General Information

Description

Emissions Control System consists of three major systems.

- The Crankcase Emission Control System prevents blow-by gas from releasing into the atmosphere. This system recycles gas back into the intake manifold (Closed Crankcase Ventilation Type).
- The Evaporative Emission Control System prevents evaporative gas from releasing into the atmosphere. This system burns gas at appropriate engine operating condition after gathering it in the canister.
- The Exhaust Emission Control System converts the three pollutants [hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx)] into harmless substances by using the 3-way catalytic converter.

Specifications

Purge Control Solenoid Valve (PCSV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	19.0 ~ 22.0 [20℃(68°F)]

Tightening Torques

Item	kgf.m	N.m	lb-ft
Positive crankcase ventilation valve installation	0.19 ~ 0.29	1.9 ~ 2.8	1.4 ~ 2.1
Canister protector installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Canister installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3

Troubleshooting

Symptom	Suspect area
Engine will not start or struggle to start	Vapor hose damaged or disconnected
Engine struggles to start	Malfunction of the Purge Control Solenoid Valve
Rough idle or engine stalls	Vapor hose damaged or disconnected
	Malfunction of the PCV valve
Rough idle	Malfunction of the Evaporative Emission Control System
Excessive oil consumption	Positive crankcase ventilation line clogged

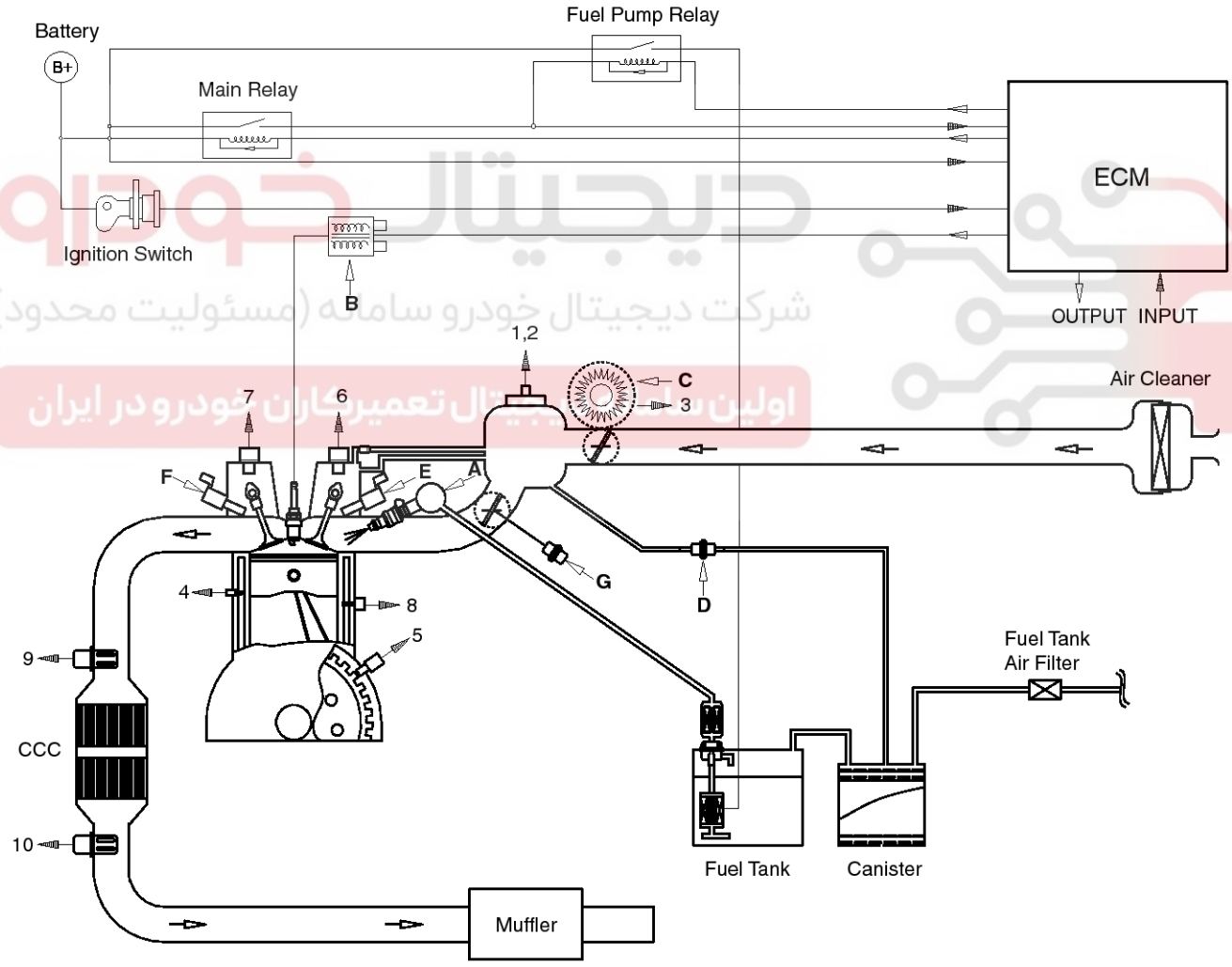
Schematic Diagram

[2.0/2.4 DOHC MPI]

1. Manifold Absolute Pressure Sensor (MAPS)
2. Intake Air Temperature Sensor (IATS)
3. Throttle Position Sensor (TPS) [integrated into ETC Module]
4. Engine Coolant Temperature Sensor (ECTS)
5. Crankshaft Position Sensor (CKPS)
6. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
7. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]
8. Knock Sensor (KS)
9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
- Accelerator Position Sensor (APS)
- A/C Pressure Transducer (APT)
- Ignition Switch Signal
- Battery Power Signal
- Vehicle Speed Signal
- Inhibitor Switch Signal
- Power Steering Switch Signal
- Brake Switch Signal

ECM

A. Injector
B. Ignition Coil
C. ETC Motor [integrated into ETC Module]
D. Purge Control Solenoid Valve (PCSV)
E. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
F. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
G. Vaiable Intake Solenoid (VIS) Valve
- Main Relay
- Fuel Pump Relay
- A/C Control
- Self Diagnosis



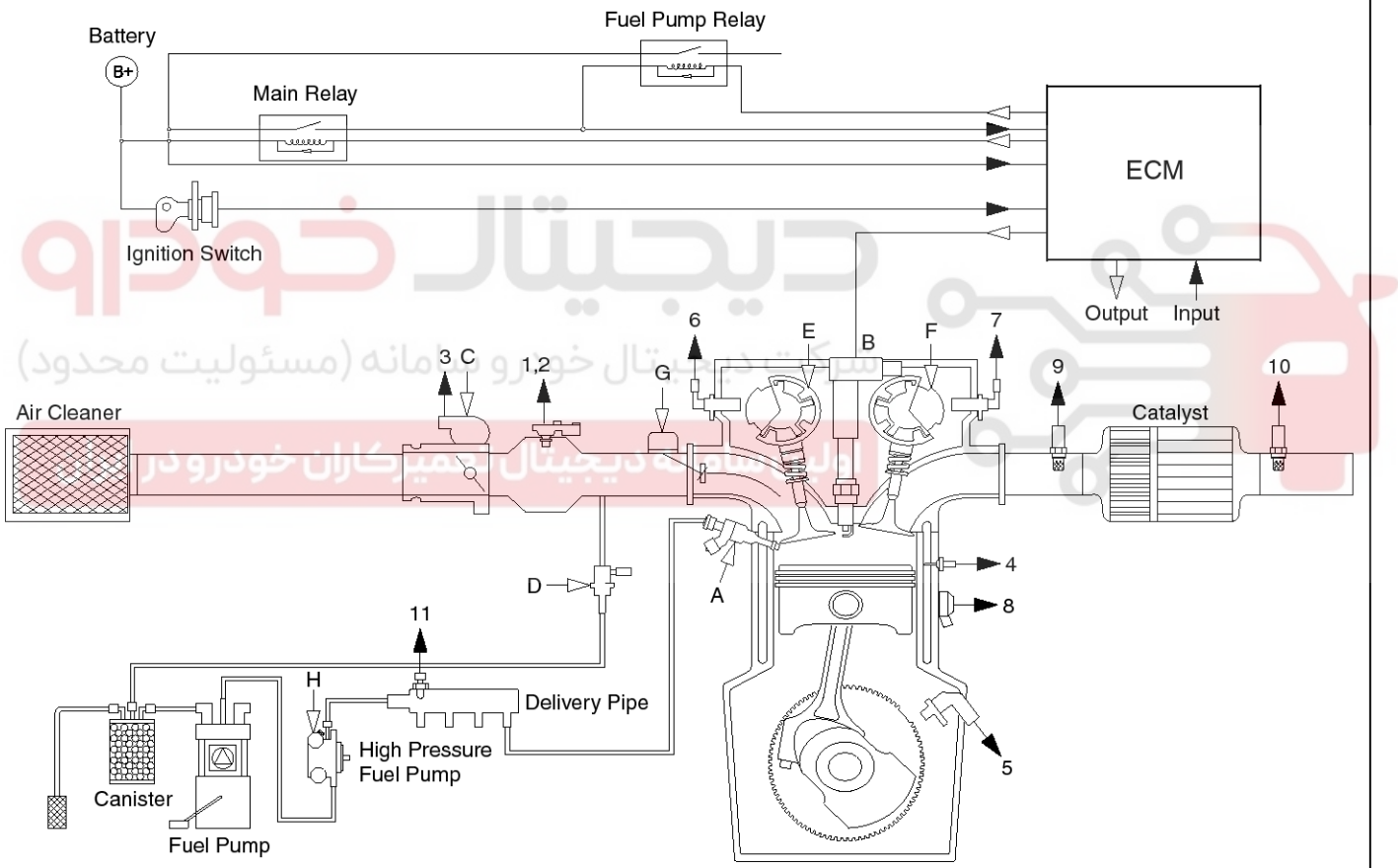
STFEC1001L

[2.4 DOHC GDI]

1. Manifold Absolute Pressure Sensor (MAPS)
2. Intake Air Temperature Sensor (IATS)
3. Throttle Position Sensor (TPS) [integrated into ETC Module]
4. Engine Coolant Temperature Sensor (ECTS)
5. Crankshaft Position Sensor (CKPS)
6. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
7. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]
8. Knock Sensor (KS)
9. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1]
10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2]
11. Rail Pressure Sensor (RPS)
- Accelerator Position Sensor (APS)
- A/C Pressure Transducer (APT)
- Ignition Switch Signal
- Battery Power Signal
- Vehicle Speed Signal
- Inhibitor Switch Signal
- Power Steering Switch Signal
- Brake Switch Signal

ECM

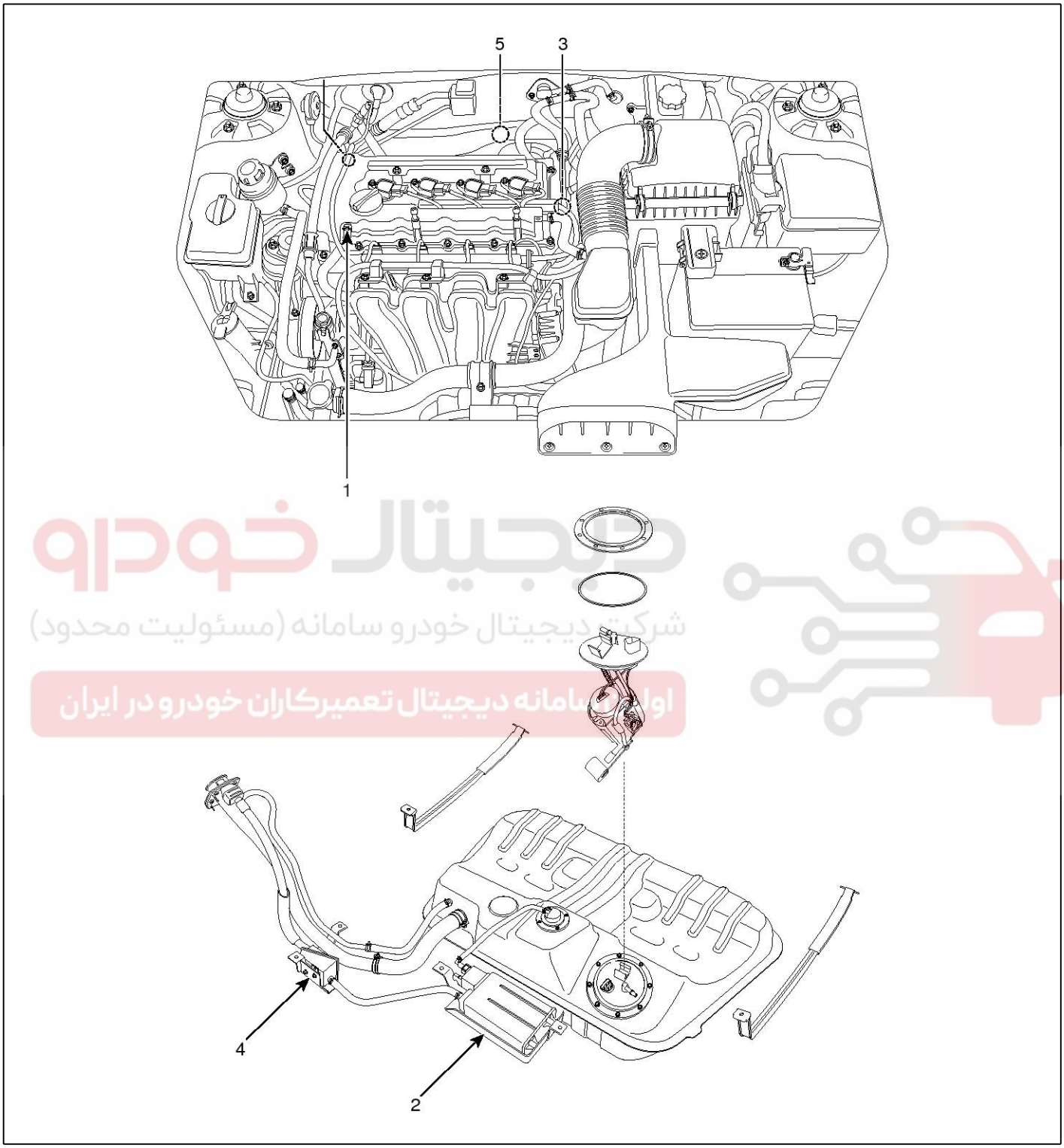
A. Injector
B. Ignition Coil
C. ETC Motor [integrated into ETC Module]
D. Purge Control Solenoid Valve (PCSV)
E. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]
F. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]
G. Vaiable Intake Solenoid (VIS) Valve
H. Fuel Pressure Regulator Valve
- Main Relay
- Fuel Pump Relay
- A/C Control
- Self Diagnosis



SYFEC1010L

Components Location

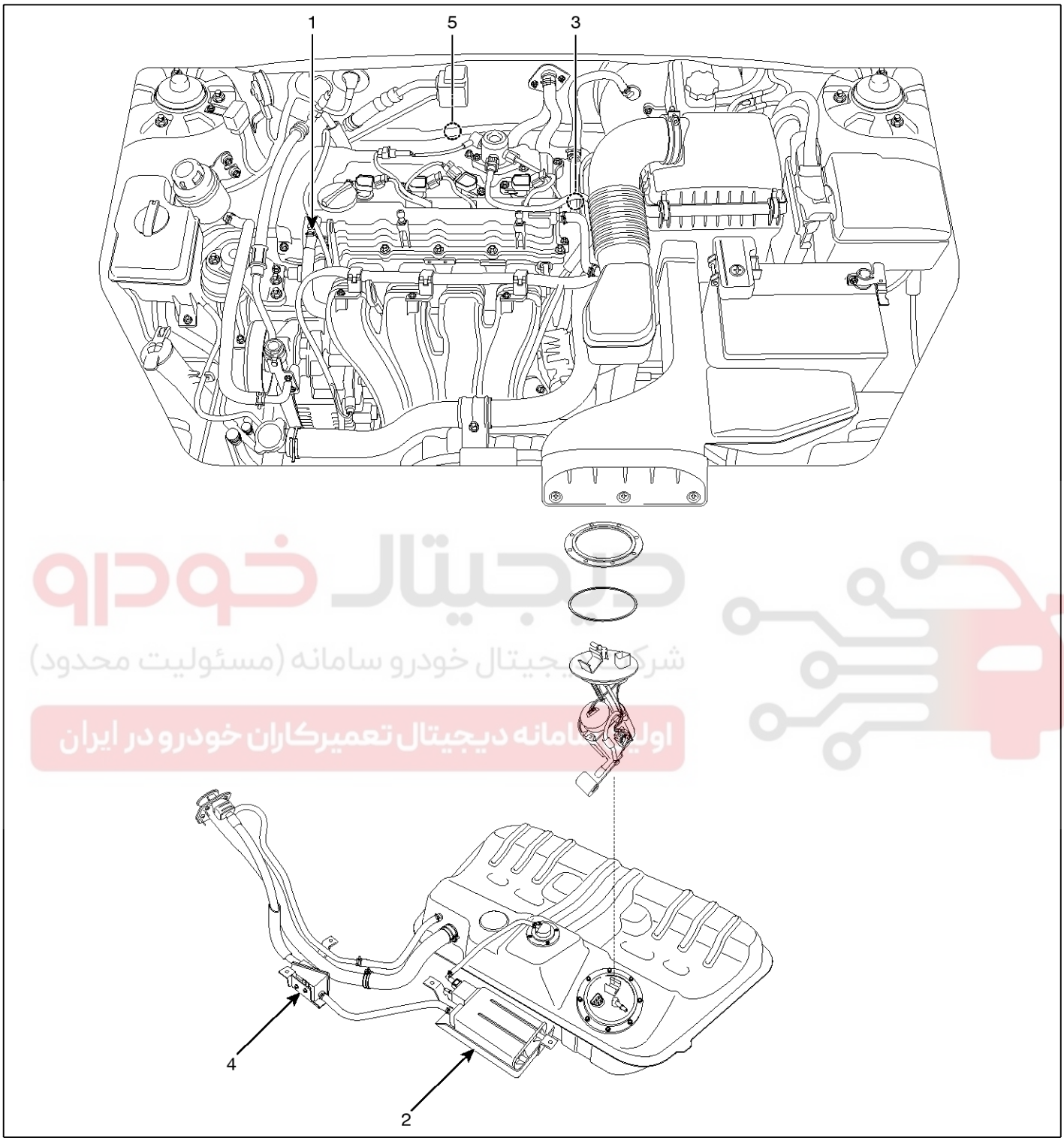
[2.0/2.4 DOHC MPI]



STFEC1002L

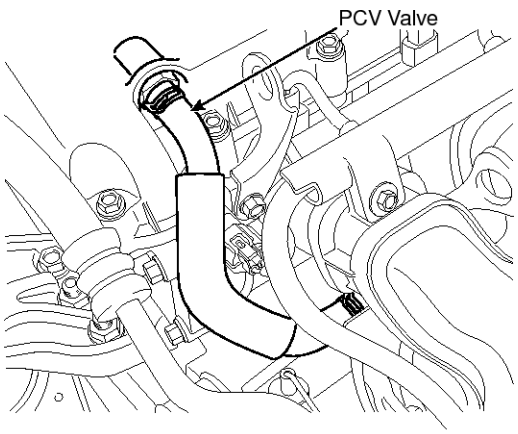
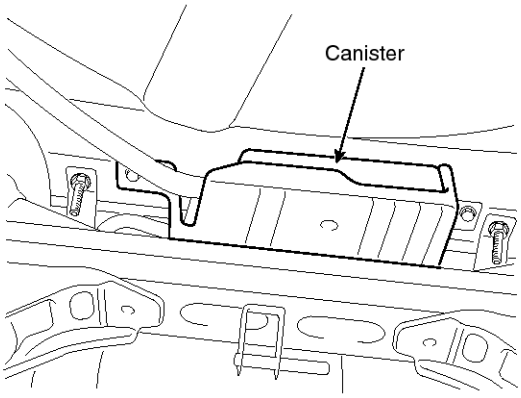
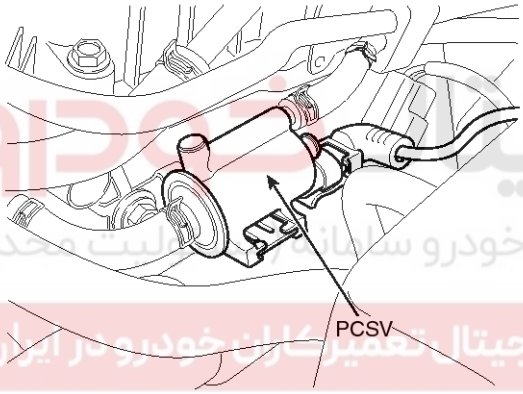
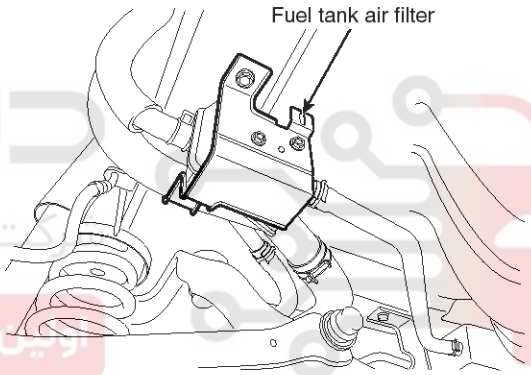
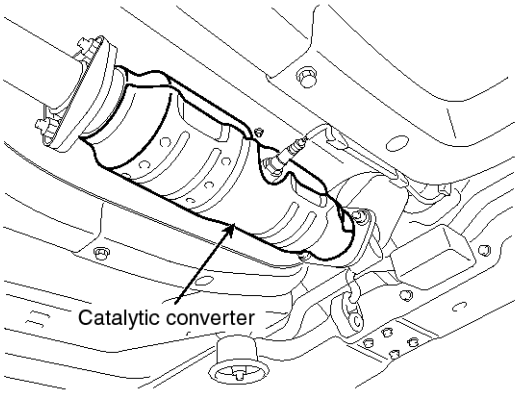
1. PCV valve
2. Canister
3. Purge control solenoid valve (PCSV)
4. Fuel tank air filter
5. Catalytic converter (CCC)

[2.4 DOHC GDI]



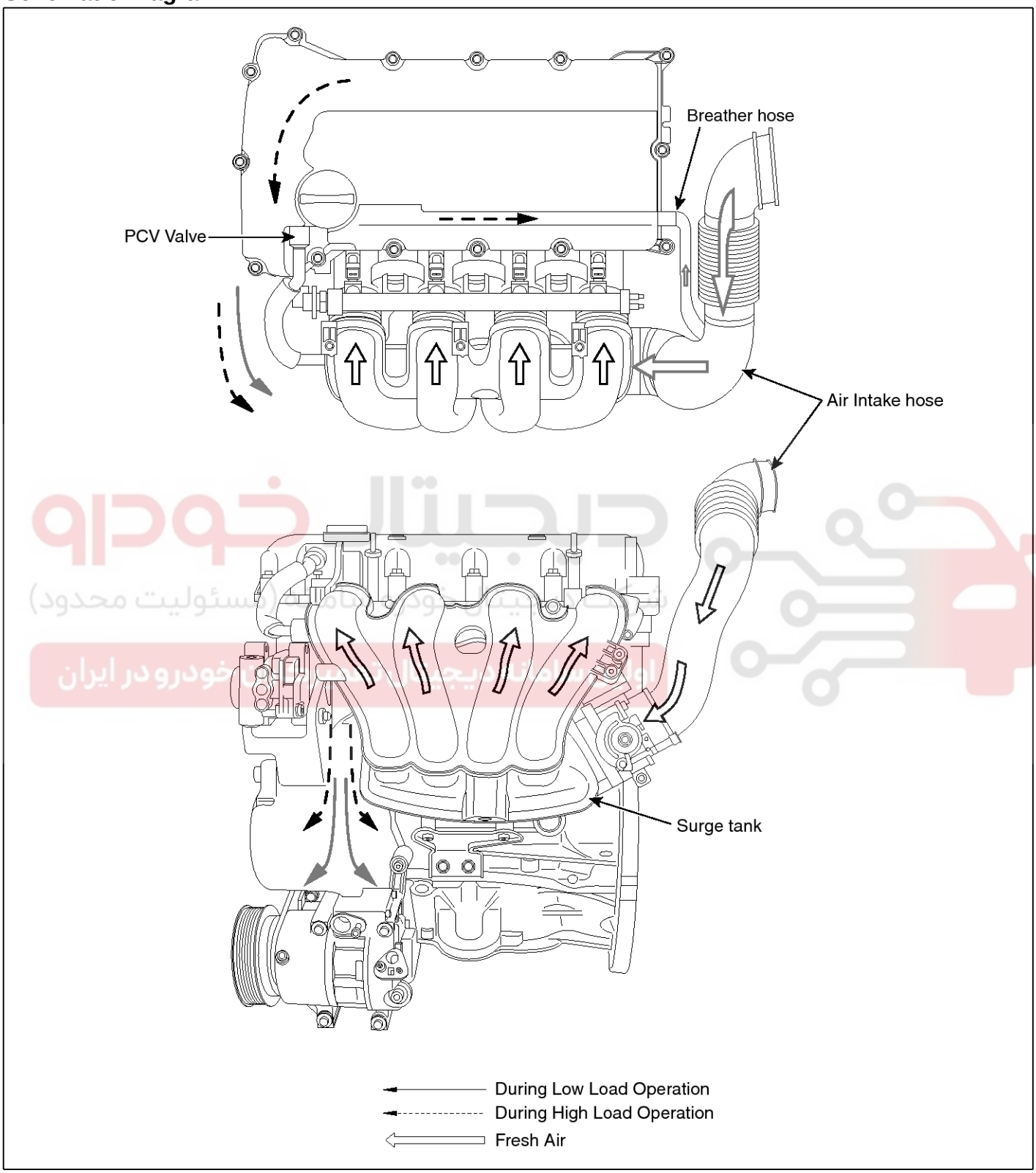
SYFEC1110L

1. PCV Valve
2. Canister
3. Purge Control Solenoid Valve (PCSV)
4. Fuel Tank Air Filter
5. Catalytic Converter (CCC)

1. PCV valve	2. Canister
 STDEC9105L	 SYFEC0110L
3. Purge control solenoid valve (PCSV)	4. Fuel tank air filter
 SXMF19115D	 SYFEC0100L
5. Catalytic converter	
 SYFEC0011L	

Crankcase Emission Control System

Schematic Diagram



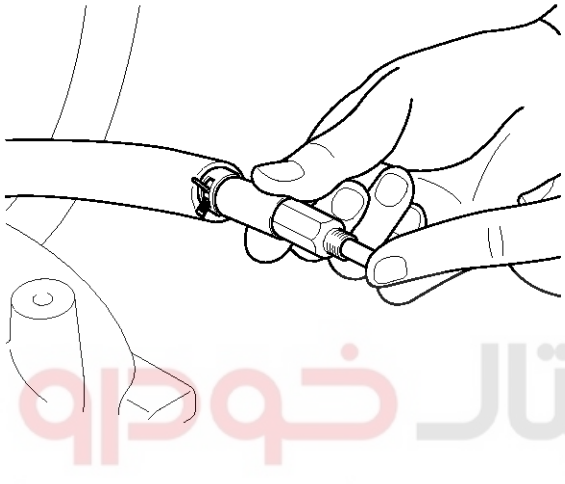
SNFEC9105N

Inspection

1. After disconnecting the vapor hose from the PCV valve, remove the PCV valve.
2. Reconnect the PCV valve to the vapor hose.
3. Run the engine at idle, then put a finger over the open end of the PCV valve and make sure that intake manifold vacuum can be felt.

NOTICE

The plunger inside the PCV valve will move back and forth at vacuum.

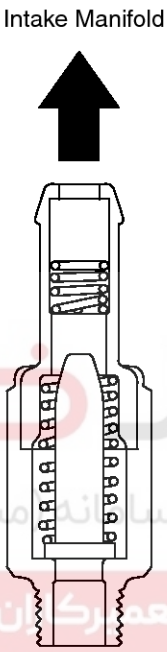
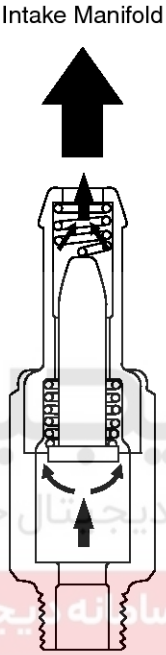
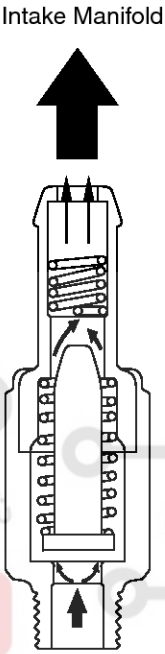
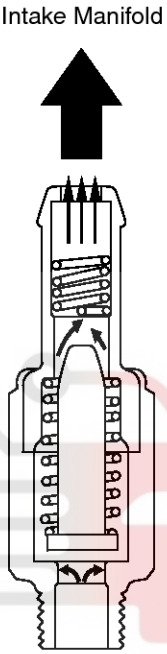


SCMEC6004L

4. If the vacuum is not felt inspect PCV operation, if operating correctly clean or replace the vapor hose.

Positive Crankcase Ventilation (PCV) Valve

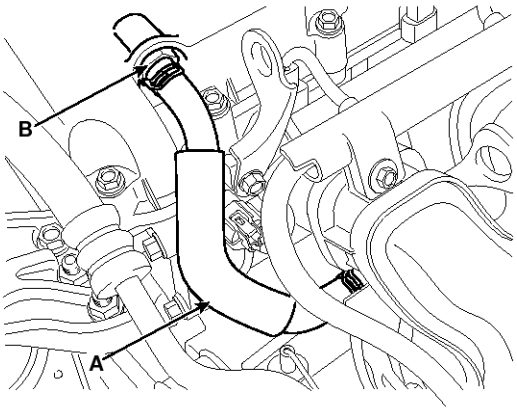
Operation Principle

Engine Condition	Not Running	Idling or Decelerating	Normal Operation	Accelerating and High Load
Vacuum in Intake Manifold	0	High	Moderate	Low
PCV Valve	Close	Slightly Open	Properly Open	Fully Open
Blow-by Gas Flow	0	Small	Medium	Large
Schematic Diagram				

SHDEC8109C

Removal

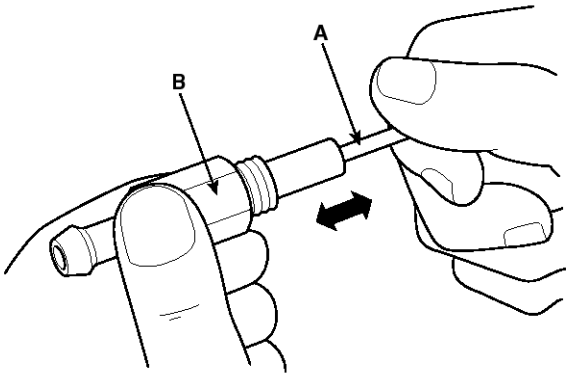
1. Disconnect the vapor hose (A).
2. Remove the PCV valve (B).



STDEC9109L

Inspection

1. Insert a thin stick (A) into the PCV valve (B) from the threaded side to check that the plunger movement.



EEDA010B

NOTICE

If the plunger does not move (PCV valve is clogged), clean or replace the valve.

Installation

1. Installation is reverse of removal.

PCV valve installation:
1.9 ~ 2.8 N.m (0.19 ~ 0.29 kgf.m, 1.4 ~ 2.1 lb-ft)

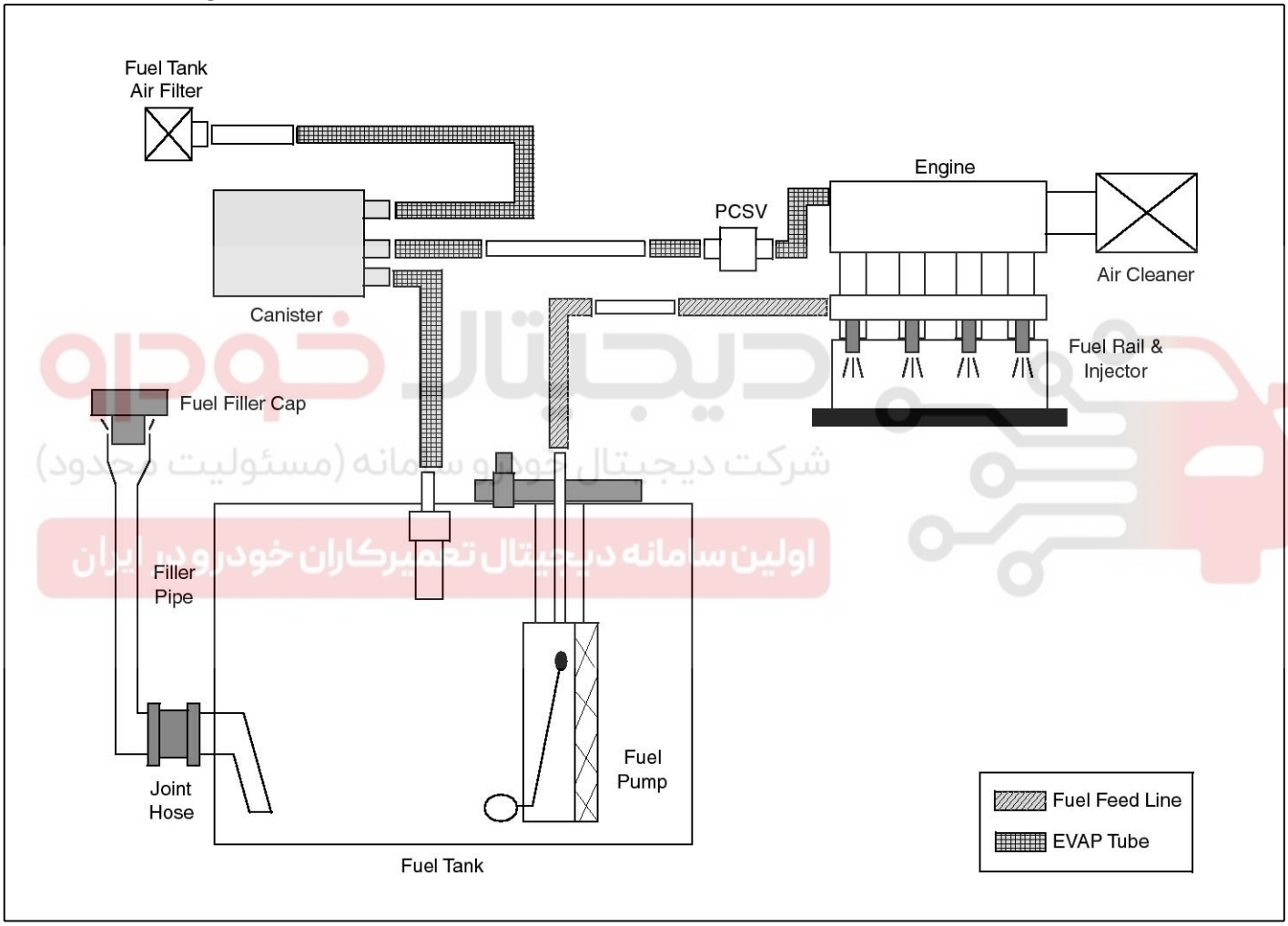
Evaporative Emission Control System

Description

Evaporative Emission Control System prevents fuel vapor stored in fuel tank from vaporizing into the atmosphere. When the fuel evaporates in the fuel tank, the vapor passes through vent hoses or tubes to the canister filled with charcoal and the canister temporarily holds the vapor in the charcoal.

If ECM determines to draw the gathered vapor into the combustion chambers during certain operating conditions, it will use vacuum in intake manifold to move it.

Schematic Diagram



SHMEC9202L

Canister

Canister is filled with charcoal and absorbs evaporated vapor in fuel tank. The gathered fuel vapor in canister is drawn into the intake manifold by the ECM/PCM when appropriate conditions are set.

Purge Control Solenoid Valve (PCSV)

Purge Control Solenoid Valve (PCSV) is installed in the passage connecting canister and intake manifold. It is a duty type solenoid valve and is operated by ECM/PCM signal.

To draw the absorbed vapor into the intake manifold, the ECM/PCM will open the PCSV, otherwise the passage remains closed.

Fuel Filler Cap

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which would seal the fuel filler. After the gasket on the fuel filler cap and the fill neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.

Inspection

[System Inspection]

1. Disconnect the vapor hose from the throttle body and connect a vacuum pump to the nipple on the throttle body.
2. Check the following points with applied vacuum using a vacuum pump.

· At Cold Engine [Engine Coolant Temperature < 60℃(140˚F)]

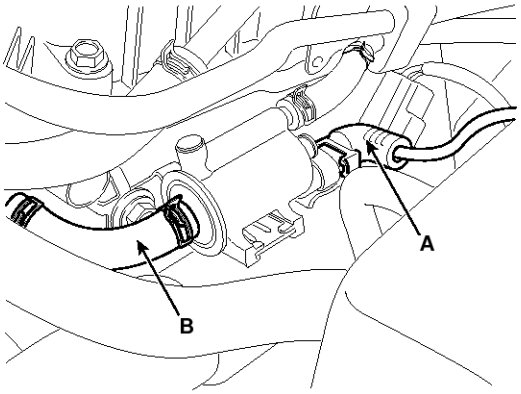
Engine Operating Condition	Applied Vacuum	Result
Idle	0.5kgf/cm² (50kPa,7.3psi)	Vacuum is held
3,000rpm		

· At Warmed Engine [Engine Coolant Temperature > 80℃(176˚F)]

Engine Operating Condition	Applied Vacuum	Result
Idle	0.5kgf/cm² (50kPa,7.3psi)	Vacuum is held
Within 3 minutes after engine start at 3,000 rpm	Try to apply vacuum	Vacuum is released
In 3 minutes after engine start at 3,000 rpm	0.5kgf/cm² (50kPa,7.3psi)	Vacuum will be held momentarily, after which, it will be released

[PCSV Inspection]

1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the PCSV connector (A).
3. Disconnect the vapor hose (B) which is connected to the intake manifold from the PCSV.



SXMEC9109D

4. After connecting a vacuum pump to the nipple, apply vacuum.
5. With the PCSV control line grounded, check the valve operation with battery voltage applied to the PCSV(Open) and removed(Closed).

Battery Voltage	Valve	Vacuum
Connected	Open	Released
Disconnected	Close	Maintained

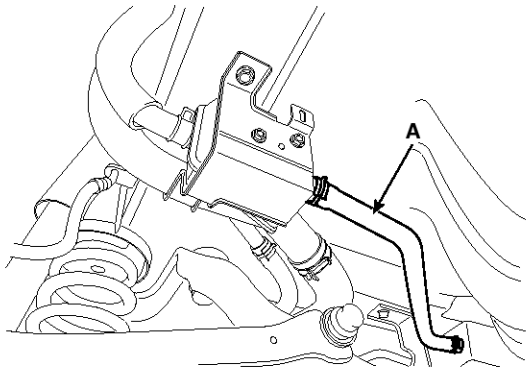
6. Measure the coil resistance of the PCSV.

Specifications: 19.0 ~ 22.0Ω [20˚C(68˚F)]

Canister

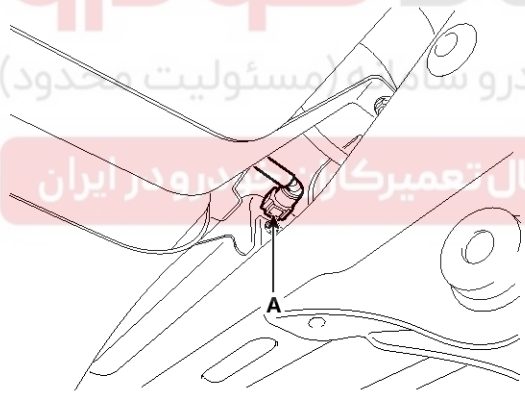
Removal

1. Lift the vehicle.
2. Disconnect the ventilation hose (A) from the fuel tank air filter.



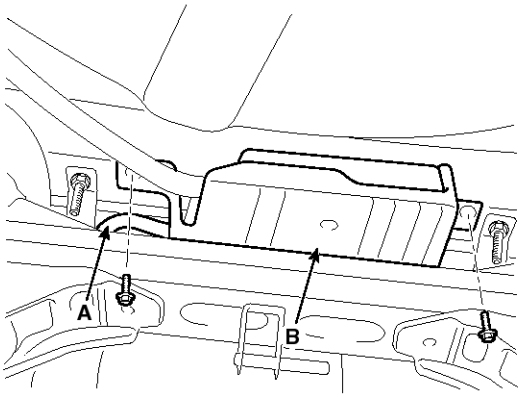
SYFEC0101L

3. Disconnect the vapor hose quick-connector (A).



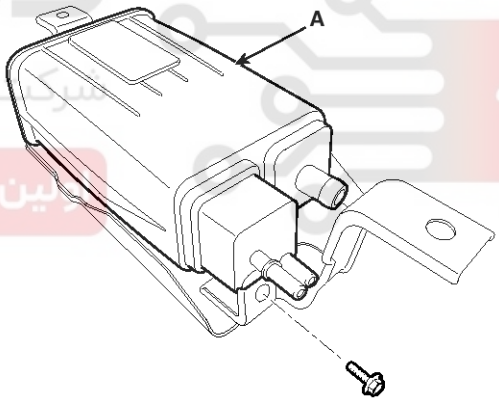
SYFFL0110L

4. Disconnect the vapor hose (A).
5. Remove the protector installation bolts and then remove the canister assembly (B).



SYFEC0111L

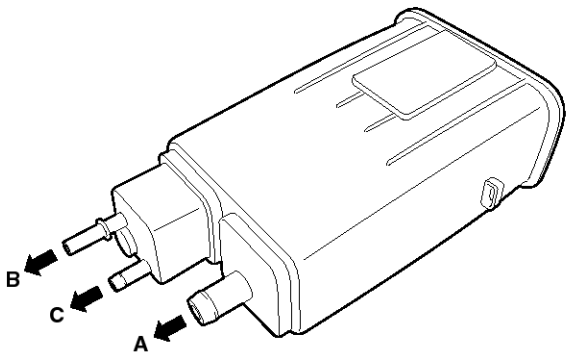
6. Remove the canister (A) from the bracket after removing a bolt.



SYFEC0120L

Inspection

1. Check for the following items visually.
   - Cracks or leakage of the canister
   - Loose connection, distortion, or damage of the vapor hose/tube



SYFEC0130L

A: Canister ↔ Atmosphere
B: Canister ↔ Fuel Tank
C: Canister ↔ Intake Manifold

Installation

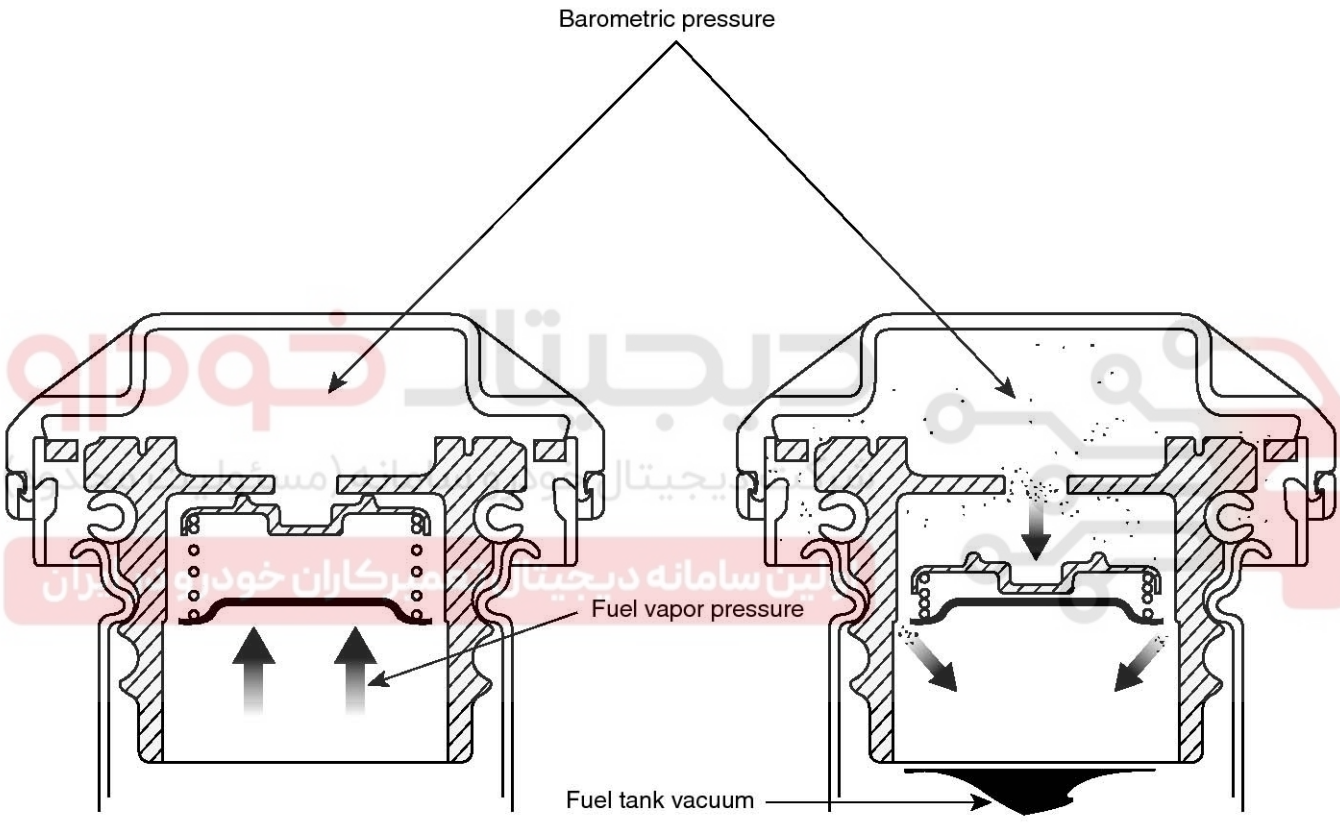
Installation is the reverse of removal.

Canister protector installation bolt:
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)
Canister installation bolt:
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Fuel Filler Cap

Description

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which seals the fuel filler. After the gasket on the fuel filler cap and the filler neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.



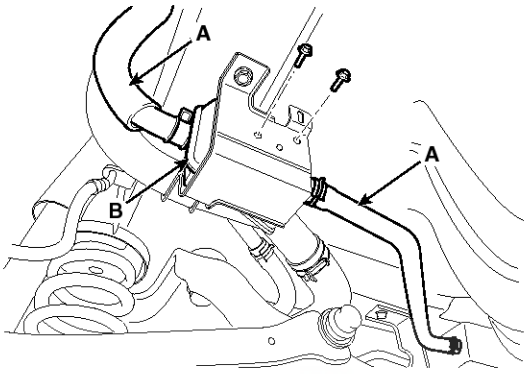
When fuel tank is under pressure. **When fuel tank is under vacuum.**

LEGE015A

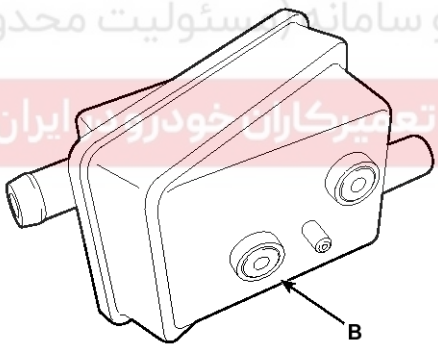
Fuel Tank Air Filter

Replacement

1. Lift the vehicle.
2. Disconnect the ventilation hose (A) from the fuel tank air filter.
3. Remove the installation bolts, and then remove the fuel tank air filter (B).



SYFEC0102L



SYFEC0140L

4. Install a new fuel tank air filter in accordance with the reverse order.

Exhaust Emission Control System

Description

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components.

Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system.

These items have been integrated into a highly effective system which controls exhaust emissions while maintaining good drivability and fuel economy.

Air/Fuel Mixture Control System [Multiport Fuel Injection (MFI) System]

The MFI system uses signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, thus precisely regulating the air/fuel mixture ratio and reducing emissions.

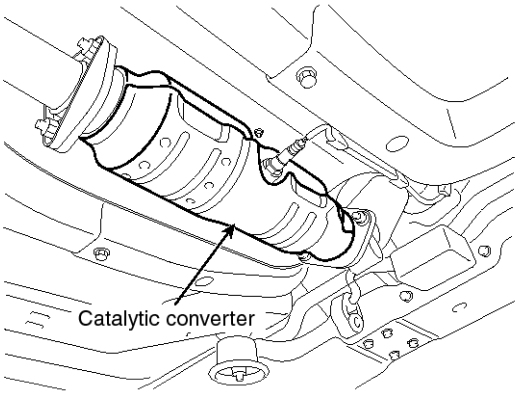
This in turn allows the engine to produce exhaust gas of the proper composition to permit the use of a three way catalyst. The three way catalyst is designed to convert the three pollutants [hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx)] into harmless substances. There are two operating modes in the MFI system.

1. Open Loop air/fuel ratio is controlled by information pre-programmed into the ECM.
2. Closed Loop air/fuel ratio is constantly adjusted by the ECM based on information supplied by the oxygen sensor.

Catalytic Converter

Description

The catalytic converter of the gasoline engine is a three way catalyst. It oxidizes carbon monoxide and hydrocarbons (HC), and separates oxygen from the oxides of nitrogen (NOx).



SYFEC0011L

CVVT (Continuously Variable Valve Timing) System

Description

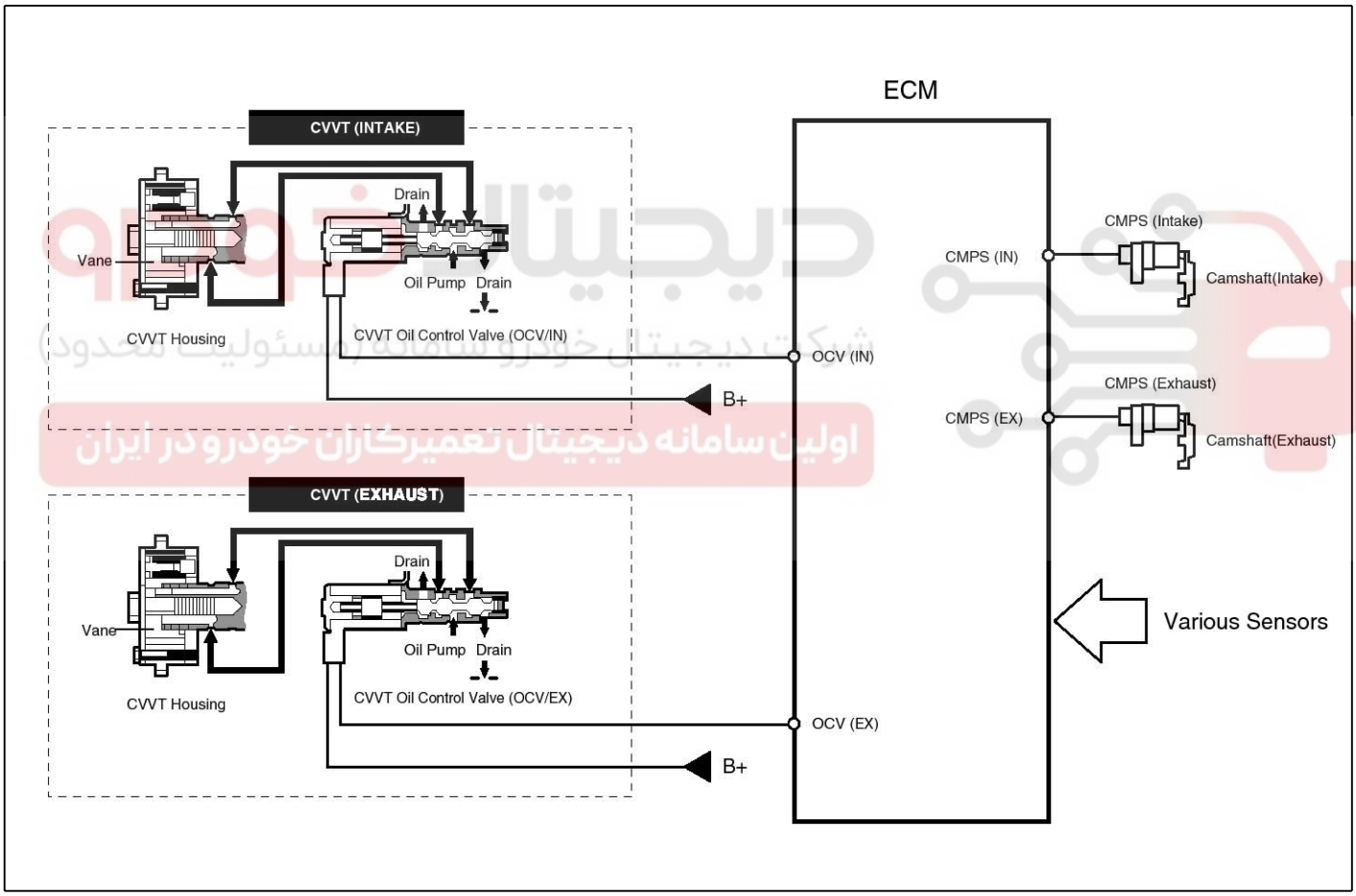
Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of

- the CVVT Oil Control Valve (OCV) which supplies the engine oil to the cam phaser or runs out the engine oil from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

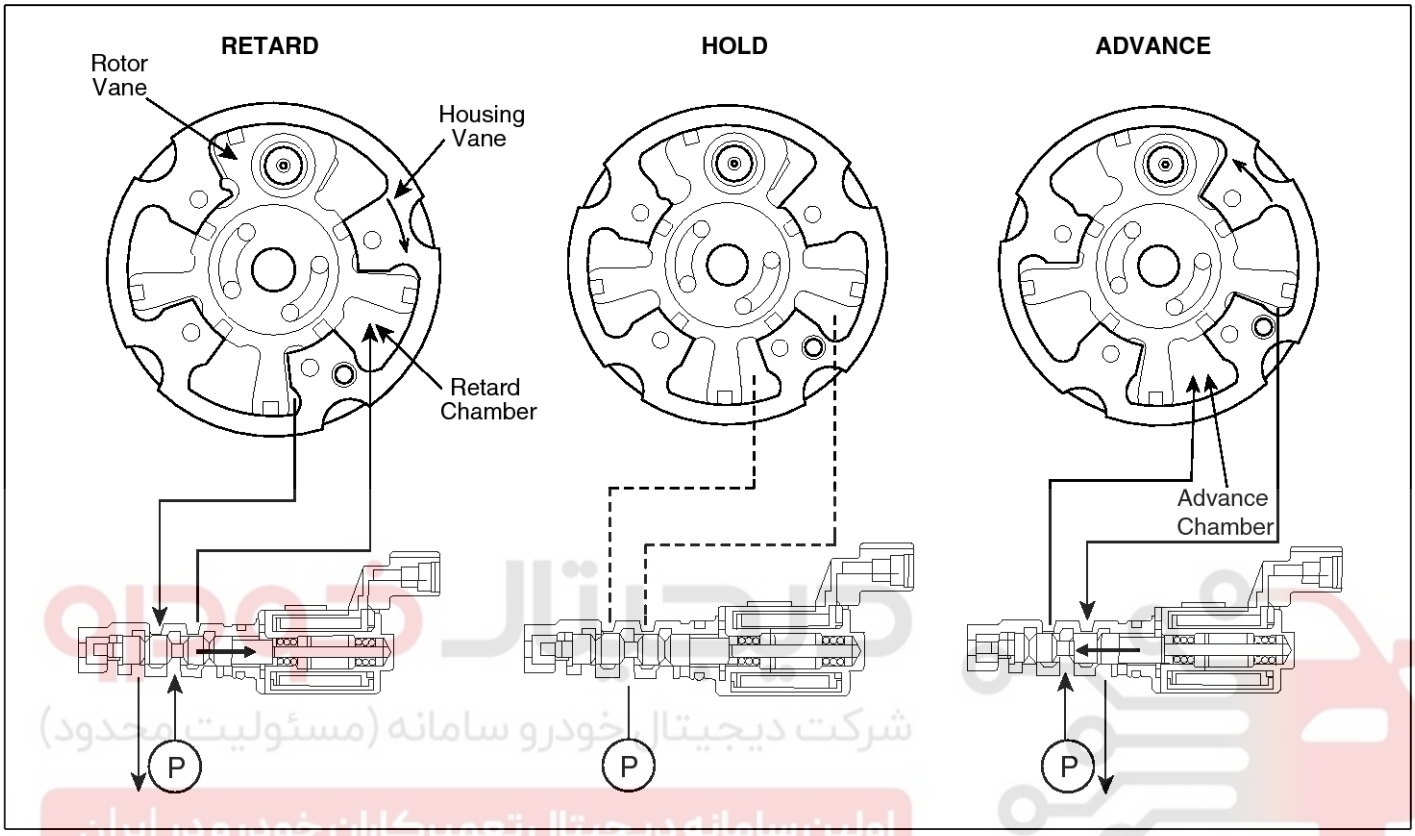
The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



SBHEC9119N

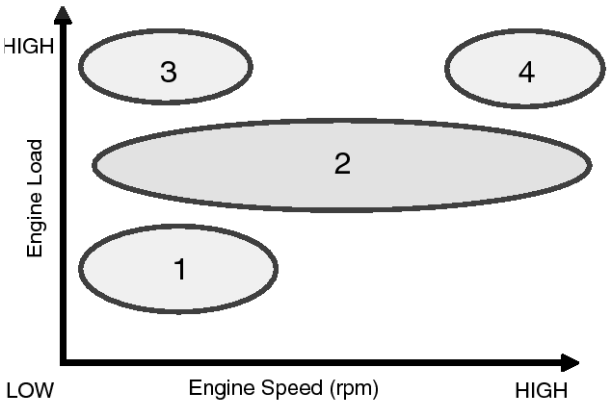
Operation Principle

The CVVT has the mechanism rotating the rotor vane with hydraulic force generated by the engine oil supplied to the advance or retard chamber in accordance with the CVVT oil control valve control.



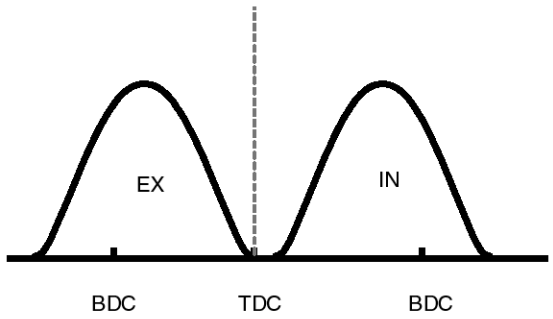
SBHEC9116N

[CVVT System Mode]



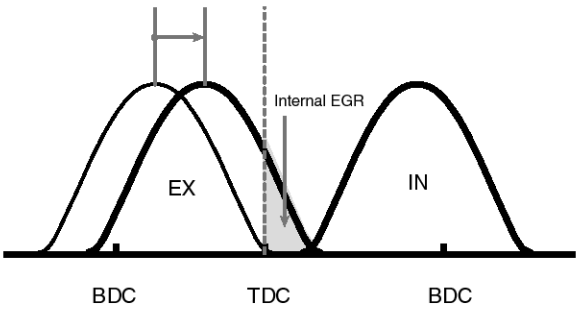
SBHEC9110N

(1) Low Speed / Low Load



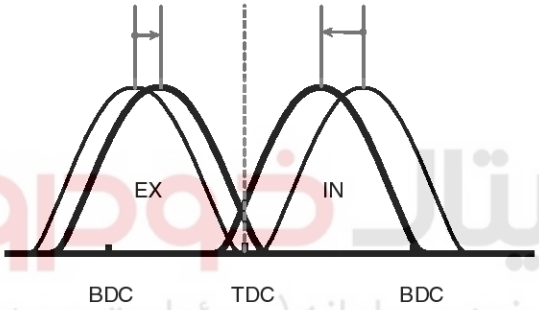
SBHEC9111N

(2) Part Load



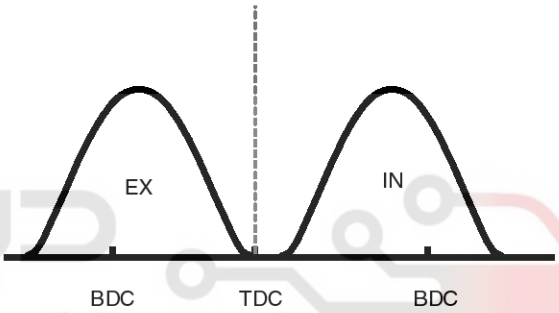
SBHEC9112N

(3) Low Speed / High Load



SBHEC9113N

(4) High Speed / High Load



SBHEC9114N

Driving Condition	Exhaust Valve		Intake Valve	
	Valve Timing	Effect	Valve Timing	Effect
(1) Low Speed /Low Load	Completely Advance	* Valve Under-lap * Improvement of combustion stability	Completely Retard	* Valve Under-lap * Improvement of combustion stability
(2) Part Load	Retard	* Increase of expansion work * Reduction of pumping loss * Reduction of HC	Retard	* Reduction of pumping loss
(3) Low Speed /High Load	Retard	* Increase of expansion work	Advance	* Prevention of intake back flow (Impr-ovement of volumetric efficiency)
(4) High Speed /High Load	Advance	* Reduction of pumping loss	Retard	* Improvement of volumetric efficiency