4

DRIVEABILITY AND EMISSIONS CONTROLS

EMISSION CONTROLS

Positive Crankcase Ventilation System

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.

OPERATION

See Figure 1

Your car is equipped with a closed Positive Crankcase Ventilation (PCV) system. The PCV system vents crankcase gases into the engine air intake where they are burned with the air/fuel mixture. The PCV system keeps pollutants from being released into the atmosphere, and also helps to keep the engine oil clean, by ridding the crankcase of moisture and corrosive fumes. The PCV system consists of the PCV valve, a closed oil fill cap and the various connecting hoses.

The PCV system recycles crankcase gases as follows: When the engine is running, clean filtered air is drawn into the crankcase through the intake air filter. As the air passes through the crankcase, it picks up the combustion gases and carries them out of the crankcase, up through the PCV valve and into the intake manifold. After they enter the intake manifold, they are drawn into the combustion chamber and burned.

The most critical component of the PCV system is the PCV valve. The PCV valve regulates the amount of ventilating air and blow-by gas to the intake manifold and also prevents backfire from traveling into the crankcase, avoiding the explosion of crankcase gases. At low engine speeds, the PCV valve is partially closed, limiting the flow of gases into the intake manifold. As engine speed increases, the valve opens to admit greater quantities of gases into the intake manifold.

If the PCV valve becomes blocked or plugged, crankcase gases will not be able to escape by the normal route. Since these gases are under pressure, they will seek an alternate route, which is usually an oil seal or gasket. As the gases escape, an oil leak will be created.

Besides causing oil leaks, a clogged PCV valve will also allow gases to remain in the crankcase for an extended period, promoting the formation of sludge in the engine.

TESTING

1. Visually inspect the PCV valve hose and the fresh air supply hose and their attaching nipples or grommets for splits, cuts, damage, clogging, or restrictions. Repair or replace, as necessary.
2. If the hoses pass inspection, remove the PCV valve from its mounting grommet. Shake the PCV valve and listen or feel for the rattle of the valve plunger within the valve body. If the valve plunger does not rattle, the PCV valve must be cleaned or replaced. If the valve plunger rattles, the PCV valve is okay; reinstall it.
3. Start the engine and bring it to normal operating temperature. Remove the fresh air supply hose from the air cleaner or air outlet tube. Place a stiff piece of paper over the hose end and wait 1 minute. If vacuum holds the paper in place, the system is okay.
4. On the 4.6L engine, the PCV system is connected with the evaporative emission system. If the paper is not held in place, disconnect the evaporative hose, cap the connector and retest. If vacuum now holds the paper in place, the problem is in the evaporative emission system.
5. If the paper is not held by vacuum, check the fresh air and PCV hoses for leaks or loose connections. Also, check for a loose fitting oil fill cap or loose dipstick. Correct as required until vacuum can be felt at the end of the supply hose.

If air pressure and oil or sludge is present at the end of the fresh air supply hose, the engine has excessive blow-by and cylinder bore or piston ring wear.

REMOVAL & INSTALLATION

Refer to Section 1 for removal and installation of the PCV valve.

Evaporative Emission Controls

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.

OBD-II EVAP System Monitor

Some of the models covered in this manual have added system components due to the EVAP system monitor incorporated in the OBD-II engine control system. A pressure sensor is mounted on the fuel tank which measures pressure inside the tank, and a purge flow sensor measures the flow of the gases from the canister into the engine. The purge valve is now called the Vapor Management Valve (VMV). It performs the same functions as the purge valve, however it looks slightly different. A canister vent solenoid is mounted on the canister, taking the place of the vent cap, providing a source of fresh air to the canister.

The PCM can store trouble codes for EVAP system performance, a list of the codes is provided later in this section. Normal testing procedure can be used, see EVAP System Component Testing in this Section.

Carbon Canister

See Figure 2

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.

Purge Control Valve

See Figure 3

The purge valves control the flow of fuel vapor from the carbon canister to the engine. Purge

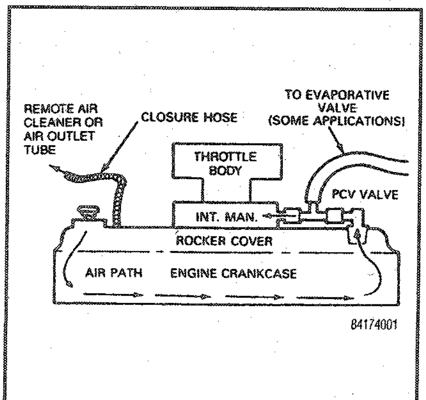

Fig. 1 PCV system functional diagram

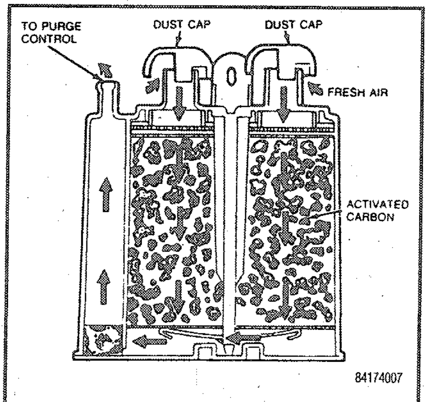

Fig. 2 Cross-section of a carbon canister

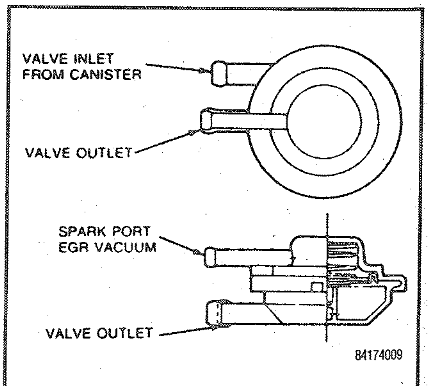

Fig. 3 Purge control valve

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.

Fuel Tank Vapor Orifice and Roll over Valve Assembly

▶ See Figure 4

Fuel vapor in the fuel tank is vented to the carbon canister through the vapor valve assembly. The valve is mounted in a rubber grommet at a central location in the upper surface of the fuel tank. A vapor space between the fuel level and the tank upper surface is combined with a small orifice and float shut-off valve in the vapor valve assembly to prevent liquid fuel from passing to the carbon canister. The vapor space also allows for thermal expansion of the fuel. 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.

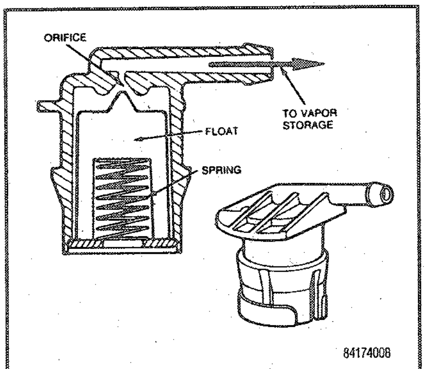

Fig. 4 Fuel tank vapor orifice and roll over valve assembly

Purge Solenoid Valve

▶ See Figure 5

The purge solenoid valve is in-line with the carbon canister and controls the flow of fuel vapors out of the canister. It is normally closed. When the engine is shut off, the vapors from the fuel tank flow into the canister. After the engine is started, the solenoid is engaged and opens, purging the vapors into the engine. With the valve open, vapors from the fuel tank are routed directly into the engine.

Pressure/Vacuum Relief Fuel Cap

The fuel cap contains an integral pressure and vacuum relief valve. The vacuum valve acts to allow air into the fuel tank to replace the fuel as it is used, while preventing vapors from escaping the tank

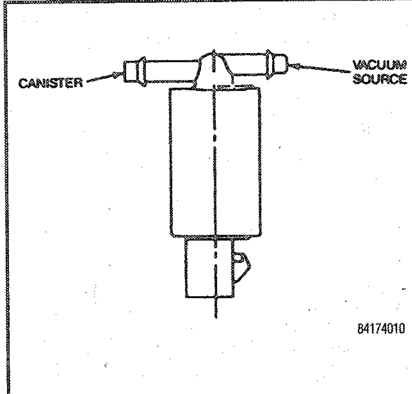

Fig. 5 Purge solenoid valve

through the atmosphere. The vacuum relief valve opens after a vacuum of −0.5 psi. The pressure valve acts as a backup pressure relief valve in the event the normal venting system is overcome by excessive generation of internal pressure or restriction of the normal venting system. The pressure relief range is 1.6–2.1 psi. Fill cap damage or contamination that stops the pressure vacuum valve from working may result in deformation of the fuel tank.

REMOVAL & INSTALLATION

Carbon Canister

1. Disconnect the negative battery cable.
2. Label and disconnect the vapor hoses from the carbon canister.
3. Remove the canister attaching screws and remove the canister.
4. Installation is the reverse of the removal procedure.

Fuel Tank Vapor Orifice and Roll over Valve Assembly

1. Disconnect the negative battery cable.
2. Remove the fuel tank as described in Section 5.
3. Remove the vapor orifice and roll over valve assembly from the fuel tank.
4. Installation is the reverse of the removal procedure.

Purge Control Valve

1. Disconnect the negative battery cable.
2. Label and disconnect the hoses from the purge control valve.
3. Remove the purge control valve.
4. Installation is the reverse of the removal procedure.

Purge Solenoid Valve

1. Disconnect the negative battery cable.
2. Label and disconnect the hoses from the purge solenoid valve.
3. Disconnect the electrical connector from the valve.
4. Remove the purge solenoid valve.
5. Installation is the reverse of the removal procedure.

Exhaust Gas Recirculation System

OPERATION

▶ See Figures 6, 7, 8 and 9

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 that 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, but it takes up volume, the net effect is to lower the temperature of the combustion chamber. There are a few different EGR systems used.

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.

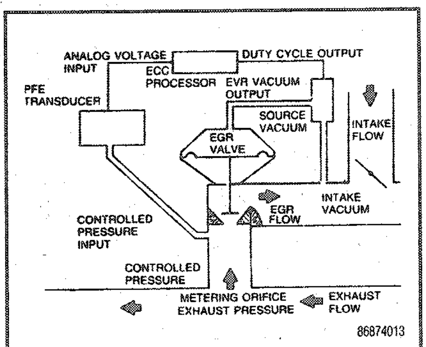

Fig. 6 Pressure Feedback Electronic (PFE) EGR system schematic

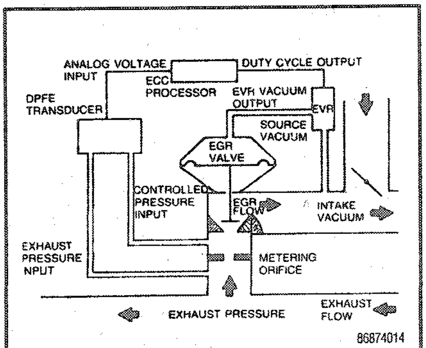

Fig. 7 Differential Pressure Feedback Electronic (DPFE) EGR system schematic

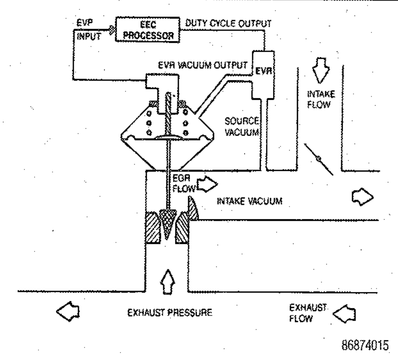

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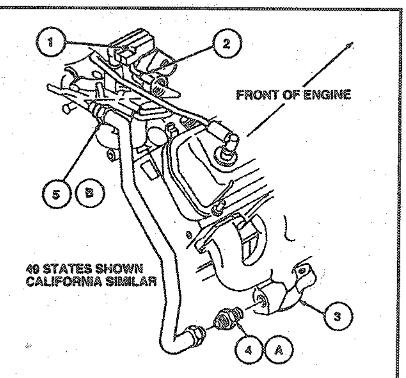
Fig. 8 Electronic EGR (EEGR) system schematic

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.

The Electronic EGR (EEGR) valve system is used on some vehicles equipped with the 5.0L 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 that 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 PCM.

The Pressure Feedback Electronic (PFE) EGR Transducer converts a varying exhaust pressure signal into a proportional analog voltage that is digitized by the PCM. The PCM uses the signal



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)

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Fig. 9 View of the EGR system components—late model 3.8L engine shown

received from the PFE transducer to compute the optimum EGR flow.

The EGR Vacuum Regulator (EVR) is an electromagnetic device that 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 ported vacuum. As the duty cycle is increased, an increased vacuum signal goes to the EGR valve.

COMPONENT TESTING

➡Many of the following testing procedures require the use of a breakout box tool for EEC systems diagnosis. SUPER STAR II tester or NEW GENERATION STAR (NGS) tester or equivalent scan tools.

DPFE Sensor

1. Disconnect the pressure hoses at the DPFE sensor.
2. Connect a hand vacuum pump to the downstream pickup marked **REF** on the sensor.
3. Using a multimeter, backprobe the SIG RTN circuit at the DPFE connector.
4. With the ignition **ON**, signal voltage should be 0.20–0.70 volts.
5. Apply 8–9 in. Hg of vacuum to the sensor. Voltage should be greater than 4 volts.
6. Quickly release the vacuum from the sensor. Voltage should drop to less than 1 volt in 3 seconds.
7. If the sensor does not respond as specified, check the power and ground circuits.
8. If power and ground circuits are functional, the sensor is faulty.

EGR Valve Control Solenoid

1. Remove the EVR solenoid.
2. Attempt to lightly blow air into the EVR solenoid.
   a. If air blows through the solenoid, replace the solenoid with a new one.
   b. If air does not pass freely through the solenoid, continue with the test.
3. Apply battery voltage (approximately 12 volts) and a ground to the EVR solenoid electrical terminals. Attempt to lightly blow air, once again, through the solenoid.
   a. If air does not pass through the solenoid, replace the solenoid with a new one.
   b. If air does not flow through the solenoid, the solenoid is OK.
4. If the solenoid is functional but the problem still exists, check the power and ground circuits.

EGR Valve

1. Install a tachometer on the engine, following the manufacturer's instructions.
2. Detach the engine wiring harness connector from the Idle Air Control (IAC) solenoid.
3. Disconnect and plug the vacuum supply hose from the EGR valve.
4. Start the engine, then apply the parking brake, block the rear wheels and position the transmission in Neutral.
5. Observe and note the idle speed.

➡If the engine will not idle with the IAC solenoid disconnected, provide an air bypass to the engine by slightly opening the throttle plate or by creating an intake vacuum leak. Do not allow the idle speed to exceed typical idle rpm.

6. Using a hand-held vacuum pump, slowly apply 5–10 in. Hg (17–34 kPa) of vacuum to the EGR valve nipple.
   a. If the idle speed drops more than 100 rpm with the vacuum applied and returns to normal after the vacuum is removed, the EGR valve is OK.
   b. If the idle speed does not drop more than 100 rpm with the vacuum applied and return to normal after the vacuum is removed, inspect the EGR valve for a blockage; clean it if a blockage is found. Replace the EGR valve if no blockage is found, or if cleaning the valve does not remedy the malfunction.

REMOVAL & INSTALLATION

DPFE Sensor

➡ See Figures 10, 11, 12, 13 and 14

1. Disconnect the negative battery cable.
2. Label and disconnect the wiring harness from the DPFE sensor.
3. Label and disconnect the vacuum hoses.
4. Remove the mounting screws and remove the DPFE sensor.

To install:

5. Position the DPFE sensor and tighten the mounting screws.

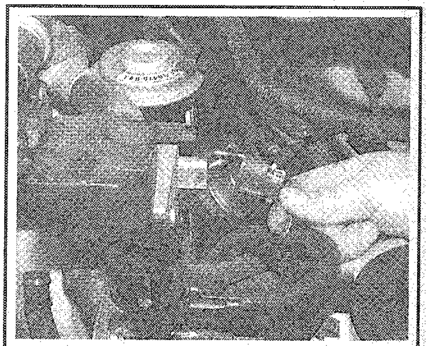
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Fig. 10 Detach the connector for the DPFE sensor

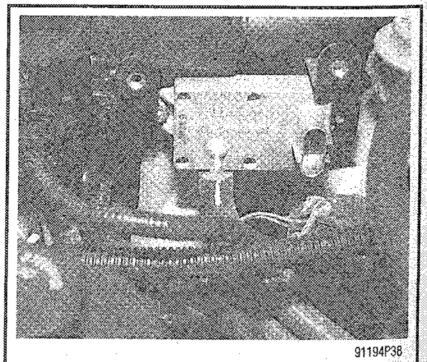
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Fig. 11 Matchmark and remove the vacuum hoses for the DPFE sensor and . . .

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Fig. 12 . . . remove the retaining nuts from the DPFE sensor and . . .

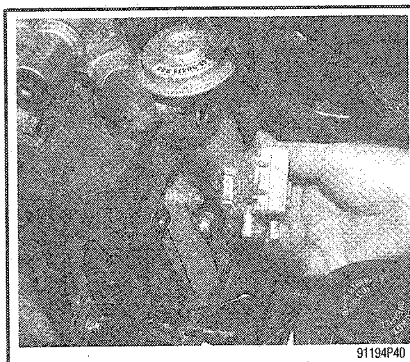

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Fig. 13 . . . remove the DPFE sensor from the intake manifold

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Fig. 14 Location of PFE sensor. Also note the EGR valve behind it. Lubricating the fasteners before removal

6. Attach all necessary hoses and wiring to the sensor.
7. Connect the negative battery cable.

EGR Valve Control Solenoid

See Figures 15, 16, 17, 18 and 19

1. Disconnect the negative battery cable.
2. Label and detach the vacuum hoses from the EVR solenoid.
3. Detach the electrical connector from the solenoid.
4. Remove the retaining hardware, and remove the solenoid.

To install:

5. Position the solenoid and install the retaining hardware.
6. Attach the main emission vacuum control connector and the wiring harness connector to the EVR solenoid.
7. Connect the negative battery cable.

EGR Valve

3.8L ENGINE

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

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.

4.6L ENGINE

See Figures 20 thru 27

1. Disconnect the negative battery cable.
2. Remove the vacuum hose from the EGR valve.
3. On the 4.6L engine, remove the nut and the brake booster bracket.
4. Disconnect the EGR valve-to-exhaust manifold tube from the EGR valve.
5. Remove the EGR valve mounting bolts, then separate the valve from the intake manifold.
6. Remove and discard the old EGR valve gas-

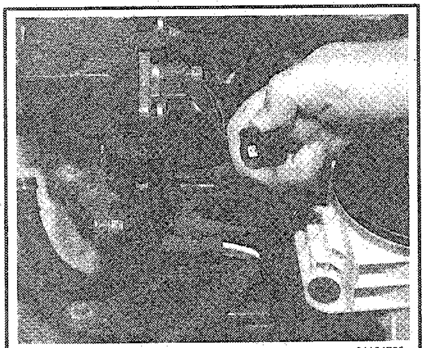

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Fig. 15 Detach the connector for the EVR solenoid

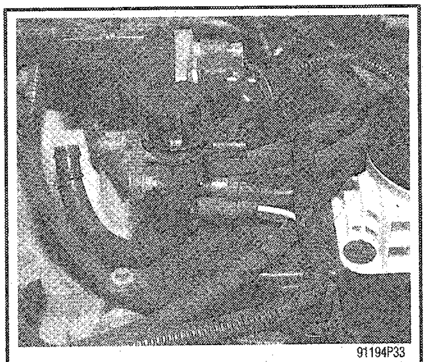

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Fig. 16 Match mark the vacuum hoses for the EVR solenoid and . . .

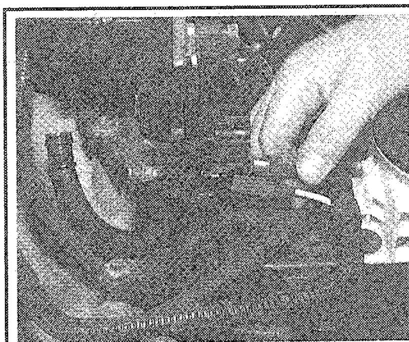

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Fig. 17 . . . remove the vacuum hoses from the EVR solenoid

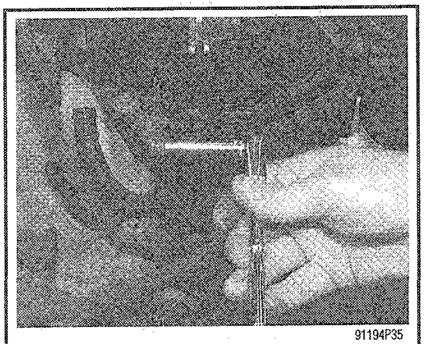

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Fig. 18 Remove the retaining nut for the solenoid and . . .

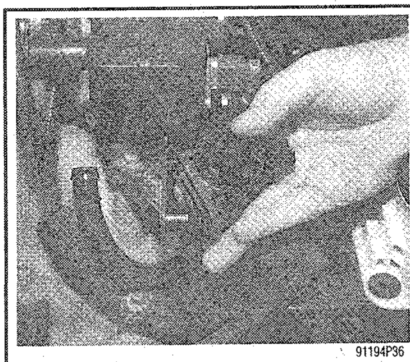

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Fig. 19 . . . remove the solenoid from the intake manifold

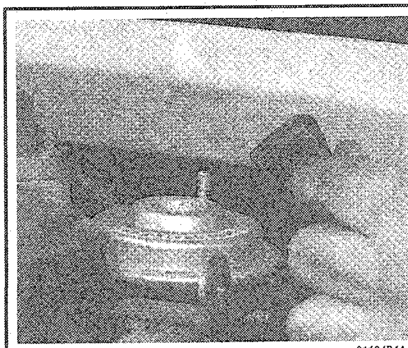

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Fig. 20 Remove the vacuum hose from the EGR valve

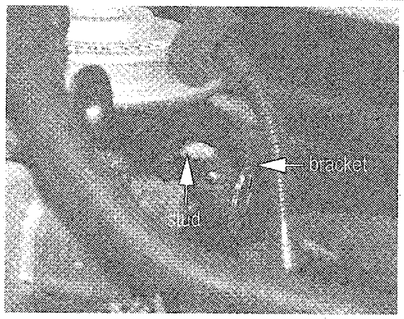

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Fig. 21 On the 4.6L engine, remove the nut and the brake booster bracket from the EGR mounting stud


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Fig. 22 Using a suitable size wrench, loosen the EGR valve-to-exhaust manifold tube and . . .

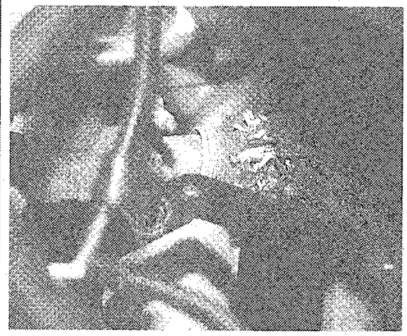
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Fig. 23 . . . remove the tube from the EGR valve

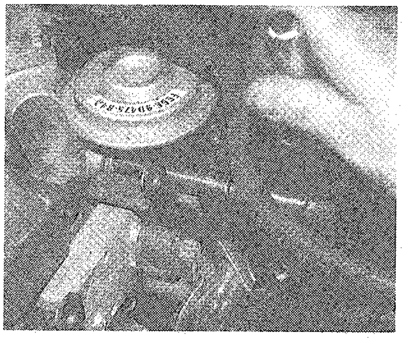
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Fig. 24 Remove the EGR valve mounting bolts and . . .

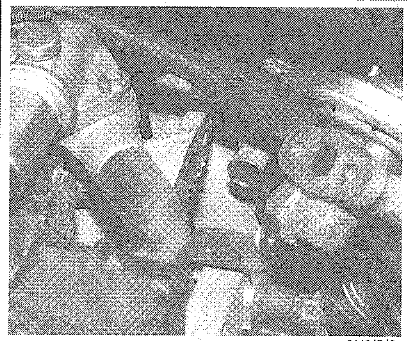
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Fig. 25 . . . remove the EGR valve from the intake manifold


91194P47

Fig. 26 Remove the EGR valve gasket and . . .

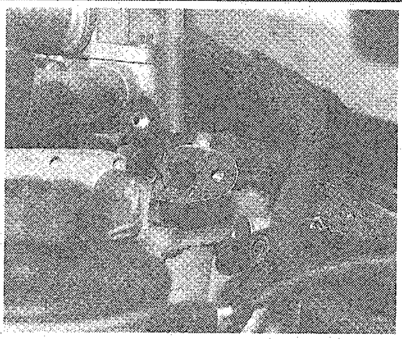
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Fig. 27 . . . thoroughly clean the EGR valve mounting surface

ket, and clean the gasket mating surfaces on the valve and the intake manifold.

To install:

7. Install the EGR valve, along with a new gasket, on the intake manifold, then install and tighten the mounting bolts.
8. Connect the EGR valve-to-exhaust manifold tube to the valve, then tighten the tube nut to 25–35 ft. lbs. (34–47 Nm).
9. Connect the vacuum hose to the EGR valve.
10. On the 4.6L engine install the brake booster bracket and the retaining nut.
11. Connect the negative battery cable.

5.0L ENGINE

1. Disconnect the negative battery cable.
2. Remove the air cleaner outlet tube.
3. Detach the EVP sensor connector.
4. Disconnect the EGR valve-to-exhaust manifold tube from the EGR valve.
5. Remove the vacuum hose from the EGR valve.
6. Remove the EGR valve mounting bolts, then separate the valve from the intake manifold.
7. Remove and discard the old EGR valve gasket, and clean the gasket mating surfaces on the valve and the intake manifold.

To install:

➡If replacing the EGR valve, transfer the EVP sensor onto the new valve.

8. Install the EGR valve, along with a new gasket, on the upper intake manifold, then install and tighten the mounting bolts.
9. Connect the EGR valve-to-exhaust manifold tube to the valve, then tighten the tube nut to 25–35 ft. lbs. (34–47 Nm).
10. Connect the vacuum hose to the EGR valve.
11. Attach the EVP sensor connector.
12. Install the air cleaner outlet tube.
13. Connect the negative battery cable.

ELECTRONIC ENGINE CONTROLS

Powertrain Control Module (PCM)

OPERATION

The Powertrain Control Module (PCM) performs many functions on your vehicle. The module accepts information from various engine sensors and computes the required fuel flow rate necessary to maintain the correct amount of air/fuel ratio throughout the entire engine operational range.

Based on the information that is received and programmed into the PCM's memory, the PCM generates output signals to control relays, actuators and solenoids. The PCM also sends out a command to the fuel injectors that meters the appropriate quantity of fuel. The module automatically senses and compensates for any changes in altitude when driving your vehicle.

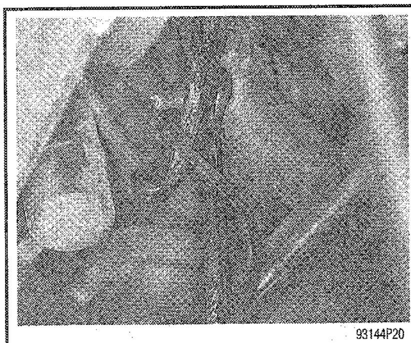
Oxygen Sensor

OPERATION

See Figure 28

The oxygen (O2) sensor is a device that produces an electrical voltage when exposed to the oxygen present in the exhaust gases. The sensor is mounted in the exhaust system, usually in the manifold or a boss located on the down pipe before the catalyst. Most of the oxygen sensors used on the sophisticated systems of today are heated internally for faster reaction when the engine is started cold. The oxygen sensor produces a voltage within zero and one volt. When there is a large amount of oxygen present (lean mixture), the sensor produces a low voltage (less than 0.4v). When there is a lesser amount present (rich mixture) it produces a higher voltage (0.6 –1.0v). The stoichiometric or correct air to fuel ratio will fluctuate between 0.4 and 0.6v. By monitoring the oxygen content and converting it to electrical voltage, the sensor acts as a rich-lean switch. The voltage is transmitted to the PCM.

Some models have two or more sensors, before the catalyst and after. This is done for a catalyst efficiency monitor that is a part of the OBD-II engine controls that are on all models from the 1995 model year on. The sensor before the catalyst measures the exhaust emissions right out of the engine, and sends the signal to the PCM about the state of the mixture as previously talked about. The second sensor reports the difference in the emissions after the exhaust gases have gone through the catalyst. This sensor reports to the PCM the amount of emissions reduction the catalyst is performing.



93144P20

Fig. 28 This is the location of the HO2 sensor on the 3.8L Continental—easily accessible

The oxygen sensor will not work until a predetermined temperature is reached, until this time the PCM is running in OPEN LOOP operation. OPEN LOOP means that the PCM has not yet begun to correct the air-to-fuel ratio by reading the oxygen sensor. After the engine comes to operating temperature, the PCM will monitor the oxygen sensor and correct the air/fuel ratio from the readings of the sensor. This is known as CLOSED LOOP operation.

A heated oxygen sensor (HO2S) has a heating element that keeps the sensor at proper operating temperature during all operating modes. Maintaining correct sensor temperature at all times allows the system to enter CLOSED LOOP operation sooner.

In CLOSED LOOP operation the PCM monitors the sensor input (along with other inputs) and adjusts the injector pulse width accordingly. During OPEN LOOP operation, the PCM ignores the sensor input and adjusts the injector pulse to a preprogrammed value based on other inputs.

TESTING

See Figure 29

WARNING

Do not pierce the wires when testing this sensor; this can lead to wiring harness damage. Backprobe the connector to properly read the voltage of the HO2S.

1. Warm the engine to normal operating temperature.
2. Turn the engine **OFF**. Disconnect the HO2S.
3. Connect a voltmeter, and engine running, measure the voltage on the DC scale between terminals **HO2S** and **SIG RTN** (GND) of the oxygen sensor connector. Voltage should fluctuate between 0.01 –1.0 volts. If voltage fluctuation is slow or voltage is not within specification, the sensor may be faulty.

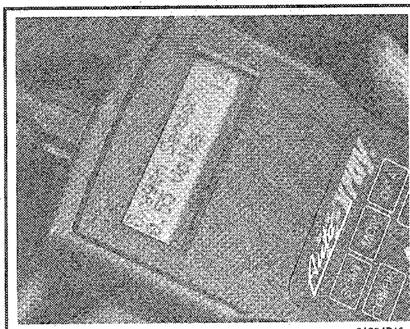
REMOVAL & INSTALLATION

See Figures 30 thru 36

An oxygen sensor socket/wrench is available from Ford or aftermarket manufacturers to ease the removal and installation of the oxygen sensor(s). If one is not available, an open-end wrench can be used.

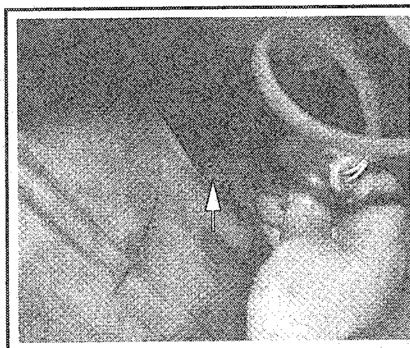
WARNING

The sensor uses a permanently attached pigtail and connector. This pigtail should



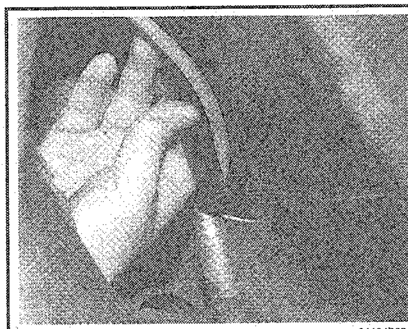
91054P13

Fig. 29 The HO2S can be monitored with an appropriate and Data-stream capable scan tool



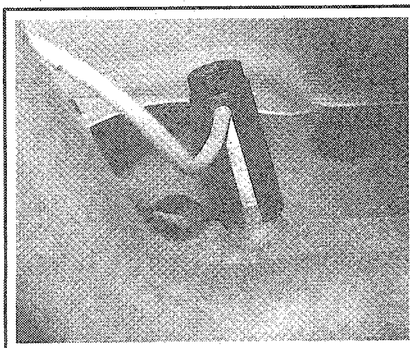
91194P20

Fig. 30 Detach the connector for the HO2S sensor



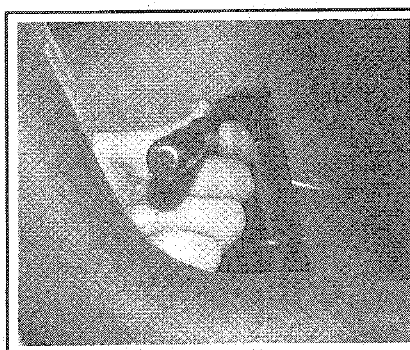
91194P23

Fig. 31 A special socket is available to remove the HO2S sensor that contains a slot for the wire harness to slide out of



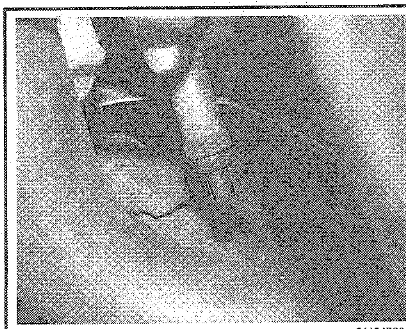
91194P22

Fig. 32 Place the socket onto the sensor and . . .



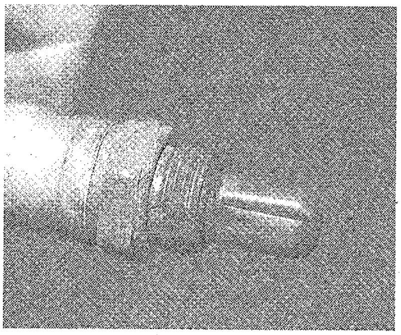
91194P21

Fig. 33 loosen the sensor using a suitable drive tool



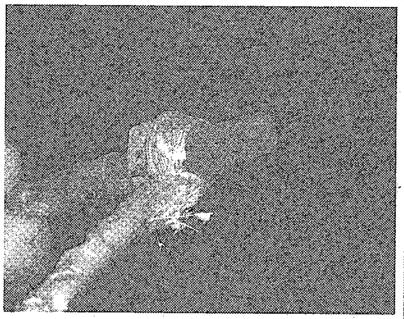
91194P26

Fig. 34 After the sensor is sufficiently loose using the drive tool, remove the sensor from the exhaust pipe by hand



91194P25

Fig. 35 Inspect the sensor tip for any signs of build-up or damage



93144P19

Fig. 36 Coat the threads of the sensor with a suitable anti-seize compound before installation

not be removed from the sensor. Damage or removal of the pigtail or connector will affect the proper operation of the sensor. Keep the electrical connector and louvered end of the sensor clean and free of grease. NEVER use cleaning solvents of any type on the sensor! The oxygen sensor may be difficult to remove when the temperature of the engine is below 120°F (49°C). Excessive force may damage the threads in the exhaust manifold or exhaust pipe.

1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Unplug the electrical connector and any attaching hardware.

➡Lubricate the sensor with penetrating oil before removal.

4. Remove the sensor using an appropriate tool. Special oxygen sensor sockets are available to remove the sensor and can be purchased at many parts stores or where automotive tools are sold. The proper size wrench can be used, most sensors are 7/8 inch or 22mm sizes.
5. A 22mm crows foot works very well.

To install:

6. Coat the threads of the sensor with a suitable anti-seize compound before installation. New sensors are treated with this compound.
7. Install the sensor and tighten it. Use care in making sure the silicone boot is in the correct position to avoid melting it during operation.
8. Attach the electrical connector.
9. Lower the vehicle.
10. Connect the negative battery cable.

Idle Air Control Valve

OPERATION

The Idle Air Control (IAC) valve adjusts the engine idle speed. The valve is located on the throttle body. The valve is controlled by a duty cycle signal from the PCM and allows air to bypass the throttle plate in order to maintain the proper idle speed.

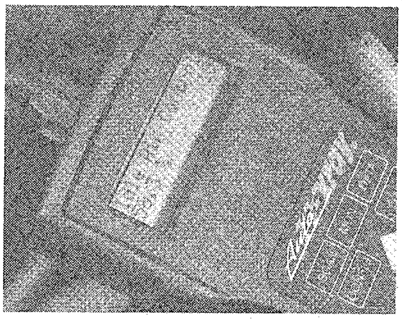
TESTING

See Figure 37

1. Turn the ignition switch to the **OFF** position.
2. Disconnect the wiring harness from the IAC valve.
3. Measure the resistance between the terminals of the valve.

➡Due to the diode in the solenoid, place the ohmmeter positive lead on the VPWR terminal and the negative lead on the ISC terminal.

4. Resistance should be 7–13 ohms.
5. If resistance is not within specification, the valve may be faulty.



91054P12

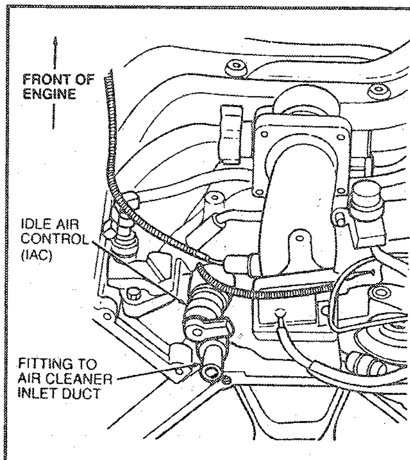
Fig. 37 The IAC can be monitored with an appropriate and Data-stream capable scan tool

REMOVAL & INSTALLATION

See Figures 38 and 39

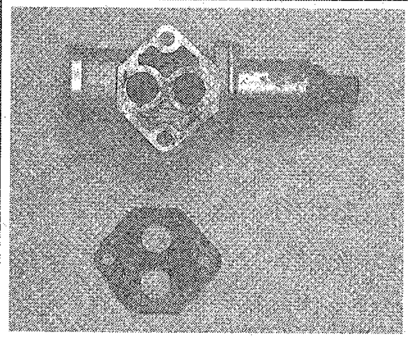
1. Disconnect the negative battery cable.
2. Detach the IAC solenoid connector.
3. Remove the two retaining bolts and remove the IAC solenoid and gasket from the throttle body.
4. Installation is the reverse of the removal procedure. Use a new gasket and tighten the retaining bolts to 71–97 inch lbs. (8–11 Nm).

➡If scraping is necessary to remove old gasket material, be careful not to damage the IAC solenoid or the throttle body gasket surfaces or drop material into the throttle body.



84174028

Fig. 38 IAC solenoid location—4.6L engine



93143P08

Fig. 39 This is an IAC valve off of a 5.0L engine

Engine Coolant Temperature (ECT) Sensor

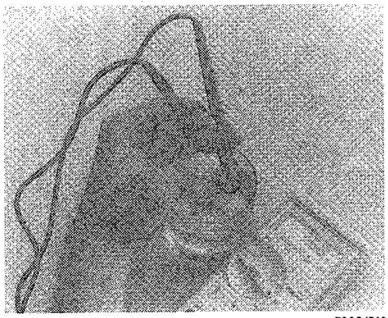
OPERATION

The Engine Coolant Temperature (ECT) sensor resistance changes in response to engine coolant temperature. The sensor resistance decreases as the coolant temperature increases, and increases as the coolant temperature decreases. This provides a reference signal to the PCM, which indicates engine coolant temperature. The signal sent to the PCM by the ECT sensor helps the PCM to determine spark advance, EGR flow rate, air/fuel ratio, and engine temperature. The ECT is a two-wire sensor, a 5-volt reference signal is sent to the sensor and the signal return is based upon the change in the measured resistance due to temperature.

TESTING

See Figures 40, 41 and 42

1. Disconnect the engine wiring harness from the ECT sensor.
2. Connect an ohmmeter between the ECT sensor terminals.



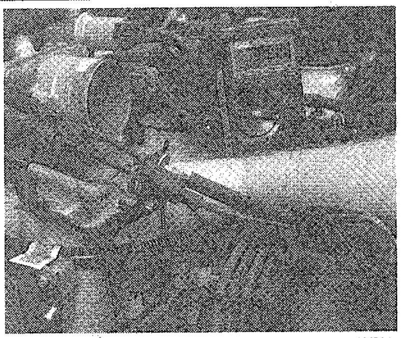
TCCS4P02

Fig. 40 Another method of testing the ECT is to submerge it in cold or hot water and check resistance

Temperature		Engine Coolant/Intake Air Temperature Sensor Values
°F	°C	Resistance (K ohms)
248	120	1.18
230	110	1.55
212	100	2.07
194	90	2.80
176	80	3.84
158	70	5.37
140	60	7.70
122	50	10.97
104	40	16.15
86	30	24.27
68	20	37.30
50	10	58.75

89694G23

Fig. 41 ECT resistance-to-temperature specifications



91194P14

Fig. 42 Test the ECT resistance across the two sensor terminals

3. With the engine cold and the ignition switch in the **OFF** position, measure and note the ECT sensor resistance.
4. Connect the engine wiring harness to the sensor.
5. Start the engine and allow the engine to reach normal operating temperature.
6. Once the engine has reached normal operating temperature, turn the engine **OFF**.
7. Again, disconnect the engine wiring harness from the ECT sensor.
8. Measure and note the ECT sensor resistance with the engine hot.
9. Compare the cold and hot ECT sensor resistance measurements with the accompanying chart.
10. If readings do not approximate those in the chart, the sensor may be faulty.

REMOVAL & INSTALLATION

See Figures 43 thru 48

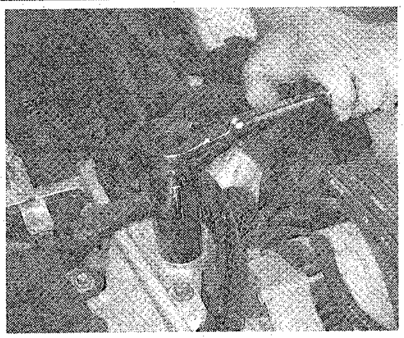
1. Disconnect the negative battery cable.
2. Drain and recycle the engine coolant.

CAUTION

Never open, service, or drain the radiator or cooling system when hot; serious burns can occur from the steam and hot coolant. In addition, when draining engine coolant, keep in mind that cats and dogs are attracted to ethylene glycol antifreeze and could drink any that is left in an uncovered container or in puddles on the ground. This

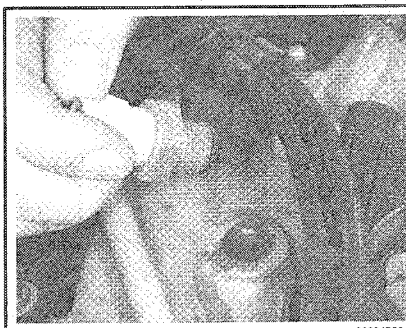
89604P21

Fig. 43 Detach the connector for the ECT sensor and . . .



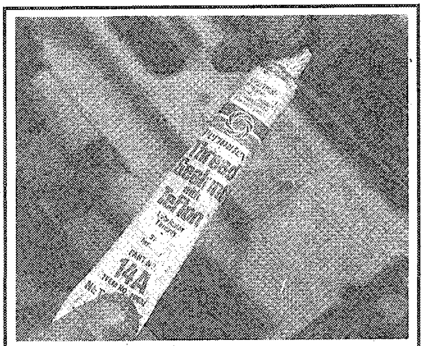
89604P22

Fig. 44 . . . and loosen the sensor using a suitable socket or other drive tool



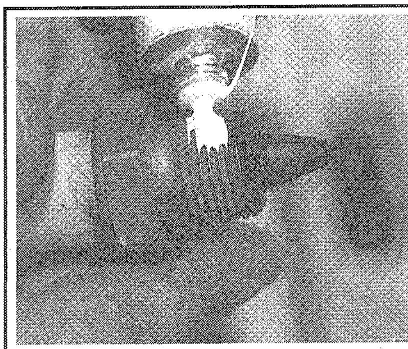
89604P23

Fig. 45 Once the sensor is sufficiently loose, remove the sensor from the intake manifold by hand



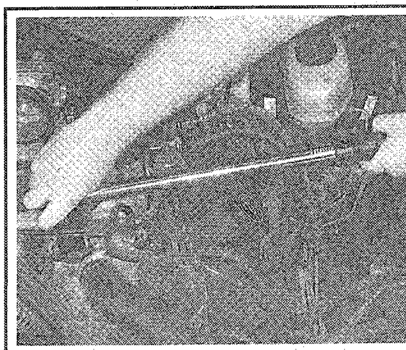
91054P36

Fig. 46 Use a quality thread sealant to . . .



91054P37

Fig. 47 . . . coat the threads of the ECT sensor before installation



89604P24

Fig. 48 The ECT sensor must be tightened with a torque wrench to specifications

will prove fatal in sufficient quantities. Always drain coolant into a sealable container. Coolant should be reused unless it is contaminated or is several years old.

3. Remove the air cleaner outlet tube if necessary.
4. Detach the ECT sensor connector.
5. Remove the ECT sensor from the intake manifold.

To install:

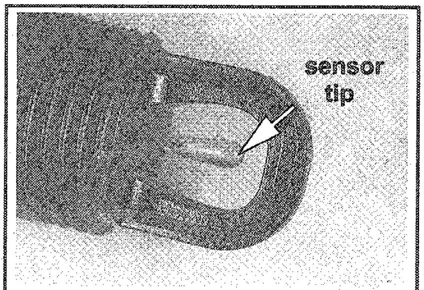
6. Coat the sensor threads with Teflon® sealant.
7. Thread the sensor into position and tighten to 6–8 ft. lbs. (8–13 Nm).
8. Attach the ECT sensor connector.
9. Install the air cleaner outlet tube.
10. Connect the negative battery cable.
11. Refill the engine cooling system.
12. Start the engine and check for coolant leaks.
13. Bleed the cooling system.

Intake Air Temperature Sensor

OPERATION

See Figure 49

The Intake Air Temperature (IAT) sensor determines the air temperature inside the intake manifold. Resistance changes in response to the ambient air temperature. The sensor has a negative temperature coefficient. As the temperature of the sensor rises the resistance across the sensor decreases. This provides a signal to the PCM indicating the temperature of the incoming air charge. This sensor helps the PCM to determine spark timing and air/fuel ratio. Information from this sensor is added to the pressure sensor information to calculate the air mass being sent to the cylinders. The IAT is a two-wire sensor, a 5-volt reference signal is sent to the sensor and the signal return is based upon the change in the measured resistance due to temperature.



89604P14

Fig. 49 The tip of the IAT sensor has an exposed thermistor that changes the resistance of the sensor based upon the force of the air rushing past it

TESTING

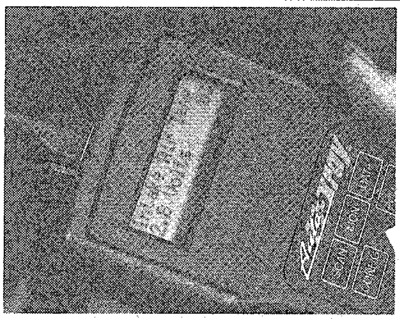
See Figures 50 and 51

1. Turn the ignition switch **OFF**.
2. Disconnect the wiring harness from the IAT sensor.
3. Measure the resistance between the sensor terminals.
4. Compare the resistance reading with the accompanying chart.
5. If the resistance is not within specification, the IAT may be faulty.
6. Connect the wiring harness to the sensor.

REMOVAL & INSTALLATION

1988–95 Models

1. Disconnect the negative battery cable.
2. Detach the electrical connector from the IAT sensor.
3. Using a suitable socket and drive tool, remove the IAT sensor from the air inlet.



91054P09

Fig. 50 The IAT sensor can be monitored with an appropriate and Data-stream capable scan tool

4. On the 5.0L engine Lincoln models, the IAT sensor is located in the intake manifold

To install:

5. Coat the sensor threads with Teflon® sealant.
6. Thread the sensor into position and tighten it to 6–8 ft. lbs. (8–13 Nm)..
7. Attach the electrical connector to the IAT sensor.
8. Connect the negative battery cable.

1996–00 Models

1. Disconnect the negative battery cable.
2. Detach the electrical connector from the IAT sensor.
3. Turn the sensor 90° counterclockwise and remove the IAT sensor from the air cleaner lid.
4. Remove the sensor O-ring and inspect it. Replace as necessary.

To install:

5. The installation is the reverse of the removal.

Mass Airflow Sensor

OPERATION

See Figure 52

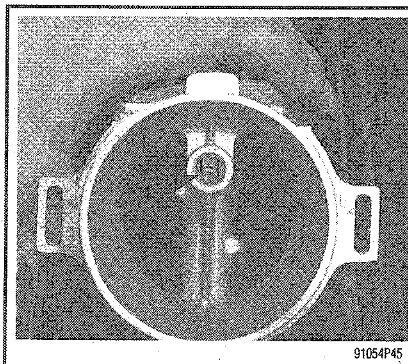
The Mass Air Flow (MAF) sensor directly measures the mass of air being drawn into the engine. The sensor output is used to calculate injector pulse width. The MAF sensor is what is referred to as a "hot-wire sensor". The sensor uses a thin platinum wire filament, wound on a ceramic bobbin and coated with glass, that is heated to 200°C (417°F) above the ambient air temperature and subjected to the intake airflow stream. A "cold-wire" is used inside the MAF sensor to determine the ambient air temperature.

Battery voltage from the EEC power relay, and a reference signal and a ground signal from the PCM are supplied to the MAF sensor. The sensor returns a signal proportionate to the current flow required keeping the "hot-wire" at the required temperature. The increased airflow across the "hot-wire" acts as a cooling fan, lowering the resistance and requiring more current to maintain the temperature of the wire. The voltage in the circuit measures the increased current. As current increases, voltage increases. As the airflow increases the signal return voltage of a normally operating MAF sensor will increase.

Temperature		Engine Coolant/Intake Air Temperature Sensor Values
°F	°C	Resistance (K ohms)
248	120	1.18
230	110	1.55
212	100	2.07
194	90	2.80
176	80	3.84
158	70	5.37
140	60	7.70
122	50	10.97
104	40	16.15
86	30	24.27
68	20	37.30
50	10	58.75

89694G23

Fig. 51 IAT resistance-to-temperature specifications



91054P45

Fig. 52 The exposed "hot wire" of the MAF sensor

TESTING

See Figure 53

1. Using a multimeter, check for voltage by backprobing the MAF sensor connector.
2. With the key **ON**, and the engine **OFF**, verify that there is at least 10.5 volts between the VPWR and GND terminals of the MAF sensor connector. If voltage is not within specification, check power and ground circuits and repair as necessary.
3. With the key **ON**, and the engine **ON**, verify that there is at least 4.5 volts between the SIG and GND terminals of the MAF sensor connector. If voltage is not within specification, check power and ground circuits and repair as necessary.
4. With the key **ON**, and the engine **ON**, check voltage between GND and SIG RTN terminals. Voltage should be approximately 0.34–1.96 volts. If voltage is not within specification, the sensor may be faulty.

93144P08

Fig. 53 Unplugging the sensor connector below the MAF sensor, for testing purposes

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Remove the air intake tube from the MAF sensor and the throttle body.
3. Detach the connector from the MAF sensor.
4. Remove the four sensor retaining screws and remove the sensor.
5. Remove the sensor gasket.

To install:

6. Installation is the reverse of removal.

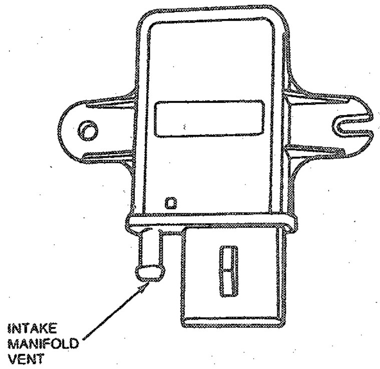
Manifold Air Pressure (MAP) Sensor

OPERATION

The most important information for measuring engine fuel requirements comes from the pressure sensor. Using the pressure and temperature data, the PCM calculates the intake air mass. It is connected to the engine intake manifold through a hose and takes readings of the absolute pressure. A piezoelectric crystal changes a voltage input to a frequency output, which reflects the pressure in the intake manifold.

Atmospheric pressure is measured when the engine is started and when driving fully loaded, then the pressure sensor information is adjusted accordingly.

The Manifold Absolute Pressure (MAP) sensor was used on the 3.8L & the 5.0L engines, until it was replaced by the Mass Air Flow (MAF). The MAP sensor operates as a pressure-sensing disc. It does not generate a voltage; instead its output is a frequency change. The sensor changes frequency according to intake manifold vacuum; as vacuum increases sensor frequency increases. This gives the Powertrain Control Module (PCM) information on engine load. The PCM uses the MAP sensor signal to help determine spark advance, EGR flow and air/fuel ratio.



84174020

Fig. 54 Manifold Absolute Pressure Sensor

TESTING

See Figures 54, 55 and 56

Unusually high or low barometric pressures can generate a false DTC for the MAP sensor. If no driveability symptoms accompany the MAP code, do not replace it.

1. Connect a MAP/BARO tester to the sensor connector and sensor harness connector. With ignition **ON** and engine **OFF**, use DVOM to measure voltage across tester terminals. If the tester's 4-6V indicator is ON, the reference voltage input to the sensor is okay.

The green light on the tester indicates that the VREF circuit is okay, 4–6 volts. A red light or no light indicates the VREF is either too low or too high.

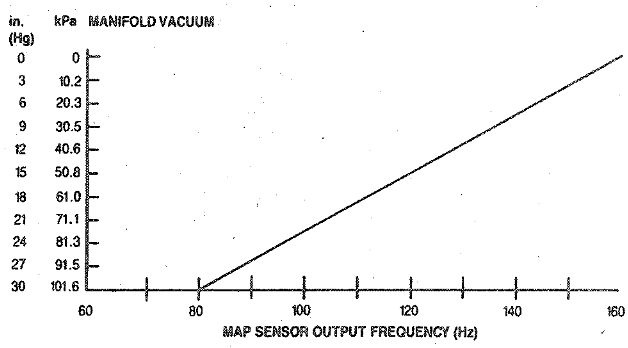
Approximate Altitude (Ft.)	Voltage Output (±.04 Volts)
0	1.59
1000	1.56
2000	1.53
3000	1.50
4000	1.47
5000	1.44
6000	1.41
7000	1.39

84174023

Fig. 55 MAP sensor altitude/voltage output relationship

MAP Sensor Graph

NOTE: **MAP sensor output frequency versus manifold vacuum data is based on 30.0 in-Hg barometric pressure.**



MAP Sensor Data

Manifold Vacuum		Frequency
in-Hg	kPa	Hz
0	0	159
3	10.2	150
6	20.3	141
9	30.5	133
12	40.6	125
15	50.8	117
18	61.0	109
21	71.1	102
24	81.3	95
27	91.5	88
30	101.6	80

84174022

Fig. 56 MAP sensor frequency data

2. Measure the reference signal of the MAP sensor. If the DVOM voltage reading is as indicated in the table, the sensor is okay.
   a. Turn the ignition **OFF**.
   b. Disconnect the vacuum hose from the MAP sensor and connect a vacuum pump in its place.
   c. Apply 18 in. Hg of vacuum to the MAP sensor.
   d. If the MAP sensor holds vacuum, it is okay. If the MAP sensor does not hold vacuum, it must be replaced.

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.
2. Detach the electrical connector and the vacuum line from the sensor.
3. Remove the sensor mounting bolts and remove the sensor.
4. Installation is the reverse of the removal procedure.

Throttle Position Sensor

OPERATION

The Throttle Position (TP) sensor is a potentiometer that provides a signal to the PCM that is directly proportional to the throttle plates position. The TP sensor is mounted on the side of the throttle body and is connected to the throttle plate shaft. The TP sensor monitors the throttle plate's movement and position, and transmits an appropriate electrical signal to the PCM. The PCM uses these signals to adjust the air/fuel mixture, spark timing, and EGR operation according to engine load at idle, part throttle, or full throttle. The TP sensor is not adjustable.

The TP sensor receives a 5-volt reference signal and a ground circuit from the PCM. A return signal circuit connects to a wiper that runs on a resistor internally in the sensor. The more the throttle opens the further the wiper moves along the resistor. At wide open throttle, the wiper essentially creates a loop between the reference signal and the signal return, returning the full, or nearly full 5 volt signal back to the PCM. At idle the signal return should be approximately 0.9 volts.

TESTING

See Figures 57, 58, 59 and 60

1. With the engine **OFF** and the ignition **ON**, check the voltage at the signal return circuit of the TP sensor by carefully backprobing the connector using a DVOM.
2. Voltage should be between 0.2 and 1.4 volts at idle.
3. Slowly move the throttle pulley to the wide-open throttle (WOT) position and watch the voltage on the DVOM. The voltage should slowly rise to slightly less than 4.8v at Wide Open Throttle (WOT).
4. If no voltage is present, check the wiring harness for supply voltage (5.0v) and ground (0.3v or less), by referring to your corresponding wiring guide. If supply voltage and ground are present, but no output voltage from TP, replace the TP sensor. If supply voltage and ground do not meet specifications, make necessary repairs to the harness or PCM.

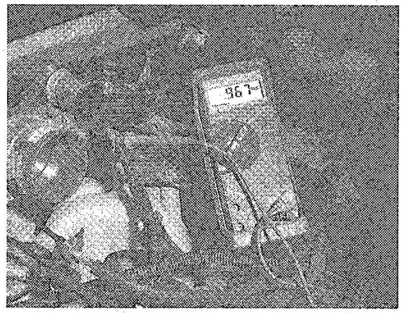

91194P53

Fig. 57 Testing the TP sensor signal return voltage at idle

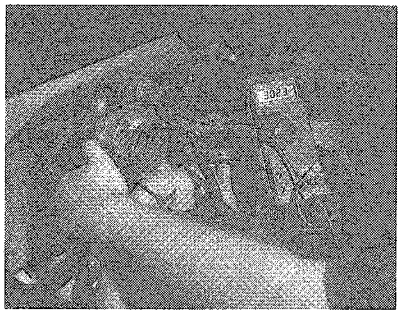

91194P55

Fig. 58 Test the operation of the TP sensor by gently opening the throttle while observing the signal return voltage. The voltage should move smoothly according to the amount the throttle is opened

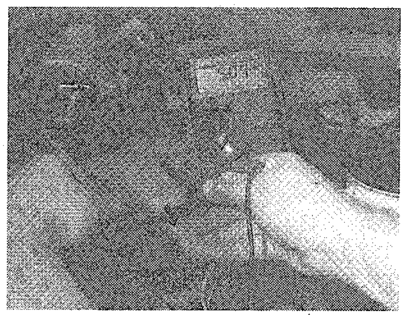

91194P52

Fig. 59 Testing the supply voltage at the TP sensor connector

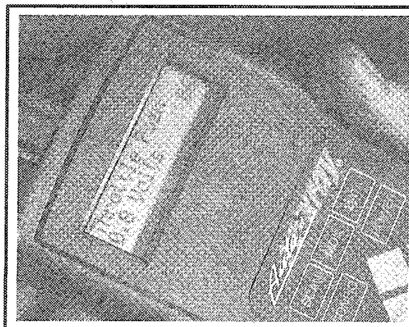

91054P11

Fig. 60 The TP sensor can be monitored with an appropriate and Data-stream capable scan tool

REMOVAL & INSTALLATION

1. Disconnect the negative battery cable.

On a 4.6L engine, it may be necessary to remove the throttle cover from the engine.

2. Disconnect the wiring harness from the TP sensor.
3. Remove the two sensor mounting screws, then pull the TP sensor off of the throttle shaft.

To install:

4. Carefully slide the rotary tangs on the sensor into position over the throttle shaft, then rotate the sensor clockwise to the installed position..

CAUTION

Failure to install the TP sensor in this manner may result in sensor damage or high idle speeds.

The TP sensor is not adjustable.

5. Install and tighten the sensor mounting screws to 27 inch lbs. (3 Nm).
6. Connect the wiring harness to the sensor.
7. If removed, install the throttle cover.
8. Connect the negative battery cable.

Camshaft Position Sensor

The Camshaft Position Sensor (CMP) is only outfitted on the 4.6L engine.

The camshaft position sensor (CMP) is a variable reluctance sensor that is triggered by a high point on the left-hand exhaust camshaft sprocket. The CMP sends a signal relating camshaft position back to the PCM and that signal is used by the PCM to check engine timing.

TESTING

1. Check voltage between the camshaft position sensor terminals PWR GND and CID.
2. With engine running, voltage should be greater than 0.1 volt AC and vary with engine speed.
3. If voltage is not within specification, check for proper voltage at the VPWR terminal.
4. If VPWR voltage is greater than 10.5 volts, sensor may be faulty.

REMOVAL & INSTALLATION

4.6L Engine

See Figures 61, 62 and 63

1. Disconnect the negative battery cable.
2. Detach the electrical connector for the CMP sensor.
3. Remove the CMP sensor retaining bolt(s) and remove the CMP sensor from the front cover.

To install:

4. Installation is the reverse of removal.

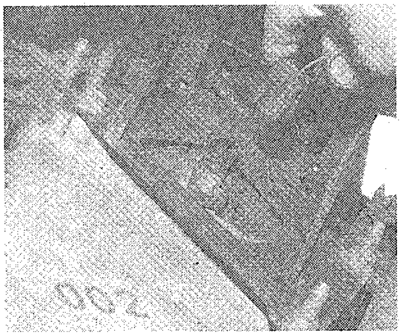

91194P57

Fig. 61 Detach the connector for the CMP sensor and . . .

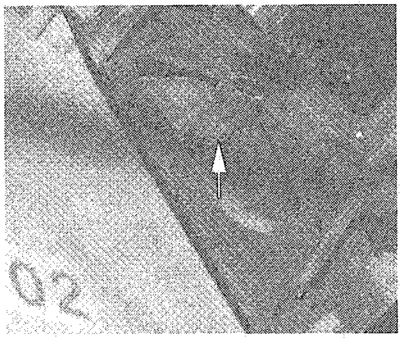

91194P58

Fig. 62 . . . remove the bolt retaining the CMP sensor to the front cover and . . .


91194P59

Fig. 63 . . . remove the sensor

Crankshaft Position Sensor

OPERATION

See Figure 64

The Crankshaft Position (CKP) sensor is a variable reluctance sensor that uses a trigger wheel to induce voltage. The CKP sensor is a fixed magnetic sensor mounted to the engine block and monitors the trigger or "pulse" wheel that is attached to the crank pulley/damper. As the pulse wheel rotates by the CKP sensor, teeth on the pulse wheel induce voltage inside the sensor through magnetism. The pulse wheel has a missing tooth that changes the reading of the sensor. This is used for the Cylinder Identification (CID) function to properly monitor and adjust engine timing by locating the number 1 cylinder. The voltage created by the CKP sensor is alternating current (A/C). This voltage reading is sent to the PCM, it is used to determine engine RPM, engine timing, and is used to fire the ignition coils.

TESTING

1. Measure the voltage between the sensor CKP sensor terminals by backprobing the sensor connector.

If the connector cannot be backprobed, fabricate or purchase a test harness.

2. Sensor voltage should be more than 0.1 volt AC with the engine running and should vary with engine RPM.
3. If voltage is not within specification, the sensor may be faulty.

REMOVAL & INSTALLATION

See Figure 65

1. Disconnect the negative battery cable.
2. Remove the accessory drive belt from the engine.
3. Raise and safely support the vehicle.
4. Remove the A/C compressor mounting bolts, but do not disconnect the A/C lines. Remove and support the compressor out of the way.
5. Detach the electrical connector for the CKP sensor.
6. Remove the CKP sensor retaining bolts and remove the CKP sensor.

To install:

7. Installation is the reverse of removal.

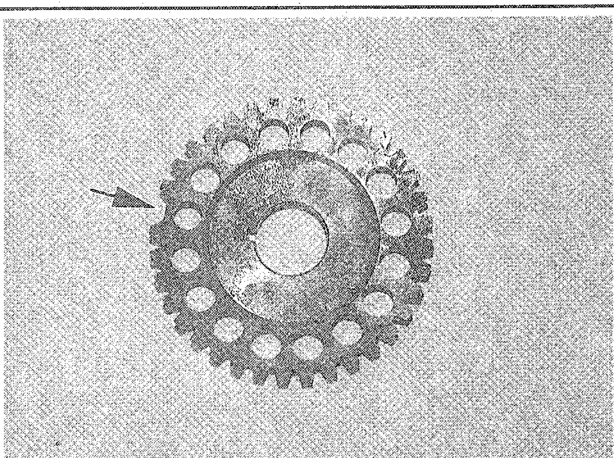

91194P63

Fig. 64 The CKP sensor trigger wheel rides on the front of the crankshaft. The missing tooth creates a fluctuation of voltage in the sensor

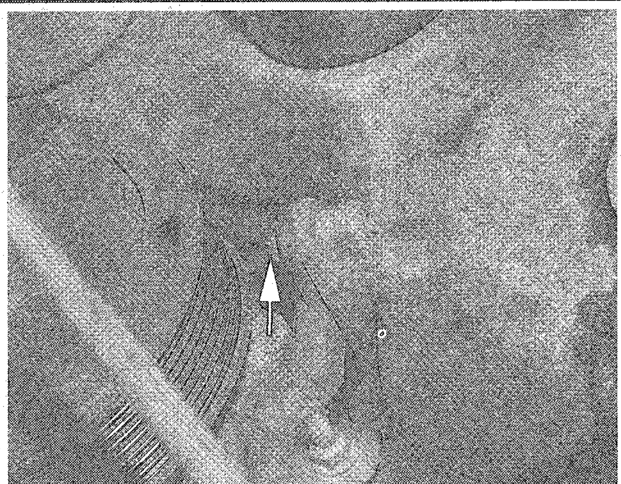

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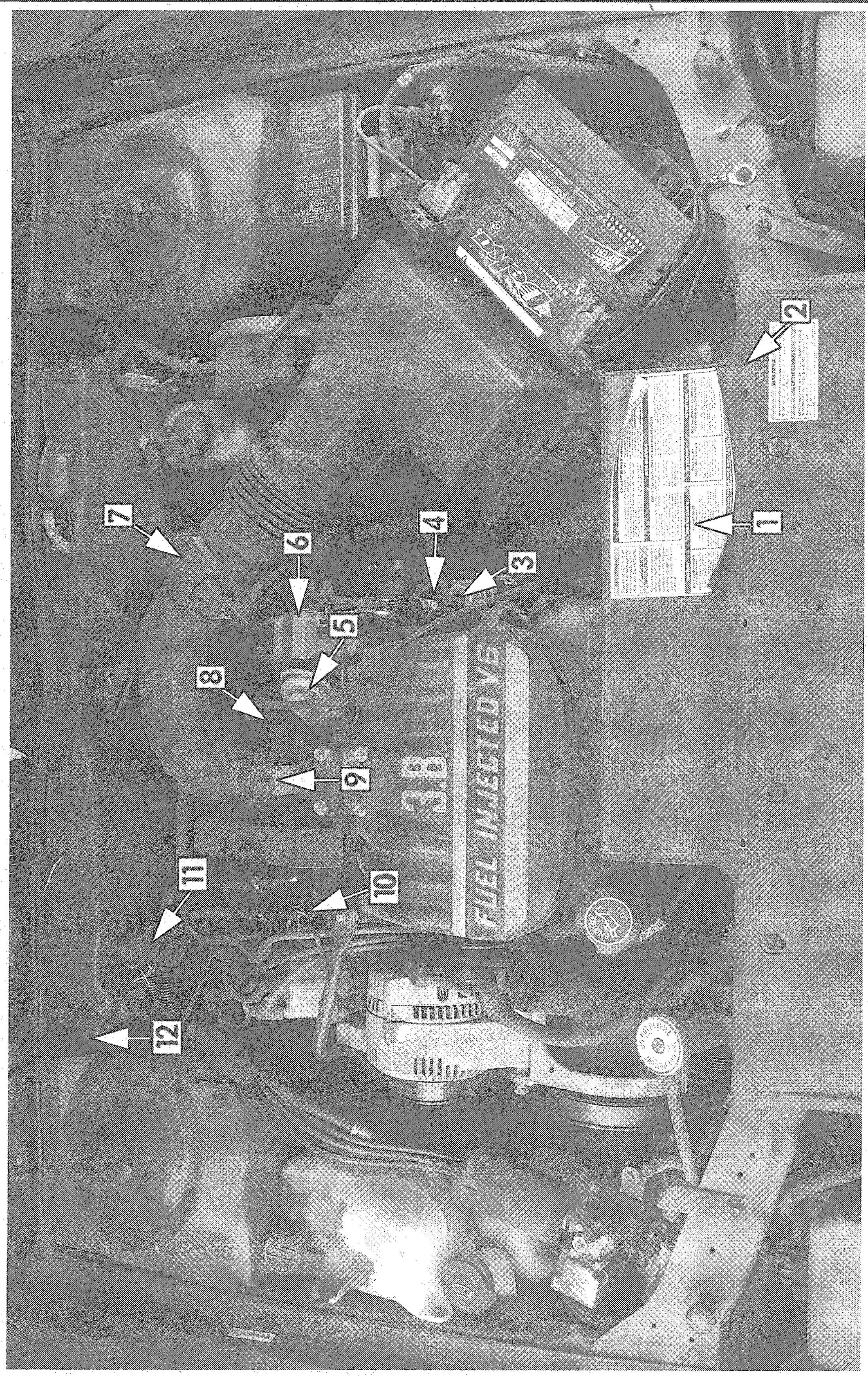
Fig. 65 Remove the retaining bolt for the CKP sensor and remove the sensor from the front cover

COMPONENT LOCATIONS

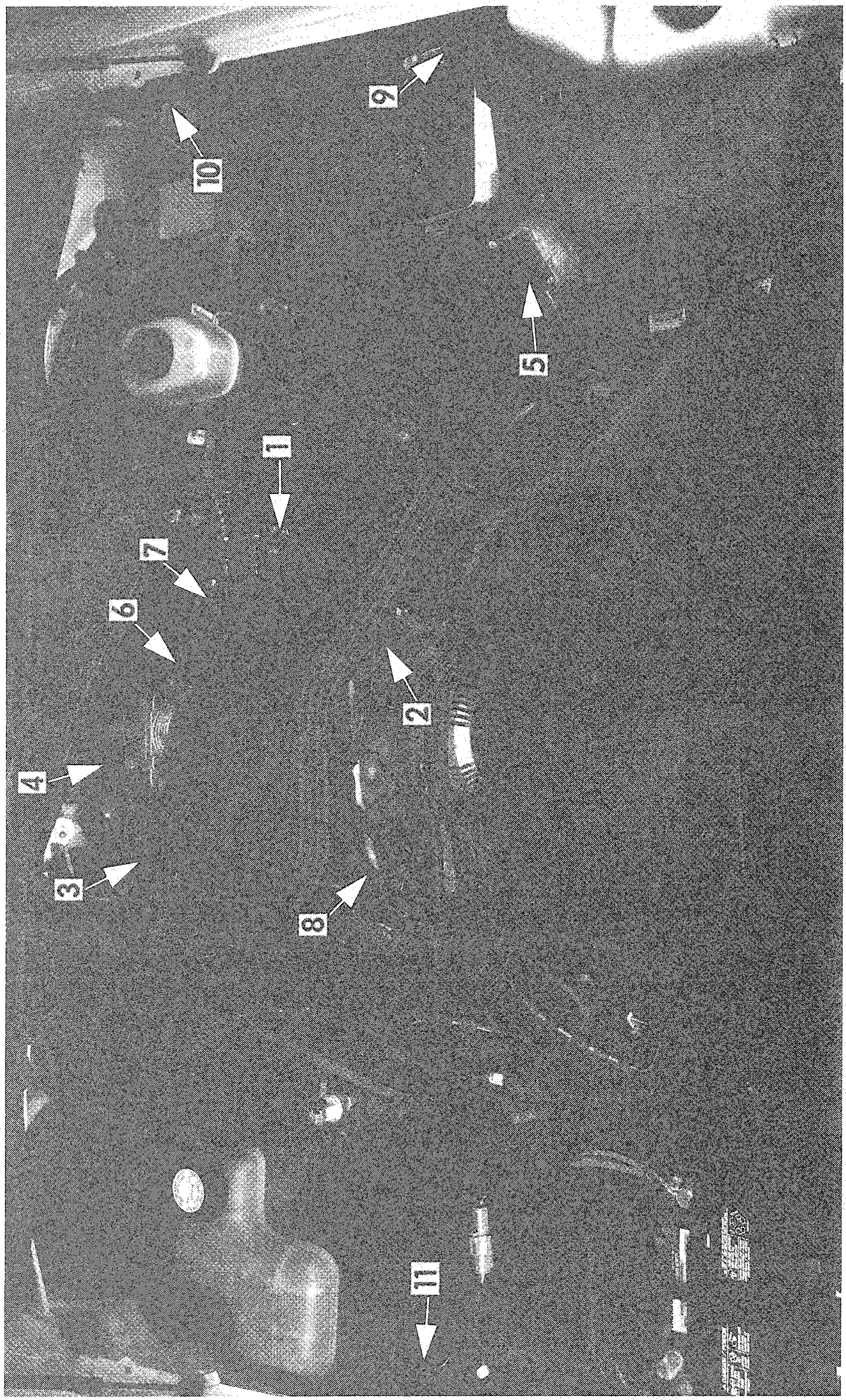


COMMON EMISSIONS AND ELECTRONIC ENGINE CONTROL COMPONENT LOCATIONS—3.8L ENGINE

1. VECI decal
2. ICRM control (under sight shield)
3. Fuel pressure regulator
4. ECT (Engine Coolant Temperature) sensor
5. EGR (Exhaust Gas Recirculation) valve
6. PFE (Pressure Feedback Exhaust) sensor
7. MAF (Mass Air Flow) sensor
8. TP (Throttle Position) sensor
9. IAC (Idle Air Control) valve
10. Fuel injector (6 total)
11. Scan tool (VIP test) connector
12. TFI (Ignition) module

COMMON EMISSIONS AND ELECTRONIC ENGINE CONTROL COMPONENT LOCATIONS—4.6L ENGINE

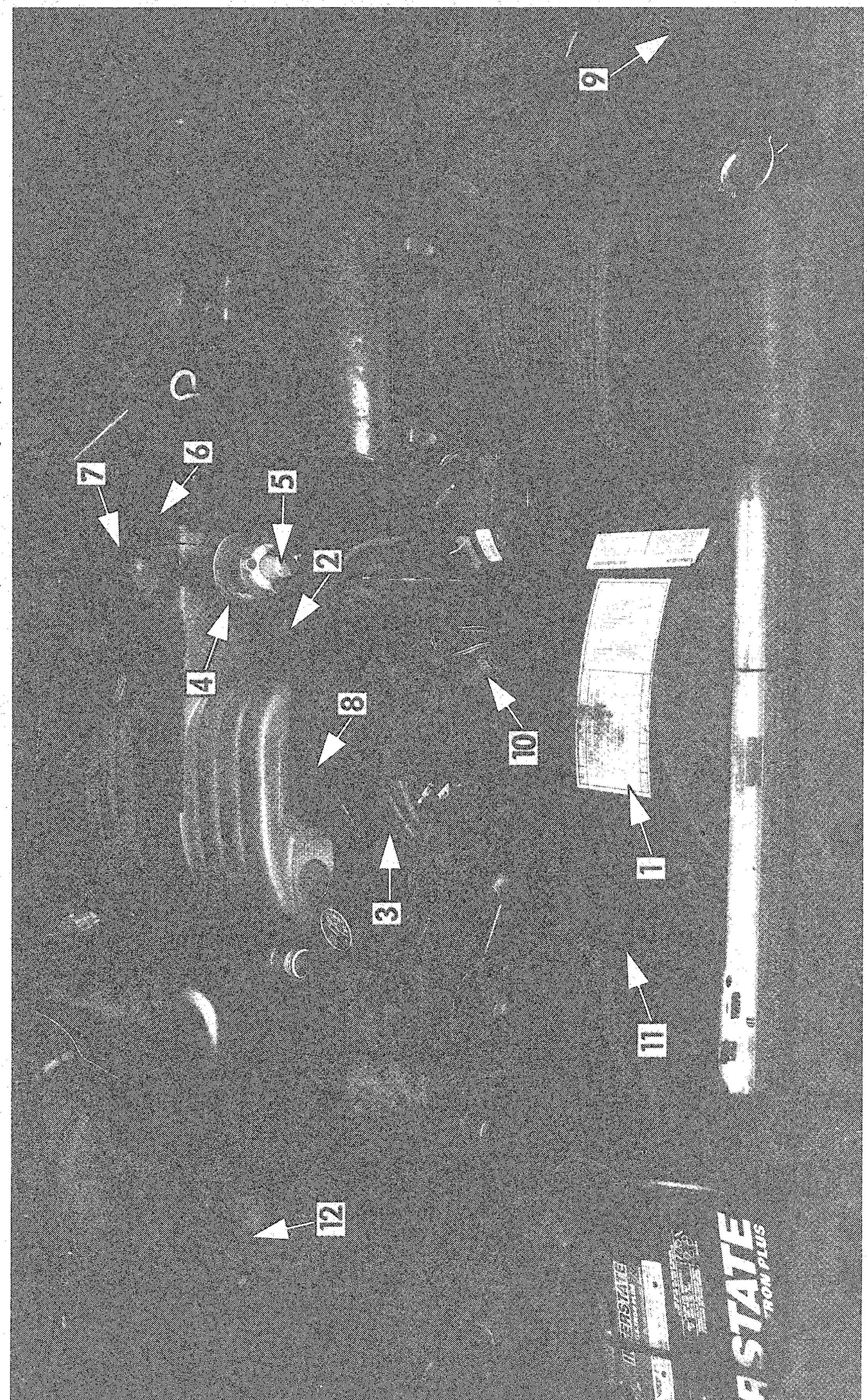
1. Fuel pressure regulator
2. ECT (Engine Coolant Temperature) sensor
3. EGR (Exhaust Gas Recirculation) valve
4. DPFE (Delta Pressure Feedback Exhaust) sensor
5. MAF (Mass Air Flow) sensor
6. TP (Throttle Position) sensor
7. IAC (Idle Air Control) valve
8. Fuel injector (8 total)
9. Scan tool (VIP test) connector
10. EDIS (Electronic Distributorless Ignition) module
11. Anti-lock brake test connector



93144P23

COMMON EMISSIONS AND ELECTRONIC ENGINE CONTROL COMPONENT LOCATIONS—5.0L ENGINE

1. VECI decal
2. Fuel pressure regulator
3. ECT (Engine Coolant Temperature) sensor
4. EGR (Exhaust Gas Recirculation) valve
5. EVP (Electronic Valve Position) sensor
6. TP (Throttle Position) sensor
7. IAC (Idle Air Control) vale
8. Fuel injectors (8 total)
9. Scan tool (VIP test) connector
10. TFI (Ignition) module
11. Thermactor pump
12. EVR (Electronic Vacuum Regulator)



TROUBLE CODES —EEC-IV SYSTEM

General Information

The Powertrain Control Module (PCM) is devoted to monitoring both input and output functions within the system. This ability forms the core of the self-diagnostic system. If a problem is detected within a circuit, the controller will recognize the fault, assign it an identification code, and store the code in a memory section. Depending on the year and model, the fault code(s) may be represented by two or three-digit numbers. The stored code(s) may be retrieved during diagnosis.

While the EEC-IV system is capable of recognizing many internal faults, certain faults will not be recognized. Because the computer system sees only electrical signals, it cannot sense or react to mechanical or vacuum faults affecting engine operation. Some of these faults may affect another component which will set a code. For example, the PCM monitors the output signal to the fuel injectors, but cannot detect a partially clogged injector. As long as the output driver responds correctly, the computer will read the system as functioning correctly. However, the improper flow of fuel may result in a lean mixture. This would, in turn, be detected by the oxygen sensor and noticed as a constantly lean signal by the PCM. Once the signal falls outside the pre-programmed limits, the engine control assembly would notice the fault and set an identification code.

FAILURE MODE EFFECTS MANAGEMENT (FMEM)

The PCM contains back-up programs that allow the engine to operate if a sensor signal is lost. If sensor input is seen to be out of range —either high or low —the FMEM program is used. The processor substitutes a fixed value for the missing sensor signal. The engine will continue to operate, although performance and driveability may be noticeably reduced. This function of the controller is sometimes referred to as the limp-in or fail-safe mode. If the missing sensor signal is restored, the FMEM system immediately returns the system to normal operation. The dashboard-warning lamp will be lit when FMEM is in effect.

HARDWARE LIMITED OPERATION STRATEGY (HLOS)

This mode is only used if the fault is too extreme for the FMEM circuit to handle. In this mode, the processor has ceased all computation and control; the entire system is run on fixed values. The vehicle may be operated but performance and driveability will be greatly reduced. The fixed or default settings provide minimal calibration, allowing the vehicle to be carefully driven in for service. The dashboard-warning lamp will be lit when HLOS is engaged. Codes cannot be read while the system is operating in this mode.

Diagnostic Link Connector

With the advent of OBD-II, the Federal Government has mandated the location of the DLC (Data Link Connector) .The Data Link Connector is located in the passenger compartment. It is attached to the instrument panel and accessible from the driver's seat.

The DLC is rectangular in design and capable of allowing access to 16 terminals. The connector has keying features that allow easy connection. The test equipment and the DLC have a latching feature to ensure a good mated connection. The Scan tool uses the DLC as a pathway to communicate with the on board computer system.

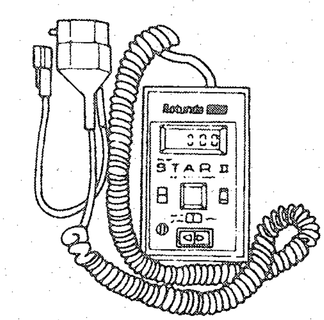
If the DLC is not located under the dash, the vehicle is using OBD-I. This is a slightly different management system in its operation and diagnosis. Look for DLC under the hood near the left front headlight on the Town Car and Mark VII, near the right side firewall on the Continental.

HAND-HELD SCAN TOOLS

➧ **See Figures 66, 67, 68 and 69**

Although stored codes may be read through the flashing of the CHECK ENGINE or SERVICE ENGINE SOON lamp, the use of hand-held scan tools such as Ford's Self-Test Automatic Readout (STAR) tester or the second generation SUPER STAR II tester or their equivalent is highly recommended. There are many manufacturers of these tools; the purchaser must be certain that the tool is proper for the intended use.

The scan tool allows any stored faults to be read from the engine controller memory. Use of the scan tool provides additional data during troubleshooting, but does not eliminate the use of the charts. The scan tool makes collecting information easier, but an operator familiar with the system must correctly interpret the data.



84924047

Fig. 66 Super Star II tester —Ford Motor Co.

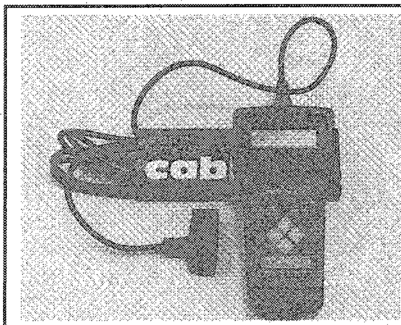


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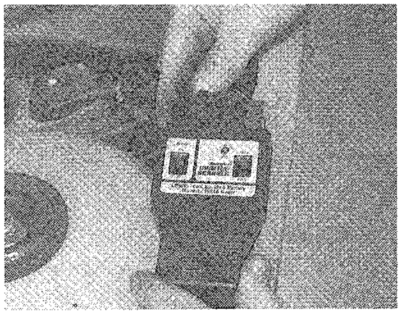
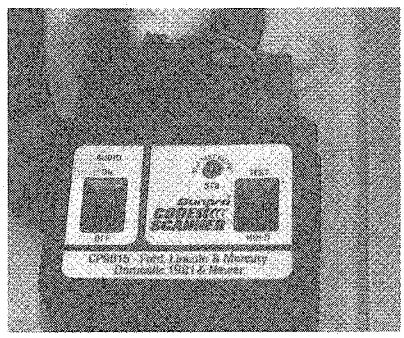
Fig. 67 Inexpensive scan tools, such as this Auto Xray ®, are available to interface with your Ford vehicle



91054P14

Fig. 68 An economically friendly alternative is this Code Scanner® from SunPro. They are purchased according to manufacturer and are available at many parts stores



91054P16

Fig. 69 The Code Scanner® from SunPro has no LCD display, just a LED that will flash out the codes and an audible buzzer to alert that the test is in progress

ELECTRICAL TOOLS

The most commonly required electrical diagnostic tool is the digital multimeter; also known as a Digital Volt Ohmmeter (DVOM), which permits voltage, resistance (ohms) and amperage to be read by one instrument.

The multimeter must be a high impedance unit, with 10 megaohms of impedance in the voltmeter. This type of meter will not place an additional load on the circuit it is testing; this is extremely important in low voltage circuits. The multimeter must be of high quality in all respects. It should be handled carefully and protected from impact or damage. Replace the batteries frequently in the unit.

Additionally, an analog (needle type) voltmeter may be used to read stored fault codes if the STAR tester is not available. The codes are transmitted as visible needle sweeps on the face of the instrument.

Nearly all the diagnostic procedures will require the use of a Breakout Box, a device that connects into the EEC-IV harness and provides testing ports for the 60 wires in the harness. Direct testing of the harness connectors at the terminals or by backprobing is not recommended; damage to the wiring and terminals are almost certain to occur.

Other necessary tools include a quality tachometer with inductive (clip-on) pickup, a fuel pressure gauge with system adapters and a vacuum gauge with an auxiliary source of vacuum.

Reading Codes

Diagnosis of a driveability problem requires attention to detail and following the diagnostic procedures in the correct order. Resist the temptation to begin extensive testing before completing the preliminary diagnostic steps. The preliminary or visual inspection must be completed in detail before diagnosis begins. In many cases this will shorten diagnostic time and often cure the problem without electronic testing.

VISUAL INSPECTION

This is possibly the most critical step of diagnosis. A detailed examination of all connectors, wiring and vacuum hoses can often lead to a repair without further diagnosis. Performance of this step relies on the skill of the technician performing it; a careful inspector will check the undersides of hoses as well as the integrity of hard-to-reach hoses blocked by the air cleaner or other components. Wiring should be checked carefully for any sign of strain, burning, crimping or terminal pull-out from a connector.

Checking connectors at components or in harnesses is required; usually, pushing them together will reveal a loose fit. Pay particular attention to ground circuits, making sure they are not loose or corroded. Remember to inspect connectors and hose fittings at components not mounted on the engine, such as the evaporative canister or relays mounted on the fender aprons. Any component or wiring near a fluid leak or spillage should be given extra attention during inspection.

Additionally, inspect maintenance items such as belt condition and tension, battery charge and condition and the radiator cap carefully. Any of these very simple items may affect the system enough to set a fault.

ELECTRONIC TESTING

If a code was set before a problem self-corrected (such as a momentarily loose connector), the code will be erased if the problem does not reoccur within 80 warm-up cycles. Codes will be output and displayed as numbers on the hand-held scan tool, such as 23. If the codes are being read on an analog voltmeter, the needle sweeps indicate the code digits. code 23 will appear as two needle pulses (sweeps) then, after a 1.6 second pause, the needle will pulse (sweep) three times.

Service Codes	Quick Test Mode
11—System pass	O/R/C
12—Rpm unable to reach upper test limit	R
13—DC motor movement not detected	O
13—Rpm unable to achieve lower test limit	R
13—DC motor did follow dashpot	C
14—PIP circuit failure	C
15—ECA read only memory test failed	O
15—ECA keep alive memory test failed	C
16—Idle rpm high with ISC off	R
16—Idle too low to perform EGO test	R
17—Idle rpm low with ISC off	R
18—SPOUT circuit open or spark angle word failure	R
18—IDM circuit failure or SPOUT circuit grounded	C
19—Failure in ECA internal voltage	O
19—CID circuit failure	C
19—Rpm dropped too low in ISC off test	R
19—Rpm for EGR test not achieved	R
21—ECT out of self-test range	O/R
22—BP sensor out of self-test range	O/C
22—BP or MAP out of self-test range	O/R/C
23—TP out of self-test range	O/R
23—TP out of self-test range	O/R/C
24—ACT sensor out of self-test range	O/R
25—Knock not sensed during dynamic test	R
26—VAF/MAF out of self-test range	O/R
28—VAT out of self-test range	O/R
29—Insufficient input from vehicle speed sensor	C
31—PFE, EVP or EVR circuit below minimum voltage	O/R/C
32—EPT circuit voltage low (PFE)	R/C
32—EVP voltage below closed limit	O/R/C
32—EGR not controlling	R
33—EGR valve opening not detected	R/C
33—EGR not closing fully	R
34—Defective PFE sensor or voltage out of range	O
34—EPT sensor voltage high (PFE)	R/C
34—EVP voltage above closed limit	O/R/C
34—EGR opening not detected	R
35—PFE or EVP circuit above maximum voltage	O/R/C
35—Rpm too low to perform EGR test	R
38—Idle tracking switch circuit open	C
39—AXOD lock up failed	C
41—HEGO sensor circuit indicates system lean	R
41—No HEGO switching detected	R
42—HEGO sensor circuit indicates system rich	R
42—No HEGO switching detected—reads rich	C
43—HEGO lean at wide open throttle	C
44—Thermactor air system inoperative—ride side	R
45—Thermactor air upstream during self-test	R
45—Coil 1 primary circuit failure	C
46—Thermactor air not bypassed during self-test	R
46—Coil 2 primary circuit failure	C
47—Measured airflow low at base idle	R
48—Coil 3 primary circuit failure	C
48—Measured airflow high at base idle	R
49—SPOUT signal defaulted to 10°BTDC or SPOUT open	C
51—ECT/ACT reads −40°F or circuit open	O/C
52—Power steering pressure switch circuit open	O
52—Power steering pressure switch always open or closed	R

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EEC-IV trouble codes—(1 of 3)

Service Codes	Quick Test Mode
53—TP circuit above maximum voltage	O/C
54—ACT sensor circuit open	O/C
55—Keypower circuit open	R
56—VAF or MAF circuit above maximum voltage	O/C
56—MAF circuit above maximum voltage	O/R/C
57—Octane adjust service pin in use	O
57—AXOD neutral pressure switch circuit failed open	C
58—Idle tracking switch circuit open	O
58—Idle tracking switch closed/circuit grounded	R
58—VAT reads −40°F or circuit open	O/C
59—Idle adjust service pin in use	O
59—AXOD 4/3 pressure switch circuit failed open	C
59—Low speed fuel pump circuit open—Battery to ECA	O/C
59—AXOD 4/3 pressure switch failed closed	O
61—ECT reads 254°F or circuit grounded	O/C
62—AXOD 4/3 or 3/2 pressure switch circuit grounded	O
63—TP circuit below minimum voltage	O/C
64—ACT sensor input below test minimum or grounded	O/C
65—Never went to closed loop fuel control	C
66—MAF sensor input below minimum voltage	C
66—VAF sensor below minimum voltage	O/C
66—MAF circuit below minimum voltage	R/C
67—Neutral/drive switch open or A/C on	O
67—Clutch switch circuit failure	C
67—Neutral/drive switch open or A/C on	O/R
68—Idle tracking switch closed or circuit grounded	O
68—Idle tracking switch circuit open	R
68—AXOD transmission temperature switch failed open	O/R/C
68—VAT reads 254°F or circuit grounded	O/C
69—AXOD 3/2 pressure switch circuit failed closed	O
69—AXOD 3/4 pressure switch circiut failed open	C
70—ECA DATA communications link circuit failure	C
71—Software re-initialization detected	C
71—Idle tracking switch shorted to ground	C
71—Cluster control assembly circuit failed	C
72—Insufficient MAF/MAP change during dynamic test	R
72—Power interrupt or re-initialization detected	C
72—Message center control assembly circuit failed	C
73—Insufficient throttle position change	O
73—Insufficient TP change during dynamic test	R
74—Brake on/off switch failure or not actuated	R
75—Brake on/off switch circuit closed or ECA input open	R
76—Insufficient VAF change during dynamic test	R
77—No WOT seen in self-test or operator error	R
79—A/C or defrost on during self-test	O

93144G05

EEC-IV trouble codes —(2 of 3)

Service Codes	Quick Test Mode
81—IAS circuit failure	0
81—Air management 2 circuit failure	0
82—Air management 1 circuit failure	0
82—Supercharger bypass circuit failure	0
83—High speed electro drive fan circuit failure	0
83—Low speed fuel pump circuit failure	0/C
84—EGR vacuum solenoid circuit failure	0
84—EGR vacuum regulator circuit failure	0/R
85—Canister purge circuit failure	0/R
85—Canister purge solenoid circuit failure	0
85—Adaptive fuel lean limit reached	C
86—3-4 shift solenoid circuit failure	0
86—Adaptive fuel rich limit reached	C
87—Fuel pump primary circuit failure	0/C
87—Fuel pump primary circuit failure	0/C/R
87—Fuel pump primary circuit failure	0
88—Electro drive fan circuit failure	0
89—Converter clutch override circuit failure	0
89—Lock-up solenoid circuit failure	0
91—HEGO sensor indicates system lean	R
91—No HEGO switching detected	C
92—HEGO sensor indicates system rich	R
93—TP sensor input low at maximum motor travel	0
94—Thermactor air system inoperative-left side	R
95—Fuel pump secondary circuit failure—ECA to ground	0/C
96—Fuel pump secondary circuit failure—Battery to ECA	0/C
96—High speed fuel pump circuit open	0/C
98—Hard fault present	R
99—EEC has not learned to control idle: ignore codes 12 & 13	R

No Codes: Cannot begin self-test or cannot transmit codes
Codes Not Listed: Do not apply to vehicle being tested
0—Key on, engine off test
R—Key on, engine running test
C—Continuous memory
① Front HEGO
② Right HEGO
③ Left HEGO
④ Rear HEGO

93144G06

EEC-IV trouble codes —(3 of 3)

Key On Engine Off (KOEO) Test

See Figures 70 thru 76

1. Connect the scan tool to the self-test connectors. Make certain the test button is unlatched or up.
2. Start the engine and run it until normal operating temperature is reached.
3. Turn the engine **OFF** for 10 seconds.
4. Activate the test button on the STAR tester.
5. Turn the ignition switch **ON** but do not start the engine.
6. The KOEO codes will be transmitted. Six to nine seconds after the last KOEO code, a single separator pulse will be transmitted. Six to nine seconds after this pulse, the codes from the Continuous Memory will be transmitted.
7. Record all service codes displayed. Do not depress the throttle on gasoline engines during the test.

Key On Engine Running (KOER) Test

See Figures 66, 75, and 77

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1. Make certain the self-test button is released or de-activated on the STAR tester.
2. Start the engine and run it at 2000 rpm for two minutes. This action warms up the oxygen sensor.
3. Turn the ignition switch **OFF** for 10 seconds.
4. Activate or latch the self-test button on the scan tool.
5. Start the engine. The engine identification

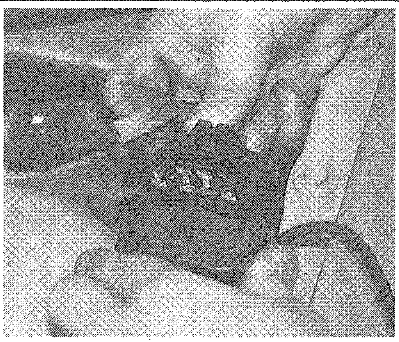

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Fig. 70 Connect the scan tool to the DLC connector

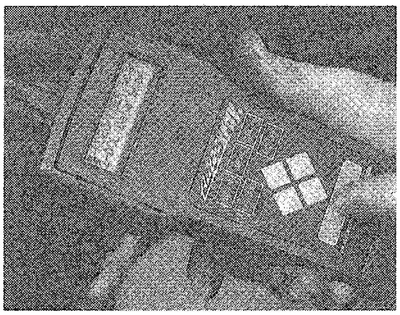

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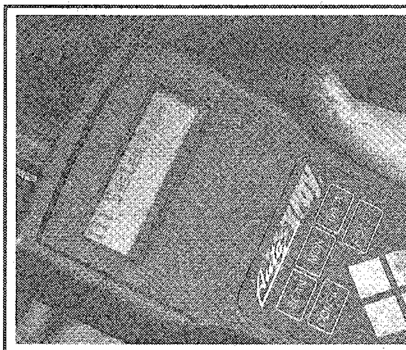
Fig. 71 The scan tool menu will be displayed, follow the instructions included with the scan tool



91054P08

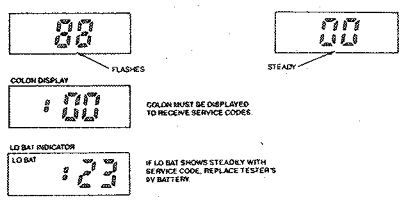
Fig. 72 This PCM had no DTC's stored and passed the KOEO

91054P06

Fig. 73 This PCM had a DTC 113 stored. Most scan tools will give a code definition on-screen as the Auto X-ray shown here informs what code 113 is for— the IAT sensor

91054P07

Fig. 74 If the A/C or Blower motor is left on, a code 539 will be tripped. Turn the A/C or blower motor off and retest



84924040

Fig. 75 STAR tester displays; note that the colon must be present before codes can be received

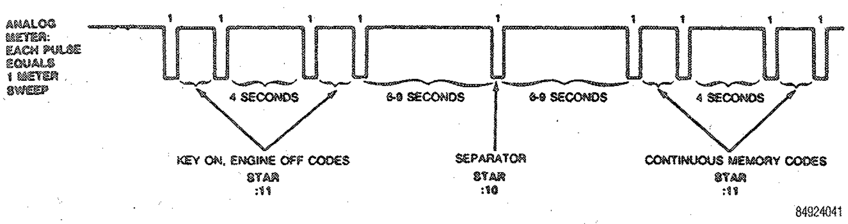


Fig. 76 Code transmission during KOEO test. Note that the continuous memory codes are transmitted after a pause and a separator pulse

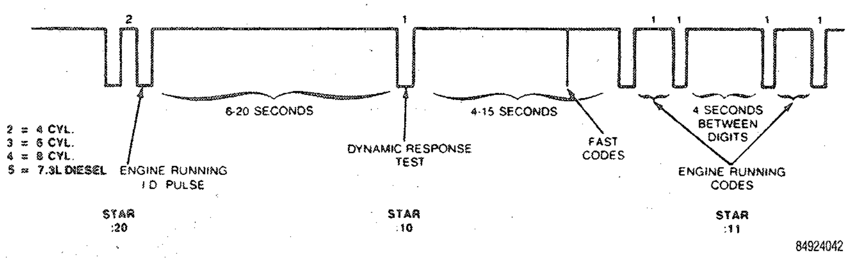


Fig. 77 Code transmission during KOER testing begins with the engine identification pulse and may include a dynamic response prompt

code will be transmitted. This is a single digit number representing ½ the number of cylinders in a gasoline engine. On the STAR tester, this number may appear with a zero, such as 20 = 2. The code is used to confirm that the correct processor is installed and that the self-test has begun.

6. If the vehicle is equipped with a Brake On/Off (BOO) switch, the brake pedal must be depressed and released after the ID code is transmitted.

7. If the vehicle is equipped with a Power Steering Pressure Switch (PSPS), the steering wheel must be turned at least ½ turn and released within 2 seconds after the engine ID code is transmitted.

8. Certain Ford vehicles will display a Dynamic Response code 6 –20 seconds after the engine ID code. This will appear as one pulse on a meter or as a 10 on the STAR tester. When this code appears, briefly take the engine to wide-open throttle. This allows the system to test the throttle position, MAF and MAP sensors.

9. All relevant codes will be displayed and should be recorded. Remember that the codes refer only to faults present during this test cycle. Codes stored in Continuous Memory are not displayed in this test mode.

10. Do not depress the throttle during testing unless a dynamic response code is displayed.

Reading Codes With Analog Voltmeter

See Figures 78 and 79

In the absence of a scan tool, an analog voltmeter may be used to retrieve stored fault codes. Set the meter range to read DC 0 –15 volts. Connect the + lead of the meter to the battery positive terminal and connect the -; lead of the meter to the self-test output pin of the diagnostic connector.

Follow the directions given previously for performing the KOEO and KOER tests. To activate the tests, use a jumper wire to connect the signal return pin on the diagnostic connector to the self-test input connector. The self-test input line is the separate wire and connector with or near the diagnostic connector.

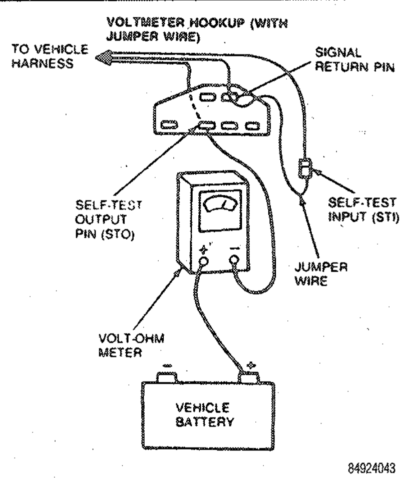


Fig. 78 Correct hookup to read codes with a voltmeter

The codes will be transmitted as groups of needle sweeps. This method may be used to read either 2 or 3-digit codes. The Continuous Memory codes are separated from the KOEO codes by 6 seconds, a single sweep and another 6-second delay.

Malfunction Indicator Lamp Method

See Figures 80 and 81

The Malfunction Indicator Lamp (MIL) on the dashboard may also be used to retrieve the stored codes. This method displays only the stored codes and does not allow any system investigation. It should only be used in field conditions where a quick check of stored codes is needed.

Follow the directions given previously for performing the scan tool procedure. To activate the tests, use a jumper wire to connect the signal return pin on the diagnostic connector to the Self-Test Input (STI) connector. The self-test input line is the separate wire and connector with or near the diagnostic connector.

Codes are transmitted by place value with a pause between the digits; for example, code 32 would be sent as 3 flashes, a pause and 2 flashes. A slightly longer pause divides codes from each other. Be ready to count and record codes; the only way to repeat a code is to recycle the system. This method may be used to read either 2 or 3-digit codes. The Continuous Memory codes are separated from the other codes by 6 seconds, a single flash and another 6-second delay.

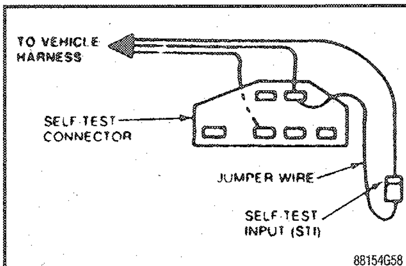


Fig. 80 Only one jumper wire is needed to read codes through the MIL or the message center

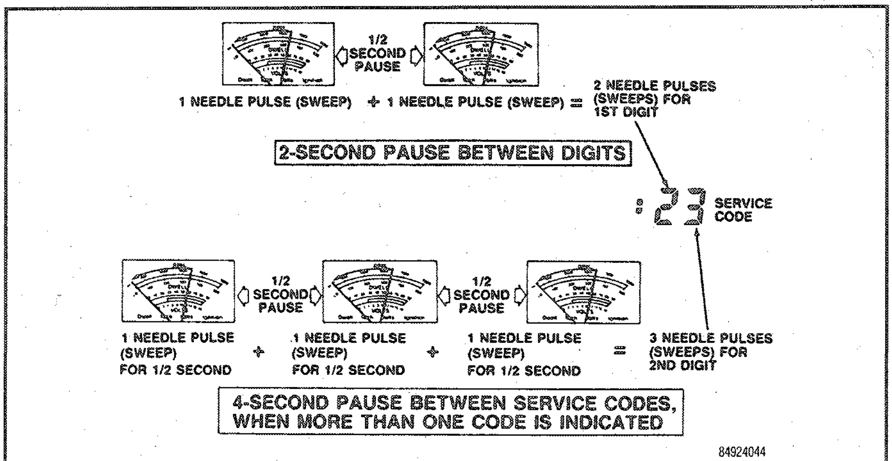


Fig. 79 Code display patterns on an analog voltmeter

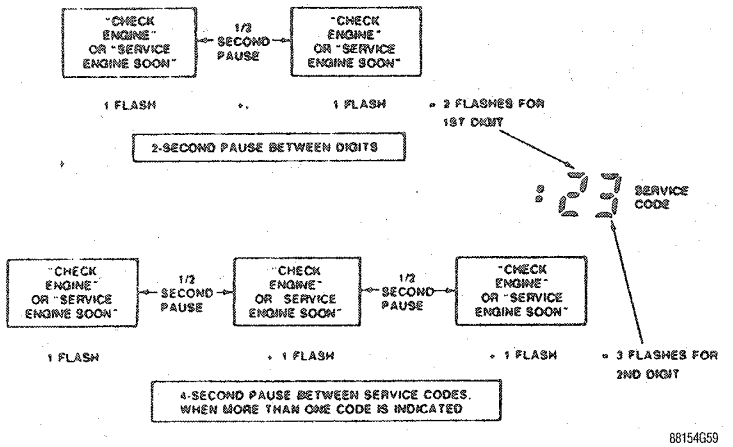


Fig. 81 Code display pattern using the dashboard warning lamp

Other Test Modes

CONTINUOUS MONITOR OR WIGGLE TEST

Once entered, this mode allows the operator to attempt to recreate intermittent faults by wiggling or tapping components, wiring or connectors. The test may be performed during either KOEO or KOER procedures. The test requires the use of either an analog voltmeter or a hand-held scan tool.

To enter the continuous monitor mode during KOEO testing, turn the ignition switch **ON** . Activate the test, wait 10 seconds, then deactivate, and reactivate the test; the system will enter the continuous monitor mode. Tap, move, or wiggle the harness, component or connector suspected of causing the problem; if a fault is detected, the code will store in the memory. When the fault occurs, the dash-warning lamp will illuminate, the STAR tester will light a red indicator (and possibly beep) and the analog meter needle will sweep once.

To enter this mode in the KOER test:

1. Start the engine and run it at 2000 rpm for two minutes. This action warms up the oxygen sensor.
2. Turn the ignition switch **OFF** for 10 seconds.
3. Start the engine.
4. Activate the test, wait 10 seconds, then deactivate, and reactivate the test; the system will enter the continuous monitor mode.
5. Tap, move, or wiggle the harness, component or connector suspected of causing the problem; if a fault is detected, the code will store in the memory.
6. When the fault occurs, the dash-warning lamp will illuminate, the STAR tester will light a red indicator (and possibly beep) and the analog meter needle will sweep once.

OUTPUT STATE CHECK

This testing mode allows the operator to energize and de-energize most of the outputs controlled by the EEC-IV system. Many of the outputs may be checked at the component by listening for a click or feeling the item move or engage by a hand placed on the case. To enter this check:

1. Enter the KOEO test mode.
2. When all codes have been transmitted, depress the accelerator all the way to the floor and release it.
3. The output actuators are now all ON. Depressing the throttle pedal to the floor again switches the all the actuator outputs OFF.
4. This test may be performed as often as necessary, switching between ON and OFF by depressing the throttle.
5. Exit the test by turning the ignition switch **OFF** , detaching the jumper at the diagnostic connector or releasing the test button on the scan tool.

Clearing Codes

CONTINUOUS MEMORY CODES

These codes are retained in memory for 40 warm-up cycles. To clear the codes for purposes of testing or confirming repair, perform the code reading procedure. When the fault codes begin to be displayed, de-activate the test either by disconnecting the jumper wire (if using a meter, MIL or message center) or by releasing the test button on the hand scanner. Stopping the test during code transmission will erase the Continuous Memory. Do not disconnect the negative battery cable to clear these codes; the Keep Alive memory will be cleared and a new code, 19, will be stored for loss of PCM power.

KEEP ALIVE MEMORY

The Keep Alive Memory (KAM) contains the adaptive factors used by the processor to compensate for component tolerances and wear. It should not be routinely cleared during diagnosis. If an emission related part is replaced during repair, the KAM must be cleared. Failure to clear the KAM may cause severe driveability problems since the correction factor for the old component will be applied to the new component.

To clear the Keep Alive Memory, disconnect the negative battery cable for at least 5 minutes. After the memory is cleared and the battery reconnected, the vehicle must be driven at least 10 miles (16 km) so that the processor may relearn the needed correction factors. The distance to be driven depends on the engine and vehicle, but all drives should include steady-throttle cruise on open roads. Certain driveability problems may be noted during the drive because the adaptive factors are not yet functioning.

TROUBLE CODES —EEC-V SYSTEM (OBD-II)

General Information

The Powertrain Control Module (PCM) is given responsibility for the operation of the emission control devices, cooling fans, ignition and advance and in some cases, automatic transmission functions. Because the EEC-V oversees both the ignition timing and the fuel injection operation, a precise air/fuel ratio will be maintained under all operating conditions. The PCM is a microprocessor or small computer that receives electrical inputs from several sensors, switches, and relays on and around the engine.

Based on combinations of these inputs, the PCM controls various output devices concerned with engine operation and emissions. The control module relies on the signals to form a correct picture of current vehicle operation. If any of the input signals is incorrect, the PCM reacts to whatever picture is painted for it. For example, if the coolant temperature sensor is inaccurate and reads too low, the PCM may see a picture of the engine never warming up. Consequently, the engine settings will be maintained as if the engine were cold. Because so many inputs can affect one output, correct diagnostic procedures are essential on these systems.

One part of the PCM is devoted to monitoring both input and output functions within the system. This ability forms the core of the self-diagnostic system. If a problem is detected within a circuit, the control module will recognize the fault, assign it an Diagnostic Trouble Code (DTC), and store the code in memory. The stored code(s) may be retrieved during diagnosis.

While the EEC-V system is capable of recognizing many internal faults, certain faults will not be recognized. Because the control module sees only electrical signals, it cannot sense or react to mechanical or vacuum faults affecting engine operation. Some of these faults may affect another component which will set a code. For example, the PCM monitors the output signal to the fuel injectors, but cannot detect a partially clogged injector. As long as the output driver responds correctly, the computer will read the system as functioning correctly. However, the improper flow of fuel may result in a lean mixture. This would, in turn, be detected by the oxygen sensor and noticed as a constantly lean signal by the PCM. Once the signal falls outside the pre-programmed limits, the control module would notice the fault and set an trouble code.

Additionally, the EEC-V system employs adaptive fuel logic. This process is used to compensate for normal wear and variability within the fuel system. Once the engine enters steady-state operation, the control module watches the oxygen sensor signal for a bias or tendency to run slightly rich or lean. If such a bias is detected, the adaptive logic corrects the fuel delivery to bring the air/fuel mixture towards a centered or 14.7:1 ratio. This compensating shift is stored in a non-volatile memory which is retained by battery power even with the ignition switched **OFF** . The correction factor is then available the next time the vehicle is operated.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) is located on the instrument panel. The lamp is connected to the PCM and will alert the driver to certain malfunctions within the EEC-V system. When the lamp is illuminated, the PCM has detected a fault and stored a DTC in memory.

The light will stay illuminated as long as the fault is present. Should the fault self-correct, the MIL will extinguish but the stored code will remain in memory.

Under normal operating conditions, the MIL should illuminate briefly when the ignition key is turned **ON** . This is commonly known as a prove-out. As soon as the PCM receives a signal that the engine is cranking, the lamp should extinguish. The lamp should remain extinguished during the normal operating cycle.

Data Link Connector

The Data Link Connector (DLC) may be found in the following location:

- Under the driver's side dashboard, near the steering column.

The DLC is rectangular in design and capable of allowing access to 16 terminals. The connector has keying features that allow easy connection. The test equipment and the DLC have a latching feature to ensure a good mated connection.

ELECTRICAL TOOLS

The most commonly required electrical diagnostic tool is the Digital Multimeter, allowing voltage, resistance, and amperage to be read by one instrument.

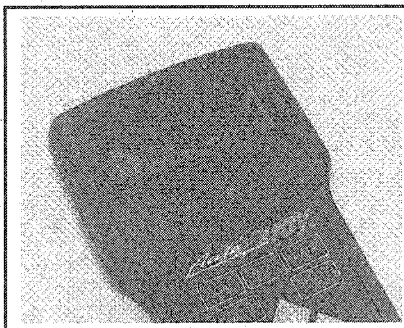
The multimeter must be a high impedance unit, with 10 megaohms of impedance in the voltmeter. This type of meter will not place an additional load on the circuit it is testing; this is extremely important in low voltage circuits. The multimeter must be of high quality in all respects. It should be handled carefully and protected from impact or damage. Replace the batteries frequently in the unit.

Reading Codes

See Figure 82

The EEC-V equipped engines utilize On Board Diagnostic II (OBD-II) DTC's, which are alphanumeric (they use letters and numbers). The letters in the OBD-II DTC's make it highly difficult to convey the codes through the use of anything but a scan tool. Therefore, to read the codes on these vehicles it is necessary to utilize an OBD-II compatible scan tool.

Since each manufacturers scan tool is different, please follow the manufacturer's instructions for connecting the tool and obtaining code information.



TCCS4P08

Fig. 82 When using a scan tool, make sure to follow all of the manufacturer's instructions carefully to ensure proper diagnosis

Clearing Codes

CONTINUOUS MEMORY CODES

These codes are retained in memory for 40 warm-up cycles. To clear the codes for the purposes of testing or confirming repair, perform the code reading procedure. When the fault codes begin to be displayed, de-activate the test by either disconnecting the jumper wire (meter, MIL or message center) or releasing the test button on the hand scanner. Stopping the test during code transmission will erase the Continuous Memory. Do not disconnect the negative battery cable to clear these codes; the Keep Alive memory will be cleared and a new code, 19, will be stored for loss of PCM power.

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To clear the Keep Alive Memory, disconnect the negative battery cable for at least 5 minutes. After the memory is cleared and the battery reconnected, the vehicle must be driven at least 10 miles so that the processor may relearn the needed correction factors. The distance to be driven depends on the engine and vehicle, but all drives should include steady-throttle cruise on open roads. Certain driveability problems may be noted during the drive because the adaptive factors are not yet functioning.

EEC-V Diagnostic Trouble Codes (DTC's)

P0000 No Failures
P0100 Mass or Volume Air Flow Circuit Malfunction
P0101 Mass or Volume Air Flow Circuit Range/Performance Problem
P0102 Mass or Volume Air Flow Circuit Low Input
P0103 Mass or Volume Air Flow Circuit High Input
P0104 Mass or Volume Air Flow Circuit Intermittent
P0105 Manifold Absolute Pressure/Barometric Pressure Circuit Malfunction
P0106 Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance Problem
P0107 Manifold Absolute Pressure/Barometric Pressure Circuit Low Input
P0108 Manifold Absolute Pressure/Barometric Pressure Circuit High Input
P0109 Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent
P0110 Intake Air Temperature Circuit Malfunction
P0111 Intake Air Temperature Circuit Range/Performance Problem
P0112 Intake Air Temperature Circuit Low Input
P0113 Intake Air Temperature Circuit High Input
P0114 Intake Air Temperature Circuit Intermittent
P0115 Engine Coolant Temperature Circuit Malfunction
P0116 Engine Coolant Temperature Circuit Range/Performance Problem
P0117 Engine Coolant Temperature Circuit Low Input
P0118 Engine Coolant Temperature Circuit High Input
P0119 Engine Coolant Temperature Circuit Intermittent
P0120 Throttle/Pedal Position Sensor/Switch "A" Circuit Malfunction
P0121 Throttle/Pedal Position Sensor/Switch "A" Circuit Range/Performance Problem
P0122 Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input
P0123 Throttle/Pedal Position Sensor/Switch "A" Circuit High Input
P0124 Throttle/Pedal Position Sensor/Switch "A" Circuit Intermittent
P0125 Insufficient Coolant Temperature For Closed Loop Fuel Control
P0126 Insufficient Coolant Temperature For Stable Operation
P0130 O2 Circuit Malfunction (Bank 1 Sensor 1)
P0131 O2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)
P0132 O2 Sensor Circuit High Voltage (Bank 1 Sensor 1)
P0133 O2 Sensor Circuit Slow Response (Bank 1 Sensor 1)
P0134 O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)
P0135 O2 Sensor Heater Circuit Malfunction (Bank 1 Sensor 1)
P0136 O2 Sensor Circuit Malfunction (Bank 1 Sensor 2)
P0137 O2 Sensor Circuit Low Voltage (Bank 1 Sensor 2)
P0138 O2 Sensor Circuit High Voltage (Bank 1 Sensor 2)
P0139 O2 Sensor Circuit Slow Response (Bank 1 Sensor 2)
P0140 O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 2)
P0141 O2 Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)
P0142 O2 Sensor Circuit Malfunction (Bank 1 Sensor 3)
P0143 O2 Sensor Circuit Low Voltage (Bank 1 Sensor 3)

P0144 O2 Sensor Circuit High Voltage (Bank 1 Sensor 3)
P0145 O2 Sensor Circuit Slow Response (Bank 1 Sensor 3)
P0146 O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 3)
P0147 O2 Sensor Heater Circuit Malfunction (Bank 1 Sensor 3)
P0150 O2 Sensor Circuit Malfunction (Bank 2 Sensor 1)
P0151 O2 Sensor Circuit Low Voltage (Bank 2 Sensor 1)
P0152 O2 Sensor Circuit High Voltage (Bank 2 Sensor 1)
P0153 O2 Sensor Circuit Slow Response (Bank 2 Sensor 1)
P0154 O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 1)
P0155 O2 Sensor Heater Circuit Malfunction (Bank 2 Sensor 1)
P0156 O2 Sensor Circuit Malfunction (Bank 2 Sensor 2)
P0157 O2 Sensor Circuit Low Voltage (Bank 2 Sensor 2)
P0158 O2 Sensor Circuit High Voltage (Bank 2 Sensor 2)
P0159 O2 Sensor Circuit Slow Response (Bank 2 Sensor 2)
P0160 O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 2)
P0161 O2 Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)
P0162 O2 Sensor Circuit Malfunction (Bank 2 Sensor 3)
P0163 O2 Sensor Circuit Low Voltage (Bank 2 Sensor 3)
P0164 O2 Sensor Circuit High Voltage (Bank 2 Sensor 3)
P0165 O2 Sensor Circuit Slow Response (Bank 2 Sensor 3)
P0166 O2 Sensor Circuit No Activity Detected (Bank 2 Sensor 3)
P0167 O2 Sensor Heater Circuit Malfunction (Bank 2 Sensor 3)
P0170 Fuel Trim Malfunction (Bank 1)
P0171 System Too Lean (Bank 1)
P0172 System Too Rich (Bank 1)
P0173 Fuel Trim Malfunction (Bank 2)
P0174 System Too Lean (Bank 2)
P0175 System Too Rich (Bank 2)
P0180 Fuel Temperature Sensor "A" Circuit Malfunction
P0181 Fuel Temperature Sensor "A" Circuit Range/Performance
P0182 Fuel Temperature Sensor "A" Circuit Low Input
P0183 Fuel Temperature Sensor "A" Circuit High Input
P0184 Fuel Temperature Sensor "A" Circuit Intermittent
P0185 Fuel Temperature Sensor "B" Circuit Malfunction
P0186 Fuel Temperature Sensor "B" Circuit Range/Performance
P0187 Fuel Temperature Sensor "B" Circuit Low Input
P0188 Fuel Temperature Sensor "B" Circuit High Input
P0189 Fuel Temperature Sensor "B" Circuit Intermittent
P0190 Fuel Rail Pressure Sensor Circuit Malfunction
P0191 Fuel Rail Pressure Sensor Circuit Range/Performance
P0192 Fuel Rail Pressure Sensor Circuit Low Input
P0193 Fuel Rail Pressure Sensor Circuit High Input
P0194 Fuel Rail Pressure Sensor Circuit Intermittent
P0200 Injector Circuit Malfunction
P0201 Injector Circuit Malfunction —Cylinder 1
P0202 Injector Circuit Malfunction —Cylinder 2
P0203 Injector Circuit Malfunction —Cylinder 3
P0204 Injector Circuit Malfunction —Cylinder 4
P0205 Injector Circuit Malfunction —Cylinder 5
P0206 Injector Circuit Malfunction —Cylinder 6
P0207 Injector Circuit Malfunction —Cylinder 7
P0208 Injector Circuit Malfunction —Cylinder 8
P0215 Engine Shutoff Solenoid Malfunction
P0217 Engine Over Temperature Condition
P0218 Transmission Over Temperature Condition
P0219 Engine Over Speed Condition
P0220 Throttle/Pedal Position Sensor/Switch "B" Circuit Malfunction
P0221 Throttle/Pedal Position Sensor/Switch "B" Circuit Range/Performance Problem
P0222 Throttle/Pedal Position Sensor/Switch "B" Circuit Low Input
P0223 Throttle/Pedal Position Sensor/Switch "B" Circuit High Input
P0224 Throttle/Pedal Position Sensor/Switch "B" Circuit Intermittent
P0225 Throttle/Pedal Position Sensor/Switch "C" Circuit Malfunction
P0226 Throttle/Pedal Position Sensor/Switch "C" Circuit Range/Performance Problem
P0227 Throttle/Pedal Position Sensor/Switch "C" Circuit Low Input
P0228 Throttle/Pedal Position Sensor/Switch "C" Circuit High Input
P0229 Throttle/Pedal Position Sensor/Switch "C" Circuit Intermittent
P0230 Fuel Pump Primary Circuit Malfunction
P0231 Fuel Pump Secondary Circuit Low
P0232 Fuel Pump Secondary Circuit High
P0233 Fuel Pump Secondary Circuit Intermittent
P0261 Cylinder 1 Injector Circuit Low
P0262 Cylinder 1 Injector Circuit High
P0263 Cylinder 1 Contribution/Balance Fault
P0264 Cylinder 2 Injector Circuit Low
P0265 Cylinder 2 Injector Circuit High
P0266 Cylinder 2 Contribution/Balance Fault
P0267 Cylinder 3 Injector Circuit Low
P0268 Cylinder 3 Injector Circuit High
P0269 Cylinder 3 Contribution/Balance Fault
P0270 Cylinder 4 Injector Circuit Low
P0271 Cylinder 4 Injector Circuit High
P0272 Cylinder 4 Contribution/Balance Fault
P0273 Cylinder 5 Injector Circuit Low
P0274 Cylinder 5 Injector Circuit High
P0275 Cylinder 5 Contribution/Balance Fault
P0276 Cylinder 6 Injector Circuit Low
P0277 Cylinder 6 Injector Circuit High
P0278 Cylinder 6 Contribution/Balance Fault
P0279 Cylinder 7 Injector Circuit Low
P0280 Cylinder 7 Injector Circuit High
P0281 Cylinder 7 Contribution/Balance Fault
P0282 Cylinder 8 Injector Circuit Low
P0283 Cylinder 8 Injector Circuit High
P0284 Cylinder 8 Contribution/Balance Fault
P0300 Random/Multiple Cylinder Misfire Detected
P0301 Cylinder 1 —Misfire Detected
P0302 Cylinder 2 —Misfire Detected
P0303 Cylinder 3 —Misfire Detected
P0304 Cylinder 4 —Misfire Detected
P0305 Cylinder 5 —Misfire Detected
P0306 Cylinder 6 —Misfire Detected
P0307 Cylinder 7 —Misfire Detected
P0308 Cylinder 8 —Misfire Detected
P0320 Ignition/Distributor Engine Speed Input Circuit Malfunction
P0321 Ignition/Distributor Engine Speed Input Circuit Range/Performance
P0322 Ignition/Distributor Engine Speed Input Circuit No Signal
P0323 Ignition/Distributor Engine Speed Input Circuit Intermittent
P0325 Knock Sensor 1 —Circuit Malfunction (Bank 1 or Single Sensor)
P0326 Knock Sensor 1 —Circuit Range/Performance (Bank 1 or Single Sensor)
P0327 Knock Sensor 1 —Circuit Low Input (Bank 1 or Single Sensor)
P0328 Knock Sensor 1 —Circuit High Input (Bank 1 or Single Sensor)
P0329 Knock Sensor 1 —Circuit Input Intermittent (Bank 1 or Single Sensor)
P0330 Knock Sensor 2 —Circuit Malfunction (Bank 2)
P0331 Knock Sensor 2 —Circuit Range/Performance (Bank 2)
P0332 Knock Sensor 2 —Circuit Low Input (Bank 2)
P0333 Knock Sensor 2 —Circuit High Input (Bank 2)
P0334 Knock Sensor 2 —Circuit Input Intermittent (Bank 2)
P0335 Crankshaft Position Sensor "A" Circuit Malfunction
P0336 Crankshaft Position Sensor "A" Circuit Range/Performance
P0337 Crankshaft Position Sensor "A" Circuit Low Input
P0338 Crankshaft Position Sensor "A" Circuit High Input
P0339 Crankshaft Position Sensor "A" Circuit Intermittent
P0340 Camshaft Position Sensor Circuit Malfunction
P0341 Camshaft Position Sensor Circuit Range/Performance
P0342 Camshaft Position Sensor Circuit Low Input
P0343 Camshaft Position Sensor Circuit High Input
P0344 Camshaft Position Sensor Circuit Intermittent
P0350 Ignition Coil Primary/Secondary Circuit Malfunction
P0351 Ignition Coil "A" Primary/Secondary Circuit Malfunction
P0352 Ignition Coil "B" Primary/Secondary Circuit Malfunction
P0353 Ignition Coil "C" Primary/Secondary Circuit Malfunction
P0354 Ignition Coil "D" Primary/Secondary Circuit Malfunction

P0355 Ignition Coil "E" Primary/Secondary Circuit Malfunction
P0356 Ignition Coil "F" Primary/Secondary Circuit Malfunction
P0357 Ignition Coil "G" Primary/Secondary Circuit Malfunction
P0358 Ignition Coil "H" Primary/Secondary Circuit Malfunction
P0359 Ignition Coil "I" Primary/Secondary Circuit Malfunction
P0360 Ignition Coil "J" Primary/Secondary Circuit Malfunction
P0361 Ignition Coil "K" Primary/Secondary Circuit Malfunction
P0362 Ignition Coil "L" Primary/Secondary Circuit Malfunction
P0370 Timing Reference High Resolution Signal "A" Malfunction
P0371 Timing Reference High Resolution Signal "A" Too Many Pulses
P0372 Timing Reference High Resolution Signal "A" Too Few Pulses
P0373 Timing Reference High Resolution Signal "A" Intermittent/Erratic Pulses
P0374 Timing Reference High Resolution Signal "A" No Pulses
P0375 Timing Reference High Resolution Signal "B" Malfunction
P0376 Timing Reference High Resolution Signal "B" Too Many Pulses
P0377 Timing Reference High Resolution Signal "B" Too Few Pulses
P0378 Timing Reference High Resolution Signal "B" Intermittent/Erratic Pulses
P0379 Timing Reference High Resolution Signal "B" No Pulses
P0385 Crankshaft Position Sensor "B" Circuit Malfunction
P0386 Crankshaft Position Sensor "B" Circuit Range/Performance
P0387 Crankshaft Position Sensor "B" Circuit Low Input
P0388 Crankshaft Position Sensor "B" Circuit High Input
P0389 Crankshaft Position Sensor "B" Circuit Intermittent
P0400 Exhaust Gas Recirculation Flow Malfunction
P0401 Exhaust Gas Recirculation Flow Insufficient Detected
P0402 Exhaust Gas Recirculation Flow Excessive Detected
P0403 Exhaust Gas Recirculation Circuit Malfunction
P0404 Exhaust Gas Recirculation Circuit Range/Performance
P0405 Exhaust Gas Recirculation Sensor "A" Circuit Low
P0406 Exhaust Gas Recirculation Sensor "A" Circuit High
P0407 Exhaust Gas Recirculation Sensor "B" Circuit Low
P0408 Exhaust Gas Recirculation Sensor "B" Circuit High
P0410 Secondary Air Injection System Malfunction
P0411 Secondary Air Injection System Incorrect Flow Detected
P0412 Secondary Air Injection System Switching Valve "A" Circuit Malfunction
P0413 Secondary Air Injection System Switching Valve "A" Circuit Open
P0414 Secondary Air Injection System Switching Valve "A" Circuit Shorted
P0415 Secondary Air Injection System Switching Valve "B" Circuit Malfunction
P0416 Secondary Air Injection System Switching Valve "B" Circuit Open
P0417 Secondary Air Injection System Switching Valve "B" Circuit Shorted
P0418 Secondary Air Injection System Relay "A" Circuit Malfunction
P0419 Secondary Air Injection System Relay "B" Circuit Malfunction
P0420 Catalyst System Efficiency Below Threshold (Bank 1)
P0421 Warm Up Catalyst Efficiency Below Threshold (Bank 1)
P0422 Main Catalyst Efficiency Below Threshold (Bank 1)
P0423 Heated Catalyst Efficiency Below Threshold (Bank 1)
P0424 Heated Catalyst Temperature Below Threshold (Bank 1)
P0430 Catalyst System Efficiency Below Threshold (Bank 2)
P0431 Warm Up Catalyst Efficiency Below Threshold (Bank 2)
P0432 Main Catalyst Efficiency Below Threshold (Bank 2)
P0433 Heated Catalyst Efficiency Below Threshold (Bank 2)
P0434 Heated Catalyst Temperature Below Threshold (Bank 2)
P0440 Evaporative Emission Control System Malfunction
P0441 Evaporative Emission Control System Incorrect Purge Flow
P0442 Evaporative Emission Control System Leak Detected (Small Leak)
P0443 Evaporative Emission Control System Purge Control Valve Circuit Malfunction
P0444 Evaporative Emission Control System Purge Control Valve Circuit Open
P0445 Evaporative Emission Control System Purge Control Valve Circuit Shorted
P0446 Evaporative Emission Control System Vent Control Circuit Malfunction
P0447 Evaporative Emission Control System Vent Control Circuit Open
P0448 Evaporative Emission Control System Vent Control Circuit Shorted
P0449 Evaporative Emission Control System Vent Valve/Solenoid Circuit Malfunction
P0450 Evaporative Emission Control System Pressure Sensor Malfunction
P0451 Evaporative Emission Control System Pressure Sensor Range/Performance
P0452 Evaporative Emission Control System Pressure Sensor Low Input
P0453 Evaporative Emission Control System Pressure Sensor High Input
P0454 Evaporative Emission Control System Pressure Sensor Intermittent
P0455 Evaporative Emission Control System Leak Detected (Gross Leak)
P0460 Fuel Level Sensor Circuit Malfunction
P0461 Fuel Level Sensor Circuit Range/Performance
P0462 Fuel Level Sensor Circuit Low Input
P0463 Fuel Level Sensor Circuit High Input
P0464 Fuel Level Sensor Circuit Intermittent
P0465 Purge Flow Sensor Circuit Malfunction
P0466 Purge Flow Sensor Circuit Range/Performance
P0467 Purge Flow Sensor Circuit Low Input
P0468 Purge Flow Sensor Circuit High Input
P0469 Purge Flow Sensor Circuit Intermittent
P0480 Cooling Fan 1 Control Circuit Malfunction
P0481 Cooling Fan 2 Control Circuit Malfunction
P0482 Cooling Fan 3 Control Circuit Malfunction
P0483 Cooling Fan Rationality Check Malfunction
P0484 Cooling Fan Circuit Over Current
P0485 Cooling Fan Power/Ground Circuit Malfunction
P0500 Vehicle Speed Sensor Malfunction
P0501 Vehicle Speed Sensor Range/Performance
P0502 Vehicle Speed Sensor Circuit Low Input
P0503 Vehicle Speed Sensor Intermittent/Erratic/High
P0505 Idle Control System Malfunction
P0506 Idle Control System RPM Lower Than Expected
P0507 Idle Control System RPM Higher Than Expected
P0510 Closed Throttle Position Switch Malfunction
P0530 A/C Refrigerant Pressure Sensor Circuit Malfunction
P0531 A/C Refrigerant Pressure Sensor Circuit Range/Performance
P0532 A/C Refrigerant Pressure Sensor Circuit Low Input
P0533 A/C Refrigerant Pressure Sensor Circuit High Input
P0534 A/C Refrigerant Charge Loss
P0550 Power Steering Pressure Sensor Circuit Malfunction
P0551 Power Steering Pressure Sensor Circuit Range/Performance
P0552 Power Steering Pressure Sensor Circuit Low Input
P0553 Power Steering Pressure Sensor Circuit High Input
P0554 Power Steering Pressure Sensor Circuit Intermittent
P0560 System Voltage Malfunction
P0561 System Voltage Unstable
P0562 System Voltage Low
P0563 System Voltage High
P0565 Cruise Control On Signal Malfunction
P0566 Cruise Control Off Signal Malfunction
P0567 Cruise Control Resume Signal Malfunction
P0568 Cruise Control Set Signal Malfunction
P0569 Cruise Control Coast Signal Malfunction
P0570 Cruise Control Accel Signal Malfunction
P0571 Cruise Control/Brake Switch "A" Circuit Malfunction
P0572 Cruise Control/Brake Switch "A" Circuit Low
P0573 Cruise Control/Brake Switch "A" Circuit High
P0574 Through P0580 Reserved for Cruise Codes

P0600 Serial Communication Link Malfunction
P0601 Internal Control Module Memory Check Sum Error
P0602 Control Module Programming Error
P0603 Internal Control Module Keep Alive Memory (KAM) Error
P0604 Internal Control Module Random Access Memory (RAM) Error
P0605 Internal Control Module Read Only Memory (ROM) Error
P0606 PCM Processor Fault
P0608 Control Module VSS Output "A" Malfunction
P0609 Control Module VSS Output "B" Malfunction
P0620 Generator Control Circuit Malfunction
P0621 Generator Lamp "L" Control Circuit Malfunction
P0622 Generator Field "F" Control Circuit Malfunction
P0650 Malfunction Indicator Lamp (MIL) Control Circuit Malfunction
P0654 Engine RPM Output Circuit Malfunction
P0655 Engine Hot Lamp Output Control Circuit Malfunction
P0656 Fuel Level Output Circuit Malfunction
P0700 Transmission Control System Malfunction
P0701 Transmission Control System Range/Performance
P0702 Transmission Control System Electrical
P0703 Torque Converter/Brake Switch "B" Circuit Malfunction
P0704 Clutch Switch Input Circuit Malfunction
P0705 Transmission Range Sensor Circuit Malfunction (PRNDL Input)
P0706 Transmission Range Sensor Circuit Range/Performance
P0707 Transmission Range Sensor Circuit Low Input
P0708 Transmission Range Sensor Circuit High Input
P0709 Transmission Range Sensor Circuit Intermittent
P0710 Transmission Fluid Temperature Sensor Circuit Malfunction
P0711 Transmission Fluid Temperature Sensor Circuit Range/Performance
P0712 Transmission Fluid Temperature Sensor Circuit Low Input
P0713 Transmission Fluid Temperature Sensor Circuit High Input
P0714 Transmission Fluid Temperature Sensor Circuit Intermittent
P0715 Input/Turbine Speed Sensor Circuit Malfunction
P0716 Input/Turbine Speed Sensor Circuit Range/Performance
P0717 Input/Turbine Speed Sensor Circuit No Signal
P0718 Input/Turbine Speed Sensor Circuit Intermittent
P0719 Torque Converter/Brake Switch "B" Circuit Low
P0720 Output Speed Sensor Circuit Malfunction
P0721 Output Speed Sensor Circuit Range/Performance
P0722 Output Speed Sensor Circuit No Signal
P0723 Output Speed Sensor Circuit Intermittent
P0724 Torque Converter/Brake Switch "B" Circuit High
P0725 Engine Speed Input Circuit Malfunction
P0726 Engine Speed Input Circuit Range/Performance
P0727 Engine Speed Input Circuit No Signal
P0728 Engine Speed Input Circuit Intermittent
P0730 Incorrect Gear Ratio
P0731 Gear 1 Incorrect Ratio
P0732 Gear 2 Incorrect Ratio
P0733 Gear 3 Incorrect Ratio
P0734 Gear 4 Incorrect Ratio
P0735 Gear 5 Incorrect Ratio
P0736 Reverse Incorrect Ratio
P0740 Torque Converter Clutch Circuit Malfunction
P0741 Torque Converter Clutch Circuit Performance or Stuck Off
P0742 Torque Converter Clutch Circuit Stuck On
P0743 Torque Converter Clutch Circuit Electrical
P0744 Torque Converter Clutch Circuit Intermittent
P0745 Pressure Control Solenoid Malfunction
P0746 Pressure Control Solenoid Performance or Stuck Off
P0747 Pressure Control Solenoid Stuck On
P0748 Pressure Control Solenoid Electrical
P0749 Pressure Control Solenoid Intermittent
P0750 Shift Solenoid "A" Malfunction
P0751 Shift Solenoid "A" Performance or Stuck Off
P0752 Shift Solenoid "A" Stuck On
P0753 Shift Solenoid "A" Electrical
P0754 Shift Solenoid "A" Intermittent
P0755 Shift Solenoid "B" Malfunction
P0756 Shift Solenoid "B" Performance or Stuck Oft
P0757 Shift Solenoid "B" Stuck On
P0758 Shift Solenoid "B" Electrical
P0759 Shift Solenoid "B" Intermittent
P0760 Shift Solenoid "C" Malfunction
P0761 Shift Solenoid "C" Performance Or Stuck Oft
P0762 Shift Solenoid "C" Stuck On
P0763 Shift Solenoid "C" Electrical
P0764 Shift Solenoid "C" Intermittent
P0765 Shift Solenoid "D" Malfunction
P0766 Shift Solenoid "D" Performance Or Stuck Oft
P0767 Shift Solenoid "D" Stuck On
P0768 Shift Solenoid "D" Electrical
P0769 Shift Solenoid "D" Intermittent
P0770 Shift Solenoid "E" Malfunction
P0771 Shift Solenoid "E" Performance Or Stuck Oft
P0772 Shift Solenoid "E" Stuck On
P0773 Shift Solenoid "E" Electrical
P0774 Shift Solenoid "E" Intermittent
P0780 Shift Malfunction
P0781 1 –2 Shift Malfunction
P0782 2 –3 Shift Malfunction
P0783 3 –4 Shift Malfunction
P0784 4 –5 Shift Malfunction
P0785 Shift/Timing Solenoid Malfunction
P0786 Shift/Timing Solenoid Range/Performance
P0787 Shift/Timing Solenoid Low
P0788 Shift/Timing Solenoid High
P0789 Shift/Timing Solenoid Intermittent
P0790 Normal/Performance Switch Circuit Malfunction
P0801 Reverse Inhibit Control Circuit Malfunction
P0803 1–4 Upshift (Skip Shift) Solenoid Control Circuit Malfunction
P0804 1–4 Upshift (Skip Shift) Lamp Control Circuit Malfunction
P1000 OBD II Monitor Testing Not Complete More Driving Required
P1001 Key On Engine Running (KOER) Self-Test Not Able To Complete, KOER Aborted
P1100 Mass Air Flow (MAF) Sensor Intermittent
P1101 Mass Air Flow (MAF) Sensor Out Of Self-Test Range
P1111 System Pass 49 State
P1112 Intake Air Temperature (IAT) Sensor Intermittent
P1116 Engine Coolant Temperature (ECT) Sensor Out Of Self-Test Range
P1117 Engine Coolant Temperature (ECT) Sensor Intermittent
P1120 Throttle Position (TP) Sensor Out Of Range (Low)
P1121 Throttle Position (TP) Sensor Inconsistent With MAF Sensor
P1124 Throttle Position (TP) Sensor Out Of Self-Test Range
P1125 Throttle Position (TP) Sensor Circuit Intermittent
P1127 Exhaust Not Warm Enough, Downstream Heated Oxygen Sensors (HO_2S) Not Tested
P1128 Upstream Heated Oxygen Sensors (HO_2S) Swapped From Bank To Bank
P1129 Downstream Heated Oxygen Sensors (HO_2S) Swapped From Bank To Bank
P1130 Lack Of Upstream Heated Oxygen Sensor (HO_2S 11) Switch, Adaptive Fuel At Limit (Bank #1)
P1131 Lack Of Upstream Heated Oxygen Sensor (HO_2S 11) Switch, Sensor Indicates Lean (Bank #1)
P1132 Lack Of Upstream Heated Oxygen Sensor (HO_2S 11) Switch, Sensor Indicates Rich (Bank#1)
P1137 Lack Of Downstream Heated Oxygen Sensor (HO_2S 12) Switch, Sensor Indicates Lean (Bank#1)
P1138 Lack Of Downstream Heated Oxygen Sensor (HO_2S 12) Switch, Sensor Indicates Rich (Bank#1)
P1150 Lack Of Upstream Heated Oxygen Sensor (HO_2S 21) Switch, Adaptive Fuel At Limit (Bank #2)
P1151 Lack Of Upstream Heated Oxygen Sensor (HO_2S 21) Switch, Sensor Indicates Lean (Bank#2)
P1152 Lack Of Upstream Heated Oxygen Sensor (HO_2S 21) Switch, Sensor Indicates Rich (Bank #2)
P1157 Lack Of Downstream Heated Oxygen Sensor (HO_2S 22) Switch, Sensor Indicates Lean (Bank #2)
P1158 Lack Of Downstream Heated Oxygen Sensor (HO_2S 22) Switch, Sensor Indicates Rich (Bank#2)
P1169 (HO_2S 12) Signal Remained Unchanged For More Than 20 Seconds After Closed Loop
P1170 (HO_2S 11) Signal Remained Unchanged For More Than 20 Seconds After Closed Loop

P1173 Feedback A/F Mixture Control (HO_2S 21) Signal Remained Unchanged For More Than 20 Seconds After Closed Loop
P1195 Barometric (BARO) Pressure Sensor Circuit Malfunction (Signal Is From EGR Boost Sensor)
P1196 Starter Switch Circuit Malfunction
P1218 Cylinder Identification (CID) Stuck High
P1219 Cylinder Identification (CID) Stuck Low
P1220 Series Throttle Control Malfunction (Traction Control System)
P1224 Throttle Position Sensor "B" (TP-B) Out Of Self-Test Range (Traction Control System)
P1230 Fuel Pump Low Speed Malfunction
P1231 Fuel Pump Secondary Circuit Low With High Speed Pump On
P1232 Low Speed Fuel Pump Primary Circuit Malfunction
P1233 Fuel Pump Driver Module Off-line (MIL DTC)
P1234 Fuel Pump Driver Module Disabled Or Off-line (No MIL)
P1235 Fuel Pump Control Out Of Range (MIL DTC)
P1236 Fuel Pump Control Out Of Range (No MIL)
P1237 Fuel Pump Secondary Circuit Malfunction (MIL DTC)
P1238 Fuel Pump Secondary Circuit Malfunction (No DMIL)
P1260 THEFT Detected —Engine Disabled
P1261 High To Low Side Short —Cylinder #1 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1262 High To Low Side Short —Cylinder #2 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1263 High To Low Side Short —Cylinder #3 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1264 High To Low Side Short —Cylinder #4 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1265 High To Low Side Short —Cylinder #5 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1266 High To Low Side Short —Cylinder #6 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1267 High To Low Side Short —Cylinder #7 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1268 High To Low Side Short —Cylinder #8 (Indicates Low side Circuit Is Shorted To B+ Or To The High Side Between The IDM And The Injector)
P1270 Engine RPM Or Vehicle Speed Limiter Reached
P1271 High To Low Side Open —Cylinder #1 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1272 High To Low Side Open —Cylinder #2 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1273 High To Low Side Open —Cylinder #3 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1274 High To Low Side Open —Cylinder #4 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1275 High To Low Side Open —Cylinder #5 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1276 High To Low Side Open —Cylinder #6 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1277 High To Low Side Open —Cylinder #7 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1278 High To Low Side Open —Cylinder #8 (Indicates A High To Low Side Open Between The Injector And The IDM)
P1285 Cylinder Head Temperature (CHT) Over Temperature Sensed
P1288 Cylinder Head Temperature (CHT) Sensor Out Of Self-Test Range
P1289 Cylinder Head Temperature (CHT) Sensor Circuit Low Input
P1290 Cylinder Head Temperature (CHT) Sensor Circuit High Input
P1299 Engine Over Temperature Condition
P1309 Misfire Detection Monitor Is Not Enabled
P1320 Distributor Signal Interrupt
P1336 Crankshaft Position Sensor (Gear)
P1345 No Camshaft Position Sensor Signal
P1351 Ignition Diagnostic Monitor (IDM) Circuit Input Malfunction
P1351 Indicates Ignition System Malfunction
P1352 Indicates Ignition System Malfunction
P1353 Indicates Ignition System Malfunction
P1354 Indicates Ignition System Malfunction
P1355 Indicates Ignition System Malfunction
P1356 PIPs Occurred While IDM Pulse width Indicates Engine Not Turning
P1357 Ignition Diagnostic Monitor (IDM) Pulse width Not Defined
P1358 Ignition Diagnostic Monitor (IDM) Signal Out Of Self-Test Range
P1359 Spark Output Circuit Malfunction
P1364 Spark Output Circuit Malfunction
P1390 Octane Adjust (OCT ADJ) Out Of Self-Test Range
P1397 System Voltage Out Of Self Test Range
P1400 Differential Pressure Feedback EGR (DPFE) Sensor Circuit Low Voltage Detected
P1401 Differential Pressure Feedback EGR (DPFE) Sensor Circuit High Voltage Detected/EGR Temperature Sensor
P1402 EGR Valve Position Sensor Open Or Short
P1403 Differential Pressure Feedback EGR (DPFE) Sensor Hoses Reversed
P1405 Differential Pressure Feedback EGR (DPFE) Sensor Upstream Hose Off Or Plugged
P1406 Differential Pressure Feedback EGR (DPFE) Sensor Downstream Hose Off Or Plugged
P1407 Exhaust Gas Recirculation (EGR) No Flow Detected (Valve Stuck Closed Or Inoperative)
P1408 Exhaust Gas Recirculation (EGR) Flow Out Of Self-Test Range
P1409 Electronic Vacuum Regulator (EVR) Control Circuit Malfunction
P1410 Check That Fuel Pressure Regulator Control Solenoid And The EGR Check Solenoid Connectors Are Not Swapped
P1411 Secondary Air Injection System Incorrect Downstream Flow Detected
P1413 Secondary Air Injection System Monitor Circuit Low Voltage
P1414 Secondary Air Injection System Monitor Circuit High Voltage
P1442 Evaporative Emission Control System Small Leak Detected
P1443 Evaporative Emission Control System —Vacuum System, Purge Control Solenoid Or Purge Control Valve Malfunction
P1444 Purge Flow Sensor (PFS) Circuit Low Input
P1445 Purge Flow Sensor (PFS) Circuit High Input
P1449 Evaporative Emission Control System Unable To Hold Vacuum
P1450 Unable To Bleed Up Fuel Tank Vacuum
P1455 Evaporative Emission Control System Control Leak Detected (Gross Leak)
P1460 Wide Open Throttle Air Conditioning Cut-Off Circuit Malfunction
P1461 Air Conditioning Pressure (ACP) Sensor Circuit Low Input
P1462 Air Conditioning Pressure (ACP) Sensor Circuit High Input
P1463 Air Conditioning Pressure (ACP) Sensor Insufficient Pressure Change
P1464 Air Conditioning (A/C) Demand Out Of Self-Test Range/A/C On During KOER Or CCT Test
P1469 Low Air Conditioning Cycling Period
P1473 Fan Secondary High, With Fan(s) Off
P1474 Low Fan Control Primary Circuit Malfunction
P1479 High Fan Control Primary Circuit Malfunction
P1480 Fan Secondary Low, With Low Fan On
P1481 Fan Secondary Low, With High Fan On
P1483 Power To Fan Circuit Over current
P1484 Open Power/Ground To Variable Load Control Module (VLCM)
P1485 EGR Control Solenoid Open Or Short
P1486 EGR Vent Solenoid Open Or Short
P1487 EGR Boost Check Solenoid Open Or Short
P1500 Vehicle Speed Sensor (VSS) Circuit Intermittent
P1501 Vehicle Speed Sensor (VSS) Out Of Self-Test Range/Vehicle Moved During Test
P1502 Invalid Self Test —Auxiliary Powertrain Control Module (APCM) Functioning
P1504 Idle Air Control (IAC) Circuit Malfunction
P1505 Idle Air Control (IAC) System At Adaptive Clip
P1506 Idle Air Control (IAC) Overspeed Error
P1507 Idle Air Control (IAC) Underspeed Error
P1512 Intake Manifold Runner Control (IMRC) Malfunction (Bank#1 Stuck Closed)
P1513 Intake Manifold Runner Control (IMRC) Malfunction (Bank#2 Stuck Closed)
P1516 Intake Manifold Runner Control (IMRC) Input Error (Bank #1)
P1517 Intake Manifold Runner Control (IMRC) Input Error (Bank #2)
P1518 Intake Manifold Runner Control (IMRC) Malfunction (Stuck Open)
P1519 Intake Manifold Runner Control (IMRC) Malfunction (Stuck Closed)
P1520 Intake Manifold Runner Control (IMRC) Circuit Malfunction
P1521 Variable Resonance Induction System (VRIS) Solenoid #1 Open Or Short
P1522 Variable Resonance Induction System (VRIS) Solenoid#2 Open Or Short
P1523 High Speed Inlet Air (HSIA) Solenoid Open Or Short

P1530 Air Condition (A/C) Clutch Circuit Malfunction
P1531 Invalid Test —Accelerator Pedal Movement
P1536 Parking Brake Applied Failure
P1537 Intake Manifold Runner Control (IMRC) Malfunction (Bank#1 Stuck Open)
P1538 Intake Manifold Runner Control (IMRC) Malfunction (Bank#2 Stuck Open)
P1539 Power To Air Condition (A/C) Clutch Circuit Overcurrent
P1549 Problem In Intake Manifold Tuning (IMT) Valve System
P1550 Power Steering Pressure (PSP) Sensor Out Of Self-Test Range
P1601 Serial Communication Error
P1605 Powertrain Control Module (PCM) —Keep Alive Memory (KAM) Test Error
P1608 PCM Internal Circuit Malfunction
P1609 PCM Internal Circuit Malfunction (2.5L Only)
P1625 B+ Supply To Variable Load Control Module (VLCM) Fan Circuit Malfunction
P1626 B+ Supply To Variable Load Control Module (VLCM) Air Conditioning (A/C) Circuit
P1650 Power Steering Pressure (PSP) Switch Out Of Self-Test Range
P1651 Power Steering Pressure (PSP) Switch Input Malfunction
P1660 Output Circuit Check Signal High
P1661 Output Circuit Check Signal Low
P1663 Fuel Delivery Command Signal (FDCS) Circuit Failure
P1667 Cylinder Identification (CID) Circuit Failure
P1668 PCM —IDM Diagnostic Communication Error
P1670 EF Feedback Signal Not Detected
P1701 Reverse Engagement Error
P1703 Brake On/Off (BOO) Switch Out Of Self-Test Range
P1704 Digital Transmission Range (TR) Sensor Failed To Transition State
P1705 Transmission Range (TR) Sensor Out Of Self-Test Range
P1705 Park Neutral Position (PNP) Problem
P1706 High Vehicle Speed In Park
P1709 Park Or Neutral Position (PNP) Switch Out Of Self-Test Range
P1711 Transmission Fluid Temperature (TFT) Sensor Out Of Self-Test Range
P1714 Shift Solenoid "A" Inductive Signature Malfunction
P1715 Shift Solenoid "B" Inductive Signature Malfunction
P1716 Transmission Malfunction
P1717 Transmission Malfunction
P1719 Transmission Malfunction
P1720 Vehicle Speed Sensor (VSS) Circuit Malfunction
P1727 Coast Clutch Solenoid Inductive Signature Malfunction
P1728 Transmission Slip Error —Converter Clutch Failed
P1731 Improper 1 –2 Shift
P1732 Improper 2 –3 Shift
P1733 Improper 3 –4 Shift
P1734 Improper 4 –5 Shift
P1740 Torque Converter Clutch (TCC) Inductive Signature Malfunction
P1741 Torque Converter Clutch (TCC) Control Error
P1742 Torque Converter Clutch (TCC) Solenoid Failed On (Turns On MIL)
P1743 Torque Converter Clutch (TCC) Solenoid Failed On (Turns On TCIL)
P1744 Torque Converter Clutch (TCC) System Mechanically Stuck In Off Position
P1746 Electronic Pressure Control (EPC) Solenoid Open Circuit (Low Input)
P1747 Electronic Pressure Control (EPC) Solenoid Short Circuit (High Input)
P1748 Electronic Pressure Control (EPC) Malfunction
P1749 Electronic Pressure Control (EPC) Solenoid Failed Low
P1751 Shift Solenoid#1 (SS1) Performance
P1754 Coast Clutch Solenoid (CCS) Circuit Malfunction
P1756 Shift Solenoid#2 (SS2) Performance
P1760 Overrun Clutch SN
P1761 Shift Solenoid #(SS2) Performance
P1762 Transmission Malfunction
P1765 3 –2 Timing Solenoid Malfunction (2.5L Only)
P1779 TCIL Circuit Malfunction
P1780 Transmission Control Switch (TCS) Circuit Out Of Self-Test Range
P1783 Transmission Over Temperature Condition
P1784 Transmission Malfunction
P1785 Transmission Malfunction
P1786 Transmission Malfunction
P1787 Transmission Malfunction
P1788 3 –2 Timing/Coast Clutch Solenoid (3 –2/CCS) Circuit Open
P1789 3 –2 Timing/Coast Clutch Solenoid (3 –2/CCS) Circuit Shorted
P1792 Idle (IDL) Switch (Closed Throttle Position Switch) Malfunction
P1794 Loss Of Battery Voltage Input
P1797 Neutral Switch Circuit Malfunction
P1900 Cooling Fan
U1021 SCP Indicating The Lack Of Air Conditioning (A/C) Clutch Status Response
U1039 Vehicle Speed Signal (VSS) Missing Or Incorrect
U1051 Brake Switch Signal Missing Or Incorrect
U1073 SCP Indicating The Lack Of Engine Coolant Fan Status Response
U1131 SCP Indicating The Lack Of Fuel Pump Status Response
U1135 SCP Indicating The Ignition Switch Signal Missing Or Incorrect
U1256 SCP Indicating A Communications Error
U1451 Lack Of Response From Passive Anti-Theft System (PATS) Module —Engine Disabled

VACUUM DIAGRAMS

Following are vacuum diagrams for most of the engine and emissions package combinations covered by this manual. Because vacuum circuits will vary based on various engine and vehicle options, always refer first to the vehicle emission control information label, if present. Should the label be missing, or should vehicle be equipped with a different engine from the vehicle's original equipment, refer to the diagrams below for the same or similar configuration.

If you wish to obtain a replacement emissions label, most manufacturers make the labels available for purchase. The labels can usually be ordered from a local dealer.

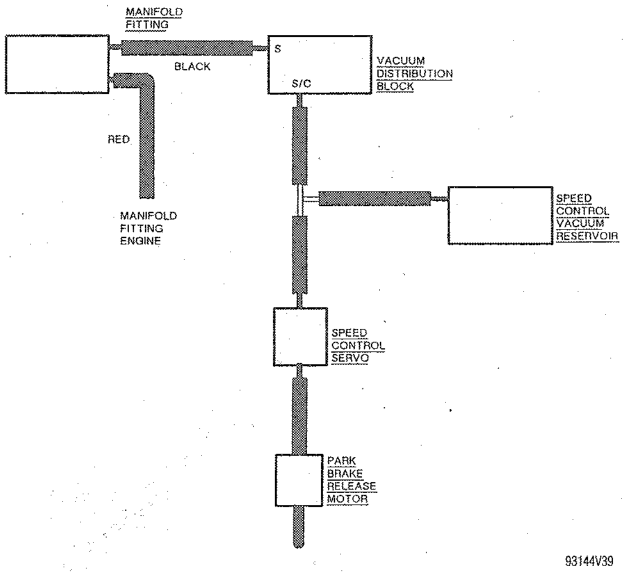

Fig. 83 1988–1990 Continental typical vacuum diagram—3.8L engine

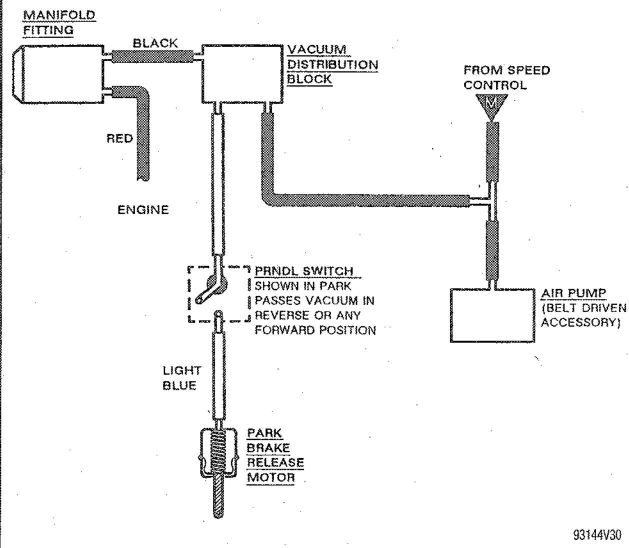

Fig. 84 1988–1990 Mark VII typical vacuum diagram—5.0L engine

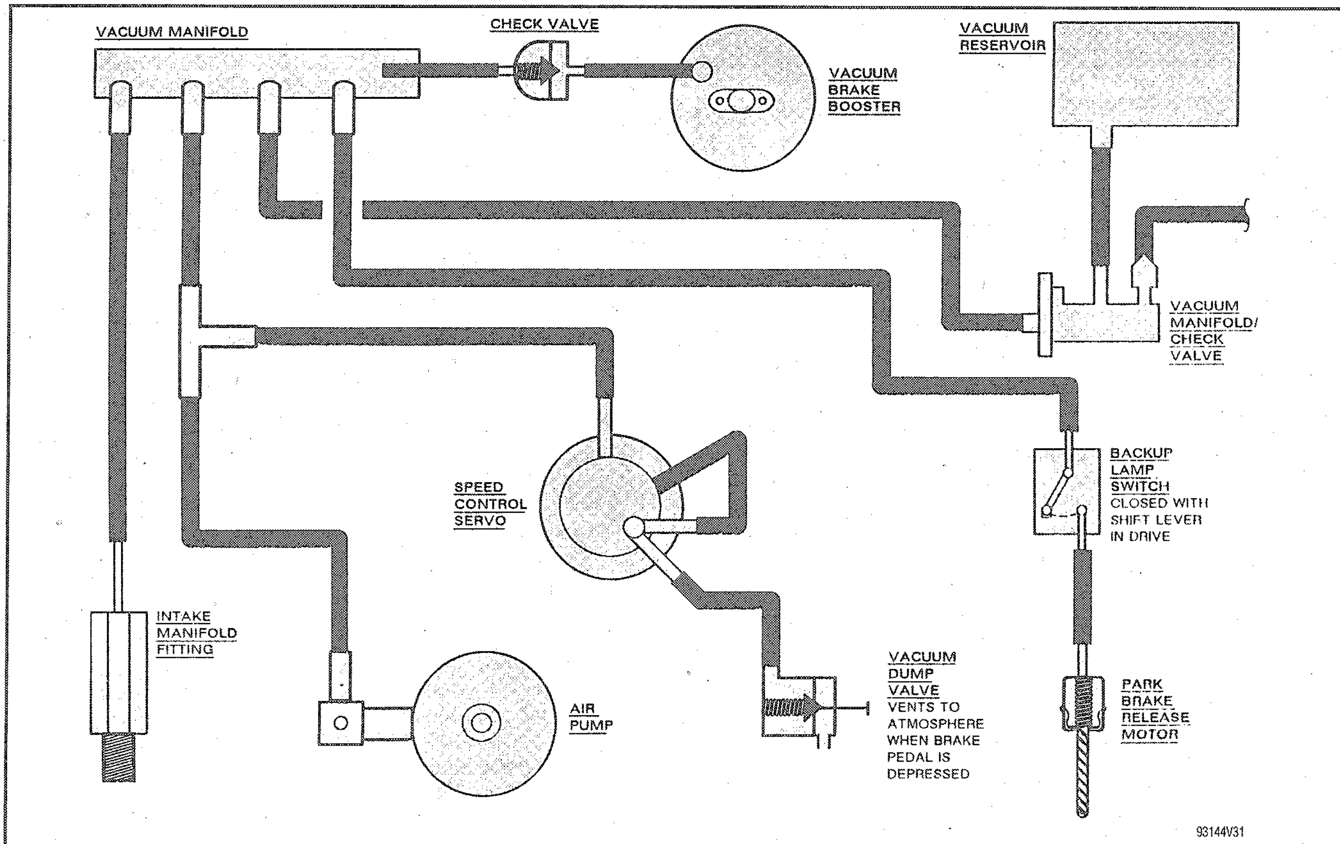

Fig. 85 1988–1990 Town Car typical vacuum diagram—5.0L engine (1 of 2)

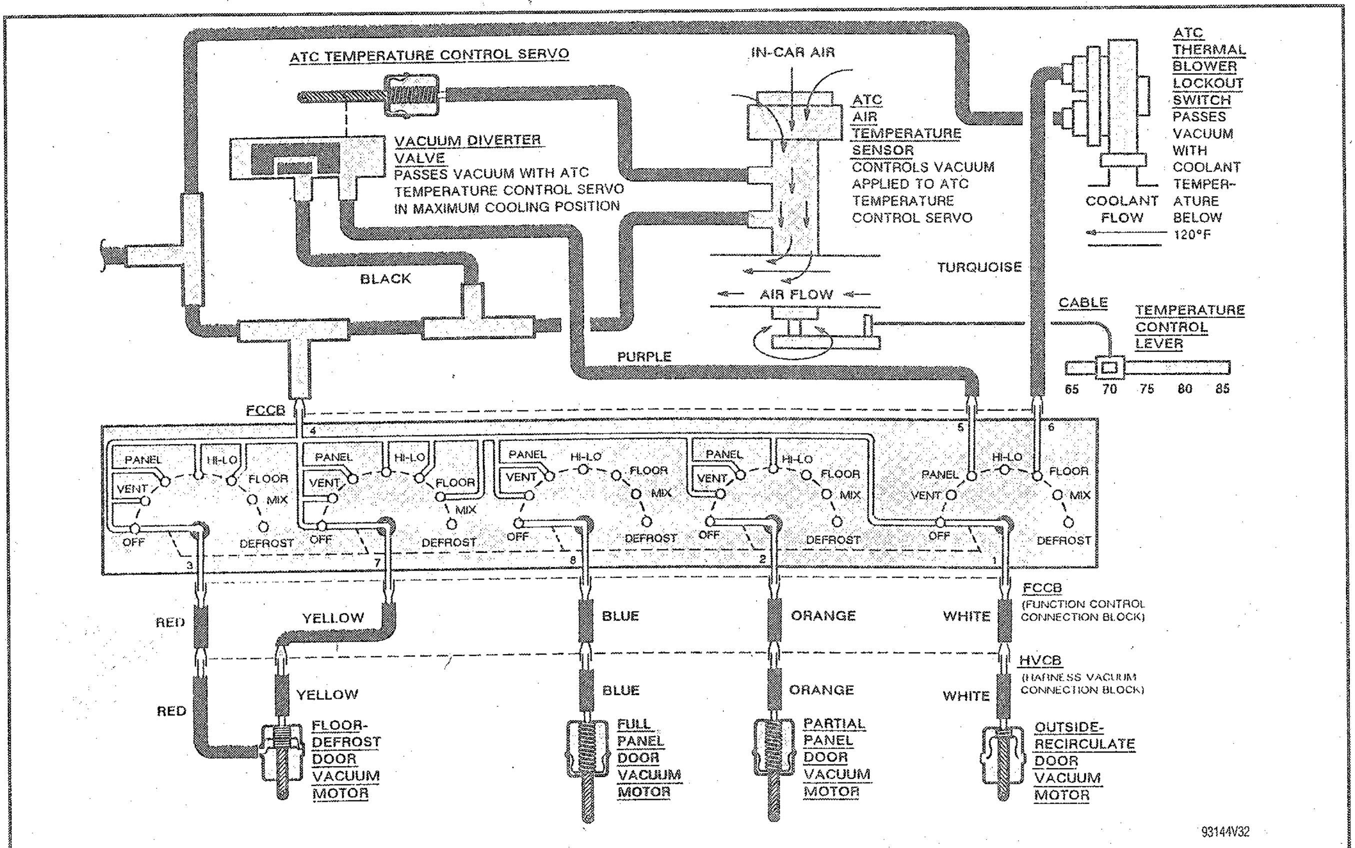

Fig. 86 1988–1990 Town Car typical vacuum diagram—5.0L engine (2 of 2)

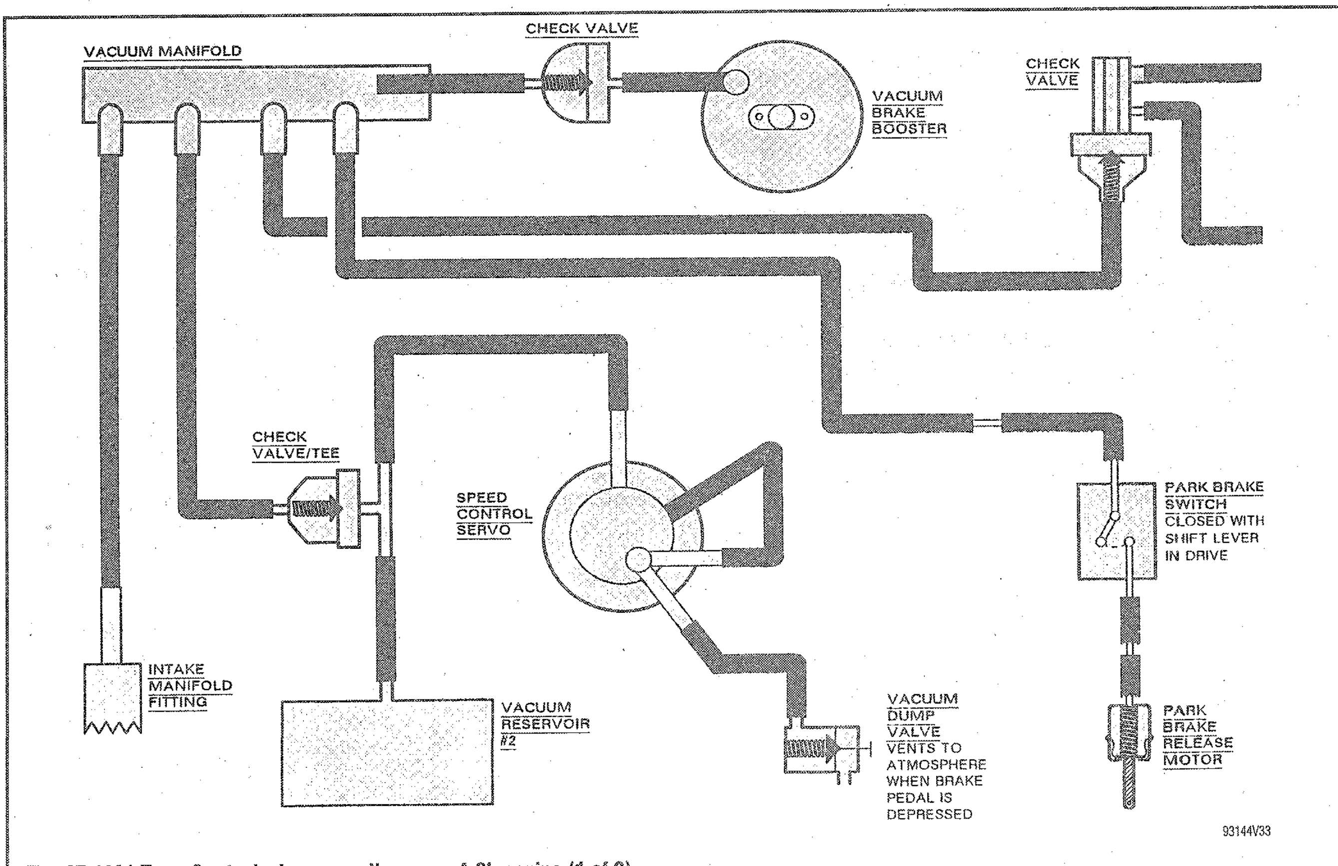

Fig. 87 1991 Town Car typical vacuum diagram—4.6L engine (1 of 2)

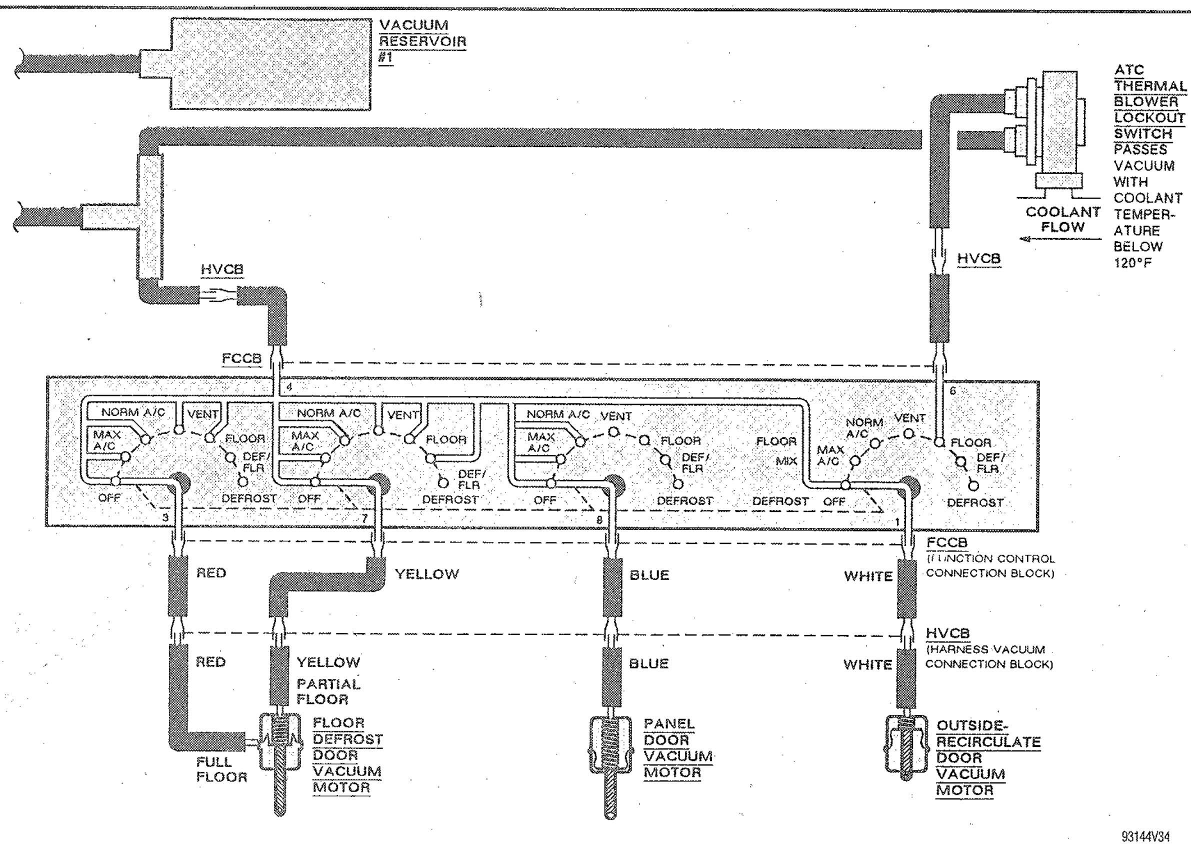

Fig. 88 1991 Town Car typical vacuum diagram—4.6L engine (2 of 2)

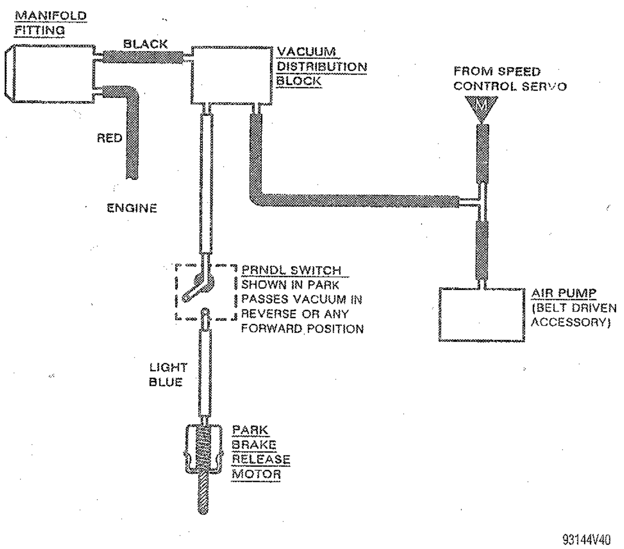

Fig. 89 1991 Mark VII typical vacuum diagram—5.0L engine

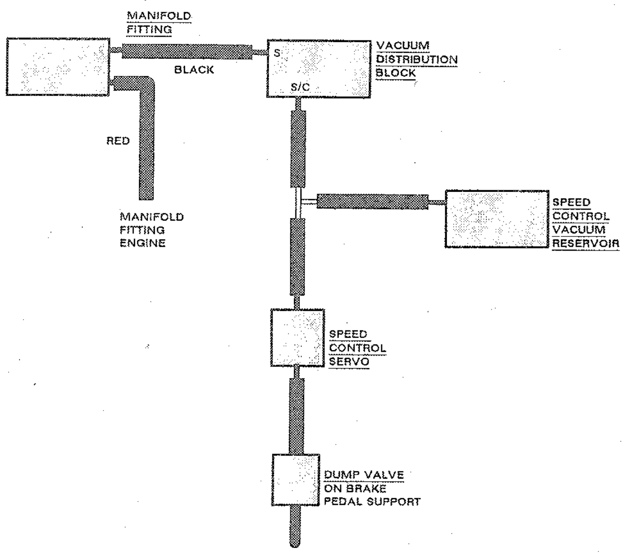

Fig. 90 1992 Continental typical vacuum diagram—3.8L engine

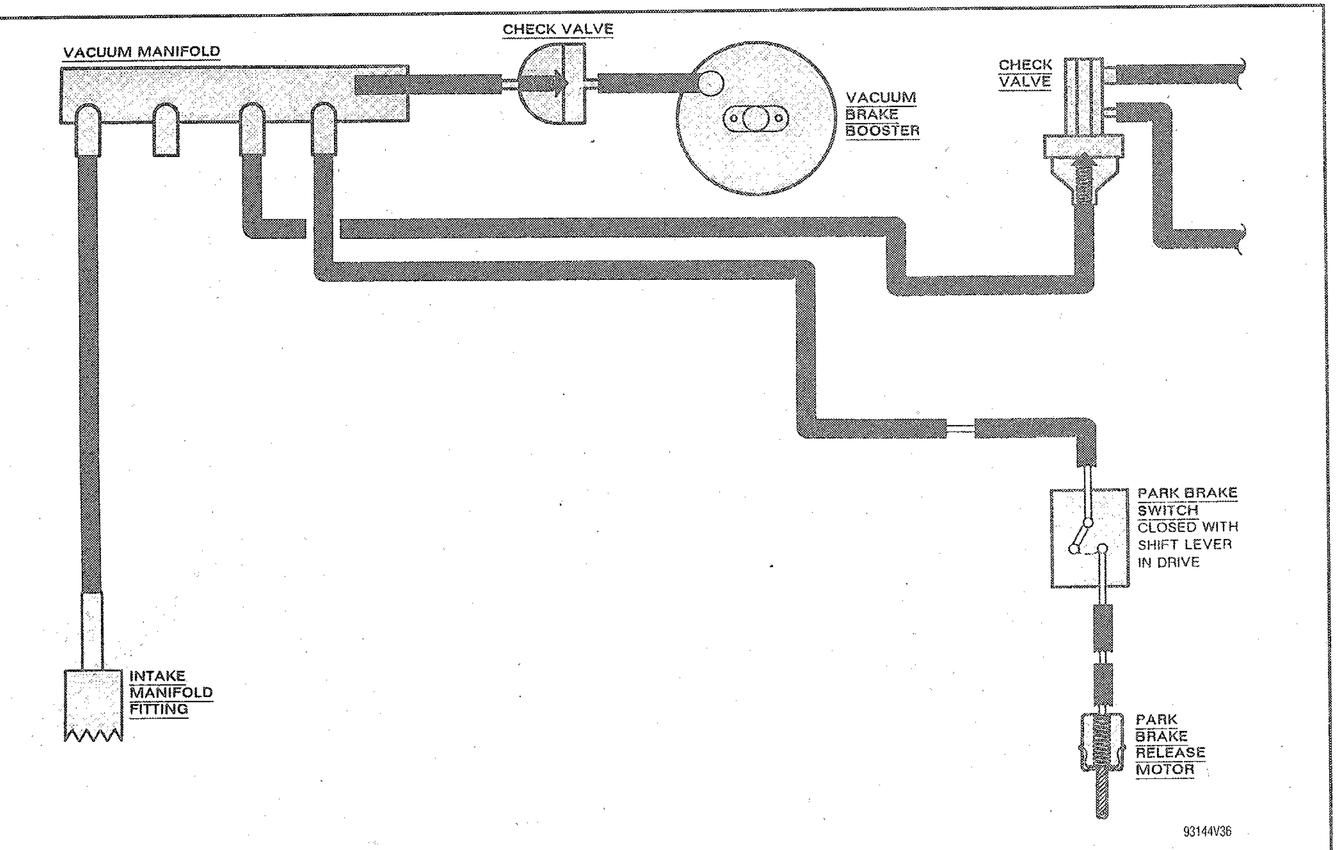

Fig. 91 1992 Town Car typical vacuum diagram—4.6L engine (1 of 2)

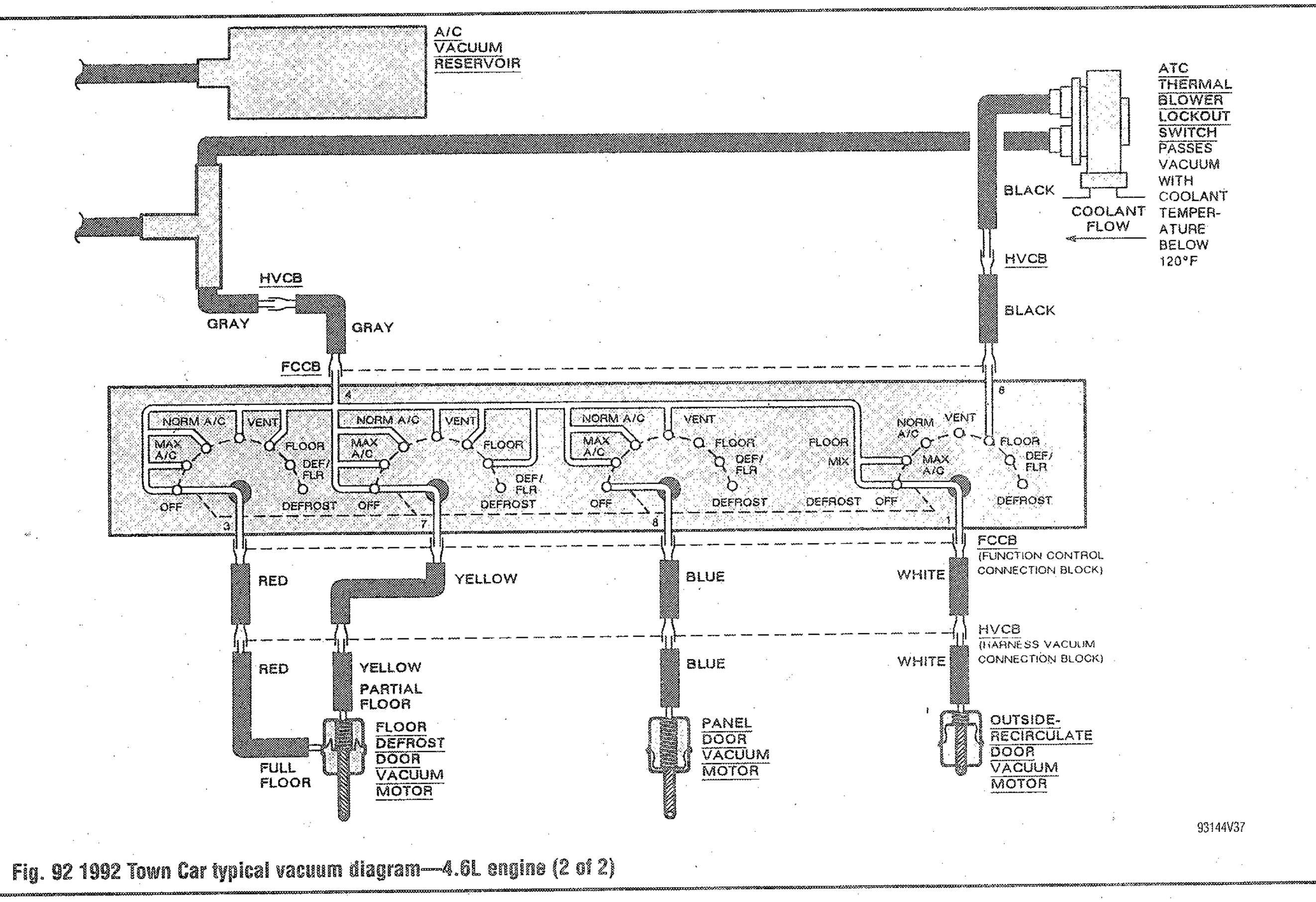

Fig. 92 1992 Town Car typical vacuum diagram—4.6L engine (2 of 2)

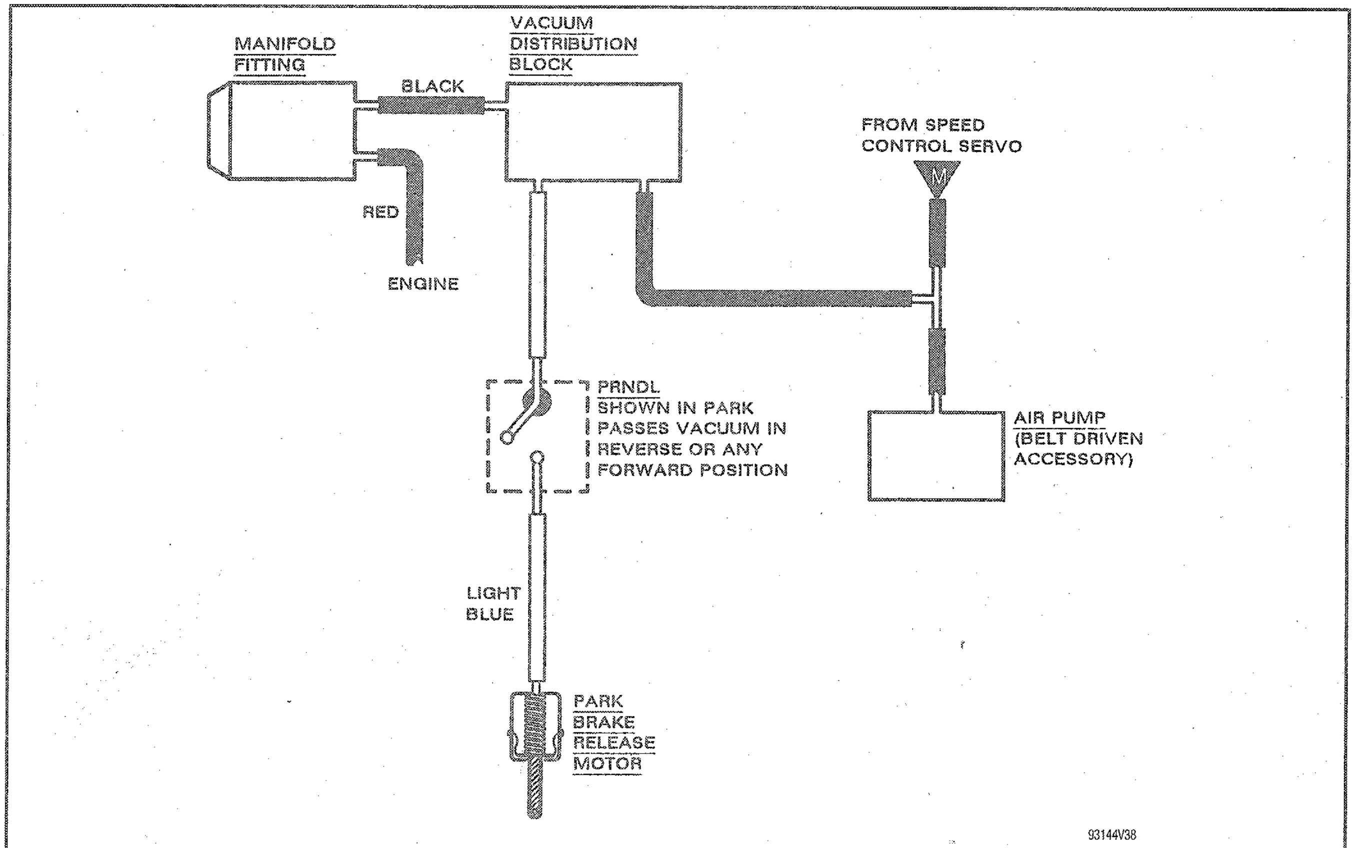

Fig. 93 1992 Mark VII typical vacuum diagram—5.0L engine

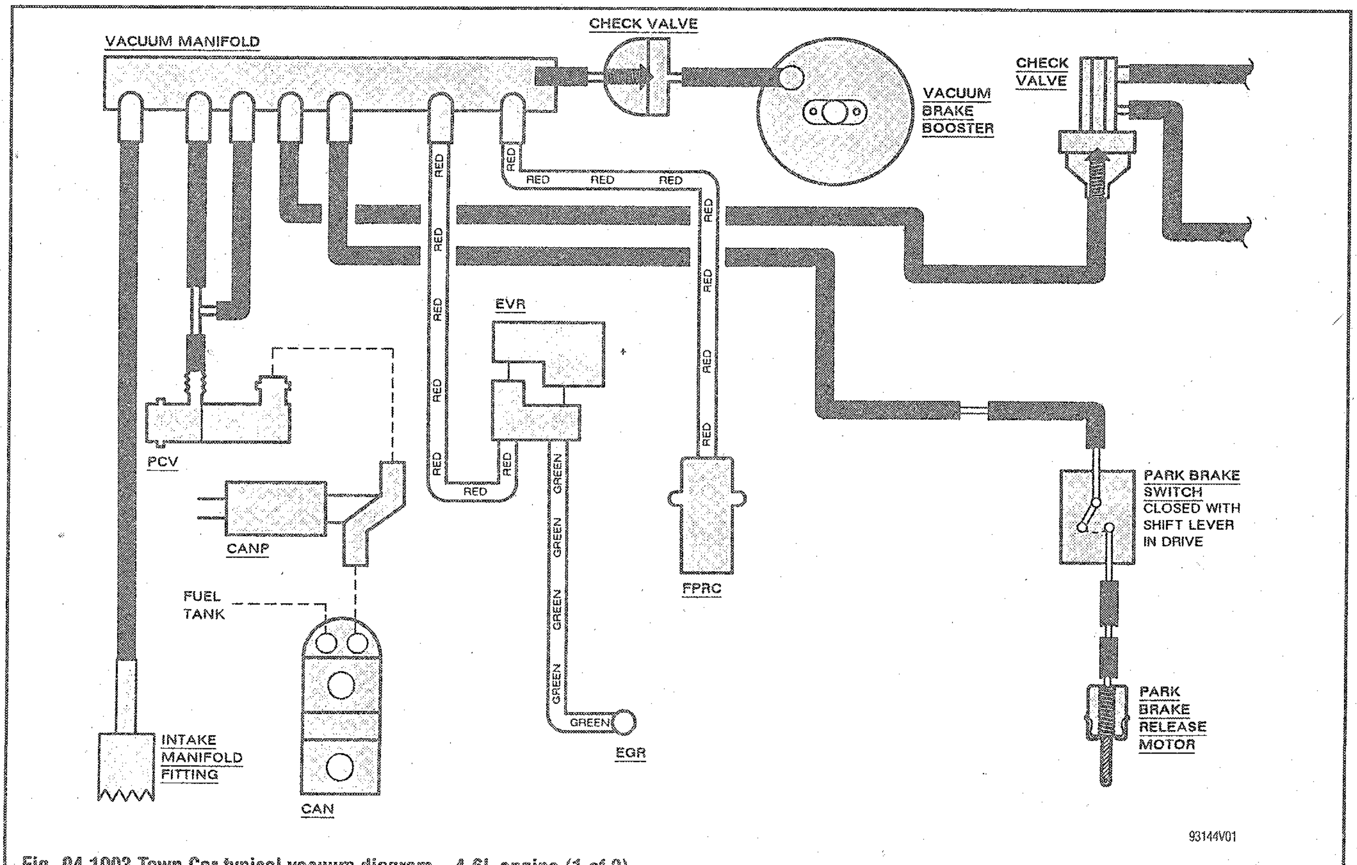

Fig. 94 1993 Town Car typical vacuum diagram—4.6L engine (1 of 2)

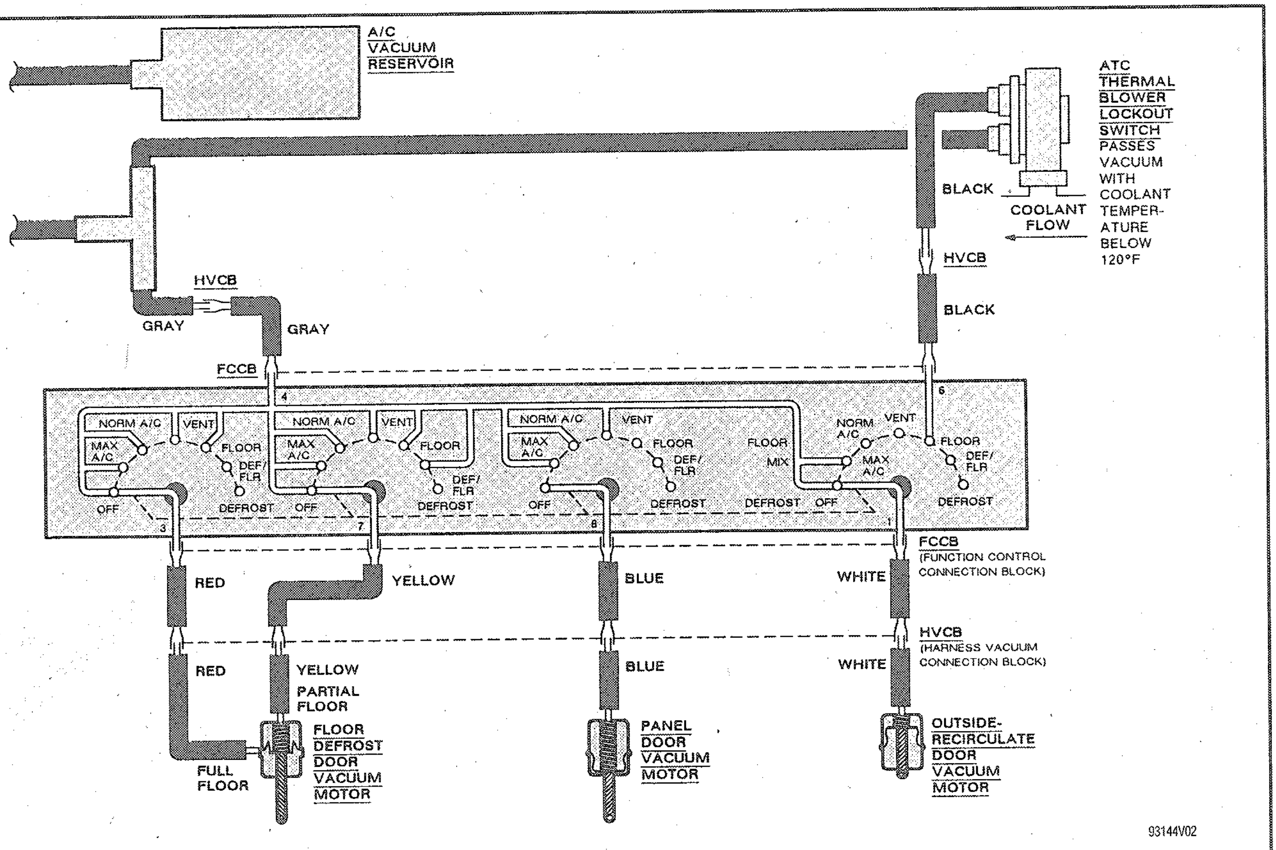

Fig. 95 1993 Town Car typical vacuum diagram—4.6L engine (2 of 2)

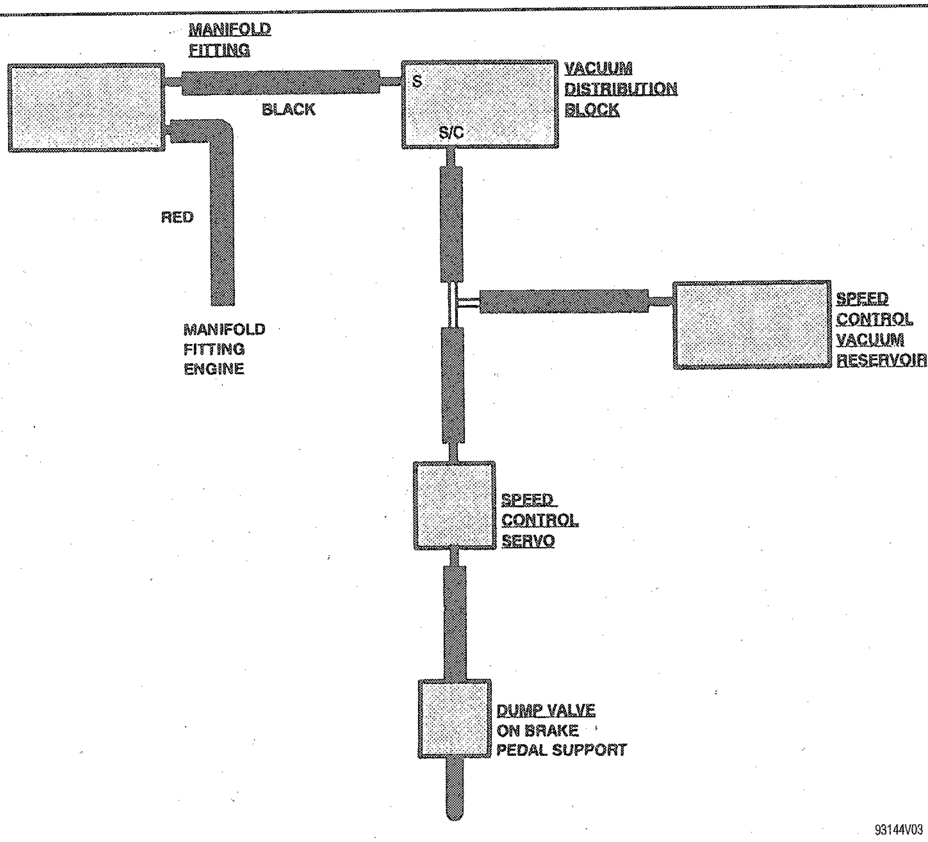

Fig. 96 1993 Continental typical vacuum diagram—3.8L engine

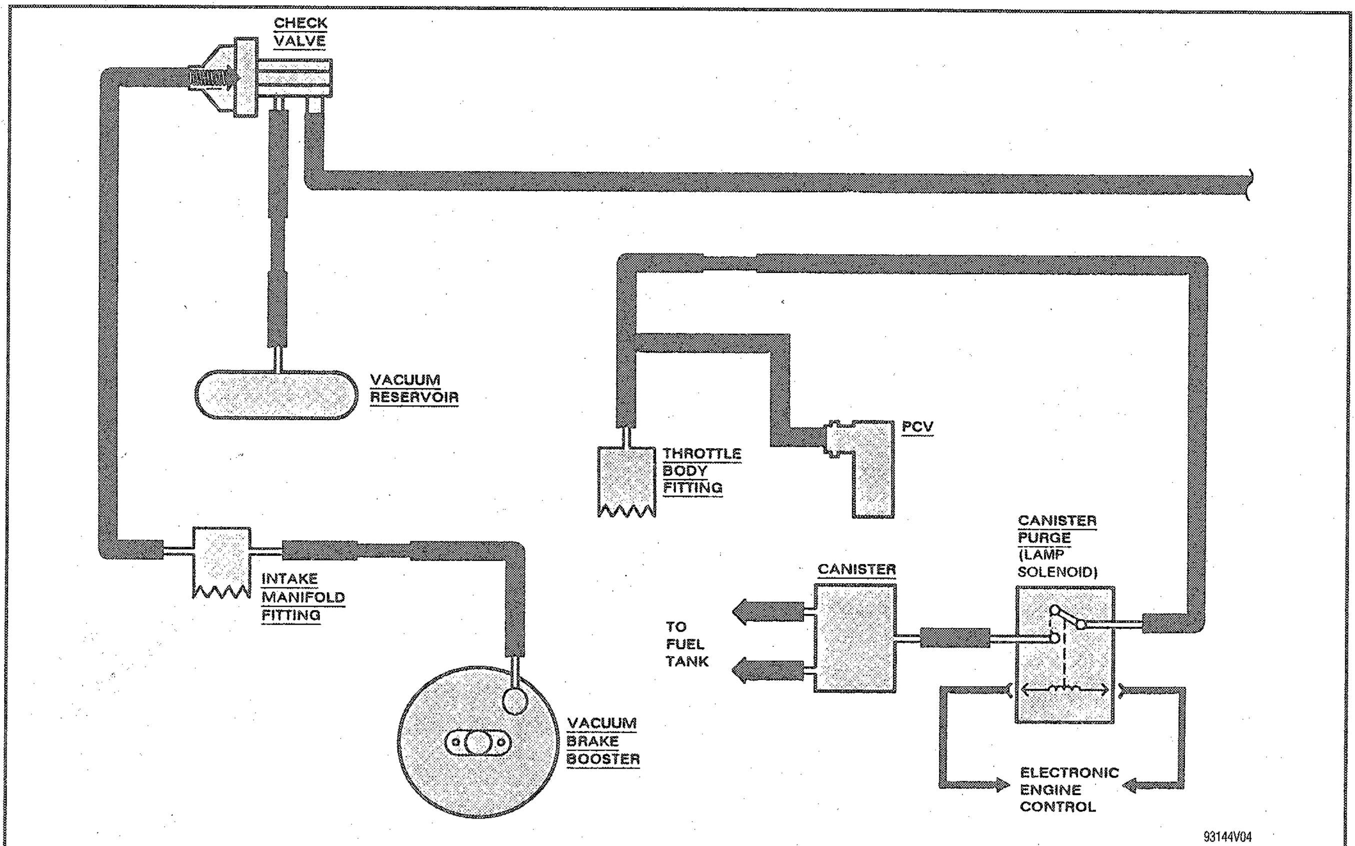

Fig. 97 1993 Mark VIII typical vacuum diagram—4.6L engine (1 of 2)

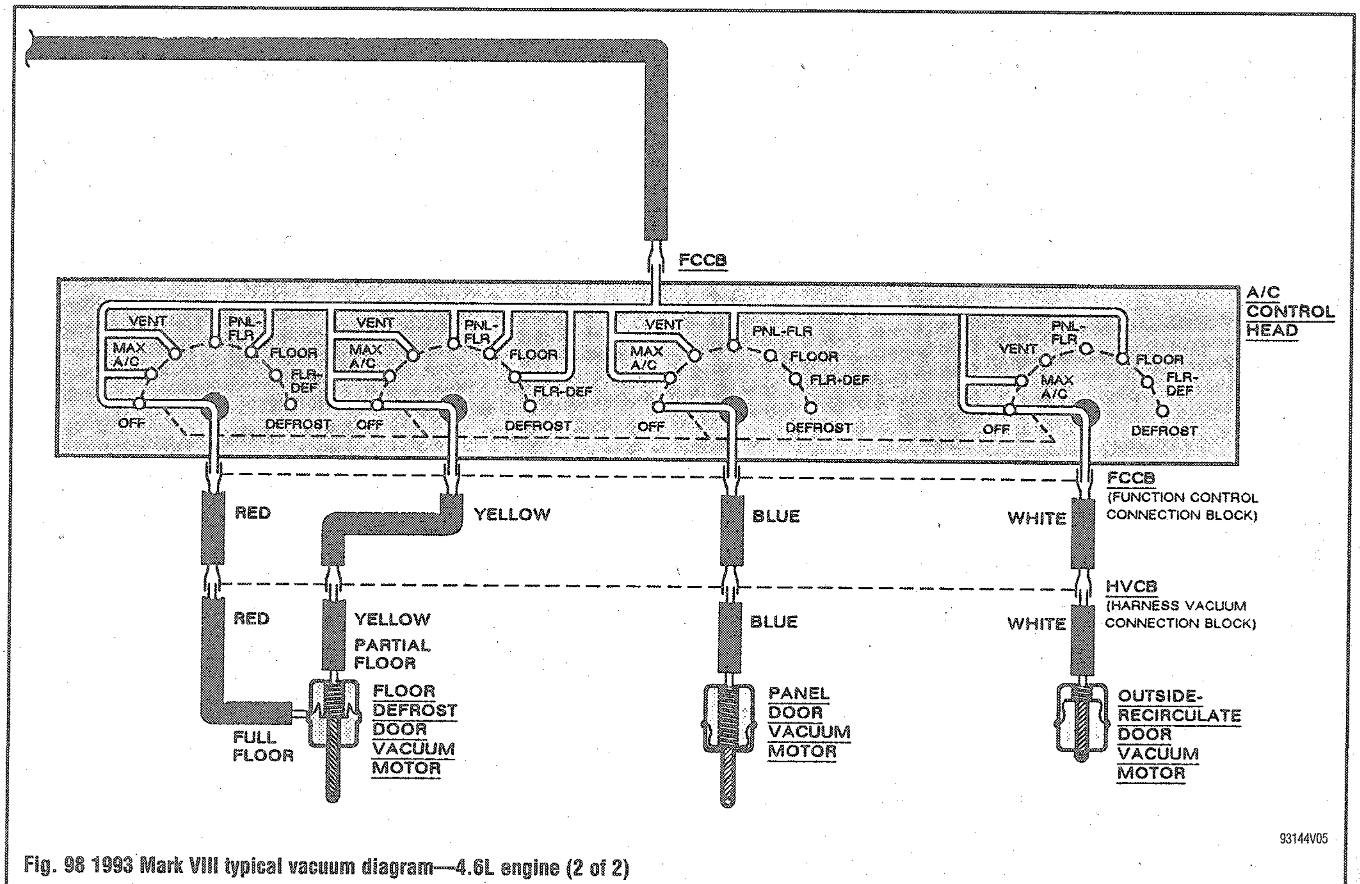

Fig. 98 1993 Mark VIII typical vacuum diagram—4.6L engine (2 of 2)

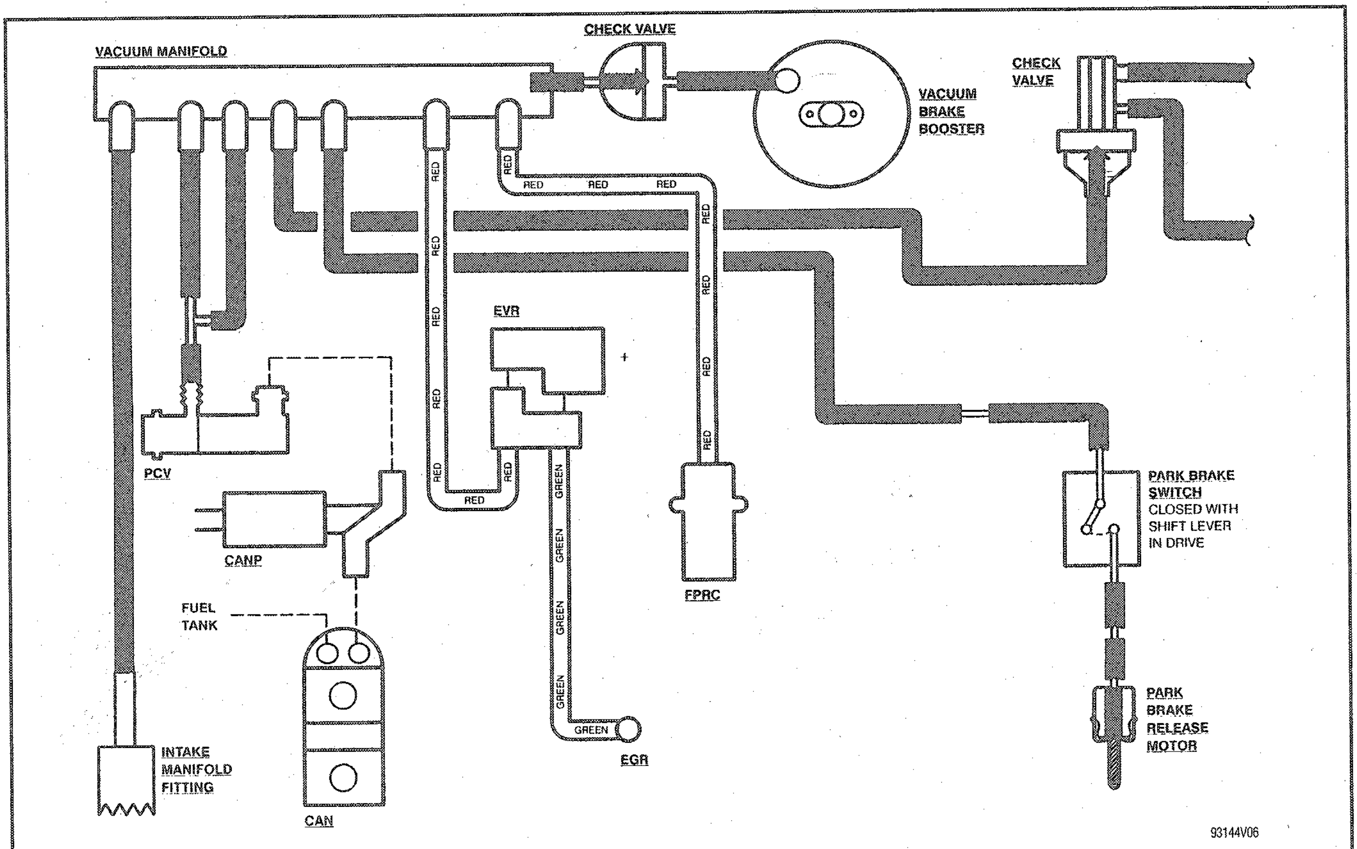

Fig. 99 1994 Town Car typical vacuum diagram—4.6L engine (1 of 2)

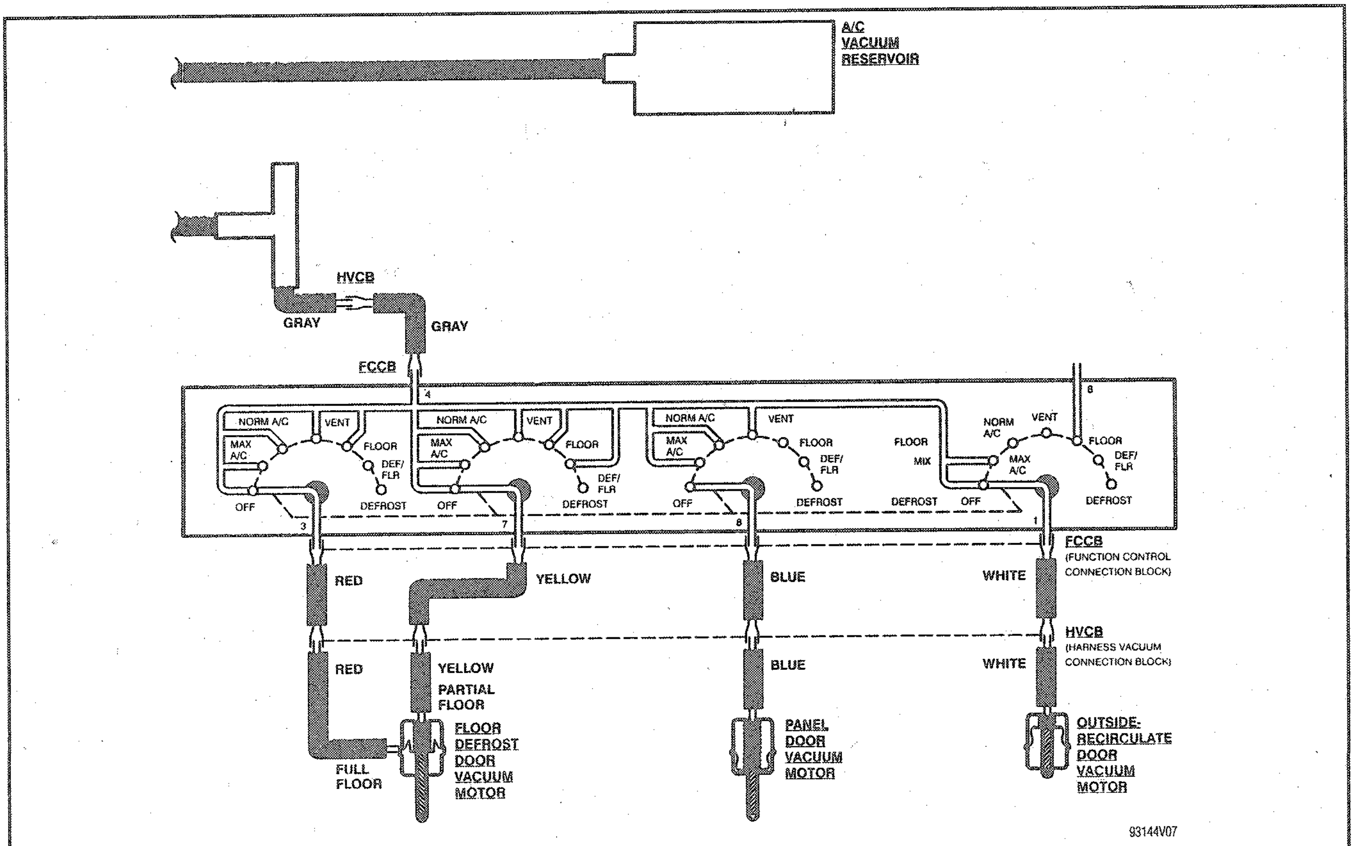

Fig. 100 1994 Town Car typical vacuum diagram—4.6L engine (2 of 2)

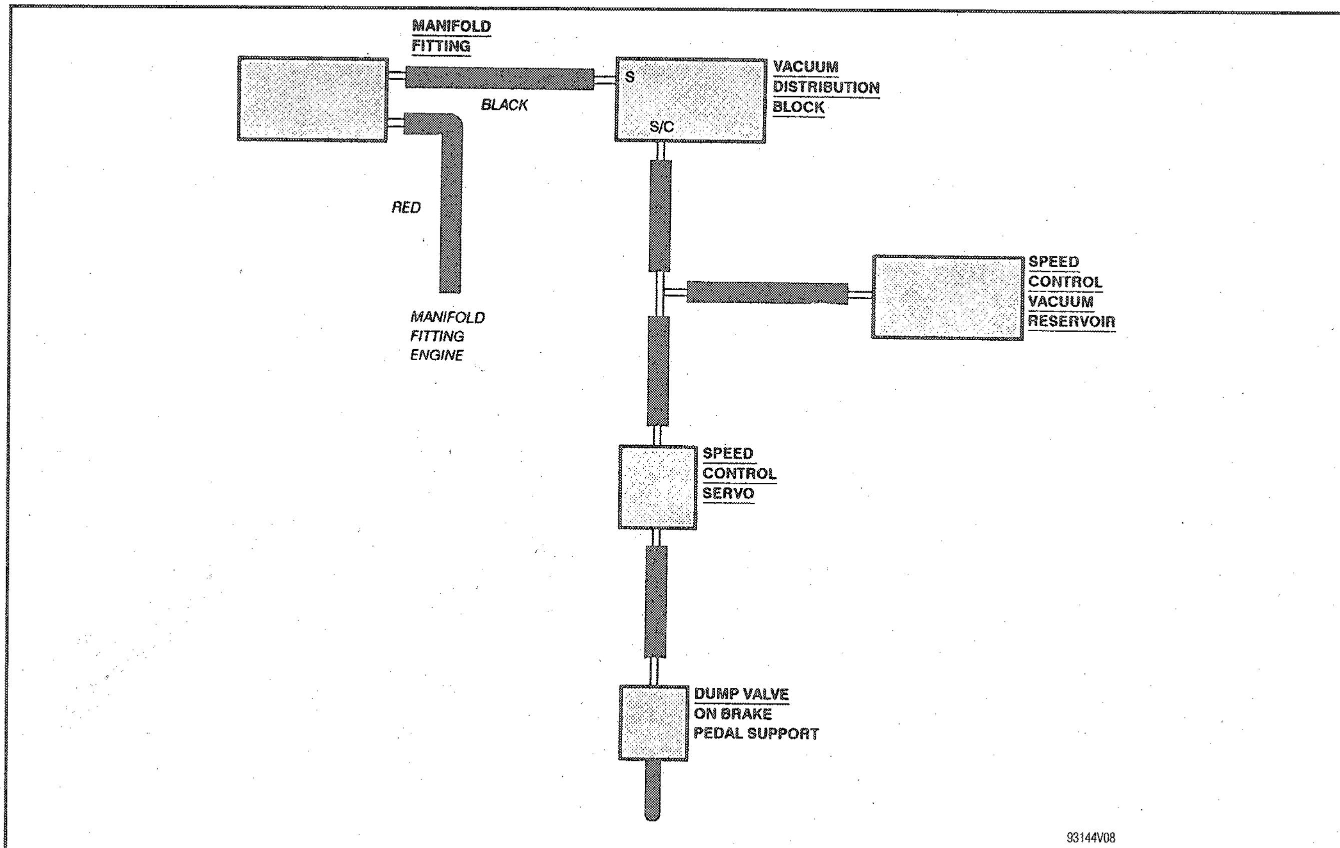

Fig. 101 1994 Continental typical vacuum diagram—3.8L engine

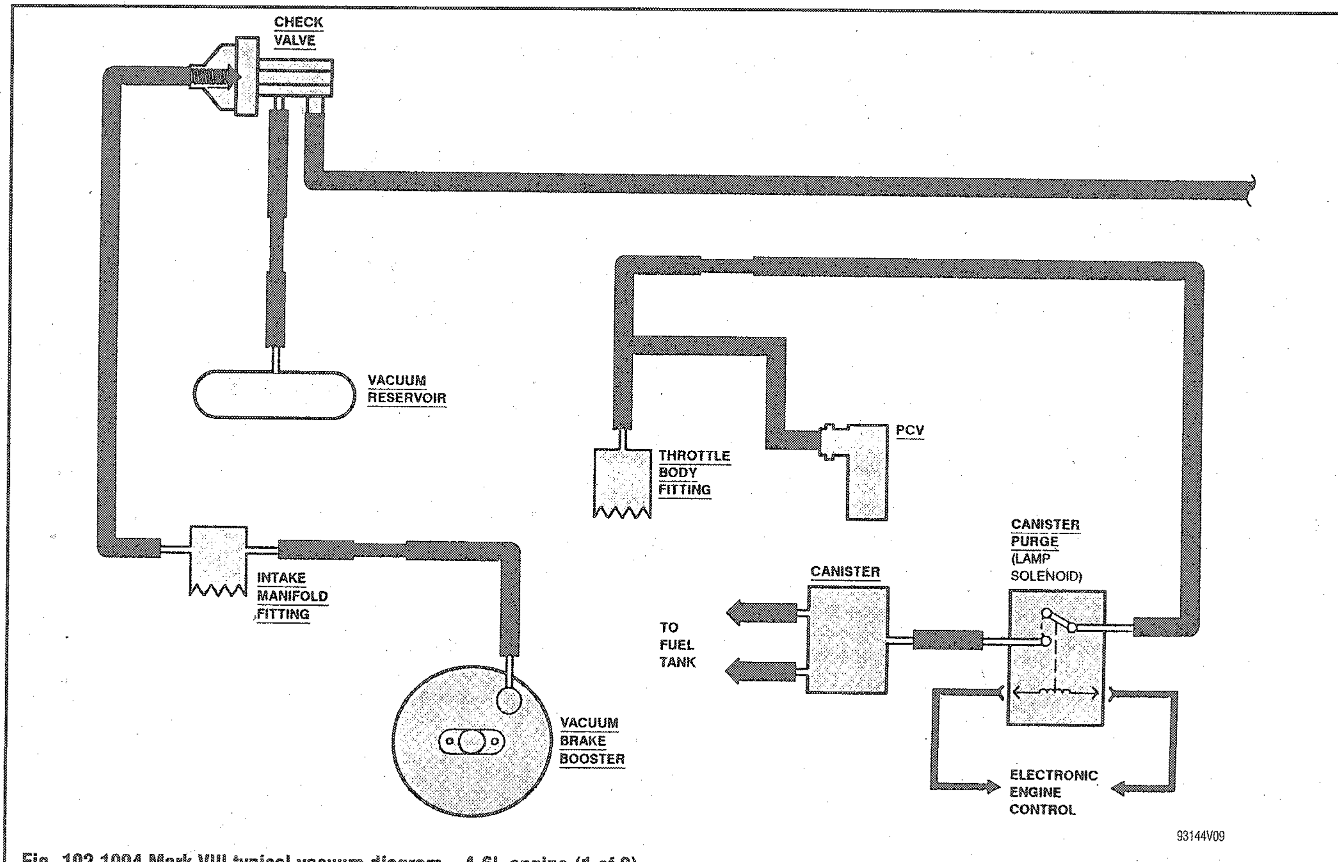

Fig. 102 1994 Mark VIII typical vacuum diagram—4.6L engine (1 of 3)

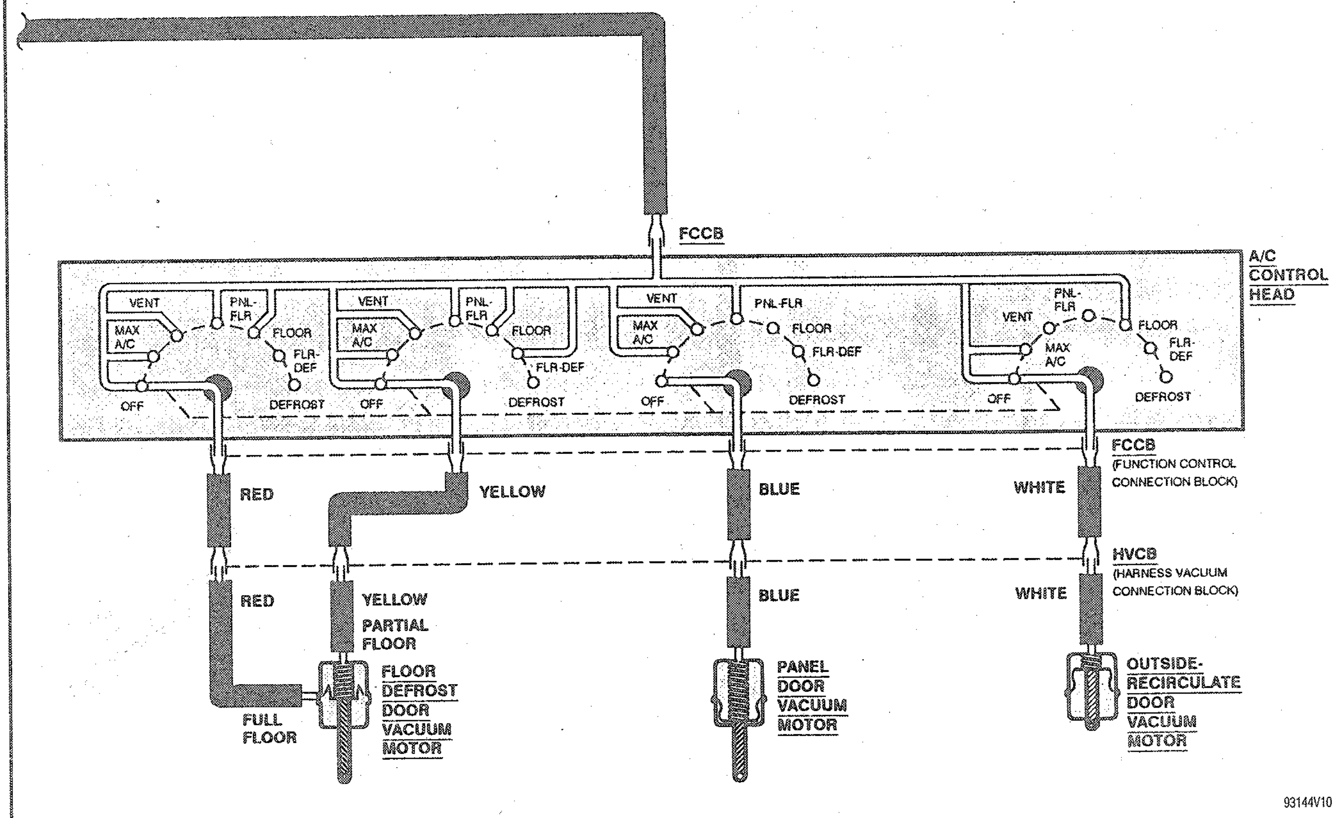

Fig. 103 1994 Mark VIII typical vacuum diagram—4.6L engine (2 of 3)

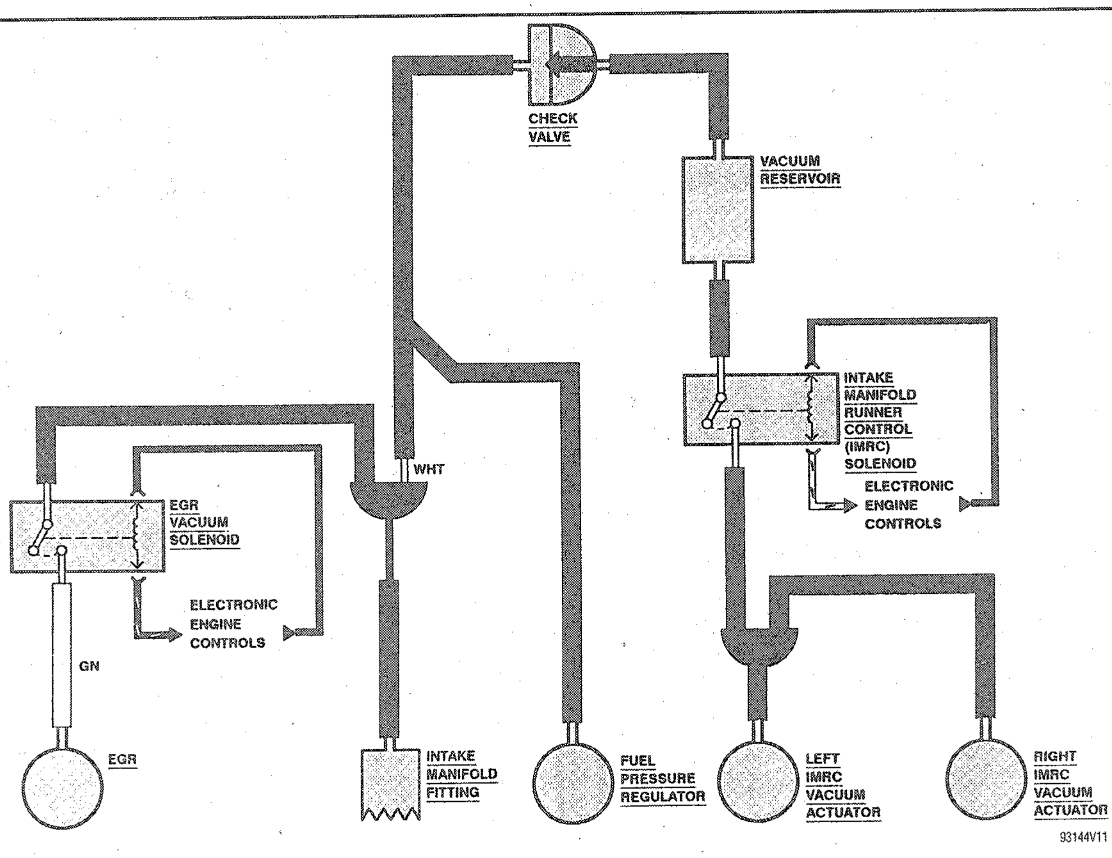

Fig. 104 1994 Mark VIII typical vacuum diagram—4.6L engine (3 of 3)

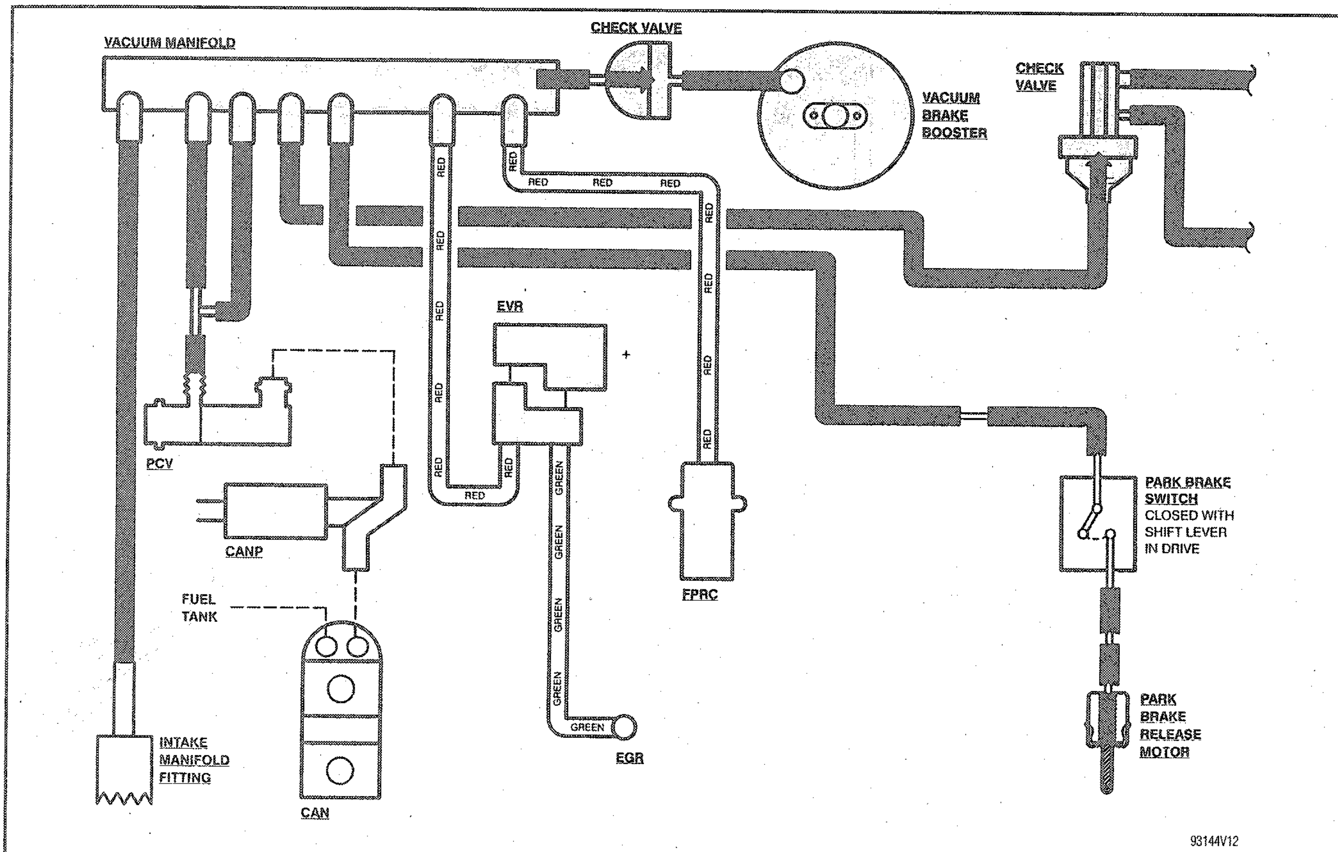

Fig. 105 1995 Town Car typical vacuum diagram—4.6L engine (1 of 2)

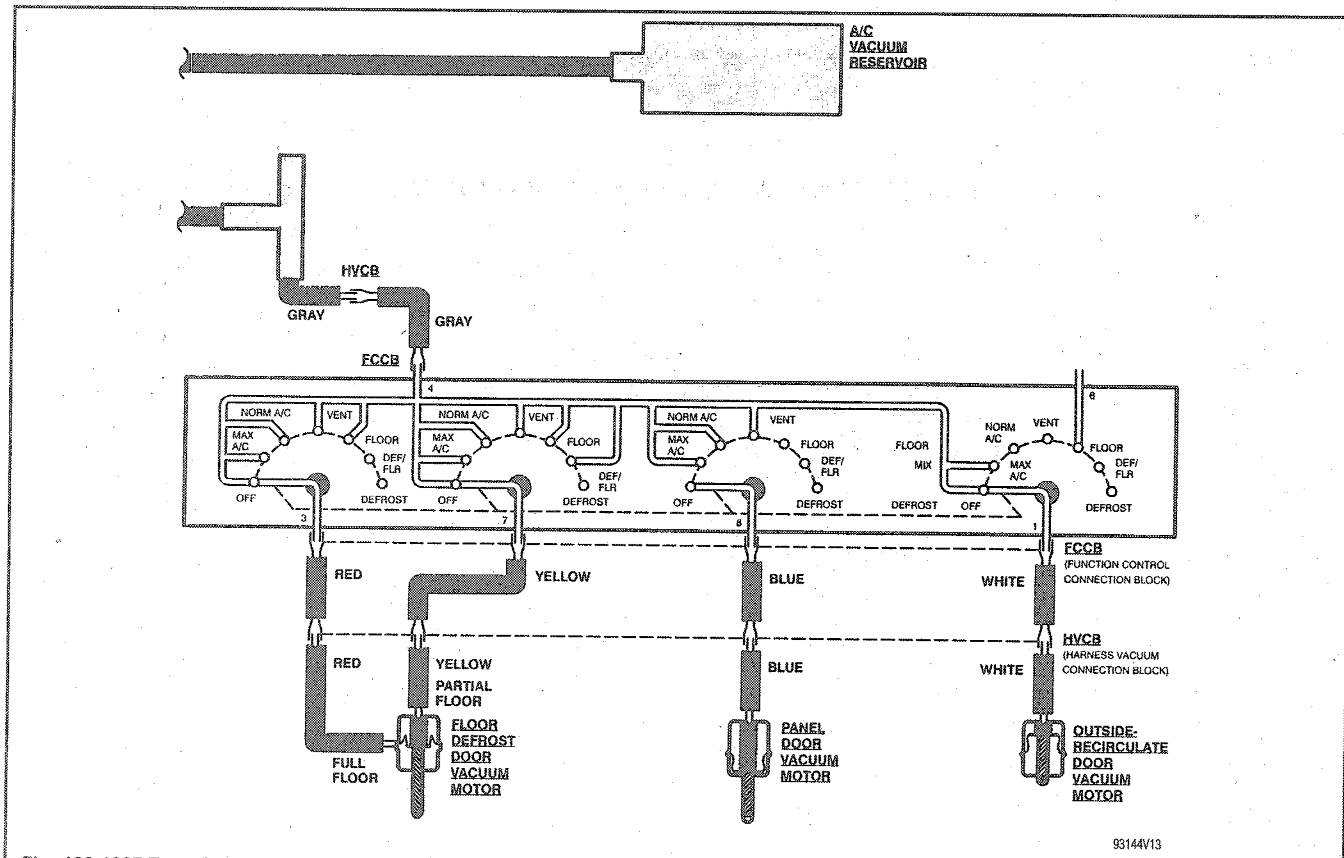

Fig. 106 1995 Town Car typical vacuum diagram—4.6L engine (2 of 2)

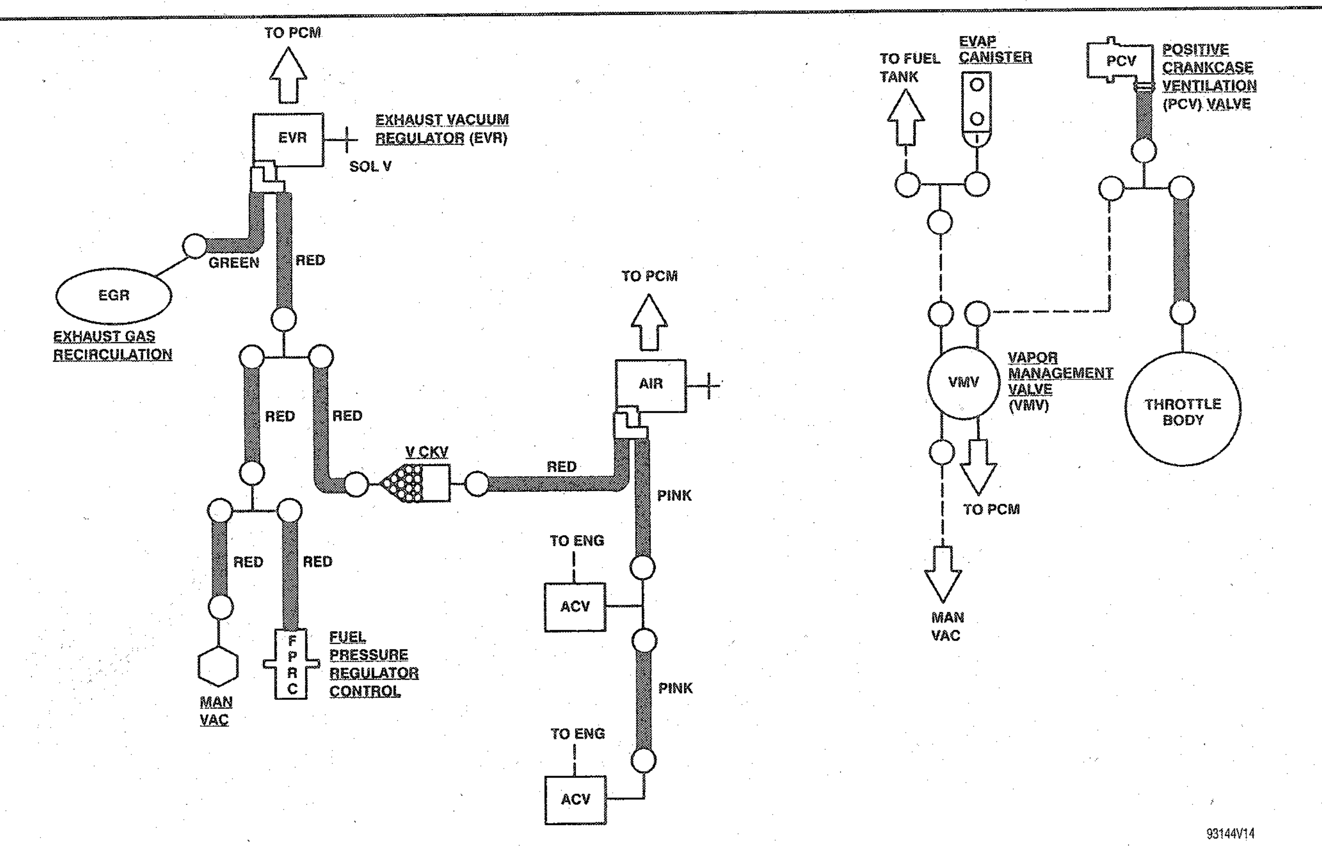

Fig. 107 1995 Continental typical vacuum diagram—4.6L engine

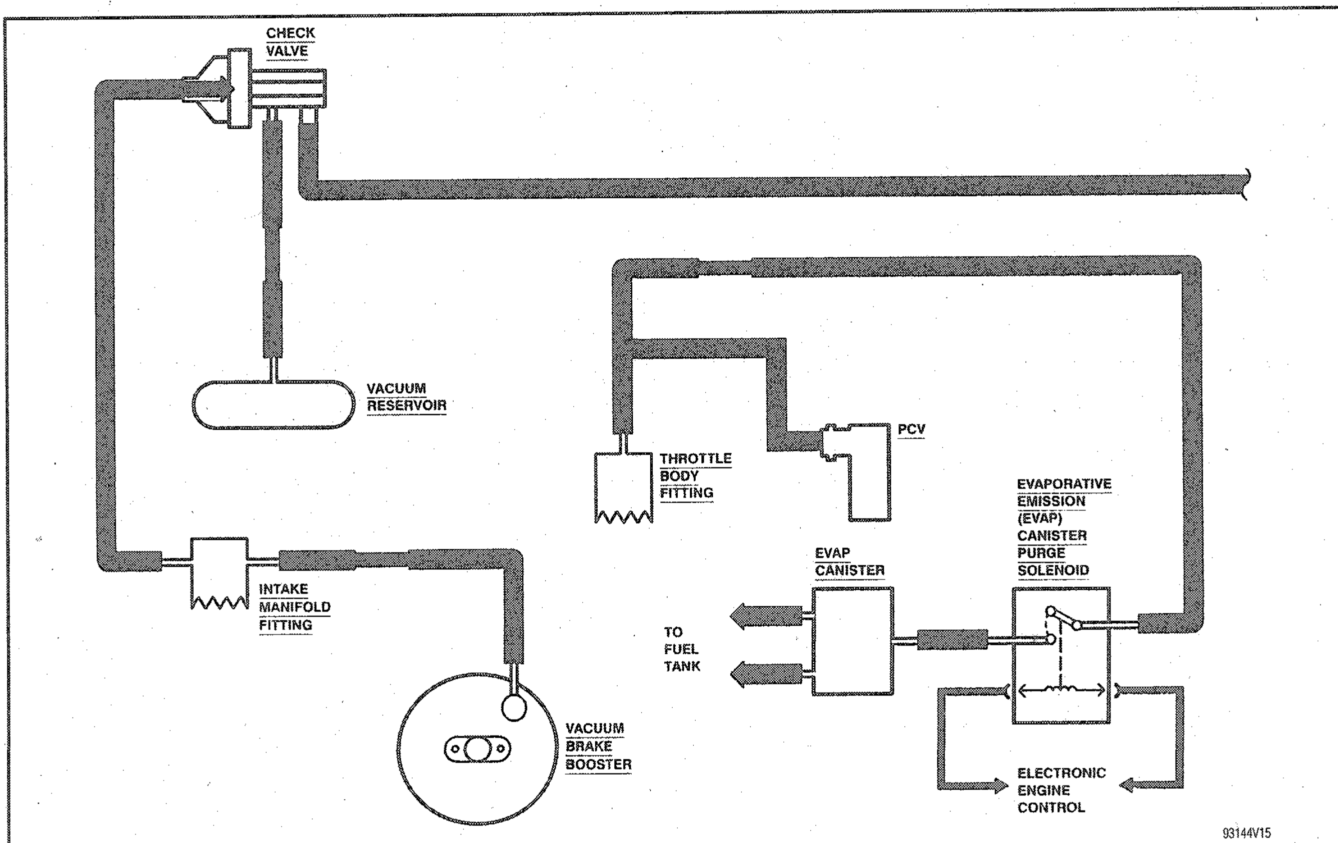

Fig. 108 1995 Mark VIII typical vacuum diagram—4.6L engine (1 of 3)

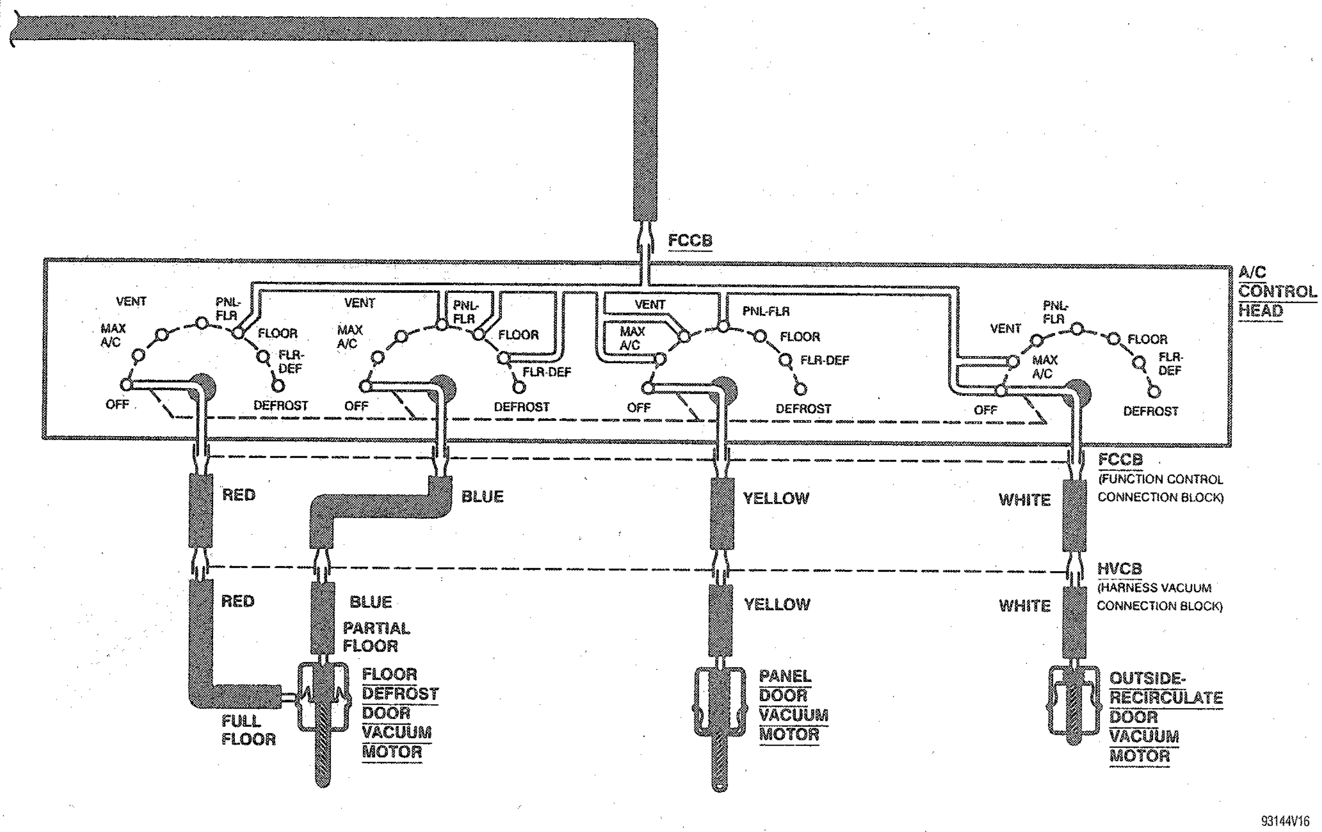

Fig. 109 1995 Mark VIII typical vacuum diagram—4.6L engine (2 of 3)

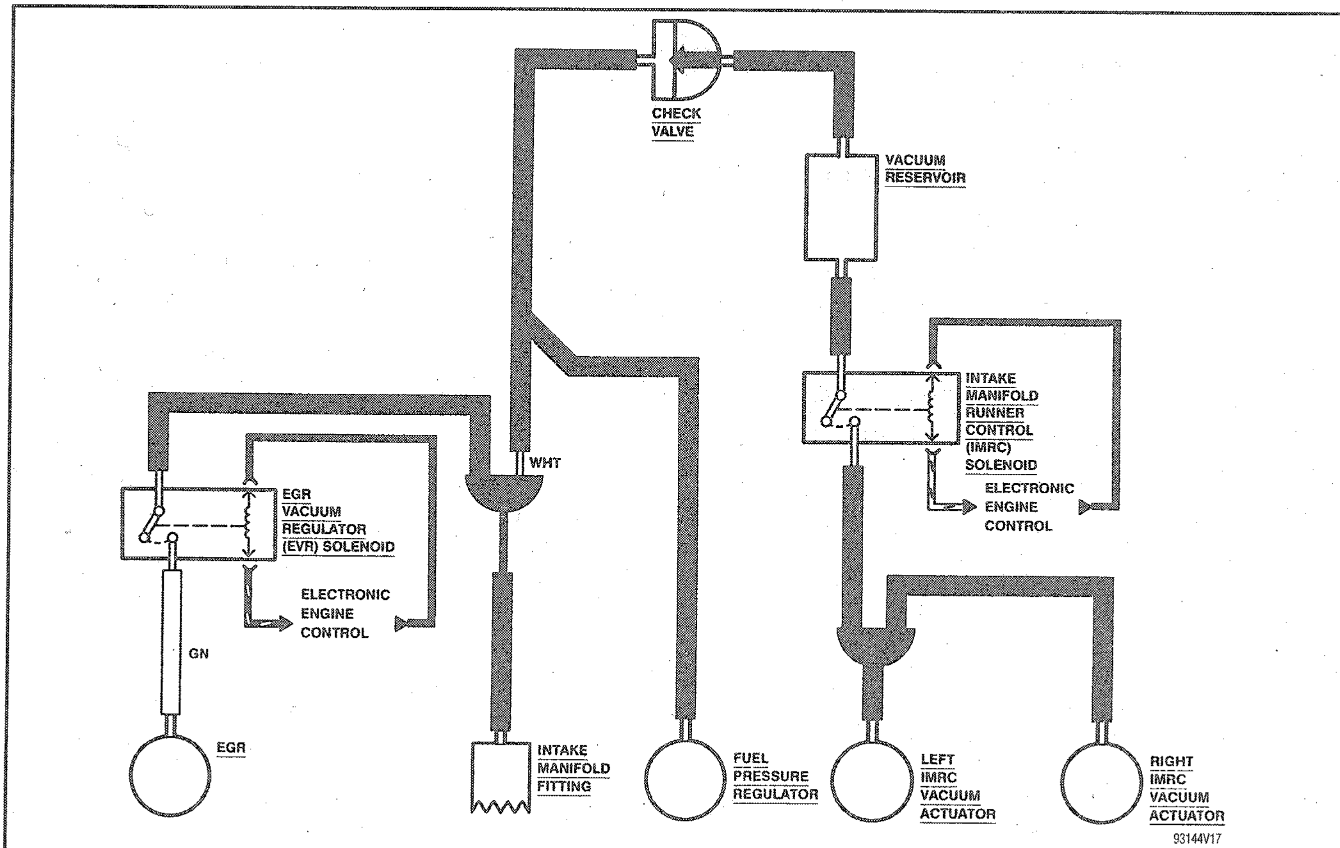

Fig. 110 1995 Mark VIII typical vacuum diagram—4.6L engine (3 of 3)

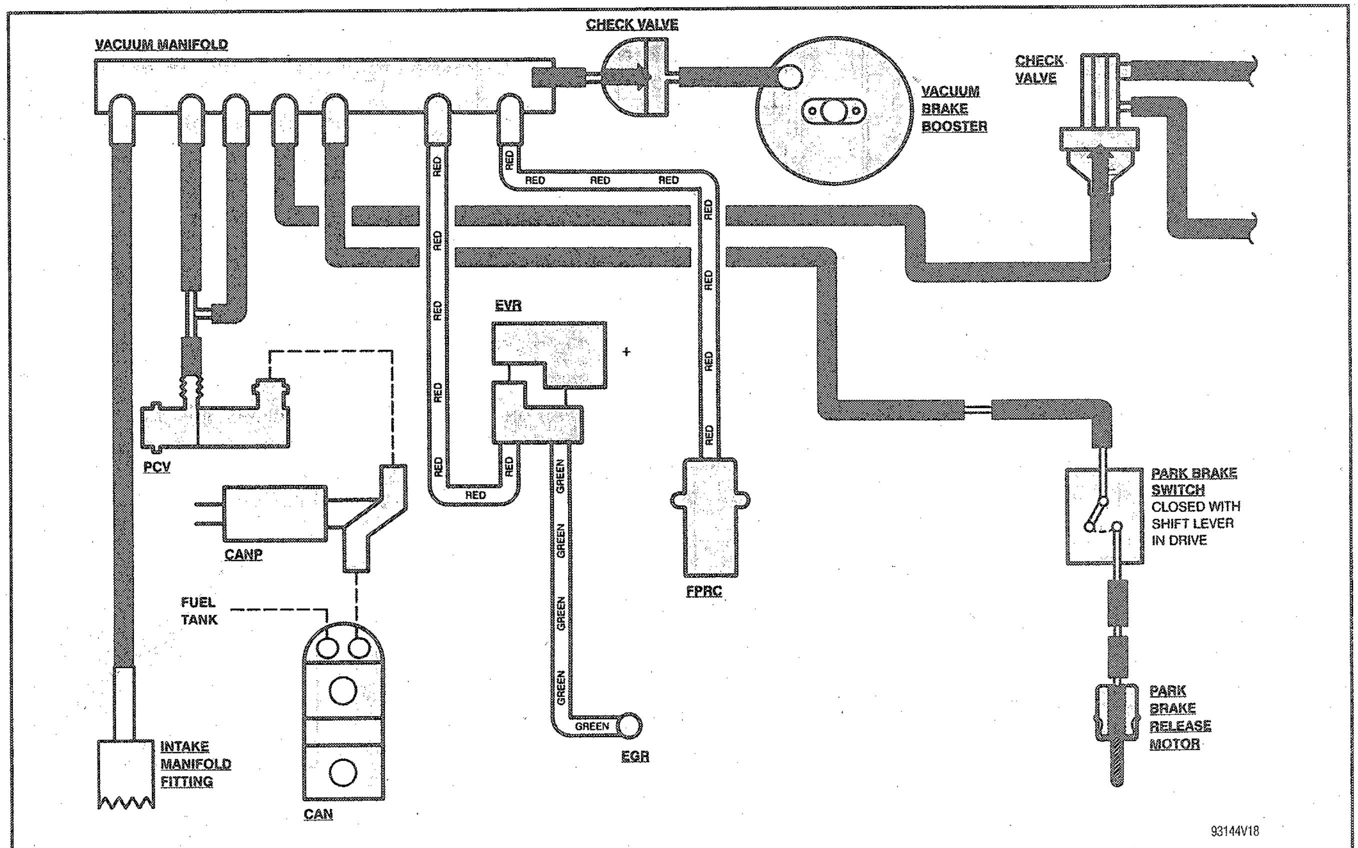

Fig. 111 1996 Town Car typical vacuum diagram—4.6L engine (1 of 2)

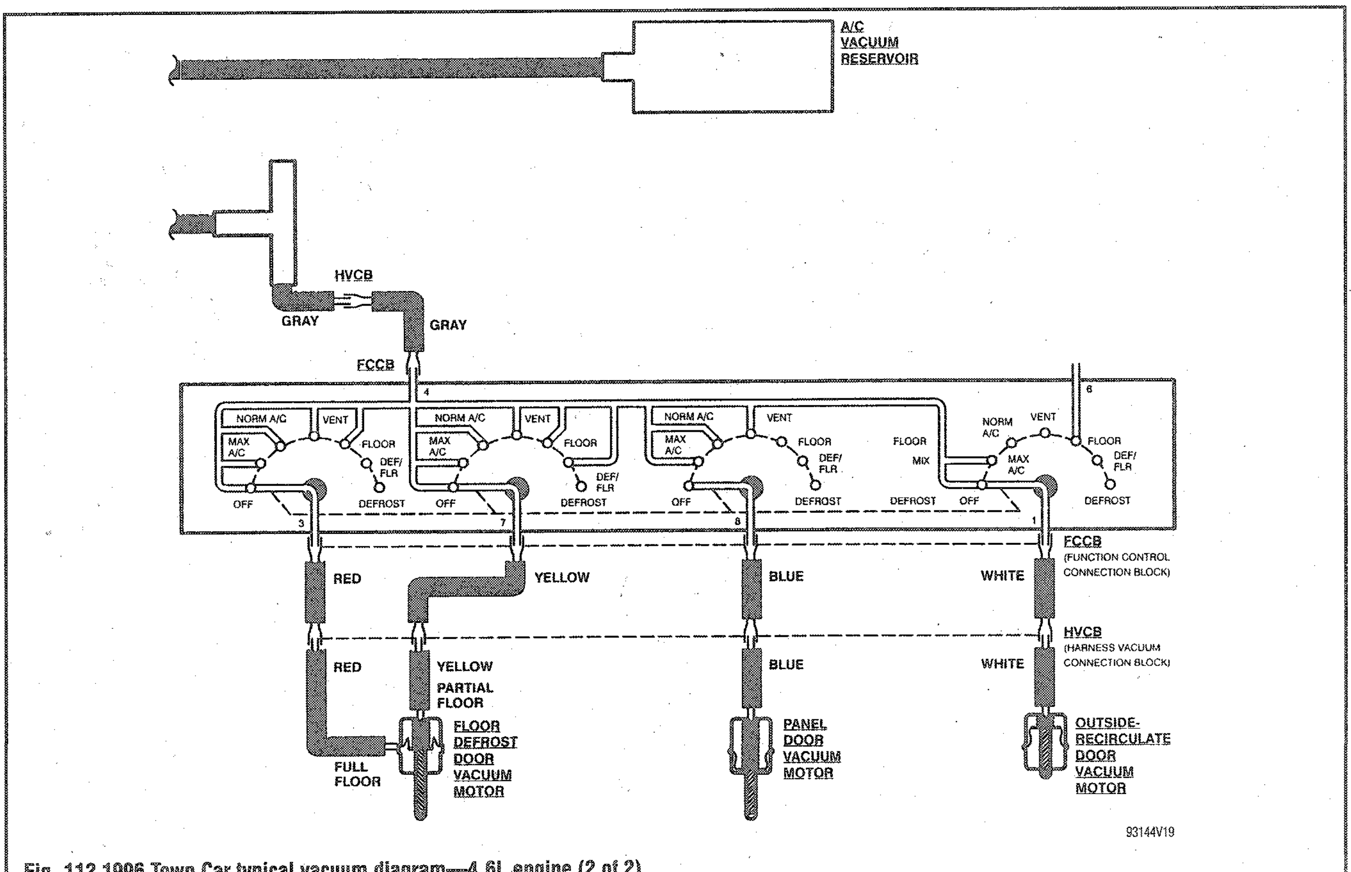

Fig. 112 1996 Town Car typical vacuum diagram—4.6L engine (2 of 2)

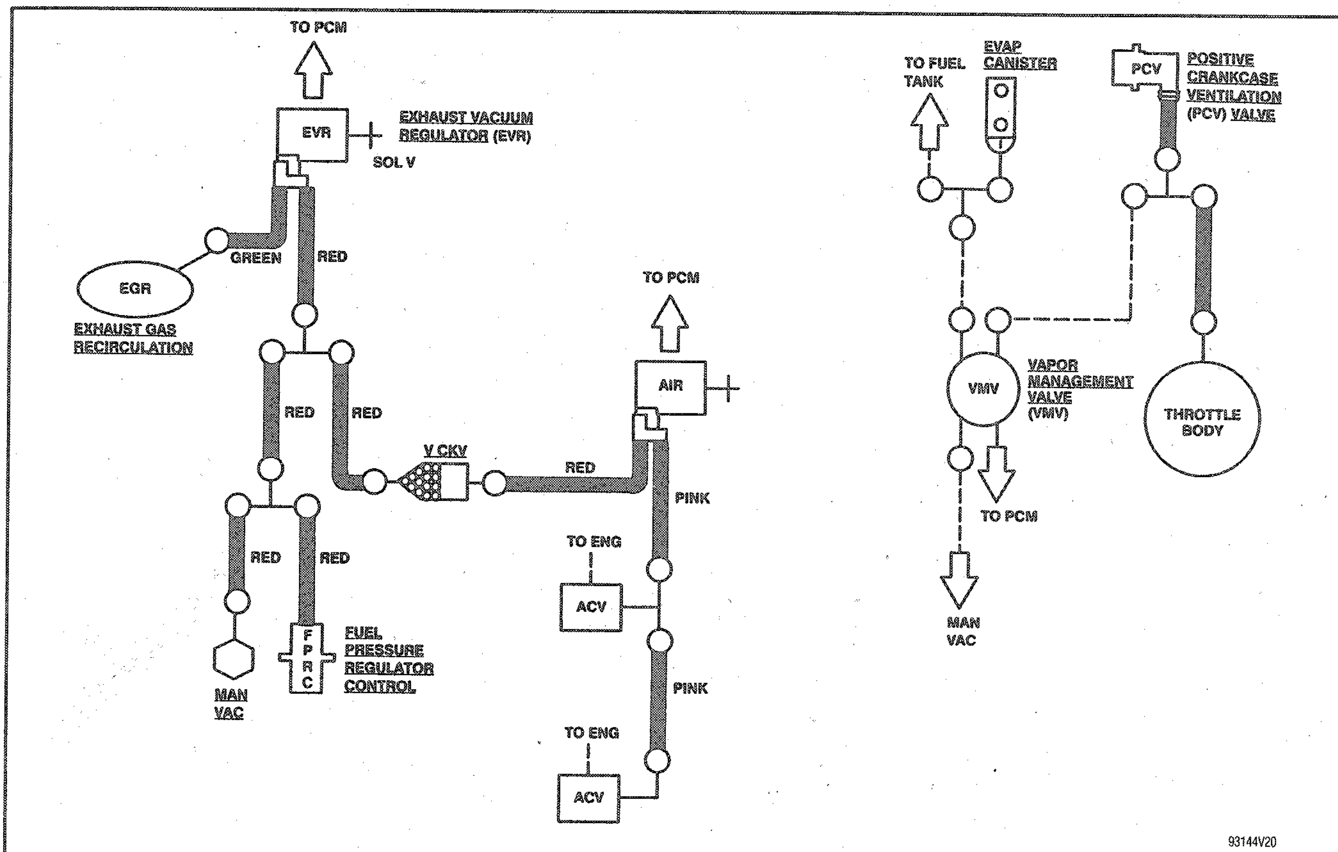

Fig. 113 1996 Continental typical vacuum diagram—4.6L engine

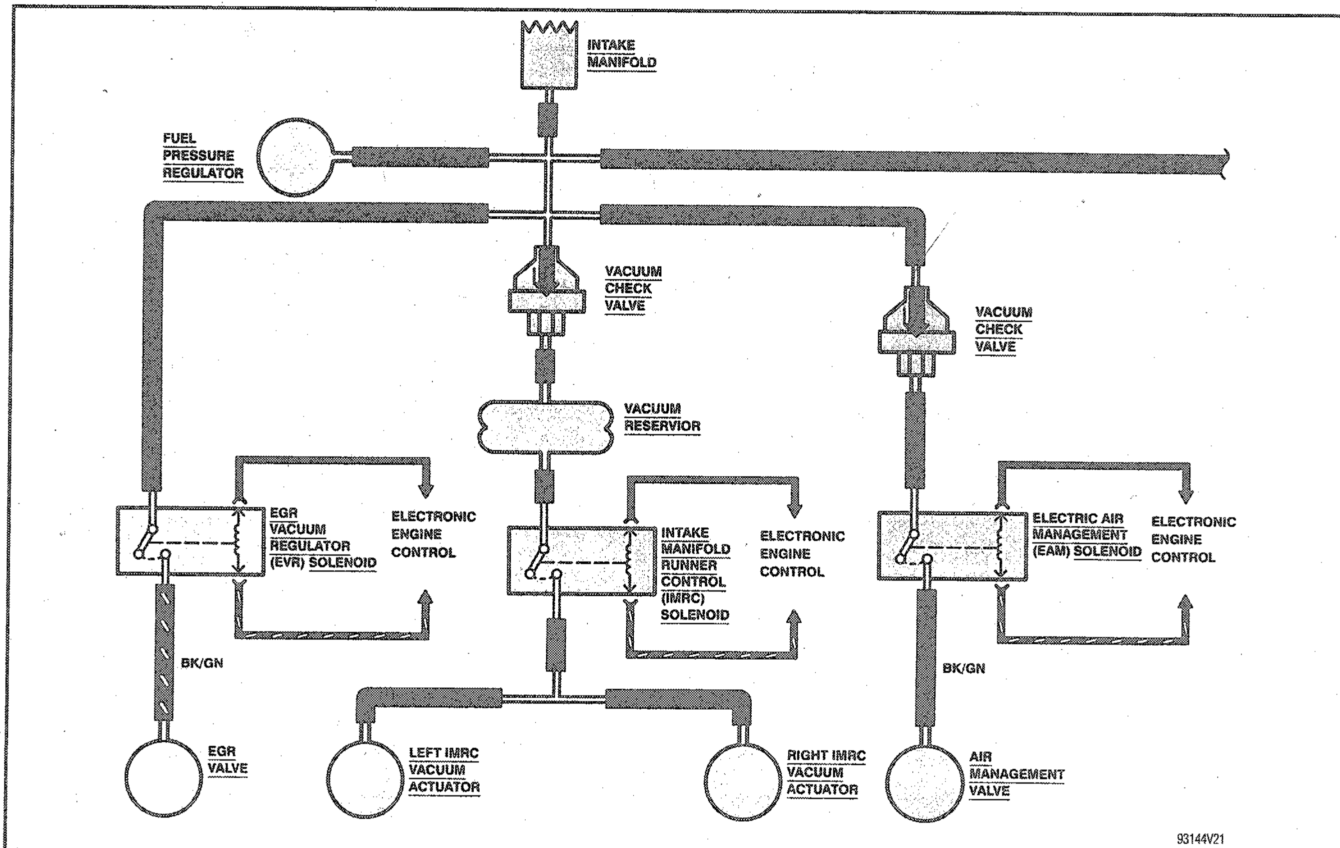

Fig. 114 1996 Mark VIII typical vacuum diagram—4.6L engine (1 of 3)

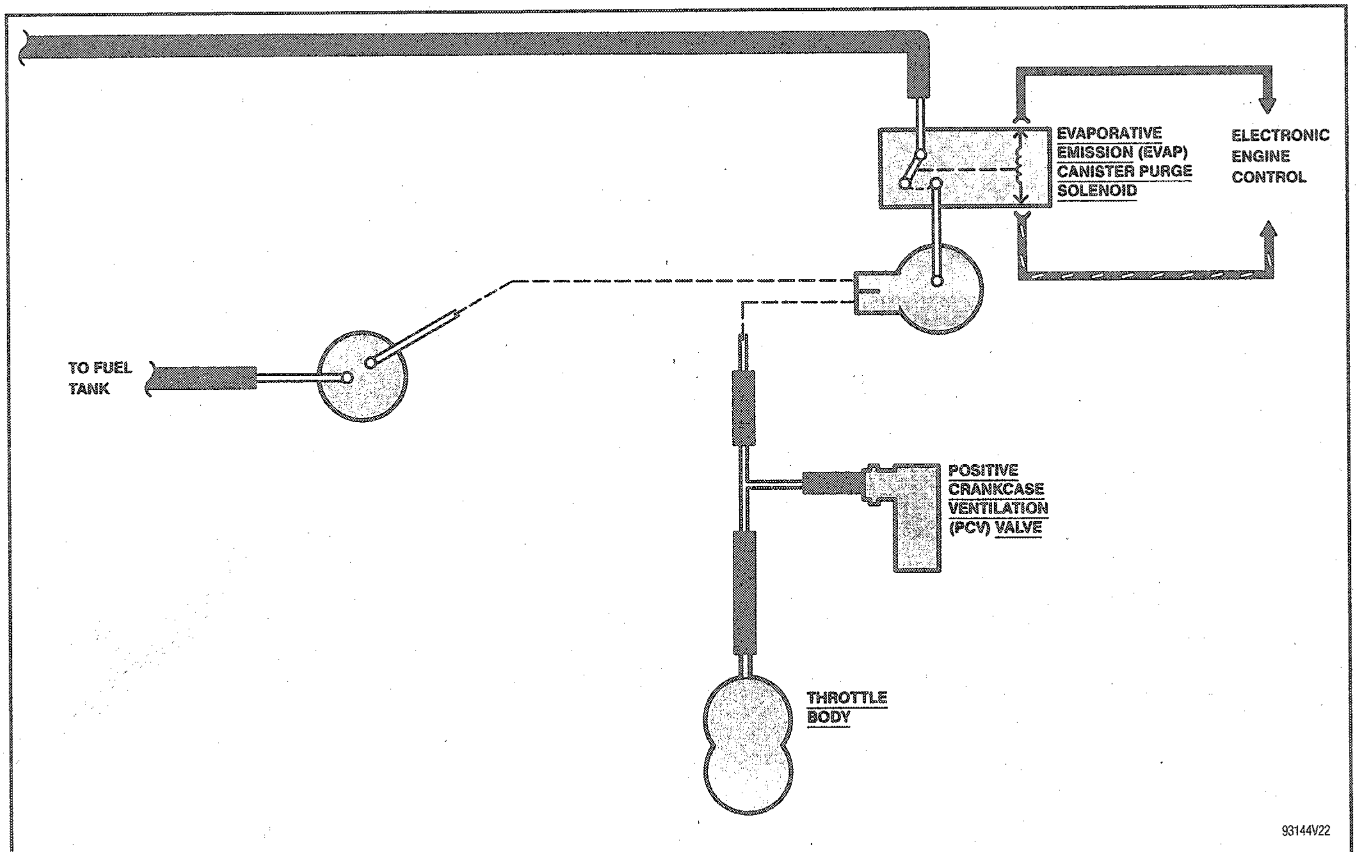

Fig. 115 1996 Mark VIII typical vacuum diagram—4.6L engine (2 of 3)

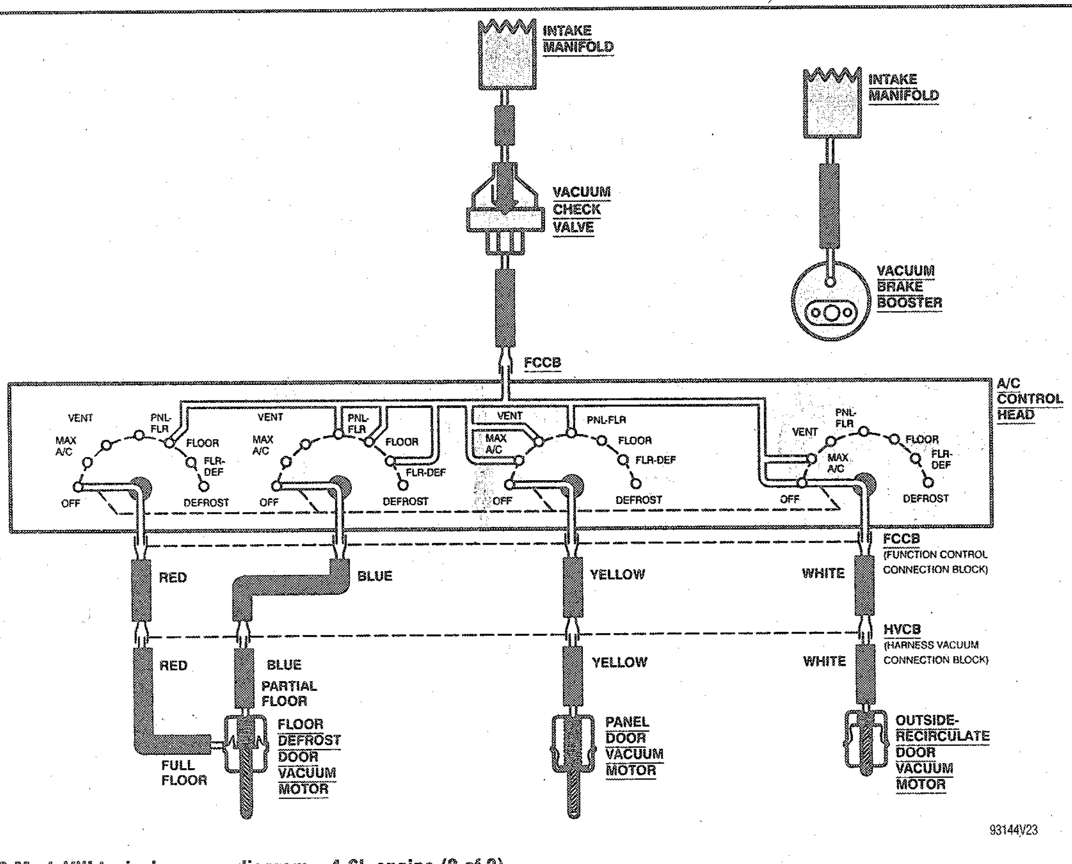

Fig. 116 1996 Mark VIII typical vacuum diagram—4.6L engine (3 of 3)

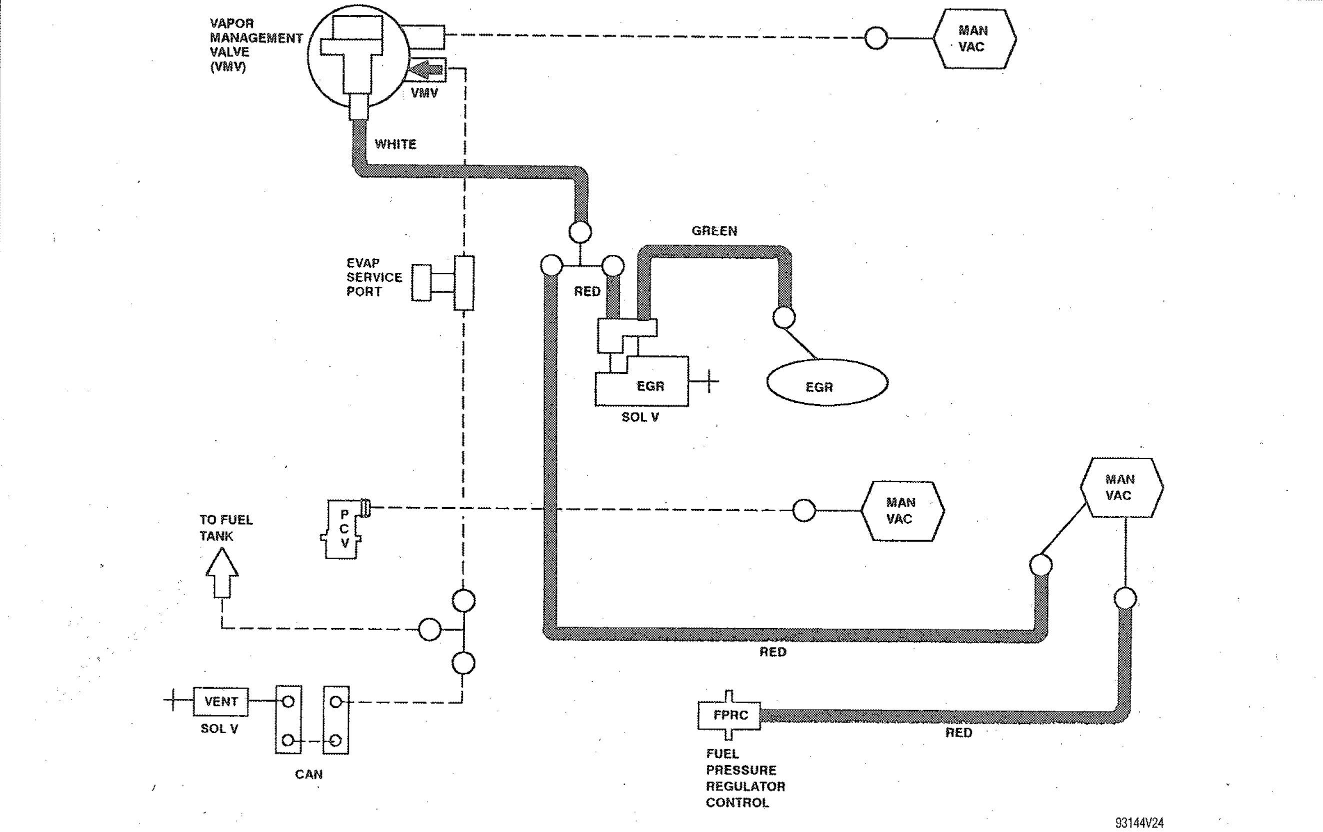

Fig. 117 1997 Town Car typical vacuum diagram—4.6L engine

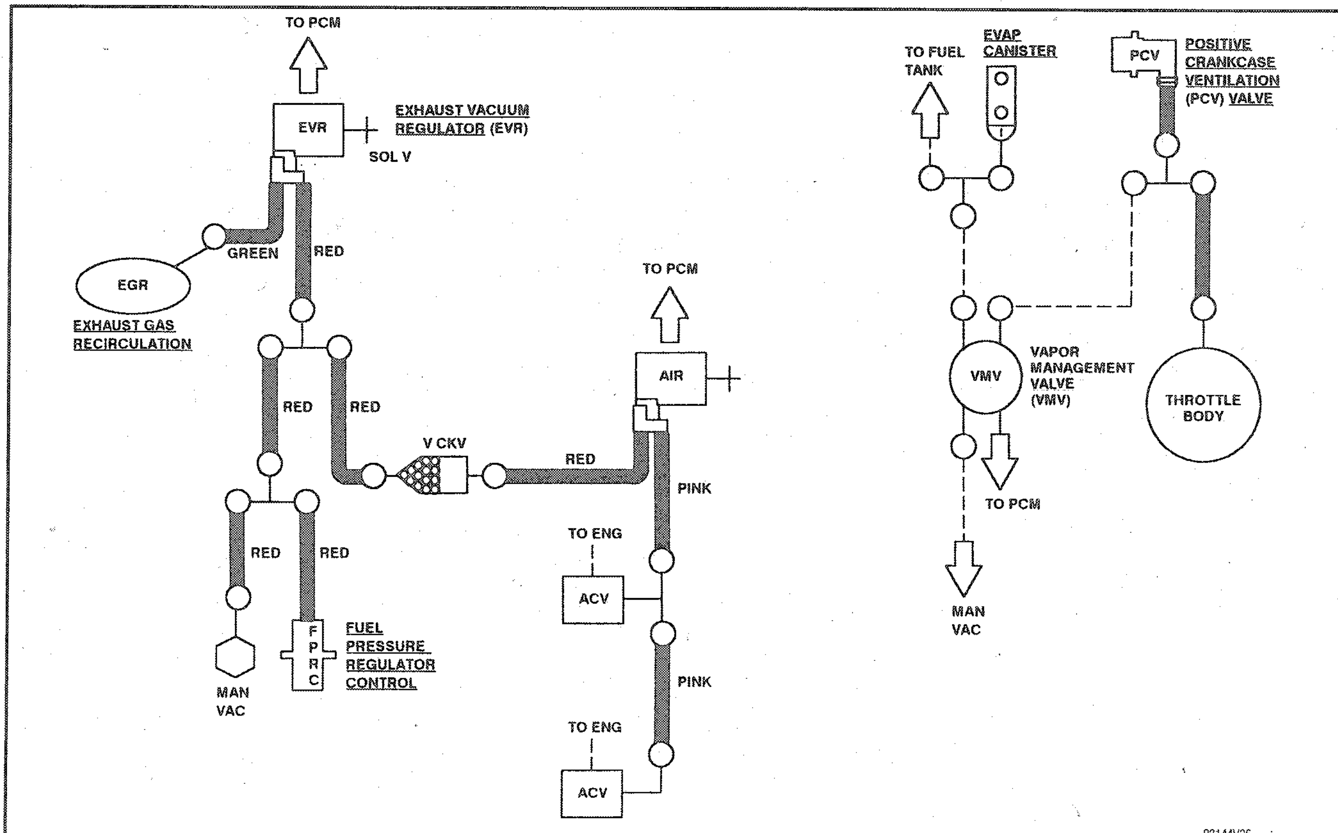

Fig. 118 1997 Continental typical vacuum diagram—4.6L engine

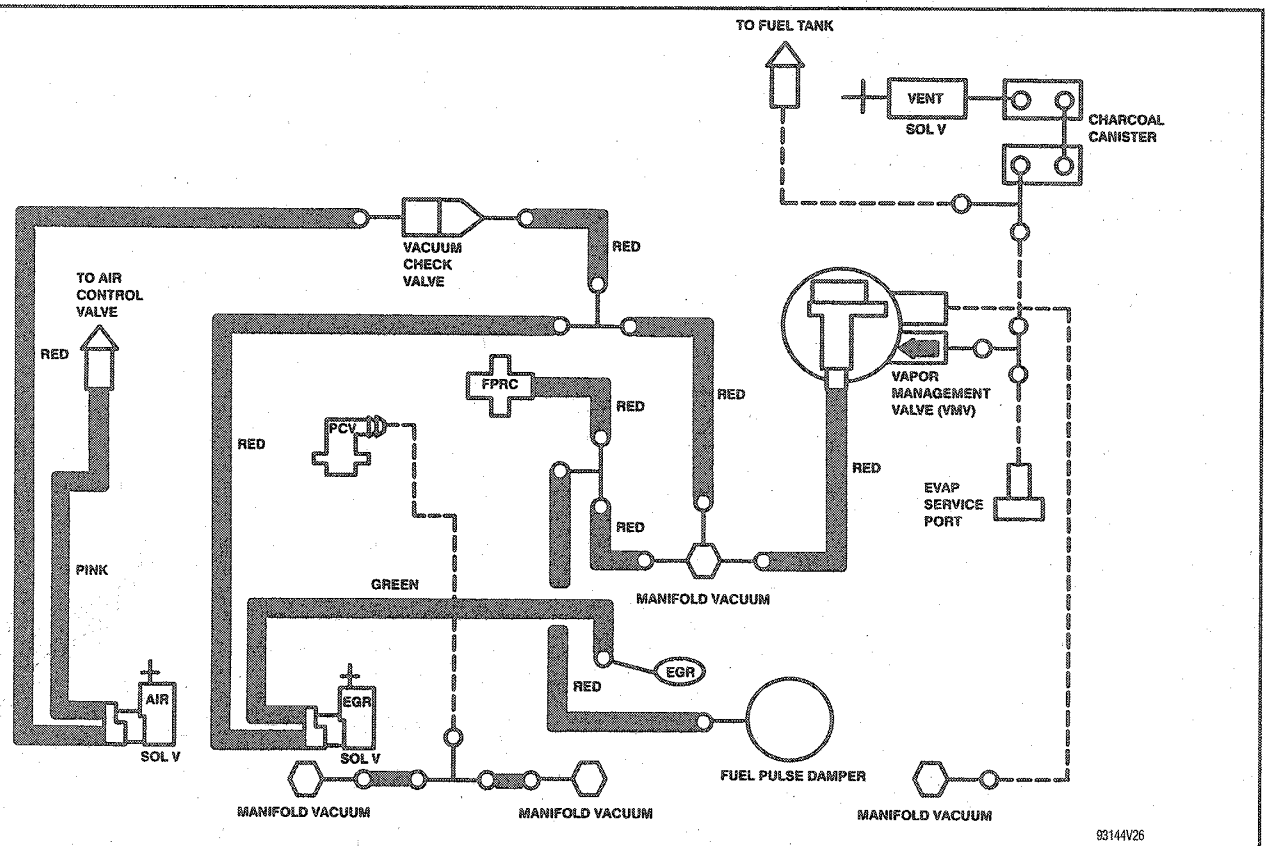

Fig. 119 1997 Mark VIII typical vacuum diagram—4.6L engine

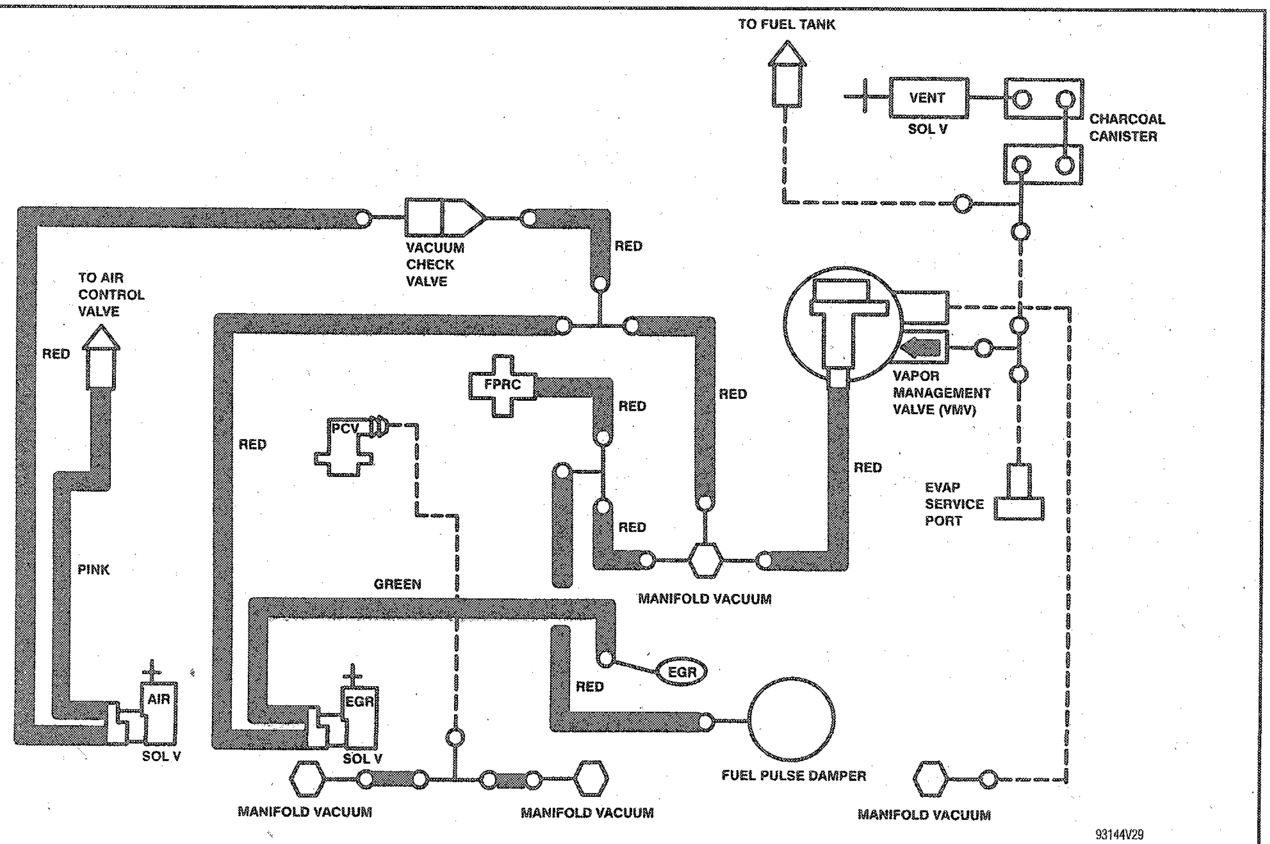

Fig. 120 1998 Mark VIII typical vacuum diagram—4.6L engine

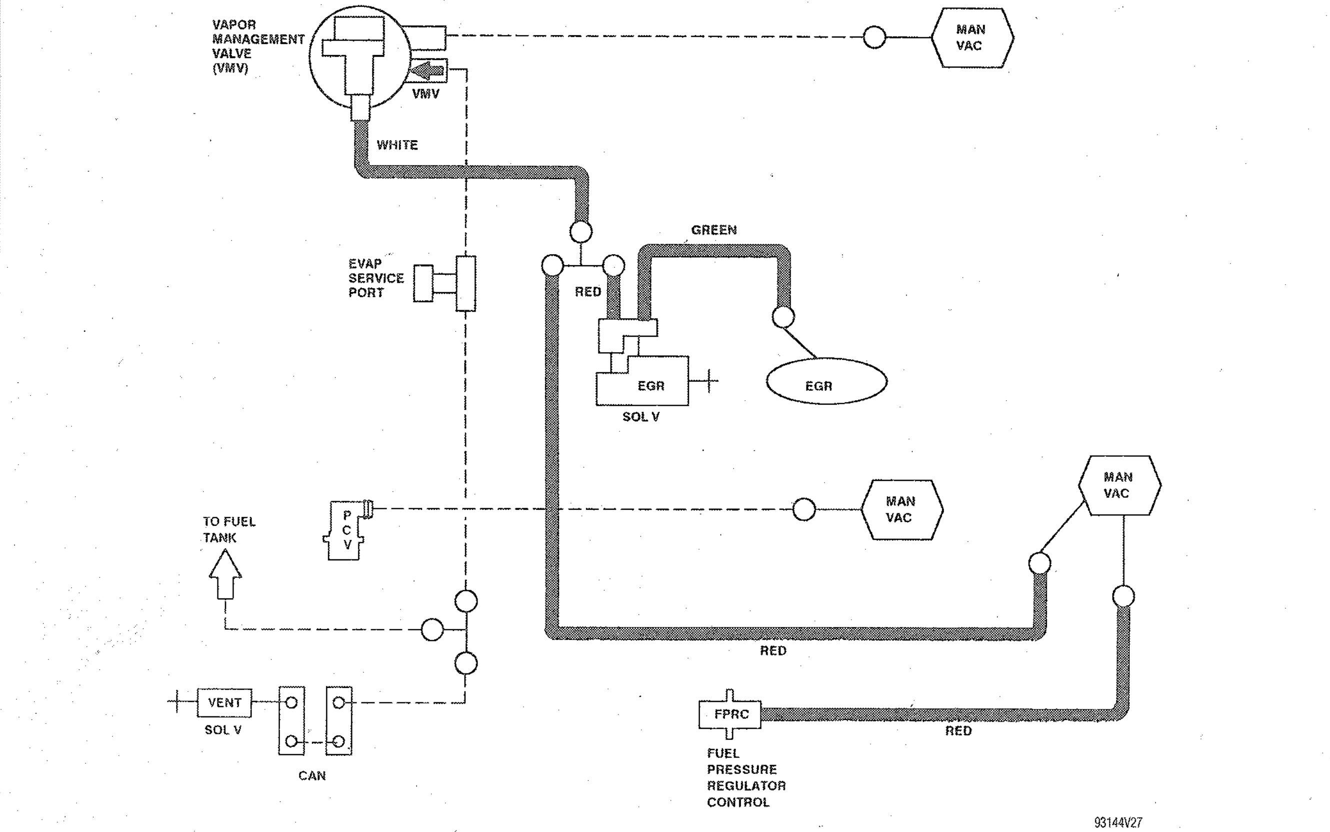

Fig. 121 1998–00 Town Car typical vacuum diagram—4.6L engine

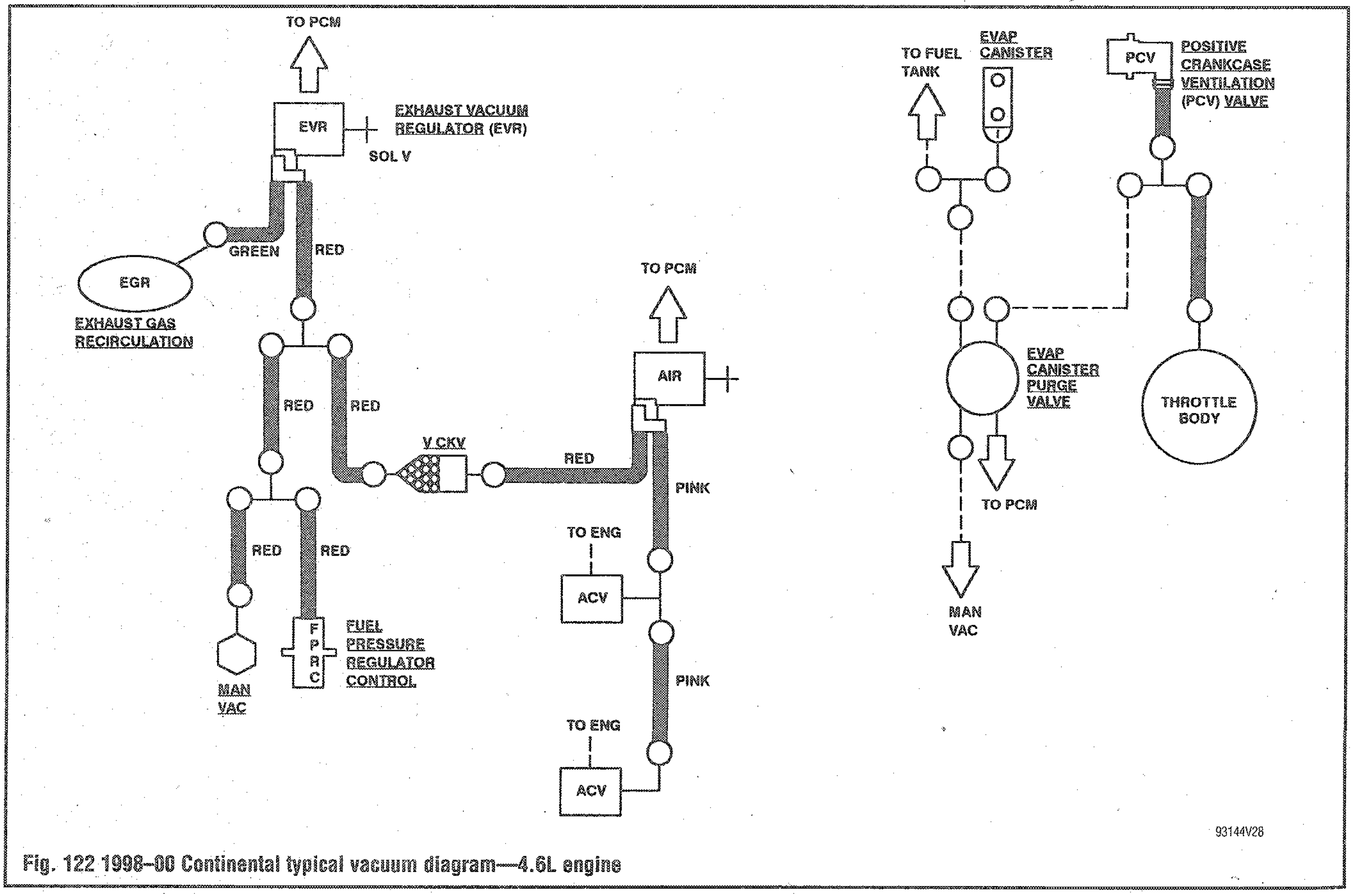

Fig. 122 1998–00 Continental typical vacuum diagram—4.6L engine

MANUFACTURER RECOMMENDED SEVERE MAINTENANCE INTERVALS

VEHICLE MAINTENANCE INTERVAL

	Miles (x1000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	km (x1000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Component	Type of Service																				
Engine oil and filter	Replace	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tires	Rotate		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓
Air cleaner	Replace										✓										✓
Spark plugs ①	Replace																				✓
Drive belt	Inspect																				✓
Cooling system	Inspect					✓					✓					✓					✓
Coolant	Replace																✓				
PCV valve	Replace																				✓
Automatic transmission fluid & filter	Replace							✓							✓						
Exhaust heat shields	Inspect										✓										✓
Brake linings and drums	Inspect			✓			✓			✓			✓			✓			✓		
Brake pads and rotors	Inspect			✓			✓			✓			✓			✓			✓		
Fuel filter	Replace					✓					✓										
Lubricate suspension	Inspect					✓					✓					✓					✓
Brake line hoses and connections	Inspect					✓					✓					✓					✓
Front suspension	Inspect					✓					✓					✓					✓
Bolts and nuts on chassis body	Inspect					✓					✓					✓					✓
Steering linkage operation	Inspect					✓					✓					✓					✓

Perform maintenance at the same intervals for mileage beyond that on this chart

Follow the severe service interval schedule if the vehicle is driven in the following conditions:

- towing a trailer or using a car-top carrier
- operating in severe dust conditions
- extensive idling such as a police car, taxi, or delivery service
- short trips of less than 10 miles when outside temperatures remain below 0°F (-18°C)

① Except on the 4.6L engines. Replace every 100,000 miles on the 4.6L engines.

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