Chapter 4 Part D:
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

1 General information

Exhaust system

1 The exhaust system consists of front, intermediate and rear sections, the number varying according to model. The system is suspended from the underbody on rubber mountings, and bolted to the exhaust manifold at the front. Flanged joints incorporating gasket seals or pipe clamps are used to secure the sections. The front section downpipe is of twin, or "siamesed" type and is attached to the manifold by a flanged joint incorporating compression springs or by a single spherical joint. On TU series engines, a ball-and-socket type joint is provided between the front downpipe and intermediate pipes, to allow for engine movement.

2 Later fuel-injected models are equipped with a catalytic converter as part of the exhaust emission control system.

Emission control systems

3 Various systems may be fitted to reduce the emission of unburned hydrocarbons and harmful exhaust gases into the atmosphere. Basically, these systems can be divided as follows:

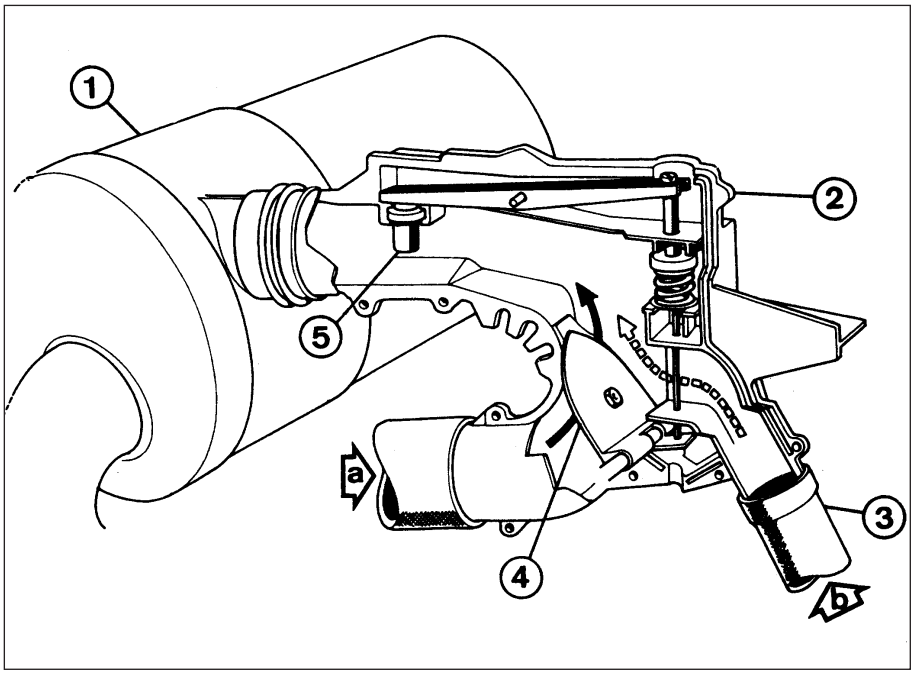
a) Air inlet heating system.
b) Crankcase ventilation system.
c) Electro-pneumatic ignition timing retarding system.
d) Catalytic converter.
e) Fuel vapour recirculation system.

4 The operation of the systems is described briefly in the following paragraphs.

Air inlet heating system

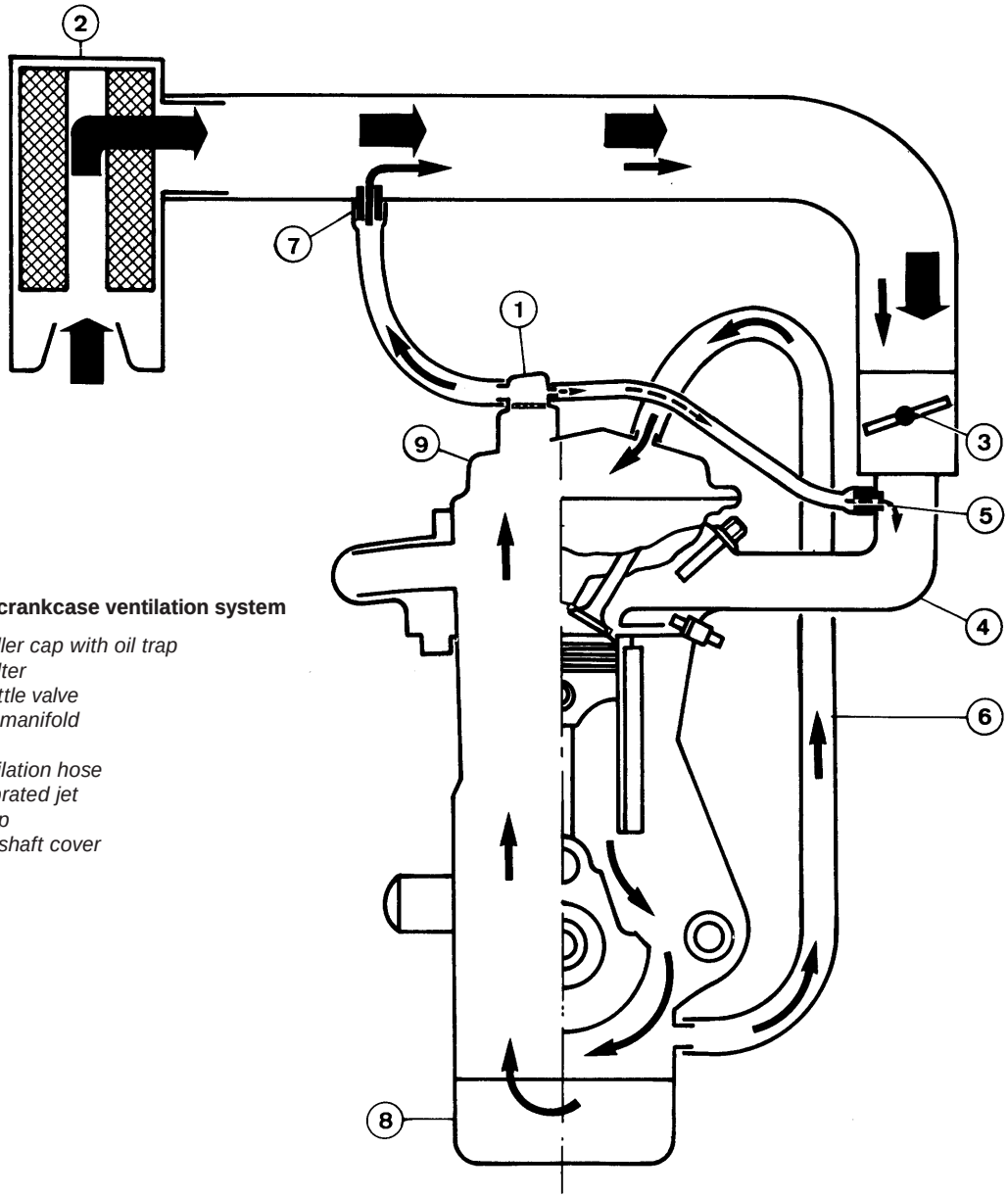
5 This system is fitted to certain carburettor and all single-point fuel injection models, and assists the vaporisation of the fuel, providing more complete combustion of the fuel/air mixture **(see illustration)**. This is achieved by controlling the temperature of the air entering the engine.

6 The air drawn through the air inlet pipe from the engine compartment is mixed with hot air drawn from a shroud around the exhaust manifold. The proportions of hot and cold air are controlled by the position of a flap valve, which in turn is controlled by a wax thermostat and a vacuum capsule (connected to the inlet manifold).



1.5 Typical air intake heating system

1 Air cleaner
2 Air ducting
3 Exhaust manifold hot air duct
4 Flap valve
5 Wax thermostat
a Cold air
b Hot air



1.7 Typical crankcase ventilation system

1 Oil filler cap with oil trap
2 Air filter
3 Throttle valve
4 Inlet manifold
5 Jet
6 Ventilation hose
7 Calibrated jet
8 Sump
9 Camshaft cover

Crankcase ventilation system

7 This system is fitted to all models, and prevents the gases produced in the crankcase from being released into the atmosphere, at the same time preventing a build-up of pressure in the crankcase **(see illustration)**.

8 Crankcase gases are drawn into the air inlet tract, where they are mixed with clean air. The gases are then burnt with the fuel/air mixture in the engine, and expelled through the exhaust.

Electro-pneumatic ignition timing retarding system

9 This system is used on models fitted with the Mono-Jetronic A2.2 fuel injection system, and reduces the nitrous oxide (NOx) content in the exhaust gases **(see illustration)**. This is achieved by reducing the temperature at the end of the combustion by reducing the ignition advance at certain engine temperatures.

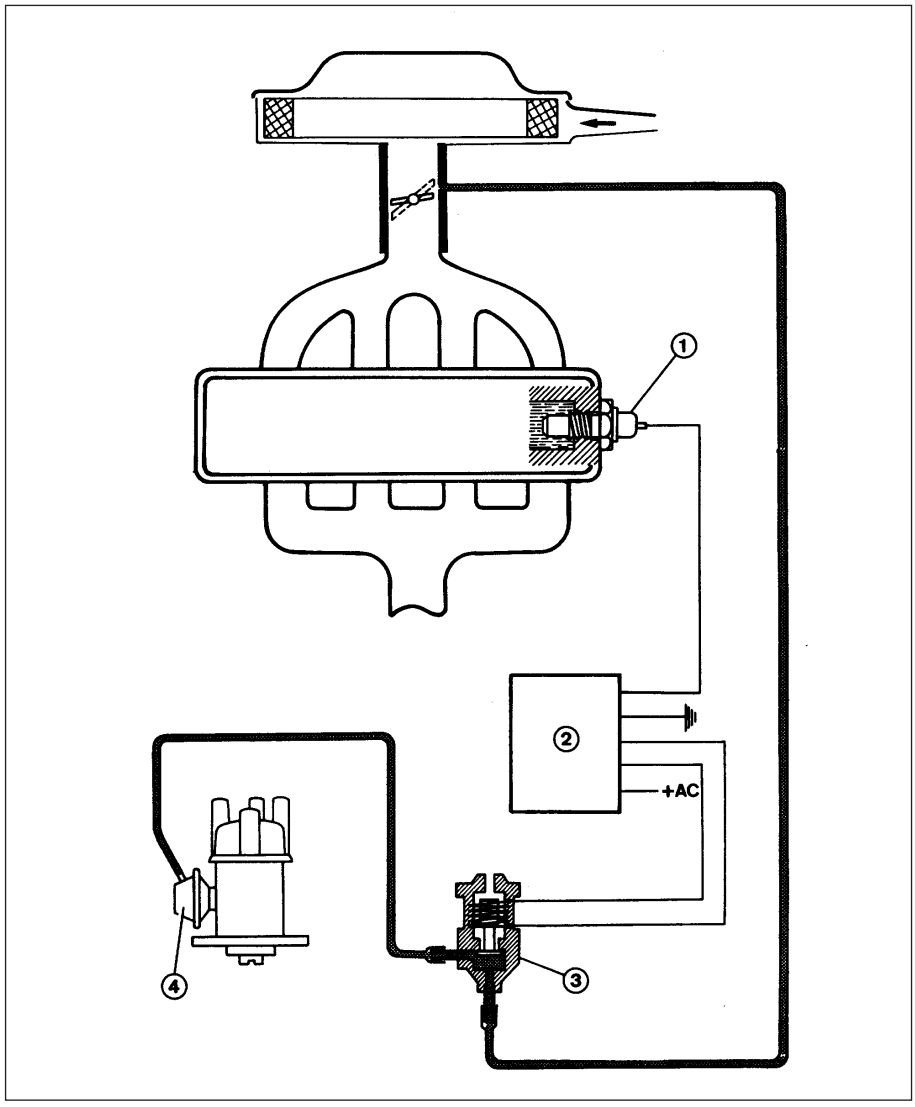
10 The engine temperature is measured by a coolant temperature sensor, and this information is transmitted to the electronic control unit, which controls the solenoid valve. Under certain engine temperature conditions, the solenoid valve cuts off the vacuum to the distributor vacuum capsule, therefore reducing the ignition advance.

Catalytic converter

11 Catalytic converters have been introduced progressively on all models in the range, to meet emissions regulations.

12 The catalytic converter is located in the exhaust system, and operates in conjunction with an exhaust gas oxygen sensor to reduce exhaust gas emissions. The catalytic converter effectively cleans the exhaust gases by speeding up their decomposition.

13 In order for a catalytic converter to operate effectively, the air/fuel mixture must be very accurately controlled, and this is achieved by measuring the oxygen content of the exhaust gas. The oxygen sensor transmits information on the exhaust gas oxygen content to the electronic control unit, which adjusts the air/fuel mixture strength accordingly.



1.9 Electro-pneumatic ignition timing retarding system

1 Coolant temperature sensor
2 Electronic control unit
3 Solenoid valve
4 Distributor vacuum capsule

Fuel vapour recirculation system

14 This system has been introduced progressively on all fuel injection models, and prevents fuel vapour from the fuel tank from being ejected into the atmosphere **(see illustration)**.

15 The fuel filler cap is sealed, and the fuel vapours from the tank pass into a carbon canister, via a calibrated orifice and a pipe. The fuel vapour is absorbed by the carbon filling in the canister.

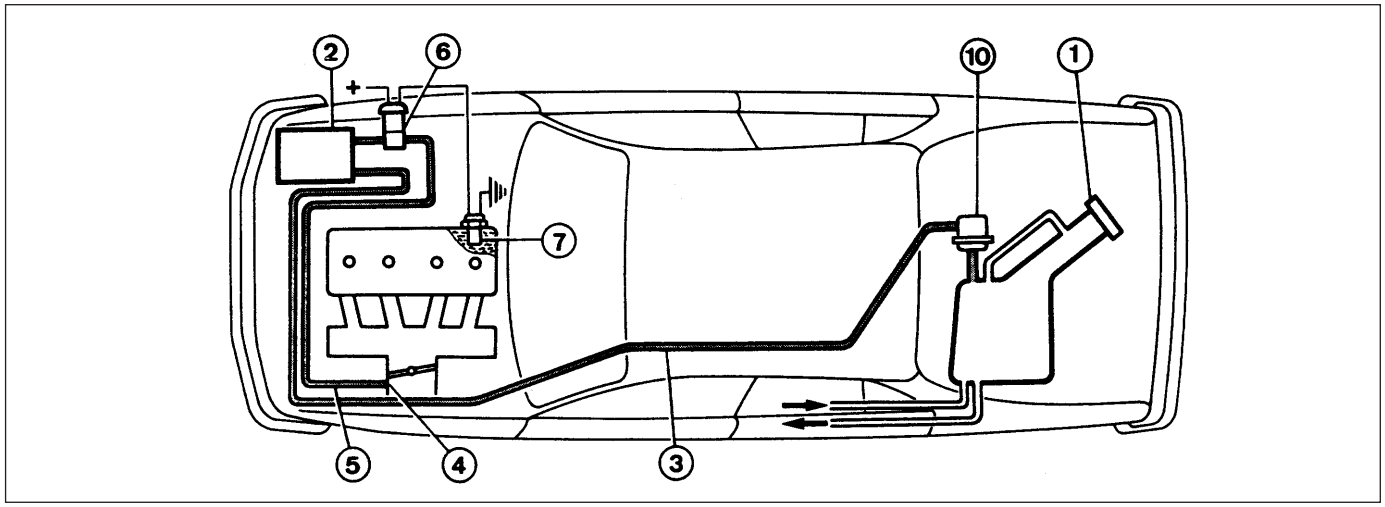
16 When the engine is running, it draws a proportion of its inlet air through the carbon canister, and this air picks up the fuel vapour contained in the carbon canister.

17 A solenoid valve mounted in the pipe between the canister and the inlet manifold prevents the system from operating when the engine is cold. The solenoid valve is controlled by the electronic control unit, on the basis of information received from the coolant temperature sensor.

2 Exhaust system - removal and refitting

Removal

1 Details of exhaust system routing and mounting will vary with model and year, but the principles of removal and refitting remain the same **(see illustration)**.



1.14 Fuel vapour recirculation system

1 Fuel filler cap
2 Charcoal canister
3 Hose
4 Calibrated orifice
5 Hose
6 Solenoid valve
7 Coolant temperature sensor
10 Safety valve

2 In many cases it will be found easier to remove the complete system from the car and then to renew individual sections on the bench.
3 To remove the complete system, raise and support the vehicle at a convenient working height (see *"Jacking and vehicle support"*). Apply penetrating oil to the nuts, bolts and clamps which will have to be undone.
4 Where applicable, disconnect the oxygen sensor wiring plug is disconnected before removing the downpipe.
5 Unbolt the flanged joint at the union of the exhaust system with the downpipe or at the manifold connection. According to model, unbolt the additional support brackets at the transmission.
6 With the aid of an assistant, unhook the system from its mountings and remove it.
7 With the system removed, undo the retaining clamp bolts and separate the various sections as required.

Refitting

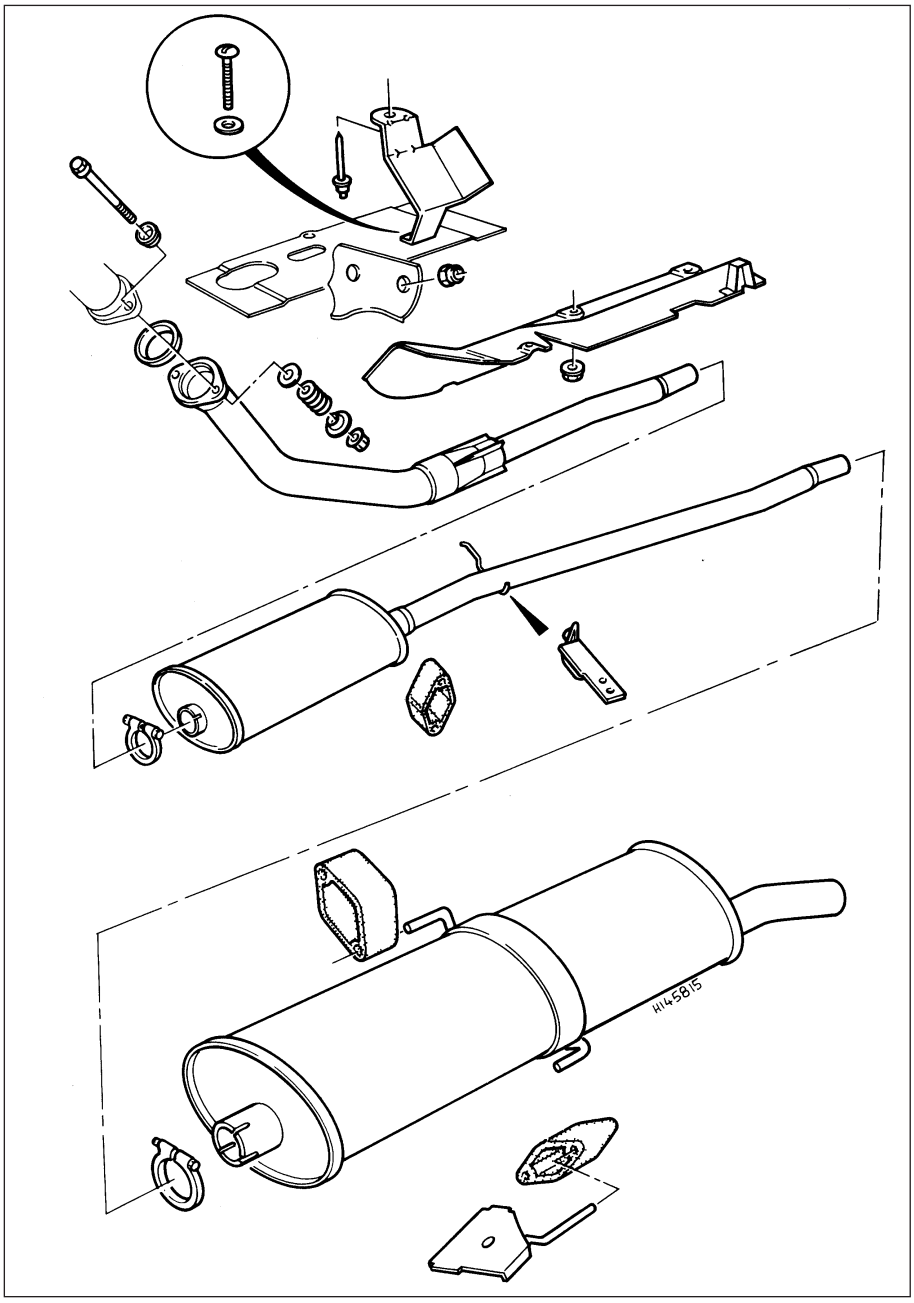
8 Refitting is a reversal of removal, noting the following points:

a) Ensure that all traces of corrosion have been removed from the flanges and renew all necessary gaskets.
b) Inspect the rubber mountings for signs of damage or deterioration, and renew as necessary.
c) When tightening a spring loaded flange joint, tighten the flange mounting nuts evenly so that the special springs are compressed equally; approximately four threads of the bolt should be visible and the springs should be compressed to approximately 22.0 mm.
d) Prior to tightening the exhaust system fasteners, ensure that all rubber mountings are correctly located, and that there is adequate clearance between the exhaust system and vehicle underbody.

3 Exhaust manifold - removal and refitting

Removal

1 Disconnect the battery negative lead.
2 Where applicable, disconnect the hot-air inlet hose from the manifold shroud and remove it from the vehicle. Slacken and remove the three retaining screws, and remove the shroud from the top of the exhaust manifold
3 Firmly apply the handbrake, then jack up the front of the vehicle and support it on axle stands (see *"Jacking and vehicle support"*).
4 Undo the nuts/bolts securing the front downpipe to the manifold then, according to model, remove the bolt securing the pipe to its mounting bracket. Disconnect the downpipe from the manifold.
5 Undo the retaining nuts securing the manifold to the cylinder head **(see illustration)**.



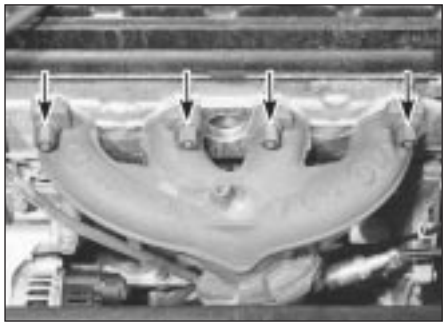
2.1 Typical exhaust system layout

Manoeuvre the manifold from the engine and discard the manifold gaskets.

Refitting

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

a) Examine all the exhaust manifold studs for signs of damage and corrosion; remove all traces of corrosion, and repair or renew any damaged studs.
b) Ensure that the manifold and cylinder head sealing faces are clean and flat, and fit the new manifold gaskets.
c) Reconnect the downpipe to the manifold using the information given in Section 2.



3.5 Exhaust manifold upper retaining nuts (arrowed)

4 Air inlet heating system components - removal and refitting

Note*: The components of the system vary slightly according to engine type. The following procedures depict one of the more common systems, but all are similar.*

Vacuum switch

Removal

1 Remove the air cleaner housing-to-carburettor inlet duct.
2 Bend up the tangs on the switch retaining clip, then remove the clip, along with its seal, and withdraw the switch from inside the duct. Examine the seal for signs of damage or deterioration, and renew if necessary.

Refitting

3 On refitting, ensure that the switch and duct mating surfaces are clean and dry, and position the switch inside the duct.
4 Fit the seal over the switch unions, and refit the retaining clip. Ensure that the switch is pressed firmly against the duct, and secure it in position by bending down the retaining clip tangs. Refit the duct.

Air temperature control valve

Removal

5 Disconnect the vacuum pipe from the air temperature control valve, then slacken the retaining clips securing the inlet ducts to the valve.
6 Disconnect both inlet ducts and the hot-air inlet hose from the control valve assembly, and remove it from the vehicle.

Refitting

7 Refitting is the reverse of the removal procedure, noting that the air temperature control valve assembly can only be renewed as a complete unit.

5 Crankcase ventilation system components - removal and refitting

The crankcase ventilation system consists simply of a number of ventilation hoses, and a wire mesh filter in the engine oil filler cap on certain models. Removal and refitting is self-explanatory, but it may be necessary to detach surrounding components for improved access. Refer to the various Chapters of this manual as necessary if problems are encountered.

6.2 Disconnecting wiring plug from ignition retarding system solenoid valve

6 Electro-pneumatic ignition retarding system components - removal and refitting

Solenoid valve

Removal

1 The valve is located on a bracket at the rear of the engine compartment. To remove the valve, proceed as follows.
2 Disconnect the battery negative lead, then disconnect the wiring plug from the valve **(see illustration)**.
3 Note the orientation of the valve, then disconnect the hoses from the valve, and pull the valve from its bracket.

Refitting

4 Refitting is a reversal of removal, ensuring that the valve is correctly orientated, as noted before removal.

Coolant temperature sensor

Removal

5 The sensor is located in the left-hand end of the cylinder head, below the engine coolant temperature sensor for the fuel injection system.
6 To remove the sensor, partially drain the cooling system (see Chapter 1), then disconnect the wiring, and unscrew and remove the sensor.

Refitting

7 When refitting the sensor, ensure that the seal is in good condition, and take care not to overtighten the switch. Refill the cooling system on completion as described in Chapter 1 and *"Weekly checks"*.

7 Catalytic converter - general information and precautions

The catalytic converter is a reliable and simple device, which needs no maintenance in itself, but there are some facts of which an owner should be aware if the converter is to function properly for its full service life.

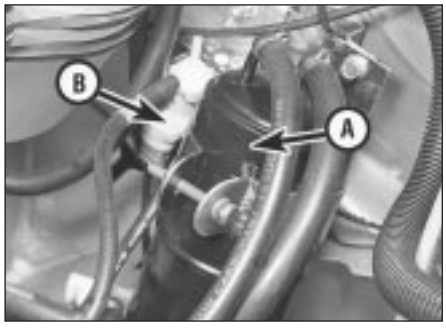
a) DO NOT use leaded petrol in a vehicle equipped with a catalytic converter - the lead will coat the precious metals, reducing their converting efficiency, and will eventually destroy the converter.
b) Always keep the ignition and fuel systems well-maintained in accordance with the manufacturer's schedule (see Chapter 1).
c) If the engine develops a misfire, do not drive the vehicle at all (or at least as little as possible) until the fault is cured.
d) DO NOT push - or tow-start the vehicle - this will soak the catalytic converter in unburned fuel, causing it to overheat when the engine does start.
e) DO NOT switch off the ignition at high engine speeds, ie do not "blip" the throttle immediately before switching off.
f) DO NOT use fuel or engine oil additives - these may contain substances harmful to the catalytic converter.
g) DO NOT continue to use the vehicle if the engine burns oil to the extent of leaving a visible trail of blue smoke.
h) Remember that the catalytic converter operates at very high temperatures. DO NOT, therefore, park the vehicle in dry undergrowth, over long grass or piles of dead leaves, after a long run.
I) Remember that the catalytic converter is FRAGILE. Do not strike it with tools during servicing work.
j) In some cases, a sulphurous smell (like that of rotten eggs) may be noticed from the exhaust. This is common to many catalytic converter-equipped vehicles. Once the vehicle has covered a few thousand miles, the problem should disappear - in the meantime, try changing the brand of petrol used.
k) The catalytic converter used on a well-maintained and well-driven vehicle should last for between 50 000 and 100 000 miles. If the converter is no longer effective, it must be renewed.

8 Fuel vapour recirculation system components - removal and refitting

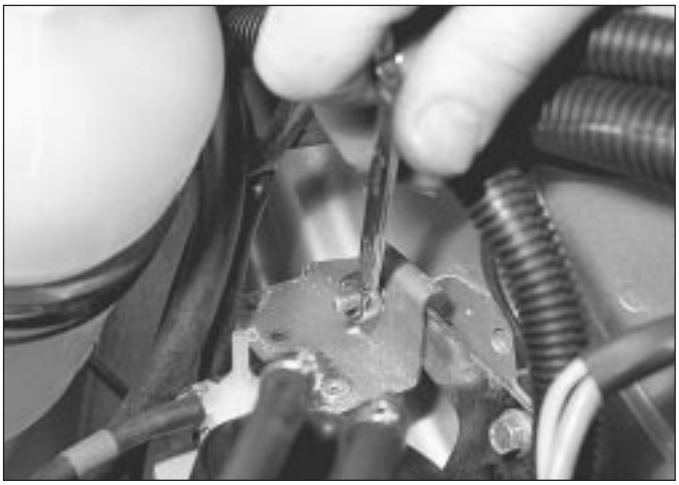
Carbon canister

Removal

1 The carbon canister is located at the rear left-hand corner of the engine compartment **(see illustration)**.
2 To remove the canister, first disconnect the hoses, noting their locations to ensure correct refitting.



8.1 Fuel vapour recirculation system carbon canister (A) and solenoid valve (B)



8.7a Unscrew the securing nut . . .

8.7b . . . and withdraw the solenoid bracket

3 Unscrew the clamp bolt, and lift the canister from its clamp on the body panel.

Refitting

4 Refitting is a reversal of removal, but ensure that the hoses are correctly reconnected, as noted before removal.

Solenoid valve

Removal

5 The solenoid valve is mounted on a bracket next to the carbon canister, at the rear left-hand corner of the engine compartment.

6 To remove the valve, first disconnect the battery negative lead.

7 Unbolt the bracket from the body panel, then disconnect the wiring plug **(see illustrations)**.

8 Disconnect the hoses from the valve, noting their locations to ensure correct refitting, then withdraw the valve.

Refitting

9 Refitting is a reversal of removal, ensuring that the hoses are correctly reconnected, as noted before removal.