Chapter 4 Part B:
Fuel system - multi-point injection

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

System type

1.2 litre models	Bosch Motronic 1.5.5 engine management system
1.6 litre models	Weber IAW engine management system
1.8 litre models	Hitachi engine management system

Fuel system data

Fuel pump type	Electric, immersed in fuel tank
Fuel pump delivery rate	120 litres/hour
Regulated fuel pressure	3.0 bar
Coolant temperature sensor:	
At -10°C	9000 to 10 000 ohms
At 0°C	5700 to 6300 ohms
At 30°C	1600 to 1700 ohms
At 100°C	137 to 133 ohms
Inlet air temperature sensor:	
At 0°C	5300 to 6500 ohms
At 10°C	3400 to 4200 ohms
At 20°C	2300 to 2700 ohms
Injector electrical resistance:	
1.2 litre models	16.2 ohms
1.6 litre models	13.7 to 15.2 ohms
1.8 litre models	10.8 to 13.2 ohms
Engine idle speed (non-adjustable):	
1.2 litre models	800 ± 30 rpm
1.6 litre models	800 ± 30 rpm
1.8 litre models	850 ± 50 rpm
Exhaust emissions limit:	
CO	0.35 % maximum

Recommended fuel

Minimum octane rating	95 RON unleaded (Premium unleaded)

Torque wrench settings

	Nm	lbf ft
Coolant temperature sensor	25	18
Inlet manifold:		
1.2 litre	15	11
1.6 litre	30	22
1.8 litre	25	18

1 General information and precautions

General information

Three different types of engine management system are fitted to the multi-point fuel injection models covered in this Chapter. Each of the systems covered here is a self-contained engine management system, controlling both the fuel injection and ignition functions. This Chapter deals with the fuel injection system components only - refer to Chapter 5B for details of the ignition system components. Chapter 4A covers the fuel injection system components fitted to 1.4 litre models with single-point fuel injection.

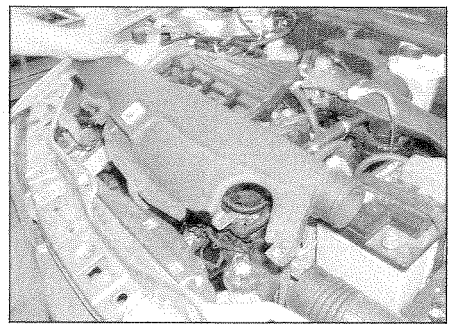
The engine management systems are very similar in their design and operation; similarities and differences are outlined in the following text.

The fuel injection system comprises a fuel tank with an electric fuel pump, a fuel filter, fuel supply and return lines, a throttle body, a fuel rail with four electromagnetic fuel injectors, and an Electronic Control Unit (ECU) together with its associated sensors, actuators and wiring.

The fuel pump has an integrated fuel gauge level sender and is mounted inside the fuel tank, immersed in the fuel. It delivers a constant supply of fuel through a cartridge filter to the throttle body and fuel pressure regulator (which is mounted on the fuel rail). The pressure regulator maintains a near-constant fuel pressure at the fuel injectors, and returns excess fuel to the tank via the return line. This constant-flow system also helps to prevent localised fuel heating in the engine compartment, reducing the fuel vaporisation that can cause difficult hot starting. Note that all 1.2 litre, and later 1.6 litre, models do not have a fuel return line or fuel rail-mounted pressure regulator; the pressure regulator is housed inside the fuel pump itself, in the fuel tank.

The electromagnetic, pintle-type fuel injectors are opened and closed by an Electronic Control Unit (ECU), which calculates the injection timing and duration according to engine speed, throttle position and rate of opening, engine load, coolant temperature and exhaust gas oxygen content information, received from sensors mounted on and around the engine. The injectors are operated sequentially, so that the required quantity of fuel for each cylinder is injected once per cycle, on the induction stroke only. During starting, engine timing cannot be established until the crankshaft has started and rotated at least twice. During this time, banked injection is employed, ie fuel is injected into all cylinders simultaneously until the correct timing can be established.

1.2 and 1.6 litre models measure engine load by calculating the mass of air entering the engine. This is achieved by monitoring signals from the inlet air temperature and inlet manifold vacuum sensors; air volume and density measurements can be derived from these sensors, allowing air mass to be calculated.

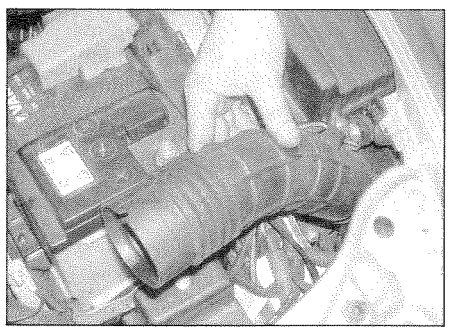


2.1 Removing the air intake

1.8 litre models use a different approach - the mass of air entering the engine is measured directly by a hot-wire type mass airflow meter. Air passing through the meter cools an electrically-heated wire filament, the amount of cooling is proportional to the air mass flow rate. The cooling has the effect of altering the electrical resistance of the filament and this in turn alters the signal voltage produced by the meter and sent to the ECU. As the mass air mass flow rate is measured directly, there is no requirement for an inlet air temperature sensor or a manifold absolute pressure sensor.

Inlet air is drawn into the engine through the air cleaner, which contains a renewable paper filter element.

Idle speed is controlled principally by an idle speed actuator, mounted on the side of the throttle body. On 1.6 litre and 1.8 litre models, the actuator controls a valve which alters the amount of air that bypasses the main throttle valve. On 1.2 litre models, the idle actuator acts directly on the throttle valve, rather than controlling a separate bypass valve. In addition, fine control of the idle speed is achieved by the ECU advancing or retarding the ignition timing in small increments, to adjust the torque produced by the engine. Loads that can have a sudden significant effect on engine idle speed (such as the air conditioning, power steering and automatic transmission systems) are monitored via additional sensors. When such loads are detected, the ECU increases the engine idle speed to prevent stalling.



2.2 Removing the first section of air inlet duct

Information on the degree of throttle opening, and the rate of its change, is provided by the throttle potentiometer (or position sensor). This device is effectively a variable resistor attached to the throttle valve. Its most important function is to signal the ECU when the throttle is in the idle (closed) or full-throttle (wide open) positions.

The ECU provides cold starting fuel mixture enrichment by monitoring the coolant and inlet air temperature parameters and increasing the injector opening duration accordingly.

The exhaust gas oxygen content is constantly monitored by the ECU via the oxygen (lambda) sensor, which is mounted in the exhaust downpipe. The ECU then uses this information to modify the injection timing and duration to maintain the optimum air/fuel ratio. An exhaust catalyst is fitted to all models. The ECU also controls the operation of the activated charcoal filter evaporative loss system - refer to Chapter 4D for further details.

Precautions

Many procedures in this Chapter require the removal of fuel lines and connections, which may result in 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 that residual pressure will remain in the fuel lines long after the vehicle was last used. When disconnecting any fuel line, first depressurise the fuel system (see Section 7).

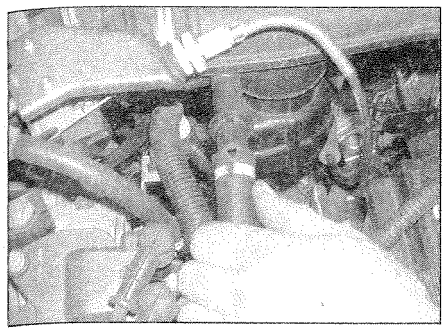
2 Air cleaner and inlet system - removal and refitting

Removal

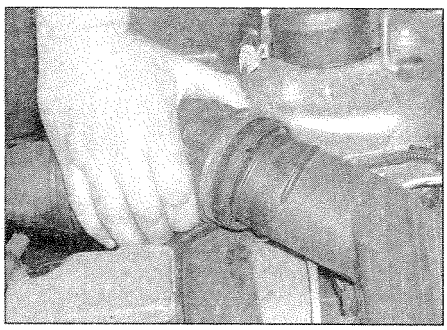
1 Unscrew and remove the two bolts from the front crossmember, and lift out the air intake, disconnecting it from the air inlet duct leading to the air cleaner (slacken the securing clip, where applicable) **(see illustration).**

2 The first section of the air inlet duct can be removed from the air cleaner either by slackening the securing clip, or by pulling and twisting the duct to release it **(see illustration).**

3 On 1.8 litre models, a resonator box is fitted under the front crossmember. This can be removed if required by slackening the clip securing the air hose to the air cleaner elbow, and then removing the bolt securing the resonator to the front crossmember.

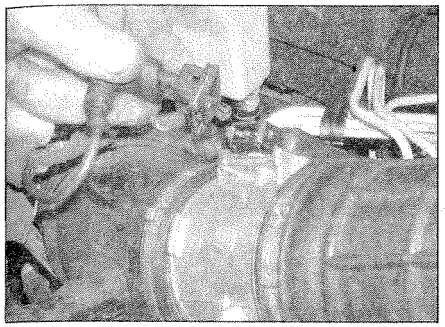


2.5 Disconnecting the breather hose from the air inlet duct

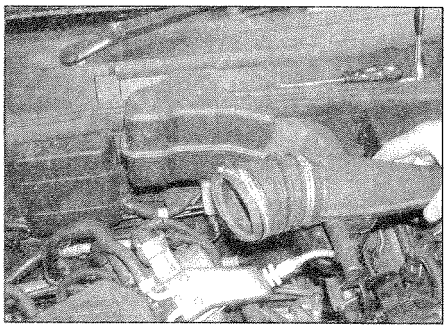


2.6 Disconnecting the air inlet duct from the air cleaner lid

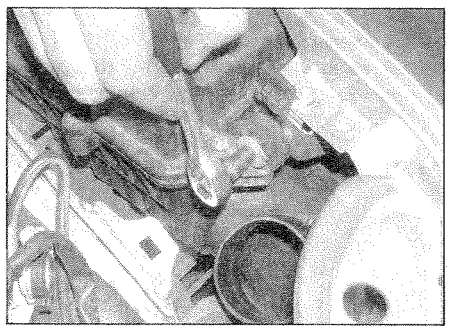
2.7a Unscrew and remove the airflow meter mounting bolts . . .



2.7b . . . then disconnect the airflow meter wiring plug



2.8 Removing the air inlet duct



2.9a To remove the air cleaner, undo the bolt at the front . . .

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

5 Where applicable, slacken the clips and disconnect the crankcase ventilation hoses from the main air inlet duct that connects the throttle body to the air cleaner **(see illustration)**.

6 If not already done, release the clip and detach the main air inlet duct from the air cleaner lid **(see illustration)**.

7 On 1.8 litre models, unscrew the two bolts securing the airflow meter to its mounting bracket, then disconnect the wiring plug **(see illustrations)**. Unless the airflow meter is being worked on, it is best to remove the meter with the inlet duct - otherwise the two clips at either end of the meter must be disturbed.

8 Release the hose clips securing the main intake duct to the throttle body, then pull the duct away from the throttle body **(see illustration)**. Recover the sealing ring (where fitted). Check the ring for condition and renew it if necessary.

9 Slacken and withdraw the securing bolts **(see illustrations)** and lift the air cleaner from the engine compartment, noting the following points:

a) On 1.2 litre models, it will be necessary to disconnect the secondary resonator pipe before removing the intake duct.

b) On the models seen in our workshop, it was found that the air cleaner would not come out upwards, and in fact the left-hand wheelarch liner had to be removed to lower the air cleaner from its location.

Refitting

10 Refitting is a reversal of removal.

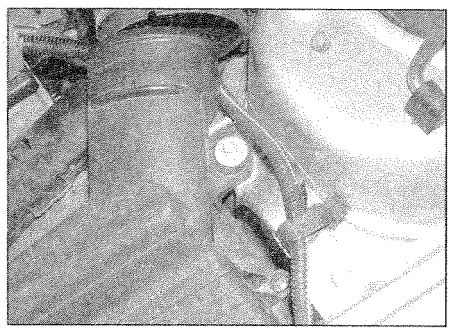
3 Accelerator cable - removal, refitting and adjustment

Removal

1 Disconnect the battery negative cable and position it away from the terminal as described in Chapter 5A.

2 Working in the driver's footwell, undo the three securing screws and remove the footrest. Remove the trim panels from the underside of the facia, as necessary to gain access to the foot pedal mountings.

3 Release the plastic eyelet at the end of the accelerator cable from the spigot at the top of the accelerator pedal linkage.

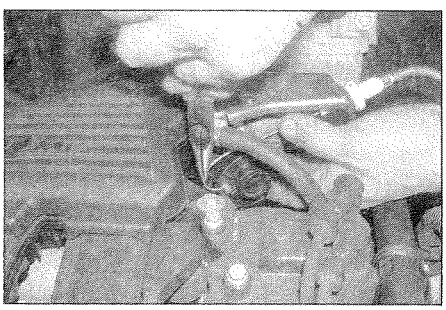


2.9b . . . and at the rear, securing the air cleaner to the inner wing

4 Relieve the tension from the accelerator cable by grasping the throttle quadrant and turning it by hand. Unhook the nipple at the end of the cable inner from the throttle quadrant **(see illustration)**.

5 Working at the accelerator cable mounting bracket, unscrew the adjuster sleeve (or remove the adjustment clip), then withdraw the accelerator cable outer from the bracket grommet. Prise the grommet from the bracket (where necessary) and move the cable away from the throttle body **(see illustration)**. Note that on earlier 1.6 litre models, the cable outer is secured to the bracket by means of a metal spring clip. Slide the clip free to release the cable from the bracket, but note the slot to which clip was fitted, to aid refitting.

6 Release the accelerator cable from the clip located underneath the power steering fluid reservoir, at the rear of the engine compartment.



3.4 Open the throttle by hand, and unhook the cable end fitting from the throttle quadrant

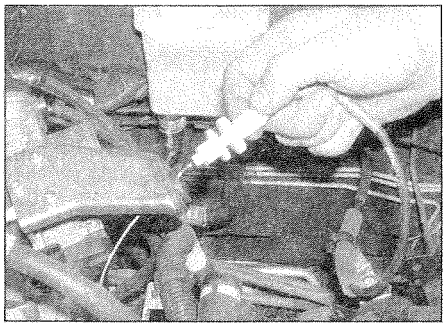
7 Unscrew and remove the nut securing the plastic cable mounting to the bulkhead, and release the mounting from the grommet in the bulkhead **(see illustration)**.
8 Withdraw the accelerator cable through the bulkhead aperture from the inside of the vehicle into the engine compartment.

Refitting

9 Refitting is a reverse of the removal process. On completion, adjust the cable as described in the next sub-Section.

Adjustment - early 1.6 litre models

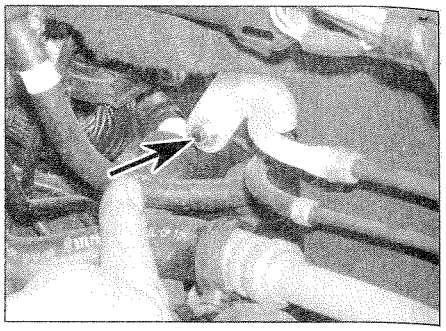
10 Working at the cable mounting bracket adjacent to the throttle body in the engine compartment, remove the spring clip from the slotted section of the accelerator cable outer.
11 Pull the cable lightly through the mounting bracket to tension it, so that all slack in the cable inner is taken up, however do apply so much tension that the throttle disc starts to turn.
12 Press the spring clip into the nearest accessible slot in cable outer, so that the clip bears against the surface of the mounting bracket.
13 Check that throttle disc is positioned against its end stop - if it is not, there is too much tension in the accelerator cable - correct this by repositioning the spring clip in the adjacent slot **(see illustration)**. When correctly adjusted, the accelerator cable should eliminate any free movement at the accelerator pedal; check this by moving the pedal by hand.



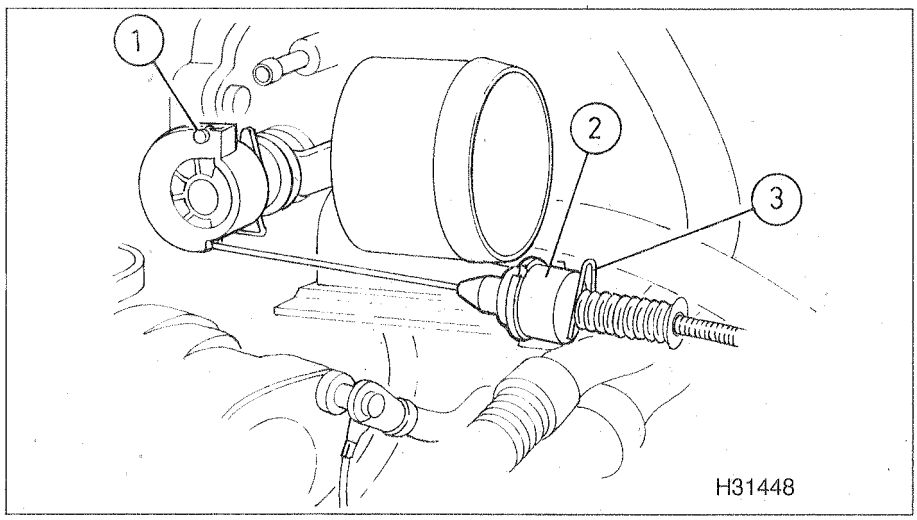
3.5 Unscrew the adjuster and release the cable end fitting from its mounting bracket

Adjustment - 1.2 litre, later 1.6 litre and 1.8 litre models

14 Working at the cable mounting bracket adjacent to the throttle body in the engine compartment, loosen the locknut (where fitted) and turn the adjustment sleeve until all slack is removed from the cable inner **(see illustration)**.
15 Check that throttle disc is positioned against its end stop - if it is not, there is too much tension in the accelerator cable - slacken the adjustment sleeve slightly. When correctly adjusted, the accelerator cable should eliminate any free movement at the accelerator pedal; check this by moving the pedal by hand.
16 With the engine switched off, have an assistant depress the accelerator pedal fully, then check that the throttle disc is wide open by looking down into the throttle body. Repeat the adjustment process if this is not the case. Where applicable, tighten the locknut on completion.



3.7 Accelerator cable guide securing nut (arrowed)



3.13 Cable end fitting (1), grooved cable outer (2) and spring clip (3)

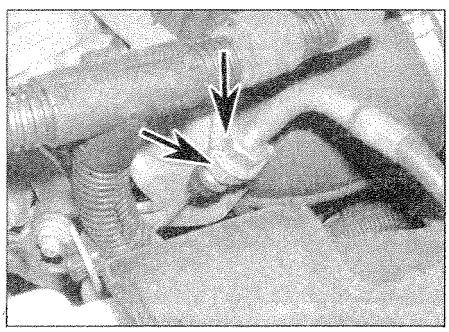
4 Engine management system components - removal and refitting

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

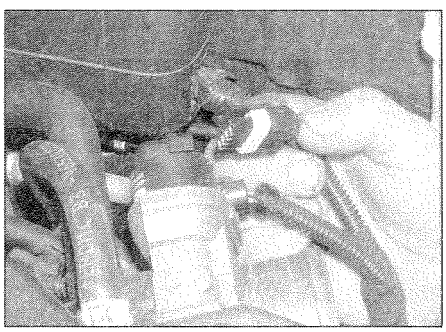
Throttle body assembly

Removal

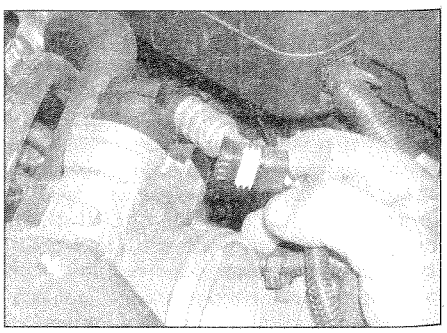
1 Disconnect the negative cable from the battery terminal.
2 With reference to Section 2, remove the section of air inlet duct that connects the throttle body to the air cleaner.
3 Unplug the wiring connectors from the idle air control valve and the throttle potentiometer **(see illustrations)**.



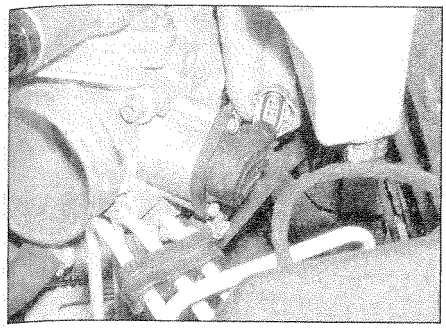
3.14 Accelerator cable locknut and adjuster nut (arrowed) - 1.8 litre model



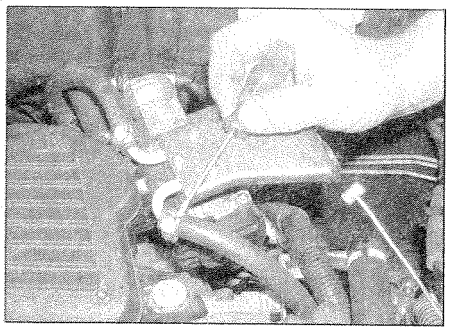
4.3a Disconnect the idle air control valve . . .



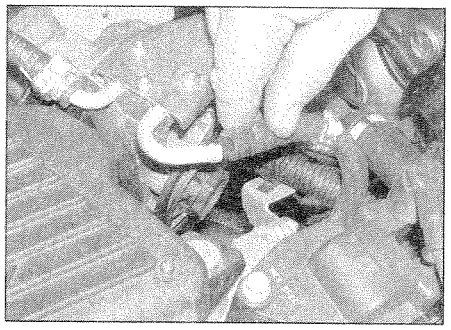
4.3b . . . and the throttle potentiometer (1.6 litre model)



4.3c Disconnecting the throttle potentiometer on a 1.8 litre model



4.6a Release the hose clips . . .



4.6b . . . then disconnect the coolant hoses from the throttle body

4 With reference to Section 3, release the accelerator cable inner from the throttle quadrant, then free the cable outer from its retaining bracket. Position the cable clear of the throttle body.

5 Where applicable, release the clips and disconnect the EVAP purge valve and crankcase ventilation hoses from the throttle body.

6 On 1.6 litre and 1.8 litre models, apply clamps to the coolant hoses leading to and from the throttle body, then release the clips and disconnect the hoses from the throttle body ports **(see illustrations)**.

7 Release the wiring harness as necessary from the clips in the vicinity of the throttle body, noting how it is routed.

8 Slacken and remove the bolts securing the throttle body assembly to the inlet manifold, then remove the assembly along with its insulating spacer (where fitted). On later 1.6 litre models, note the wiring harness bracket which is retained by one of the throttle body bolts - move it to one side **(see illustrations)**.

Refitting

9 Refitting is a reversal of the removal procedure, bearing in mind the following points:

a) Examine the insulating spacer for signs of damage, and renew if necessary.

b) Ensure the throttle body, inlet manifold and insulating spacer mating surfaces are clean and dry, then fit the throttle body and spacer, and securely tighten the retaining bolts.

c) Where applicable, ensure all hoses are correctly reconnected and that their retaining clips are securely tightened.

d) Adjust the accelerator cable as described in Section 3.

Fuel rail and injectors

Removal

Warning: Ensure that the engine has cooled completely before starting work.

10 Depressurise the fuel system as described in Section 7.

11 On 1.2 and 1.6 litre models, remove the throttle body assembly as described earlier in this Section.

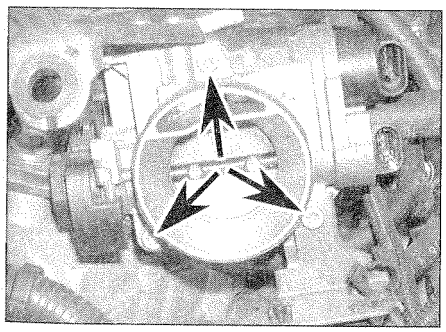
12 On 1.2 and 1.6 litre models, remove the upper section of the inlet manifold as described in Section 8. On 1.6 litre models, the lower section of the inlet manifold must also be removed - see Section 8.

13 Loosen the clips and disconnect the fuel inlet and outlet hoses from the fuel rail, or at the rear of the engine compartment - be prepared for some fuel spillage. Note the fitted positions of the hoses to aid refitting later. Later models are equipped with quick-release fuel hose couplings, which are released by squeezing the sides of the coupling, and pulling apart **(see illustrations)**.

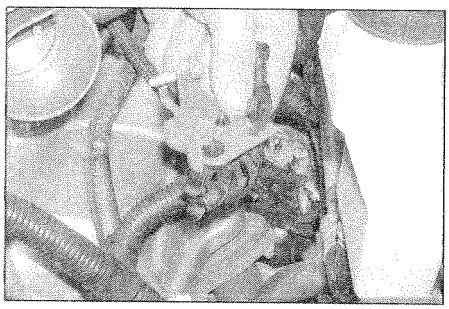
14 Unplug the main injector wiring harness connector, where applicable **(see illustration)**.

15 Disconnect the vacuum hose from the fuel pressure regulator (early 1.6 litre models, and all 1.8 litre models) **(see illustration)**.

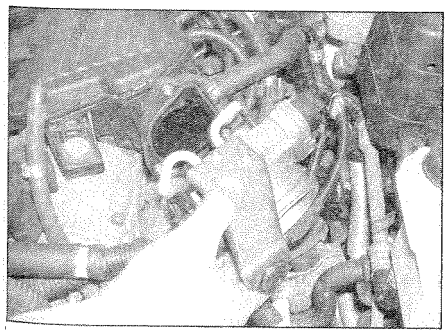
16 Unscrew the bolts securing the fuel rail assembly to the inlet manifold, then carefully pull the fuel rail, together with the fuel injectors, from the inlet manifold **(see illustrations)**.



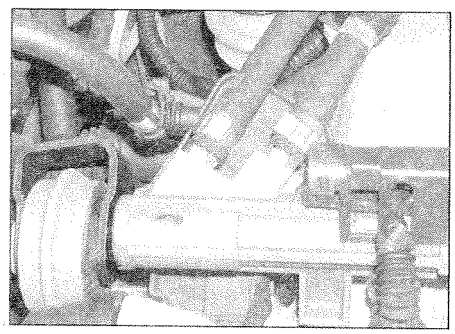
4.8a Throttle body securing bolts (arrowed) - 1.6 litre model



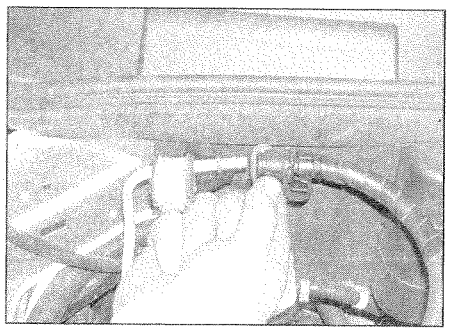
4.8b On 1.6 litre models, one of the throttle body bolts secures this wiring harness bracket



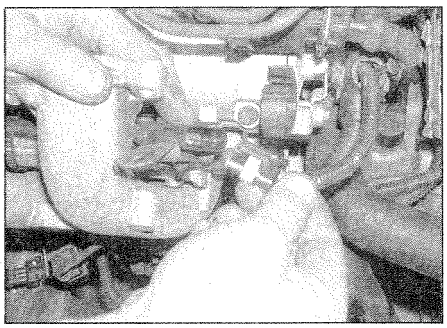
4.8c Removing the throttle body



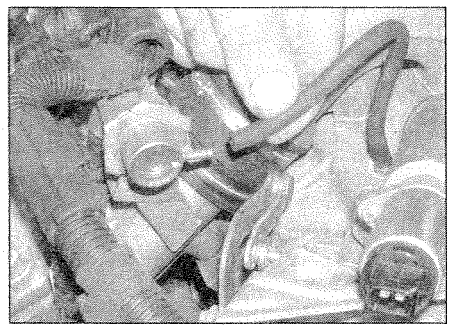
4.13a Fuel hose connections and arrow markings - 1.8 litre model



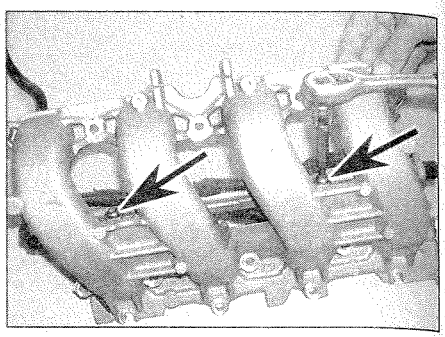
4.13b Disconnecting a quick-release fuel line - 1.6 litre model



4.14 Disconnecting the injector wiring - 1.6 litre model



4.15 Disconnecting the fuel pressure regulator vacuum hose - 1.8 litre model

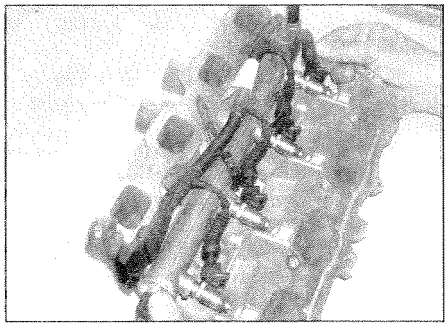


4.16a Unscrew the fuel rail mounting bolts (arrowed) . . .

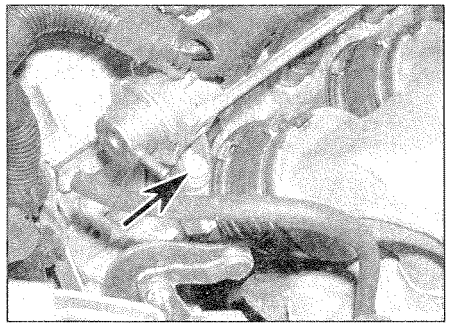
17 Remove the assembly from the engine and remove the injector lower O-ring seals **(see illustrations)**.

18 The injectors can be removed individually from the fuel rail by unplugging the relevant wiring connector, sliding out the metal clip (where fitted) and easing the injector from the rail. Remove the injector upper O-ring seals **(see illustrations)**.

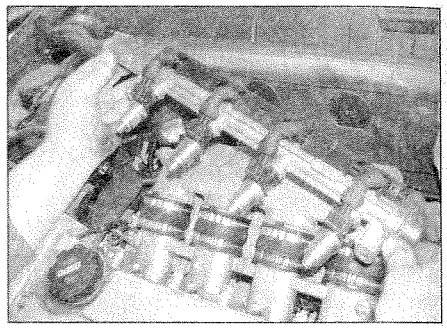
19 On models so equipped, remove the retaining clip, or undo the securing screws (as applicable) and withdraw the fuel pressure regulator from the fuel rail **(see illustration)**. Recover the seal, and renew if necessary.



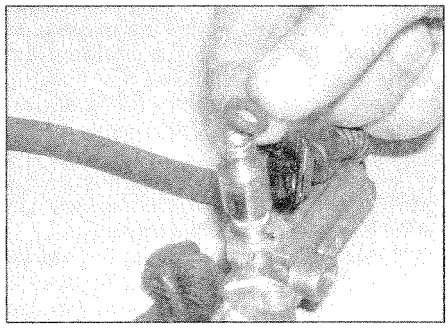
4.16b . . . and remove the fuel rail assembly from the inlet manifold - 1.6 litre model



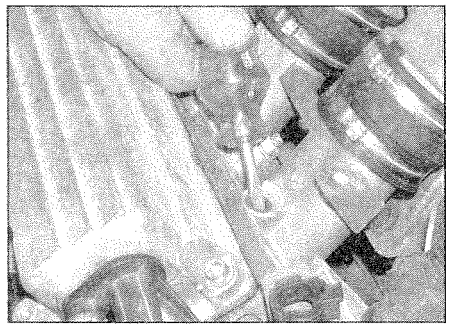
4.16c One of the fuel rail mounting bolts . . .



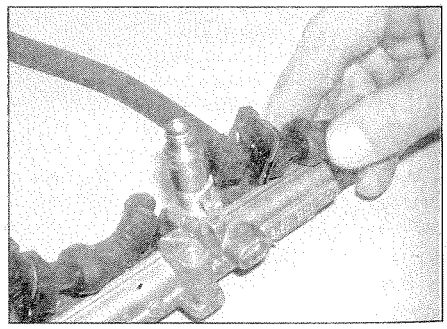
4.16d . . . and removing the fuel rail on a 1.8 litre model



4.17a Removing the injector lower O-ring seals on a 1.6 litre model . . .

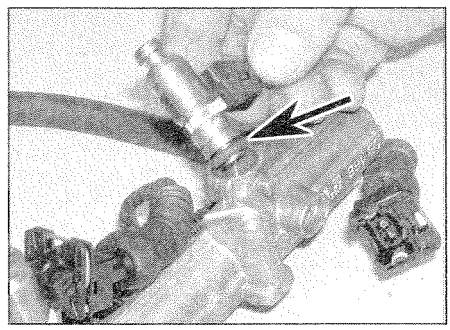


4.17b . . . and prising them out on a 1.8 litre model

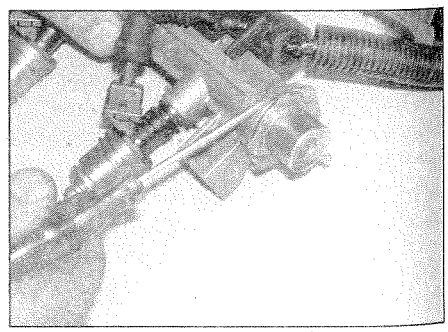


4.18a Disconnect the injector wiring plug . . .

4.18b . . . slide out the locking clip (where fitted) . . .



4.18c . . . and remove the injector from the fuel rail (O-ring seal arrowed)



4.19 Prise off the pressure regulator retaining clip to remove it

Refitting

20 Refit the injectors and fuel rail by following the removal procedure, in reverse, noting the following points:

a) Renew the O-ring seals before refitting the injectors. Take care when fitting the injectors to the fuel rail, and do not press them in further than required to fit the retaining clip, otherwise the O-ring seal may be damaged.

b) Ensure that the injector retaining clips are securely seated.

c) Make sure the fuel supply hose (and where applicable, the fuel return hose) are correctly fitted as noted on removal.

d) Check that all vacuum and electrical connections are remade correctly and securely.

e) On completion check the fuel rail and injectors for fuel leaks.

Fuel pressure regulator

Note: *Later models with the 'returnless' fuel system (see Section 1) have their pressure regulator mounted inside the fuel pump/sender unit in the fuel tank. Refer to Section 5 for details of pump/sender unit removal.*

Removal

Early 1.6 litre models

21 Remove the throttle body assembly as described earlier in this Section.

22 Depressurise the fuel system as described in Section 7.

23 Unplug the wiring connectors from the inlet air temperature and manifold pressure sensors.

24 Release the clip and disconnect the EVAP hose from the inlet manifold port.

25 Remove the upper section of the inlet manifold with reference to Section 8.

26 Disconnect the vacuum hose from the port on the side of the regulator.

27 Extract the retaining clip and pull the pressure regulator out of the fuel rail; recover the O-ring seal.

1.8 litre models

28 Remove the fuel rail and injectors as described earlier in this Section.

29 Disconnect the vacuum hose from the port on the side of the regulator.

30 Extract the retaining clip and pull the pressure regulator out of the fuel rail; recover the O-ring seal.

Refitting

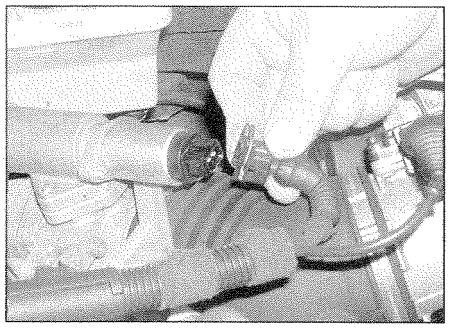
31 Refit the fuel pressure regulator by following the removal procedure in reverse. Renew the O-ring seal and refit the vacuum hose securely.

Idle air control valve (1.6 and 1.8 litre models)

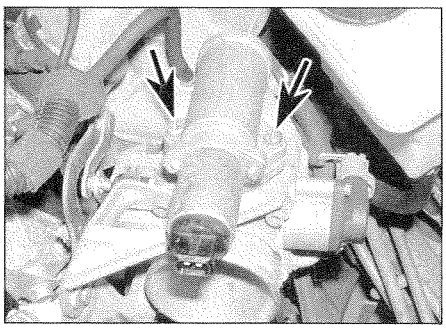
Removal

32 Disconnect the battery negative cable, then unplug the wiring connector from the actuator valve **(see illustration)**.

33 On early models, undo the securing screws and withdraw the valve from the throttle body **(see illustration)**; on later models, unscrew the unit itself.



4.32 Disconnect the idle air control valve wiring plug



4.33 Idle air control valve retaining screws (arrowed)

Refitting

34 Refit the actuator by following the removal procedure in reverse. Noting the following points:

a) Clean the threads of the screws or valve body, and apply a coat of locking compound to the threads before refitting.

b) Take great care to ensure that the plunger is correctly aligned with its bore, before tightening the actuator securing screws.

c) Delay reconnecting the battery negative cable for about 20 minutes. After this, the ECU will correctly reposition the idle actuator valve when the engine is started for the first time.

Idle actuator (1.2 litre models)

Note: *On 1.2 litre models, the throttle potentiometer is integral with the idle actuator.*

35 Disconnect the battery negative cable, then unplug the wiring connector from the actuator valve.

36 Undo the securing screws and withdraw the valve from the throttle body.

Refitting

37 Refit the actuator by following the removal procedure in reverse.

Throttle potentiometer

Note: *On 1.2 litre models, the throttle potentiometer is integral with the idle actuator.*

38 Disconnect the battery negative cable, then unplug the wiring connector from the potentiometer.

39 On early models, undo the securing screws and withdraw the valve from the throttle body **(see illustration)**; on later models, the potentiometer appears to be integral with the throttle body.

Refitting

40 Refit the potentiometer by following the removal procedure in reverse, noting the following points:

a) Note that the mounting holes are not slotted; no adjustment of the potentiometer's position is possible or necessary, as the ECU adapts to the potentiometer and 'learns' the idle and full throttle positions.

b) On 1.8 litre models, ensure that drive dog on the sensor rotor is above the corresponding pin on the throttle disc shaft, when the sensor is refitted.

c) Clean the threads of the screws or valve body, and apply a coat of locking compound to the threads before refitting.

Intake air temperature sensor

Removal

41 On 1.2 litre and later 1.6 litre models, the intake air temperature sensor is integral with the manifold absolute pressure (MAP) sensor. On 1.8 litre models, an intake air temperature sensor is not fitted (see Section 1). On early 1.6 litre models, the sensor is mounted at the rear of the upper section of the inlet manifold.

42 Ensure that the ignition is switched off, then unplug the wiring from the sensor at the connector.

43 Unscrew the sensor from the manifold, taking care to avoid damaging the plastic connector.

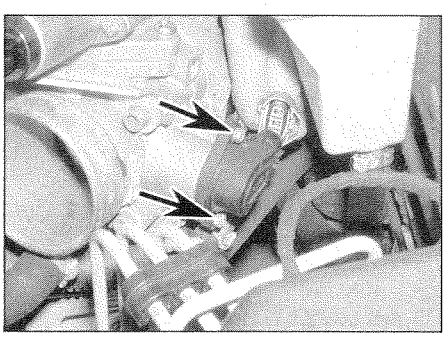
Refitting

44 Refit the sensor by following the removal procedure in reverse.

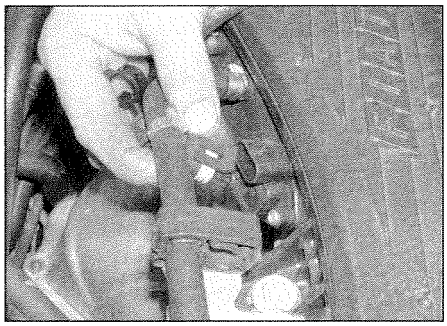
Manifold absolute pressure (MAP) sensor

Removal

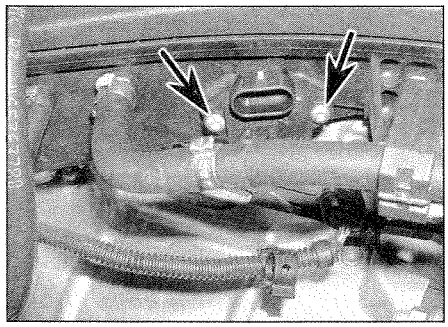
45 On early 1.6 litre models, the MAP sensor is mounted on a bracket at the rear of the engine compartment. Ensure that the ignition is switched off, then unplug the vacuum hose and wiring connector from the sensor, undo



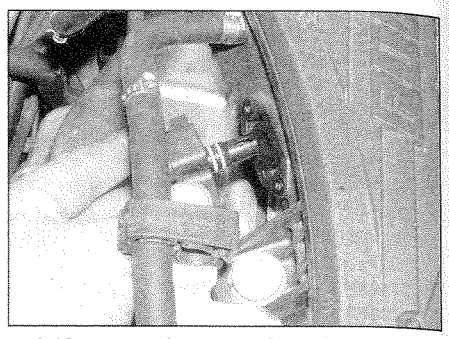
4.39 Disconnect the throttle potentiometer wiring plug - securing screws arrowed



4.46a Unplug the wiring connector . . .



4.46b . . . then unscrew the retaining screws (arrowed) . . .



4.46c . . . and remove the MAP sensor from the inlet manifold

the three securing screws and remove the sensor from its bracket. Refitting is a reversal of removal.

46 On 1.2 litre models and later 1.6 litre models, the combined MAP/inlet air temperature sensor is fitted to the right-hand end of the inlet manifold. Ensure that the ignition is switched off, then unplug the wiring connector from the sensor, undo the securing screws and remove the sensor **(see illustrations)**.

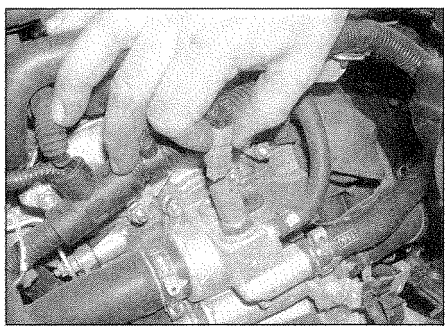
47 A MAP sensor is not fitted to 1.8 litre models (see Section 1).

Refitting

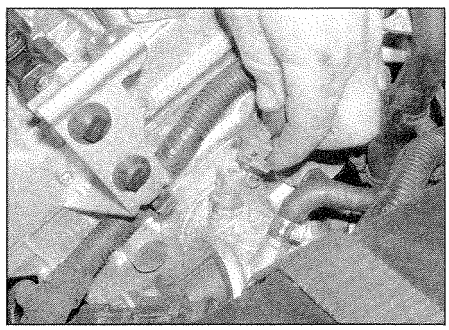
49 Refitting is a reversal of removal.

Coolant temperature sensor

50 On 1.2 litre models, the coolant temperature sensor is located at the rear of the cylinder head on the left-hand side. On 1.6 litre and 1.8 litre models, the sensor is located at the left-hand end of the engine, on the thermostat housing.



4.51a Disconnecting the coolant temperature sensor on a 1.6 litre model . . .



4.51b . . . and on a 1.8 litre model

51 Drain the cooling system with reference to Chapter 1, or be prepared for coolant spillage. Ensure that the ignition is switched off, then unplug the wiring from the sensor at the connector **(see illustrations)**.

52 Unscrew the sensor and remove it from the cylinder head. Recover the sealing washer where fitted. If using a socket, take care not to damage the wiring connector on the sensor.

Refitting

53 Refitting is a reversal of removal. Where applicable, fit a new sealing washer. Tighten the sensor to the specified torque. Do not exceed the specified torque, otherwise the unit's threads may be damaged.

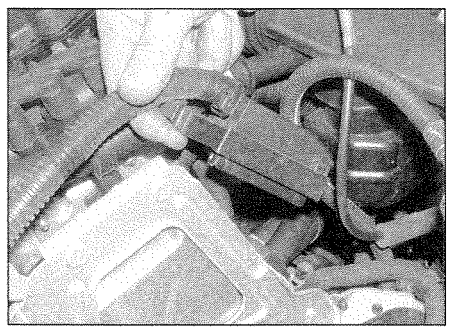
Electronic control unit (ECU)

Note: *The ECU communicates with the anti-theft/immobiliser system when the vehicle is started. Once the ignition key electronic code has been stored by the ECU, the unit cannot be used on any other vehicle. For this reason, do not attempt to diagnose problems with the engine management system by connecting the ECU to another vehicle, or by substituting an ECU from another vehicle.*

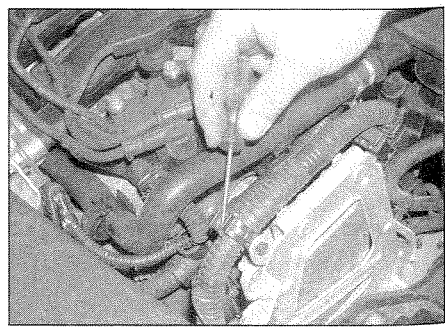
54 Disconnect the negative cable from the battery terminal as described in Chapter 5A, before starting work.

1.2 litre models

55 On 1.2 litre models, the ECU is mounted at the rear left-hand corner of the engine compartment. The multiway harness connectors are secured in position by locking bars. To release the connectors, pivot the locking bars upwards and then pull the connectors squarely away from the ECU. The ECU can then be removed by slackening and withdrawing its securing bolts.



4.58a Release the locking clip and disconnect the large multi-plug . . .



4.58b . . . then release the harness clips . . .

56 Refitting is a reversal of removal - ensure that the connector locking bars are pressed firmly home.

1.6 litre models

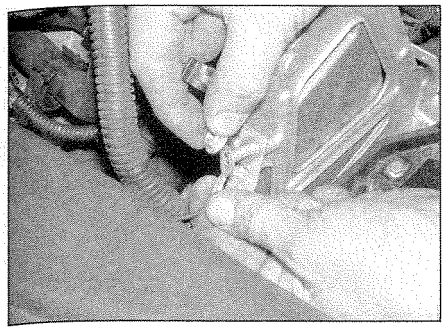
57 On early 1.6 litre models, the ECU is mounted at the side of the battery, in the front left-hand corner of the engine compartment. To remove it, unplug the wiring connector then slacken and withdraw the four securing bolts. Access to the lower two bolts is limited, and may be improved by raising and supporting the front of the vehicle.

58 On later 1.6 litre models, the ECU is mounted in the same place, but there are two ECU wiring connectors, both secured by locking bars which must be slid to one side to allow disconnection. The upper section of the ECU mounting bracket must be unbolted moved to one side to allow the removal of the ECU itself **(see illustrations)**.

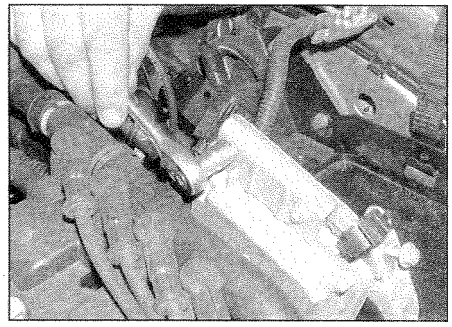
59 Refitting is a reversal of removal - where applicable, ensure that the connector locking bars are pressed firmly home.

1.8 litre models

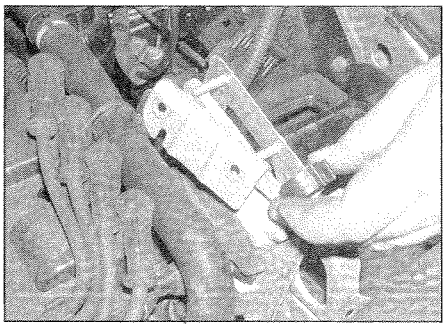
60 The ECU is mounted inside the right-hand footwell, at the base of the A-pillar behind a plastic trim panel. Remove the trim panel; note that on left-hand drive models, it will be necessary to remove the glovebox assembly from the facia, with reference to Chapter 11.



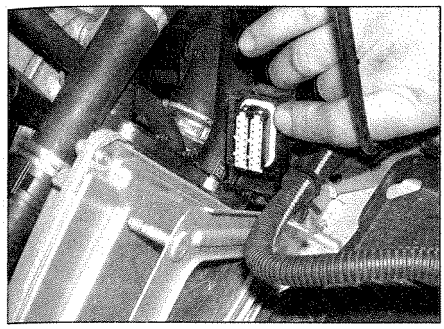
4.58c . . . and disconnect the earth lead



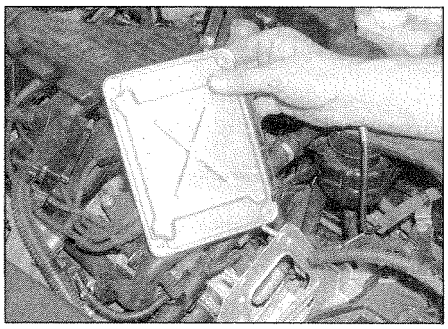
4.58d Unscrew the mounting nuts . . .



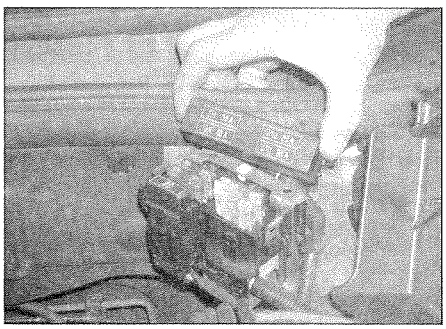
4.58e . . . remove the upper mounting plate . . .



4.58f . . . disconnect the lower multi-plug . . .



4.58g . . . and remove the ECU



4.64a Remove the fusebox lid at the rear of the engine compartment . . .

Unplug the wiring connectors and unscrew the earth cable from the bodywork. Undo the mounting bracket securing screws and remove the ECU from the vehicle.

61 Refitting is a reversal of removal.

Inertia switch

62 Refer to the information given in Chapter 4A, Section 5.

Fuel injection system fuses and relays

63 The injection system relays are located in similar positions to those described in Chapter 4A, Section 5.

64 The main system fuse is located underneath a plastic cover at the left-hand rear corner of the engine compartment **(see illustrations)**.

65 The individual fuses for the fuel pump and injection/ignition are located in one of the fuse locations inside the car - refer to Chapter 12 and/or the wiring diagrams for details **(see illustration)**.

Airflow meter (1.8 litre models)

Removal

66 Disconnect the battery negative lead as described in Chapter 5A.

67 Unplug the wiring connector from the airflow meter.

68 Release the hose clips and remove the meter from the inlet air ducting.

Refitting

69 Refitting is a reversal of removal.

Camshaft position sensor

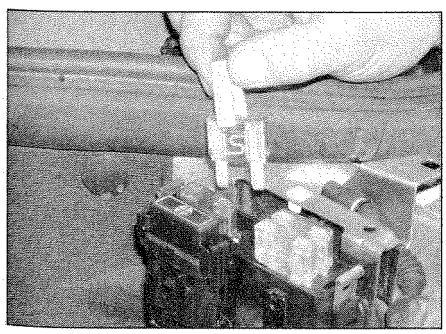
1.6 litre models

70 The camshaft position sensor is only fitted to pre-1999 models, prior to the introduction of the Step A engine.

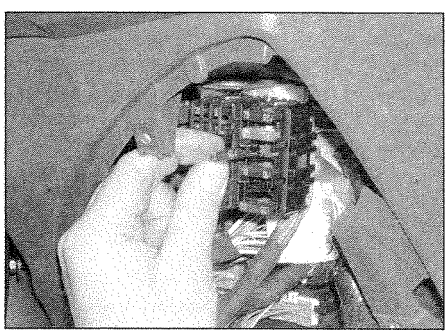
71 Remove the timing belt and inlet camshaft sprocket as described in Chapter 2C, Sections 4 and 5.

72 Remove the two bolts securing the sensor **(see illustration)**. Withdraw the sensor from the engine, and disconnect the wiring plug.

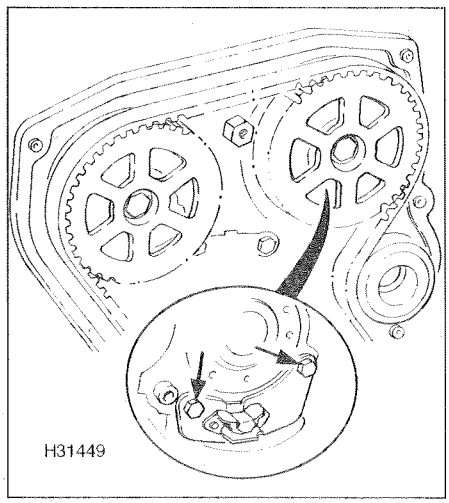
73 Refitting is a reversal of removal.



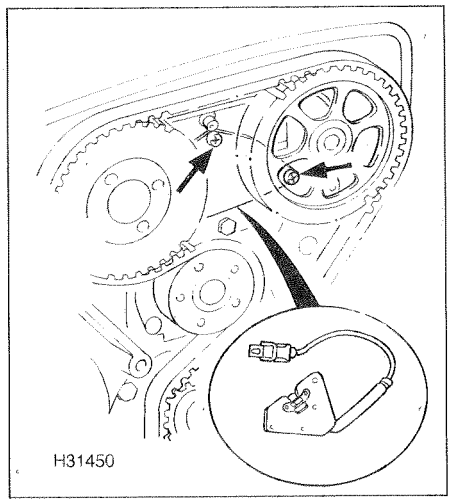
4.64b . . . and pull out the main system fuse



4.65 Removing the fuel pump fuse on a 1.6 litre model



4.72 Camshaft position sensor location and securing bolts - 1.6 litre model



4.75 Camshaft position sensor location and securing bolts - 1.8 litre model

1.8 litre models

74 Remove the timing belt and exhaust camshaft sprocket as described in Chapter 2D, Sections 4 and 5.

75 Remove the two bolts securing the sensor **(see illustration)**. Withdraw the sensor from the engine, and disconnect the wiring plug at the rear of the timing belt cover.

76 Refitting is a reversal of removal.

Vehicle speed (speedometer) sensor

77 Refer to the information given in Chapter 4A, Section 5.

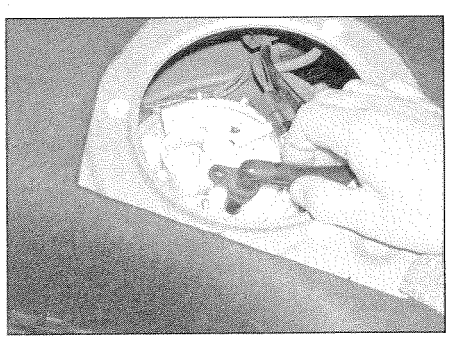
5 Fuel pump/ fuel gauge sender unit - removal and refitting

Removal

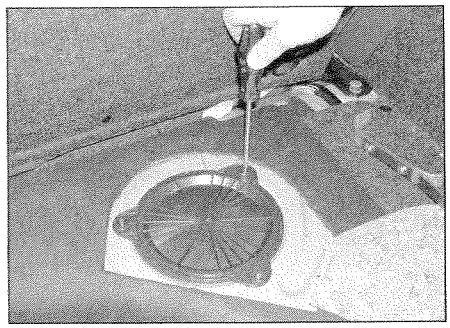
Note: *Refer to the precautions in Section 1 before proceeding.*

1 Disconnect the negative cable from the battery terminal.

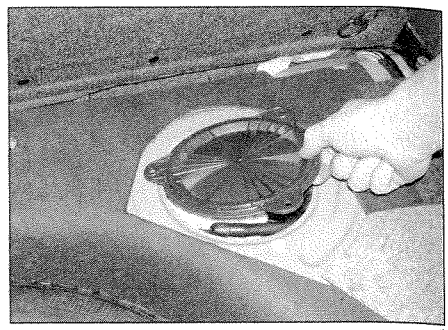
2 Remove the press stud fixings and detach the carpet from the load space floor.



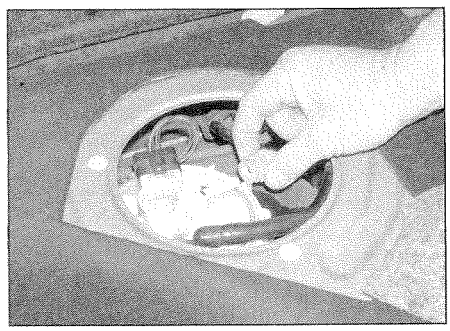
5.6 Disconnecting the fuel tank breather pipe



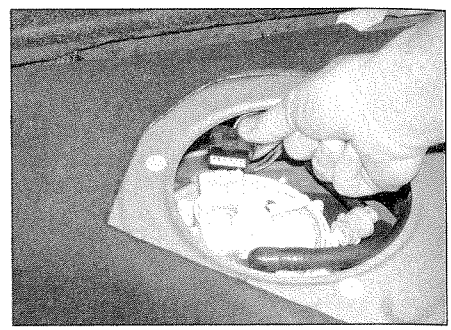
5.3a Remove the screws . . .



5.3b . . . and take off the dust cover for access to the sender unit



5.4 Disconnecting the fuel supply pipe from the sender unit

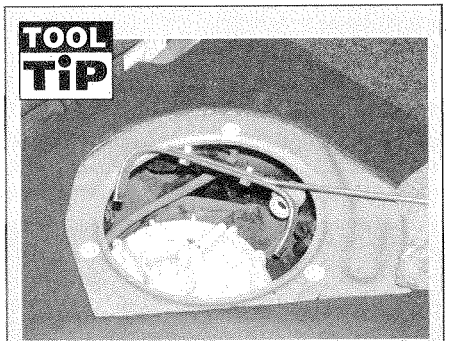


5.5 Unplug the wiring connector from the sender unit

3 Undo the screws and remove the dust cover from the access aperture in the floorpan **(see illustrations)**.

4 Bearing in mind the warning given in Section 1, disconnect the fuel supply line by pressing the tabs and separating the quick-release connection **(see illustration)**. Plug the end of the line or cover with adhesive tape, to prevent the ingress of debris.

5 Unplug the wiring connectors from the top of the fuel pump/gauge sender unit **(see illustration)**.



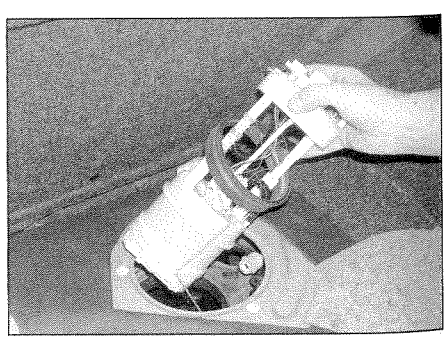
With the limited access available to the sender unit ring nut, and the fact that the nut is very tight, we had to make up a tool to unscrew it. The tool is made from two metal strips - one bent to fit across the ring nut to provide two 'legs' which engage in the ribs on the ring nut, and one bolted to the first, to act as a handle.

6 As applicable, disconnect the breather pipe and/or return line from the sender unit. The breather pipe on later models is secured by a nut, and is then pulled out of the tank **(see illustration)**.

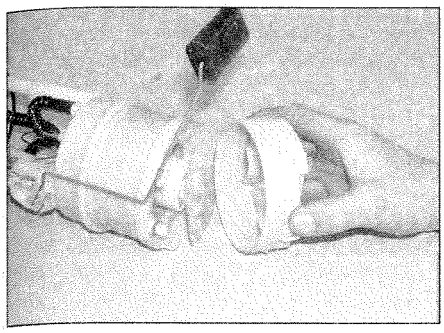
7 Using a suitable tool, unscrew the large ring nut that secures the pump/sender unit to the top of the fuel tank. We made up a simple claw tool in the workshop, which engages in the ribs around the edge of the ring nut **(see Tool Tip)**.

8 Carefully withdraw the unit from the fuel tank. Some careful manipulation will be required, to allow the sender unit float arm to exit the tank without snagging. Suspend the unit above the tank aperture for a few minutes, to allow the excess fuel to drain away **(see illustration)**.

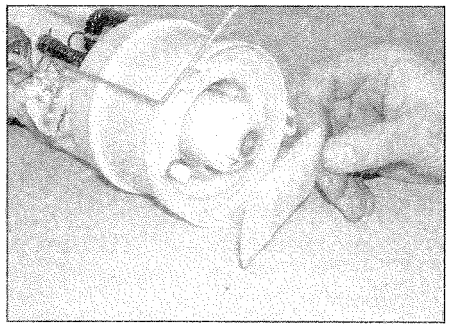
9 Recover the sealing ring from the fuel tank aperture, if it wasn't removed with the sender unit.



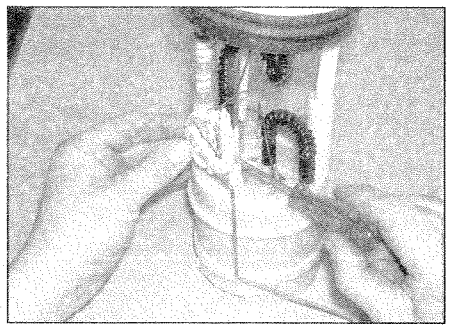
5.8 Removing the pump/sender unit



5.10a Once the base of the unit has been unclipped . . .



5.10b . . . the pump filter can also be unclipped and removed



5.10c Removing the float assembly

HAYNES HINT ***If the pump/sender unit is not being refitted immediately, screw the retaining nut back onto the tank temporarily, as the fittings may swell over a period of time, making refitting difficult.***

10 The sender unit fuel filter can be inspected by unclipping the round cover at the base of the unit. The float assembly can also be unclipped from the side of the unit, and the wiring disconnected **(see illustrations)**. The pump unit hoses must be disconnected before it too is unclipped from the base of the unit - it appears, however, that separating the hose connections may destroy them, so have replacement hoses available for refitting.

11 From the FIAT information available at the time of writing, it appears that no pump/sender unit components are available separately. On later models with a 'returnless' fuel system, the pressure regulator fitted to top of the sender unit is not available, nor was it even clear how it might be removed **(see illustration)**.

Refitting

12 Refitting is a reversal of the removal procedure, noting the following points:

a) It is advisable to use a new sealing ring.
*b) Refit the ring nut loosely to the top of the sender unit before offering it into position **(see illustration)**.*
c) Take care as the unit is fitted that the sealing ring does not get pushed into the tank.
*d) Align the arrowhead marking on top of the tank with the similar mark on the sender unit **(see illustration)**.*
e) Prior to refitting the dust cover, reconnect the battery, then start the engine and check the unions for signs of leakage.

6 Fuel tank - removal and refitting

Refer to Section 7 in Chapter 4A.

7 Fuel injection system - depressurisation

Note 1: *Refer to the precautions in Section 1 before proceeding.*
Note 2: *On later models with a 'returnless' fuel supply system, the fuel pressure can be relieved via the quick-release coupling at the end of the fuel rail. This should carried out using a FIAT fuel pressure discharge kit; it may be possible to hire or borrow a kit from you iocal dealer, if required.*

1 The fuel supply system referred to in this Section is defined as the tank-mounted fuel pump, the fuel filter, the throttle body and pressure regulator components, 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 Make sure that the ignition is switched off (take out the key).

3 Referring to Section 4, pull out the fuse for the fuel pump (or remove the fuel pump relay). If the injection/ignition fuse or the main system fuse are removed, the injectors will not open, so defeating the purpose of this exercise.

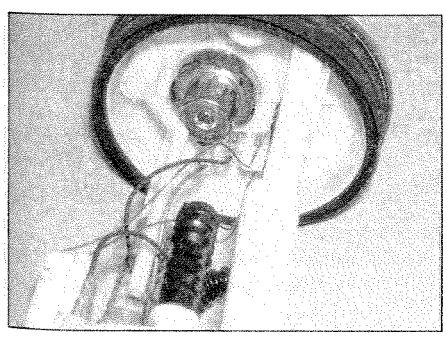
4 Try to start the engine, keeping the engine cranking for several seconds. It may fire and run for a little while - if so, let it run until it stops.

5 Once the injectors have opened and closed several times, this will reduce the fuel pressure to a safer level. However, fuel will still be present in the system, and care should still be taken.

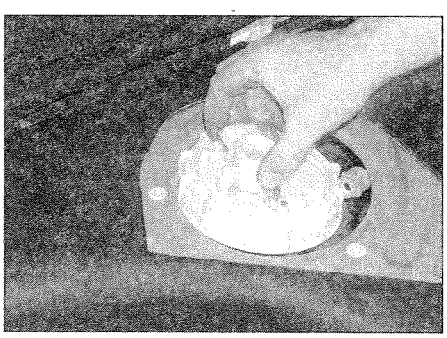
6 Disconnect the negative cable from the battery terminal, then refit the fuel pump fuse (or relay).

7 On later models, a Schrader-type valve (like a tyre valve) is fitted to the end of the fuel rail, and this may be used to depressurise the system. Unscrew the plastic valve cap, then place rags around the valve, to soak up spilt fuel **(see illustration)**. Use a suitable tool to depress the centre of the valve, and release the fuel under pressure. Once the pressure has dissipated, refit the plastic valve cap.

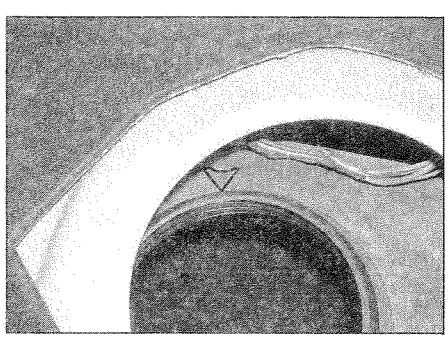
8 Even when the pressure has been released, care should still be taken when opening a fuel line connection. Place a container beneath the relevant connection/union to be disconnected, and have a large rag ready to soak up any escaping fuel not being caught by the container.



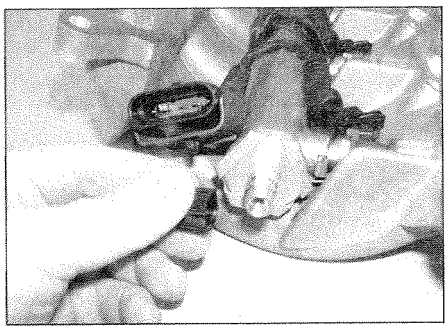
5.11 View of the pressure regulator and its wiring connections



5.12a Make sure the ring nut is in position before fitting the unit



5.12b Arrowhead marking on top of the fuel tank



7.7 Plastic cap removed from fuel rail pressure relief valve - seen on a 1.6 litre model, with the inlet manifold removed

9 Slowly open the connection or union nut (as applicable) to avoid a sudden release of fuel, and wrap the rag around the connection to catch any fuel which may be expelled. Once the fuel has been soaked up, disconnect the fuel line, and insert plugs to minimise fuel loss and prevent the entry of dirt into the fuel system.

8 Inlet manifold - removal and refitting

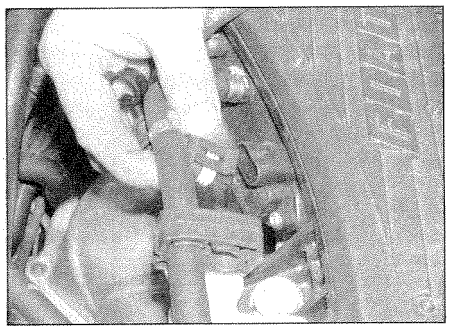
Note: *Refer to the warning given in Section 1 before proceeding.*

Removal - 1.2 and 1.6 litre models

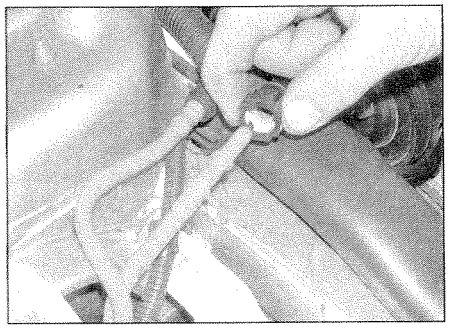
Upper section

1 Remove the throttle body assembly as described in Section 4.

2 Unplug the wiring connector from the inlet air temperature and manifold pressure (MAP) sensor **(see illustration)**.



8.2 Disconnecting the MAP sensor wiring plug



8.3 Disconnecting the EVAP (charcoal canister) hose at the inner wing connection

3 Release the clip and disconnect the EVAP hose from the inlet manifold port. Alternatively on later models, trace the EVAP hose back, and separate the quick-release connection at the right-hand side of the engine compartment (this saves destroying another hose clip) **(see illustration)**.

1.6 litre models

4 As applicable, disconnect the crankcase breather pipe and brake servo vacuum pipe from the rear of the manifold, identifying them for location if necessary **(see illustrations)**. On early models, disconnect the vacuum pipe for the fuel pressure regulator.

5 To gain access to some of the manifold bolts, it is necessary to unbolt the oil filler tube from the front of the engine; one of the bolts also secures the oil dipstick tube **(see illustration)**.

6 On later models, also unbolt the bracket for the knock sensor **(see illustration)**.

7 Move the oil filler tube forwards, clear of the engine - it can be removed completely if preferred **(see illustration)**.

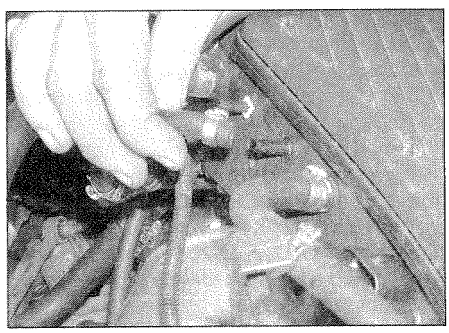
All models

8 Progressively slacken and withdraw the securing bolts or nuts, and detach the upper section of the inlet manifold from the lower section. Note the location of any wiring harness or hose brackets fitted to the bolts, and recover the gasket(s) **(see illustrations)**.

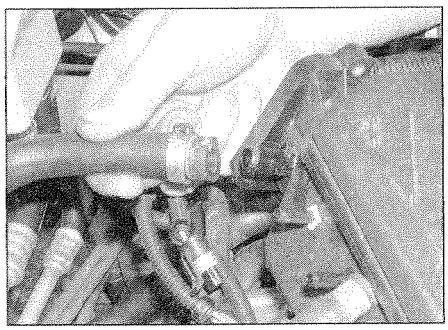
Lower section

1.2 litre models

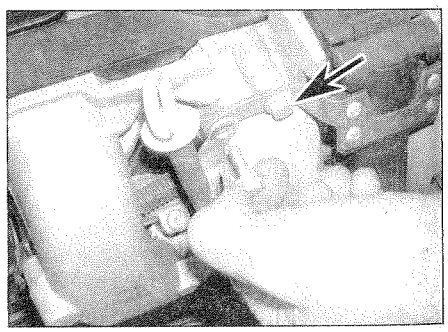
9 Unplug the wiring connector from the coolant temperature sensor (situated on the left-hand side of the manifold).



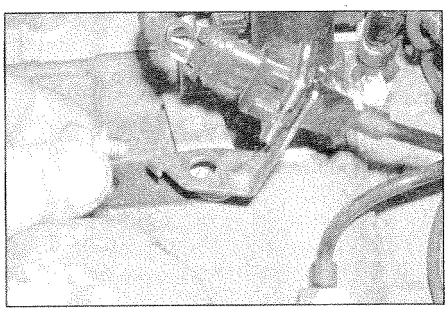
8.4a Disconnect the breather hoses . . .



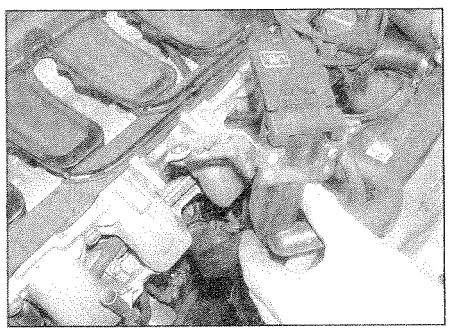
8.4b . . . and the brake servo vacuum hose



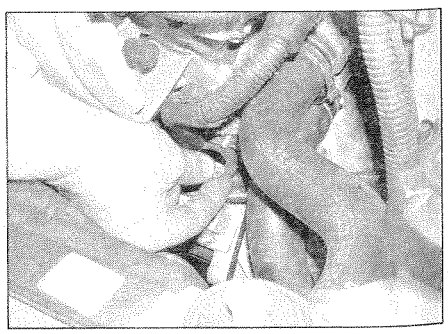
8.5 Remove the bolts securing the oil filler tube



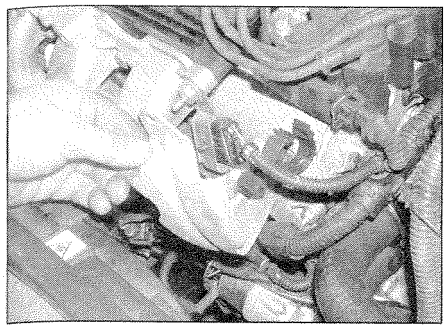
8.6 Remove the knock sensor mounting bracket bolt, and move the bracket to one side



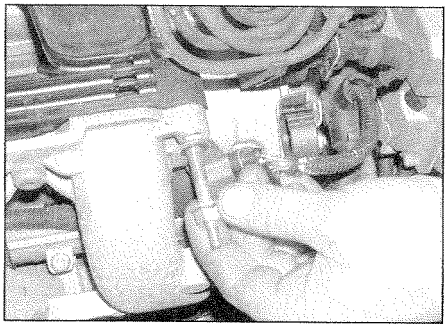
8.7 Move the oil filler tube clear of the inlet manifold



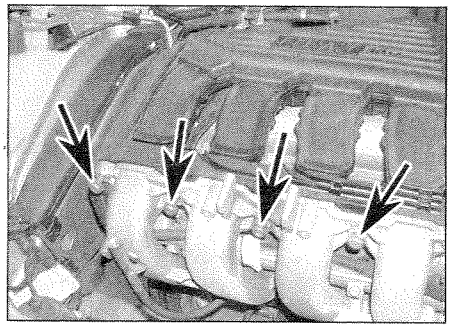
8.8a On 1.6 litre models, unscrew this nut . . .



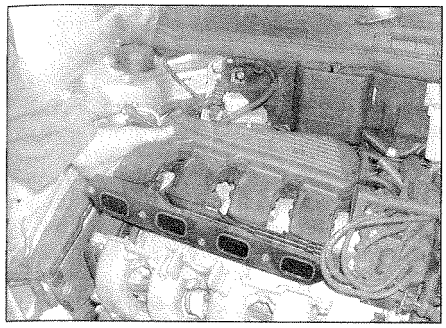
8.8b . . . and remove this wiring harness bracket . . .



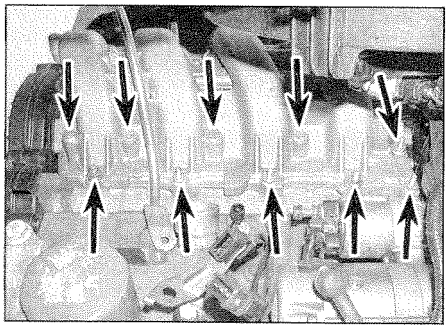
8.8c . . . for access to one of the manifold bolts



8.8d Remove the remaining bolts (arrowed) . . .



8.8e . . . and remove the upper section of the inlet manifold



8.15 Lower inlet manifold fasteners (arrowed)

10 Undo the bolt securing the accelerator cable mounting bracket to the manifold, and position it clear of the manifold.

11 Slacken the retaining clip and disconnect the coolant hose from the rear of the manifold.

12 Disconnect the brake vacuum hose.

1.6 litre models

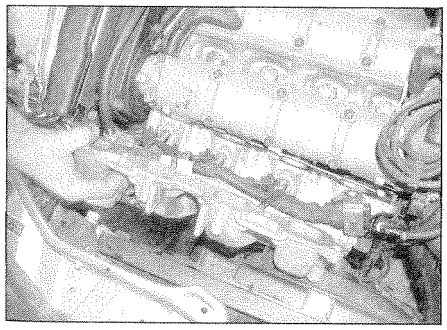
13 Remove the upper section of the manifold as described above.

14 Disconnect the wiring plug and fuel hose(s) from the fuel rail and injectors, using the information in Section 4.

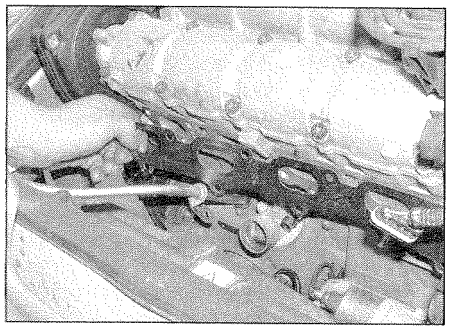
15 The lower section of the manifold is secured by eight bolts and two studs/nuts **(see illustration)**. Note that the manifold is slotted where it fits over the studs, to make removal and refitting easier.

All models

16 Undo the retaining nuts and bolts, and remove the lower section of the manifold from the cylinder head. Remove the gasket and discard it; a new one should be used on refitting **(see illustrations)**.



8.16a Remove the inlet manifold lower section . . .



8.16b . . . and recover the gasket

Removal - 1.8 litre models

17 The upper and lower sections of the manifold are removed together, and can be separated after removal if required.

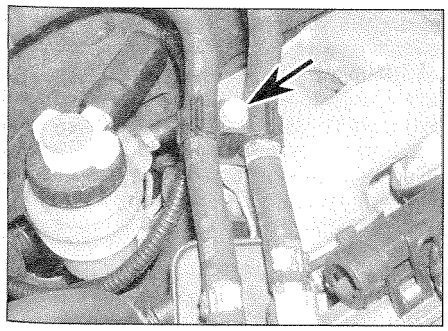
18 Remove the throttle body, and the fuel rail and injectors, as described in Section 4. Unbolt the fuel hose guide bracket from the top of the manifold **(see illustration)**.

19 Disconnect the coolant hose at the rear of the expansion tank, and unclip it from the support brackets at the right-hand end of the manifold (right as seen from the driver's seat) **(see illustrations)**.

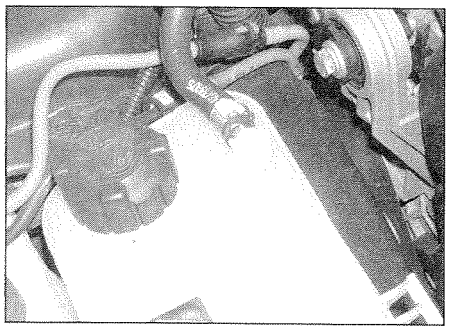
20 Disconnect the EVAP hose (coloured blue) from the manifold by depressing the hose collar with a small screwdriver, and pulling out the hose **(see illustration)**.

21 Noting their locations, disconnect the two wiring plugs from the ignition power module at the right-hand end of the manifold **(see illustration)**.

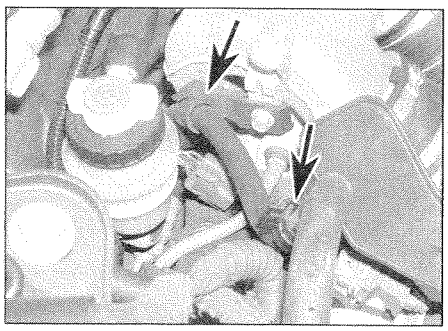
22 Jack up the front of the car, and support on axle stands (see *Jacking and vehicle support*).



8.18 Fuel hose guide bracket bolt (arrowed)



8.19a Disconnect the coolant hose at the rear of the expansion tank . . .



8.19b . . . and unclip the hose from the support brackets (arrowed) on the manifold

Chapter 4 Part C:
Exhaust and emission control 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

Torque wrench settings	Nm	lbf ft
Exhaust manifold nuts:		
1.2 litre	27	20
1.4 and 1.8 litre	25	18
1.6 litre	30	22
Exhaust manifold-to-downpipe nuts	30	22
Exhaust system clamp nuts/bolts	25	18
Oxygen sensor:		
1.2 litre	36	27
1.4 litre	55	41
1.6 and 1.8 litre	40	30

1 General information

1 All models use unleaded petrol, and have various features built into the fuel system to help minimise harmful emissions. All models are equipped with a crankcase emission-control system, a catalytic converter, and an evaporative emission control system to minimise fuel vapour emissions.

Crankcase emission control

2 To reduce the emission of unburned hydrocarbons from the crankcase into the atmosphere, the engine is sealed and the blow-by gases and oil vapour are drawn from inside the crankcase, through an oil separator, into the inlet tract to be burned by the engine during normal combustion.

3 Under conditions of high manifold depression (idling, deceleration) the gases will be sucked positively out of the crankcase. Under conditions of low manifold depression (acceleration, full-throttle running) the gases are forced out of the crankcase by the (relatively) higher crankcase pressure; if the engine is worn, the raised crankcase pressure (due to increased blow-by) will cause some of the flow to return under all manifold conditions.

Exhaust emission control

4 To minimise the amount of pollutants which escape into the atmosphere, all models are fitted with a catalytic converter in the exhaust system. The system is of the closed-loop type, in which an oxygen sensor in the exhaust system provides the fuel-injection/ignition system ECU with constant feedback, enabling the ECU to adjust the mixture to provide the best possible conditions for the converter to operate.

5 The oxygen sensor's tip is sensitive to oxygen, and sends the ECU a varying voltage depending on the amount of oxygen in the exhaust gases; if the intake air/fuel mixture is too rich, the exhaust gases are low in oxygen so the sensor sends a low-voltage signal, the voltage rising as the mixture weakens and the amount of oxygen rises in the exhaust gases.

6 Peak conversion efficiency of all major pollutants occurs if the intake air/fuel mixture is maintained at the chemically-correct ratio for the complete combustion of petrol of 14.7 parts (by weight) of air to 1 part of fuel (the 'Stoichiometric ratio'). The sensor output voltage alters in a large step at this point (known as the Lambda point), the ECU using the signal change as a reference point and correcting the intake air/fuel mixture accordingly by altering the fuel injector pulse width.

Evaporative emission control

7 To minimise the escape into the atmosphere of unburned hydrocarbons, an evaporative emissions control system is also fitted to all models. The fuel tank filler cap is sealed and a charcoal canister is mounted behind the right-hand front wing. The canister collects the petrol vapours released from the fuel in the tank when the car is parked and stores them until they can be cleared from the canister (under the control of the engine management system ECU) via the purge valve into the inlet tract to be burned by the engine during normal combustion.

8 To ensure that the engine runs correctly when it is cold and/or idling and to protect the catalytic converter from the effects of an over-rich mixture, the purge control valve is not opened by the ECU until the engine has warmed up, and the engine is under load; the valve solenoid is then modulated on and off to allow the stored vapour to pass into the inlet tract.