

# ENGINE AND EMISSION CONTROL

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# ENGINE CONTROL SYSTEM <4G9-GDI>

## GENERAL

### OUTLINE OF CHANGE

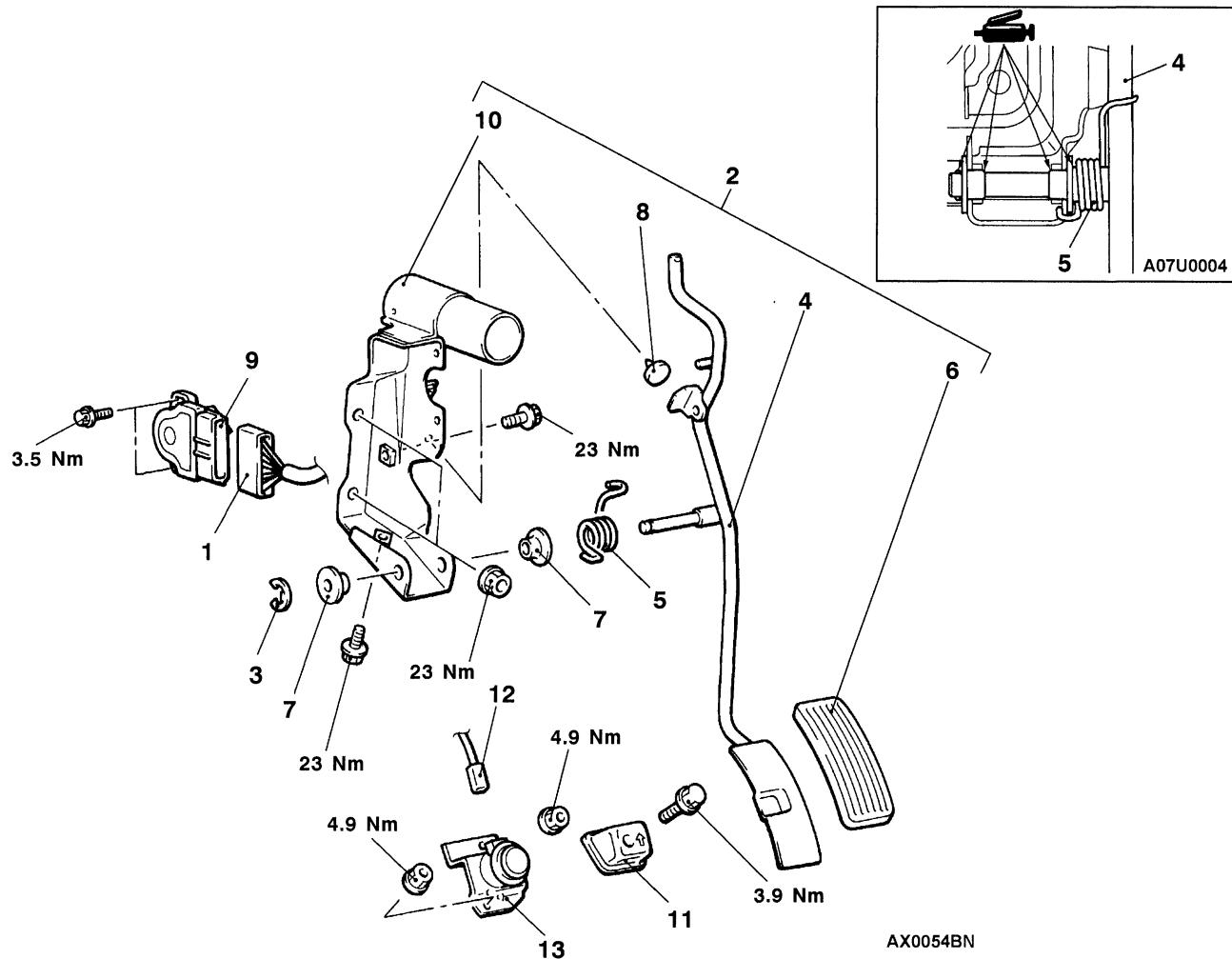
The service procedures have been revised due to the addition of the accelerator pedal position sensor.

## ACCELERATOR PEDAL

### REMOVAL AND INSTALLATION

#### Post-installation Operation

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



#### Removal steps

1. Accelerator pedal position sensor connector
2. Accelerator pedal assembly
3. Snap ring
4. Accelerator pedal
5. Return spring
6. Accelerator pedal pad
7. Bushing
8. Stopper
9. Accelerator pedal position sensor
10. Accelerator pedal bracket
11. Accelerator pedal stopper <M/T>
12. Wide open throttle switch connector <A/T>
13. Wide open throttle switch <A/T>

# AUTO-CRUISE CONTROL SYSTEM <4G9-GDI>

## GENERAL

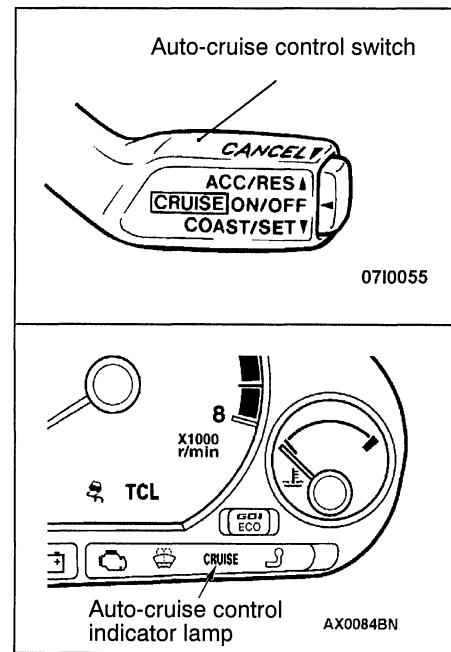
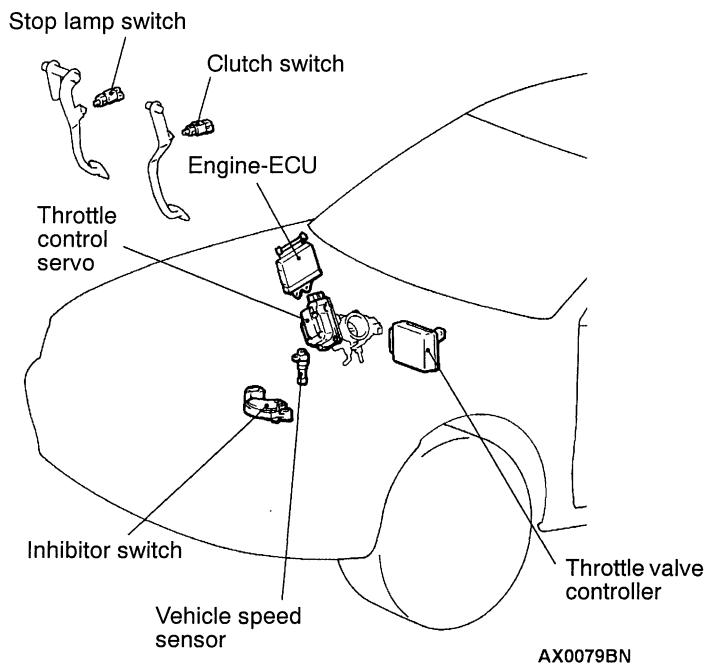
### OUTLINE OF CHANGE

The following service procedures have been added to correspond to the introduction of the electronically controlled throttle valve system and a built-in auto-cruise control switch.

## GENERAL INFORMATION

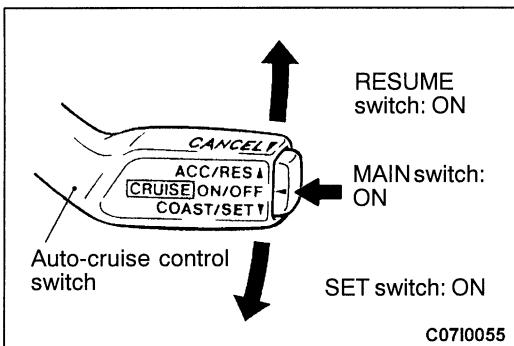
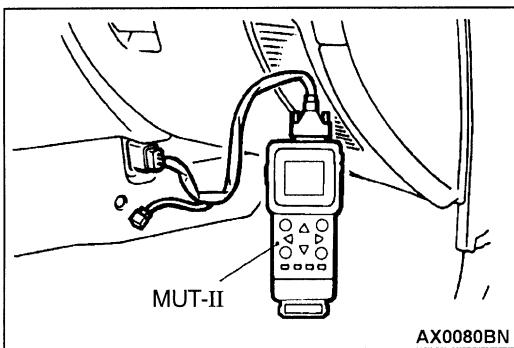
By using the auto-cruise control, the driver can drive at the speed he/she likes (in a range of

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



## SPECIAL TOOL

Tool	Number	Name	Use
	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

### DIAGNOSIS FUNCTION

#### METHOD OF READING THE DIAGNOSIS CODES

##### WHEN USING THE MUT-II

Connect the MUT-II to the diagnosis connector and take a reading of the diagnosis codes.

##### Caution

Turn the ignition switch to LOCK (OFF) position before connecting or disconnecting the MUT-II.

##### WHEN USING THE AUTO-CRUISE CONTROL INDICATOR LAMP

1. Turn the ignition switch to ON, and then turn on the MAIN switch of the auto-cruise control switch.
2. Turn off the MAIN switch of the auto-cruise control switch and the ignition switch.
3. While the MAIN switch and the SET switch of the auto-cruise control switch remain on, turn the ignition switch to ON. Then turn on the RESUME switch of the auto-cruise control switch within one second.

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

When the diagnosis code No.23 is output	When no diagnosis code is output
<p>When the diagnosis code No.23 is output</p>	<p>When no diagnosis code is output</p>

### METHOD OF ERASING DIAGNOSIS CODES

#### WHEN USING THE MUT-II

Connect the MUT-II to the diagnosis connector and erase the diagnosis code.

##### Caution

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

#### WHEN NOT USING THE MUT-II

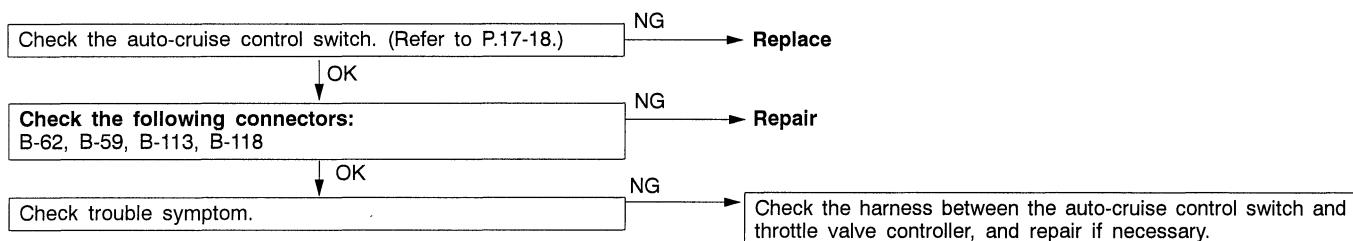
1. Turn the ignition switch to LOCK (OFF) position.
2. After disconnecting the battery cable from the battery (-) terminal for 10 seconds or more, reconnect the cable.

## INSPECTION CHART FOR DIAGNOSIS CODES

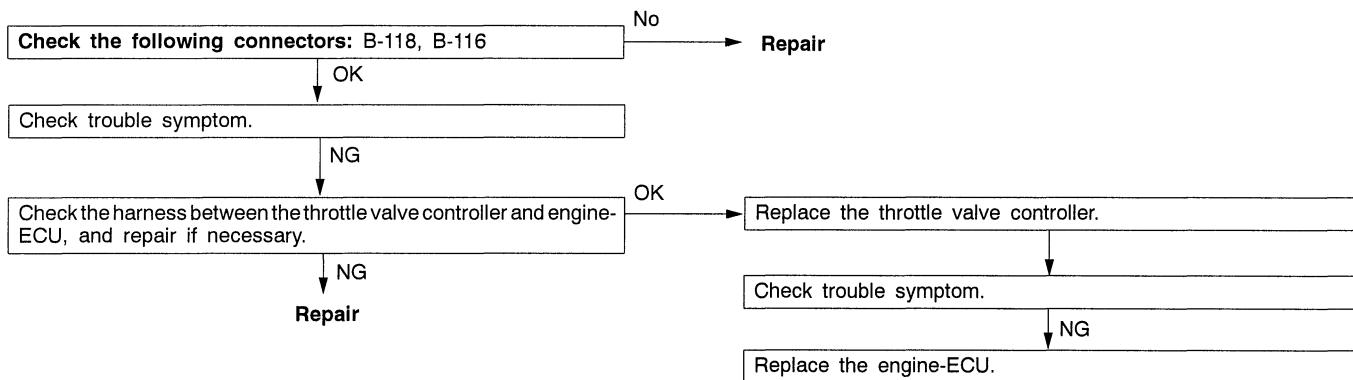
Code No.	Diagnosis item	Reference page
15	Auto-cruise control switch system	17-5
21	Cancel latch signal system	17-5
22	Stop lamp switch system	17-6
23	Engine-ECU system	17-7

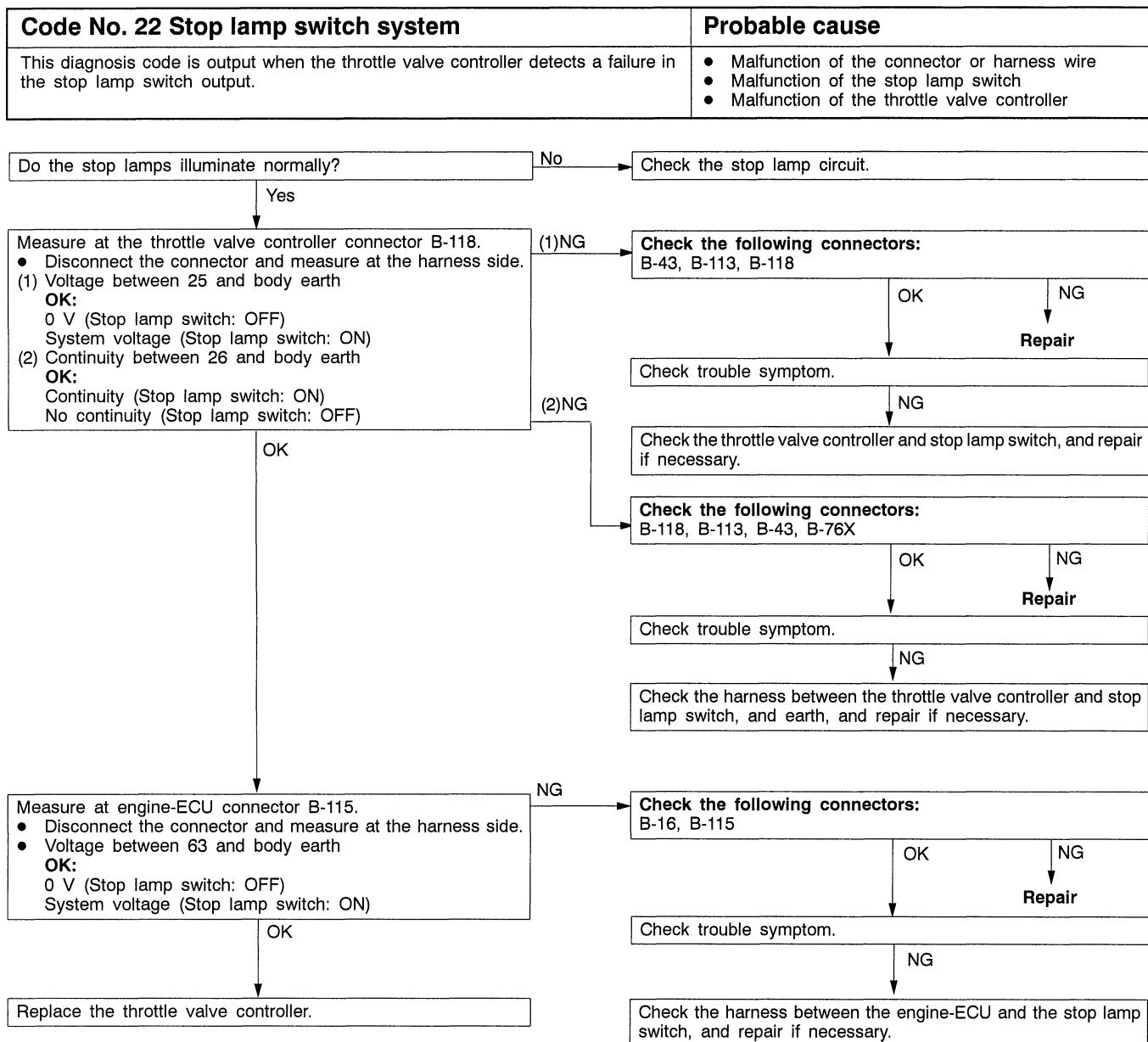
## INSPECTION PROCEDURE FOR DIAGNOSIS CODES

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> </ul>

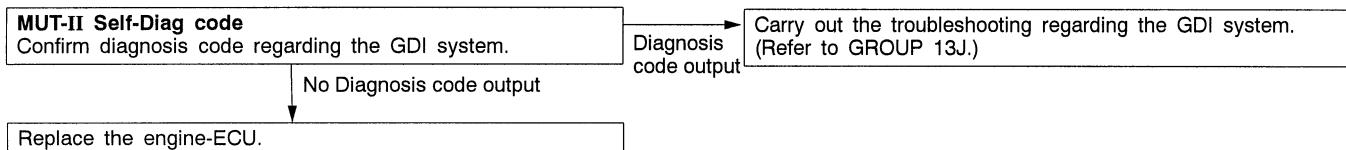


Code No. 21 Cancel latch signal system	Probable cause
The throttle valve controller and the engine-ECU send a cancel holding information to the engine-ECU via a cancel latch signal line and the serial communication line. This diagnosis code is output if there is a failure in the cancel latch signal line,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





Code No. 23 Engine-ECU system	Probable cause
<p>This diagnosis code is output if the engine-ECU system is defective as follows:</p> <ul style="list-style-type: none"> <li>• Communication error between the throttle valve controller and the engine-ECU</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 connector</li> <li>• Malfunction of the harness</li> <li>• Malfunction of the engine-ECU</li> </ul>



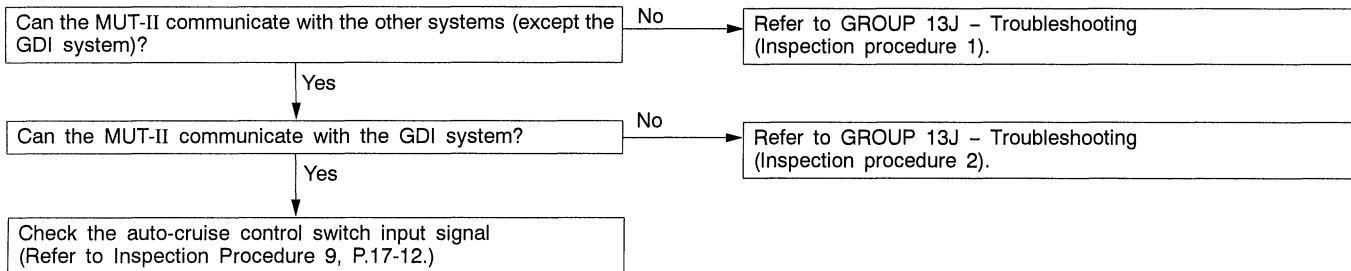
## INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptom		Inspection procedure No.	Reference page
Communication with MUT-II is not possible.		1	17-8
Auto-cruise control is not cancelled.	Even if brake pedal is depressed	2	17-8
	Even if clutch pedal is depressed <M/T>	3	17-9
	Even if select lever is set to N range <A/T>	4	17-9
	Even if CANCEL switch is set to ON	5	17-10
Auto-cruise control cannot be set.		6	17-10
Hunting (repeated acceleration and deceleration) occurs at the set vehicle speed.		7	17-11
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 is normal.)		8	17-11

## INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

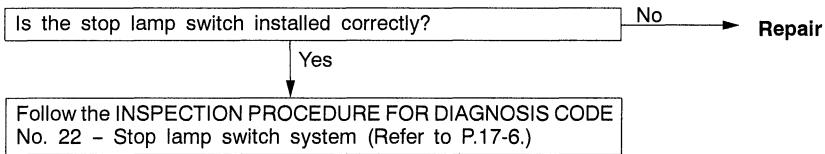
### Inspection Procedure 1

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. If the MUT-II can not communicate with only the GDI 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 the MUT-II can not communicate with only the auto-cruise control system, the auto-cruise control switch circuit may be defective.</p>	<ul style="list-style-type: none"> <li>• Malfunction of the connector or 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</li> </ul>



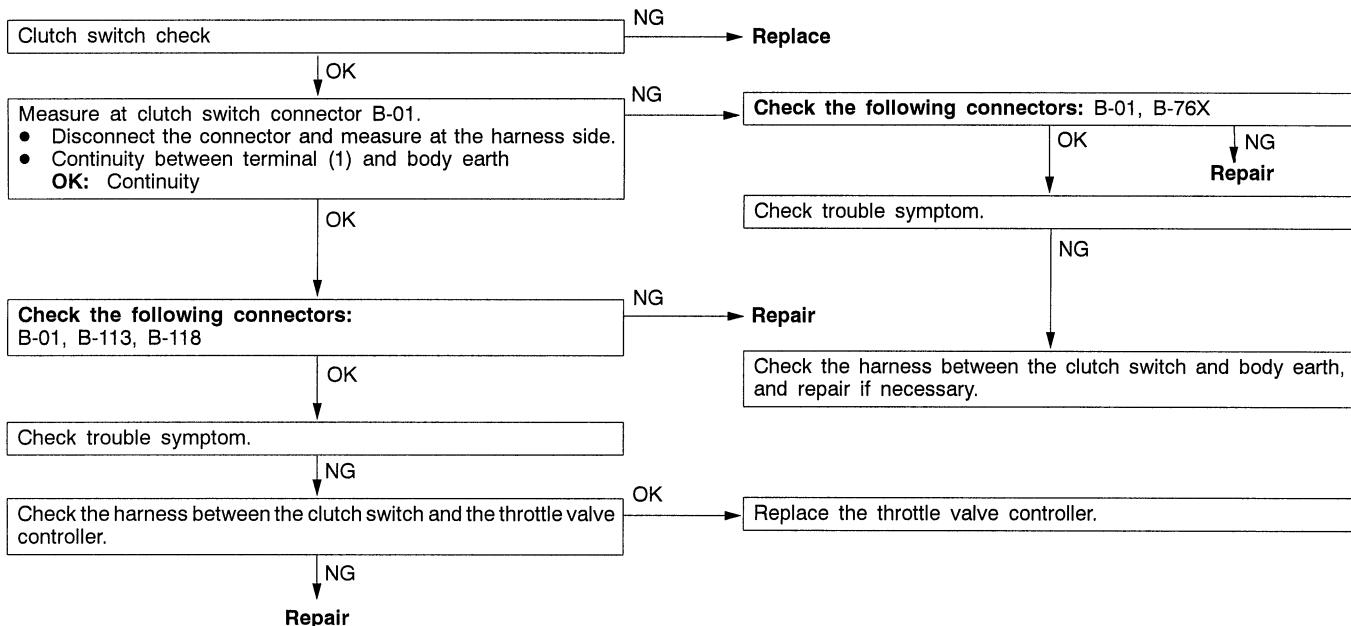
### Inspection Procedure 2

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

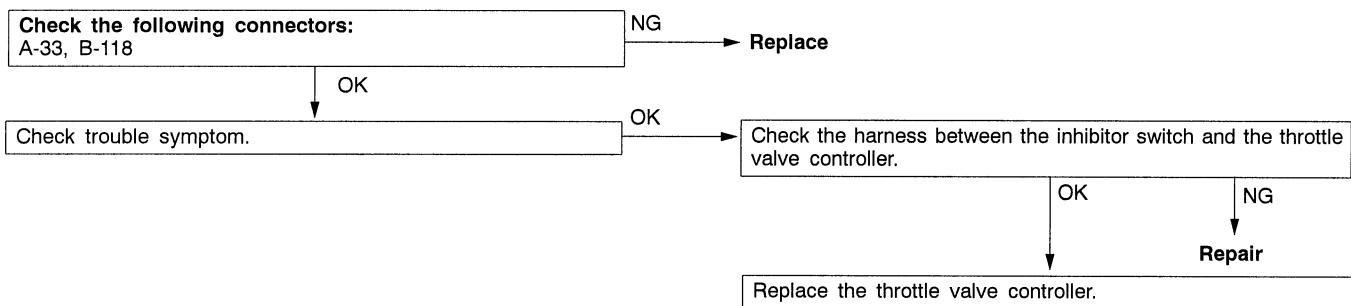


**Inspection Procedure 3**

<b>Even if clutch pedal is depressed, auto-cruise control is not cancelled. &lt;M/T&gt;</b>	<b>Probable cause</b>
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**

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



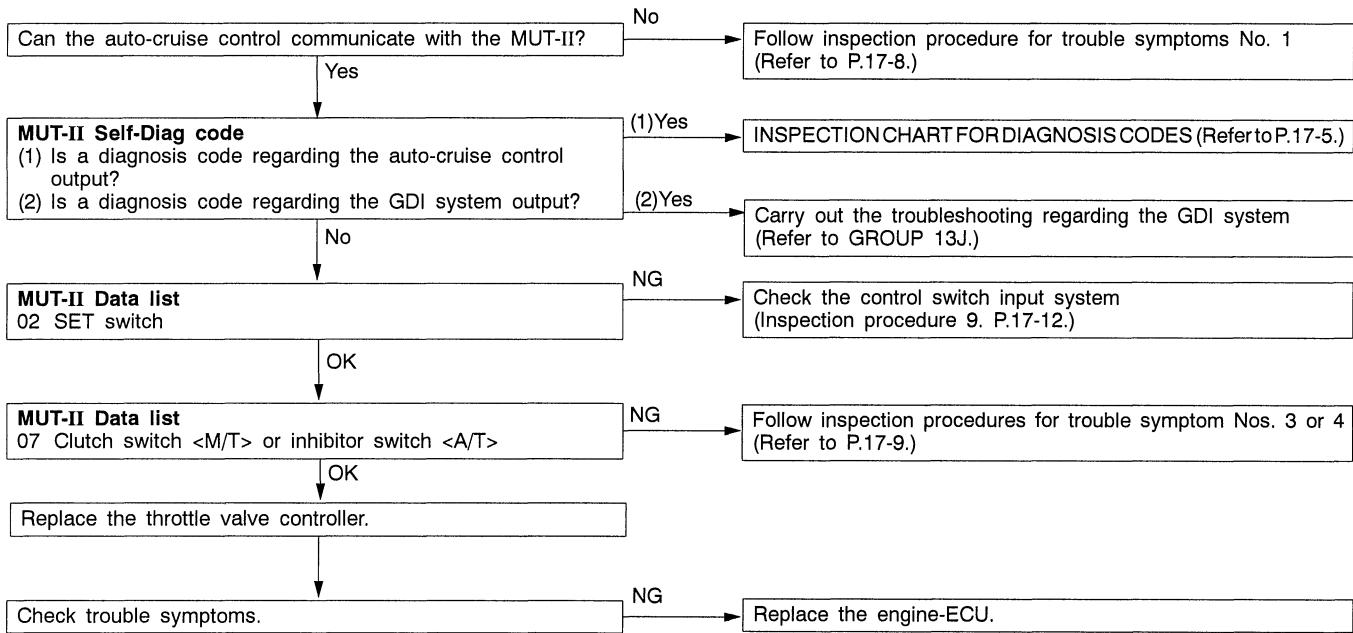
### Inspection Procedure 5

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.

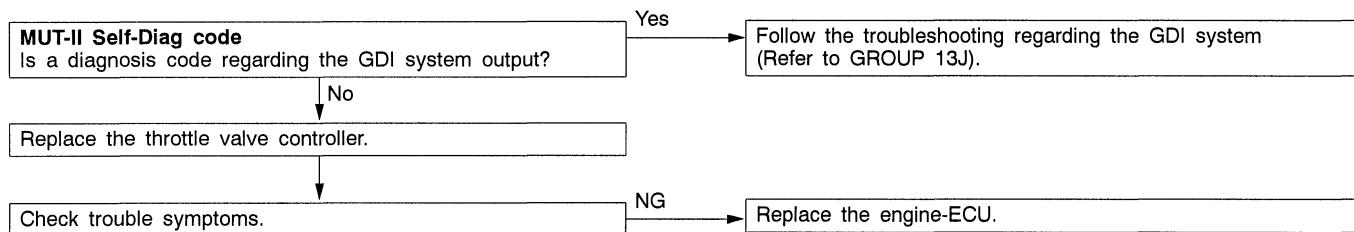
### Inspection Procedure 6

Auto-cruise control cannot be set.	Probable cause
<p>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 input switch codes.</p>	<ul style="list-style-type: none"> <li>• Malfunction of the auto-cruise control switch</li> <li>• Malfunction of the harnesses or connectors</li> <li>• Malfunction of the control switch</li> <li>• Malfunction of the throttle valve controller</li> <li>• Malfunction of the engine-ECU</li> </ul>



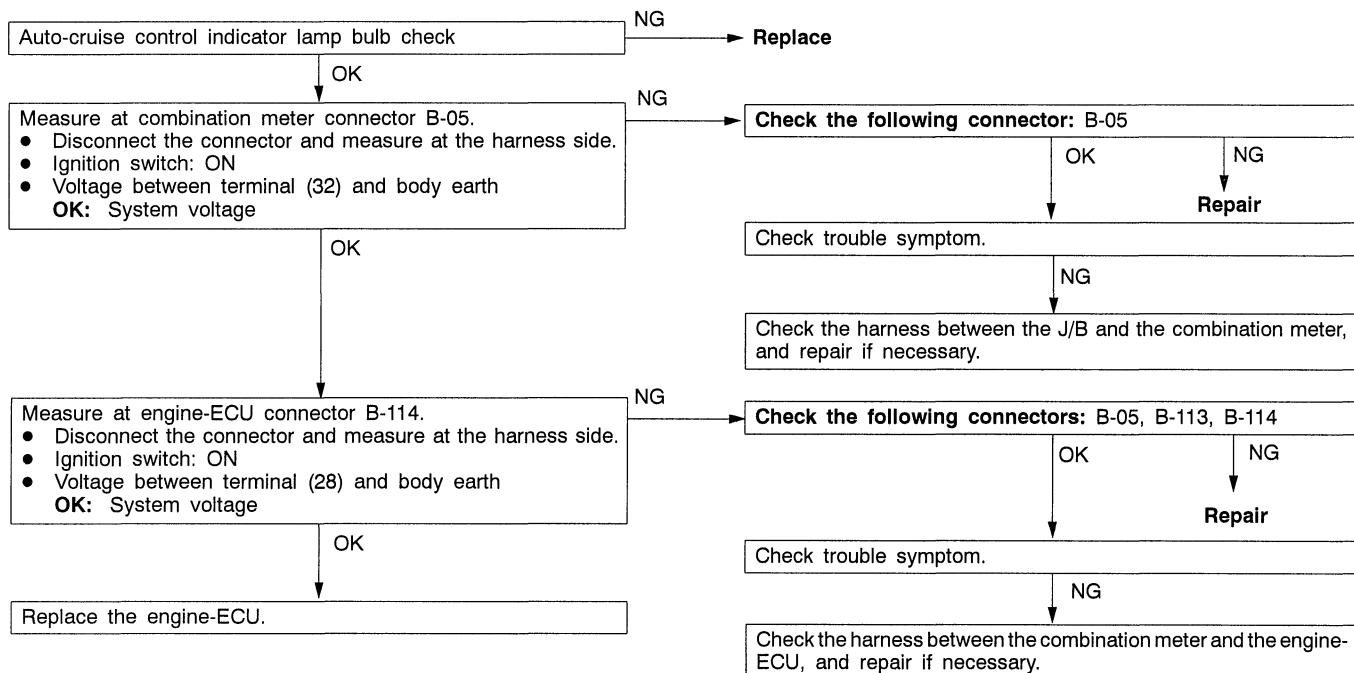
### Inspection Procedure 7

Hunting (repeated acceleration and deceleration) occurs at the set vehicle speed.	Probable cause
<p>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.</p>	<ul style="list-style-type: none"> <li>• Malfunction of the connector and harness</li> <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</li> </ul>



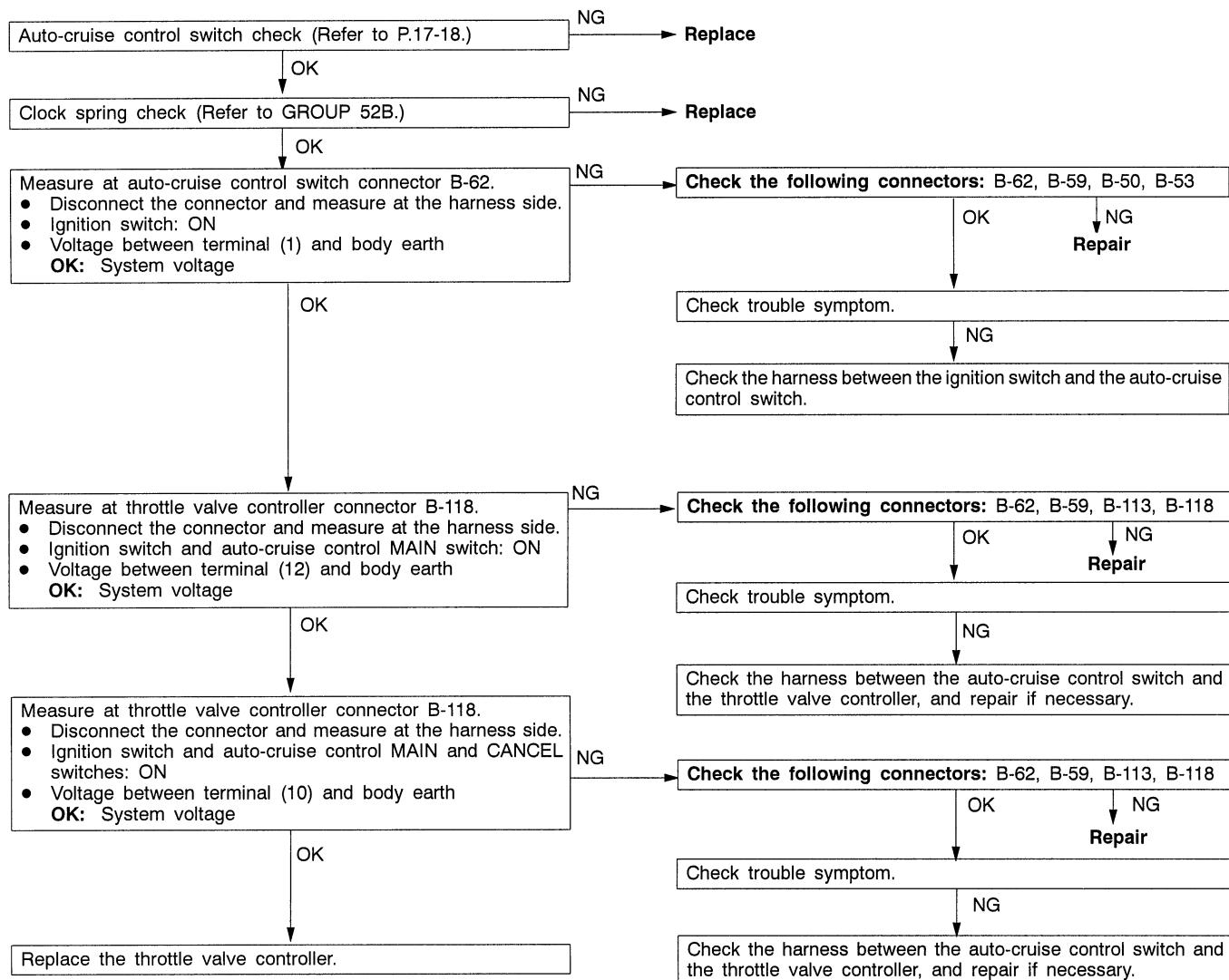
### Inspection Procedure 8

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 is normal.)	Probable cause
<p>There may be a burnt-out bulb or a malfunction of the auto-cruise control indicator lamp circuit.</p>	<ul style="list-style-type: none"> <li>• Burnt-out bulb</li> <li>• Malfunction of the connector and harness</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 throttle valve controller and the engine-ECU, 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.

#### Caution

**Turn the ignition switch to LOCK (OFF) position before connecting and disconnecting the MUT-II.**

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

Item No.	Check item		Check conditions	Normal condition	
01	Auto-cruise control switch	MAIN	MAIN switch: ON	ON	
			MAIN switch: OFF	OFF	
02		SET	SET switch: ON	ON	
			SET switch: OFF	OFF	
03		RESUME	RESUME switch: ON	ON	
			RESUME switch: OFF	OFF	
04		CANCEL	CANCEL switch: ON	ON	
			CANCEL switch: OFF	OFF	
05	Stop lamp switch		Brake pedal: Depressed	ON	
			Brake pedal: Released	OFF	
06	Stop lamp switch		Brake pedal: Depressed	OFF	
			Brake pedal: Released	ON	
07	Clutch switch <M/T>		Clutch pedal: Depressed	ON	
			Clutch pedal: Released	OFF	
	Inhibitor switch <A/T>		Selector lever: N position	ON	
			Selector lever: Other than N position	OFF	
08	Accelerator pedal position switch		Accelerator pedal: Released	ON	
			Accelerator pedal: Depressed	OFF	
09	Auto-cruise control		Auto-cruise control: Activated	ON	
			Auto-cruise control: No activated	OFF	
10	Vehicle speed sensor	Road test the vehicle		The speedometer and the MUT-II display the same value.	
11	Throttle position sensor (1st channel)		Accelerator pedal: Released	450 – 800 mV	
			Accelerator pedal: Depressed	The more deeply the pedal is depressed, the higher value the MUT-II displays	
			Accelerator pedal: Fully depressed	4,200 – 4,900 mV	
12	Accelerator pedal position sensor (2nd channel)		Accelerator pedal: Released	935 – 1,135 mV	
			Accelerator pedal: Depressed	The more deeply the pedal is depressed, the higher value the MUT-II displays	
			Accelerator pedal: Fully depressed	4,000 mV or more	

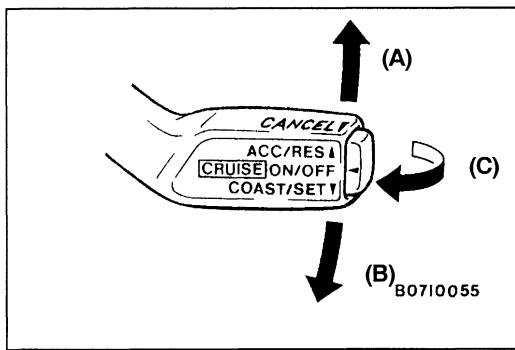
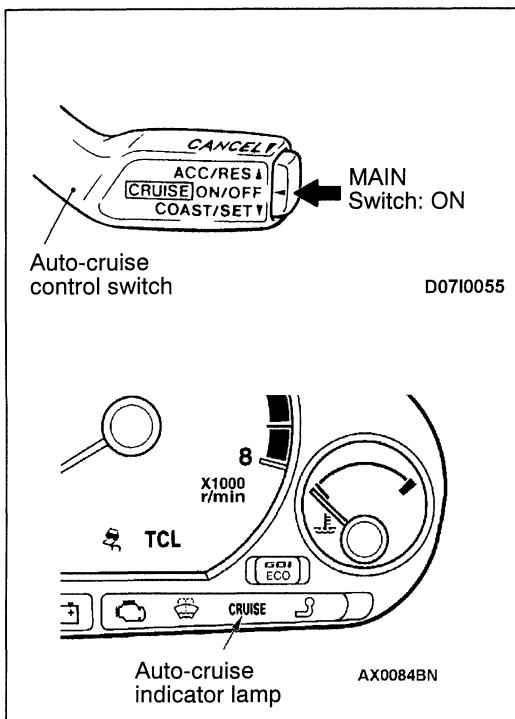
**CHECK AT THE THROTTLE VALVE CONTROLLER TERMINALS**

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26

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Terminal No.	Check item	Check conditions			Normal condition
1	Throttle control servo (A+)	Ignition switch: ON Accelerator pedal: Fully depressed position to released position			Value changes
9	Throttle control servo (B+)				
14	Throttle control servo (A-)				
15	Throttle control servo (B-)				
2	Throttle control servo power supply	Ignition switch: ON			System voltage
3, 4, 16	Earth	–			0 V
5	Power supply	Ignition switch: ON			System voltage
6	Sensor power supply	Ignition switch: ON			4.5 – 5.5 V
7	Throttle position sensor (1st channel)	Ignition switch: ON	Accelerator pedal: Released		0.4 – 0.8 V
			Accelerator pedal: Fully depressed		4.2 – 4.9 V
10	Auto-cruise control switch	Ignition switch: ON MAIN switch: ON	SET switch: ON		Approximately 3 V
			RESUME switch: ON		Approximately 6 V
			CANCEL switch: ON		System voltage
			All swishes: OFF		0 V
11	Clutch switch <M/T>	Ignition switch: ON	Clutch pedal: Depressed		0 V
			Clutch pedal: Released		8 – 14 V
	Inhibitor switch <A/T>	Ignition switch: ON	Selector lever: N or P position		0 V
			Selector lever: Other than the above		8 – 14 V
12	Auto-cruise control switch	Ignition switch: ON	MAIN switch: ON		System voltage
			MAIN switch: OFF		0 V
17	Sensor earth	–			0 V

Terminal No.	Check item	Check conditions	Normal condition
20	Accelerator pedal position sensor (2nd channel)	Ignition switch: ON	Accelerator pedal: Released 0.9 – 1.2 V
			Accelerator pedal: Fully depressed 4 V or more
22	Ignition switch (IG)	Ignition switch: ON	System voltage
23	Auto-cruise control cancel latch signal	Auto-cruise control: Activated	0 V
		Auto-cruise control: Not activated	System voltage
25	Stop lamp switch	Brake pedal: Depressed	System voltage
		Brake pedal: Released	0 V
26	Stop lamp switch	Ignition switch: ON	Brake pedal: Depressed 0 V
			Brake pedal: Released System voltage



## ON-VEHICLE SERVICE

The other items than the below are the same as the ones for 4G9-MPI.

### AUTO-CRUISE CONTROL SWITCH CHECK

#### AUTO-CRUISE 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 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 vehicle's 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 held, 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

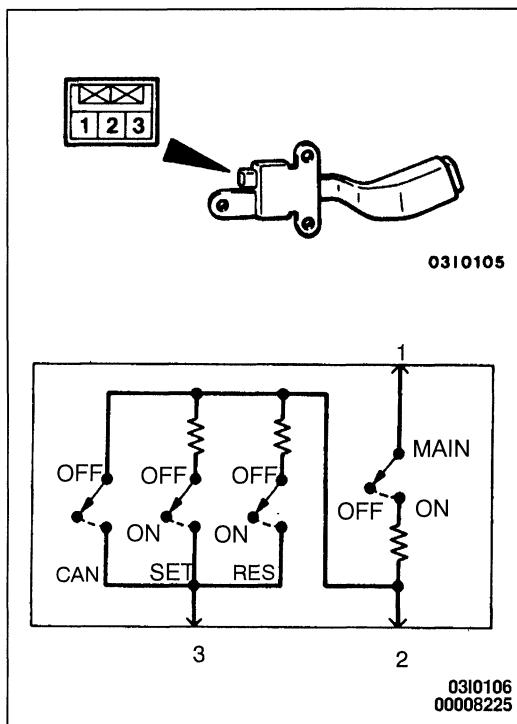
1. Set to the desired speed.
2. Push the auto-cruise control switch in the direction of arrow (B).
3. Check to be sure that deceleration continues while the switch is pressed, and that when it is released the constant speed at the time when it was released becomes the driving speed.

#### 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

### INSPECTION

#### 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	
Switch OFF	No continuity	
CANCEL switch: ON	Terminals 1 and 3	Approx. 3.9 kΩ
	Terminals 2 and 3	Approx. 0 Ω
RESUME switch: ON	Terminals 1 and 3	Approx. 4.8 kΩ
	Terminals 2 and 3	Approx. 910 Ω
SET switch: ON	Terminals 1 and 3	Approx. 4.1 kΩ
	Terminals 2 and 3	Approx. 220 Ω
MAIN switch: ON	Terminals 1 and 2	Approx. 3.9 kΩ

# EMISSION CONTROL SYSTEM <4G9>

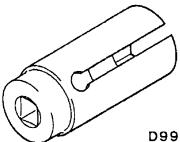
## GENERAL

### OUTLINE OF CHANGES

The service procedures have been revised due to the following changes:

- The purge port vacuum characteristics has been changed <MPI>.
- The purge port nipple has been relocated <GDI>.
- The catalytic converter has been changed.

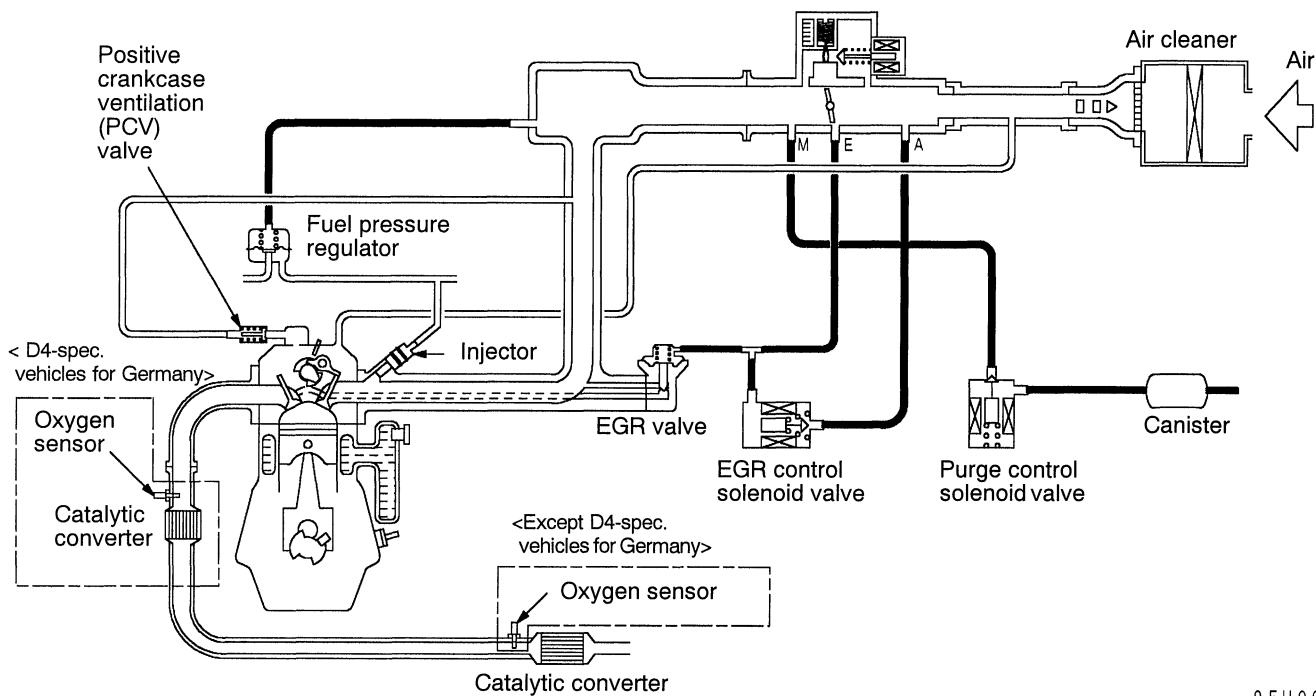
## SPECIAL TOOL

Tool	Number	Name	Use
 D998770	MD998770	Oxygen sensor wrench	Removal/Installation of oxygen sensor

## VACUUM HOSE

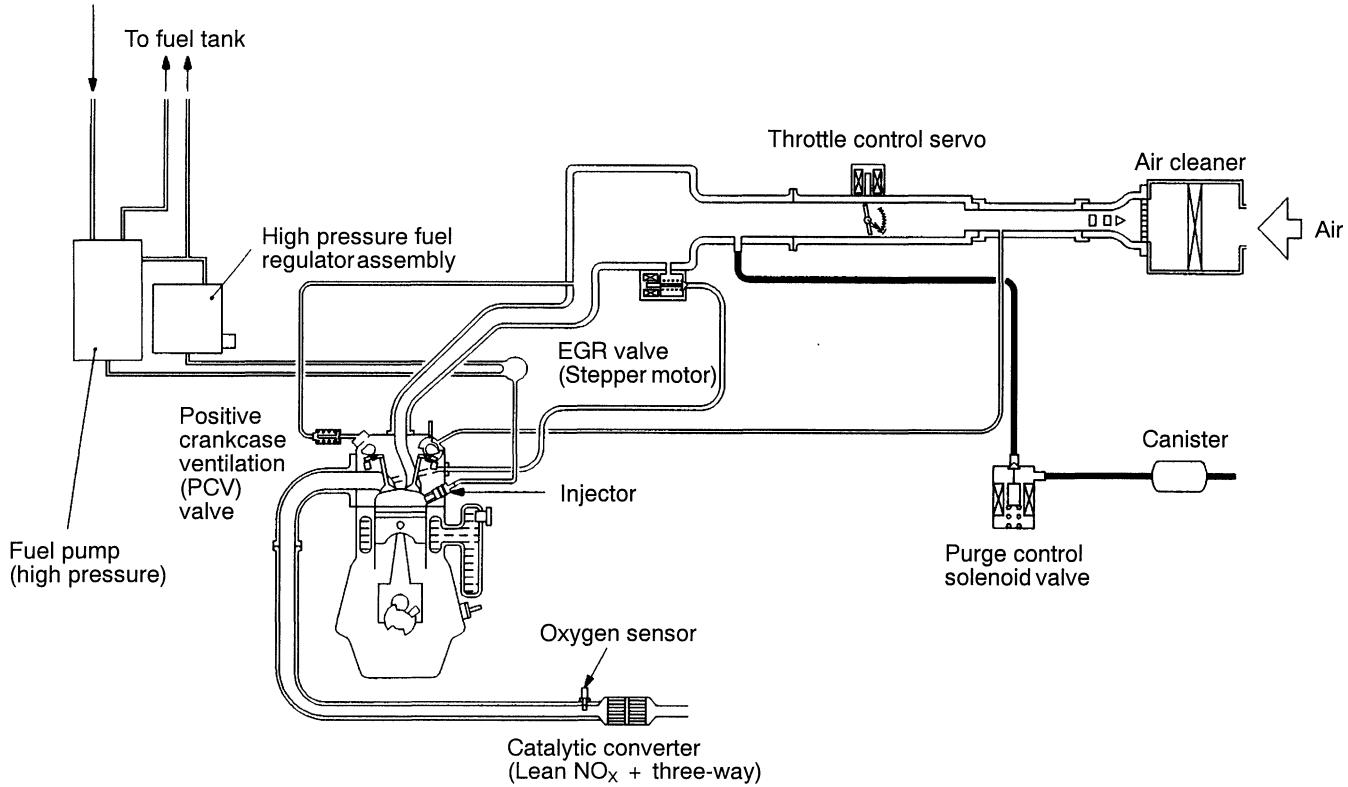
### VACUUM HOSE PIPING DIAGRAM

<MPI>



&lt;GDI&gt;

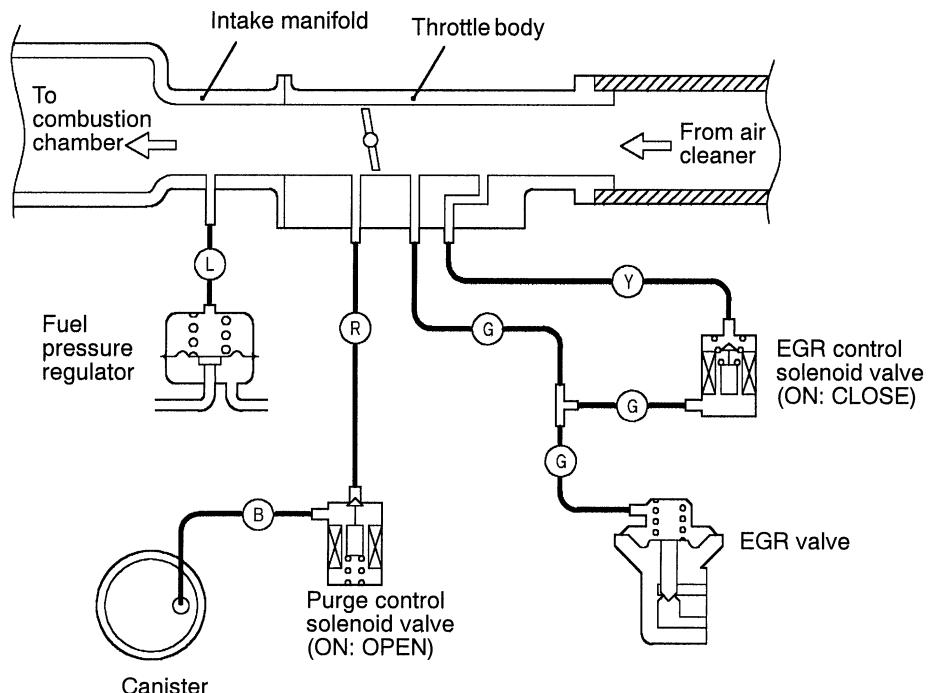
From fuel pump (low pressure)



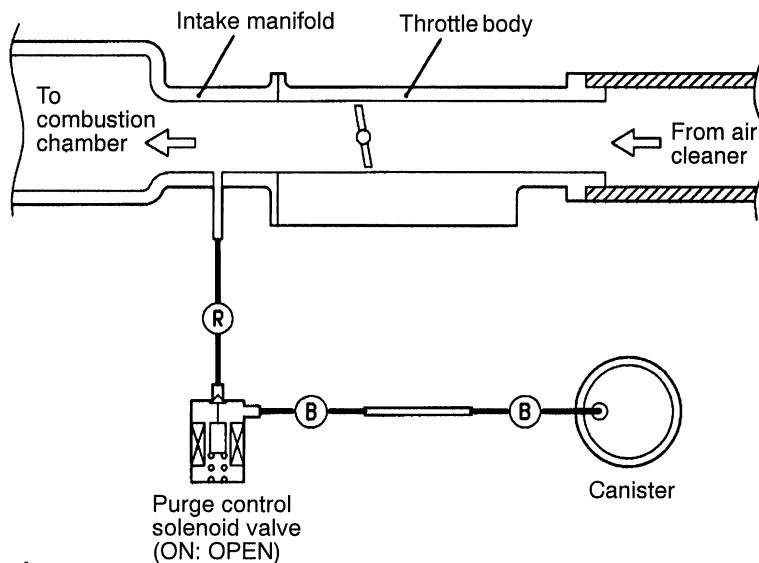
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VACUUM CIRCUIT DIAGRAM

<MPI>



<GDI>

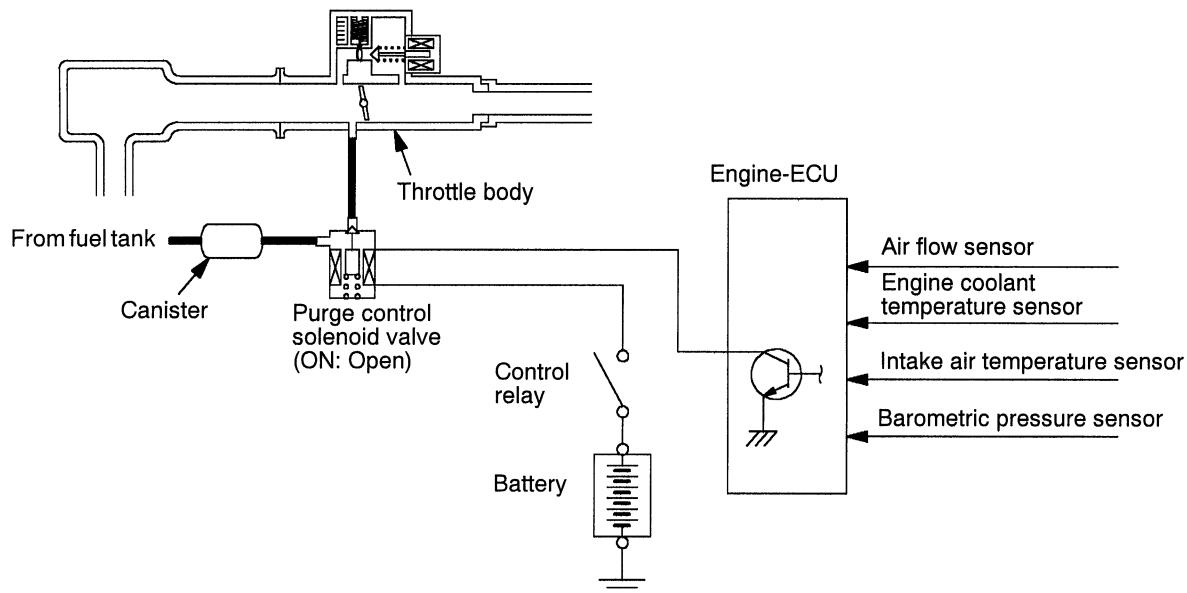


W6048AE

## EVAPORATIVE EMISSION CONTROL SYSTEM

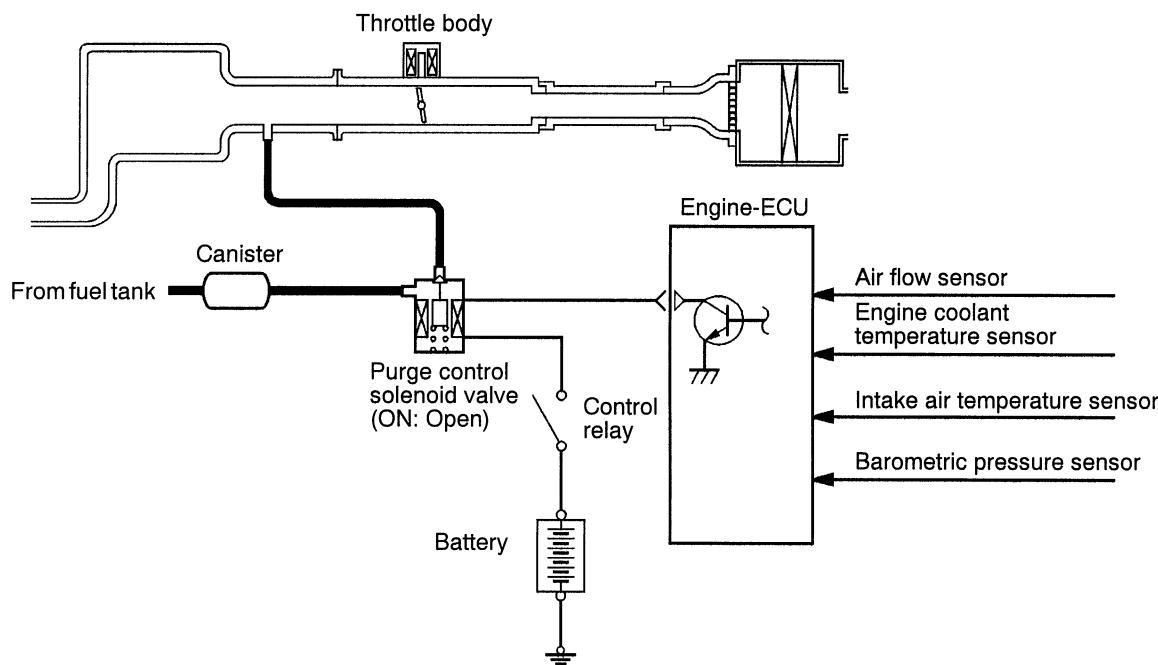
### SYSTEM DIAGRAM

&lt;MPI&gt;

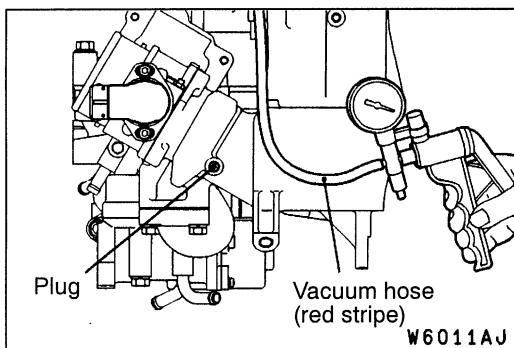


9 FU 0960

&lt;GDI&gt;



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### PURGE CONTROL SYSTEM CHECK <GDI>

1. Disconnect the vacuum hose (red stripe) 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**

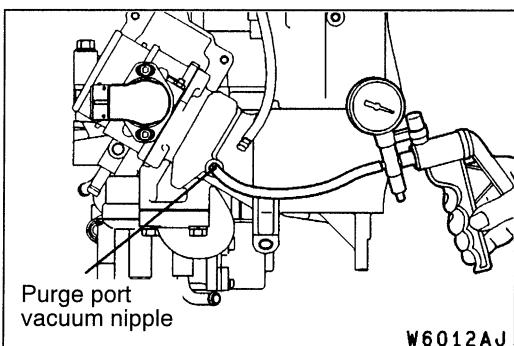
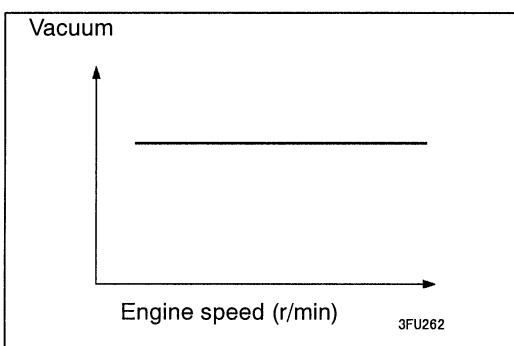
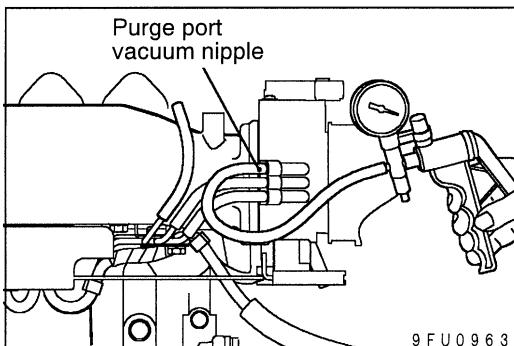
(Engine coolant temperature: 40°C or less)

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
At idle	Vacuum is maintained
3,000 r/min (fore approximately 3 minutes after the engine is started.)	Vacuum will leak.



### PURGE PORT VACUUM CHECK <MPI>

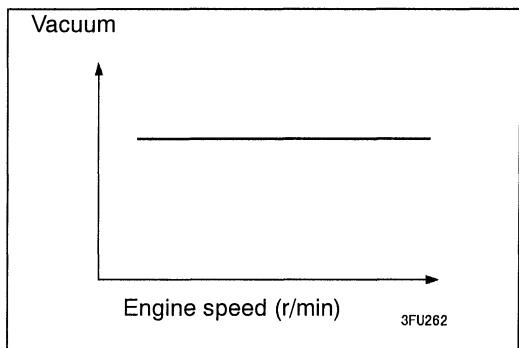
1. Disconnect the vacuum hose (red stripe) from the throttle body purge vacuum nipple and connect a hand vacuum pump to the nipple.
2. Start the engine and check that the vacuum remains fairly constant after racing the engine.

#### NOTE

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

### PURGE PORT VACUUM CHECK <GDI>

1. Disconnect the vacuum hose (red stripe) 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**

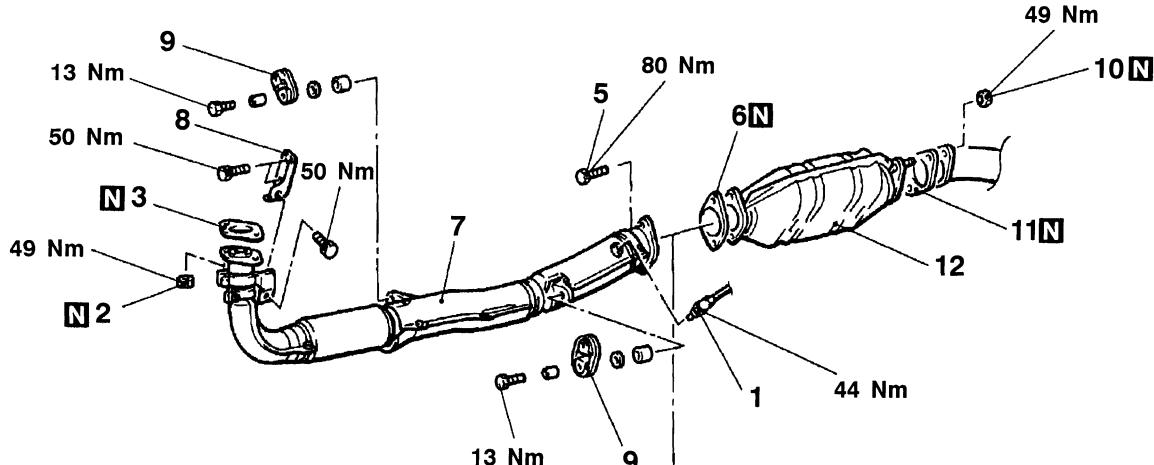
If vacuum changes, it is possible that the intake manifold purge port may be clogged and require cleaning.

## CATALYTIC CONVERTER

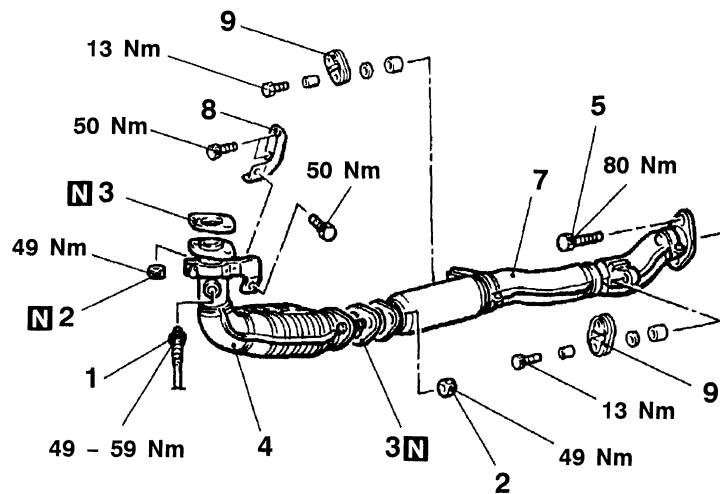
### REMOVAL AND INSTALLATION

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

<MPI-D3 spec.>



<MPI-D4 spec.>



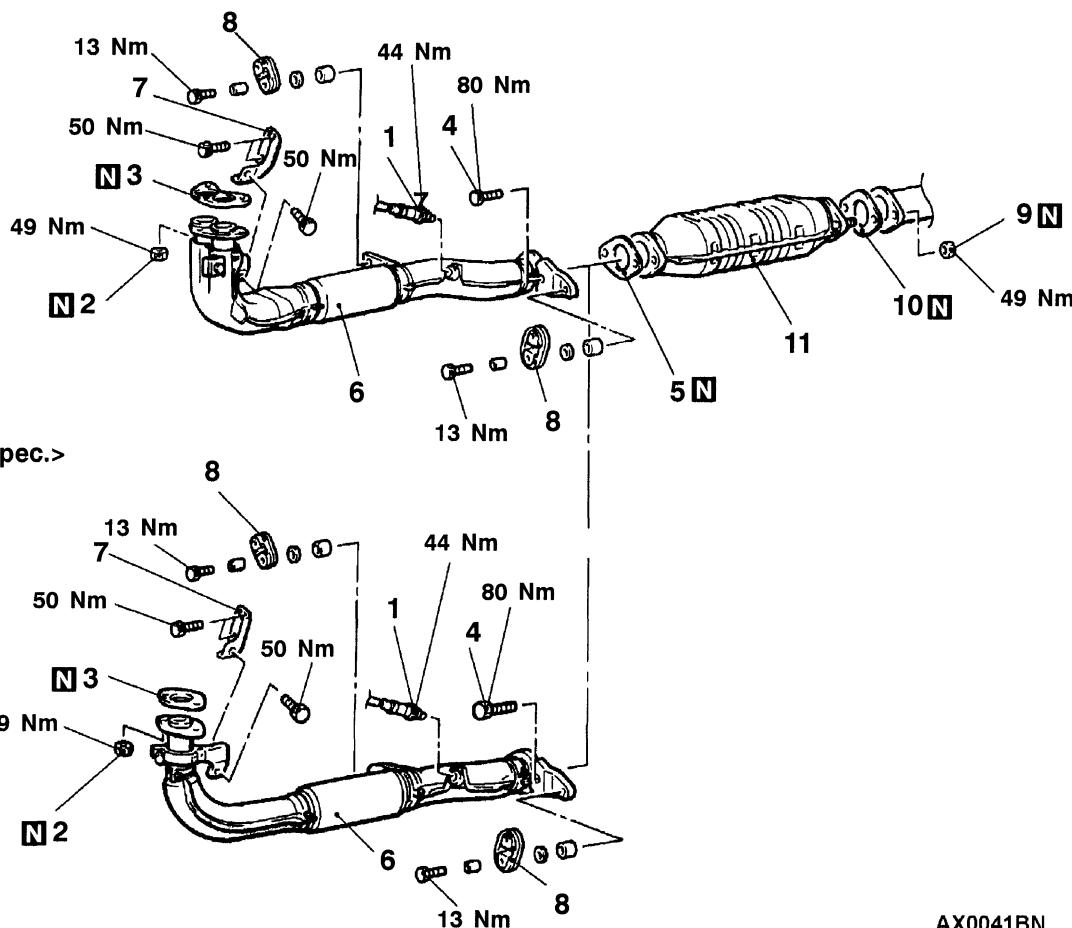
AX0040BN

#### Removal steps



1. Oxygen sensor
2. Self-locking nut
3. Gasket
4. Front catalytic converter  
<MPI-D4 spec.>
5. Bolt
6. Gasket
7. Front exhaust pipe
8. Front exhaust pipe bracket
9. Hunger
10. Self-locking nut
11. Gasket
12. Catalytic converter

### <GDI-D3 spec.>

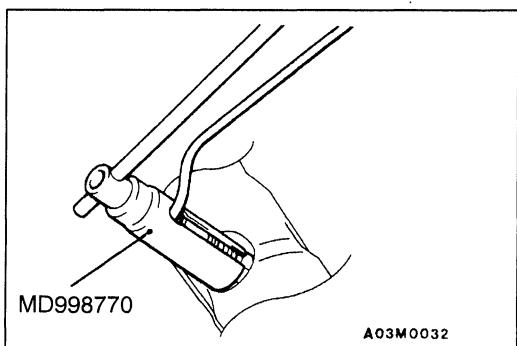


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## Removal steps



1. Oxygen sensor	7. Front exhaust pipe bracket
2. Self-locking nut	8. Hunger
3. Gasket	9. Self-locking nut
4. Bolt	10. Gasket
5. Gasket	11. Catalytic converter
6. Front exhaust pipe	



## **REMOVAL SERVICE POINT**



## INSTALLATION SERVICE POINT

