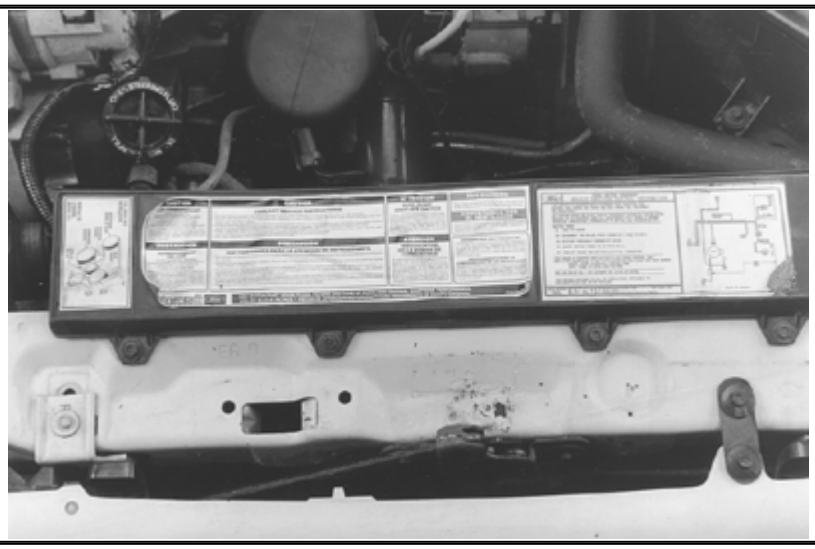
EMISSION CONTROLS

Introduction

There are three sources of automotive pollutants: crankcase fumes, exhaust gases and gasoline evaporation. The pollutants formed from these substances can be grouped into three categories: unburned hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x). The equipment that is used to limit these pollutants is commonly called emission control equipment.



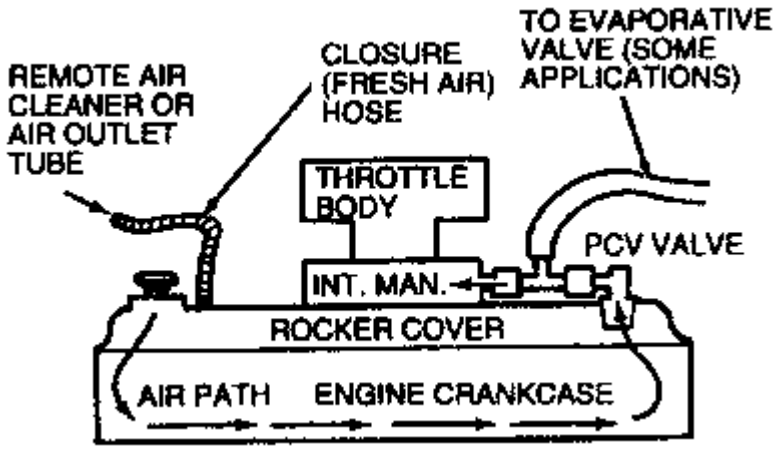
The vehicle emission control information label includes instructions for engine control system adjustment

Positive Crankcase Ventilation (PCV) System

OPERATION

The Positive Crankcase Ventilation (PCV) system is used on all vehicles covered by this manual. The PCV system vents harmful combustion blow-by fumes from the engine crankcase into the engine air intake for burning with the fuel and air mixture. The PCV system maximizes oil cleanliness by venting moisture and corrosive fumes from the crankcase.

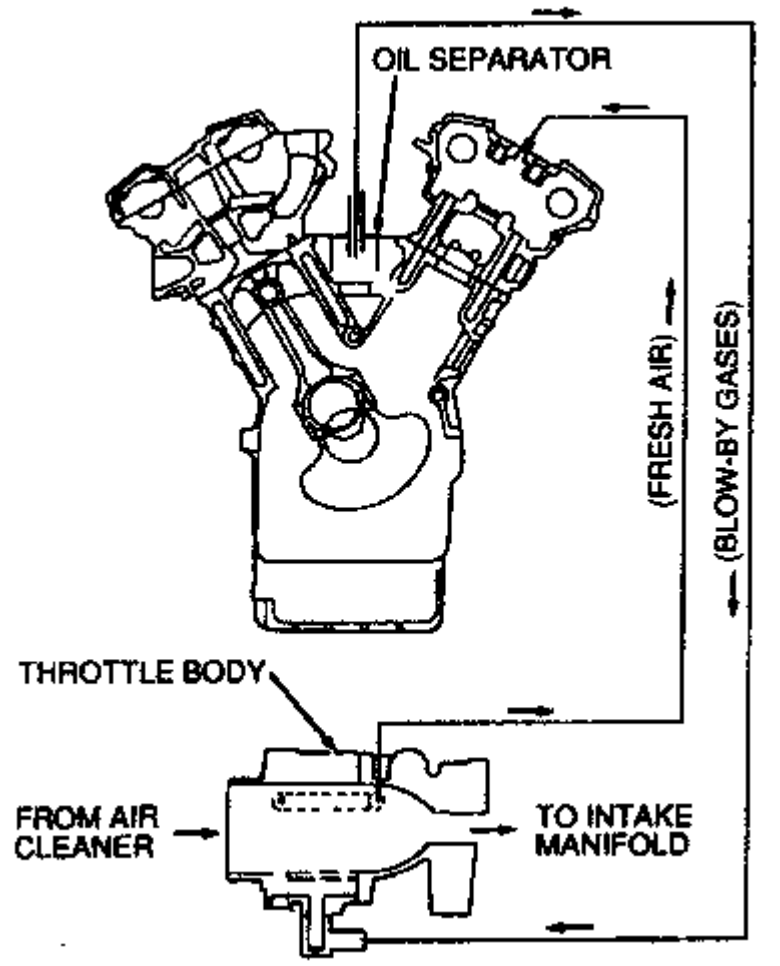
All of the vehicles covered by this manual, except for the 3.0L and the 3.2L SHO engines, utilize a PCV valve. The PCV valve limits the fresh air intake to suit the engine demand and also serves to prevent combustion backfiring into the crankcase. The PCV valve controls the amount of blow-by vapors pulled into the intake manifold from the crankcase. It also acts as a one-way check valve that prevents air from entering the crankcase in the opposite direction.



Positive Crankcase Ventilation (PCV) system schematic-except SHO vehicles

Click to enlarge

The PCV system on the SHO vehicles is unique because is does not use a PCV valve. Instead, the crankcase gases flow through an oil separator to three ports in the throttle body. Fresh air for the PCV system is supplied from another port on the throttle body to the cylinder head cover. Under various throttle conditions, the air and crankcase gases flow differently through the ports in the throttle body.

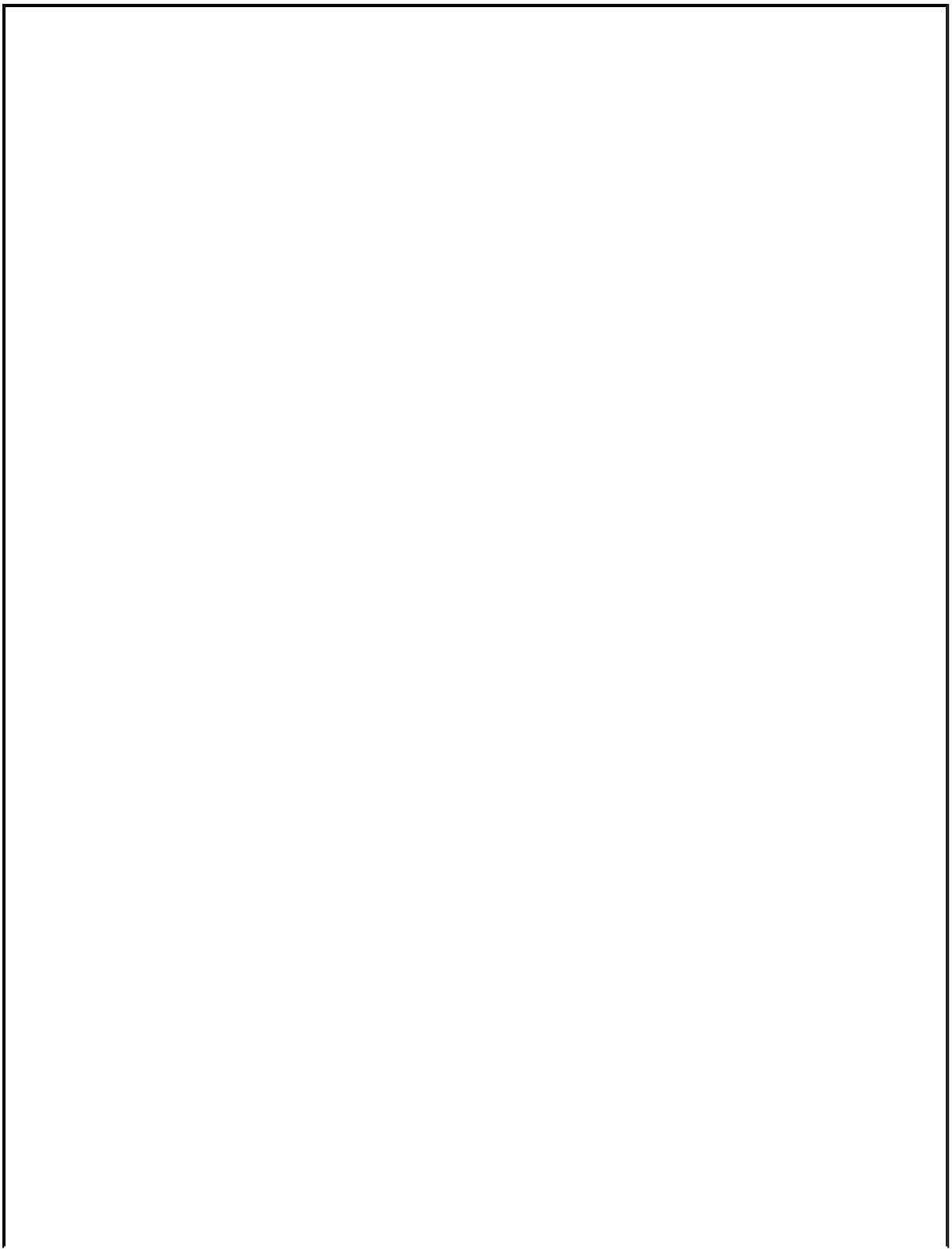


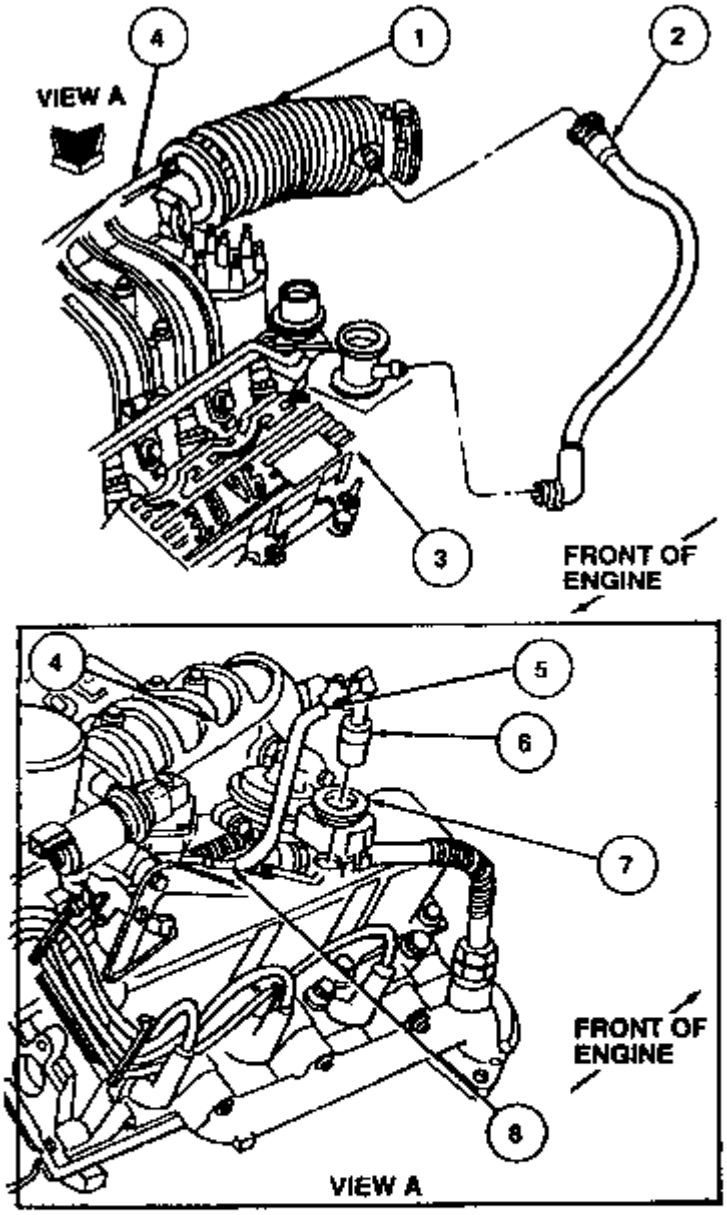
Positive Crankcase Ventilation (PCV) system schematic-3.0L and 3.2L SHO vehicles

Click to enlarge

On some engine applications, the PCV system is connected with the evaporative emission system. Do not remove the PCV system from the engine, as doing so will adversely affect fuel economy and engine ventilation, with resultant shortening of engine life.

The components used in the PCV valve system consist of the PCV valve (or tube as in SHO applications), the rubber mounting grommet in the valve cover, the nipple in the air intake system and the necessary connecting hoses.





Item	Part Number	Description
1	9B659	Air Cleaner Outlet Tube
2	6853	Crankcase Ventilation Hose
3	6582	Valve Cover
4	9E926	Throttle Body
5	6853	Crankcase Ventilation Hose
6	6A666	Positive Crankcase Ventilation Valve
7	6A892	Crankcase Ventilation Grommet
8	9E926	Throttle Body

PCV system components-3.0L shown, 2.5L similar

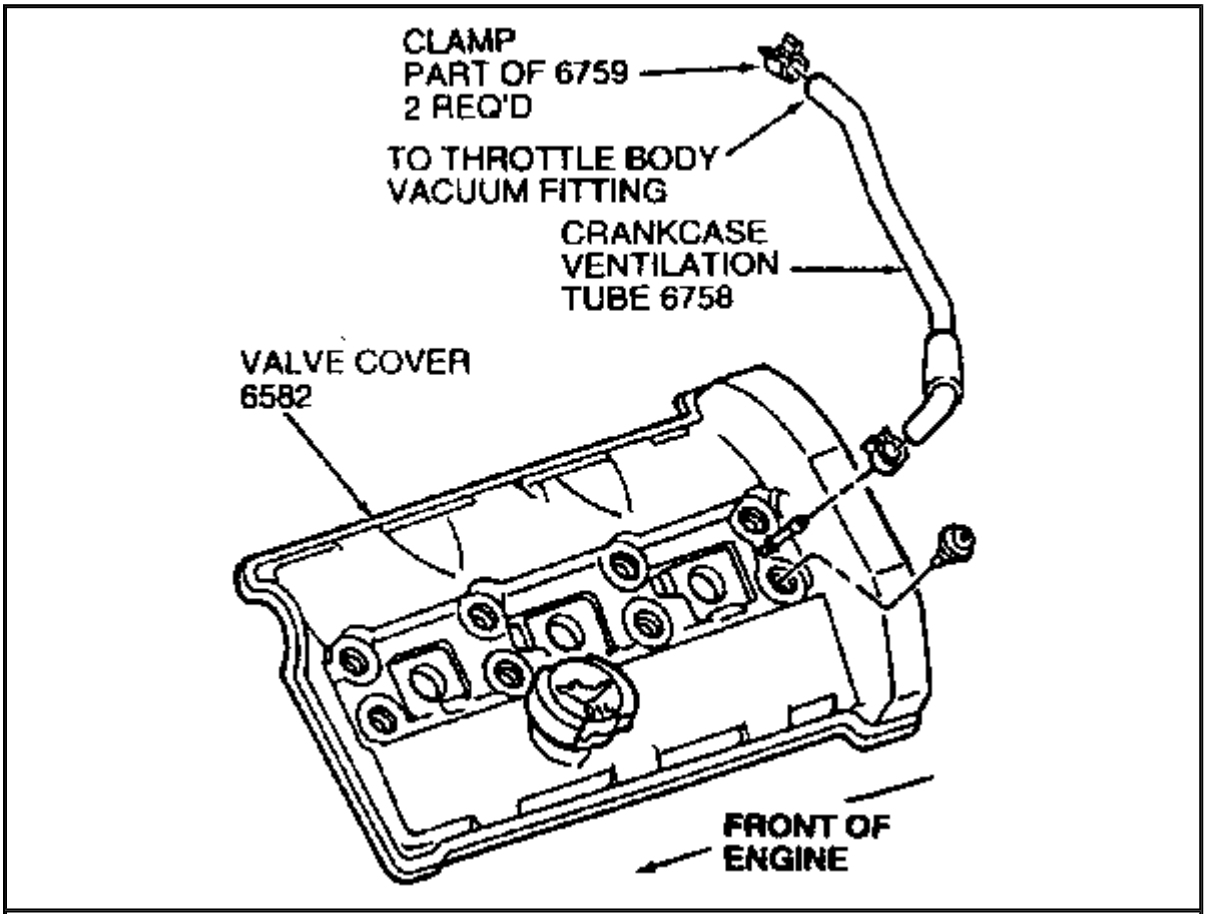
Click to enlarge

SYSTEM INSPECTION

1. **Visually inspect the components of the PCV system. Check for rough idle, slow**

starting, high oil consumption and loose, leaking, clogged or damaged hoses.

2. Check the fresh air supply hose and the PCV hose for air leakage or flow restriction caused by loose engagement, hose splitting, cracking, kinking, nipple damage, poor rubber grommet fit or any other damage.
3. If a component is suspected as the obvious cause of a malfunction, correct the cause before proceeding to the next step.
4. If all checks are okay, proceed to the pinpoint tests.



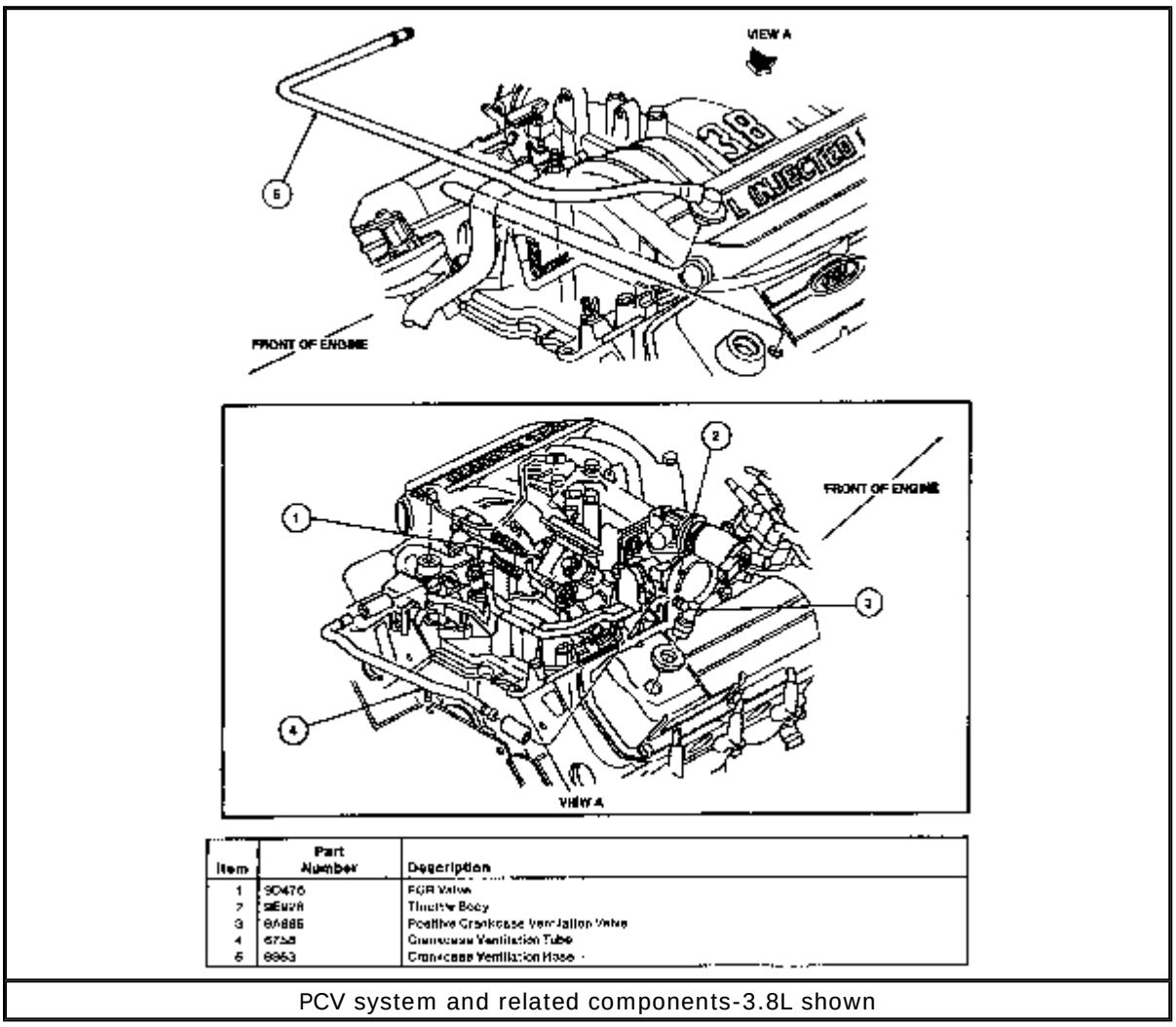
PCV system and related components-3.0L and 3.2L SHO vehicles

Click to enlarge

PINPOINT TESTS

1. Remove the PCV valve from the valve cover grommet and shake the valve. If the valve rattles when shaken, reinstall and proceed to Step 2. If the valve does not rattle, it is sticking and should be replaced.
2. Start the engine and bring to normal operating temperature.
3. On the 2.5L engine, remove the corrugated hose from the oil separator nipple. On all other engines, disconnect the hose from the remote air cleaner or air outlet tube.
4. Place a stiff piece of paper over the nipple or hose end and wait 1 minute. If vacuum holds the paper in place, the system is okay; reconnect the hose. If the paper is not held in place, the system is plugged or the evaporative emission valve, if so equipped, is leaking. If the evaporative emission valve is suspected of leaking, proceed to Step 5.
5. Disconnect the evaporative hose, if equipped, and cap the connector.

6. **Place a stiff piece of paper over the hose/nipple, as in Step 4 and wait 1 minute. If vacuum holds the paper in place, proceed to evaporative emission system testing. If the paper is not held in place, check for vacuum leaks/obstruction in the system: oil cap, PCV valve, hoses, cut grommets, the oil separator on the 2.5L engine and valve cover for bolt torque/gasket leak.**



Item	Part Number	Description
1	9D475	EGR Valve
2	9E926	Throttle Body
3	6A666	Positive Crankcase Ventilation Valve
4	6758	Crankcase Ventilation Tube
5	6663	Crankcase Ventilation Hose

PCV system and related components-3.8L shown

Click to enlarge

REMOVAL & INSTALLATION

1. **Remove the PCV valve from the mounting grommet in the valve cover.**
2. **Disconnect the valve from the PCV hose and remove the valve from the vehicle.**
3. **Installation is the reverse of the removal procedure.**

Evaporative Emission Control (EEC) System

OPERATION

The evaporative emission control system prevents the escape of fuel vapors to the atmosphere under hot soak and engine off conditions by storing the vapors in a carbon canister. Then, with the engine warm and running, the system controls the purging of stored vapors from the canister to the engine, where they are efficiently burned.

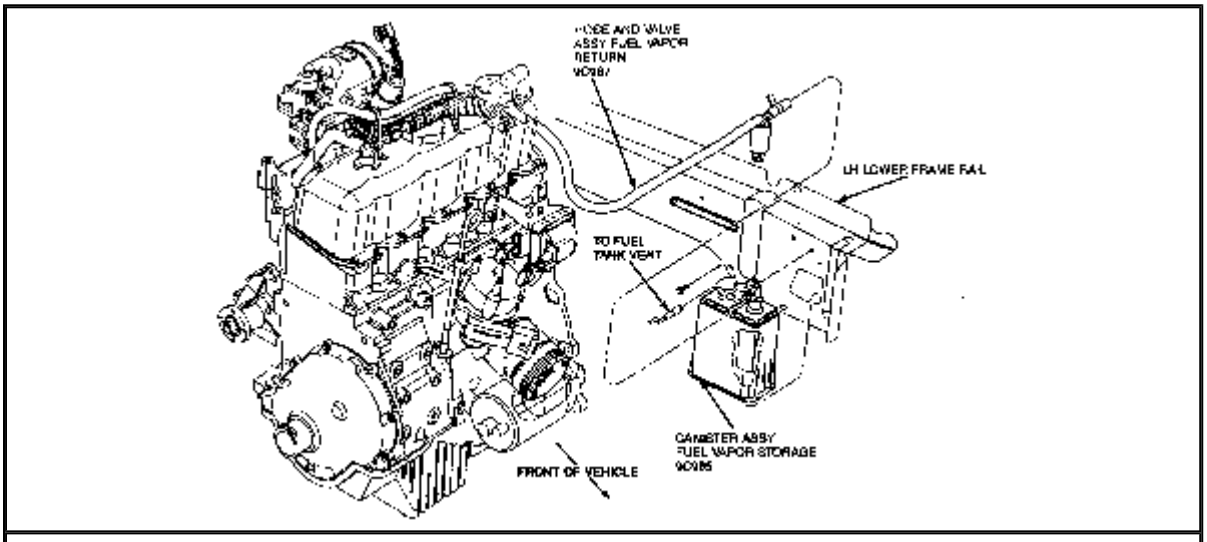
Evaporative emission control components consist of the carbon canister, purge valve(s), vapor valve, rollover vent valve, check valve and the necessary lines. All vehicles may not share all components.

The carbon canister contains vapor absorbent material to facilitate the storage of fuel vapors. Fuel vapors flow from the fuel tank to the canister, where they are stored until purged to the engine for burning.

The purge valves control the flow of fuel vapor from the carbon canister to the engine. Purge valves are either vacuum or electrically controlled. When electrically controlled, a purge valve is known as a purge solenoid. A vehicle may be equipped with a vacuum purge valve or purge solenoid or a combination of the two. Purging occurs when the engine is at operating temperature and off idle.

The vapor valve is located on or near the fuel tank. Its function is to prevent fuel from flooding the carbon canister. The vapor valve incorporates the rollover valve. In the event of a vehicle rollover, the valve blocks the vapor line automatically to prevent fuel leakage.

The check valve is located in the fuel filler cap or on the underside of the vehicle. Its function is to protect the fuel tank from heat build-up rupture and cool-down collapse by allowing air to pass in or out of the tank to equalize pressure. On cool-down, air enters either at the carbon canister vent or at the check valve.



EEC system for the 2.5L engine

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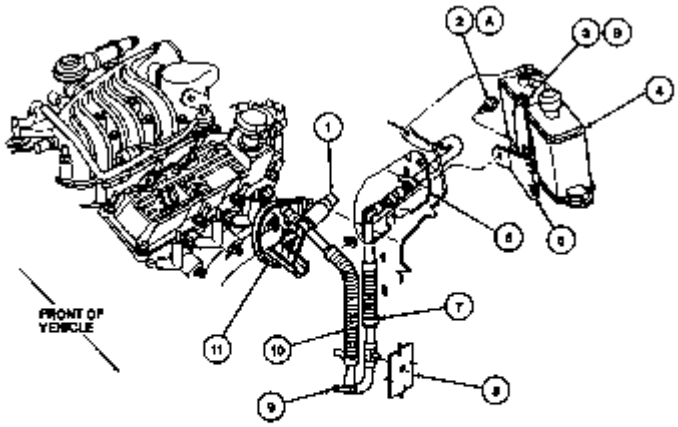
SYSTEM INSPECTION

1. **Visually inspect the components of the evaporative emission system. Check for the following, as applicable:**
   - **Discharged battery**
   - **Damaged connectors**
   - **Damaged insulation**
   - **Malfunctioning ECU**
   - **Damaged air flow meter or speed sensor**
   - **Inoperative solenoids**

- **Fuel odor or leakage**
- **Damaged vacuum or fuel vapor lines**
- **Loose or poor line connections**
- **Poor driveability during engine warm-up**

2. **Check the wiring and connectors for the solenoids, vane air flow meter, speed sensor and ECU, as applicable, for looseness, corrosion, damage or other problems. This must be done with the engine fully warmed up so as to activate the purging controls.**
3. **Check the fuel tank, fuel vapor lines, vacuum lines and connections for looseness, pinching, leakage, damage or other obvious cause for malfunction.**
4. **If fuel line, vacuum line or orifice blockage is suspected as the obvious cause of an observed malfunction, correct the cause before proceeding further.**



Item	Part Number	Description
1	9C915	Evaporative Emission Canister Purge Solenoid
2	N606888-S2	Bolt
3	N610668-S9	Bolt
4	9D663	Evaporative Emissions Canister
5	9D664	Evaporative Emission Canister Bracket
6		L-Headlamp Opening (Part of 16A387)

Item	Part Number	Description
7	9K318	Evaporative Emission Tube
8	16138	Radiator Support
9	9A262	Fuel Tank Vent Tube (Part of 9K313)
10	W0387	Evaporative Emission Hose
11	35373	Tie Strap
A		Tighten to 21.2-28.8 N·m (15-21 Lb-Ft)
B	--	Tighten to 5.2-7.2 N·m (48-63 Lb-In)

EEC system for the 3.0L engine (except SHO and Flexible Fuel)

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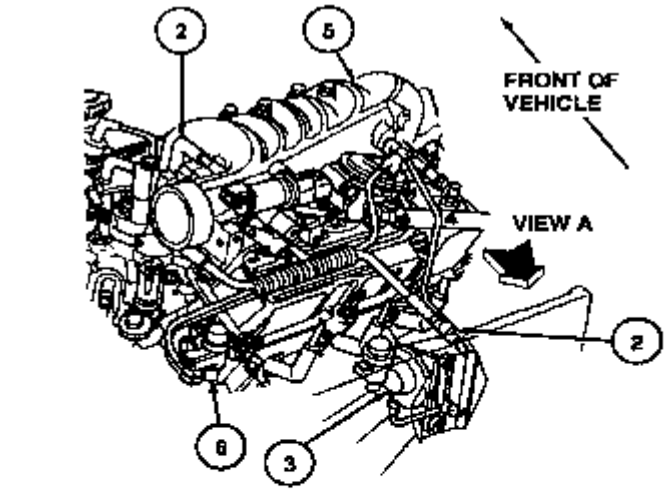
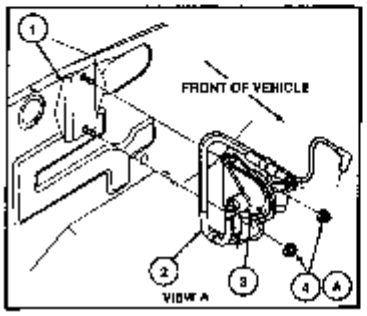
ADJUSTMENT

Carbon Canister

There are no moving parts and nothing to wear in the canister. Check for loose, missing cracked or broken connections and parts. There should be no liquid in the canister.

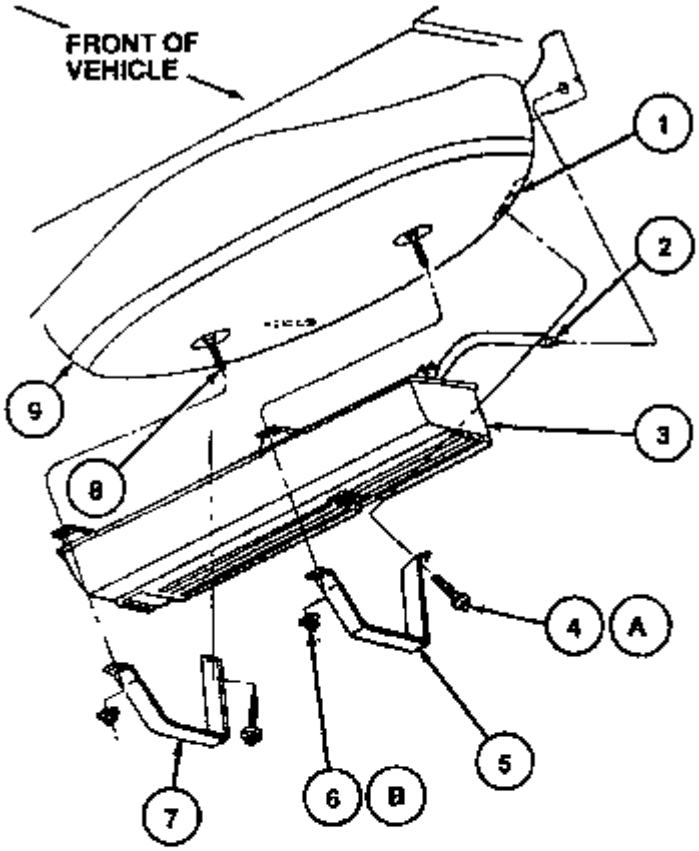




Item	Part Number	Description
1	31613	Dash Panel
2	AF4A8	Main Emission Vacuum Control Connector
3	9C915	Evaporative Emission Canister Purge Solenoid
4	N617165-S1	Nut (2 Req'd)
5	9E926	Throttle Body
6	9J459	EGR Vacuum Regulator Control
A	—	Tighten to 7.8-10.4 N·m (69-92 Lb-In)

EEC system for the 3.0L Flexible Fuel (FF) engine

Click to enlarge



Item	Part Number	Description
1	N801658-S190	U-Nut (2 Req'd)
2	9J279	Fuel and Vapor Return Tube
3	9D653	Evaporative Emissions Canister
4	N804568-S190	Bolt (2 Req'd)
5	9D666	RH Evaporative Emission Canister Strap
6	N804796-S56	Nut (2 Req'd)
7	9D666	LH Evaporative Emission Canister Strap
8	14258	Stud (2 Req'd)
9	11215	Rear Floor Pan
A	—	Tighten to 40.3-54.7 N·m (30-40 Lb-Ft)
B	—	Tighten to 21.2-28.8 N·m (15-21 Lb-Ft)

The 3.0L Flexible Fuel vehicles utilize four canisters mounted under the rear floor pan

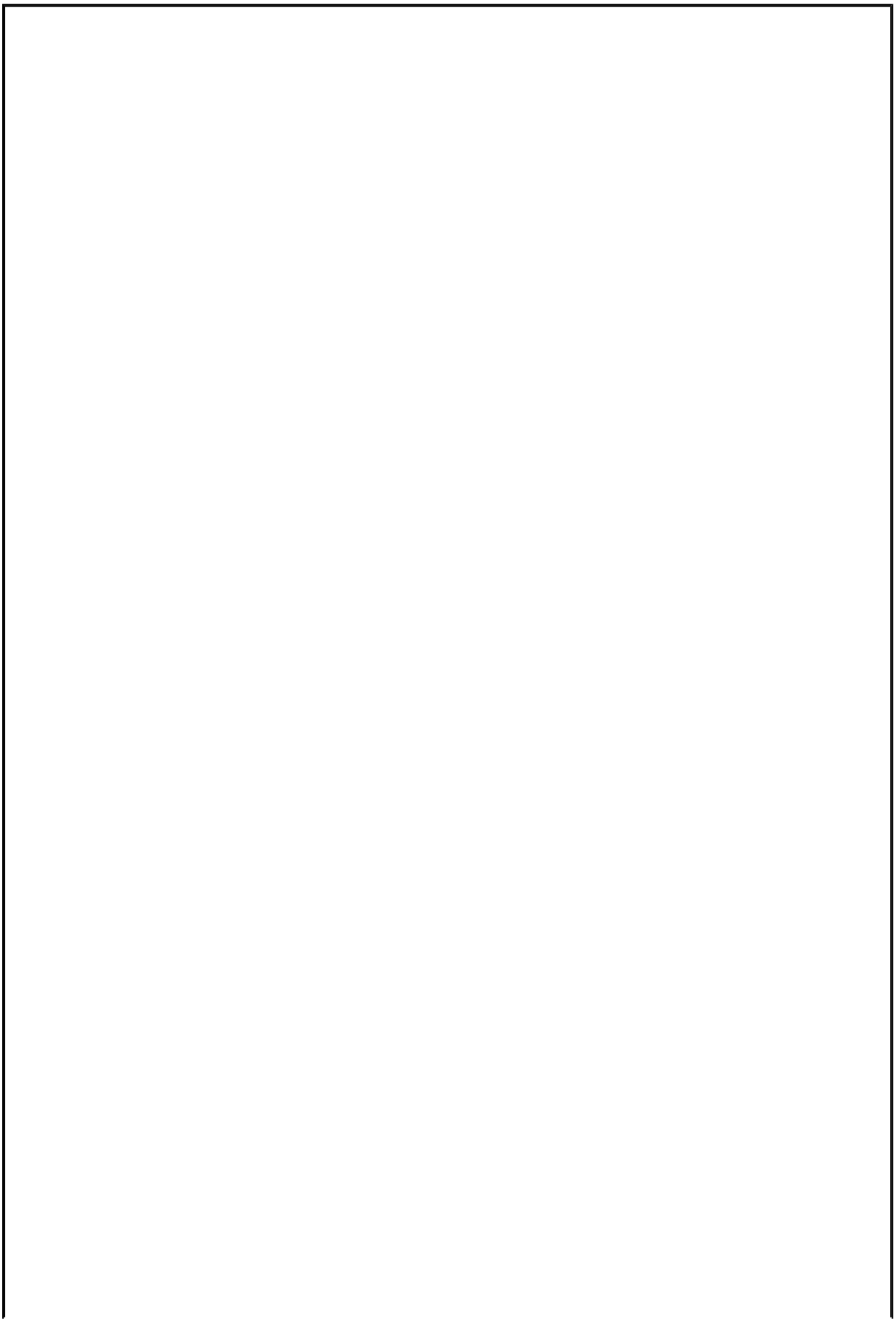
Click to enlarge

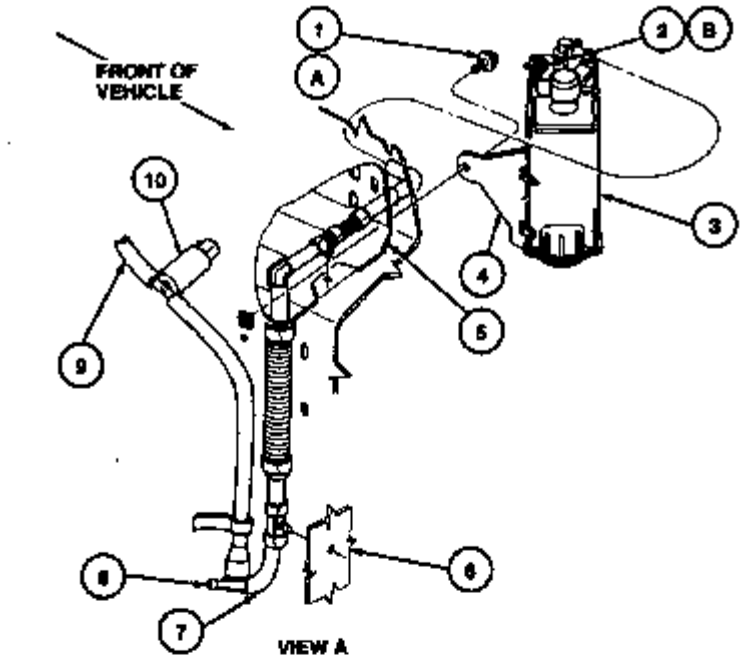
REMOVAL & INSTALLATION

Carbon Canister

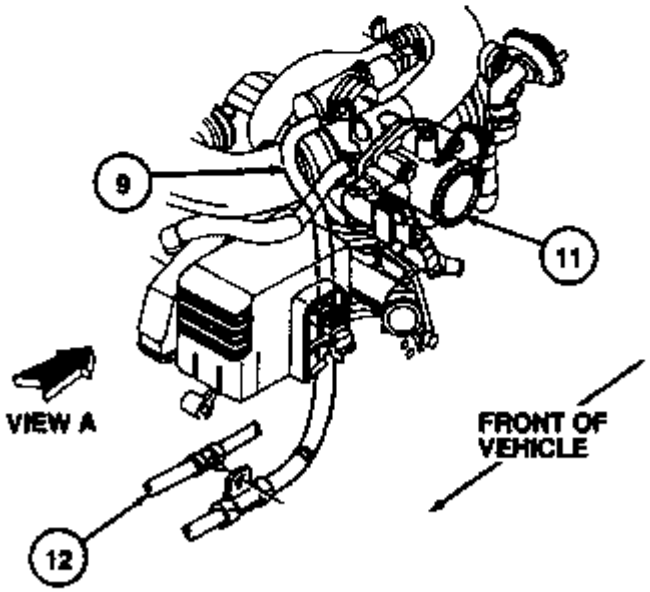
1. **Disconnect the negative battery cable.**
2. **Detach the vapor hoses from the carbon canister.**

3. **Remove the canister mounting bolts and/or retaining straps, then remove the canister. The 3.0L Flexible Fuel engine uses four canisters mounted under the rear floor pan.**
4. **Installation is the reverse of the removal procedure.**





Item	Part Number	Description
1	N606688-S2	Bolt
2	N610959-S2	Bolt
3	9D653	Evaporative Emissions Canister
4	9D665	Evaporative Emission Canister Bracket
5	—	LH Headlamp Opening (Part of 16138)
6	16138	Radiator Support
7	9K313	Evaporative Emission Tube



Item	Part Number	Description
8	9A228	Fuel Tank Vent Tube (Part of 9K313)
9	9E325	Evaporative Emission Hose
10	9C915	Evaporative Emission

EEC system for the 3.0L SHO engine

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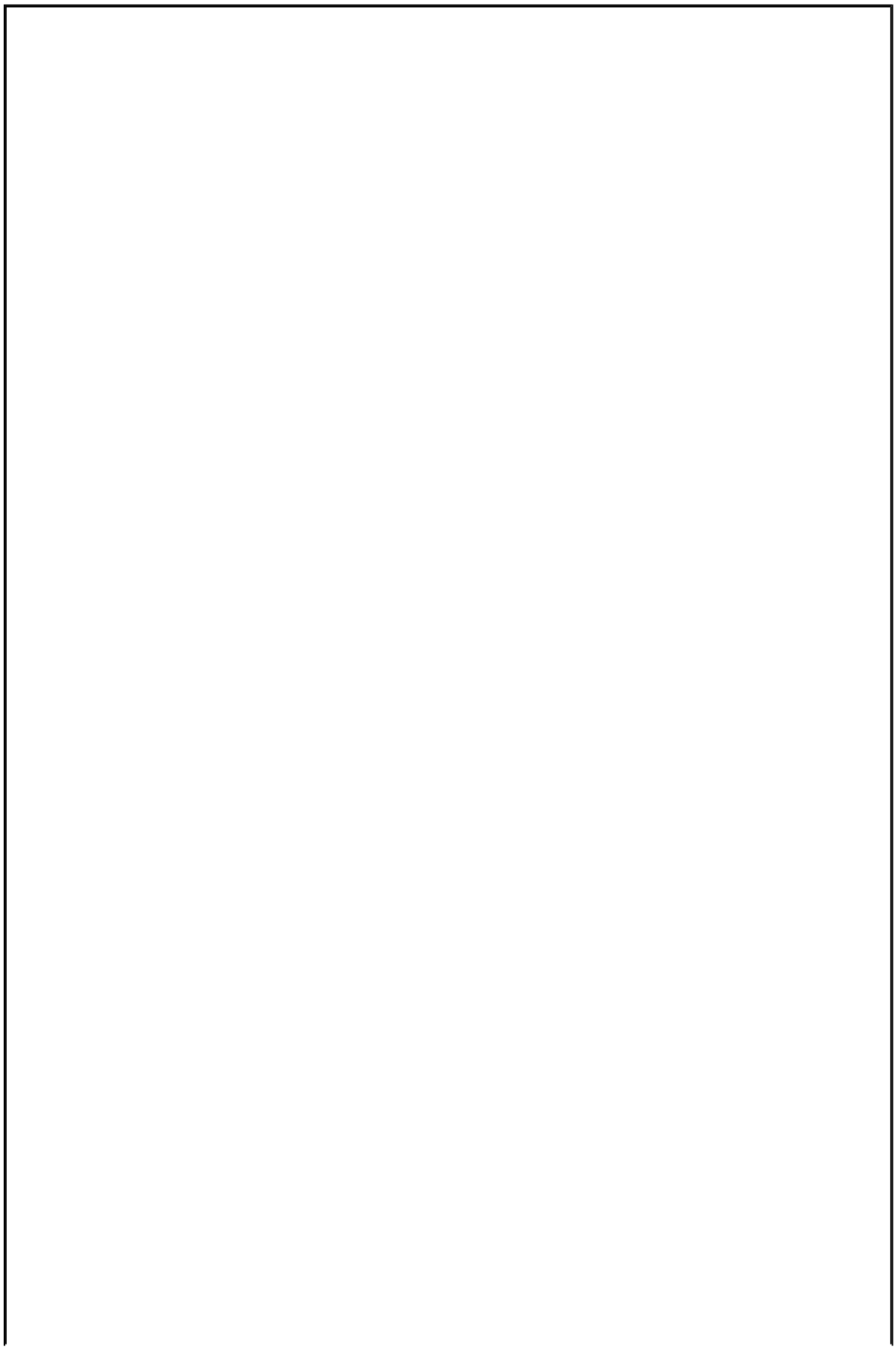
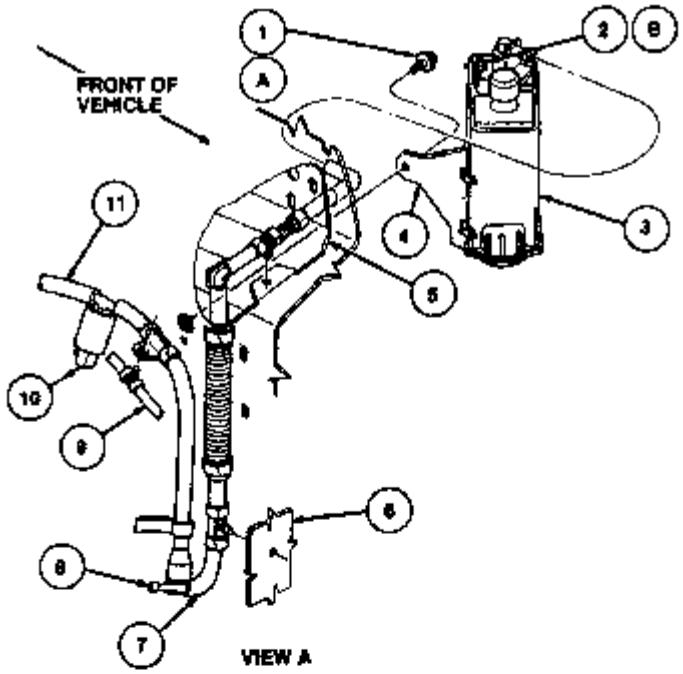
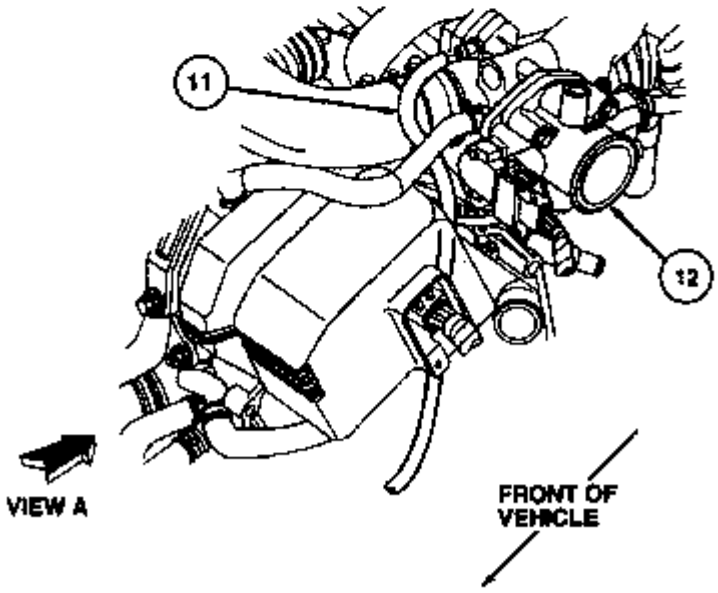




Item	Part Number	Description
1	N606689-S2	Screw and Washer Assy
2	N610969-S2	Bolt
3	9D653	Evaporative Emissions Canister
4	9D665	Evaporative Emission Canister Bracket
5	—	LH Headlamp Opening (Part of 16138)
6	16138	Radiator Support
7	9K313	Evaporative Emission Tube



Item	Part Number	Description
8	9A228	Fuel Tank Vent Tube (Part of

EEC system for the 3.2L SHO engine

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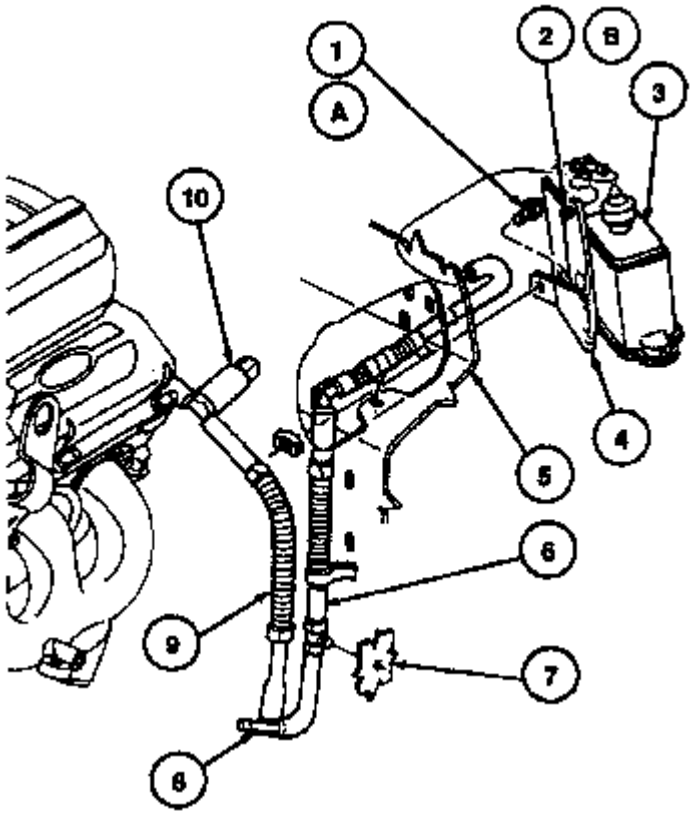

Item	Part Number	Description
1	N606688-S2	Bolt
2	N610959-S2	Bolt
3	9D653	Evaporative Emissions Canister
4	9D665	Evaporative Emission Canister Bracket
5	—	LH Headlamp Opening (Part of 16138)
6	9K313	Evaporative Emission Tube
7	16138	Radiator Support
8	9A228	Fuel Tank Vent Tube
9	9C967	Evaporative Emission Hose
10	9C915	Evaporative Emission Canister Purge Solenoid
A	—	Tighten to 21.2-28.8 N·m (15-21 Lb-Ft)
B	—	Tighten to 5.2-7.2 N·m (46-63 Lb-In)

EEC system for the 3.8L engine

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Purge Valves

1. **Disconnect the negative battery cable.**
2. **Disconnect the vacuum hose or the electrical connector from the purge valve.**
3. **Disconnect the vapor hoses and remove the purge valve from the vehicle.**
4. **Installation is the reverse of the removal procedure.**

Vapor Valve

1. **Disconnect the negative battery cable.**
2. **Raise and safely support the vehicle. Remove the fuel tank to gain access to the vapor valve.**
3. **Disconnect the vapor hoses from the vapor valve.**
4. **Remove the vapor valve mounting screws and the vapor valve from the underside of the vehicle, or remove the vapor valve from the fuel tank, as necessary.**
5. **Installation is the reverse of the removal procedure.**

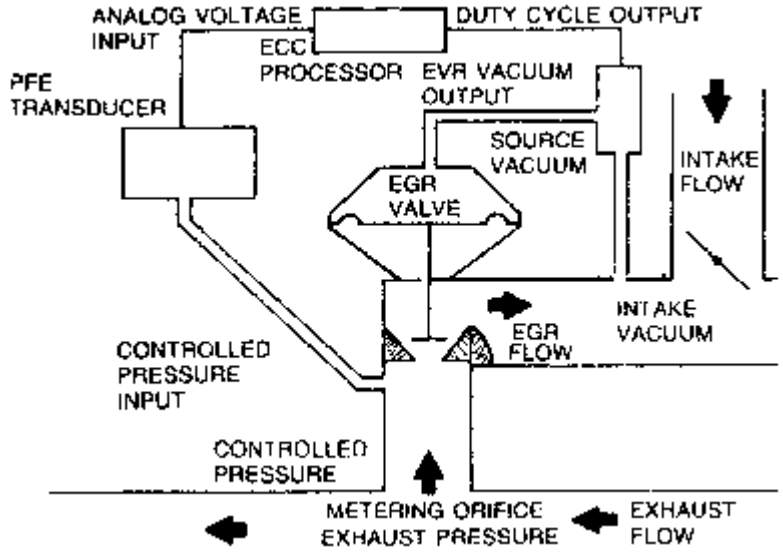
Exhaust Gas Recirculation System

OPERATION

The Exhaust Gas Recirculation (EGR) system is designed to reintroduce exhaust gas into the combustion cycle, thereby lowering combustion temperatures and reducing the formation of nitrous oxide. This is accomplished by the use of an EGR valve which opens under specific engine operating conditions, to admit a small amount of exhaust gas into the intake manifold, below the throttle plate. The exhaust gas mixes with the incoming air charge and displaces a portion of the oxygen in the air/fuel mixture entering the combustion chamber. The exhaust gas does not support combustion of the air/fuel mixture but it takes up volume, the net effect of which is to lower the temperature of the combustion chamber. There are a few different EGR systems used on front wheel drive vehicles.

The most commonly used system is the Pressure Feedback Electronic (PFE) system. The PFE is a subsonic closed loop EGR system that controls EGR flow rate by monitoring the pressure drop across a remotely located sharp-edged orifice. The system uses a pressure transducer as the feedback device and controlled pressure is varied by valve modulation using vacuum output of the EGR Vacuum Regulator (EVR) solenoid. With the PFE system, the EGR valve only serves as a pressure regulator rather than a flow metering device.

The Differential Pressure Feedback Electronic (DPFE) EGR system operates in the same manner except it directly monitors the pressure drop across the metering orifice. This allows for a more accurate assessment of EGR flow requirements.



Pressure Feedback Electronic (PFE) EGR system schematic

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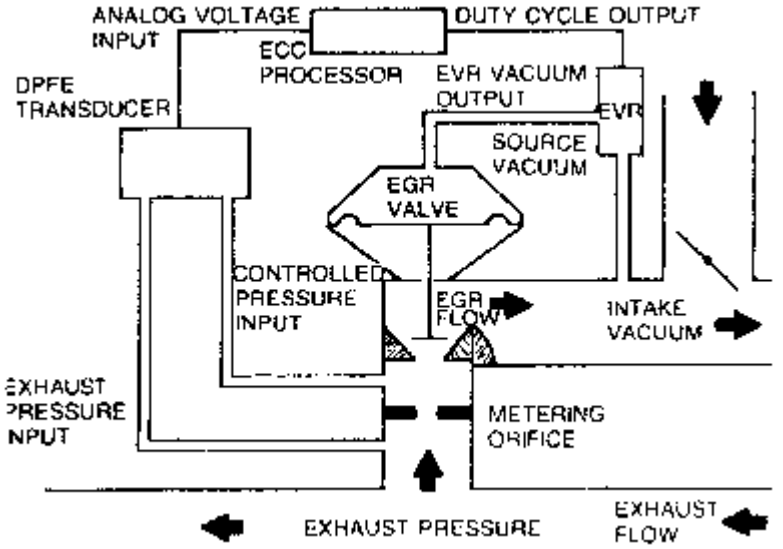

Differential Pressure Feedback Electronic (DPFE) EGR system schematic

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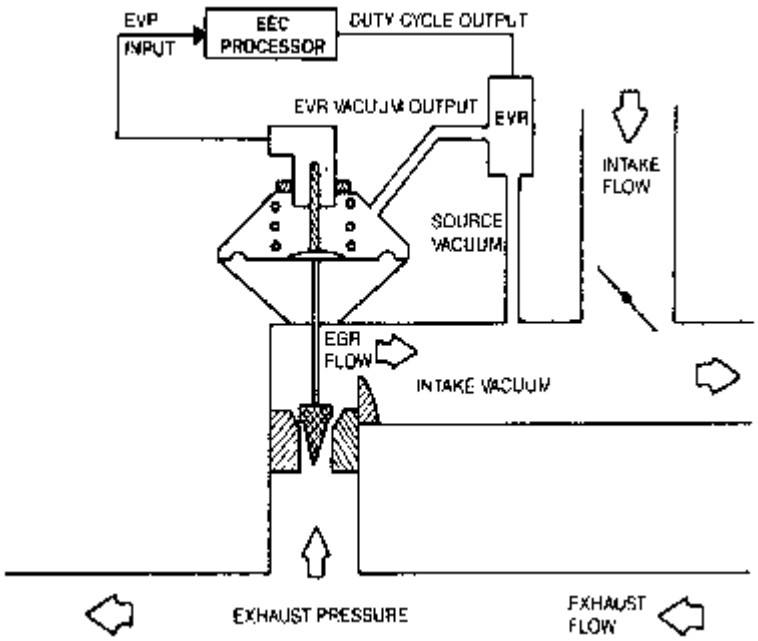
The Electronic EGR (EEGR) valve system is used on some vehicles equipped with the 2.5L engine. An electronic EGR valve is required in EEC systems where EGR flow is controlled according to computer demands by means of an EGR Valve Position (EVP) sensor attached to the valve. The valve is operated by a vacuum signal from the electronic vacuum regulator which actuates the valve diaphragm. As supply vacuum overcomes the spring load, the diaphragm is actuated. This lifts the pintle off of its seat allowing exhaust gas to recirculate. The amount of flow is proportional to the pintle position. The EVP sensor mounted on the valve sends an electrical signal of its position to the ECU.



Electronic EGR (EEGR) system schematic

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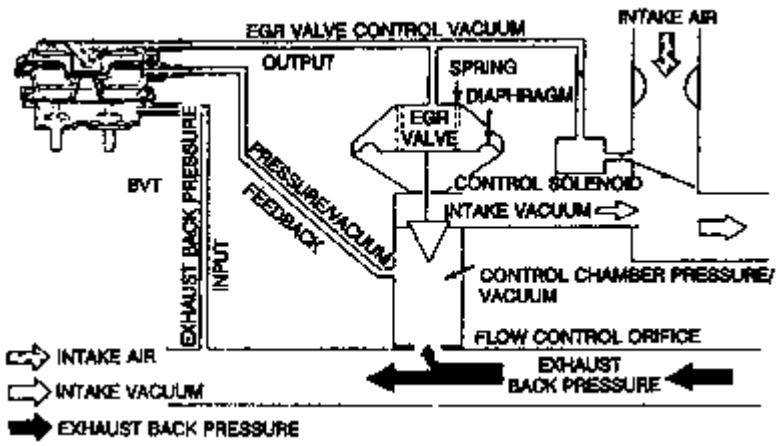
The ported EGR valve is the most common form of EGR valve. It is operated by a vacuum signal which actuates the valve diaphragm. As the vacuum increases sufficiently to overcome the power spring, the valve is opened allowing EGR flow. The vacuum to the EGR valve is controlled using devices such as the EVR or the BVT, depending on system application.

The Electronic EGR (EEGR) valve is similar to the ported EGR valve. It is also vacuum operated, lifting the pintle off of its seat to allow exhaust gas to recirculate when the vacuum signal is strong enough. The difference lies in the EVP sensor, which is mounted on top of the electronic EGR valve. The electronic EGR valve assembly is not serviceable. The EVP sensor and the EGR valve must be serviced separately.

The Pressure Feedback Electronic (PFE) EGR Transducer converts a varying exhaust pressure signal into a proportional analog voltage which is digitized by the ECU. The ECU uses the signal received from the PFE transducer to complete the optimum EGR flow.

The EGR Valve Position (EVP) sensor provides the ECU with a signal indicating the position of the EGR valve. The Back pressure Variable Transducer (BVT) controls the vacuum input to the EGR valve based on the engine operating condition.



Back pressure Variable Transduced (BVT) EGR system schematic

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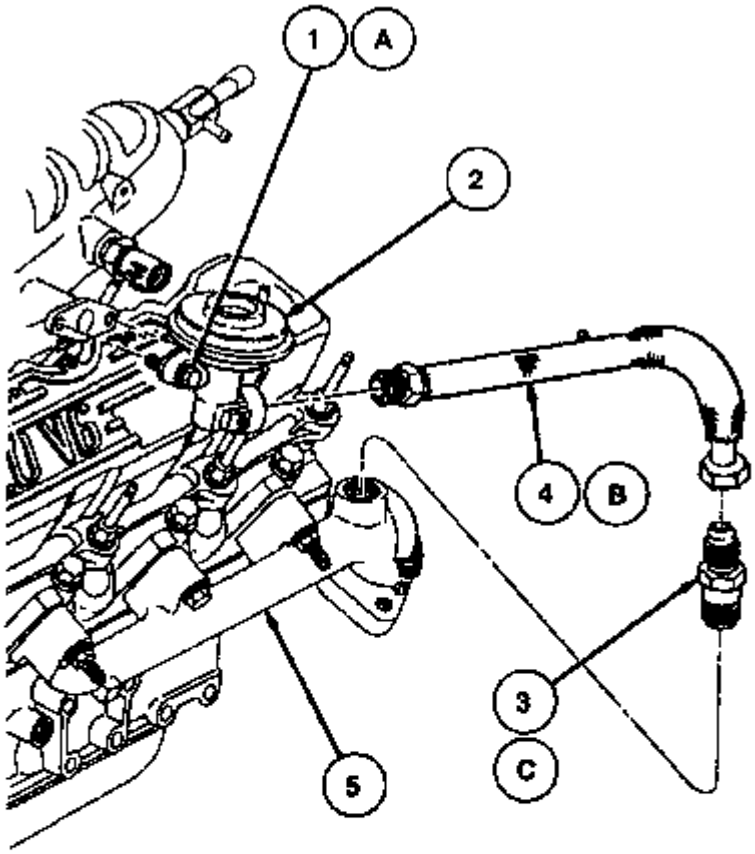
The EGR Vacuum Regulator (EVR) is an electromagnetic device which controls vacuum output to the EGR valve. The EVR replaces the EGR solenoid vacuum vent valve assembly. An electric current in the coil induces a magnetic field in the armature. The magnetic field pulls the disk back, closing the vent and increasing the vacuum level. The vacuum source is either manifold or vacuum. As the duty cycle is increased, an increased vacuum signal goes to the EGR valve.



Item	Part Number	Description
1A	N804073-S8	Bolt (2 Req'd)
2	9D475	EGR Valve
3C	9F485	EGR Valve Tube to Manifold Connector
4B	9D477	EGR Valve to Exhaust Manifold Tube
5	9430	Exhaust Manifold
A		Tighten to 20-30 N·m (15-22 Lb-Ft)
B		Tighten to 35-45 N·m (26-33 Lb-Ft)
C		Tighten to 45-65 N·m (33-48 Lb-Ft)

EGR system and related components for the 3.0L engine (except SHO)

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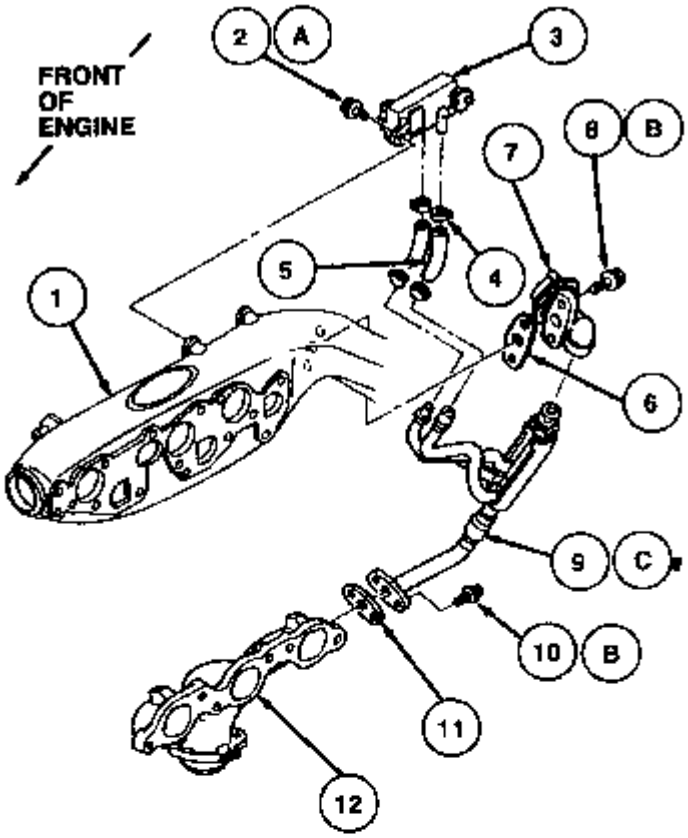
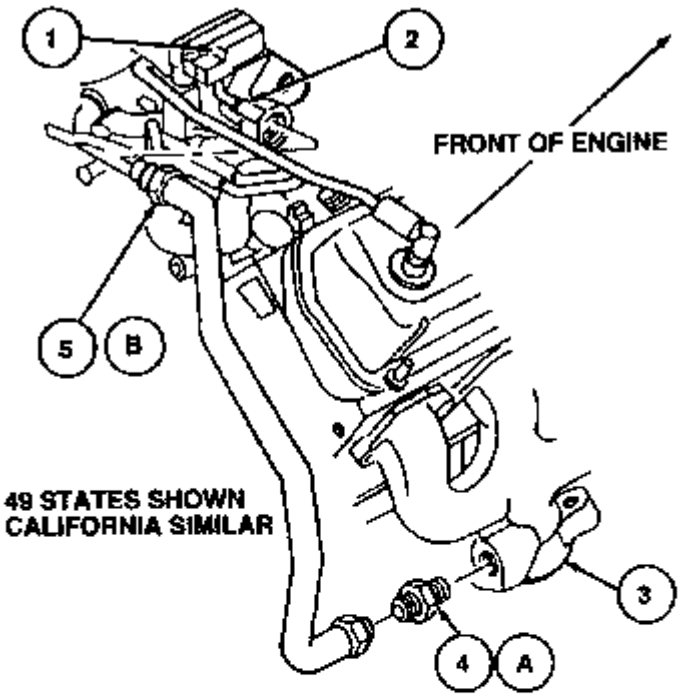


Item	Part Number	Description
1	9424	Intake Manifold
2A	90105-06531	Bolt (2 Req'd)
3	9J460	EGR Pressure Valve Sensor
4	—	Clamp (4 Req'd) (Part of 9P761)
5	9P761	EGR Pressure Valve Sensor Hose (2 Req'd)
6	9D476	EGR Valve Gasket
7	9D475	EGR Valve
8B	90119-08151	Bolt (2 Req'd)
9C	9D477	EGR Valve to Exhaust Manifold Tube
10B	90119-08146	Bolt (2 Req'd)
11	9F470	EGR Valve Tube Inlet Gasket
12	9430	Exhaust Manifold
A		Tighten to 2-3 N-m (18-27 Lb-In)
B		Tighten to 15-23 N-m (11-17 Lb-Ft)
C		Tighten to 45-65 N-m (33-48 Lb-Ft)

Exploded view of the EGR valve and related components-3.0L and 3.2L SHO engines

Click to enlarge



Item	Part Number	Description
1	9J460	EGR Pressure Valve Sensor
2	9D475	EGR Valve
3	9430	Exhaust Manifold
4A	9F485	EGR Valve Tube to Manifold Connector
5B	9D477	EGR Valve to Exhaust Manifold Tube
A		Tighten to 45-65 N·m (33-48 Lb-Ft)
B		Tighten to 35-45 N·m (26-33 Lb-Ft)

View of the EGR system components-late model 3.8L engine shown

Click to enlarge

TESTING

Back pressure Variable Transducer (BVT)

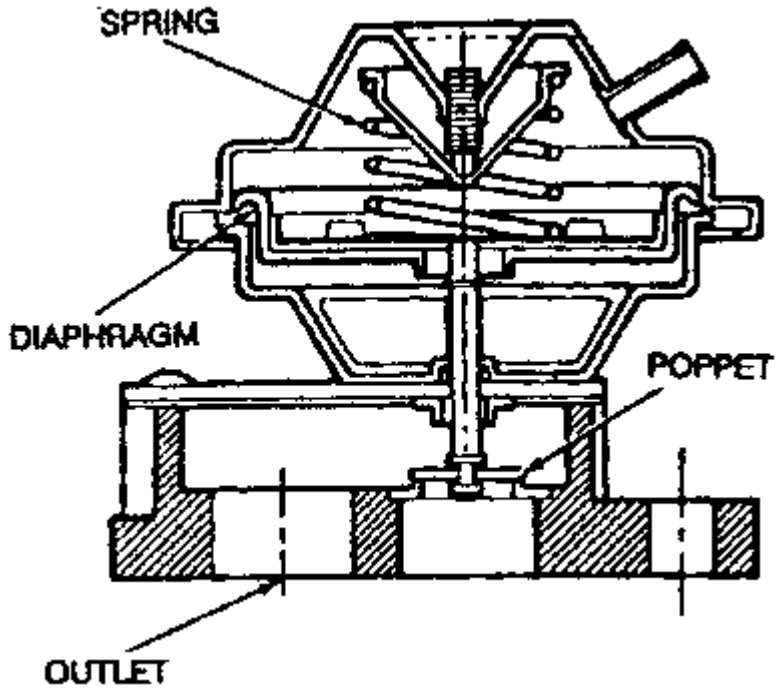
1. Make sure all vacuum hoses are correctly routed and securely attached. Replace cracked, crimped or broken hoses.
2. Make sure there is no vacuum to the EGR valve at idle with the engine at normal operating temperature.
3. Connect a suitable tachometer.
4. Detach the idle air bypass valve electrical connector.
5. Remove the vacuum supply hose from the EGR valve nipple and plug the hose.
6. Start the engine and let it idle with the transaxle selector lever in Neutral. Check the engine idle speed and adjust to the proper specification, if necessary.

7. **Slowly apply 5-10 in. Hg (17-34 kPa) of vacuum to the EGR valve vacuum nipple using a suitable hand vacuum pump.**
8. **When vacuum is fully applied to the EGR valve, check for the following:**
    1. **If idle speed drops more than 100 rpm or if the engine stalls, perform the next step. Otherwise, check for a vacuum leak at the EGR valve, and, if a leak is found, replace the valve.**
    2. **If the EGR passages are blocked, clean the EGR valve using a suitable cleaner.**
    3. **Remove the vacuum from the EGR valve. If the idle speed does not return to normal specifications (or within 25 rpm), check for contamination; clean the valve.**
    4. **If the symptom still exists, replace the EGR valve.**
9. **Attach the idle air bypass valve electrical connector.**
10. **Unplug and reconnect the EGR vacuum supply hose.**
11. **Disconnect the vacuum connection at the BVT.**
12. **Gently blow into the hose to port C until the relief valve closes and at the same time apply 5-10 in. Hg (17-34 kPa) of vacuum to port E with the hand vacuum pump. Port E should hold vacuum as long as there is pressure on port C.**
13. **Apply a minimum of 5-10 in. Hg (17-34 kPa) of vacuum to ports B and C using the hand vacuum pump. Ports B and C should hold vacuum.**
14. **Replace the BVT if any of the ports do not hold vacuum.**
15. **Reconnect the vacuum at the BVT.**
16. **If neither the EGR valve nor the BVT were replaced, the system is okay.**

REMOVAL & INSTALLATION

Ported EGR Valve

1. **Disconnect the negative battery cable.**
2. **Detach the vacuum line(s) and/or electrical connector(s) from the EGR valve.**
3. **Unfasten the mounting bolts, then remove the EGR valve. Remove all old gasket material.**

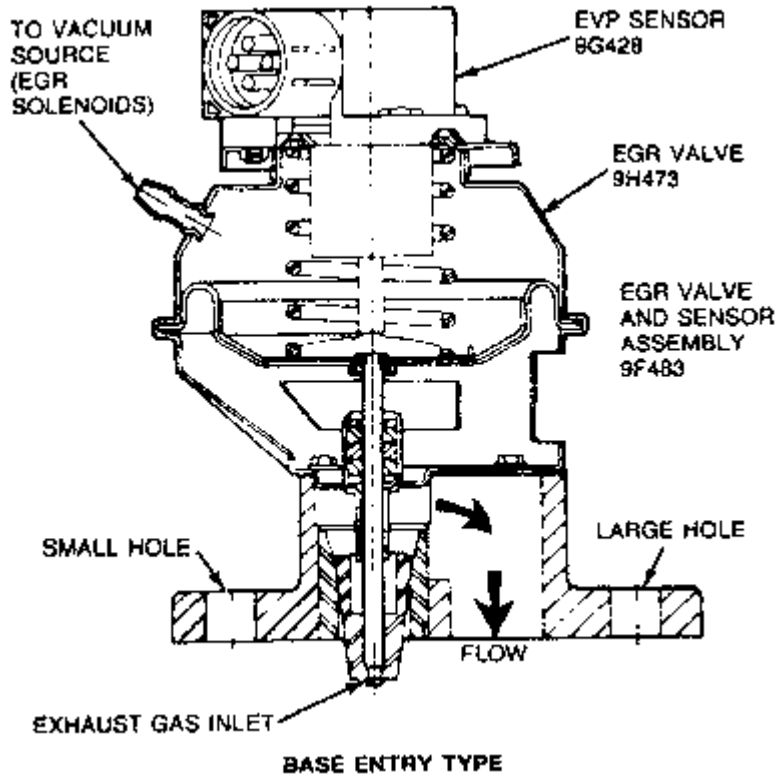


Cross-sectional view of a ported EGR valve assembly

To install:

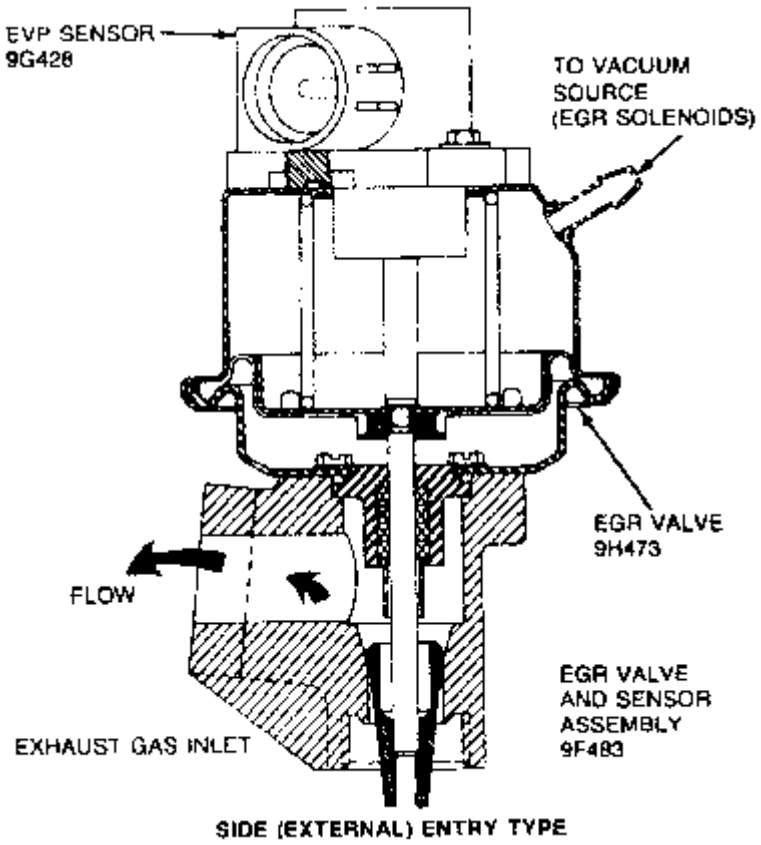
4. **Using a new gasket, install the EGR valve, then secure using the retaining bolts.**
5. **Attach any vacuum lines or electrical connectors disengaged during removal.**
6. **Connect the negative battery cable.**

Electronic EGR (EEGR) Valve



Cross-sectional view of a base entry-type electronic EGR valve

Click to enlarge



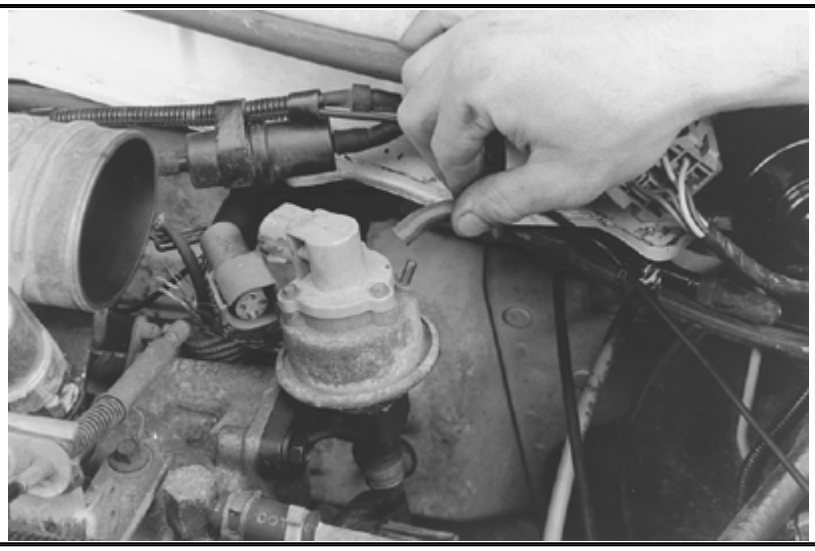
Cross-sectional view of a side (external) entry-type electronic EGR valve

Click to enlarge

1. **Disconnect the negative battery cable.**
2. **Disengage the the electrical connector from the EVP sensor.**

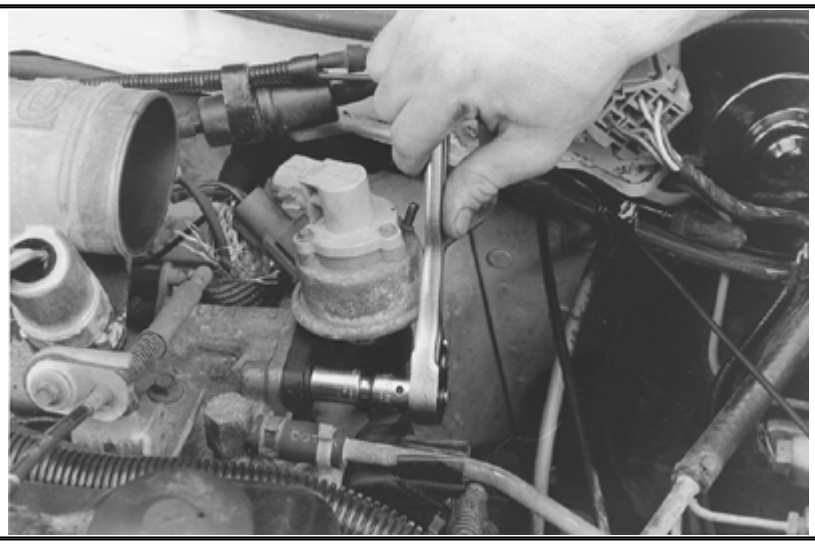
Disengage the electrical connector from the EVP sensor-early model 2.5L engine

3. **Disconnect the vacuum line from the EGR valve.**

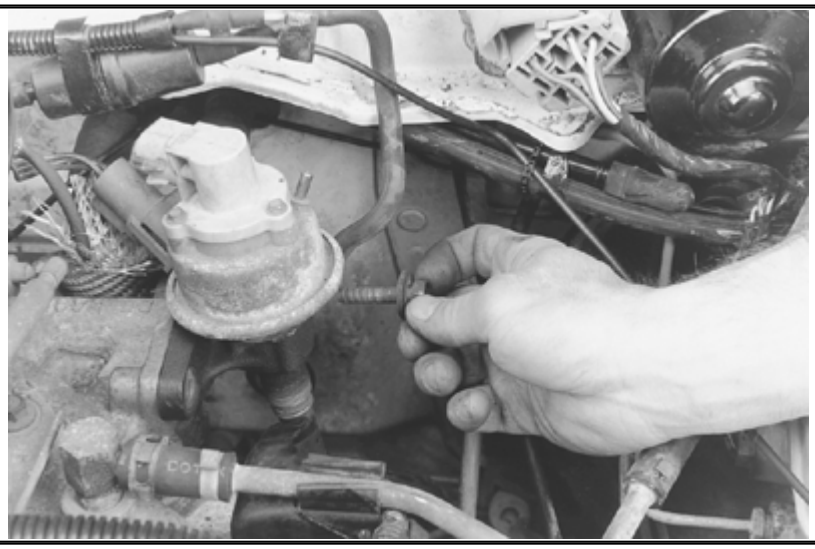


Disconnect the vacuum line from the EGR valve

4. **Remove the mounting bolts and remove the EGR valve.**

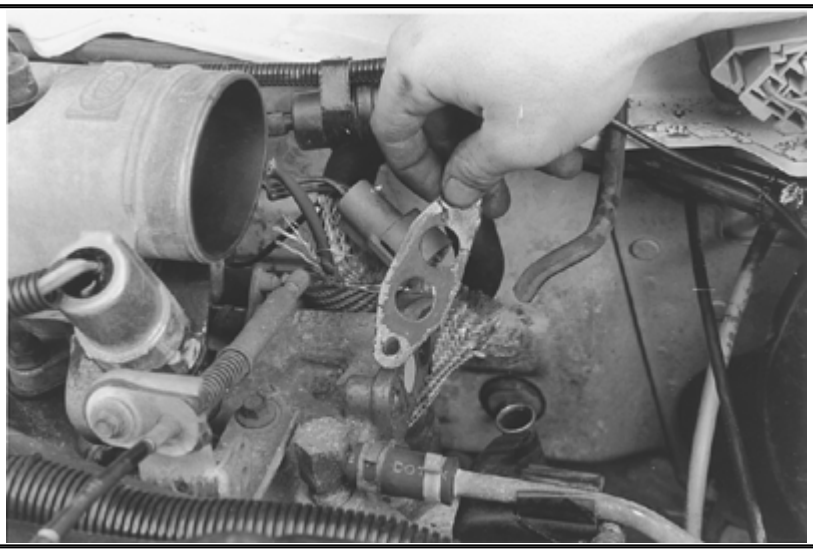


Disconnect the mounting bolts from the EGR valve



Remove the mounting bolts from the EGR valve

Remove the EGR valve from the vehicle-early model engine shown



When installing the EGR valve, be sure to remove the old gasket and install a new one

5. **Remove the EVP sensor from the EGR valve.**
6. **Remove all old gasket material from the mating surfaces.**

To install:

7. **Install the EVP sensor to the EGR valve.**
8. **Using a new gasket, install the EGR valve in the vehicle, then secure using the retaining bolts.**
9. **Connect the vacuum line to the EGR valve, then engage the electrical connector.**
10. **Connect the negative battery cable.**

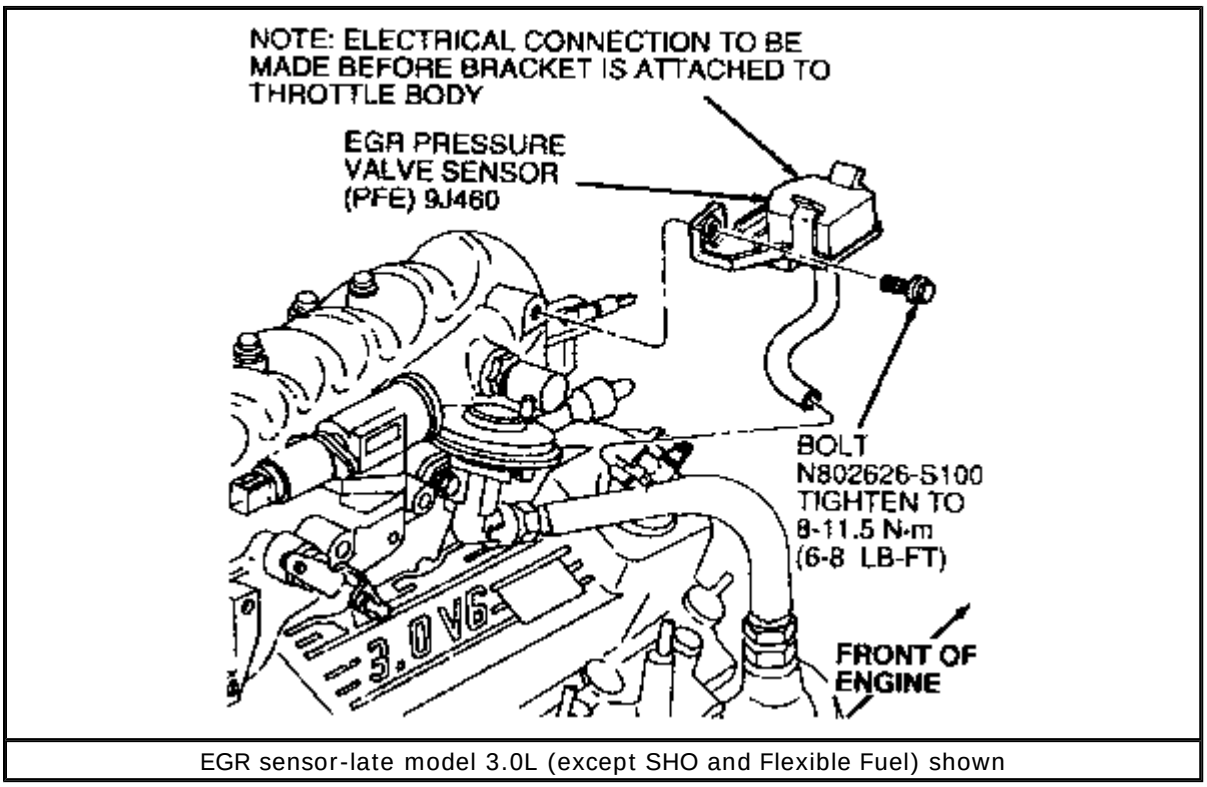
Pressure Feedback Electronic (PFE) EGR Transducer

1. **Disconnect the negative battery cable.**
2. **Separate the electrical connector and the exhaust pressure line from the transducer.**
3. **Remove the transducer from the vehicle.**

To install:

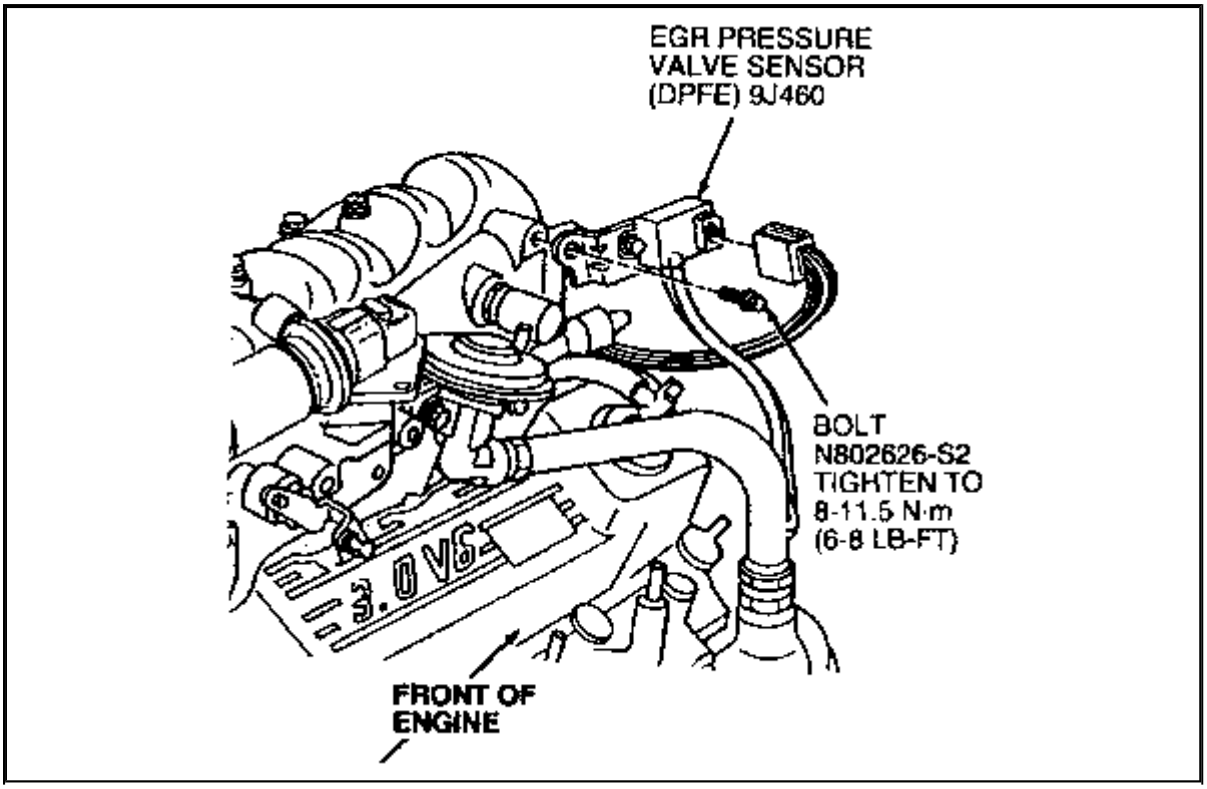
4. **Install the transducer, then engage the electrical connector and connect the exhaust pressure line to the transducer.**
5. **Connect the negative battery cable.**

EGR Valve Position (EVP) Sensor



EGR sensor-late model 3.0L (except SHO and Flexible Fuel) shown

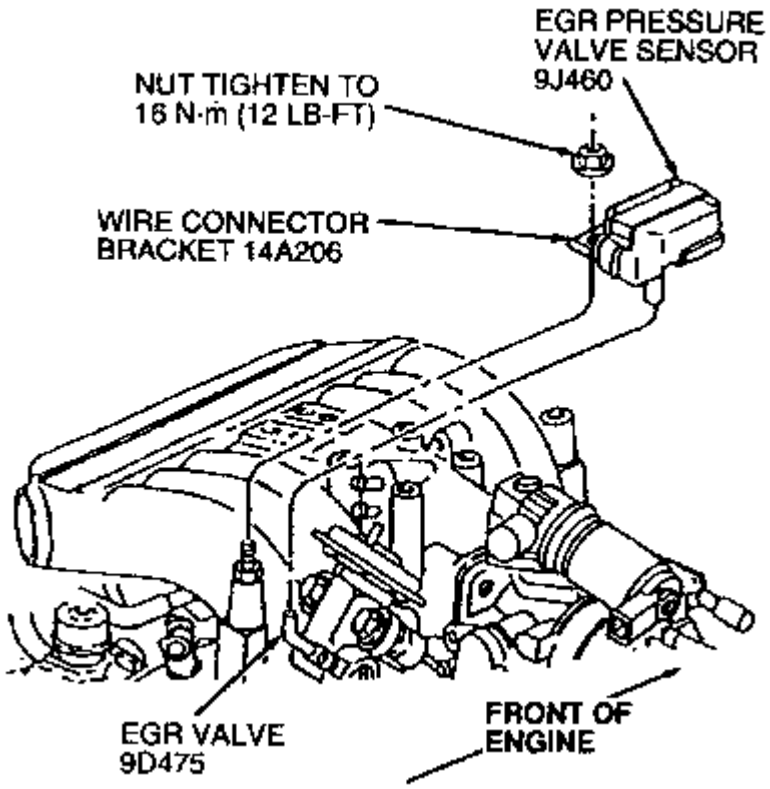
Click to enlarge



EGR sensor location-3.0L Flexible Fuel engines

Click to enlarge

1. **Disconnect the negative battery cable.**
2. **Disengage the electrical connector from the sensor.**



EGR sensor-late model 3.8L shown

Click to enlarge

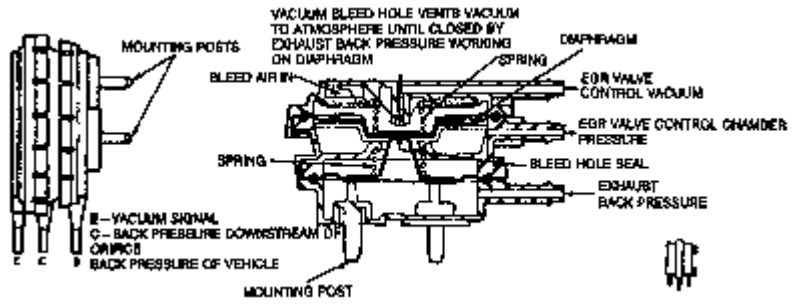
3. **Disconnect the sensor mounting nuts, then remove the sensor from the EGR valve.**

To install:

4. **Install the sensor on the EGR valve, then secure using the mounting nuts.**
5. **Engage the electrical connector to the sensor, then connect the negative battery cable.**

Back pressure Variable Transducer (BVT)

1. **Disconnect the negative battery cable.**
2. **Disconnect the vacuum lines from the BVT.**



Cross-sectional view of a Back Pressure Variable Transducer (BVT)

Click to enlarge

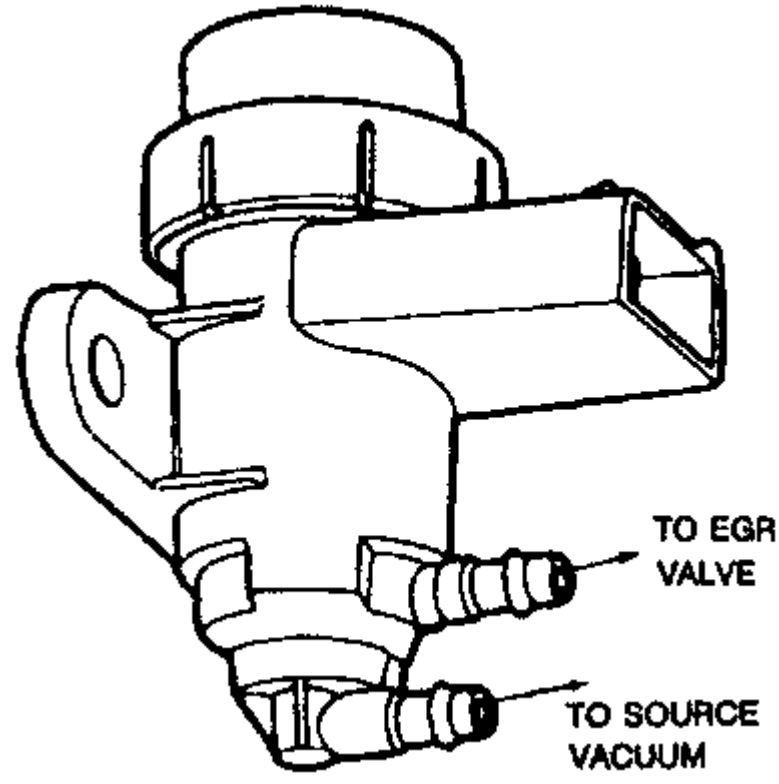
3. **Remove the BVT from its mounting position, then remove it from the vehicle.**

To install:

4. **Install the BVT in its mounting position.**
5. **Connect the vacuum lines to the BVT, then connect the negative battery cable.**

EGR Vacuum Regulator (EVR)

1. **Disconnect the negative battery cable.**
2. **Disengage the electrical connector and the vacuum lines from the regulator.**



EGR vacuum regulator assembly

3. **Remove the regulator mounting bolts, then remove the regulator from the vehicle.**

To install:

4. **Install the regulator in the vehicle, then secure using the retaining bolts.**
5. **Connect the vacuum lines, then engage the electrical connector to the regulator.**
6. **Connect the negative battery cable.**

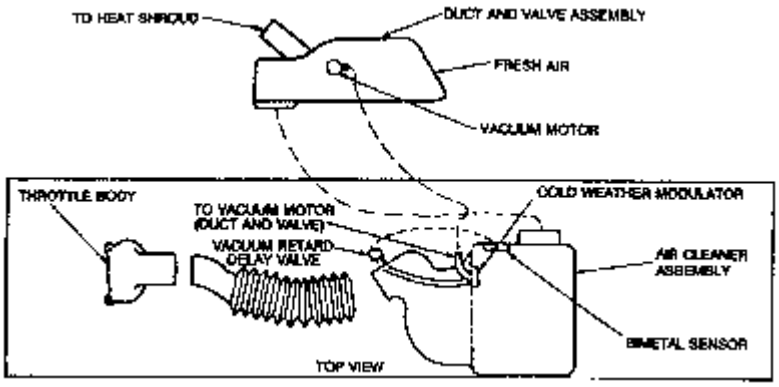
Exhaust Emission Control System

The exhaust emission control system begins at the air intake and ends at the tailpipe. Most vehicles are equipped with a thermostatic air inlet system, exhaust catalyst, and either a thermactor air injection system or pulse air injection system.

Thermostatic Air Inlet System

OPERATION

Most of the engines covered by this manual utilize the themostatic air inlet system. The thermostatic air inlet system regulates the air inlet temperature by drawing in air from a cool air source, as well as heated air from a heat shroud which is mounted on the exhaust manifold. The system consists of the following components: duct and valve assembly, heat shroud, bimetal sensor, cold weather modulator, vacuum delay valve and the necessary vacuum lines and air ducts. All vehicles do not share all components.

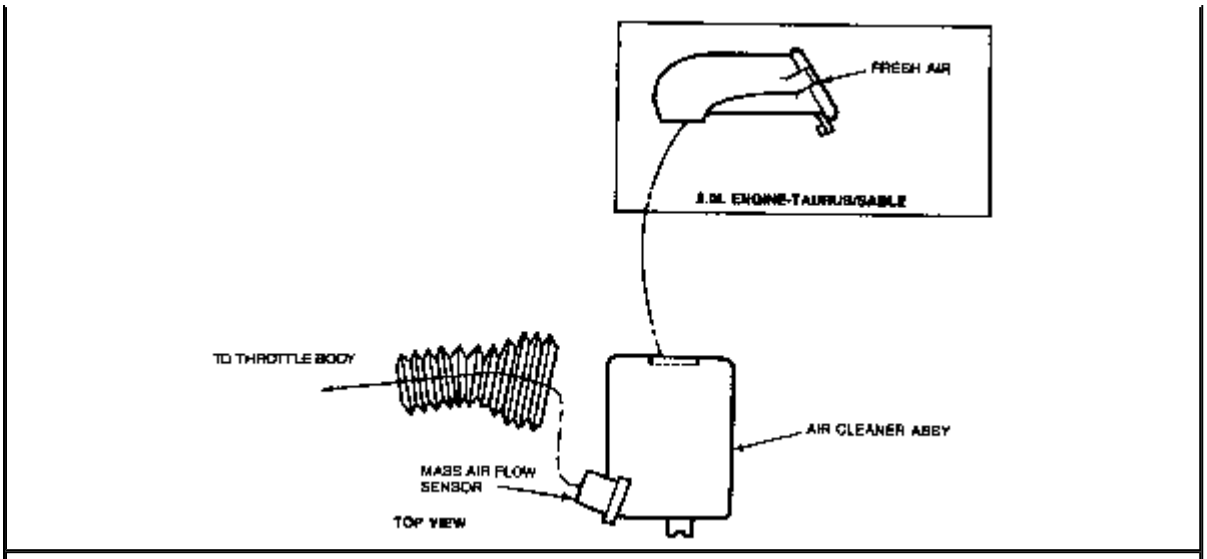


Thermostatic Air Inlet System-2.5L engine

Click to enlarge

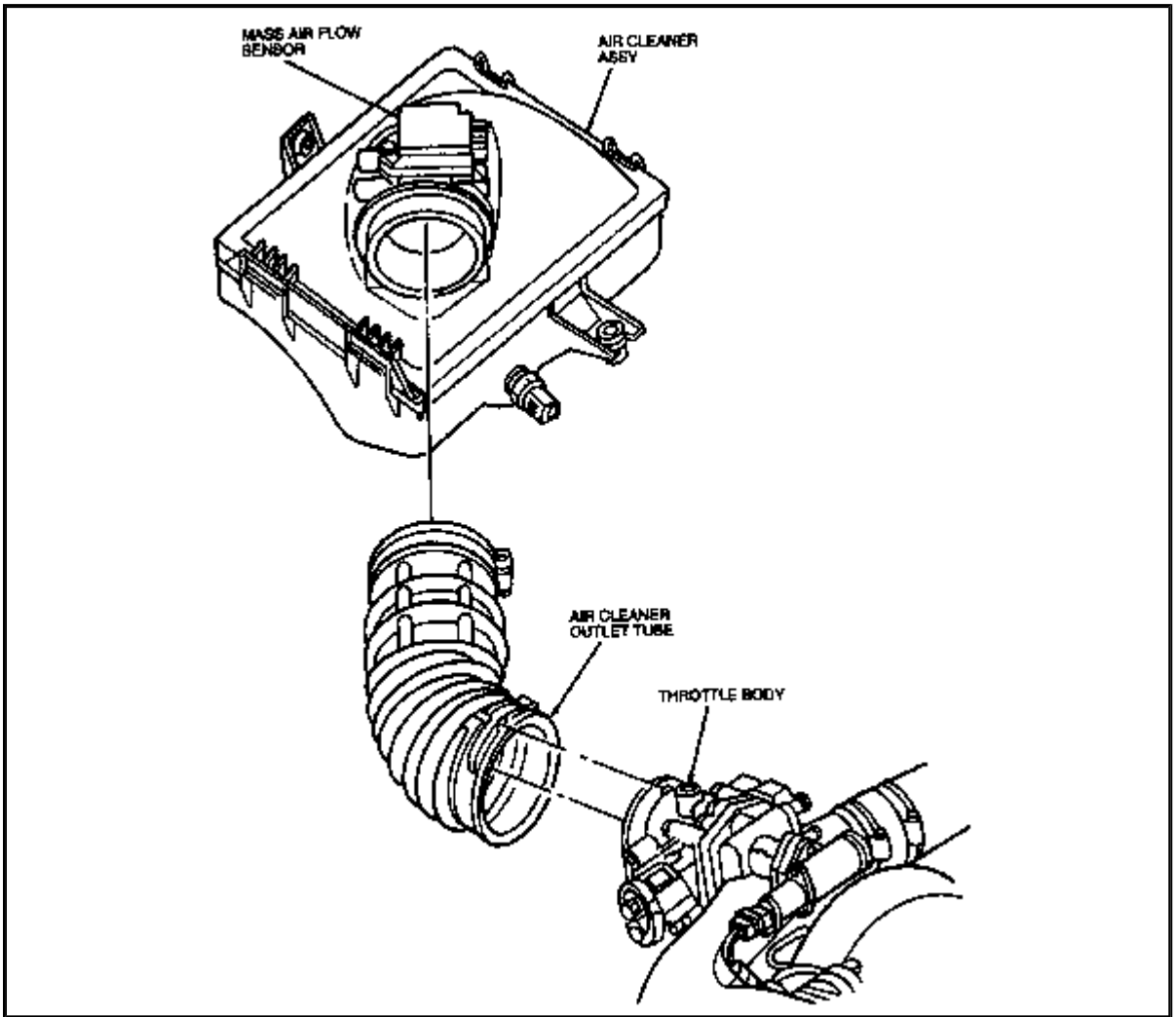
Duct and Valve Assembly

The duct and valve assembly which regulates the air flow from the cool and heated air sources is located either inside the air cleaner or mounted on the air cleaner. The flow is regulated by means of a door that is operated by a vacuum motor. The operation of the motor is controlled by delay valves, temperature sensors and other vacuum control systems. All vary with each application and engine calibration.



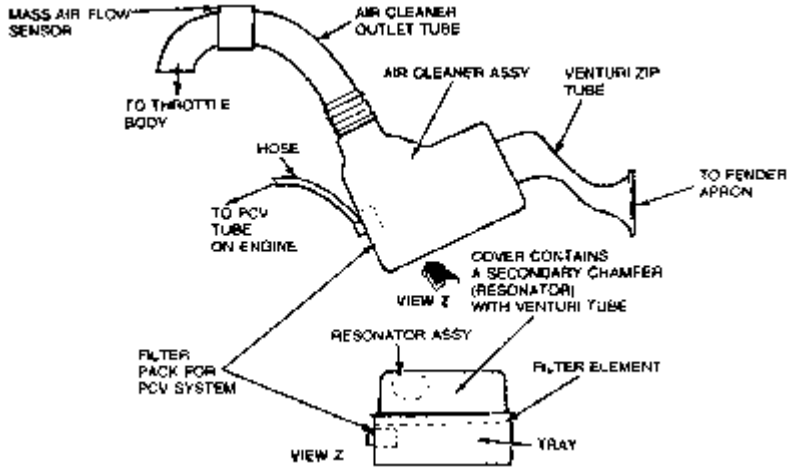
Duct assembly-3.0L engine (except SHO)

Click to enlarge



Duct assembly-3.0L/3.2L SHO engines

Click to enlarge



Duct assembly-3.8L engine

Click to enlarge

Bimetal Sensor

The core of the bimetal sensor is made of two different types of metals bonded together, each having different temperature expansion rates. At a given increase in temperature, the shape of the sensor core changes, bleeding off vacuum available at the vacuum motor. This permits the vacuum motor to open the duct door to allow fresh air in while shutting off full heat. The bimetal sensor is calibrated according to the needs of each particular application.

Cold Weather Modulator

The cold weather modulator is used in addition to the bimetal sensor to control the inlet air temperature. The modulator traps vacuum in the system, so the door will not switch to cold air when the vacuum drops during acceleration. The cold weather modulator only works when the outside air is cold.

Vacuum Delay Valve

The vacuum delay valve is used for the gradual release of vacuum to the vacuum motor.

TESTING

Duct and Valve Assembly

1. **If the duct door is in the closed to fresh air position, remove the hose from the air cleaner vacuum motor.**
2. **The door should go to the open to fresh air position. If it sticks or binds, service or replace, as required.**
3. **If the door is in the open to fresh air position, check the door by applying 8 in. Hg (27 kPa) or greater of vacuum to the vacuum motor.**
4. **The door should move freely to the closed to fresh air position. If it binds or sticks, service or replace, as required.**

Make sure the vacuum motor is functional before changing the duct and valve assembly.

Bimetal Sensor

1. **Bring the temperature of the bimetal sensor below 75°F (24°C) and apply 16 in. Hg (54 kPa) of vacuum with a vacuum pump at the vacuum source port of the sensor.**
2. **The duct door should stay closed. If not, replace the bimetal sensor.**
3. **The sensor will bleed off vacuum to allow the duct door to open and let in fresh air at or above the following temperatures:**
    1. **Brown: 75°F (24°C)**
    2. **Pink, black or red: 90°F (32.2°C)**
    3. **Blue, yellow or green: 105°F (40.6°C) Do not cool the bimetal sensor while the engine is running.**

Cold Weather Modulator

A 16 in. Hg (54 kPa) vacuum applied to the motor side of the modulator holds or leaks as follows:

- **Black: holds below 20°F (-6.7°C) and leaks above 35°F (1.7°C)**
- **Blue: holds below 40°F (4.4°C) and leaks above 55°F (12.8°C)**
- **Green: holds below 50°F (10°C) and leaks above 76°F (24.4°C)**
- **Yellow: holds above 65°F (18.3°C) and leaks below 50°F (10°C)**

Vacuum Delay Valve

1. **Connect a hand vacuum pump to the vacuum delay valve.**
2. **Valves with 1 side black or white and the other side colored are good if vacuum can be built up in 1 direction but not the other direction and if that built up vacuum can be seen to slowly decrease.**
3. **Valves with both sides the same color are good if vacuum can be built up in both directions before visibly decreasing.**

Be careful in order to prevent oil or dirt from getting into the valve.

REMOVAL & INSTALLATION

Duct and Valve Assembly

1. **Disconnect the negative battery cable.**
2. **Disconnect the vacuum hose from the vacuum motor.**
3. **Separate the vacuum motor from the vacuum operated door and remove the vacuum motor.**

To install:

4. **Install the motor to the vacuum operated door.**
5. **Connect the vacuum hose to the vacuum motor.**
6. **Connect the negative battery cable.**

Bimetal Sensor

1. **Disconnect the negative battery cable.**
2. **Remove the air cleaner housing lid to gain access to the sensor.**
3. **Disconnect the vacuum hoses from the sensor. It may be necessary to move the air cleaner housing to accomplish this.**
4. **Remove the sensor from the air cleaner housing.**

To install:

5. **Install the sensor in the air cleaner housing.**
6. **Connect the vacuum hoses to the sensor, then install the air cleaner housing lid.**
7. **Connect the negative battery cable.**

Cold Weather Modulator

1. **Disconnect the negative battery cable.**
2. **Remove the air cleaner housing lid to gain access to the modulator.**
3. **Disconnect the vacuum hoses from the modulator. It may be necessary to move the air cleaner housing to accomplish this.**
4. **Remove the modulator from the air cleaner housing.**

To install:

5. **Install the modulator in the air cleaner housing.**
6. **Connect the vacuum hoses to the modulator, then install the air cleaner housing lid.**
7. **Connect the negative battery cable.**

Vacuum Delay Valve

1. **Disconnect the negative battery cable.**
2. **Disconnect the vacuum hoses from the delay valve.**
3. **Remove the valve from the vehicle.**

To install:

4. **Install the valve in the vehicle, then connect the vacuum hoses.**
5. **Connect the negative battery cable.**

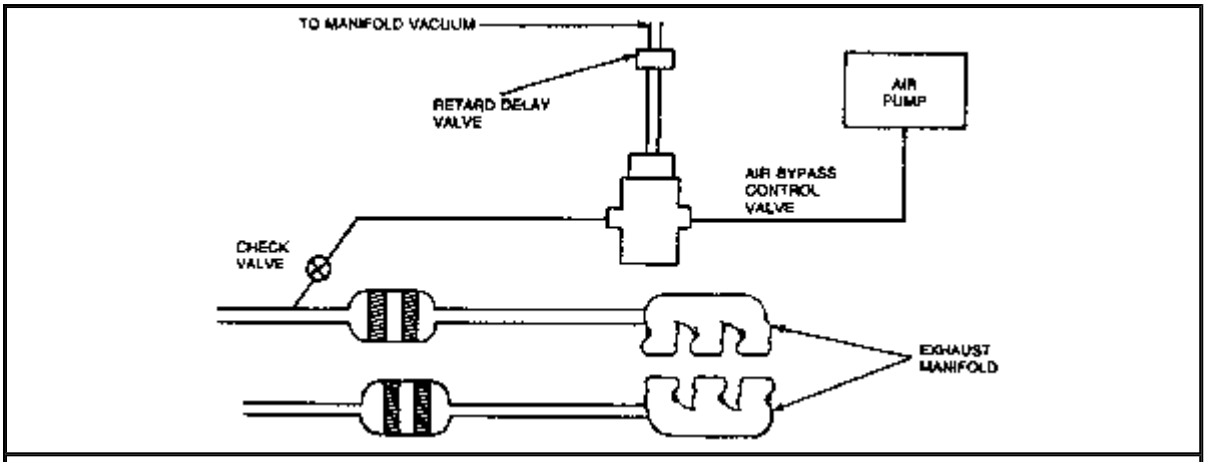
Thermactor Air Injection System

OPERATION

A conventional thermactor air injection system is used on some vehicles equipped with the 3.8L engine. The system reduces hydrocarbon and carbon monoxide content of the exhaust gases by continuing the combustion of unburned gases after they leave the combustion chamber. This is done by injecting fresh air into the hot exhaust stream leaving the exhaust ports, or into the catalyst. At this point, the fresh air mixes with hot exhaust gases to promote further oxidation of both the hydrocarbons and carbon monoxide, thereby reducing their

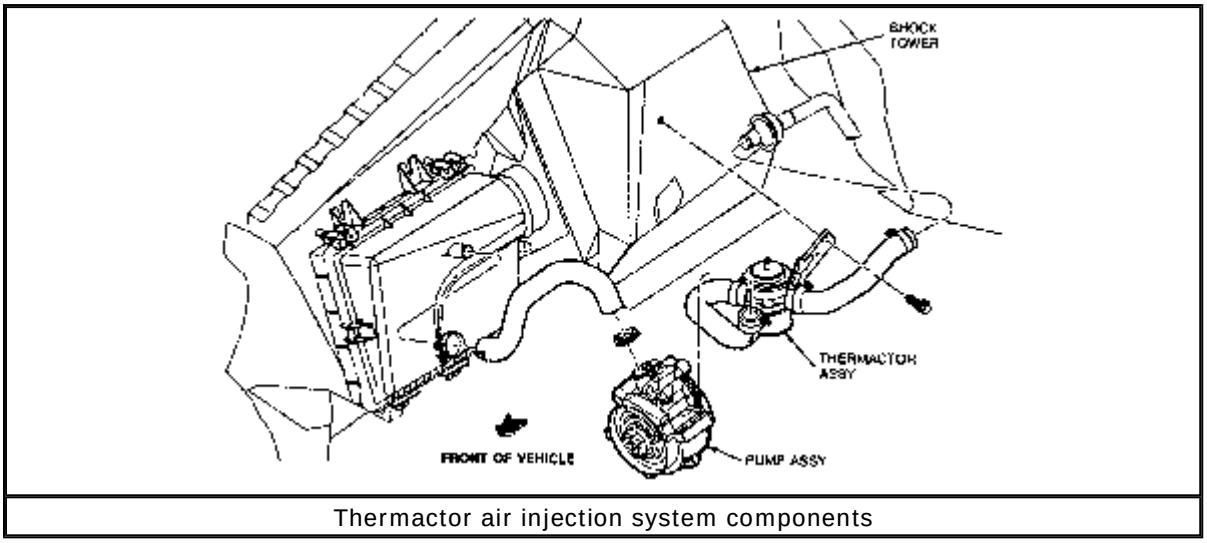
concentration, and converting some of them into harmless carbon dioxide and water. During highway cruising and WOT operation, the thermactor air is dumped to atmosphere to prevent overheating in the exhaust system.

A typical air injection system consists of an air supply pump and filter, air bypass valve, check valves, air manifold, air hoses and air control valve.



Thermactor air injection system

Click to enlarge

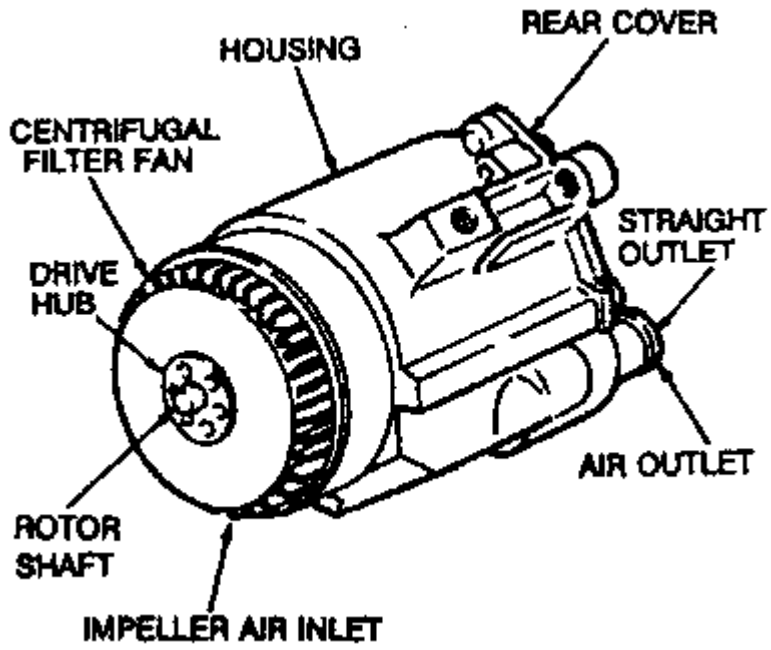


Thermactor air injection system components

Click to enlarge

Air Supply Pump

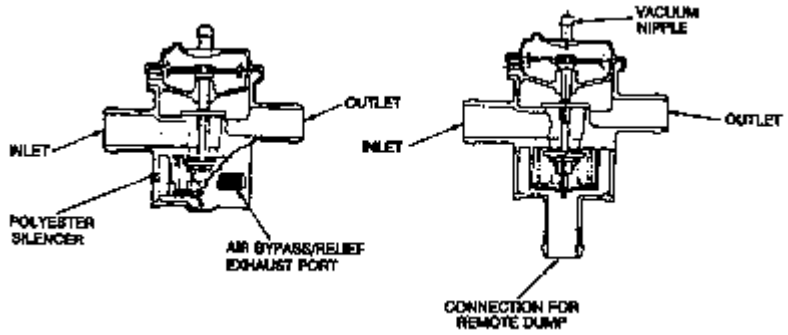
The air supply pump is a belt-driven, positive displacement, vane-type pump that provides air for the thermactor system. It is available in 19 and 22 cu. in. (311.35 and 360.5cc) sizes, either of which may be driven with different pulley ratios for different applications. The pump receives air from a remote silencer filter on the rear side of the engine air cleaner attached to the pump's air inlet nipple or through an impeller-type centrifugal filter fan.



Air supply pump assembly

Air Bypass Valve

The air bypass valve supplies air to the exhaust system with medium and high applied vacuum signals when the engine is at normal operating temperature. With low or no vacuum applied, the pumped air is dumped through the silencer ports of the valve or through the dump port.

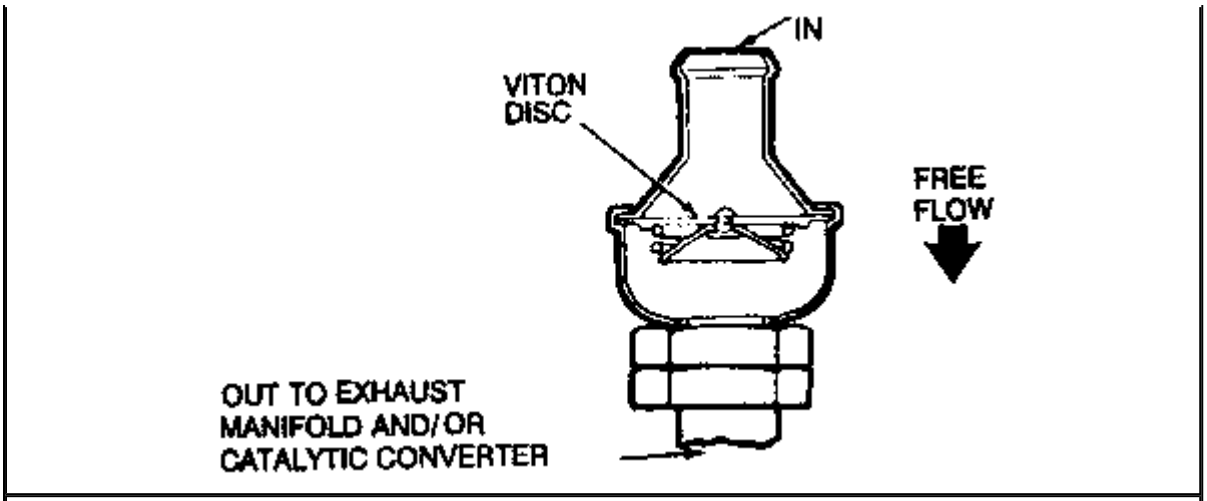


Cross-sectional view of an air bypass valve

Click to enlarge

Air Check Valve

The air check valve is a one-way valve that allows thermactor air to pass into the exhaust system while preventing exhaust gases from passing in the opposite direction.

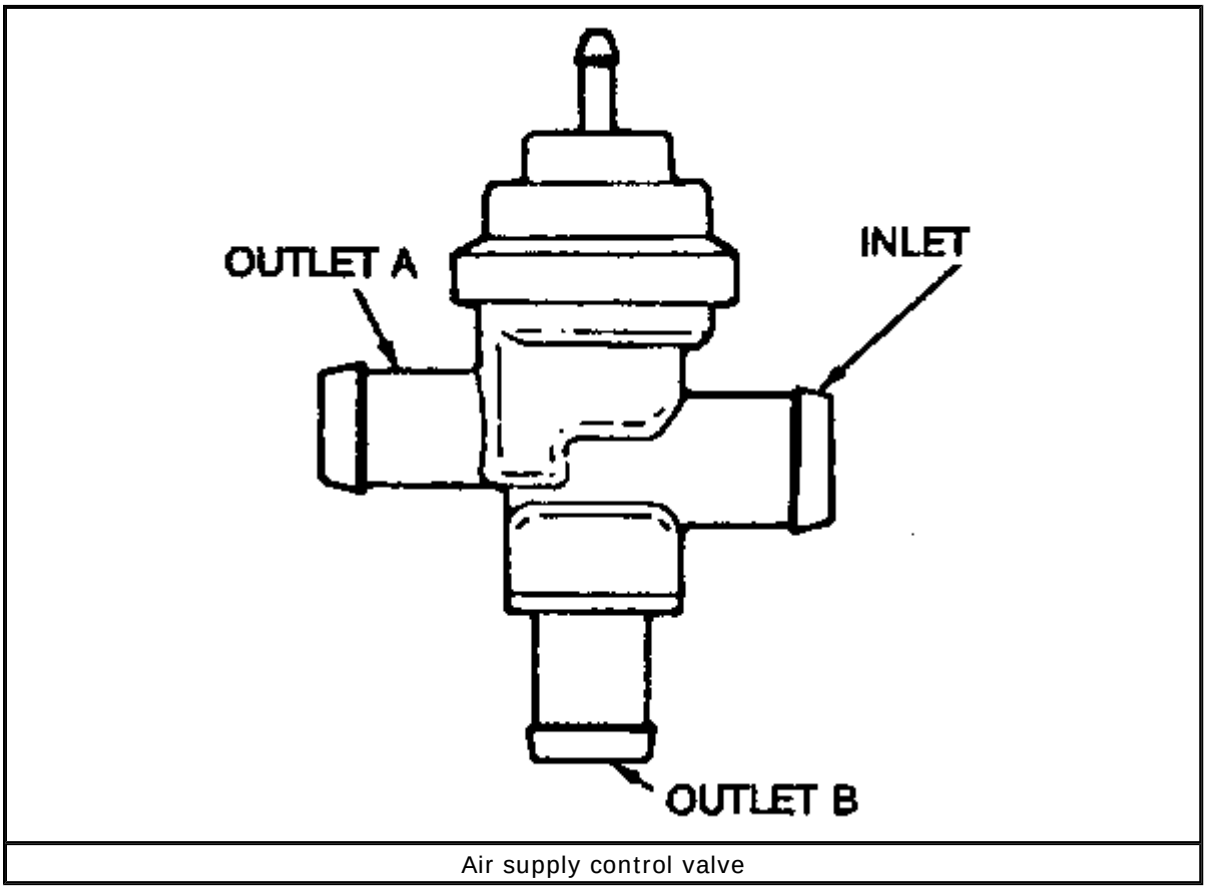


Air check valve

Click to enlarge

Air Supply Control Valve

The air supply control valve directs air pump output to the exhaust manifold or downstream to the catalyst system, depending upon the engine control strategy. It may also be used to dump air to the air cleaner or dump silencer.

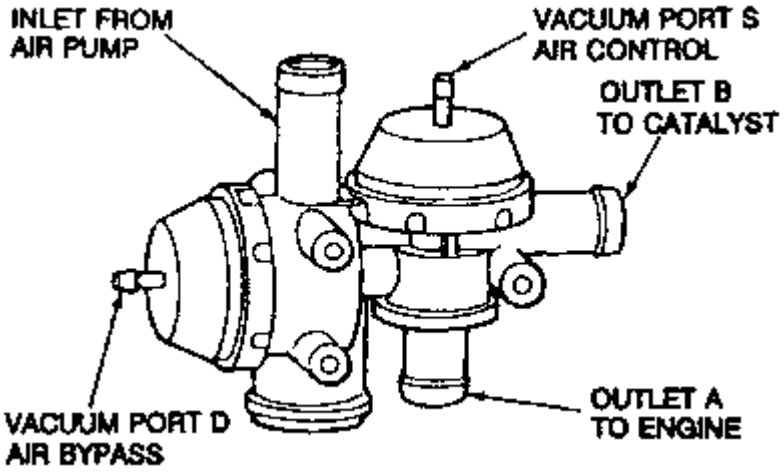


Air supply control valve

Combination Air Bypass/Air Control Valve

The combination air control/bypass valve combines the secondary air bypass and air control functions. The valve is located in the air supply line between the air pump and the upstream/downstream air supply check valves.

The air bypass portion controls the flow of thermactor air to the exhaust system or allows thermactor air to be bypassed to atmosphere. When air is not being bypassed, the air control portion of the valve switches the air injection point to either an upstream or downstream location.

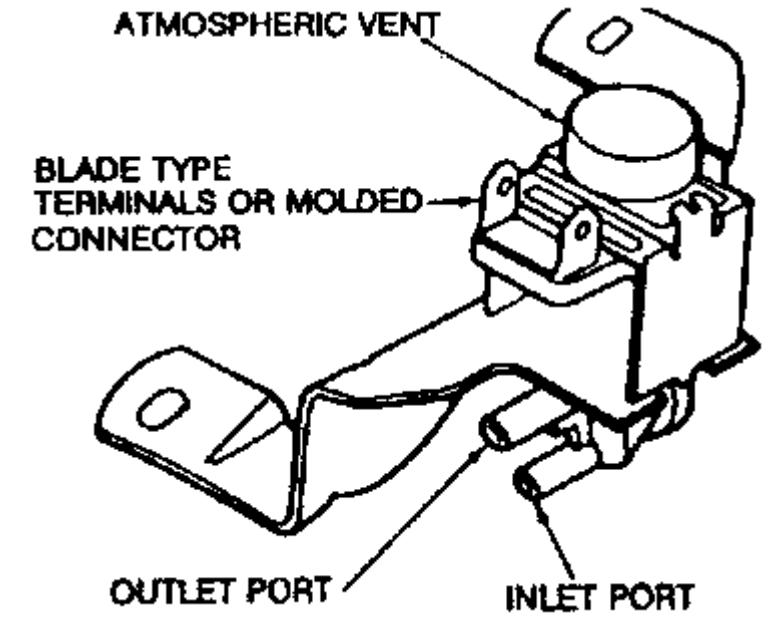


Combination air bypass/air control valve

Click to enlarge

Solenoid Vacuum Valve

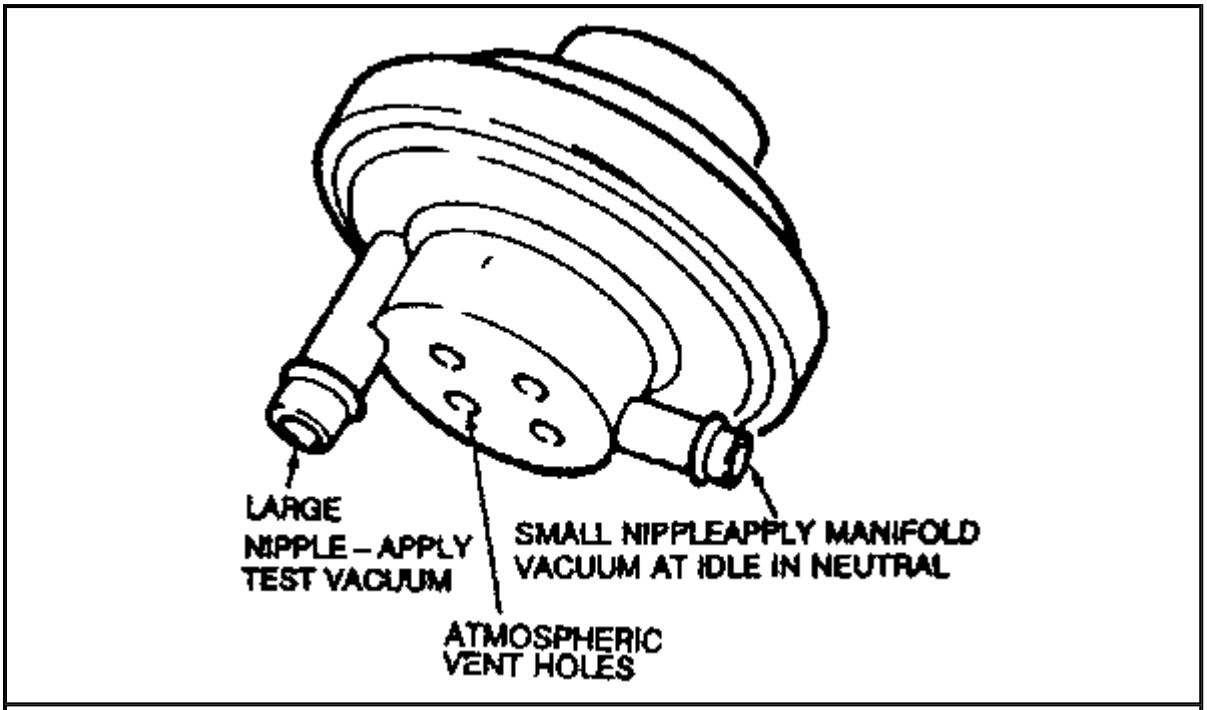
The normally closed solenoid valve assembly consists of 2 vacuum ports with an atmospheric vent. The valve assembly can be with or without control bleed. The outlet port of the valve is opened to atmospheric vent and closed to the inlet port when de-energized. When energized, the outlet port is opened to the inlet port and closed to atmospheric vent. The control bleed is provided to prevent contamination entering the solenoid valve assembly from the intake manifold.



Solenoid vacuum valve assembly

Thermactor Idle Vacuum (TIV) Valve

The TIV valve vents the vacuum signal to the atmosphere when the preset manifold vacuum or pressure is exceeded. It is used to divert thermactor airflow during cold starts to control exhaust backfire.



Thermactor idle vacuum valve assembly

TESTING

Air Supply Pump

1. **Check belt tension and adjust if needed.**

Do not pry on the pump to adjust the belt. The aluminum housing is likely to collapse.

2. **Disconnect the air supply hose from the bypass control valve.**
3. **The pump is operating properly if airflow is felt at the pump outlet and the flow increases as engine speed increases.**

Air Bypass Valve

1. **Disconnect the air supply hose at the valve outlet.**
2. **Remove the vacuum line to check that a vacuum signal is present at the vacuum nipple. There must be vacuum present at the nipple before proceeding.**
3. **With the engine at 1500 rpm and the vacuum line connected to the vacuum nipple, air pump supply air should be heard and felt at the air bypass valve outlet.**
4. **With the engine at 1500 rpm, disconnect the vacuum line. Air at the outlet should be significantly decreased or shut off. Air pump supply air should be heard or felt at the silencer ports or at the dump port.**
5. **If the air bypass valve does not successfully complete these tests, check the air pump. If the air pump is operating properly, replace the air bypass valve.**

Check Valve

1. Visually inspect the thermactor system hoses, tubes, control valve(s) and check valve(s) for leaks that may be due to the backflow of exhaust gas. If holes are found and/or traces of exhaust gas products are evident, the check valve may be suspect.
2. Check valves should allow free flow of air in the incoming direction only. The valves should check or block the free flow of exhaust gas in the opposite direction.
3. Replace the valve if air does not flow as indicated or if exhaust gas backflows in the opposite direction.

Air Supply Control Valve

1. Verify that airflow is being supplied to the valve inlet by disconnecting the air supply hose at the inlet and verifying the presence of airflow with the engine at 1500 rpm. Reconnect the air supply hose to the valve inlet.
2. Disconnect the air supply hose at outlets A and B.
3. Remove the vacuum line at the vacuum nipple.
4. Accelerate the engine to 1500 rpm. Airflow should be heard and felt at outlet B with little or no airflow at outlet A.
5. With the engine at 1500 rpm, connect a direct vacuum line from any manifold vacuum fitting to the air control valve vacuum nipple. Airflow should be heard and felt at outlet A with little or no airflow at outlet B.
6. If airflow is noted in Steps 4 and 5, the valve is okay. Reinstall the clamps and hoses. If the valve does not pass Step 4 and/or 5, replace the valve.

Combination Air Bypass/Air Control Valve

1. Disconnect the hoses from outlets A and B.
2. Disconnect and plug the vacuum line to port D.
3. With the engine operating at 1500 rpm, airflow should be noted coming out of the bypass vents.
4. Reconnect the vacuum line to port D, then disconnect and plug the vacuum line to port S. Make sure vacuum is present in the line to vacuum port D.
5. With the engine operating at 1500 rpm, airflow should be noted coming out of outlet B and no airflow should be detected at outlet A.
6. Apply 8-10 in. Hg (27-34 kPa) of vacuum to port S. With the engine operating at 1500 rpm, airflow should be noted coming out of outlet A.
7. If the valve is the bleed type, some lesser amount of air will flow from outlet A or B and the main discharge will change when vacuum is applied to port S.

Solenoid Vacuum Valve Assembly

1. The ports should allow air to flow when the solenoid is energized.
2. Check the resistance at the solenoid terminals with an ohmmeter. The resistance should be 51-108 ohms.
3. If the resistance is not as specified, replace the solenoid.

The valve can be expected to have a very small leakage rate when energized or de-energized. This leakage is not measurable in the field and is not detrimental to valve function.

Thermactor Idle Vacuum Valve

The following applies to TIV valves with the code words ASH or RED on the decal.

1. **Apply the parking brake and block the drive wheels. With the engine at idle, and the transaxle selector lever in N on automatic transaxle equipped vehicles or Neutral on manual transaxle equipped vehicles, apply vacuum to the small nipple and place fingers over the TIV valve atmospheric vent holes. If no vacuum is sensed, the TIV is damaged and must be replaced.**
2. **With the engine still idling and the transaxle selector lever remaining in N or Neutral, apply 1.5-3.0 in. Hg (5-10 kPa) of vacuum to the large nipple of the ASH TIV valve or 3.5-4.5 in. Hg (12-15 kPa) of vacuum to the large nipple of the RED TIV valve from a test source. If vacuum is still sensed when placing fingers over the vent holes, the TIV is damaged and must be replaced.**
3. **If the TIV valve meets both requirements, disconnect the TIV valve small nipple from the manifold vacuum and the TIV valve large nipple from the test vacuum. Reconnect the TIV valve to the original hoses or connectors.**

REMOVAL & INSTALLATION

Air Supply Pump

1. **Disconnect the negative battery cable.**
2. **Remove the drive belt from the air pump pulley.**
3. **Disconnect the air hose(s) from the air pump.**
4. **Remove the mounting bolts and, if necessary, the mounting brackets.**
5. **Remove the air pump from the vehicle.**

To install:

6. **Install the air pump in the vehicle, then secure using the mounting bolts and/or brackets.**
7. **Connect the air hose to the air pump, then install the belt on the air pump pulley.**
8. **Connect the negative battery cable.**

Air Bypass Valve

1. **Disconnect the negative battery cable.**
2. **Tag and disconnect the air inlet hose, the outlet hose and the vacuum hose from the bypass valve.**
3. **Remove the bypass valve from the vehicle.**

To install:

4. **Install the bypass valve in the vehicle.**
5. **Connect the vacuum hose, the outlet hose and the air inlet hose to the bypass valve, as tagged during removal.**
6. **Connect the negative battery cable.**

Check Valve

1. Disconnect the negative battery cable.
2. Disconnect the input hose from the check valve.
3. Remove the check valve from the connecting tube.

To install:

4. Fasten the check valve to the connecting tube.
5. Connect the input hose to the check valve.
6. Connect the negative battery cable.

Air Supply Control Valve

1. Disconnect the negative battery cable.
2. Disconnect the air hoses and the vacuum line from the air control valve.
3. Remove the air control valve from the vehicle.

To install:

4. Install the control valve in the vehicle.
5. Connect the vacuum line and the air hoses to the air control valve.
6. Connect the negative battery cable.

Combination Air Bypass/Air Control Valve

1. Disconnect the negative battery cable.
2. Disconnect the air hoses and vacuum lines from the valve.
3. Remove the valve from the vehicle.

To install:

4. Install the valve in the vehicle.
5. Connect the vacuum lines and the air hoses to the valve.
6. Connect the negative battery cable.

Solenoid Vacuum Valve Assembly

1. Disconnect the negative battery cable.
2. Detach the electrical connector and the vacuum lines from the solenoid valve.
3. Unfasten the mounting bolts and remove the solenoid valve.

To install:

4. Install the solenoid valve, then secure using the mounting bolts.
5. Connect the vacuum lines, then engage the electrical connector to the solenoid valve.
6. Connect the negative battery cable.

Thermactor Idle Vacuum Valve

1. **Disconnect the negative battery cable.**
2. **Disconnect the vacuum lines from the TIV valve, then remove the valve from the vehicle.**

To install:

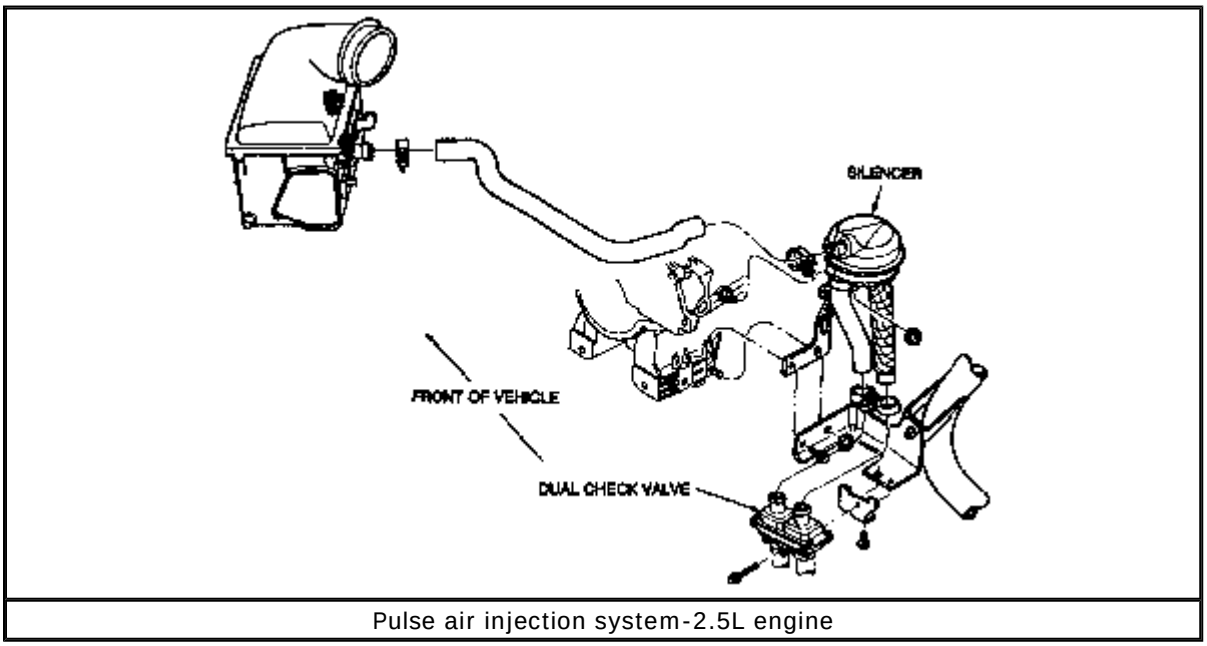
3. **Install the TIV valve in the vehicle, then connect the vacuum lines to the valve.**
4. **Connect the negative battery cable.**

Pulse Air Injection System

OPERATION

The pulse air injection system is used on some vehicles equipped with the 2.5L engine.

The pulse air injection system does not use an air pump. Instead the system uses natural pulses present in the exhaust system to pull air into the catalyst through a pulse air valve. The pulse air valve is connected to the catalyst with a long tube and to the air cleaner and silencer with hoses.



Pulse air injection system-2.5L engine

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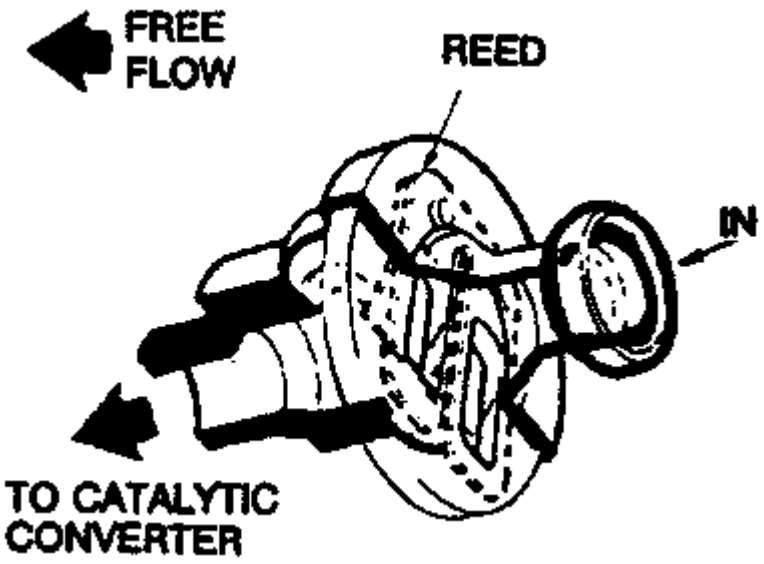
Pulse Air Valve

The pulse air control valve is normally closed. Without a vacuum signal from the solenoid, the flow of air is blocked.



Pulse air valve flow schematic

Air Silencer/Filter

The air silencer is a combustion silencer and filter for the pulse air system. The air silencer is mounted in a convenient position in the engine compartment and is connected to the pulse air valve inlet by means of a flexible hose.

Check Valve

The air check valve is a one-way valve that allows air to pass into the exhaust system while preventing exhaust gases from passing in the opposite direction.

Solenoid Vacuum Valve Assembly

The normally closed solenoid valve assembly consists of 2 vacuum ports with an atmospheric vent. The valve assembly can be with or without control bleed. The outlet port of the valve is opened to atmospheric vent and closed to the inlet port when de-energized. When energized, the outlet port is opened to the inlet port and closed to atmospheric vent. The control bleed is provided to prevent contamination entering the solenoid valve assembly from the intake manifold.

TESTING

Pulse Air Valve

1. **Visually inspect the system hoses, tubes, control valve(s) and check valve(s) for leaks that may be due to backflow of exhaust gas. If holes are found and/or traces of exhaust gas products are evident, the check valve may be suspect.**
2. **The valve should allow free flow of air in one direction only. The valve should check or block, the free flow of exhaust gas in the opposite direction.**
3. **Replace the valve if air does not flow as indicated or if exhaust gas backflows in the wrong direction.**
4. **Remove the inlet hose.**
5. **Apply the parking brake and block the drive wheels. With the engine idling at normal operating temperature and the transaxle selector lever in N on automatic transaxle equipped vehicles or Neutral on manual transaxle equipped vehicles, air**

should be drawn into the valve.

6. Remove the vacuum line; the air flow should stop.
7. If these conditions are met, the valve is operating properly.
8. If these conditions are not met, verify that vacuum is present at the valve. Check the solenoid valve if vacuum is not present.
9. If vacuum is present but no air flows, check the pulse air check valve, silencer filter and air cleaner for blocked or restricted passages.
10. If vacuum is present and no blocked or restricted passages are found, replace the valve.

Air Silencer/Filter

1. Inspect the hoses and air silencer for leaks.
2. Disconnect the hose from the air silencer outlet, remove the silencer and visually inspect for plugging.
3. The air silencer is operating properly, if no plugging or leaks are encountered.

Check Valve

1. Visually inspect the system hoses, tubes, control valve(s) and check valve(s) for leaks that may be due to the backflow of exhaust gas. If holes are found and/or traces of exhaust gas products are evident, the check valve may be suspect.
2. Check valves should allow free flow of air in the incoming direction only. The valves should check or block, the free flow of exhaust gas in the opposite direction.
3. Replace the valve if air does not flow as indicated or if exhaust gas backflows in the opposite direction.

Solenoid Vacuum Valve Assembly

1. The ports should flow air when the solenoid is energized.
2. Check the resistance at the solenoid terminals with an ohmmeter. The resistance should be 51-108 ohms.
3. If the resistance is not as specified, replace the solenoid.

The valve can be expected to have a very small leakage rate when energized or de-energized. This leakage is not measurable in the field and is not detrimental to valve function.

REMOVAL & INSTALLATION

Pulse Air Valve

1. Disconnect the negative battery cable.
2. Disconnect the air hose(s) from the pulse air valve.
3. Disconnect the vacuum line, if necessary.
4. Remove the pulse air valve.

To install:

5. **Install the pulse air valve, then, if removed, connect the vacuum line.**
6. **Connect the air hose(s) from the pulse air valve.**
7. **Connect the negative battery cable.**

Air Silencer/Filter

1. **Disconnect the negative battery cable.**
2. **Disconnect the hose from the silencer.**
3. **Remove the silencer from the vehicle.**

To install:

4. **Install the silencer, then connect the hose.**
5. **Connect the negative battery cable.**

Check Valve

1. **Disconnect the negative battery cable.**
2. **Disconnect the input hose from the check valve.**
3. **Remove the check valve from the connecting tube.**

To install:

4. **Fasten the check valve to the connecting tube.**
5. **Connect the input hose to the check valve.**
6. **Connect the negative battery cable.**

Solenoid Vacuum Valve Assembly

1. **Disconnect the negative battery cable.**
2. **Disengage the electrical connector, then disconnect the vacuum lines from the solenoid valve.**
3. **Remove the mounting bolts, then remove the solenoid vacuum valve.**

To install:

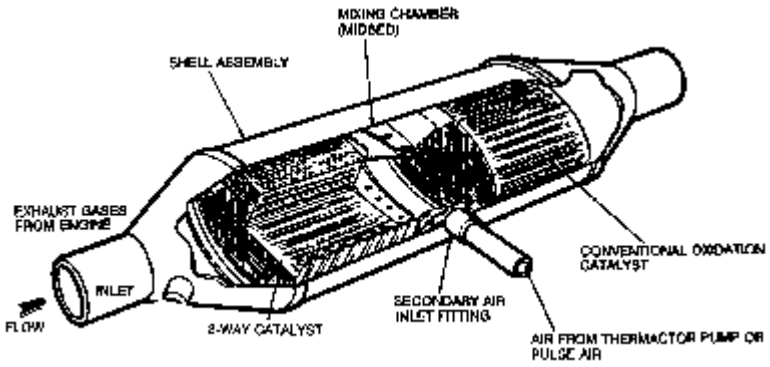
4. **Install the solenoid valve, then fasten using the mounting bolts.**
5. **Connect the vacuum lines, then engage the electrical connector to the solenoid valve.**
6. **Connect the negative battery cable.**

Catalytic Converters

Engine exhaust consists mainly of Nitrogen (N_2), however, it also contains Carbon Monoxide (CO), Carbon Dioxide (CO_2), Water Vapor (H_2O), Oxygen (O_2), Nitrogen Oxides (NOx) and Hydrogen (H), as well as various unburned Hydrocarbons (HC). Three of these exhaust components, CO, NOx and HC, are major air pollutants, so their emission to the atmosphere has to be controlled.

The catalytic converter, mounted in the engine exhaust stream, plays a major role in the emission control system. The converter works as a gas reactor whose catalytic function is to speed up the heat producing chemical reaction between the exhaust gas components in order to reduce the air pollutants in the engine exhaust. The catalyst material, contained inside the converter, is made of a ceramic substrate that is coated with a high surface area alumina and impregnated with catalytically active, precious metals.

All vehicles use a 3-way catalyst and some also use with a conventional oxidation catalyst. The conventional oxidation catalyst, containing Platinum (Pt) and Palladium (Pd), is effective for catalyzing the oxidation reactions of HC and CO. The 3-way catalyst, containing Platinum (Pt) and Rhodium (Rh) or Palladium (Pd) and Rhodium (Rh), is not only effective for catalyzing the oxidation reactions of HC and CO, but it also catalyzes the reduction of NOx.



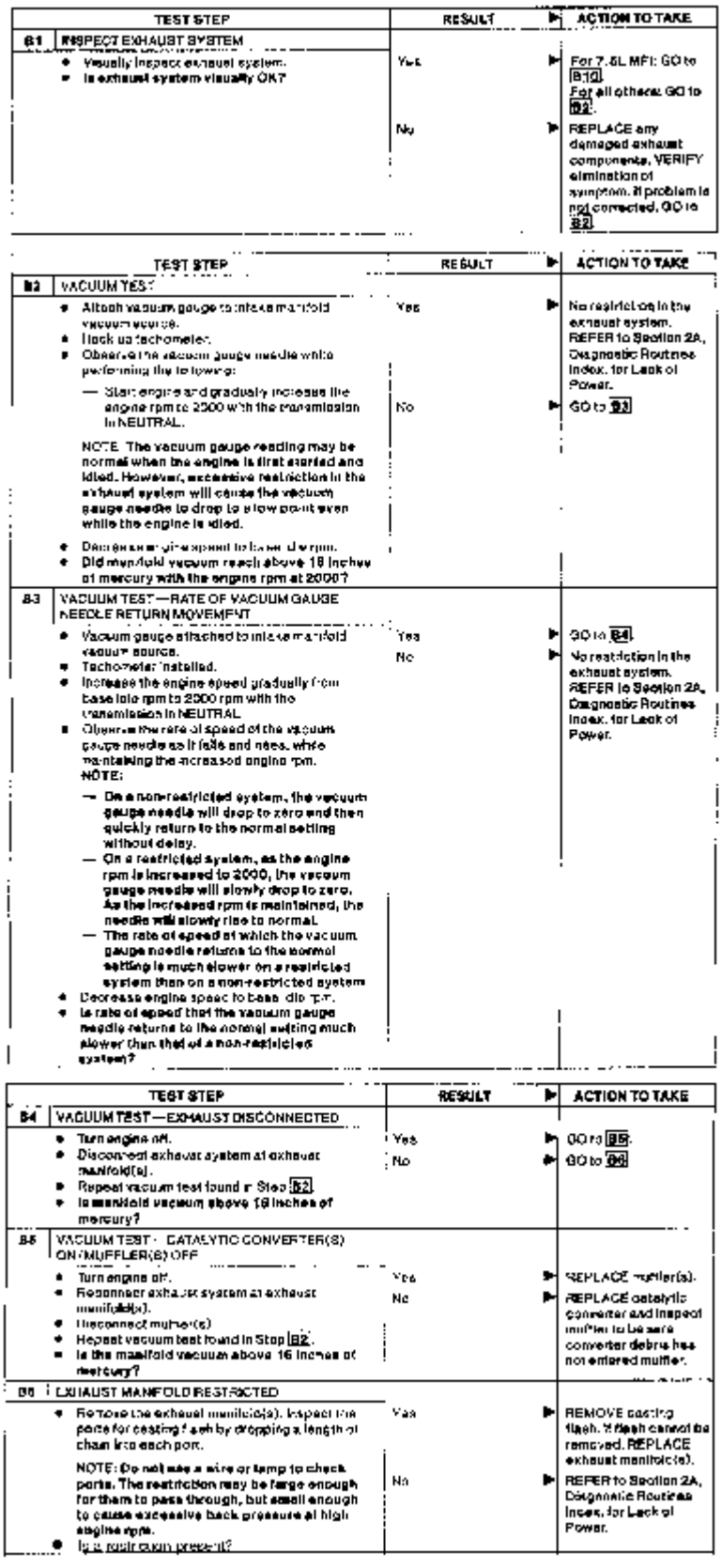
Cross-sectional view of a catalytic converter assembly

Click to enlarge

The catalytic converter assembly consists of a structured shell containing a monolithic substrate; a ceramic, honeycomb construction. In order to maintain the converter's exhaust oxygen content at a high level to obtain the maximum oxidation for producing the heated chemical reaction, the oxidation catalyst usually requires the use of a secondary air source. This is provided by the pulse air or thermactor air injection systems.

The catalytic converter is protected by several devices that block out the air supply from the air injection system when the engine is laboring under one or more of the following conditions:

- **Cold engine operation with rich choke mixture**
- **Abnormally high engine coolant temperatures above 225°F (107°C), which may result from a condition such as an extended, hot idle on a hot day**
- **Wide-open throttle**
- **Engine deceleration**
- **Extended idle operation**



TEST STEP	RESULT	ACTION TO TAKE
B1 INSPECT EXHAUST SYSTEM • Visually inspect exhaust system. • Is exhaust system visually OK?	Yes	For 7.5L MFI: GO to B10. For all others: GO to B2.
	No	REPLACE any damaged exhaust components. VERIFY elimination of symptom. If problem is not corrected, GO to B2.

TEST STEP	RESULT	ACTION TO TAKE
B2 VACUUM TEST • Attach vacuum gauge to intake manifold vacuum source. • Hook up tachometer. • Observe the vacuum gauge needle while performing the following: — Start engine and gradually increase the engine rpm to 2000 with the transmission in NEUTRAL. NOTE: The vacuum gauge reading may be normal when the engine is first started and idled. However, excessive restriction in the exhaust system will cause the vacuum gauge needle to drop to a low point even while the engine is idled. • Decrease engine speed to base idle rpm. • Did manifold vacuum reach above 18 inches of mercury with the engine rpm at 2000?	Yes	No restriction in the exhaust system. REFER to Section 2A, Diagnostic Routines Index, for Lack of Power.
	No	GO to B3.
B3 VACUUM TEST—RATE OF VACUUM GAUGE NEEDLE RETURN MOVEMENT • Vacuum gauge attached to intake manifold vacuum source. • Tachometer installed. • Increase the engine speed gradually from base idle rpm to 2000 rpm with the transmission in NEUTRAL. • Observe the rate of speed of the vacuum gauge needle as it falls and rises, while maintaining the increased engine rpm. NOTE: — On a non-restricted system, the vacuum gauge needle will drop to zero and then quickly return to the normal setting without delay. — On a restricted system, as the engine rpm is increased to 2000, the vacuum gauge needle will slowly drop to zero. As the increased rpm is maintained, the needle will slowly rise to normal. — The rate of speed at which the vacuum gauge needle returns to the normal setting is much slower on a restricted system than on a non-restricted system. • Decrease engine speed to base idle rpm. • Is rate of speed that the vacuum gauge needle returns to the normal setting much slower than that of a non-restricted system?	Yes	GO to B4.
	No	No restriction in the exhaust system. REFER to Section 2A, Diagnostic Routines Index, for Lack of Power.

TEST STEP	RESULT	ACTION TO TAKE
B4 VACUUM TEST—EXHAUST DISCONNECTED • Turn engine off. • Disconnect exhaust system at exhaust manifold(s). • Repeat vacuum test found in Step B2. • Is manifold vacuum above 18 inches of mercury?	Yes	GO to B5.
	No	GO to B6.
B5 VACUUM TEST - CATALYTIC CONVERTER(S) OR MUFFLER(S) OFF • Turn engine off. • Reconnect exhaust system at exhaust manifold(s). • Disconnect muffler(s). • Repeat vacuum test found in Step B2. • Is the manifold vacuum above 16 inches of mercury?	Yes	REPLACE muffler(s).
	No	REPLACE catalytic converter and inspect muffler to be sure converter debris has not entered muffler.
B6 EXHAUST MANIFOLD RESTRICTED • Remove the exhaust manifold(s). Inspect the ports for casting flash by dropping a length of chain into each port. NOTE: Do not use a wire or tang to check ports. The restriction may be large enough for them to pass through, but small enough to cause excessive back pressure at high engine rpm. • Is a restriction present?	Yes	REMOVE casting flash. If flash cannot be removed, REPLACE exhaust manifold(s).
	No	REFER to Section 2A, Diagnostic Routines Index, for Lack of Power.

Catalyst and exhaust system diagnostic data

Click to enlarge

Service Interval Reminder Lights

RESETTING

Approximately every 5,000 or 7,500 miles (8,000 or 12,000 km), depending on engine application, the word SERVICE will appear on the electronic display for the first 1.5 miles (2.4 km) to remind the driver that is is time for the regular vehicle service interval maintenance (for example, an oil change).

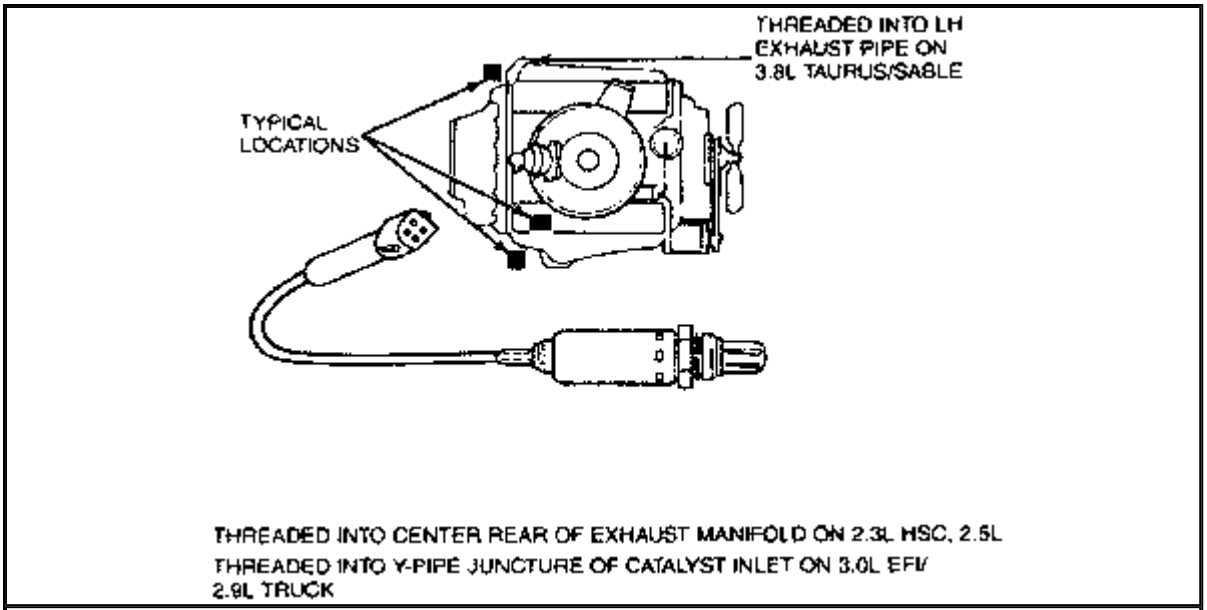
To reset the service interval reminder light for another interval, proceed as follows.

1. **With the engine running, press the ODO SEL and TRIP RESET buttons.**
2. **Hold the buttons down until the SERVICE light disappears from the display and 3 audible beeps are heard to verify that the service reminder has been reset.**

Do not confuse the service interval reminder light with the CHECK ENGINE or SERVICE ENGINE SOON Malfunction Indicator Light (MIL). An illuminated MIL likely indicates the presence of a self-diagnostic trouble code. Information on reading such trouble codes appears later in this section.

Oxygen Sensor

The oxygen sensor or Heated Exhaust Gas Oxygen (HEGO) sensor supplies the ECU with a signal which indicates a rich or lean condition during engine operation. This input information assists the ECU in determining the proper air/fuel ratio. The oxygen sensor is threaded into the exhaust manifold on all vehicles.



Heated Exhaust Gas Oxygen (HEGO) sensor assembly

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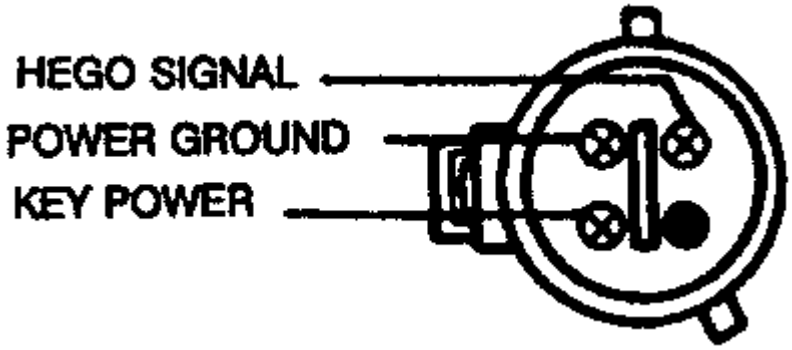
TESTING

Except Engines Equipped With MAF Sensor

1. **Disconnect the oxygen sensor from the vehicle harness.**
2. **Connect a voltmeter between the HEGO signal terminal of the oxygen sensor connector and the negative battery terminal.**



Oxygen sensor (HEGO) assembly electrical connector

3. **Disconnect and plug the vacuum line at the MAP sensor and set the voltmeter on the 20 volt scale.**
4. **Apply 10-14 in. Hg (34-47 kPa) of vacuum to the MAP sensor.**
5. **Start the engine and run it at approximately 2000 rpm for 2 minutes.**
6. **If the voltmeter does not indicate greater than 0.5 volts within 2 minutes, replace the sensor.**

REMOVAL & INSTALLATION

1. **Disconnect the negative battery cable.**
2. **Disengage the oxygen/heated exhaust gas oxygen sensor electrical connector.**
3. **Remove the sensor from the exhaust manifold or exhaust pipes, as applicable.**

To install:

4. **Install the sensor in the exhaust manifold or pipe.**
5. **Engage the sensor electrical connector.**
6. **Connect the negative battery cable.**