Chapter 4 Part E:
Manifolds, 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

Fuel evaporative emission control system - carburettor engines

Ported vacuum switch operating temperature:	
Two-port valve	52 to 55°C (125 to 131°F)
Three-port valve	52 to 55°C (125 to 131°F)

1 General information

All models utilise a light alloy inlet manifold which on carburettor models is coolant heated to improve the atomisation of the fuel/air mixture.

The exhaust manifold is of cast iron construction and incorporates a heated air box as part of the air inlet system on carburettor models.

The exhaust system fitted as original equipment is of single or two section type incorporating a silencer and expansion box and suspended on rubber mountings under the car.

Emission control consists of reducing the emission of noxious gases and vapours, which are by products of combustion, into the atmosphere. The system can be divided into three categories; fuel evaporative emission control, crankcase emission control and exhaust emission control. The components and system operation for Escort models operating in the United Kingdom are as follows.

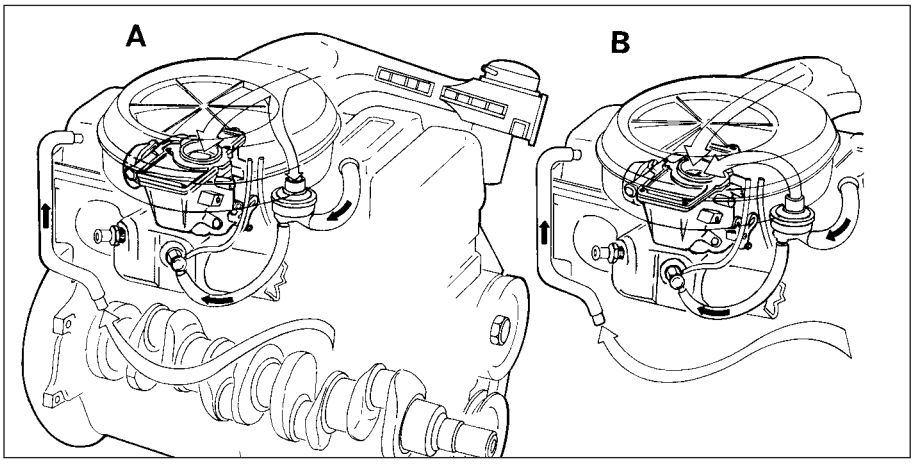
Fuel evaporative emission control

Carburettor engines

Fuel evaporative emission control simply consists of internal venting of the carburettor float chamber and closed circuit fuel tank ventilation.

Central Fuel Injection (CFI) engine models

To minimise the escape of unburned hydrocarbons, the fuel tank filler cap is sealed, and a charcoal canister collects the petrol vapours generated in the fuel tank when the car is parked. The canister stores them until they can be cleared from the canister (under the control of the fuel injection/ignition system electronic control unit) via the canister purge solenoid valve. When the valve is opened, the fuel vapours pass into the inlet tract, to be burned by the engine during normal combustion.



1.9 Typical crankcase ventilation system as used on CVH engines with carburettor

A Ventilation at idle with part-closed throttle
B Ventilation at full throttle position

Crankcase emission control

OHV engines

On OHV engines a closed circuit crankcase ventilation system is used ensuring that blow-by gases which pass the piston rings and collect in the crankcase, as well as oil vapour, are drawn into the combustion chambers to be burnt.

The system consists of a vented engine oil filler cap connected by one hose to the inlet manifold and by another to the air cleaner. The gas flow is controlled by a calibrated port in the oil filler cap and by manifold vacuum according to throttle position.

CVH engines

On CVH engines a closed circuit crankcase ventilation system is also used **(see illustration)**.

At light throttle openings, the emissions are drawn out of the rocker cover, through a control orifice in the crankcase ventilation filter (where fitted), and into the inlet manifold. Under full throttle conditions the gas flow routing is still as just described, but in addition the gases are drawn through a filter and pass into the air cleaner.

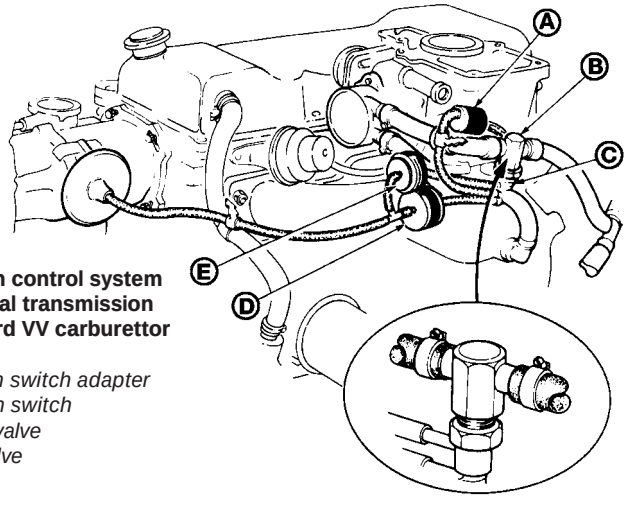
This arrangement offsets any tendency for the fuel/air ratio to be adversely affected at full throttle.

Exhaust emission control

Carburettor engine models

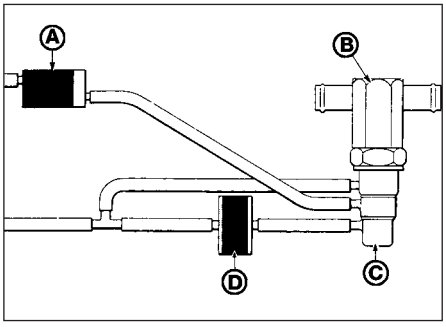
On carburettor engine models an exhaust emission control system is used of which the exact components fitted can vary according to model. In general the system operates as follows.

To improve driveability during warm-up conditions and to keep exhaust emission levels to a minimum, a vacuum-operated, temperature-sensitive emission control system is fitted to OHV and CVH engines covered by this manual. The system is designed to ensure that the rate of distributor vacuum advance is compatible with the change in fuel/air mixture flow under all throttle conditions, thus resulting in more complete combustion and reduced exhaust emissions.



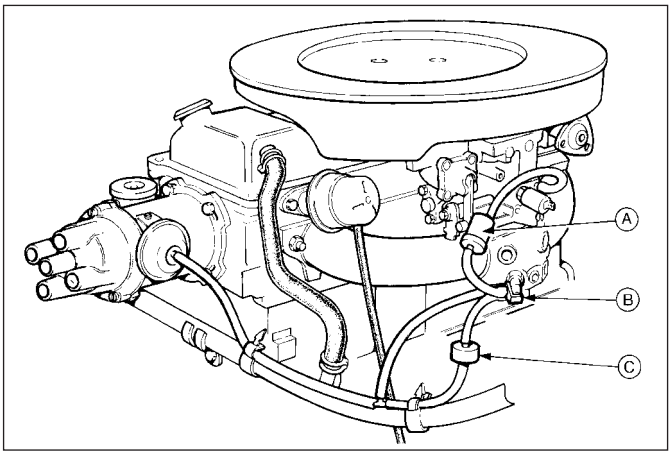
1.15a Emission control system fitted to manual transmission models with Ford VV carburettor

A Fuel trap
B Ported vacuum switch adapter
C Ported vacuum switch
D Spark sustain valve
E Spark delay valve



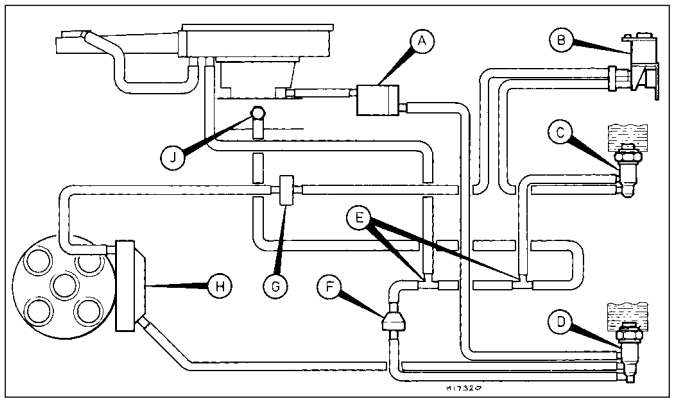
1.15b Alternative emission control system layout for manual transmission models with Ford VV carburettor

A Fuel trap
B Ported vacuum switch adapter
C Ported vacuum switch
D Spark sustain valve



1.15c Emission control system layout for manual transmission models with Weber 2V carburettor

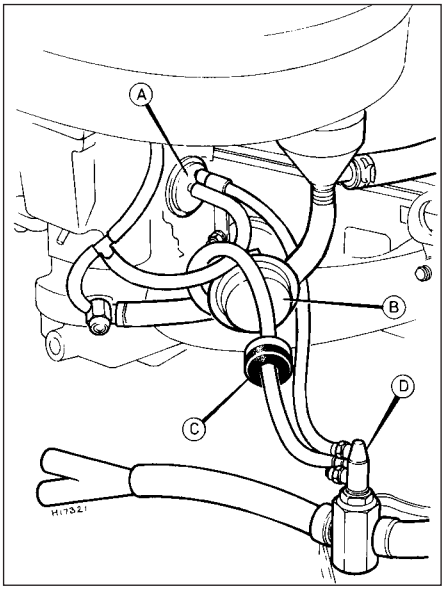
A Fuel trap
B Ported vacuum switch
C Spark sustain valve



1.15d Emission control system layout for automatic transmission models with Ford VV carburettor

A Fuel trap
B Two-way solenoid
C Ported vacuum switch (blue)
D Ported vacuum switch (green)
E T-connectors
F Check valve
G Restrictor
H Dual diaphragm distributor
J Inlet manifold connection

Under part throttle cruising conditions, distributor vacuum advance is required to allow time for the fuel/air mixture in the cylinders to burn. When returning to a part throttle opening after accelerating or decelerating, the distributor vacuum increases before the fuel/air mixture has stabilised. On certain engines this can lead to short periods of incomplete combustion and increased exhaust emission. To reduce this condition a spark delay valve is incorporated in the vacuum line between the carburettor and distributor to reduce the rate at which the distributor advances. Under certain conditions, particularly during the period of engine warm-up, some models may suffer from a lack of throttle response. To overcome this problem a spark sustain valve may be fitted in the vacuum line either individually or in conjunction with the spark delay valve. This valve is used to maintain distributor vacuum under transient throttle conditions, thus stabilising the combustion process.



1.16 Carburettor speed control system layout

A Temperature vacuum switch
B Carburettor speed control valve
C Spark delay valve
D Ported vacuum switch and adapter

The operation of the valves is controlled by a ported vacuum switch (PVS) which has the vacuum lines connected to it. The PVS is actuated by the engine cooling water and is sensitive to changes in engine operating temperature. A fuel trap prevents fuel or fuel vapour from being drawn into the distributor vacuum unit **(see illustrations)**.

The carburettor speed control system is an integral part of the emission control system on some UK models as well as for some overseas market models **(see illustration)**.

The system's function is to improve the air and fuel mixture when the engine is cold in low ambient temperatures. It achieves this by increasing the air volume to the inlet manifold in order to weaken the mixture ratio which has been enriched by choke operation.

The carburettor speed control valve is fitted to a vacuum hose which is located between the air cleaner unit and the inlet manifold on UK models.

Central Fuel Injection (CFI) engine models

To minimise the amount of pollutants which escape into the atmosphere, a catalytic converter is fitted in the exhaust system of CFI engine models.

The system is of a closed loop type. A Heated Exhaust Gas Oxygen (HEGO) sensor located in the exhaust system provides the fuel injection/ignition electronic control unit with constant feedback, enabling the control unit to adjust the mixture to provide the best possible conditions for the converter to operate.

2 Inlet manifold - removal and refitting

Note: *A new gasket will be required on refitting.*

Carburettor models

Removal

1 Disconnect the battery negative lead.
2 Remove the air cleaner as described in Part A of this Chapter.
3 Refer to Chapter 1 and drain the cooling system.
4 Remove the carburettor as described in Part A of this Chapter according to type.
5 Disconnect the manifold coolant hoses.
6 Make a careful note of all vacuum connections at the vacuum switches and solenoids and disconnect them.
7 Where applicable disconnect the switch wiring multi-plugs after noting their locations.
8 Undo the manifold retaining nuts and withdraw the manifold from the cylinder head studs. Recover the gasket.

Refitting

9 Refitting is the reverse sequence to removal but use a new gasket and ensure that the mating faces are clean. On completion refill the cooling system as described in Chapter 1.

XR3i and XR3i Cabriolet models with mechanical (Bosch K- and KE-Jetronic) fuel injection

Removal

10 Disconnect the battery negative lead.
11 Remove the warm-up regulator, throttle housing, fuel injectors and cold start valve as described in Part B of this Chapter.
12 Drain the cooling system (Chapter 1).

13 Make a note of the vacuum hose, crankcase ventilation hose and wiring multi-plug locations as applicable and disconnect them.
14 Disconnect the coolant hoses at the manifold intermediate flange.
15 Check that all wiring and hoses have been disconnected from above and below the manifold, then undo the retaining nuts.
16 Withdraw the manifold and intermediate flange together with their gaskets.

Refitting

17 Refitting is the reverse sequence to removal, but use a new gasket on each side of the intermediate flange. Refit the cold start valve, fuel injectors, throttle housing and warm-up regulator as described in Part B of this Chapter, and on completion refill the cooling system as described in Chapter 1.

RS Turbo models (1985 to May 1986)

Removal

18 Disconnect the battery negative lead.
19 Remove the throttle housing, fuel injectors and cold start valve as described in Part B of this Chapter.
20 Drain the cooling system (Chapter 1).
21 Disconnect the crankcase ventilation hose and vacuum hose from the top of the plenum chamber.
22 Disconnect the vacuum servo hose from the side of the plenum chamber.
23 From below the inlet manifold remove the auxiliary air device as described in Part B of this Chapter, then disconnect the thermo-time switch and temperature sensor wiring multi-plugs after noting their locations.
24 Remove the oil cooler-to-inlet manifold connecting hose.
25 From above, undo the bolts and remove the plenum chamber support bracket.
26 Undo the nuts and remove the inlet manifold and plenum chamber from the cylinder head. Recover the gasket.
27 If required undo the nuts and separate the plenum chamber from the inlet manifold. Recover the gaskets.

Refitting

28 Refitting is the reverse sequence to removal, but use new gaskets on all flange joints. Refit the auxiliary air device, cold start valve, fuel injectors and throttle housing as described in Part B of this Chapter, and refill the cooling system as described in Chapter 1.

RS Turbo models (May 1986-on)

Removal

29 Disconnect the battery negative lead.
30 Remove the throttle housing, fuel injectors, cold start valve and auxiliary air device as described in Part B of this Chapter.
31 Drain the cooling system (Chapter 1).
32 Disconnect the crankcase ventilation hose and vacuum hose from the top of the manifold and the vacuum servo hose from the side.
33 From beneath the manifold disconnect the thermo-time switch and temperature sensor wiring multi-plugs after noting their locations, and the coolant hoses from the intermediate flange.
34 Remove the oil cooler-to-manifold connecting hose.
35 Undo the retaining nuts and withdraw the manifold and intermediate flange together with their gaskets.

Refitting

36 Refitting is the reverse sequence to removal, but use a new gasket on each side of the intermediate flange. Refit the auxiliary air device, cold start valve, fuel injectors and throttle housing as described in Part B of this Chapter and on completion refill the cooling system as described in Chapter 1.

Central Fuel Injection (CFI) engine models

37 Remove the CFI unit as described in Part C of this Chapter.
38 The remainder of the procedure is similar to that described previously in this Section for carburettor engine models.

Electronic Fuel Injection (EFI) engine models

Removal

39 Depressurise the fuel system as described in Part D of this Chapter.
40 Disconnect the battery negative lead.
41 Remove the air inlet ducting, and disconnect the throttle cable from the throttle linkage (see Part A of this Chapter).
42 Remove the fuel rail and fuel injectors as described in Part D of this Chapter.
43 Noting their locations, disconnect the coolant, vacuum and breather hoses from the manifold.
44 Disconnect the wiring multi-plugs from the engine sensors at the inlet manifold.
45 Undo the retaining bolts, and withdraw the manifold from the cylinder head. Where applicable, note the location of the engine lifting bracket and/or earth lead. Remove the gasket.

Refitting

46 Commence refitting by cleaning all traces of old gasket from the mating faces of the manifold and the cylinder head.
47 Refitting is the reversal of removal, using a new gasket. Refit the remainder of the components with reference to the appropriate Parts of this Chapter.

3 Exhaust manifold - removal and refitting

Note: *A new gasket will be required on refitting.*

Removal

1 Disconnect the battery negative lead.
2 On carburettor and CFI engine models remove the air cleaner as described in the appropriate Part of this Chapter.
3 Remove the turbocharger on RS Turbo models as described in Part B of this Chapter.
4 On EFI engines, unbolt the air inlet pipe and move it to one side.
5 Where applicable, unbolt the hot air shroud for access to the manifold securing nuts.
6 Support the exhaust system on a jack or blocks, then disconnect the downpipe at the manifold. On models with CFI engines, take care not to strain the HEGO sensor wiring (see Part C of this Chapter).
7 Undo the nuts securing the manifold to the cylinder head and remove it from the engine. Recover the manifold gasket.

Refitting

8 Refitting is the reverse sequence to removal, but refit the turbocharger on RS Turbo models as described in Part B of this Chapter.

4 Exhaust system - renewal

1 The layout of the exhaust system varies considerably according to model and engine. All except the RS Turbo versions can be renewed in sections; coupling sleeves are supplied, enabling an old section to be cut out and a new one inserted without the need to renew the entire system all at once.

4.2a Exhaust silencer mounting . . .

4.2b . . . and expansion box mounting

2 It is recommended when working on an exhaust system that the complete assembly be removed from under the vehicle by releasing the downpipe from the manifold and unhooking the flexible suspension hangers **(see illustrations)**.
3 Assemble the complete system, but do not fully tighten the joint clips until the system is back in the vehicle. Use a new exhaust manifold/flange gasket and check that the flexible mountings are in good order, also check the connecting flange joint.
4 Set the silencer and expansion box in their correct attitudes in relation to the rest of the system before finally tightening the joint clips.
5 Check that with reasonable deflection in either direction, the exhaust does not knock against any adjacent components.

5 Fuel evaporative emission control system components (Central Fuel Injection/CFI engines) - removal and refitting

Carbon canister

Removal

1 The carbon canister is located behind the bumper, under the front right-hand wheelarch **(see illustration)**.
2 Disconnect the battery negative lead.
3 Remove the wheelarch liner.
4 Disconnect the pipe from the carbon canister.
5 Remove the screw securing the canister to the mounting bracket, and withdraw the canister.

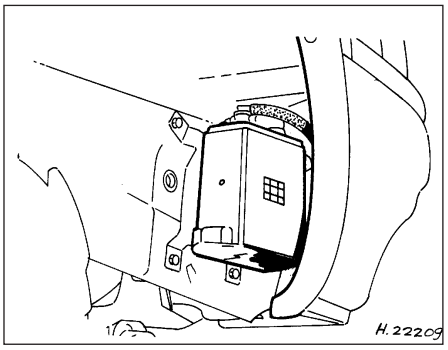
Refitting

6 Refitting is a reversal of removal.

Carbon canister purge solenoid

Removal

7 The solenoid is located near the bulkhead on the right-hand side of the engine compartment **(see illustration)**.



5.1 Carbon canister location (wheelarch liner removed) - CFI engine

8 Disconnect the battery negative lead.
9 Disconnect the solenoid wiring plug.
10 Disconnect both hoses from the solenoid, noting their locations, then withdraw the solenoid from the vehicle.

Refitting

11 Refitting is a reversal of removal.

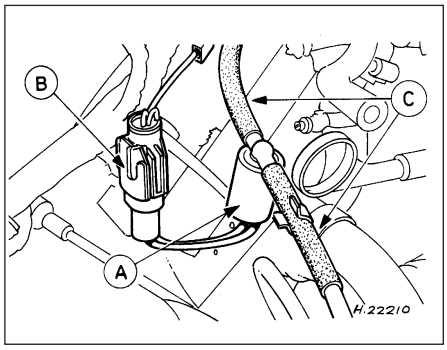
6 Crankcase emission control system components - removal and refitting

Carburettor and Central Fuel Injection (CFI) engines

1 On OHV and HCS engines renewal of the vented oil filler cap and crankcase ventilation hoses is simply a matter of removing them from their locations and fitting new parts as required.
2 On CVH engines the crankcase ventilation filter (where fitted) can be renewed by pulling it out of the air cleaner after disconnecting the hoses **(see illustration)**. Ensure that the sealing grommet is in position in the air cleaner before pushing a new filter into place.

Mechanical (Bosch K- and KE-Jetronic) fuel injection engines

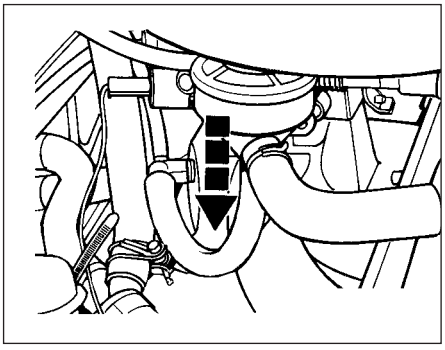
3 On fuel-injection engines the crankcase ventilation filter is located on the right-hand



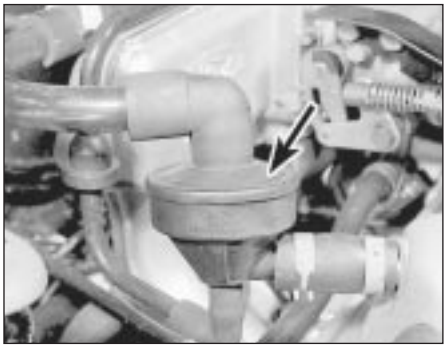
5.7 Carbon canister purge solenoid location - CFI engine

A Canister purge solenoid
B Wiring plug
C Hose

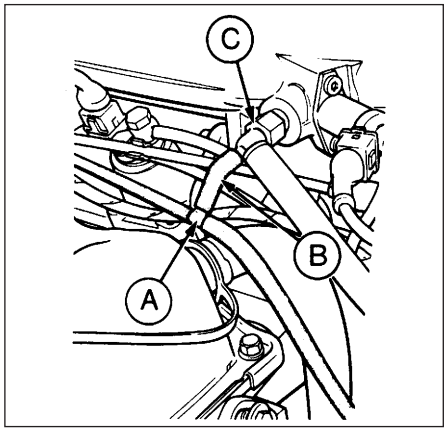
side of the engine and can be removed after disconnecting the hoses **(see illustration)**. On early versions detach the filter from its support bracket also. Refitting is a reversal of removal.
4 During the course of production modifications have been made to the crankcase ventilation system on K-Jetronic fuel-injected engines to eliminate stalling and rough idling caused by oil from the crankcase venting system contaminating the throttle housing.
5 Three versions of the system may be encountered. If the stalling and rough idling problems are encountered on cars equipped with the Mk 1 or Mk 2 system, then they should be uprated to Mk 3 specification as described in the following paragraphs. It should be noted that even the latest (Mk 3) level system failed to cure the problem completely and at the beginning of 1986 a revised throttle housing was introduced. These can be identified by having their idle speed adjustment screw located on the top of the housing under a tamperproof cap, rather than underneath the housing as on early versions. The latest version of throttle housing can be fitted to early cars but the work should



6.2 Crankcase ventilation filter renewal on CVH engines with carburettor - pull valve in direction of arrow

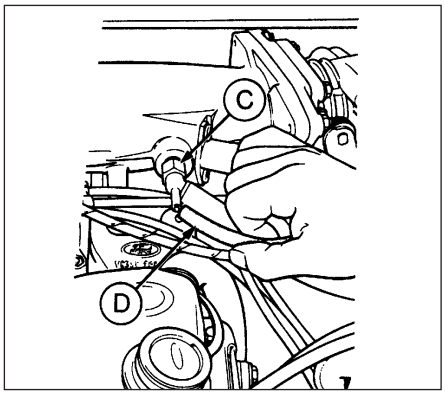


6.3 Crankcase ventilation filter location (arrowed) on KE-Jetronic fuel-injected engines



6.9 Components of Mk 1 crankcase ventilation system - fuel-injection models

A T-connector
B Short hose
C Plenum chamber connector

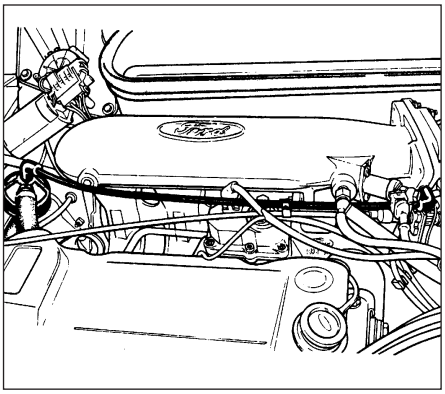


6.10 Fuel shut-off valve hose (D) and plenum chamber connector (C) on Mk 1 type crankcase ventilation system - fuel-injection models

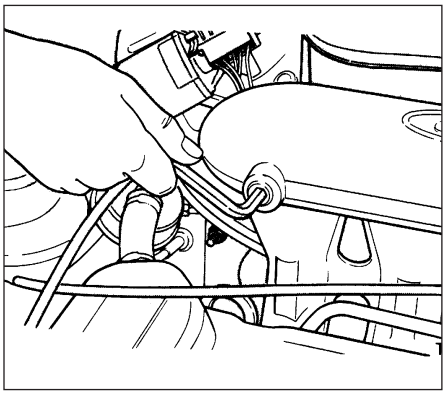
be carried out by a dealer, as numerous modifications are involved. The latest version of crankcase ventilation system should always be fitted first however, as follows.

6 As a preliminary operation, remove the idle speed adjustment screw and blow out the idle passage in the throttle housing using air pressure.

7 Refit the screw.



6.19 Mk 2 crankcase ventilation system - fuel-injection models



6.15a Unscrewing the plenum chamber plug - fuel-injection models

Cars with earliest type (Mk 1) crankcase ventilation system

8 Remove and discard the crankcase ventilation filter vacuum hose.

9 Remove and discard the T-connector and also the short hose **(see illustration)**.

10 Fit the overrun fuel shut off valve hose to the plenum chamber connector **(see illustration)**.

11 Remove and discard the crankcase ventilation filter bracket.

12 Remove and discard the hose which runs between the ventilation filter and the rocker cover.

13 Turn the filter and its hose, which is connected to the air cleaner, so that the small spigot on the filter is uppermost.

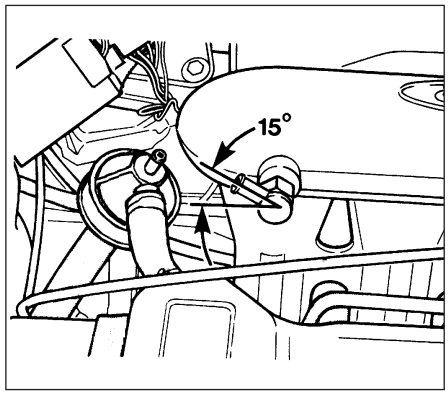
14 Fit a new hose between the filter and rocker cover, secure it with the hose clips.

15 Remove and discard the plug from the plenum chamber and in its place screw in the angled connectors. Set the connector as shown **(see illustrations)**.

16 Connect the ventilation filter to the angled connector using a new hose.

17 Seat the idle speed screw gently and then unscrew it two complete turns.

18 Bring the engine to normal working temperature and adjust the idle speed and mixture as described in Chapter 1.



6.15b Correct setting of plenum chamber angled connector - fuel-injection models

Cars with Mk 2 crankcase ventilation system

19 Remove and discard the crankcase ventilation filter vacuum hose and fit a blanking cap to the hose connector on the throttle housing end of the plenum chamber **(see illustration)**.

20 Remove and discard the plug from the plenum chamber and substitute the new angled connector as described in paragraph 15.

21 Fit the new hose between the ventilation filter and the angled connector.

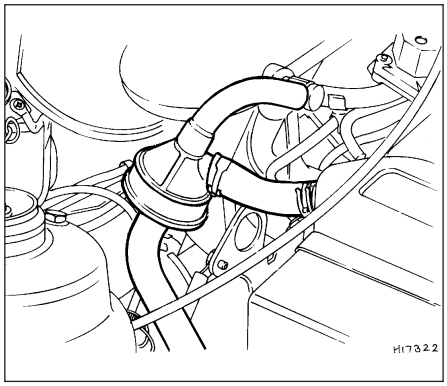
22 Repeat the operations described in paragraphs 17 and 18.

23 Later model cars have the crankcase ventilation filter hose connections as shown **(see illustration)**.

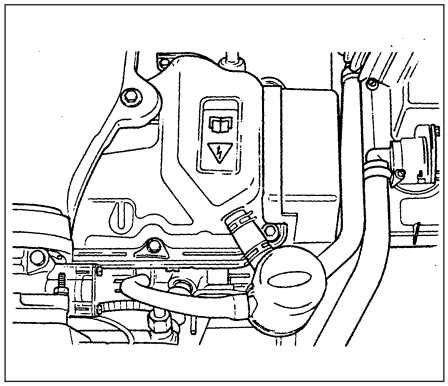
Electronic Fuel Injection (EFI) engines

24 A crankcase ventilation filter is fitted in the hose run to the air cleaner. During the course of production, modifications have been made to the crankcase ventilation system, and two versions of the system may be encountered **(see illustrations)**.

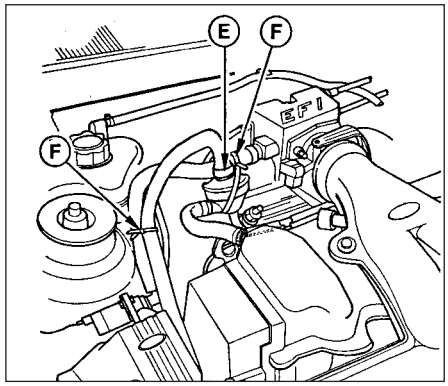
25 Removal and refitting of the filter is simply a matter of disconnecting the relevant hoses.



6.23 Mk 3 crankcase ventilation system - fuel-injection models



6.24a Early type crankcase ventilation system - 1.6 EFI engine



6.24b Later type crankcase ventilation system - 1.6 EFI engine

E Hose clip F Cable-ties

7 Exhaust emission control system components - removal and refitting

Carburettor engines

Spark delay/sustain valve

Removal

1 Disconnect the vacuum lines at the valve and remove the valve from the engine.

Refitting

2 When refitting a spark delay valve it must be positioned with the black side (marked CARB) towards the carburettor and the coloured side (marked DIST) towards the distributor. When refitting a spark sustain valve the side marked VAC must be towards the carburettor and the side marked DIST towards the distributor.

Ported vacuum switch

Removal

3 Remove the filler cap from the expansion tank to reduce pressure in the cooling system. If the engine is hot, remove the cap slowly using a rag to prevent scalding.

4 Disconnect the vacuum lines and the water hoses, then unscrew the valve.

Refitting

5 When refitting the valve, note that the vacuum line from the carburettor is connected to the middle outlet on the PVS, the vacuum line from the spark delay valve (where fitted) is connected to the outlet nearest to the threaded end of the PVS, and the vacuum line from the spark sustain valve is connected to the outlet furthest from the threaded end of the PVS.

6 Reconnect the water hoses and if necessary top-up the cooling system.

Fuel trap

Removal

7 Disconnect the vacuum lines and remove the fuel trap from the engine.

Refitting

8 When refitting, make sure that the fuel trap is positioned with the black side (marked CARB) towards the carburettor and the white side (marked DIST) towards the PVS **(see illustration)**.

Central Fuel Injection (CFI) engines

Catalytic converter

Removal

Note: *Handle the catalyst with care. Any sudden knocks can cause damage to the internal substrates*

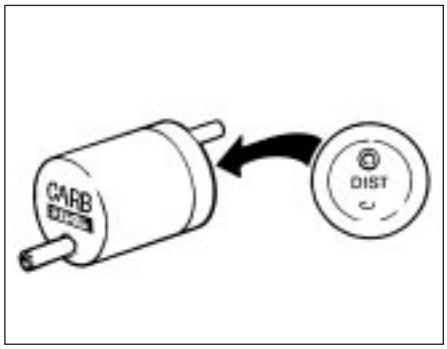
9 Disconnect the battery negative lead.

10 Apply the handbrake, then jack up the front of the vehicle and support it securely on axle stands (see "*Jacking and Vehicle Support*").

11 Remove the bolts from the exhaust downpipe-to-catalytic converter flanged joint.

12 Unscrew the nuts, and remove the clamp securing the rear of the catalytic converter to the exhaust system.

13 Unhook the catalytic converter from the rubber mountings, and carefully manipulate the converter from under the vehicle. If necessary, unhook the front end of the exhaust system from the rubber mountings to ease the procedure.



7.8 Fuel trap marked for direction of fitting

Refitting

14 Commence refitting by ensuring that the mating faces of the catalytic converter, downpipe, and exhaust system are clean.

15 Examine the mounting rubbers, and renew if necessary, noting that the rubbers used are of a special high temperature type due to the high operating temperature of the catalyst.

16 Loosely fit the catalytic converter in position, but do not tighten the fixings yet. Use a new gasket at the converter-to-downpipe flanged joint.

17 Carefully align the downpipe, converter and exhaust system, then tighten the fixings.

18 Lower the vehicle and reconnect the battery negative lead, then start the engine and check the exhaust system for leaks.

Heater Exhaust Gas Oxygen (HEGO) sensor

19 Refer to Part C of this Chapter.

Notes