# Chapter 4
# Fuel and exhaust systems

## Contents



## Degrees of difficulty

**Easy,** suitable for novice with little experience 

**Fairly easy,** suitable for beginner with some experience 

**Fairly difficult,** suitable for competent DIY mechanic 

**Difficult,** suitable for experienced DIY mechanic 

**Very difficult,** suitable for expert DIY or professional 

## Specifications

### Fuel system

| | kPa | psi |
|---|---|---|
| Fuel pressure: | | |
| Ignition ON, engine not running | 260 to 300 | 38 to 44 |
| Engine idling: | | |
| Vacuum hose detached from fuel pressure regulator | 280 to 320 | 40 to 46 |
| Vacuum hose attached to fuel pressure regulator | 210 to 260 | 30 to 38 |
| Fuel system hold pressure | 145 | 21 |
| Fuel injector resistance | 2.0 to 3.0 ohms | |
| **Idle speed** | Must be set by authorised service department | |

### Torque wrench settings

| | Nm | lbf ft |
|---|---|---|
| Throttle body mounting bolts | 19 | 14 |
| Fuel rail mounting bolts | 12 | 9 |

## 1 General information

The fuel system consists of a fuel tank, an electric fuel pump either located externally, next to the fuel tank (1988 to 1990 models) or in the fuel tank (1991 to 1994 models), an EFI fuel pump relay and main relay, an inertia switch, fuel injectors and fuel rail, an air cleaner assembly and a throttle body unit.

### *Multi Point Fuel Injection (MPFI) system*

Multi point fuel injection uses timed impulses to sequentially inject the fuel directly into the intake port of each cylinder. The injectors are controlled by the Electronic Control Unit (ECU). The ECU monitors various engine parameters and delivers the exact amount of fuel, in the correct sequence, into the intake ports. The throttle body serves only to control the amount of air passing into the system. Because each cylinder is equipped with an injector mounted immediately adjacent to the intake valve, much better control of the fuel/air mixture ratio is possible.

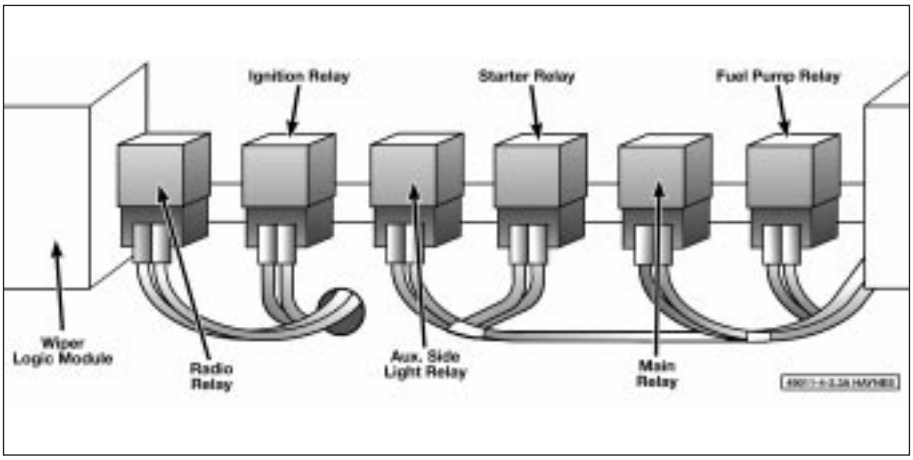
### *Fuel pump and lines*

Fuel is circulated from the fuel tank to the fuel injection system, and back to the fuel tank, through a pair of metal lines running along the underside of the vehicle. On early models (1988 to 1990), an electric fuel pump is attached to the chassis next to the fuel tank. On later models (1991 to 1994), the fuel pump and fuel level sender unit are located inside the fuel tank. A vapour return system routes all vapours and hot fuel back to the fuel tank through a separate return line.

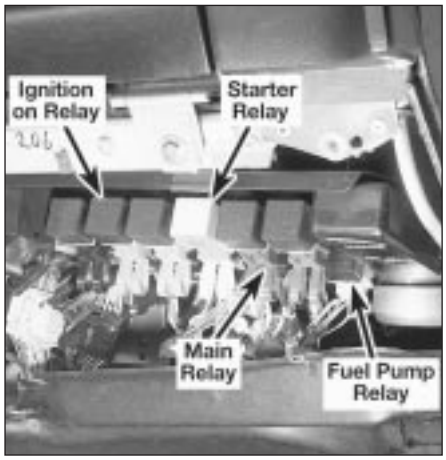
The fuel pump will operate as long as the engine is cranking or running and the ECU is receiving ignition reference pulses from the electronic ignition system (see Chapter 5). If there are no reference pulses, the fuel pump will shut off after 2 or 3 seconds.

### *Inertia switch*

These models are equipped with an inertia switch that is wired in the circuit between the fuel pump relay, the ignition switch and the fuel pump (refer to the wiring diagrams at the end of Chapter 12). The inertia switch is a




**2.3a Relay locations on a 1988 model**




**2.3b Relay locations on a 1989 model**

special electrical device that provides circuit protection by switching off the ignition and fuel pump upon impact in the event of vehicle collision. Later Jaguar models are equipped with an additional specialised inertia switch. This later device switches OFF all ignition fed circuits, locks the fuel filler cap, locks the boot (only if doors are locked) and unlocks the doors if they are locked during the accident. All these functions are directed by the inertia switch. The inertia switch is located behind the left kick panel. Refer to Chapter 12 for more information.

### *Exhaust system*

The exhaust system includes an exhaust manifold equipped with an exhaust oxygen sensor, a catalytic converter, an exhaust pipe, and a silencer.

The catalytic converter is an emission control device added to the exhaust system to reduce pollutants. A single-bed converter is used in combination with a three-way (reduction) catalyst. See Chapter 6 for more information regarding the catalytic converter.

## 2 Fuel pressure relief

***Warning: Petrol 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 natural gas-type appliance (such as a water heater or a clothes dryer) with a pilot light is present. Since petrol 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.***

**1** Before servicing any fuel system component, you must relieve the fuel pressure to minimise the risk of fire or personal injury.

**2** Remove the fuel filler cap - this will relieve any pressure built up in the tank.

**3** Remove the fuel pump relay from the main relay panel **(see illustrations)**. **Note:** *These models are equipped with a fuel pump relay that is located in various areas of the vehicle depending on the year. On 1988 and 1989 models, the fuel pump relay is under the glovebox. On 1990 to 1992 models, the fuel pump relay is in the engine compartment on the left side, attached to the brake pedal hanger. On 1993 models, the fuel pump relay is in the boot. On 1994 models, it's in the engine compartment on the right side of the bulkhead. Refer to the relay location charts in Chapter 12 for additional information.*

**4** Start the engine and wait for the engine to stall, then turn the ignition key to Off. Disconnect the cable from the negative terminal of the battery before beginning any work on the fuel system.

***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

**5** The fuel system is now depressurised.

**Note:** *Place a rag around the fuel line before removing any hose clamp or fitting to prevent any residual fuel from spilling onto the engine.*

**2.3c On 1992 models, the fuel pump relay is located in the left rear corner of the engine compartment**

## 3 Fuel pump/fuel pressure - check

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

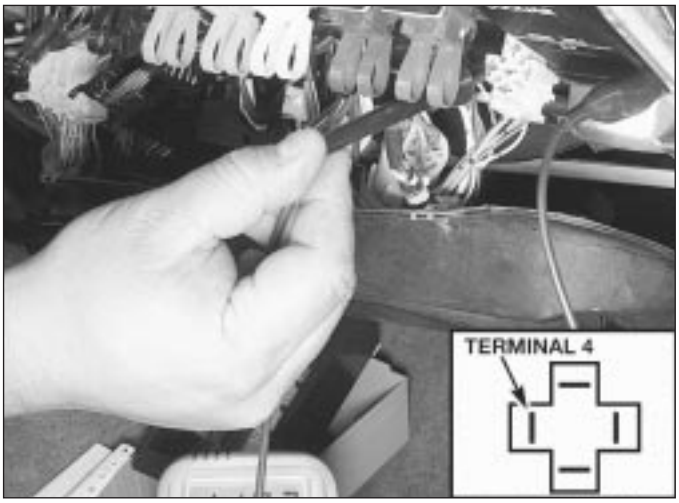
**Note:** *To perform the fuel pressure test, you will need to obtain a fuel pressure gauge and adapter set (fuel line fittings).*

**Note:** *On 1988 to 1990 models, the fuel pump may chatter excessively and the engine may stall frequently during hot weather. If stalling occurs, the engine will restart after a cool-down period. Dual fuel pumps can be installed by a dealer service department or other qualified repair facility to remedy this problem.*

### *Preliminary inspection*

**1** Should the fuel system fail to deliver the proper amount of fuel, or any fuel at all, inspect it as follows. Remove the fuel filler cap. Have an assistant turn the ignition key to the ON position (engine not running) while you listen at the fuel filler opening. You should hear a whirring sound that lasts for a couple of seconds. On 1988 to 1990 models, listen behind the left rear wheel (external fuel pump) for the fuel pump sound.

**2** If you don't hear anything, check the fuel pump relay **(see illustration 2.3a, b or c)** and




**3.3a Checking for battery voltage at the fuel pump relay connector ( 1989 model)**

**3.3b Checking for battery voltage to the main relay (1989 model)**

circuit. If all circuits are intact and not damaged, check the inertia switch. **Note:** *The inertia switch is a special device that shuts down power to the ignition and the fuel pump in the event of an accident. See Chapter 12 for checking and resetting procedures for the inertia switch.*

**3** Remove the relay and check for battery voltage to the fuel pump relay connector **(see illustration)**. If there is battery voltage present, check the relay for proper operation. Refer to the relay checking procedure in Chapter 12. **Note:** *If battery voltage is not available, check for battery voltage to the main relay* **(see illustration)***. Refer to the relay location diagrams in Chapter 12. The main relay, which is located next to the fuel pump relay, supplies voltage to the fuel pump and ignition system.*

**4** If battery voltage is present, check for battery voltage directly at the fuel pump electrical connector **(see illustrations)**, within two seconds of the ignition key being turned On. If there is no voltage, check the fuel pump circuit. If there is voltage present, renew the pump (see Section 4). **Note:** *It will be necessary to raise the vehicle and support it securely on axle stands to gain access to the fuel pump electrical connectors. Have an assistant operate the ignition key and be sure to block the front wheels to avoid any movement of the vehicle.*

## Operating pressure check

**5** Relieve the fuel system pressure (see Section 2). Detach the cable from the negative battery terminal.

***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

**6** Detach the fuel line from the fuel rail and connect a fuel pressure gauge **(see illustrations)** between the fuel pulsation damper and the fuel rail. Tighten the hose clamps securely.

**7** Attach the cable to the negative battery terminal. Start the engine.

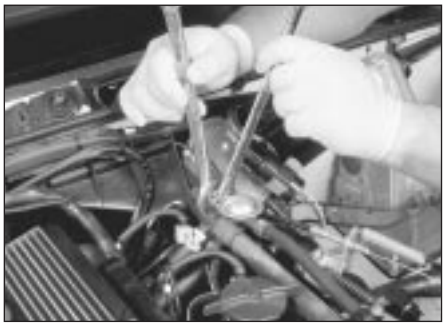
**8** Note the fuel pressure and compare it with the pressure listed in this Chapter's Specifications.

**9** Disconnect the vacuum hose from the fuel pressure regulator and hook up a hand-held vacuum pump **(see illustration)** to the port on the fuel pressure regulator.

**10** Read the fuel pressure gauge with vacuum applied to the pressure regulator and also with no vacuum applied. The fuel pressure should decrease as vacuum increases (and increase as vacuum decreases).

**3.4a Remove the rubber boot from the fuel pump electrical connector and check for voltage while an assistant turns the ignition key (1989 model shown)**

**3.4b Check for battery voltage to the fuel pump on the harness connector near the fuel tank on models with in-tank fuel pumps**



**3.6a Remove the fuel line from the fuel pulsation damper . . .**

**3.6b . . . then refit the fuel pressure gauge between the fuel rail and the fuel pressure damper using a T-fitting**

**3.9 Check fuel pressure without vacuum applied to the fuel pressure regulator, then with vacuum applied; fuel pressure should DECREASE as vacuum INCREASES**

**3.12 Using a pair of pliers, squeeze the return line and observe the fuel pressure increase (wrap a rag around the fuel line so you don't damage it)**

**11** Reconnect the vacuum hose to the regulator and check the fuel pressure at idle, comparing your reading with the value listed in this Chapter's Specifications. Disconnect the vacuum hose and watch the gauge - the pressure should jump up considerably as soon as the hose is disconnected. If it doesn't, check for a vacuum signal to the fuel pressure regulator (see Step 14).

**12** If the fuel pressure is low, pinch the fuel return line shut **(see illustration)** and watch the gauge. If the pressure doesn't rise, the fuel pump is defective or there is a restriction or leak in the fuel feed line, or the pump is faulty. If the pressure rises sharply, renew the pressure regulator.

**13** If the fuel pressure is too high, turn the engine off. Disconnect the fuel return line and blow through it to check for a blockage. If there is no blockage, renew the fuel pressure regulator.

**14** Connect a vacuum gauge to the pressure regulator vacuum hose. Start the engine and check for vacuum **(see illustration)**. The fuel pressure regulator receives manifold vacuum that decreases (increases fuel pressure) when the engine speed is raised (acceleration). If there isn't vacuum present, check for a clogged hose or vacuum port. If the amount of vacuum is adequate but the pressure is too high, renew the fuel pressure regulator.

**15** Turn the ignition switch to OFF, wait five minutes and recheck the pressure on the gauge. Compare the reading with the specified hold pressure. If the hold pressure is less than specified:

*a) The fuel lines may be leaking.*
*b) The fuel pressure regulator may be allowing the fuel pressure to bleed through to the return line.*
*c) A fuel injector (or injectors) may be leaking.*
*d) The fuel pump may be defective.*

**3.14 Connect a vacuum gauge to the vacuum line leading to the fuel pressure regulator and check the vacuum source**

## 4 Fuel pump - removal and refitting

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

**Note 1:** *On early models (1988 to 1990), an electric fuel pump is attached to the chassis next to the fuel tank. On later models (1991 to 1994), the fuel pump is inside the fuel tank.*

**Note 2:** *On 1988 to 1990 models, the fuel pump may chatter excessively and the engine may stall frequently during hot weather. If stalling occurs, the engine will restart after a cool-down period. Dual fuel pumps can be installed by a dealer service department or other qualified repair facility to remedy this problem.*

**1** Remove the fuel tank filler cap to relieve any pressure in the fuel tank. Relieve the fuel pressure (see Section 2).

**2** Disconnect the cable from the negative terminal of the battery.

***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

### *External fuel pumps*

**3** Raise the vehicle and support it securely on axle stands.

**4** Disconnect the fuel lines from the fuel pump.

**5** Disconnect the electrical connectors from the fuel pump **(see illustration 3.4a)**.

**6** Remove the fuel pump bracket retaining nuts **(see illustration)**.

**7** Carefully withdraw the fuel pump from the rubber case inside the fuel pump bracket and angle the fuel pump over the rear suspension and out near the wheel on the left side of the vehicle.

**8** Refitting is the reverse of removal.

### *In-tank fuel pumps*

**9** Raise the vehicle and support it securely on axle stands.

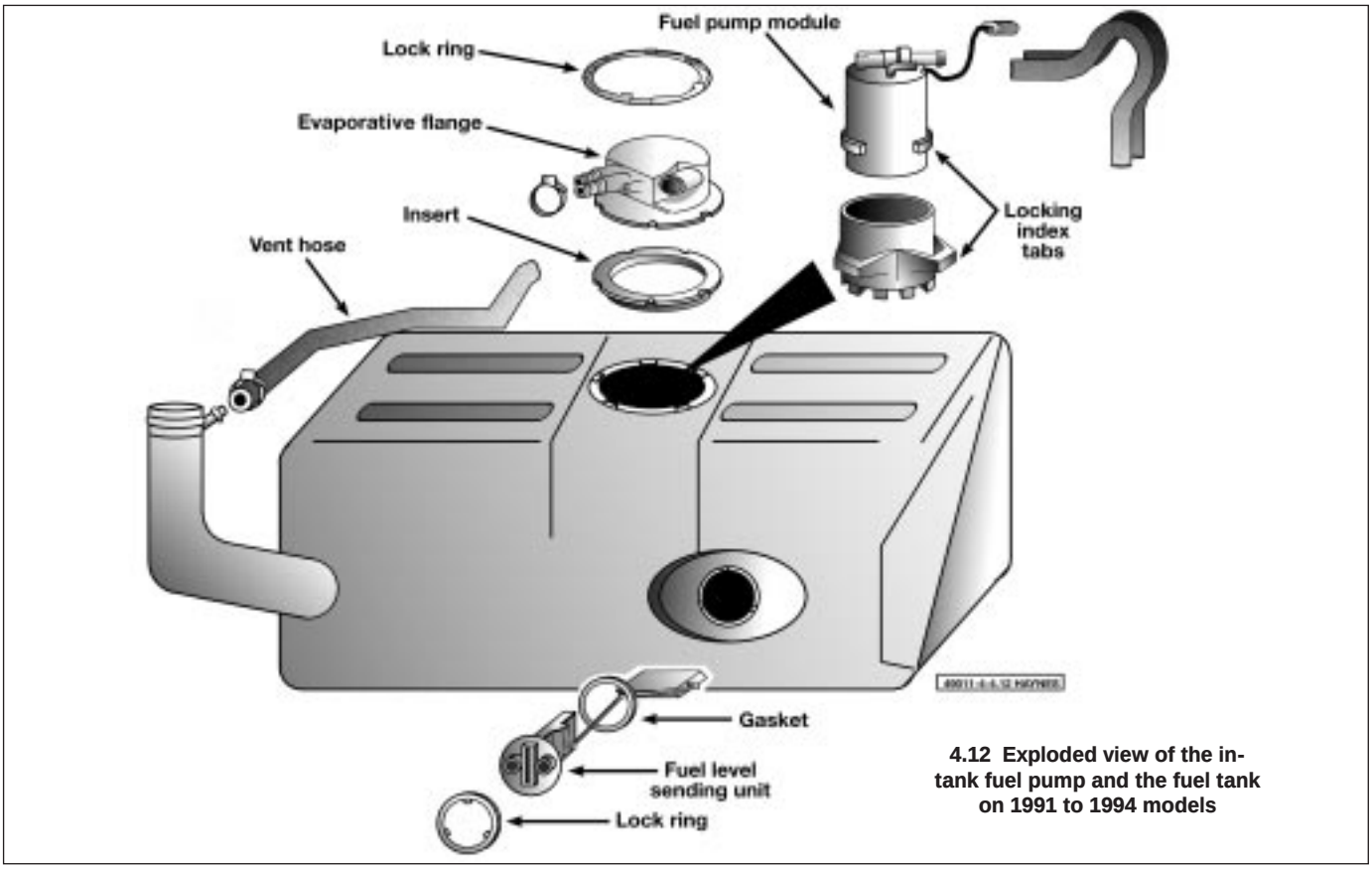
**10** Disconnect the fuel pump and fuel level sender unit electrical connectors and the fuel lines.

**11** Remove the fuel tank from the boot (see Section 7).

**12** Disconnect the fuel lines from the evaporative flange **(see illustration)**. Remove the lock ring with a hammer and brass punch, tapping the lock ring anti-clockwise.

**13** Withdraw the fuel pump module from the fuel tank. **Note:** *The fuel pump module is*

**4.6 Remove the fuel pump mounting nuts (arrowed) and slide the fuel pump out of the rubber casing (1989 model shown)**




**4.12 Exploded view of the in-tank fuel pump and the fuel tank on 1991 to 1994 models**

*indexed near the bottom, therefore it will be necessary to turn the module slightly to unlock it from the rubber holder mounted on the bottom of the fuel tank.*

**14** Renew the fuel pump module as a single unit.

**15** Refitting is the reverse of removal.

## 5 Fuel level sender unit - check and renewal

***Warning: Petrol is highly flammable, so take precautions when you work on any part of the fuel system. See the Warning in Section 2.***

**Note:** *Some 1994 models may be equipped with faulty fuel level sender units. A tight float rod bushing may cause the float to stick and indicate high fuel levels while the tank is almost empty.*

### Check

**1** Before performing any tests on the fuel level sender unit, completely fill the tank with fuel.

**2** Remove the boot liner (see Chapter 12) to expose the fuel level sender unit access cover.

**3** Disconnect the fuel level sender unit electrical connector located on the access cover. **Note:** *1991 to 1994 models are equipped with a fuel pump module and a sender unit assembly while 1988 and 1989 models are equipped with only the fuel level sender unit inside the tank.*

**4** Position the ohmmeter probes on the electrical connector terminals **(see illustration)** and check for resistance. Use the 200 ohm scale on the ohmmeter.

**5** With the fuel tank completely full, the resistance should be about 18 to 20 ohms.

**6** Reconnect the electrical connector and drive it until the tank is nearly empty.

**7** Check the resistance. The resistance of the sender unit should be about 190 to 200 ohms.


**5.4 Connect the probes of the ohmmeter to the fuel level sender unit terminals and check the resistance of the float assembly**

**8** If the readings are incorrect, renew the sender unit. **Note:** *The test can also be performed with the fuel level sender unit removed from the fuel tank. Using an ohmmeter, check the resistance of the sender unit with the swing arm completely down (tank empty) and with the arm up (tank full)* **(see illustration)**. *The resistance should change steadily from 200 ohms to around 18 ohms.*

### Renewal

***Warning: The fuel level in the tank must be less than half full to safely remove the fuel pump/sender unit assembly from the fuel***


**5.8 An accurate check of the sender unit can be made by removing it from the fuel tank and observing the resistance with the float down (empty) and then extended (full)**

**5.10 Use a brass punch and remove the lock ring by tapping on it in an anti-clockwise direction**

**5.11 Lift the fuel level sender unit assembly from the fuel tank at an angle so as not to damage the float or arm**

***tank. If there is any doubt about the amount of fuel in the tank, drain the fuel tank completely before attempting this procedure (Section 7, paragraph 1).***

**9** Disconnect the cable from the negative terminal of the battery. Disconnect the fuel level sender unit/fuel pump electrical connector.

***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

**10** Using a brass punch, tap on the lock ring anti-clockwise **(see illustration)** until the tabs align with the indentations in the fuel tank.

**11** Carefully angle the sender unit out of the opening without damaging the fuel level float **(see illustration)**.

**12** Refitting is the reverse of removal.

## 6 Fuel lines and fittings - inspection and renewal

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

**Note:** *If there is a distinct knocking noise coming from the dash when the engine is idling, the fuel feed hose may have hardened, restricting fuel flow and causing abnormal sounds. Replace the fuel inlet (feed) hose with a new one.*

### Inspection

**1** Once in a while, you will have to raise the vehicle to service or renew some component (an exhaust pipe hanger, for example). Whenever you work under the vehicle, always inspect fuel lines and all fittings and connections for damage or deterioration.

**2** Check all hoses and pipes for cracks, kinks, deformation or obstructions.

**3** Make sure all hoses and pipe clips attach their associated hoses or pipes securely to the underside of the vehicle.

**4** Verify all hose clamps attaching rubber hoses to metal fuel lines or pipes are a tight fit between the hoses and pipes.

### Renewal

**5** If you must renew any damaged sections, use hoses or pipes constructed from exactly the same material as the section you are replacing. Do not refit substitutes constructed from inferior or inappropriate material or you could cause a fuel leak or a fire.

**6** Always, before detaching or disassembling any part of the fuel line system, note the routing of all hoses and pipes and the orientation of all clamps and clips to assure that new sections are identically installed.

**7** Before detaching any part of the fuel system, be sure to relieve the pressure in the tank by removing the fuel tank cap, then relieve the fuel system pressure (Section 2). Cover the fitting being disconnected with a rag to absorb any fuel that may leak out.

## 7 Fuel tank - removal and refitting

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

**1** This procedure is much easier to perform if the fuel tank is empty. Some models may have a drain plug for this purpose. If for some reason the drain plug can't be removed, postpone the job until the tank is empty or siphon the fuel into an approved container using a siphoning kit (available at most motor factors).

***Warning: Do not start the siphoning action by mouth!***

**2** Remove the fuel filler cap to relieve fuel tank pressure.

**3** Detach the battery negative cable.

***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

**4** If the tank is full or nearly full, drain the fuel into an approved container.

**5** Raise the vehicle and place it securely on axle stands.

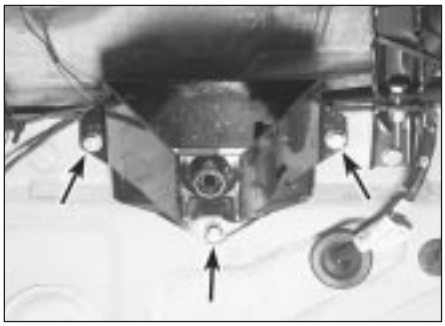
**6** Remove the filler neck vent tube clamp **(see illustration)** and separate the tube from the fuel filler neck.

**7** Remove the fuel filler assembly bolts **(see illustration)** and slide the large rubber boot down the neck of the fuel tank. **Note:** *These vehicles are susceptible to clogging of the fuel overflow line. If this happens, excess fuel or*

**7.6 Remove the clamp that retains the fuel filler assembly to the filler neck**

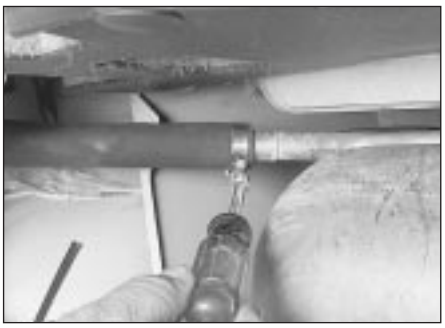
**7.7a Remove bolts (arrowed) that retain the fuel filler assembly to the body and slide the assembly down the filler neck of fuel tank**

**7.7b Direct low pressure compressed air into the hole for the overflow line if clogged**



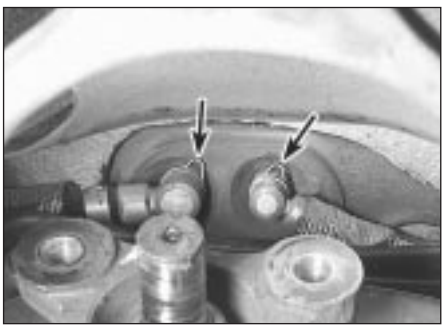
**7.8 Remove the bolts (arrowed) from the spare tyre bracket and lift out the assembly**

**7.9a Disconnect the flexible fuel lines from the metal fuel lines**

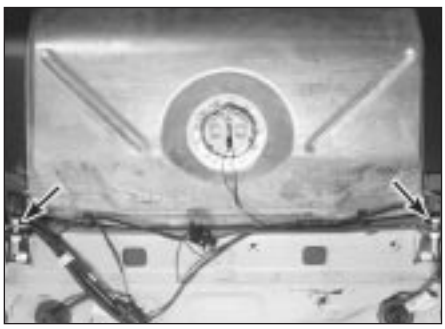


**7.9b Disconnect the vapour return line from the fuel tank**

**7.9c Disconnect the canister purge line from the fuel tank**



**7.9d Remove the clips (arrowed) that retain the fuel lines to the fuel tank using needle-nose pliers**



**7.10 Remove the tank strap bolts (arrowed) from the body**

*water in the fuel filler cap recess could flow into the boot, causing a dangerous condition and/or an unpleasant mess. To correct this condition, direct low-pressure compressed air into the overflow hole* **(see illustration)***, which should be enough to clear any obstruction in the line.*

**8** Remove the spare tyre and the spare tyre bracket assembly **(see illustration)**.

**9** Disconnect the fuel lines, the vapour return line and the canister vent line **(see illustrations)**. **Note:** *Be sure to plug the hoses to prevent leakage and contamination of the fuel system.* Remove the driveline to gain access to the fuel line connectors next to the tank (see Chapter 8). Working under the vehicle, remove the pins using a needle-nose pliers, turn the connectors slightly to loosen them from the grommets and pull the fuel lines out of the tank.

**10** Remove the retaining bolts from the fuel tank retaining straps **(see illustration)**.

**11** Pull the fuel tank out into the boot area.

Be careful to angle the fuel filler neck away from the body.

**12** Remove the tank from the vehicle.

**13** Refitting is the reverse of removal.

## 8 Fuel tank cleaning and repair - general information

**1** Any repairs to the fuel tank or filler neck should be carried out by a professional who has experience in this critical and potentially dangerous work. Even after cleaning and flushing of the fuel system, explosive fumes can remain and ignite during repair of the tank.

**2** 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 garages where a natural petrol-type appliance is located, because the pilot light could cause an explosion.

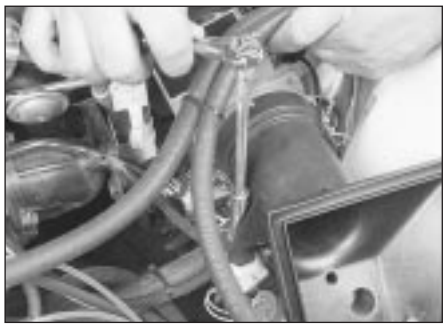
## 9 Air cleaner assembly - removal and refitting

**1** Detach the clips and remove the air filter cover and the filter element (see Chapter 1).

**2** Remove the bolts and remove the air cleaner assembly from the engine compartment **(see illustrations).**

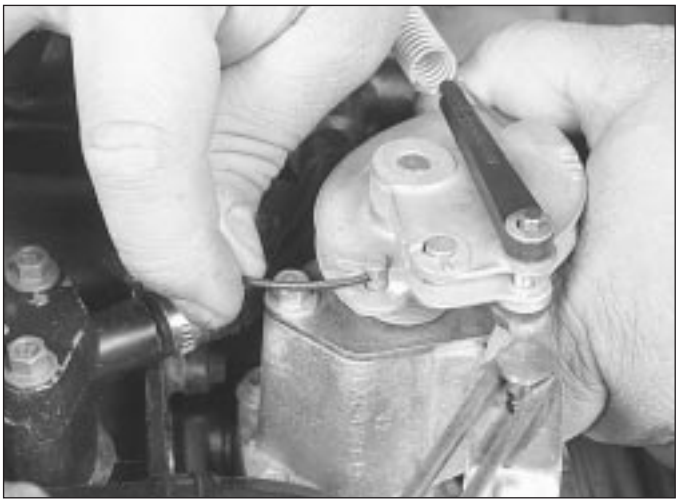
**3** Refitting is the reverse of removal.

**9.2a Remove the bolts (arrowed) from the air cleaner assembly**



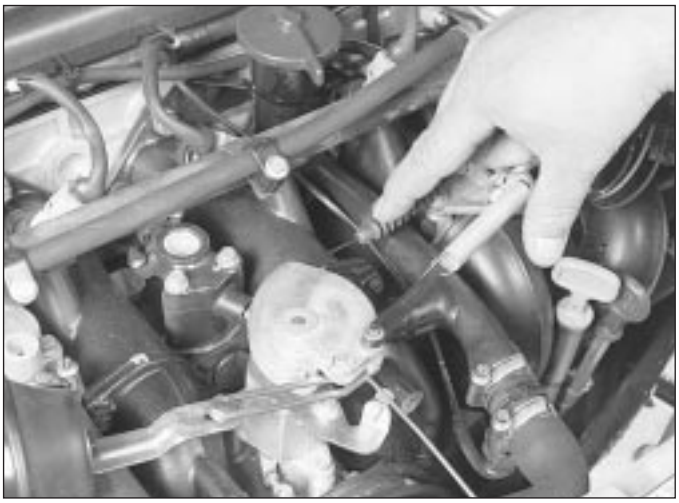
**9.2b Also, remove the bolt that retains the air intake duct to the MAF sensor and lift the assembly from the compartment**

**10.2 Loosen the locknuts on the accelerator cable**



**10.3 Rotate the bellcrank and remove the cable end from the slot**

**10.4 Remove circlip (arrowed) and separate cable from the accelerator pedal by pulling the pin from the pedal assembly**



**10.9 Make sure the throttle closes completely and there is a slight amount of flex in the cable**

## 10 Accelerator cable - removal, refitting and adjustment

### *Removal*

**1** Detach the cable from the negative terminal of the battery.

***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

**2** Loosen the locknut on the threaded portion of the throttle cable at the throttle body **(see illustration).**

**3** Rotate the throttle lever, then slip the throttle cable end out of the slot in the lever **(see illustration)**.

**4** Detach the throttle cable from the accelerator pedal **(see illustration)**.

**5** From inside the vehicle, pull the cable through the bulkhead.

### *Refitting and adjustment*

**6** Refitting is the reverse of removal.

**7** To adjust the cable, fully depress the accelerator pedal and check that the throttle is fully opened.

**8** If not fully opened, loosen the locknuts, depress accelerator pedal and adjust the cable until the throttle is fully open.

**9** Tighten the locknuts and recheck the adjustment. Make sure the throttle closes fully when the pedal is released **(see illustration)**.

**10** After the cable is adjusted, check the adjustment of the bellcrank. Use a small clamp and a straight rod or stiff wire (coat hanger) and attach it to the brake master cylinder in such a way that the tip acts as a pointer. Align the pointer with “A” (automatic transmission) or “M” (manual transmission) on the bellcrank **(see illustration)**,depending on what type of transmission is installed in the vehicle.

**11** Slowly rotate the bellcrank until it reaches the throttle stop (wide open throttle) and check to make sure the pointer aligns with the notch in the bellcrank **(see illustration)**.

**12** If necessary, adjust the position of the throttle stop using a spanner and turn the throttle stop screw until the bellcrank reaches the correct position. Lock the throttle stop screw in place.

**10.10 Attach a strong wire (coat hanger) to the master cylinder using a clamp and align it with the notch on the bellcrank**

**10.11 Rotate the bellcrank until it reaches wide open throttle and make sure the pointer aligns with the A on the bellcrank. Adjust if necessary**

**13** Allow the bellcrank to return to the idle position and test the adjustment once again until the correct adjustment has been attained.

## 11 Electronic Fuel Injection (EFI) system - general information

**1** These models are equipped with an Electronic Fuel Injection (EFI) system. This fuel injection system is designed by Bosch but licensed by Lucas and is called the Lucas LH Engine Management system. The EFI system is composed of three basic sub systems: fuel system, air induction system and electronic control system **(see illustration)**.

### *Fuel system*

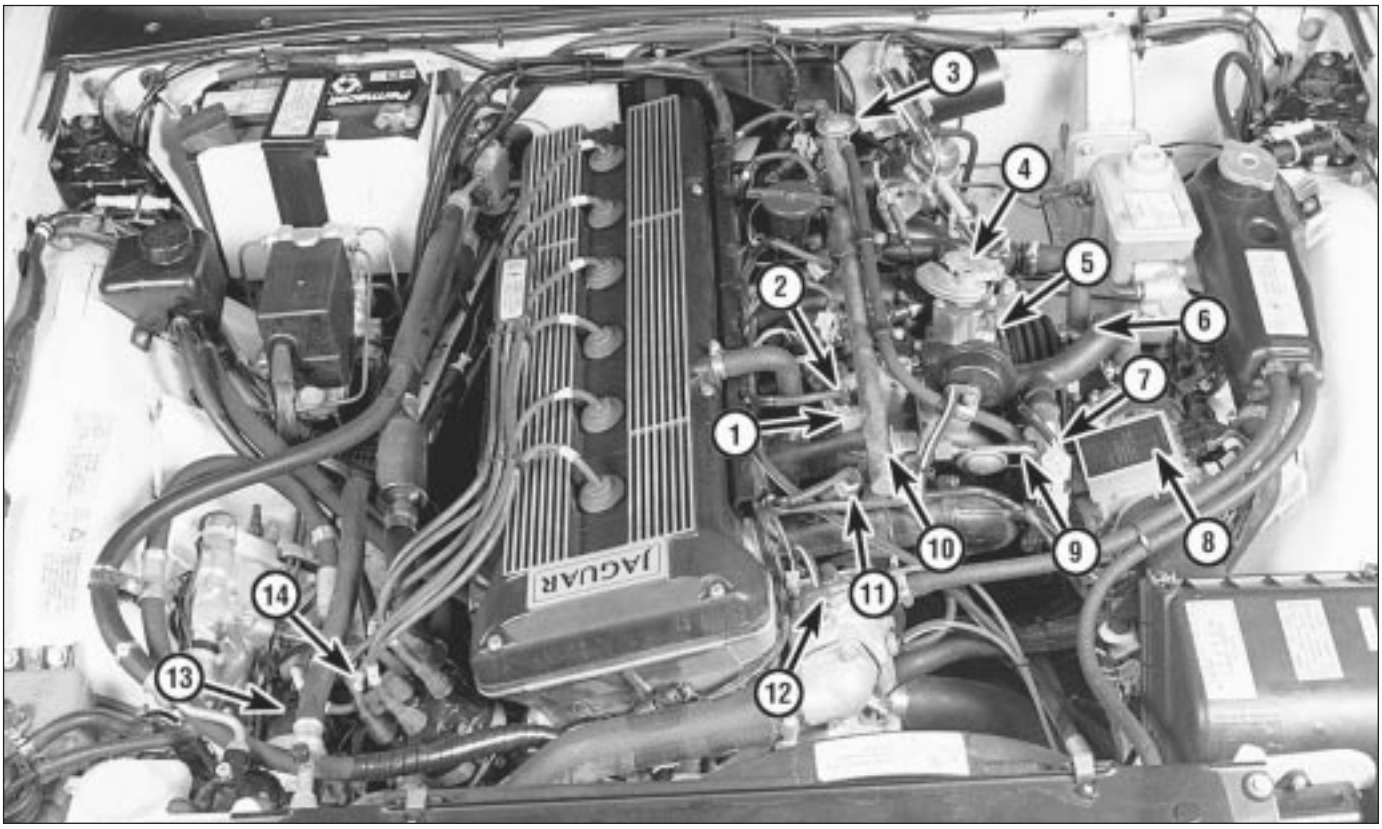
**2** An electric fuel pump is located on the chassis of the rear suspension (external) (1988 to 1990) or inside the fuel tank (1991 to 1994) The fuel pump supplies fuel under constant pressure to the fuel rail, which distributes fuel evenly to all injectors. From the fuel rail, fuel is injected into the intake ports, just above the intake valves, by fuel injectors. The amount of fuel supplied by the injectors is precisely controlled by an Electronic Control Unit (ECU). A pressure regulator controls system pressure in relation to intake manifold vacuum. A fuel filter between the fuel pump and the fuel rail filters fuel to protect the components of the system.

### *Air induction system*

**3** The air system consists of an air filter housing, a Mass Air Flow (MAF) sensor (airflow meter), Intake Air Temperature (IAT) sensor and a throttle body. The MAF sensor is an information gathering device for the ECU. A heated element determines the temperature differential by measuring the current changes which in turn measures the mass (weight and volume) of air entering the engine. This information helps the ECU determine the amount of fuel to be injected by the injectors. The throttle plate inside the throttle body is controlled by the driver. As the throttle plate opens, the amount of air that can pass through the system increases, so the potentiometer opens further and the ECU signals the injectors to increase the amount of fuel delivered to the intake ports. Refer to Chapter 6 for additional information on the fuel injection system sensors, test procedures and renewal procedures.

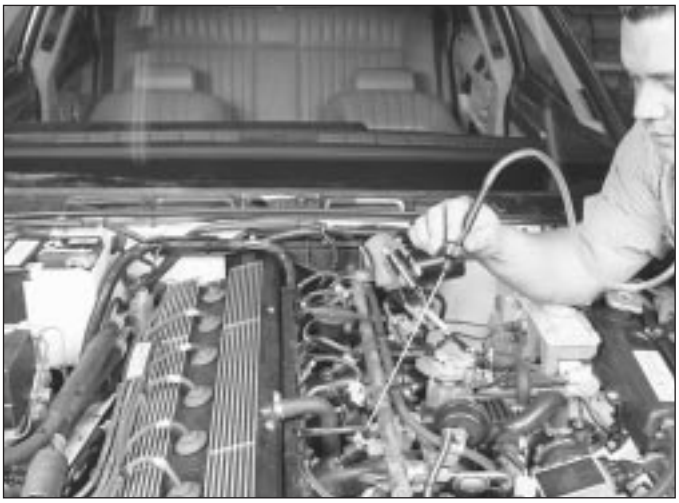
### *Electronic control system*

**4** The Computer Control System controls the EFI and other systems by means of an Electronic Control Unit (ECU), which employs a microcomputer. The ECU receives signals from a number of information sensors which monitor such variables as intake air volume, intake air temperature, coolant temperature, engine rpm, acceleration/deceleration and exhaust oxygen content. These signals help the ECU determine the injection duration necessary for the optimum air/fuel ratio. Some

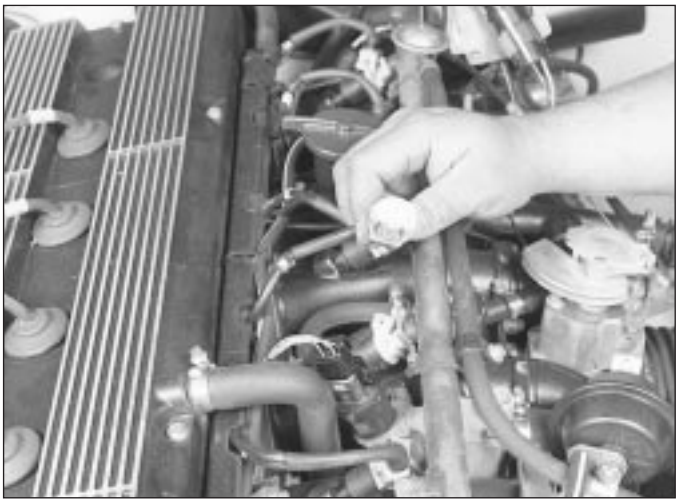



**11.1 Fuel injection and emission control component locations for the 3.6 litre 1989 XJ6**

*1 Fuel pressure regulator (under fuel rail)*
*2 Idle Speed Control (ISC) motor*
*3 Fuel pressure damper*
*4 Bellcrank*
*5 Throttle body (below bellcrank)*
*6 Intake Air Temp. (IAT) sensor*
*7 Supplementary air valve*
*8 Mass Airflow (MAF) sensor*
*9 Throttle potentiometer (under throttle body)*
*10 Fuel rail*
*11 Fuel injector*
*13 Ignition amplifier (below block valve)*
*14 Distributor*



**12.7 Use a stethoscope or a screwdriver to determine if the injectors are working properly - they should make a steady clicking sound that rises and falls with engine speed changes**



**12.8 Refit the "noid" light into the fuel injector electrical connector and check to see that it blinks with the engine running**

of these sensors and their corresponding ECU-controlled relays are not contained within EFI components, but are located throughout the engine compartment. For further information regarding the ECU and its relationship to the engine electrical and ignition system, see Chapter 6.

## 12 Electronic Fuel Injection (EFI) system - check

**1** Check the earth wire connections for tightness. Check all wiring and electrical connectors that are related to the system. Loose electrical 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** If a blown fuse is found, renew it and see if it blows again. If it does, search for a shorted wire in the harness related to the system.
**5** Check the air intake duct from the MAF sensor to the intake manifold for leaks, which will result in an excessively lean mixture. Also check the condition of the vacuum hoses connected to the intake manifold.
**6** Remove the air intake duct from the throttle body and check for carbon and residue build-up. If it's dirty, clean with aerosol carburettor cleaner (make sure the can says it's safe for use with oxygen sensors and catalytic converters) and a toothbrush.
**7** With the engine running, place a stethoscope against each injector, one at a time, and listen for a clicking sound, indicating operation **(see illustration)**.
**8** If there is a problem with an injector, purchase a special injector test light (noid light) and refit it into the injector electrical connector (see illustration). Start the engine and make sure that each injector connector flashes the noid light. This will test for the proper voltage signal to the injector. ***Caution: If the engine will not start and the noid light indicates that each injector is receiving the proper signal, there is a good possibility that the injector(s) is stuck open and allowing fuel into the combustion chamber in excessive amounts***. If the spark plugs are fouled, detach the primary (low voltage) wires from the ignition coil, disable the fuel pump by removing the fuel pump relay (see Section 2), remove the spark plugs and crank the engine over. If fuel sprays from the spark plug holes, the engine is flooded and the fuel must be removed from the combustion chambers.
**9** With the engine OFF and the fuel injector electrical connectors disconnected, measure the resistance of each injector **(see illustration)**. Each injector should measure about 2.0 to 3.0 ohms. If not, the injector is probably faulty.

**12.9 Using an ohmmeter, measure the resistance across both terminals of the injector**

**10** The remainder of the system checks should be left to a Jaguar service department or other qualified repair workshop, as there is a chance that the control unit may be damaged if not performed properly.

## 13 Electronic Fuel Injection (EFI) system - component check and renewal

***Warning: Petrol is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the Warning in Section 2.***
***Caution: If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.***

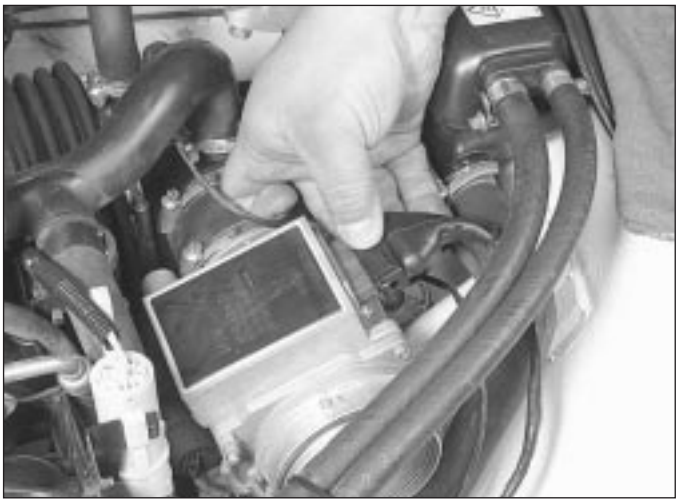
### *Throttle body*

#### Check

**1** Verify that the throttle linkage operates smoothly.
**2** Start the engine, detach each vacuum hose and, using your finger, check the vacuum at each port on the throttle body with the engine at idle and above idle. The vacuum available from the throttle body is ported. Raise the engine rpm and watch as vacuum increases. It may be necessary to use a vacuum gauge. Refer to Chapter 2B for additional information concerning vacuum checks.

#### Renewal

***Warning: Wait until the engine is completely cool before beginning this procedure.***
**3** Detach the cable from the negative terminal of the battery *(see the* **Caution** *at the beginning of this Section)*.
**4** Drain the radiator (see Chapter 1).



**13.7 Push up on the clip and remove the harness connector from the MAF sensor**

**13.8 Remove the air intake duct clamp from the MAF sensor housing**

**5** Remove the air cleaner (see Chapter 1) and the air cleaner housing (see Section 9).
**6** Remove the air intake duct.
**7** Detach the electrical connector from the MAF sensor **(see illustration)**.
**8** Remove the clamp that retains the MAF sensor to the air intake duct **(see illustration)** and lift the MAF sensor assembly from the engine compartment.
**9** Detach the throttle cable from the bellcrank (see Section 10), then remove the bellcrank assembly from the throttle body **(see illustration)**.
**10** Detach the kickdown cable from the bellcrank and set the cable and brackets aside (see Chapter 7).
**11** Clearly label, then detach, all vacuum and coolant hoses from the throttle body.
**12** Disconnect the electrical connector from the throttle potentiometer.
**13** Remove the four throttle body mounting bolts and detach the throttle body from the intake manifold.
**14** Using a soft brush and carburettor cleaner, thoroughly clean the throttle body casting, then blow out all passages with compressed air.
***Caution: Do not clean the throttle position sensor with any solvents or sprays. Just wipe it off with a clean, soft cloth.***
**15** Refitting of the throttle body is the reverse of removal.
**16** Be sure to tighten the throttle body mounting bolts to the torque listed in this Chapter's Specifications.

### Adjustment

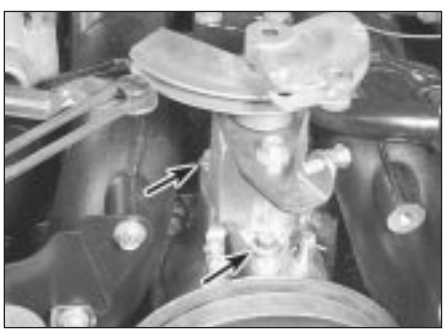
**17** Remove the air intake duct to expose the throttle body and butterfly valve.
**18** Make sure the throttle body is clean and free of burrs, nicks or carbon build-up **(see illustration)**.
**19** Measure the clearance between the butterfly valve (throttle plate) and the wall of the throttle body **(see illustration)**. It should be 0.05 mm (0.002 inch).
**20** If the gap is incorrect, loosen the throttle stop locknut **(see illustration)** and turn the throttle stop screw until the correct clearance is attained.
**21** Refit the air intake duct and surrounding components.

## *Idle Speed Control (ISC) motor*

**Note:** *The minimum idle speed is pre-set at the factory and should not require adjustment under normal operating conditions; however if the throttle body has been replaced or you suspect the minimum idle speed has been tampered with (for example, if the idle speed screw was removed from the throttle body) have the vehicle checked by a dealer service department or a qualified automotive repair workshop.*

### Check

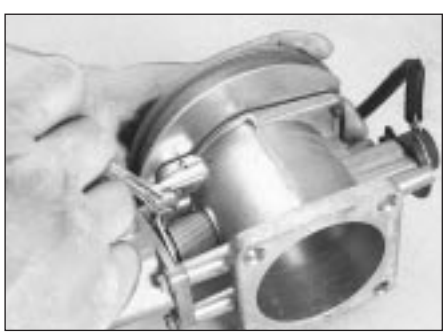
**22** Start the engine and allow it to reach normal operating temperature. Switch on the



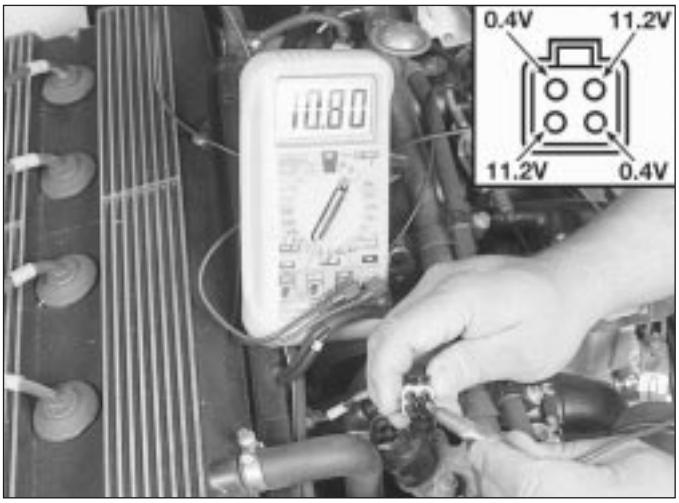
**13.9 Remove the bellcrank assembly bolts (arrowed) and separate it from the throttle body**

**13.18 The area inside the throttle body near the throttle plate suffers from sludge build-up because the PCV hose vents crankcase vapour into the intake duct**

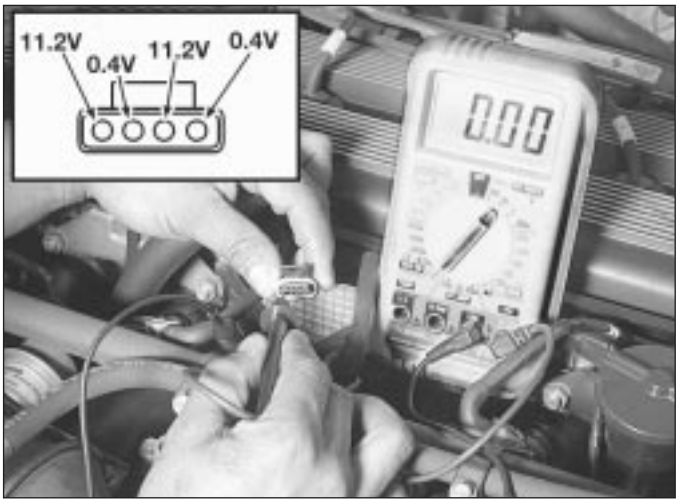
**13.19 Measure clearance between the butterfly valve and the throttle body**



**13.20 Adjust the butterfly angle by loosening the locknut on the throttle stop and turning the adjustment bolt**




**13.23a To check the ISC motor, turn the ignition key ON (engine not running) and check for the proper voltage amounts at the harness connector (1989 model shown)**




**13.23b Later models are equipped with a different shape ISC connector but the voltage values should be the same as the early style**

headlights or heated rear window and confirm that the engine rpm decreases at first and then increases. This check monitors the ISC motor as it is signalled by the computer to increase idle speed due to additional amperage required from the charging system. As the headlights draw current from the charging system, the alternator will create resistance on the belt as it works to produce the additional energy. If the rpm does not increase, check the ISC motor.

**23** Check for approximately 11.2 volts to the ISC stepper motor **(see illustrations).** Disconnect the ISC harness connector and working on the harness side, check for 11.2 volts with the ignition key ON (engine not running). Also, check the corresponding terminals for the correct voltage amounts. If the correct voltage does not exist, check the wiring harness. Refer to the wiring diagrams at the end of Chapter 12.

**24** The ISC motor or stepper motor can be checked for correct operation but a special tool is required to activate the internal coils. Have the stepper motor checked by a dealer service department or other qualified repair workshop.

**25** Reconnect the ISC motor electrical connector.

### Renewal

**26** Detach the cable from the negative terminal of the battery *(see* **Caution** *at the beginning of this Section)*.

**27** Use a large open-end spanner and unscrew the ISC motor from the housing **(see illustration)**.

**28** Refitting is the reverse of removal, but be sure to use a new gasket.

## *Fuel rail and fuel injectors*

**Note:** *If there is a distinct knocking noise coming from the dash when the engine is idling, the fuel feed hose may have hardened restricting fuel flow and causing abnormal sounds. Replace the fuel inlet (feed) hose with a new part from the dealer parts department.*

### Check

**29** Refer to the fuel injection system checking procedure (see Section 12).

### Renewal

**30** Relieve the fuel pressure (see Section 2).

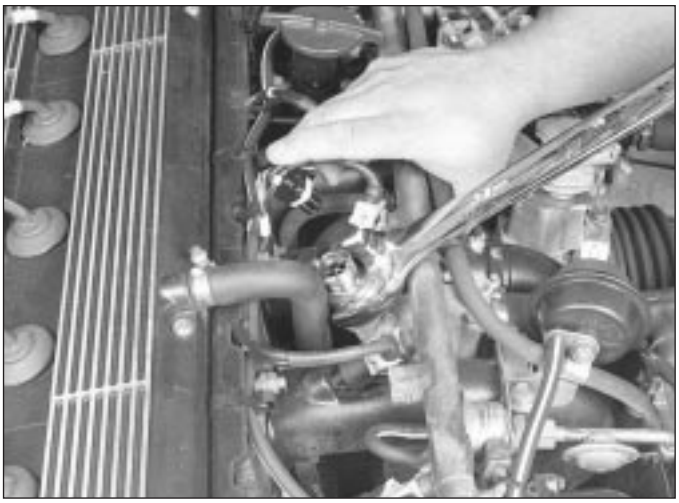
**31** Detach the cable from the negative terminal of the battery *(see* **Caution** *at the beginning of this Section)*.

**32** Disconnect the fuel injector wiring connectors and set the injector wire harness aside.

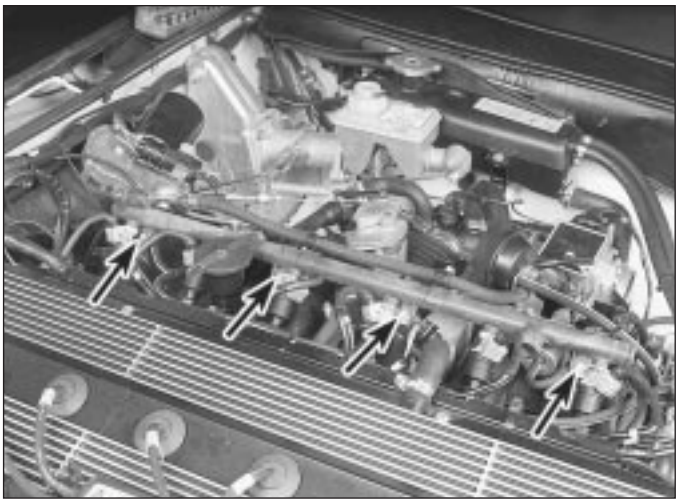
**33** Detach the vacuum sensing hose from the fuel pressure regulator.

**34** Disconnect the fuel lines from the fuel pressure regulator and the fuel rail **(see illustration 3.6a)**

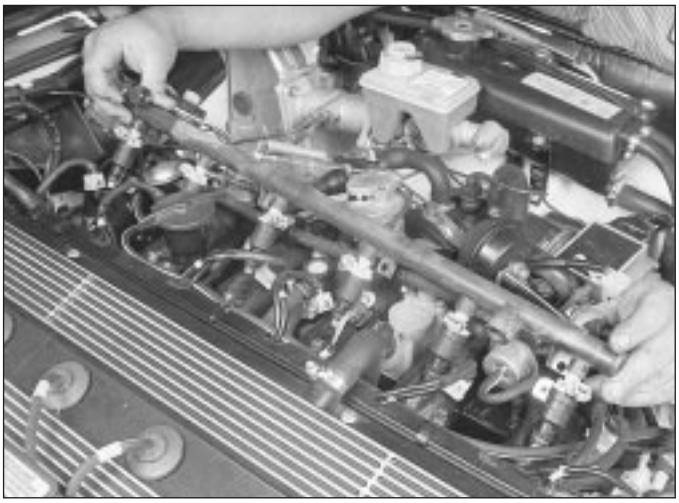
**35** Remove the fuel rail mounting bolts **(see illustration).**



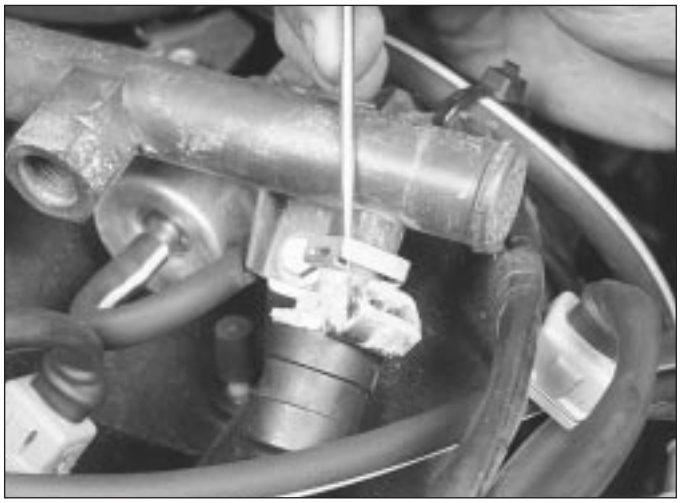
**13.27 Use a large open end spanner to remove the ISC motor from the intake manifold**



**13.35 Remove the fuel rail mounting bolts (arrowed) . . .**



**13.36 . . . and remove the fuel rail with the fuel injectors attached**



**13.37 Remove the fuel injector retaining clips from the fuel rail using a small screwdriver**

**36** Remove the fuel rail with the fuel injectors attached **(see illustration)**.
**37** Prise off the clips and remove the fuel injector(s) from the fuel rail **(see illustration)**.
**38** If you are replacing the injector(s), discard the old injector. If you intend to re-use the same injectors, renew the grommets and O-rings **(see illustrations)**.
**39** Refitting of the fuel injectors is the reverse of removal. Apply a light film of clean engine oil to the O-rings before refitting them.
**40** Tighten the fuel rail mounting bolts to the torque listed in this Chapter's Specifications.

## *Fuel pressure regulator*

### Check

**41** Refer to the fuel pump/fuel pressure check procedure (see Section 3).

### Renewal

**42** Relieve the fuel pressure (see Section 2) and detach the cable from the negative terminal of the battery *(see the* **Caution** *at the beginning of this Section)*.
**43** Detach the vacuum hose from the regulator.
**44** Remove the fuel rail and the injectors as an assembly (see Steps 30 to 39).
**45** Remove the fuel line from the fuel pressure regulator **(see illustration)**.
**46** Remove the fuel pressure regulator mounting bolts and detach the pressure regulator from the engine.
**47** The remainder of refitting is the reverse of removal. Make sure the fuel lines are secure and there are no leaks before using the car.

## *Supplementary air valve*

### Check

**48** The supplementary air valve provides additional throttle valve bypass air during cold starting and cold running conditions below 15° F. This output actuator is controlled by the computer (ECU) in response to information received from the coolant temperature sensor, intake air temperature sensor and other information sensors working with the fuel injection system.
**49** Check for battery voltage to the supplementary air valve. With the engine cold, backprobe the electrical connector using a long pin and check for battery voltage **(see illustration)**. Voltage should exist.
**50** Because of the special tools required to test the supplementary air valve, have it tested by a dealer service department or other qualified repair facility.

### Renewal

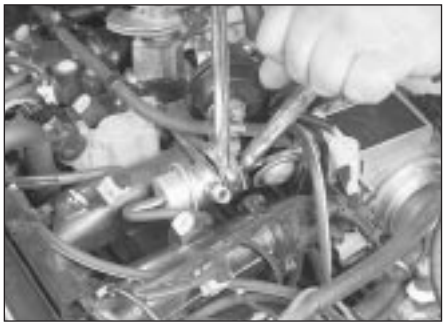
**51** Remove the intake hoses, the mounting screws and detach the supplementary air valve from the engine.
**52** Refitting is the reverse of removal.
**53** Be sure to use a new gasket when refitting the idle-up valve.

## *Air intake plenum*

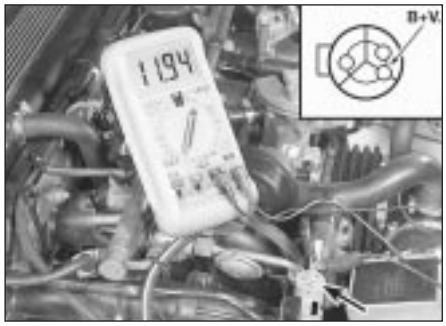
**Note:** *The air intake plenum is removed and installed as a complete unit with the intake manifold. In the event of damage or leaks, remove the air intake plenum and intake*

**13.38a If you plan to refit the original injectors, remove and discard the O-rings and grommets and fit new ones**

**13.38b Pick out the old injector seal but make sure the injector body is not damaged in the process**



**13.45 Disconnect the fuel pressure regulator from the fuel return line**




**13.49 Check for battery voltage to the supplementary air valve**

*manifold as a single unit and have it repaired by a dealer service department. Refer to Chapter 2 for removal and refitting procedures.*

## 14 Exhaust system servicing - general information

***Warning: Inspection and repair of exhaust system components should be done only after the components have cooled.***

**1** The exhaust system consists of the exhaust manifold, catalytic converter, the silencer, the tailpipe and all connecting pipes, brackets, hangers and clamps. The exhaust system is attached to the body with mounting brackets and rubber hangers **(see illustrations)**. If any of these parts are damaged or deteriorated, excessive noise and vibration will be transmitted to the body. **Note:** *The exhaust system configuration changes with later model updates. Earlier models (1988 and 1989) are equipped with a pre-catalytic converter near the exhaust manifold incorporating a single exhaust pipe to the silencer. Later models are equipped with dual exhaust pipes, dual catalytic converters and silencers.*

**2** Conducting regular inspections of the exhaust system will 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. 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, they will probably have to be cut from the exhaust system. The convenient way to accomplish this is to have a silencer repair workshop remove the corroded sections with a cutting torch. If, however, you want to save money by doing it yourself and you don't have an oxy/acetylene welding outfit with a cutting torch, simply cut off the old components with a hacksaw. If you have compressed air, special pneumatic cutting chisels can also be used. If you do decide to tackle the job at home, be sure to wear eye protection to protect your eyes from metal chips and work gloves to protect your hands.

**14.1a The rear tailpipe section is fastened to the chassis with a special rubber mount (arrowed) that pivots with road movement. Check for deterioration and alignment**

**14.1b Check the condition of the flexible rubber mounts that hang the silencer to the chassis**

**14.1c On dual silencer models, check the condition of the mount (arrowed) and the clamps**

**14.4 Use penetrating spray on the exhaust flange nuts before attempting to remove them**

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

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

*b) Apply penetrating oil to the exhaust system component fasteners to make them easier to remove* **(see illustration)**.

*c) Use new gaskets, hangers and clamps when refitting exhaust system components.*

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

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

***Warning: The catalytic converter operates at very high temperatures and takes a long time to cool. Wait until it's completely cool before attempting to remove the converter. It's a good idea to wear suitable gloves. Failure to observe these points could result in serious burns.***