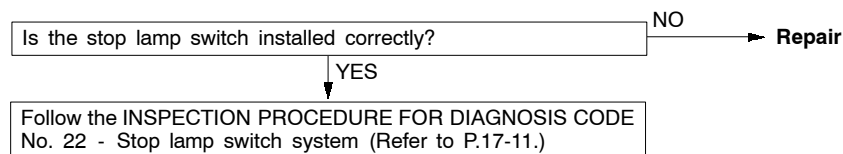
Communication with MUT-II is not possible.	Probable cause
<p>If the MUT-II can not also communicate with the systems other than the GDI system, the diagnosis line circuit may be defective.</p> <p>If the MUT-II can not communication with only the GDI system and the auto-cruise control system, the harness wire between the engine-ECU &lt;M/T&gt; or engine-A/T-ECU &lt;A/T&gt; and the diagnosis connector, may be defective.</p> <p>In addition, if the MUT-II can not communication with only the auto-cruise control system, the auto-cruise control switch may be defective.</p>	<ul style="list-style-type: none"> <li>● Malfunction of the connector</li> <li>● Malfunction of the harness</li> <li>● Malfunction of the auto-cruise control switch</li> <li>● Malfunction of the throttle valve controller</li> <li>● Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>● Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> </ul>





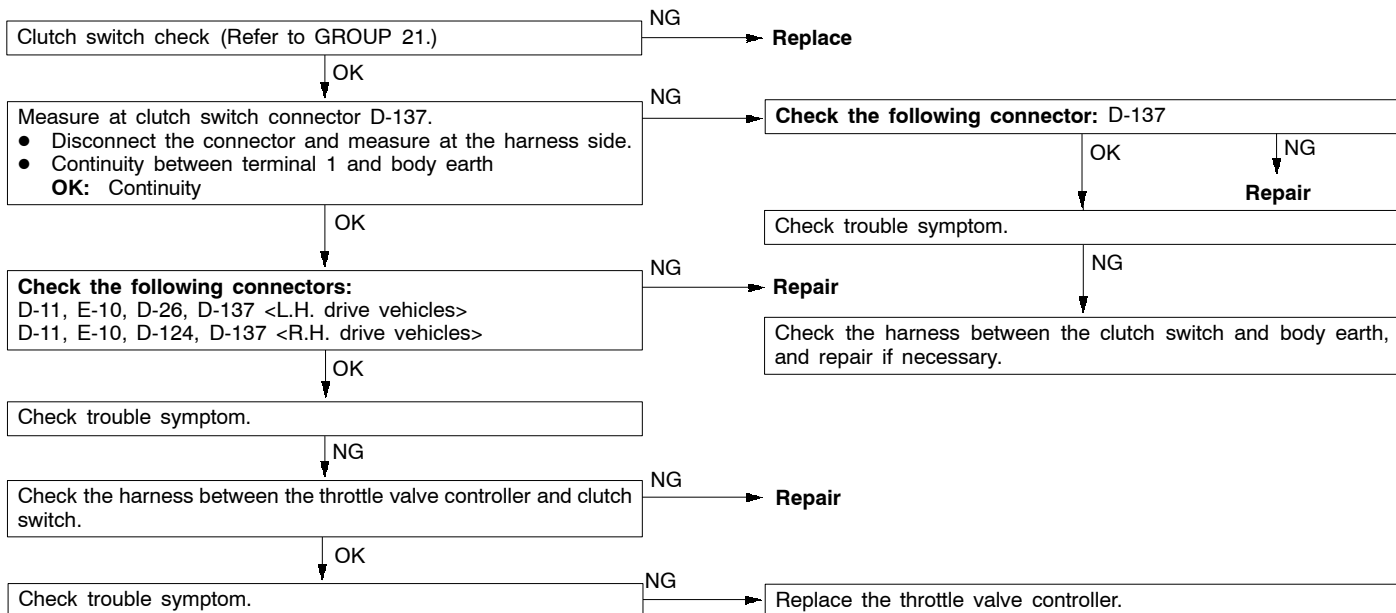
## Inspection Procedure 2

Even if brake pedal is depressed, auto-cruise control is not cancelled.	Probable cause
The cause is probably a malfunction of stop lamp switch or a malfunction of stop lamp circuit.	<ul style="list-style-type: none"> <li>• Malfunction of the stop lamp switch</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the throttle valve controller</li> </ul>



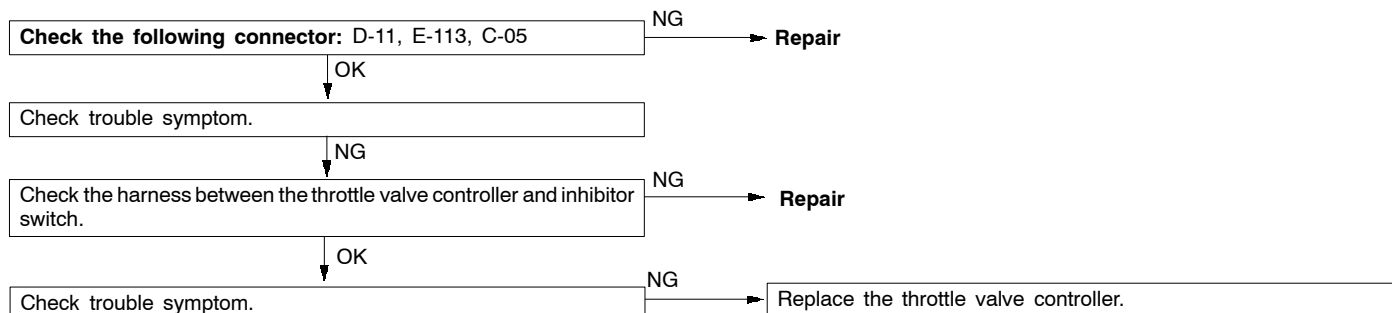
## Inspection Procedure 3

Even if clutch pedal is depressed, auto-cruise control is not cancelled. <M/T>	Probable cause
The cause is probably a malfunction of clutch switch or clutch switch circuit.	<ul style="list-style-type: none"> <li>• Malfunction of the clutch switch</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the throttle valve controller</li> </ul>



#### Inspection Procedure 4

Even if select lever is set to N range, auto-cruise control is not cancelled. <A/T>	Probable cause
The cause is probably a defective inhibitor switch circuit.	<ul style="list-style-type: none"> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the throttle valve controller</li> </ul>



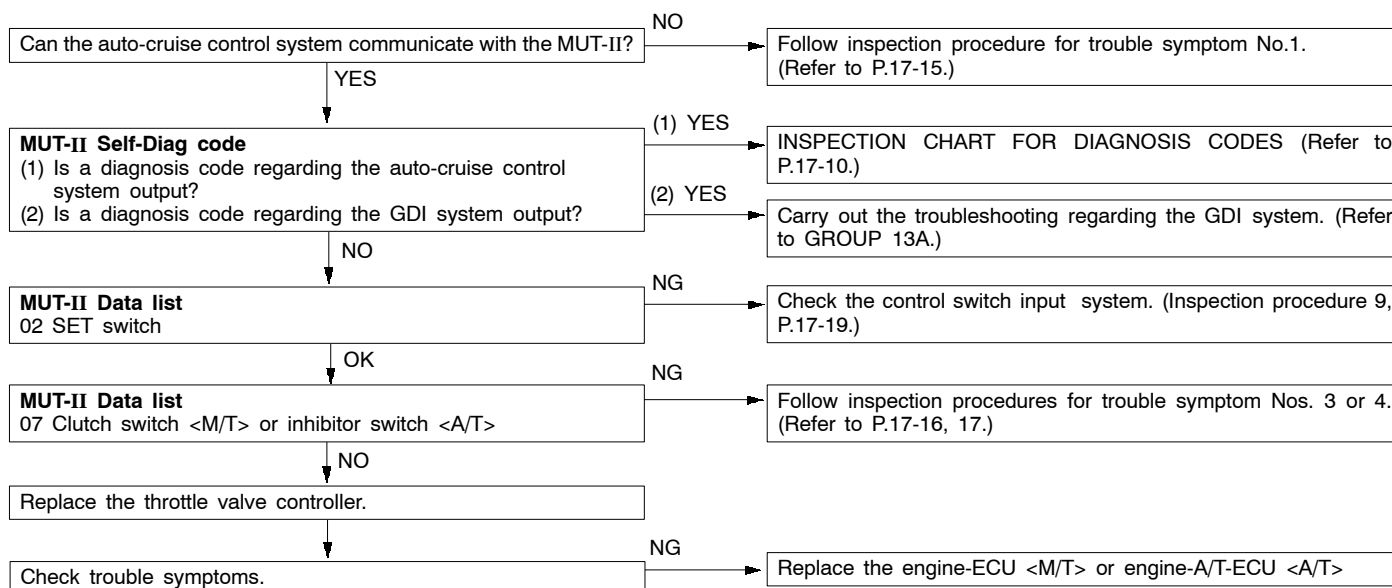
#### Inspection Procedure 5

Even if auto-cruise control CANCEL switch is set to ON, auto-cruise control is not cancelled.	Probable cause
The cause is probably an open-circuit in the circuit inside the CANCEL switch.	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> </ul>

Replace the auto-cruise control switch.

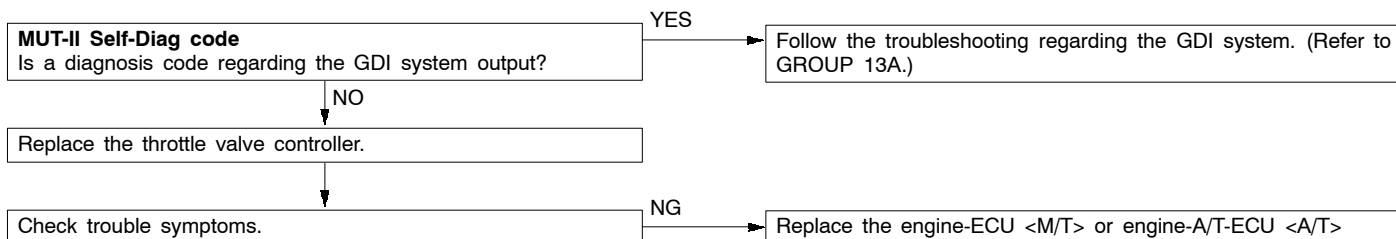
#### Inspection Procedure 6

Auto-cruise control cannot be set.	Probable cause
The cause is probably that the fail-safe function is cancelling auto-cruise control. In this case, the MUT-II can be used to check the trouble symptoms in each system by inspecting the diagnosis codes. The MUT-II can also be used to check if the circuits of each input switch are normal or not by inspecting the data list.	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> <li>• Malfunction of the harnesses</li> <li>• Malfunction of the connectors</li> <li>• Malfunction of the throttle valve controller</li> <li>• Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>• Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> </ul>



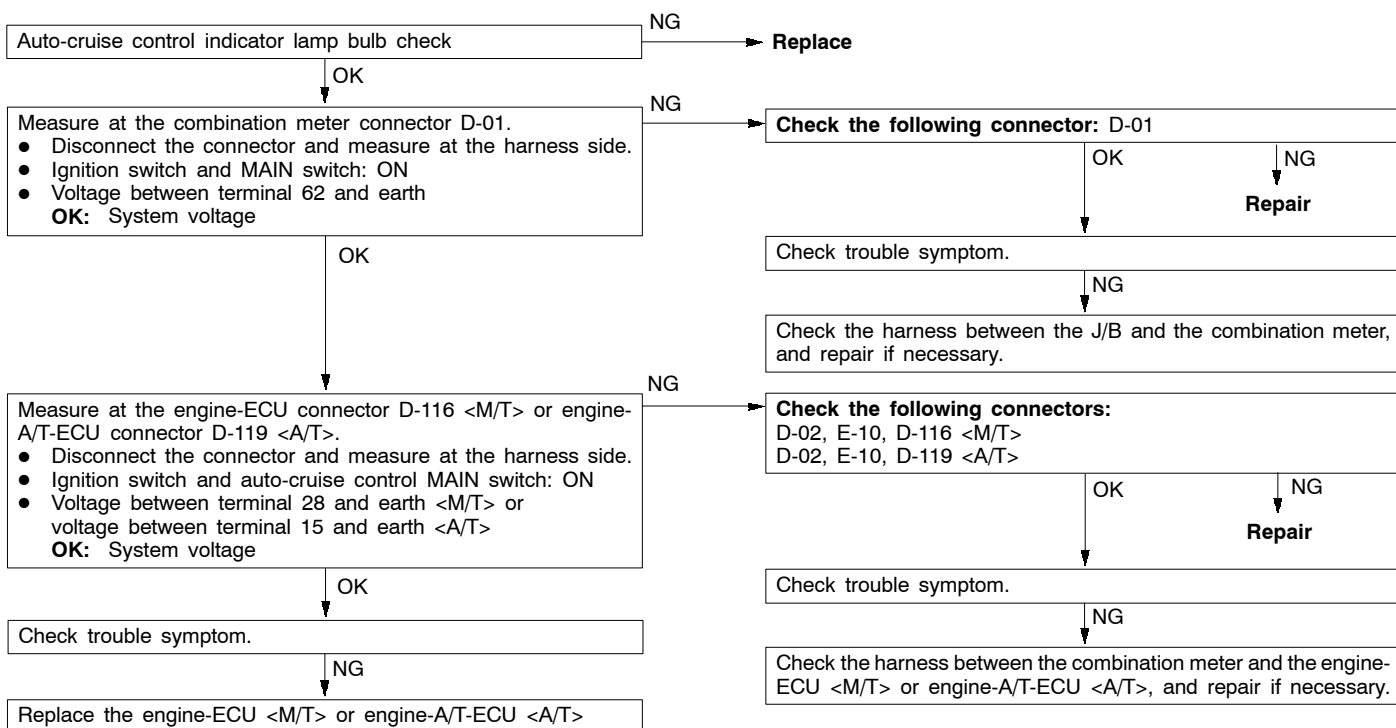
## Inspection Procedure 7

Hunting (repeated acceleration and deceleration) occurs at the set vehicle speed.	Probable cause
The cause is probably a malfunction of vehicle speed sensor or throttle control servo. In either case, a diagnosis code regarding the GDI system must be confirmed.	<ul style="list-style-type: none"> <li>• Malfunction of the vehicle speed sensor</li> <li>• Malfunction of the throttle control servo</li> <li>• Malfunction of the throttle valve controller</li> <li>• Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>• Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> </ul>



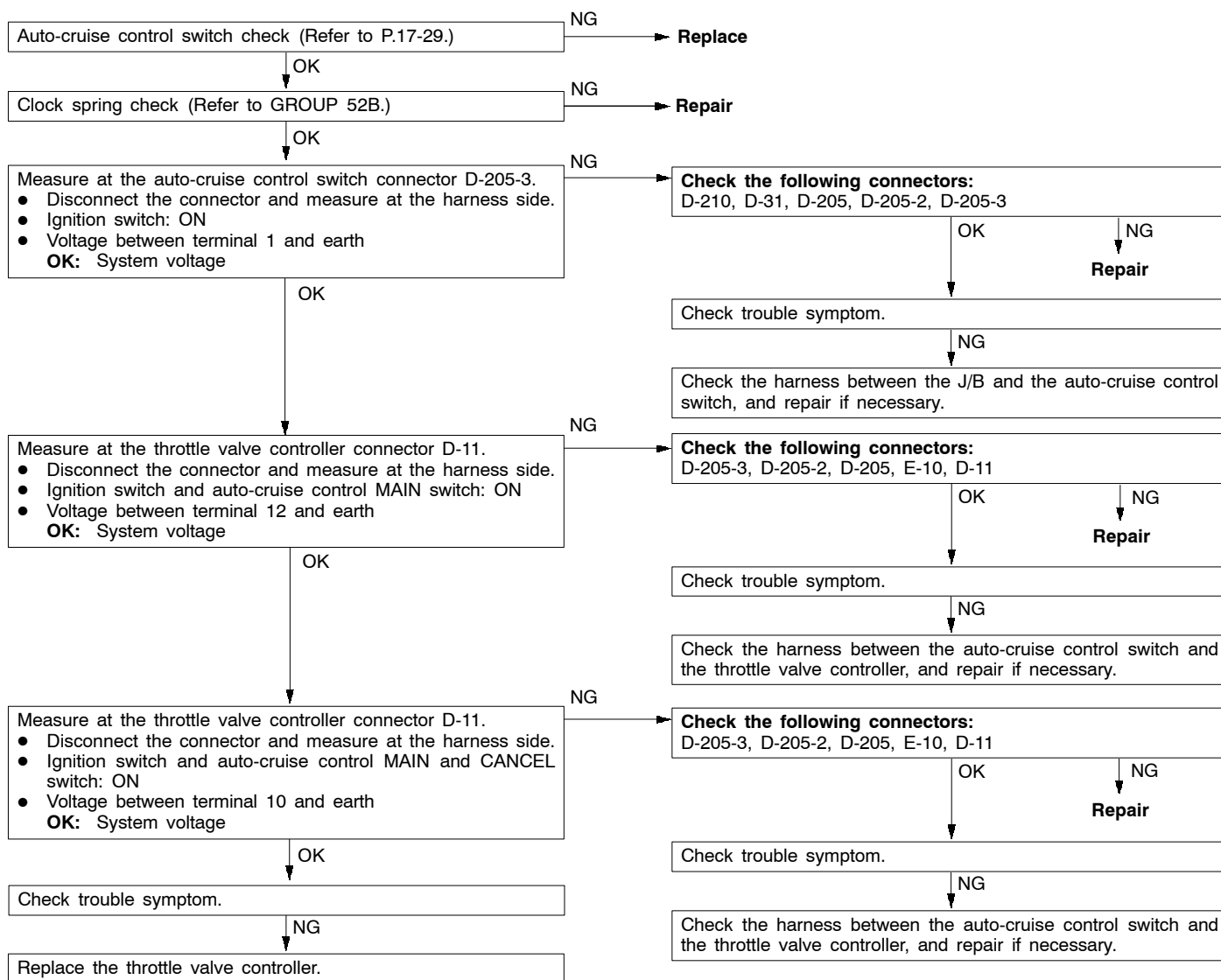
## Inspection Procedure 8

When the MAIN switch of the auto-cruise control switch is turned on, the auto-cruise control indicator lamp does not illuminate. (However, the auto-cruise control in normal.)	Probable cause
There may be a burnt-out bulb or a malfunction of the auto-cruise control indicator lamp circuit.	<ul style="list-style-type: none"> <li>• Burnt-out bulb</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the engine-ECU &lt;M/T&gt;</li> <li>• Malfunction of the engine-A/T-ECU &lt;A/T&gt;</li> </ul>



## Inspection Procedure 9

## Auto-cruise control switch input system check

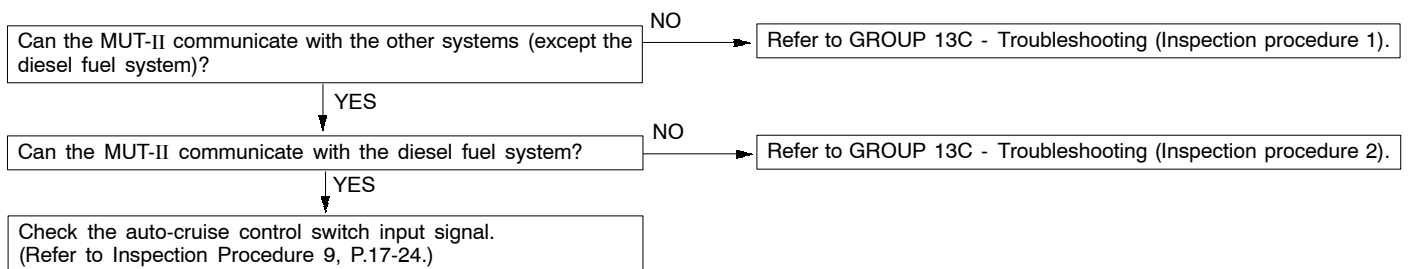


**INSPECTION CHART FOR TROUBLE SYMPTOMS <4M4>**

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.		1	17-20
Auto-cruise control is not cancelled.	Even if brake pedal is depressed	2	17-21
	Even if clutch pedal is depressed <M/T>	3	17-21
	Even if select lever is set to N range <A/T>	4	17-22
	Even if CANCEL switch is set to ON	5	17-22
Auto-cruise control cannot be set.		6	17-22
Hunting (repeated acceleration and deceleration) occurs at the set vehicle speed.		7	17-23
When the MAIN switch of the auto-cruise control switch is turned ON, the auto-cruise control indicator lamp does not illuminate. (However, the auto-cruise control system is normal.)		8	17-23

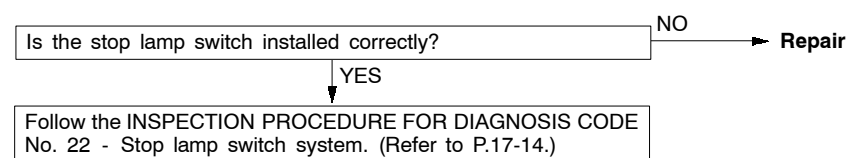
**INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS <4M4>****Inspection Procedure 1**

Communication with MUT-II is not possible.	Probable cause
If the MUT-II can not also communicate with the systems other than the diesel fuel system, the diagnosis line circuit may be defective. If the MUT-II can not communicate with only the diesel fuel system and the auto-cruise control system, the harness wire between the engine-ECU and the diagnosis connector, may be defective. In addition, if the MUT-II can not communicate with only the auto-cruise control system, the auto-cruise control switch may be defective.	<ul style="list-style-type: none"><li>● Malfunction of the connector</li><li>● Malfunction of the harness</li><li>● Malfunction of the auto-cruise control switch</li><li>● Malfunction of the engine-ECU</li></ul>



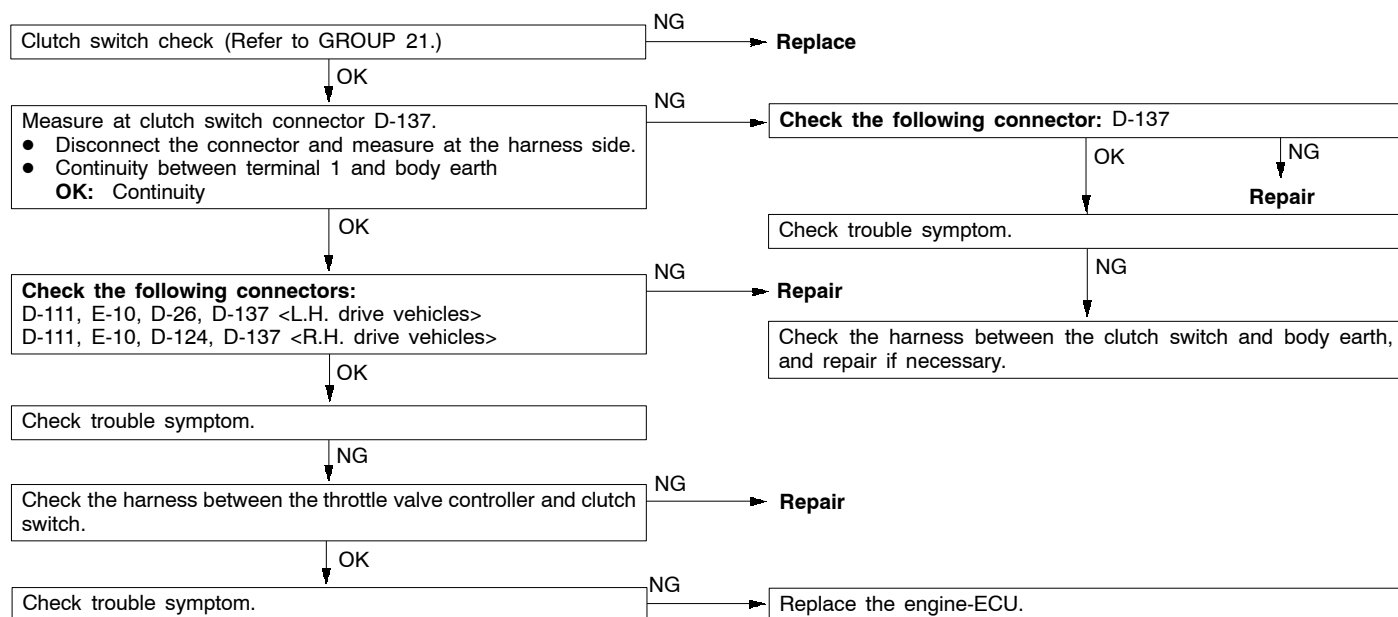
## Inspection Procedure 2

Even if brake pedal is depressed, auto-cruise control is not cancelled.	Probable cause
The cause is probably a malfunction of stop lamp switch or a malfunction of stop lamp circuit.	<ul style="list-style-type: none"> <li>• Malfunction of the stop lamp switch</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the engine-ECU</li> </ul>



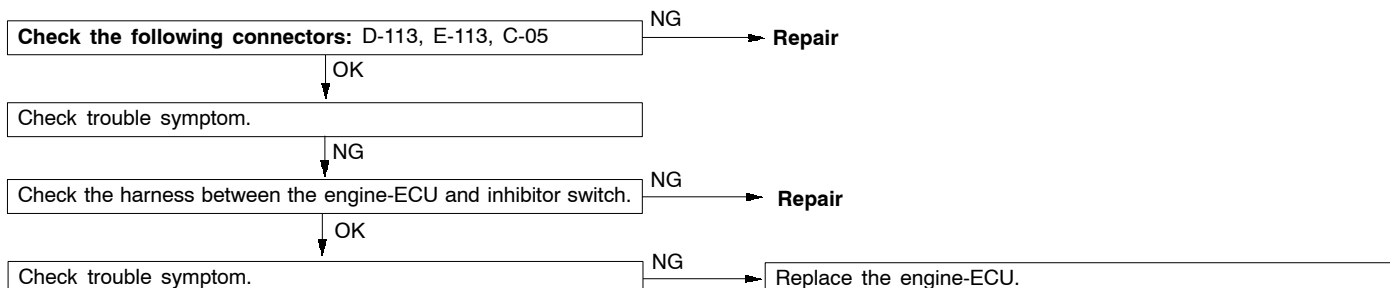
## Inspection Procedure 3

Even if clutch pedal is depressed, auto-cruise control is not cancelled. <M/T>	Probable cause
The cause is probably a malfunction of clutch switch or clutch switch circuit.	<ul style="list-style-type: none"> <li>• Malfunction of the clutch switch</li> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the engine-ECU</li> </ul>



## Inspection Procedure 4

Even if select lever is set to N range, auto-cruise control is not cancelled. <A/T>	Probable cause
The cause is probably a defective inhibitor switch circuit.	<ul style="list-style-type: none"> <li>• Malfunction of the connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the engine-ECU</li> </ul>



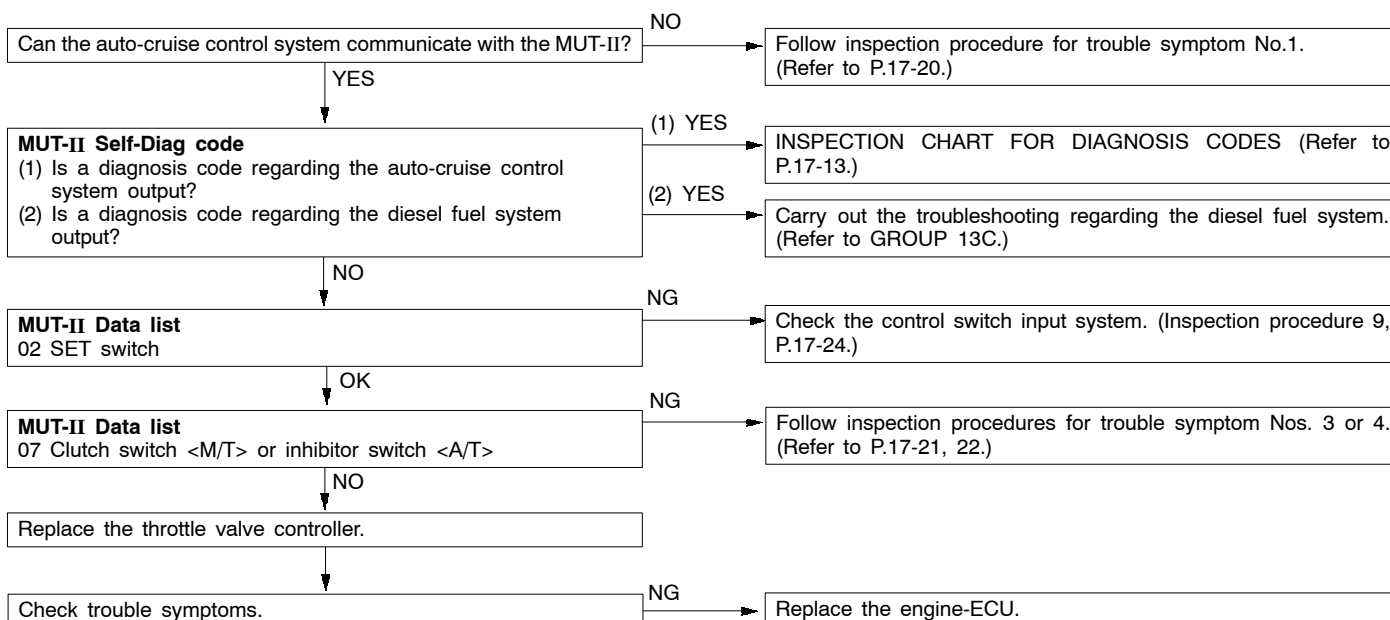
## Inspection Procedure 5

Even if auto-cruise control CANCEL switch is set to ON, auto-cruise control is not cancelled.	Probable cause
The cause is probably an open-circuit in the circuit inside the CANCEL switch.	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> </ul>

Replace the auto-cruise control switch.

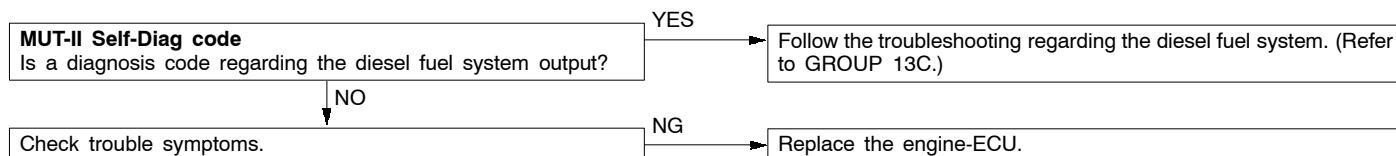
## Inspection Procedure 6

Auto-cruise control cannot be set.	Probable cause
The cause is probably that the fail-safe function is cancelling auto-cruise control. In this case, the MUT-II can be used to check the trouble symptoms in each system by inspecting the diagnosis codes. The MUT-II can also be used to check if the circuits of each input switch are normal or not by inspecting the data list.	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> <li>• Malfunction of the harnesses</li> <li>• Malfunction of the connectors</li> <li>• Malfunction of the engine-ECU</li> </ul>



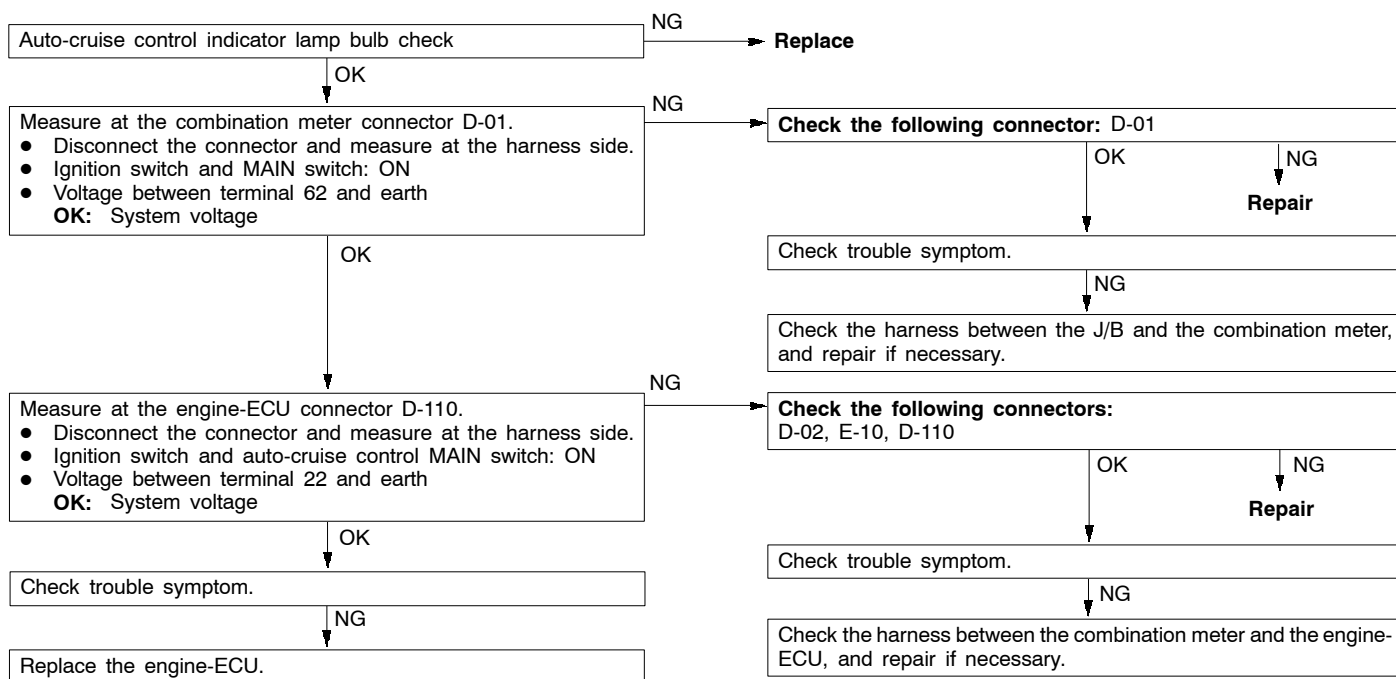
## Inspection Procedure 7

Hunting (repeated acceleration and deceleration) occurs at the set vehicle speed.	Probable cause
The cause is probably a malfunction of vehicle speed sensor or GE actuator (electronic governor). In either case, a diagnosis code regarding the diesel fuel system must be confirmed.	<ul style="list-style-type: none"> <li>Malfunction of the vehicle speed sensor</li> <li>Malfunction of the GE actuator (electronic governor)</li> <li>Malfunction of the engine-ECU</li> </ul>



## Inspection Procedure 8

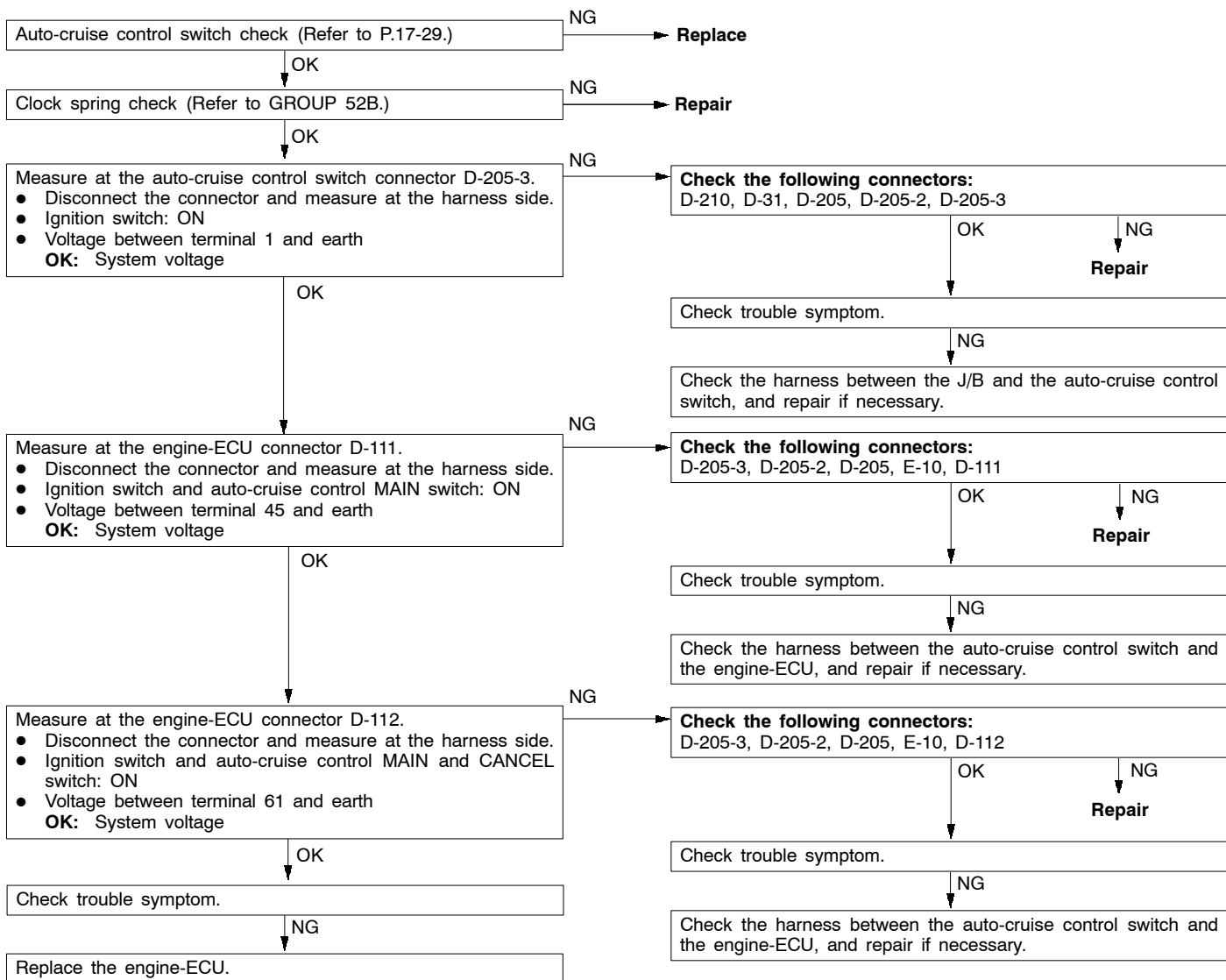
When the MAIN switch of the auto-cruise control switch is turned on, the auto-cruise control indicator lamp does not illuminate. (However, the auto-cruise control in normal.)	Probable cause
There may be a burnt-out bulb or a malfunction of the auto-cruise control indicator lamp circuit.	<ul style="list-style-type: none"> <li>Burnt-out bulb</li> <li>Malfunction of the harness</li> <li>Malfunction of the connector</li> <li>Malfunction of the engine-ECU</li> </ul>





## Inspection Procedure 9

### Auto-cruise control switch input system check



**DATA LIST REFERENCE TABLE**

For the data, which is input to the engine-ECU <6G7-M/T, 4M4>, engine-A/T-ECU <6G7-A/T> and

throttle valve controller <6G7>, the following items can be read out by using the MUT-II.

**HOW TO READ OUT DATA LIST**

1. Connect the MUT-II to the 16-pin diagnosis connector.

2. Turn the ignition switch to "ON" position.
3. Select "auto-cruise control" on the MUT-II menu, and then read out the data list.

**Caution**

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

**<6G7>**

Terminal No.	Check item		Check conditions		Normal condition
01	Auto-cruise control switch	MAIN	MAIN switch: ON		ON
			MAIN switch: OFF		OFF
02		SET (COAST)	MAIN switch: ON	SET switch: ON	ON
				SET switch: OFF	OFF
03		RESUME (ACCEL)		RESUME switch: ON	ON
				RESUME switch: OFF	OFF
04		CANCEL		CANCEL switch: ON	ON
				CANCEL switch: OFF	OFF
05	Stop lamp switch (for stop lamp circuit)		Brake pedal: Depressed		ON
			Brake pedal: Released		OFF
06	Stop lamp switch (for auto-cruise control circuit)		Brake pedal: Depressed		OFF
			Brake pedal: Released		ON
07	Clutch switch <M/T>		Clutch pedal: Depressed		ON
			Brake pedal: Released		OFF
	Inhibitor switch <A/T>		Selector lever: “N”, “P” position		ON
			Selector lever: Other than “N”, “P” position		OFF
08	Accelerator switch (Idle position switch)		Accelerator pedal: Released		ON
			Accelerator pedal: Depressed		OFF
09	Auto-cruise control system		Auto-cruise control system: Activated		ON
			Auto-cruise control system: Not activated		OFF
10	Vehicle speed sensor		Road test the vehicle		The speedometer and the MUT-II display the same value.

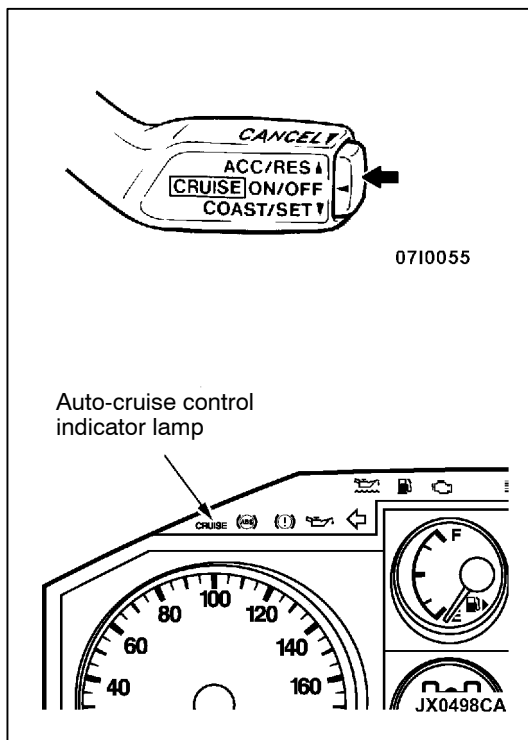
## 17-26 ENGINE AND EMISSION CONTROL - Auto-cruise Control System

Terminal No.	Check item	Check conditions	Normal condition
11	Throttle position sensor	Accelerator pedal: Fully depressed	450 - 800 mV
		Accelerator pedal: Depressed	The more deeply the pedal is depressed, the higher value the MUT-II display
		Accelerator pedal: Release	4,200 - 4,900 mV
12	Accelerator pedal position sensor	Accelerator pedal: Fully depressed	985 - 1,085 mV
		Accelerator pedal: Depressed	The more deeply the pedal is depressed, the higher value the MUT-II display
		Accelerator pedal: Release	4,000 mV or more

### <4M4>

Terminal No.	Check item		Check conditions		Normal condition
01	Auto-cruise control switch	MAIN	MAIN switch: ON		ON
			MAIN switch: OFF		OFF
02		SET (COAST)	MAIN switch: ON	SET switch: ON	ON
				SET switch: OFF	OFF
03				RESUME (ACCEL)	RESUME switch: ON
		RESUME switch: OFF			OFF
04		CANCEL		CANCEL switch: ON	ON
				CANCEL switch: OFF	OFF
05		Stop lamp switch (for stop lamp circuit)		Brake pedal: Depressed	
	Brake pedal: Released			OFF	
06	Stop lamp switch (for auto-cruise control circuit)		Brake pedal: Depressed		OFF
			Brake pedal: Released		ON
07	Clutch switch <M/T>		Clutch pedal: Depressed		ON
			Brake pedal: Released		OFF
	Inhibitor switch <A/T>		Selector lever: “N”, “P” position		ON
			Selector lever: Other than “N”, “P” position		OFF
08	Accelerator switch (Idle position switch)		Accelerator pedal: Released		ON
			Accelerator pedal: Depressed		OFF
09	Auto-cruise control system		Auto-cruise control system: Activated		ON
			Auto-cruise control system: Not activated		OFF

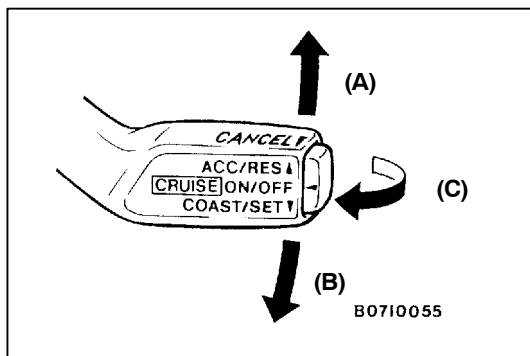
Terminal No.	Check item	Check conditions	Normal condition
10	Vehicle speed sensor	Road test the vehicle	The speedometer and the MUT-II display the same value.
11	Accelerator pedal position sensor	Accelerator pedal: Fully depressed	0.9 - 1.1 V
		Accelerator pedal: Release	4.1 V or more



## ON-VEHICLE SERVICE

### AUTO-CRUISE CONTROL MAIN SWITCH CHECK

1. Turn the ignition key to ON.
2. Check to be sure that the indicator lamp within the combination meter illuminates when the MAIN switch is switched ON.



## AUTO-CRUISE CONTROL SWITCH CHECK

### AUTO-CRUISE CONTROL SETTING

1. Switch ON the MAIN switch.
2. Drive at the desired speed within the range of approximately 40-200 km/h.
3. Push the auto-cruise control switch in the direction of arrow (B).
4. Check to be sure that when the switch is released the speed is the desired constant speed.

#### NOTE

If the vehicles speed decreases to approximately 15 km/h below the set speed because of climbing a hill for example, the auto-cruise control will be cancelled.

### SPEED-INCREASE SETTING

1. Set to the desired speed.
2. Push the auto-cruise control switch in the direction of arrow (A).
3. Check to be sure that acceleration continues while the switch is hold, and that when it is released the constant speed at the time when it was released becomes the driving speed.

#### NOTE

Acceleration can be continued even if the vehicle speed has passed the high-speed limit (approx. 200 km/h). But the speed when the auto-cruise control switch is released will be recorded as the high-speed limit.

### SPEED-REDUCTION SETTING

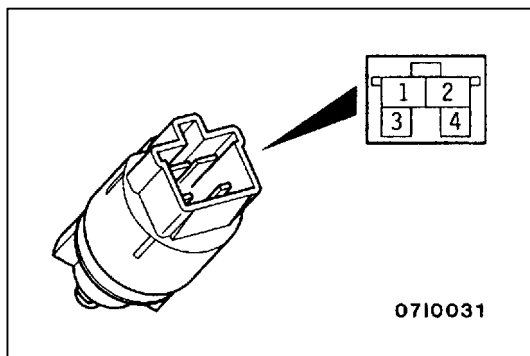
1. Set to the desired speed.
2. Push the auto-cruise control switch in the direction of arrow (B).
3. Check to be sure that deceleration continues while the switch is pressed, and that when it is released the constant speed at the time when it was released becomes the driving speed.

#### NOTE

When the vehicle speed reaches the low limit (approximately 40 km/h) during deceleration, the auto-cruise control will be cancelled.

### RETURN TO THE SET SPEED BEFORE CANCELLATION AND AUTO-CRUISE CONTROL CANCELLATION

1. Set the auto-cruise speed control.
2. When any of the following operations are performed while at constant speed during auto-cruise control, check if normal driving is resumed and deceleration occurs.
  - a. The auto-cruise control switch is pushed in the direction of arrow (C).
  - b. The brake pedal is depressed.
  - c. The clutch pedal is depressed. <M/T>
  - d. The selector lever is moved to the "N" range. <A/T>
3. When the auto-cruise control switch is pushed in the direction of arrow (A) at a vehicle speed of 40 km/h or higher, check if the vehicle speed returns to the speed before auto-cruise control driving was cancelled, and constant speed driving occurs.
4. When the MAIN switch is turned to OFF while driving at constant speed, check if normal driving is resumed and deceleration occurs.

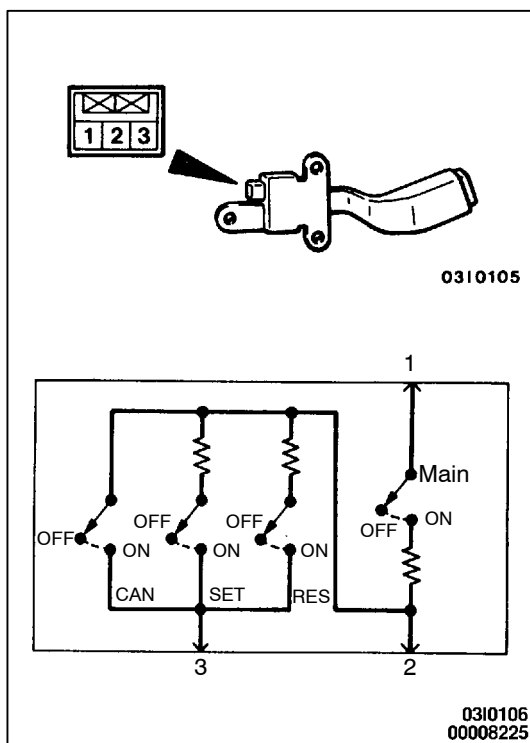


## AUTO-CRUISE CONTROL COMPONENT CHECK

### STOP LAMP SWITCH

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

Measurement conditions	Terminal No.			
	1	2	3	4
When brake pedal is depressed. (for stop lamp circuit)	○	○		
When brake pedal is depressed. (for auto-cruise control circuit)			○	○



## AUTO-CRUISE CONTROL SWITCH CHECK

Measure the resistance between the terminals when each of the SET, RESUME, CANCEL and MAIN switches is pressed. If the values measured at this time correspond to those in the table below, then there is no problem.

Switch position		Resistance between terminals	
MAIN switch: OFF		No continuity	
MAIN switch: ON		Terminals 1 and 2	Approx. 3.9 kΩ
MAIN switch: ON	CANCEL switch: ON	Terminals 2 and 3	Approx. 0 Ω
	RESUME switch: ON	Terminals 2 and 3	Approx. 910 Ω
	SET switch: ON	Terminals 2 and 3	Approx. 220 Ω

## CLUTCH PEDAL POSITION SWITCH

Refer to GROUP 21 - On-vehicle Service.

## THROTTLE POSITION SENSOR

Refer to GROUP 13A - On-vehicle Service.

## VEHICLE SPEED SENSOR CHECK

Refer to GROUP54 - Combination meters.

## **AUTO-CRUISE CONTROL SWITCH**

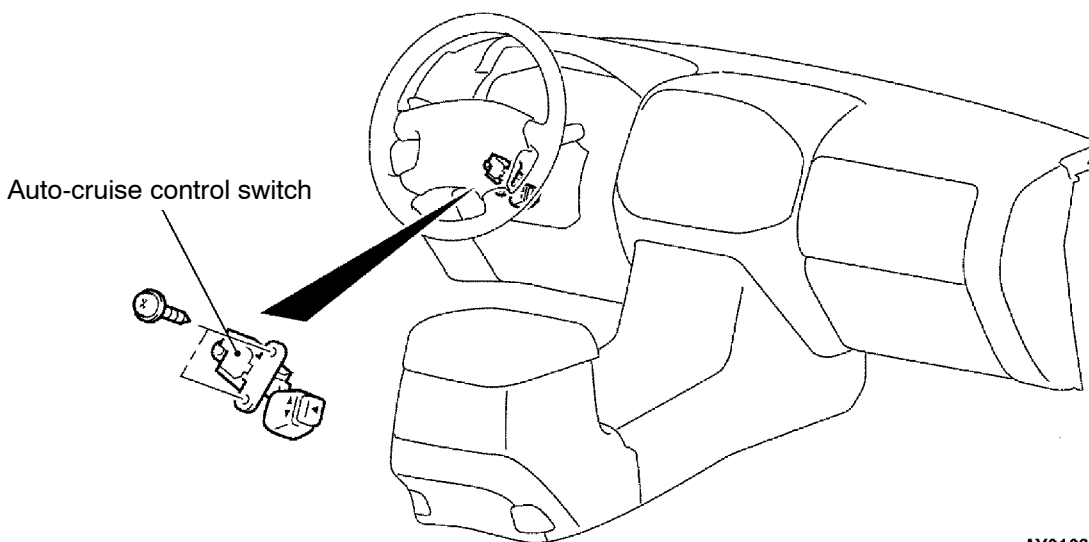
### **REMOVAL AND INSTALLATION**

**CAUTION: SRS**

Before removal of air bag module, refer to  
**GROUP 52B - SRS Service Precautions and Air  
Bag Modules and Clock Spring.**

**Pre-removal and Post-installation Operation**

Air Bag Module Removal and Installation  
(Refer to GROUP 52B.)



AY0102CA

# EMISSION CONTROL SYSTEM <6G7>

## GENERAL INFORMATION

The emission control system consists of the following subsystems:

- Crankcase emission control system
- Evaporative emission control system
- Exhaust emission control system

Items	Name	Specification
Crankcase emission control system	Positive crankcase ventilation (PCV) valve	Variable flow type (Purpose: HC reduction)
Evaporative emission control system	Canister Purge control solenoid valve	Equipped Duty cycle type solenoid valve (Purpose: HC reduction)
Exhaust emission control system	Air-fuel ratio control device - GDI system	Oxygen sensor feedback type (Purpose: CO, HC, NOx reduction)
	Exhaust gas recirculation system • EGR valve	Equipped Stepper motor type (Purpose: NOx reduction)
	Catalytic converter	Monolith type (Purpose: CO, HC, NOx reduction)

## EMISSION CONTROL DEVICE REFERENCE TABLE

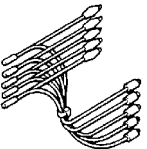
Related parts	Crankcase emission control system	Evaporative emission control system	Air/fuel ratio control system	Catalytic converter	Exhaust gas recirculation system	Reference page
PCV valve	×					17-35
Purge control solenoid valve		×				17-38
GDI system component		×	×			GROUP 13A
Catalytic converter				×		17-44
EGR valve					×	17-40



## SERVICE SPECIFICATIONS

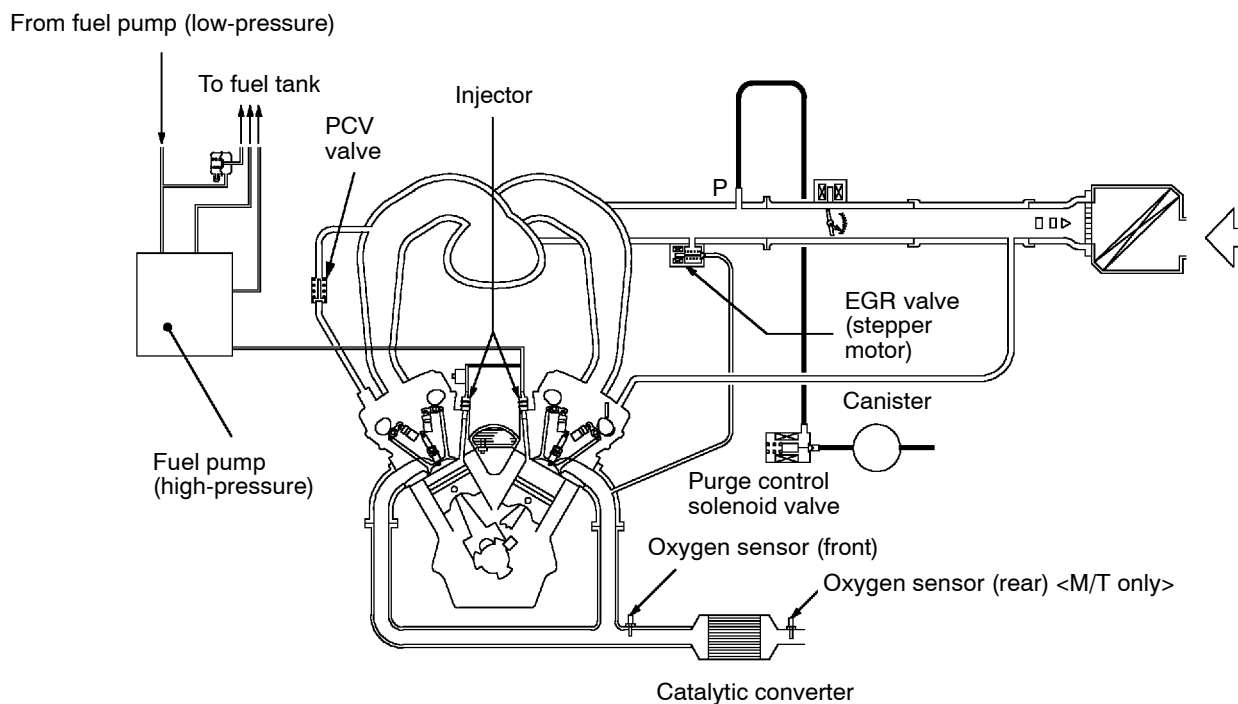
Items	Standard value
Purge control solenoid valve coil resistance (at 20°C) Ω	28 - 36
EGR valve coil resistance (at 20°C) Ω	10 - 20

## SPECIAL TOOL

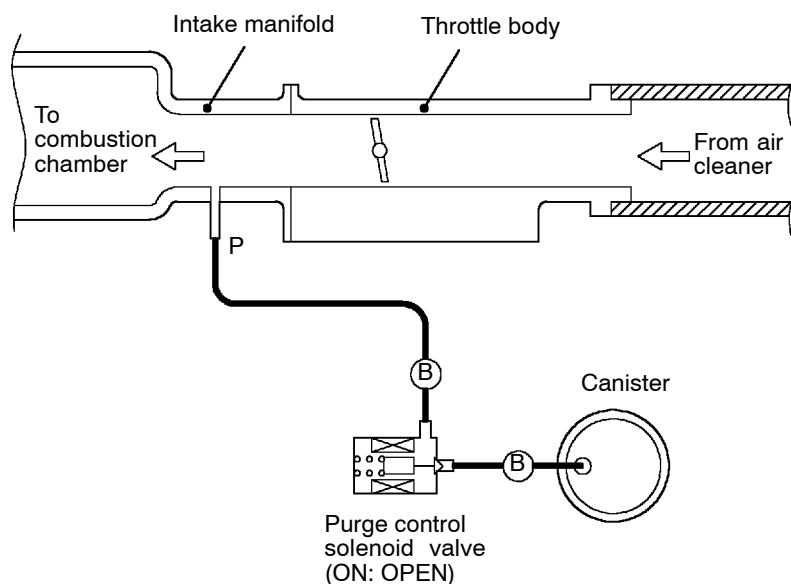
Tool	Number	Name	Use
 B991658	MB991658	Test harness set	Inspection of EGR valve

## VACUUM HOSE

### VACUUM HOSE PIPING DIAGRAM



X6130CA

**VACUUM CIRCUIT DIAGRAM**

**Vacuum hose colour**  
B: Black

X6131CA

**VACUUM HOSE CHECK**

1. Using the piping diagram as a guide, check to be sure that the vacuum hoses are correctly connected.
2. Check the connection condition of the vacuum hoses, (removed, loose, etc.) and check to be sure that there are no bends or damage.

**VACUUM HOSE INSTALLATION**

1. When connecting the vacuum hoses, they should be securely inserted onto the nipples.
2. Connect the hoses correctly, using the vacuum hose piping diagram as a guide.

## CRANKCASE EMISSION CONTROL SYSTEM

### GENERAL INFORMATION

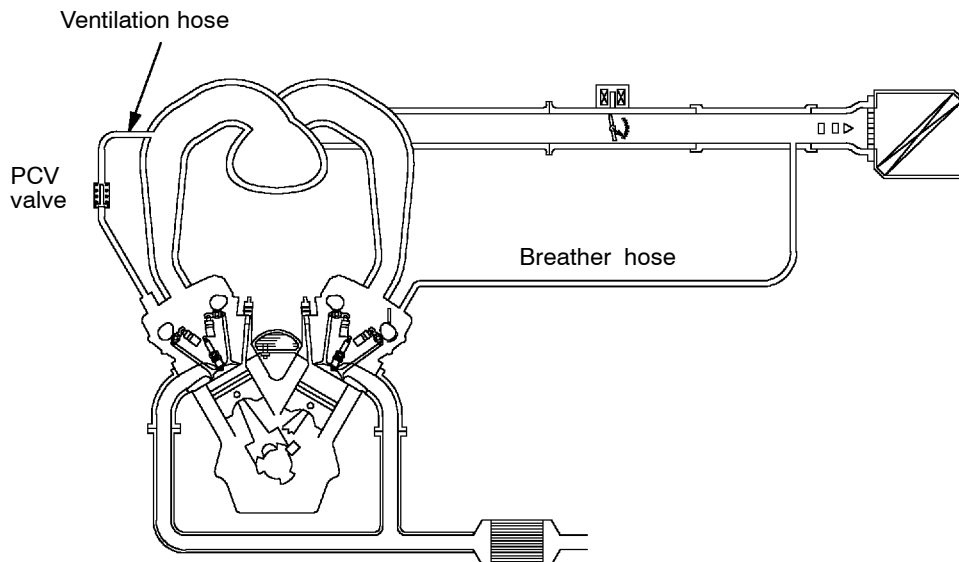
The crankcase emission control system prevents blow-by gases from escaping inside the crankcase into the atmosphere.

Fresh air is sent from the air cleaner into the crankcase through the breather hose. The air becomes mixed with the blow-by gases inside the crankcase.

The blow-by gas inside the crankcase is drawn into the intake manifold through the positive crankcase ventilation (PCV) valve.

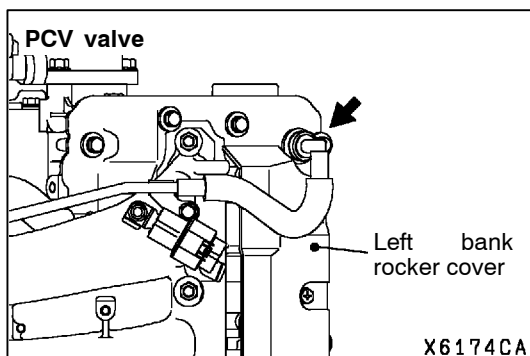
The PCV valve lifts the plunger according to the intake manifold vacuum so as to regulate the flow of blow-by gas properly. In other words, the blow-by gas flow is regulated during low load engine operation to maintain engine stability, while the flow is increased during high load operation to improve the ventilation performance.

### SYSTEM DIAGRAM



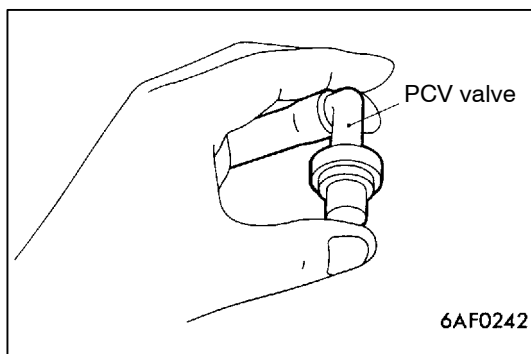
X6132CA

### COMPONENT LOCATION



**POSITIVE CRANKCASE VENTILATION SYSTEM CHECK**

1. Remove the ventilation hose from the PCV valve.
2. Remove the PCV valve from the rocker cover.
3. Reinstall the PCV valve at the ventilation hose.
4. Start the engine and run at idle.

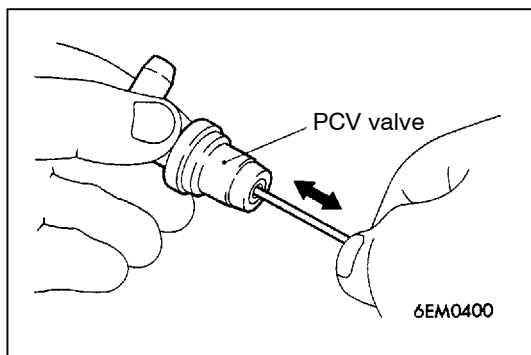


5. Place a finger at the opening of the PCV valve and check that vacuum of the intake manifold is felt.

**NOTE**

At this moment, the plunger in the PCV valve moves back and forth.

6. If vacuum is not felt, clean the PCV valve or replace it.

**PCV VALVE CHECK**

1. Insert a thin rod into the PCV valve from the side shown in the illustration (rocker cover installation side), and move the rod back and forth to check that the plunger moves.
2. If the plunger does not move, there is clogging in the PCV valve. In this case, clean or replace the PCV valve.

## EVAPORATIVE EMISSION CONTROL SYSTEM

### GENERAL INFORMATION

The evaporative emission control system prevents fuel vapours generated in the fuel tank from escaping into the atmosphere.

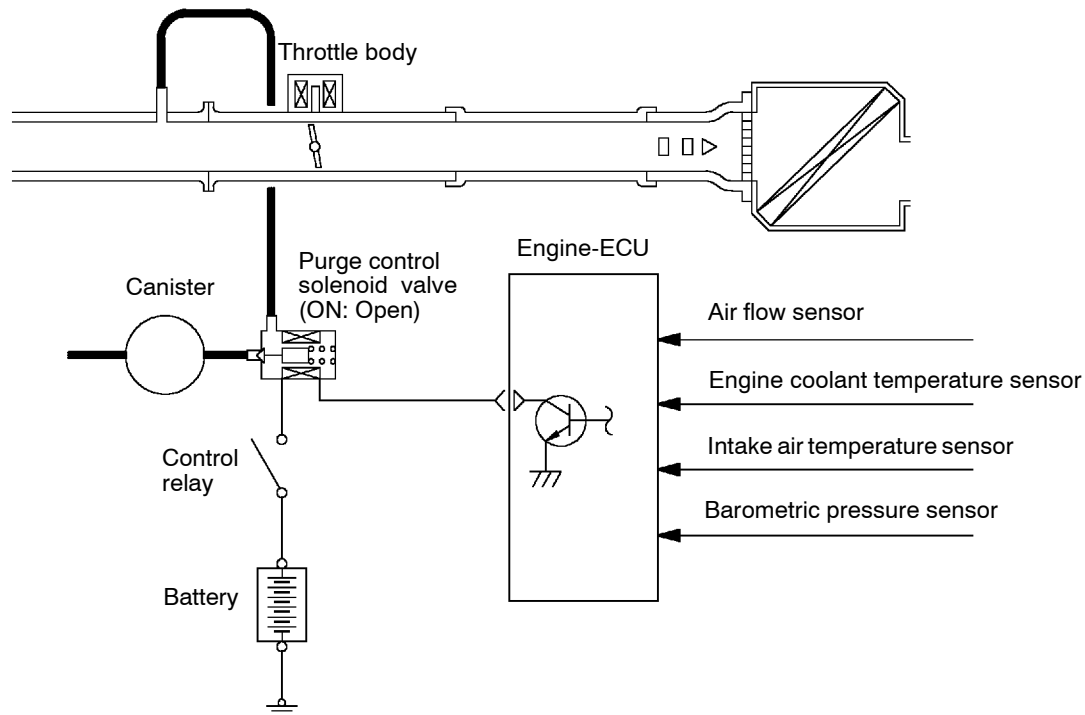
Fuel vapours from the fuel tank flow through the fuel tank pressure control valve and vapour pipe/hose to be stored temporarily in the canister. When driving the vehicle, fuel vapours stored in the canister flow through the purge solenoid and purge port and go into the intake manifold to be

sent to the combustion chamber.

When the engine coolant temperature is low or when the intake air quantity is small (when the engine is at idle, for example), the engine control unit turns the purge solenoid off to shut off the fuel vapour flow to the intake manifold.

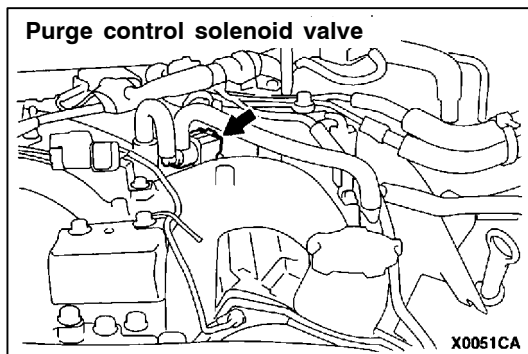
This does not only insure the driveability when the engine is cold or running under low load but also stabilize the emission level.

### SYSTEM DIAGRAM

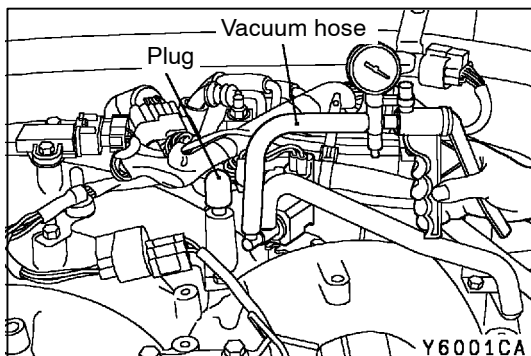


X6037CA

### COMPONENT LOCATION



X0051CA



### PURGE CONTROL SYSTEM CHECK

1. Disconnect the vacuum hose from the intake manifold and connect it to a hand vacuum pump.
2. Plug the nipple from which the vacuum hose was removed.
3. When the engine is cold or hot, apply a vacuum of 53 kPa, and check the condition of the vacuum.

#### When engine is cold

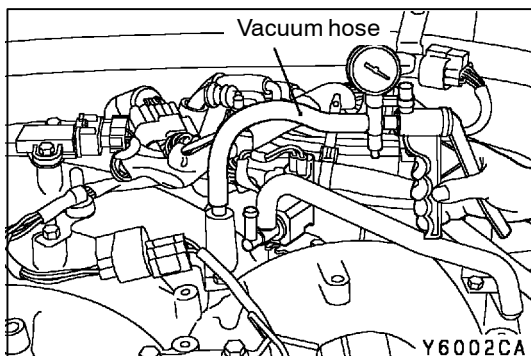
(Engine coolant temperature: 40°C or less)

Engine condition	Normal condition
At idle	Vacuum is maintained.
3,000 r/min	

#### When engine is hot

(Engine coolant temperature: 80°C or higher)

Engine condition	Normal condition
<ul style="list-style-type: none"> <li>• At idle</li> <li>• for approximately 6 minutes after the engine is started.</li> </ul>	Vacuum is maintained.
<ul style="list-style-type: none"> <li>• 3,000 r/min</li> <li>• for approximately 3 minutes after the engine is started.</li> </ul>	



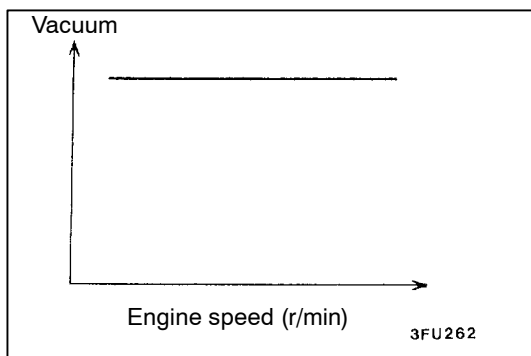
### PURGE PORT VACUUM CHECK

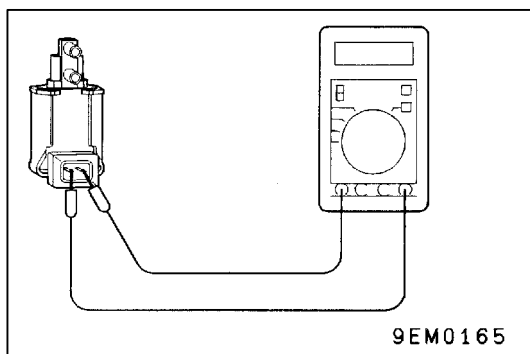
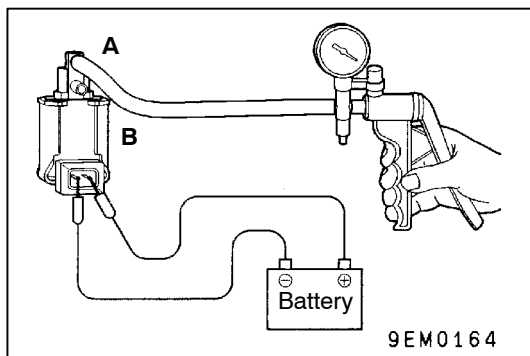
1. Disconnect the vacuum hose from the intake manifold purge vacuum nipple and connect a hand vacuum pump to the nipple.

2. Start the engine and check that the vacuum remains fairly constant after racing the engine.

#### NOTE

If vacuum changes, it is possible that the throttle body purge port may be clogged and require cleaning.





## PURGE CONTROL SOLENOID VALVE CHECK

### NOTE

When disconnecting the vacuum hose, always make a mark so that it can be reconnected at original position.

1. Disconnect the vacuum hose from the solenoid valve.
2. Disconnect the harness connector.
3. Connect a hand vacuum pump to nipple (A) of the solenoid valve (refer to the illustration at left).
4. Check airtightness by applying a vacuum with voltage applied directly from the battery to the purge control solenoid valve and without applying voltage.

Battery voltage	Normal condition
Applied	Vacuum leaks
Not applied	Vacuum maintained

5. Measure the resistance between the terminals of the solenoid valve.

**Standard value: 30 - 34  $\Omega$  (at 20°C)**

## EXHAUST GAS RECIRCULATION (EGR) SYSTEM

### GENERAL INFORMATION

The exhaust gas recirculation (EGR) system lowers the nitrogen oxide (NOx) emission level. When the air/fuel mixture combustion temperature is high, a large quantity of nitrogen oxides (NOx) is generated in the combustion chamber. Therefore, this system recirculates part of emission gas from

the exhaust port of the cylinder head to the combustion chamber through the intake manifold to decrease the air/fuel mixture combustion temperature, resulting in reduction of NOx.

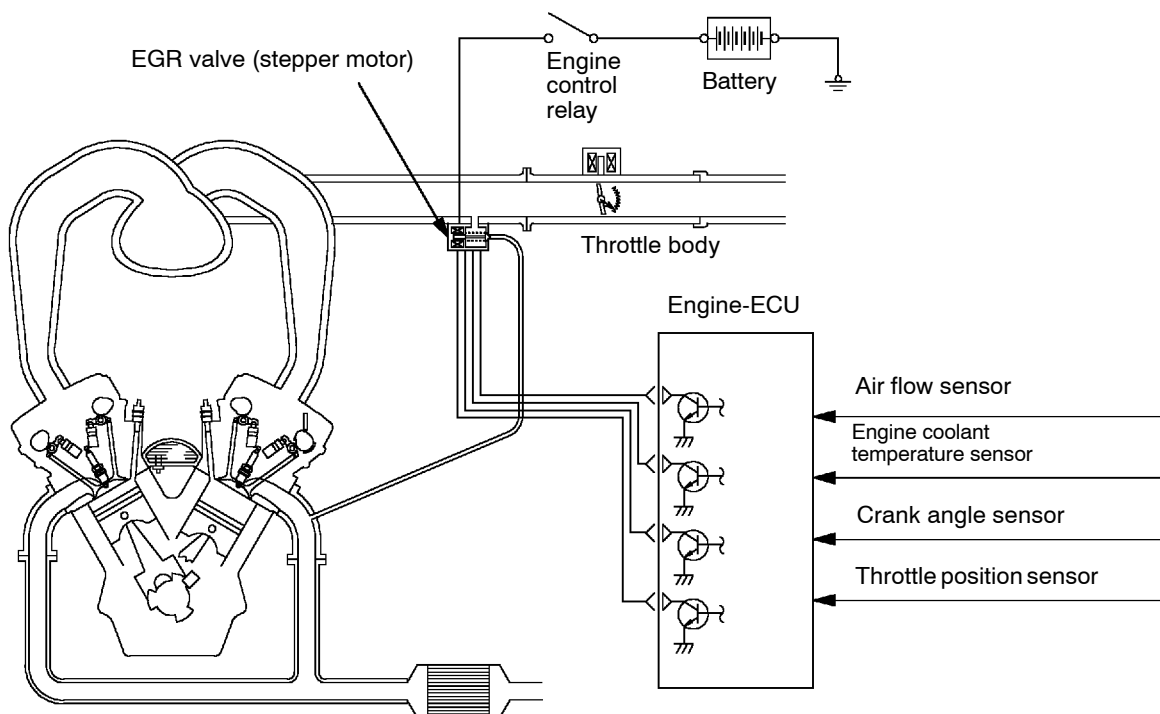
The EGR flow rate is controlled by the EGR valve so as not to decrease the driveability.

### OPERATION

The EGR valve is being closed and does not recirculate exhaust gases under one of the following conditions. Otherwise, the EGR valve is opened and recirculate exhaust gases.

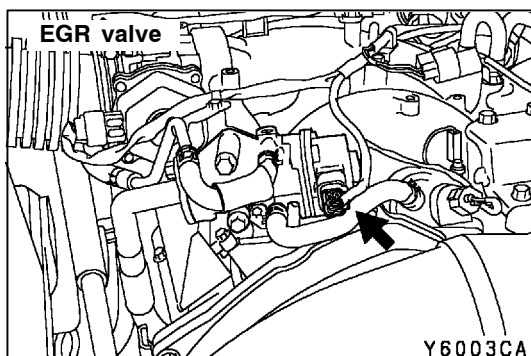
- The engine coolant temperature is low.
- The engine is at idle.
- The throttle valve is widely opened.

### SYSTEM DIAGRAM



X6134CA

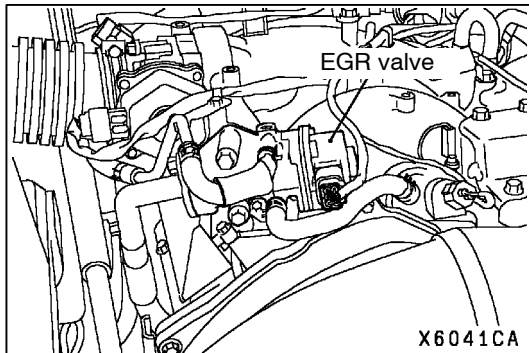
### COMPONENT LOCATION





## EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM CHECK

Refer to GROUP 13 - Troubleshooting.



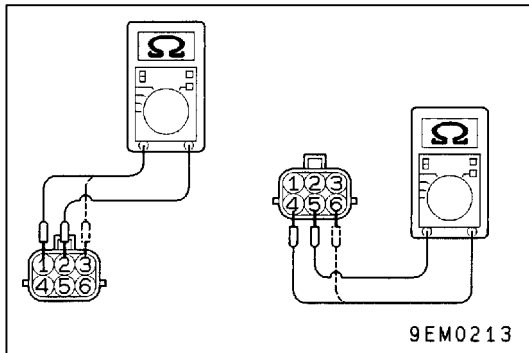
### EGR VALVE (STEPPER MOTOR) CHECK

#### Checking the Operation Sound

1. Check that the operation sound of the stepper motor can be heard from the EGR valve when the ignition switch is turned to ON (without starting the engine).
2. If the operation sound cannot be heard, check the stepper motor drive circuit.

#### NOTE

If the circuit is normal, the cause is probably a malfunction of the stepper motor or of the engine-ECU.



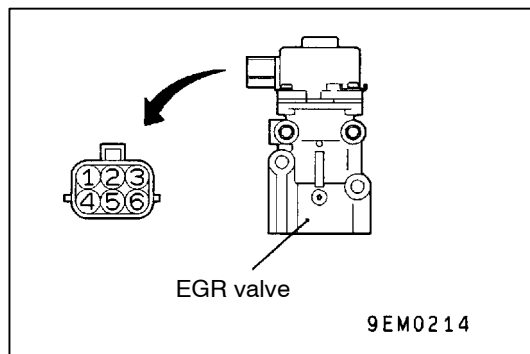
#### Checking the Coil Resistance

1. Disconnect the EGR valve connector.
2. Measure the resistance between the EGR valve-side connector terminal No.2 and terminal No.1 or terminal No.3.

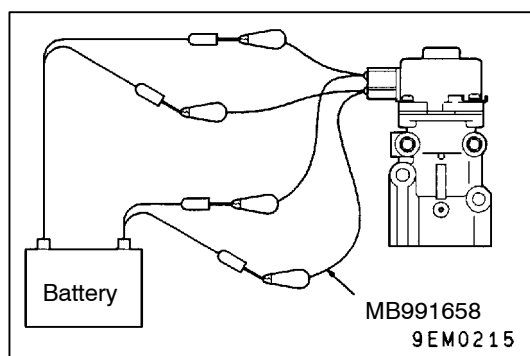
**Standard value: 10 - 20  $\Omega$  (at 20°C)**

3. Measure the resistance between the EGR valve-side connector terminal No.5 and terminal No.4 or terminal No.6.

**Standard value: 10 - 20  $\Omega$  (at 20°C)**

**Operation Check**

1. Remove the EGR valve.
2. Connect the special tool (test harness: MB991658) to the EGR valve-side connector.
3. Connect terminal No.2 to the positive (+) terminal of the battery.
4. Connect terminal No.1 and terminal No.3 to the negative (-) terminal of battery to test if any vibration occurs (as though the stepper motor is shaking slightly) due to the operation of the stepper motor.
5. Connect terminal No.5 to the positive (+) terminal of battery.



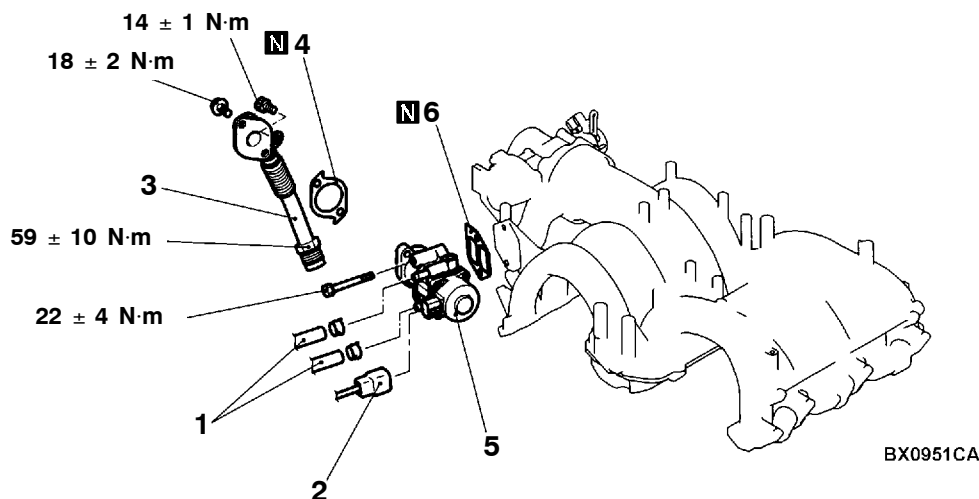
6. Connect terminal No.4 and terminal No.6 to the negative (-) terminal of battery to test if any vibration occurs (as though the stepper motor is shaking slightly) due to the operation of the stepper motor.
7. If the results of testing show that the vibration could be felt, the stepper motor is normal.

# EGR VALVE

## REMOVAL AND INSTALLATION

### Pre-removal Operation

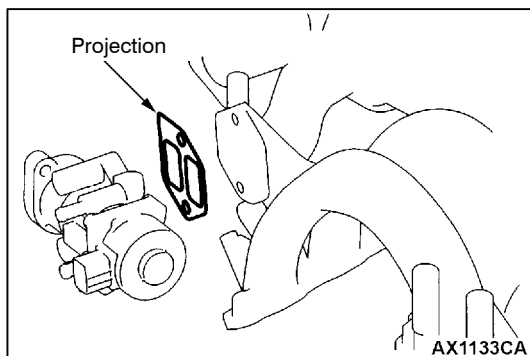
- Engine Coolant Draining and Refilling (Refer to GROUP 14 - On-vehicle Service.)
- Engine Cover Removal and Installation (Refer to GROUP 11A - Timing Belt.)
- Air Cleaner Assembly Removal and Installation (Refer to GROUP 15)



### Removal steps

1. Water hose connection
2. EGR valve connector
3. EGR pipe

4. EGR pipe gasket
5. EGR valve
6. EGR valve gasket



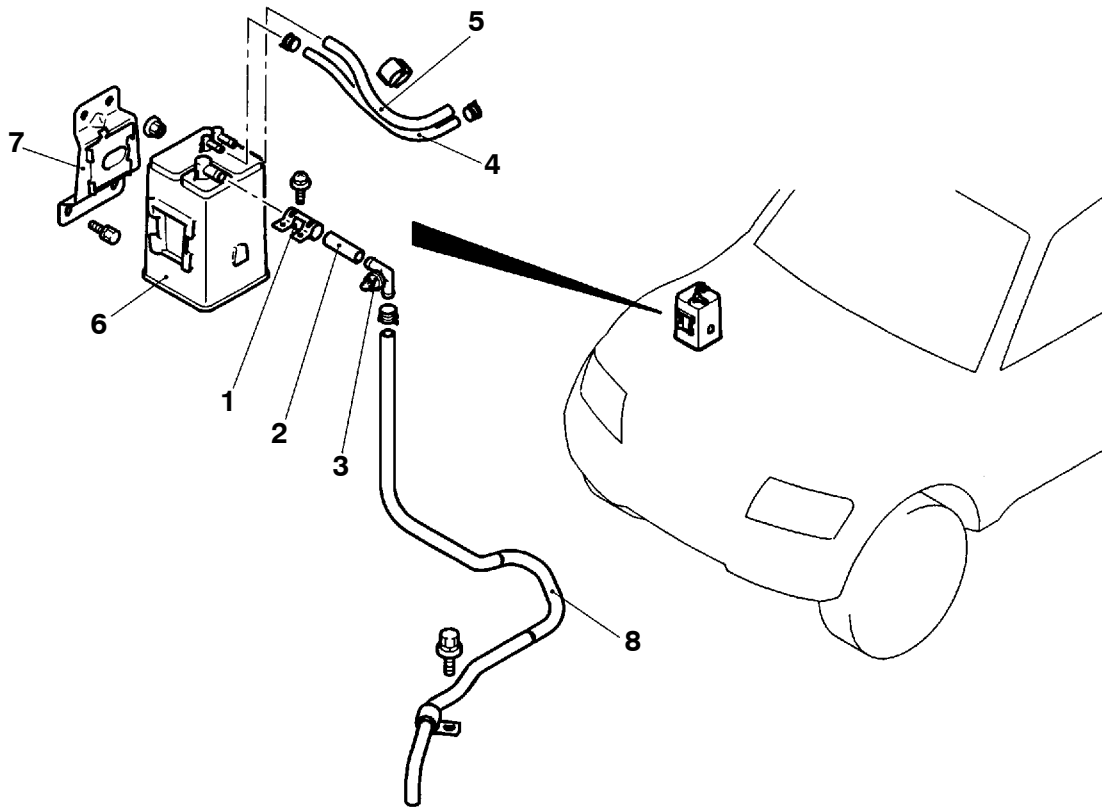
## INSTALLATION SERVICE POINT

### ▶A◀ EGR VALVE GASKET INSTALLATION

Install the gasket so that its projection faces towards the direction shown.

## CANISTER

### REMOVAL AND INSTALLATION



AY0296CA

#### Removal steps

1. Hose clip
2. Vapor hose
3. Breather valve
4. Vapor hose connection

5. Purge hose connection
6. Canister
7. Canister bracket

## CATALYTIC CONVERTER

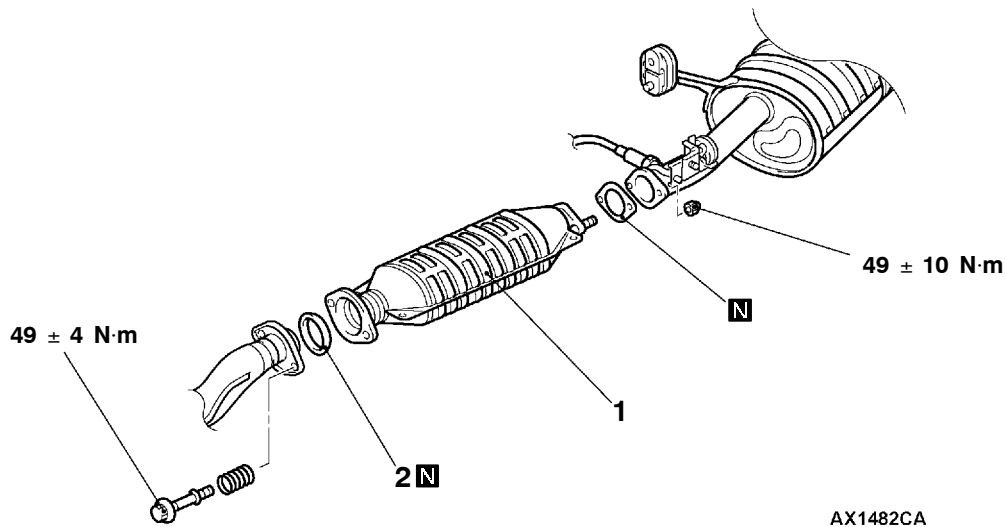
### GENERAL INFORMATION

The three-way catalytic converter, together with the closed loop air-fuel ratio control based on the oxygen sensor signal, oxidizes carbon monoxides (CO) and hydrocarbons (HC) and reduces nitrogen oxides (NOx).

When the mixture is controlled at stoichiometric air-fuel ratio, the three-way catalytic converter provides the highest purification against the three constituents, namely, CO, HC and NOx.

### REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operation**  
Under Cover Removal and Installation



#### Removal steps

1. Catalytic converter
2. Seal ring

# EMISSION CONTROL SYSTEM <4D5>

## GENERAL INFORMATION

The electronically-controlled EGR system and the fuel injection timing control system (load timer) reduce the level of exhaust gases (NO<sub>x</sub>).

Items	Name	Specification
Exhaust emission control system	Exhaust gas recirculation system <ul style="list-style-type: none"> <li>• EGR valve</li> <li>• EGR solenoid valve No.1</li> <li>• EGR solenoid valve No.2</li> </ul>	Electronically-controlled EGR system Single type Duty cycle solenoid valve ON-OFF solenoid valve

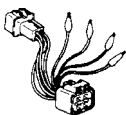
## SERVICE SPECIFICATIONS

Items		Standard value
EGR solenoid valve Nos. 1 and 2 resistance (at 20°C) Ω		36 - 44
Lever position sensor output voltage V	Idle position	0.8 - 1.0
	Fully open	3.7 - 4.9
Engine speed sensor resistance kΩ		1.3 - 1.9
Engine coolant temperature sensor resistance (Built-in engine coolant temperature gauge unit) kΩ	At 0°C	7.7 - 9.5
	At 20°C	2.9 - 3.6
	At 40°C	1.3 - 1.7
	At 80°C	0.26 - 0.35

## SEALANT

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

## SPECIAL TOOL

Tool	Number	Name	Use
	MD998464	Test harness (4P, square)	Inspection of lever position sensor

## EXHAUST GAS RECIRCULATION (EGR) SYSTEM

### GENERAL INFORMATION

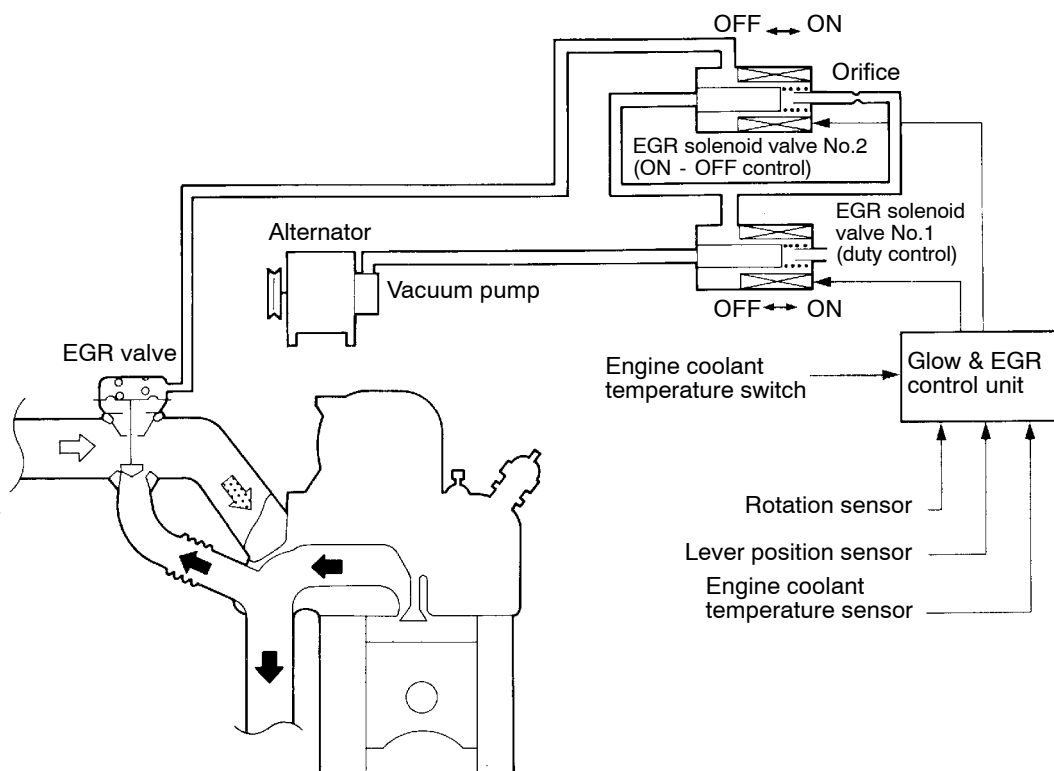
The electronically-controlled EGR system consists of an EGR valve, a vacuum pump, EGR solenoid valves Nos.1 and 2, glow & EGR control unit and various sensors.

The EGR valve is controlled by the negative pressure inside the valve, which is controlled by EGR solenoid valves Nos.1 and 2.

The EGR solenoid valves Nos.1 and 2 are optimally controlled by the glow & EGR control unit in response to the engine operation conditions, based on data received from each sensor.

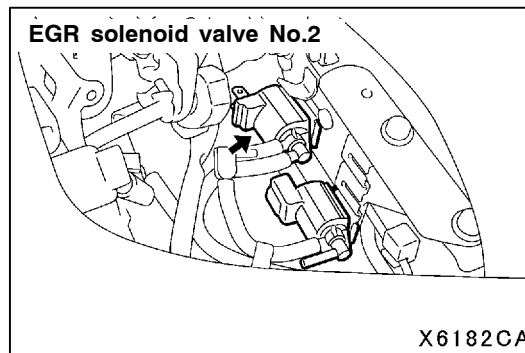
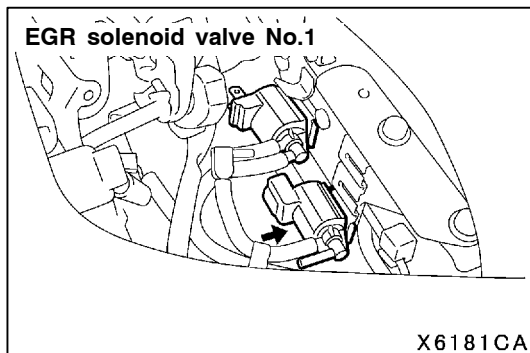
In this way, the EGR is controlled to reduce NOx emissions while maintaining good engine performance.

### SYSTEM DIAGRAM

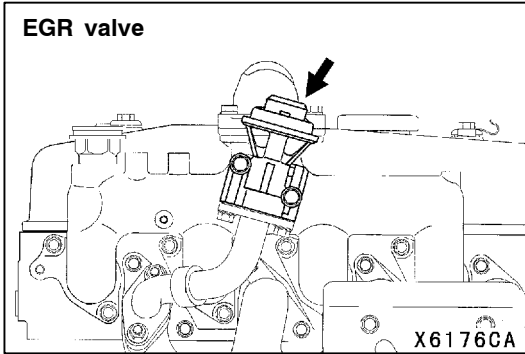


DEM0662

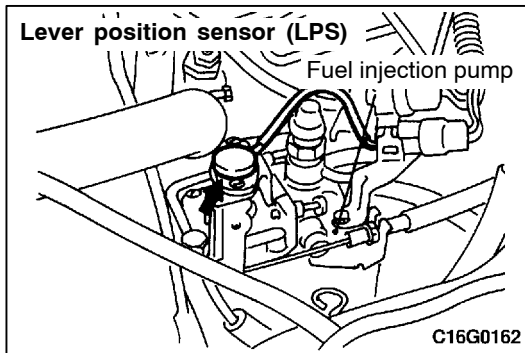
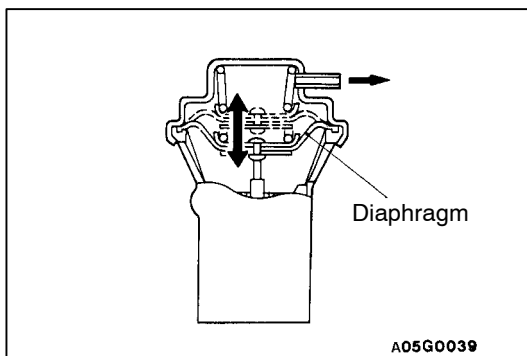
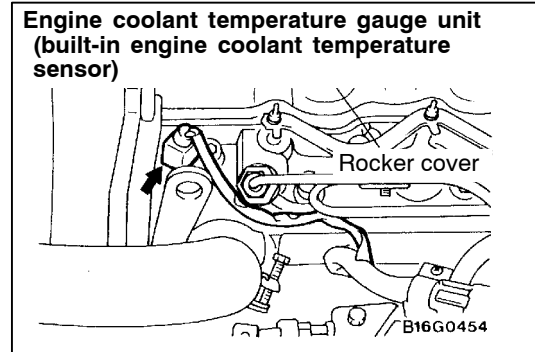
### COMPONENT LOCATION



EGR valve



Lever position sensor (LPS)

Engine coolant temperature gauge unit  
(built-in engine coolant temperature  
sensor)

## FUNCTION CHECK

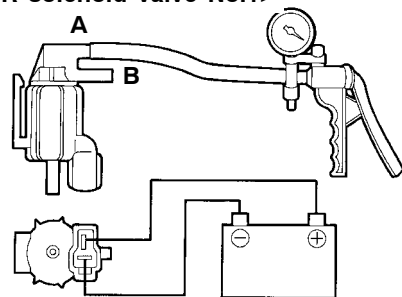
1. Start the engine and warm it up until the engine coolant temperature reaches 65°C or above.
2. Race the engine by suddenly depressing the accelerator pedal, then check that the EGR valve diaphragm lifts.

## EGR SOLENOID VALVE OPERATION CHECK

1. Remove EGR solenoid valve Nos.1 and 2 connectors and vacuum hoses.
2. Attach a vacuum pump to each nipple of the EGR solenoid valve Nos. 1 and 2 connectors and apply negative pressure. Check that the valves are airtight both when voltage is applied to each terminal of the EGR solenoid valve Nos. 1 and 2 and when it is not applied.



&lt;EGR solenoid valve No.1&gt;

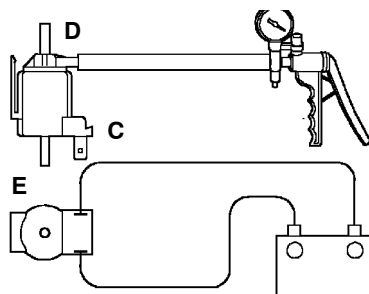


DEM0019

### EGR solenoid valve No.1

Battery voltage	Normal condition
When current is flowing	Vacuum leaks (Vacuum is maintained when nipple B is plugged)
When current is not flowing	Vacuum is maintained

&lt;EGR solenoid valve No.2&gt;



X6135CA

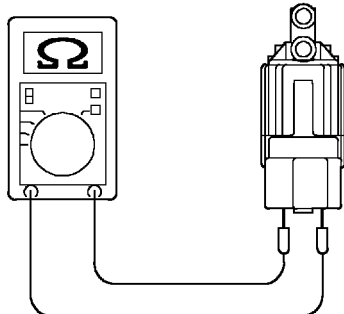
### EGR solenoid valve No.2

Battery voltage	Normal condition
When current is flowing	Vacuum leaks (Vacuum is maintained when nipple D is plugged)
When current is not flowing	Vacuum leaks (Vacuum is maintained when nipple E is plugged)

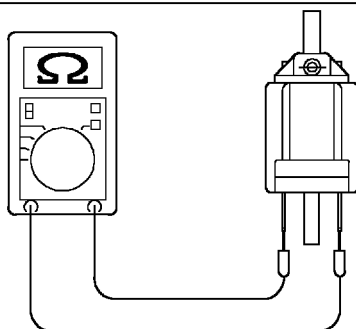
## EGR SOLENOID VALVE RESISTANCE CHECK

Measure terminal resistance of EGR solenoid valves Nos. 1 and 2 with a circuit tester.

**Standard value: 36 - 44  $\Omega$  (at 20°C)**



X6136CA

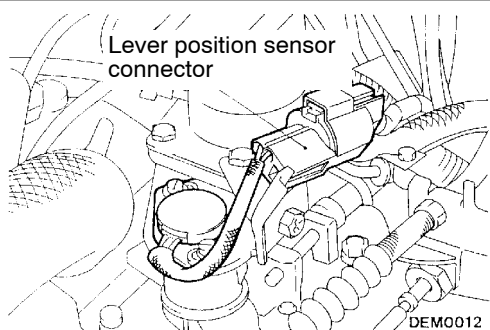


X6137CA

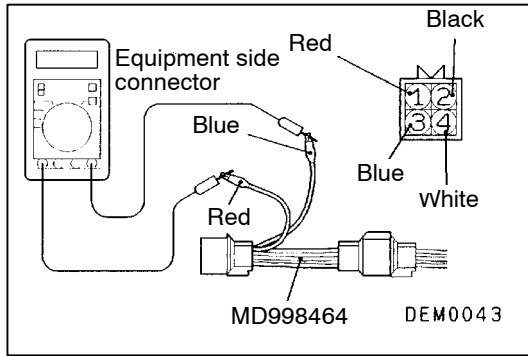
## LEVER POSITION SENSOR (LPS) ADJUSTMENT

1. Run the engine until the engine coolant temperature reaches to 80°C or above, and then release the fast idle.
2. Loosen the accelerator cable tension sufficiently.
3. Connect the special tool (test harness) to the lever position sensor connector, as shown.

Lever position sensor connector



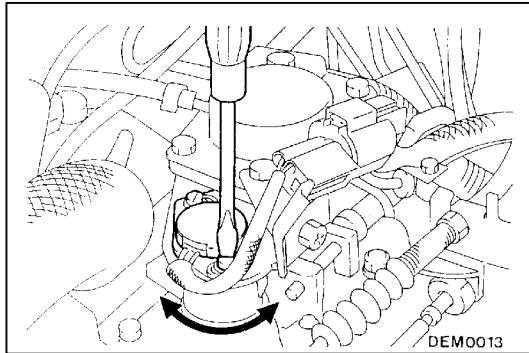
DEM0012



4. Connect a digital-type voltmeter between lever position sensor terminals 1 (red clip) and 3 (blue clip).
5. Turn the ignition switch to "ON". (Do not start the engine.)
6. Measure output voltage of the lever position sensor.

**Standard value:**

Lever condition	Voltage V
Idle position	0.8 - 1.0
Fully open	3.7 - 4.9

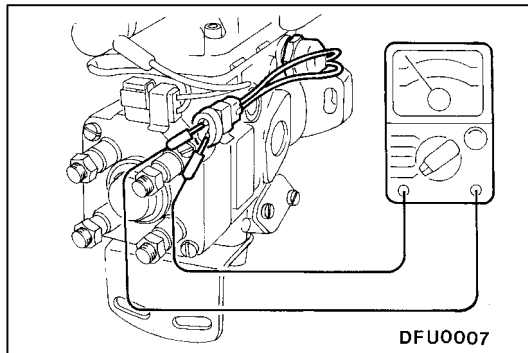


7. If the voltage is outside the standard value, adjust by loosening the lever position sensor mounting screw and turning the lever position sensor body. After adjustment, tighten the screw.

**NOTE**

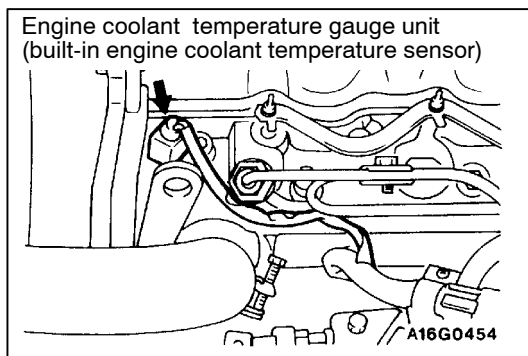
Voltage increases when the lever position sensor body is turned clockwise.

8. Turn the ignition switch off.
9. Adjust the accelerator cable play.

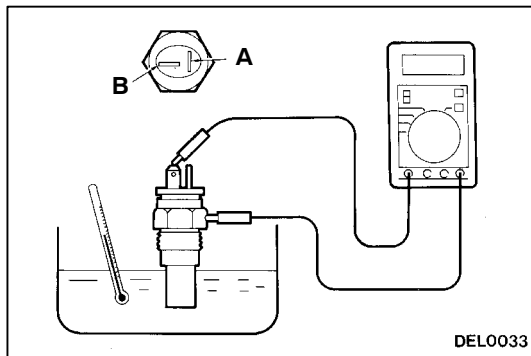
**ENGINE SPEED SENSOR CHECK**

1. Disconnect the engine speed sensor connector.
2. Measure resistance between the engine speed sensor terminals.

**Standard value:** 1.3 - 1.9 k $\Omega$

**ENGINE COOLANT TEMPERATURE SENSOR CHECK**

1. Remove the engine coolant temperature gauge unit.



2. Measure resistance between terminal (B) and the body earth when the temperature sensing portion of the engine coolant temperature gauge unit is immersed in hot water.

Temperature (°C)	Resistance (kΩ)
0	7.7 - 9.5
20	2.9 - 3.6
40	1.3 - 1.7
80	0.26 - 0.35

3. If the resistance deviates from the standard value greatly, replace the gauge unit.
4. Apply sealant to the threaded portion.

**Specified sealant:**

**3M NUT Locking Part No. 4171 or equivalent**

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

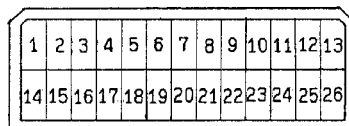
**Sensor tightening torque: 35 Nm**

6. Connect the wiring harness connectors.

## CHECK AT THE GLOW & EGR CONTROL UNIT

### TERMINAL VOLTAGE CHECK CHART

#### Glow & EGR Control Unit Connector Terminal Arrangement

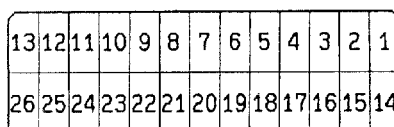


DEM0029

Terminal No.	Check item	Check condition (Engine condition)		Normal condition
3	EGR solenoid valve No.1	Ignition switch: ON		Battery voltage
		While engine is idle after having warmed up, suddenly depress the accelerator pedal.		Momentarily increases
6	Lever position sensor	Ignition switch: ON	Set throttle lever to idle position	0.8 - 1.0 V
			Fully open throttle lever	3.7 - 4.9 V
7	Sensor impressed voltage	Ignition switch: ON		4.8 - 5.2 V
16	EGR solenoid valve No.2	Ignition switch: ON		Battery voltage
		While engine is idle after having warmed up, suddenly depress the accelerator pedal.		Momentarily decreases

### HARNESS-SIDE CONNECTOR TERMINAL RESISTANCE AND CONTINUITY CHECK CHART

#### Glow & EGR Control Unit Harness-Side Connector Terminal Arrangement



DEM0026

Terminal No.	Check item	Normal condition (Check condition)
3 - 1	EGR solenoid valve No.1	36 - 44 $\Omega$ (At 20°C)
5 - Body earth	Engine coolant temperature sensor	7.7 - 9.5 k $\Omega$ (Coolant temperature at 0°C)
		2.9 - 3.6 k $\Omega$ (Coolant temperature at 20°C)
		1.3 - 1.7 k $\Omega$ (Coolant temperature at 40°C)
		0.26 - 0.35 k $\Omega$ (Coolant temperature at 80°C)
11 - 24	Engine speed sensor	1.3 - 1.9 k $\Omega$
16 - 1	EGR solenoid valve No.2	36 - 44 $\Omega$ (At 20°C)

# EMISSION CONTROL SYSTEM <4M4-VEHICLES WITH EGR>

## GENERAL INFORMATION

The electronically-controlled EGR system and the fuel injection timing control system (load timer) reduce the level of exhaust gases (NO<sub>x</sub>).

Items	Name	Specification
Exhaust emission control system	Exhaust gas recirculation system <ul style="list-style-type: none"><li>• EGR valve</li><li>• EGR solenoid valve No.1</li><li>• EGR solenoid valve No.2</li></ul>	Electronically-controlled EGR system Single type Duty cycle solenoid valve ON-OFF solenoid valve

## SERVICE SPECIFICATIONS

Items	Standard value
EGR solenoid valve No.1/No. 2 resistance (at 20°C) Ω	36 - 44

## EXHAUST GAS RECIRCULATION (EGR) SYSTEM

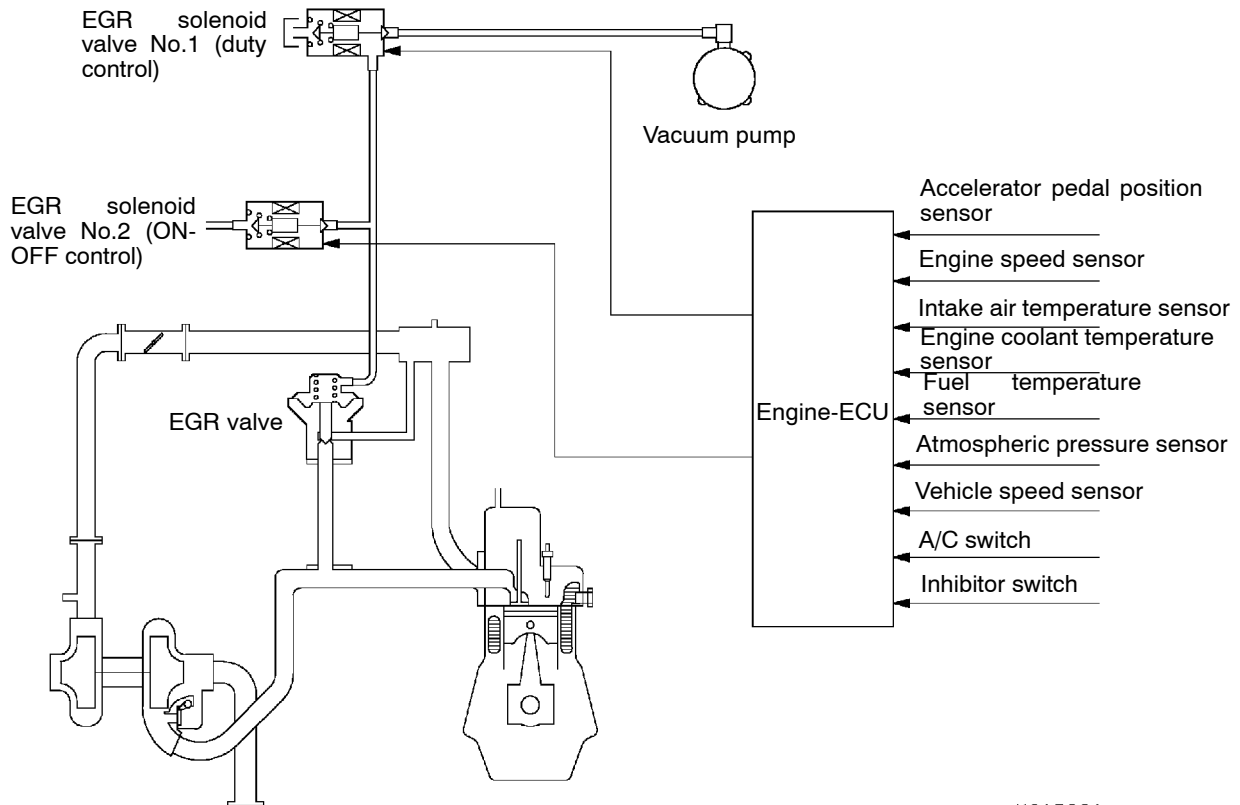
### GENERAL INFORMATION

The electronically-controlled EGR system consists of an EGR valve, vacuum pump, EGR solenoid valves No. 1 and No. 2, glow & EGR control unit and various sensors.

The EGR valve is controlled by the negative pressure inside the valve, which is controlled by EGR solenoid valves No. 1 and No. 2.

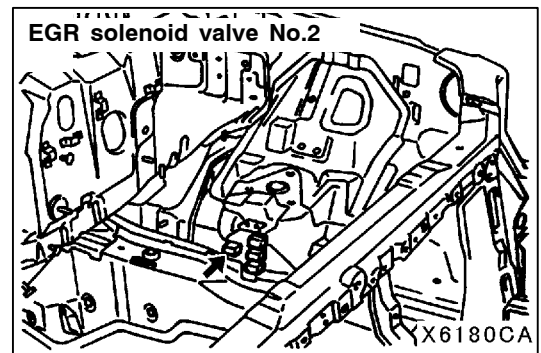
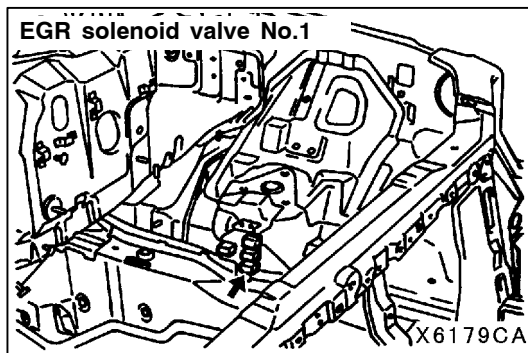
The EGR solenoid valves No.1 and No. 2 are optimally controlled by the glow & EGR control unit in response to the engine operation conditions, based on data input from each of the sensors. In this way, the EGR is controlled to reduce NO<sub>x</sub> emissions while maintaining good engine performance.

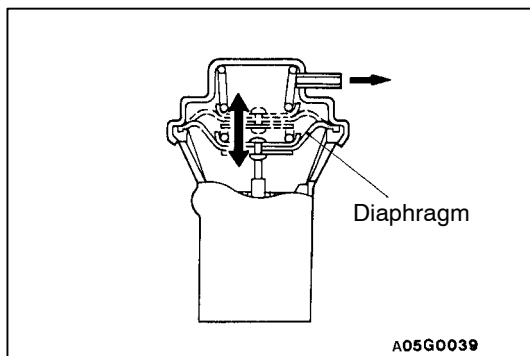
### SYSTEM DIAGRAM



X6178CA

### COMPONENT LOCATION



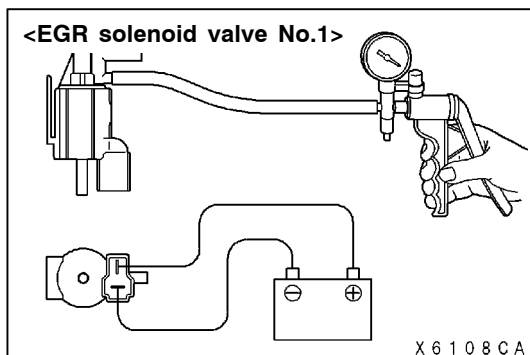
**FUNCTION CHECK**

1. Start the engine and warm it up until the engine coolant temperature reaches 65°C or above.
2. Turn the A/C switch "OFF".
3. Place the selector lever in P range.

4. Check the operation of the EGR valve.

**Normal condition:**

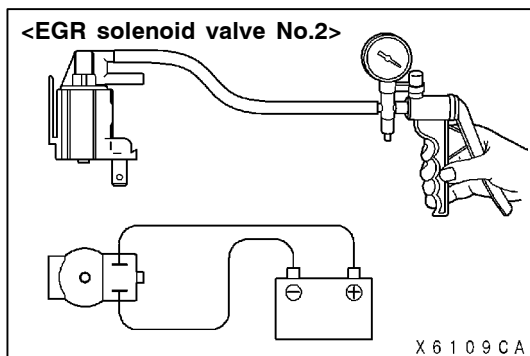
Engine condition	EGR valve condition
Idling without any load	Open
Sudden racing	Closed (Diaphragm lowers)

**EGR SOLENOID VALVE OPERATION CHECK**

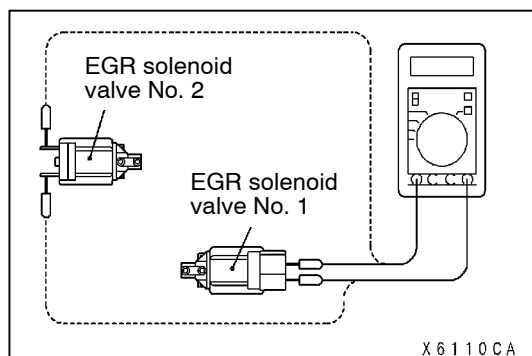
1. Attach a vacuum pump to each nipple of the EGR solenoid valves as shown and apply negative pressure.
2. Check that the valves are airtight both when voltage is applied to each terminal of the EGR solenoid valve and when it is not applied.

**EGR solenoid valve No.1**

Battery voltage	Normal condition
When current is flowing	Vacuum leaks (Vacuum is maintained when nipple A is plugged).
When current is not flowing	Vacuum leaks (Vacuum is maintained when nipple B is plugged).

**EGR solenoid valve No.2**

Battery voltage	Normal condition
When current is flowing	Vacuum leaks (Vacuum is maintained when nipple C is plugged).
When current is not flowing	Vacuum is maintained.

**EGR SOLENOID VALVE RESISTANCE CHECK**

Measure the resistance between the terminals of the solenoid valve.

**Standard value: 36 - 44  $\Omega$  (at 20°C)**

**ACCELERATOR PEDAL POSITION SENSOR (APS), ENGINE COOLANT TEMPERATURE SENSOR, INTAKE AIR TEMPERATURE SENSOR, FUEL TEMPERATURE SENSOR CHECK**

Refer to GROUP 13C - On-vehicle Service.

**CHECK AT ENGINE-ECU**

Refer to GROUP 13C - Troubleshooting.

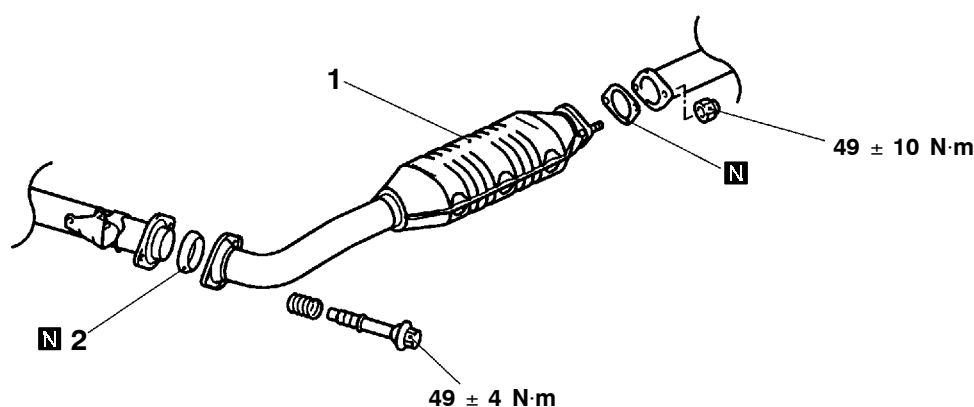
**CATALYTIC CONVERTER****GENERAL INFORMATION**

The three-way catalytic converter, together with the closed loop air-fuel ratio control based on the oxygen sensor signal, oxidizes carbon monoxides (CO) and hydrocarbons (HC) and reduces nitrogen oxides (NOx).

When the mixture is controlled at stoichiometric air-fuel ratio, the three-way catalytic converter provides the highest purification against the three constituents, namely, CO, HC and NOx.

**REMOVAL AND INSTALLATION**

**Pre-removal and Post-installation Operation**  
Under Cover Removal and Installation



AX0869CA

**Removal steps**

1. Catalytic converter
2. Seal ring



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**NOTES**

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# ENGINE AND EMISSION CONTROL

## CONTENTS

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# ENGINE CONTROL SYSTEM

## GENERAL

### OUTLINE OF CHANGE

Electronic-controlled throttle valve system has been used instead of a conventional cable-type accelerator mechanism <4D5>.

Its service procedure is the same as for previous models with 6G7 or 4M4 engine.

## EMISSION CONTROL SYSTEM <4D5-STEP III>

## GENERAL

### OUTLINE OF CHANGES

Some service procedures have been established as the following changes have been made due to the compliance with the Emission Regulation Step III.

- An electronic-controlled EGR valve and EGR cooler have been used.
- A catalytic converter has been added.

## GENERAL INFORMATION

The electronically-controlled EGR system reduces the level of exhaust gases (NO<sub>x</sub>).

Items	Name	Specification
Exhaust emission control system	Exhaust gas recirculation system <ul style="list-style-type: none"><li>• EGR valve</li><li>• EGR solenoid valve No.1</li><li>• EGR solenoid valve No.2</li><li>• EGR valve position sensor</li></ul>	Electronically-controlled EGR system Single type ON-OFF solenoid valve ON-OFF solenoid valve Variable resistor type

## SERVICE SPECIFICATIONS

Items	Standard value
EGR solenoid valve Nos. 1 and 2 resistance (at 20°C) Ω	36 - 44

## EXHAUST GAS RECIRCULATION (EGR) SYSTEM

### GENERAL INFORMATION

The electronically-controlled EGR system consists of an EGR valve, a vacuum pump, EGR solenoid valves Nos.1 and 2, EGR valve position sensor and engine-ECU.

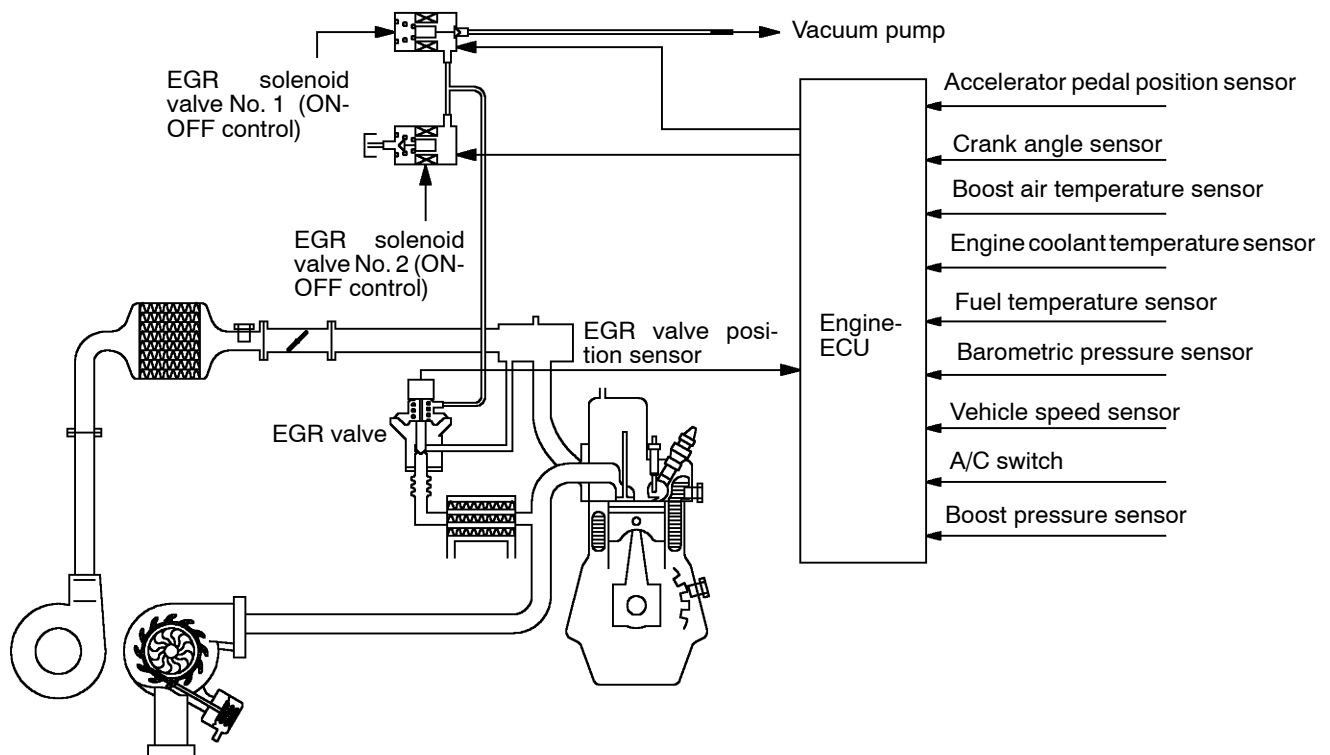
The EGR valve is controlled by the negative pressure inside the valve, which is controlled by EGR solenoid valves Nos.1 and 2.

In order to obtain EGR amount corresponding to each operating condition, the appropriate opening of the EGR valve is calculated based on the input signal from each sensor.

Feedback control of the EGR solenoid valves No. 1 and No. 2 operation is carried out based on the signal from EGR valve position sensor so that the opening of the EGR valve can be quickly adjusted to the target angle.

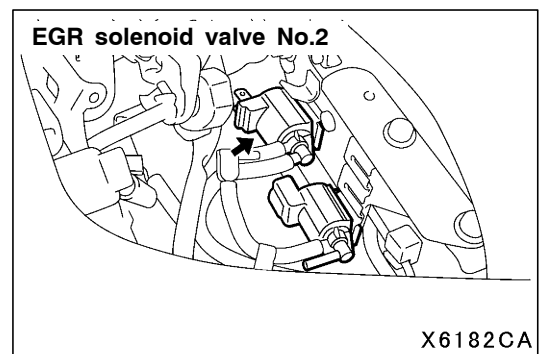
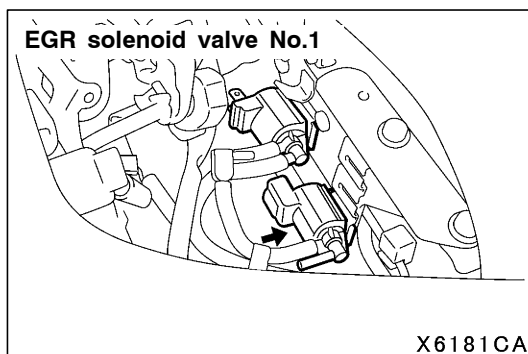
In this way, the EGR is controlled to reduce NOx emissions while maintaining good engine performance.

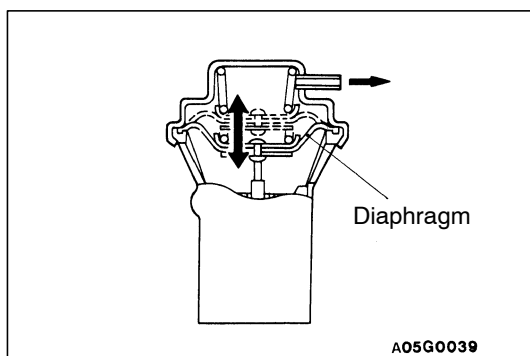
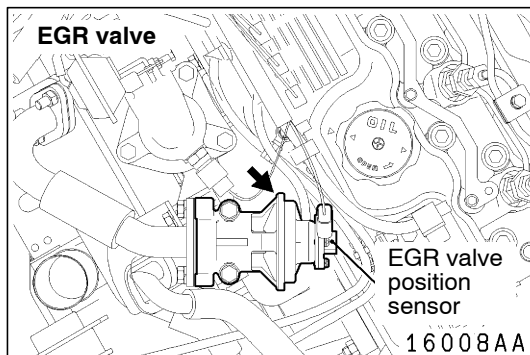
### SYSTEM DIAGRAM



16006CA

### COMPONENT LOCATION



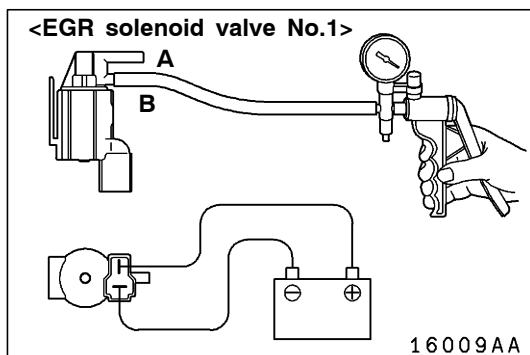


## FUNCTION CHECK

1. Start the engine and warm it up until the engine coolant temperature reaches 65°C or above.
2. Race the engine by suddenly depressing the accelerator pedal, then check that the EGR valve diaphragm lifts.

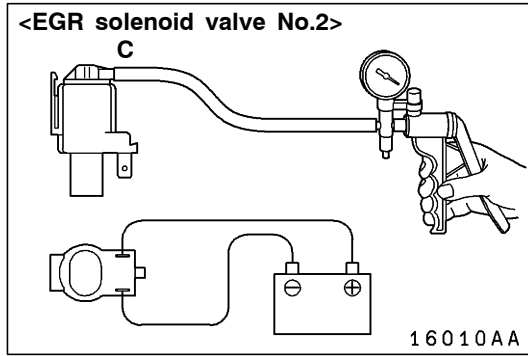
## EGR SOLENOID VALVE OPERATION CHECK

1. Remove EGR solenoid valve Nos.1 and 2 connectors and vacuum hoses.
2. Attach a vacuum pump to each nipple of the EGR solenoid valve Nos. 1 and 2 and connect each connector of EGR solenoid valve to battery and apply negative pressure. Check that the valves are airtight both when voltage is applied to each terminal of the EGR solenoid valve Nos. 1 and 2 and when it is not applied.



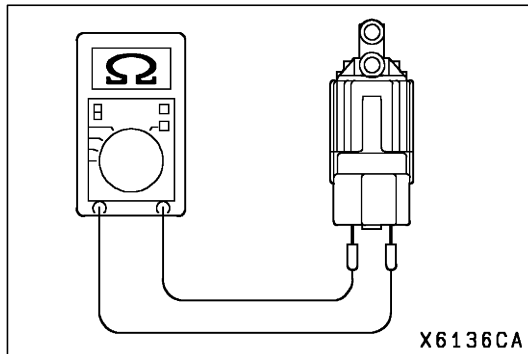
## EGR solenoid valve No.1

Battery voltage	Normal condition
When current is flowing	Vacuum leaks (Vacuum is maintained when nipple A is plugged)
When current is not flowing	Vacuum is maintained



### EGR solenoid valve No.2

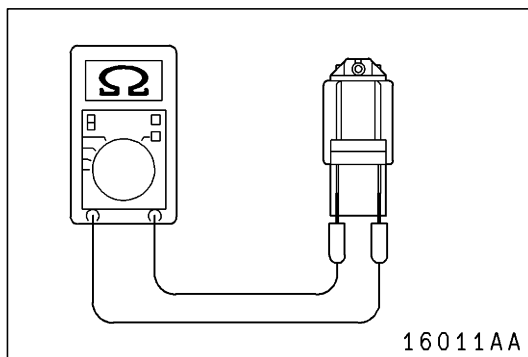
Battery voltage	Normal condition
When current is flowing	Vacuum is maintained
When current is not flowing	Vacuum leaks



### EGR SOLENOID VALVE RESISTANCE CHECK

Measure terminal resistance of EGR solenoid valves Nos. 1 and 2 with a circuit tester.

**Standard value: 36 - 44  $\Omega$  (at 20°C)**



### ACCELERATOR PEDAL POSITION SENSOR (APS), ENGINE COOLANT TEMPERATURE SENSOR, BOOST AIR TEMPERATURE SENSOR, FUEL TEMPERATURE SENSOR, EGR VALVE POSITION SENSOR CHECK

Refer to GROUP 13E - On-vehicle Service.

### CHECK AT ENGINE-ECU TERMINALS

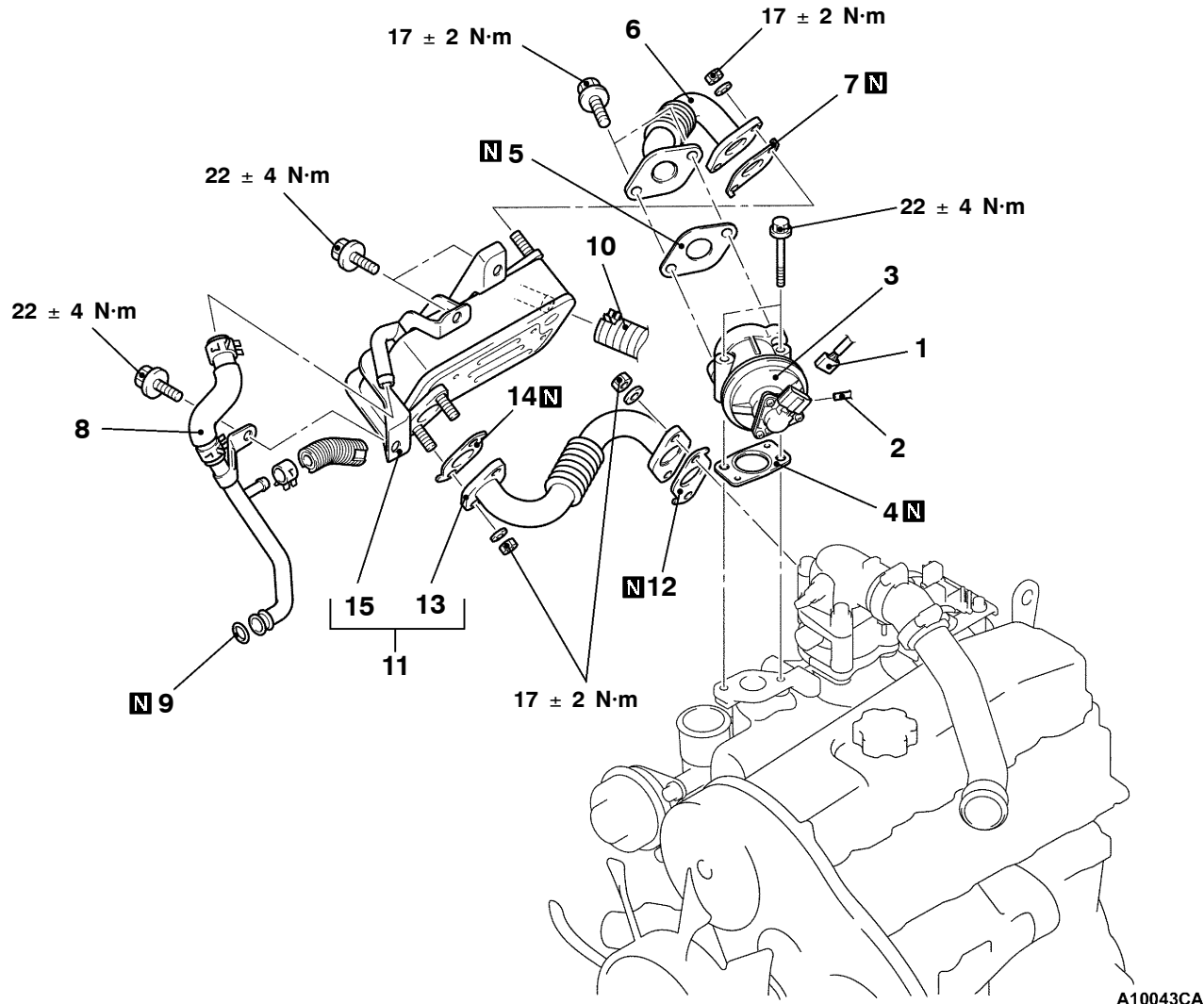
Refer to GROUP 13E - Troubleshooting.

## EGR VALVE AND EGR COOLER

### REMOVAL AND INSTALLATION

#### Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying.

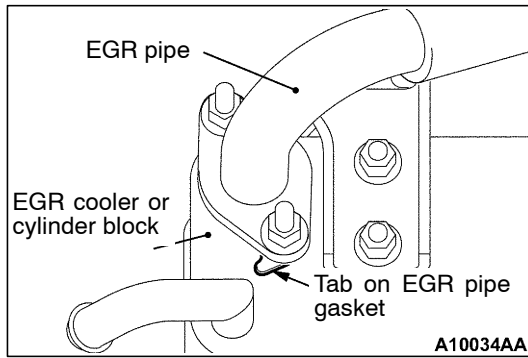


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#### Removal steps

1. EGR valve connector
2. Vacuum hose connection
3. EGR valve
4. EGR gasket
5. EGR pipe gasket
6. EGR upper pipe
7. EGR pipe gasket
8. Water pipe and hose assembly

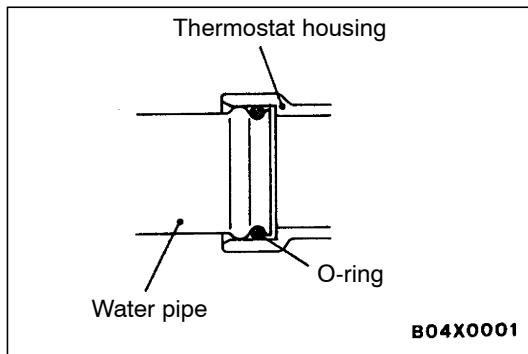
9. O-ring
10. Water hose connection
11. EGR cooler and EGR lower pipe assembly
12. EGR pipe gasket
13. EGR lower pipe
14. EGR pipe gasket
15. EGR cooler



## INSTALLATION SERVICE POINT

### ►A◄ EGR PIPE GASKET INSTALLATION

The tab on the EGR pipe gasket should be positioned as shown.

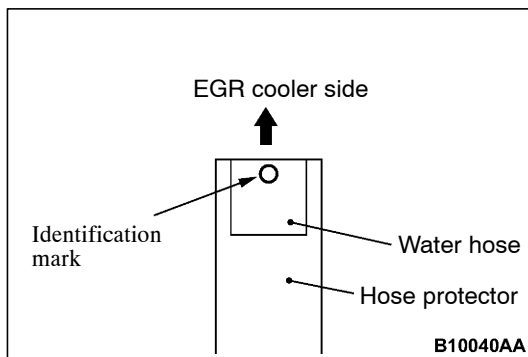


### ►B◄ O-RING INSTALLATION

Rinse the mounting location of the O-ring and water pipe with water, and install the O-ring and water pipe.

#### Caution

1. Care must be taken not to permit engine oil or other greases to adhere to the O-ring.
2. When inserting the pipe, check to be sure that there is no sand, dirt, etc. on its inner surface.



### ►C◄ WATER PIPE AND HOSE ASSEMBLY INSTALLATION

If the water hose is separated from the water pipe for any reason, the identification mark on the water hose end should face towards the EGR cooler.



## CATALYTIC CONVERTER

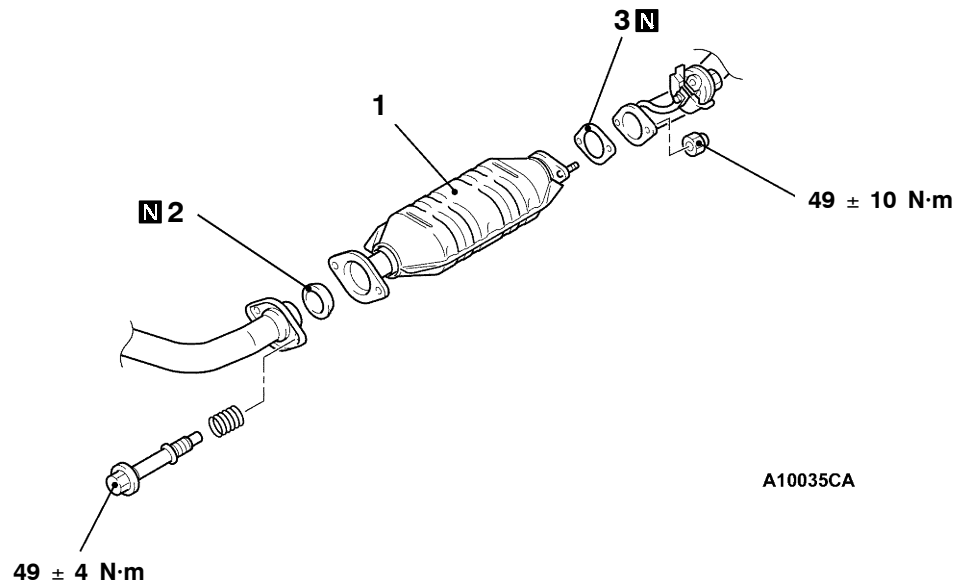
### GENERAL INFORMATION

The three-way catalytic converter, together with the closed loop air-fuel ratio control based on the oxygen sensor signal, oxidizes carbon monoxides (CO) and hydrocarbons (HC) and reduces nitrogen oxides (NOx).

When the mixture is controlled at stoichiometric air-fuel ratio, the three-way catalytic converter provides the highest purification against the three constituents, namely, CO, HC and NOx.

### REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operation**  
Under Cover Removal and Installation



#### Removal steps

1. Catalytic converter
2. Seal ring
3. Gasket

# EMISSION CONTROL SYSTEM <4M4>

## GENERAL

### OUTLINE OF CHANGE

Some service procedures have been established as the following changes have been made due to the compliance with the Emission Regulation Step III.

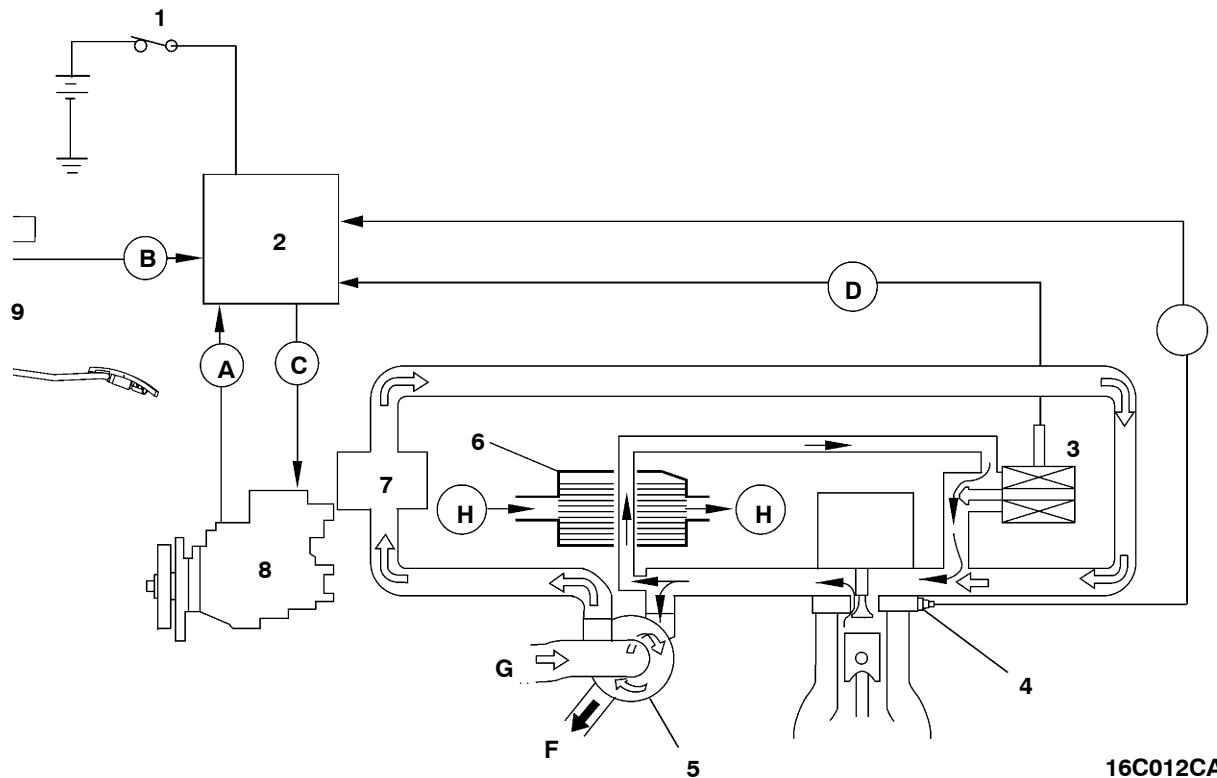
- An electronic-controlled EGR valve and EGR cooler have been used.

## SERVICE SPECIFICATION

Items	Standard value
EGR valve assembly output voltage V	0.5 - 4.5

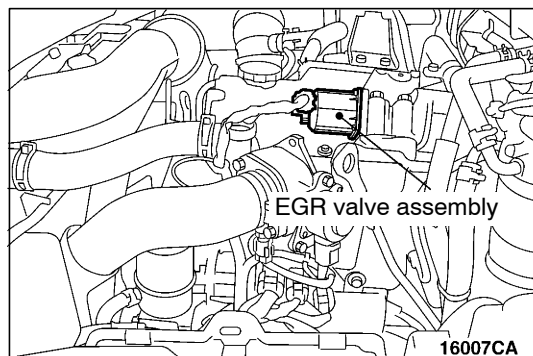
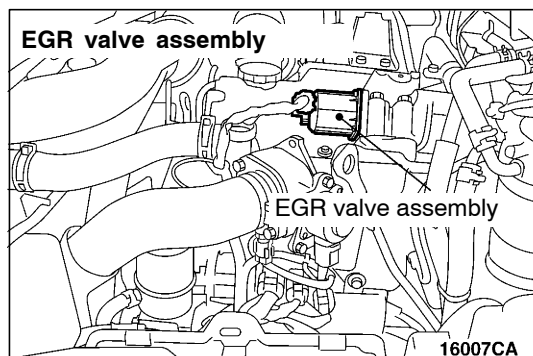
## EXHAUST GAS RECIRCULATION (EGR) SYSTEM

### SYSTEM DIAGRAM



16C012CA

- |                                      |   |
|--------------------------------------|---|
| 1. Ignition switch                   | A. Engine speed signal                    |
| 2. Engine-ECU                        | B. Accelerator pedal opening angle signal |
| 3. EGR valve assembly                | C. Fuel injection timing control signal   |
| 4. Engine coolant temperature sensor | D. EGR valve control signal               |
| 5. Turbocharger                      | E. Engine coolant temperature signal      |
| 6. EGR cooler                        | F. Exhaust gas                            |
| 7. Intercooler                       | G. Intake air                             |
| 8. Fuel injection pump               | H. Engine coolant                         |
| 9. Accelerator pedal                 |   |

**COMPONENT LOCATION****EGR VALVE ASSEMBLY CHECK**

1. Connect the MUT-II to the diagnosis connector to check for data list item No.32.
2. Start the engine, and warm up the engine.
3. Raise the engine speed gradually, and make sure that the output voltage changes within the standard value range.

**Standard value: 0.5 - 4.5 V**

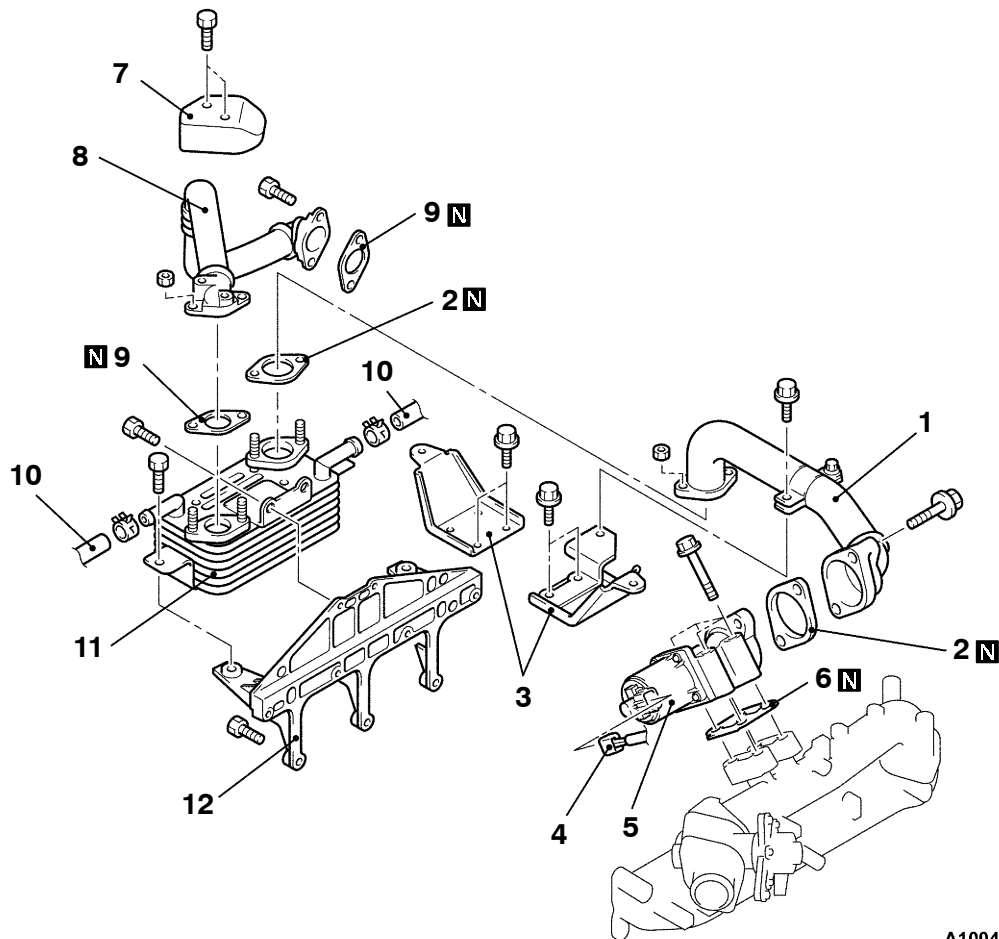
4. If not within the standard value range, replace the EGR valve.

## EGR VALVE AND EGR COOLER <4M4>

### REMOVAL AND INSTALLATION

#### Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying.
- Engine Cover Removal and Installation.



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#### Removal steps

1. EGR pipe B
  2. EGR pipe gasket
  3. Engine cover bracket
  4. EGR valve connector
  5. EGR valve
  6. EGR valve gasket
  7. EGR pipe insulator
  8. EGR pipe A
  9. EGR pipe gasket
  10. Water hose connection
  11. EGR cooler assembly
  12. EGR cooler bracket
- Air cleaner assembly

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**NOTES**

## GROUP 17

# ENGINE AND EMISSION CONTROL

## AUTO-CRUISE CONTROL SYSTEM

### GENERAL

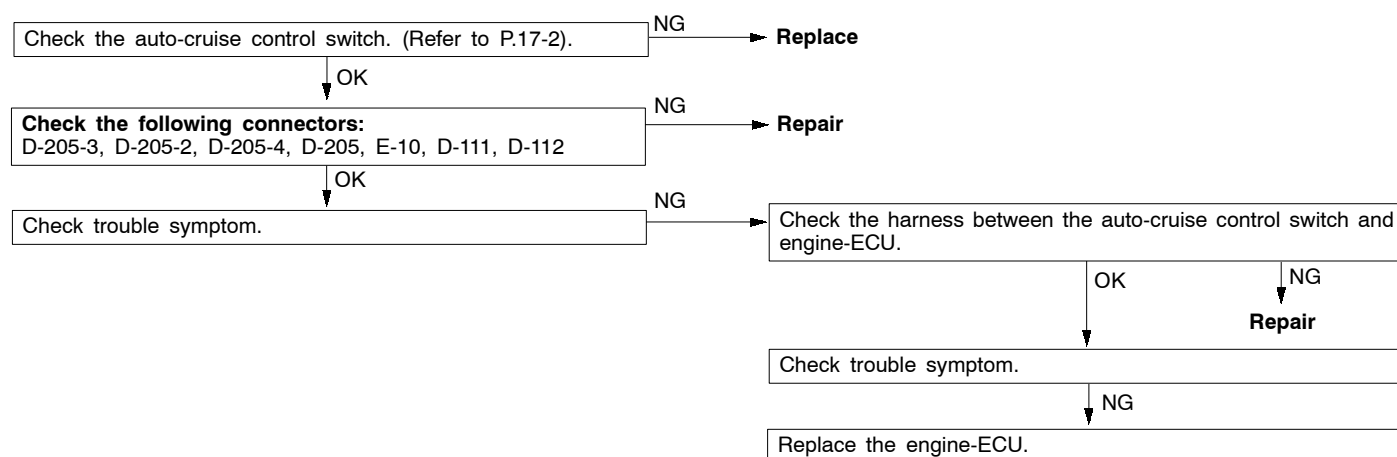
### OUTLINE OF CHANGE

The following service procedures have been established due to the change of the auto-cruise control switch. <4M4 engine model>

### TROUBLESHOOTING <4M4>

### INSPECTION PROCEDURE FOR DIAGNOSIS CODES

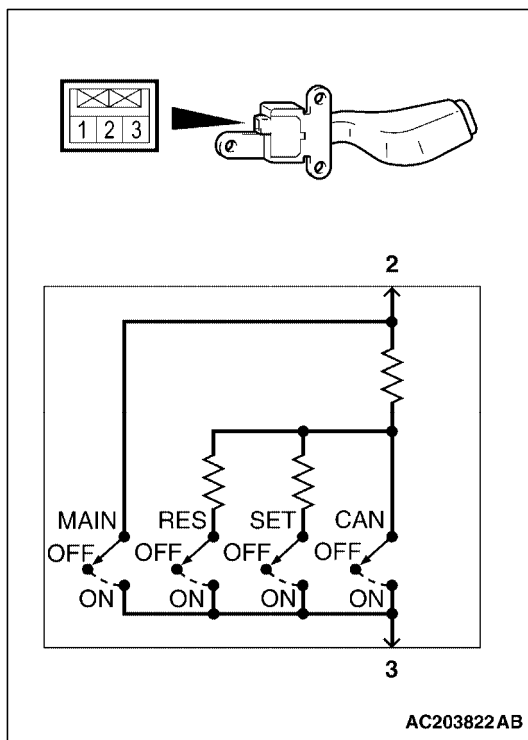
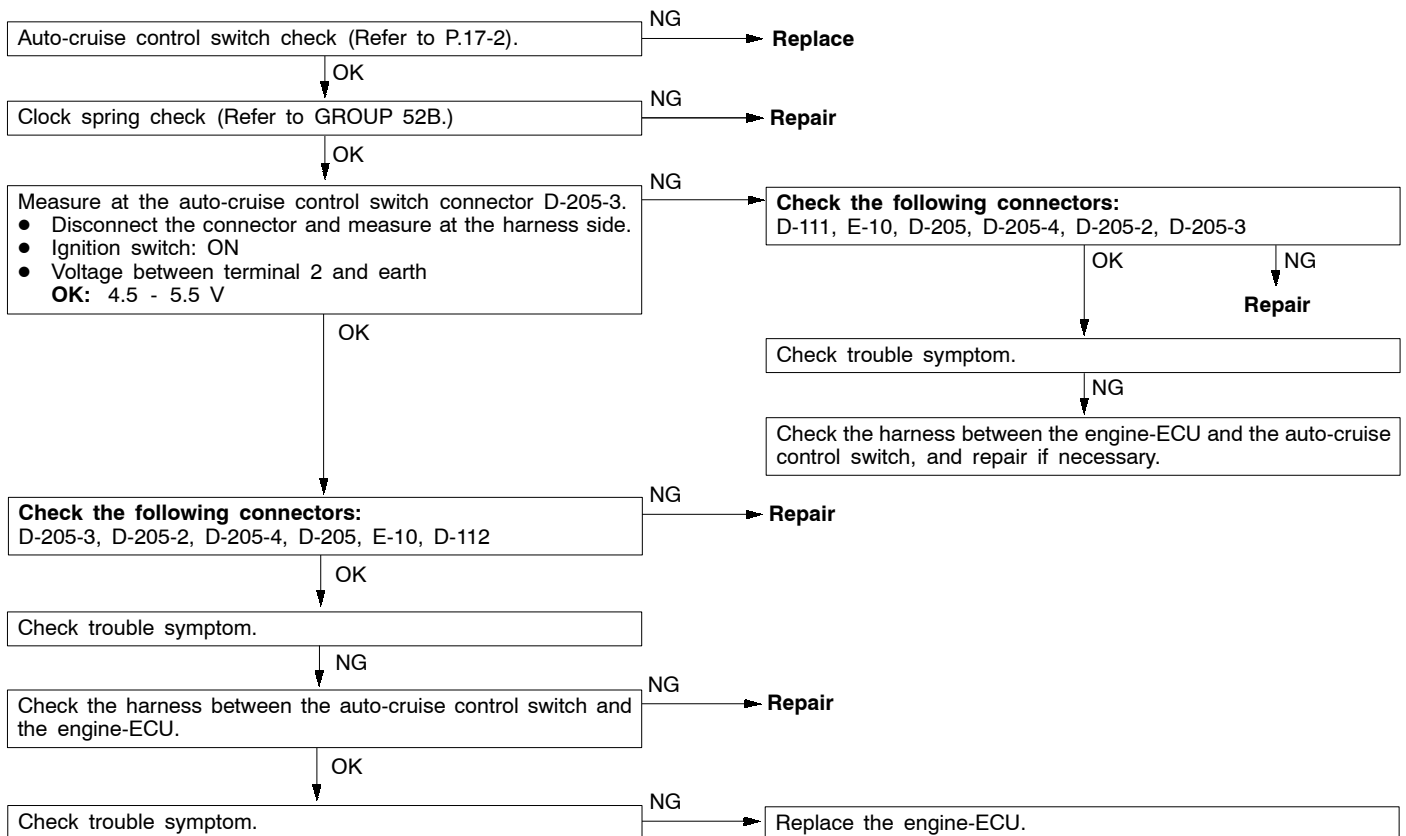
Code No. 15 Auto-cruise control switch system	Probable cause
This diagnosis code is output if the RESUME and SET switches of the auto-cruise control switch remain on.	<ul style="list-style-type: none"><li>• Malfunction of the auto-cruise control switch</li><li>• Malfunction of the connector</li><li>• Malfunction of the harness</li><li>• Malfunction of the engine-ECU</li></ul>



## INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

### Inspection Procedure 9

#### Auto-cruise control switch input system check



## ON-VEHICLE SERVICE <4M4>

### AUTO-CRUISE CONTROL COMPONENT CHECK AUTO-CRUISE CONTROL SWITCH CHECK

Measure the resistance between the terminals when each of the SET, RESUME, CANCEL and MAIN switches is pressed. If the values measured at this time correspond to those in the table below, then there is no problem.

Switch position	Resistance between terminals	
MAIN switch: OFF	No continuity	
MAIN switch: ON	Terminals 2 and 3	Approx. 0 Ω
CANCEL switch: ON	Terminals 2 and 3	Approx. 100 Ω
RESUME switch: ON	Terminals 2 and 3	Approx. 887 Ω
SET switch: ON	Terminals 2 and 3	Approx. 300 Ω

# EMISSION CONTROL SYSTEM <4M4>

## GENERAL

### OUTLINE OF CHANGE

Due to the changes on the EGR pipe, the service procedure of the EGR valve has been established.  
<Vehicles complying with Emission Regulation Step II>

## EGR VALVE

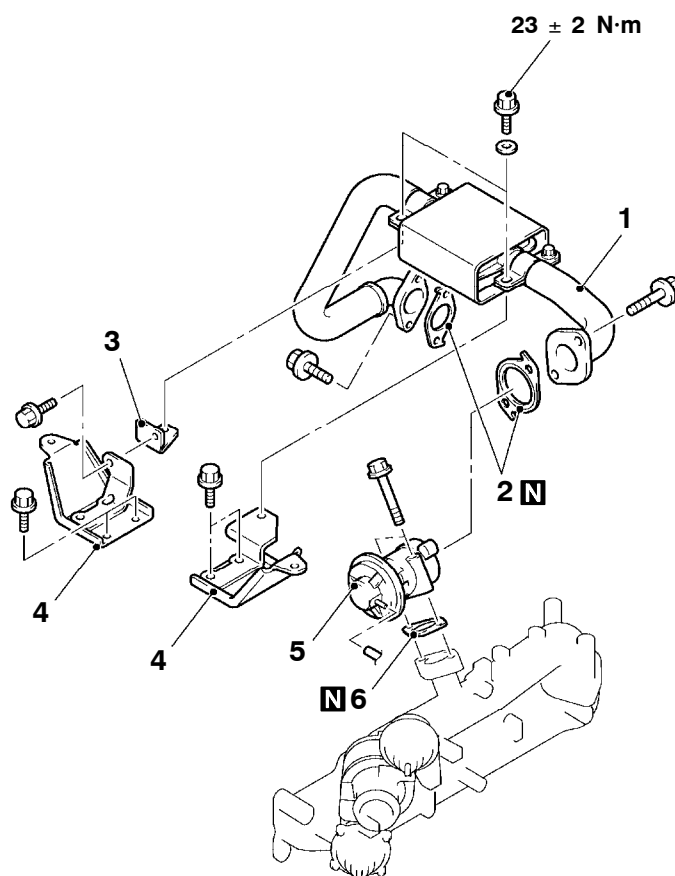
### REMOVAL AND INSTALLATION

<Vehicles complying with Emission Regulation Step II>

#### Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying
- Engine Cover Removal and Installation

<M/T>



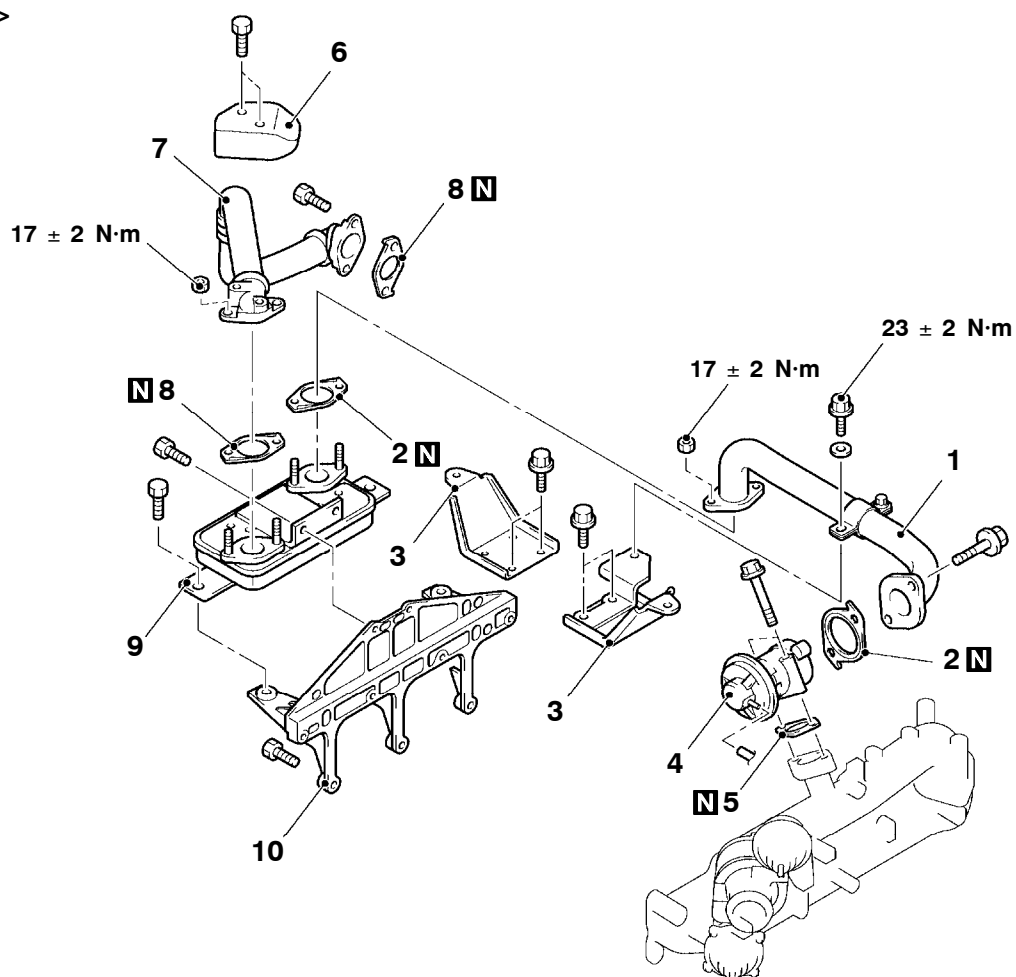
AC205548AB

#### Removal steps

1. EGR pipe
2. EGR pipe gaskets
3. EGR pipe stay
4. Engine cover brackets
5. EGR valve
6. EGR valve gasket



&lt;A/T&gt;



AC205549AB

**Removal steps**

1. EGR pipe B
2. EGR pipe gaskets
3. Engine cover brackets
4. EGR valve
5. EGR valve gasket
- Air cleaner assembly
6. EGR pipe insulator
7. EGR pipe A
8. EGR pipe gaskets
9. EGR box
10. EGR box bracket