4

FUEL AND EXHAUST SYSTEMS

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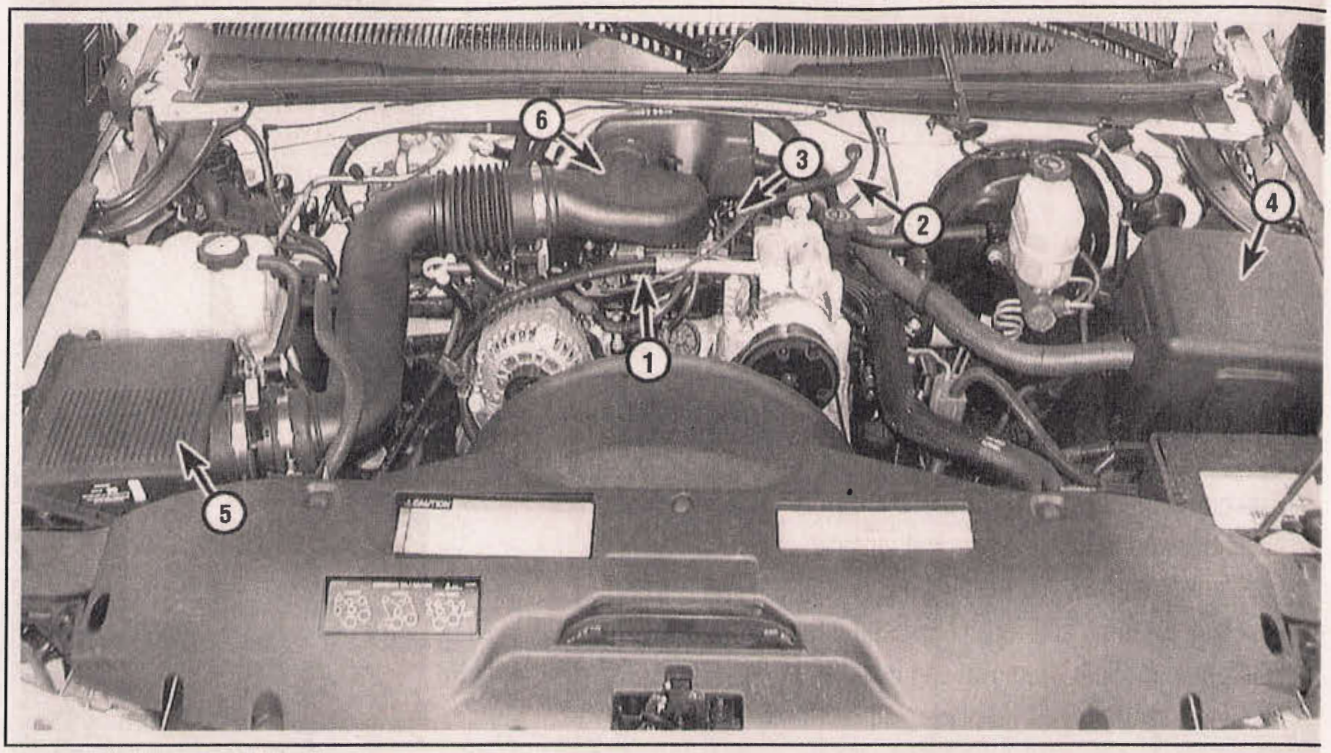
17 Exhaust system servicing - general information

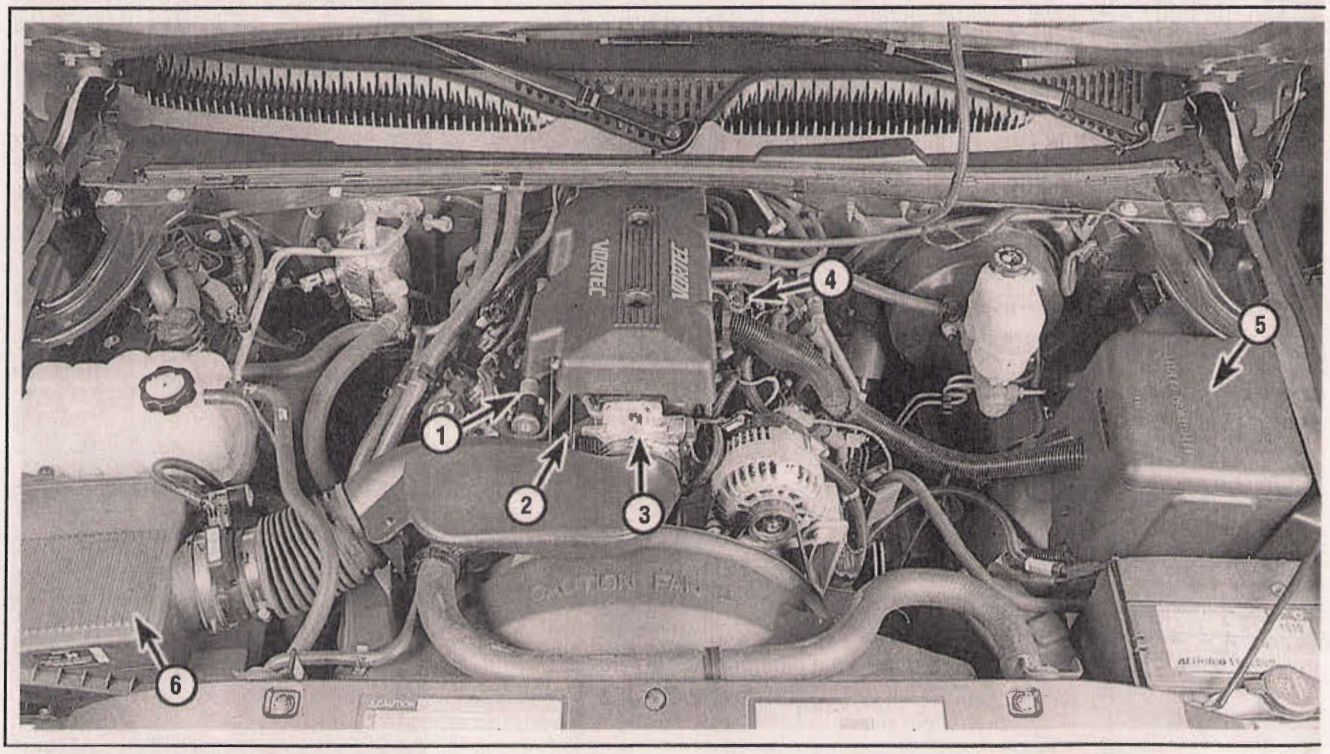
Reference to other Chapters

Air filter replacement - See Chapter 1
Exhaust system check - See Chapter 1
Fuel system check - See Chapter 1
SERVICE ENGINE SOON light - See Chapter 6



1.1a Typical fuel system components - V6 engine

1 *Throttle body*
2 *Accelerator cable*
3 *Fuel meter body and injectors (under upper intake manifold plenum)*
4 *Fuel pump relay (inside Underhood Electrical Center)*
5 *Air filter housing*
6 *Air intake duct and resonator*



1.1b Typical fuel system components - V8 engines

1 *Fuel rail and injectors*
2 *Accelerator cable*
3 *Throttle body*
4 *Fuel pressure regulator*
5 *Fuel pump relay (inside Underhood Electrical Center)*
6 *Air filter housing*

1 General information

Refer to illustrations 1.1a and 1.1b

WARNING:

Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a gas-type appliance (such as a water heater or a clothes dryer) is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.

All models covered by this manual are equipped with Sequential Fuel Injection (SFI) (see illustrations). SFI systems use timed impulses to sequentially inject the fuel directly into the intake ports of each cylinder in the same sequence as the firing order. The Powertrain Control Module (PCM) controls the injectors. The PCM monitors various engine parameters and delivers the correct amount of fuel, in firing order sequence, into the intake ports. For more information about the fuel injection system, see Section 11.

The fuel pump is located in the roof of the fuel tank and protrudes down into the fuel inside the fuel tank. You must lower the fuel tank before you can remove the fuel pump from the fuel tank. The fuel level sending unit is an integral component of the fuel pump and it must be accessed in the same manner.

Models equipped with dual fuel tanks are equipped with a secondary fuel pump. The secondary fuel pump is mounted on the frame near the secondary fuel tank. This pump is activated by the PCM and sends fuel from the secondary tank into the primary tank when the fuel level in the primary tank falls below two gallons of the secondary tank. Once the primary fuel tank is low, it will empty all the fuel from the secondary tank.

There are two different types of fuel pressure regulation systems. 1999 through 2003 V8 models and 2004 and earlier V6 engines are equipped with a return-type fuel system. Fuel pressure is regulated at the throttle body (V6 models) or fuel rail (V8 models) by a fuel pressure regulator. Excess fuel is returned to the fuel tank by way of the fuel return line. 2004 and later V8 models and 2005 and later V6 models are equipped with a returnless fuel system. Fuel pressure is regulated at the fuel pump in the fuel tank by a fuel pressure regulator. Excess fuel is returned directly to the tank without extra lines or hoses.

There are two fuel filters. A nylon mesh fuel "sock" or strainer is located at the lower (inlet) end of the fuel pump/fuel level sending unit. The strainer is an extended-life part and does not need to be replaced at scheduled maintenance intervals. It should only be replaced if it becomes clogged with sediment. The main fuel filter, which looks like a small metal canister, is located under the vehicle, between the fuel tank and the engine compartment. It must be replaced at the specified service interval (see Chapter 1).

The exhaust system consists of the two exhaust manifolds and, on most models, two catalytic converters, exhaust pipes and mufflers. All of these components are replaceable. For further information regarding the catalytic converters, refer to Chapter 6.

2 Fuel pressure relief procedure

Refer to illustration 2.3

WARNING:

See the Warning in Section 1.

1 Remove the fuel filler cap. This will relieve any pressure that has built-up in the tank.

2 Locate the fuse and relay box in the engine compartment (see Section 3 in Chapter 12).

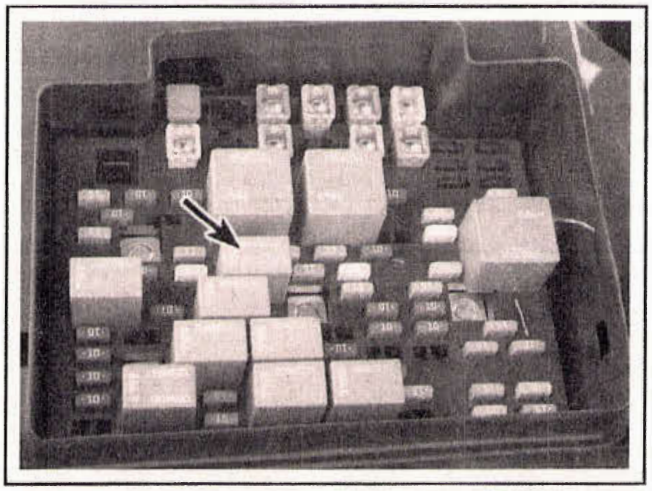
3 Remove the fuel pump relay (see illustration) from the engine compartment fuse and relay box. You can locate any relay by looking at the relay guide printed on the underside of the fuse box cover.

4 Turn the ignition key to START and crank over the engine for several seconds. It will either start momentarily and immediately stall, or it won't start at all.

5 Turn the ignition key to the OFF position.

6 Disconnect the cable from the negative terminal of the battery before beginning work on the fuel system.

7 After all work on the fuel system has been completed, install the fuel pump relay. The CHECK ENGINE light or SERVICE ENGINE SOON light might come on during operation because the engine was cranked with the fuel pump relay unplugged. The light will probably go out after a period of normal operation. If it doesn't, you'll have to clear the Diagnostic Trouble Code (DTC) with a generic scan tool (see Chapter 6) or have the DTC cleared by a dealer service department or other qualified repair shop.



2.3 To depressurize the fuel system, remove the fuel pump relay, which is located inside the fuse and relay box in the engine compartment (this is the relay location on a Silverado model with a 4.3L V6) (be sure to check the underside of the fuse box cover for the relay location on your model)

3 Fuel pump/fuel pressure - check

WARNING:

See the Warning in Section 1.

PRELIMINARY CHECK

1 The fuel pump is located inside the fuel tank, which muffles its sound when the engine is running. But you can actually hear the fuel pump. Sit inside the vehicle with the windows closed, turn the ignition key to ON (not START) and listen carefully for the soft whirring sound made by the fuel pump as it's briefly turned on by the PCM to pressurize the fuel system prior to starting the engine. You will only hear a soft whirring sound for a second or two, but that sound tells you that the pump is working. If you can't hear the pump from inside the vehicle, remove the fuel filler cap, depress the spring-loaded door inside the fuel filler neck, then have an assistant turn the ignition switch to ON while you listen for the sound of the pump operating for a couple of seconds. If the pump does not come on when the ignition key is turned to ON, check the fuel pump fuse and relay both of which are located in the engine compartment fuse and relay box. If the fuse and relay are okay, check the wiring back to the fuel pump. If the fuse, relay and wiring are okay, the fuel pump is probably defective. If the pump runs continuously with the ignition key in its ON position, the Powertrain Control Module (PCM) is probably defective. Have the PCM checked by a dealer service department or other qualified repair shop.

PRESSURE CHECK

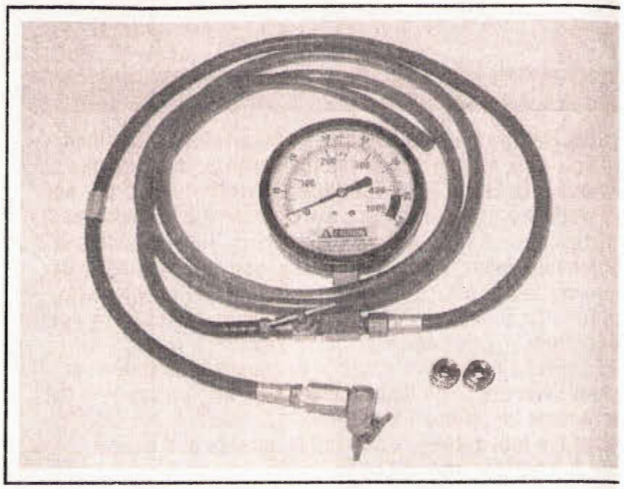
2 Relieve the fuel system pressure (see Section 2).

1999 through 2003 V8 models/2005 and later V6 models

Refer to illustrations 3.3a, 3.3b and 3.3c

Note: In order to perform the fuel pressure test, you will need a fuel pressure gauge capable of measuring high fuel pressure. The fuel gauge must be equipped with the proper fitting required to attach it to the test port. To test the fuel pressure regulator, a fuel shut off valve must be installed in the fuel return line with the necessary adapters.

3 Remove the cap from the fuel pressure test port and attach a fuel pressure gauge (see illustration). The test port is located on the fuel supply line on 4.3L V6 engines and the fuel rail on 4.8L, 5.3L and 6.0 V8 engines.



3.3a To check the fuel pressure, you'll need a fuel pressure gauge capable of reading the fuel pressure within the specified operating system pressure, a hose to connect the gauge to the fuel pressure test port and an adapter suitable for connecting the hose to the Schrader valve type test port

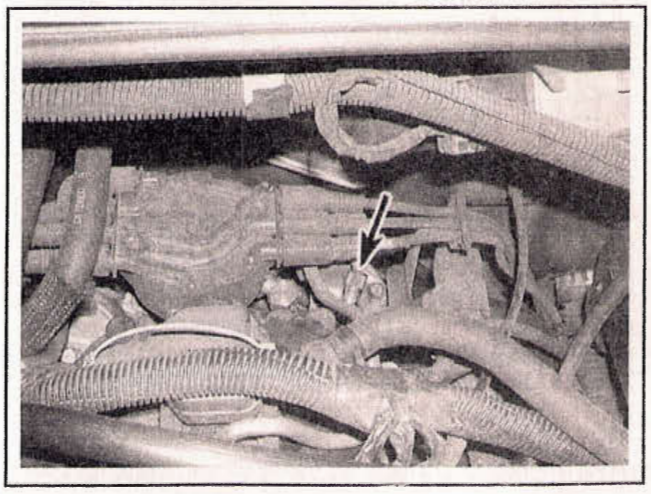
4 Turn the ignition key ON (engine not running). The fuel pump should run for approximately two seconds then shut off. Note the pressure indicated on the gauge and compare your reading with the pressu listed in this Chapter's Specifications. Cycle the ignition key On and O several times, if necessary, to obtain the highest reading.

5 If the fuel pressure is lower than specified, turn the ignition key Off and relieve the fuel system pressure. Install a fuel shut-off valve in the fuel return line and close the valve.

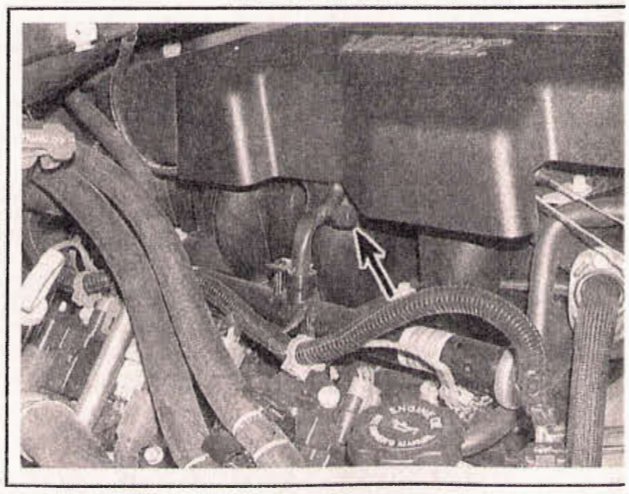
CAUTION:

Do not pinch the flexible fuel line shut or damage to the fuel li may occur.

Turn the ignition key On and note the fuel pressure.



3.3b Fuel pressure test port location - V6 models



3.3c Fuel pressure test port location - V8 models

CAUTION:

Do not allow the fuel pressure to rise above 75 psi or damage to the fuel pressure regulator may occur. If the fuel pressure is now above the specified pressure, replace the fuel pressure regulator (see Section 14).

If the fuel pressure is still lower than specified, check the fuel lines and the fuel filter for restrictions. If no restriction is found, remove the fuel pump module (see Section 7) and check the fuel strainer for restrictions, check the fuel flex pipe for leaks and check the fuel pump wiring for high resistance. If no problems are found, replace the fuel pump.

6 If the fuel pressure recorded in Step 4 is higher than specified, check the fuel return line for restrictions. If no restrictions are found, replace the fuel pressure regulator (see Section 14).

7 If the fuel pressure is within specifications, start the engine.

WARNING:

Make sure the fuel pressure gauge hose is positioned away from the engine drivebelt before starting the engine.

With the engine running, the fuel pressure should be 3 to 10 psi below the pressure recorded in Step 4. If it isn't, remove the vacuum hose from the fuel pressure regulator and verify there is 12 to 14 in-Hg of vacuum present at the hose. If vacuum is not present at the hose, check the hose for a restriction or a leak. If vacuum is present, reconnect the hose to the fuel pressure regulator. If the fuel pressure regulator does not decrease the fuel pressure with vacuum applied, replace the fuel pressure regulator.

➡Note: On V6 models, the fuel pressure regulator cannot be accessed without some disassembly. Therefore the fuel pressure regulator vacuum check cannot be performed.

8 Turn the engine off and monitor the fuel pressure for five minutes. The fuel pressure should not drop more than 5 psi within five minutes. If it does, there is a leak in the fuel line, a fuel injector is leaking or the fuel pump module check valve is defective.

2004 and later V8 models/2005 and later V6 models

➡Note: In order to perform the fuel pressure test, you will need a fuel pressure gauge capable of measuring high fuel pressure. You'll also need suitable fittings or adapters to attach it to the fuel rail. A dealer service department or other qualified shop should have a diagnostic scan tool that will give a more accurate graph of the performance of the fuel supply system as the engine is running.

9 For this check, you'll need to obtain a fuel pressure gauge with a hose and an adapter suitable for connecting it to the Schrader valve type test port on the fuel feed line or fuel rail (see illustration 3.3a).

10 The test port is located on the fuel supply rail (see illustration 3.3b or 3.3c).

11 Unscrew the threaded cap from the test port and connect the fuel pressure gauge hose to the test port.

12 Turn the ignition key ON (engine not running) and check the pressure on the gauge, comparing your reading with the pressure listed in this Chapter's Specifications.

13 If the fuel pressure is not within specifications, check the following:

a) If the pressure is lower than specified, check for a restriction in the fuel system (that includes the inlet strainer and the fuel filter). If there is no restriction, the fuel pressure regulator or the fuel pump could be defective.

b) If the fuel pressure is higher than specified, replace the fuel pressure regulator (see Section 14).

4 Fuel lines and fittings - repair and replacement

♦ Refer to illustration 4.2

WARNING 1:

Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the Warning in Section 2.

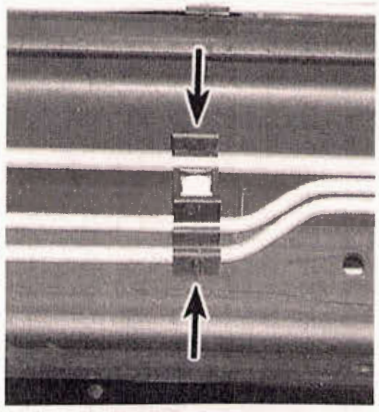
WARNING 2:

Before disconnecting any fuel line fittings, relieve the fuel system pressure (see Section 2) and equalize tank pressure by removing the fuel filler cap. This procedure will merely relieve the increased pressure necessary for the engine to run - remember that fuel will still be present in the system components, so you should be ready for fuel spills when disconnecting fuel line fittings.

1 Always relieve the fuel pressure (see Section 2) before servicing fuel lines or fittings, then disconnect the cable from the negative battery terminal before proceeding.

2 The fuel supply and return lines run from the fuel tank to the fuel meter body on V6 engines or to the fuel rail on V8 engines (1999 through 2003 models). The Evaporative Emission Control (EVAP) system vapor lines connect the fuel tank to the EVAP canister and connect the canister to the canister purge solenoid on the intake manifold. The fuel and EVAP lines are secured to the underbody with small plastic brackets that are attached to the underside of the vehicle (see illustration). To detach the lines from these brackets, spread the clips of the bracket apart and pull the line out.

3 Whenever you're working under the vehicle, be sure to inspect all fuel and EVAP lines for leaks, kinks, dents and other damage. Always replace a damaged fuel or EVAP line immediately. Leaking fuel and



4.2 The fuel lines (and EVAP lines) are secured to the underside of the vehicle by small plastic clips. This one is typical

EVAP lines will result in loss of fuel and excessive air pollution (the leaking raw fuel emits unburned hydrocarbon vapors into the atmosphere).

4 If you find signs of dirt in the lines during disassembly, disconnect all lines and blow them out with compressed air. Inspect the fuel strainer on the lower end of the fuel pump for damage and deterioration. And inspect the fuel filter (see Chapter 1).

STEEL TUBING

5 Because fuel lines used on fuel-injected vehicles are under fairly high pressure, it is critical that they be replaced with lines of equivalent specification. Never use copper or aluminum tubing to replace steel tubing. These materials cannot withstand normal vehicle vibration.

6 Some steel fuel lines have threaded fittings. When loosening these fittings to service or replace components:

a) Hold the stationary fitting with one wrench while loosening or tightening the tubing nut with another.

b) If you're going to replace one of these fittings, use original equipment parts or parts that meet original equipment standards.

PLASTIC TUBING

7 Some of the fuel and EVAP lines on the vehicles covered in this manual are plastic. If you ever have to replace a plastic line, use only plastic tubing meeting original equipment standards.

CAUTION:

When removing or installing plastic fuel line tubing, be careful not to bend or twist it too much, which can damage it. And damaged fuel lines MUST be replaced! Also, be aware that the plastic fuel tubing is NOT heat resistant, so keep it away from excessive heat. Nor is it acid-proof, so don't wipe it off with a shop rag that has been used to wipe off battery electrolyte. If you accidentally spill or wipe electrolyte on plastic fuel tubing, replace the tubing.

FLEXIBLE HOSES

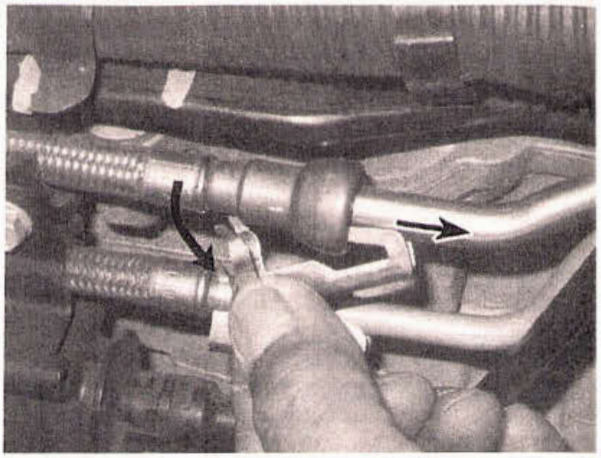
WARNING:

Use only original equipment replacement hoses or their equivalent. Unapproved hoses might fail when subjected to the high operating pressures of the fuel system.

8 Don't route fuel hoses within four inches of exhaust system components or within ten inches of a catalytic converter. Make sure that no flexible hoses are installed directly against the vehicle, particularly in places where there is any vibration. If allowed to touch some vibrating part of the vehicle, a hose can easily become chafed and it might start leaking. A good rule of thumb is to maintain a minimum of 1/4-inch clearance around a hose (or metal line) to prevent contact with the vehicle underbody.

FUEL LINE AND EVAP LINE FITTINGS

9 The vehicles covered in this manual use two kinds of fuel line quick-connect fittings (metal or plastic) for most connections at the fuel pump, the fuel tank, under the vehicle and in the engine compartment. (A third type of plastic quick-connect fitting is used only at the EVAP canister and on the vent hose connection at the fuel tank for the EVAP canister vent solenoid.)



4.12 Pull the end of the retainer off the fuel line, then disengage the other end from the female side of the fitting

10 The procedure for releasing each type of fuel line fitting is diffe ent. But a few rules of thumb apply to all fittings:

1) Inspect the fitting for dirt. If the fitting is dirty, clean it off befor disassembling it. The seals in the fitting will stick to the fuel li as they age. Twist the fitting on the line, then push and pull the fitting until it moves freely.

2) Always disconnect all fuel line fittings from a fuel system comp nent before removing the component.

3) When disconnecting a quick-connect fitting, inspect the condit of the retainer before reconnecting the fitting. The best strategy with respect to retainers is to simply replace the retainer every time that you disconnect the fitting.

4) When you disconnect a fitting with an O-ring inside, inspect th O-ring before reconnecting the fitting. Fuel line fittings are und the same pressure as the rest of the fuel system, so to avoid leaks (and fires!) make VERY SURE that the O-ring is good con dition. Even better, simply replace it.

5) In most cases, the fitting itself is a non-removable part of the fu line, so you might have to replace an entire fuel line if a fitting damaged or defective.

Metal collar quick-connect fittings

Disconnection

Refer to illustrations 4.12, 4.13a and 4.13b

Note: You'll need a special tool set (available at most auto parts stores) to disconnect these fittings.

11 Relieve the fuel system pressure (see Section 2).

12 Pull off the clip end of the retainer, then remove it from the fittin (see illustration).

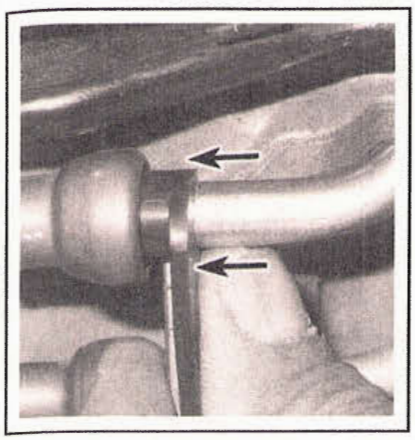
13 Using a fuel line separator tool of the proper size (available at most auto parts stores), insert the tool into the female side of the fitting, then push it into the fitting to release the locking tabs and pull th fitting apart (see illustrations).

Reconnection

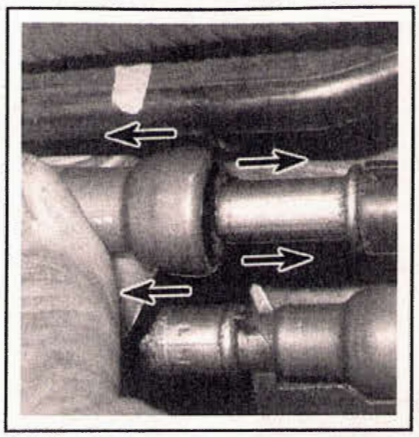
Refer to illustrations 4.14 and 4.17

14 Inspect the O-ring (see illustration). If it's dried out, cracked, to or otherwise deteriorated, replace it.

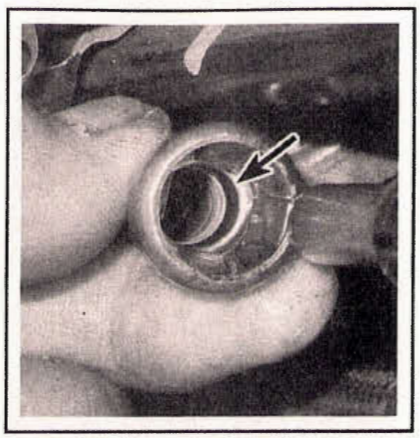
15 Apply a few drops of clean engine oil to the male pipe end.



4.13a Insert the fuel line separator tool into the female side of the fitting, push it into the fitting until it releases the locking tabs inside the fitting . . .



4.13b . . . then pull the lines apart



4.14 Inspect the O-ring inside the female side of the fitting; if it's cracked, torn or deteriorated, replace it

16 Push both sides of the fitting together until the retaining tabs snap into place. Pull on both sides of the fitting to verify that it's securely connected.

17 Install the retainer, making sure it clips into place (see illustration).

18 Start the engine and check for fuel leaks.

Plastic collar quick-connect fittings

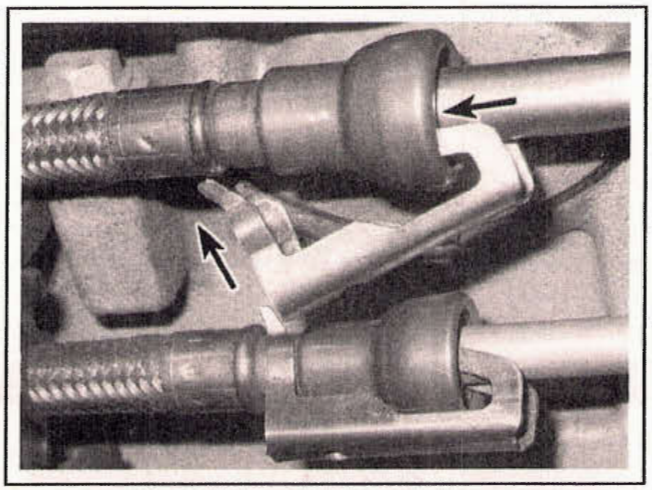
Disconnection

Refer to illustrations 4.19a and 4.19b

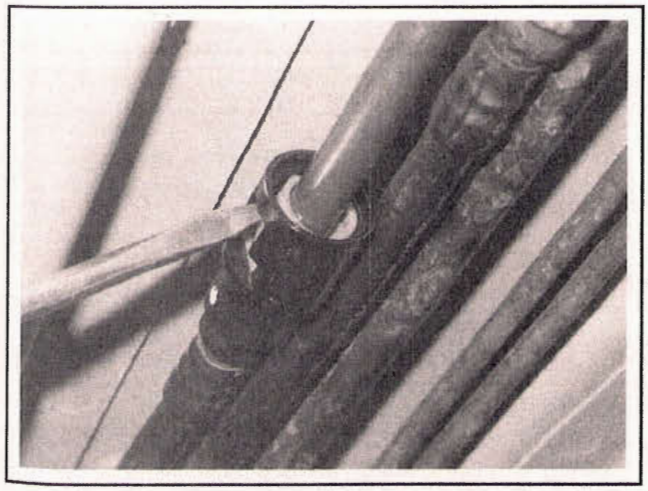
19 To release this type of quick-connect fitting, depress the tabs of the retainer (see illustration). Once the retainer is released, continue pressing on the tabs while pulling the two fuel lines apart (see illustration).

20 Remove and discard the old retainer from the male side of the fitting.

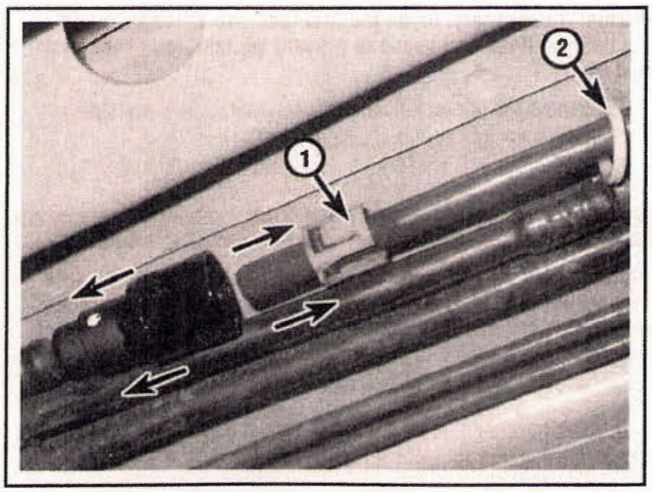
21 Remove and discard the indicator ring from the male side of the fitting.



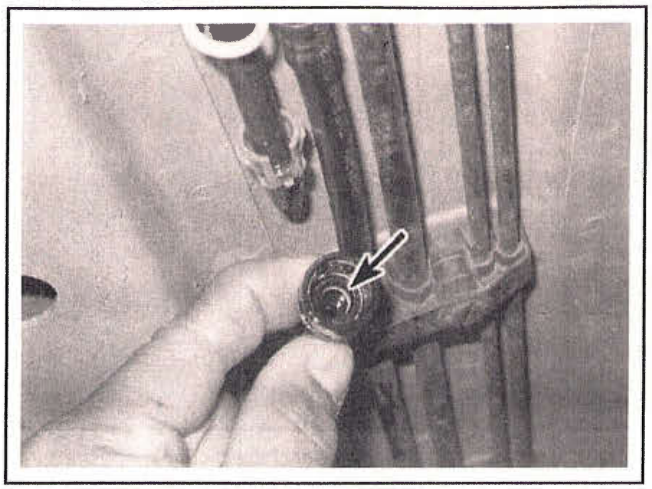
4.17 To install a retainer, insert the hooked end into the female side of the fitting, then push the clip end onto the fuel line until it snaps into place



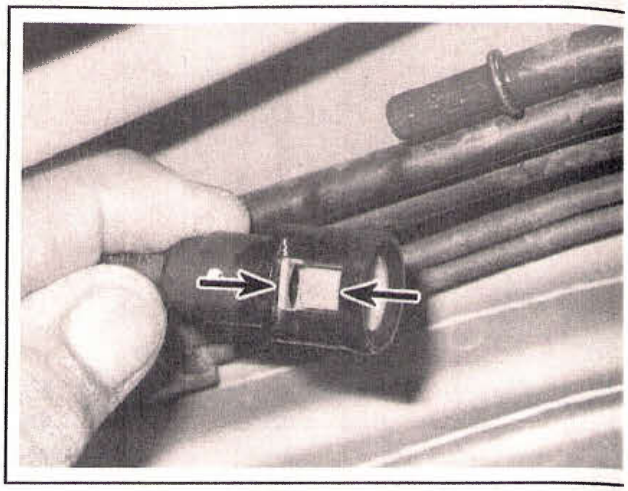
4.19a To release a plastic quick-connect fitting, depress the tabs on the retainer with a small screwdriver, then continue pressing on them . . .



4.19b . . . until the two fuel lines are disconnected, then remove and discard the old retainer (1) and the indicator ring (2) (the indicator ring is used only during factory assembly; there is no need to reinstall it)



4.22 Inspect the O-ring inside the female side of the fitting; if it's cracked, torn or deteriorated, replace it



4.23 Install a new retainer in the female side of the fitting; make sure that the release tabs are aligned with the windows in the connector

Reconnection

Refer to illustrations 4.22 and 4.23

22 Inspect the O-ring inside the female side of the fitting (see illustration). If it's dried out, cracked, torn or deteriorated, replace it.

23 Insert a new retainer in the female side of the fitting. Make sure that the release tabs are aligned with the "windows" of the connector (see illustration).

24 Apply a few drops of engine oil to the tip of the male fuel line.

25 Push both sides of the fitting together until the retainer release tabs snap into place.

26 Pull on both sides of the fitting to verify that it's securely connected.

27 Start the engine and check for fuel leaks.

5 Fuel tank - removal and installation

Refer to illustrations 5.5, 5.9, 5.10, 5.11 and 5.12

WARNING:

See the *Warning* in Section 1.

Note: If necessary, clean the fuel tank and areas surrounding the fuel lines and hoses to prevent contaminating the fuel system.

1 Remove the fuel tank filler cap to relieve fuel tank pressure.
2 Relieve the fuel system pressure (see Section 2).
3 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

4 Using a siphoning kit (available at most auto parts stores), siphon the fuel into an approved gasoline container.

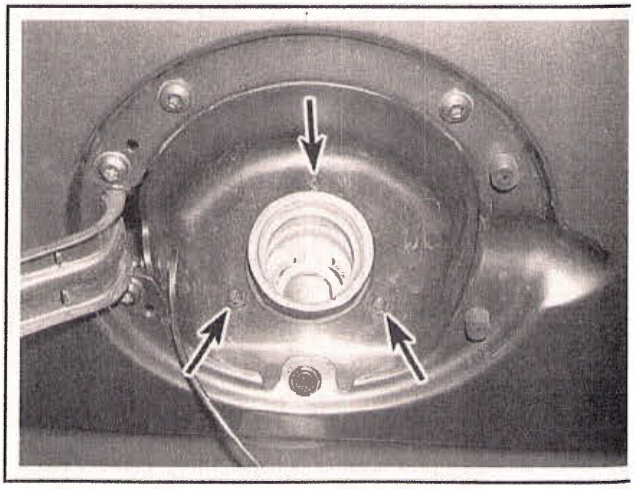
WARNING:

Do not start the siphoning action by mouth!

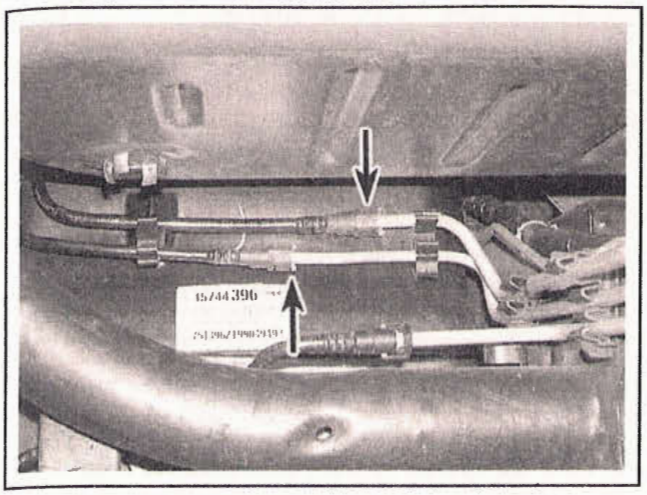
5 On pick-up models, open the fuel filler door and remove the screws retaining the fuel filler tube flange to the body housing (see illustration).

6 Raise the vehicle and support it securely on jackstands. On models so equipped, remove the bolts and the shield over the fuel tank.

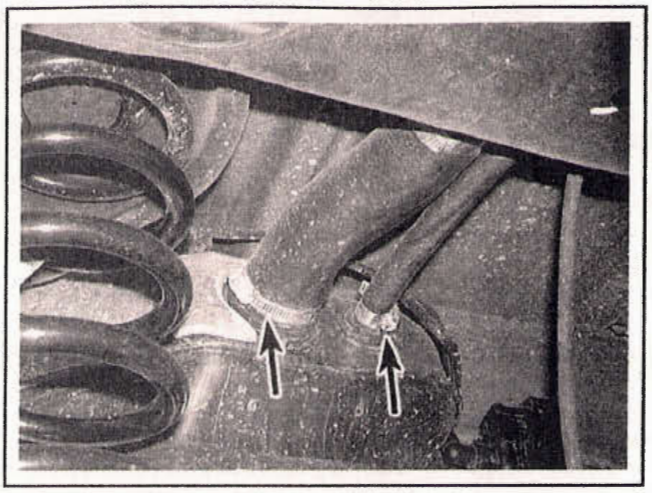
7 On pick-up models, remove the fuel filler pipe ground strap from the body.



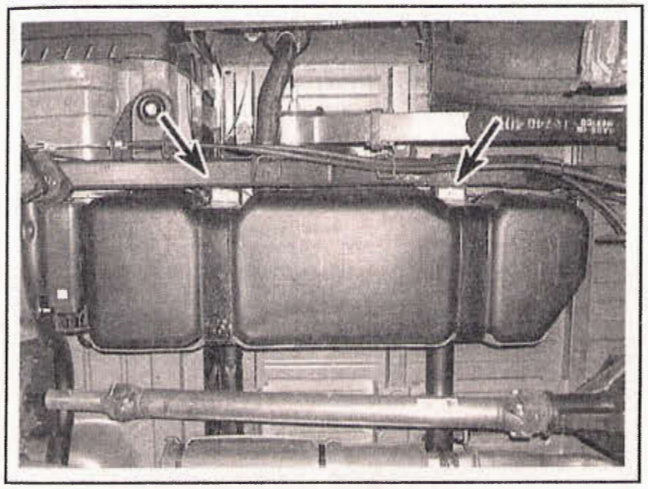
5.5 On pick-up models, remove the fuel filler pipe retaining screws (arrows)



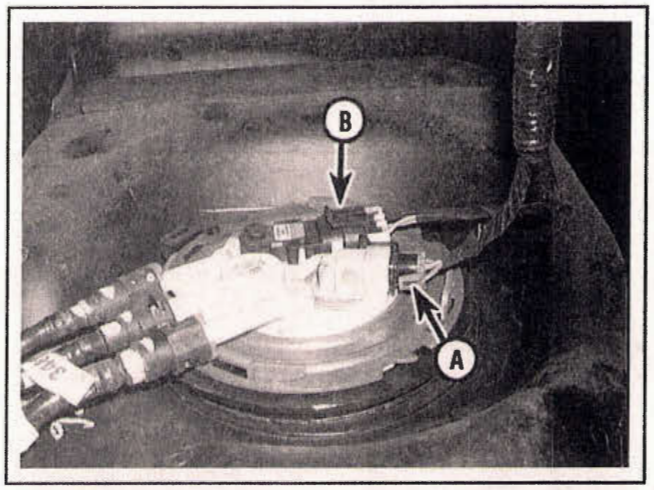
5.9 Disconnect the fuel supply and return lines (arrows)



5.10 On SUV models, loosen the hose clamps and disconnect the fuel filler and vent hoses (arrows) from the fuel tank



5.11 Remove the fuel tank strap bolts (arrows) and remove the straps



5.12 Lower the fuel tank and disconnect the fuel pump/fuel level sending unit (A) and fuel tank pressure sensor (B) electrical connectors from the fuel pump module

8 Remove the EVAP canister (see Chapter 6).

9 Disconnect the fuel supply and return lines (see Section 4) (see illustration).

10 On SUV models, loosen the hose clamps and disconnect the fuel filler and vent hoses from the fuel tank (see illustration).

11 Position a transmission jack under the fuel tank and support the tank. Remove the fuel tank strap bolts and remove the straps (see illustration).

12 Lower the tank slightly and disconnect the electrical connectors from the fuel pump module (see illustration).

13 Lower the jack and remove the tank from the vehicle.

14 On pick-up models, loosen the hose clamps and disconnect the fuel filler hose from the fuel tank.

15 Installation is the reverse of removal.

6 Fuel tank cleaning and repair - general information

1 The fuel tanks installed in the vehicles covered by this manual are not repairable. If the fuel tank becomes damaged, it must be replaced.

2 Cleaning the fuel tank (due to fuel contamination) should be performed by a professional with the proper training to carry out this critical and potentially dangerous work. Even after cleaning and flushing, explosive fumes may remain inside the fuel tank.

3 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside a garage where a natural gas-type appliance is located.

7 Fuel pump module - removal and installation

Refer to illustrations 7.5 and 7.6

WARNING:

See the *Warning* in Section 1.

1 Relieve the fuel system pressure (see Section 2).
2 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

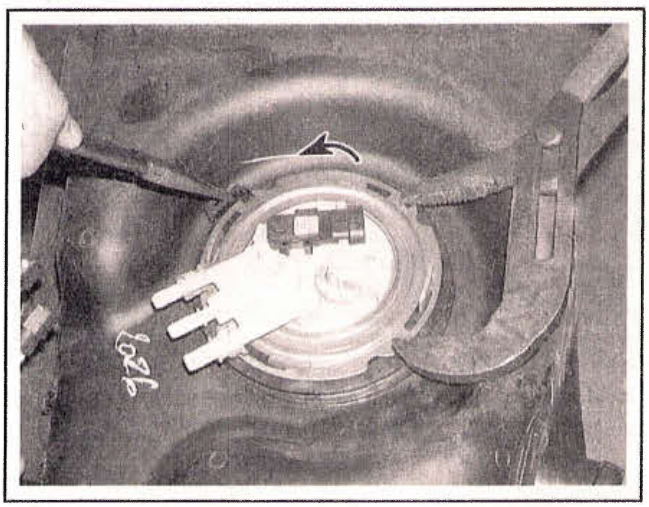
3 Remove the fuel tank from the vehicle (see Section 5).
4 Disconnect the fuel lines and EVAP line from the fuel pump module.
5 While prying the locking tab out, rotate the fuel pump module retaining ring counterclockwise until it's loose (see illustration).

6 Remove the fuel pump module from the tank (see illustration) Angle the assembly slightly to avoid damaging the fuel level sendin unit float.

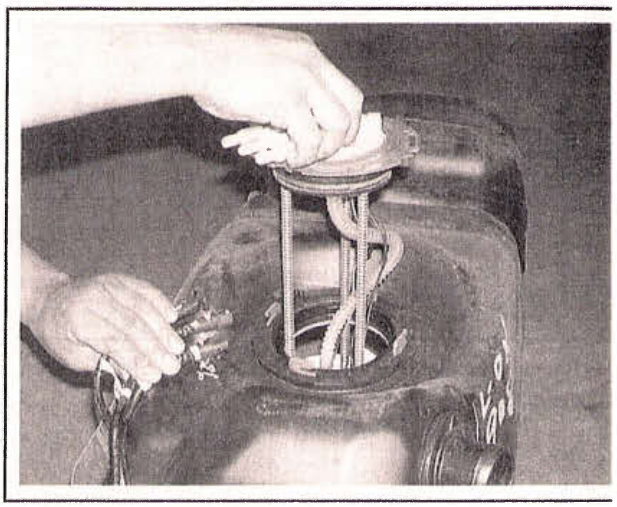
WARNING:

Some fuel may remain in the module reservoir and spill as the module is removed. Have several shop towels ready and drain pan nearby to place the module in.

7 The electric fuel pump is not serviced separately. In the event failure, the complete assembly must be replaced. Transfer the fuel p sure sensor and fuel level sending unit to the new fuel pump modul assembly, if necessary (see Section 8).
8 Clean the fuel tank sealing surface and install a new seal on t fuel pump module.
9 Install the fuel pump module, aligning the fuel line fittings wit the fuel lines.
10 Press the fuel pump module down until seated and install the retaining ring. Make sure the retaining ring is fully seated and the lc ing tab is engaged with the slot.
11 The remainder of installation is the reverse of removal.



7.5 Release the locking tab and loosen the fuel pump module retaining ring by rotating it counterclockwise



7.6 Carefully remove the fuel pump module from the tank and drain the fuel from the reservoir

8 Fuel level sending unit - replacement

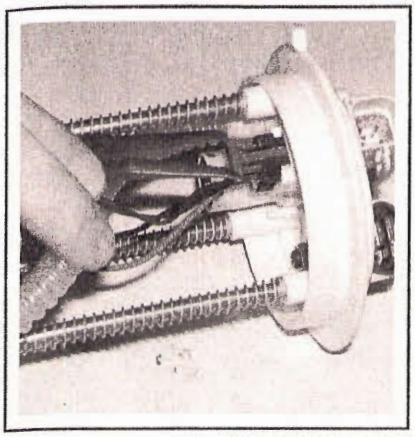
WARNING:

See the *Warning* in Section 1.

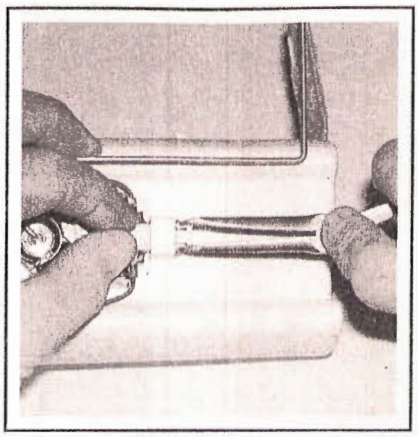
REPLACEMENT

Refer to illustrations 8.2, 8.3 and 8.4

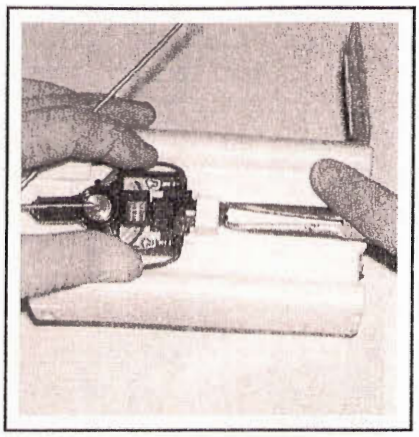
1 Remove the fuel tank and the fuel pump module (see Sections and 7).



8.2 Disconnect the fuel pump/ fuel level sending unit electrical connector from the fuel pump module



8.3 Remove the sending unit retaining clip



8.4 Pinch the tabs together and remove the fuel level sending unit from module

2 Disconnect the fuel level sending unit electrical connector from the module cover (see illustration).

3 Remove the sending unit retaining clip (see illustration).

4 Pinch the tabs together and slide the fuel level sending unit off the module (see illustration). Note the routing of the wiring for installation.

5 Installation is the reverse of removal.

9 Air filter housing - removal and installation

Refer to illustrations 9.2, 9.3, 9.4 and 9.5

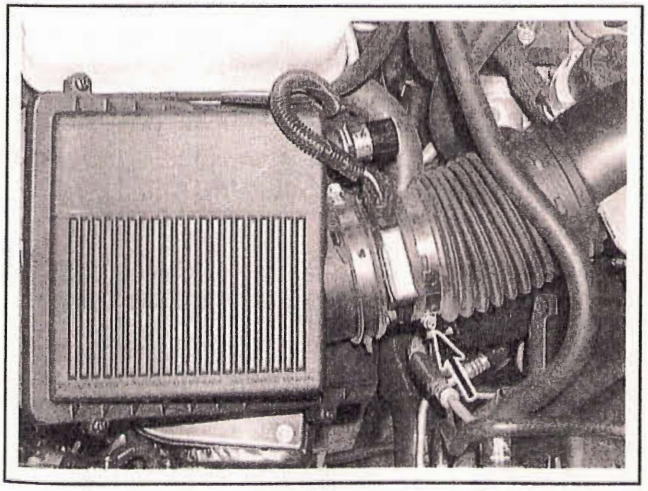
1 Disconnect the electrical connector from the mass airflow sensor.

2 Loosen the air intake duct hose clamp and separate the air intake duct from the mass airflow sensor (see illustration on next page). Remove the mass airflow sensor (see Chapter 6).

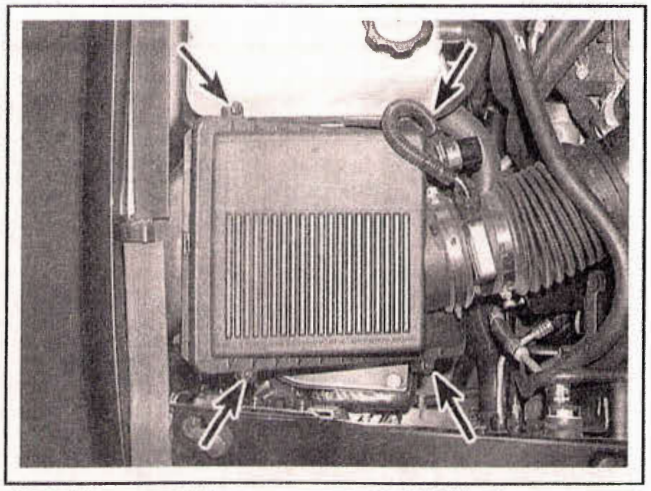
CAUTION:

Handle the mass airflow sensor carefully, damage to the sensor will effect the operation of the fuel injection system.

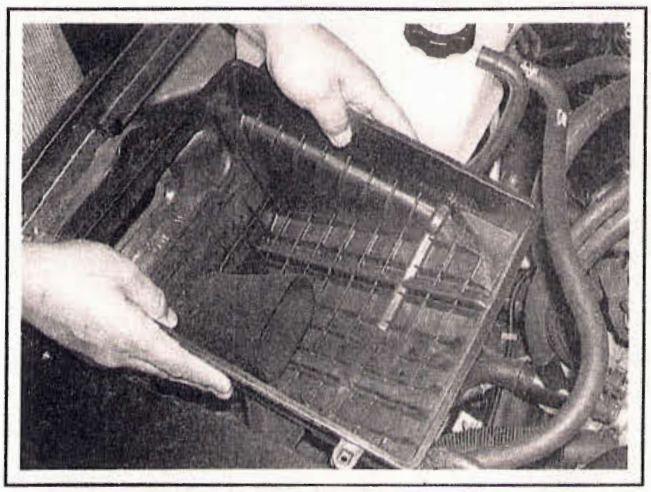
3 Loosen the screws and remove the cover and the air filter element (see illustration).



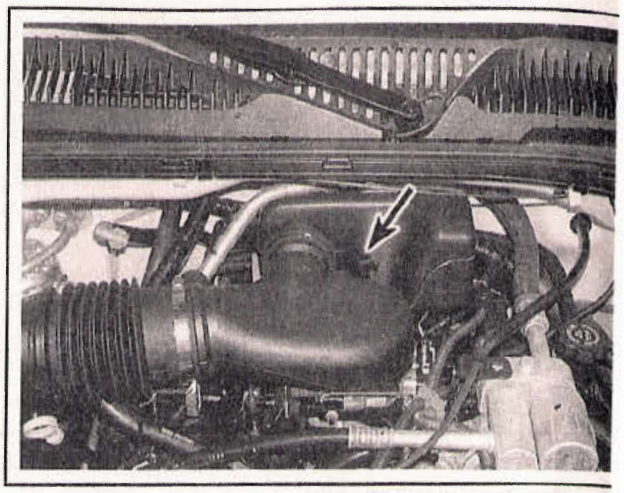
9.2 Loosen the hose clamp (arrow) and disconnect the air intake duct from the MAF sensor



9.3 Loosen the screws (arrows) and remove the air filter housing cover



9.4 Grasp the air filter housing and pull the studs out of the mounting grommets



9.5 On V6 models, remove the wing nut (arrow) and tilt the resonator forward to detach the clip from the throttle body

4 Grasp the housing and pull it straight up to detach the housing studs from the mounting adapter grommets (see illustration). Remove the assembly from the engine compartment.

5 If necessary, loosen the hose clamps, detach the fasteners and separate the air intake duct and resonator assembly from the throttle body (see illustration).

6 Installation is the reverse of removal.

10 Accelerator cable/Throttle Actuator Control (TAC) system - replacement

Refer to illustrations 10.4, 10.5a, 10.5b and 10.6

Note: All engines use a conventional accelerator cable except for some 2001 and later 4.8L, 5.3L and 6.0L V8 engines equipped with the Throttle Actuator Control (TAC) system.

1 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

ACCELERATOR CABLE

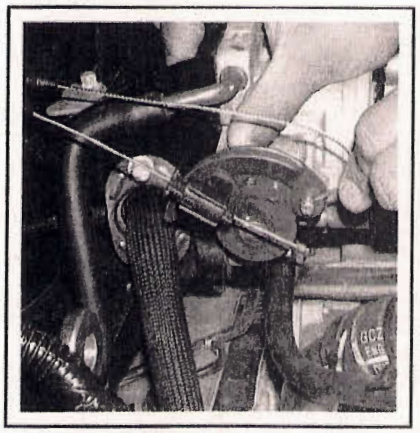
2 On V6 models, remove the air intake duct and resonator from throttle body. On V8 models, remove the intake manifold cover.

3 Detach the cruise control cable from the throttle lever.

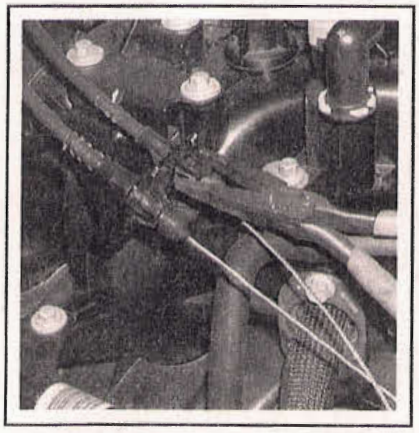
4 Rotate the throttle lever and separate the accelerator cable end from the throttle lever (see illustration).

5 Depress the locking tabs on the cable housing and push the c housing through the bracket. Detach the cable from the cable routin retainers (see illustrations).

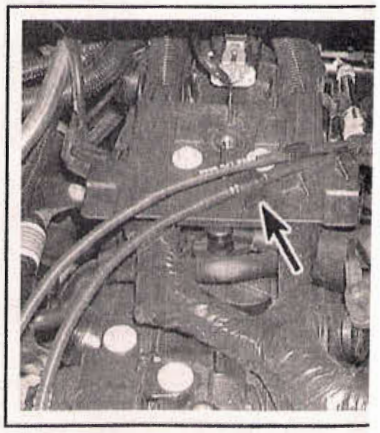
6 Remove the trim panel from under the dash and detach the ca from the accelerator pedal (see illustration).



10.4 Rotate the throttle lever and pass the cable through the slot in the throttle lever



10.5a Depress the locking tabs and remove the cable from the bracket

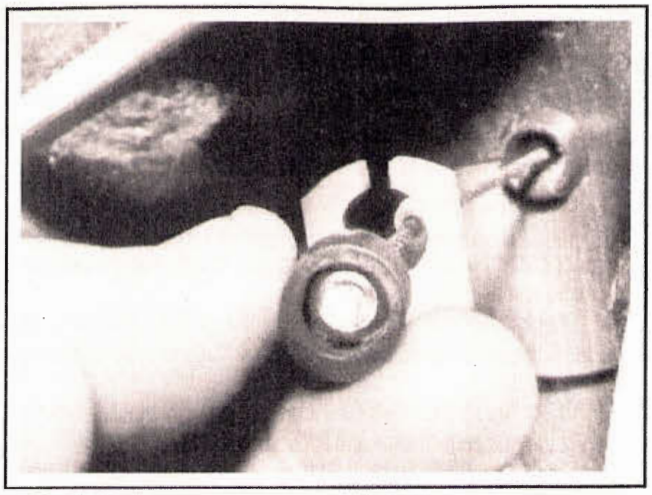


10.5b Detach the cable from the cable routing retainers

7 Depress the locking tabs on the cable housing and push the cable through the firewall and into the engine compartment.
8 Remove the cable from the engine compartment.
9 Installation is the reverse of removal.

THROTTLE CONTROL ACTUATOR (TAC) SYSTEM

10 Later models with 4.8L, 5.3L and 6.0L V8 engines are equipped with the Throttle Actuator Control (TAC) system, which is an all-electronic (no accelerator cable) throttle control system. Instead of an accelerator cable, which provides a direct mechanical link between the position of the accelerator pedal and the position of the throttle plate inside the throttle body, TAC-equipped vehicles use a pair of Accelerator Pedal Position (APP) sensors at the accelerator pedal assembly to monitor the angle of the accelerator pedal. Refer to Chapter 6 for more information on the accelerator pedal sensor.



10.6 Pull the accelerator cable retainer out of the pedal and slide the cable through the slot

11 Fuel injection system - general information

The Sequential Multi Port Fuel Injection (SFI) system consists of three sub-systems: air intake, engine control and fuel delivery. The system uses a Powertrain Control Module (PCM) along with the sensors (coolant temperature sensor, throttle position sensor, mass airflow sensor, oxygen sensor, etc.) to determine the proper air/fuel ratio under all operating conditions.

The fuel injection system and the engine control system are closely linked in function and design. For additional information, refer to Chapter 6.

AIR INTAKE SYSTEM

The air intake system consists of the air filter, the air intake ducts, the throttle body, the air intake plenum (V6) and the intake manifold.

When the engine is idling, the air/fuel ratio is controlled by the idle air control system, which consists of the Powertrain Control Module (PCM) and the idle air control valve. This idle air control regulates the amount of airflow past the throttle plate and into the intake manifold, thus increasing or decreasing the engine idle speed. The PCM receives information from the sensors (vehicle speed, coolant temperature, air conditioning, power steering mode etc.) and adjusts the idle according to the demands of the engine and driver. Refer to Chapter 6 for information on the idle air control valve.

EMISSIONS AND ENGINE CONTROL SYSTEM

The emissions and engine control system is described in detail in Chapter 6.

FUEL DELIVERY SYSTEM

➡Note: 2005 and later models use a Returnless Fuel System. This system uses a fuel pulse damper instead of a fuel pressure regulator, and has no fuel return lines to the fuel tank.

The fuel delivery system consists of these components: the fuel pump, the fuel pressure regulator, the fuel meter body (V6) or fuel rail (V8) and the fuel injectors.

The fuel pump is an electric type. Fuel is drawn through an inlet screen into the pump, flows through the one-way valve, passes through the fuel filter and is delivered to the fuel meter body/fuel rail and injectors. The pressure regulator maintains a constant fuel pressure to the injectors. Excess fuel is routed back to the fuel tank through the fuel pressure regulator.

The injectors are solenoid-actuated pintle types consisting of a solenoid, plunger, needle valve and housing. When current is applied to the solenoid coil, the needle valve raises and pressurized fuel sprays out the nozzle. The injection quantity is determined by the length of time the valve is open (the length of time during which current is supplied to the solenoid coils).

On V6 models, the injectors are housed in a central fuel meter body located under the upper intake manifold (plenum). Six individual poppet nozzles are connected to the fuel injectors with nylon tubes. The injectors, tubes and poppet nozzles are serviced as an assembly. V8 models use a more conventional fuel rail/injector assembly.

The fuel pump relay is located in the engine compartment electrical center. The PCM controls the relay by supplying battery voltage to the relay coil. When energized, the fuel pump relay connects battery voltage to the fuel pump. If the PCM senses there is NO signal from the camshaft or crankshaft sensors (as with the engine not running or cranking), the PCM will de-energize the relay.

12 Fuel injection system - check

Refer to illustrations 12.7, 12.8 and 12.9

Note: The following procedure is based on the assumption that the fuel pressure is adequate (see Section 3).

1 Check all electrical connectors that are related to the system. Check the ground wire connections for tightness. Loose connectors and poor grounds can cause many problems that resemble more serious malfunctions.

2 Check to see that the battery is fully charged, as the control unit and sensors depend on an accurate supply voltage in order to properly meter the fuel.

3 Check the air filter element - a dirty or partially blocked filter will severely impede performance and economy (see Chapter 1).

4 Check the related fuses. If a blown fuse is found, replace it and see if it blows again. If it does, search for a wire shorted to ground in the harness.

5 Check the air intake duct from the air filter housing to the throttle body for leaks, which will result in an excessively lean mixture. Also check the condition of all vacuum hoses connected to the intake manifold and/or throttle body.

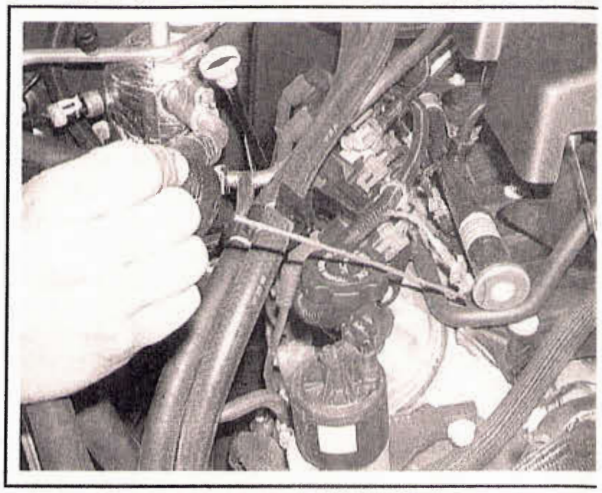
6 Remove the air intake duct from the throttle body and check for dirt, carbon or other residue build-up on the throttle bore and throttle plate. If it's dirty, clean it with carburetor cleaner spray, a toothbrush and a shop towel.

CAUTION:

Do not use a solvent containing Methyl Ethyl Ketone or damage to the throttle body may occur.

7 On V8 models, start the engine and place an automotive stethoscope against each injector, one at a time, and listen for a clicking sound, indicating operation (see illustration). If you don't have a stethoscope, place the tip of a screwdriver against the injector and listen through the handle.

8 On V8 models, disconnect the injector electrical connectors and measure the resistance of each injector (see illustration). Compare the measurements with the resistance values listed in this Chapter's Sp fications.

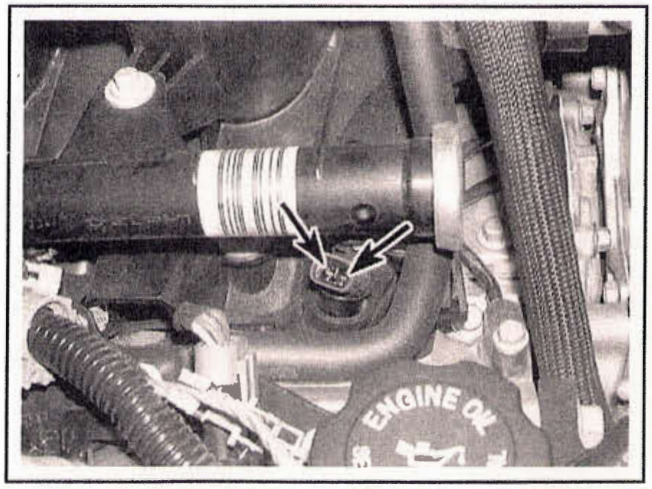


12.7 On V8 models, use a stethoscope to determine if the injectors are working properly - they should make a steady clicking sound that rises and falls with engine speed chang

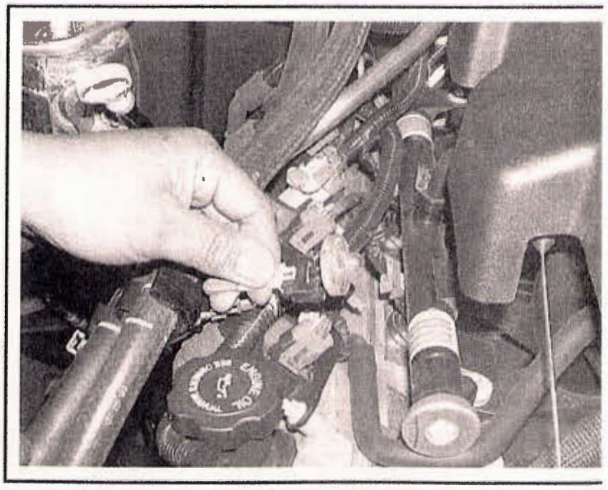
Note: On V6 models, disconnect the fuel injector harness main connector at the fuel meter body and perform the tests there. Refer to the wiring diagrams at the end of Chapter 12 determine the terminals for testing by wire color.

9 On V8 models, install an injector test light ("noid" light) into each injector electrical connector, one at a time (see illustration). C the engine over. Confirm that the light flashes evenly on each conn tor. This tests the PCM control of the injectors. If the light does not flash, have the PCM checked at a dealer service department or othe properly equipped repair facility.

Note: On V6 models, disconnect the fuel injector harness main connector at the fuel meter body and perform the tests there. Refer to the wiring diagrams at the end of Chapter 12 determine the terminals for testing by wire color.



12.8 Measure the resistance of each injector across the two terminals of the injector



12.9 Install the "noid" light (available at most auto parts stores) into each injector electrical connector and confirm that it blinks when the engine is cranking

13 Throttle body - removal and installation

Refer to illustrations 13.8a and 13.8b

WARNING:

Wait until the engine is completely cool before beginning this procedure.

1 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

2 On V8 models, partially drain the cooling system (see Chapter 1).
3 Remove the air intake duct and resonator.
4 Disconnect the electrical connectors from the throttle body.
5 Label and detach the vacuum hoses from the throttle body.
6 Detach the accelerator cable (see Section 10) and if equipped, the cruise control cable. On V6 models, remove the accelerator cable brackets.

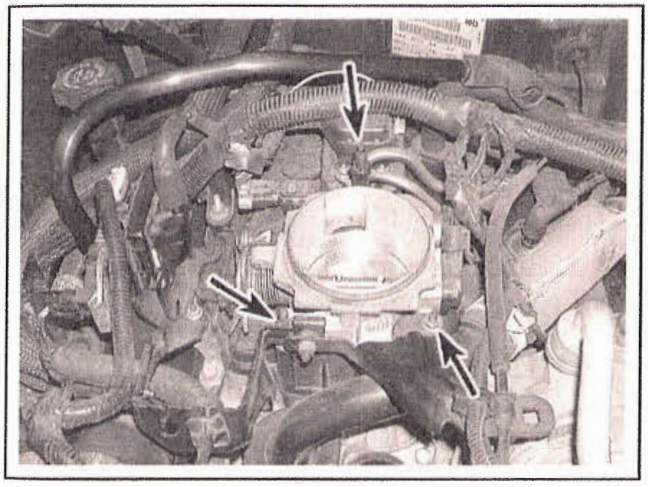
Note: Some 2001 and later models are equipped with Electronic Throttle Control (ETC). On these models, there is no throttle cable, just electrical harness connectors at the throttle body and accelerator pedal, which is equipped with an Accelerator Pedal Position (APP) sensor.

7 On V8 models, detach the coolant hoses from the throttle body.
8 Remove the mounting bolts/nuts and remove the throttle body and gasket (see illustrations).
9 Remove all traces of old gasket material from the throttle body and intake manifold and install a new gasket.

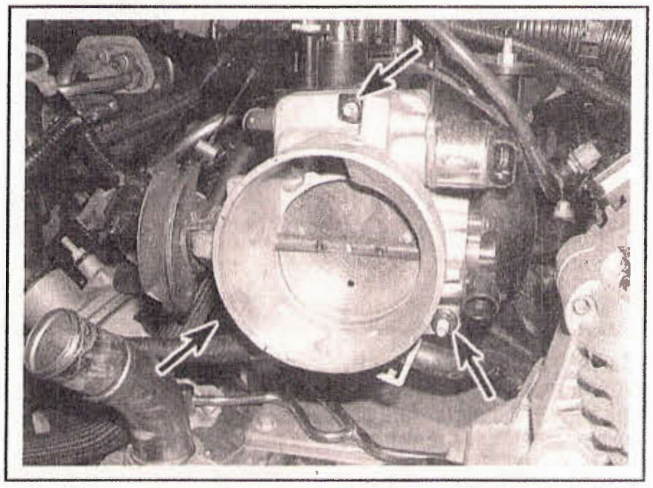
CAUTION:

Do not use solvent or a sharp tool to clean the throttle body gasket surface or damage to the throttle body may occur.

10 Install the throttle body and tighten the bolts to the torque listed in this Chapter's Specifications.
11 The remainder of installation is the reverse of removal.



13.8a Throttle body mounting bolts (arrows) - V6 models



13.8b Throttle body mounting nuts (arrows) - early V8 models

14 Fuel pressure regulator - replacement

Refer to illustrations 14.5a, 14.5b and 14.6

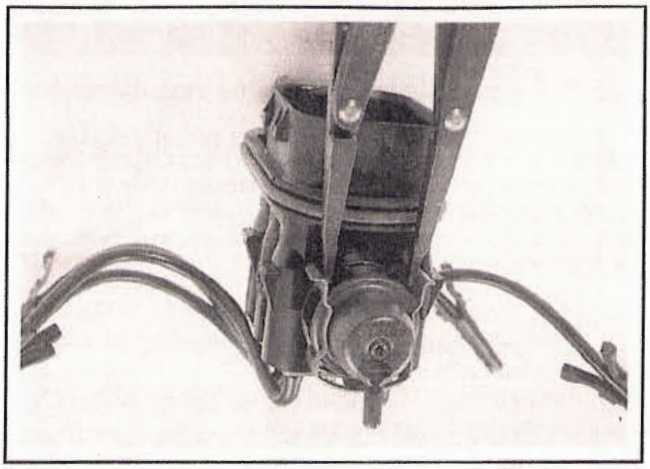
WARNING:

See the *Warning* in Section 1.

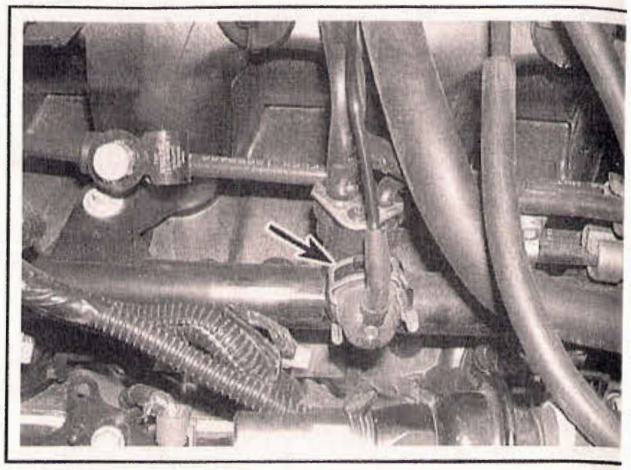
1 Relieve the fuel system pressure (see Section 2).
2 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).



14.5a Remove the fuel pressure regulator retaining clip - 2004 and earlier V6 models



14.5b Remove the fuel pressure regulator retaining clip - 2003 and earlier V8 models

1999 THROUGH 2003 V8 MODELS/1999 THROUGH 2004 V6 MODELS

Refer to illustrations 14.5a, 14.5b and 14.6

WARNING:

See the Warning in Section 1.

3 On V6 models, remove the upper intake manifold for access to the fuel meter body (see Section 15).

4 On V8 models, remove the intake manifold cover and detach the vacuum hose from the port on the regulator.

5 Remove the pressure regulator retaining clip and detach the fuel pressure regulator (see illustrations).

CAUTION:

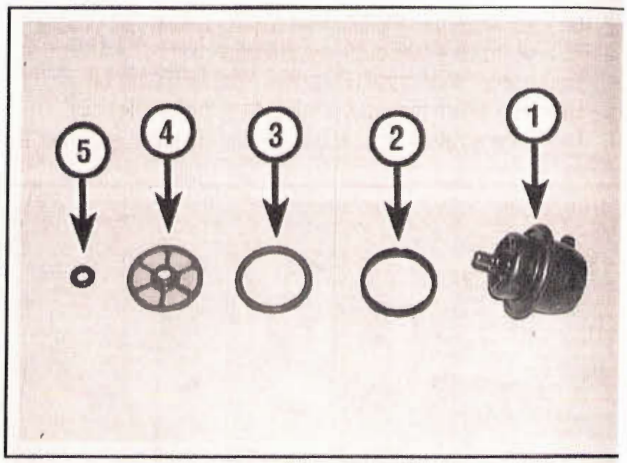
On 2002 models, there are three different calibrations of regulators. If replacing a regulator, bring your old unit (and its retaining clip) to the parts store or dealership to ensure you get the right regulator and matching retaining clip.

6 Be sure to replace all O-ring seals, lubricating them with a light film of engine oil (see illustration).

Note: The small O-ring may remain in the fuel meter body or fuel rail.

7 Check the filter disc for contamination and clean or replace it as necessary.

8 The remainder of installation is the reverse of removal.



14.6 Fuel pressure regulator components

1 *Fuel pressure regulator*
2 *Back-up ring*
3 *Large O-ring*
4 *Filter disc*
5 *Small O-ring*

2004 AND LATER V8 MODELS/2005 V6 MODELS

9 Remove the fuel pump module (see Section 7).

10 Remove the fuel level sending unit (see Section 8).

11 Replace the fuel pump module (fuel pulse damper/fuel pump) a a complete unit.

12 The remainder of installation is the reverse of removal.

15 Fuel meter body and injectors (V6 models) - removal and installation

WARNING:

See the *Warning* in Section 1.

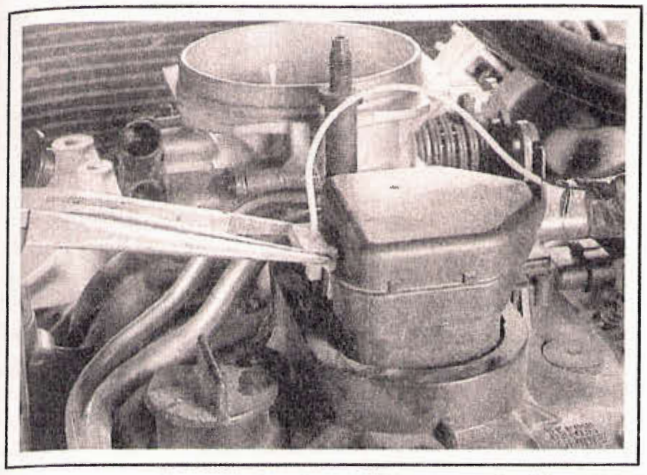
Note: When replacing components of the fuel meter body/injector assembly, refer to the identification numbers on the fuel meter body and injectors. Fuel injectors are calibrated with different flow rates and must not be interchanged with injectors from a different application.

REMOVAL

Refer to illustrations 15.3, 15.4a, 15.4b, 15.5, 15.6, 15.7a, 15.7b, 15.8 and 15.9

1 Relieve the fuel system pressure (see Section 2).

2 Disconnect the cable from the negative battery terminal.



15.3 Remove the retaining clip and disconnect the electrical connector from the fuel meter body

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

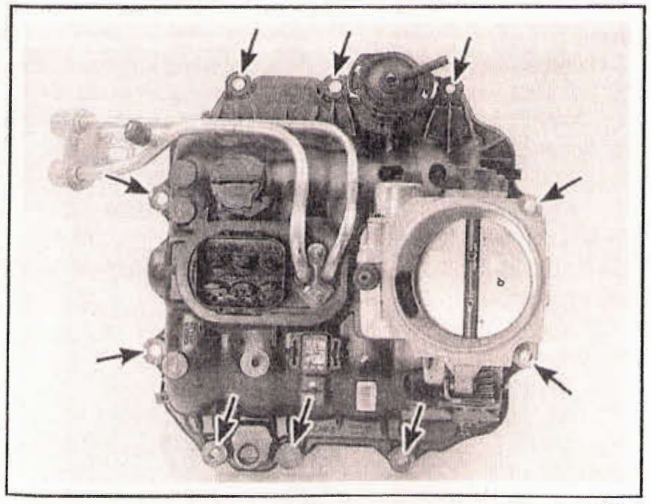
3 Remove the retaining clip and disconnect the electrical connector from the fuel meter body (see illustration).

4 Disconnect the fuel supply and return lines from the fittings at the rear of the engine (see illustration). Remove the bracket bolt. Loosen the nuts attaching the fuel lines to the fuel meter body and remove the lines (see illustration).

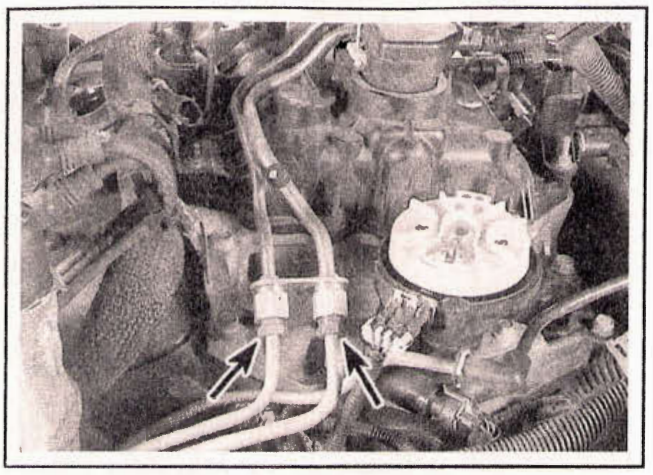
5 Remove the throttle body (see Section 13) and the accelerator control cable bracket. Remove the ignition coil/module assembly (see Chapter 5). Remove the EVAP purge valve (see Chapter 6). Remove the remaining mounting studs and carefully remove the upper intake manifold (see illustration).

CAUTION:

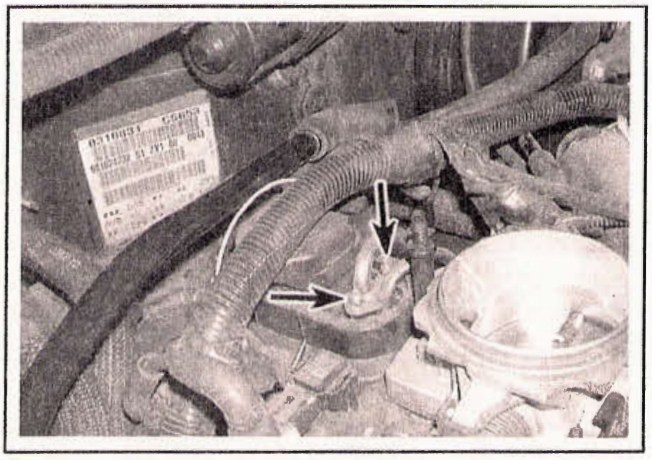
Do not clean the composite upper intake manifold with solvent.



15.5 Upper intake manifold bolt locations (arrows) (upper intake manifold removed for clarity)



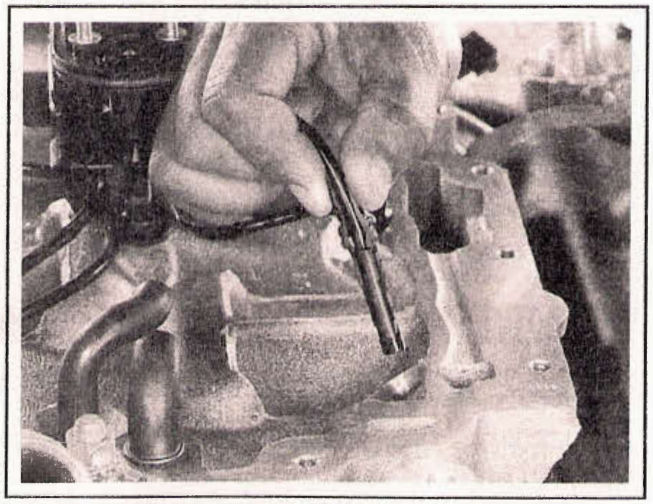
15.4a Disconnect the fuel supply and return lines from the fittings (arrows)



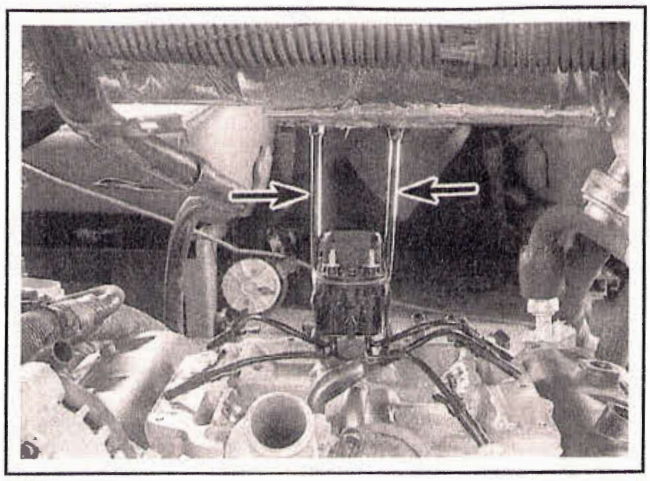
15.4b Remove the fuel line nuts and retainers (arrows) and remove the fuel lines from the fuel meter body

6 Detach the poppet nozzles by squeezing the tabs together and pulling the nozzle straight out of the intake manifold (see illustration).

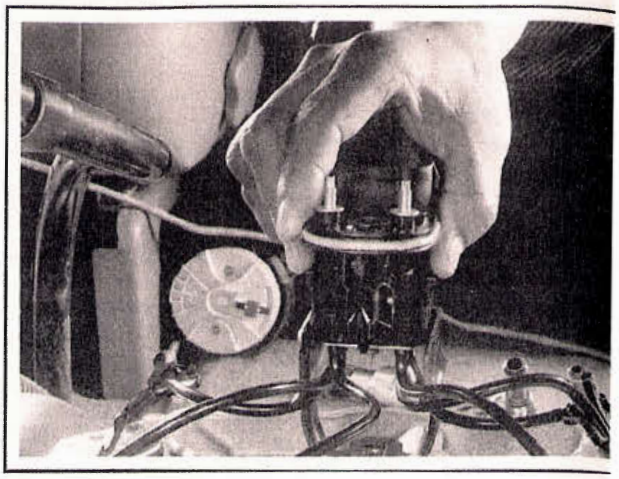
➡Note: Apply a numbered tag to each nozzle or line with the corresponding cylinder number.



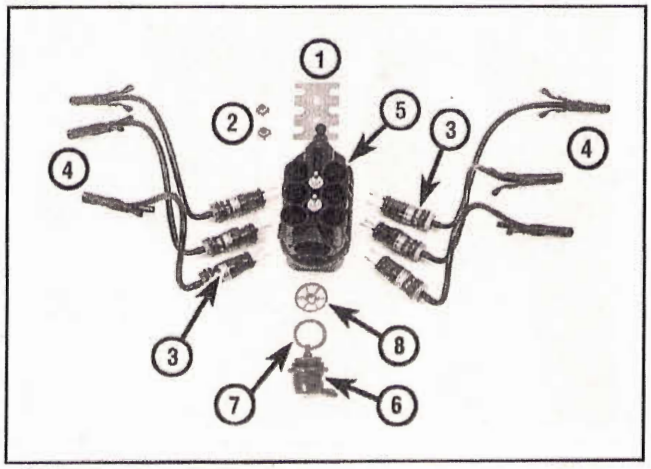
15.6 Squeeze the tabs and pull the poppet nozzle out of the intake manifold



15.7a Using two tools (arrows), pry the locking tabs away from the fuel meter body . . .



15.7b . . . and remove the fuel meter body along with the fuel lines and poppet nozzles from the intake manifold



15.8 Fuel meter body components

1 *Fuel injector hold-down plate*
2 *Nuts*
3 *Fuel injectors*
4 *Poppet nozzles*
5 *Fuel meter body*
6 *Fuel pressure regulator (2004 and earlier models)/ fuel pulse damper (2005 and later models)*
7 *O-ring*
8 *Filter screen*

7 Pry the bracket locking tabs away from the fuel meter body and pull the assembly off the bracket (see illustrations). Place the assembly on a clean work bench.

8 Remove the fuel injector hold-down plate nuts and remove the plate from the fuel meter body (see illustration).

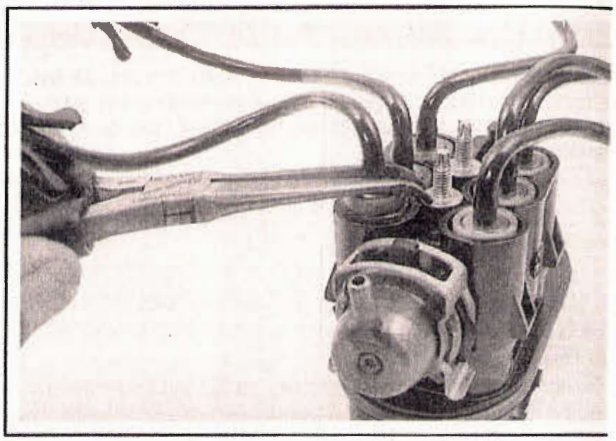
9 While pulling down on the injector tube fitting, push the injector out of the fuel meter body with a dull screwdriver (see illustration). Be careful not to damage the electrical terminals.

CAUTION:

Do not attempt to remove the fuel line or poppet nozzle from the injector. They are serviced as a complete assembly.

INSTALLATION

10 Replace the injector O-rings. Apply a light coat of clean engine oil to the O-rings and press the injector into the fuel meter body until



15.9 To remove an injector from the fuel meter body, pull o the tube fitting while pushing the injector out

seated. Make sure the electrical terminals are properly aligned and tl fuel tubes and nozzles are properly routed.

11 Install the injector hold-down plate and nuts.

12 Install the fuel meter body onto the intake manifold bracket. Install the poppet nozzles into the intake manifold, snapping them in place. Gently pull up on the fuel tube to ensure the nozzles are prope seated.

13 Inspect the fuel meter body and upper intake manifold seals fc damage. Install new seals, if necessary. Install the upper intake man fold. Apply thread locking compound to the upper intake manifold b and tighten the bolts to the torque listed in this Chapter's Specifications. Install the EVAP purge valve and ignition coil/module assemb

14 Inspect the fuel line O-rings and retainers for damage. Replac the O-rings and retainers, if necessary. Install the fuel lines onto the fuel meter body. Apply thread locking compound to the fuel line bra bolt and install the bracket.

15 Inspect the throttle body seal for damage. Replace the seal, if necessary and install the throttle body (see Section 13).

16 The remainder of installation is the reverse of removal.

17 After the fuel meter body/injector assembly installation is com plete, turn the ignition switch to On, but don't operate the starter (th activates the fuel pump for about two seconds, which builds up fuel pressure in the fuel lines and the fuel meter body). Cycle the ignitio On and Off several times, then check the fuel lines and fuel meter b for fuel leakage.

16 Fuel rail and injectors (V8 models) - removal and installation

WARNING:

See the *Warning* in Section 1.

➡Note 1: E-85 models (ethanol, 85 percent) are equipped with a special design fuel rail. The fuel rail crossover pipe should NOT be detached from either fuel rail. Additionally, injector O-rings and retaining clips are not available separately; if an O-ring or clip needs replacing, the injector must be replaced.

➡Note 2: When replacing components of the fuel rail/injector assembly, refer to the identification numbers on the fuel rail and injectors. Fuel injectors are calibrated with different flow rates and must not be interchanged with injectors from a different application.

REMOVAL

Refer to illustrations 16.6, 16.7, 16.8, 16.9a and 16.9b

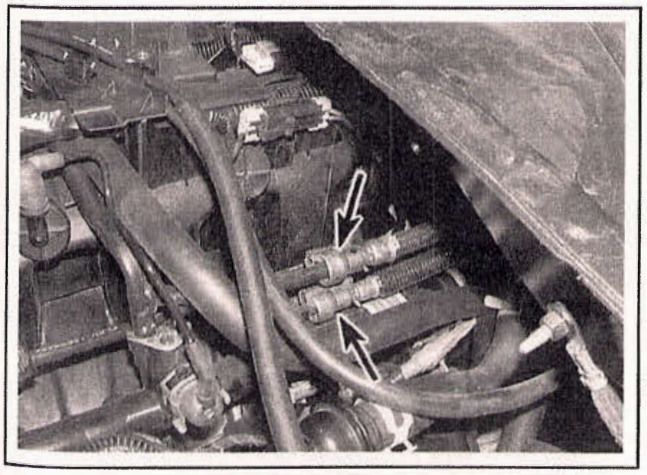
1 Relieve the fuel pressure (see Section 2).
2 Disconnect the cable from the negative battery terminal.

CAUTION:

On models equipped with the Theftlock audio system, be sure the lockout feature is turned off before performing any procedure which requires disconnecting the battery (see the front of this manual).

3 Remove the air intake duct and resonator (see Section 9). Remove the upper intake manifold cover and the cover mounting bracket.
4 Disconnect the accelerator cable and cruise control cable from the throttle body. Detach the cables from the bracket and position the cables aside.
5 Disconnect any electrical connectors that will interfere with fuel rail removal. Detach the upper engine wiring harness from the retainers and position the wiring harness aside.
6 Disconnect the fuel injector electrical connectors (see illustration).

➡Note: Apply a numbered tag to each connector with the corresponding cylinder number.



16.7 Using the proper fuel line disconnect tool, disconnect the fuel supply and return lines (arrows) from the fuel rail pipes

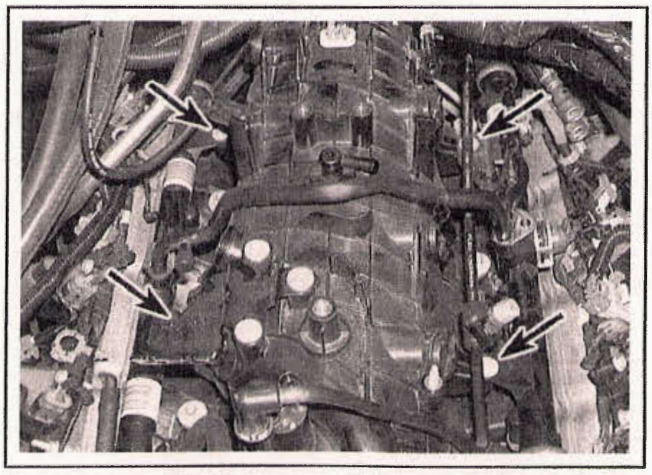
16.6 Pull the retainer up, push in on the tab and disconnect the electrical connector from the fuel injector

CAUTION:

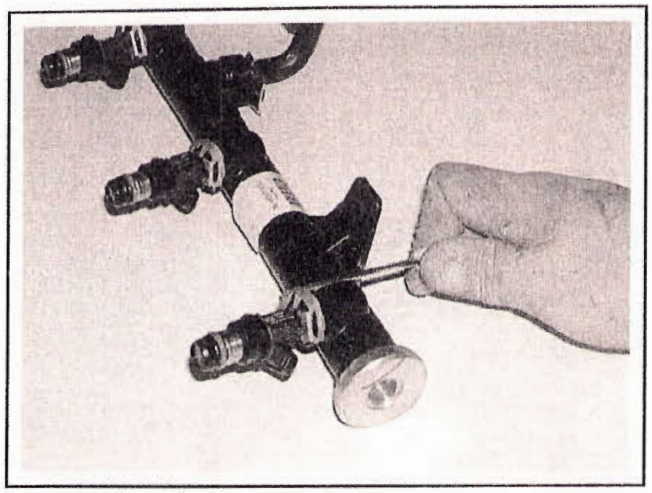
On some models, the injector connectors are equipped with Connector Position Assurance (CPA) clips. Use only your fingers to release these clips, as pliers will damage them.

7 Disconnect the fuel supply and return lines from the fuel rail (see illustration). Disconnect the vacuum line from the fuel pressure regulator.
8 Clean any debris from around the injectors. Remove the fuel rail mounting bolts (see illustration). Loosen (but do not remove) the crossover tube retaining screw at the right (passenger) side fuel rail. Gently rock the fuel rail and injectors to loosen the injectors. Remove the fuel rail and fuel injectors as an assembly.
9 Remove the retaining clip and remove the injector(s) from the fuel rail assembly (see illustrations). Remove and discard the O-rings and seals.

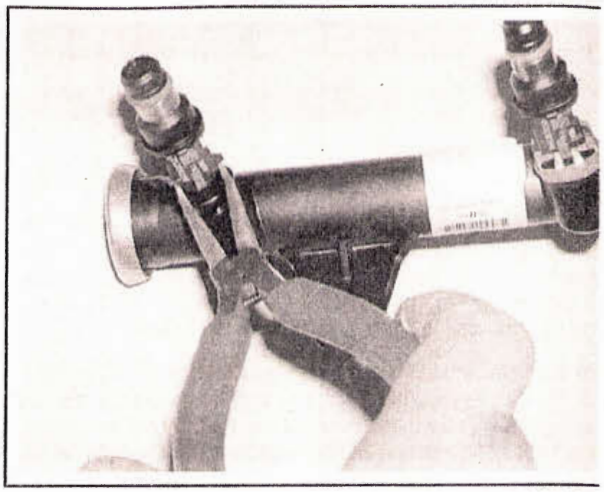
➡Note: Whether you're replacing an injector or a leaking O-ring, it's a good idea to remove all the injectors from the fuel rail and replace all the O-rings (except on VIN Z [E-85 models], since the O-rings aren't available separately).



16.8 Remove the fuel rail mounting bolts (arrows)



16.9a Remove the fuel injector retaining clip . . .



16.9b . . . and pry the injector out the fuel rail with a forked

INSTALLATION

10 Coat the new O-rings with clean engine oil and install them on the injector(s), then insert each injector into its corresponding bore in the fuel rail. Install the injector retaining clip.

11 Install the injector and fuel rail assembly on the intake manifold and fully seat the injectors. Apply thread locking compound to the fuel rail mounting bolts and tighten them to the torque listed in this Chapter's Specifications. Tighten the crossover tube retainer screw at the right fuel rail.

12 Connect the fuel supply and return lines and make sure they' securely installed.

13 Connect the electrical connectors to each injector, referring tc numbered tags.

14 The remainder of installation is the reverse of removal.

15 After the fuel rail/injector assembly installation is complete, t the ignition switch to On, but don't operate the starter (this activates fuel pump for about two seconds, which builds up fuel pressure in fuel lines and the fuel rail). Cycle the ignition On and Off several tin then check the fuel lines, fuel rail and injectors for fuel leakage.

17 Exhaust system servicing - general information

WARNING:

Inspection and repair of exhaust system components should be done only after enough time has elapsed after driving the vehicle to allow the system components to cool completely. Also, when working under the vehicle, make sure it is securely supported on jackstands.

1 The exhaust system consists of the exhaust manifolds, catalytic converters, muffler, resonators, the tailpipe and all connecting pipes, brackets, hangers and clamps. The exhaust system is attached to the body with mounting brackets and rubber hangers. If any of the parts are improperly installed, excessive noise and vibration will be transmitted to the body.

MUFFLER AND PIPES

Refer to illustrations 17.2a and 17.2b

2 Conduct regular inspections of the exhaust system to keep it safe and quiet. Look for any damaged or bent parts, open seams, holes, loose connections, excessive corrosion or other defects which could allow exhaust fumes to enter the vehicle (see illustrations). Also check the catalytic converter when you inspect the exhaust system (see below). Deteriorated exhaust system components should not be repaired; they should be replaced with new parts.

3 If the exhaust system components are extremely corroded or rusted together, welding equipment will probably be required to rem them. The convenient way to accomplish this is to have a muffler re shop remove the corroded sections with a cutting torch. If, however you want to save money by doing it yourself (and you don't have a welding outfit with a cutting torch), simply cut off the old componer with a hacksaw. If you have compressed air, special pneumatic cutti chisels can also be used. If you do decide to tackle the job at home sure to wear safety goggles to protect your eyes from metal chips a work gloves to protect your hands.

4 Here are some simple guidelines to follow when repairing the exhaust system:

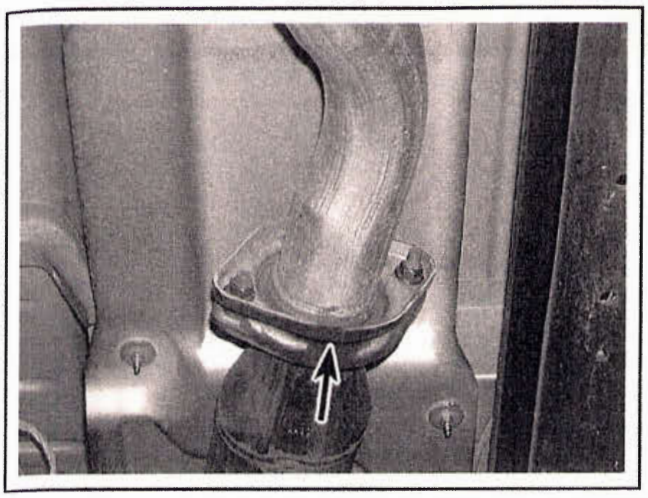
a) Work from the back to the front when removing exhaust syste components.

b) Apply penetrating oil to the exhaust system component faster to make them easier to remove.

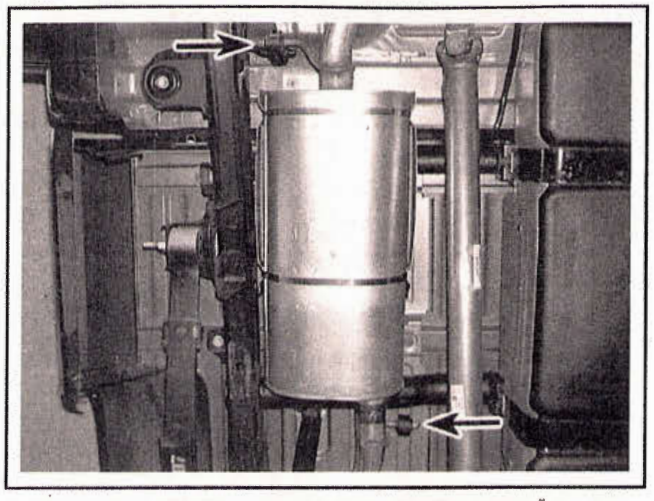
c) Use new gaskets, hangers and clamps when installing exhaus systems components.

d) Apply anti-seize compound to the threads of all exhaust syste fasteners during reassembly.

e) Be sure to allow sufficient clearance between newly installed and all points on the underbody to avoid overheating the floo pan and possibly damaging the interior carpet and insulation. Pay particularly close attention to the catalytic converter and shield.



17.2a Inspect the exhaust system connections for leakage (arrow)



17.2b Inspect the rubber hangers for damage

CATALYTIC CONVERTER

WARNING:

The converter gets very hot during operation. Make sure it has cooled down before you touch it.

➡Note: See Chapter 6 for additional information on the catalytic converter.

5 Periodically inspect the heat shield for cracks, dents and loose or missing fasteners.

6 Inspect the converter for cracks or other damage.

7 If the catalytic converter requires replacement, refer to Chapter 6.

Specifications

Fuel pressure (key ON, engine OFF)	
V6 engines	60 to 66 psi
V8 engines	
VIN Z (E-85 [ethanol, 85-percent])	48 to 54 psi
All others	55 to 62 psi
Fuel injector resistance (approximate)	
V6 engine	not available
V8 engine	
1999 through 2002	11.4 to 12.6 ohms
2003 and later	11 to 14 ohms

Torque specifications

	Ft-lbs (unless otherwise indicated)
Fuel rail mounting bolts (V8 engines)	89 in-lbs
Fuel tank mounting strap bolts	30
Throttle body mounting bolts	
V6 engine	
1999 and 2000	18
2001 and later	80 in-lbs
V8 engine	
1999 through 2002	97 in-lbs
2003 and later	89 in-lbs
Upper intake manifold bolts (V6 engine)	
Step 1	44 in-lbs
Step 2	80 in-lbs