

# ENGINE AND EMISSION CONTROL

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# EMISSION CONTROL SYSTEM

## 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 control servo	Equipped Stepper motor type (Purpose: NOx reduction)
	Catalytic converter	Monolith type (Purpose: CO, HC, NOx reduction)

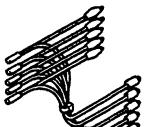
## EMISSION CONTROL DEVICE REFERENCE TABLE

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	×					17-6
Purge control solenoid valve		×				17-9
GDI system component		×	×			GROUP 13J
Catalytic converter				×		17-12
EGR control servo					×	17-11

## SERVICE SPECIFICATIONS

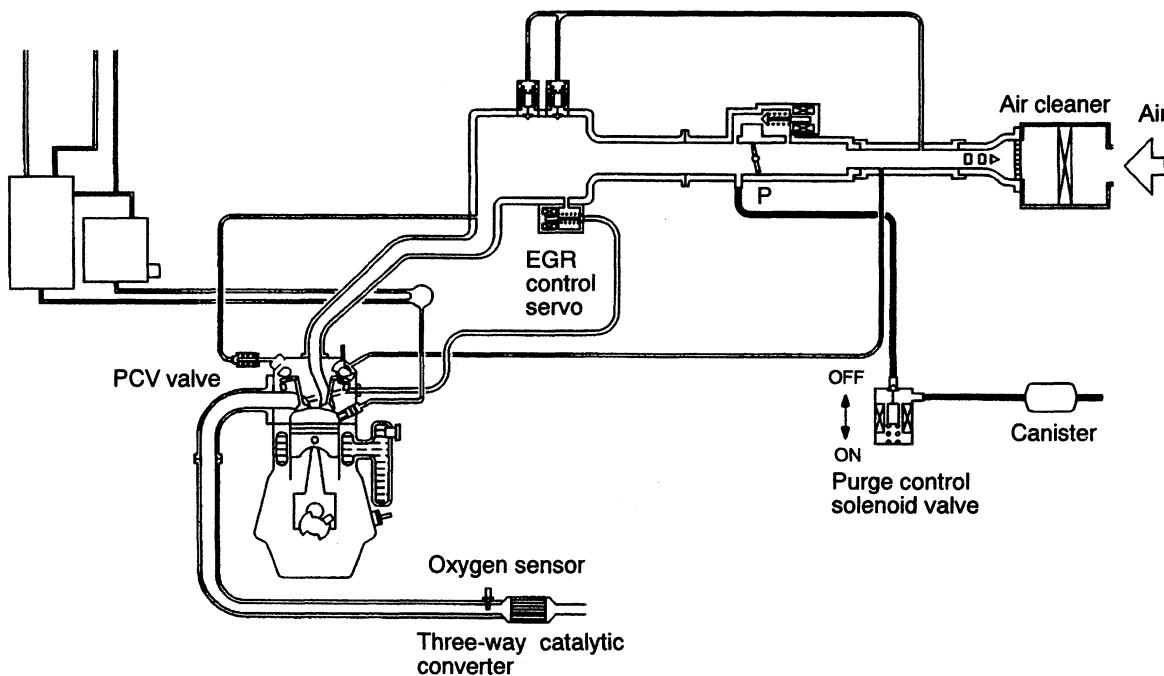
Items	Standard value
Purge control solenoid valve coil resistance (at 20°C) $\Omega$	36 – 44
EGR control servo coil resistance (at 20°C) $\Omega$	10 – 20

## SPECIAL TOOL

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

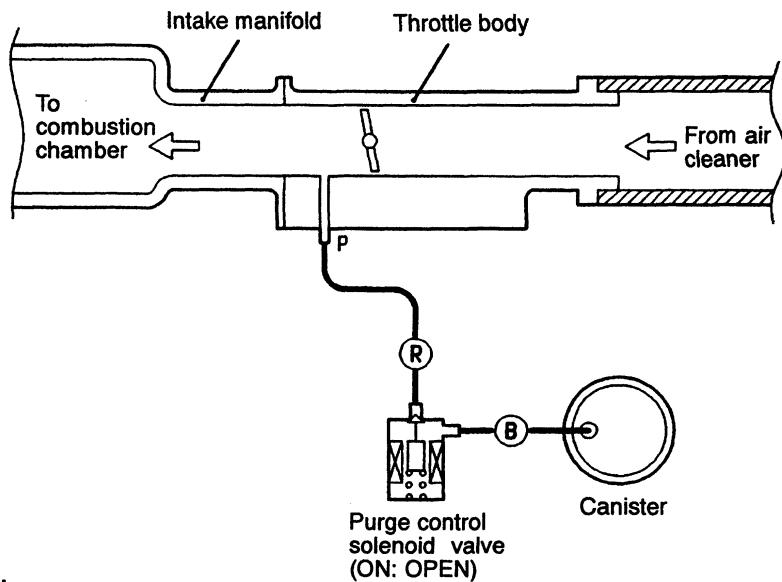
## VACUUM HOSE

### VACUUM HOSE PIPING DIAGRAM



9EM0246

## VACUUM CIRCUIT DIAGRAM



Vacuum hose colour  
B: Black  
R: Red

9EM0247

## 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

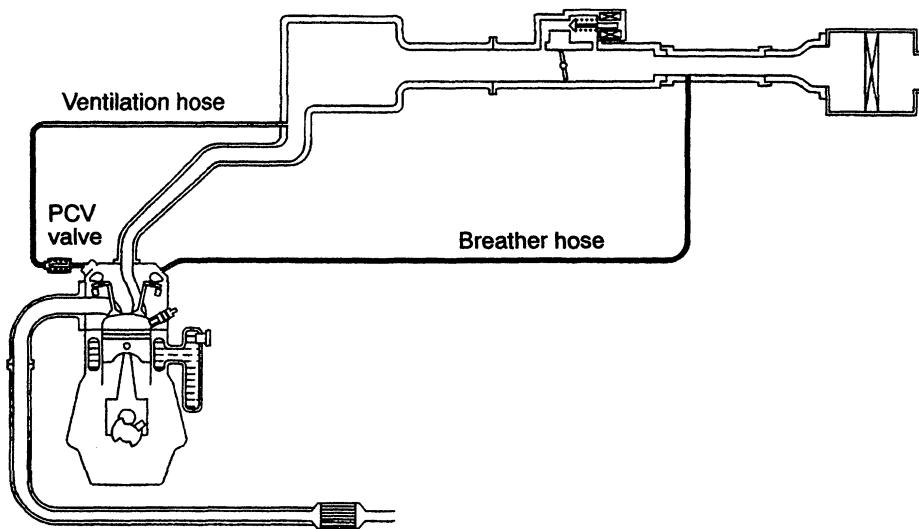
The crankcase emission control system prevents blow-by gases from escaping inside the crankcase into the atmosphere.

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.

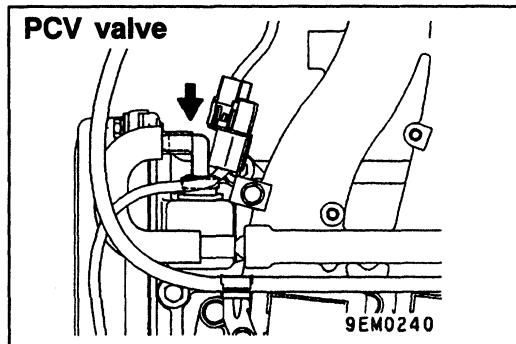
The PCV valve lifts the plunger according to the intake manifold vacuum so as to regulate the flow of blow-by gas properly. In other words, the blow-by gas flow is regulated during low load engine operation to maintain engine stability, while the flow is increased during high load operation to improve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

### SYSTEM DIAGRAM



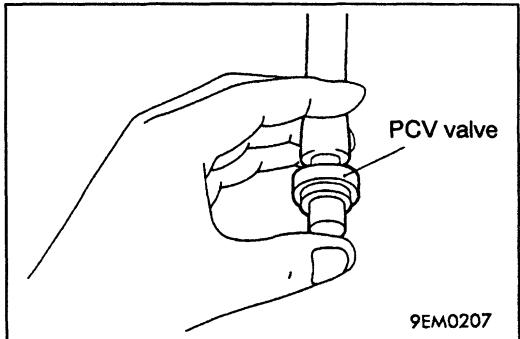
9EM0205

### 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.

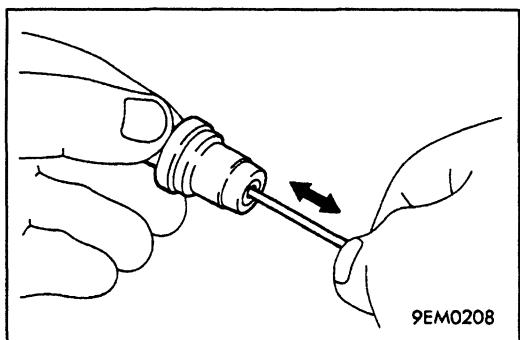


5. Place a finger at the opening of the PCV valve and check that vacuum of the intake manifold is felt.

### 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.

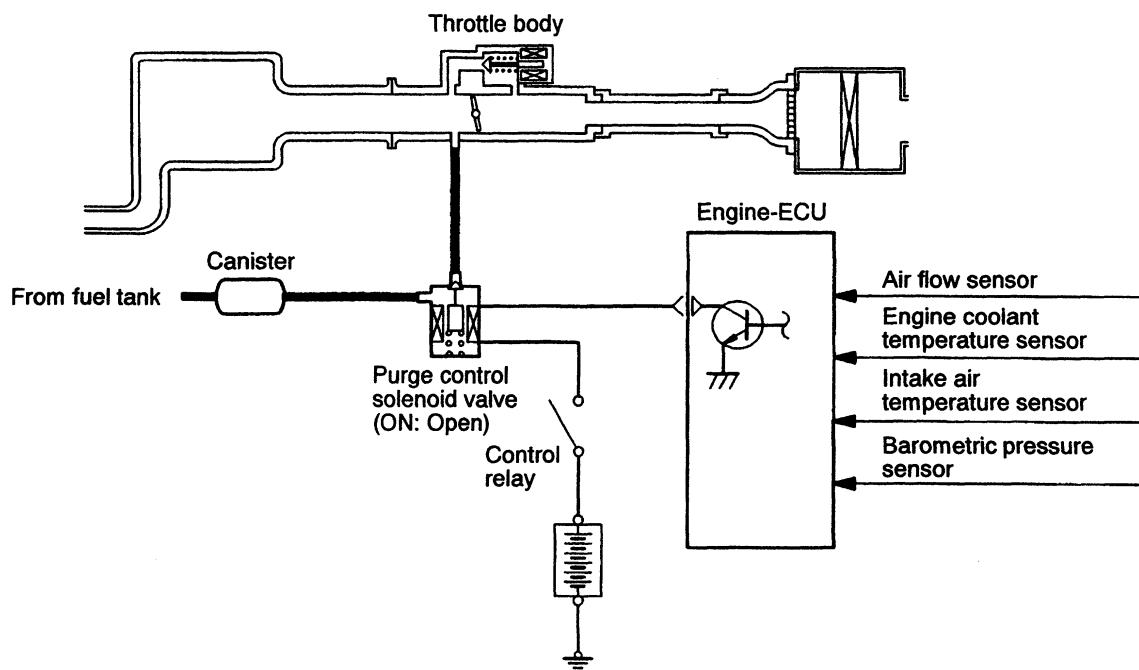
Fuel vapours from the fuel tank flow through the fuel tank pressure control valve and vapour pipe/hose to be stored temporarily in the canister. When driving the vehicle, fuel vapours stored in the canister flow through the purge solenoid and purge port and go into the intake manifold to be

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.

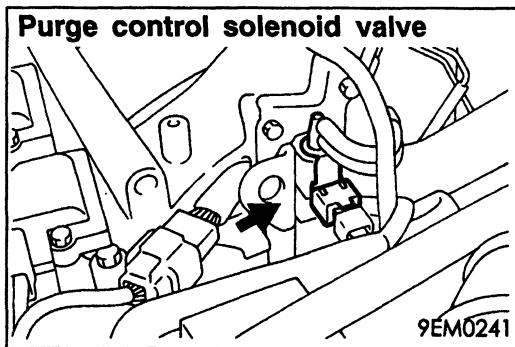
This does not only insure the driveability when the engine is cold or running under low load but also stabilize the emission level.

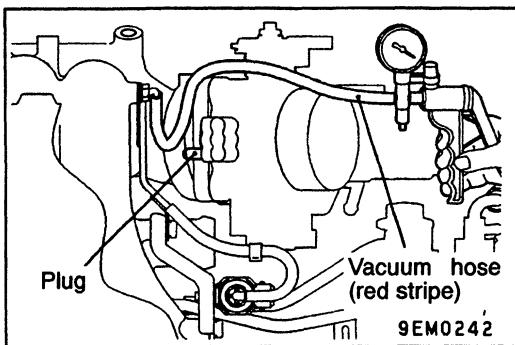
### SYSTEM DIAGRAM



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### COMPONENT LOCATION





### PURGE CONTROL SYSTEM CHECK

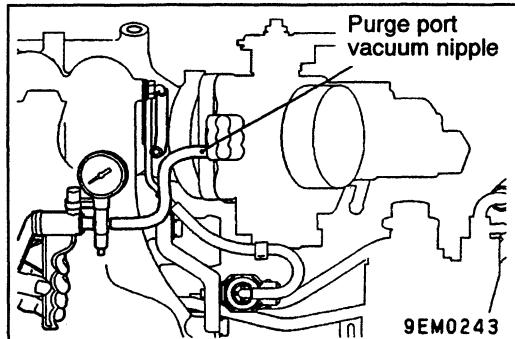
1. Disconnect the vacuum hose (red stripe) from the throttle body and connect it to a hand vacuum pump.
2. Plug the nipple from which the vacuum hose was removed.
3. When the engine is cold or hot, apply a vacuum of 53 kPa, and check the condition of the vacuum.

**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.

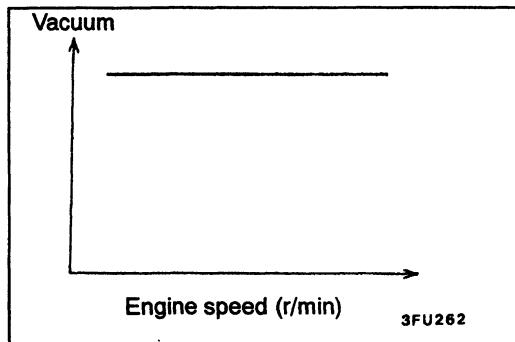


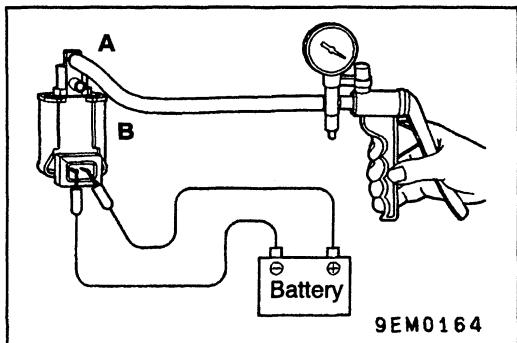
### PURGE PORT VACUUM CHECK

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.



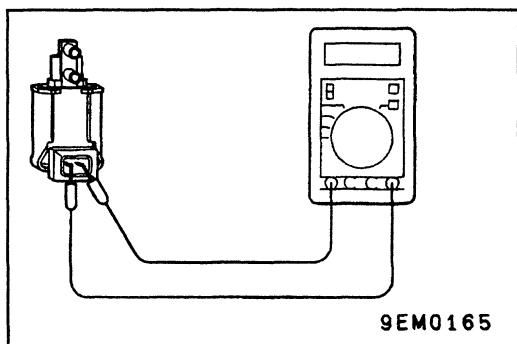


## PURGE CONTROL SOLENOID VALVE CHECK

### NOTE

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

1. Disconnect the vacuum hose (black stripe, red stripe) 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: 36–44 Ω (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

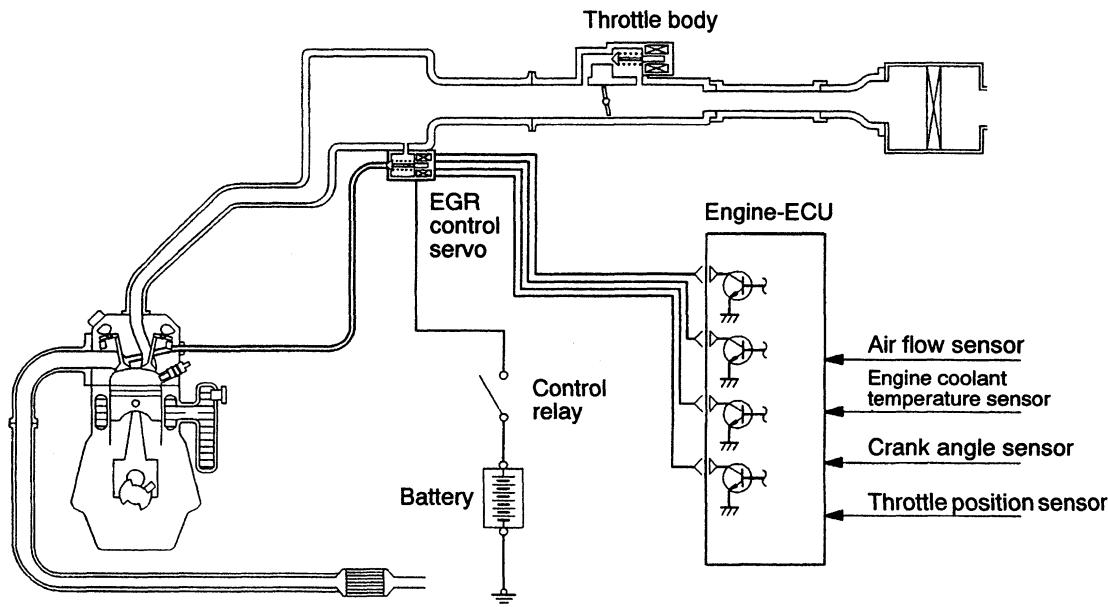
the exhaust port of the cylinder head to the combustion chamber through the intake manifold to decrease the air/fuel mixture combustion temperature, resulting in reduction of NOx. The EGR flow rate is controlled by the EGR control servo so as not to decrease the driveability.

### OPERATION

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

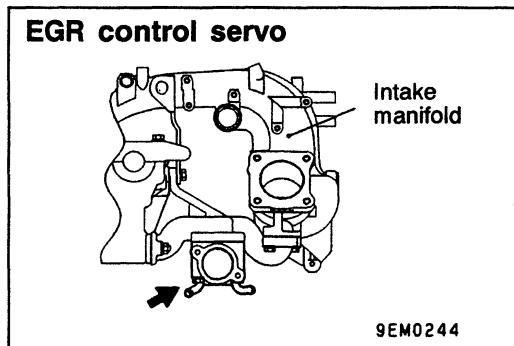
- The engine coolant temperature is low.
- The engine is at idle.
- The throttle valve is widely opened.

### SYSTEM DIAGRAM



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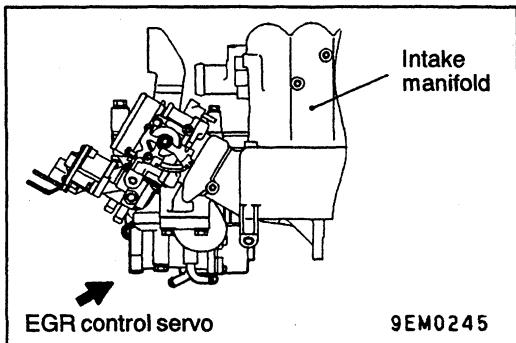
### COMPONENT LOCATION



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### EXHAUST GAS RECIRCULATION (EGR) CONTROL SYSTEM CHECK

Refer to GROUP 13J – Troubleshooting.



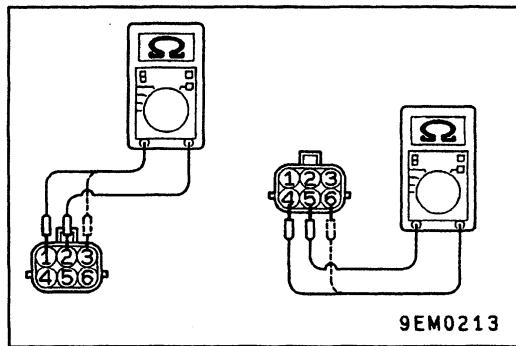
## EGR CONTROL SERVO (STEPPER MOTOR) CHECK

### Checking the Operation Sound

1. Check that the operation sound of the stepper motor can be heard from the EGR control servo 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.



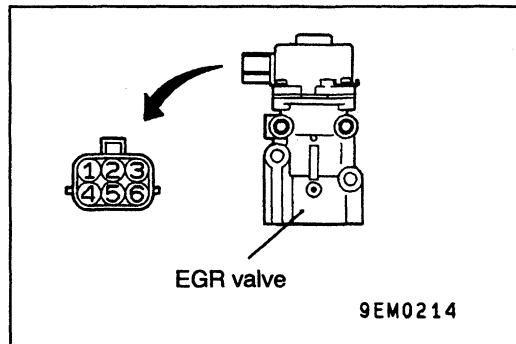
### Checking the Coil Resistance

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

**Standard value: 10 – 20 Ω (at 20°C)**

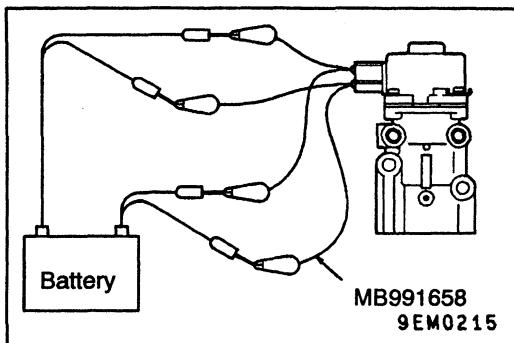
3. Measure the resistance between the EGR control servo-side connector terminal No.5 and terminal No.4 or terminal No.6.

**Standard value: 10 – 20 Ω (at 20°C)**



### Operation Check

1. Remove the EGR control servo.
2. Connect the special tool (test harness set) to the EGR control servo-side connector.
3. Connect terminal No.2 and terminal No.5 to the positive (+) terminal of power supply of approximately 6 V.
4. Connect each clip to the negative (-) terminal of power supply in the order given below to test if any vibration occurs (as though the stepper motor is shaking slightly) due to the operation of the stepper motor.

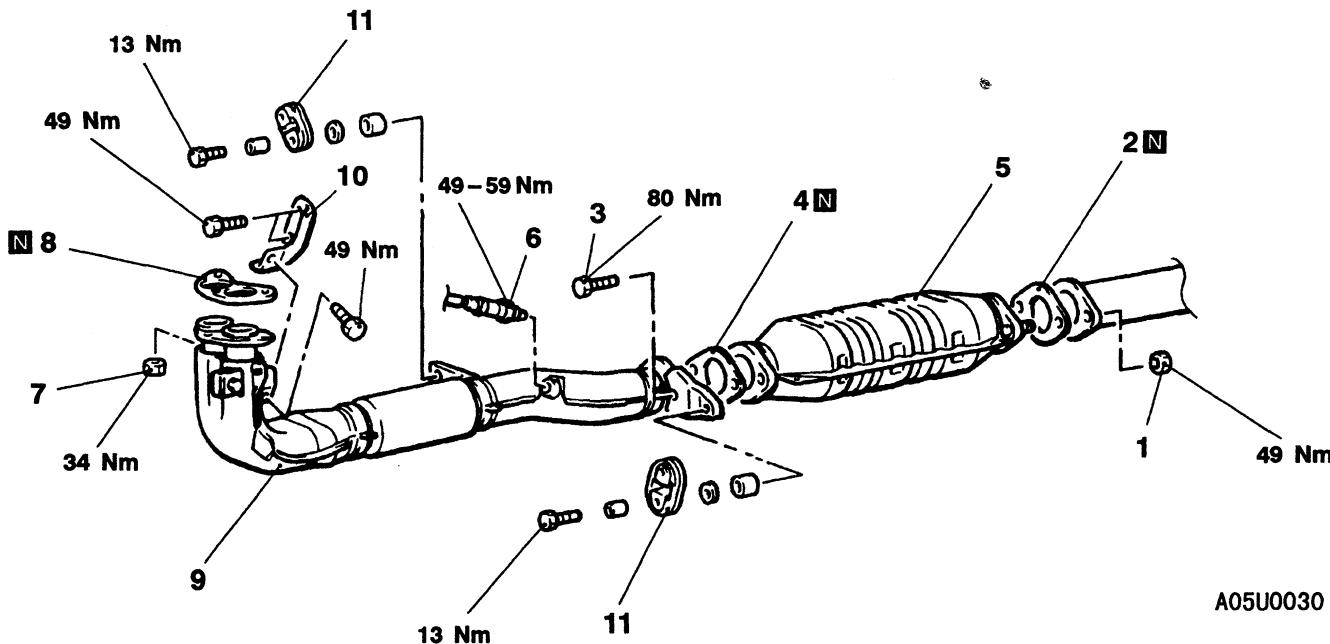


- (1) Connect terminal No.1 and terminal No.4 to the negative (-) terminal of the power supply.
- (2) Connect terminal No.3 and terminal No.4 to the negative (-) terminal of the power supply.
- (3) Connect terminal No.3 and terminal No.6 to the negative (-) terminal of the power supply.
- (4) Connect terminal No.1 and terminal No.6 to the negative (-) terminal of the power supply.
- (5) Connect terminal No.1 and terminal No.4 to the negative (-) terminal of the power supply.
- (6) Repeat the test in the order from (5) to (1).

5. If the results of testing show that the vibration could be felt, the stepper motor is normal.

## CATALYTIC CONVERTER REMOVAL AND INSTALLATION

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



### Removal steps

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