Chapter 2 Part A:
SOHC engine procedures

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

General

Type	
All models	Four-cylinder, in-line, water-cooled, transversely mounted at front of vehicle. Single belt-driven overhead camshaft, acting on hydraulic valve lifters
Manufacturer’s engine codes:	
14 NV	1.4 litre (1389 cc)
16 SV	1.6 litre (1598 cc)
X16 SZ	1.6 litre (1598 cc) ‘Ecotec’ type engine
C16 NZ	1.6 litre (1598 cc) + catalyst
C16 NZ2	1.6 litre (1598 cc) + catalyst
18 SV	1.8 litre (1796 cc)
C18 NZ	1.8 litre (1796 cc) + catalyst
20 NE	2.0 litre (1998 cc)
20 SEH	2.0 litre (1998 cc) + early SRi
C20 NE	2.0 litre (1998 cc) + catalyst

Pistons:	Bore (mm)	Stroke (mm)
14 NV	77.6	73.4
16 SV, C16 SV, C16 NZ and X16 SZ	79.0	81.5
C16 NZ2	80.0	79.5
18 SV and C18 NZ	84.8	79.5
20 NE, 20 SEH and C20 NE	86.0	86.0

Compression ratio		
14 NV	9.4 : 1	
16 SV, X16 SZ, 18 SV and 20 SEH	10.0 : 1	
C16 NZ, C16 NZ2, C18 NZ, 20 NE and C20 NE	9.2 : 1	
Maximum power:		
14 NV	55 kW (75 bhp) at 5600 rpm	
16 SV	60 kW (82 bhp) at 5400 rpm	
X16 SZ	52 kW (71 bhp) at 5000 rpm	
C16 NZ and C16 NZ2	55 kW (75 bhp) at 5200 rpm	
18 SV and C18 NZ	66 kW (90 bhp) at 5400 rpm	
20 NE and C20 NE	85 kW (116 bhp) at 5200 rpm	
20 SEH	95 kW (129 bhp) at 5600 rpm	
Maximum torque:		
14 NV	108 Nm at 3000 rpm	
X16 SZ	128 Nm at 2800 rpm	
16 SV	130 Nm at 2600 rpm	
C16 NZ and C16 NZ2	125 Nm at 2800 rpm	
18 SV	148 Nm at 2800 rpm	
C18 NZ	145 Nm at 3000 rpm	
20 NE	175 Nm at 2600 rpm	
20 SEH	180 Nm at 4600 rpm	
C20 NE	170 Nm at 2600 rpm	
Firing order:		
All models	1-3-4-2 (No 1 cylinder at timing belt end)	

Cylinder block:

Material	Cast iron
Maximum permissible bore out-of round	0.013 mm
Maximum permissible bore taper	0.013 mm
Maximum permissible rebore oversize	0.5 mm

Crankshaft and bearings

Number of main bearings	5	
Main bearing journal diameter (mm):		
14 NV, 16 SV, C16 NZ and X16 SZ		
Standard	54.980 to 54.997	
0.25mm undersize	54.730 to 54.747	
0.50mm undersize	54.482 to 54.495	
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH		
Standard	57.974 to 57.995	
0.25mm undersize	57.732 to 57.745	
0.50mm undersize	57.482 to 57.495	
Main bearing shell colour codes:	**Bearing cap shells**	**Cylinder block shells**
14 NV, 16 SV, C16 NZ and X16 SZ		
Standard	Brown	Green
0.25 mm undersize	Brown/blue	Green/blue
0.50 mm undersize	Brown/white	Green/white
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH		
Standard	Brown/green/white	
0.25mm undersize	Brown/blue and Green/blue	
0.50mm undersize	Brown/white and Green/white	
Centre (thrust) main bearing journal width (mm):		
14 NV, 16 SV, C16 NZ and X 16 SZ		
Standard	26.000 to 26.052	
0.25mm undersize	26.200 to 26.252	
0.50mm undersize	26.400 to 26.452	
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH		
Standard	25.950 to 26.002	
0.25mm undersize	26.150 to 26.202	
0.50mm undersize	26.350 to 26.402	
Big-end bearing journal diameter (mm):		
14 NV, 16 SV, C16 NZ and X16 SZ		
Standard	42.971 to 42.987	
0.25mm undersize	42.721 to 42.737	
0.50mm undersize	42.471 to 42.487	
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH		
Standard	48.970 to 48.988	
0.25mm undersize	48.720 to 48.738	
0.50mm undersize	48.470 to 48.488	

Crankshaft and bearings (continued)

Big-end bearing shell colour codes (all models):	
Standard	None
0.25 mm undersize	Blue
0.50 mm undersize	White
Main and big-end bearing journal out-of-round (all models)	0.04 mm maximum
Main bearing permissible movement (mm):	
14 NV, 16 SV, C16 NZ and X16 SZ	0.017 to 0.047
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	0.015 to 0.040
Big-end bearing permissible movement (mm):	
14 NV, 16 SV, C16 NZ and X16 SZ	0.019 to 0.071
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	0.006 to 0.031
Crankshaft endfloat (mm):	
14 NV, 16 SV, C16 NZ and X16 SZ	0.1 to 0.2
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	0.050 to 0.152
Connecting rod endfloat (mm) (all models)	0.07 to 0.24

Piston and cylinder bores (Ø in mm)

	Bore diameter	Piston dia	ID mark
14 NV:			
Production size 1	77.56	77.54	6
	77.57	77.55	7
	77.58	77.56	8
Production size 2	77.59	77.57	99
	77.60	77.58	00
	77.61	77.59	01
	77.62	77.60	02
0.5 mm oversize	78.07	78.05	7 + 0.5
16 SV, C16 NZ and X16 SZ:			
Production size 1	78.95	78.93	5
	78.96	78.94	6
	78.97	78.95	7
	78.98	78.96	8
Production size 2	78.99	78.97	99
	79.00	78.98	00
	79.01	78.99	01
	79.02	79.00	02
Production size 3	79.03	79.01	03
	79.04	79.02	04
	79.05	79.03	05
	79.06	79.04	06
Production size 4	79.07	79.05	07
	79.08	79.06	08
	79.09	79.07	09
	79.10	79.08	1
0.5 mm oversize	79.48	79.45	7 + 0.5
C16 NZ2:			
Production	79.98	n/a	98
	79.90	n/a	99
	80.00	n/a	00
	80.01	n/a	01
	80.02	n/a	02
18 SV and C18 NZ:			
Production size 1	84.78 mm	84.76 mm	8
Production size 2	84.79 mm	84.77 mm	99
	84.80 mm	84.78 mm	00
	84.81 mm	84.79 mm	01
	84.82 mm	84.80 mm	02
0.5 mm oversize	85.27 mm	85.25 mm	7 + 0.5
20 NE, C20 NE and 20 SEH:			
Production size 1	85.98 mm	85.96 mm	8
Production size 2	85.99 mm	85.97 mm	99
	86.00 mm	85.98 mm	00
	86.01 mm	85.99 mm	01
	86.02 mm	86.00 mm	02
0.5 mm oversize	86.47 mm	86.45 mm	7 + 0.5
Piston clearance in bore (mm) (all models)	0.02 to 0.04		

Piston rings

Number (per piston) (all models)	2 compression, 1 oil control
Ring end gap (mm):	
Compression	0.3 to 0.5
Oil control (top and bottom sections)	0.4 to 1.4
Ring gap offset (to gap of adjacent ring)*	180º

** See Section 32 for oil control ring sections*

Cylinder head

Material (all models)	Light alloy
Maximum permissible distortion of sealing face (all models)	0.025 mm
Height of cylinder head (sealing surface to sealing surface) (all models)	96.00 ± 0.25 mm
Valve seat width (mm):	
14 NV, 16 SV, C16 NZ, X 16 SZ and C16 NZ2	
Inlet	1.3 to 1.5
Exhaust	1.6 to 1.8
18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	
Inlet	1.0 to 1.5
Exhaust	1.7 to 2.2

Camshaft

Camshaft bearing journal diameter:	**Normal (mm)**	**0.1 mm undersize**
14 NV, 16 SV, C16 NZ and X16 SZ:		
No 1	39.435 to 39.455	
No 2	39.685 to 39.705	
No 3	39.935 to 39.955	
No 4	40.185 to 40.205	
No 5	40.435 to 40.455	
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH:		
No 1	42.455 to 42.470	42.355 to 42.370
No 2	42.705 to 42.720	42.605 to 42.620
No 3	42.955 to 42.970	42.855 to 42.870
No 4	43.205 to 43.220	43.105 to 43.120
No 5	43.455 to 43.470	43.355 to 43.370
Camshaft bearing diameter in housing:		
14 NV, 16 SV, C16 NZ and X16 SZ:		
No 1	39.500 to 39.525	
No 2	39.750 to 39.775	
No 3	40.000 to 40.025	
No 4	40.250 to 40.275	
No 5	40.500 to 40.525	
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH:		
No 1	42.500 to 42.525	42.400 to 42.425
No 2	42.750 to 42.775	42.650 to 42.675
No 3	43.000 to 43.025	42.900 to 42.925
No 4	43.250 to 43.275	43.150 to 43.175
No 5	43.500 to 43.525	43.400 to 43.425
Cam lift (mm):		
14 NV (inlet and exhaust)	6.12	
16 SV and C16 NZ:		
Inlet	5.61	
Exhaust	6.12	
C16 NZ2, 18 SV and C18 NZ		
Inlet	6.01	
Exhaust	6.39	
C20 NE and 20 NE (inlet and exhaust)	6.67	
20 SEH (inlet and exhaust)	6.70	
Maximum permissible radial run-out (mm) (all models)	0.04	
Endfloat (mm) (all models)	0.09 to 0.21	

Timing belt (engines without automatic tension roller)

Tension, using Vauxhall gauge KM-51 0-A (see Section 11):	
14NV, 16 SV and C16 NZ:	
New belt, cold	5.5
New belt, warm	8.0
Used belt, cold	4.0
Used belt, warm	7.0

18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH:	
New belt, cold	4.5
New belt, warm	7.5
Used belt, cold	2.5
Used belt, warm	7.0

Valves and guides

	Inlet	Exhaust
Overall length - production (mm):		
14 NV	105.0	105.0
16 SV, X 16 SZ and C16 NZ	101.5	101.5
C16 NZ2	104.2	104.2
18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	104.2	104.0
Overall length - service (mm):		
14 NV	104.6	104.6
16 SV, X 16 SZ and C16 NZ	101.1	101.1
C16 NZ2	103.8	103.8
18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	103.8	103.6
Head diameter (mm):		
14 NV	33.0	29.0
16 SV, X 16 SZ, C16 NZ and C16 NZ2	38.0	31.0
18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	41.8	36.5
Stem diameter (mm), (all engines):		
Standard	6.998 to 7.012	6.978 to 6.992
0.075 mm oversize	7.073 to 7.087	7.053 to 7.067
0.150 mm oversize	7.148 to 7.162	7.128 to 7.142
0.250 mm oversize	7.248 to 7.262	7.228 to 7.242
Valve guide bore (mm), (all engines):		
Standard	7.030 to 7.050	
0.075 mm oversize	7.105 to 7.125	
0.150 mm oversize	7.180 to 7.200	
0.250 mm oversize	7.280 to 7.300	
Valve clearance in guide (mm), (all engines):		
Inlet	0.018 to 0.052	
Exhaust	0.038 to 0.072	
Valve seat angle:		
All models	44º	
Valve clearances:		
All models	Automatic adjustment by hydraulic lifters	

Flywheel

Maximum permissible lateral run-out of starter ring gear (all models)	0.5 mm
Refinishing limit - maximum depth of material that may be removed from clutch friction surface (all models)	0.3 mm

Lubrication system

Lubricant type/specification	See *Lubricants and fluids* in "*Weekly checks*"
Lubricant capacity	See Chapter 1 Specifications
Oil pump clearances:	
Inner-to-outer gear teeth clearance (backlash) (all models)	0.0 to 0.2 mm
Gear-to-housing clearance (endfloat):	
14 NV, 16 SV, C16 NZ and X 16 SZ	0.08 to 0.15 mm
C16 NZ2, 18 SV, C18 NZ, 20 NE, C20 NE and 20 SEH	0.03 to 0.10 mm
Oil pressure at idle (engine warm) (all models)	1.5 bar (21.8 lbf/in^2)

Torque wrench settings

	Nm	lbf ft

Note: *Use new bolts where asterisked (*). The torque settings stated for the cylinder head are only applicable to latest specification bolts, available from Vauxhall. Earlier type or alternative make, head bolts may require different torques. Consult your supplier.*

Air inlet pre-heat to exhaust manifold	8	6
Alternator and inlet manifold to brackets:		
1.4 and 1.6 litre, (except C16 NZ2)	20	15
C16 NZ2, 1.8 and 2.0 litre	18	13
Alternator to bracket (M8)	30	22
Alternator to bracket (M10)	40	30
Alternator to shackle	25	18
Big-end bearing cap: *		
1.4 and 1.6 litre, (except C16 NZ2)		
Stage 1	25	18
Stage 2	Angle tighten by 30º	

Torque wrench settings (continued)	Nm	lbf ft
Big-end bearing cap: *		
C16 NZ2, 1.8 and 2.0 litre:		
Stage 1	35	26
Stage 2	Angle tighten by 45º	
Stage 3	Angle tighten by 15º	
Camshaft housing cover to housing	8	6
Camshaft pulley to camshaft	45	33
Camshaft thrust plate	8	6
Coolant outlet to thermostat housing:		
C 16 NZ2, 1.8 and 2.0 litre	8	6
Coolant pump to cylinder block:		
1.4 and 1.6 litre, (except C 16 NZ2) (M6)	8	6
C16 NZ2, 1.8 and 2.0 litre (M8)	25	18
Crankshaft sensor wheel:		
C16 NZ2, 1.8 and 2.0 litre	13	10
Cylinder head to cylinder block: *		
1.4 and 1.6 litre, (except C16 NZ2):		
Stage 1	25	18
Stage 2	Angle tighten by 60º	
Stage 3	Angle tighten by 60º	
Stage 4	Angle tighten by 60º	
C16 NZ2, 1.8 and 2.0 litre:		
Stage 1	25	18
Stage 2	Angle tighten by 90º	
Stage 3	Angle tighten by 90º	
Stage 4	Angle tighten by 90º	
Drivebelt (ribbed) pulley/timing belt drive to crankshaft: *		
1.4 and 1.6 litre, (except C16 NZ2):		
Stage 1	55	41
Stage 2	Angle tighten by 45º	
Stage 3	Angle tighten by 15º	
Drivebelt pulley to timing belt drive	20	15
Drivebelt (ribbed) tensioner to cylinder block	20	15
Drivebelt (ribbed) tensioner to support:		
1.4 and 1.6 litre, (except C16 NZ2)	20	15
C16 NZ2, 1.8 and 2.0 litre	18	13
Engine bracket to cylinder block	60	44
Engine bracket to transmission	60	44
Engine mounting bracket to engine bracket	60	44
Engine mounting to engine mounting bracket	65	48
Engine mounting to front axle housing	40	30
Engine mounting to power steering pump support	60	44
Engine mounting to side member	65	48
Exhaust manifold to cylinder head	22	16
Exhaust pipe to manifold	25	18
Flexplate to crankshaft	60	44
Flywheel to crankshaft: *		
1.4 and 1.6 litre, (except C16 NZ2):		
Stage 1	35	26
Stage 2	Angle tighten by 30º	
Stage 3	Angle tighten by 15º	
C16 NZ2, 1.8 and 2.0 litre:		
Stage 1	65	48
Stage 2	Angle tighten by 30º	
Stage 3	Angle tighten by 15º	
Front timing belt cover to rear cover	4	3
Fuel pump to camshaft housing	18	13
Guide sleeve, release bearing to transmission	22	16
Heat shield sleeves to cylinder head	30	22
Inlet manifold to cylinder head	22	16
Knock sensor to cylinder block (X16 SZ)	13	10
Main bearing cap: *		
Stage 1	50	37
Stage 2	Angle tighten by 45º	
Stage 3	Angle tighten by 15º	
Oil filter to oil pump/cylinder block	6	4

Oil pick-up pipe bracket to cylinder block	6	4
Oil pick-up pipe to oil pump	8	6
Oil pipes to radiator	22	16
Oil pressure switch to oil pump:		
1.4 and 1.6 litre, (except C16 NZ2)	30	22
C16 NZ2, 1.8 and 2.0 litre	40	30
Oil pressure relief valve to oil pump	30	22
Oil pump cover to oil pump	6	4
Oil pump to cylinder block	6	4
Oxygen sensor to exhaust manifold	30	22
Power steering pump bracket to support:		
C16 NZ2, 1.8 and 2.0 litre	18	13
Power steering pump to support	25	18
Right engine mounting to subframe	65	48
Shackle to alternator	25	18
Spark plugs	25	18
Starter to cylinder block (M10)	45	33
Starter to cylinder block (M12)	60	44
Sump:		
1.4 and 1.6 litre, (except C16 NZ2)	8	6
C16 NZ2, 1.8 and 2.0 litre	15	11
Sump drain plug	55	41
Support to cylinder block	35	26
Temperature sender to cylinder head	20	15
Thermostat housing:		
1.4 and 1.6 litre, (except C16 NZ2)	10	7
C16 NZ2, 1.8 and 2.0 litre	15	11
Timing belt tensioner to oil pump:		
1.4 and 1.6 litre, (except C16 NZ2)	55	41
Timing belt cover to oil pump/camshaft housing:		
1.4 and 1.6 litre, (except C16 NZ2)	12	9
C16 NZ2, 1.8 and 2.0 litre	6	4
Timing belt drive gear to crankshaft:		
C16 NZ2, 1.8 and 2.0 litre:		
Stage 1	130	96
Stage 2	Angle tighten by between 40º to 50º	
Transmission to engine (M10)	45	33
Transmission to engine (M12)	60	44

1 General description

General

The engine is of four-cylinder, in-line single or double overhead camshaft type (depending on model), mounted transversely at the front of the vehicle.

The crankshaft runs in five shell-type bearings, and the centre bearing incorporates a thrust bearing shell to control crankshaft endfloat.

The connecting rods are attached to the crankshaft by horizontally split shell-type big-end bearings. On single overhead camshaft (SOHC) models, the pistons are attached to the connecting rods by gudgeon pins, which are an interference fit in the connecting rod small-end bore. The aluminium alloy pistons are fitted with three piston rings: two compression rings and an oil control ring.

The camshaft on SOHC engines is driven from the crankshaft by a toothed composite rubber belt. Each cylinder has two valves (one inlet and one exhaust), operated through rocker arms that are supported at their pivot ends by hydraulic self-adjusting valve lifters (tappets).

The inlet and exhaust valves are each closed by a single valve spring, and operate in guides pressed into the cylinder head.

A gear-type oil pump is located in a housing attached to the front of the cylinder block, and is driven directly from the crankshaft. A full-flow type oil filter is fitted.

The distributor is driven directly from the end of the camshaft. On carburettor models, the mechanical fuel pump is operated from the front end of the camshaft. The coolant pump is located at the front of the cylinder block, and is driven by the timing belt.

Chapter 2A describes the SOHC engine repair procedures. Many repairs and specifications to the DOHC engine are similar to the 2.0 litre SOHC. However where they differ, details can be found in Chapter 2B.

Engine identification codes - general

Before ordering spare parts, or carrying out any repair or overhaul operations on the engine, it is essential to identify the exact engine type being worked on. Later engines, although outwardly similar in appearance, often have significant differences in repair procedures, even though they may be of the same displacement and model year.

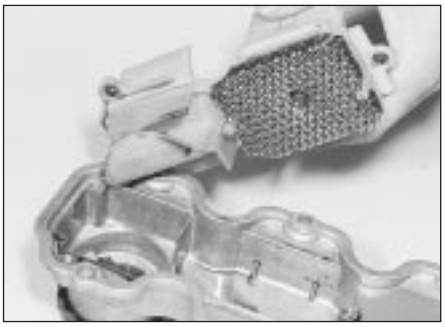
The following sub-Sections in this Chapter are mainly specific to engine type, as will be noted from the sub-Section headings. Check the engine identification code first, which is located on a horizontal surface on the exhaust manifold side of the cylinder block, at the distributor end. On later engines, the code is on the cylinder block-to-transmission flange, next to the engine oil dipstick.

2 Crankcase ventilation system - description and maintenance

Description

1 A crankcase ventilation system is fitted to all models, but the systems differ in detail depending on the model concerned.

2 Oil fumes and blow-by gases (combustion gases that have passed by the piston rings) are drawn from the crankcase into the area of



2.3 Crankcase ventilation filter removed from camshaft cover - 1.6 litre engine

the cylinder head above the camshaft(s) through a hose. From here the gases are drawn into the inlet manifold/throttle body (as applicable) and/or the air box on the carburettor (where applicable), where they are re-burnt with fresh air/fuel mixture, hence reducing harmful exhaust emissions.

Maintenance

3 Certain models have a mesh filter inside the camshaft cover, which should be cleaned in paraffin if clogging is evident **(see illustration)**.

4 On high mileage vehicles, particularly when regularly used for short journeys, a jelly-like deposit may be evident inside the crankcase ventilation system hoses. If excessive deposits are present, the relevant hose(s) should be removed and cleaned.

5 Periodically inspect the system hoses for security and damage, and renew as necessary. Note that damaged or loose hoses can cause various engine running problems that can be difficult to trace.

6 The crankcase breather/dipstick tube can be unbolted from the cylinder block after disconnecting the hose. Use a new gasket when refitting.

3 Compression test - description

Description

1 If engine performance is poor, or if misfiring occurs which cannot be attributed to the ignition or fuel system, a compression test can provide diagnostic clues. If the test is performed regularly, it can give warning of trouble on a high mileage engine before any other symptoms become apparent.

2 The engine must be at operating temperature, the battery must be fully charged, and the spark plugs must be removed. The help of an assistant will also be required.

3 Disable the ignition system by disconnecting the coil LT ("+15") wire. Fit the compression tester to No 1 cylinder spark plug hole.

4 Have the assistant hold the throttle wide open and crank the engine on the starter. Record the highest reading obtained on the compression tester.

5 Repeat the test on the remaining cylinders, recording the pressure developed in each.

6 The difference in pressure between any two cylinders should be no more than 1.0 bar (14.5 lbf/in2). If the pressure in any cylinder is low, pour a teaspoonful of clean engine oil into the spark plug hole, and repeat the test.

7 If the addition of oil temporarily improves the compression pressure, this indicates that cylinder bore or piston ring wear was responsible for the pressure loss. No improvement suggests that leaking or burnt valves, or a blown head gasket may be to blame.

8 A low reading from two adjacent cylinders is almost certainly due to the head gasket leaking between them.

9 On completion of the test, refit the spark plugs and reconnect the coil LT wire.

4 Major operations possible with the engine in the vehicle

1 The following operations may be carried out without removing the engine from the vehicle:

a) Removal and refitting of oil pressure relief valve (see Section 30)
b) Removal and refitting of timing belt and sprockets
c) Removal and refitting of camshaft housing (SOHC engines)
d) Removal and refitting of camshaft(s)
e) Removal and refitting of cylinder head
f) Removal and refitting of sump
g) Removal and refitting of oil pump
h) Removal and refitting of piston/connecting rod assemblies
i) Removal and refitting of flywheel
j) Renewal of crankshaft front oil seal
k) Removal and refitting of engine/transmission mountings

Note: *It is possible to renew the crankshaft rear oil seal with the engine in the vehicle, but this requires the use of special tools, and is a difficult operation, due to the lack of working space. For this reason, this operation is described with the engine removed from the vehicle.*

5 Major operations requiring engine removal

The engine must be removed from the vehicle to carry out the following operations:

a) Renewal of the crankshaft main bearings
b) Removal and refitting of the crankshaft
c) Renewal of crankshaft rear oil seal

6 Method of engine removal

The engine may be removed either on its own, or together with the transmission. Unless work is also necessary on the transmission, it is recommended that the engine is removed on its own. In either case, the engine or engine/transmission assembly must be lifted out through the top of the engine compartment, using a hoist and lifting tackle.

7 Engine - removal and refitting, (leaving transmission in car)

Note: *A hoist and lifting tackle will be required for this operation. If the torque converter is removed (even partially) from the transmission, a considerable amount of the fluid inside it will leak out. To prevent this, when prising the engine from the transmission and removing it, be careful to keep the torque converter pressed firmly into the transmission. If the transmission is to be removed for some time, retain the torque converter by bolting a strip of metal across the bellhousing mating surface.*

Removal

1 Disconnect the battery negative lead.

2 Remove the bonnet (Chapter 11).

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

4 Drain the cooling system, remove the radiator and transmission fluid cooler hoses (automatic models), as described in Chapter 3.

5 Drain the engine oil as described in Chapter 1, remove the oil filter and discard, safely.

6 Remove the air cleaner (or air cleaner cover), the air cleaner trunking, and the air box from the carburettor or throttle body (as applicable), referring to Chapter 4A or 4B, if necessary. On carburettor models, disconnect the hot air hose from the exhaust manifold hot air shroud and the air cleaner, and remove the hose. On automatic models, disconnect additional wiring, hoses, etc., from the carburettor, as described in Chapter 4A.

7 Remove the alternator, as described in Chapter 5.

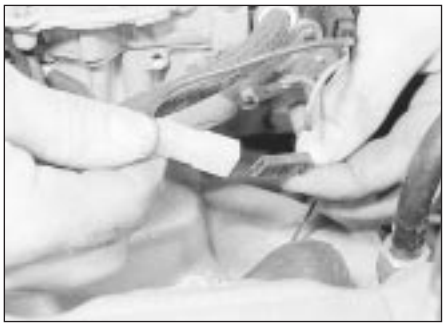
8 On models with power steering, remove the hydraulic pump, as described in Chapter 10.

9 Disconnect the brake servo vacuum hose from the inlet manifold.

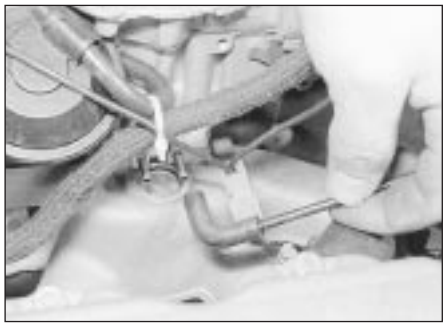
10 Disconnect the throttle cable from the throttle lever and the bracket on the carburettor or inlet manifold, as applicable.

11 On carburettor models, disconnect the coolant hoses from the automatic choke housing, and disconnect the wiring from the automatic choke heater and the choke pull-down solenoid **(see illustrations)**. Also disconnect the air box vacuum pipe from the carburettor.

7.11A Disconnect the coolant hoses from the automatic choke housing . . .



7.11B . . .and disconnect the choke heater/pull-down solenoid wiring plug - 1.6 litre model

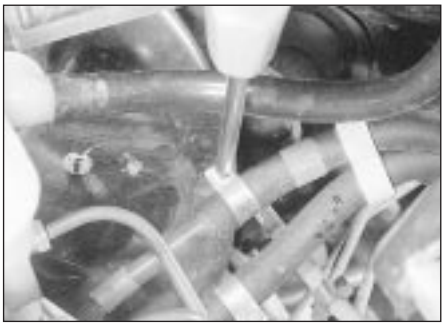


7.12 Disconnect the pressure sensor vacuum pipe from the carburettor - 1.6 litre model

12 Disconnect the pressure sensor vacuum pipe from the carburettor **(see illustration)**.
13 Remove the coolant hose(s) from the inlet manifold and/or throttle body, as applicable.
14 Disconnect the fuel hoses from the fuel pump and vapour separator on carburettor models or from the fuel pipes at the right-hand side of the engine compartment on other models. Be prepared for fuel spillage, and take adequate fire precautions. Plug the open ends of the pipes and hoses, to prevent dirt ingress and further fuel leakage **(see illustrations)**.
15 Disconnect all relevant wiring connections and plugs, and remove the fuel injection wiring harness. Pull up on the wiring harness housing, and compress the wiring plug retaining clips to release the harness housing from the fuel injectors **(see illustration)**.

7.14A Disconnecting a fuel hose from the fuel pump - 1.6 litre model

16 Disconnect the heater coolant hoses from the coolant gallery at the rear of the cylinder block.
17 Disconnect the wiring from the following components (where applicable):
a) Starter motor
b) Distributor (note HT lead positions)
c) Oil pressure switch
d) Oil temperature switch
e) TDC sensor
f) Oil level sensor
g) Knock sensor
h) Coolant temperature sensor
i) Temperature gauge sender
18 Make a final check to ensure that all relevant hoses, pipes and wires have been disconnected, and that they are positioned clear of the engine.
19 Remove the front section of the exhaust system, as described in Chapter 4C.
20 Unbolt and remove the bellhousing cover plate **(see illustration)**.
21 Remove the clutch (if applicable), as described in Chapter 6. On automatic models, use chalk or a felt-tip pen to mark the relationship of the torque converter to the flexplate before unbolting the torque converter. Refer to note at the beginning of this Section and to Chapter 7B for further information.
22 Remove the crankshaft pulley. Some pulleys are secured by four bolts, which must be unscrewed using an Allen key or hexagon bit. Unscrew each of the three bolts in turn and remove them. On other engines, the pulley is secured by a single bolt, which also secures the crankshaft sprocket. On manual transmission models, if the engine is in the vehicle, the crankshaft can be prevented from turning by having an assistant engage first gear and depress the brake pedal. Alternatively, the flywheel (or flexplate, on automatics), ring gear teeth can be jammed, through the bellhousing cover aperture using a large screwdriver, or similar tool. Access to the crankshaft pulley is most easily obtained through the right-hand wheel arch, after removing the roadwheel.
23 Attach a hoist and lifting gear to the engine lifting brackets on the cylinder head, and support the weight of the engine.
24 Unscrew and remove two of the three upper engine-to-transmission bolts, accessible from the engine compartment, leaving one fastened for safety.
25 Unbolt the right-hand engine mounting from the body and from the cylinder block, and withdraw the mounting bracket.
26 Unscrew and remove the four lower engine-to-transmission bolts.
27 Support the transmission using a trolley jack and interposed block of wood. Remove the last upper transmission bolt.
28 Manipulate the engine as necessary to separate it from the transmission. Note that the transmission locates on dowels in the cylinder block.
29 Carefully raise the hoist, and lift the engine from the vehicle, taking care not to damage any of the surrounding components in the engine compartment.



7.14B Fuel hose-to-pipe connections at right-hand side of engine compartment - 2.0 litre SOHC model

7.15 Removing the fuel injection wiring harness - 2.0 litre SOHC model

7.20 Removing the transmission bellhousing cover plate

30 With the engine removed, the transmission can be supported by placing a length of wood between the bellhousing and the front suspension subframe. Once the wooden support is in place, remove the trolley jack from under the transmission.

Refitting

Note: *New left and right-hand engine/transmission mounting-to-body bolts must be used on refitting.*

31 Use an M10 x 1.25 bottoming tap to clean the threads in the torque converters threaded bosses and ensure that new bolts are available for reassembly, where applicable.

> **HAYNES HiNT** ***If a tap is not available, cut two slots into the threads of one of the old flywheel bolts and use the bolt to remove the locking compound from the threads.***

32 Support the transmission with a trolley jack and remove the length of wood from between the bellhousing and the subframe.

33 Support the engine with the hoist and lifting tackle, and gently lower it into position in the engine compartment.

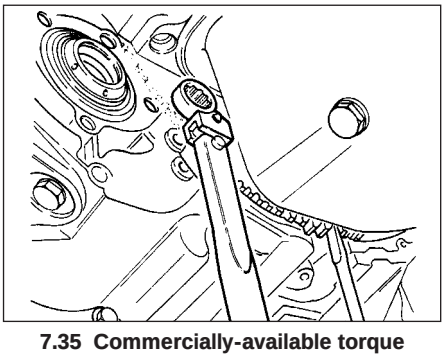
34 Mate the engine and transmission together, ensuring that the transmission locates on the dowels in the cylinder block, then refit the three upper engine-to-transmission bolts.

35 Tighten all nuts and bolts to their specified torque wrench settings. When tightening the torque converter-to-flexplate bolts to their specified torque wrench settings, a commercially available adapter will be required **(see illustration).**

36 If the clutch is still bolted to the flywheel, 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.

37 Refit the four lower engine-to-transmission bolts, but again do not fully tighten them at this stage.

38 Fit the right-hand engine mounting bracket to the cylinder block, and tighten the securing bolts to the specified torque.



7.35 Commercially-available torque wrench adapter being used to tighten torque converter bolts

39 Manipulate the engine and transmission as necessary to enable the right-hand engine mounting-to-body bolts to be fitted, then fit new bolts and tighten them to the specified torque.

40 Tighten all the engine-to-transmission bolts to the specified torque, then disconnect the lifting tackle and hoist from the engine, and remove the trolley jack from beneath the transmission.

41 Refit the transmission bellhousing cover plate.

42 Refit the clutch, as described in Chapter 6.

43 Refit the front section of the exhaust system, as described in Chapter 4C.

44 Refit the crankshaft pulley using a reversal of the removal procedure described earlier in paragraph 22, and tighten the securing bolt(s) to the specified torque.

45 Lower the vehicle to the ground.

46 Refit all relevant wires, pipes and hoses, etc., using a reversal of the removal procedure described earlier.

47 Where applicable, refit the power steering pump, tension the pump drivebelt, and bleed the hydraulic fluid circuit, as described in Chapter 10.

48 Refit the alternator and tension the drivebelt, as described in Chapter 5.

49 Refit the air cleaner components, referring to Chapter 4A or 4B, if necessary. On carburettor models reconnect the hot air hose to the exhaust manifold hot air shroud.

50 Fit a new oil filter (if not already replaced), and fill the engine with oil, as described in Chapter 1.

51 Refit the radiator and refill the cooling system, as described in Chapter 3.

52 Refit the bonnet as described in Chapter 11.

53 Reconnect the battery negative lead.

54 Refer to Section 37

8 Engine and transmission - removal, separation, reconnection and refitting

Note: *A hoist and lifting tackle will be required for this operation*

Removal

1 Proceed as described in Section 7, paragraphs 1 to 18 inclusive.

2 Working in the engine compartment, remove the gear selector linkage, as described in Chapters 7A and 7B, as appropriate.

3 On manual transmission models, remove the retaining clip, then slide the clutch cable from the release lever, pushing the release lever back towards the bulkhead if necessary to allow the cable to be disconnected. On automatic models disconnect the selector cable from the actuating lever, then either unbolt the cable bracket or release the cable from the bracket. In either case, pull the cable support from the bracket on the transmission casing, then move the cable and secure to one side out of the way, taking note of its routing.

4 Disconnect the wiring from the reversing lamp switch, which is located at the front of the manual transmission casing, above the left-hand mounting bracket. On automatic models, disconnect the transmission wiring by unplugging the five connector plugs from the various switches, solenoids and sensors. Release also the wiring from any clips or ties securing to the vehicle.

5 Where applicable, withdraw the automatic transmission breather hose from under the battery bracket. Disconnect the oxygen sensor wiring if fitted.

6 Unscrew the securing sleeve, and disconnect the speedometer cable from the transmission.

7 Unscrew the retaining nut, and disconnect the earth strap from the transmission endplate.

8 Make a final check to ensure that all relevant hoses, pipes, wires etc. have been disconnected, and that they are positioned clear of the engine and transmission.

9 Proceed as described in Section 7, paragraphs 19 and 22.

10 Disconnect the inboard ends of the driveshafts from the differential, referring to the relevant paragraphs of Chapter 8. Be prepared for oil spillage as the driveshafts are withdrawn, and plug the apertures in the differential, to prevent further loss of oil and dirt ingress. Support the driveshafts by suspending them with wire or string - do not allow them to hang down under their own weight.

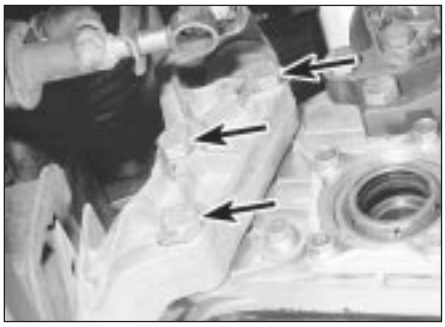
11 Attach a hoist and lifting gear to the engine lifting brackets on the cylinder head, and support the weight of the engine.

12 Remove the left-hand transmission mounting completely by unscrewing the two bolts securing the rubber mounting to the vehicle, body, and the three bolts securing the mounting bracket to the transmission **(see illustration)**.

13 Unbolt the right-hand engine mounting from the body and from the cylinder block, and withdraw the mounting bracket.

8.12 Left-hand transmission mounting viewed from underside of vehicle

8.14A Rear engine/transmission mounting-to-front subframe nuts



8.14B Rear engine/transmission mounting-to-transmission bolts (arrowed)

14 Working under the vehicle, unscrew and remove the two nuts securing the engine/transmission rear mounting to the front subframe, and the three bolts securing the mounting bracket to the transmission, then withdraw the mounting bracket **(see illustrations)**.

15 Carefully swing the engine/transmission assembly across the engine compartment as necessary, to allow the assembly to be lifted vertically from the vehicle by raising the hoist. Take care not to damage any of the surrounding components in the engine compartment.

Separation

16 With the engine/transmission assembly removed, support the assembly on blocks of wood positioned on a workbench, or failing that, on a clean area of the workshop floor.

17 Clean away any external dirt using paraffin or a water-soluble solvent and a stiff brush.

18 Unbolt and remove the transmission bellhousing cover plate.

19 Ensure that both engine and transmission are adequately supported, then unscrew and remove the engine-to-transmission bolts.

20 Carefully withdraw the transmission from the engine, ensuring that the weight of the transmission is not allowed to hang on the input shaft while it is engaged with the clutch friction disc. Note that the transmission locates on dowels positioned in the cylinder block.

21 On automatic models unbolt the transmission bellhousing cover plate (three bolts), then use chalk or a felt-tip pen to mark the relationship of the torque converter to the flexplate before unbolting the torque converter. **Note:** *If the torque converter is removed (even partially) from the transmission, a considerable amount of the fluid inside it will leak out. To prevent this, when prising the transmission off its locating dowels and removing it, be careful to keep the torque converter pressed firmly into the transmission. If the transmission is to be removed for some time, retain the torque converter by bolting a strip of metal across the bellhousing mating surface.* Applying a spanner to the crankshaft pulley/sprocket bolt, rotate the crankshaft until the first bolt appears, then use a screwdriver or similar to jam the flexplate ring gear teeth to prevent it from rotating as the bolt is unscrewed. Unscrew each of the three bolts in turn and remove them.

Reconnection

22 Before beginning the refitting operations, check that the two original bolts that secured the left-hand transmission rubber mounting to the vehicle body rotate freely in their threaded bores in the body. If necessary, re-cut the threaded bores using an M10 x 1.25 mm tap.

> **HAYNES HiNT** ***If a tap is not available, cut two slots into the threads of one of the old flywheel bolts and use the bolt to remove the locking compound from the threads.***

23 Where applicable, if the clutch assembly has been removed from the flywheel, it will prove easier to refit after the transmission has been refitted.

24 On automatics, if any fluid was spilled from the torque converter, be careful to refill it as much as possible. Wipe clean the converter's spigot to prevent damage to the transmission's input shaft oil seal as the converter is installed, and ensure that the converter engages correctly on the fluid pump shaft.

25 If the transmission has been renewed, be careful to flush clean the radiator fluid cooler passages. Vauxhall recommend the use of low-pressure compressed air, but this will require great care to avoid deforming the radiator.

26 Be very careful to ensure that all components are scrupulously clean, to avoid the risk of dirt getting into the system.

27 Use an M10 x 1.25 bottoming tap to clean the threads in the torque converters threaded bosses and ensure that new bolts are available for reassembly, where applicable.

28 Tighten all nuts and bolts to their specified torque wrench settings.

29 Refer also to Section 7, paragraphs 35 and 36.

30 Carefully offer the transmission to the engine until the bellhousing is located on the dowels in the cylinder block, then refit the engine-to-transmission bolts, and tighten them to the specified torque.

31 Refit the transmission bellhousing cover plate.

Refitting

32 Working under the vehicle, refit the rear engine/transmission mounting to the transmission, using new locking plates under the bolt heads, and tighten the bolts to the specified torque.

33 Fit the two bolts securing the engine/transmission rear mounting to the front subframe, but do not fully tighten at this stage.

34 Fit the right-hand engine mounting bracket to the cylinder block, and tighten the securing bolts to the specified torque.

35 Fit new right-hand engine mounting-to-body bolts, but do not fully tighten them at this stage.

36 Fit the left-hand transmission mounting bracket to the transmission, and tighten the securing bolts to the specified torque.

37 Fit new left-hand transmission mounting-to-body bolts, and tighten them to the specified torque.

38 Tighten the right-hand engine mounting-to-body bolts and the engine/transmission rear mounting-to-front subframe bolts to their specified torques, then remove the lifting tackle and hoist from the engine.

39 Where applicable, the clutch can now be fitted, and the transmission input shaft can be pressed into engagement with the splined hub of the clutch friction disc, (see Chapter 5).

40 Reconnect the inboard ends of the driveshafts to the differential, with reference to the relevant paragraphs of Chapter 8, and using new snap rings.

41 Refit the front section of the exhaust system, as described in Chapter 4C.

42 Refit the crankshaft pulley, using a reversal of the removal procedure described in Section 7, paragraph 22, and tighten the securing bolt(s) to the specified torque.

43 On automatic models, connect the wires to the various switches, solenoids and sensors. Replace the transmission breather hose and oxygen sensor (if fitted).

44 Reconnect the transmission earth strap, and tighten the securing nut.

45 Lower the vehicle to the ground.

46 Reconnect the speedometer cable to the transmission, and tighten the securing sleeve.

47 Reconnect the reversing lamp wiring.

48 On manual transmission models, refit the clutch cable to the bracket on the transmission casing, then reconnect the cable to the release lever, and adjust the cable as described in Chapter 6. Ensure that the cable is routed as noted during removal.

49 Refit the gear selector linkage, as described in Chapter 7A, if applicable.

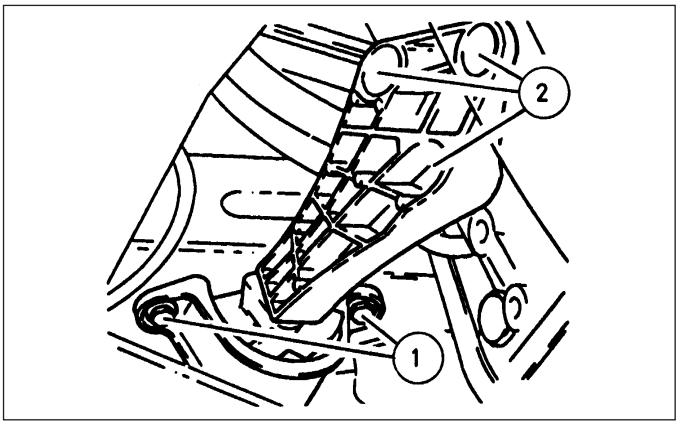
50 Proceed as described in Section 7, paragraphs 41 to 52 inclusive.

51 Top-up the transmission oil level, as described in Chapters 7A and 7B.

52 Adjust the selector cable on completion, and refill the transmission with fluid (see above).

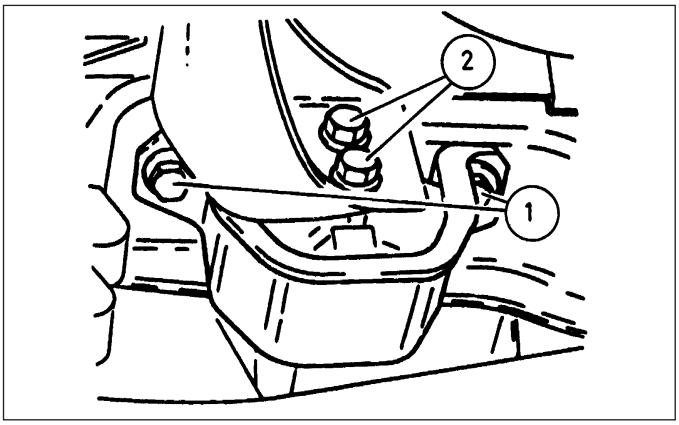
53 Reconnect the battery negative lead.

54 Refer to Section 37



9.4 Right-hand engine mounting

1 Mounting block-to-body bolts
2 Mounting bracket-to-cylinder block bolts



9.12 Left-hand engine/transmission mounting

1 Mounting block-to-body bolts
2 Mounting block-to-mounting bracket bolts

9 Engine and transmission mountings - renewal

Note: *New left and right-hand engine/transmission mounting-to-body bolts must be used on refitting*

1 The engine/transmission assembly is suspended in the engine compartment on three mountings, two of which are attached to the transmission, and one to the engine.

Right-hand mounting

2 If not already done, apply the handbrake, then raise the front of the vehicle, and support securely on axle stands (see "*Jacking and Vehicle Support*")..

3 Attach lifting tackle and a hoist to the engine lifting brackets on the cylinder head, and support the weight of the engine.

4 Working under the vehicle, unbolt the engine mounting bracket from the cylinder block, and unbolt the mounting block from the body, then withdraw the bracket/mounting assembly **(see illustration)**.

5 Unbolt the mounting block from the bracket.

6 Fit the new mounting block to the bracket, and tighten the securing bolts to the specified torque.

7 Refit the mounting bracket to the cylinder block, and tighten the securing bolts to the specified torque.

8 Fit new mounting block-to-body bolts, and tighten them to the specified torque.

9 Disconnect the lifting tackle and hoist from the engine.

10 Lower the vehicle to the ground.

Left-hand mounting

11 Proceed as described in paragraphs 2 and 3.

12 Working under the vehicle, unbolt the mounting block from the mounting bracket and the body **(see illustration)**.

13 Before fitting the new mounting block, check that the original engine bolts which secured the mounting block to the body rotate freely in their threaded bores in the body. If necessary, re-cut the threaded bores using an M10 x 1.25 mm tap.

> **HAYNES HiNT** ***If a tap is not available, cut two slots into the threads of one of the old flywheel bolts and use the bolt to remove the locking compound from the threads.***

14 Fit the new mounting block to the bracket, and tighten the securing bolts to the specified torque.

15 Fit new mounting block-to-body bolts, and tighten them to the specified torque.

16 Proceed as described in paragraphs 9 and 10.

Rear mounting

17 Proceed as described in paragraphs 2 and 3.

18 Working under the vehicle, unbolt the mounting block from the front subframe and the mounting bracket.

19 Fit the new mounting block to the subframe and mounting bracket, and tighten the securing bolts to the specified torque.

20 Proceed as described in paragraphs 9 and 10.

10 Engine dismantling and reassembly - general

General

1 Ideally, the engine should be mounted on a dismantling stand, but if this is not available, stand the engine on a strong bench, at a comfortable working height. Failing this, the engine will have to be stripped down on the floor.

2 Cleanliness is most important, and if the engine is dirty, it should be cleaned with paraffin in an upright position.

3 Avoid working with the engine directly on a concrete floor, as grit presents a real source of trouble.

4 If the engine oil appears extremely dirty or contaminated, avoid inverting the engine until the sump has been removed. This will prevent any contaminated "sludge" from entering the oilways.

5 As parts are removed, clean them in a paraffin bath. Do not immerse parts with internal oilways in paraffin, as it is difficult to remove, usually requiring a high pressure hose. Clean oilways with nylon pipe cleaners.

6 It is advisable to have containers available to hold small items, to prevent loss and confusion when refitting.

7 Always obtain complete sets of gaskets when the engine is being dismantled. Keep the old gaskets as they can be used as patterns to make replacements should new gaskets not be available.

8 Where possible, refit nuts, bolts and washers to their locations after removal of the relevant components, as this helps protect the threads, and will also prove helpful during reassembly.

9 Retain unserviceable components, to compare them with the new components supplied.

10 Many of the engine components are secured using socket-headed "Torx" or "Allen" bolts, and tools will be required to remove and refit such bolts.

11 Read through each relevant Section of this Chapter carefully *before beginning work,* to ensure that any special tools that may be required are available. Many components (gaskets, oil seals, and certain bolts) must be renewed on reassembly; where applicable, obtain the required new components before starting work.

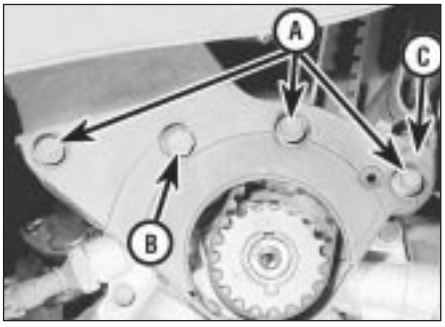
12 Before beginning a complete strip of the engine, the following ancillary components can be removed once the engine has been removed from the vehicle:

a) Inlet and exhaust manifolds (where applicable)
b) Starter motor
c) Rear coolant gallery and hoses
d) Oil pressure switch
e) Oil temperature switch (where applicable)
f) Oil level sensor (where applicable)
g) Knock sensor (where applicable)
h) TDC sensor (where applicable)
i) Distributor components
j) Fuel pump (where applicable)
k) Thermostat/housing (N 16 NZ2, 1.8 and 2.0 litre models)
l) Power steering pump and mounting bracket (where applicable)
m) Alternator mounting bracket
n) Engine lifting brackets
o) Dipstick/crankcase breather tube
p) Inlet manifold mounting bracket (where applicable)

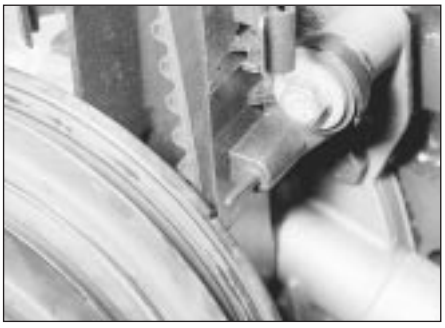
13 To ensure maximum life, with minimum trouble, from a rebuilt engine, not only must everything be correctly assembled, but it must also be spotlessly clean. All oilways and coolant passages must be clear, and all washers must be fitted in their original positions. Oil all bearings and other moving surfaces thoroughly with clean engine oil during assembly.

14 Before assembly begins, renew any bolts or studs with damaged threads.

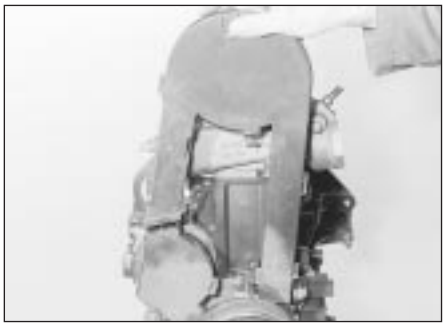
15 Obtain a torque wrench, an angle-torque gauge, sockets and bits, an oil can, clean lint-free rag, and a set of engine gaskets and oil seals, together with a new oil filter.



11.5C Timing belt lower (small) outer cover screws (A), tensioner screw (B), ignition timing fixed reference mark (C)



11.7B . . .and notch in crankshaft pulley aligned with pointer on rear timing belt cover - 2.0 litre engine



11.5A Remove the main outer timing belt cover . . .

16 If they have been removed, new cylinder head bolts, flywheel bolts, big-end bearing cap bolts and main bearing cap bolts will also be required.

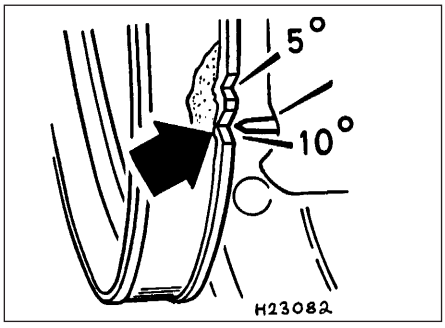
17 On completion of reassembly, refit the applicable ancillary components listed in paragraph 12.

18 Follow procedure shown in Section 37.

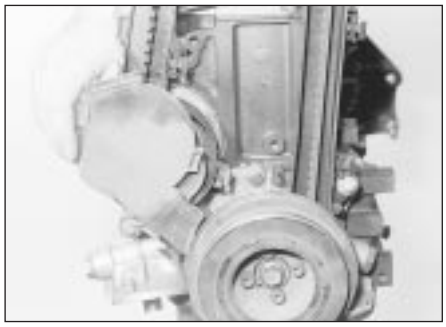
11 Timing belt and sprockets (without automatic tensioner) - removal, refitting and adjustment

Note: *A two-legged puller may be required to remove the crankshaft sprocket on N 16 NZ2, 1.8 and 2.0 litre models. Some of the later 1.4 and 1.6 litre engines, identifiable by the squared-off top surfaces of the timing belt covers, are fitted with spring-loaded auto-matic timing belt tensioners to ensure correct belt tensioning on assembly.*

11.7A Camshaft sprocket TDC mark aligned with notch in rear timing belt cover . . .



11.7C Crankshaft pulley 10° BTDC notch aligned with pointer on rear timing belt cover - 1.4 litre engine



11.5B . . .and the smaller cover from the coolant pump - 2.0 litre engine

Removal

1 Disconnect the battery negative lead.

2 On models with power steering, remove the pump drivebelt, see Chapters 1 and 10.

3 Remove the alternator drivebelt, as described in Chapter 5.

4 On C 16 NZ2, 1.8 and 2.0 litre models, disconnect the wiring from the temperature gauge sender.

5 Release the securing clips (or hexagon-headed screws, if fitted), and remove the main outer timing belt cover, then unclip the smaller outer timing belt cover from the coolant pump. Where applicable, three screws retain the lower (small) outer cover to the rear cover, the fourth secures the tensioner **(see illustrations)**.

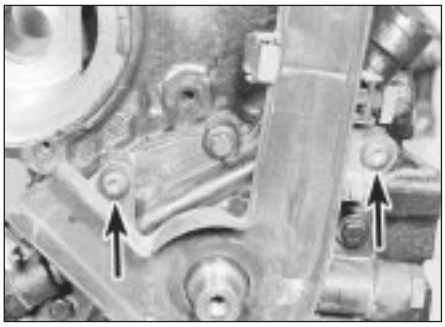
6 On 1.6 litre models with power steering, remove the power steering pump, as described in Chapter 10.

7 Turn the crankshaft using a socket or spanner on the crankshaft sprocket bolt, until the timing mark on the camshaft sprocket is aligned with the notch in the rear timing belt cover, and the notch in the crankshaft pulley is aligned with the pointer on the rear timing belt cover **(see illustrations)**. Note that on 1.4 litre engine there are two notches in the crankshaft pulley, representing 5° and 10° BTDC, and the 10° BTDC notch should be aligned with the pointer **(see illustration)**.

8 Loosen the three coolant pump securing bolts **(see illustration)**, and turn the pump to relieve the tension in the timing belt, then slide the belt from the camshaft sprocket.

11.8 Loosening a coolant pump securing bolt - 2.0 litre engine

11.17A Loosening the main rear timing belt cover lower securing bolt - 2.0 litre engine



11.17B Main rear timing belt cover lower securing bolts (arrowed) - 1.6 SV engine

11.18 Unscrewing the coolant pump rear belt cover securing bolt - 2.0 litre engine

9 The crankshaft pulley must now be removed. On 1.4 and 1.6 litre engines (except C 16 NZ2), the pulley is secured by a single bolt, which also secures the crankshaft sprocket. On C 16 NZ2, 1.8 and 2.0 litre engines, the pulley is secured by four bolts, which must be unscrewed using an Allen key or hexagon bit. On manual transmission models, if the engine is in the vehicle, the crankshaft can be prevented from turning by having an assistant engage first gear and depress the brake pedal. Alternatively, the flywheel ring gear teeth can be jammed using a large screwdriver or similar tool.

10 With the crankshaft pulley removed, the timing belt can be withdrawn.

11 If desired, the sprockets and the rear timing belt cover can be removed as follows, otherwise go on to paragraph 23.

12 To remove the camshaft sprocket, first disconnect the breather hose(s) from the camshaft cover, then unscrew the securing bolts noting the locations of the HT lead brackets and any other wiring brackets, and remove the camshaft cover.

13 Recover the gasket. Prevent the camshaft from turning by holding it with a spanner on the flats provided between No's 3 and 4 camshaft lobes, and unscrew the camshaft sprocket bolt.

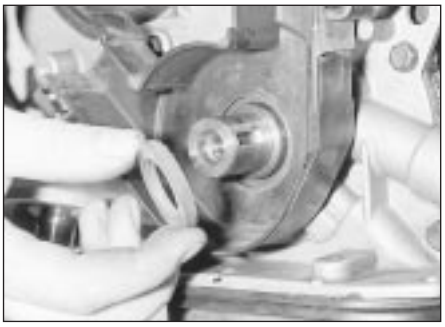
14 Withdraw the sprocket from the end of the camshaft.

15 To remove the crankshaft sprocket on 1.4 and 1.6 litre engines (except C 16 NZ2), if necessary, remove the lower securing bolts from the main rear timing belt cover and use two large screwdrivers behind the cover to lever off the sprocket. Remove the Woodruff key if it is loose.

16 To remove the crankshaft sprocket on C 16 NZ2, 1.8 and 2.0 litre engines, it will be necessary to prevent the crankshaft from turning, as described in paragraph 9. Take care when unscrewing the sprocket bolt, as it is very tight. If necessary, use a two-legged puller to remove the sprocket. Recover the Woodruff key and the thrustwasher from the end of the crankshaft.

17 To remove the main rear timing belt cover on C 16 NZ2, 1.8 and 2.0 litre models disconnect the TDC sensor wiring plug and unclip the wiring from the belt cover. Then unscrew the two upper securing bolts and the lower securing bolt(s) (one in the case of C 16 NZ2, 1.8 and 2.0 litre engines, two on other SOHC engines). Withdraw the cover, manipulating it from the smaller rear belt cover on the coolant pump **(see illustrations)**.

18 If desired, the smaller rear belt cover can be removed from the coolant pump, after unscrewing the securing bolt **(see illustration)**, by rotating it to disengage it from the retaining flange on the pump.



11.20A Refit the thrustwasher . . .

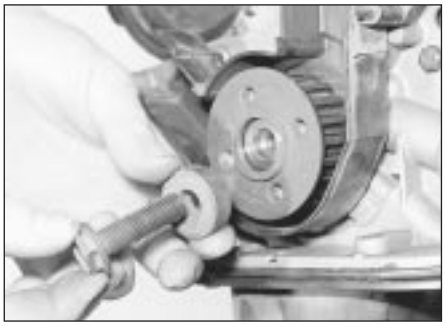
11.20B . . . the Woodruff key . . .

Refitting

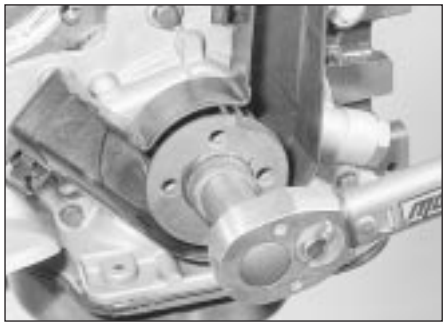
19 Refit the rear timing belt cover(s) using a reversal of the removal procedure, and ensuring that the main cover engages correctly with the smaller cover on the coolant pump.

20 On C 16 NZ2, 1.8 and 2.0 litre engines, refit the thrustwasher and the Woodruff key to the end of the crankshaft. Then refit the crankshaft sprocket, and tighten the securing bolt to the specified torque in the two stages given in the Specifications. Ensure that the washer is in place under the bolt head, and prevent the crankshaft from turning as during removal **(see illustrations)**.

11.20C . . .the crankshaft sprocket . . .



11.20D . . .and the washer and bolt



11.20E Tighten the bolt to the specified torque . . .

11.20F . . .then through the specified angle - 2.0 litre engine

11.21 Crankshaft sprocket fits with flange and pulley locating lug outermost - 1.6 litre engine

11.22A Refit the camshaft sprocket . . .

11.22B . . . and tighten the securing bolt to the specified torque - 2.0 litre engine

11.22C Fit the camshaft cover gasket . . .

11.22D . . . fit the cover and tighten the bolts. Note position of HT lead brackets

21 On 1.4 and 1.6 litre engines (except C 16 NZ2), refit the Woodruff key to the end of the crankshaft where applicable. Then refit the crankshaft sprocket with the flange and locating lug for the crankshaft pulley outermost **(see illustration)**.

22 Refit the camshaft sprocket, ensuring that the locating pin on the end of the camshaft engages with the hole in the sprocket, and tighten the securing bolt to the specified torque. Prevent the camshaft from turning as during removal. Check the condition of the camshaft cover gasket and renew if necessary, then refit the camshaft cover, ensuring that the HT lead brackets and any other wiring bracket are correctly located, and reconnect the breather hose(s) **(see illustrations)**.

23 Temporarily refit the crankshaft pulley and ensure that the crankshaft pulley and camshaft sprocket timing marks are still aligned as described in paragraph 7, then refit the timing belt around the sprockets **(see illustration)**, starting at the crankshaft sprocket.

24 Refit the crankshaft pulley, and tighten the securing bolt(s) to the specified torque **(see illustrations)**. If necessary, prevent the crankshaft from turning as during removal.

25 Adjust the timing belt tension, as described in Section 11.

26 On 1.6 litre models with power steering, refit the power steering pump, as described in Chapter 10.

27 Refit the outer timing belt covers, and on C 16 NZ2, 1.8 and 2.0 litre models, reconnect the temperature gauge sender wiring.

28 Refit the alternator drivebelt and adjust the drivebelt tension, as described in Chapter 5.

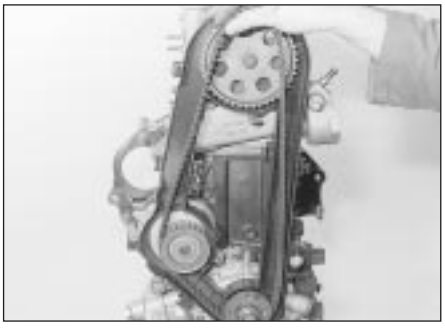
29 On C 16 NZ2, 1.8 and 2.0 litre models with power steering, refit the power steering pump drivebelt and adjust the drivebelt tension, as described in Chapters 1 and 10.

30 Reconnect the battery negative lead.

Adjustment

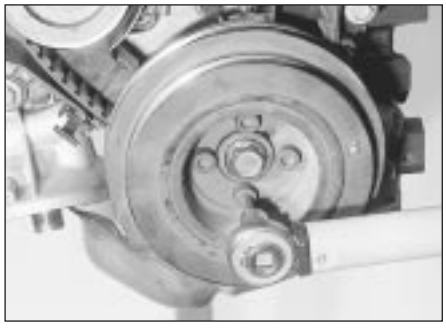
Note: *The manufacturers specify the use of a special gauge Vauxhall tool No KM-510-A for checking the timing belt tension. If access to a gauge cannot be obtained it is strongly recommended that the vehicle is taken to a Vauxhall dealer to have the belt tension checked at the earliest opportunity*

31 The tension of a used timing belt should be checked with the engine at normal operating temperature. The tension of a new timing belt should be checked with the engine cold.

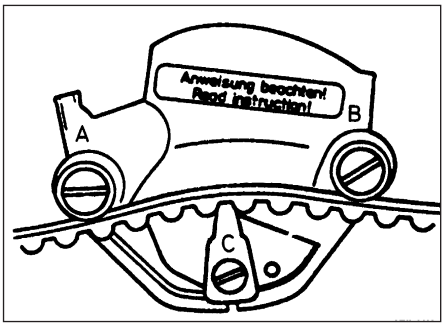


11.23 Refitting the timing belt - 2.0 litre engine

11.24A Refitting the crankshaft pulley - 1.6 litre engine

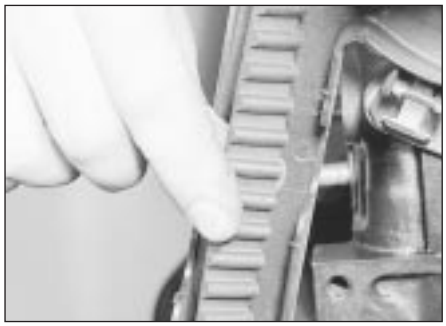


11.24B Tightening a crankshaft pulley securing bolt - 2.0 litre engine



11.34 Tension blade KM-510-A correctly positioned on timing belt. Belt must pass through points A, B and C - SOHC engines

11.35 Note the reading on the scale of the tension gauge - 1.6 litre engine



11.42 Checking timing belt tension by twisting belt through 90º between thumb and forefinger

32 Release the securing clips and remove the main outer timing belt cover, then unclip the smaller outer timing belt cover from the coolant pump.

33 Turn the crankshaft through at least quarter of a turn clockwise using a socket or spanner on the crankshaft sprocket bolt.

34 If the special gauge is available, place the locked gauge at the centre of the belt run between the coolant pump and the camshaft sprocket. The gauge should locate on the timing belt **(see illustration)**.

35 Slowly release the operating lever on the gauge, then lightly tap the gauge two or three times, and note the reading on the scale **(see illustration)**.

36 If the reading is not as specified, loosen the three coolant pump securing bolts, and rotate the pump in the required direction to achieve the desired reading on the gauge. Rotate the pump clockwise to increase the belt tension, or anti-clockwise to decrease the tension.

37 Lightly tighten the coolant pump securing bolts.

38 Remove the tensioning gauge, and turn the crankshaft through one full turn clockwise.

39 Re-check the belt tension as described in paragraphs 4 and 5.

40 If the tension is not as specified, repeat paragraphs 6 to 9 inclusive until the desired, consistent, reading is obtained.

41 On completion of adjustment, remove the checking gauge, tighten the coolant pump bolts to the specified torque, and refit the outer timing belt covers.

42 If the special checking gauge is not available, the timing belt tension can be checked approximately by twisting the belt between the thumb and forefinger, at the centre of the run between the coolant pump and the camshaft sprocket. It should just be possible to twist the belt through 90° using moderate pressure **(see illustration)**. If adjustment is necessary, continue as described previously in this Section, but have the belt tension checked by a Vauxhall dealer using the special gauge at the earliest opportunity. If in doubt, err on the tight side when adjusting the tension, as if the belt is too slack, it may jump on the sprockets, which could result in serious engine damage.

12 Timing belt and tensioner 1.4 and 1.6 models (not C16 NZ2) - removal, refitting and adjustment

Removal

1 Remove the timing belt outer covers as described in Section 11, paragraphs 1 to 5.

2 To lock the tensioner in its slackest position for removal and refitting, move the tensioner indicator arm clockwise until the holes align in the baseplate and the arm. Then insert a close-fitting pin, such as a drift, to retain them **(see illustration)**. The tensioner can then be unbolted, or the belt can be removed.

3 Check that the tensioner roller rotates smoothly and easily, with no noises or signs of free play, roughness or notchy movement. Check also that there is no sign of physical wear or damage. If the tensioner is faulty in any way, or if there is any reason to doubt the continued efficiency of its spring, the complete assembly must be renewed.

Refitting

4 On refitting, ensure that the tensioner baseplate lug engages with the hole in the oil pump housing, then tighten the tensioner bolt securely and remove the locking pin; the tensioner should be quite free to move.

5 Set the belt tension as described below.

Adjustment

6 Whenever the timing belt is disturbed, whether during belt renewal or any other engine overhaul work, its tension must be set on assembly - note that this procedure must **only** be carried out on a **cold** engine.

7 It is assumed that the belt has been removed and refitted, i.e. that the crankshaft pulley and timing belt outer covers are removed, that the tensioner is unlocked (see above) and that No 1 cylinder is in its firing position (just before TDC on the compression stroke). Temporarily refit the crankshaft pulley bolt and remove the spark plugs so that the crankshaft can be rotated easily.

8 Note also that turning the coolant pump with the precision required is a great deal easier if a special spanner (Kent-Moore Part No KM-421-A) is used. Alternatives are available from manufacturers such as Sykes-Pickavant (Part No 031300) **(see illustration)**.

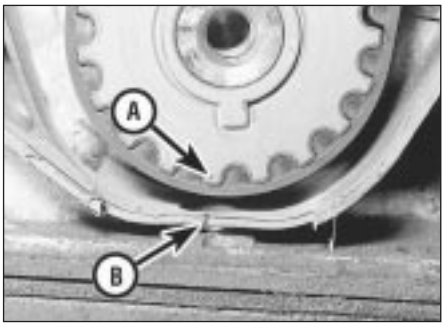
9 With the belt refitted and correctly routed (see Section 11), ensure that the punch mark on the crankshaft sprocket and the stamped line on the camshaft sprocket are aligned with their respective timing belt rear cover notches **(see illustrations)**.

10 Tighten the belt by slackening its three securing bolts, and turning the coolant pump clockwise until the holes align in the tensioner indicator arm and baseplate (the tensioner indicator arm will then have moved fully clockwise to its stop). Lightly tighten the pump securing bolts, just sufficiently to prevent the pump from moving.

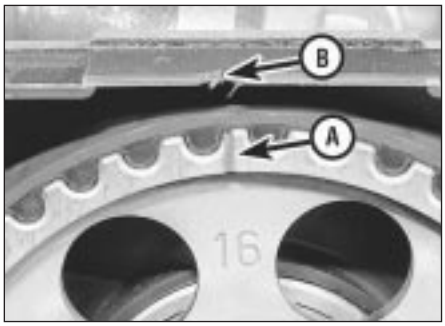
11 Using a spanner applied to the crankshaft pulley bolt, turn the crankshaft smoothly

12.2 Using a close-fitting drift to lock the tensioner. Note baseplate lug engaged in oil pump housing (arrowed)

12.8 Using a special spanner to adjust the timing belt by moving the coolant pump



12.9A Align punch mark (A) on crankshaft sprocket with timing belt rear cover notch (B) . . .



12.9B . . . and stamped line (A) on camshaft sprocket with timing belt rear cover notch (B)

12.12 Timing belt tension is correct when the tensioner indicator pointer aligns with the centre of the baseplate notch

(without jerking it or the belt may jump a tooth), through 2 complete revolutions (720°) clockwise, until the camshaft and crankshaft sprocket timing marks are once again aligned as described in paragraph 13. The position of the coolant pump must not alter.

12 Slacken the timing belt by turning the coolant pump anti-clockwise until the tensioner's indicator pointer is in the centre of its baseplate notch; the timing belt tension is then correct **(see illustration)**. Tighten the coolant pump bolts to the specified torque wrench setting (see Chapter 3), then turn the crankshaft through two further turns clockwise and recheck the setting.

13 If the pointer and notch are not aligned, the operation must be repeated from paragraph 7. On completion, refit all components removed.

13 Timing belt cover aperture, 1.4 and 1.6 models - general

General

The rear timing belt cover fitted to 1991 and 1992 model year 1.4 and 1.6 litre engines, incorporates a small aperture just above the oil pump housing. In certain circumstances, it is possible for foreign objects, such as gravel, to penetrate through this aperture and cause the timing belt to jump a tooth on its sprockets. For this reason, it is desirable to cover the aperture to prevent the possibility of this occurrence. A modified cover without an aperture was introduced for 1993 models.

A piece of suitably moulded sponge rubber (P/N 90469594), is available from Vauxhall dealers to enable the aperture to be covered. On models without power steering, the sponge rubber can be inserted into the cover aperture from above. If power steering is fitted, the sponge rubber is inserted into place from below. If access is difficult, particularly if the drivebelt is of the ribbed V-belt type, it may be easier to remove the alternator/power steering pump drivebelt as described in Chapter 5. Refit, and where applicable adjust, the belt tension on completion.

14 Timing belt and tensioner C16 NZ2, 1.8 and 2.0 litre - removal, refitting and adjustment

Removal

1 An alternative type of spring loaded automatic timing belt tensioner is fitted to these engines, from 1993 onward **(see illustration)**. The tensioner assembly is similar to other automatic tensioners, but the removal and refitting procedures vary as follows.

2 The timing belt main outer cover may be secured either by clips or by hexagon-headed screws to the rear cover; in some cases, a combination of clips and screws may be used.

3 To release the belt tension before removal, unscrew the timing belt tensioner securing bolt slightly then, with a tool inserted in the slot on the tensioner arm, turn the tensioner arm until the timing belt is slack. If necessary, remove completely and examine the tensioner as described in Section 12.

Refitting

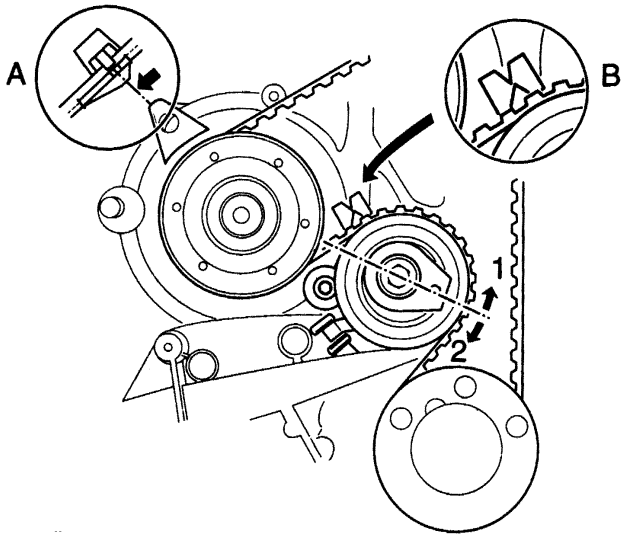
4 Refit the tensioner into position and tighten the securing bolt slightly.

5 Ensure that the coolant pump is correctly positioned by checking that the lug on the coolant pump flange is aligned with the corresponding lug on the cylinder block. If this is not the case, slacken the coolant pump mounting bolts slightly and move the pump accordingly (see Chapter 3). Tighten the bolts to the specified torque on completion.

6 Refit the timing belt then tension it as follows.

Adjustment

7 Slacken the automatic tensioner securing bolt and move the tensioner arm anti-clockwise, until the tensioner pointer lies at its stop. Tighten the tensioner securing bolt to hold the tensioner in this position.



14.1 Timing belt automatic tensioner details (alternative type)

A Alignment lugs on coolant pump and cylinder block
B Tensioner pointer aligned with notch in tensioner bracket
1 Move the tensioner arm anti-clockwise to release the belt tension
2 Move the tensioner arm clockwise to tension the belt

8 Turn the crankshaft through two complete revolutions in the normal direction of rotation, and check that with the crankshaft pulley TDC mark aligned with the pointer on the rear timing belt cover. The TDC mark on the camshaft sprocket is still aligned with the notch in the timing belt rear cover. Slacken the automatic tensioner securing bolt again and move the tensioner arm clockwise, until the tensioner pointer is aligned with the notch in the tensioner bracket. In the first few hours of operation a new belt will be subjected to 'settling-in', (known as the running-in procedure). If you are refitting a used belt (one that has been 'run-in'), align the pointer to approximately 4 mm to the left of the notch **(see illustration)**.

9 Tighten the tensioner securing bolt securely. Turn the crankshaft through one complete revolution, in the normal direction of rotation, and check that the crankshaft and camshaft timing marks still align. Then refit the remainder of the components as described in Section 12.

10 With the timing belt adjustment set in this way, correct tension will always be maintained by the automatic tensioner and no further checking or adjustment will be necessary.

15 Camshaft front oil seal - removal and refitting

Removal

1 The camshaft front oil seal may be renewed with the engine in the vehicle without removing the camshaft as follows.

2 Remove the timing belt and the camshaft sprocket, as described in Section 11.

3 Punch or drill a small hole in the centre of the now-exposed oil seal. Screw in a self-tapping screw, and pull on the screw with pliers to extract the seal.

Refitting

4 Clean the oil seal seat with a wooden or plastic scraper.

5 Grease the lips of the new seal, and drive it into position until it is flush with the housing, using a socket or tube. Take care not to damage the seal lips during fitting.

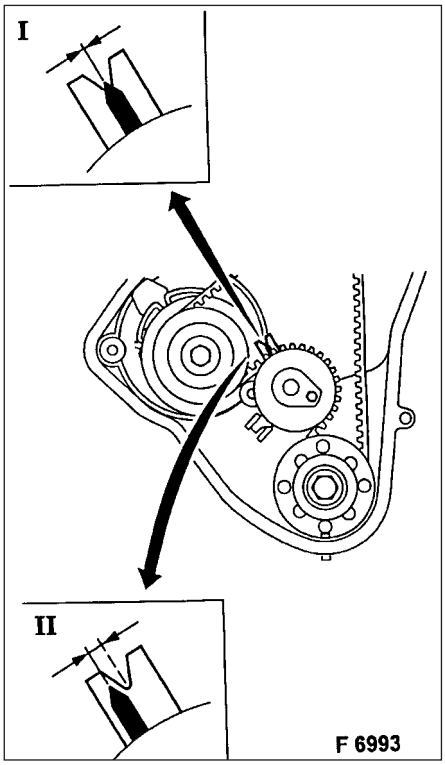
6 Refit the camshaft sprocket and the timing belt and tension the timing belt as described in Section 11.

16 Camshaft rear oil seal - removal and refitting

Removal

1 The camshaft rear oil seal may be renewed with the engine in the vehicle without removing the camshaft as follows.

2 Remove the distributor as described in Chapter 5



14.8 Timing belt adjustment

1 Alignment for new belts
2 Alignment for 'run-in' belts (gap is approximately 4 mm to the left of centre)

3 On 1.4 and 1.6 litre models (except C16 NZ2), the seal takes the form of an O-ring on the rear of the distributor body. Prise off the old O-ring carefully, using a screwdriver.

4 On C16 NZ2, 1.8 and 2.0 litre models, prise the seal from the camshaft housing

Refitting

5 On 1.4 and 1.6 litre models (except C16 NZ2), fit the new O-ring, and refit the distributor as described in Chapter 5.

6 On C16 NZ2, 1.8 and 2.0 litre models, fit the new seal so that it is flush with the end of the housing, then refit the distributor components as described in Chapter 5.

17 Camshaft housing and camshaft - general

Note: *The engine must be cold when removing the camshaft housing.* **Do not** *remove the camshaft housing from a hot engine. New cylinder head bolts must be used on refitting and sealer will be required when refitting the camshaft housing. Also see paragraph 3 before starting work:*

General

1 The camshaft can only be removed without disturbing the housing, if a special tool is available to depress the cam followers whilst the camshaft is withdrawn.

2 If such a tool is available, the camshaft can be removed, after removing the timing belt and camshaft sprocket as described in Section 11.

3 If the special tool is not available, the camshaft housing must be removed. Since the cylinder head bolts must be removed, it is strongly recommended that a new cylinder head gasket is fitted. If the gasket is not renewed, and it "blows" on reassembly, the cylinder head will have to be removed to renew the gasket, and another new set of bolts will have to be obtained for refitting. You have been warned!

4 Removal and refitting of the camshaft housing is described in Section 18, along with cylinder head removal and refitting. If it is decided not to disturb the cylinder head, the relevant paragraphs referring specifically to cylinder head removal and refitting can be ignored.

5 Removal of the camshaft from the housing is described in Section 18.

18 Camshaft housing and camshaft - dismantling, inspection and reassembly

Dismantling

1 With the camshaft housing removed from the cylinder head as described in Section 18, continue as follows.

2 Remove the distributor and it's components as described in Chapter 5 and on C 16 NZ2, 1.8 and 2.0 litre, carefully prise out the camshaft rear oil seal.

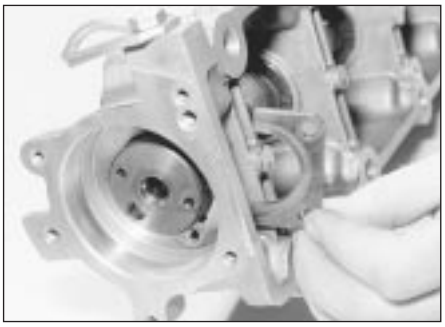
3 On carburettor models, remove the fuel pump, referring to Chapter 4A, if necessary.

4 Working at the distributor end of the camshaft, unscrew the two camshaft thrustplate securing bolts, using an Allen key or hexagon bit **(see illustration)**.

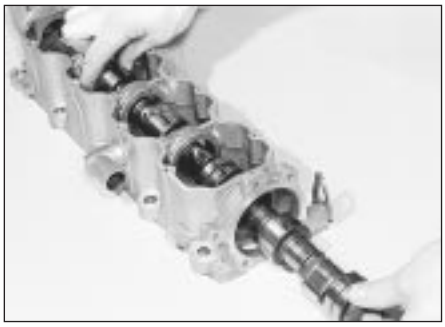
5 Withdraw the thrustplate, noting which way round it is fitted **(see illustration)**.

6 Carefully withdraw the camshaft from the distributor end of the camshaft housing, taking care not to damage the bearing journals **(see illustration)**.

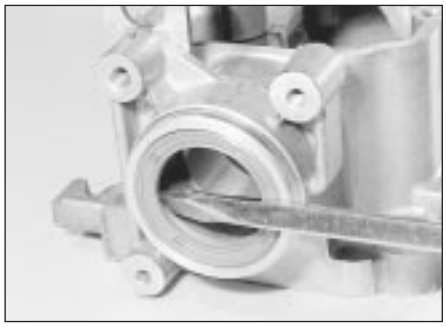
18.4 Camshaft thrustplate and securing bolts - 1.6 litre engine



18.5 Removing the camshaft thrustplate - 2.0 litre engine



18.6 Withdrawing the camshaft from the housing - 2.0 litre engine



18.10 Prising out the camshaft front oil seal - 2.0 litre engine

Inspection

7 With the camshaft removed, examine the bearings in the camshaft housing for signs of obvious wear or pitting. If evident, a new camshaft housing will probably be required.

8 The camshaft itself should show no marks or scoring on the journal or cam lobe surfaces. If evident, renew the camshaft. Note that if the camshaft is renewed, all the rocker arms should also be renewed.

9 Check the camshaft thrustplate for signs of wear or grooves, and renew if evident.

10 It is advisable to renew the camshaft front oil seal as a matter of course if the camshaft has been removed. Prise out the old seal using a screwdriver **(see illustration)**.

Reassembly

11 Carefully drive in the new front seal until it is flush with the housing, using a socket or tube. On C 16 NZ2, 1.8 and 2.0 litre models, fit a new camshaft rear oil seal. Replace the distributor O-ring on other models **(see illustrations)**.

12 Begin reassembly by liberally oiling the bearings in the housing and the oil seal lip. Carefully insert the camshaft into the housing from the distributor end, taking care to avoid damage to the bearings.

13 Refit the thrustplate, and tighten the securing bolts **(see illustration)**. Check the camshaft endfloat by inserting a feeler blade between the thrustplate and the camshaft end flange. If the endfloat exceeds that specified, renew the thrustplate.

14 Where applicable, refit the fuel pump, referring to Chapter 4, if necessary.

15 Refit the distributor as described in Chapter 5.

16 Refit the camshaft housing, as described in Section 18.

17 If a new camshaft has been fitted, it is important to observe the following running-in schedule (unless otherwise specified by the manufacturer) immediately after initially starting the engine:

One minute at 2000 rpm
One minute at 1500 rpm
One minute at 3000 rpm
One minute at 2000 rpm

18 Change the engine oil (but not the filter, unless due) approximately 600 miles (1000 km) after fitting a new camshaft.

19 Camshafts, "undersize" C16 NZ2, 1.8 and 2.0 litre engines - general

General

1 The camshafts and camshaft housings for these engines are sorted on production into one of two size groups; standard and 0.10 mm "undersize". Note that this is not intended to provide replacements for worn engines, but is to allow for production tolerances; either may be fitted to new engines.

2 "Undersize" components are marked with a spot of violet-coloured paint, that on the camshaft housing being applied on top at the timing belt end.

3 Whenever the camshaft or its housing are to be renewed, check (by direct measurement, if necessary) whether they are standard or undersize and ensure that only matching items are obtained for reassembly.

20 Cylinder head - removal and refitting (engine in vehicle)

Note: *The engine must be cold when the cylinder head is removed. Do not remove the cylinder head from a hot engine. New cylinder head bolts and a new cylinder head gasket must be used on refitting and sealer will be required when refitting the camshaft housing. The torque settings stated are only applicable to latest specification head bolts, available from Vauxhall. Earlier type or alternative make, head bolts may require different torques. Consult your supplier.*

Removal

1 Disconnect the battery negative lead.

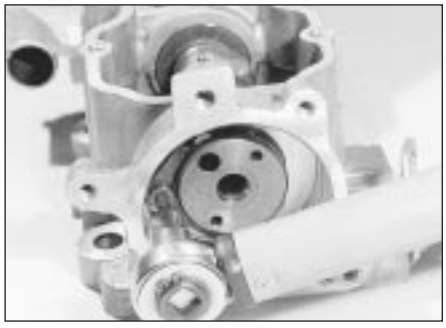
2 Drain the cooling system, as described in Chapter 3.

3 Disconnect the exhaust downpipe from the manifold, referring to Chapter 4C.

4 The cylinder head can be removed complete with the manifolds, or the manifolds can be detached from the cylinder head before removal, with reference to the relevant Sections of Chapter 4A, 4B or 4C. If no work is to be carried out on the inlet manifold, it can be unbolted from the cylinder head and

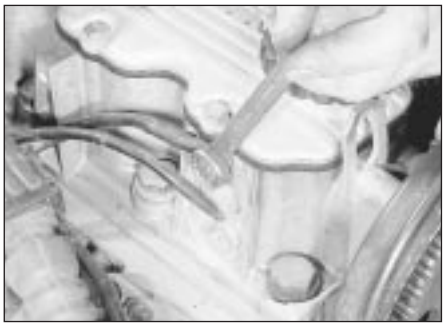
18.11A Fitting a new camshaft front oil seal using a special tool - 2.0 litre engine

18.11B Fitting a new camshaft rear oil seal - 2.0 litre engine



18.13 Tightening a camshaft thrustplate securing bolt - 2.0 litre engine

20.7 Disconnecting a camshaft cover breather hose - 2.0 litre engine



20.10 Unbolting the fuel injection wiring harness earth leads from the camshaft housing - 2.0 litre engine

20.11 Disconnecting the crankcase breather tube stub hose - 1.6 litre engine

supported to one side out of the way, thus avoiding the need to disconnect the relevant hoses, pipes and wiring.

5 If the cylinder head is to be removed complete with the manifolds, disconnect all relevant hoses, pipes and wiring from the inlet manifold and associated components, referring to Chapter 4A or 4B. On carburettor models, disconnect the hot air hose from the shroud on the exhaust manifold. Loosen the alternator mountings, with reference to Chapter 5, then unbolt the upper alternator mounting from the inlet manifold.

6 If the inlet manifold is to be left in the engine compartment, continue as follows, otherwise go on to paragraph 15.

7 Disconnect the air cleaner trunking from the air box on the carburettor or throttle body, or directly from the throttle body (as applicable), and disconnect the camshaft cover breather hose that runs to the carburettor or throttle body (as applicable), **(see illustration)**.

8 On C 16 NZ2, 1.8 and 2.0 litre models, disconnect the smaller coolant hose from the top of the thermostat housing.

9 On 1.6 litre models (except C 16 NZ2), disconnect the breather hose (which runs from the camshaft cover to the inlet manifold) at the camshaft cover.

10 On fuel injection models, unbolt the two wiring harnesses earth leads from the camshaft housing **(see illustration)**.

11 On 1.4 and 1.6 litre models (except C 16 NZ2), disconnect the stub hose that connects the crankcase breather tube to the rear of the camshaft housing **(see illustration)**.

12 Loosen the alternator mountings, referring to Chapter 5, then unbolt the upper alternator mounting from the inlet manifold.

13 Make a final check to ensure that all necessary hoses, pipes and wires have been disconnected, then unscrew the securing nuts, noting the location of the engine lifting bracket, and lift the inlet manifold from the cylinder head. Ensure that the manifold is properly supported, taking care not to strain any of the hoses, pipes and wires, etc., which are still connected.

14 Recover the manifold gasket from the cylinder head.

15 If desired, remove the exhaust manifold, with reference to Chapter 4C.

16 Remove the timing belt and the camshaft sprocket, as described in Section 11.

17 Unscrew the two upper rear timing belt cover securing bolts from the camshaft housing.

18 Disconnect the HT leads from the spark plugs and the coil, labelling them if necessary to aid refitting, and remove the distributor cap, referring to Chapter 5. Where applicable, disconnect the distributor wiring plug.

19 If not already done, disconnect the stub hose that connects the crankcase breather tube to the camshaft housing. If applicable unscrew the bolt securing the crankcase breather tube bracket to the end of the cylinder head **(see illustrations)**.

20 Disconnect the coolant hoses from the thermostat housing.

21 On carburettor models, disconnect the fuel hoses from the fuel pump. Be prepared for fuel spillage, and plug the open ends of the hoses, to prevent further fuel loss and dirt ingress.

22 Make a final check to ensure that all relevant hoses, pipes and wires, etc., have been disconnected.

23 Working from the outside inwards in a spiral pattern as shown **(see illustration)**, loosen all the cylinder head bolts by a quarter of a turn. Then loosen all the bolts by half a turn, and finally loosen and remove the bolts. Recover the washers.

24 Lift the camshaft housing from the cylinder head **(see illustration)**. If necessary, tap the housing gently with a soft-faced mallet to free it from the cylinder head, but do not lever at the mating faces. Note that the camshaft housing is located on dowels.

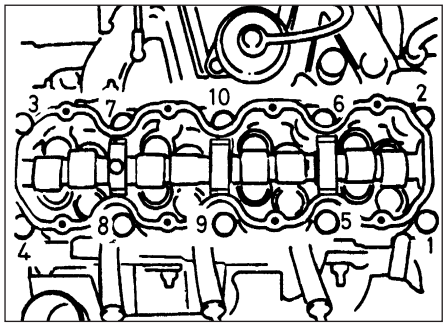
25 Lift the rocker arms and their thrust pads from the cylinder head, keeping them in order so that they can be refitted in their original positions **(see illustrations)**.

26 Lift the hydraulic valve lifters from the cylinder head, and place them upright in an oil bath until they are to be refitted **(see illustration)**. Ensure that the depth of oil is sufficient to fully cover the valve lifters, and keep the lifters in order, so that they can be refitted in their original positions.

27 Lift the cylinder head from the cylinder block **(see illustration)**. If necessary, tap the cylinder head gently with a soft-faced mallet to free it from the block, but do not lever at the mating faces. Note that the cylinder head is located on dowels.

20.19A Disconnecting the crankcase breather tube stub hose - 2.0 litre engine

20.19B Unbolting the crankcase breather tube bracket from the cylinder head - 2.0 litre model



20.23 Cylinder head bolt loosening sequence - SOHC engines

20.24 Lifting the camshaft housing from the cylinder head - 1.6 litre engine

20.25A Lift the rocker arms . . .

20.25B . . . and their thrust pads from the cylinder head - 1.6 litre engine

28 Recover the cylinder head gasket and discard it.

Refitting

29 Clean the cylinder head and block mating faces, and the camshaft housing and cylinder head mating faces by careful scraping. Take care not to damage the cylinder head and camshaft housing, which are made of light alloy and are easily scored. Cover the coolant passages and other openings with masking tape or rag to prevent dirt and carbon falling in. Mop out all the oil from the bolt holes; if oil is left in the holes, hydraulic pressure could crack the block when the bolts are refitted.

30 If desired, the cylinder head can be dismantled and inspected as described in Sections 22 and 23, and the camshaft housing can be dismantled as described in Section 18.

31 Begin refitting by locating a new gasket on the block so that the word "OBEN" or "TOP" can be read from above **(see illustrations)**.

32 With the mating faces scrupulously clean, locate the cylinder head on the block so that the positioning dowels engage in their holes.

33 Refit the hydraulic valve lifters, thrust pads and rocker arms to the cylinder head in their original positions. Liberally oil the valve lifter bores, and if new lifters are being fitted initially immerse each one in a container of clean engine oil and compress it (by hand) several times to charge it. Lubricate the contact faces of the valve lifters, thrust pads and rocker arms with a little molybdenum disulphide grease **(see illustration)**.

34 Temporarily refit the crankshaft sprocket, and ensure that the timing marks are still positioned as they were before the timing belt was removed (see Section 11).

35 Apply sealing compound (Vauxhall part No 90094714, or equivalent) to the cylinder head top mating face **(see illustration)**, then refit the camshaft housing to the cylinder head.

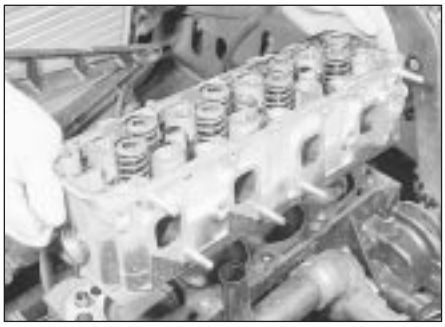
36 Fit the new cylinder head bolts, ensuring that the washers are in place under their heads, and screw the bolts in *by hand* as far as possible **(see illustration)**.

37 Tighten the bolts working from the inside outwards in a spiral pattern as shown **(see illustration)**. Tighten the bolts in the four stages given in the Specifications - i.e. tighten all bolts to the Stage 1 torque, then tighten all bolts to Stage 2 and so on **(see illustrations)**.

38 Further refitting is a reversal of the removal procedure, remembering the following points.

39 Ensure that the HT leads are refitted to their correct cylinders.

20.26 Lift the hydraulic valve lifters from the cylinder head - 1.6 litre engine



20.27 Lifting the cylinder head from the cylinder block - 1.6 litre engine

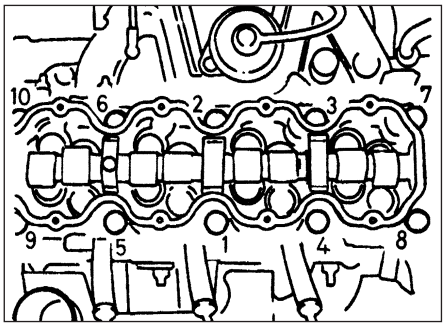
20.31A Cylinder head gasket "Oben/TOP" markings

20.31B Cylinder head gasket correctly located over dowel in cylinder block

20.33 Lubricate the valve lifter contact faces with molybdenum disulphide grease

20.35 Apply sealing compound to the cylinder head top mating face

20.36 Fit new cylinder head bolts, ensuring that the washers are in place



20.37A Cylinder head bolt tightening sequence - SOHC engines

20.37B Tighten the cylinder head bolts to the specified torque . . .

20.37C . . .then through the specified angle - 2.0 litre engine

40 Refit the camshaft sprocket and the timing belt and tension the timing belt as described in Section 11.
41 Where applicable, refit the manifolds to the cylinder head, with reference to Chapter 4A, 4B or 4C, using new gaskets.
42 Reconnect the exhaust downpipe to the manifold, using a new gasket, referring to Chapter 4C, if necessary.
43 Refit the upper alternator mounting to the inlet manifold, then adjust the alternator drivebelt tension, as described in Chapter 5.
44 Refill the cooling system, as described in Chapter 3.
45 On completion, check that all relevant hoses, pipes and wires, etc., have been reconnected.
46 When the engine is started, check for signs of leaks.
47 Once the engine has reached normal operating temperature, check and if necessary adjust the idle speed (where applicable) and the mixture (where applicable), with reference to Chapter 4A or 4B.

21 Cylinder head - removal and refitting (engine removed)

Note: *New cylinder head bolts and a new cylinder head gasket must be used on refitting, and sealer will be required when refitting the camshaft housing.*
The torque settings stated are only applicable to latest specification head bolts, available from Vauxhall. Earlier type or alternative make, head bolts may require different torques. Consult your supplier.

Removal

1 The cylinder head can be removed complete with the manifolds, or the manifolds can be detached from the cylinder head before removal, with reference Chapter 4A, 4B or 4C.
2 Remove the timing belt and the camshaft sprocket, as described in Section 11.
3 Unscrew the two upper rear timing belt cover securing bolts from the camshaft housing **(see illustration)**.
4 Disconnect the HT leads from the spark plugs, labelling them if necessary to aid refitting, and remove the distributor cap referring to Chapter 5.
5 If not already done, disconnect the stub hose that connects the crankcase breather tube to the camshaft housing. If applicable, unscrew the bolt securing the crankcase breather tube bracket to the end of the cylinder head.
6 Make a final check to ensure that all relevant hoses, pipes and wires have been disconnected.

Refitting

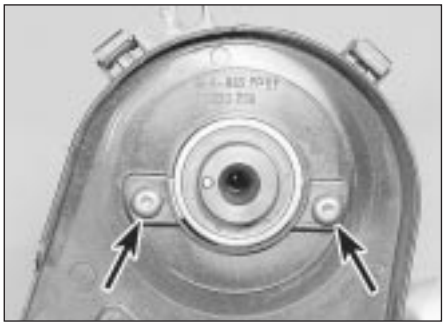
7 Proceed as described in Section 21, paragraphs 23 to 41 inclusive, but in addition note the following.
8 On completion check that all relevant hoses, pipes and wires, etc., have been reconnected.

22 Cylinder head - dismantling and reassembly

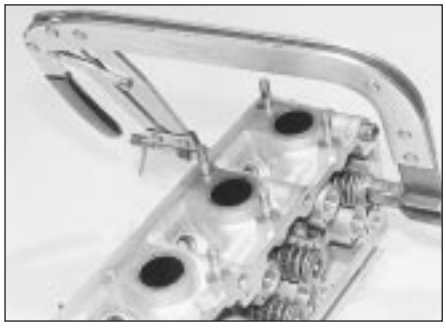
Note: *A valve spring compressor tool will be required for this operation. New valve stem oil seals must be used on reassembly*

Dismantling

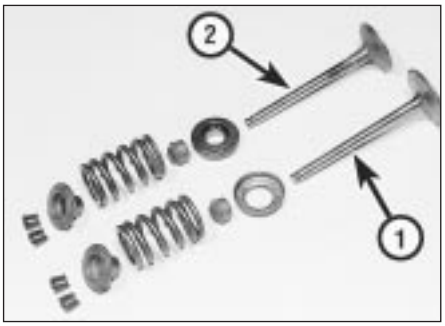
1 With the cylinder head removed as described in Section 21, clean away all external dirt.
2 If not already done, remove the thermostat housing, and on 1.4 and 1.6 litre models, the thermostat, as described in Chapter 3. Remove the manifolds as described in Chapter 4A, 4B or 4C. Remove the spark plugs if not already done.
3 To remove a valve, fit a valve spring compressor tool. Ensure that the arms of the compressor tool are securely positioned on the head of the valve and the spring cap **(see illustration)**.
4 Compress the valve spring to relieve the pressure of the spring cap acting on the collets. If the spring cap sticks on the valve stem, support the compressor tool and give the end a light tap with a hammer to help free the spring cap.
5 Extract the two split collets, then slowly release the compressor tool.
6 Remove the spring cap, spring, valve stem oil seal, and the spring seat, then withdraw the valve.



21.3 Upper rear timing belt cover securing bolts (arrowed) - 1.6 litre engine



22.3 Valve spring compressor tool fitted to No 1 exhaust valve - 2.0 litre engine



22.7 Inlet (1) and exhaust (2) valve components

22.11 Inserting an exhaust valve into its guide

22.12 Fit the valve seat (exhaust valve shown)

7 Repeat the procedure for the remaining valves, keeping all components in strict order, so that they can be refitted in their original positions **(see illustration)**.

8 The cylinder head and valves can be inspected for wear and damage as described in Section 23.

Reassembly

9 With all components cleaned, begin reassembly as follows.

10 Starting at one end of the cylinder head, fit the valve components as follows.

11 Insert the appropriate valve into its guide, ensuring that the valve stem is well lubricated with clean engine oil **(see illustration)**. Note that if the original components are being refitted, all components must be refitted in their original positions.

12 Fit the spring seat **(see illustration)**.

13 New valve stem oil seals should be supplied with a fitting sleeve, which fits over the collet groove in the valve stem, to prevent damage to the oil seal as it is slid down the valve stem **(see illustration)**. If no sleeve is supplied, wind a short length of tape round the top of the valve stem to cover the collet groove.

14 Push the valve stem oil seal down the valve stem using a tube until the seal is fully engaged with the spring seat **(see illustrations)**. Remove the fitting sleeve or tape, as applicable, from the valve stem.

15 Fit the valve spring and the spring cap **(see illustrations)**.

16 Fit the spring compressor tool, and compress the valve spring until the spring cap passes beyond the collet groove in the valve stem.

17 Apply a little grease to the collet groove, then fit the split collets into the groove, with the narrow ends nearest the spring **(see illustration)**. The grease should hold them in the groove.

18 Slowly release the compressor tool, ensuring that the collets are not dislodged from the groove. When the compressor is fully released, give the top of the valve assembly a sharp tap with a soft-faced mallet to settle the components.

19 Repeat the procedure for the remaining valves, ensuring that all components are refitted in their original positions, where applicable.

20 Where applicable, refit the manifolds as described in Chapter 4A, 4B or 4C, and/or the thermostat and thermostat housing as described in Chapter 3. Refit the spark plugs if desired.

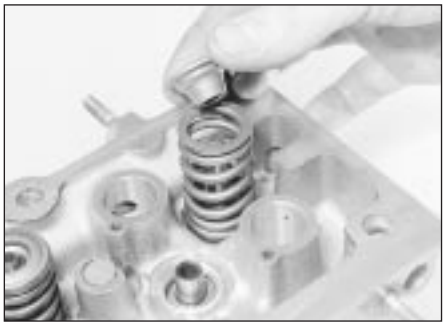
21 Refit the cylinder head as described in Section 21.

22.13 Slide the oil seal fitting sleeve down the valve stem . . .

22.14A . . . then fit the valve stem oil seal . . .

22.14B . . . and push onto the spring seat using a socket

22.15A Fit the valve spring . . .



22.15B . . .and the spring cap

22.17 Retain the split collets with a little grease

23 Cylinder head - inspection and renovation

Note: *Refer to a dealer for advice before attempting to carry out valve grinding or valve seat reciting operations, as these operations may not be possible for the DIY mechanic. This is due to the fitment of hardened valve seats for use with unleaded petrol*

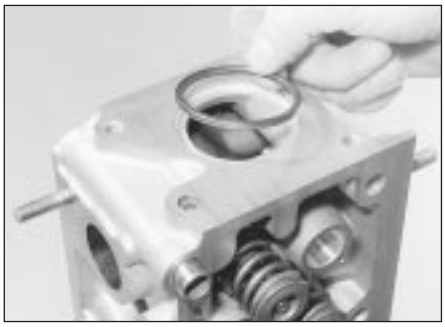
Warning: The exhaust valves fitted to 20 XEJ and C 20 XE (DOHC) models are fitted with sodium to improve their heat transfer. Sodium is a highly reactive metal, which will ignite or explode spontaneously on contact with water (including water vapour in the air). These must NOT be disposed of with ordinary scrap. Seek advice from a Vauxhall dealer or your Local Authority, if the valves are to be disposed of.

Inspection

1 Remember that the cylinder head is of light alloy construction and is easily damaged, use a blunt scraper or rotary wire brush to clean all traces of carbon deposits from the combustion spaces and the ports. The valve stems and valve guides should also be freed from any carbon deposits. Wash the combustion spaces and ports down with paraffin and scrape the cylinder head surface free of any foreign matter with the side of a steel rule, or a similar article.

2 If the engine is installed in the car, clean the pistons and the top of the cylinder bores. If the pistons are still in the block, it is essential that great care is taken to ensure that no carbon gets into the cylinder bores. This could scratch the cylinder walls or cause damage to the pistons and rings. To ensure this does not happen, first turn the crankshaft so that two of the pistons are at the top of their bores. Insert rag into the other two bores or seal them off with paper and masking tape. The waterways should also be covered with small pieces of masking tape, to prevent particles of carbon entering the cooling system and damaging the coolant pump.

3 Press a little grease into the gap between the cylinder walls and the two pistons that are to be worked on. With a blunt scraper, carefully scrape away the carbon from the piston crown, taking great care not to scratch the aluminium. Also scrape away the carbon from the surrounding lip of the cylinder wall. When all carbon has been removed, scrape away the grease that will now be contaminated with carbon particles, taking care not to press any into the bores. To assist prevention of carbon build-up, the piston crown can be polished with a metal polish. Remove the rags or masking tape from the other two cylinders, and turn the crankshaft so that the two pistons that were at the bottom are now at the top. Place rag or masking tape in the cylinders that have been decarbonised, and continue as just described.



23.9 Renewing the thermostat housing sealing ring - 2.0 litre engine

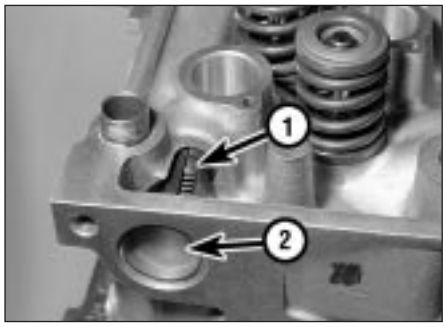
4 Examine the heads of the valves for pitting and burning, especially the heads of the exhaust valves. The valve seatings should be examined at the same time. If the pitting on the valve and seat is very slight, the marks can be removed by grinding the seats and valves together with coarse, and then fine, valve grinding paste.

5 Where bad pitting has occurred to the valve seats, it will be necessary to recut them and fit new valves. This latter job should be entrusted to the local dealer or engineering works. In practice it is very seldom that the seats are so badly worn. Normally it is the valve that is too badly worn for refitting, and the owner can easily buy a new set of valves and match them to the seats by valve grinding.

Renovation

6 Valve grinding is carried out as follows. Smear a trace of coarse carborundum paste on the seat face and apply a suction grinder tool to the valve head. With a semi-rotary motion, grind the valve head to its seat, lifting the valve occasionally to redistribute the grinding paste. When a dull matt even surface is produced on both the valve seat and the valve, wipe off the paste and repeat the process with fine carborundum paste, lifting and turning the valve to redistribute the paste as before. A light spring placed under the valve head will greatly ease this operation. When a smooth unbroken ring of light grey matt finish is produced, on both valve and valve seat faces, the grinding operation is complete. Carefully clean away every trace of grinding compound, taking great care to leave none in the ports or in the valve guides. Clean the valves and valve seats with a paraffin-soaked rag, then with a clean rag, and finally, if an air line is available, blow the valves, valve guides and valve ports clean.

7 Check that all valve springs are intact. If any one is broken, all should be renewed. Check the free height of the springs against new ones. If some springs are not long enough, replace them all. Springs suffer from fatigue and it is a good idea to renew them even if they look serviceable.



23.10 Oil pressure regulating valve (1) and plug (2) - 2.0 litre engine

8 The cylinder head can be checked for warping either by placing it on a piece of plate glass or using a straight-edge and feeler blades. If there is any doubt or if its block face is corroded, have it re-faced by your dealer or motor engineering works.

9 On 1.8 and 2.0 litre, always renew the sealing ring between the cylinder head and the thermostat housing when the head is removed for overhaul **(see illustration)**. Reference to Chapter 21 will show that a considerable amount of work is involved if it is wished to renew the sealing ring with the cylinder head installed.

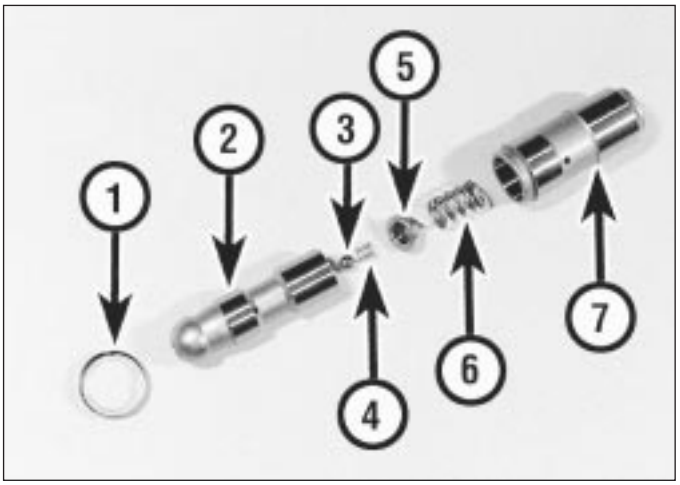
10 If the oil pressure regulating valve in the cylinder head is to be renewed, access is gained through the circular plug covering the end of the valve **(see illustration)**. The old valve must be crushed, then its remains extracted, and a thread (M10) cut in the valve seat to allow removal using a bolt. A new valve and plug can then be driven into position. In view of the intricacies of this operation, it is probably best to have the valve renewed by a Vauxhall dealer if necessary.

24 Hydraulic valve lifters - inspection

Inspection

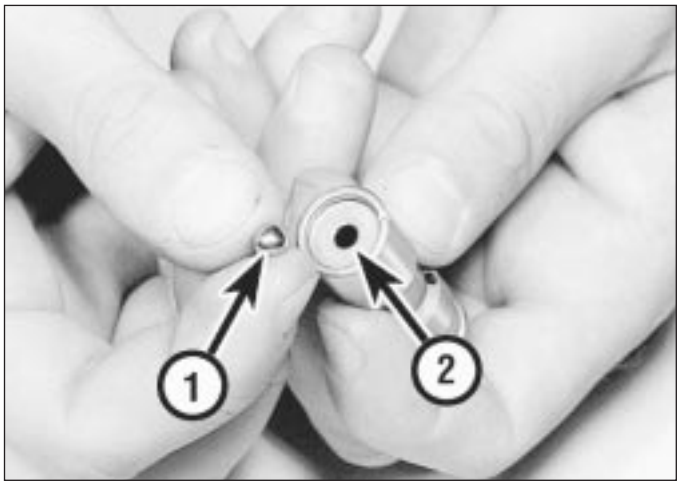
1 On engines that have covered a high mileage, or for which the service history (particularly oil changes) is suspect, it is possible for the valve lifters to suffer internal contamination. In extreme cases this may result in increased engine top end noise and wear. To minimise the possibility of problems occurring later in the life of the engine, it is advisable to dismantle and clean the hydraulic valve lifters as follows whenever the cylinder head is overhauled. Note that no spare parts are available for the valve lifters, and if any of the components are unserviceable, the complete assembly must be renewed **(see illustration)**.

2 With the cylinder head removed and dismantled as described in Sections 21 and 23, first inspect the valve lifter bores in the



24.1 Hydraulic valve lifter components - SOHC engines

1 Collar
2 Plunger
3 Ball
4 Small spring
5 Plunger cap
6 Large spring
7 Cylinder



24.8 Locate the ball (1) on it's seat (2) in the base of the plunger

cylinder head for wear. If excessive wear is evident, the cylinder head must be renewed. Also check the valve lifter oil holes in the cylinder head for obstructions.

3 Starting with number 1 valve lifter, carefully pull the collar from the top of the valve lifter cylinder. It should be possible to remove the collar by hand - if a tool is used, take care not to distort the collar.

4 Withdraw the plunger from the cylinder, and recover the spring.

5 Using a small screwdriver, carefully prise the cap from the base of the plunger. Recover the spring and ball from under the cap, taking care not to lose them as the cap is removed.

6 Carefully clean all the components using paraffin or solvent, paying particular attention to the machined surfaces of the cylinder (internal surfaces), and piston (external surfaces). Thoroughly dry all the components using a lint-free cloth. Carefully examine the springs for damage or distortion - the complete valve lifter must be renewed if the springs are not in perfect condition.

7 Lubricate the components sparingly with clean engine oil of the correct grade, then reassemble as follows.

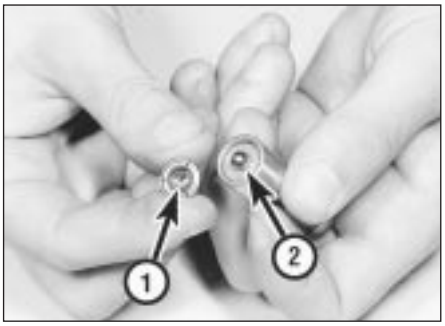
8 Invert the plunger, and locate the ball on its seat in the base of the plunger **(see illustration)**.

9 Locate the smaller spring on its seat in the plunger cap, then carefully refit the cap and spring, ensuring that the spring locates on the ball. Carefully press around the flange of the cap, using a small screwdriver if necessary, until the flange is securely located in the groove in the base of the plunger **(see illustrations)**.

10 Locate the larger spring over the plunger cap, ensuring that the spring is correctly seated, and slide the plunger and spring assembly into the cylinder **(see illustrations)**.

11 Slide the collar over the top of the plunger, and carefully compress the plunger by hand, until the collar can be pushed down to engage securely with the groove in the cylinder **(see illustration)**.

12 Repeat the above procedures on the remaining valve lifters.



24.9A Spring (1) located in plunger cap, and ball (2) located on seat in plunger

24.9B Locate the cap flange in the plunger groove

24.10A Locate the spring over the plunger cap . . .

24.10B . . .then slide the plunger and spring assembly into the cylinder

24.11 Slide the collar (1) over the top of the plunger and engage with the groove (2) in the cylinder

25 Flywheel - removal, inspection and refitting

Note: *New flywheel securing bolts must he used on refitting. Certain models are fitted with a 'Pot type' flywheel. Although, it has a deeply recessed surface for the clutch disc, the operations below are the same.*

Removal

1 If not already done, remove the clutch, (Chapter 6), and the starter motor, (Chapter 5).
2 If the engine is in the vehicle, remove the clutch release bearing and its guide sleeve, as described in Chapter 6.
3 Although the flywheel bolt holes are offset so that the flywheel can only be fitted in one position, it will make refitting easier if alignment marks are made between the flywheel and the end of the crankshaft.
4 Prevent the flywheel from turning by jamming the ring gear teeth using a large screwdriver or similar tool. Access is most easily obtained through the starter motor aperture if the engine is in the vehicle.
5 Unscrew the securing bolts, and remove the flywheel **(see illustration)**. *Take care, as the flywheel is heavy!*

Inspection

6 With the flywheel removed, it can be inspected as follows.
7 If the teeth on the flywheel starter ring are badly worn, or if some are missing, then it will be necessary to remove the ring and fit a new one.
8 The old ring can be split with a cold chisel, after making a cut with a hacksaw blade between two gear teeth. Take great care not to damage the flywheel during this operation, and use eye protectors always. Once the ring has been split, it will spread apart and can be lifted from the flywheel.
9 The new ring gear must be heated to 180 to 230°C (356 to 446°F) and unless facilities for heating by oven or flame are available, leave the fitting to a dealer or motor engineering works. The new ring gear must not be overheated during this work, or the temper of the metal will be altered.
10 The ring should be tapped gently down onto its register, and left to cool naturally - the contraction of the metal on cooling will ensure that it is a secure and permanent fit.
11 If the clutch friction disc contact surface of the flywheel is scored, or on close inspection, show's evidence of small hairline cracks (caused by overheating), it may be possible to have the flywheel surface ground. This is provided that the overall thickness of the flywheel is not reduced too much. Consult a specialist engine repairer and if it is not possible, renew the flywheel complete.

Refitting

12 Refitting is a reversal of removal, remembering the following points.
13 Align the previously made marks on the flywheel and crankshaft, and fit new flywheel securing bolts. Tighten them to the specified torque in the two stages given in the Specifications, whilst preventing the flywheel from turning, as during removal **(see illustrations)**.
14 Where applicable, refit the clutch release bearing, guide sleeve, and the clutch, as described in Chapter 6.

26 Flexplate (automatic transmission) - removal and refitting

Removal

1 Remove the transmission (Chapter 7B).
2 Prevent the flexplate from turning by jamming its ring gear teeth using a large screwdriver or similar tool.
3 Unbolt and remove the flexplate. Examine the bolts and renew them all as a set if there is the slightest doubt about their condition.
4 The ring gear can be checked, and renewed if necessary, as described in Section 25.

Refitting

5 Refitting is the reverse of the removal procedure. If the bolts are to be re-used, use a wire brush to clean their threads, apply a few drops of thread-locking compound (Vauxhall Part No 90167347, or equivalent) to the threads of each bolt on refitting. Tighten the bolts to the specified torque wrench setting.

25.5 Removing the flywheel - 1.6 litre engine

6 Refit the transmission, refer to Chapter 7B if necessary.

27 Crankshaft front oil seal - renewal

Renewal

1 Remove the timing belt and the rear timing belt cover, as described in Section 11.
2 Ensure that the Woodruff key is removed from the end of the crankshaft.
3 Punch or drill a small hole in the centre of the now-exposed oil seal. Screw in a self-tapping screw, and pull on the screw with pliers to extract the seal. Several attempts may be necessary. Be careful not to damage the sealing face of the crankshaft.
4 Clean the oil seal seat with a wooden or plastic scraper.
5 Before fitting the new oil seal, steps must be taken to protect the oil seal lips from damage, and from turning back on the shoulder at the front end of the crankshaft. Grease the seal lips, and then wind tape around the end of the crankshaft to form a gentle taper.
6 Tap the seal into position using a large socket or tube, until the seal is flush with the outer face of the oil pump housing.
7 Refit the rear timing belt cover and the timing belt tension the timing belt as described in Section 11.

25.13A Tool for locking flywheel fitted to engine-to-transmission bolt hole - 1.6 litre engine

25.13B Tighten the flywheel securing bolts to the specified toque . . .

25.13C . . .and then through the specified angle - 1.6 litre engine

28.4 Fitting a new crankshaft rear oil seal - 2.0 litre engine

28 Crankshaft rear oil seal - renewal

Renewal

1 With the engine removed from the vehicle, remove the flywheel, or flexplate (as applicable) as described in Sections 25 and 26.
2 Punch or drill a small hole in the centre of the now-exposed oil seal. Screw in a self-tapping screw, and pull on the screw with pliers to extract the seal. Several attempts may be necessary. Be careful not to damage the sealing face of the crankshaft.
3 Clean the oil seal seat with a wooden or plastic scraper.
4 Grease the lips of the new seal, then tap the seal into position using a tube, until flush with the outer faces of the cylinder block and rear main bearing cap **(see illustration).**
5 Refit the flywheel or flexplate (if applicable), as described in Sections 25 or 26.

29 Sump - removal and refitting

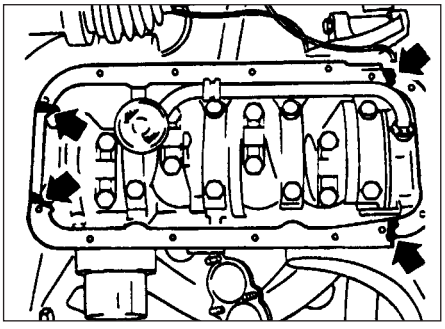
Note: *The sump gasket(s) must be renewed on refitting and sealer will be required for use on the oil pump and rear main bearing cap-to-cylinder block joints*

Removal

1 If the engine is in the vehicle, continue as follows, otherwise go on to paragraph 9.
2 Disconnect the battery negative lead.
3 Drain the engine oil, referring to Chapter 1 if necessary, then refit and tighten the drain plug.
4 Apply the handbrake, then jack up the front of the vehicle, and support securely on axle stands (see "*Jacking and Vehicle Support*").
5 Remove the front section of the exhaust system, as described in Chapter 4C.
6 Where applicable, disconnect the wiring from the oil level sensor.
7 Unscrew the securing bolts and remove the engine-to-transmission blanking plate from the bellhousing.
8 Remove the securing bolts, and withdraw the sump. Note that on most models, the sump baffle will probably be pulled away from the cylinder block with the sump, but cannot be removed until the oil pick-up pipe has been removed.
9 On 1.6, 1.8 and 2.0 litre models, to remove the sump baffle, it is necessary to unbolt the bracket securing the oil pick-up pipe to the cylinder block. The baffle can then be manipulated over the oil pick-up pipe. On C 16 NZ2, 1.8 and 2.0 litre models, prise the rubber gasket from the sump baffle.
10 If need be, the oil pick-up pipe can be removed by unscrewing the single bolt securing the support bracket to the cylinder block (if not already done). Then remove the two bolts securing the end of the pipe to the oil pump. Recover the O-ring.
11 Clean all traces of old gasket and sealing compound from the mating faces of the cylinder block, sump baffle (where applicable), and sump.

Refitting

12 Begin refitting by applying sealing compound (Vauxhall part No 90485251 or equivalent) to the joints between the oil pump and cylinder block, and the rear main bearing cap and cylinder block **(see illustrations)**.
13 On C 16 NZ2, 1.8 and 2.0 litre locate a new rubber gasket over the sump baffle flange, ensuring that it is seated correctly **(see illustration)**.
14 On 1.6, 1.8 and 2.0 litre models, offer the sump baffle up to the cylinder block, manipulating it over the oil pick-up pipe where applicable.
15 If the oil pick-up pipe has been removed, refit it to the oil pump using a new O-ring and tighten bolts to the specified torque **(see illustrations)**.
16 Where applicable, refit the bracket securing the oil pick-up pipe to the cylinder block, ensuring that it passes through the relevant hole in the sump baffle, if applicable **(see illustration)**.
17 Coat the sump securing bolts with thread-locking compound (i.e. Vauxhall part No. 90167347), then refit the sump, and tighten the bolts to the specified torque **(see illustrations)**.



29.12A Apply sealing compound (arrowed) to oil pump and rear main bearing cap joints before refitting sump

29.12B Applying sealing compound to the joint between the oil pump and cylinder block - 2.0 litre engine

29.13 Locate a new rubber gasket over the sump baffle flange - 2.0 litre engine

29.15A Fit a new O-ring to the oil pick-up pipe . . .

29.15B . . .and tighten the securing bolts to the specified torque - 2.0 litre engine

29.16 Refitting the oil pick-up pipe bracket - 2.0 litre engine

29.17A Coat the sump securing bolts with thread-locking compound before fitting

29.17B Refitting the sump - 2.0 litre engine

18 If the engine is in the vehicle, further refitting is a reversal of the removal procedure, but refit the front section of the exhaust system referring to Chapter 4C. On completion, refill the engine with oil, as described in Chapter 1.

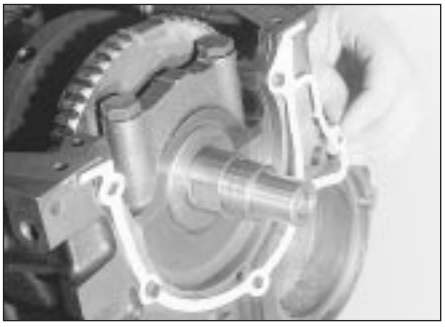
30 Oil pump - removal and refitting

Removal

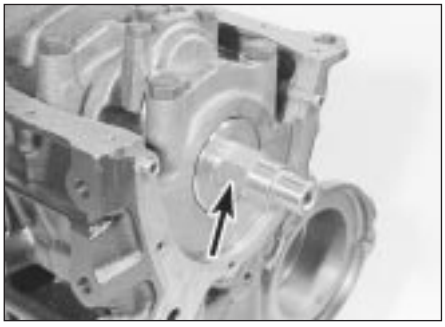
1 Remove the timing belt, sprockets and the rear timing belt cover, as shown in Section 11.
2 Remove the sump, oil pick-up pipe and sump baffle (where applicable), as described in Section 29.
3 On C 16 NZ2, 1.8 and 2.0 litre engines, unscrew the oil filter from its mounting on the oil pump, referring to Chapter 1, if necessary.
4 Disconnect the wiring from the oil pressure switch mounted on the oil pump.
5 Remove the securing bolts, and withdraw the oil pump from the cylinder block. Recover the gasket.
6 The oil pump can be dismantled for inspection, as described in Section 31.

Refitting

7 Thoroughly clean the mating faces of the oil pump and cylinder block, then locate a new gasket on the block **(see illustration)**.
8 Before refitting the oil pump, steps must be taken to protect the oil seal lips from damage, and from turning back on the shoulder at the front end of the crankshaft. Grease the seal lips, and then wind tape around the crankshaft to form a gentle taper.
9 Refit the oil pump, ensuring that the inner gear engages with the flats on the crankshaft, and tighten the securing bolts to the specified torque, then remove the tape from the end of the crankshaft **(see illustrations)**.
10 Reconnect the wiring to the oil pressure switch.
11 On C 16 NZ2, 1.8 and 2.0 litre engines, fit a new oil filter, with reference to Chapter 1.
12 Refit the sump baffle (where applicable), oil pick-up tube and sump, as described in Section 29.
13 Refit the rear timing belt cover and the timing belt, and tension the timing belt as described in Section 11.



30.7 Fit a new oil pump gasket to the cylinder block - 2.0 litre engine



30.9A Oil pump inner gear must engage with hexagon flats on crankshaft (arrowed) on 1.4 and 1.6 litre engines . . .

30.9B . . .and with two flats (arrowed) on 1.8 and 2.0 litre engines

30.9C Tighten the oil pump securing bolts to the specified torque - 2.0 litre SOHC engine

31 Oil pump - dismantling, inspection and reassembly

Note: *A new crankshaft front oil seal must be used on reassembly*

Dismantling

1 With the oil pump removed as described in Section 30, continue as follows.
2 Remove the securing screws and withdraw the rear cover **(see illustration)**. The screws may be very tight, in which case it may be necessary to use an impact driver to remove them.

31.2 Removing an oil pump rear cover securing screw - 2.0 litre SOHC engine

31.3 Check the clearance between the inner and outer gear teeth . . .

31.4 . . .and between the edges of the gears and the housing - 2.0 litre SOHC engine

31.7 Oil pressure relief valve components - 2.0 litre SOHC engine

Inspection

3 Check the clearance between the inner and outer gear teeth (backlash) using a feeler blade **(see illustration)**.

4 Check the clearance between the edges of the gears and the housing (endfloat) using a straight edge and a feeler blade **(see illustration)**.

5 If any of the clearances are outside the specified limits, renew the components as necessary.

6 Ensure that the gears and the interior of the pump body are scrupulously clean before reassembly, and note that the outer gear is marked with a punch dot to indicate the gear outer face.

7 The oil pressure relief valve components can be removed from the pump by unscrewing the cap **(see illustration)**. Examine the spring and plunger, and renew if necessary.

Reassembly

8 Thoroughly clean the components before refitting.

9 Always renew the crankshaft front oil seal at the front of the oil pump housing. Prise out the old seal using a screwdriver, and fit the new seal using a socket or tube, so that it is flush with the outer face of the housing **(see illustrations)**.

10 Ensure that the mating faces of the rear cover and the pump housing are clean, then coat the pump housing mating face with sealing compound (Vauxhall part No 90485251, or equivalent) and refit the rear cover. Refit and tighten the securing screws.

11 Refit the pump, as described in Section 30.

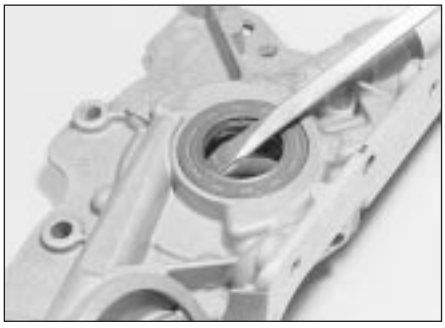
32 Pistons and connecting rods - removal and refitting

Note: *New big-end cap bolts must be used on refitting*

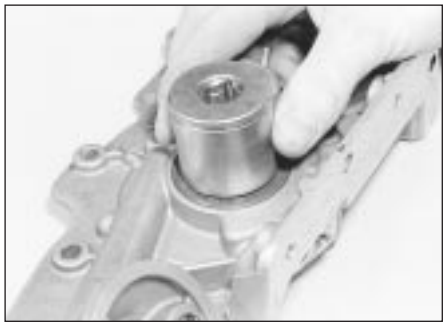
Removal

1 Remove the cylinder head, as described previously in Section 20.

2 Remove the sump, oil pick-up pipe and sump baffle (where applicable), as described in Section 29.



31.9A Prise out the old crankshaft front oil seal . . .



31.9B . . .and fit the new seal using a socket - 2.0 litre SOHC engine

3 If the connecting rods and big-end caps are not marked to indicate their positions in the cylinder block (i.e. cylinder numbers), centre-punch them at adjacent points either side of the cap/rod joint. Note to which side of the engine the marks face **(see illustration)**.

4 Unscrew the big-end cap bolts from the first connecting rod, and remove the cap. If the bearing shells are to be re-used, tape the cap and shell together.

5 Check the top of the piston bore for a wear ridge. If evident, carefully scrape it away with a ridge reaming tool, otherwise as the piston is pushed out of the block, the piston rings may jam against the ridge.

6 Place the wooden handle of a hammer against the bottom of the connecting rod, and push the piston/rod assembly up and out of the cylinder bore. Recover the bearing shell, and tape it to the connecting rod if it is to be re-used.

7 Remove the remaining three assemblies in a similar way. Rotate the crankshaft as necessary to bring the big-end bolts to the most accessible position.

8 The piston can be separated from the connecting rod by removing the circlips that secure the fully floating gudgeon pin. Note the orientation of the piston and connecting rod before separation, and if necessary, make alignment marks. Reassembly is a reversal of dismantling ensuring that the piston and connecting rod are correctly orientated.

9 The pistons and connecting rods can be examined for wear and damage, as described in Section 33, and the bearings can be examined as described in Section 35.

Refitting

10 Begin reassembly by laying the piston/connecting rod assemblies out in their correct order, complete with bearing shells, ready for refitting into their respective bores in the cylinder block.

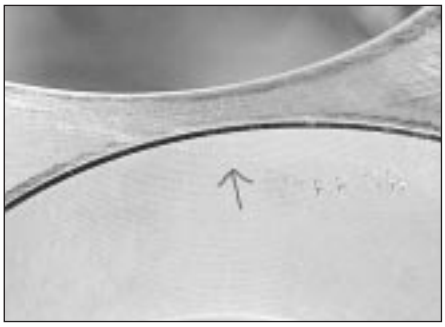
11 Ensure that the seats for the bearing shells are absolutely clean, and then fit the shells into the seats.

12 Wipe out the cylinder bores and oil them. Oil the piston rings liberally, and ensure that the ring gaps are positioned as described in Section 33.

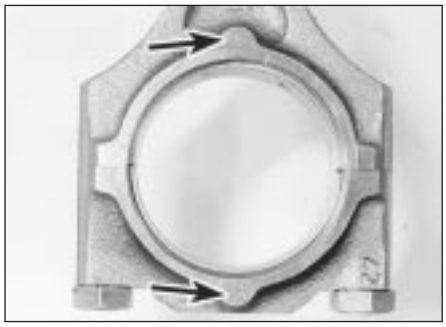
13 Fit a piston ring compressor tool to the first assembly to be installed.

32.3 Big-end cap centre punch identification marks (circled). Note that lug on bearing cap faces flywheel end of engine - 2.0 litre SOHC engine

32.14A Piston crown arrow must point towards timing belt end of engine - 1.6 litre engine



32.14B . . .and similarly for the 2.0 litre SOHC engine



32.14C Lugs (arrowed) on connecting rod and big-end cap must point towards flywheel end of engine - 1.6 litre engine

14 Insert the rod and piston into the top of the cylinder bore, so that the base of the compressor stands on the block. Check that the connecting rod markings are towards the side of the engine noted during removal. Note that the arrow or notch, as applicable, on the piston crown should point towards the timing belt end of the engine, and the lugs on the connecting rods should point towards the flywheel end of the engine **(see illustrations)**.

15 Apply the wooden handle of a hammer to the piston crown and tap the assembly into the bore, at the same time releasing the compressor **(see illustration)**.

16 Oil the relevant crankpin, then guide the big-end of the connecting rod near to the crankpin, and pull it firmly onto the crankpin. Ensure that the bearing shell remains in position in the connecting rod.

17 Fit the big-end cap, with the markings towards the side of the engine noted during removal **(see illustration)**. Note that the lug should point towards the flywheel end of the engine.

18 Fit new big-end cap bolts, and tighten them to the specified torque in the two stages given in the Specifications **(see illustrations)**.

19 Repeat the procedure on the remaining three assemblies.

20 Refit the sump baffle (where applicable), oil pick-up pipe and sump, as described in Section 29.

21 Refit the cylinder head, as described previously in this Section 20.

32.15 Tapping a piston into its bore - 2.0 litre SOHC engine

32.17 Fitting a big-end bearing cap - 2.0 litre SOHC engine

33 Pistons and connecting rods - examination and renovation

Examination

1 Examine the mating faces of the big-end caps to see if they have ever been filed, in a mistaken attempt to take up bearing wear. This is extremely unlikely, but if evident, the offending connecting rods and caps must be renewed.

2 Check the alignment of the rods visually, and if all is not well, take the rods to a Vauxhall dealer for a more detailed check.

3 The gudgeon pins are an interference (shrink) fit in the connecting rod small ends. Separation of the pistons and rods is a job for a dealer due to the special tools required, as is any remedial action required if the gudgeon pin is no longer an interference fit in the rod.

4 Examine the pistons for ovality, scoring and scratches.

5 If new rings are to be fitted to the existing pistons, expand the old rings over the tops of the pistons. The use of two or three old feeler blades will be helpful in preventing the rings dropping into empty grooves. Note that the oil control ring is in three sections, and note which way up each ring is fitted, for use when refitting **(see illustrations)**.

Renovation

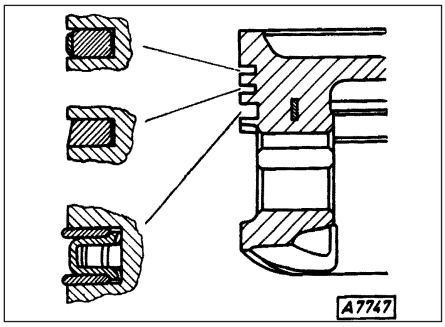
6 Before fitting the new rings to the pistons, insert them into their relevant cylinder bores, and check that the ring end gaps are within the specified limits using a feeler blade **(see illustration)**. Check the ring gaps at the upper and lower limits of the piston travel in the bores.

32.18A Tighten the big-end cap bolts to the specified torque . . .

32.18B . . .then through the specified angle - 2.0 litre SOHC engine

33.5A Using a feeler blade to aid removal of a piston ring - 2.0 litre SOHC engine

33.5B Removing the centre section of the oil control ring - 2.0 litre SOHC engine



33.5C Sectional view showing correct orientation of piston rings - all engines

7 If any of the ring end gaps exceed the specified tolerance, the relevant rings will have to be renewed, and if the ring grooves in the pistons are worn, new pistons may be required.
8 Clean out the piston ring grooves using a piece of old piston ring as a scraper. Take care not to scratch the surface of the pistons. Protect your fingers, piston ring edges are sharp. Also probe the groove oil return holes, to ensure that they are not blocked.
9 Check the cylinder bores for signs of wear ridges towards the top of the bores. If wear ridges are evident, and new piston rings are being fitted, the top ring must be stepped to clear the wear ridge, or the bore must be de-ridged using a scraper.
10 Fit the oil control ring sections with the lower steel ring gap offset 25 to 50 mm to the right of the spreader ring gap, and the upper steel ring gap offset by the same distance to the left of the spreader ring gap.
11 Fit the lower compression ring, noting that the ring is tapered or stepped. The ring should be fitted with the word "TOP" uppermost.
12 Fit the upper compression ring, and offset the ring gap by 180° to the lower compression ring gap. If a stepped ring is being fitted, fit the ring with the smaller diameter of the step uppermost.
13 If new pistons are to be fitted, they must be selected from the grades available, after measuring the cylinder bores as described in Section 36.
14 Normally the appropriate oversize pistons are supplied by the dealer when the block is rebored.
15 Whenever new piston rings are being installed, the glaze on the original cylinder bores should be "broken", using either abrasive paper or a glaze-removing tool in an electric drill. If abrasive paper is used, use strokes at 60° to the bore centre line, to create a cross-hatching effect.

34 Crankshaft and bearings - removal and refitting

Note: *New main bearing cap bolts must be used on refitting*

Removal

1 With the engine removed from the vehicle, continue as follows.
2 Remove the cylinder head, as described previously in Section 20.
3 Remove the sump, oil pick-up pipe and sump baffle (where applicable), as described in Section 29.
4 Remove the oil pump, as described in Section 30.
5 Remove the flywheel or flexplate (if applicable), as described in Sections 25 and 26.
6 Remove the pistons and connecting rods, as described in Section 32.
7 Invert the engine so that it is standing on the top face of the cylinder block.
8 The main bearing caps are numbered 1 to 4 from the timing belt end of the engine. The rear (flywheel end) cap is not marked. To ensure that the caps are refitted the correct way round, note that the numbers are read from the coolant pump side of the engine with the engine inverted **(see illustration)**.
9 Unscrew and remove the main bearing cap bolts, and tap off the bearing caps. If the bearing shells are to be re-used, tape them to their respective caps.
10 Note that the centre bearing shell incorporates thrust flanges to control crankshaft endfloat.
11 Lift the crankshaft (complete with timing sensor wheel, if fitted), from the crankcase.
12 Extract the upper bearing shells, and identify them for position if they are to be re-used.
13 The crankshaft, bearings and sensor wheel can be examined for wear and damage, as described in Section 35, and the cylinder block and bores can be examined as described in Section 36.

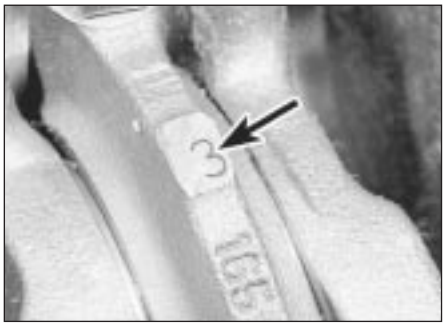
Refitting

14 Begin refitting by ensuring that the crankcase and crankshaft are thoroughly clean, and that all oilways are clear. If possible, blow through the oil drillings with compressed air, and inject clean engine oil into them.

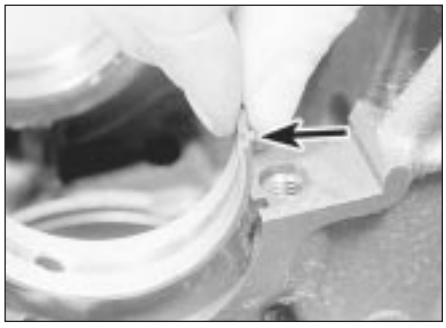
> **HAYNES HiNT** ***A good alternative to compressed air, is to use a water dispersing lubricant spray into each hole, using the spout provided.***

15 If the crankshaft is being replaced, where applicable, transfer the timing sensor wheel and tighten to correct torque.
16 Wipe clean the bearing shell seats in the crankcase and the bearing caps, then fit the upper bearing shells to their seats.
17 Note that there is a tag on the back of each bearing shell, which engages with a groove in the relevant seat in the crankcase or bearing cap **(see illustration)**.
18 If new bearing shells are being fitted, wipe away all traces of protective grease.

33.6 Measuring a piston ring end gap using a feeler blade



34.8 Main bearing cap identification mark (arrowed) - 1.6 litre engine



34.17 Main bearing shell tag (arrowed) engages with groove in cylinder block - 2.0 litre SOHC engine

34.19 Fitting a central main bearing shell. Note thrust flanges - 2.0 litre SOHC engine

19 Note that the central bearing shells have thrust flanges which control crankshaft endfloat **(see illustration)**. Note also that the shells fitted to the crankcase all have oil duct holes, while only the centre main bearing cap shell has an oil duct hole.

20 When the shells are firmly located in the crankcase and the bearing caps, lubricate them with clean engine oil.

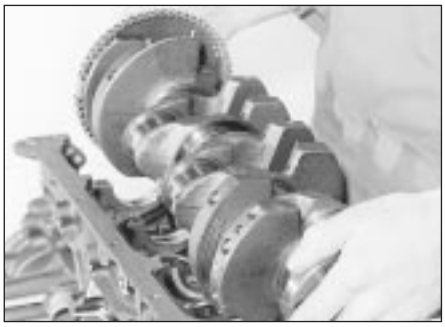
21 Fill the lips of a new crankshaft rear oil seal with grease, and fit it to the end of the crankshaft.

22 Carefully lower the crankshaft into position in the crankcase **(see illustration)**.

23 If necessary, seat the crankshaft using light blows with a rubber hammer on the crankshaft balance webs.

24 Lubricate the main bearing journals and shells **(see illustration)**, and then fit numbers 2, 3 and 4 main bearing caps, and tighten the new bolts as far as possible by hand.

34.27A Tighten the main bearing cap bolts to the specified torque . . .



34.22 Lowering the crankshaft into the crankcase - 2.0 litre SOHC engine

34.25A Fill the side grooves of the rear main bearing cap with RTV jointing compound . . .

25 Fill the side grooves of the rear main bearing cap with RTV jointing compound (Vauxhall part No 90485251, or equivalent). Coat the lower surfaces of the bearing cap with sealing compound (Vauxhall part No 15 04 200, or equivalent), **(see illustrations)**. Fit the bearing cap, and tighten the new bolts as far as possible by hand.

26 Fit the front (No 1) main bearing cap, and tighten the new bolts as far as possible by hand, ensuring that the bearing cap is exactly flush with the end face of the cylinder block.

27 Working from the centre bearing cap outwards, tighten the bearing cap securing bolts to the specified torque in the two stages given in the Specifications; i.e. tighten all bolts to Stage 1, then tighten all bolts to Stage 2 and Stage 3 **(see illustrations)**.

34.24 Lubricate the main bearing shells before fitting the caps - 2.0 litre SOHC engine

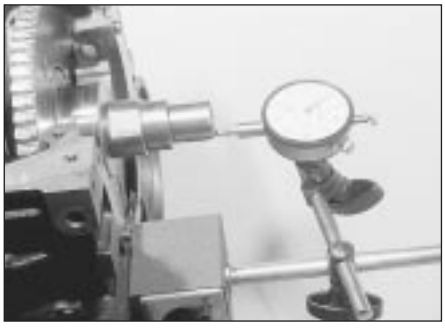
34.25B . . .and the lower surfaces with sealing compound - 2.0 litre SOHC engine

28 When all bolts have been fully tightened, inject further RTV jointing compound into the side grooves of the rear main bearing cap, until it is certain that they are full.

29 Now rotate the crankshaft, and check that it turns freely, with no signs of binding or tight spots.

30 Check that the crankshaft endfloat is within the specified limits, using a dial gauge, or by inserting a feeler blade between the thrust flange of the centre main bearing shell and the machined surface of the crankshaft **(see illustrations)**. Before measuring, ensure that the crankshaft is fully forced towards one end of the crankcase, to give the widest possible gap at the measuring location. Incorrect endfloat will most likely be due to crankshaft wear or to incorrect regrinding, assuming that the correct bearing shells have been fitted.

34.27B . . .then through the specified angle - 2.0 litre SOHC engine



34.30A Check crankshaft endfloat using a dial gauge . . .

34.30B . . .or a feeler blade - 2.0 litre SOHC engine

31 Refit the previously removed components, referring to the relevant Sections of this Chapter.

35 Crankshaft and bearings - examination

Examination

1 Examine the crankpin and main journal surfaces for signs of scoring or scratches, and check the ovality and taper of the crankpins and main journals. If the bearing surface dimensions do not fall within the tolerance ranges given in the Specifications at the beginning of this Chapter, the crankpins and/or main journals will have to be reground.
2 Big-end and crankpin wear is accompanied by distinct metallic knocking, particularly noticeable when the engine is pulling from low revs, and some loss of oil pressure.
3 Main bearing and main journal wear is accompanied by severe engine vibration rumble - getting progressively worse as engine rev's increase - and again by loss of oil pressure.
4 If the crankshaft requires regrinding, take it to an engine reconditioning specialist, who will machine it for you and supply the correct undersize bearing shells.
5 Inspect the big-end and main bearing shells for signs of general wear, scoring, pitting and scratches. The bearings should be matt grey in colour. With leadindium bearings, should a trace of copper colour be noticed, the bearings are badly worn, as the lead bearing material has worn away to expose the indium underlay. Renew the bearings if they are in this condition, or if there are any signs of scoring or pitting. ***You are strongly advised to renew the bearings - regardless of their condition at time of major overhaul. Refitting used bearings is a false economy.***
6 The undersizes available are designed to correspond with crankshaft regrind sizes. The bearings are in fact, slightly more than the stated undersize, as running clearances have been allowed for during their manufacture.
7 Main and big-end bearing shells can be identified as to size by the marking on the back of the shell. Standard size shell bearings are marked STD or .00, undersize shells are marked with the undersize such as 0.020 u/s. This marking method applies only to replacement bearing shells, and not to those used during production.
8 An accurate method of determining bearing wear is by using a Plastigage. The crankshaft is located in the main bearings (and, if necessary, the big-end bearings), and the Plastigage filament is located across the journal. Vauxhall recommend that the crankshaft journal and bearing shells are lightly lubricated, to prevent the Plastigage from tearing as the bearing cap is removed. The bearing cap should be fitted, and the bolts tightened to the specified torque. The cap is then removed, and the width of the filament is checked against a scale that shows the bearing running clearance. The clearance should be compared with that given in the Specifications.
9 Where applicable, check the teeth of the crankshaft TDC sensor wheel for damage **(see illustration).** If evident, the crankshaft must be renewed.
10 Similarly, check the condition of the pins in the front crankshaft balance weight, which serve as detect points for the plug-in diagnostic sensor used by Vauxhall dealers **(see illustration)**.

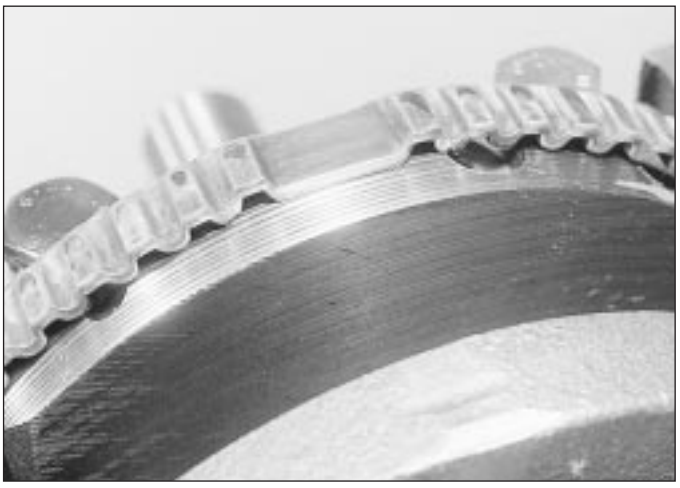
36 Cylinder block and bores - examination and renovation

Examination

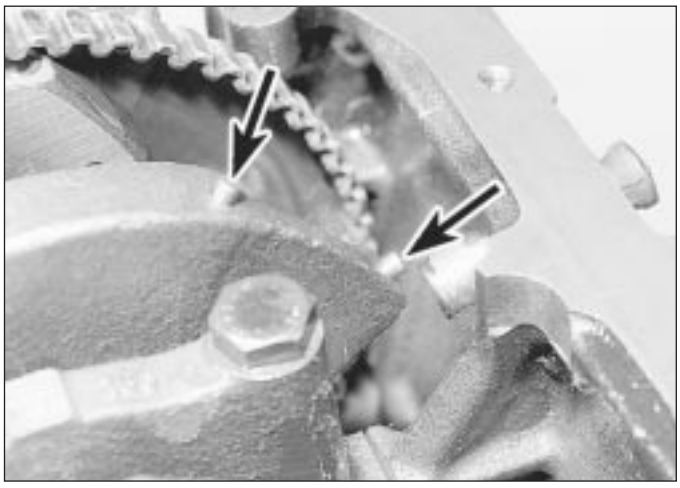
1 Examine the cylinder bores for taper, ovality, scoring and scratches. Start by carefully examining the top of the cylinder bores. If they are at all worn, a very slight ridge will be found on the thrust side. This marks the top of the piston ring travel. The owner will have a good indication of the bore wear before dismantling the engine, or removing the cylinder head. Excessive oil consumption, accompanied by blue smoke from the exhaust, is a sure sign of worn cylinder bores and piston rings.
2 Measure the bore diameter across the block, and just below any ridge. This can be done with an internal micrometer or a dial gauge. Compare this with the diameter of the bottom of the bore, which is not subject to wear. If no measuring instruments are available, use a piston from which the rings have been removed, and measure the gap between it and the cylinder wall with a feeler blade. Refer to the Specifications. If the cylinder wear exceeds the permitted tolerances, then the cylinders will need reboring, in which case note the following points:

a) Piston and cylinder bores are closely matched in production. The actual diameter of the piston is indicated by numbers on its crown; the same numbers stamped on the crankcase indicate the bore diameter
b) After reboring has taken place, the cylinder bores should be measured accurately and oversize pistons selected from the grades available to give the specified piston-to-bore clearance
c) For grading purposes, the piston diameter is measured across the bottom of the skirt

3 If the wear is marginal and within the tolerances given, new special piston rings can be fitted to offset the wear.
4 Thoroughly examine the crankcase and cylinder block for cracks and damage, and use a piece of wire to probe all oilways and waterways to ensure that they are unobstructed.



35.9 Check the condition of the TDC sensor wheel teeth at the front of the crankshaft - 2.0 litre SOHC engine



35.10 Check the condition of the pins (arrowed) in the front crankshaft balance weight - 2.0 litre SOHC engine

5 Note that the rubber plug located next to the bellhousing flange on the cylinder block covers the aperture for the installation of a diagnostic TDC sensor. The sensor, when connected to a monitoring unit, indicates TDC from the position of the pins set into the crankshaft balance weight.

37 Examination and renovation - general

General

1 With the engine completely stripped, clean all components and examine them for wear. Each component should be checked, and where necessary renewed or renovated, as described in the relevant Sections of this Chapter.

2 Renew main and big-end bearing shells as a matter of course, unless it is known that they have had little wear, and are in perfect condition.

3 If in doubt whether to renew a component that is still just serviceable, consider the time and effort that will be incurred should the component fail at an early date after rebuild. Obviously, the age and expected life of the vehicle must influence the standards applied.

4 Gaskets, oil seals and O-rings must all be renewed as a matter of routine. Flywheel, cylinder head, and main and big-end bearing cap bolts must be renewed, because of the high stress to which they are subjected.

5 Renew the engine core plugs while they are easily accessible, if they show signs of leakage. Knock out the old plugs with a hammer and chisel or punch. Clean the plug seats, smear the new plugs with sealing compound, and tap them squarely into position.

38 Initial start-up after major overhaul or repair

1 Make a final check to ensure that everything has been reconnected to the engine, and that no rags or tools have been left in the engine compartment.

2 Check that oil and coolant levels are correct.

3 Start the engine. This may take a little longer than usual, as fuel is pumped to the engine.

4 Check that the oil pressure warning lamp goes out when the engine starts. This may take a few seconds as the new oil filter fills with oil.

5 Run the engine at a fast tickover, and check for leaks of oil, fuel and coolant. If a new camshaft has been fitted, pay careful attention to the running-in procedure given in Section 18, paragraphs 17 and 18. Where applicable, check the power steering and/or automatic transmission fluid cooler unions for leakage. Some smoke and odd smells may be experienced, as assembly lubricants and sealers burn off the various components.

6 Bring the engine to normal operating temperature. Check the ignition timing, idle speed and the mixture (where applicable), as described in Chapter 4A or 4B.

7 Allow the engine to cool, then recheck the oil and coolant levels. Top-up if necessary

8 If new bearings, pistons, etc., have been fitted, the engine should be run-in at reduced speeds and loads for the first 500 miles (800 km) or so. It is beneficial to change the engine oil and filter after this mileage.