Chapter 2 Part D:
Engine removal and overhaul procedures

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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

Note: *At the time of writing, many specifications for certain engines were not available. Where the relevant specifications are not given here, refer to your Peugeot dealer for further information.*

Cylinder head

Maximum gasket face distortion	0.05 mm
Cylinder head height::	
XV, XW and XY series engines	Not available
XU series engines	141.0 ± 0.05 mm
TU series engines	111.2 ± 0.08 mm

Valves

Valve head diameter:	
Inlet:	
XV8 engines	34.8 mm
XW7, XY7 and XY8 engines	37.0 mm
XU5J engines	40.0 mm
All other XU series engines	41.6 mm
TU9 series engines	34.8 mm
TU1 series engines	36.8 mm
TU3, TU3A, TU3M and TU3S engines	36.8 mm
TU3FM engines	39.5 mm
Exhaust:	
XV8 engines	27.8 mm
XW7, XY7 and XY8 engines	29.5 mm
XU5J engines:	
Early models	32.0 mm
Later models	32.95 mm
All other XU series engines	34.5 mm
TU9 series engines	27.9 mm
TU1 series engines	29.4 mm
TU3, TU3A, TU3M and TU3S engines	29.4 mm
TU3FM engines	31.4 mm
Valve stem diameter:	
Inlet:	
XV, XW and XY series engines	8.0 mm
XU51 and XU5M series engines	7.30 mm
All other XU series engines	7.98 mm
TU series engines	6.99 mm

Valve stem diameter (continued):	
Exhaust:	
XV, XW and XY series engines	8.0 mm
XU5J series engines	7.96 mm
XU5JA and XU9J series engines	7.98 mm
XU51 and XU5M series engines	7.30 mm
TU series engines	6.97 mm
Overall length:	
Inlet:	
XV, XW and XY series engines	Not available
XU series engines	109.29 mm
TU series engines	110.76 mm
Exhaust:	
XV, XW and XY series engines	Not available
XU series engines	108.79 mm
TU series engines	110.60 mm

Cylinder block

Cylinder bore/liner diameter (nominal in three grades):	
XV series engines	70.0 mm
XW series engines	72.0 mm
XY series engines	75.0 mm
XU5 series engines	83.0 mm
XU9 series engines	83.0 mm
TU9 series engines	70.0 mm
TU1 series engines	72.0 mm
TU3 series engines	75.0 mm
Maximum cylinder bore/liner taper*	0.10 mm
Maximum cylinder bore/liner ovality*	0.10 mm
Liner protrusion above block mating surface:	
XV, XW and XY series engines:	
With paper type base seals	0.11 to 0.18 mm
With O-ring type base seals	0.10 to 0.17 mm
XU series engines:	
Pre-1987 models	0.08 to 0.15 mm
1987 models onward	0.03 to 0.10 mm
TU series (aluminium block) engines	0.03 to 0.10 mm
Maximum difference between any two liners:	
XV, XW and XY series engines with paper type base seals	0.04 mm
All other engines	0.05 mm

**These are suggested figures, typical for this type of engine - no exact values are stated by Peugeot.*

Pistons

Piston to bore clearance:	
XV, XW, and XY series engines	0.07 to 0.09 mm
XU series engines	Not available
TU series engines	0.03 to 0.05 mm

Piston rings

End gaps*	0.3 to 0.5 mm

**These are suggested figures, typical for this type of engine - no exact values are stated by Peugeot.*

Crankshaft

Endfloat:	
XV, XW and XY series engines	0.07 to 0.27 mm
All other engines	0.07 to 0.32 mm
Main bearing journal diameter:	
XV, XW and XY series engines:	
Standard	49.965 to 49.981 mm
Undersize	49.665 to 49.681 mm
XU series engines:	
Standard	59.981 to 60.000 mm
Undersize	59.681 to 59.700 mm
TU series engines:	
Standard	49.965 to 49.981 mm
Undersize	49.665 to 49.681 mm

Big-end bearing journal diameter:	
XV, XW and XY series engines:	
Standard	44.975 to 44.991 mm
Undersize	44.675 to 44.691 mm
XU5 series engines:	
Standard	44.971 to 44.990 mm
Undersize	44.671 to 44.690 mm
XU9 series engines:	
Standard	49.680 to 50.000 mm
Undersize	49.380 to 49.700 mm
TU9 series engines:	
Standard	37.992 to 38.008 mm
Undersize	37.692 to 37.708 mm
TU1 and TU3 series engines:	
Standard	44.975 to 44.991 mm
Undersize	44.675 to 44.691 mm
Maximum bearing journal out-of-round (all models)	0.007 mm
Main bearing running clearance:	
XV, XW and XY series engines*	0.023 to 0.048 mm
XU series engines:**	
Models up to mid-1994	0.034 to 0.075 mm
Mid-1994 onwards models	0.025 to 0.062 mm
TU series (aluminium block) engines:**	
Models up to mid-1993	0.023 to 0.083 mm
Mid-1993 onwards models	0.010 to 0.034 mm
TU series (cast-iron block) engines	0.023 to 0.048 mm
Big-end bearing running clearance - all models*	0.025 to 0.050 mm

**These are suggested figures, typical for this type of engine - no exact values are stated by Peugeot.*

***On XU series engines and TU series (aluminium block) engines the bearing clearance was modified on later models - see text for further information.*

Torque wrench settings

	Nm	lbf ft
XV, XW and XY series engines		
Main bearing (crankcase housing) bolts:		
Stage 1	36	27
Stage 2	51	38
Big-end cap nuts	36	27
Engine/transmission connecting bolts	9	7
Engine mounting nuts	34	25
XU series engines		
Main bearing cap nuts and bolts	49	36
Main bearing cap side bolts	24	18
Big-end cap nuts:		
Stage 1	40	30
Fully slacken all nuts, then tighten to:		
Stage 2	20	15
Stage 3	Tighten through a further 70º	
Oil seal carrier plate bolts	15	11
Oil pressure switch	24	18
Engine-to-transmission bolts	45	33
Engine mounting bracket bolts:		
M8	34	25
M10	45	33
Engine mountings:		
RH nut	27	20
LH nut	35	26
Battery tray/bracket	18	13
Lower mounting centre bolt	34	25
Lower mounting to subframe	45	33
TU series engines		
Big-end bearing cap	37.5	28
Main bearing ladder casting - aluminium block engines (models with plain No 5 main bearing half-shell fitted to cylinder block - see text):		
11 mm bolts:		
Stage 1	20	15
Stage 2	Tighten through a further 45º	
6 mm bolts	8	6

Torque wrench settings (continued)	Nm	lbf ft
Main bearing ladder casting - aluminium block engines (models with grooved No 5 main bearing half-shell fitted to cylinder block - see text):		
11 mm bolts:		
Stage 1	20	15
Stage 2	Tighten through a further 55º	
Fully slacken bolt, then tighten to:		
Stage 3	20	15
Stage 4	Tighten through a further 45º	
6 mm bolts	8	6
Main bearing cap bolts (cast-iron block engine):		
Stage 1	20	15
Stage 2	Tighten through a further 45º	
Oil pressure switch	28	21
Engine-to-transmission bolts	35	26
Engine/transmission left-hand mounting:		
Mounting bracket-to-transmission nuts	20	15
Mounting bracket-to-body bolts	25	18
Mounting rubber nuts	20	15
Centre nut	65	48
Engine/transmission rear mounting:		
Mounting-to-cylinder block bolts	40	30
Mounting link-to-mounting bolt	70	52
Mounting link-to-body bolt	50	37
Engine/transmission right-hand mounting bracket nuts	45	33

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 5, 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 5. 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.

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 at the rear 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 Peugeot 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 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.

On all models covered by this manual, the engine and transmission are removed as a complete assembly, upwards and out of the engine bay. The engine and transmission are then separated with the assembly on the bench.

3 Engine/manual transmission - removal, separation, reconnection and refitting

Removal

Note: *The engine can be removed from the car only as a complete unit with the transmission; the two are then separated for overhaul.*

1 Park the vehicle on firm, level ground. Chock the rear wheels, then firmly apply the handbrake. Jack up the front of the vehicle, and securely support it on axle stands (see "*Jacking and vehicle support*"). Remove the front roadwheels.

2 Set the bonnet in the upright position, and remove the battery and tray as described in Chapter 5A.

3 Remove the complete air cleaner assembly and all inlet ducting, as described in the relevant Part of Chapter 4.

4 If the engine is to be dismantled, working as described in Chapter 1, first drain the oil and remove the oil filter. Clean and refit the drain plug, tightening it securely.

5 On XU and TU series engines, drain the transmission oil as described in Chapter 7A. Refit the drain and filler plugs (as applicable), and tighten them to their specified torque settings.

6 Remove the alternator as described in Chapter 5A.

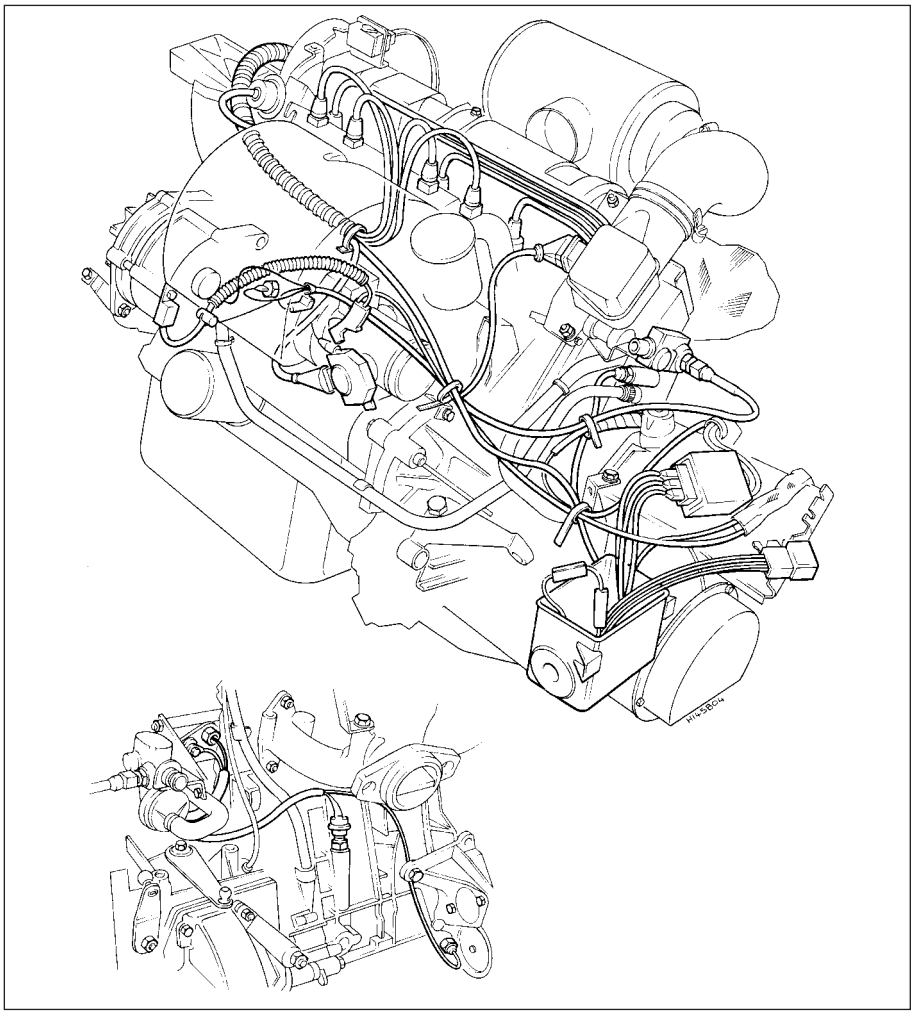
7 Where applicable, remove the power steering pump as described in Chapter 10. Where possible, unbolt the pump and move it aside without disconnecting the fluid hoses.

8 On models with air conditioning, unbolt the compressor, and position it clear of the engine. Support the weight of the compressor by tying it to the vehicle body, to prevent any excess strain being placed on the compressor lines whilst the engine is removed. Do not disconnect the refrigerant lines from the compressor (refer to the warnings given in Chapter 3).

9 Drain the cooling system as described in Chapter 1 then remove the radiator as described in Chapter 3. Note that it is not strictly necessary to remove the radiator, but it does improve clearance, and removes the risk of damaging the radiator as the engine is removed. If the radiator is to be left in position, disconnect the top and bottom radiator hoses at both ends and remove them completely. It is also a good idea to place a sheet of cardboard (or preferably plywood) between the engine and radiator as protection against any accidental contact.

10 On carburettor models, carry out the following operations, using the information given in the relevant Part of Chapter 4:

a) Disconnect the fuel feed and return hoses.
b) Disconnect the throttle and where applicable the choke cables from the carburettor.
c) Where fitted, disconnect the braking system servo vacuum hose from the inlet manifold.



3.16 Typical engine wiring harness connections (XU series fuel injected engine shown)

d) Disconnect the exhaust system downpipe from the exhaust manifold and remove the support brackets or clamps securing it to the engine or transmission.

11 On fuel injection models, carry out the following operations, using the information given in the relevant Part of Chapter 4:

a) Depressurise the fuel system, and disconnect the fuel feed and return hoses.
b) Disconnect the throttle cable.
c) Disconnect the fuel system wiring connectors.
d) Disconnect all vacuum hoses from the inlet manifold.
e) Disconnect the exhaust system downpipe from the exhaust manifold and remove the support brackets or clamps securing it to the engine or transmission.

12 Referring to Chapter 3, release the retaining clip and disconnect the heater matrix hoses from their connection on the engine compartment bulkhead.

13 Working as described in Chapter 6, disconnect the clutch cable from the transmission, and position it clear of the working area.

14 Carry out the following operations, using the information given in Chapter 7A:

a) Disconnect the gearchange selector rod/link rods (as applicable) from the transmission.
b) Disconnect the speedometer cable from the speedometer drive.
c) Where applicable, release the power steering pipe from the underside of the transmission.
d) Disconnect the wiring connector(s) from the reversing light switch and speedometer drive (as applicable).

15 Remove both driveshafts as described in Chapter 8.

16 On some models it will be possible to remove the engine/transmission complete with the engine wiring harness left in position. This saves having to disconnect each individual wire from its relevant connection and its retaining clips. Unfortunately this will not be possible on all models, but where it is, trace the wiring harness back from the engine to the wiring connector(s) in the front, left-hand corner of the engine compartment **(see illustration)**. Release the locking ring(s) by

3.21 Removing the engine and manual transmission

twisting them anti-clockwise and disconnect the connectors. Also, where applicable, trace the harness lead(s) back to the relay box, situated beside the battery. Unclip the wiring connector plate from the front of the relay box cover, then undo the retaining nut and remove the cover. Lift up the engine harness lead cover; then undo the nut(s) and release the lead(s) from the relay box. Check that all the relevant connectors have been disconnected, and that the wiring is released from any relevant clips or ties, so that it is free to be removed with the engine/transmission. Where it is not possible to separate the harness at the main connectors, make careful notes and disconnect all individual wiring connectors attached to the engine and transmission.

17 Manoeuvre the engine hoist into position, and attach it to the lifting brackets bolted to the engine. Raise the hoist until it is supporting the weight of the engine.

18 On XU and TU series engines from underneath the vehicle, slacken and remove the nuts and bolts securing the rear engine mounting link to the mounting assembly and subframe, and remove the link. On all models, undo the nuts/bolts securing the left-hand and right-hand engine mounting brackets to the engine and mountings, and remove the brackets and mountings as necessary.

19 Make a final check that any components which would prevent the removal of the engine/transmission from the car have been removed or disconnected. Ensure that components such as the gearchange selector rod are secured so that they cannot be damaged on removal.

20 Slowly and methodically lift the engine/transmission out of the car, ensuring that nothing is trapped or damaged. Enlist the help of an assistant during this procedure, as it will be necessary to tilt the assembly slightly to clear the body panels.

21 Once the engine is high enough, lift it out over the front of the body, and lower the unit to the ground **(see illustration)**.

Separation

22 With the engine/transmission assembly removed, support the assembly on suitable blocks of wood, on a workbench (or failing that, on a clean area of the workshop floor).

XV, XW and XY series engines

23 Unscrew and remove the flywheel housing-to-engine connecting bolts and nuts.

24 There are thirteen bolts and two nuts altogether. Note that an engine lifting lug and earth strap are fitted under some of the bolts.

25 Refer to Chapter 6 and remove the clutch assembly, ignoring any procedures that have already been carried out as part of the engine/transmission removal sequence.

26 Unbolt and remove the flywheel (Chapter 2A), then slacken and remove the retaining bolts, and remove the starter motor.

27 Unscrew and remove the two bolts and the nut close to the crankshaft oil seal **(see illustration)**.

28 Unscrew the engine-to-transmission flange connecting bolts. Unbolt the right-hand rear engine mounting.

29 Unscrew and remove the crankshaft pulley nut. In order to hold the crankshaft against rotation, temporarily screw in two bolts into the holes in the flywheel mounting flange and place a long lever between them.

30 Remove the crankshaft pulley.

31 Remove the rocker cover.

32 Remove the timing chain cover and extract the fuel pump operating plunger **(see illustration)**.

33 Unscrew and remove the remaining connecting bolts and nuts which are located on the final drive casing side near the driveshaft oil seals.

34 Using a length of wood, prise the engine and transmission apart **(see illustration)**.

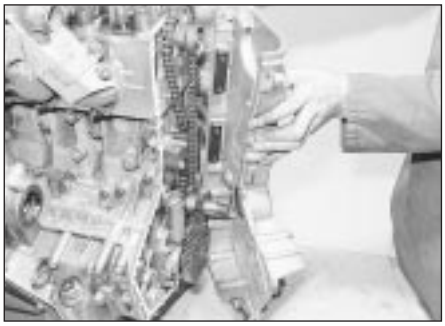
XU and TU series engines

35 Undo the retaining bolts, and remove the flywheel lower cover plate (where fitted) from the transmission.

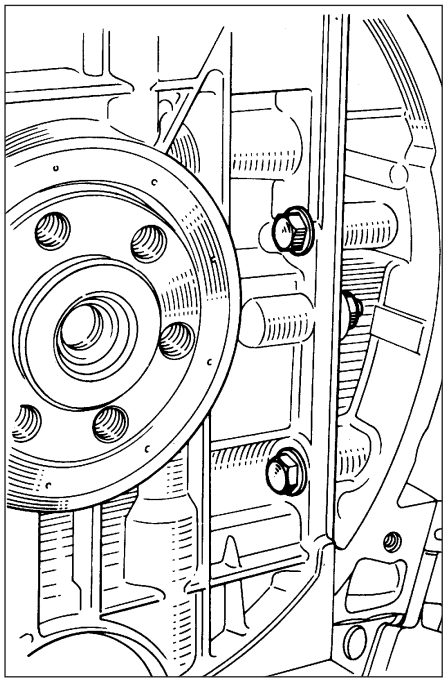
36 Slacken and remove the retaining bolts, and remove the starter motor from the transmission.

37 Ensure that both engine and transmission are adequately supported, then slacken and remove the remaining bolts securing the transmission housing to the engine. Note the correct fitted positions of each bolt (and the relevant brackets) as they are removed, to use as a reference on refitting.

38 Carefully withdraw the transmission from the engine, ensuring that the weight of the



3.32 Removing the timing chain cover



3.27 Remove the two bolts and nut close to the crankshaft oil seal - XV, XW and XY series engines

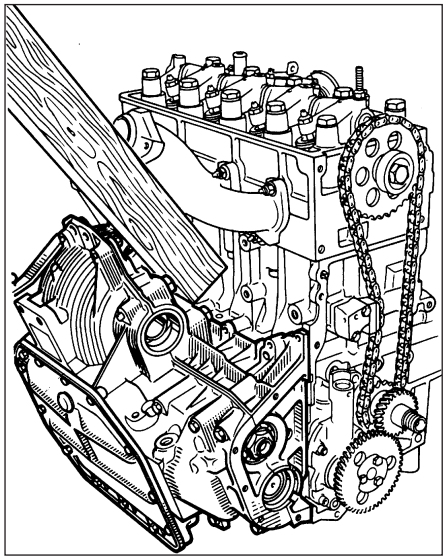
transmission is not allowed to hang on the input shaft while it is engaged with the clutch friction plate.

39 If they are loose, remove the locating dowels from the engine or transmission, and keep them in a safe place.

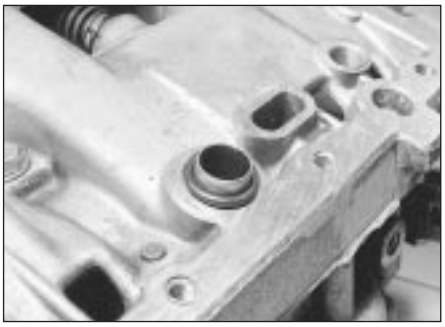
Reconnection

XV, XW and XY series engines

40 If removed, check that the oil pump pick-up strainer is in position within the transmission casing.



3.34 Separating the engine from the transmission



3.45 Locate a new O-ring oil seal on the transmission casing

41 Fit the sump cover to the transmission using a new gasket.
42 Tighten the tighten the cover bolts and drain plug to the specified torque.
43 Fit the protective cover plate to the sump cover.
44 Apply jointing compound to the mating surfaces on the engine and transmission.
45 On the transmission, locate a new O-ring seal and check that the locating dowels and the studs are in position **(see illustration)**.
46 Offer the transmission to the engine, screw in the connecting bolts and nuts and tighten to the specified torque.
47 With the fuel pump operating rod in place, locate the timing chain cover using a new gasket. The bolt nearest the coolant pump pulley must be located in the cover before offering it up, otherwise the pulley will prevent the bolt entering its cover hole. Use the crankshaft pulley to centralise the timing chain cover and refit the remaining cover bolts. Note that the coolant hose safety rod must be fitted under its cover bolts. This rod prevents the coolant hose being cut by the rim of the coolant pump pulley should the hose sag.
48 Tighten the timing chain cover bolts to the specified torque and then trim the upper ends of the gasket flush. Fit the rocker cover using a new gasket. Do not overtighten the securing bolts.
49 Tighten the crankshaft pulley nut to the specified torque.
50 Refit the flywheel (Chapter 2A) and the clutch and transfer gear assembly (Chapter 6).
51 If they were removed, bolt the engine mountings to the flywheel housing.
52 Fit the starter motor. Tighten the bolts and nuts in the following order:
a) Starter drive end flange to flywheel housing
b) Brush end bracket to engine crankcase
c) Brush end bracket to starter motor

XU and TU series engines

53 Apply a smear of high-melting-point grease (Peugeot recommend the use of Molykote BR2 plus - available from your Peugeot dealer) to the splines of the transmission input shaft. Do not apply too much, otherwise there is a possibility of the grease contaminating the clutch friction plate.
54 Ensure that the locating dowels are correctly positioned in the engine or transmission.
55 Carefully offer the transmission to the engine, until the locating dowels are engaged. Ensure that the weight of the transmission is not allowed to hang on the input shaft as it is engaged with the clutch friction disc.
56 Refit the transmission housing-to-engine bolts, ensuring that all the necessary brackets are correctly positioned, and tighten them securely.
57 Refit the starter motor, and securely tighten its retaining bolts.
58 Where necessary, refit the lower flywheel cover plate to the transmission, and securely tighten its retaining bolts.

Refitting

59 Reconnect the hoist and lifting tackle to the engine lifting brackets. With the aid of an assistant, lift the assembly over the engine compartment.
60 The assembly should be tilted as necessary to clear the surrounding components, as during removal; lower the assembly into position in the engine compartment, manipulating the hoist and lifting tackle as necessary.
61 With the engine/transmission in position, and centralised over its mountings, refit the engine/transmission mountings using a reverse of the removal operations, but only tighten the mounting nuts/bolts finger tight at this stage.
62 Where applicable, from underneath the vehicle, refit the rear mounting link and install both its bolts.
63 Rock the engine to settle it on its mountings, then go around and tighten all the mounting nuts and bolts to their specified torque settings. The hoist can then be detached from the engine and removed.
64 The remainder of the refitting procedure is a direct reversal of the removal sequence, noting the following points:
a) Ensure that the wiring loom is correctly routed and retained by all the relevant retaining clips; all connectors should be correctly and securely reconnected.
b) Prior to refitting the driveshafts to the transmission, renew the driveshaft oil seals as described in Chapter 7A.
c) Ensure that all coolant hoses are correctly reconnected, and securely retained by their retaining clips.
d) Reconnect the clutch cable as described in Chapter 6.
e) Adjust the choke cable and/or throttle cable (as applicable) as described in the relevant Part of Chapter 4.
f) Refill the engine and transmission with the correct quantity and type of lubricant, as described in Chapter 1 and 7A.
g) Refill the cooling system as described in Chapter 1.

4 Engine/automatic transmission - removal, separation, reconnection and refitting

Removal

Note: *The engine can be removed from the car only as a complete unit with the transmission; the two are then separated for overhaul.*
1 Carry out the operations described in paragraphs 1 to 12 of Section 3, noting that the transmission oil draining procedure is given in Chapter 1.
2 Carry out the following operations, using the information given in Chapter 7B:
a) Remove the transmission dipstick tube.
b) Disconnect the wiring from the starter inhibitor/reversing light switch and the speedometer drive housing. Release the earth strap(s) from the top of the transmission housing.
c) Disconnect the selector cable.
d) Release the power steering pipe from the transmission.
e) Disconnect the speedometer cable.
3 Remove the engine/transmission as described in paragraphs 15 to 21 of Section 3.

Separation

4 With the engine/transmission assembly removed, support the assembly on suitable blocks of wood, on a workbench (or failing that, on a clean area of the workshop floor).
5 Detach the kickdown cable from the throttle cam. Work back along the cable, freeing it from any retaining clips, and noting its correct routing.
6 Undo the retaining bolts and remove the driveplate lower cover plate from the transmission, to gain access to the torque converter retaining bolts. Slacken and remove the visible bolt. Rotate the crankshaft using a socket and extension bar on the pulley bolt, and undo the remaining bolts securing the torque converter to the driveplate as they become accessible.
7 Slacken and remove the retaining bolts, and remove the starter motor from the transmission.
8 To ensure that the torque converter does not fall out as the transmission is removed, secure it in position using a length of metal strip bolted to one of the starter motor bolt holes.
9 Ensure that both the engine and transmission are adequately supported, then slacken and remove the remaining bolts securing the transmission housing to the engine. Note the correct fitted positions of each bolt (and any relevant brackets) as they are removed, to use as a reference on refitting.
10 Carefully withdraw the transmission from the engine. If the locating dowels are a loose fit in the engine/transmission, remove them and keep them in a safe place.

Reconnection

11 Ensure that the bush fitted to the centre of the crankshaft is in good condition. Apply a little Molykote G1 grease (available from your Peugeot dealer) to the torque converter centring pin. Do not apply too much, otherwise there is a possibility of the grease contaminating the torque converter.
12 Ensure that the locating dowels are correctly positioned in the engine or transmission.
13 Carefully offer the transmission to the engine, until the locating dowels are engaged.
14 Refit the transmission housing-to-engine bolts, ensuring that all the necessary brackets are correctly positioned, and tighten them to the specified torque setting.
15 Remove the torque converter retaining strap installed prior to removal. Align the torque converter threaded holes with the retaining plate, and refit the three retaining bolts.
16 Tighten the torque converter retaining bolts to the specified torque setting, then refit the driveplate lower cover.
17 Refit the starter motor, and securely tighten its retaining bolts.

Refitting

18 Refit the engine/transmission to the vehicle as described in paragraphs 59 to 63 of Section 3.
19 The remainder of the refitting procedure is a reversal of the removal sequence, noting the following points:

a) Ensure that the wiring loom is correctly routed, and retained by all the relevant retaining clips; all connectors should be correctly and securely reconnected.
b) Prior to refitting the driveshafts to the transmission, renew the driveshaft oil seals (see Chapter 7).
c) Ensure that all coolant hoses are correctly reconnected, and securely retained by their retaining clips.
d) Adjust the selector cable and kickdown cable as described in Chapter 7B.
e) Adjust the throttle cable as described in Chapter 4.
f) Refill the engine and transmission with correct quantity and type of lubricant, as described in Chapter 1.
g) Refill the cooling system as described in Chapter 1.

5 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:

a) Alternator mounting brackets.
b) Engine mountings and brackets (Part A, B or C of this Chapter).
c) The ignition system and HT components including all sensors, distributor cap and rotor arm, ignition module, HT leads and spark plugs (Chapters 1 and 5).
d) Power steering pump and air conditioning compressor brackets (where fitted).
e) Thermostat and housing, coolant pump, coolant outlet chamber/elbow (Chapter 3).
f) Dipstick tube.
g) Carburettor/fuel system components (Chapter 4).
h) All electrical switches and sensors.
i) Inlet and exhaust manifolds (Chapter 4).
j) Oil filter (Chapter 1).
k) Fuel pump - carburettor engines only (Chapter 4).
l) Flywheel/driveplate (Part A, B or C of this Chapter).

Note: *When removing the external components from the engine, pay close attention to details that may be helpful or important during refitting. Note the fitting 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.

a) Inlet and exhaust manifolds (Chapter 4).
b) Timing chain, sprockets, tensioner and oil pump - XV, XW and XY series engines.
c) Timing belt, sprockets and tensioner - XU and TU series engines.
d) Cylinder head.
e) Flywheel/driveplate - XU and TU series engines.
f) Sump - XU and TU series engines.
g) Oil pump - XU and TU series engines.
h) Piston/connecting rod assemblies (Section 7).
i) Crankshaft (Section 8).

6 Cylinder head - dismantling, cleaning, inspection and reassembly

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

Dismantling

1 Remove the cylinder head as described in Part A, B or C of this Chapter (as applicable).
2 If not already done, remove the inlet and exhaust manifolds with reference to the relevant Part of Chapter 4.
3 Remove the camshaft, followers and shims (as applicable) as described in Part A, B or C of this Chapter.
4 Using a valve spring compressor, compress each valve spring in turn until the split collets can be removed. Release the compressor, and lift off the spring retainer, spring and spring seat. Using a pair of pliers, carefully extract the valve stem oil seal from the top of the guide **(see illustrations)**.
5 If, when the valve spring compressor is screwed down, the spring retainer refuses to free and expose the split collets, gently tap the top of the tool, directly over the retainer, with a light hammer. This will free the retainer.
6 Withdraw the valve through the combustion chamber **(see illustration)**.

6.4a Compress the valve spring with a compressor and remove the split collets . . .

6.4b . . . Release the compressor and remove the spring retainer . . .

6.4c . . . spring . . .

6.4d . . . spring seat and valve stem oil seal

6.6 Withdraw the valve through the combustion chamber

7 It is essential that each valve is stored together with its collets, retainer, spring, and spring seat. The valves should also be kept 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 each valve assembly in a labelled polythene bag or similar small container **(see illustration)**. Note that No 1 valve is nearest to the transmission (flywheel/driveplate) end of the engine.

Cleaning

8 Thoroughly clean all traces of old gasket material and sealing compound from the cylinder head upper and lower mating surfaces. Use a suitable cleaning agent together with a soft putty knife; do not use a metal scraper or the faces will be damaged.

9 Remove the carbon from the combustion chambers and ports, then clean all traces of oil and other deposits from the cylinder head, paying particular attention to the bearing journals, cam follower bores (where applicable), valve guides and oilways.

10 Wash the head thoroughly with paraffin or a suitable solvent. Take plenty of time and do a thorough job. Be sure to clean all oil holes and galleries very thoroughly, dry the head completely and coat all machined surfaces with light oil.

11 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 an engineering works are required. Make a list of all items that require attention.*

Cylinder head

12 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.

13 Use a straight-edge and feeler blade to check that the cylinder head gasket surface is not distorted. If it is, it may be possible to have it machined. Seek the advice of a Peugeot dealer or engine overhaul specialist if distortion is suspected.

14 Examine the valve seats in each of the combustion chambers. If they are severely pitted, cracked, or burned, 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.

15 Check the valve guides for wear by inserting the relevant valve, and checking for side-to-side motion of the valve. A very small amount of movement is acceptable. If the movement seems excessive, remove the valve. Measure the valve stem diameter (see below), and renew the valve if it is worn. If the valve stem is not worn, the wear must be in the valve guide, and the guide must be renewed. The renewal of valve guides is best carried out by a Peugeot dealer or engine overhaul specialist, who will have the necessary tools available.

16 If renewing the valve guides, the valve seats should be re-cut or re-ground only *after* the guides have been fitted.

Valves

17 Examine the head of each valve for pitting, burning, cracks, and general wear. 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 or excessive wear on the tip of each valve stem. Renew any valve that shows any such signs of wear or damage.

18 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.

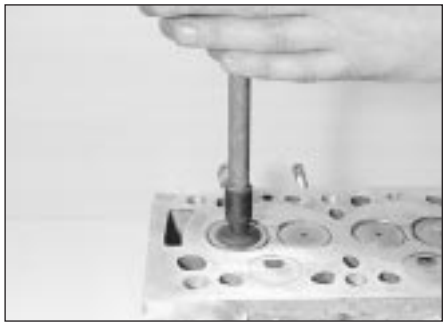
19 If the valves are in satisfactory condition, they should be ground (lapped) into their respective seats, to ensure a smooth, gas-tight seal. If the seat is only lightly pitted, or if it has been re-cut, fine grinding compound *only* should be used to produce the required finish. Coarse valve-grinding 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 (where possible) is required.

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

21 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 **(see illustration)**. With a semi-rotary action, grind the valve head to its seat,

6.7 Place each valve and its associated components in a labelled polythene bag

6.18 Measuring the valve stem diameter



6.21 Grinding-in a valve

lifting the valve occasionally to redistribute the grinding compound. A light spring placed under the valve head will greatly ease this operation.

22 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.

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

Valve components

24 Examine the valve springs for signs of damage and discoloration. No minimum free length is specified by Peugeot, so the only way of judging valve spring wear is by comparison with a new component.

25 Stand each spring on a flat surface, and check it for squareness. If any of the springs are damaged, distorted or have lost their tension, obtain a complete new set of springs. It is normal to renew the valve springs as a matter of course if a major overhaul is being carried out.

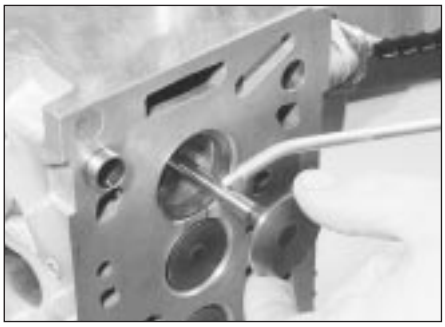
26 Renew the valve stem oil seals regardless of their apparent condition.

Reassembly

27 Lubricate the stems of the valves, and insert the valves into their original locations **(see illustration)**. If new valves are being fitted, insert them into the locations to which they have been ground.

28 Refit the spring seat then, working on the first valve, dip the new valve stem seal in fresh engine oil. Carefully locate it over the valve and onto the guide. Take care not to damage the seal as it is passed over the valve stem. Use a suitable socket or metal tube to press the seal firmly onto the guide **(see illustration)**.

29 Locate the valve spring on top of its seat, then refit the spring retainer.



6.27 Lubricate the valve stems prior to refitting

30 Compress the valve spring, and locate the split collets in the recess in the valve stem. Release the compressor, then repeat the procedure on the remaining valves.

> **HAYNES HiNT** ***Use a little dab of grease to hold the collets in position on the valve stem while the spring compressor is released.***

31 With all the valves installed, place the cylinder head face down on blocks on the bench and, using a hammer and interposed block of wood, tap the end of each valve stem to settle the components.

32 Refit the camshaft, followers and shims (as applicable) as described in Part A, B or C of this Chapter.

33 The cylinder head can then be refitted as described in Part A, B or C of this Chapter.

7 Piston/connecting rod assembly - removal and inspection

Removal

XV, XW and XY series engines

1 With the cylinder head removed, unscrew and remove the bolts which hold the crankcase half sections together. Split the crankcase and keep the main bearing shells with their crankcase web recesses if the shells are to be used again **(see illustration)**.

6.28 Fitting a valve stem oil seal using a socket

2 Remove the crankshaft oil seal.

3 Mark the rim of the cylinder liners in respect of their position and orientation in the block. Note that No 1 cylinder liner is at the transmission (flywheel) end of the engine.

4 Mark the big-end caps and the connecting rods so that they can be refitted in their original sequence and the correct way round. A centre punch or hacksaw blade is useful for this purpose.

5 Unscrew the big-end nuts and remove the caps **(see illustration)**. If the bearing shells are to be used again, keep them taped to their respective cap.

6 Using a hammer handle, push the piston up through the bore, and remove it from the top of the cylinder liner. Recover the bearing shell, and tape it to the connecting rod for safe-keeping.

7 Loosely refit the big-end cap to the connecting rod, and secure with the nuts - this will help to keep the components in their correct order.

XU and TU series engines

8 Remove the cylinder head, sump and oil pump as described in Part B or C of this Chapter (as applicable).

9 Using a hammer and centre-punch, paint or similar, mark each connecting rod and big-end bearing cap with its respective cylinder number on the flat machined surface provided; if the engine has been dismantled before, note carefully any identifying marks made previously **(see illustration)**. Note that No 1 cylinder is at the transmission (flywheel) end of the engine.

7.1 Undo the bolts and split the crankcase half sections - XV, XW and XY series engines

7.5 Remove the big-end bearing caps

7.9 Marks made on connecting rod and bearing cap - XU and TU series engines

10 Turn the crankshaft to bring pistons 1 and 4 to BDC (bottom dead centre).
11 Unscrew the nuts from No 1 piston big-end bearing cap. Take off the cap, and recover the bottom half bearing shell **(see illustration)**. If the bearing shells are to be re-used, tape the cap and the shell together.
12 To prevent the possibility of damage to the crankshaft bearing journals, tape over the connecting rod stud threads.
13 Using a hammer handle, push the piston up through the bore, and remove it from the top of the cylinder block/liner. Recover the bearing shell, and tape it to the connecting rod for safe-keeping.
14 Loosely refit the big-end cap to the connecting rod, and secure with the nuts - this will help to keep the components in their correct order.
15 Remove No 4 piston assembly in the same way.
16 Turn the crankshaft through 180° to bring pistons 2 and 3 to BDC (bottom dead centre), and remove them in the same way.

Inspection

17 Before the inspection process can begin, the piston/connecting rod assemblies must be cleaned, and the original piston rings removed from the pistons.
18 Carefully expand the old rings over the top of the pistons. The use of two or three old feeler blades will be helpful in preventing the rings dropping into empty grooves **(see illustration)**. Be careful not to scratch the piston with the ends of the ring. The rings are brittle, and will snap if they are spread too far. They are also very sharp - protect your hands and fingers. Note that the third ring may incorporate an expander. Always remove the rings from the top of the piston. Keep each set of rings with its piston if the old rings are to be re-used.
19 Scrape away all traces of carbon from the top of the piston. A hand-held wire brush (or a piece of fine emery cloth) can be used, once the majority of the deposits have been scraped away.
20 Remove the carbon from the ring grooves in the piston, using an old ring. Break the ring in half to do this (be careful not to cut your fingers - piston rings are sharp). Be careful to remove only the carbon deposits - do not remove any metal, and do not nick or scratch the sides of the ring grooves.
21 Once the deposits have been removed, clean the piston/connecting rod assembly with paraffin or a suitable solvent, and dry thoroughly. Make sure that the oil return holes in the ring grooves are clear.
22 If the pistons and cylinder liners/bores are not damaged or worn excessively, the original pistons can be refitted. Normal piston wear shows up as even vertical wear on the piston thrust surfaces, and slight looseness of the top ring in its groove. New piston rings should always be used when the engine is reassembled.

7.11 Removing a big-end bearing cap and shell

23 Carefully inspect each piston for cracks around the skirt, around the gudgeon pin holes, and at the piston ring "lands" (between the ring grooves).
24 Look for scoring and scuffing on the piston skirt, holes in the piston crown, and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating, and/or abnormal combustion which caused excessively high operating temperatures. The cooling and lubrication systems should be checked thoroughly. Scorch marks on the sides of the pistons show that blow-by has occurred. A hole in the piston crown, or burned areas at the edge of the piston crown, indicates that abnormal combustion (pre-ignition, knocking, or detonation) has been occurring. If any of the above problems exist, the causes must be investigated and corrected, or the damage will occur again. The causes may include incorrect ignition timing, or a carburettor or fuel injection system fault.
25 Corrosion of the piston, in the form of pitting, indicates that coolant has been leaking into the combustion chamber and/or the crankcase. Again, the cause must be corrected, or the problem may persist in the rebuilt engine.
26 On aluminium-block engines with wet liners, it is not possible to renew the pistons separately; pistons are only supplied with piston rings and a liner, as part of a matched assembly (see Section 9). On cast-iron block engines, pistons can be purchased from a Peugeot dealer.
27 Examine each connecting rod carefully for signs of damage, such as cracks around the big-end and small-end bearings. Check that the rod is not bent or distorted. Damage is highly unlikely, unless the engine has been seized or badly overheated. Detailed checking of the connecting rod assembly can only be carried out by a Peugeot dealer or engine repair specialist with the necessary equipment.
28 On XU series engines, due to the tightening procedure for the connecting rod big-end cap retaining nuts, it is highly recommended that the big-end cap nuts and bolts are renewed as a complete set prior to refitting.

7.18 Using old feeler blades to assist removal of the piston rings

29 On all engines, the gudgeon pins are an interference fit in the connecting rod small-end bearing. Therefore, piston and/or connecting rod renewal should be entrusted to a Peugeot dealer or engine repair specialist, who will have the necessary tooling to remove and install the gudgeon pins.

8 **Crankshaft -** removal and inspection

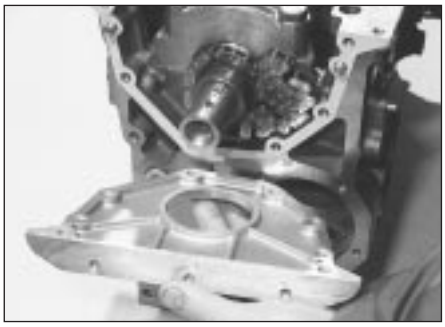
Removal

Note: *If no work is to be done on the pistons and connecting rods, then removal of the cylinder head and pistons will not be necessary. Instead, the pistons need only be pushed far enough up the bores so that they are positioned clear of the crankpins.*
1 With reference to Part A, B or C of this Chapter, and earlier Sections of this Part as applicable, carry out the following:
a) Separate the engine from the transmission.
b) Remove the timing chain/belt and crankshaft sprocket.
c) Remove the sump - XU and TU series engines.
d) Remove the oil pump.
e) Remove the clutch components and flywheel/driveplate.

XV, XW and XY series engines

2 Unscrew and remove the bolts which hold the crankcase half sections together. Split the crankcase and keep the main bearing shells with their crankcase web recesses if the shells are to be used again.
3 Remove the crankshaft oil seal.
4 If the piston/connecting rod assemblies are to be left in place, mark the big-end caps and the connecting rods so that they can be refitted in their original sequence and the correct way round. Note that No 1 cylinder liner is at the transmission (flywheel) end of the engine.
5 Unscrew the big-end nuts and remove the caps and lower big-end bearing shells.
6 Before removing the crankshaft it is advisable to check the endfloat using a dial gauge in contact with the end of the crankshaft. Push the crankshaft fully one way,

8.7 Checking crankshaft endfloat using feeler blades



8.11 Removing the oil seal carrier from the front of the block - XU series engines

8.12a Slide off the oil pump drive sprocket . . .

and then zero the gauge. Push the crankshaft fully the other way, and check the endfloat. The result can be compared with the specified amount, and will give an indication as to whether new thrustwashers are required.

7 If a dial gauge is not available, feeler blades can be used. First push the crankshaft fully towards the flywheel end of the engine, then use feeler blades to measure the gap between the web of the crankpin and the thrustwasher **(see illustration)**.

8 Lift the crankshaft from its crankcase half section, keep the shell bearings in their original web recesses if they are to be used again and retrieve the semi-circular thrust-washers from either side of No 2 bearing web.

9 Loosely refit the big-end caps to the connecting rods, and secure with the nuts - this will help to keep the components in their correct order.

XU series engines

10 Remove the pistons and connecting rods as described in Section 7. (Refer to the Note at the beginning of this Section).

11 Slacken and remove the retaining bolts, and remove the oil seal carrier from the front (timing belt) end of the cylinder block, along with its gasket (where fitted) **(see illustration)**.

12 Remove the oil pump drive chain, and slide the drive sprocket and spacer (where fitted) off the end of the crankshaft. Remove the Woodruff key, and store it with the sprocket for safe-keeping **(see illustrations)**.

13 Before removing the crankshaft it is advisable to check the endfloat as described in paragraphs 6 and 7.

14 The main bearing caps should be numbered 1 to 5, starting from the transmission (flywheel/driveplate) end of the engine **(see illustration)**. If not, mark them accordingly using a centre-punch. Also note the correct fitted depth of the rear crankshaft oil seal in the bearing cap.

15 Undo the two bolts (one at the front of the block, and one at the rear) securing the centre main bearing cap to the block. Remove the bolts, along with their sealing washers.

16 Slacken and remove the main bearing cap retaining bolts/nuts, and lift off each bearing cap. Recover the lower bearing shells, and tape them to their respective caps for safe-keeping. Also recover the lower thrustwasher halves from the side of No 2 main bearing cap **(see illustration)**. Remove the rubber sealing strips from the sides of No 1 main bearing cap, and discard them.

17 Lift out the crankshaft, and discard the rear oil seal.

18 Recover the upper bearing shells from the cylinder block, and tape them to their respective caps for safe-keeping. Remove the upper thrustwasher halves from the side of No 2 main bearing, and store them with the lower halves.

TU series aluminium block engines

19 Remove the pistons and connecting rods as described in Section 7. (Refer to the Note at the beginning of this Section).

20 Before removing the crankshaft it is advisable to check the endfloat as described in paragraphs 6 and 7.

21 Work around the outside of the cylinder block, and unscrew all the small (6 mm) bolts securing the main bearing ladder to the base of the cylinder block. Note the correct fitted depth of both the left- and right-hand crankshaft oil seals in the cylinder block/main bearing ladder.

22 Working in a diagonal sequence, evenly and progressively slacken the ten large (11 mm) main bearing ladder retaining bolts by a turn at a time. Once all the bolts are loose, remove them from the ladder.

23 With all the retaining bolts removed, carefully lift the main bearing ladder casting away from the base of the cylinder block. Recover the lower main bearing shells, and tape them to their respective locations in the casting. If the two locating dowels are a loose fit, remove them and store them with the casting for safe-keeping.

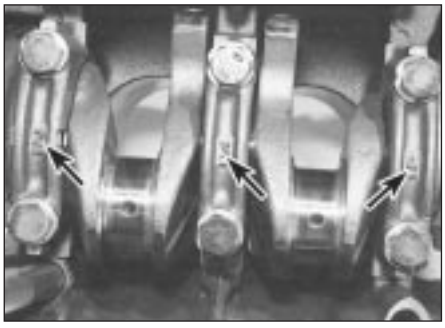
24 Lift out the crankshaft, and discard both the oil seals. Remove the oil pump drive chain from the end of the crankshaft. Where necessary, slide off the drive sprocket, and recover the Woodruff key.

25 Recover the upper main bearing shells, and store them along with the relevant lower bearing shell. Also recover the two thrustwashers (one fitted either side of No 2 main bearing) from the cylinder block.

TU series cast-iron block engines

26 Remove the pistons and connecting rods as described in Section 7. (Refer to the Note at the beginning of this Section).

8.12b . . . and remove the Woodruff key



8.14 Main bearing cap identification markings (arrowed)

8.16 Removing the main bearing cap and thrustwashers (arrowed)

27 Before removing the crankshaft it is advisable to check the endfloat as described in paragraphs 6 and 7.
28 Unbolt and remove the crankshaft left- and right-hand oil seal housings from each end of the cylinder block, noting the correct fitted locations of the locating dowels. If the locating dowels are a loose fit, remove them and store them with the housings for safe-keeping.
29 Remove the oil pump drive chain, and slide the drive sprocket off the end of the crankshaft. Remove the Woodruff key, and store it with the sprocket for safe-keeping.
30 The main bearing caps should be numbered 1 to 5 from the transmission (flywheel) end of the engine. If not, mark them accordingly using a centre-punch or paint.
31 Unscrew and remove the main bearing cap retaining bolts, and withdraw the caps. Recover the lower main bearing shells, and tape them to their respective caps for safe-keeping.
32 Carefully lift out the crankshaft, taking care not to displace the upper main bearing shell.
33 Recover the upper bearing shells from the cylinder block, and tape them to their respective caps for safe-keeping. Remove the thrustwasher halves from the side of No 2 main bearing, and store them with the bearing cap.

Inspection

34 Clean the crankshaft using paraffin or a suitable solvent, and dry it, preferably with compressed air if available. Be sure to clean the oil holes with a pipe cleaner or similar probe, to ensure that they are not obstructed.

Warning: Wear eye protection when using compressed air!

35 Check the main and big-end bearing journals for uneven wear, scoring, pitting and cracking.
36 Big-end bearing wear is accompanied by distinct metallic knocking when the engine is running (particularly noticeable when the engine is pulling from low speed) and some loss of oil pressure.
37 Main bearing wear is accompanied by severe engine vibration and rumble - getting progressively worse as engine speed increases - and again by loss of oil pressure.
38 Check the bearing journal for roughness by running a finger lightly over the bearing surface. Any roughness (which will be accompanied by obvious bearing wear) indicates that the crankshaft requires regrinding (where possible) or renewal.
39 If the crankshaft has been reground, check for burrs around the crankshaft oil holes (the holes are usually chamfered, so burrs should not be a problem unless regrinding has been carried out carelessly). Remove any burrs with a fine file or scraper, and thoroughly clean the oil holes as described previously.

8.40 Measuring a crankshaft big-end journal diameter

40 Using a micrometer, measure the diameter of the main and big-end bearing journals, and compare the results with the *Specifications* **(see illustration)**. By measuring the diameter at a number of points around each journal's circumference, you will be able to determine whether or not the journal is out-of-round. Take the measurement at each end of the journal, near the webs, to determine if the journal is tapered. Compare the results obtained with those given in the *Specifications*.
41 Check the oil seal contact surfaces at each end of the crankshaft for wear and damage. If the seal has worn a deep groove in the surface of the crankshaft, consult an engine overhaul specialist; repair may be possible, but otherwise a new crankshaft will be required.
42 At the time of writing, it was not clear whether Peugeot produce oversize bearing shells for all of these engines. On some engines, if the crankshaft journals have not already been reground, it may be possible to have the crankshaft reconditioned, and to fit oversize shells (see Section 13). If no oversize shells are available and the crankshaft has worn beyond the specified limits, it will have to be renewed. Consult your Peugeot dealer or engine specialist for further information on parts availability.

9 Cylinder block/crankcase - cleaning and inspection

Cleaning

1 Remove all external components and electrical switches/sensors from the block.
2 On aluminium block engines with wet liners, remove the liners as described in paragraph 11.
3 Scrape all traces of gasket from the cylinder block/crankcase, and from the main bearing ladder (where fitted), taking care not to damage the gasket/sealing surfaces.
4 Remove all oil gallery plugs (where fitted). The plugs are usually very tight - they may have to be drilled out, and the holes re-tapped. Use new plugs when the engine is reassembled.
5 If any of the castings are extremely dirty, all should be steam-cleaned.
6 After the castings are returned, clean all oil holes and oil galleries one more time. Flush all internal passages with warm water until the water runs clear. Dry thoroughly, and apply a light film of oil to all mating surfaces, to prevent rusting. On cast-iron block engines, also oil the cylinder bores. If you have access to compressed air, use it to speed up the drying process, and to blow out all the oil holes and galleries.

Warning: Wear eye protection when using compressed air!

7 If the castings are not very dirty, you can do an adequate cleaning job with hot (as hot as you can stand!), soapy water and a stiff brush. Take plenty of time, and do a thorough job. Regardless of the cleaning method used, be sure to clean all oil holes and galleries very thoroughly, and to dry all components well. On cast-iron block engines, protect the cylinder bores as described above, to prevent rusting.
8 All threaded holes must be clean, to ensure accurate torque readings during reassembly. To clean the threads, run the correct-size tap into each of the holes to remove rust, corrosion, thread sealant or sludge, and to restore damaged threads **(see illustration)**. If possible, use compressed air to clear the holes of debris produced by this operation.

Warning: Wear eye protection when cleaning out these holes in this way!

9 Apply suitable sealant to the new oil gallery plugs, and insert them into the holes in the block. Tighten them securely.
10 If the engine is not going to be reassembled right away, cover it with a large plastic bag to keep it clean; protect all mating surfaces and the cylinder bores as described above, to prevent rusting.

Inspection (aluminium cylinder block with wet liners)

11 Remove the liner clamps (where used), then use a hard wood drift to tap out each liner from the inside of the cylinder block.

9.8 Cleaning a cylinder block threaded hole using a suitable tap

9.11 Cylinder liner with paper base seal

When all the liners are released, tip the cylinder block/crankcase on its side and remove each liner from the top of the block. As each liner is removed, stick masking tape on its left-hand (transmission side) face, and write the cylinder number on the tape. No 1 cylinder is at the transmission (flywheel/driveplate) end of the engine. Remove the paper base seal or O-ring from the base of each liner, and discard **(see illustration)**.

12 Check each cylinder liner for scuffing and scoring. Check for signs of a wear ridge at the top of the liner, indicating that the bore is excessively worn.

13 If the necessary measuring equipment is available, measure the bore diameter of each cylinder liner at the top (just under the wear ridge), centre, and bottom of the cylinder bore, parallel to the crankshaft axis.

14 Next, measure the bore diameter at the same three locations, at right-angles to the crankshaft axis.

15 Repeat the procedure for the remaining cylinder liners.

16 If the liner wear is excessive at any point, or if the cylinder liner walls are badly scored or scuffed, then renewal of the relevant liner assembly will be necessary. If there is any doubt about the condition of the cylinder bores, seek the advice of a Peugeot dealer or engine reconditioning specialist.

17 If renewal is necessary, new liners, complete with pistons and piston rings, can be purchased from a Peugeot dealer. Note that it is not possible to buy liners individually - they are supplied only as a matched assembly complete with piston and rings.

18 To allow for manufacturing tolerances, pistons and liners are separated into three size groups. The size group of each piston is indicated by a letter (A, B or C) stamped onto its crown, and the size group of each liner is indicated by a series of 1 to 3 notches on the upper lip of the liner **(see illustration)**; a single notch for group A, two notches for group B, and three notches for group C (on some engines the actual letters A, B, C may also appear on the liners instead of the notches). Ensure that each piston and its respective liner are both of the same size group. It is permissible to have different size group piston and liner assemblies fitted to the same engine, but never fit a piston of one size group to a liner in a different group.

19 Prior to installing the liners it is necessary to check the liner protrusion above the top of the cylinder block as follows.

XV, XW and XY series engines with paper type base seals

20 If the cylinder liners had paper type base seals, the liner protrusion must be measured and seals of the correct thickness selected.

21 Paper base seals are available in four different thicknesses:

Blue	*0.087 mm*
White	*0.102 mm*
Red	*1.122 mm*
Yellow	*0.147 mm*

22 The correct protrusion for each liner above the surface of the cylinder block is given in the *Specifications* and it is preferable to aim for the greater protrusion when selecting new seals.

23 Fit the liners without the seals into their original locations. If new liners are being fitted, they of course can be fitted in any order.

24 Using a dial indicator or feeler blades and a straight-edge, measure the protrusion of each liner above the top of the cylinder block **(see illustration)**.

25 It is now a simple matter to select a paper base seal which, when its thickness is added to the recorded protrusion will equal the specified protrusion.

26 Make sure that the difference in protrusion between adjacent liners does not exceed 0.04 mm. If it does, reduce the seal thickness on the greater protruding liner.

27 If new liners are being fitted, the protrusion differences can be eliminated by changing the position of the liner in the block or by twisting it on its base.

28 Prior to installing the liners, thoroughly clean the liner mating surfaces in the cylinder block, and use fine abrasive paper to polish away any burrs or sharp edges which might damage the liner base seals. Clean the liners and wipe dry, then fit the selected paper seals to the base of each liner so that their tabs are diametrically opposite to the liner rim marks. To aid installation, apply a smear of oil to the base of the liner.

29 Insert each liner into its correct location in the block then, using a hammer and a block of wood, tap each liner lightly but fully onto its locating shoulder. Wipe clean, then lightly oil, all exposed liner surfaces, to prevent rusting.

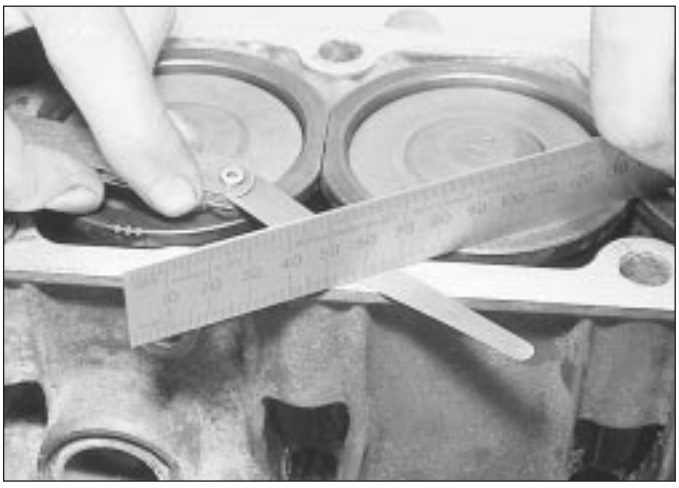
XV, XW and XY series engines with O-ring type seals

30 If the original liners are being refitted then the projection should be correct once new O-ring seals have been fitted.

31 If new liners are being fitted, then measure the protrusion of each liner without its seal as described in paragraph 24 and compare the figures obtained with those given in the *Specifications*.

32 If the difference between adjacent liners exceeds 0.05 mm, rotate the liners through half a turn or interchange the liner position in the block.

9.18 Cylinder liner size group marking



9.24 Measuring cylinder liner protrusion

9.36 Fitting a liner to the cylinder block

33 Prior to installing the liners, thoroughly clean the liner mating surfaces in the cylinder block, and use fine abrasive paper to polish away any burrs or sharp edges which might damage the liner base seals. Clean the liners and wipe dry, then fit the O-ring seals to the base of each liner. To aid installation, apply a smear of oil to the base of the liner.

34 Insert each liner into its correct location in the block then, using a hammer and a block of wood, tap each liner lightly but fully onto its locating shoulder. Wipe clean, then lightly oil, all exposed liner surfaces, to prevent rusting.

XU and TU series engines

35 Prior to installing the liners, thoroughly clean the liner mating surfaces in the cylinder block, and use fine abrasive paper to polish away any burrs or sharp edges which might damage the liner base seals. Clean the liners and wipe dry, then fit a new O-ring to the base of each liner. To aid installation, apply a smear of oil to each O-ring and to the base of the liner.

36 If the original liners are being refitted, use the marks made on removal to ensure that each is refitted the correct way round, and is inserted into its original bore. Insert each liner into the cylinder block, taking care not to damage the O-ring, and press it home as far as possible by hand **(see illustration)**. Using a hammer and a block of wood, tap each liner lightly but fully onto its locating shoulder. Wipe clean, then lightly oil, all exposed liner surfaces, to prevent rusting.

37 With all four liners correctly installed, use a dial gauge (or a straight-edge and feeler blade) to check that the protrusion of each liner above the upper surface of the cylinder block is within the limits given in the *Specifications*. The maximum difference between any two liners must not be exceeded. Note that the liner protrusion figures are different for later XU series engines.

38 If new liners are being fitted, it is permissible to interchange them to bring the difference in protrusion within limits. Remember to keep each piston with its respective liner.

39 If liner protrusion cannot be brought within limits, seek the advice of a Peugeot dealer or engine reconditioning specialist before proceeding with the engine rebuild.

Inspection (cast-iron cylinder block)

40 Visually check the castings for cracks and corrosion. Look for stripped threads in the threaded holes. If there has been any history of internal water leakage, it may be worthwhile having an engine overhaul specialist check the cylinder block/crankcase with special equipment. If defects are found, have them repaired if possible, or renew the assembly.

41 Check each cylinder bore for scuffing and scoring. Check for signs of a wear ridge at the top of the cylinder, indicating that the bore is excessively worn.

42 If the necessary measuring equipment is available, measure the bore diameter of each cylinder liner at the top (just under the wear ridge), centre, and bottom of the cylinder bore, parallel to the crankshaft axis.

43 Next, measure the bore diameter at the same three locations, at right-angles to the crankshaft axis. As no tolerance figures are actually stated by Peugeot, if there is any doubt about the condition of the cylinder bores, seek the advice of a Peugeot dealer or suitable engine reconditioning specialist.

44 At the time of writing, it was not clear whether oversize pistons were available for all models. Consult your Peugeot dealer for the latest information on piston availability. If oversize pistons are available, then it may be possible to have the cylinder bores rebored and fit the oversize pistons. If oversize pistons are not available, and the bores are worn, renewal of the block seems to be the only option.

10 Main and big-end bearings - inspection

Inspection

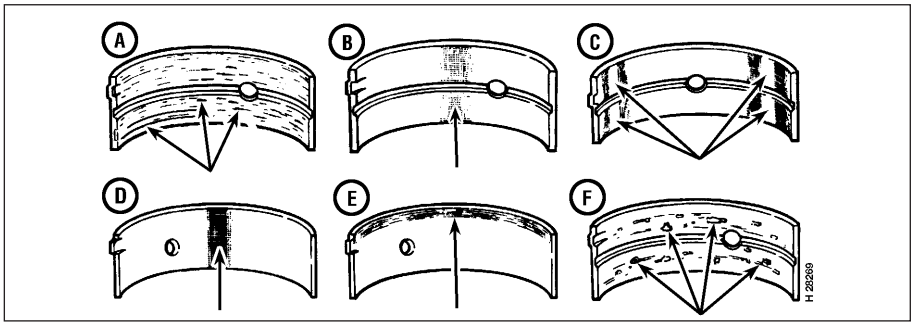
1 Even though the main and big-end bearing shells should be renewed during the engine overhaul, the old shells should be retained for close examination, as they may reveal valuable information about the condition of the engine.

2 Bearing failure occurs because of lack of lubrication, the presence of dirt or other foreign particles, overloading the engine, and corrosion **(see illustration)**. Regardless of the cause of bearing failure, the cause must be corrected (where applicable) before the engine is reassembled, to prevent it from happening again.

3 When examining the bearing shells, remove them from the cylinder block/crankcase and main bearing caps, and from the connecting rods and the big-end bearing caps, then lay them out on a clean surface in the same general position as their location in the engine. This will enable you to match any bearing problems with the corresponding crankshaft journal. *Do not* touch any shell's bearing surface with your fingers while checking it, or the delicate surface may be scratched.

4 Dirt or other foreign matter gets into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass through filters or the crankcase ventilation system. It may get into the oil, and from there into the bearings. Metal chips from machining operations and normal engine wear are often present. Abrasives are sometimes left in engine components after reconditioning, especially when parts are not thoroughly cleaned using the proper cleaning methods. Whatever the source, these foreign objects often end up embedded in the soft bearing material, and are easily recognised. Large particles will not embed in the material, and will score or gouge the shell and journal. The best prevention for this cause of bearing failure is to clean all parts thoroughly, and to keep everything spotlessly-clean during engine assembly. Frequent and regular engine oil and filter changes are also recommended.

5 Lack of lubrication (or lubrication breakdown) has a number of inter-related causes. Excessive heat (which thins the oil), overloading (which squeezes the oil from the bearing face) and oil



10.2 Typical bearing failures

A Scratched by dirt; dirt embedded in bearing material
B Lack of oil; overlay wiped out
C Improper seating; bright (polished sections)
D Tapered journal; overlay gone from entire surface
E Radius ride
F Fatigue failure; craters or pockets

leakage (from excessive bearing clearances, worn oil pump or high engine speeds) all contribute to lubrication breakdown. Blocked oil passages, which usually are the result of misaligned oil holes in a bearing shell, will also starve a bearing of oil, and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the shell's steel backing. Temperatures may increase to the point where the steel backing turns blue from overheating.

6 Driving habits can have a definite effect on bearing life. Full-throttle, low-speed operation (labouring the engine) puts very high loads on bearings, which tends to squeeze out the oil film. These loads cause the shells to flex, which produces fine cracks in the bearing face (fatigue failure). Eventually, the bearing material will loosen in pieces, and tear away from the steel backing.

7 Short-distance driving leads to corrosion of bearings, because insufficient engine heat is produced to drive off condensed water and corrosive gases. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the engine bearings, the acid attacks and corrodes the bearing material.

8 Incorrect shell refitting during engine assembly will lead to bearing failure as well. Tight-fitting shells leave insufficient bearing running clearance, and will result in oil starvation. Dirt or foreign particles trapped behind a bearing shell result in high spots on the bearing, which lead to failure.

9 *Do not* touch any shell's bearing surface with your fingers during reassembly; there is a risk of scratching the delicate surface, or of depositing particles of dirt on it.

11 Engine overhaul - reassembly sequence

1 Before reassembly begins, ensure that all new parts have been obtained, and that all necessary tools are available. Read through the entire procedure to familiarise yourself with the work involved, and to ensure that all items necessary for reassembly of the engine are at hand. In addition to all normal tools and materials, thread-locking compound will be needed. A suitable tube of liquid sealant will also be required for the joint faces that are fitted without gaskets. It is recommended that Peugeot's own product(s) are used, which are specially formulated for this purpose.

2 In order to save time and avoid problems, engine reassembly can be carried out in the following order:

a) Crankshaft (Section 13).*
b) Piston/connecting rod assemblies (Section 14).*
c) Oil pump - XU and TU series engines.
d) Sump - XU and TU series engines (See Part B or C as applicable).
e) Flywheel (See Part A, B or C as applicable).
f) Cylinder head (See Part A, B or C - as applicable).
g) Timing chain/belt, sprockets and tensioner (See Part A, B, or C as applicable).
h) Oil pump - XV, XW and XY series engines.
i) Engine external components.

**On XV XW and XY series engines the piston connecting rod assemblies must be fitted before the crankshaft due to the arrangement of the split crankcase.*

3 At this stage, all engine components should be absolutely clean and dry, with all faults repaired. The components should be laid out (or in individual containers) on a completely clean work surface**.**

12 Piston rings - refitting

1 Before fitting new piston rings, the ring end gaps must be checked as follows.

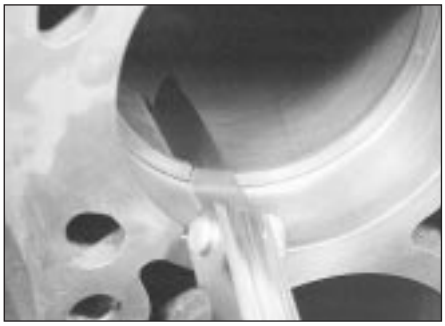
2 Lay out the piston/connecting rod assemblies and the new piston ring sets, so that the ring sets will be matched with the same piston and cylinder during the end gap measurement and subsequent engine reassembly.

3 Insert the top ring into the first cylinder, and push it down the bore using the top of the piston. This will ensure that the ring remains square with the cylinder walls. Position the ring near the bottom of the cylinder bore, at the lower limit of ring travel. Note that the top and second compression rings are different. The second ring is easily identified by the step on its lower surface, and by the fact that its outer face is tapered.

4 Measure the end gap using feeler blades.

5 Repeat the procedure with the ring at the top of the cylinder bore, at the upper limit of its travel **(see illustration)**, and compare the measurements with the figures given in the *Specifications*. Where no figures are given, seek the advice of a Peugeot dealer or engine reconditioning specialist.

6 If the gap is too small (unlikely if genuine Peugeot parts are used), it must be enlarged, or the ring ends may contact each other during engine operation, causing serious damage. Ideally, new piston rings providing the correct end gap should be fitted. As a last resort, the end gap can be increased by filing the ring ends very carefully with a fine file. Mount the file in a vice equipped with soft jaws, slip the ring over the file with the ends contacting the file face, and slowly move the ring to remove material from the ends. Take care, as piston rings are sharp, and are easily broken.



12.5 Measuring piston ring end gap

7 With new piston rings, it is unlikely that the end gap will be too large. If the gaps are too large, check that you have the correct rings for your engine and for the particular cylinder bore size.

8 Repeat the checking procedure for each ring in the first cylinder, and then for the rings in the remaining cylinders. Remember to keep rings, pistons and cylinders matched up.

9 Once the ring end gaps have been checked and if necessary corrected, the rings can be fitted to the pistons.

10 Fit the piston rings using the same technique as for removal. Fit the bottom (oil control) ring first, and work up. When fitting a three piece oil control ring, first insert the expander and position its gap in line with the centre of the gudgeon pin. Fit the scraper rings with their gaps positioned 20 to 30 mm either side of the expander gap. Where the oil control scraper is of one-piece type, position its gap 180° from the expander gap. Ensure that the second compression ring is fitted the correct way up, with its identification mark (either a dot of paint or the word "TOP" or "TOPC" stamped on the ring surface) at the top, and the stepped surface at the bottom **(see illustration)**. Arrange the gaps of the top and second compression rings 120° either side of the oil control expander gap. **Note:** *Always follow any instructions supplied with the new piston ring sets - different manufacturers may specify different procedures. Do not mix up the top and second compression rings, as they have different cross-sections.*

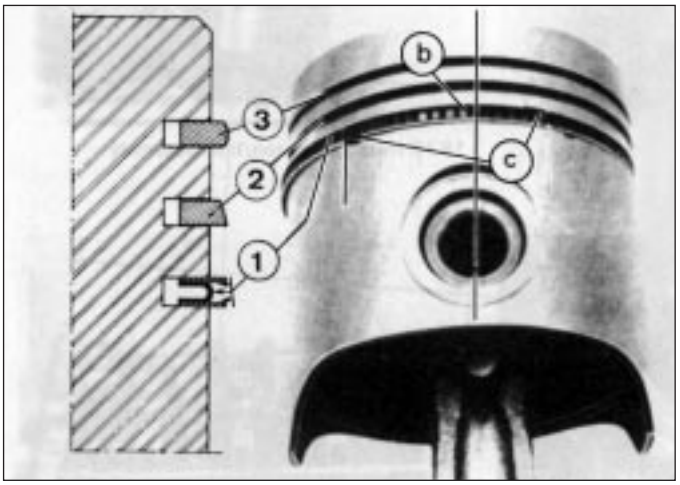
13 Crankshaft - refitting and main bearing running clearance check

Main bearing shell selection

XV, XW and XY series engines

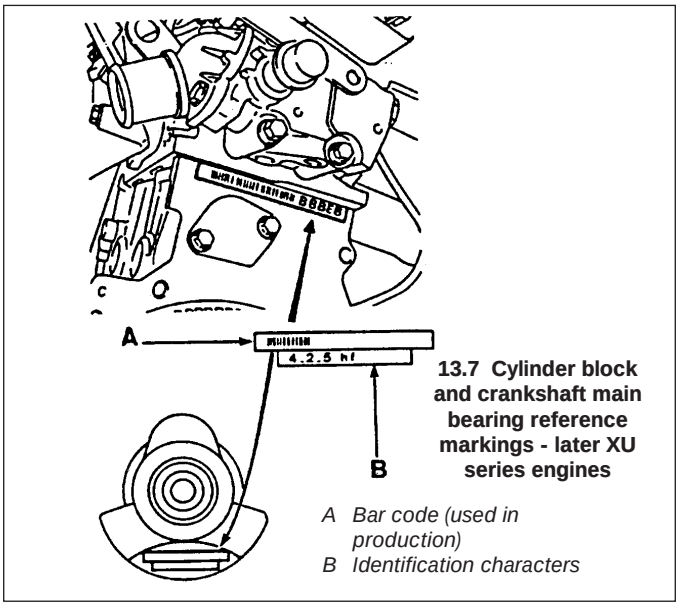
1 Bearing shells on these engines are not graded and are supplied in one standard size or one oversize only, to match the dimensions of the respective journal. As the manufacturer's do not specify an actual running clearance dimension for the bearings, the only safe course of action is to fit new shells whenever an overhaul is being undertaken. Assuming that the relevant crankshaft journals are all within tolerance, the running clearances will then be correct.

2 Note also that from early 1986, the locating tabs of the main bearing shells are offset, and it is not possible to fit the earlier type of main bearing shell to later models with this modification. Seek the advice of a Peugeot dealer or engine overhaul specialist when selecting bearing shells.



12.10 Piston ring identification

1 Oil control ring
2 Second compression ring
3 First compression ring
b Oil control expander ring gap
c Oil control scraper ring gaps



13.7 Cylinder block and crankshaft main bearing reference markings - later XU series engines

A Bar code (used in production)
B Identification characters

XU series engines

3 On some early engines, both the upper and lower bearing shells were of the same thickness.

4 However, on later engines the main bearing running clearance was significantly reduced. To enable this to be done, four different grades of bearing shell were introduced. The grades are indicated by a colour-coding marked on the edge of each shell, which denotes the shell's thickness, as listed in the following table. The upper shell on all bearings is of the same size, and the running clearance is controlled by fitting a lower bearing shell of the required thickness. This arrangement has been fitted to all engines produced since mid-1994 and, if possible, should also be fitted to earlier engines during overhaul (see paragraph 11).

Bearing colour code	**Thickness (mm)**	
	Standard	***Undersize***
Upper bearing:		
Yellow	*1.856*	*2.006*
Lower bearing:		
Blue (Class A)	*1.836*	*1.986*
Black (Class B)	*1.848*	*1.998*
Green (Class C)	*1.859*	*2.009*
Red (Class D)	*1.870*	*2.020*

Note*: On later engines, upper shells are easily distinguished from lower shells, by their grooved bearing surface; the lower shells have a plain surface*.

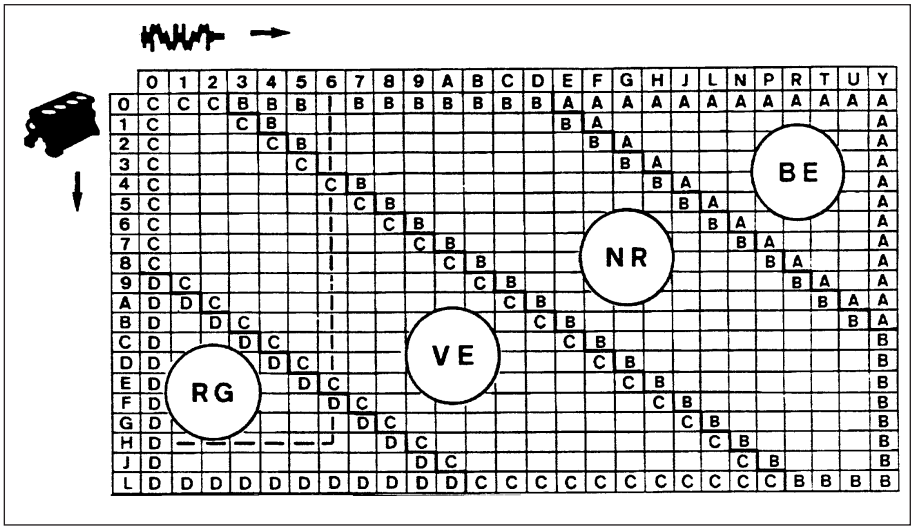
5 On early engines, the correct size of bearing shell must be selected by measuring the running clearance as described under the sub-heading below.

6 On engines produced since mid-1994, when the new bearing shell sizes were introduced, the crankshaft and cylinder block/crankcase have had reference marks on them to identify the size of the journals and bearing bores.

7 The cylinder block reference marks are on the left-hand (transmission) end of the block. The crankshaft reference marks are on the left-hand (transmission) end of the crankshaft, on the left-hand web of No 1 crankpin **(see illustration)**. These marks can be used to select bearing shells of the required thickness as follows.

8 On both the crankshaft and block, there are two lines of identification, a bar code, which is used by Peugeot during production, and a row of five characters (letters and numbers). The first character in the sequence refers to the relevant size of No 1 bearing (at the flywheel/driveplate end) and the last letter in the sequence refers to the relevant size of No 5 main bearing. These marks can be used to select the required bearing shell grade as follows.

9 Obtain the identification character of both the relevant crankshaft journal and the cylinder block bearing bore. Note that the crankshaft characters are listed across the top of the chart, and the cylinder block characters down the side **(see illustration)**. Trace a vertical line down from the relevant crankshaft character, and a horizontal line across from the relevant cylinder block character, and find the point at which both lines cross. This crossover point will indicate the grade of lower bearing shell required to give the correct main bearing running clearance. For example, the illustration shows cylinder block reference H, and crankshaft reference 6, crossing at a point within the area of Class D, indicating that a Red (Class D) lower bearing shell is required to give the correct main bearing running clearance.



13.9 Main bearing shell selection chart - later XU series engines

BE Blue (Class A) *NR Black (Class B)* *VE Green (Class C)* *RG Red (Class D)*

10 Repeat this procedure so that the required bearing shell grade is obtained for each of the five main bearing journals.

11 Seek the advice of your Peugeot dealer on parts availability, and on the best course of action when ordering new bearing shells. **Note**: *On early models, at overhaul it is recommended that the later bearing shell arrangement is fitted. This, however, should only be done if the lubrication system components are upgraded (necessitating replacement of the oil pump relief valve piston and spring, as well as the pump sprocket and drive chain) at the same time. If the new bearing arrangement is to be used without uprating the lubrication system, Peugeot state that Blue (Class A) lower bearing shells should be fitted. Refer to your Peugeot dealer for further information.*

TU series engines

12 As with the XU series engines described previously, the TU aluminium block engine originally had upper and lower bearing shells of the same thickness, with only two sets of bearing shell sizes available; standard and oversize. On aluminium block engines from mid-1993 onwards, and all cast-iron block engines, to ensure that the main bearing running clearance can be accurately set, there are three different grades of bearing shell. The grades are indicated by a colour-coding marked on the edge of each shell, which denotes the shell's thickness, as listed in the following table. The upper shell on all bearings is of the same size (class B, colour code black), and the running clearance is controlled by fitting a lower bearing shell of the required thickness. This later arrangement should also, if possible, be fitted to earlier engines during overhaul.

Aluminium block engine

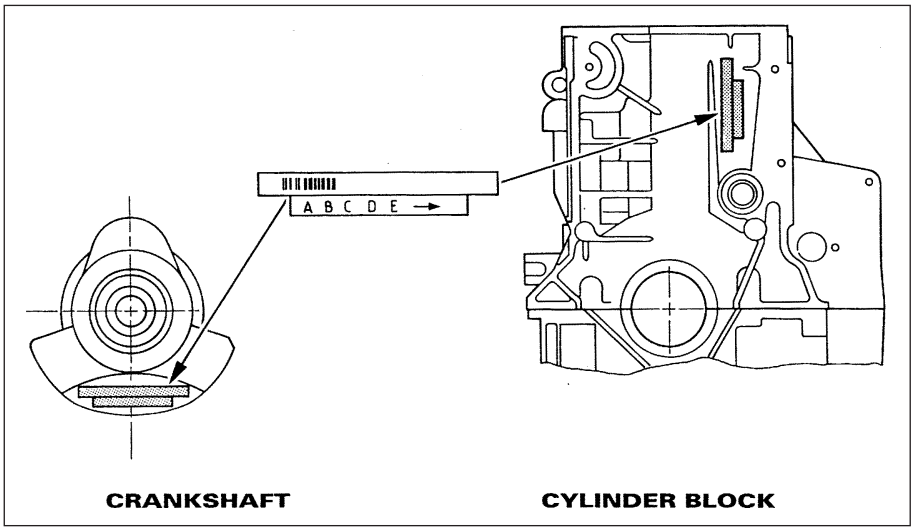
Bearing colour code	Thickness (mm)	
	Standard	***Undersize***
Blue (class A)	1.823	1.973
Black (class B)	1.835	1.985
Green (class C)	1.848	1.998

Cast-iron block engine

Bearing colour code	Thickness (mm)	
	Standard	***Undersize***
Blue (class A)	1.844	1.994
Black (class B)	1.858	2.008
Green (class C)	1.869	2.019

13 New bearing shells can be selected using the reference marks on the cylinder block/crankcase. The cylinder block marks identify the diameter of the bearing bores and the crankshaft marks, the diameter of the crankshaft journals. On early engines, the correct size of bearing shell must be selected by measuring the running clearance as described under the sub-heading below.

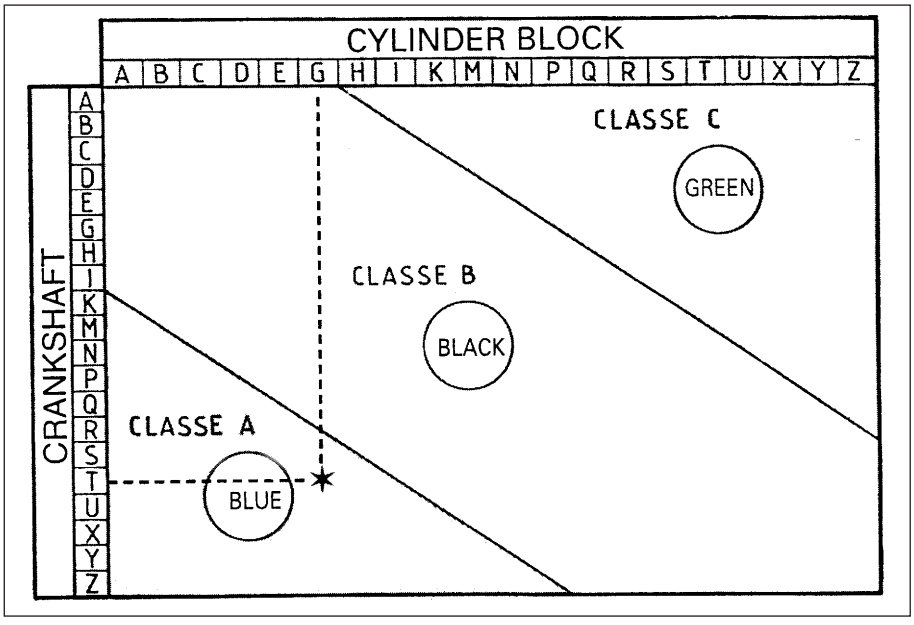
14 The cylinder block reference marks are on the right-hand (timing belt) end of the block, and the crankshaft reference marks are on the right-hand (timing belt) end of the crankshaft, on the right-hand web of No 4 crankpin **(see illustration)**. These marks can be used to select bearing shells of the required thickness as follows.



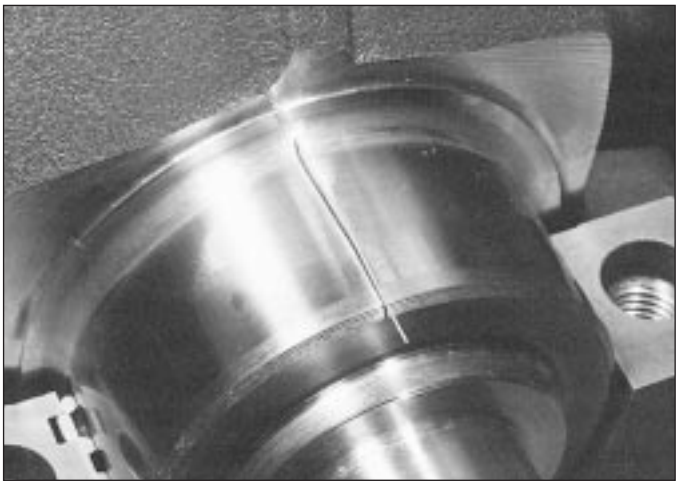
13.14 Cylinder block and crankshaft main bearing reference markings - TU series engines

15 On both the crankshaft and block there are two lines of identification: a bar code, which is used by Peugeot during production, and a row of five letters. The first letter in the sequence refers to the size of No 1 bearing (at the flywheel/driveplate end). The last letter in the sequence (which is followed by an arrow) refers to the size of No 5 main bearing. These marks can be used to select the required bearing shell grade as follows.

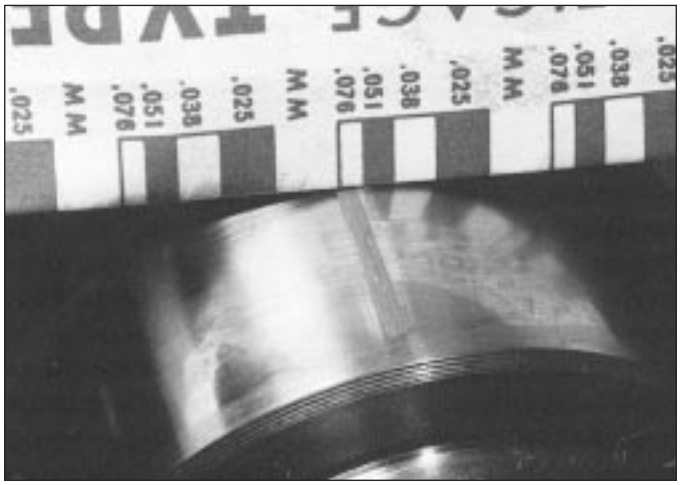
16 Obtain the identification letter of both the relevant crankshaft journal and the cylinder block bearing bore. Noting that the cylinder block letters are listed across the top of the chart, and the crankshaft letters down the side, trace a vertical line down from the relevant cylinder block letter, and a horizontal line across from the relevant crankshaft letter, and find the point at which both lines cross. This crossover point will indicate the grade of lower bearing shell required to give the correct main bearing running clearance. For example, the illustration shows cylinder block reference G, and crankshaft reference T, crossing at a point within the area of Class A, indicating that a blue-coded (Class A) lower bearing shell is required to give the correct main bearing running clearance **(see illustration)**.



13.16 Main bearing shell selection chart - TU series engines



13.26 Plastigage in place on a crankshaft main bearing journal



13.29 Measure the width of the deformed Plastigage using the scale on the card

17 Repeat this procedure so that the required bearing shell grade is obtained for each of the five main bearing journals.

18 Seek the advice of your Peugeot dealer for the latest information on parts availability when ordering new bearing shells.

Main bearing running clearance check

XU series engines

19 On early engines, if the modified bearing shells are to be fitted, obtain a set of new (Yellow) upper bearing shells and new Blue (Class A) lower bearing shells. On later (mid-1994 on) engines where the modified bearing shells are already fitted, the running clearance check can be carried out using the original bearing shells, although it is preferable to use a new set, since the results obtained will be a lot more conclusive.

20 Clean the backs of the bearing shells, and the bearing locations, in both the cylinder block/crankcase and the main bearing caps.

21 Press the bearing shells into their locations, ensuring that the tab on each shell engages in the notch in the cylinder block/crankcase or bearing cap, and taking care not to touch any shell's bearing surface with your fingers. There is conflicting information from the manufacturer on the exact placement of the grooved and plain bearing shells, which appears to vary according to engine code and model year. Also, the bearing arrangement on the project cars dismantled in the preparation of this manual did not conform to the expected placement, but no harm seemed to have resulted. As a general recommendation, if the old bearing shells are being used they must be positioned in their original locations. If new bearing shells are being used on early models, fit the plain shells in all locations that had a plain shell on removal, and likewise for the grooved shells. From mid-1994 onwards, all upper bearing shells are grooved, whereas all lower shells are plain.

22 The running clearance can be checked in either of two ways.

23 One method (which will be difficult to achieve without a range of internal micrometers or internal/external expanding calipers) is to refit the main bearing caps to the cylinder block/crankcase, with bearing shells in place. With the cap retaining bolts tightened to the specified torque, measure the internal diameter of each assembled pair of bearing shells. If the diameter of each corresponding crankshaft journal is measured and then subtracted from the bearing internal diameter, the result will be the main bearing running clearance.

24 The second (and more accurate) method is to use a product known as Plastigage. This consists of a fine thread of perfectly round plastic, which is then compressed between the bearing shell and the journal. When the shell is removed, the plastic is deformed, and can be measured with a specified card gauge supplied with the kit. The running clearance is determined from this gauge. Plastigage should be available from your Peugeot dealer, otherwise, enquiries at one of the larger specialist quality motor factors should produce the name of a stockist in your area. The procedure for using Plastigage is as follows.

25 With the main bearing upper shells in place, carefully lay the crankshaft in position. Do not use any lubricant; the crankshaft journals and bearing shells must be perfectly clean and dry.

26 Cut several lengths of the appropriate-size Plastigage (they should be slightly shorter than the width of the main bearings), and place one length on each crankshaft journal axis **(see illustration)**.

27 With the main bearing lower shells in position, refit the main bearing caps and tighten their retaining bolts to the specified torque. Take care not to disturb the Plastigage, and do not rotate the crankshaft at any time during this operation.

28 Remove the main bearing caps again, taking great care not to disturb the Plastigage, nor to rotate the crankshaft.

29 Compare the width of the crushed Plastigage on each journal to the scale printed on the Plastigage envelope, to obtain the main bearing running clearance **(see illustration)**. Compare the clearance measured with that given in the *Specifications* at the start of this Chapter.

30 If the clearance is significantly different from that expected, the bearing shells may be the wrong size (or excessively worn, if the original shells are being re-used). Before deciding that different size shells are required, make sure that no dirt or oil was trapped between the bearing shells and the caps or block when the clearance was measured. If the Plastigage was wider at one end than at the other, the crankshaft journal may be tapered.

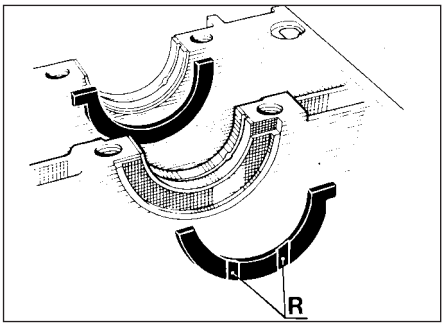
31 If the clearance is not as specified, use the reading obtained, along with the shell thicknesses quoted above, to calculate the necessary grade of bearing shells required. When calculating the bearing clearance required, bear in mind that it is always better to have the running clearance towards the lower end of the specified range, to allow for wear in use.

32 Where necessary, obtain the required grades of bearing shell, and repeat the running clearance checking procedure as described above.

33 On completion, carefully scrape away all traces of the Plastigage material from the crankshaft and bearing shells, using a fingernail or other object which is unlikely to score the bearing surfaces.

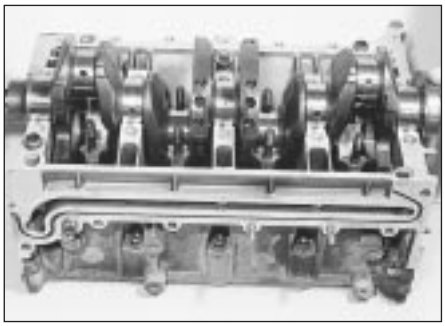
TU series aluminium block engines

34 The procedure is similar to that described in paragraphs 20 to 33, except that the lower shells are fitted to the main bearing ladder instead of the individual bearing caps. On early engines, if the modified bearing shells are to



13.38 Crankshaft thrustwashers - XV, XW and XY series engines

R Oil grooves



13.39 Lowering the crankshaft into place

13.41 Crankcase flange O-ring seal

be fitted, obtain a set of new Black (Class B) upper bearing shells and new Blue (Class A) lower bearing shells. On later (mid-1993 on) engines where the modified bearing shells are already fitted, the running clearance check can be carried out using the original bearing shells, although it is preferable to use a new set as described above, since the results obtained will be a lot more conclusive. Note that on most models, all the bearing shells are plain except those fitted to journals 2 and 4 which are grooved. Some engines, however, may have a grooved bearing shell fitted to the upper (cylinder block) location of No 5 main bearing. Fit the ladder, tighten the bolts to the specified torque and carry out the running clearance check.

TU series cast-iron block engines

35 The procedure is similar to that described in paragraphs 20 to 33 except that all the bearing shells are plain except those fitted to journals 2 and 4 which are grooved.

Final crankshaft refitting

XV, XW and XY series engines

36 Due to the arrangement of the split crankcase it is necessary to have the pistons, and connecting rods in place in the block before refitting the crankshaft. Carry out the operations described in Section 14, then proceed as follows.

37 Place the bearing shells in their locations as described earlier. If new shells are being fitted, ensure that all traces of protective grease are cleaned off using paraffin. Wipe dry the shells with a lint-free cloth. Liberally lubricate each bearing shell in the cylinder block/crankcase with clean engine oil.

38 Fit the semi-circular thrustwashers which control crankshaft endfloat. The oil grooves of the thrustwashers must be against the machined face of the crankshaft **(see illustration)**.

39 Oil the shell bearings and lower the crankshaft into position **(see illustration)**.

40 Reconnect the connecting rods to the crankshaft as described in Section 14.

41 Fit a new O-ring seal to the crankcase flange and check that the locating dowels are in position **(see illustration)**.

42 Apply jointing compound to the flange.

43 Clean the recesses in the remaining crankcase housing section and fit the main bearing shells. Note that the grooved shells are located in positions 2 and 4.

44 Locate the housing, taking care not to displace the bearing shells.

45 Screw in the ten main bearing/casing bolts with flat washers; noting that the two longer bolts are at the flywheel housing end and the very long one at the crankshaft pulley end on the oil pump side **(see illustration)**.

46 Tighten the bolts in the sequence given in two stages to the specified torque **(see illustration)**.

47 Now screw in and tighten the seven casing flange bolts with their spring washers **(see illustration)**.

13.45 Tightening the main bearing/casing bolts

48 Fit a new crankshaft rear oil seal as described in Part A of this Chapter.

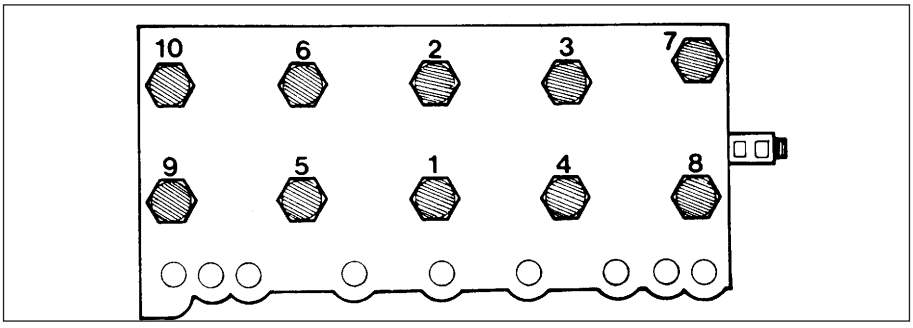
49 Where removed, fit the cylinder head, as described in Part A.

XU series engines

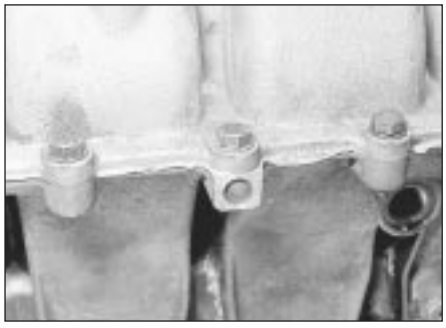
50 Carefully lift the crankshaft out of the cylinder block once more.

51 Using a little grease, stick the upper thrustwashers to each side of the No 2 main bearing upper location. Ensure that the oilway grooves on each thrustwasher face outwards (away from the cylinder block) **(see illustration)**.

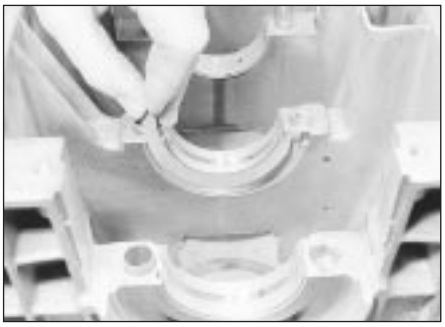
52 Place the bearing shells in their locations as described earlier. If new shells are being fitted, ensure that all traces of protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth. Liberally lubricate each bearing shell in the cylinder block/crankcase and cap with clean engine oil.



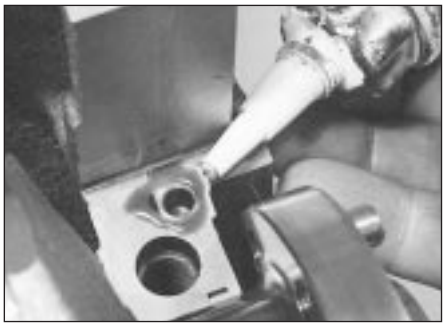
13.46 Main bearing/casing bolt tightening sequence - XV, XW and XY series engines



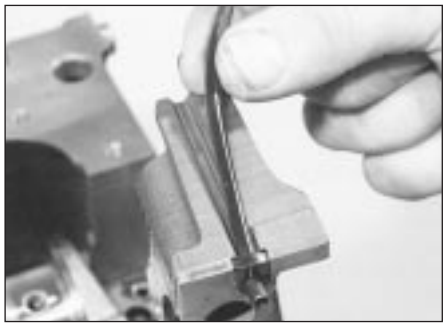
13.47 Refit the casing flange bolts and washers



13.51 Fitting the thrustwasher upper segments - XU series engines



13.56 Applying sealant to the cylinder block No 1 main bearing cap mating face



13.57 Fitting a sealing strip to No 1 main bearing cap

53 Lower the crankshaft into position so that Nos 2 and 3 cylinder crankpins are at TDC; Nos 1 and 4 cylinder crankpins will be at BDC, ready for fitting No 1 piston.

54 Lubricate the lower bearing shells in the main bearing caps with clean engine oil. Make sure that the locating lugs on the shells engage with the corresponding recesses in the caps.

55 Fit main bearing caps Nos 2 to 5 to their correct locations, ensuring that they are fitted the correct way round (the bearing shell tab recesses in the block and caps must be on the same side). Insert the bolts/nuts, tightening them only loosely at this stage.

56 Apply a small amount of sealant to the No 1 main bearing cap mating face on the cylinder block, around the sealing strip holes **(see illustration)**.

57 Locate the tab of each sealing strip over the pins on the base of No 1 bearing cap, and press the strips into the bearing cap grooves **(see illustration)**. It is now necessary to obtain two thin metal strips, of 0.25 mm thickness or less, in order to prevent the strips moving when the cap is being fitted. Peugeot garages use a special tool, which acts as a clamp. Metal strips (such as old feeler blades) can be used, provided all burrs which may damage the sealing strips are first removed.

58 Where applicable, oil both sides of the metal strips, and hold them on the sealing strips. Fit the No 1 main bearing cap, insert the bolts loosely, then carefully pull out the metal strips in a horizontal direction, using a pair of pliers if necessary **(see illustration)**.

59 Tighten all the main bearing cap bolts/nuts evenly to the specified torque. Using a sharp knife, trim off the ends of the No 1 bearing cap sealing strips, so that they protrude above the cylinder block/crankcase mating surface by approximately 1 mm

60 Refit the centre main bearing side retaining bolts and sealing washers (one at the front of the block, and one at the rear) and tighten them both to the specified torque **(see illustration)**.

61 Fit a new crankshaft rear oil seal as described in Part B of this Chapter.

62 Refit the piston/connecting rod assemblies to the crankshaft as described in Section 14.

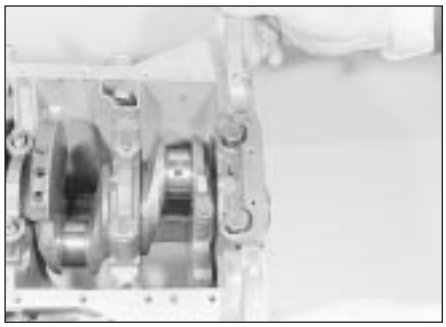
63 Refit the Woodruff key, then slide on the oil pump drive sprocket and spacer (where fitted), and locate the drive chain on the sprocket.

64 Ensure that the mating surfaces of the front oil seal carrier and cylinder block are clean and dry. Note the correct fitted depth of the oil seal then, using a large flat-bladed screwdriver, lever the old seal out of the housing.

65 Apply a smear of suitable sealant to the oil seal carrier mating surface. Ensure that the locating dowels are in position, then slide the carrier over the end of the crankshaft and into position on the cylinder block. Tighten the carrier retaining bolts to the specified torque.

66 Fit a new crankshaft front oil seal as described in Part B of this Chapter.

67 Ensuring that the drive chain is correctly located on the sprocket, refit the oil pump and sump as described in Part B of this Chapter.



13.58 Using feeler blades to protect the sealing strips as the cap is fitted

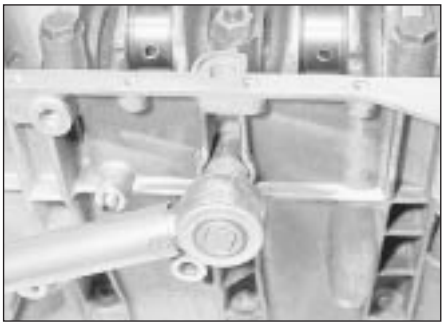
68 Where removed, refit the cylinder head as described in Part B.

TU series aluminium block engines

69 Carefully lift the crankshaft out of the cylinder block once more.

70 Using a little grease, stick the upper thrustwashers to each side of the No 2 main bearing upper location; ensure that the oilway grooves on each thrustwasher face outwards (away from the cylinder block) **(see illustration)**.

71 Place the bearing shells in their locations as described earlier. If new shells are being fitted, ensure that all traces of protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth. Liberally lubricate each bearing shell in the cylinder block/crankcase with clean engine oil **(see illustration)**.

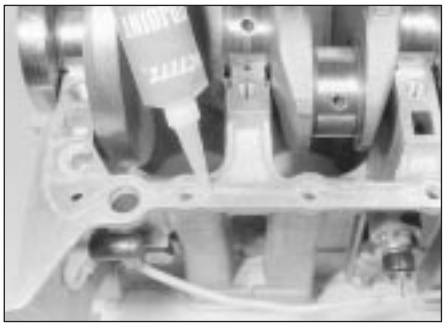


13.60 Refit and tighten the centre main bearing side bolts

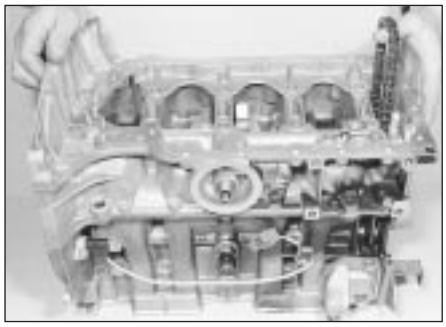
13.70 Refitting a crankshaft thrustwasher - TU series aluminium block engine

13.71 Ensure each bearing shell tab (arrowed) is correctly located and apply clean oil

13.72 Refitting the oil pump drive chain and sprocket



13.73 Apply a thin film of sealant to the cylinder block/crankcase mating face . . .



13.74 . . . then lower the main bearing ladder into position

72 Refit the Woodruff key, then slide on the oil pump drive sprocket, and locate the drive chain on the sprocket **(see illustration)**. Lower the crankshaft into position so that Nos 2 and 3 cylinder crankpins are at TDC; Nos 1 and 4 cylinder crankpins will be at BDC, ready for fitting No 1 piston.

73 Thoroughly degrease the mating surfaces of the cylinder block/crankcase and the main bearing ladder. Apply a thin bead of suitable sealant to the cylinder block/crankcase mating surface of the main bearing ladder casting, then spread to an even film **(see illustration)**.

74 Lubricate the lower bearing shells with clean engine oil, then refit the main bearing ladder, ensuring that the shells are not displaced, and that the locating dowels engage correctly **(see illustration)**.

75 Install the ten 11 mm main bearing ladder retaining bolts, and tighten them all by hand only. Working progressively outwards from the centre bolts, tighten the ten bolts, by a turn at a time, to the specified Stage 1 torque wrench setting. Once all the bolts have been tightened to the Stage 1 setting, angle-tighten the bolts through the specified Stage 2 angle using a socket and extension bar. It is recommended that an angle-measuring gauge is used during this stage of the tightening, to ensure accuracy **(see illustrations)**. If a gauge is not available, use a dab of white paint to make alignment marks between the bolt head and casting prior to tightening; the marks can then be used to check that the bolt has been rotated sufficiently during tightening.

76 Refit all the 6 mm bolts securing the main bearing ladder to the base of the cylinder block, and tighten them to the specified torque. Check that the crankshaft rotates freely. On engines with a grooved bearing shell fitted to the upper (cylinder block) location of No 5 main bearing, working on one bolt at a time starting with the centre and working progressively outwards, loosen the 11 mm main bearing ladder retaining bolts, and then tighten to the Stage 3 and then Stage 4 torque wrench settings.

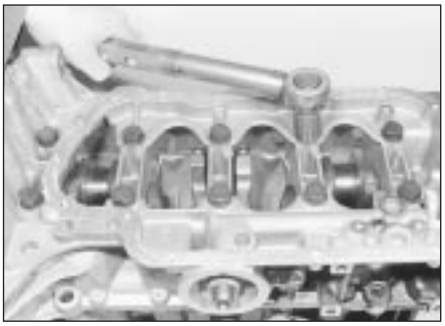
77 Refit the piston/connecting rod assemblies to the crankshaft as described in Section 14.

78 Ensuring that the drive chain is correctly located on the sprocket, refit the oil pump and sump as described in Part A of this Chapter.

79 Fit two new crankshaft oil seals as described in Part A.

80 Refit the flywheel as described in Part A of this Chapter.

81 Where removed, refit the cylinder head as described in Part A. Also refit the crankshaft sprocket and timing belt as described in Part A.



13.75a Tighten the 11 mm main bearing bolts to the Stage 1 torque setting . . .

13.75b . . . then angle-tighten them through the specified Stage 2 angle

TU series cast-iron block engines

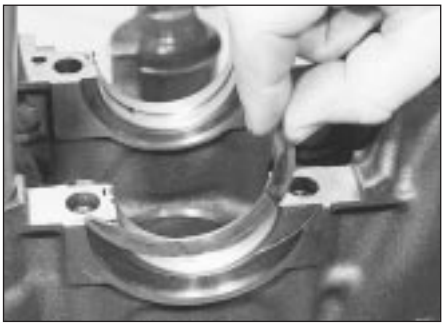
82 Carefully lift the crankshaft out of the cylinder block once more.

83 Using a little grease, stick the upper thrustwashers to each side of the No 2 main bearing upper location. Ensure that the oilway grooves on each thrustwasher face outwards (away from the cylinder block) **(see illustration)**.

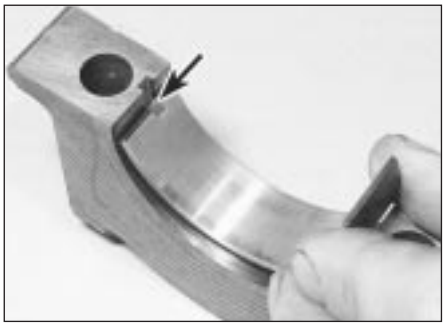
84 Place the bearing shells in their locations as described earlier **(see illustration)**. If new shells are being fitted, ensure that all traces of protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth. Liberally lubricate each bearing shell in the cylinder block/crankcase and cap with clean engine oil.

85 Lower the crankshaft into position so that Nos 2 and 3 cylinder crankpins are at TDC; Nos 1 and 4 cylinder crankpins will be at BDC, ready for fitting No 1 piston.

86 Lubricate the lower bearing shells in the main bearing caps with clean engine oil. Make sure that the locating lugs on the shells engage with the corresponding recesses in the caps.

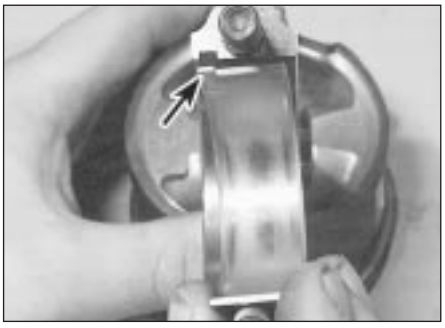


13.83 Fitting a thrustwasher to No 2 main bearing upper location - TU series cast iron block engines



13.84 Ensure that the tab (arrowed) is correctly located in the cap when fitting the bearing shells

87 Fit the main bearing caps to their correct locations, ensuring that they are fitted the correct way round (the bearing shell lug recesses in the block and caps must be on the same side). Insert the bolts loosely.
88 Tighten the main bearing cap bolts to the specified Stage 1 torque wrench setting. Once all the bolts have been tightened to the Stage 1 setting, angle-tighten the bolts through the specified Stage 2 angle, using a socket and extension bar. It is recommended that an angle-measuring gauge is used during this stage of the tightening, to ensure accuracy. If a gauge is not available, use a dab of white paint to make alignment marks between the bolt head and casting prior to tightening; the marks can then be used to check that the bolt has been rotated sufficiently during tightening.
89 Check that the crankshaft rotates freely.
90 Refit the piston/connecting rod assemblies to the crankshaft as described in Section 14.
91 Refit the Woodruff key to the crankshaft groove, and slide on the oil pump drive sprocket. Locate the drive chain on the sprocket.
92 Ensure that the mating surfaces of front oil seal housing and cylinder block are clean and dry. Note the correct fitted depth of the front oil seal then, using a large flat-bladed screwdriver, lever the seal out of the housing.
93 Apply a smear of suitable sealant to the oil seal housing mating surface, and make sure that the locating dowels are in position. Slide the housing over the end of the crankshaft, and into position on the cylinder block. Tighten the housing retaining bolts securely.
94 Repeat the operations in paragraphs 92 and 93, and fit the rear oil seal housing.
95 Fit a new front and rear crankshaft oil seal as described in Part C of this Chapter.
96 Ensuring that the chain is correctly located on the drive sprocket, refit the oil pump and sump as described in Part C of this Chapter.
97 Refit the flywheel as described in Part C of this Chapter.
98 Where removed, refit the cylinder head and install the crankshaft sprocket and timing belt as described in the relevant Sections of Part C.



14.5 Ensure that the tab (arrowed) is correctly located in the connecting rod when fitting the bearing shells

14 Piston/connecting rod assembly - refitting and big-end bearing clearance check

Selection of bearing shells

1 On most engines, there are two sizes of big-end bearing shell produced by Peugeot; a standard size for use with the standard crankshaft, and an oversize for use once the crankshaft journals have been reground.
2 Consult your Peugeot dealer for the latest information on parts availability. To be safe, always quote the diameter of the crankshaft big-end crankpins when ordering bearing shells.
3 Prior to refitting the piston/connecting rod assemblies, it is recommended that the big-end bearing running clearance is checked as follows.

Big-end bearing running clearance check

4 Clean the backs of the bearing shells, and the bearing locations in both the connecting rod and bearing cap.
5 Press the bearing shells into their locations, ensuring that the tab on each shell engages in the notch in the connecting rod and cap. Take care not to touch any shell's bearing surface with your fingers **(see illustration)**. If the original bearing shells are being used for the check, ensure that they are refitted in their original locations. The clearance can be checked in either of two ways.
6 One method is to refit the big-end bearing cap to the connecting rod, ensuring that they are fitted the correct way around (see paragraph 21), with the bearing shells in place. With the cap retaining nuts correctly tightened, use an internal micrometer or vernier caliper to measure the internal diameter of each assembled pair of bearing shells. If the diameter of each corresponding crankshaft journal is measured and then subtracted from the bearing internal diameter, the result will be the big-end bearing running clearance.
7 The second, and more accurate method is to use Plastigage (see Section 13).
8 Ensure that the bearing shells are correctly fitted. Place a strand of Plastigage on each (cleaned) crankpin journal.
9 Refit the (clean) piston/connecting rod assemblies to the crankshaft, and refit the big-end bearing caps, using the marks made or noted on removal to ensure that they are fitted the correct way around.
10 Tighten the bearing cap nuts as described below in paragraph 22 or 23 (as applicable). Take care not to disturb the Plastigage, nor rotate the connecting rod during the tightening sequence.
11 Dismantle the assemblies without rotating the connecting rods. Use the scale printed on the Plastigage envelope to obtain the big-end bearing running clearance.
12 If the clearance is significantly different from that expected, the bearing shells may be the wrong size (or excessively worn, if the original shells are being re-used). Make sure that no dirt or oil was trapped between the bearing shells and the caps or block when the clearance was measured. If the Plastigage was wider at one end than at the other, the crankshaft journal may be tapered.
13 Note that Peugeot do not specify a recommended big-end bearing running clearance. The figure given in the *Specifications* is a guide figure, which is typical for this type of engine. Before condemning the components concerned, refer to your Peugeot dealer or engine reconditioning specialist for further information on the specified running clearance. Their advice on the best course of action to be taken can then also be obtained.
14 On completion, carefully scrape away all traces of the Plastigage material from the crankshaft and bearing shells. Use your fingernail, or some other object which is unlikely to score the bearing surfaces.

Final piston/connecting rod refitting

15 Note that the following procedure assumes that the cylinder liners (where fitted) are in position in the cylinder block/crankcase as described in Section 9, and that on XU and TU series engines, the crankshaft and main bearing ladder/caps are in place (see Section 13). On XV, XW and XY series engines, do not fit the crankshaft until all the piston/connecting rod assemblies have been inserted.
16 Ensure that the bearing shells are correctly fitted as described earlier. If new shells are being fitted, ensure that all traces of the protective grease are cleaned off using paraffin. Wipe dry the shells and connecting rods with a lint-free cloth.
17 Lubricate the cylinder bores, the pistons, and piston rings, then lay out each piston/connecting rod assembly in its respective position.
18 Start with assembly No 1. Make sure that the piston rings are still spaced as described in Section 12, then clamp them in position with a piston ring compressor.
19 Insert the piston/connecting rod assembly into the top of cylinder/liner No 1. Ensure that the arrow on the piston crown is pointing towards the timing chain/belt end of the engine. Using a block of wood or hammer handle against the piston crown, tap the assembly into the cylinder/liner until the piston crown is flush with the top of the cylinder/liner **(see illustration)**.
20 On XV, XW and XY series engines, refit the remaining three piston/connecting rod assemblies in the same way. The crankshaft should then be placed in position in the crankcase as described in Section 13.
21 Ensure that the bearing shell is still correctly installed. Liberally lubricate the

14.19 Tap the piston into the bore using a hammer handle

14.22 Tightening a big-end bearing cap nut using a torque wrench . . .

14.23 . . . and further, on XU series engines, through the specified angle using an angle tightening gauge

crankpin and both bearing shells. Taking care not to mark the cylinder/liner bores, pull the piston/connecting rod assembly down the bore and onto the crankpin. Refit the big-end bearing cap, tightening its retaining nuts finger-tight at first. Note that the faces with the identification marks must match (which means that the bearing shell locating tabs abut each other).

22 On XV, XW, XY and TU series engines, tighten the bearing cap retaining nuts evenly and progressively to the specified torque setting **(see illustration)**.

23 On XU series engines, tighten the bearing cap retaining nuts evenly and progressively to the Stage 1 torque setting. Fully slacken both nuts, then tighten them to the Stage 2 torque setting. Once both nuts have been tightened to the Stage 2 setting, angle-tighten them through the specified Stage 3 angle, using a socket and extension bar. It is recommended that an angle-measuring gauge is used during this stage of the tightening, to ensure accuracy **(see illustration)**. If a gauge is not available, use a dab of white paint to make alignment marks between the nut and bearing cap prior to tightening; the marks can then be used to check that the nut has been rotated sufficiently during tightening.

24 On XU and TU series engines, once the bearing cap retaining nuts have been correctly tightened, rotate the crankshaft. Check that it turns freely; some stiffness is to be expected if new components have been fitted, but there should be no signs of binding or tight spots.

25 On XU and TU series engines, refit the remaining three piston/connecting rod assemblies in the same way.

26 On XV, XW and XY series engines, continue the crankshaft refitting procedure described in Section 13. On all other engines, refit the cylinder head and oil pump as described in Part B or C of this Chapter (as applicable).

15 Engine - initial start-up after overhaul

1 With the engine refitted in the vehicle, double-check the engine oil and coolant levels. Make a final check that everything has been reconnected, and that there are no tools or rags left in the engine compartment.

2 Remove the spark plugs. On models with a distributor, disable the ignition system by disconnecting the ignition HT coil lead from the distributor cap, and earthing it on the cylinder block. Use a jumper lead or similar wire to make a good connection. On models with a static (distributorless) ignition system, disable the ignition system by disconnecting the LT wiring connector from the ignition module, referring to Chapter 5B for further information.

3 Turn the engine on the starter until the oil pressure warning light goes out. Refit the spark plugs, and reconnect the spark plug (HT) leads, referring to Chapter 1 for further information. Reconnect any HT leads or wiring which was disconnected in paragraph 2.

4 Start the engine, noting that this may take a little longer than usual, due to the fuel system components having been disturbed.

5 While the engine is idling, check for fuel, water and oil leaks. Don't be alarmed if there are some odd smells and smoke from parts getting hot and burning off oil deposits.

6 Assuming all is well, keep the engine idling until hot water is felt circulating through the top hose, then switch off the engine.

7 Check the ignition timing and the idle speed settings (as appropriate), then switch the engine off.

8 After a few minutes, recheck the oil and coolant levels as described in Chapter 1, and top-up as necessary.

9 On XV, XW and XY series engines, and XU series engines with hexagon type cylinder head bolts, it will be necessary to re-tighten the head bolts after the engine has been run up to normal working temperature then switched off and allowed to cool (see Part A and B of this Chapter, as applicable). On all other engines, if they were tightened as described, there is no need to re-tighten the cylinder head bolts once the engine has first run after reassembly.

10 If new pistons, rings or crankshaft bearings have been fitted, the engine must be treated as new, and run-in for the first 500 miles (800 km). *Do not* operate the engine at full-throttle, or allow it to labour at low engine speeds in any gear. It is recommended that the oil and filter be changed at the end of this period.