

# EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

# *EC(H4DOTC)*

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## SYSTEM OVERVIEW

### EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

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## 1. System Overview

There are three emission control systems which are as follows:

- Crankcase emission control system
- Exhaust emission control system
  - Three-way catalytic converter
  - Air/fuel (A/F) control system
  - Ignition control system
- Evaporative emission control system

# SYSTEM OVERVIEW

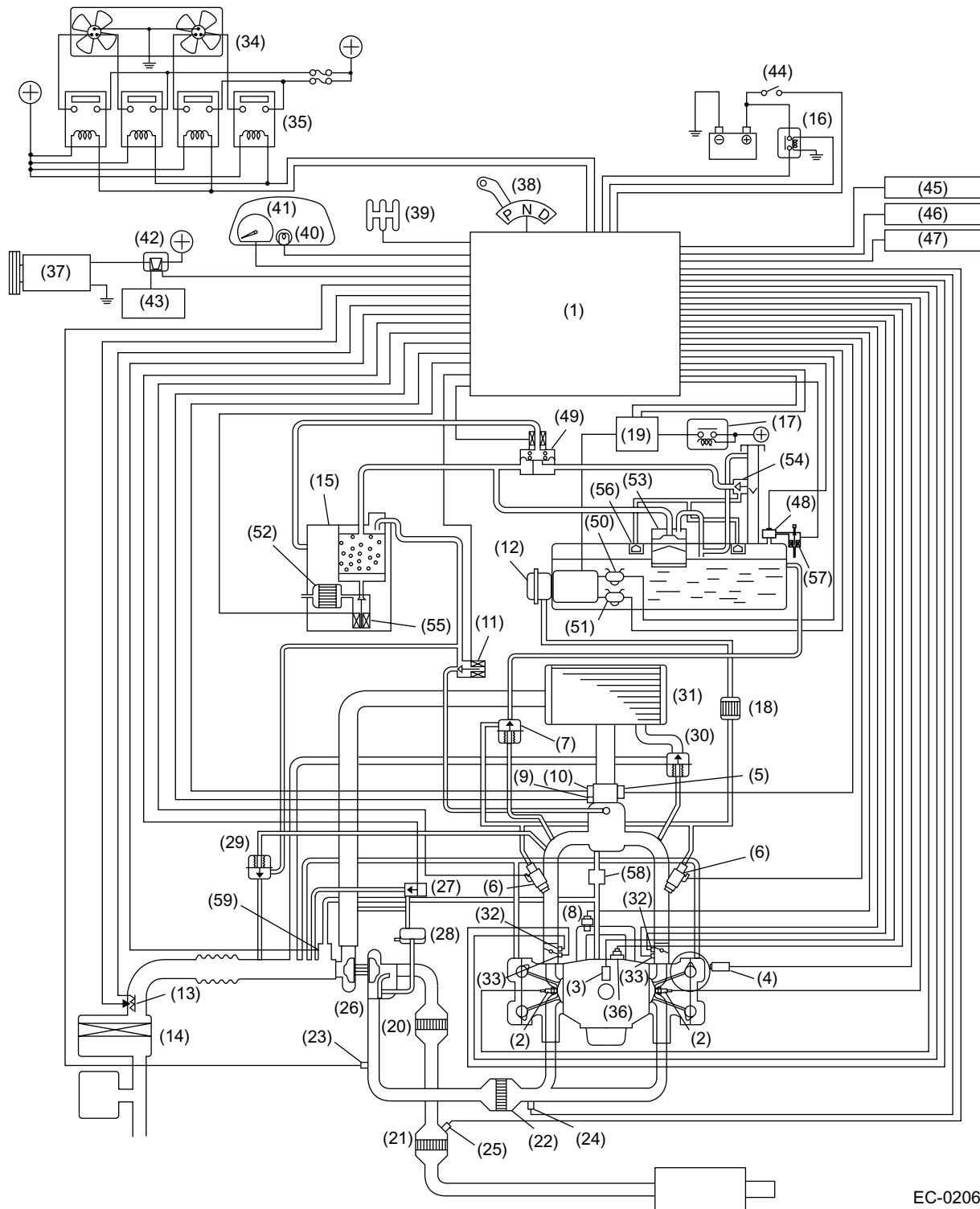
## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

Item			Main components	Function		
Crankcase emission control system			Positive crankcase ventilation (PCV) valve	Draws blow-by gas into intake manifold from crankcase and burns it together with air-fuel mixture. Amount of blow-by gas to be drawn in is controlled by intake manifold pressure.		
Exhaust emission control system	Catalytic converter	Pre	Catalytic converter	Oxidizes HC and CO contained in exhaust gases as well as reducing NOx.		
		Front				
		Rear				
	Air/fuel (A/F) control system		Engine control module (ECM)	Receives input signals from various sensors, compares signals with stored data, and emits a signal for optimal control of air-fuel mixture ratio.		
			Front oxygen (A/F) sensor	Detects density of oxygen contained exhaust gases.		
			Rear oxygen sensor	Detects density of oxygen contained in exhaust gases.		
			Throttle position sensor	Detects throttle opening.		
			Manifold absolute pressure sensor	Detects absolute pressure of intake manifold.		
			Mass air flow and intake air temperature sensor	Detects amount of intake air.		
				Detects intake air temperature at air cleaner case.		
	Ignition control system		ECM	Receives various signals, compares signals with basic data stored in memory, and emits a signal for optimal control of ignition timing.		
			Crankshaft position sensor	Detects engine speed (revolution).		
			Camshaft position sensor	Detects reference signal for combustion cylinder discrimination.		
			Engine coolant temperature sensor	Detects coolant temperature.		
			Knock sensor	Detects engine knocking.		
Evaporative emission control system			Canister	Absorbs evaporative gas which occurs in fuel tank when engine stops, and releases it to combustion chambers for a complete burn when engine is started. This prevents HC from being discharged into atmosphere.		
			Purge control solenoid valve	Receives a signal from ECM and controls purge of evaporative gas absorbed by canister.		
			Pressure control solenoid valve	Receives a signal from ECM and controls evaporative gas pressure in fuel tank.		
ORVR system			Vent valve	Controls evaporation pressure in fuel tank.		
			Drain valve	Closes the evaporation line by receiving a signal from ECM to check the evaporation gas leak.		

# SCHEMATIC DIAGRAMS

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

## 2. Schematic Diagrams



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# SCHEMATIC DIAGRAMS

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

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- (1) Engine control module (ECM)
- (2) Ignition coil and igniter assembly
- (3) Crankshaft position sensor
- (4) Camshaft position sensor
- (5) Throttle position sensor
- (6) Fuel injector
- (7) Pressure regulator
- (8) Engine coolant temperature sensor
- (9) Manifold absolute pressure sensor
- (10) Idle air control solenoid valve
- (11) Purge control solenoid valve
- (12) Fuel pump
- (13) Mass air flow and intake air temperature sensor
- (14) Air cleaner element
- (15) Canister
- (16) Main relay
- (17) Fuel pump relay
- (18) Fuel filter
- (19) Fuel pump control unit
- (20) Front catalytic converter
- (21) Rear catalytic converter
- (22) Pre-catalytic converter
- (23) Exhaust temperature sensor
- (24) Front oxygen (A/F) sensor
- (25) Rear oxygen sensor
- (26) Turbocharger
- (27) Wastegate control solenoid valve
- (28) Wastegate controller
- (29) Purge valve
- (30) Air bypass valve
- (31) Intercooler
- (32) Tumble generator valve position sensor
- (33) Tumble generator valve actuator
- (34) Radiator fan
- (35) Radiator fan relay
- (36) Knock sensor
- (37) A/C compressor
- (38) Inhibitor switch (AT models)
- (39) Neutral position switch (MT models)
- (40) Engine malfunction indicator light (MIL)
- (41) Tachometer
- (42) A/C relay
- (43) A/C control module
- (44) Ignition switch
- (45) Transmission control module (TCM)
- (46) Vehicle speed sensor
- (47) Data link connector
- (48) Fuel tank pressure sensor
- (49) Pressure control solenoid valve
- (50) Fuel temperature sensor
- (51) Fuel level sensor
- (52) Drain filter
- (53) Vent valve
- (54) Shut-off valve
- (55) Drain valve
- (56) Fuel cut valve
- (57) Fuel tank sensor control valve
- (58) PCV valve
- (59) PCV diagnosis connector

# CRANKCASE EMISSION CONTROL SYSTEM

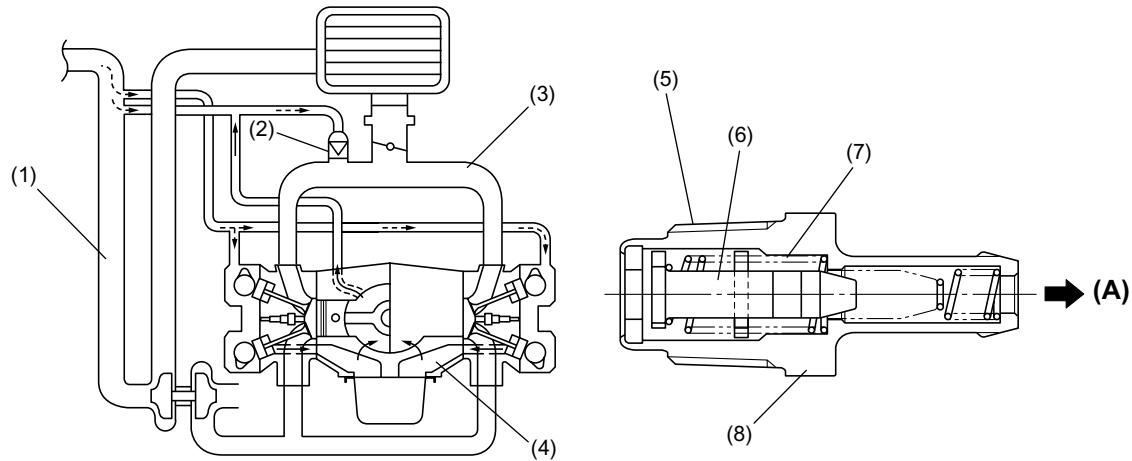
## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

### 3. Crankcase Emission Control System

- The positive crankcase ventilation (PCV) system prevents air pollution which will be caused by blow-by gas being emitted from the crankcase.

The system consists of a sealed oil filler cap, rocker covers with fresh air inlet, connecting hoses, a PCV valve and an air intake duct.

- In a part-throttle condition, the blow-by gas in the crankcase flows into the intake manifold through the connecting hose of crankcase and PCV valve by the strong vacuum created in the intake manifold. Under this condition, fresh air is introduced into the crankcase through the connecting hose of the rocker cover.
- In a wide-open-throttle condition, a part of blow-by gas flows into the air intake duct through the connecting hose and is drawn into the throttle chamber, because under this condition, the intake manifold vacuum is not strong enough to introduce through the PCV valve all blow-by gases that increase in the amount with engine speed.
- The PCV hose is provided with a leak detection function.



EC-00211

- (1) Intake duct
- (2) PCV valve
- (3) Intake manifold
- (4) Crankcase

- (5) Case
- (6) Valve
- (7) Spring
- (8) PCV valve

(A) To intake manifold

## 4. Three-way Catalytic Converter

- The basic materials of the three-way catalytic converter are platinum (Pt), rhodium (Rh) and palladium (Pd), and a thin coat of their mixture is applied onto a honeycomb or porous ceramic (carrier). To avoid damaging the catalytic converter, only unleaded gasoline should be used.
- The catalytic converter reduces HC, CO and NOx in exhaust gases through chemical reactions (oxidation and reduction). These harmful components are reduced most efficiently when their concentrations are in a certain balance. These concentrations vary with the air-fuel ratio. The ideal air-fuel ratio for reduction of these components is the stoichiometric ratio.
- Therefore, the air-fuel ratio needs to be controlled to around the stoichiometric ratio to purify the exhaust gases most efficiently.

## **AIR/FUEL (A/F) CONTROL SYSTEM**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

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### **5. Air/Fuel (A/F) Control System**

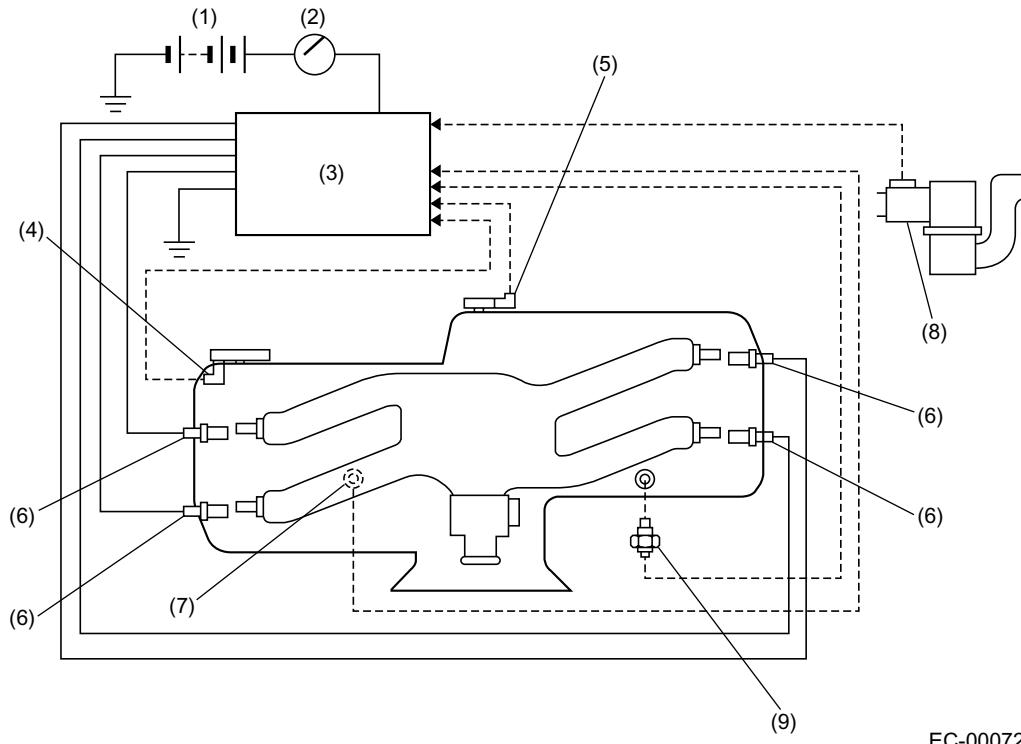
- The air/fuel (A/F) control system makes a correction to the basic fuel injection duration in accordance with the signals from the front oxygen (A/F) sensor and the rear oxygen sensor so that the stoichiometric ratio is maintained, thus ensuring most effective exhaust gas purification by the three-way catalytic converter. Different basic fuel injection durations are preset for various engine speeds and loads, as well as the amount of intake air.
- This system also has a learning control function which stores the corrected data in relation to the basic fuel injection in the memory map. This allows an appropriate air-fuel ratio correction to be added automatically in quick response to any situation that requires such an effect. Thus, the air-fuel ratio is optimally maintained under various conditions while purifying exhaust gases most effectively, improving driving performance and compensating for changes in sensors' performance over time.

### 6. Ignition Control System

- The ignition system is controlled by the ECM.

The ECM monitors the operating condition of the engine using the signals from the sensors and switches shown below and determines the ignition timing most appropriate for each engine operating condition. Then it sends a signal to the igniter, commanding generation of a spark at that timing.

- The ECM uses a preprogrammed map for a “closed-loop” control which provides its ignition timing control with excellent transient characteristics, i.e., highly responsive ignition timing control.



- (1) Battery
- (2) Ignition switch
- (3) ECM
- (4) Camshaft position sensor
- (5) Crankshaft position sensor

- (6) Ignition coil and igniter assembly
- (7) Knock sensor
- (8) Mass air flow and intake air temperature sensor
- (9) Engine coolant temperature sensor

## EVAPORATIVE EMISSION CONTROL SYSTEM

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

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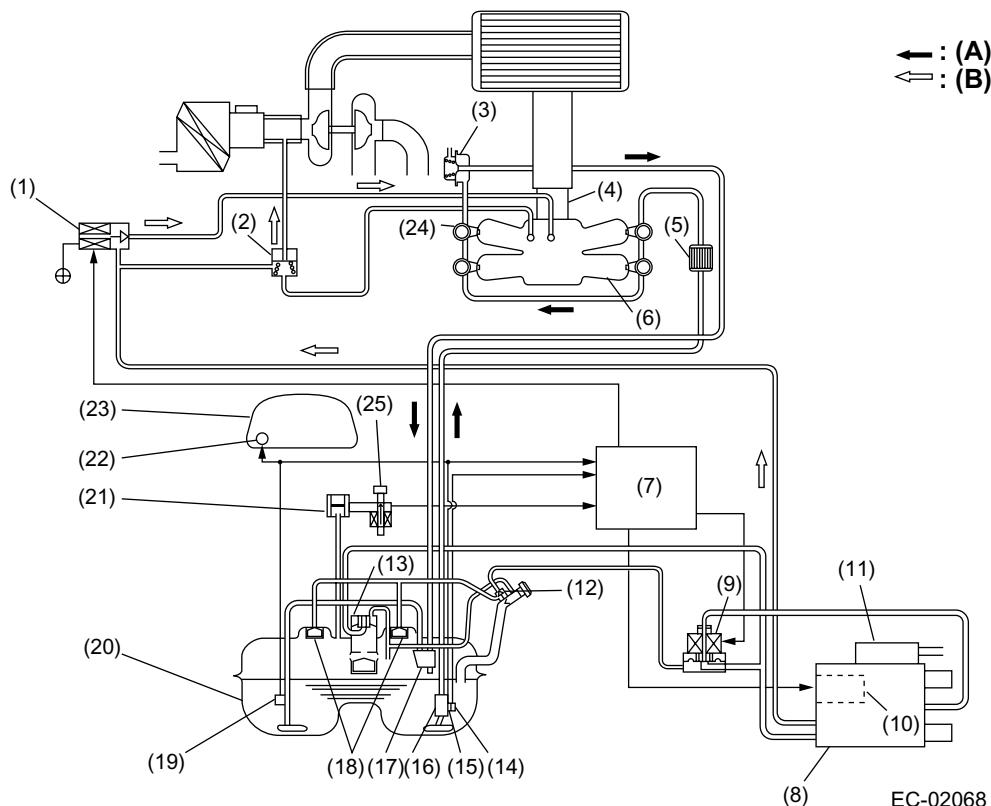
### 7. Evaporative Emission Control System

#### A: GENERAL

- The evaporative emission control system prevents fuel vapors from escaping into atmosphere. This system includes a canister, purge control solenoid valve, fuel cut valve, and the lines connecting them.
- Fuel vapors in the fuel tank are introduced into the canister through the evaporation line, and are absorbed by activated carbon in it. The fuel cut valve is also incorporated in the fuel tank line.
- The purge control solenoid valve is controlled optimally by the ECM according to the engine condition.
- The pressure control solenoid valve incorporated in the fuel tank evaporation line regulates the pressure/vacuum in the fuel tank under the control of the ECM which uses the signal from the fuel tank pressure sensor.
- The diagnosis of the evaporative emission control system is performed by turning each solenoid valve ON/OFF to vary the pressure inside the fuel tank and measure this pressure change with the fuel tank pressure sensor in order to check for leaks and proper valve operation.

# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)



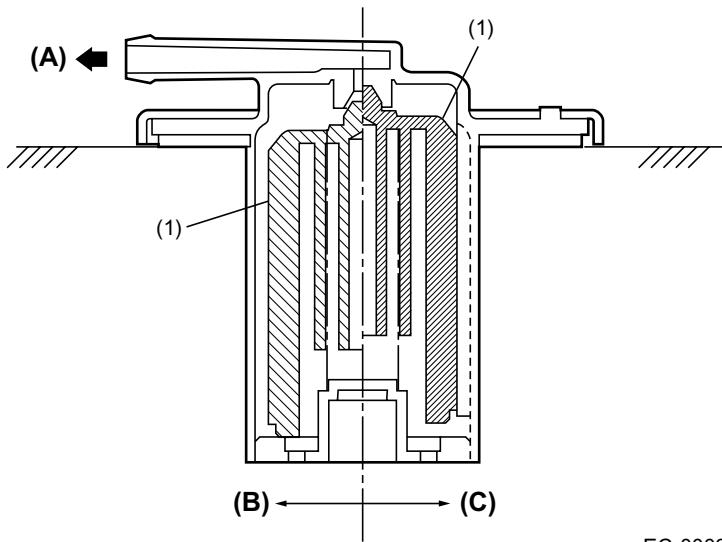
(1) Purge control solenoid valve	(11) Drain filter	(21) Fuel tank pressure sensor
(2) Purge valve	(12) Shut-off valve	(22) Fuel gauge
(3) Pressure regulator	(13) Vent valve	(23) Combination meter
(4) Throttle body	(14) Fuel temperature sensor	(24) Fuel injector
(5) Fuel filter	(15) Fuel level sensor	(25) Fuel tank sensor control valve
(6) Intake manifold	(16) Fuel pump	
(7) ECM	(17) Jet pump	<b>(A) Fuel line</b>
(8) Canister	(18) Fuel cut valve	<b>(B) Fuel evaporation line</b>
(9) Pressure control solenoid valve	(19) Fuel sub level sensor	
(10) Drain valve	(20) Fuel tank	

# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

### B: FUEL CUT VALVE

The fuel cut valve is built onto the evaporation pipe of the fuel tank. The rising level of the fuel in the fuel tank causes the float to move up and close the cap hole so that no fuel can enter the evaporation line.



EC-00022

(1) Float

(A) To canister

(B) Valve open

(C) Valve closed

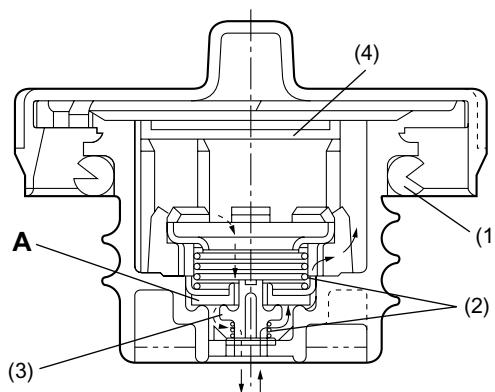
## EVAPORATIVE EMISSION CONTROL SYSTEM

### EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

#### C: FUEL TANK CAP

The fuel tank cap has a relief valve which prevents development of vacuum in the fuel tank in the event of a problem with the fuel vapor line.

When there is no problem with the fuel vapor line, the filler pipe is sealed at the portion (A) and by the seal pressed against the filler pipe end. If vacuum develops in the fuel tank, the atmospheric pressure forces the spring down to open the valve; consequently outside air flows into the fuel tank, thus controlling the inside pressure.



EC-00023

- (1) Seal
- (2) Spring
- (3) Valve
- (4) Filter

# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

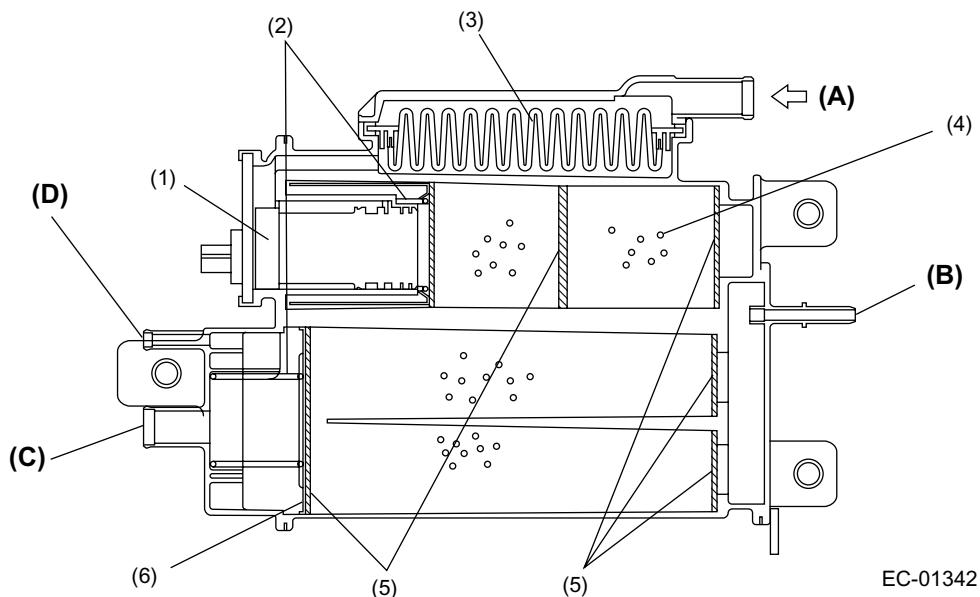
### D: CANISTER

The canister incorporates a drain valve and a drain filter.

The charcoal filled in the canister temporarily stores fuel vapors. When the purge control solenoid valve is opened by a signal from the ECM, the external fresh air entering the canister carries the fuel vapors into the collector chamber.

The drain filter is installed at the air inlet port of the drain valve. It cleans the air taken in the canister through the drain valve.

The drain valve is located just below the drain filter. The drain valve is forcibly closed by a signal from the ECM while the evaporation system diagnosis is being conducted.



- (1) Drain valve
- (2) Spring
- (3) Drain filter
- (4) Activated charcoal
- (5) Filter

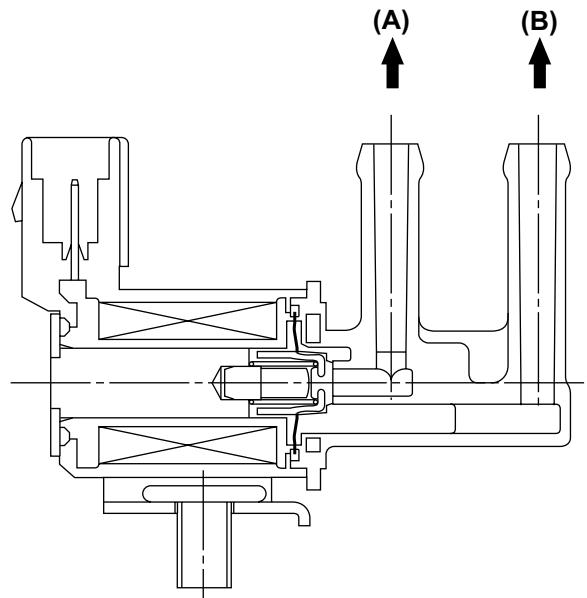
- (A) Air
- (B) To pressure control solenoid valve
- (C) From fuel tank
- (D) To purge control solenoid valve

## EVAPORATIVE EMISSION CONTROL SYSTEM

### EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

#### E: PURGE CONTROL SOLENOID VALVE

The purge control solenoid valve is on the evaporation line between the canister and intake manifold. The valve is installed under the intake manifold and lets the evaporative gas absorbed by the canister be drawn into the intake manifold.



EC-00074

- (A) To canister
- (B) To intake manifold

# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

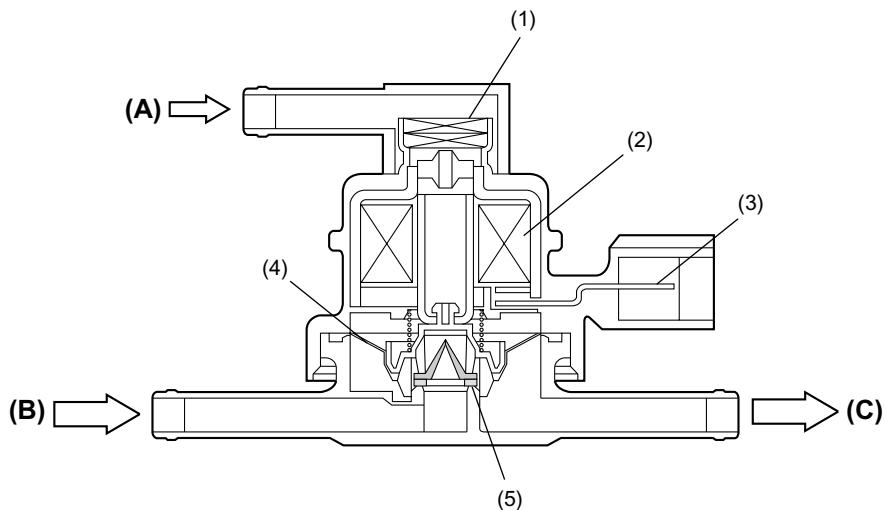
### F: PRESSURE CONTROL SOLENOID VALVE

The fuel tank pressure control solenoid valve is located in the evaporation line between the canister and the fuel tank. It adjusts the fuel tank inside pressure under the control of the ECM.

When the tank inside pressure becomes higher than the atmospheric pressure, the valve is opened allowing fuel vapors to be introduced into the canister.

On the other hand, when the tank inside pressure becomes lower than the atmospheric pressure, external air is taken from the drain valve into the canister.

The pressure control solenoid valve can also be electrically closed for diagnosis of the evaporative emission control system.



EC-00026

(1) Filter	(A) Atmospheric pressure
(2) Coil	(B) Shut-off valve
(3) Connector terminal	(C) To fuel tank
(4) Diaphragm	
(5) Valve	

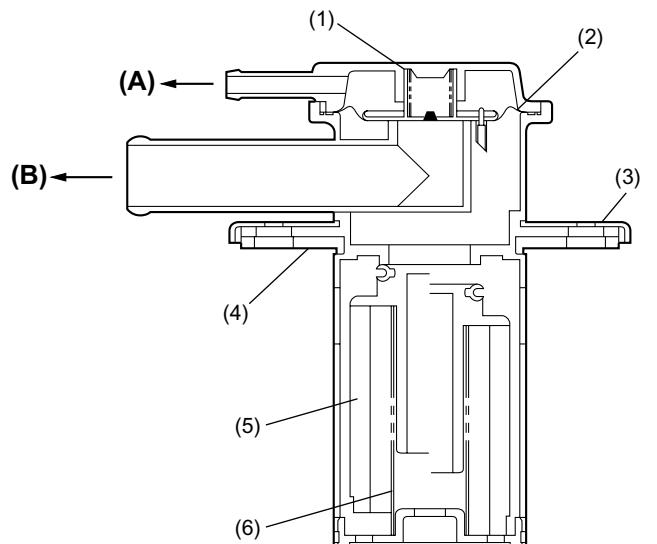
# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

### G: VENT VALVE

The vent valve is located in the fuel tank. During filling the fuel tank, fuel vapors are introduced into the canister through the vent valve.

When the fuel vapor pressure becomes higher than the atmospheric pressure and overcomes the spring force which is applied to the back side of the diaphragm, the port toward the canister is opened. The vent valve also contains a float which closes the port toward the canister when the fuel level rises.



- (1) Spring
- (2) Diaphragm
- (3) Plate cover
- (4) Packing
- (5) Float
- (6) Float spring

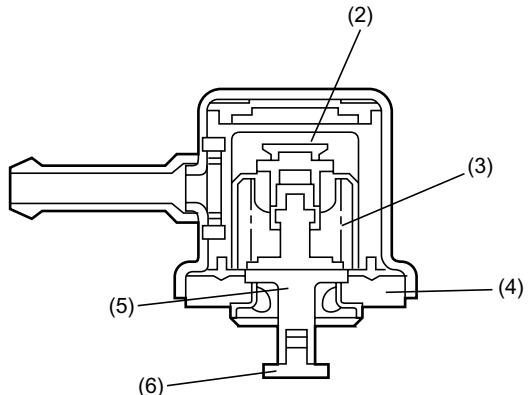
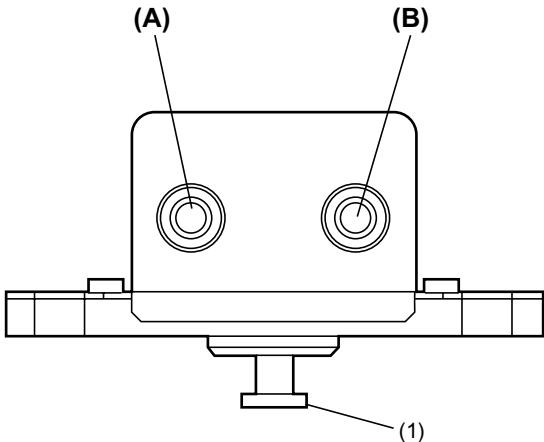
- (A) To filler pipe
- (B) To canister

# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

### H: SHUT-OFF VALVE

The shut-off valve is located at the top of the fuel filler pipe. When a filler gun is inserted into the filler pipe, the shut-off valve closes the evaporation line.



EC-00029

(1) Pin	(A) To canister
(2) Valve	(B) To fuel tank
(3) Spring	
(4) Plate	
(5) Shaft	
(6) Pin	

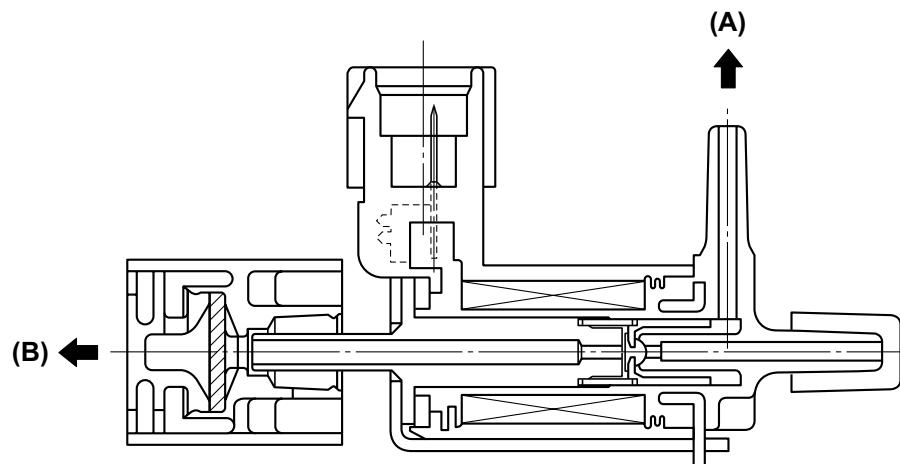
# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

### I: FUEL TANK SENSOR CONTROL VALVE

The fuel tank sensor control valve is installed on the top of the fuel tank and its one end is connected to the fuel tank pressure sensor while its other end is open to the atmosphere.

Normally the passage to the fuel tank pressure sensor is open to the atmosphere, however, the passage is closed when the ECM sends a signal to make a diagnosis of the evaporative emission control system.



EC-00214

(A) Fuel tank pressure sensor

(B) Atmosphere

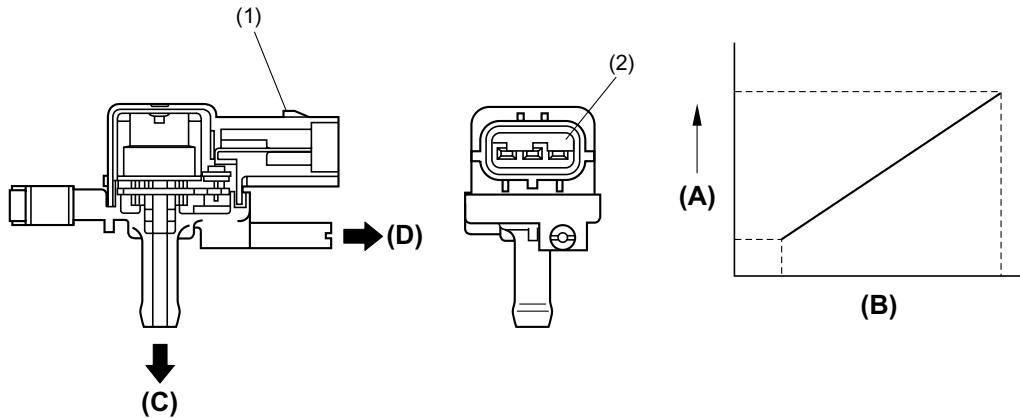
# EVAPORATIVE EMISSION CONTROL SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

### J: FUEL TANK PRESSURE SENSOR

The fuel tank pressure sensor is installed on the top of the fuel tank and measures the pressure in the fuel tank.

The measured pressure is converted into an electrical signal and sent to the ECM for diagnosis of the evaporative emission control system.



EC-00213

(1) Connector

(2) Terminal

(A) Output voltage

(B) Input pressure

(C) To fuel tank

(D) To fuel tank sensor control valve

## 8. On-board Refueling Vapor Recovery (ORVR) System

### A: GENERAL

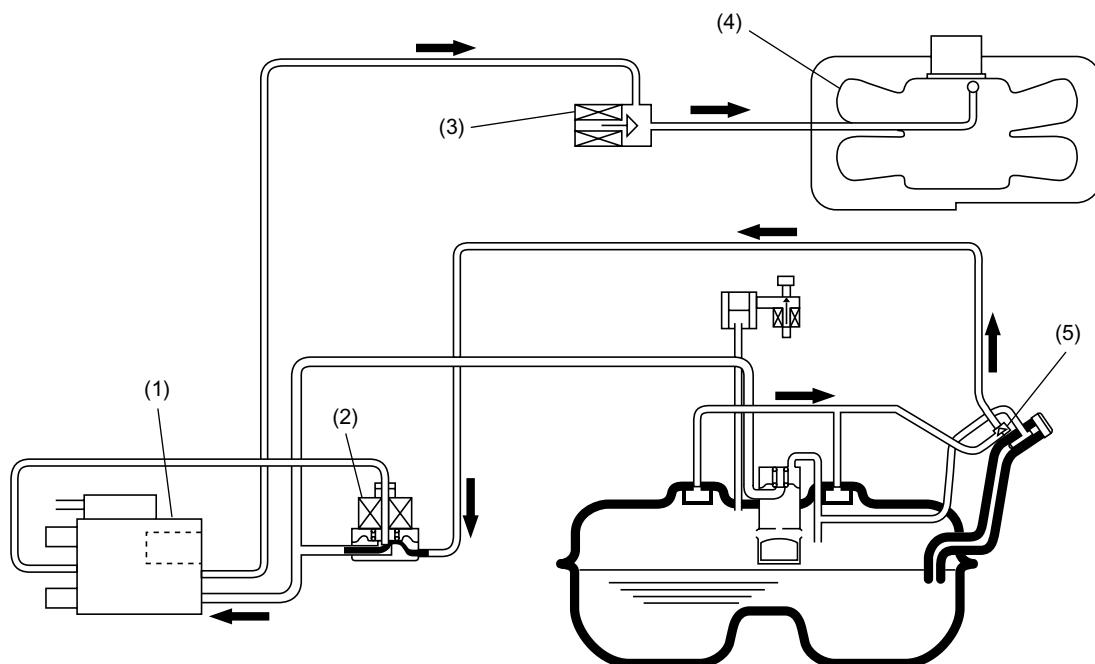
The on-board refueling vapor recovery system allows the fuel vapors in the fuel tank to be introduced directly into the canister through the vent valve when the fuel tank inside pressure increases as a result of refueling.

The diagnosis of the system is performed by monitoring the fuel tank inside pressure data from the fuel tank pressure sensor while forcibly closing the drain valve.

### B: OPERATION

- While driving

Since the back side of the diaphragm in the pressure control solenoid valve is open to the atmosphere, the diaphragm is held pressed by the atmospheric pressure in the position where only the external air is introduced into the canister. When the fuel vapor pressure acting on the other side of the diaphragm increases and overcomes the atmospheric pressure, it pushes the diaphragm and opens the port through which the fuel vapors make their way to the canister.



EC-02069

- (1) Canister
- (2) Pressure control solenoid valve
- (3) Purge control solenoid valve

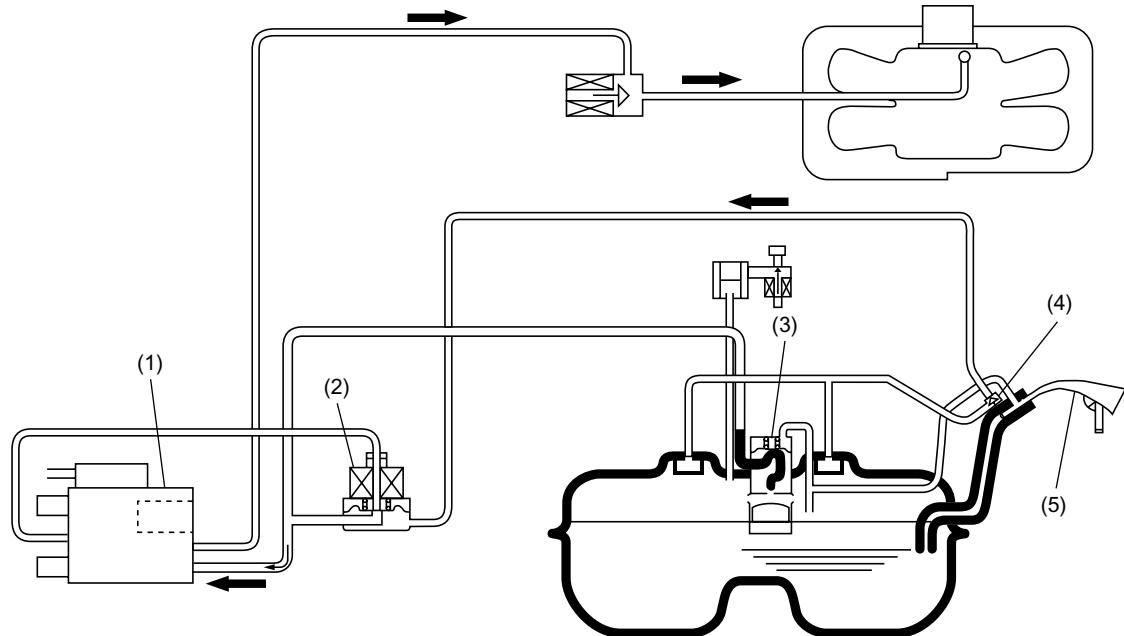
- (4) Intake manifold
- (5) Shut-off valve: open

# ON-BOARD REFUELING VAPOR RECOVERY (ORVR) SYSTEM

## EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

- While refueling

As the fuel enters the fuel tank, the tank inside pressure increases. When the inside pressure becomes higher than the atmospheric pressure, the port of the vent valve opens, allowing the fuel vapors to be introduced into the canister through the vent line. The fuel vapors are absorbed by charcoal in the canister, so the air discharged from the drain valve contains no fuel. When a filler gun is inserted, the shut-off valve closes the evaporation line.



EC-02070

(1) Canister

(2) Pressure control solenoid valve

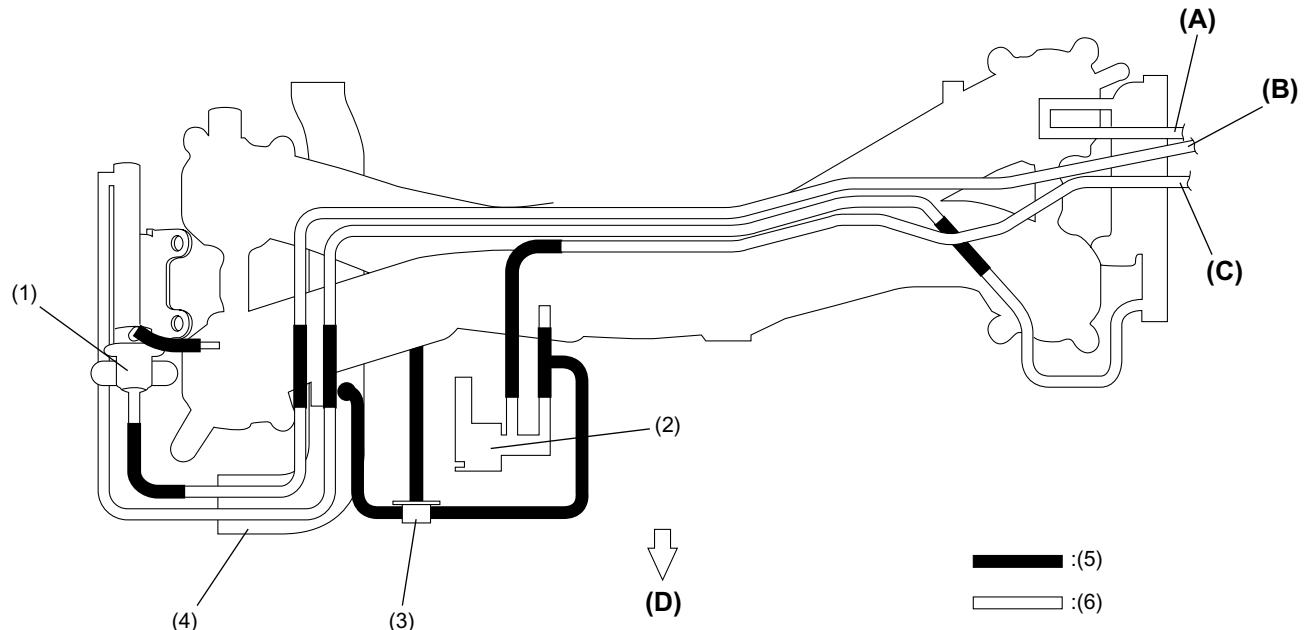
(3) Vent valve

(4) Shut-off valve: closed

(5) Filler gun

### 9. Vacuum Connections

The hose and pipe connections of the intake manifold, throttle body and other related parts are as shown in the illustration.



EC-00212

(1) Pressure regulator	(A) Delivery pipe
(2) Purge control solenoid valve	(B) Return pipe
(3) Purge valve	(C) Evaporation pipe
(4) Intake duct	(D) Front of vehicle
(5) Hose	
(6) Pipe	

## **VACUUM CONNECTIONS**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

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**MEMO**