






# Chapter 4 Part B:

## Fuel and exhaust systems - fuel-injected models

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### 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	
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### Specifications

#### System type

1.4 and 1.6 litre models	Multec CFI (single-point injection)
1.8 litre models:	
Early (18E engine) models	Bosch LE Jetronic (multi-point injection)
Later (18SE engine) models	Bosch L3 Jetronic (multi-point injection)
2.0 litre models:	
8-valve models:	
Early (Pre 1990) models	Bosch Motronic ML4.1 (multi-point injection)
Later (1990 on) models	Bosch Motronic M1.5 (multi-point injection)
16-valve models	Bosch Motronic M2.5 (multi-point injection)

#### Fuel pump

Type	Electric
Pressure:	
1.4 and 1.6 litre models	1.0 bar
1.8 and 2.0 litre models	2.5 bar

#### Adjustment data

Idle speed:	
1.4 litre models	830 to 990 rpm
1.6 litre models	720 to 880 rpm
1.8 litre models:	
Early (pre 1990) models:	
Manual transmission	900 to 950 rpm
Automatic transmission	800 to 850 rpm
Later (1990 on) models	800 to 900 rpm
2.0 litre models	720 to 780 rpm (not adjustable - regulated by control unit)
Exhaust gas CO content (at idle)	Less than 1.0%*

\*On models equipped with a catalytic converter the exhaust gas CO content is regulated by the control unit and is not adjustable

#### Recommended fuel

Minimum octane rating:	
Models without a catalytic converter	98 RON leaded (4-star) or unleaded (Super unleaded)*
Models with a catalytic converter	95 RON unleaded (Unleaded premium) <b>only</b>


\*If the necessary precautions are taken, 95 RON unleaded (unleaded premium) petrol can be used (see Section 4 for details)

Torque wrench setting	Nm	lbf ft
Multec CFI components:		
Throttle body/injector unit retaining nuts	22	16
Throttle body/injector housing upper section retaining screws	6	4
Inlet manifold	22	16
Throttle valve potentiometer screws	2	2
Injector valve bolt	3	2
Pressure regulator unit screws	3	2
Idle air control stepper motor retaining screws	3	2
Oxygen sensor unit	38	28
Inlet manifold nuts and bolts	22	16

1 General information and precautions

1 The fuel system consists of a fuel tank mounted under the rear of the car with an electric fuel pump immersed in it, a fuel filter, fuel feed and return lines. On 1.4 and 1.6 litre models, the pump supplies fuel to throttle body unit which incorporates the fuel injection valve and pressure regulator. On 1.8 and 2.0 litre models, the fuel pump supplies fuel to the fuel rail which acts as a reservoir for the four fuel injectors which inject fuel into the inlet tracts. On all models a fuel filter is incorporated in the feed line from the pump to the fuel rail to ensure the fuel supplied to the injectors is clean.

2 Refer to Section 5 for further information on the operation of the relevant fuel injection system.

 **Warning:** Many of the procedures in this Chapter require the removal of fuel lines and connections which may result in some fuel spillage. Before carrying out any operation on the fuel system refer to the precautions given in Safety first! at the beginning of this Manual and follow them implicitly. Petrol is a highly dangerous and volatile liquid and the precautions necessary when handling it cannot be overstressed.

**Note:** Residual pressure will remain in the fuel lines long after the vehicle was last used, when disconnecting any fuel line, depressurise the fuel system as described in Section 7.



2.5a Two of the air cleaner securing bolts (arrowed) - 2.0 litre 16-valve

2 Air cleaner housing - removal and refitting

Removal

1.4 and 1.6 litre models

1 Refer to the information given for the carburettor models in Chapter 4A. For information on the air temperature control system refer to Chapter 4A, Section 4.

1.8 and 2.0 litre 8-valve models

2 Remove the air cleaner element as described in Chapter 1.

3 Disconnect the air intake tube then undo the retaining screws and remove the housing from the engine compartment.

2.0 litre 16-valve models

4 Remove the trunking which connects the air cleaner to the air mass meter.

5 Remove the three bolts which secure the air cleaner. Remove the air cleaner (see illustrations).

Refitting

6 Refit by reversing the removal operations.

3 Accelerator cable - removal, refitting and adjustment

Refer to Chapter 4A, Section 9, substituting "throttle housing" in for all references to the "carburettor".



2.5b The third air cleaner bolt - 2.0 litre 16-valve

4 Unleaded petrol - general information and usage

**Note:** The information given in this Chapter is correct at the time of writing and applies only to petrols currently available in the UK. If updated information is thought to be required check with a Vauxhall dealer. If travelling abroad consult one of the motoring organisations (or a similar authority) for advice on the petrols available and their suitability for your vehicle.

1 The fuel recommended by Vauxhall is given in the Specifications Section of this Chapter, followed by the equivalent petrol currently on sale in the UK.

2 RON and MON are different testing standards; RON stands for Research Octane Number (also written as RM), while MON stands for Motor Octane Number. Fuel requirements are as follows.

1.4 and 1.6 litre models

3 All 1.4 and 1.6 litre fuel-injected models are fitted with catalytic converters and **must** therefore be run on 95 (RON) unleaded fuel only. Under no circumstances should leaded (UK "4-star") fuel be used as this will damage the catalytic converter.

1.8 litre models

4 All 1.8 litre models are designed to run on 98 (RON) octane leaded or unleaded petrol (see Specifications). If it is wished to run the vehicle on 95 (RON) unleaded petrol the following operations **must** first be carried out;



2.5c Removing the air cleaner - 2.0 litre 16-valve

this is necessary to avoid detonation (knocking and pinking) which could lead to possible engine damage

**5** On early (18E engine) models, to allow the vehicle to run on 95 (RON) unleaded petrol, the ignition timing **must** be retarded by 3° (see Chapter 5 for details). **Do not** use 95 (RON) unleaded petrol if the ignition timing has not been retarded.

**6** On later (18SE engine) models a fuel octane rating coding plug in the ignition system wiring harness (see illustration). The plug which is located on the right-hand side of the engine compartment, is set during production to give optimum engine output and efficiency when run on 98 (RON) fuel. To run the vehicle on 95 (RON) unleaded fuel, the plug position can be reset to modify the timing characteristics of the ignition system. To reset the plug, release its locking clip then remove the plug and rotate it through half a turn (180°) before reconnecting it. **Note:** If after making the adjustment, the octane rating of the fuel used is found to be so low that excessive knocking still occurs, seek the advice of your Vauxhall dealer.

## 2.0 litre models

**7** On all models with a catalytic converter, 95 (RON) unleaded fuel **must** be used. Under no circumstances should leaded (UK "4-star") fuel be used as this will damage the catalytic converter.

**8** All models not equipped with a catalytic converter can be designed to run on 98 (RON) octane leaded or unleaded petrol (see Specifications). If it is wished to run the vehicle on 95 (RON) unleaded petrol, the fuel octane rating plug must be set to the "95" position (see paragraph 6); this is necessary to avoid detonation (knocking and pinking) which could lead to possible engine damage

## 5 Fuel injection system - general information

### 1.4 and 1.6 litre models

**1** The MULTEC Central Fuel Injection (CFI) system is fitted to 1.4 litre (C14NZ) and 1.6 litre (C16NZ) engine models and provides a simple method of fuel metering whereby fuel is injected into the inlet manifold by a single solenoid operated fuel injector unit. The injector unit is located centrally in the top of the throttle valve housing and this is mounted on the top of the inlet manifold. The length of time for which the injector remains open determines the quantity of fuel reaching the cylinders for combustion. The electrical signals which determine the fuel injector opening duration are calculated by the Electronic Control Unit (ECU) from the information supplied by a network of sensors. The fuel pressure is regulated mechanically.

**2** The signals fed to the ECU include inlet manifold vacuum from the Manifold Absolute Pressure (MAP) sensor; engine speed and



4.6 Octane rating plug in the "95" setting position

crankshaft position from the distributor; road speed from a sensor at the base of the speedometer cable; the position of the throttle valve plate from the throttle position sensor; engine coolant temperature; and the oxygen content in the exhaust gases via a sensor in the exhaust manifold. Battery voltage is also monitored by the ECU.

**3** Using the information gathered from the various sensors, the ECU sends out signals to control the system actuators. The actuators include the fuel injector, the idle air control stepper motor, the fuel pump relay and the ignition control unit.

**4** The ECU also has a diagnostic function which can be used in conjunction with special Vauxhall test equipment for fault diagnosis. With the exception of basic checks to ensure that all relevant wiring and hoses are in good condition and securely connected, fault diagnosis should be entrusted to a Vauxhall dealer.

**5** The system incorporates a three-way catalytic converter to reduce exhaust gas pollutants, and a closed-loop fuel mixture control (by means of the exhaust gas oxygen sensor) is used. The mixture control remains in an open-loop mode (using pre-programmed values stored in the ECU memory) until the exhaust gas oxygen sensor reaches its normal operating temperature.

### 1.8 litre models

#### Early (18E engine) models

**6** A Bosch LE Jetronic fuel injection system is fitted to all early 1.8 litre models fitted with the 18E engine.

**7** By means of electronic control, the fuel injection system supplies the precise amount of fuel for optimum engine performance with minimum exhaust emission levels. This is achieved by continuously monitoring the engine using various sensors, whose data is input to an electronic control unit in the form of electrical signals. Based on this constantly-changing data, the control unit determines the fuel necessary to suit all engine speed and load conditions, which is then injected directly into the inlet manifold.

**8** The main components of the system are:

- a) Control unit - the signals delivered by the various sensors are processed in the

control unit, and from these signals, the appropriate control impulses for the fuel injectors are generated. Additional circuitry within the control unit operates an overrun fuel cut-off to reduce fuel consumption, and a cold start booster for cold starting fuel enrichment.

- b) Control relay - this comprises an electronic timing element and a switch relay, which cuts off the fuel supply immediately after the engine stops.
- c) Airflow sensor - the amount of air drawn in by the engine is measured by the airflow sensor to determine the engine load condition. This is achieved by using a flap valve attached to a spindle, which is free to pivot within the airflow sensor bore, and is deflected by the passage of intake air. Attached to the flap valve spindle is a potentiometer, which transforms the angular position of the flap valve into a voltage, which is then sent to the control unit. Airflow passing through the sensor is one of the main variables used by the control unit to determine the precise fuel requirement for the engine at any given time.
- d) Fuel injectors - each fuel injector consists of a solenoid-operated needle valve, which opens under commands from the control unit. Fuel from the fuel distribution pipe is then delivered through the injector nozzle into the inlet manifold. All four fuel injectors operate simultaneously; once for each turn of the crankshaft regardless of inlet valve position. Therefore, each injector will operate once with the inlet valve closed, and once with it open, for each cycle of the engine. The fuel injectors always open at the same time relative to crankshaft position, but the length of time in which they stay open, eg the injector duration, is governed by other variables, and is determined by the control unit. For a given volume of air passing through the airflow sensor, the control unit can enrich the air/fuel mixture ratio by increasing the injector duration, or weaken it by decreasing the duration.
- e) Fuel pump - the fuel pump is an electric self-priming roller cell unit, located at the rear of the car. Fuel from the tank is delivered by the pump, at a predetermined pressure, through the fuel filter to the fuel distribution pipe. From the fuel distribution pipe, the fuel is supplied to the four fuel injectors the excess being returned to the fuel tank via the fuel pressure regulator. A greater volume of fuel is circulated through the system than will be needed, even under the most extreme operating conditions, and this continual flow ensures that a low fuel temperature is maintained. This reduces the possibility of vapour lock, and ensures good hot starting characteristics.
- f) Fuel pressure regulator - the fuel pressure regulator is fitted to the fuel distribution



pipe, and controls the operating pressure in the fuel system. The unit consists of a metal housing, divided into two chambers by a diaphragm. Fuel from the fuel distribution pipe fills one chamber of the regulator, whilst the other chamber contains a compression spring, and is subject to inlet manifold vacuum via a hose connected to the manifold, downstream of the throttle valve. A valve attached to the diaphragm opens a fuel return port in the fuel chamber of the regulator as the diaphragm deflects. When the fuel pressure in the regulator exceeds a certain value, the diaphragm is deflected, and fuel returns to the tank through the now open return port. This also occurs when the port is opened by the deflection of the diaphragm under the influence of manifold vacuum. Therefore, as manifold vacuum increases, the regulated fuel pressure is reduced in direct proportion.

- g) Throttle valve switch - the throttle valve switch is attached to the throttle spindle on the throttle valve housing. As the throttle spindle turns in response to movement of the accelerator pedal, contacts within the switch are closed at the two extremes of shaft movement. One contact closes in the Idle position, and one in the full-throttle position. These signals are then processed by the control unit to determine throttle valve position.
- h) Auxiliary air valve - this device comprises a large-bore air channel, connected by hoses to the throttle housing and inlet manifold, and allowing intake air to bypass the throttle valve. In the centre of the air channel is a blocking plate attached to a bi-metal strip. When the engine is cold, the blocking plate is withdrawn from the air channel, allowing air to pass through the valve. As the engine warms up, a current is supplied to the valve, heating the bi-metal strip and causing the blocking plate to begin closing the air channel until, as engine temperature increases, the channel is closed completely. The additional air passing through the valve is measured by the airflow sensor, which compensates by increasing the injector duration to provide additional fuel. Therefore, the engine receives a greater air/fuel mixture during cold driveaway and warm-up conditions.
- i) Temperature sensors - information on engine (coolant) temperature and intake air temperatures are measured by sensors, one located in the coolant jacket and the other in the intake air stream. The sensors consist of resistors whose resistance decreases as temperature increases. The change in electrical resistance of the sensors is measured by the control unit, and this information is used to modify injector duration accordingly.

### Later (1987 onwards) 1.8 litre models

**9** A Bosch L3 Jetronic fuel injection system is fitted to all later 1.8 litre models fitted with the 18SE engine.

**10** The system is based on the LE system used previously, but it has a digital control system, rather than the analogue system used on the LE type. The L3 system control unit is housed within the engine compartment as part of the airflow sensor assembly, and the system wiring layout differs to suit.

### 2.0 litre models

**11** The Motronic systems fitted to 2.0 litre models control the fuel injection and ignition systems as an integrated package. This has considerable advantages in terms of efficiency, performance and reduction of exhaust emissions.

**12** Idle speed is regulated by the opening and closing of an electrically-operated valve which allows air to bypass the throttle butterfly. No manual adjustment is possible.

**13** Ignition timing is advanced and retarded electronically in response to engine speed and load, engine temperature and inducted air temperature. Engine speed information comes from an inductive pulse sensor on the side of the cylinder block. The sensor is mounted close to the toothed lockwasher attached to the crankshaft No 1 counterweight. The passage of each lockwasher tooth produces an electrical pulse in the sensor. This signal is transmitted to the control unit.

**14** The system fitted to 8-valve models before 1990 is known as Motronic ML4.1. The fuel injection side is very similar to the LE/L3 Jetronic systems fitted to 1.8 models. The control unit is located behind the trim panel in the driver's footwell.

**15** 1990 8-valve models are fitted with a system known as Motronic M1.5. The main difference is in the control unit, which triggers the injectors in pairs instead of all together as previously. There are also minor differences in the fixings of the fuel pressure regulator and the fuel injector rail. The fuel pump is now immersed in the tank instead of being fitted alongside.

**16** The system fitted to 16-valve models is known as Motronic M2.5. The most significant difference from the other Motronic systems is in the way that intake air is measured. Where the other systems measure air volume by means of a flap, the M2.5 system measures air mass by its cooling effect on a hot wire. The M2.5 system also incorporates knock control, whereby detonation (pre-ignition or pinking) is sensed and causes the ignition timing to be retarded.

**17** Injection on the M2.5 system is fully sequential. Each injector is individually controlled to deliver fuel at the optimum moment in the induction process. The ignition distributor carries a Hall Effect sensor which sends the control unit a cylinder recognition signal.

**18** On all systems, the control unit incorporates self-testing and fault detection features. Fault codes are stored in the unit, but these are only accessible to Vauxhall

dealers or other specialists with the necessary test equipment.

**19** If a fault is detected by the control unit, a 'limp home' program comes into operation by means of which an average value is substituted for the normal output of a defective or disconnected sensor. In this case the vehicle is still driveable, albeit with reduced performance and efficiency. A warning light on the instrument panel, carrying an outline of an engine and a lightning symbol, warns the driver that a fault has occurred.

## 6 Fuel system - depressurisation

**Note:** Refer to the warning note in Section 1 before proceeding.



**Warning:** The following procedure will merely relieve the pressure in the fuel system - remember that fuel will still be

present in the system components and take precautions accordingly before disconnecting any of them.

**1** The fuel system referred to in this Section is defined as the tank-mounted fuel pump, the fuel filter, the fuel injectors, the fuel rail and the pressure regulator, and the metal pipes and flexible hoses of the fuel lines between these components. All these contain fuel which will be under pressure while the engine is running and/or while the ignition is switched on. The pressure will remain for some time after the ignition has been switched off and must be relieved before any of these components are disturbed for servicing work.

**2** Disconnect the battery negative terminal.

**3** Place a container beneath the relevant connection/union to be disconnected, and have a large rag ready to soak up any fuel not being caught by the container.

**4** Slowly loosen the connection or union nut (as applicable) to avoid a sudden release of pressure and position the rag around the connection to catch any fuel spray which may be expelled. Once the pressure is released, disconnect the fuel line and insert plugs to minimise fuel loss and prevent the entry of dirt into the fuel system.

## 7 Fuel pump - removal and refitting

**Note:** Refer to the warning note in Section 1 before proceeding.

### Removal

#### 1.4, 1.6 and later (1990 on) 2.0 litre 8-valve models

**1** The fuel pump is located inside the fuel tank. Before removing the pump, detach the battery earth lead.

**2** Lift up the rear seat cushion and remove the access cover from the floor to reveal the pump.



7.6 Fuel pump, damper and filter assembly

3 Disconnect the electrical connectors from the pump.

4 Bearing in mind the information in Section 6, slacken the retaining clip and disconnect the fuel hose. Plug the hose end to minimise fuel loss.

5 Undo the retaining bolts and remove the pump assembly from the tank. Recover the rubber seal.

#### 1.8 and 2.0 litre models (except later 1990 on 2.0 litre 8-valve models)

6 The fuel pump is located underneath the vehicle, just in front of the fuel tank (see illustration). Before removing the pump or associated components, detach the battery earth lead.

7 Clamp the fuel hoses on either side of the pump to prevent loss of fuel when they are disconnected. Self-locking grips are useful for this. Disconnect the hoses, bearing in mind the information given in Section 6.

8 Unscrew the pump mounting clamp bolts and withdraw the pump from its flexible insulator. Disconnect the electrical plug as the pump is withdrawn.

9 Alternatively, the pump can be removed complete with filter and damper diaphragm unit if the mounting strap nuts are unscrewed and the assembly removed from its flexible mountings.

### Refitting

#### 1.4, 1.6 and later (1990 on) 2.0 litre 8-valve models

10 Refitting is the reversal of removal using a new rubber seal. Prior to refitting make sure the pump filter is clean and undamaged. If necessary, unclip the filter and renew it.

#### 1.8 and 2.0 litre models (except later 1990 on 2.0 litre 8-valve models)

11 Refitting is the reverse of removal, ensuring the hose clips are securely tightened. On completion, start the engine and check the hoses for signs of leakage.

### 8 Fuel gauge sender unit - removal and refitting

Refer to Chapter 4 Part A, Section 6.

### 9 Fuel tank - removal and refitting

Refer to Chapter 4 Part A, Section 7.

### 10 Fuel injection system - testing and adjustment

#### Testing

1 If a fault appears in the fuel injection system first ensure that all the system wiring connectors are securely connected and free of corrosion. Then ensure that the fault is not due to poor maintenance; ie, check that the air cleaner filter element is clean, the spark plugs are in good condition and correctly gapped, the cylinder compression pressures are correct, the ignition timing is correct and the engine breather hoses are clear and undamaged, referring to Chapters 1, 2 and 5 for further information.

2 If these checks fail to reveal the cause of the problem the vehicle should be taken to a suitably equipped Vauxhall dealer for testing. Your dealer has access to special electronic diagnostic equipment which will locate the fault quickly and simply, alleviating the need to test all the system components individually (a time consuming operation that carries a high risk of damaging the control unit).

#### Adjustment

3 On 1.4 and 1.6 litre models, whilst experienced home mechanics with a considerable amount of skill and equipment (including a good-quality tachometer and a good-quality, carefully-calibrated exhaust gas analyser) may be able to check the exhaust CO level and the idle speed, if these are found to be in need of adjustment the car **must** be taken to a suitably-equipped Vauxhall dealer for testing. Neither the mixture (exhaust gas CO level) or idle speed are adjustable, and should either be incorrect then a fault must be present in the fuel injection system.

4 On 1.8 litre models, both the idle speed and idle mixture (exhaust gas CO level) are adjustable. Refer to Chapter 1 for information on the adjustment procedure.

5 On 2.0 litre models not equipped with a catalytic converter the idle mixture (exhaust gas CO level) can be adjusted as described in Chapter 1, however the idle speed is regulated by the control unit and is not adjustable. On models with a catalytic converter, both the idle speed and mixture (exhaust gas CO level) are regulated by the control unit (see paragraph 3). Should the idle speed/mixture (as applicable) be incorrect then a fault must be present in the fuel injection system.

### 11 Single-point fuel injection system components (1.4 and 1.6 litre models) - removal and refitting

1 Disconnect the battery negative lead and proceed as described under the relevant sub-heading (see illustration).

#### Throttle body/injector housing unit components

2 The following items can be removed from the throttle body/injector housing unit for inspection and where necessary, renewal. If the unit is in position in the car, first remove the air cleaner unit to allow suitable access to the appropriate component (see illustration).

#### Throttle valve potentiometer

3 Disconnect the wiring connector from the potentiometer, then undo the retaining screws and remove the potentiometer from the throttle housing (see illustrations).

4 Refitting is a reversal of the removal procedure. Ensure that the throttle valve is fully shut as the potentiometer is fitted into position and that the pick-up is properly seated on the throttle spindle. Tighten the retaining screws to the specified torque setting.

5 Reconnect the wiring plug and refit the air cleaner unit.

#### Injection valve

6 Disconnect the wiring plug. Undo the retaining screw then carefully lever the injection valve free using a suitable screwdriver. Remove the injection valve together with its holder (see illustrations).

7 Refit in the reverse order of removal. Always renew the seal rings and as the injection unit is pressed into position, ensure that the wiring connector is facing up (towards the retaining screw). If the retaining screw was fitted with a washer, discard the washer and apply a suitable locking compound to the screw threads before screwing it into position.

#### Throttle body upper injector housing

8 Detach the wiring connector, undo the retaining screws and lift the upper injector housing clear of the main body. Remove the seal.

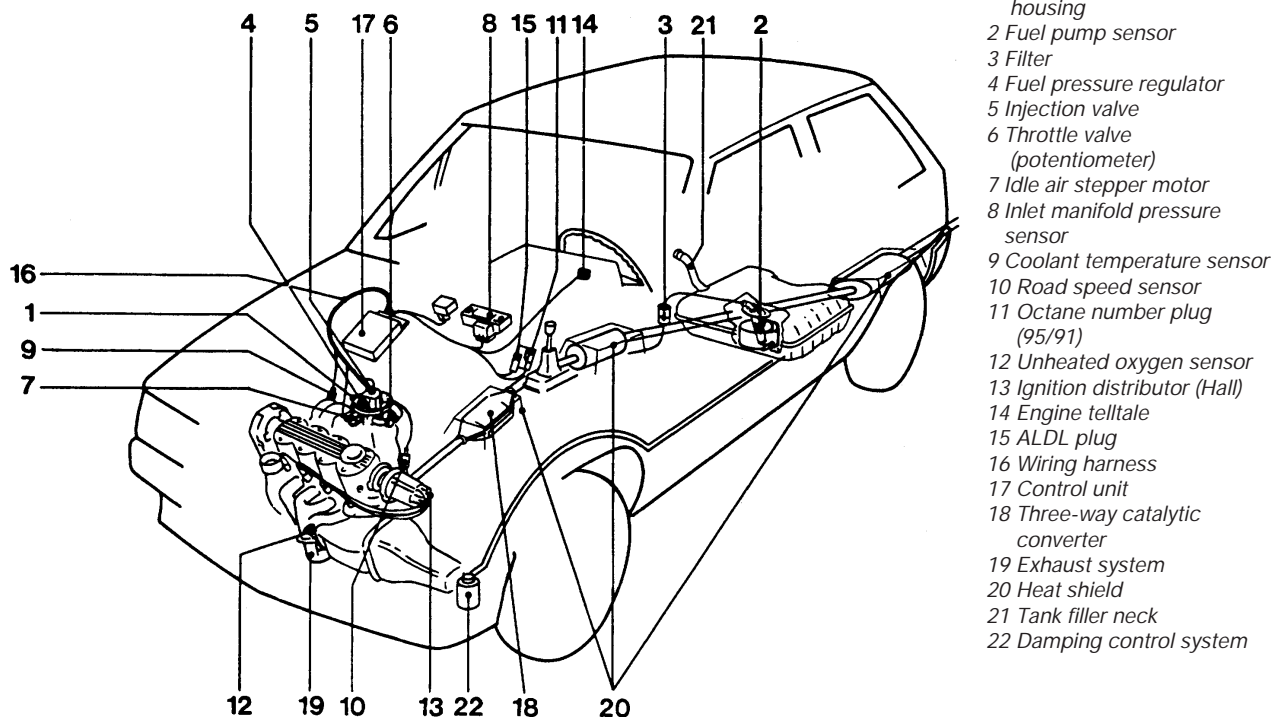
9 Unscrew the union nuts and detach the fuel lines from the injector housing.

10 Refit in the reverse order of removal. Remove the seal located between the upper housing and the main body. Where the retaining screws were fitted with washers, discard the washers and coat the threads of the screws with a suitable locking compound. Tighten the retaining screws to the specified torque to secure the upper body to the main body.

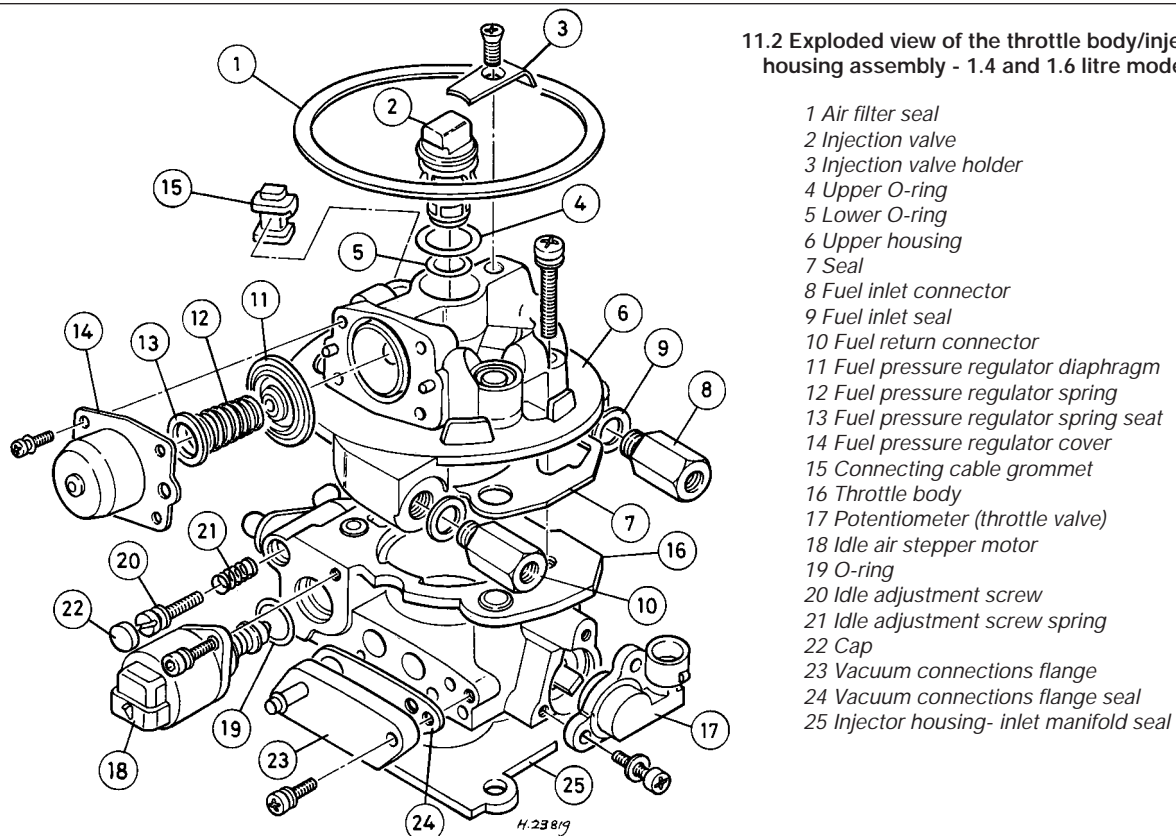
#### Idle air stepper motor

11 Detach the wiring connector, undo the retaining screws and withdraw the idle air stepper motor unit from the injector unit housing (see illustrations).

11.1 Single-point fuel injection system components and location on 1.4 litre model



11.2 Exploded view of the throttle body/injector housing assembly - 1.4 and 1.6 litre models



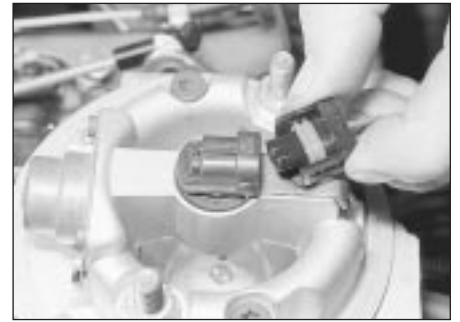




11.3a Detach the wiring connector from the throttle valve potentiometer



11.3b Throttle valve potentiometer removal



11.6a Disconnect the wiring connector ...



11.6b ... undo the retaining screw ...



11.6c ... and remove the injector



11.11a Detach the wiring connector ...

12 Refit in the reverse order of removal. To avoid damaging the injector housing as the motor unit is refitted, press the cone in against its stop and check that the top of the cone to the mating flange face is within 28 mm (see illustration).

#### Throttle body/injector housing unit

13 Disconnect the wiring connectors from the throttle body/injector housing.

14 Disconnect the operating rod, then unscrew and remove the two retaining nuts from the studs and carefully lift the throttle body/injector housing from the inlet manifold. Remove the gasket and clean the mating surfaces.

15 Refit in the reverse order of removal, but be sure to fit a new gasket between the manifold and the throttle body/injector unit. Tighten the retaining nuts to the specified torque setting.

#### Pressure regulator

16 Prior to removal of the regulator unit, a new diaphragm must be obtained as this must be renewed whenever the cover is removed. Release the pressure in the fuel system as

described in Section 6.

17 Undo the four retaining screws and carefully withdraw the regulator unit cover, spring and diaphragm (see illustrations).

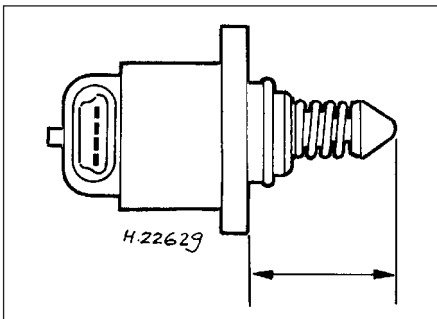
18 Refit in the reverse order of removal.



11.11b ... undo the retaining screws ...



11.11c ... and remove the idle air stepper motor



11.12 Idle air stepper motor cone tip-to-flange distance should be as specified



11.17a Undo the retaining screws ...



11.17b ... and remove the pressure regulator cover, spring and diaphragm

Ensure that the new diaphragm and its seatings are clean. Note that no adjustment to the regulator unit is necessary (or possible).

### Inlet manifold pressure sensor

**19** This unit is located on the engine side of the bulkhead. Disconnect the wiring connector and the vacuum hose, then detach and remove the unit from the bulkhead.

**20** Refit in the reverse order of removal, ensuring that the vacuum hose and wiring plug are securely reconnected. Position the vacuum hose so that it progressively slopes down between the inlet manifold pressure sensor and the throttle housing.

### Control unit

**21** Detach and remove the trim panel from the right-hand footwell to gain access to the control unit.

**22** Disconnect the wiring multi-plug connectors, undo the retaining screw then release and remove the control unit.

**23** The control unit also contains a programmable memory (PROM) unit in which the engine/vehicle data and calibration are stored. If this unit is known to be faulty it can be removed from the control unit and renewed separately. If the control unit is at fault, the PROM unit should be removed from it, the control unit alone renewed and the original PROM unit fitted to the new control unit.

**24** To separate the PROM from the control unit, detach and withdraw the cover from the end of the control unit, then press back the retaining clips, unplug and withdraw the PROM unit from the control unit. When removed, no attempt must be made to open and/or tamper with the PROM unit. Ensure that its plug contacts are clean and in good condition.

**25** If renewing the control unit it is important that the part number/code sticker label is transferred to the new unit.

**26** Refit in the reverse order of the removal procedure. On completion, switch on the ignition and check for satisfactory operation.

### Coolant temperature sensor

**27** Partially drain the cooling system to allow the temperature sensor to be removed without excessive coolant loss (Chapter 1).

**28** Disconnect the multi-plug from the temperature sensor, then unscrew the sensor. Note the position of the sealing ring.

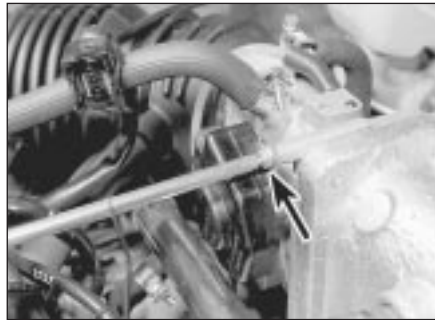
**29** Refitting is a reversal of the removal procedure, using a new sealing ring and tightening the sensor securely.

### Road speed sensor

**30** Unclip the road speed sensor multi-plug, located near the base of the speedometer cable, and disconnect it. Unscrew and detach the speedometer cable from the sensor.

**31** Unscrew the road speed sensor from its gearbox location and remove it.

**32** Refitting is the reverse to removal.



12.4 Tightening a throttle valve switch screw

### Oxygen sensor

**33** Refer to Section 12, paragraphs 93 to 96.

## 12 Multi-point fuel injection system components (1.8 and 2.0 litre models) - removal and refitting

**1** Disconnect the battery and proceed as described under the relevant sub-heading.

### 1.8 litre models

#### Throttle valve switch

**2** Disconnect the wiring plug from the switch.  
**3** Remove the two mounting screws and pull the switch off the throttle valve spindle.

**4** Refit in the reverse order to removal, adjusting the switch as follows. Release the switch mounting screws and rotate the switch in an anti-clockwise direction until resistance is felt. Tighten the screws (see illustration). Have an assistant open the throttle valve slightly by depressing the accelerator pedal. A click should be heard from the switch as the throttle opens; another click should be heard when the pedal is released..

#### Fuel injectors

##### Early (pre 1990) models

**5** Make sure that the engine is cool, and that all sources of external ignition (eg pilot lights) have been extinguished. Disconnect the battery earth lead.

**6** Bearing in mind the information given in Section 6, release the hose clamps and



12.8 Undoing a fuel injector retaining bolt



12.6 Slackening a fuel rail hose clamp

withdraw the fuel rail from the injectors (see illustration). Catch as much fuel as possible.

**7** Disconnect the wiring plugs from the injectors.

**8** Unscrew the retaining bolts (two per injector) and withdraw the injectors from their holders, being careful not to damage the needle valves (see illustration).

**9** Refit in the reverse order to removal; renew the injector sealing rings if their condition is at all doubtful.

##### Later (1990 on) models

**10** Refer to paragraphs 5 to 9, noting that the fuel rail is retained by bolts and the injectors are secured to the fuel rail by clips.

#### Airflow meter

**11** The airflow meter is located between the air cleaner and the throttle valve housing.

**12** Disconnect the wiring harness plug from the airflow meter. Release the securing band and remove the rubber trunking (see illustration).

**13** Release the spring clips and remove the airflow meter with the upper part of the air cleaner housing.

**14** Unbolt the airflow meter from the air cleaner housing (see illustration).

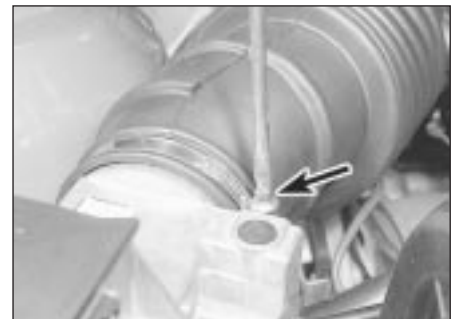
**15** Check the meter flap for free movement, without any jerkiness. If necessary, clean away any dirt in the area of the flap using a clean lint-free rag.

**16** Refit in the reverse order to removal.

#### Control unit

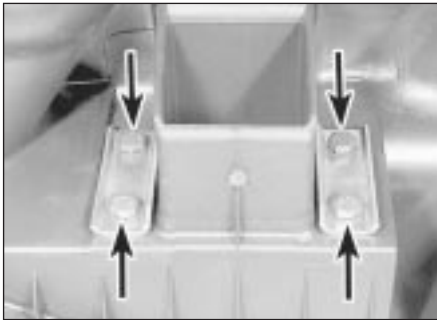
##### Early (pre 1990) models

**17** The control unit is located at the side of the front footwell, on the passenger side.



12.12 Disconnecting the airflow meter trunking





12.14 Airflow meter securing bolts (arrowed)

18 Remove the footwell trim panel.  
19 Make sure that the ignition is switched off, then release the multi-plug spring clip and disconnect the multi-plug.

20 Remove the three securing screws and withdraw the control unit.

21 Refit in the reverse order to removal, but make sure that the ignition is switched off before reconnecting the multi-plug.

#### Later (1990 on) models

22 Remove the airflow meter as described earlier.

23 Remove the four screws which secure the cover to the top of the airflow meter (these may be hidden by blanking plugs). Remove the cover and insert, then the control unit.

24 Refitting is the reverse of removal.

#### Coolant temperature sensor

25 The coolant temperature sensor for the fuel injection system is located near the alternator. Because it is additional to the



12.38 Fuel pressure regulator



12.36a Removing the control relay and bracket

temperature gauge sensor, it is known as temperature sensor II.

26 Partially drain the cooling system - about 3 litres should be sufficient.

27 Disconnect the electrical lead and unscrew the sensor.

28 Refit in the reverse order to removal. Use a little sealant on the sensor threads, and refill the cooling system on completion.

#### Auxiliary air valve

29 The auxiliary air valve is bolted to the side of the camshaft housing.

30 Disconnect the wiring plug from the valve.

31 Release the hose clips and disconnect the air hoses from the valve.

32 Unbolt and remove the valve.

33 The function of the valve may be checked by looking through the hose connecting stubs. A clear passage should exist between the stubs when the valve is cold. As the valve is heated (achieved by connecting its terminals to a 12 volt battery) the regulator disc should move round and block the hole.

34 Refit in the reverse order to removal, using new hose clips if necessary. An air leak on the intake side of the valve will raise the idle speed.

#### Control relay

35 The control relay is located on the front suspension strut turret. Unplugging the relay disables the fuel pump - this is necessary when performing a compression test.

36 Slacken the securing bolt, remove the relay and its bracket from the turret, and withdraw the relay from the plug (see illustrations).



12.36b Unplugging the control relay

37 Refit in the reverse order to removal.

#### Fuel pressure regulator

38 The fuel pressure regulator is located between injectors 3 and 4 (see illustration).

39 Disconnect the battery earth lead and take appropriate fire precautions.

40 Clamp the fuel hoses to minimise fuel loss, using self-locking grips with suitably protected jaws.

41 Disconnect the fuel and vacuum hoses from the pressure regulator and remove it. Be prepared for fuel spillage.

42 Refit in the reverse order to removal.

#### 2.0 litre models

43 Refer to the information given earlier for the 1.8 litre models, information for additional components is as follows

#### Idle speed adjuster

44 Note the routing and positioning of the air hoses, then disconnect the multi-plug and the air hoses from the idle speed adjuster (see illustrations). On the 16-valve engine the adjuster is located below the inlet manifold; access is not good but is easier from below.

45 Refitting is the reverse of the removal procedure.

#### Control unit

46 The control unit is located behind the side trim panel in the driver's footwell. To remove the trim panel, first remove the front two screws from the driver's 'kick plate' and peel back the door surround strip in the area next to the side trim panel (see illustrations).



12.44a Disconnect the idle speed adjuster multi-plug . . .



12.44b . . . and the air hoses (arrowed)



12.46a Remove the kick plate screws . . .



12.46b . . . and peel back the door surround strip



12.47 Prise out the clips to release the trim panel



12.48 Motronic control unit location

47 Open the access panel in the side trim. Prise out the plastic retaining clips and withdraw the side trim panel (see illustration).

48 Remove the retaining screws to release the control unit (see illustration). Release the multi-plug catch and disconnect the multi-plug. Handle the control unit with care if it is to be re-used.

49 Refitting is the reverse of the removal procedure.

#### Inductive pulse sensor

50 Refer to Chapter 5.

#### Fuel injectors - Motronic ML4.1 and M1.5

51 Remove the idle speed adjuster.

52 Disconnect the wiring plugs from the fuel injectors.

53 Unbolt the fuel rail from the inlet manifold, bearing in mind the information in Section 6.

54 Remove the clips which secure the

injectors to the fuel rail by prising them out.

55 Disconnect the brake servo hose from the throttle body housing.

56 Unbolt the fuel supply hose bracket.

57 Carefully lift the fuel rail away from the manifold and pull out the injectors.

58 Refitting is the reverse of the removal procedure. If the old injectors are being refitted, use new sealing rings.

#### Fuel injectors - Motronic M2.5

59 Remove the pre-volume chamber as described earlier.

60 Bearing in mind the information in Section 6, clean around the unions on the fuel rail, then disconnect the supply and return hoses from it (see illustration). Be prepared for fuel spillage.

61 Disconnect the two crankcase ventilation hoses from the camshaft cover. To improve access, remove the larger of the two hoses completely.

62 Disconnect the vacuum hose from the fuel pressure regulator.

63 Disconnect the multi-plugs from the air mass meter and from the throttle valve switch.

64 Unbolt the throttle cable bracket and move it aside.

65 Remove the nuts securing the earth straps at each end of the fuel rail (see illustration).

66 The injector multi-plugs must now be disconnected. Each plug is secured by a spring clip, which must be levered out with a small screwdriver or long-nosed pliers. With all the multi-plugs released, cut or undo cable ties as necessary and move the wiring rail forwards so that it rests on the camshaft cover (see illustrations).

67 Remove the two bolts which secure the fuel rail to the inlet manifold.

68 Pull the rail and injectors away from the manifold.

69 Individual injectors may now be removed from the rail by removing their retaining clips and pulling them from the rail (see illustrations).



12.60 Disconnecting the fuel supply line from the fuel rail



12.65 One of the earth straps on the fuel rail



12.66a Removing the spring clip from an injector multi-plug



12.66b Lifting the wiring rail off the injectors



12.69a Remove the retaining clip



12.69b . . . and pull out the injector



**12.73 Disconnecting the fuel return line from the fuel pressure regulator**

**70** Refitting is the reverse of the removal procedure. If the old injectors are being refitted, use new sealing rings.

#### **Throttle valve potentiometer - Motronic M1.5**

**71** The throttle valve potentiometer is removed and refitted in the same way as the throttle valve switch (which it replaces) on earlier models. There is no need for adjustment.

#### **Fuel pressure regulator - Motronic M1.5 and 2.5**

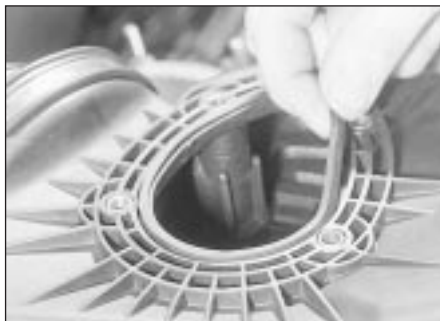
**72** On Motronic M2.5 systems, remove the pre-volume chamber.

**73** Bearing in mind the information in Section 6, disconnect the fuel return union from the pressure regulator (see illustration). Be prepared for fuel spillage.

**74** Disconnect the vacuum hose from the regulator (see illustration).



**12.79 Idle speed adjuster hose attachment to pre-volume chamber**



**12.80 Pre-volume chamber sealing ring**



**12.74 Disconnecting the vacuum hose**

**75** Remove the four Torx screws which secure the pressure regulator to the fuel rail. A small E6 Torx spanner will be needed for access to the screws. If this is not available the fuel rail will have to be removed so that the screws can be undone with a socket or (at a pinch) self-locking pliers. With the screws removed, the pressure regulator can be removed from the rail.

**76** Refitting is the reverse the removal.

#### **Pre-volume chamber - Motronic M2.5**

**77** Remove the four Allen screws which secure the pre-volume chamber to the throttle housing (see illustration). On some models there is a fifth screw to the left which must also be removed.

**78** Release the hose clip which secures the air mass meter to the pre-volume chamber.

**79** Lift the pre-volume chamber slightly and disconnect the idle speed adjuster hose from the left-hand end (see illustration). Remove the pre-volume chamber.

**80** Refitting is the reverse of the removal procedure, but note that it is important that the ring which seals the throttle body to the pre-volume chamber is not displaced during fitting. Air leaks at this point will weaken the mixture and dirt may enter. Secure the ring to the chamber if necessary with a few dabs of sealant (see illustration).

#### **Throttle valve switch - Motronic M 2.5**

**81** Remove the pre-volume chamber and the air mass meter.

**82** Disconnect the multi-plug from the switch (see illustration). Remove the two screws and withdraw the switch.



**12.82 Disconnecting the throttle valve switch multi-plug**



**12.77 Removing a pre-volume chamber screw**

**83** Refitting is the reverse of the removal procedure. Adjust the switch before tightening the screws as described in paragraph 4 of this Section.

#### **Air mass meter - Motronic M2.5**

**84** Disconnect the multi-plug from the air mass meter (see illustration).

**85** Release the hose clips from each end of the meter and remove it. Do not drop it, it is fragile.

**86** Refitting is the reverse of the removal procedure.

#### **Coolant temperature sensor - Motronic M2.5**

**87** Partially drain the cooling system at the radiator bottom hose to bring the coolant level below the level of the thermostat housing.

**88** Disconnect the multi-plug from the sensor on the thermostat housing. The Motronic sensor is the larger of the two the smaller one feeds the temperature gauge. Unscrew the sensor and remove it.

**89** Refitting is the reverse of the removal procedure, noting the following points:

- Use a new sealing ring on the sensor, and apply a little sealant to its threads.*
- Refill the cooling system as described in Chapter 1.*

#### **Knock sensor - Motronic M2.5**

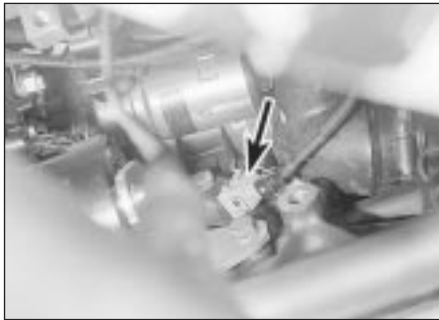
**90** The knock sensor is on the rear of the cylinder block. Unless the inlet manifold has been removed, access is easiest from below.

**91** Disconnect the multi-plug (coloured red or orange) from the knock sensor. Remove the securing screw and the sensor (see illustration).

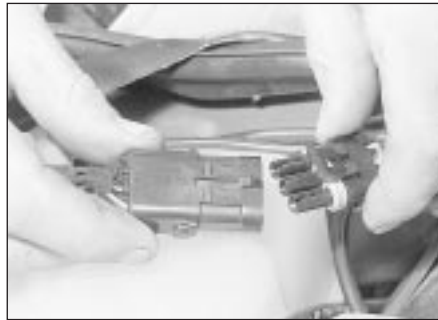


**12.84 Disconnecting the multi-plug from the air mass meter**





12.91 Knock sensor multi-plug (arrowed) seen from below



12.94 Disconnecting the oxygen sensor multi-plug



12.95 Removing the oxygen sensor



12.98a Canister clamp nut (arrowed)



12.98b Disconnecting a hose from the canister



12.100 Disconnecting the vent valve multi-plug

**92** Refitting is the reverse of the removal procedure, but make sure that the sensor and its seat are perfectly clean and that the sensor is secured firmly. Failure to observe these points could lead to damage to the engine, because a poorly mounted sensor will not pick up knocking (pinking) and the appropriate ignition correction will not be applied.

#### Oxygen sensor - models with a catalytic converter

**93** Bring the engine to operating temperature, then switch it off and disconnect the battery.

**94** Disconnect the oxygen sensor multi-plug, which is located near the right-hand suspension turret (see illustration). Free the wiring leading to the sensor.

**95** Working under the vehicle, unscrew the sensor from the exhaust manifold (see illustration).

**96** Refitting is the reverse of the removal procedure. Note that the makers specify the use of a special anti-seize compound made of graphite and glass beads. New sensors are provided with their threads already coated with this compound. When refitting a used sensor, obtain some of the special compound from a Vauxhall dealer.

#### Carbon canister - 16-valve models with a catalytic converter

**97** Raise the front of the vehicle and remove the left-hand roadwheel.

**98** Slacken the canister clamp nut. Release the canister from the clamp, disconnect the

hoses from it and remove it (see illustrations). Treat the canister with the same precautions as would apply to a fuel tank - it may be full of vapour.

**99** Refitting is the reverse of the removal procedure.

#### Vent valve - 16-valve models with a catalytic converter

**100** Disconnect the multi-plug and the hoses from the vent valve (see illustration). Unbolt the valve bracket and remove the valve and bracket.

**101** Refitting is the reverse of the removal procedure.

### 13 Inlet manifold - removal and refitting

#### Removal

##### 1.4 and 1.6 litre models

**1** Refer to the information given in Section 11, Chapter 4A, for information on the various electrical components which must be disconnected.

##### 1.8 litre models

**2** Disconnect the battery earth lead.

**3** Disconnect the injection wiring harness plugs and earth connections as follows:

- a) Airflow meter plug.
- b) Coolant temperature sensor (see illustration).
- c) Fuel injectors (see illustration).
- d) Throttle valve switch (see illustration).

e) Auxiliary air valve (see illustration).

f) Cam cover earth tags.

**4** Disconnect the distributor vacuum hose from the throttle valve housing (see illustration).

**5** Depressurise the cooling system by unscrewing the expansion tank cap, taking precautions against scalding if the system is hot. Disconnect and plug the coolant hoses from the throttle valve housing.

**6** Disconnect the air inlet duct from the housing.

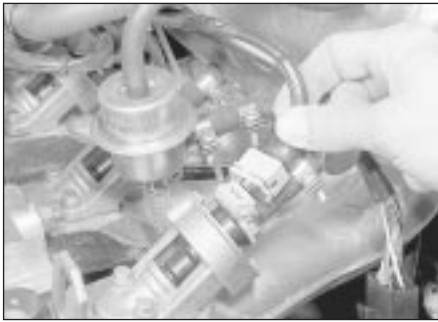
**7** Disconnect the brake servo and crankcase ventilation hoses from the housing.

**8** Disconnect and plug the fuel hoses from the fuel rail stubs. The hoses are different sizes and one of them carries a white band for identification. Be prepared for fuel spillage.

**9** Disconnect the accelerator cable from the throttle levers. The cable inner is secured by a



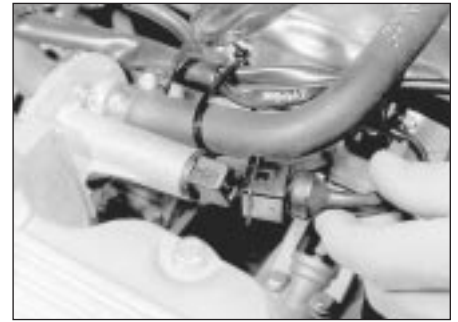
13.3a Coolant temperature sensor plug (arrowed)



13.3b Disconnecting a fuel injector plug



13.3c Unplugging the throttle valve switch lead connector



13.3d Unplugging the auxiliary air valve

wire clip, and the outer is retained in its bracket by an E-clip (see illustration).

**10** Unscrew the nuts which secure the inlet manifold to the cylinder head. The lower nuts are different to reach: a small socket or ring spanner will be needed.

**11** Lift away the manifold and recover the gasket (see illustrations).

#### 2.0 litre 8-valve models

**12** Refer to the information given above in paragraphs 2 to 11, noting the hose connections shown (see illustration).

#### 2.0 litre 16-valve models

**13** Disconnect the battery earth (negative) lead.

**14** Drain the cooling system (see Chapter 1).

**15** Remove the pre-volume chamber, the air mass meter and its trunking as described in Section 12.

**16** Remove the alternator drivebelt and the

adjuster strap nut and bolt (see Chapter 1).

**17** Disconnect the throttle cable from the throttle housing. Pull the cable out of the retainer and move it aside (see illustration).

**18** Remove the 9 nuts which secure the manifold to the cylinder head. These are all stiff and some are not easily accessible; a socket with a "wobble drive" or universal joint will be needed. Once the nuts are removed, slide the manifold back on its studs to improve access to the injector wiring rail.

**19** Disconnect the two breather hoses from the camshaft cover.

**20** Disconnect the injector wiring rail from the injectors as described earlier.

**21** Release the earth straps from each end of the fuel rail.

**22** If a vent valve is fitted, disconnect the multi-plug and the hose from it.

**23** Disconnect the throttle position switch multi-plug.

**24** Bearing in mind the information given in Section 6, disconnect the fuel supply and return unions from the fuel rail. Be prepared for fuel spillage.

**25** Release the fuel supply hose bracket from the throttle housing.

**26** Release the cable tie which secures the coolant hoses to the right-hand side of the manifold.

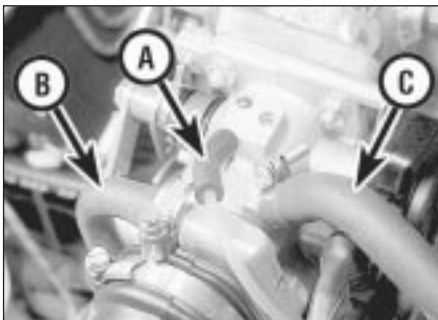
**27** Disconnect the brake servo vacuum hose and the large coolant hose from the base of the manifold (see illustrations).

**28** Unhook the clutch cable from the bracket behind the manifold.

**29** Disconnect the small coolant hose from the expansion tank.

**30** Disconnect the air hose which connects the idle speed adjuster to the base of the manifold.

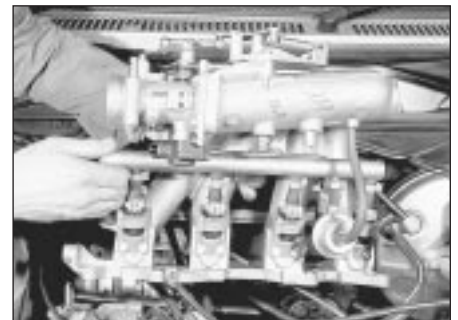
**31** With the help of an assistant, lift the manifold to gain access to the idle speed



13.4 Distributor vacuum hose (A), coolant hose (B) and breather (C) on throttle housing



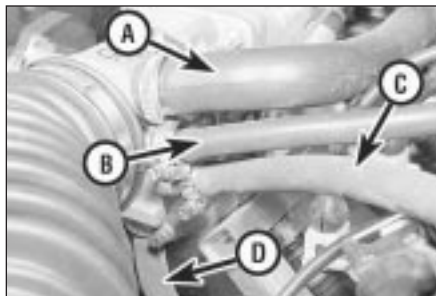
13.9 Accelerator cable at engine end



13.11a Removing the inlet manifold - 1.8 litre model



13.11b Inlet manifold showing injectors fuel rail and associated components



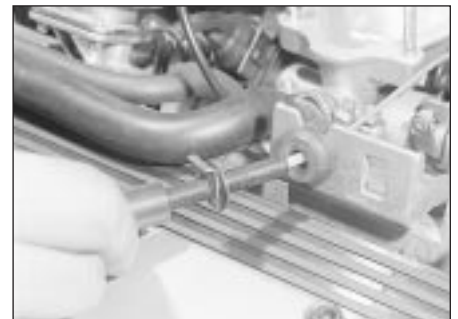
13.12 Throttle valve housing - ML4.1

A Hose from idle speed adjuster

B Crankcase ventilation hose

C Coolant hose

D Coolant hose



13.17 Pulling the throttle cable out of the retainer



13.27a Disconnect the brake servo hose . . .

adjuster and the knock sensor. Disconnect the multiplugs from these components and feed the wiring harness back through the manifold.

32 Remove the manifold complete with fuel rail and injectors (see illustration). Recover the gasket.

### Refitting

33 Refitting is the reverse of the removal procedure, noting the following points:

- a) Use a new manifold gasket (see illustration).



13.33 Fitting a new inlet manifold gasket



13.27b . . . and the large coolant hose

b) Tighten the manifold nuts to the specified torque.

c) Refill and bleed the cooling system as described in Chapter 1.

## 14 Exhaust manifold - removal and refitting

### Removal

#### 2.0 litre 16-valve models

1 Raise and securely support the front of the vehicle (see "Jacking and Vehicle Support").

2 Disconnect the battery earth (negative) lead.

3 Remove the manifold heat shield, which is secured by three bolts at the top and two of the manifold nuts at the bottom (see illustration).

4 Remove the remaining 10 nuts which secure the manifold.

5 On models with an oxygen sensor, disconnect the sensor multiplug (near the right-hand suspension mounting) and free the wiring leading to the sensor.

5 Working under the vehicle, unbolt the manifold-to-exhaust system flexible joint and



13.32 Removing the inlet manifold - 2. litre 16-valve model

support bracket (see illustration).

6 Lift away the manifold and recover the gasket.

### All other models

7 Refer to Chapter 4A. On models with an oxygen sensor, disconnect the sensor multiplug and free the wiring to prevent it being strained whilst the manifold is removed.

### Refitting

8 Refitting is the reverse of the removal procedure, using a new manifold gasket (see illustration).

## 15 Exhaust system - inspection, removal and refitting

1 Refer to Chapter 4A. On models with an oxygen sensor, it will be necessary to disconnect the sensor multi-plug and free the wiring from its retaining clips before removal. On refitting ensure the sensor wiring is correctly routed and in no danger of contacting the exhaust system.



14.3 Removing an exhaust manifold heat shield bolt



14.5 Manifold-to-exhaust system joint and bracket



14.8 Fitting a new exhaust manifold gasket