

| Torque wrench settings | Nm | lbf ft |
|--|-----------------------------|--------|
| Main bearing cap bolts and nuts | 80 | 59 |
| Crankpin (big-end) bearing cap bolts: | | |
| Stage 1 | 18 | 13 |
| Stage 2 | Angle-tighten a further 90° | |
| Piston-cooling oil jet/blanking plug Torx screws | 9 | 7 |
| Cylinder block and head oilway blanking plugs: | | |
| M6 x 10 | 9 | 7 |
| M10 x 11.5 - in block | 23 | 17 |
| 1/4 PTF plug - in block | 24 | 18 |
| Engine-to-transmission bolts | 41 | 30 |

Note: Refer to Part C of this Chapter for remaining torque wrench settings.

1 General information

Included in this Part of Chapter 2 are details of removing the engine/transmission from the car and general overhaul procedures for the cylinder head, cylinder block/crankcase and all other engine internal components.

The information given ranges from advice concerning preparation for an overhaul and the purchase of replacement parts, to detailed step-by-step procedures covering removal, inspection, renovation and refitting of engine internal components.

After Section 6, all instructions are based on the assumption that the engine has been removed from the car. For information concerning in-car engine repair, as well as the removal and refitting of those external components necessary for full overhaul, refer to Part A, B or C of this Chapter (as applicable) and to Section 6. Ignore any preliminary dismantling operations described in Part A, B or C that are no longer relevant once the engine has been removed from the car.

2 Engine/transmission removal - preparation and precautions

If you have decided that an engine must be removed for overhaul or major repair work, several preliminary steps should be taken.

Locating a suitable place to work is extremely important. Adequate work space, along with storage space for the car, will be needed. If a workshop or garage is not available, at the very least, a flat, level, clean work surface is required.

If possible, clear some shelving close to the work area and use it to store the engine components and ancillaries as they are removed and dismantled. In this manner the components stand a better chance of staying clean and undamaged during the overhaul. Laying out components in groups together with their fixing bolts, screws etc will save time and avoid confusion when the engine is refitted.

Clean the engine compartment and engine/transmission before beginning the removal procedure; this will help visibility and help to keep tools clean.

On three of the engines covered in this manual (CVH, PTE, and Zetec), the unit can only be withdrawn by removing it complete with the transmission; the vehicle's body must be raised and supported securely, sufficiently high that the engine/transmission can be unbolted as a single unit and lowered to the ground; the engine/transmission unit can then be withdrawn from under the vehicle and separated. On all engines, an engine hoist or A-frame will be necessary. Make sure the equipment is rated in excess of the combined weight of the engine and transmission.

The help of an assistant should be available; there are certain instances when one person cannot safely perform all of the operations required to remove the engine from the vehicle. Safety is of primary importance, considering the potential hazards involved in this kind of operation. A second person should always be in attendance to offer help in an emergency. If this is the first time you have removed an engine, advice and aid from someone more experienced would also be beneficial.

Plan the operation ahead of time. Before starting work, obtain (or arrange for the hire of) all of the tools and equipment you will need. Access to the following items will allow the task of removing and refitting the engine/transmission to be completed safely and with relative ease: an engine hoist - rated in excess of the combined weight of the engine/transmission, a heavy-duty trolley jack, complete sets of spanners and sockets as described in "Tools and working facilities" at the rear of this manual, wooden blocks, and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and fuel. A selection of different sized plastic storage bins will also prove useful for keeping dismantled components grouped together. If any of the equipment must be hired, make sure that you arrange for it in advance, and perform all of the operations possible without it beforehand; this may save you time and money.

Plan on the vehicle being out of use for quite a while, especially if you intend to carry out an engine overhaul. Read through the whole of this Section and work out a strategy

based on your own experience and the tools, time and workspace available to you. Some of the overhaul processes may have to be carried out by a Ford dealer or an engineering works - these establishments often have busy schedules, so it would be prudent to consult them before removing or dismantling the engine, to get an idea of the amount of time required to carry out the work.

When removing the engine from the vehicle, be methodical about the disconnection of external components. Labelling cables and hoses as they are removed will greatly assist the refitting process.

Always be extremely careful when lifting the engine/transmission assembly from the engine bay. Serious injury can result from careless actions. If help is required, it is better to wait until it is available rather than risk personal injury and/or damage to components by continuing alone. By planning ahead and taking your time, a job of this nature, although major, can be accomplished successfully and without incident.

3 Engine - removal and refitting (HCS engines)



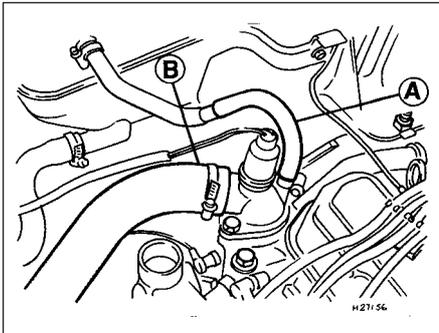
Warning: Petrol is extremely flammable, so take extra precautions when disconnecting any part of the fuel system.

Don't smoke, or allow naked flames or bare light bulbs, in or near the work area, and don't work in a garage where a natural-gas appliance (such as a clothes dryer or water heater) is installed. If you spill petrol on your skin, rinse it off immediately. Have a fire extinguisher rated for petrol fires handy, and know how to use it.

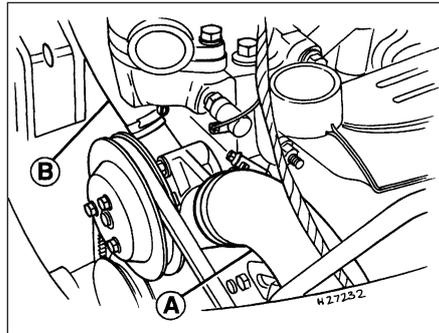
Note: Read through the entire Section, as well as reading the advice in the preceding Section, before beginning this procedure. The engine is removed separately from the transmission and is lifted upwards and out of the engine compartment.

Removal

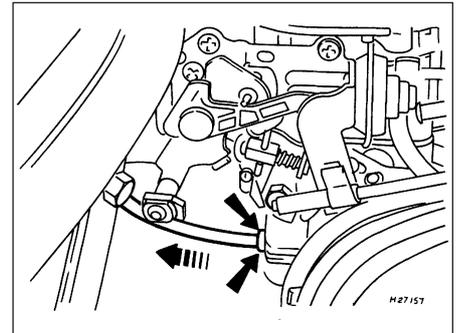
- 1 On fuel injection engines, refer to Chapter 4B and depressurise the fuel system.
- 2 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).



3.6a Disconnect the overflow hose (A) and the top hose (B) from the thermostat housing



3.6b Disconnect the bottom hose (A) and the heater hose (B) from the water pump



3.8 Detach the servo vacuum hose from the manifold

3 Referring to Chapter 1 for details, drain the coolant and engine oil. Refit the drain plug to the sump on completion.

4 Remove the bonnet as described in Chapter 11.

5 Remove the air cleaner assembly as described in the relevant Part of Chapter 4.

6 Release the retaining clips and detach the

following coolant hoses. Allow for coolant spillage as the hoses are detached (see illustrations):

- a) All hoses at the thermostat housing.
- b) Bottom hose from the radiator to the water pump.
- c) Heater hoses at the bulkhead and water pump.
- d) Inlet manifold coolant supply hose (where applicable).

7 Disconnect the fuel trap vacuum hose from the inlet manifold.

8 Disconnect the brake servo unit vacuum hose from the inlet manifold, by pushing the hose retainer in towards the manifold and simultaneously pulling free the hose (see illustration).

9 Refer to the relevant Part of Chapter 4 for details, and detach the accelerator cable. Where applicable, detach the choke cable from the carburettor.

10 Compress the quick-release couplings at the sides, and detach the fuel supply hose and return hose from the fuel pump, CFI unit or fuel rail (see illustration). Allow for fuel spillage as the hoses are disconnected, and plug the exposed ends to prevent further

spillage and the ingress of dirt. Position the hoses out of the way.

11 Note their locations and disconnect the wiring connectors from the following (see illustrations):

- a) Coolant temperature gauge sender unit.
- b) The oil pressure switch.
- c) The radio earth lead.
- d) The cooling fan thermostatic switch.
- e) The DIS/E-DIS ignition coil.
- f) The crankshaft speed/position sensor.
- g) The engine coolant temperature sensor.
- h) The idle cut-off valve.

12 Disconnect the remaining wiring multi-plugs from the engine sensors at the inlet manifold and from the oxygen sensor (where fitted) in the exhaust manifold or downpipe.

13 Chock the rear wheels then jack up the front of the car and support it on axle stands (see "Jacking and Vehicle Support").

14 Unscrew the retaining nuts, and detach the exhaust downpipe from the exhaust manifold. Remove the seal from the joint flange.

15 Refer to Chapter 5A for details, and remove the starter motor.

16 Undo the two retaining bolts, and remove the clutch lower cover plate.

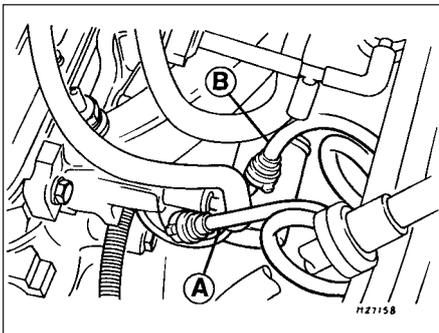
17 Unscrew the retaining bolt, and detach the gearshift stabiliser from the transmission.

18 Unscrew and remove the engine/

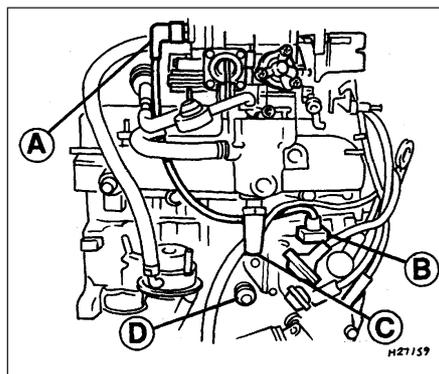
HAYNES
HINT



Whenever you disconnect any vacuum lines, coolant or emissions hoses, wiring connectors and fuel lines, always label them clearly, so that they can be correctly reassembled. Masking tape and/or a touch-up paint applicator work well for marking items. Take instant photos, or sketch the locations of components and brackets.

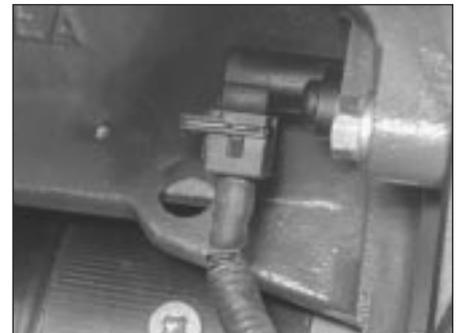


3.10 Fuel supply (A) and return (B) hose connections at the fuel pump

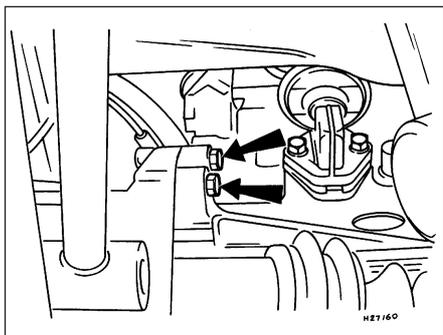


3.11a Wiring connections to the HCS engine

- A Idle cut-off valve
- B DIS ignition coil
- C Engine coolant temperature sensor
- D Oil pressure switch



3.11b Engine crankshaft position sensor and multi-plug



3.18 Engine-to-transmission flange attachment bolts (arrowed)

transmission flange attachment bolts (see illustration).

19 Check that the appropriate underside attachments are disconnected and out of the way, then lower the vehicle to the ground.

20 Unbolt and remove the heat shield from the exhaust manifold.

21 Attach a suitable hoist to the engine. It is possible to fabricate lifting eyes to connect the hoist to the engine, but make sure that they are strong enough, and connect them to the inlet and exhaust manifold at diagonally-opposite ends of the engine.

22 With the hoist securely connected, take the weight of the engine. Unscrew and remove the right-hand engine mounting side bolt from under the right-hand wheel arch. Unscrew and remove the mounting retaining nut and washer from the suspension strut cup retaining plate, and the three bolts securing the mounting unit to the cylinder block.

23 Locate a jack under the transmission, and raise it to take the weight of the transmission.

24 Unscrew and remove the remaining engine-to-transmission retaining bolts on the upper flange.

25 Check around the engine to ensure that all of the relevant fixings and attachments are disconnected and out of the way for the removal.

26 Enlist the aid of an assistant, then move the engine sideways and away from the transmission, whilst simultaneously raising the transmission. When the engine is separated from the transmission, carefully guide it up and out of the engine compartment. Do not allow the weight of the engine to hang on the transmission input shaft at any point during the removal (or refitting) of the engine. When the engine sump is clear of the vehicle, swing the power unit out of the way, and lower it onto a trolley (if available). Unless a mobile hoist is being used, it will be necessary to move the vehicle rearwards and out of the way in order to allow the engine to be lowered for removal. In this instance, ensure that the weight of the transmission is well supported as the vehicle is moved.

27 While the engine is removed, check the mountings; renew them if they are worn or damaged. Similarly, check the condition of all coolant and vacuum hoses and pipes (see

Chapter 1); components that are normally hidden can now be checked properly, and should be renewed if there is any doubt at all about their condition. Also, take the opportunity to overhaul the clutch components (see Chapter 6). It is regarded by many as good working practice to renew the clutch assembly as a matter of course, whenever major engine overhaul work is carried out. Check also the condition of all components disturbed on removal, and renew any that are damaged or worn.

Refitting

28 Refitting is in general, a reversal of the removal procedure, but the following special points should be noted.

29 Before coupling the engine to the transmission, apply a thin smear of high-melting-point grease onto the transmission input shaft splines. If the clutch has been removed, ensure that the clutch disc is centralised, and disconnect the clutch cable from the release lever on the transmission casing.

30 Tighten all fixings to their recommended torque wrench settings.

31 Check that the mating faces are clean, and fit a new exhaust downpipe-to-manifold gasket and self-locking nuts when reconnecting this joint.

32 Ensure that all wiring connections are correctly and securely made.

33 Remove the plugs from the fuel lines before reconnecting them correctly and securely.

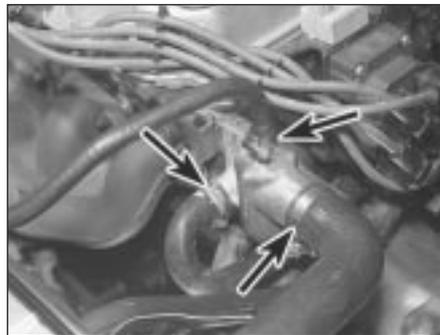
34 Reconnect and adjust the accelerator and choke cables as described in the relevant Part of Chapter 4. The refitting details for the air cleaner components are also given in that Chapter.

35 Renew any coolant hoses (and/or retaining clips) that are not in good condition.

36 Refer to Chapter 6 for details on reconnecting the clutch cable.

37 When the engine is fully refitted, check that the various hoses are connected, and then top-up the engine oil and coolant levels as described in Chapter 1 and "Weekly Checks".

38 When engine refitting is completed, refer to Section 19 for the engine start-up procedures.



4.6a Coolant hose connections to the thermostat (arrowed)

4 Engine/transmission - removal and refitting (CVH and PTE engines)



Warning: Petrol is extremely flammable, so take extra precautions when disconnecting any part of the fuel system.

Don't smoke, or allow naked flames or bare light bulbs, in or near the work area, and don't work in a garage where a natural-gas appliance (such as a clothes dryer or water heater) is installed. If you spill petrol on your skin, rinse it off immediately. Have a fire extinguisher rated for petrol fires handy, and know how to use it.

Note: Read through the entire Section, as well as reading the advice in Section 2, before beginning this procedure. The engine and transmission are removed as a unit, lowered to the ground and removed from underneath, then separated outside the vehicle.

Removal

1 On all fuel injection engines, refer to Chapter 4B, C or D as applicable and depressurise the fuel system.

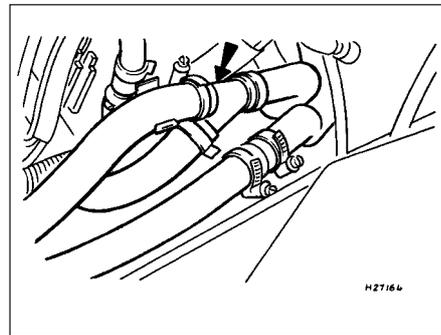
2 Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).

3 Referring to Chapter 1 for details, drain the coolant and the engine oil. Refit the drain plug to the sump on completion.

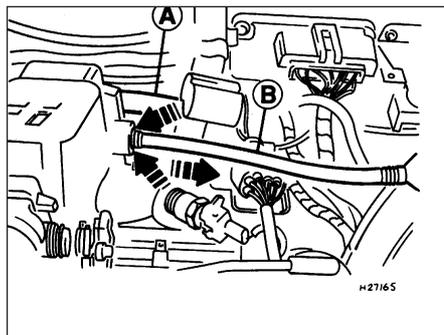
4 Refer to Chapter 11 for details, and remove the bonnet.

5 Remove the air cleaner assembly and air inlet components as described in the relevant Part of Chapter 4.

6 Release the retaining clips and detach the coolant top hose, the heater hose and the radiator overflow hose from the thermostat housing. Disconnect the coolant hose from the inlet manifold, and the bottom hose from the water pump and/or the radiator (see illustrations). On 1.4 litre CFI fuel injection models, also disconnect the coolant hose from the injection unit. On EFI and SEFI fuel injection models, detach the heater hose Y-connector. Allow for coolant spillage as the hoses are detached. On turbocharged engines, disconnect the coolant return hose from the turbocharger connecting pipe.



4.6b Heater coolant hoses and Y-connector on 1.6 litre EFI fuel injection models



4.11 Vacuum hose to MAP sensor (A) and brake servo (B)



4.12a Disconnect the wiring at the temperature gauge sender unit . . .



4.12b . . . the oil pressure switch . . .

HAYNES HINT Whenever you disconnect any vacuum lines, coolant or emissions hoses, wiring connectors and fuel lines, always label them clearly, so that they can be correctly reassembled. Masking tape and/or a touch-up paint applicator work well for marking items. Take instant photos, or sketch the locations of components and brackets.

7 Refer to the relevant Part of Chapter 4 for details, and disconnect the accelerator cable from the throttle linkage and support/adjuster bracket. Where applicable, also disconnect the choke cable. Position the cable(s) out of the way.

8 On carburettor models, disconnect the fuel supply hose from the fuel pump, and the return hose from the carburettor.

9 On CFI models, detach the fuel hose at the injector/pressure regulator unit, and the return line, by compressing the couplings whilst pulling the hoses free from their connections. On EFI and SEFI models, unscrew the union nut to detach the fuel line from the fuel rail; release the retaining clip to detach the return pipe from the pressure regulator. Plug the exposed ends of the hoses and connections, to prevent fuel spillage and the ingress of dirt. Position the hoses out of the way.

10 Press the clamp ring inwards, and simultaneously pull free the brake servo hose

from the inlet manifold. Position it out of the way.

11 On CFI and EFI models, detach the vacuum hose from the MAP sensor, and the hose between the carbon canister and the fuel injection unit (see illustration).

12 Note their connections and routings, and detach the following wiring connections, according to model (see illustrations):

- a) Coolant temperature sender unit.
- b) Oil pressure switch.
- c) E-DIS ignition coil unit. or distributor.
- d) Coolant temperature sensor.
- e) Cooling fan thermostatic switch.
- f) Carburettor.
- g) Earth lead (radio).
- h) Reversing light switch (from transmission).
- i) Crankshaft position sensor.
- j) Earth leads from the transmission and engine.

13 Disconnect the wiring at the following additional items specific to fuel injection models only.

- a) Inlet air temperature sensor.
- b) Vehicle speed sensor.
- c) Throttle plate control motor (CFI models).
- d) Throttle position sensor.
- e) Injector harness connector.
- f) Idle speed control valve (EFI and SEFI models).

14 Unscrew the retaining bolt and detach the bracket locating the wiring and coolant hoses above the transmission.

15 Disconnect the speedometer drive cable from the transmission.

16 On manual transmission models, disconnect the clutch cable from the release lever at the transmission (see Chapter 6 for details). Position the cable out of the way.

17 On vehicles fitted with the anti-lock braking system, refer to Chapter 9 and release the left-hand modulator from its mounting bracket, without disconnecting the rigid brake pipes or return hose. Tie the modulator securely to the bulkhead.

18 Chock the rear wheels then jack up the front of the car and support it on axle stands (see "Jacking and Vehicle Support"). Allow sufficient clearance under the vehicle to withdraw the engine and transmission units from under the front end.

19 On XR2i models, refer to Chapter 10 and remove the front suspension crossmember.

20 Where applicable on catalytic converter-equipped vehicles, release the multi-plug from the bracket and disconnect the wiring connector from the oxygen sensor in the exhaust downpipe.

21 Undo the three retaining bolts, detach the exhaust downpipe from the manifold, and collect the gasket from the flange joint. Now disconnect the exhaust downpipe from the rest of the system, and remove it from the vehicle.

22 Where fitted, undo the four retaining nuts and two bolts securing the front part of the exhaust heat shield to the floor, then remove the heat shield.

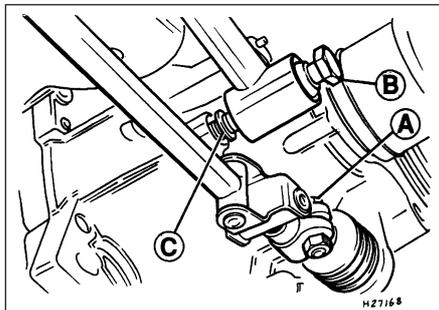
23 Refer to Chapter 5A and remove the alternator and starter motor. On models with power steering, refer to Chapter 10 and remove the power steering pump.

Manual transmission models

24 On 4-speed models, select 2nd gear; on 5-speed models, select 4th gear, to assist in correct adjustment of the gearchange during reassembly. If it is likely that the gear lever will be moved from this position before refitting, mark the relative position of the transmission shift rod and the selector shaft before separating them. Undo the clamp bolt, and then pull free and detach the shift rod from the selector shaft (see illustration).



4.12c . . . and the crankshaft position sensor



4.24 Manual transmission shift rod clamp bolt (A), stabiliser-to-transmission bolt (B) and washer (C)

2D•10 Engine removal and overhaul procedures

25 Unscrew the retaining bolt, and detach the shift rod stabiliser from the transmission. As it is detached, note the washer located between the stabiliser and the transmission. Tie the stabiliser and the shift rod up out of the way.

Automatic transmission models

26 Unclip and detach the wiring connector from the starter inhibitor switch (on the transmission housing).

27 Referring to the relevant Part of Chapter 4 for details, unhook the accelerator (cam plate) cable from the carburettor or fuel injection unit (as applicable) at the transmission end of the cable. Undo the retaining bolt and detach the cable sheath bracket from the transmission. Detach the cam plate cable from the link.

28 Undo the two nuts from the selector cable bracket which connects it to the lever on the selector shaft. Disconnect the yoke from the lever on the selector shaft and the cable from the lever.

29 Unscrew the union nuts, and disconnect the oil cooler feed and return pipes from the transmission. Allow for a certain amount of spillage, and plug the connections to prevent the ingress of dirt.

All models

30 Unscrew the retaining nut and withdraw the Torx-type clamp bolt securing the lower suspension arm to the spindle carrier on each side.

31 Refer to Chapter 10 for details, and detach the right-hand and left-hand track rod end balljoints from the spindle carriers.

32 On vehicles fitted with the anti-lock braking system, refer to Chapter 9 and release the right-hand modulator from its mounting bracket without disconnecting the rigid brake pipes or return hose. Tie the modulator securely to the bulkhead. Additionally, undo the three bolts securing the modulator bracket.

33 Insert a suitable lever between the right-hand driveshaft inner joint and the transmission housing, and prise free the driveshaft from the transmission; be prepared for oil spillage from the transmission case through the vacated driveshaft aperture. As it is being prised free, simultaneously pull the roadwheel outwards on that side, to enable the driveshaft inboard end to separate from the transmission. Once it is free, suspend and support the driveshaft from the steering gear, to prevent unnecessary strain being placed on the driveshaft joints.

34 Insert a suitable plastic plug (or if available, an old driveshaft joint), into the transmission driveshaft aperture, to immobilise the gears of the differential unit.

35 Proceed as described above in paragraphs 33 and 34, and disconnect the left-hand driveshaft from the transmission.

36 Connect a suitable lift hoist and sling to the engine, connecting to the lifting eyes.

When securely connected, take the weight of the engine/transmission unit so that the tension is relieved from the mountings.

37 Undo the retaining bolts and nuts and detach the right-hand engine mounting from the vehicle body.

38 Undo the four bolts securing the transmission bearer to the underside of the vehicle body. The transmission bearer is removed with the engine/transmission assembly.

39 Unscrew the three retaining bolts, and remove the auxiliary drivebelt cover from under the crankshaft pulley.

40 The engine/transmission unit should now be ready for removal from the vehicle. Check that all of the associated connections and fittings are disconnected from the engine and transmission, and positioned out of the way.

41 Enlist the aid of an assistant to help steady and guide the power unit down through the engine compartment as it is removed. If available, position a suitable engine trolley or crawler board under the engine/transmission so that when lowered, the power unit can be withdrawn from the front end of the vehicle, and then moved to the area where it is to be cleaned and dismantled. On automatic transmission models, particular care must be taken not to damage the transmission fluid pan (sump) during the removal and subsequent refitting processes.

42 Carefully lower the engine and transmission unit, ensuring that no fittings become snagged. Detach the hoist and remove the power unit from under the vehicle.

43 Referring to the relevant Part of Chapter 7, separate the transmission from the engine.

44 While the engine/transmission is removed, check the mountings; renew them if they are worn or damaged. Similarly, check the condition of all coolant and vacuum hoses and pipes (see Chapter 1). Components that are normally hidden can now be checked properly, and should be renewed if there is any doubt at all about their condition. Where the vehicle is fitted with manual transmission, take the opportunity to inspect the clutch components (see Chapter 6). It is regarded by many as good working practice to renew the clutch assembly as a matter of course, whenever major engine overhaul work is carried out. Check also the condition of all components (such as the transmission oil seals) disturbed on removal, and renew any that are damaged or worn.

Refitting

45 Refitting is a reversal of removal, however note the following additional points:

- Refer to the applicable Chapters and Sections as for removal.
- Fit new spring clips to the grooves in the inboard end of the right- and left-hand driveshaft joints. Lubricate the splines with transmission oil prior to fitting.

- Renew the exhaust flange gasket when reconnecting the exhaust. Ensure that all wires are routed clear of the exhaust system and, on catalytic converter models, ensure that the heat shields are securely and correctly fitted.
- Ensure that all earth lead connections are clean and securely made.
- Tighten all nuts and bolts to the specified torque.
- Fit a new oil filter, and refill the engine and transmission with oil, with reference to Chapter 1.
- Refill the cooling system with reference to Chapter 1.
- Refit the alternator and starter motor with reference to Chapter 5A.
- Where applicable, refit the power steering pump with reference to Chapter 10.

46 When engine and transmission refitting is complete, refer to the procedures described in Section 19 before restarting the engine.

5 Engine/transmission - removal and refitting (Zetec engines)



Warning: Petrol is extremely flammable, so take extra precautions when disconnecting any part of the fuel system.

Don't smoke, or allow naked flames or bare light bulbs, in or near the work area, and don't work in a garage where a natural-gas appliance (such as a clothes dryer or water heater) is installed. If you spill petrol on your skin, rinse it off immediately. Have a fire extinguisher rated for petrol fires handy, and know how to use it.

Note: Read through the entire Section, as well as reading the advice in Section 2, before beginning this procedure. The engine and transmission are removed as a unit, lowered to the ground and removed from underneath, then separated outside the vehicle.

Removal

- Park the vehicle on firm, level ground, apply the handbrake firmly, and slacken the nuts securing both front roadwheels.
- Depressurise the fuel system as described in Chapter 4D.
- Disconnect the battery negative (earth) lead (refer to Chapter 5A, Section 1).
- Place protective covers on the wings, then remove the bonnet (see Chapter 11).
- Drain the cooling system and the engine oil (see Chapter 1).
- Remove the air inlet components and the complete air cleaner assembly as described in Chapter 4D.
- Equalise the pressure in the fuel tank by removing the filler cap, then release the fuel feed and return quick-release couplings, and pull the hoses off the fuel pipes. Plug or cap all open fittings.



5.11 Unbolt the engine/transmission-to-body earth lead from the transmission



5.14a Disconnect the wiring multi-plug from the ignition coil . . .



5.14b . . . the radio interference suppressor . . .

**HAYNES
HINT**

Whenever you disconnect any vacuum lines, coolant or emissions hoses, wiring connectors and fuel lines, always label them clearly, so that they can be correctly reassembled. Masking tape and/or a touch-up paint applicator work well for marking items. Take instant photos, or sketch the locations of components and brackets.

8 Disconnect the accelerator cable from the throttle linkage as described in Chapter 4D. Secure the cable clear of the engine/transmission.

9 Releasing its wire clip, unplug the wiring connector from the power steering pressure switch (where fitted), then disconnect the earth cable from the engine lifting eye. Refit the bolt after disconnecting the cable.

10 Marking or labelling all components as they are disconnected, disconnect the vacuum hoses as follows:

- a) From the rear of the inlet manifold.
- b) The braking system vacuum servo unit hose - from the inlet manifold (see Chapter 9 for details).
- c) While you are there, trace the vacuum line from the pulse-air filter housing, and disconnect it from the pulse-air solenoid valve.
- d) Secure all these hoses so that they won't get damaged as the engine/transmission is removed.

11 Unbolt the engine/transmission-to-body

earth lead from the transmission (see illustration). Disconnect the speedometer drive cable (see Chapter 12) and secure it clear of the engine/transmission.

12 Disconnect the earth strap at the top of the engine/transmission flange, and the adjacent bolt securing the wiring harness clip.

13 Where the vehicle is fitted with manual transmission, disconnect the clutch cable (see Chapter 6).

14 Marking or labelling all components as they are disconnected, disconnect the engine wiring connectors as follows (see illustrations):

- a) The multi-plug from the E-DIS ignition coil.
- b) The radio interference suppressor from the DIS ignition coil.
- c) The reversing light switch multi-plug.
- d) The engine main wiring loom multi-plug behind the E-DIS ignition coil.
- e) The crankshaft speed/position sensor and vehicle speed sensor multi-plugs.
- f) The oxygen sensor multi-plug.

15 Unbolt the exhaust manifold heat shield, and lift it clear.

16 Remove the auxiliary drivebelt (see Chapter 1).

17 Marking or labelling all components as they are disconnected and catching as much as possible of the escaping coolant in the drain tray, disconnect the cooling system hoses and pipes as follows:

- a) The coolant hoses at the thermostat housing.

b) The coolant hose at the metal cross pipe lower connection.

c) The radiator top and bottom hoses.

18 Where applicable, detach the power steering pump pressure pipe clips, release the unions and disconnect the pump pressure and return lines. Collect the fluid in a suitable container, and plug the disconnected unions.

19 On vehicles fitted with the anti-lock braking system, refer to Chapter 9 and release the left-hand modulator from its mounting bracket, without disconnecting the rigid brake pipes or return hose. Tie the modulator securely to the bulkhead.

20 Chock the rear wheels then jack up the front of the car and support it on axle stands (see "Jacking and Vehicle Support"). Remove the front roadwheels.

21 Refer to Chapter 5 if necessary, and disconnect the wiring from the starter motor and alternator.

22 Disconnect the oil pressure switch wiring connector.

23 On automatic transmission models, disconnect the starter inhibitor switch wiring and disconnect the selector cable (see Chapter 7B). Secure the cable clear of the engine/transmission.

24 Where the vehicle is fitted with manual transmission, disconnect the gearchange linkage and transmission support rod from the rear of the transmission - make alignment marks as they are disconnected (see illustrations).



5.14c . . . and the reversing light switch



5.24a Disconnect the gearchange linkage . . .



5.24b . . . and transmission support rod

25 On automatic transmission models, clean around the unions, then disconnect the fluid pipes from the transmission. Plug the openings in the transmission and the pipe unions after removal.

26 Refer to Chapter 10 and remove the front suspension crossmember.

27 Unscrew the nuts to disconnect the exhaust system front downpipe from the manifold. Undo the nuts securing the catalytic converter to the rear part of the exhaust system, and remove the converter and downpipe assembly.

28 On vehicles fitted with the anti-lock braking system, refer to Chapter 9 and release the right-hand modulator from its mounting bracket without disconnecting the rigid brake pipes or return hose. Tie the modulator securely to the bulkhead. Additionally, undo the three bolts securing the modulator bracket.

29 Disconnect both anti-roll bar links from their respective suspension struts, and both track rod end ball joints from their spindle carriers (see Chapter 10).

30 Unscrew the retaining nut and withdraw the Torx-type clamp bolt securing the lower suspension arm to the spindle carrier on each side.

31 Insert a suitable lever between the right-hand driveshaft inner joint and the transmission housing, and prise free the driveshaft from the transmission; be prepared for oil spillage from the transmission case through the vacated driveshaft aperture. As it is being prised free, simultaneously pull the roadwheel outwards on that side to enable the driveshaft inboard end to separate from the transmission. Once it is free, suspend and support the driveshaft from the steering gear, to prevent unnecessary strain being placed on the driveshaft joints.

32 Insert a suitable plastic plug (or if available, an old driveshaft joint), into the transmission driveshaft aperture, to immobilise the gears of the differential unit.

33 Proceed as described above in paragraphs 31 and 32, and disconnect the left-hand driveshaft from the transmission.

34 Remove the oil filter, referring to Chapter 1 if necessary.

35 Connect a suitable lift hoist and sling to the engine, connecting to the lift eyes. When securely connected, take the weight of the engine/transmission unit so that the tension is relieved from the mountings.

36 Unbolt the engine rear right-hand mounting from the body (one bolt in the wheel arch, one nut in the engine compartment), then unbolt the engine front right-hand mounting from the alternator mounting bracket. Unbolt the transmission bearer from the underbody.

37 The engine/transmission unit should now be hanging on the hoist only, with all components which connect it to the rest of the vehicle disconnected or removed, and secured well clear of the unit. Make a final check that this is the case.

38 Lower the engine/transmission to the ground, and withdraw it from under the vehicle.

39 Referring to the relevant Part of Chapter 7, separate the transmission from the engine.

40 While the engine/transmission is removed, check the mountings; renew them if they are worn or damaged. Similarly, check the condition of all coolant and vacuum hoses and pipes (see Chapter 1); components that are normally hidden can now be checked properly, and should be renewed if there is any doubt at all about their condition. Where the vehicle is fitted with manual transmission, take the opportunity to overhaul the clutch components (see Chapter 6). It is regarded by many as good working practice to renew the clutch assembly as a matter of course, whenever major engine overhaul work is carried out. Check also the condition of all components (such as the transmission oil seals) disturbed on removal, and renew any that are damaged or worn.

Refitting

41 Refitting is a reversal of removal, however note the following additional points:

- Refer to the applicable Chapters and Sections as for removal.
- Fit new spring clips to the grooves in the inboard end of the right- and left-hand driveshaft joints. Lubricate the splines with transmission oil prior to fitting.
- Renew the exhaust flange gaskets when reconnecting the exhaust. Ensure that all wires are routed clear of the exhaust system, and that the heat shields are securely and correctly fitted.
- Ensure that all earth lead connections are clean and securely made.
- Tighten all nuts and bolts to the specified torque.
- Fit a new oil filter, and refill the engine and transmission with oil, with reference to Chapter 1.
- Refill the cooling system with reference to Chapter 1.
- Bleed the power steering system with reference to Chapter 10.

42 When engine and transmission refitting is complete, refer to the procedures described in Section 19 before restarting the engine.

6 Engine overhaul - preliminary information

It is much easier to dismantle and work on the engine if it is mounted on a portable engine stand. These stands can often be hired from a tool hire shop. Before the engine is mounted on a stand, the flywheel/driveplate should be removed so that the stand bolts can be tightened into the end of the cylinder block/crankcase.

If a stand is not available, it is possible to dismantle the engine with it suitably

supported on a sturdy, workbench or on the floor. Be careful not to tip or drop the engine when working without a stand.

If you intend to obtain a reconditioned engine, all ancillaries must be removed first, to be transferred to the replacement engine (just as they will if you are doing a complete engine overhaul yourself). These components include the following:

- Alternator/power steering pump and mounting brackets.
- DIS/E-DIS ignition coil unit (and mounting bracket), distributor, HT leads and spark plugs.
- The thermostat and housing cover.
- Carburettor/fuel injection system components.
- Inlet and exhaust manifolds.
- Oil filter.
- Fuel pump.
- Engine mountings.
- Flywheel/driveplate.
- Water pump.

Note: When removing the external components from the engine, pay close attention to details that may be helpful or important during refitting. Note the fitted positions of gaskets, seals, washers, bolts and other small items.

If you are obtaining a "short" engine (cylinder block/crankcase, crankshaft, pistons and connecting rods all assembled), then the cylinder head, timing chain/belt (together with tensioner, tensioner and idler pulleys and covers) sump and oil pump will have to be removed also.

If a complete overhaul is planned, the engine can be dismantled in the order given below, referring to Part A, B or C of this Chapter unless otherwise stated.

- Inlet and exhaust manifolds.
- Timing chain/belt, tensioner and sprockets.
- Cylinder head.
- Flywheel/driveplate.
- Sump.
- Oil pump.
- Pistons (with connecting rods).
- Crankshaft.
- Camshaft and tappets (HCS engines).

7 Cylinder head - dismantling



Note: New and reconditioned cylinder heads are available from the manufacturers, and from engine overhaul specialists. Due to the fact that some specialist tools are required for the dismantling and inspection procedures, and new components may not be readily available, it may be more practical and economical for the home mechanic to purchase a reconditioned head, rather than to dismantle, inspect and recondition the original head.

1 Remove the cylinder head as described in Part A, B or C of this Chapter (as applicable).



7.6 Compress the valve spring to remove the collets



7.7a Remove the valve spring retainer and spring . . .



7.7b . . . followed by the valve

- 2 If not already done, remove the inlet and exhaust manifolds with reference to the relevant Part of Chapter 4.
- 3 Proceed as follows according to engine type.

HCS engines

- 4 Valve removal should commence with No 1 valve (nearest the timing chain end).
- 5 To remove the valve springs and valves from the cylinder head, a standard valve spring compressor will be required. Fit the spring compressor to the first valve and spring to be removed. Take care not to damage the valve stem with the compressor, and do not over-compress the spring, or the valve stem may bend. When tightening the compressor, it may be found that the spring retainer does not release and the collets are then difficult to remove. In this instance, remove the compressor, then press a piece of tube (or a socket of suitable diameter) so that it does not interfere with the removal of the collets, against the retainer's outer rim. Tap the tube (or socket) with a hammer to unsettle the components.
- 6 Refit the compressor, and wind it in to enable the collets to be extracted (see illustration).
- 7 Loosen off the compressor, and remove the retainer and spring. Withdraw the valve from the cylinder head (see illustrations).
- 8 Prise up and remove the valve stem seal.
- 9 Repeat the removal procedure with each of



7.9 Use a labelled plastic bag to store and identify valve components

the remaining seven valve assemblies in turn. As they are removed, keep the individual valves and their components together, and in their respective order of fitting, by placing them in a separate labelled bag (see illustration).

CVH and PTE engines

- 10 Remove the camshaft, rocker arms and tappets as described in Part B of this Chapter, being careful to store the hydraulic tappets as described.
- 11 Valve removal should commence with No 1 valve (nearest the timing belt end).
- 12 Using a standard valve spring compressor, compress the valve spring (and upper retainer) just enough to enable the split collets to be released from the groove in the top of the valve stem, then separate and extract the split collets from the valve. Do not compress the spring any further than is necessary, or the valve stem may bend. If the valve spring retainer does not release from the collets as the spring is compressed, remove the compressor, and position a piece of suitable tube over the end of the retainer, so that it does not impinge on the collets. Place a small block of wood under the valve head (with the head resting face down on the workbench), then tap the end of the tube with a hammer. Now refit the compressor tool, and compress the valve spring. The collets should release.
- 13 Extract the split collets, then slowly



7.14 Prise off the valve stem oil seal

unscrew, release and remove the compressor.

- 14 Withdraw the upper retainer and the valve spring from the valve stem, then remove the valve from the underside of the cylinder head. Use a suitable screwdriver or pliers to prise free and remove the valve stem oil seal from the guide (see illustration).
- 15 Remove the lower retainer.
- 16 Repeat the removal procedure with each of the remaining valve assemblies in turn. As they are removed, keep the valves and their associated components together, and in the originally-installed order, by placing them in a separate labelled bag (see illustration 7.9).

Zetec engines

- 17 Remove the camshafts and hydraulic tappets as described in Part C of this Chapter, being careful to store the hydraulic tappets as described.
- 18 Using a valve spring compressor, compress each valve spring in turn until the split collets can be removed. A special valve spring compressor will be required, to reach into the deep wells in the cylinder head without risk of damaging the hydraulic tappet bores; such compressors are now widely available from most good motor accessory shops. Release the compressor, and lift off the spring upper seat and spring.
- 19 If, when the valve spring compressor is screwed down, the spring upper seat refuses to free and expose the split collets, gently tap the top of the tool, directly over the upper seat, with a light hammer. This will free the seat.
- 20 Withdraw the valve through the combustion chamber. If it binds in the guide (won't pull through), push it back in, and deburr the area around the collet groove with a fine file or whetstone; take care not to mark the hydraulic tappet bores.
- 21 Ford recommend the use of their service tool 21-160 to extract the valve spring lower seat/stem oil seals; while this is almost indispensable if the seals are to be removed without risk of damage to the cylinder head, a serviceable substitute can be made from a strong spring of suitable size. Screw on the tool or spring so that it bites into the seal, then



7.21a Ford service tool in use to remove valve spring lower seat/stem oil seals . . .



7.21b . . . can be replaced by home-made tool if suitable spring can be found



7.23 Cylinder head oil-retaining valve (arrowed)

draw the seal off the valve guide (see illustrations).

22 It is essential that the valves are kept together with their collets, spring seats and springs, and in their correct sequence (unless they are so badly worn that they are to be renewed). If they are going to be kept and used again, place them in a labelled polythene bag or similar small container (see illustration 7.9). Note that No 1 valve is nearest to the timing belt end of the engine.

23 If the oil-retaining valve is to be removed (to flush out the cylinder head oil galleries thoroughly), seek the advice of a Ford dealer as to how it can be extracted; it may be that the only course of action involves destroying the valve as follows. Screw a self-tapping screw into its ventilation hole, and use the screw to provide purchase with which the valve can be drawn out; a new valve must be purchased and pressed into place on reassembly (see illustration).

engine has been severely overheated, it is best to assume that the cylinder head is warped, and to check carefully for signs of this.

Cleaning

2 Scrape away all traces of old gasket material and sealing compound from the cylinder head.

3 Scrape away the carbon from the combustion chambers and ports, then wash the cylinder head thoroughly with paraffin or a suitable solvent.

4 Scrape off any heavy carbon deposits that may have formed on the valves, then use a power-operated wire brush to remove deposits from the valve heads and stems.

Inspection

Note: *Be sure to perform all the following inspection procedures before concluding that the services of a machine shop or engine overhaul specialist are required. Make a list of all items that require attention.*

Cylinder head

5 Inspect the head very carefully for cracks, evidence of coolant leakage, and other damage. If cracks are found, a new cylinder head should be obtained.

6 Use a straight edge and feeler blade to check that the cylinder head gasket surface is not distorted (see illustration). If it is, it may be possible to re-surface it.

7 Examine the valve seats in each of the combustion chambers. If they are severely

pitted, cracked or burned, then they will need to be renewed or re-cut by an engine overhaul specialist. If they are only slightly pitted, this can be removed by grinding-in the valve heads and seats with fine valve-grinding compound, as described below.

8 If the valve guides are worn, indicated by a side-to-side motion of the valve, new guides must be fitted. Measure the diameter of the existing valve stems (see below) and the bore of the guides, then calculate the clearance, and compare the result with the specified value; if the clearance is excessive, renew the valves or guides as necessary.

9 The renewal of valve guides is best carried out by an engine overhaul specialist.

10 If the valve seats are to be re-cut, this must be done *only after* the guides have been renewed.

Valves

11 Examine the head of each valve for pitting, burning, cracks and general wear, and check the valve stem for scoring and wear ridges. Rotate the valve, and check for any obvious indication that it is bent. Look for pits and excessive wear on the tip of each valve stem. Renew any valve that shows any such signs of wear or damage.

12 If the valve appears satisfactory at this stage, measure the valve stem diameter at several points, using a micrometer (see illustration). Any significant difference in the readings obtained indicates wear of the valve stem. Should any of these conditions be apparent, the valve(s) must be renewed.

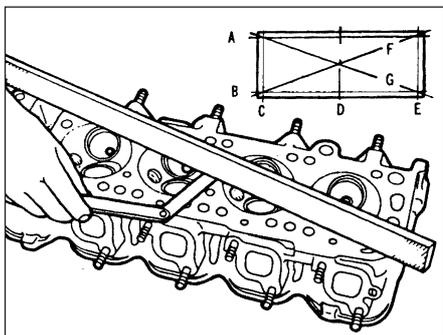
13 If the valves are in satisfactory condition, they should be ground (lapped) into their respective seats, to ensure a smooth gas-tight seal. If the seat is only lightly pitted, or if it has been re-cut, fine grinding compound *only* should be used to produce the required finish. Coarse valve-grinding compound should *not* be used unless a seat is badly burned or deeply pitted; if this is the case, the cylinder head and valves should be inspected by an expert, to decide whether seat re-cutting, or even the renewal of the valve or seat insert, is required.

14 Valve grinding is carried out as follows. Place the cylinder head upside-down on a

8 Cylinder head and valve components - cleaning and inspection



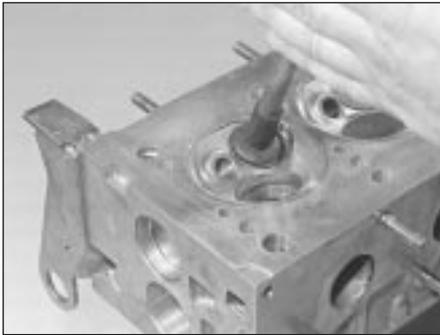
1 Thorough cleaning of the cylinder head and valve components, followed by a detailed inspection, will enable you to decide how much valve service work must be carried out during the engine overhaul. **Note:** *If the*



8.6 Check the cylinder head gasket surfaces for warpage, in the planes indicated (A to G)



8.12 Measuring the diameter of a valve stem



8.15 Grinding-in a valve seat

bench, with a block of wood at each end to give clearance for the valve stems.

15 Smear a trace of (the appropriate grade of) valve-grinding compound on the seat face, and press a suction grinding tool onto the valve head. With a semi-rotary action, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding compound (see illustration). A light spring placed under the valve head will greatly ease this operation.

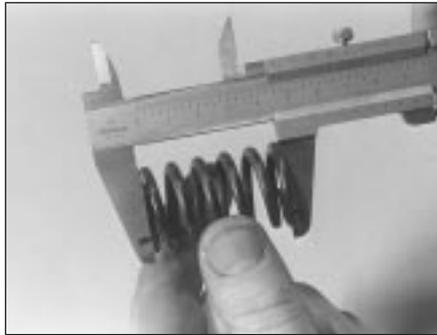
16 If coarse grinding compound is being used, work only until a dull, matt even surface is produced on both the valve seat and the valve, then wipe off the used compound, and repeat the process with fine compound. When a smooth unbroken ring of light grey matt finish is produced on both the valve and seat, the grinding operation is complete. Do not grind in the valves any further than absolutely necessary, or the seat will be prematurely sunk into the cylinder head.

17 When all the valves have been ground-in, carefully wash off all traces of grinding compound, using paraffin or a suitable solvent, before reassembly of the cylinder head.

Valve components

18 Examine the valve springs for signs of damage and discolouration, and also measure their free length (see illustration). If possible, compare each of the existing springs with a new component.

19 Stand each spring on a flat surface, and check it for squareness. If any of the springs



8.18 Checking the valve spring free length

are damaged, distorted, or have lost their tension, obtain a complete set of new springs.

20 Check the spring upper seats and collets for obvious wear and cracks. Any questionable parts should be renewed, as extensive damage will occur if they fail during engine operation. Any damaged or excessively-worn parts must be renewed; the valve spring lower seat/stem oil seals must be renewed as a matter of course whenever they are disturbed.

21 Check the rocker gear components and hydraulic tappets as described in earlier parts of this Chapter according to engine type.

9 Cylinder head - reassembly



1 Before reassembling the cylinder head, first ensure that it is perfectly clean, and that no traces of grinding paste are left in the head or on the valves and guides. Use compressed air, if available, to blow out all the oil holes and passages.

2 Commence reassembly of the cylinder head by lubricating the valve stems and guides with clean engine oil.

HCS engines

3 Insert the first valve into its guide. Wipe the oil from the top of the valve stem, then wind some insulation tape over the split collet location groove, to protect the new valve stem seal as it is fitted over the valve and into

position. As the seal is fitted, support the valve to prevent it from falling out; push the seal down the valve, and locate it flush to the valve guide. Press the seal down firmly and evenly using a suitable diameter tube or socket, and take care not to distort the seal as it is located. Check that the seal spring is correctly located to ensure that it seals correctly, then remove the tape from the valve stem (see illustrations).

4 Locate the valve spring and its retainer over the valve stem, and engage the valve spring compressor. Compress the spring and retainer just enough to allow the split collets to be inserted in the location groove in the valve stem. Holding the collets in position, slowly release and remove the valve spring compressor.



A little grease applied to the collet groove will help retain them in position.

5 Repeat the operation on the remaining valves, ensuring that each valve is fitted in its appropriate location.

6 On completion, support the cylinder head on a suitable piece of wood, and lightly strike the end of each valve stem in turn with a plastic- or copper-faced hammer to fractionally open the valve and seat the valve components.

CVH and PTE engines

7 Working on one valve at a time, fit the lower retainer into position (see illustration).

8 Check for correct orientation, then fit the new oil seal into position over the guide. Drive



9.3a Tape the end of the valve stem before fitting the valve stem seal



9.3b Press the seal into position using a suitable socket



9.7 Fit the lower retainer



9.8 Locate the seal, and tap it into position over the guide



9.9 Insert the valve into its guide



9.11 Insert the split collets into the groove in the valve stem

or press the seal squarely into place, using a suitable tube or socket (see illustration).

9 To protect the seal lips from being damaged by the collet grooves in the valve stem as it is passed through the seal, wipe any oil from the stem at the top, and mask the split collet groove on the stem with insulating tape. Lubricate the lips of the valve stem seal, and insert the valve (see illustration).

10 Remove the tape from the grooved section of the valve stem, then locate the spring and the upper retainer over the valve.

11 Locate the valve spring compressor into position, and compress the spring and cup down the valve stem so that the collet's groove is exposed above the upper retainer. Lightly grease the collet's groove in the stem, (to retain the collets in position) then locate the split collets into the groove in the stem. Slowly release and remove the valve spring compressor. As the compressor is released, ensure that the collets remain fully seated in the groove, and the upper retainer rides up over them to secure them in position (see illustration).

12 Repeat the above operations on the remaining valves, ensuring that each valve assembly is returned to its original position, or where new valves have been fitted, onto the seat to which it was ground.

13 When all of the valves have been fitted, support the cylinder head on a wooden block, and using a plastic or copper-faced hammer, lightly tap the end of each valve stem in turn to seat the respective valve assemblies.

14 Refit the camshaft, tappets and rocker arms to the cylinder head as described in Part B of this Chapter.

Zetec engines

15 Beginning at one end of the head, lubricate and install the first valve. Apply molybdenum disulphide-based grease or clean engine oil to the valve stem, and refit the valve. Where the original valves are being re-used, ensure that each is refitted in its original guide. If new valves are being fitted, insert them into the locations to which they have been ground.

16 Fit the plastic protector supplied with new valve spring lower seat/stem oil seals to the end of the valve stem, then put the new seal squarely on top of the guide, and leave it there; the action of refitting the valve spring presses the lower seat/stem oil seal into place (see illustration).

17 Refit the valve spring and upper seat.

18 Compress the spring with a valve spring compressor, and carefully install the collets in the stem groove. Apply a small dab of grease to each collet to hold it in place if necessary. Slowly release the compressor, and make sure the collets seat properly.

19 When the valve is installed, place the cylinder head flat on the bench and, using a hammer and interposed block of wood, tap the end of the valve stem gently, to settle the components.

20 Repeat the procedure for the remaining valves. Be sure to return the components to

their original locations - don't mix them up!

21 Refit the hydraulic tappets as described in Part C of this Chapter.

10 Camshaft and tappets - removal, inspection and refitting (HCS engines)



Removal

1 Refer to the applicable Sections in Part A of this Chapter and remove the cylinder head, timing chain and camshaft sprocket, and the sump.

2 Invert the engine so that it is supported on its cylinder head face (on a clean work area). This is necessary to make all of the tappets slide to the top of their stroke, thus allowing the camshaft to be withdrawn. Rotate the camshaft through a full turn, to ensure that all of the tappets slide up their bores, clear of the camshaft.

3 Before removing the camshaft, check its endfloat using a dial gauge mounted on the front face of the engine or feeler gauges. Pull the camshaft fully towards the front (timing chain) end of the engine, then insert feeler gauges between the camshaft sprocket flange and the camshaft thrust plate to assess the endfloat clearance (see illustration). The camshaft endfloat must be as specified.

4 Undo the two retaining bolts, and remove the camshaft thrust plate.

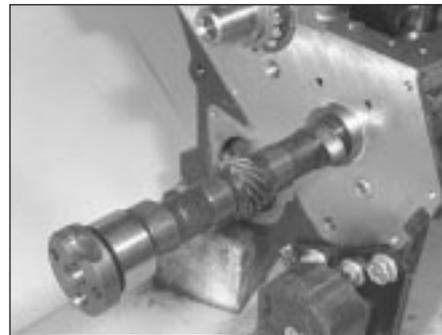
5 Carefully withdraw the camshaft from the front end of the engine (see illustration).



9.16 Valve spring pressure is sufficient to seat lower seat/stem oil seals on reassembly



10.3 Checking the camshaft endfloat



10.5 Withdrawing the camshaft from the front of the engine