Chapter 4 Part E:
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
Pulse-air system piping sleeve nuts	32	24
Exhaust manifold to cylinder head:		
HCS engines	23	17
CVH engines (non turbocharged)	16	12
CVH engines (turbocharged)	28 to 31	21 to 23
PTE engines	16	12
Zetec engines	16	12

1 General information

Exhaust system

The exhaust system is composed of an exhaust manifold, the front downpipe and catalytic converter (where fitted), and a main section incorporating two silencers. The service replacement exhaust system consists of three sections: the front downpipe/catalytic converter, the intermediate pipe and front silencer, and the tailpipe and rear silencer. The system is suspended throughout its entire length by rubber mountings.

Emission control systems

To minimise pollution of the atmosphere from incompletely-burned and evaporating gases, and to maintain good driveability and fuel economy, a number of emissions control systems are used on these vehicles. They include the following:

a) The engine management system (comprising both fuel and ignition sub-systems) itself.
b) Positive Crankcase Ventilation (PCV) system.
c) Evaporative emissions control (EVAP) system.
d) Pulse-air (PAIR) system.
e) Catalytic converter.

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

Positive crankcase ventilation system

The function of the crankcase ventilation system is to reduce the emissions of unburned hydrocarbons from the crankcase, and to minimise the formation of oil sludge. By ensuring that a depression is created in the crankcase under most operating conditions, particularly at idle, and by positively inducing fresh air into the system, the oil vapours and "blow-by" gases collected in the crankcase are drawn from the crankcase, through the air cleaner or oil separator, into the inlet tract, to be burned by the engine during normal combustion.

On HCS engines, the system consists of a vented oil filler cap (with an integral mesh filter) and a hose connecting it to a connector on the underside of the air cleaner housing. A further hose leads from the adapter/filter to the inlet manifold. Under conditions of idle and part-load, the emissions gases are directed into the inlet manifold, and dispensed with in the combustion process. Additional air is supplied through two small orifices next to the mushroom valve in the air cleaner housing, the object of which is to prevent high vacuum build-up. Under full-load conditions, when the inlet manifold vacuum is weak, the mushroom valve opens, and the emissions are directed through the air cleaner housing

into the engine induction system and thence into the combustion chambers. This arrangement eliminates any fuel mixture control problems. The operating principles for the system used on the Endura-E engine are basically the same as just described with revisions to the component locations and hose arrangement.

On CVH and PTE engines, a closed-circuit type crankcase ventilation system is used, the function of which is basically the same as that described for the HCS engine type, but the breather hose connects directly to the rocker cover. The oil filler cap incorporates a separate filter in certain applications.

On Zetec engines, the crankcase ventilation system main components are the oil separator mounted on the front (radiator) side of the cylinder block/crankcase, and the Positive Crankcase Ventilation (PCV) valve set in a rubber grommet in the separator's left-hand upper end. The associated pipework consists of a crankcase breather pipe and two flexible hoses connecting the PCV valve to a union on the left-hand end of the inlet manifold, and a crankcase breather hose connecting the cylinder head cover to the air cleaner assembly. A small foam filter in the air cleaner prevents dirt from being drawn directly into the engine.

Evaporative emissions control system

This system is fitted to minimise the escape of unburned hydrocarbons into the atmosphere. Fuel evaporative emissions control systems are limited on vehicles meeting earlier emissions regulations; carburettor float chambers are vented internally, whilst fuel tanks vent to atmosphere through a combined roll-over/anti-trickle-fill valve. On vehicles meeting the more stringent emissions regulations, the fuel tank filler cap is sealed, and a charcoal canister is used to collect and store petrol vapours generated in the tank when the vehicle is parked. When the engine is running, the vapours are cleared from the canister (under the control of the EEC IV engine management module via the canister-purge solenoid valve) into the inlet tract, to be burned by the engine during normal combustion.

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 canister-purge solenoid valve is not opened by the EEC IV module until the engine is fully warmed-up and running under part-load; the solenoid valve is then switched on and off, to allow the stored vapour to pass into the inlet tract.

Pulse-air system

This system consists of the pulse-air solenoid valve, the pulse-air valve itself, the delivery tubing, a pulse-air filter, and on some models, a check valve. The system injects filtered air directly into the exhaust ports, using the pressure variations in the exhaust gases to draw air through from the filter housing; air will flow into the exhaust only when its pressure is below atmospheric. The pulse-air valve can allow gases to flow only one way, so there is no risk of hot exhaust gases flowing back into the filter.

The system's primary function is raise exhaust gas temperatures on start-up, thus reducing the amount of time taken for the catalytic converter to reach operating temperature. Until this happens, the system reduces emissions of unburned hydrocarbon particles (HC) and carbon monoxide (CO) by ensuring that a considerable proportion of these substances remaining in the exhaust gases after combustion are burned up, either in the manifold itself or in the catalytic converter.

To ensure that the system does not upset the smooth running of the engine under normal driving conditions, it is linked by the pulse-air solenoid valve to the EEC IV module, so that it only functions during engine warm-up, when the oxygen sensor is not influencing the fuel/air mixture ratio.

Catalytic converter

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

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 uses precious metals (platinum and palladium or rhodium) as catalysts to speed up the reaction between the pollutants and the oxygen in the vehicle's exhaust gases, CO and HC being oxidised to form H_2O and CO_2 and (in the three-way type of catalytic converter) NO_x being reduced to N_2. **Note**: *The catalytic converter is not a filter in the physical sense; its function is to promote a chemical reaction, but it is not itself affected by that reaction.*

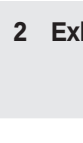
The converter consists of an element (or "substrate") of ceramic honeycomb, coated with a combination of precious metals in such a way as to produce a vast surface area over which the exhaust gases must flow; the whole being mounted in a stainless-steel box. A simple "oxidation" (or "two-way") catalytic converter can deal with CO and HC only, while a "reduction" (or "three-way") catalytic converter can deal with CO, HC and NO_x. Three-way catalytic converters are further sub-divided into "open-loop" (or "unregulated") converters, which can remove 50 to 70% of pollutants and "closed-loop" (also known as "controlled" or "regulated") converters, which can remove over 90% of pollutants.

In order for a closed-loop 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 EEC IV engine management module, which adjusts the air/fuel mixture strength accordingly.

The sensor has a built-in heating element which is controlled by the EEC IV module, in order to bring the sensor's tip to an efficient operating temperature as rapidly as possible. The sensor's tip is sensitive to oxygen, and sends the module a varying voltage depending on the amount of oxygen in the exhaust gases; if the inlet air/fuel mixture is too rich, the sensor sends a high-voltage signal. The voltage falls as the mixture weakens. Peak conversion efficiency of all major pollutants occurs if the inlet air/fuel mixture is maintained at the chemically-correct ratio for the complete combustion of petrol - 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, the module using the signal change as a reference point, and correcting the inlet air/fuel mixture accordingly by altering the fuel injector pulse width (injector opening time).

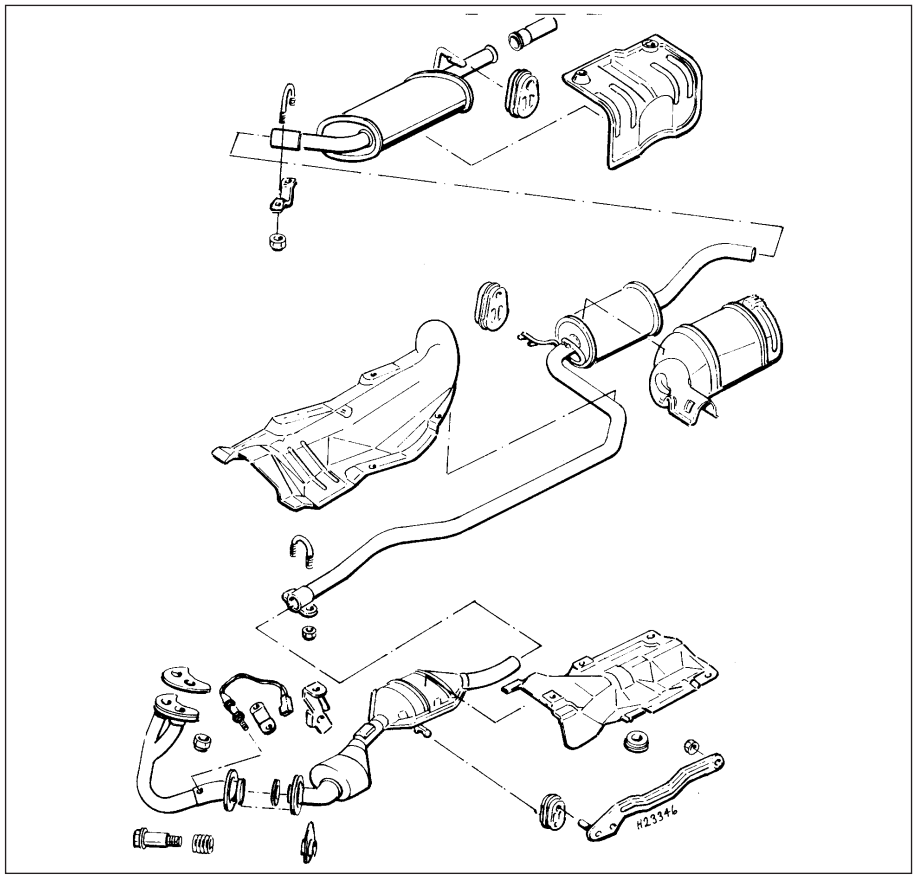
Removal and refitting procedures for the oxygen sensor are given in Parts B, C and D of this Chapter according to fuel system type.

2 Exhaust system - renewal



Warning: Inspection and repair of exhaust system components should be done only after enough time has elapsed after driving the vehicle to allow the system components to cool completely. This applies particularly to the catalytic converter, which runs at very high temperatures. Also, when working under the vehicle, make sure it is securely supported on axle stands.

If the exhaust system components are extremely corroded or rusted together, they will probably have to be cut from the exhaust system. The most convenient way of accomplishing this is to have a quick-fit exhaust repair specialist remove the corroded sections. Alternatively, you can simply cut off the old components with a hacksaw. If you do decide to tackle the job at home, be sure to wear eye protection, to protect your eyes from metal chips, and work gloves, to protect your hands. If the production-fit system is still fitted, it must be cut for the service-replacement system sections to fit. The best way of determining the correct cutting point is to obtain the new centre or rear section first then, with the old system removed, lay the two side by side on the ground. It should now be relatively easy to determine where the old system needs to be cut, and it can be marked accordingly. Remember to allow for the overlap where the two sections will plug together.



2.2a Typical exhaust system and heat shield arrangement (1.4 litre CVH CFi model shown)

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

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

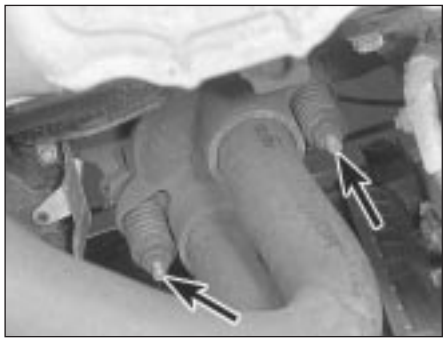
b) Apply penetrating fluid to the exhaust system component fasteners, to make them easier to remove.

c) Use new gaskets, rubber mountings and clamps.

d) Apply anti-seize compound to the threads of all exhaust system fasteners

*e) Note that on some models, the downpipe is secured to the manifold by two bolts, with a coil spring, spring seat and self-locking nut on each. On refitting, tighten the nuts until they stop on the bolt shoulders; the pressure of the springs will then suffice to make a gastight joint. Do not overtighten the nuts to cure a leak - the bolts will shear. Renew the gasket and the springs if a leak is found **(see illustrations)**.*

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



2.2b Exhaust system downpipe-to-manifold securing nuts (arrowed)

Warning: The catalytic converter operates at very high temperatures, and takes a long time to cool. Wait until it's completely cool before attempting to remove the converter. Failure to do so could result in serious burns.

3 Exhaust manifold - removal and refitting

Removal

Note: *Never work on or near the exhaust system and in particular, the catalytic converter (where fitted), while it is still hot. If this is unavoidable, wear thick gloves, and protect yourself from burns should you accidentally touch a hot exhaust component.*

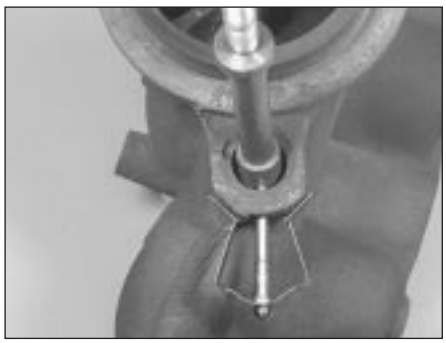
All engines except Zetec

Note: *On turbocharged engines, removal and refitting procedures for the exhaust manifold, complete with turbocharger are given in Part C, Section 20.*

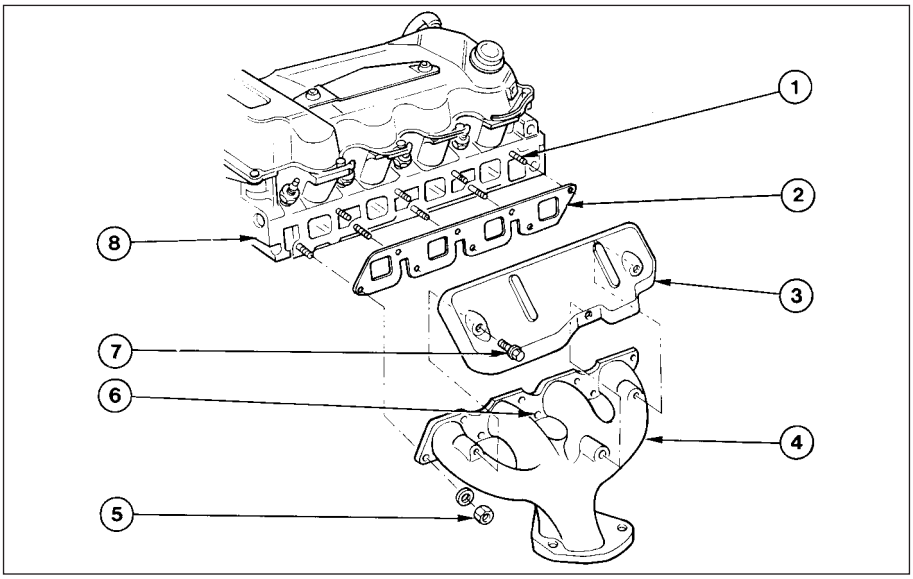
1 Disconnect the battery negative (earth) lead - see Chapter 5A, Section 1.

2.2c Showing securing bolts - note coil spring, and shoulder on bolt

2.2d Renew the exhaust system downpipe-to-manifold gasket to prevent leaks



2.2e Release the spring clip to extract the securing bolt from the manifold, when required



3.2 Exploded view of the exhaust manifold arrangement (1.6 litre CVH EFi engine models)

1 Retaining stud
2 Gasket
3 Heatshield
4 Exhaust manifold
5 Manifold retaining nut
6 Centring hole
7 Heatshield retaining bolt
8 Cylinder head

2 The exhaust manifold is secured the cylinder head by studs and nuts, and is similarly attached to the exhaust downpipe. A shroud/heat shield is bolted to the manifold, to direct exhaust-heated air into the air inlet system when the engine is cold. Access to the exhaust manifold retaining nuts is gained by first removing this shroud **(see illustration)**.

3 On vehicles equipped with a pulse-air system, remove the pulse-air piping as described in Section 7.

4 Support the exhaust downpipe on a jack or suitable blocks, and undo the downpipe-to-manifold retaining nuts. Separate the pipe from the manifold, and remove the gasket. On catalytic converter-equipped vehicles with an oxygen sensor fitted to the exhaust downpipe, take care not to stretch the sensor wiring; if necessary, disconnect the sensor's multi-plug.

5 Undo the retaining nuts, and withdraw the manifold from the cylinder head studs. Remove the manifold gasket.

Zetec engines

Note: *In addition to the new gasket and any other parts, tools or facilities needed to carry out this operation, a new plastic guide sleeve will be required on reassembly.*

6 Disconnect the battery negative (earth) lead - see Chapter 5A, Section 1.

7 Remove the air inlet components as described in Part D of this Chapter.

8 Drain the cooling system (see Chapter 1).

9 Disconnect the coolant hose and the coolant pipe/hose from the thermostat housing; secure them clear of the working area.

10 Unbolt the exhaust manifold heat shield, and withdraw both parts of the shield **(see illustration)**.

11 While the manifold can be removed with the pulse-air system components attached - unbolt the filter housing and disconnect its vacuum hose if this is to be done - it is easier to remove the pulse-air assembly first, as described in Section 7.

12 Unplug the oxygen sensor electrical connector, to avoid straining its wiring. Unscrew the nuts to disconnect the exhaust system front downpipe from the manifold.

13 Remove the nuts and detach the manifold and gasket **(see illustration)**. When removing the manifold with the engine in the vehicle, additional clearance can be obtained by unscrewing the studs from the cylinder head; a female Torx-type socket will be required.

14 Always fit a new gasket on reassembly, to carefully-cleaned components. *Do not* attempt to re-use the original gasket.

Inspection

15 Use a scraper to remove all traces of old gasket material and carbon deposits from the manifold and cylinder head mating surfaces. Provided both mating surfaces are clean and flat, a new gasket will be sufficient to ensure that the joint is gastight. *Do not* use any kind of exhaust sealant upstream of the catalytic converter, where fitted.

16 Note that on some models, the downpipe is secured to the manifold by two bolts, with a coil spring, spring seat and self-locking nut on each. On refitting, tighten the nuts until they stop on the bolt shoulders; the pressure of the springs will then suffice to make a gastight joint.

17 Do not overtighten the nuts to cure a leak - the bolts will shear; renew the gasket and the springs if a leak is found. The bolts themselves are secured by spring clips to the manifold, and can be renewed easily if damaged.

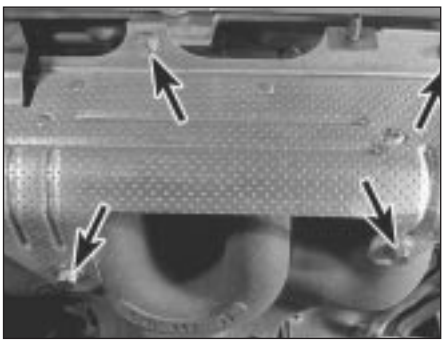
Refitting

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

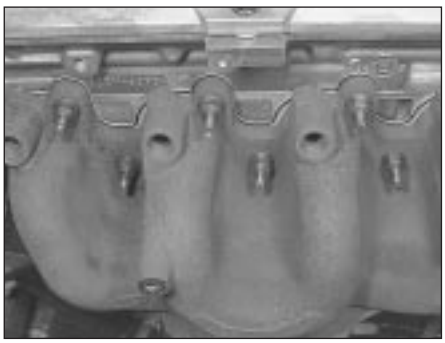
*a) Position a new gasket over the cylinder head studs, and on Zetec engines, fit a new plastic guide sleeve to the stud nearest to the thermostat housing, so that the manifold will be correctly located **(see illustration)**. **Do not** refit the manifold without this sleeve.*

b) Refit the manifold, and finger-tighten the mounting nuts.

c) Working from the centre out, and in three or four equal steps, tighten the nuts to the torque wrench settings given in the Specifications.



3.10 Exhaust manifold heat shield bolts (arrowed) (Zetec engine models)



3.13 Exhaust manifold retaining nuts (Zetec engine models)

3.18 Fit a new plastic guide sleeve to the stud (arrowed) when refitting the manifold (Zetec engine models)

d) Refit the remaining parts in the reverse order of removal. Tighten all fasteners to the specified torque wrench settings where given.
e) Where drained, refill the cooling system (see Chapter 1).
f) Run the engine, and check for exhaust leaks. Check the coolant level when fully warmed-up to normal operating temperature.

4 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. Low quality fuel with a high sulphur content will exacerbate this effect.
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.

5 Positive crankcase ventilation system - checking and component renewal

Checking

1 Checking procedures for the system components are included in Chapter 1.

Component renewal - all engines except Zetec

Air cleaner components

2 See Chapter 1.

Filter/oil separator and hoses

3 All the components relating to the positive crankcase ventilation system, with the exception of the HCS engine filter/adapter located on the underside of the air cleaner, may be removed by simple disconnection and withdrawal (having noted all connections for subsequent refitting).

4 The refitting of all components is a reversal of the removal procedure, ensuring that the connections are correctly made.

Component renewal - Zetec engines

Air cleaner components

5 See Chapter 1.

Positive Crankcase Ventilation (PCV) valve

6 The valve is plugged into the oil separator on Zetec engines **(see illustration)**. Depending on the tools available, access to the valve may be possible once the pulse-air assembly has been removed (see Section 7). If this is not feasible, proceed as outlined in paragraph 7 below.

Oil separator

7 Remove the exhaust manifold (see Section 3). The positive crankcase ventilation valve can now be unplugged and flushed, or renewed, as required, as described in Chapter 1.

8 Unbolt the oil separator from the cylinder block/crankcase, and withdraw it; remove and discard the gasket.

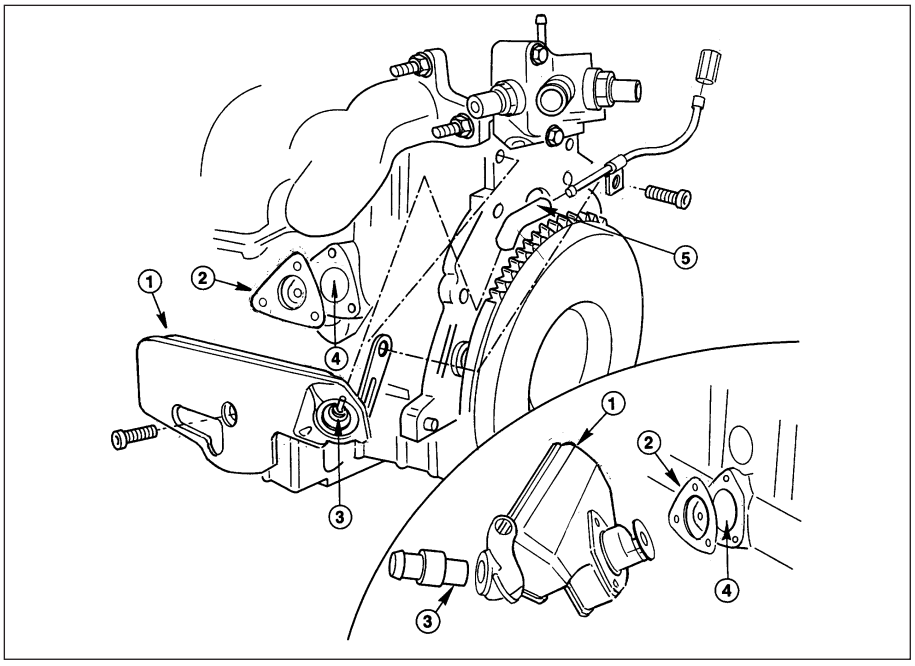
9 Flush out or renew the oil separator, as required (see Chapter 1).

10 Refitting is the reverse of the removal procedure, but use a new gasket between the oil separator and cylinder block. Refill the cooling system (see Chapter 1). Run the engine, check for exhaust leaks, and check the coolant level when it is fully warmed-up.

6 Evaporative emissions control system - checking and component renewal

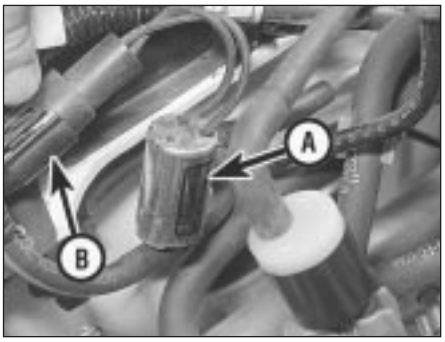
Checking

1 Poor idle, stalling and poor driveability can be caused by an inoperative canister-purge solenoid valve, a damaged canister, split or cracked hoses, or hoses connected to the wrong fittings. Check the fuel filler cap for a damaged or deformed gasket.

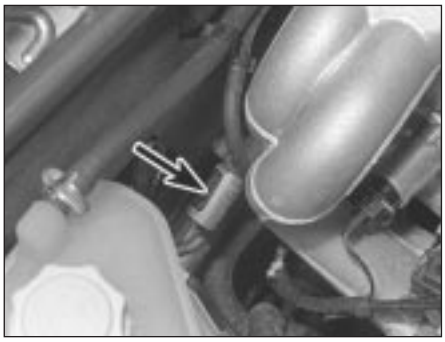


5.6 Crankcase emission control system (Zetec engine models)

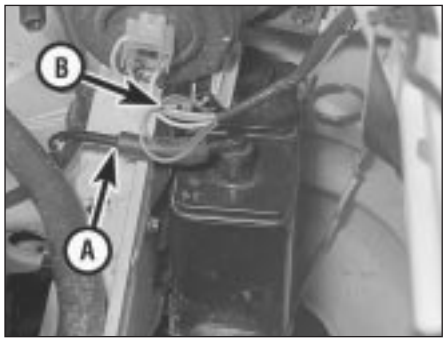
1 Oil separator
2 Gasket
3 Positive crankcase ventilation (PCV) valve
4 Cylinder block/crankcase opening
5 Crankcase breather pipe and flexible hoses



6.7a Canister purge solenoid valve (A) and multi-plug (B) (1.4 litre CVH CFi engine models)



6.7b Canister purge solenoid valve (arrowed) (Zetec engine models)



6.12a Fuel vapour pipe (A) and canister retaining screw (B) (1.4 litre CVH CFi engine models)

2 Fuel loss or fuel odour can be caused by liquid fuel leaking from fuel lines, a cracked or damaged canister, an inoperative canister-purge solenoid valve, or disconnected, misrouted, kinked or damaged vapour or control hoses.
3 Inspect each hose attached to the canister for kinks, leaks and cracks along its entire length. Repair or renew as necessary.
4 Inspect the canister. If it is cracked or damaged, renew it. Look for fuel leaking from the bottom of the canister. If fuel is leaking, renew the canister, and check the hoses and hose routing.
5 If the canister-purge solenoid valve is thought to be faulty, unplug its electrical connector and disconnect its vacuum hoses. Connect a battery directly across the valve terminals. Check that air can flow through the valve passages when the solenoid is thus energised, and that nothing can pass when the solenoid is not energised.
6 Further testing should be left to a dealer service department.

Component renewal

Charcoal canister-purge solenoid valve

7 The solenoid is located at or near to the bulkhead, behind the engine on the right-hand side **(see illustrations)**. Locate the solenoid, then remove any components as necessary to improve access.
8 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1), then unplug the valve's electrical connector. Unclip the valve from its location, then disconnect its vacuum hoses and withdraw it.
9 Refitting is the reverse of the removal procedure.

Charcoal canister

10 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
11 The canister is located in the front right-hand corner of the engine compartment.
12 Disconnect the vapour pipe from the unit, and plug it to prevent the ingress of dirt **(see illustrations)**
13 Undo the retaining screw and withdraw the unit upwards, releasing it from its bracket **(see illustration)**.
14 Refit in the reverse order of removal. Unplug the vapour pipe before reconnecting it, and ensure that it is clean and securely connected.

7 Pulse-air system - checking and component renewal

Checking

1 Poor idle, stalling, backfiring and poor driveability can be caused by a fault in the pulse-air system.
2 Inspect the vacuum pipe/hose for kinks, leaks and cracks along its entire length. Repair or renew as necessary.
3 Inspect the filter housing and piping. If either is cracked or damaged, renew it.
4 If the pulse-air solenoid valve is thought to be faulty, unplug its electrical connector and disconnect its vacuum hoses. Connect a battery directly across the valve terminals, and check that air can flow through the valve passages when the solenoid is thus energised, and that nothing can pass when the solenoid is not energised.
5 Further testing should be left to a dealer service department.

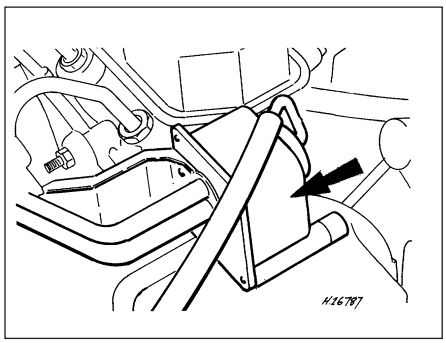
Component renewal

Pulse-air valve, filter and housing (HCS engines)

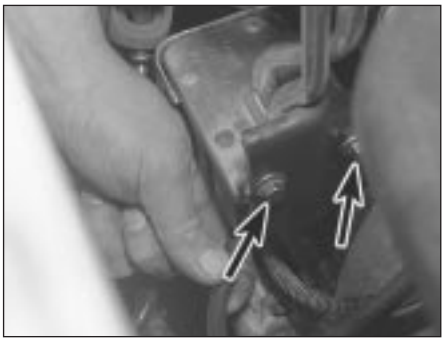
6 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
7 Disconnect the vacuum hose from the rear of the pulse-air valve assembly **(see illustration)**.
8 Undo the retaining screws, and withdraw the air-valve, filter and housing assembly from the mounting bracket.
9 To dismantle the filter housing, undo the four screws and separate the top from the base of the housing; extract the foam filter, and clean it in a suitable solvent. If any of the housing's components are worn or damaged, the assembly must be renewed.

6.12b Canister location and fuel vapour pipe (arrowed) (Zetec engine models)

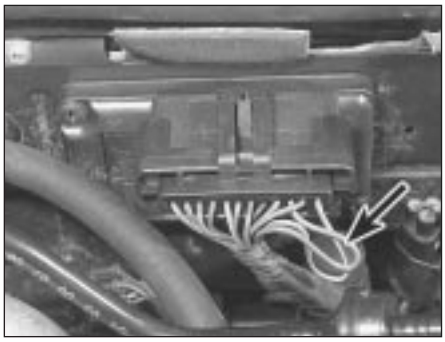
6.13 Undo the retaining screw and withdraw the canister upwards, releasing the tag (arrowed) from its bracket



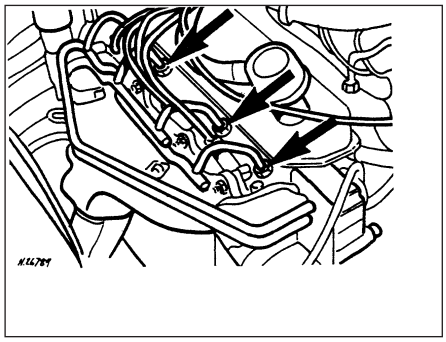
7.7 Location of pulse-air valve (arrowed) (1.3 litre HCS CFi engine models)



7.13 Disconnecting the vacuum hose from the base of the filter housing - note the housing retaining bolts (arrowed) (Zetec engine models)



7.19 Pulse-air solenoid valve location (arrowed) under ignition module



7.25 Pulse-air piping sleeve nuts (3 of 4 arrowed) (1.3 litre HCS CFi engine models)

10 Refitting is the reverse of the removal procedure.

Pulse-air valve, filter and housing (Zetec engines)

11 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
12 Chock the rear wheels then jack up the front of the car and support it on axle stands (see *"Jacking and vehicle support"*).
13 Disconnect the vacuum hose from the base of the filter housing **(see illustration)**.
14 Remove the air cleaner air inlet components for access (refer to Part D of this Chapter).
15 Remove the screws securing the filter housing to the piping, unscrew the mounting bolt, then withdraw the housing.
16 To dismantle the filter housing, undo the four screws and separate the top from the base of the housing. Extract the foam filter, and clean it in a suitable solvent. If any of the housing's components are worn or damaged, the assembly must be renewed.
17 Refitting is the reverse of the removal procedure.

Pulse-air solenoid valve

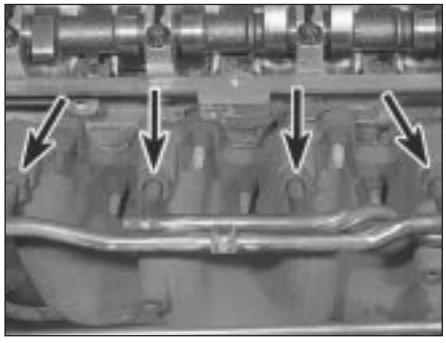
18 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
19 Releasing its wire clip, unplug the electrical connector, then release the valve from its mounting bracket. Withdraw the valve, then label and disconnect the two vacuum hoses **(see illustration)**.
20 Refitting is the reverse of the removal procedure; ensure that the hoses are correctly reconnected.

Pulse-air piping (HCS engines)

21 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
22 Remove the air cleaner if necessary for improved access (refer to Part B of this Chapter).
23 Disconnect the vacuum hose from the pulse-air valve.
24 Unbolt and detach the air tube from its fixing to the exhaust manifold, cylinder head and transmission, according to engine type.
25 Loosen off the four nuts securing the air delivery tubes to the cylinder head exhaust ports, then carefully withdraw the delivery tubes as a unit **(see illustration)**. Do not apply undue force to the tubes as they are detached.
26 Carefully clean the piping, particularly its threads and those of the manifold. Remove all traces of corrosion, which might prevent the pipes seating properly, causing air leaks when the engine is restarted.
27 On refitting, insert the piping carefully into the cylinder head ports, taking care not to bend or distort it. Apply anti-seize compound to the threads, and tighten the retaining sleeve nuts while holding each pipe firmly in its port.
28 The remainder of the refitting procedure is the reverse of removal.

Pulse-air piping (Zetec engines)

29 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
30 Remove the air cleaner air inlet components for access (refer to Part D of this Chapter).
31 Unbolt the exhaust manifold heat shield; unclip the coolant hose to allow the upper part to be withdrawn.
32 Chock the rear wheels then jack up the front of the car and support it on axle stands (see *"Jacking and vehicle support"*).
33 Disconnect the vacuum hose at the base of the pulse-air filter housing.
34 Unscrew the two bolts securing the pipe assembly to the support bracket and the four sleeve nuts securing the pipes into the exhaust manifold **(see illustration)**. Remove the pipes and filter housing as an assembly, taking care not to distort them.
35 Carefully clean the piping, particularly its threads and those of the manifold. Remove all traces of corrosion, which might prevent the pipes seating properly, causing air leaks when the engine is restarted.
36 On refitting, insert the piping carefully into the cylinder head ports, taking care not to bend or distort it. Apply anti-seize compound to the threads, and tighten the retaining sleeve nuts while holding each pipe firmly in its port; if a suitable spanner is available, tighten the sleeve nuts to the specified torque wrench setting.
37 The remainder of the refitting procedure is the reverse of removal.



7.34 Pulse-air piping sleeve nuts (arrowed) (Zetec engine models)

Notes