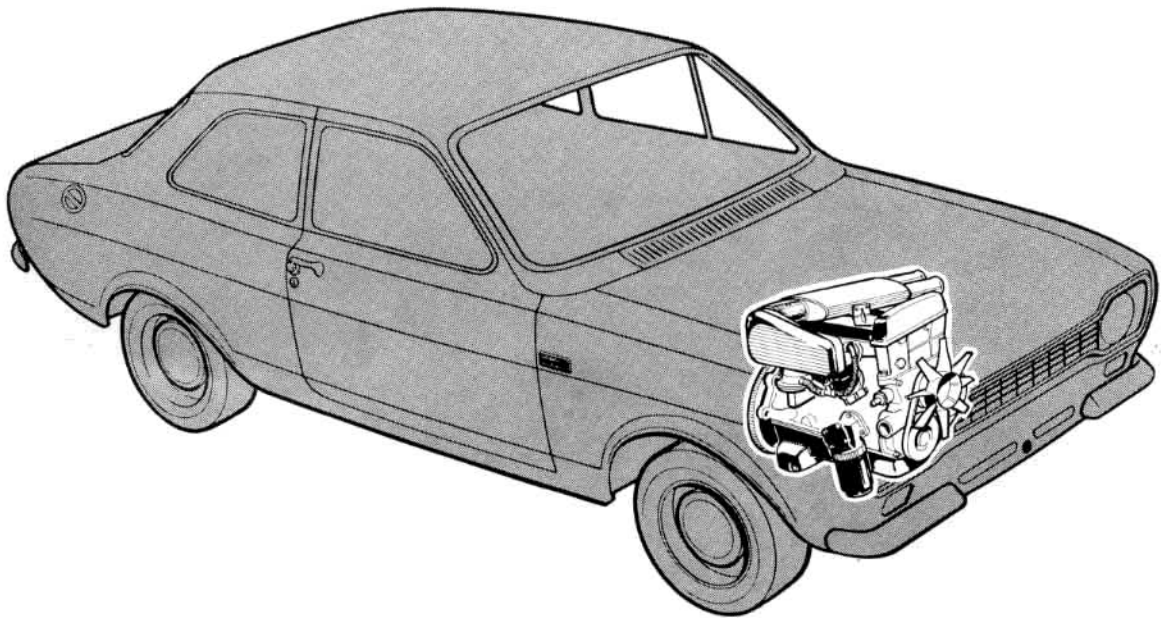


6/1
ENGINE



ESCORT TWIN CAM

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-

GENERAL DESCRIPTION

The engine is a four cylinder, twin overhead camshaft unit with a bore of 3.2506 in. (82.565 mm.) and a stroke of 2.867 in. (72.746 mm.). The capacity is 95.2 cu. in. (1,560 c.c.) and the compression ratio is 9.5 : 1.

The cylinder bores are machined directly in the cast iron cylinder block, which is cast integral with the upper half of the crankcase, and are provided with full length water jacketing.

The cast iron crankshaft runs in five large diameter main bearings fitted with steel-backed copper/lead bearing liners. End-float and thrust are controlled by half-thrust washers located in the cylinder block on either side of the centre main bearing.

Seals pressed in the front cover and the rear oil seal carrier prevent oil leaks from the front and rear of the crankshaft. The front seal runs on the pulley hub whilst the rear seal runs on the crankshaft flange itself. Either a sintered bronze spigot or needle roller bearing is pressed into the end of the crankshaft to support the gearbox first motion shaft.

The connecting rods are 'H' section forgings having separate big end caps retained by two bolts and located by spring dowel pins. Big end bearing liners are, again, steel-backed copper/lead. The small ends have steel-backed bronze bushes.

Solid skirt aluminium alloy pistons with two compression and one oil control ring situated above the piston pin bore are used. The piston pins are fully floating and are retained in position by circlips installed in grooves at each end of the piston pin bore.

The cylinder head is an aluminium casting with fully machined hemispherical combustion chambers and separate ports for each valve. The valves, which have replaceable guides and valve seat inserts, are inclined to each other and the inlets are larger than the exhausts. The valves are operated by two overhead camshafts, one for inlet valves and one for exhaust, the valves being opened directly by the cams acting on piston-type tappets.

The camshafts are driven at half engine speed by a single row timing chain from a sprocket on the crankshaft via a sprocket on an auxiliary shaft and an idler sprocket on an adjustable tensioner. The camshafts each run in five bearings which have steel-backed white metal liners. A shoulder at the front of the camshaft locates it axially in the cylinder head and controls end-float.

The auxiliary shaft is a modification of the camshaft normally used in the push rod overhead valve unit and is retained to drive the oil pump, distributor and fuel pump. The auxiliary shaft runs in three steel-backed white metal bushes and is located by a sintered metal thrust plate bolted to the cylinder block front face. A skew gear, integral with the auxiliary shaft drives the distributor and oil pump, which are both mounted on the right-hand side of the engine. An eccentric, on the auxiliary shaft, operates the fuel lift pump also situated on the right-hand side of the engine towards the rear. The front journal of the auxiliary shaft has four slots machined in its periphery to regulate the supply of oil to the camshafts and tappet gear.

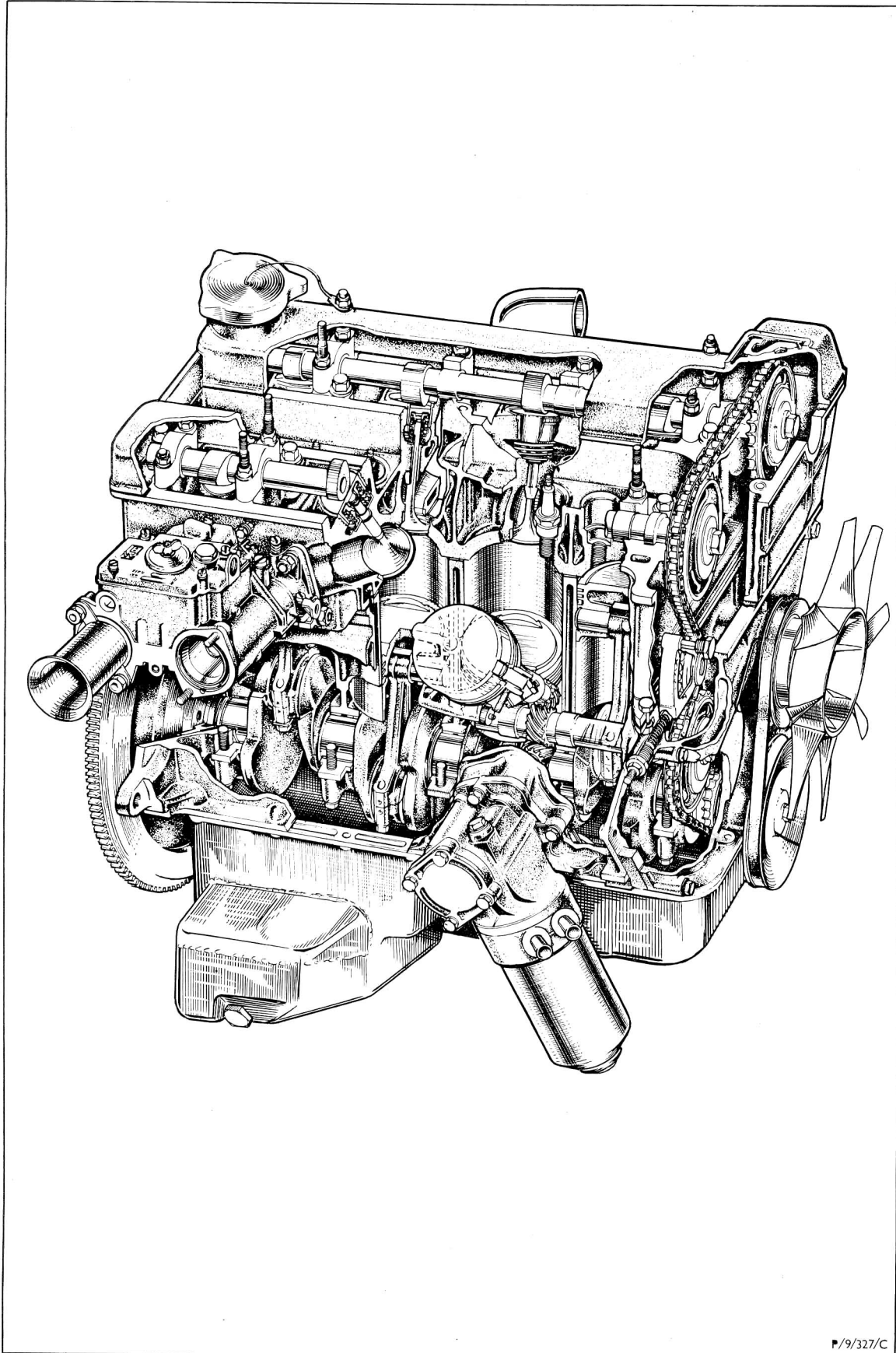
A cast iron flywheel is mounted on the crankshaft flange and ensures a smooth-running engine. The drive for the starter motor is provided by a steel ring gear shrunk onto the flywheel periphery.

The sump is a steel fabrication and has a rear well for the lubricating oil. The engine lubrication system is the force feed type incorporating a full flow oil filter. The oil pump, which is mounted externally on the engine, is of the eccentric bi-rotor type incorporating a non-adjustable plunger type relief valve. An oil cooler is fitted as standard to all vehicles and is located behind the radiator grille on the left-hand side. The oil "take-off" is from an adaptor assembled with the oil filter bowl.

An oil filler is located in the camshaft cover. Crankcase ventilation is by a closed system, crankcase fumes being discharged directly into the carburettor air intake cover.

A three point mounting for the engine and gearbox assembly is provided on sandwich type rubber insulators.

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The Engine Assembly

CYLINDER BLOCK

The cylinder block is cast iron and is cast integral with the upper half of the crankcase and is basically a 1,500 block bored out. This cylinder block can be identified by the number, 681F-6015-GA cast on the left-hand side of the block in place of the cast number prefix. Provision is made, at the rear right-hand side, for the dipstick, which locates in a tube pressed into the crankcase.

Internally the crankcase incorporates five main bearings with removable caps retained by bolts fitted without lockwashers. The intermediate and rear caps are identical, but their positions must not be interchanged. When dismantling these caps ensure that their positions are marked, this is normally done, in production, by a number 2 stamped on the front intermediate cap and 4 on the rear intermediate cap. The rear cap is not marked. All caps must be fitted with the cast arrows pointing forwards.

The cylinder bores are machined directly into the cylinder block and, in production, are graded for size, the grade number, of each bore, being stamped on the push rod side of the cylinder block adjacent to the top face.

CYLINDER HEAD

The cylinder head is an aluminium casting with fully machined hemispherical combustion chambers giving a compression ratio of 9.5 : 1, and having separate ports for each valve.

The cylinder head is secured to the cylinder block by ten $\frac{7}{16}$ in. (11.11 mm.) diameter bolts, 5.7 in. (144.78 mm.) long, with plain washers. The washers for the front left-hand bolts and the rear right-hand bolts have flats to provide clearance for the exhaust camshaft collar and the inlet camshaft rear bearing cap respectively. Three additional bolts, one each side of the front cover and one at the front of the cylinder head, in the centre, secure the front of the cylinder head to the timing case.

The tightness of the cylinder head bolts should be checked, with the engine cold, at the first 600 miles (1,000 km.) service. The tightness should also be checked 600 miles (1,000 km.) after replacing the cylinder head should it have been removed for any reason.

The cylinder head gasket is made of asbestos covered with copper on the top and tinplate underneath.

The valves are in two banks, the inlets on the right and the exhausts on the left, and operate in replaceable guides pressed into the cylinder head. These guides are located by circlips which are retained by the valve spring seats. The inlet and exhaust valve guides are not identical, the inlet guide being 1.520 in. (38.61 mm.) long and the exhaust 1.480 in. (37.59 mm.) The two guides may be readily identified by the fact that the inlet has a taper at the port end, which is 0.4 in. (10.16 mm.) long, whereas the exhaust guide is only slightly tapered, 0.2 in. (5.08 mm.) long. The valve guides may be removed and replaced, using a suitable remover and replacer tool. When replacing the valve guides heat the cylinder head to 100 to 150°C. (212 to 302°F.). Valve guides are also available in 0.001 in. (0.03 mm.), 0.005 in. (0.13 mm.) and 0.006 in. (0.15 mm.) oversizes on the outside diameter, and it is advisable to check the size against the originals when replacing guides.

After fitting, ream the valve guide bore 0.3113 to 0.3123 in. (7.907 to 7.932 mm.) using a suitable reamer. The valve seats must be recut, with the appropriate cutters, and the valves lapped in to ensure that the seal is concentric with the valve stem bore.

Recut the seats with the appropriate cutters fitted to pilot Tool No. 316-10 in handle Tool No. 316X. Where necessary the seats may be narrowed with top face and port cutters. If there is a hard glazed carbon deposit on the seat this may be removed with a glaze breaker. The valve seats should also be recut when they show signs of pitting or burning.

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Cutter Tool Number			
Seat 45°	Top Face-15°	Port-75°	Glaze Breaker-45°
317-25	317T-25	317P-22	317G-25

The valve seats have inserts which can be replaced when they become pocketed and can be obtained in 0.005 in. (0.127 mm.), 0.010 in. (0.254 mm.), 0.015 in. (0.381 mm.) oversizes.

Remove the inserts by machining two grooves 180° apart and using a small chisel remove the remaining metal in the grooves, when the insert can be prised out of its location. Care must be taken during this operation to avoid damage to the sides and bottom of the recess. Machine the recess to the required dimension appropriate to the selected replacement insert (see table below). When fitting new inserts the cylinder head should be heated to a temperature of 200°C (392°F) maximum and immersing the valve seat inserts to a temperature not lower than -80°C (-112°F). Press the insert into place, using a suitable replacer tool and allow the cylinder head to cool slowly and evenly in air.

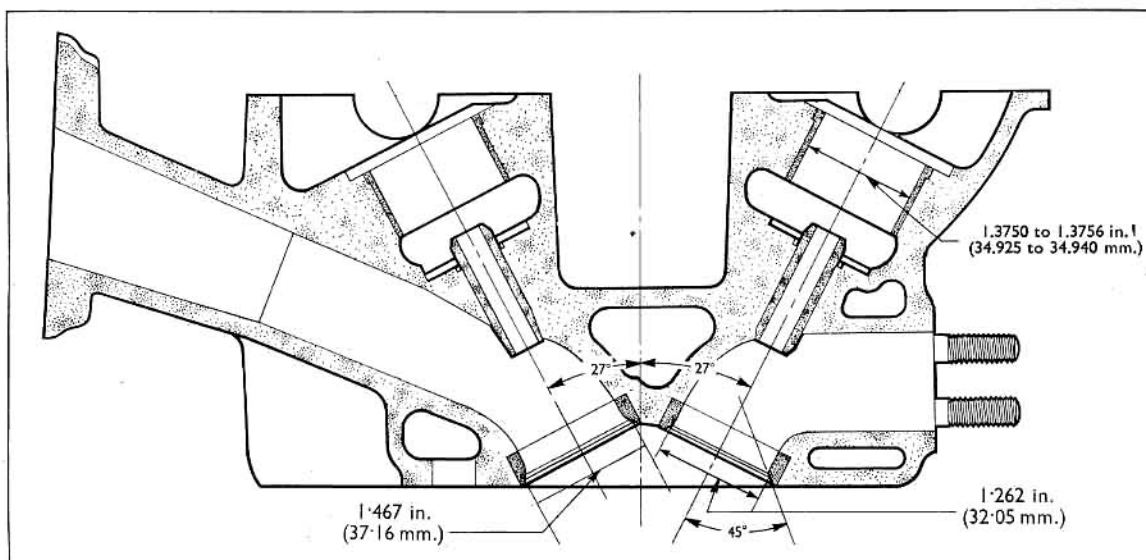
VALVE SEAT INSERTS

INLET

Size	Dimensions	Recess diameter
Standard	1.6245 in.—1.6235 in.	1.621 in.—1.620 in.
+0.005 in.	1.6295 in.—1.6285 in.	1.626 in.—1.625 in.
+0.010 in.	1.6345 in.—1.6335 in.	1.631 in.—1.630 in.
+0.015 in.	1.6395 in.—1.6385 in.	1.636 in.—1.635 in.

EXHAUST

Size	Dimensions	Recess diameter
Standard	1.4995 in.—1.4985 in.	1.496 in.—1.495 in.
+0.005 in.	1.5045 in.—1.5035 in.	1.501 in.—1.500 in.
+0.010 in.	1.5095 in.—1.5085 in.	1.506 in.—1.505 in.
+0.015 in.	1.5145 in.—1.5135 in.	1.511 in.—1.510 in.



Tappet Sleeve Bore and Valve Seat Insert Dimensions

The tappet bores are sleeved, these being available in 0.001 in. (0.025 mm.) and 0.015 in. (0.38 mm.) oversize. Should it be necessary to fit new sleeves, the cylinder head must be machined to obtain an interference fit of 0.0035 in. (0.089 mm.) to 0.0045 in. (0.114 mm.) between the head and the new tappet sleeve. Heat the cylinder head to 150°C (302°F) before fitting the sleeves. When cool machine the sleeve bore to the dimensions shown. After machining, recut the scallops to give clearance to the cams.

EXHAUST MANIFOLDS

The free flow multi-branch exhaust manifold is fabricated from welded steel tubes and has a separate pipe for each cylinder. These pipes are paired together, Nos. 1 and 4 forming one pair and Nos. 2 and 3, which pass inside of Nos. 1 and 4, the other, the pipes of each pair being joined to form a common outlet. The outlet pipes from each pair then enter the exhaust system. The exhaust manifold assembly is secured to the cylinder head by flanges welded to the pipe ends and retained with brass nuts.

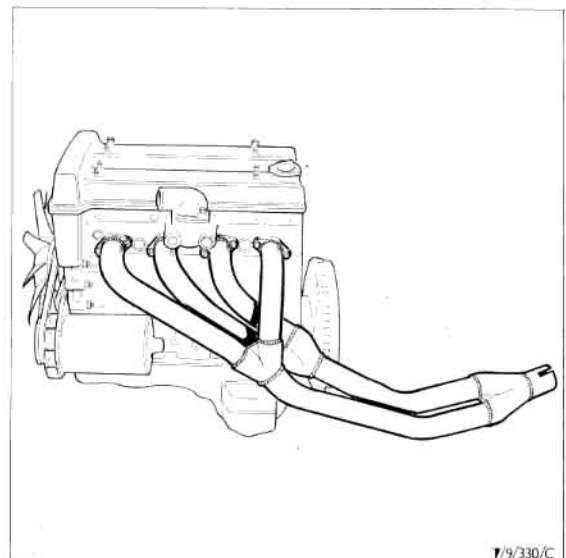
TIMING CASE

The timing case is made in two pieces, a back plate on the cylinder block and a front cover which also incorporates the water pump. Four timing marks are also incorporated on the front cover which, when a timing mark on the rear flange of the crankshaft pulley is aligned with one of them gives 30° B.T.D.C., 20° B.T.D.C., 10° B.T.D.C. and T.D.C. respectively.

The back plate is located on the cylinder block front face by a single bolt situated immediately below the water pump and is retained by the front cover, the front cover bolts passing through the back plate into the cylinder block. Where the back plate is not directly attached to the cylinder block, the back plate and front cover are secured together with nuts and bolts having fine threads. All bolts screwing into the cylinder block have coarse threads. As the bolts have different lengths and threads it is important that they are correctly located, as shown.

- (1) Bolt $\frac{1}{4}$ in. – 20 U.N.C. \times 2 $\frac{1}{4}$ in. long
- (2) Bolt $\frac{1}{4}$ in. – 28 U.N.F. \times 2 $\frac{1}{4}$ in. long and nut
- (3) Bolt $\frac{5}{16}$ in. – 18 U.N.C. \times 2 $\frac{1}{4}$ in. long
- (4) Bolt $\frac{5}{16}$ in. – 18 U.N.C. \times 1 in. long
- (5) Bolt $\frac{1}{4}$ in. – 20 U.N.C. \times $\frac{3}{4}$ in. long
- (6) Bolt $\frac{5}{16}$ in. – 18 U.N.C. \times 1 $\frac{1}{4}$ in. long
- (7) Bolt $\frac{5}{16}$ in. – 24 U.N.F. \times 1 $\frac{3}{4}$ in. long and nut

Exhaust Manifolds



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The back plate gasket is made of brown waxed paper and must be fitted without sealer as this may clog the timing chain oil feed. Before assembling the back plate to the cylinder block, check that it is flat. Ensure that the back plate lies flat on the cylinder block front face and is not held proud by the main oil gallery plug.

The front cover is fitted without a gasket, an oil-tight joint being made by using ESEE-M4G-1008A jointing compound. A gasket on top of the front cover and back plate seals the joint between the cylinder head and the timing case. Three bolts are on each side of the front cover and one at the front of the cylinder head in the centre under the camshaft cover, secure the timing case to the cylinder head.

To prevent oil leaks from around the crankshaft pulley boss an oil seal is pressed in the front cover.

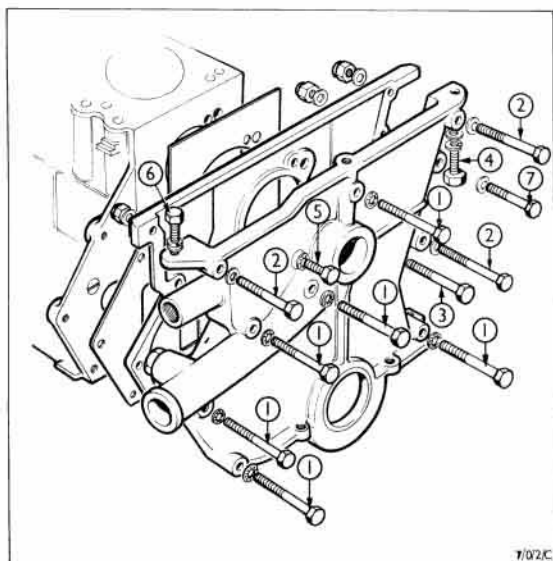
The oil seal can be removed, after first removing the front cover, by supporting the cover around the seal and driving the seal out from the rear with remover Tool No. P.6161 fitted to a 550 handle. Invert the tool and drive a new seal into the housing, again from the rear, and supporting the cover around the seal. The use of Tool No. P.6161 ensures that the seal protrudes $\frac{3}{16}$ in. (1.19 mm.) inside the cover.

When fitting the cover it is important that the oil seal is aligned concentrically with the crankshaft and pulley boss. To facilitate this a centraliser Tool No. P.6150 is inserted into the seal while fitting the cover.

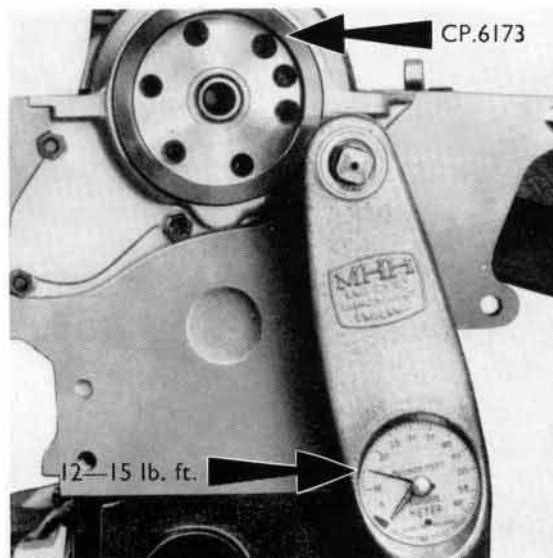
REAR OIL SEAL CARRIER

The crankshaft rear oil seal is pressed into the aluminium carrier, bolted to the cylinder block rear face, and runs on the periphery of the flywheel mounting flange. After removing the carrier, the oil seal can be easily replaced. Support the carrier, close to the seal, and drive the seal out, using a remover/replacer Tool No. P.6165 fitted to a 550 handle. Reverse the carrier, the remover/replacer tool and fit a new seal.

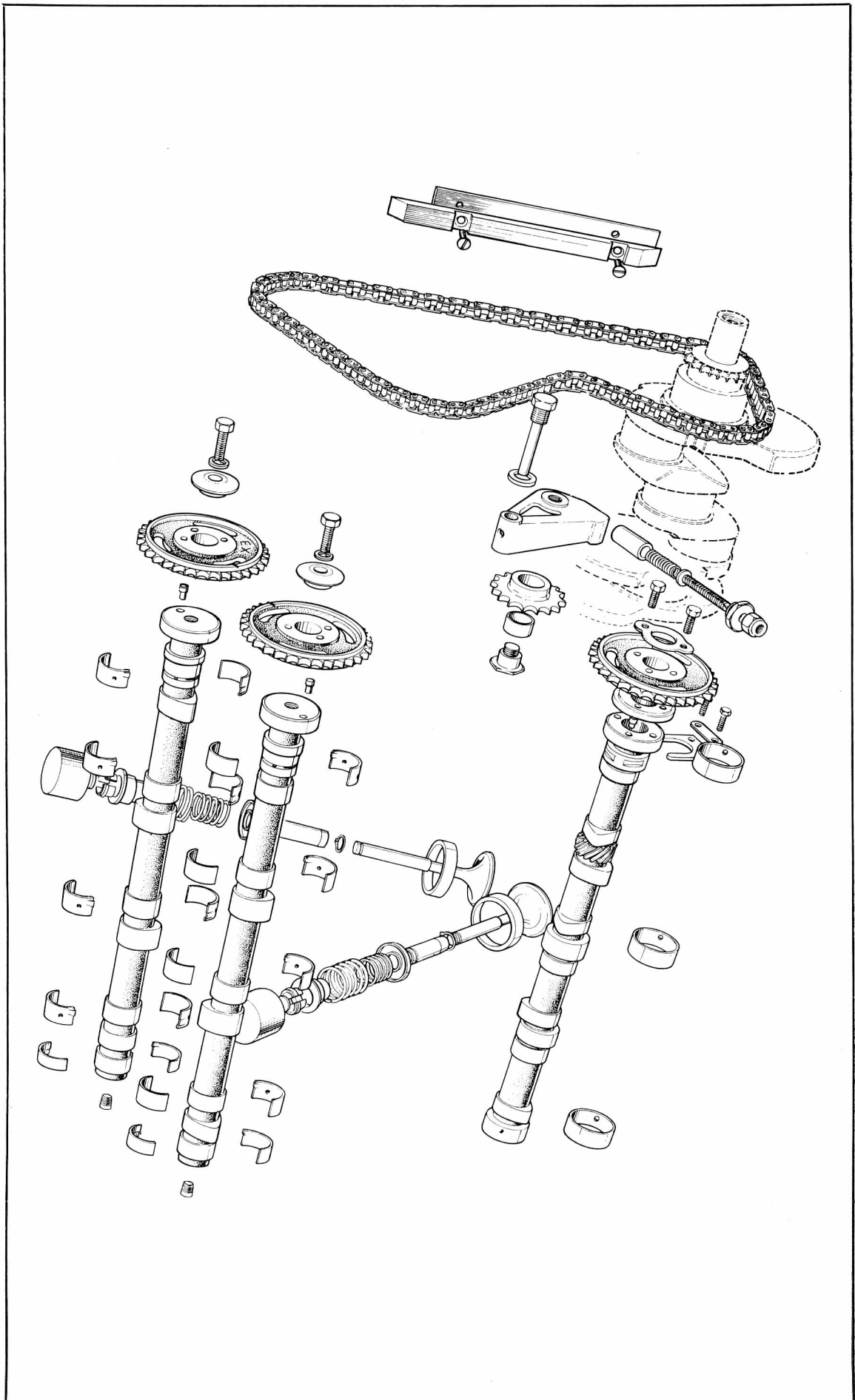
When fitting the carrier the seal must be aligned concentrically with the crankshaft if oil leaks are to be avoided. Locate a centraliser Tool No. CP.6173 in the seal and over the crankshaft while tightening the seal carrier retaining bolts.



Front Cover Bolt Locations



Crankshaft Rear Oil Seal Alignment



Valve Operating Mechanism

SUMP

The fabricated steel sump has a rear well, incorporating a longitudinal baffle, for the lubricating oil and is bolted to the base of the cylinder block. A drain plug is located in the right-hand side. The gaskets are made of cork with aluminium foil lamination.

When fitting the sump apply sealer ESEE-M4G-1008A to the front cover and rear oil seal carrier to cylinder block joints, and also to the ends of the grooves in the front cover and rear oil seal carrier. Then fit new sump gasket, followed by the cork packing strips. Refit the sump and tighten the bolts following the procedure described on page 28.

CAMSHAFT COVER

The camshafts and valves are enclosed by an aluminium cover, which also covers the camshaft sprockets and chain. This cover is retained by eight self-locking nuts and flat washers which screw onto four of the camshaft bearing cap studs. The camshaft cover gasket is made of cork. Jointing compound is not normally used, although it can be applied to the cover to hold the gasket in place.

The oil filler cap is situated on the camshaft cover at the rear of the left-hand side.

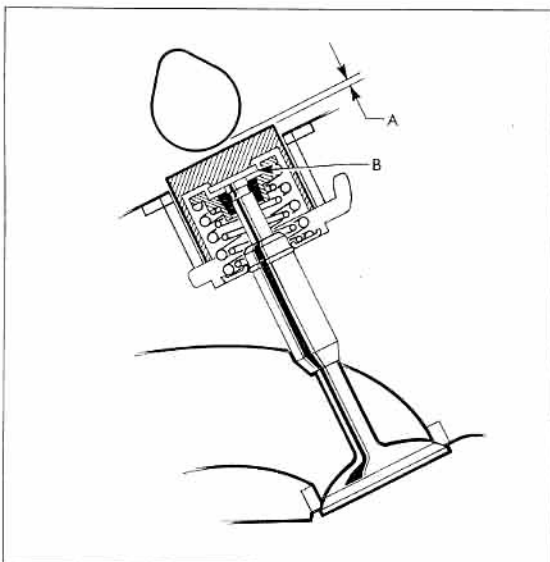
VALVES AND SPRINGS

The valves, which have 45° seats, are inclined at 27° to the vertical, the inlet valve head being larger than the exhaust. Their respective diameters are 1 ¹⁷/₃₂ in. (38.89 mm.) and 1 ⁵/₁₆ in. (33.34 mm.).

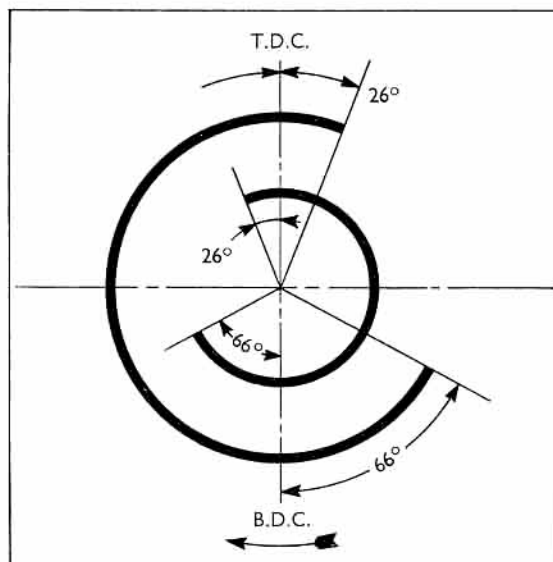
The valves are fitted with double valve springs, the inner spring has right-hand coils and the outer left-hand. The springs sit on a pressed steel seat located around the valve guide and retained by the valve guide circlips. The springs are attached to the valve stems by spring retainers with tapered split collets. The valve springs may be fitted either way round.

CAMSHAFTS AND TAPPETS

The valves are operated by two identical overhead camshafts, one for inlet valves and one for exhaust valves, the valves being opened directly by the cams acting on piston type tappets. The tappets are located in the cylinder head immediately above the valves. All the tappet bores



Valve and Tappet
(‘A’=Clearance ‘B’=Shims)



Nominal Valve Timing Diagram

in the cylinder head have sleeves. The valve clearances are adjusted by shims located underneath the tappets and resting in the valve spring retainer on top of the valve stem. The shims are available in a number of sizes from 0.065 in. (1.651 mm.) to 0.120 in. (3.048 mm.) in increments of 0.001 in. (0.025 mm.). The shim's thickness is etched around the periphery although originally it was etched on one side. When fitting this type the etched side must be adjacent to the valve stem. Any roughness caused by the etching should be removed before fitting the shim by rubbing on fine emery cloth.

The two camshafts, which are identical, give a lift of 0.35 in. (8.89 mm.) and the timing shown. The camshafts each run in five bearings with steel-backed white metal liners, four of them $\frac{3}{4}$ in. (19.05 mm.) wide and the rear one $\frac{1}{2}$ in. (12.7 mm.).

The camshaft bearing caps are located by studs screwed into the cylinder head and retained by self-locking nuts and flat washers. These caps must always be kept in their respective positions and are numbered to facilitate this. The numbers are also stamped on the cylinder head adjacent to the bearing caps.

Adjusting Valve Clearances

The valve clearances should be, inlet 0.005 to 0.007 in. (0.13 to 0.18 mm.) and exhaust 0.006 to 0.008 in. (0.15 to 0.20 mm.). Later exhaust valves with Part No. B26E020 rolled on the stem have a clearance of 0.009 in. (0.23 mm.) to 0.011 in. (0.28 mm.).

In order to check the clearance of a valve, turn the camshaft until the toe of the cam is at 180° to the tappet being checked. Then select a feeler blade or blades that can just be inserted between the tappet and the heel of the cam to measure the clearance. Note the clearance and repeat the procedure for the other valves.

Should the clearances require adjusting, remove the appropriate camshaft by unscrewing the bearing cap nuts evenly and lift the camshaft out.

NOTE – If this operation is being done on the engine it will be necessary to remove the camshaft sprocket first. To facilitate replacement it is advisable to set the valve timing marks and to slacken the timing chain tensioner before removing the sprocket.

Remove the tappets by lifting them out with a valve grinding sucker and remove the shims, keeping them in their correct order. The correct clearance may be obtained by fitting a different size shim between the valve stem and tappet. A thinner shim will be required to increase the valve clearance and a thicker one to reduce the clearance. The shim's thickness is etched around the periphery or on the side, but if this has worn off or if the shim appears to be worn, measure the thickness accurately with a micrometer. Select a shim to give the correct size from the following formula:

Shim thickness required = A – C.C.

Where A. is the actual valve clearance

C.C. is the correct valve clearance

Fit the shims into the recess in the valve spring retainer, where applicable, with the etched number on the underside. Do not use more than one shim for each valve. Any roughness caused by the etching should be removed before fitting the shim by rubbing on fine emery cloth. Fit the tappets and the camshaft. Ensure that the camshaft bearing caps are fitted in their correct positions and that the nuts are tightened gradually and evenly, starting with the centre pair and working outwards, to a torque of 9 lb. ft. (1.2 kg.m.). Refit the sprockets and timing chain (see "Valve Timing") commencing with the exhaust and then reset the ignition timing.

AUXILIARY SHAFT

The auxiliary shaft runs in three steel-backed white metal bushes located in the right-hand side of the cylinder block. The front journal of the auxiliary shaft has four flats machined in its periphery to regulate the oil supply to the camshafts.

The auxiliary shaft front and rear bushes are both approximately $\frac{3}{4}$ in. (19.05 mm.) wide, the front one having an additional oil hole for the camshaft oil feed, and the centre bush approximately $\frac{5}{8}$ in. (15.88 mm.) wide.

The bushes available in service are pre-sized and require no machining after fitting. When one bush requires replacement it is advisable to replace all three bushes as auxiliary shaft alignment may be affected if only one bush is changed.

Remove the auxiliary shaft bearing bushes, using camshaft bearing remover Tool No. P.6031 with adaptor set P.6031-3. Locate the remover and guide detail "-3a" adjacent to the collar and with the spigot in the bearing. If the centre bush is being removed use the centraliser detail "-3d". Remove the bush by screwing down the wing nut.

Replace the auxiliary shaft bushes in a similar manner (using Tool No. P.6031 with adaptor set P.6031-3).

These bushes must be assembled with the split upwards and the oil holes in line with the corresponding holes in the cylinder block. A line scribed on the remover and guide detail "-3a" can be used as a guide to facilitate this.

The auxiliary shaft is retained by a sintered iron thrust plate bolted to the cylinder block front face and located in a groove behind the auxiliary shaft flange.

TIMING CHAIN AND SPROCKETS

The camshafts and auxiliary shaft are driven at half engine speed by a single row timing chain from a sprocket on the crankshaft. Chain tension is controlled by an adjustable tensioner located between the auxiliary shaft and the inlet camshaft.

The chain tensioner consists of an idler sprocket mounted on a lever pivoted in the cylinder head and a spring-loaded adjustable plunger, acting on the lever against chain tension, located in the right-hand side of the front cover.

When correctly adjusted there should be $\frac{1}{2}$ in. (12.7 mm.) free movement in the chain between the two camshaft sprockets. This can be checked with the camshaft cover removed. To adjust the chain tension slacken the adjuster locknut and screw the adjuster in or out until the correct free movement has been obtained. Then tighten the locknut. Alternatively, the chain tension may be adjusted dynamically. To adjust, screw the adjuster in or out (as for static adjustment) to achieve the minimum noise level. A tight chain will whine and a slack chain will rattle.

Excessive chain movement may also result in the chain knocking against the damper pad, located down the left-hand side of the front cover. When replacing the retaining screws, ensure that they are thoroughly clean and apply a thin line of EM-4G-52 plastic sealer to the screw threads to prevent any possibility of oil leaks or loosening in service.

The inlet camshaft and the auxiliary shaft sprocket are not interchangeable. The exhaust camshaft sprocket, although similar, has the timing mark in a different position and must only be used on the exhaust camshaft if the correct timing is to be readily obtained. To identify it from the other sprockets it is marked "EX".

The camshaft sprockets, which are located by dowels, are retained by centre bolts and large flanged washers. The bolts are locked by spring washers and should be tightened to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.). The auxiliary shaft sprocket is also located by a dowel but is retained by two bolts locked with a locking plate. An adaptor positioned between the sprocket and the auxiliary shaft gives correct timing chain alignment and is retained by the dowel.

Valve Timing

Maximum performance can only be obtained if the valve timing is correctly set. To facilitate this, timing marks are incorporated on the camshaft sprockets and the crankshaft pulley.

The timing is correct when the timing mark on the pulley is in line with the T.D.C. timing mark on the front cover and the timing marks on the inlet and exhaust camshaft sprockets are inwards and level with the camshaft cover mounting face.

CRANKSHAFT AND BEARINGS

The cast iron dynamically balanced crankshaft runs in five main bearings having steel-backed copper/lead liners with a lead/indium overlay.

The crankshaft main bearing journals may be ground 0.010 in. (0.25 mm.) or 0.020 in. (0.51 mm.), undersize. When grinding crankshafts undersize it is important to maintain the correct fillet radii at all times. The centre main bearing journal has a double radius of 0.070 in. (1.78 mm.) and 0.080 in. (2.03 mm.) and the rear main bearing has a double fillet radius, the inner radius of which must be maintained at 0.100 to 0.110 in. (2.54 to 2.79 mm.) when regrinding. The remaining main journal fillet radii are 0.110 to 0.096 in. (2.79 to 2.44 mm.). The crankpin journal fillet radii are 0.080 to 0.094 in. (2.03 to 2.39 mm.). Grind the bearing journals with the crankshaft and grinding wheel revolving in an anti-clockwise direction as viewed from the front of the shaft. Ensure that the fillet radii are smooth and free from visual chatter marks. The main bearing journal length between the thrust faces can be increased by up to 0.020 in. (0.51 mm.) providing an equal amount is machined from each face and the corresponding oversize thrust washers fitted. When grinding the rear main journal, ensure that the width of the machining wheel is 1.30 to 1.33 in. (33.02 to 33.78 mm.), that it has a fillet radii of 0.100 to 0.110 in. (2.54 to 2.79 mm.), and that the wheel is positioned 0.074 in. (1.879 mm.) from the rear face. The crankpin length must not exceed 0.010 in. (0.25 mm.) oversize.

Main bearing journal ovality should not exceed 0.0004 in. (0.010 mm.) T.I.R. and taper 0.0005 in. (0.013 mm.). The centre main bearing run-out relative to the front and rear journals should not exceed 0.002 in. (0.05 mm.) T.I.R. The thrust faces should be smooth and square to the bearing journal within 0.0005 in. (0.013 mm.) T.I.R. After grinding, the journals should be polished with a fine lapping paper and the crankshaft revolving clockwise to produce a good surface finish.

Crankshaft end-float is controlled between 0.003 in. (0.076 mm.) 0.008 in. (0.203 mm.) by half thrust washers located in the cylinder block at the centre bearing. Standard size washers and 0.0025 in. (0.064 mm.), 0.005 in. (0.127 mm.), 0.0075 in. (0.191 mm.) and 0.010 in. (0.254 mm.) oversize washers are available.

A sprocket is located, by a woodruff key, on the front end of the crankshaft, adjacent to the front main bearing journal to drive the auxiliary shaft and camshafts. This sprocket can be removed by using a puller Tool No. P.6116, and replaced with Tool No. P.6032. When replacing the sprocket ensure that the key is pressed squarely into the keyway and that the sprocket is fitted with the boss to the rear.

A cast iron pulley for driving the water pump, fan and generator is also located by the same key as the sprocket and is retained by a centre bolt fitted with a spring and a flat washer.

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Oil leaks around the crankshaft pulley boss are prevented by an oil seal pressed into the front cover. To further assist sealing, the crankshaft is fitted with an oil slinger which reduces the quantity of oil around the seal.

The clutch pilot spigot bearing is located in a bore machined in the centre of the crankshaft flange. The spigot bearing can be removed with adaptor Tool No. CP.7600-7 fitted to remover Tool No. CP.7600A or B and replaced with Tool No. P.7137.

CONNECTING RODS

The connecting rods are H section steel forgings with detachable big end caps. The caps are located by two hollow dowel pins pressed into the connecting rod and retained by two bolts fitted without lockwashers. The connecting rod can be identified by the number forged on the web. An oil squirt hole machined in the connecting rod feeds oil from the crankpin to the non-thrust side of the cylinder bore.

The steel-backed big end bearing liners have copper/lead bearing surfaces with a lead/indium overlay. The upper liner which locates in the connecting rod incorporates an oil hole, the lower liner being plain.

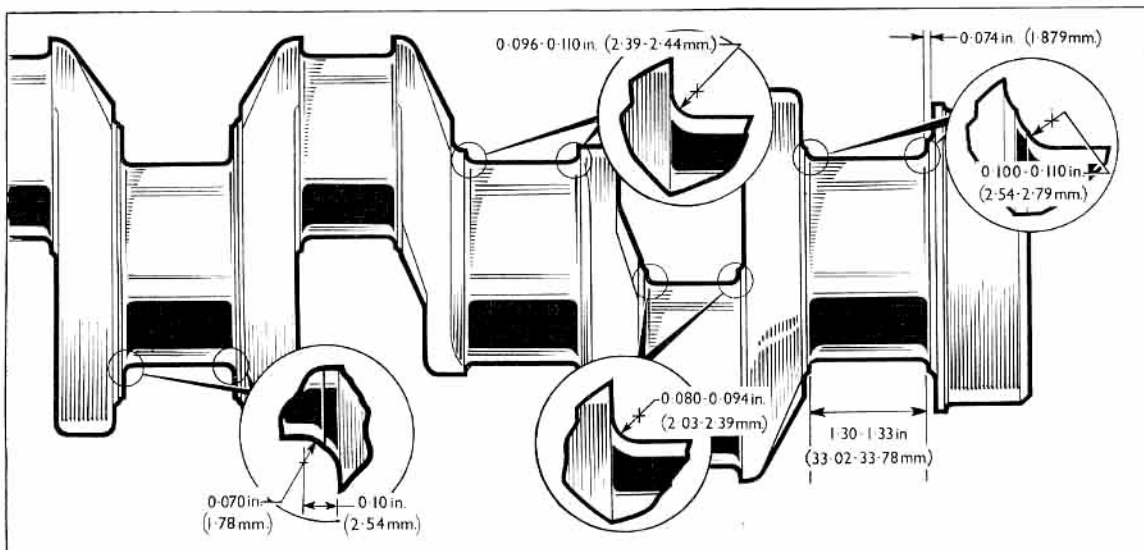
The connecting rod small end bearing is a steel-backed lead/bronze bush, which is not available in service, the connecting rod being serviced with the bush already fitted.

When dismantling an engine examine the piston markings to check the connecting rods for straightness. A heavy marking on the piston skirt above the pin on one side together with a correspondingly heavy marking below the pin on the other side indicates a bent connecting rod which should be replaced. The connecting rod small and big ends should be parallel and square to the longitudinal centre line within 0.0005 in. per inch (cm.) length.

When assembling a connecting rod to the piston ensure that it is fitted the correct way round. The marking "125E FRONT" is embossed on the web to facilitate this.

Connecting Rod Numbering

Connecting rods are numbered when installed in the engine during manufacture, to facilitate correct reassembly should they be dismantled.



Crankshaft Fillet Radii

The number is etched on the side of the big end so that a cap replaced with the numbers together must be in its original position. Never reassemble a bearing cap to another connecting rod.

It is advisable when removing connecting rods from an engine to check that the connecting rods have been numbered correctly. Where the connecting rods are unmarked they should be suitably stamped unless the connecting rods are being scrapped.

PISTONS, PISTON PINS AND RINGS

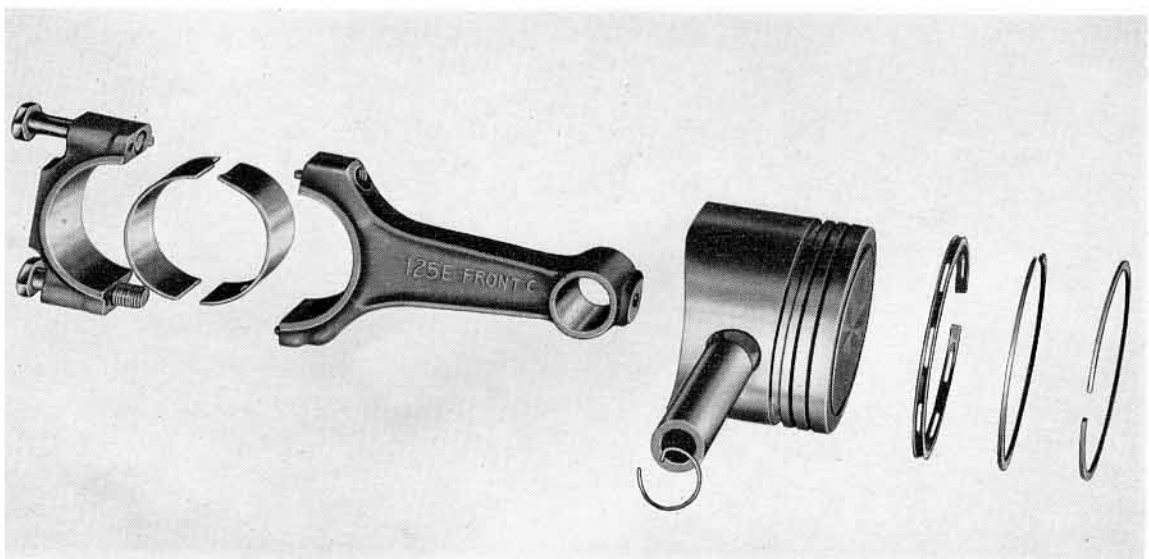
The aluminium alloy pistons are of the solid skirt type and have recesses machined in the crown to give clearance for the inclined valves. Each piston has three rings, two compression and one oil control ring, situated above the piston pin bore. The top compression rings are cargraph plated (red) to provide initial lubrication and the two lower rings are copper plated for identification purposes.

The lower compression ring is stepped externally on the bottom face and the upper ring is chrome plated and tapered. Both rings are marked "TOP" and must be fitted this way round. The "micro-land" oil control rings may be fitted either way round. This type of oil control ring can be identified by the narrow ring lands.

The piston pin is offset in the piston 0.04 in. (1.016 mm.) towards the thrust side of the engine, to minimise piston slap and uneven loading of the skirt thrust face during the power stroke. Therefore, it is important that the piston is fitted the correct way round and to facilitate this the piston crown is marked "FRONT" and must face forwards when the piston is fitted to the engine.

The tubular steel piston pins are fully floating and are retained in position by circlips installed in grooves at each end of the piston pin bore.

On assembling the piston, pin and connecting rods the assemblies are weighed. The maximum variation of weight between the piston and connecting rod assemblies fitted in an engine is 6 grams. When changing pistons or connecting rods in service, it is good practice to check the weights of the piston, pin and connecting rod assemblies and, if necessary, select parts to ensure that the weight variation between the respective assemblies does not exceed 6 grams. Oversize pistons and rings are available in 0.015 in. (0.38 mm.) sizes.



Connecting Rod and Piston Assembly

Piston Selection

During engine manufacture the cylinder bores and pistons are graded. The piston grade number is stamped on the piston crown and, in production, each cylinder bore grade number is stamped on the push rod side of the cylinder block, adjacent to the top face, during engine assembly. These grade numbers ensure that when the piston is fitted there is a clearance of 0.0030 to 0.0036 in. (0.076 to 0.091 mm.) between the piston and the cylinder bore.

When selecting standard size pistons, measure each cylinder bore at a point $1\frac{9}{16}$ in. (39.69 mm.) from the cylinder block top face, across the axis of the crankshaft, and refer to the table in the Specification, Servicing and Repair Data section, to determine the grade of piston required. Select a piston with a grade number corresponding to that found for the cylinder bore.

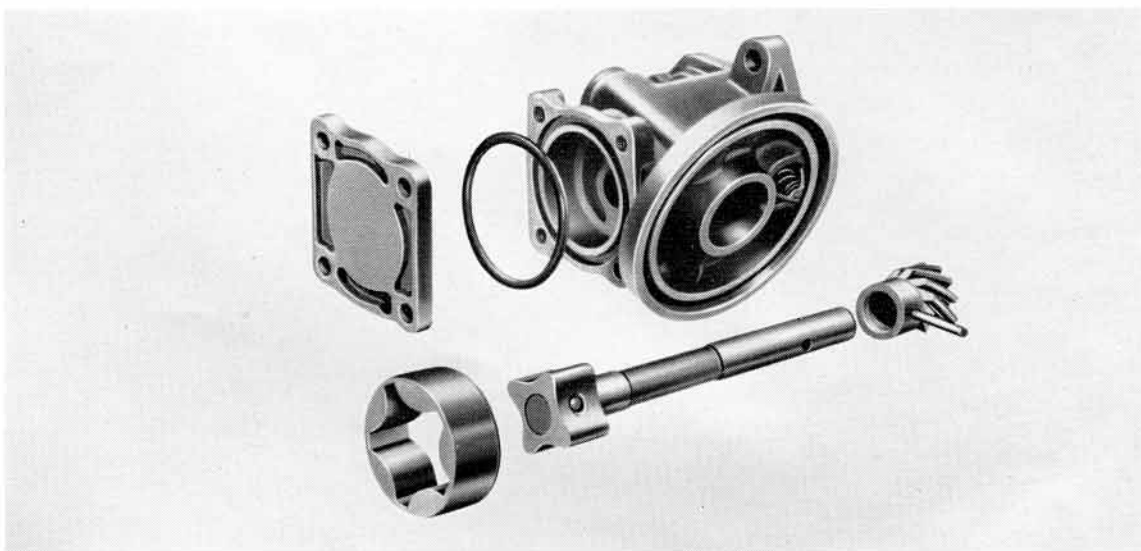
FLYWHEEL AND RING GEAR

The cast iron flywheel is located concentrically on the crankshaft flange and retained by six bolts fitted without lockwashers.

The flywheel ring gear is shrunk onto the flywheel and locates in a retention groove. The ring gear can be removed by cutting between two adjacent teeth with a hack saw and splitting the gear with a chisel. In no circumstances should pressure be applied in an attempt to dismantle the ring gear for repositioning on the flywheel.

When replacing the ring gear it must be heated evenly to a temperature not exceeding 600°F (316°C) or the ring gear wear-resistant properties will be destroyed. If the ring gear is heated by a naked flame place the ring gear on a bed of fire bricks and then play the flame in a circular motion onto the bricks about $\frac{1}{4}$ to $\frac{1}{2}$ in. (6.35 to 12.7 mm.) from the inside of the gear until it reaches the required temperature. The correct temperature can be detected by using a special type of temperature sensitive crayon, or alternatively by polishing a section of the ring gear and heating until it turns blue. Fit the ring gear with the chamfers on the leading faces of the gear teeth relative to the direction of rotation. Allow the ring gear to cool naturally in air, **do not quench**.

The flywheel and ring gear assembly are dynamically balanced to close limits. The clutch is located on the flywheel by three dowels and is retained by six bolts with spring washers.



Oil Pump

THE OIL PUMP

The oil pump and filter assembly is bolted to the right-hand side of the cylinder block and can be removed with the engine in place. The oil pump, which is driven by a skew gear on the engine auxiliary shaft, is of the eccentric bi-rotor type and has the full flow element type filter bolted to a mounting flange integral with the oil pump body.

Oil enters the pump through a tube pressed into the cylinder block sump face. A filter gauze located on the end of this tube provides primary filtration. The gauze can only be removed in conjunction with the pick-up tube. A pressure relief valve oil return pipe is also pressed into the cylinder block sump face adjacent to the inlet tube.

THE OIL FILTER

The full flow type oil filter, when bolted to the oil pump, clamps an adaptor, sending oil through the oil cooler, to the pump body. Two sealing rings are therefore necessary, one in the pump body and the other in the lower face of the adaptor, to prevent loss of oil. Because the oil cooler adaptor increases the effective length of the filter bowl, a longer retaining bolt is necessary.

To remove the filter, unscrew the retaining bolt and withdraw the filter assembly and oil cooler adaptor. Remove the sealing rings from their locations and replace with two new ones (one of which is supplied with the replacement element). When fitting, locate a new ring in its groove at four diametrically opposite points. Do not fit a ring at one point and then work it round the groove as the rubber may stretch, thus leaving a surplus which may cause an oil leak. Thoroughly clean the filter body and insert the new element. Locate a new washer (again supplied with the replacement element) on the securing bolt and refit the filter assembly and oil cooler adaptor to the oil pump body.

VENTILATION SYSTEM

The ventilation system is of the closed type relying on blow-by for displacement of the gases.

Engine fumes leave the crankcase through a ventilation tube located vertically on top of the fuel lift pump mounting pad. This tube connects the crankcase with a chamber integral with the cylinder head. A drilling in the top of this chamber provides a connection with the inside of the camshaft cover. The fumes are discharged directly into the carburettor air intake cover by a tube incorporating a flame trap.

ENGINE MOUNTINGS

The engine and gearbox assembly has a three-point mounting on bonded rubber insulators. The two front insulators consist of a cylindrical rubber block located between the engine mounting bracket and the mounting plate on the crossmember and secured by a single bolt fixing. The engine mounting bracket on the right-hand side is longer than that on the left-hand side.

The single rear insulator is secured to a pad on the gearbox extension housing and consists of a 'V'-shaped rubber block bonded to a steel reinforcement plate. This in turn is bolted to the crossmember which is then bolted to the underbody.

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SERVICE AND REPAIR OPERATIONS

When working around the engine compartment care must be taken to prevent damage to the paintwork. Immediately after opening the bonnet, wing covers must be fitted. This is assumed in all operations where required.

Before reassembling, during any operation, all components should be thoroughly cleaned, paying particular attention to joint faces and bearing surfaces. Any local high spots or burrs on the joint faces should be carefully removed with a fine oil stone. Ensure that any piece of gasket material or dirt which enters a blind tapped hole, during cleaning, is removed as the bolt may bottom on the resulting plug of dirt before the bolt head clamps the mating part. When tightening a bolt which bottoms, a characteristic springiness may be felt through the spanner or torque wrench. If this occurs, the bolt should be removed and the hole cleaned out.

Inspect all moving parts and bearing surfaces for wear. Check the dimensions of worn parts against specification, and select new parts where necessary.

OP 6000-A TUNE ENGINE

(Includes Cleaning and Adjusting Spark Plugs, Cleaning or Replacing Air Cleaner Element, Adjusting or Replacing Contact Breaker Points, Checking Timing, Cleaning and Adjusting Carburettor and Fuel Pump and Adjusting Valves)

Tools Required

Spark plug cleaner

Dwell meter

Timing light

1. Remove the air cleaner and the air intake cover.
2. Pull off the spark plug leads and remove the spark plugs. Clean the spark plugs and reset the gaps to 0.023 in. (0.58 mm.).
3. Replace the spark plugs and reconnect the spark plug leads.
4. Remove the distributor cap and examine the contact breaker points. Replace the points if badly burnt or excessive metal transfer has occurred.
5. Adjust the dwell angle to 57° to 63° at 1,000 rev./min. Alternatively adjust the point gap to 0.014 to 0.016 in. (0.36 to 0.41 mm.) and refit the distributor cap.
6. Unscrew the fuel pump sediment bowl retainer clamp and lift off the bowl and filter screen.
7. Carefully wash the screen in petrol and flush all traces of sediment from the sediment chamber and bowl.
8. Refit the screen to the fuel pump body, ensure that the gasket is in good condition, refit the sediment bowl and tighten the clamp.
9. Remove the air cleaner element and clean by shaking or blowing it through. If unserviceable, replace the element. Wash the air cleaner body with petrol.
10. Refit the air cleaner element.
11. Disconnect the fuel feed pipes at the carburettors.
12. Remove the carburettor float chamber cover.
13. Withdraw the float arm pivot pin and remove the float and gasket.
14. Unscrew all the jets and blow them clear with an air line.

15. Remove the needle valve and the needle valve body and blow it clear with an air line.
16. Clean the float, float chamber and filter gauze using clean petrol.
17. Replace all the jets and the needle valve body and needle valve.
18. Locate the gasket on the upper body and fit the float assembly, sliding the pivot pin into position. Check the float setting.
19. Refit the float chamber cover.
20. Reconnect the fuel feed pipes.
21. Adjust the valve clearances, see Operation No. 6271-B.
22. Connect the leads of a timing light using the clips provided in accordance with the manufacturer's instructions.
23. Check that the mark on the crankshaft pulley is visible and mark with chalk or paint if necessary.
24. Start the engine and point the timing light at the crankshaft pulley adjacent to the timing scale.
25. Progressively increase the engine speed to 3,500 rev./min. observing the timing mark, with the aid of the timing light, to check that the distributor advances the ignition timing.
26. At 3,500 rev./min. adjust the ignition timing to 26° B.T.D.C., if necessary, by slackening the distributor clamp and turning the distributor body as required.
27. After making an adjustment, tighten the clamp sufficiently to hold the distributor in position.
Do not over-tighten.
28. Remove the timing light.
29. Adjust the slow-running as follows with the engine at the normal operating temperature:
 - (a) Adjust all four volume control screws three-quarters of a turn out after first screwing right in.
 - (b) Adjust the throttle stop screw to give a speed of 1,000 to 1,200 rev./min.
 - (c) Synchronise the two carburettors using a proprietary synchronising tool or alternatively improvise a stethoscope from a piece of tube. Balance the two carburettors by adjusting the coupling screw until the air flow is the same through each, with a stethoscope this is denoted by the same "hiss" level in each carburettor throat.
 - (d) Adjust each volume control screw in turn to give the maximum speed possible, readjust the throttle stop screw, as necessary, to maintain a speed of 1,000 to 1,200 rev./min.
 - (e) Adjust the idling speed to 800 to 1,000 rev./min.
30. Refit the air cleaner and the air intake cover.

OP 6000-B ENGINE ASSEMBLY – CHECK COMPRESSION

Tools Required

500X Gang Gauge Set

1. Warm up the engine to the normal operating temperature.
2. Remove the air cleaner.
3. Remove all the spark plugs.
4. Set the throttle to the wide open position.

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5. Place the gang gauge in a convenient position, insert the expanding rubber plug into the No. 1 spark plug orifice and expand the plug by pulling up on the handle.
6. Crank the engine with the starter motor until full pressure is recorded on the gauge. The normal compression pressure is 180 to 200 lb./sq. in. (12.66 to 14.06 kg./sq. cm.) but at altitudes appreciably above sea level proportionally lower pressures will be obtained.
7. Test the remaining cylinders in a similar manner.
8. Replace the spark plugs and connect the plug leads.
9. Refit the air cleaner.

OP 6000-C ENGINE ASSEMBLY - REMOVE AND INSTALL

To Remove

1. Open the boot and disconnect the battery lead.
2. Open the bonnet and fit wing covers.
3. Disconnect the choke and throttle cables at the carburettors, the oil pressure gauge pipe at the engine adaptor and the water temperature sender unit lead.
4. Drain the cooling system. Disconnect the radiator hoses at the engine and remove the radiator. Then disconnect the heater hoses at the bulkhead. Drain the engine oil.
5. Disconnect the fuel supply pipe at the fuel pump and plug the open end of the supply line. Also, disconnect the brake servo hose at the induction manifold and the oil cooler hoses at the oil filter bowl connections.
6. Unscrew the two nuts securing the engine steady bar insulator. One of these nuts is located above the parcel shelf on the passenger side.
7. Disconnect the high tension lead and distributor lead from the coil, and disconnect the lead from the solenoid at the starter motor.
8. Suitably scribe the steering shaft and flexible joint to ensure correct alignment on reassembly and remove the clamping bolt.
9. Disconnect the clutch fluid supply pipe (the one with the short red flexible hose) at the bulkhead.
10. From inside the driving compartment, unscrew the two bolts securing the lower end of the steering column to the floor pan. Then unscrew the two crosshead screws securing the top end of the column to the fascia panel, disconnect the two multi-plug connectors and withdraw the assembly.
11. Unseat the gear lever boot from the transmission tunnel, unscrew the dome nut and withdraw the lever from the extension housing.
12. Jack up the front and rear of the car and fit stands.
13. Disconnect the "O" rings supporting the exhaust system, unscrew the clamp bolt where the system joins the manifold downpipe and separate the joint.
14. Mark the driveshaft and pinion flanges to ensure correct alignment on reassembly and unscrew the four securing bolts. Lower the driveshaft assembly and withdraw it from the gearbox, suitably plugging the extension housing to prevent loss of oil.
15. Support the rear end of the gearbox with a jack and remove the four bolts securing the rear mounting to the under body.
16. Lower the gearbox slightly and unscrew the bolt retaining the speedometer drive to the gearbox and place the drive gear and cable out of the way.

17. Disconnect the two front brake fluid hoses from the main lines beneath the front wheel arches and fit plugs to the open ends to prevent loss of fluid and ingress of dirt.
18. Unscrew the four bolts securing the stabiliser bar to the chassis after bending back the locking tabs.
19. Attach a sling to the engine and support its weight using a suitable crane. Then unscrew the four bolts securing the engine crossmember to the chassis.
20. With assistants supporting each suspension leg, unscrew the three bolts securing the top mounts on either side. Then, taking great care, lower the jack and crane together by small amounts until the whole assembly is clear of the vehicle.

NOTE - As the engine, gearbox and suspension system is removed as an assembly with this method, if an engine overhaul only is required the gearbox and suspension system will have to be removed first.

To Install

21. Locate the engine, gearbox and suspension assembly beneath the car. Position a jack under the gearbox housing and attach a sling to the engine and support with a crane.
22. With assistants guiding the suspension legs, carefully raise the jack and the crane until the whole assembly is located in position.
23. Engage the suspension leg upper mounting bolts and tighten to a torque of 15 to 18 lb. ft. (2.07 to 2.49 kg.m.).
24. Secure the crossmember to the chassis with the four retaining bolts tightened to a torque of 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
25. Locate the stabiliser bar and brackets in position and engage the retaining bolts. **Do not tighten these bolts until the car is resting on its four wheels.**
26. Engage the speedometer drive gear in the extension housing and secure with the retaining bolt and yoke.
27. Engage and tighten the gearbox rear mounting bolts, noting that one of these bolts also retains the earth strap. Remove the supporting jack and crane.
28. Remove the plug from the extension housing, engage the driveshaft with the gearbox mainshaft splines, re-align the driveshaft and pinion flanges and secure with the four nuts and bolts.
29. Engage the exhaust system with the manifold downpipe, refit the supporting "O" rings and secure the front joint with the clamping bolt.
30. Replace the gear lever, secure with dome nut fitted with a new gasket and replace the rubber boot on the transmission tunnel.
31. Engage the steering shaft with the flexible joint while ensuring to re-align the marks previously made and tighten the clamp bolt.
32. Fit the bolts securing the lower end of the steering column and also the two crosshead screws at the top end of the column.
33. Reconnect the multi-plug connectors behind the fascia panel.
34. Fit the engine steady bar insulator and secure with the two retaining nuts.
35. Replace the radiator, connect the hoses to the engine, the heater hoses to the bulkhead and close the drain taps.
36. Reconnect the oil cooler hoses at the oil filter bowl, the brake servo hose to the induction manifold and the oil pressure gauge supply pipe to the engine.

37. Reconnect the choke and throttle cables to the carburettors and the high tension lead and distributor lead to the coil. Also, reconnect the starter motor lead and the water temperature sender unit lead.
38. Remove the plug from the fuel supply line and connect the line to the fuel pump.
39. Reconnect the clutch fluid supply hose to the bulkhead and bleed the system as described in Operation No. 7500-A of Section 7/1.
40. Reconnect the flexible brake fluid pipes to the main lines beneath the front wheel arches and then bleed the system as described in Operation No. 2000-A of Section 2 in the basic Escort manual.
41. Jack up the front and rear of the car, remove the stands, lower the car to the ground and remove the jacks.
42. Tighten the stabiliser bar retaining bolts to a torque of 15 to 18 lb. ft. (2.07 to 2.49 kg.m.).
43. Reconnect the battery lead and close the boot.
44. Refill the cooling system with a 50% solution of Ford Antifreeze Plus.
45. Refill the engine sump with approved oil.
46. Start the engine and check for oil and water leaks.

OP 6000-C1 EXTRA: ANCILLARIES – REMOVE AND INSTALL

(Includes, carburettor, distributor, fuel pump, generator, engine mountings, oil pressure gauge adaptor).

To Remove

1. Remove the engine ancillaries. Slacken the generator mounting and remove the fan belt. Remove the fan, water pump pulley, generator and the front engine mountings. Disconnect the fuel pipe and remove the carburettors and air intake back plate, accelerator return spring bracket, fuel pump, distributor, oil pressure gauge adaptor, thermostat housing, thermostat and temperature gauge sender unit.

To Install

2. Fit the thermostat, thermostat housing, temperature gauge sender unit, front engine mountings, oil pressure gauge adaptor, fuel pump, generator, water pump pulley and fan. Fit the fan belt and adjust the tension to give $\frac{1}{2}$ in. (12.7 mm.) total free play. Tighten the generator mounting bolts to a torque of 15 to 18 lb. ft. (2.08 to 2.49 kg.m.).
3. Fit and time the distributor. Turn the engine until the crankshaft pulley timing mark is adjacent to the 12° mark on the front cover with number 1 cylinder on compression. With the low tension terminal adjacent to the cylinder block, turn the rotor until it points towards the distributor cap rear clip. Insert the distributor into its bore in this position and secure the clamp bracket to the cylinder block. Slacken the clamp and turn the distributor body until the points just open while holding the rotor against the direction of rotation to take up lost motion. Tighten the clamp sufficiently to hold the distributor in this position. **Do not over-tighten.**
4. Fit the carburettors and back plate assembly. Locate new "O" rings in the spacers and tighten the retaining nuts until there is 0.040 in. (1.02 mm.) clearance between the coils of the double coil spring washers. Connect the fuel pipe and refit the accelerator return spring bracket.

OP 6000-C2 EXTRA: CLUTCH DISC AND/OR PRESSURE PLATE - REMOVE AND INSTALL

See Operation No. 7000-A2 of Section 7/1

OP 6000-C3 EXTRA: CLUTCH PILOT SPIGOT BEARING - REMOVE AND INSTALL

See Operation No. 7000-A3 of Section 7/1

OP 6000-C4 EXTRA: FLYWHEEL - REMOVE AND INSTALL
(engine, clutch disc, pressure plate and spigot bearing removed)**Tools Required**

P.4008 Crown wheel and pinion backlash gauge

To Remove

1. Remove the flywheel.

To Install

2. Locate the flywheel squarely on the crankshaft flange and tighten the retaining bolts to a torque of:—
 - (a) 45 to 50 lb. ft. (6.22 to 6.91 kg.m.) for hexagonal bolts.
 - (b) 50 to 55 lb. ft. (6.91 to 7.60 kg.m.) for bi-hexagonal bolts.
3. Check the flywheel run-out using the gauge Tool No. P.4008 at the rim. The flywheel run-out should not exceed 0.004 in. (0.10 mm.) total indicator reading.

OP 6000-C5 EXTRA: SUMP AND/OR GASKETS - REMOVE AND INSTALL**Tools Required**

200A or B Engine stand
P.6107 Universal stand adaptor

To Remove

1. Fit a universal stand adaptor Tool No. P.6107 and mount the engine on a stand Tool No. 200A or B.
2. Remove the sump and gasket.
3. Clean the sump and cylinder block faces and remove the cork packing strips.

To Install

4. Apply sealer ESEE-M4G-1008A to the front cover and rear oil seal carrier to cylinder block joints, and also to the ends of the grooves in the front cover and rear oil seal carrier. Then fit the new sump gaskets, followed by the cork packing strips.
5. Refit the sump and engage the corner bolts and tighten sufficiently to allow engagement of the remainder.
6. Engage remaining bolts and tighten all bolts sufficiently to clamp gasket.

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7. Tighten all bolts to 7 to 9 lb. ft. (0.97 to 1.24 kg.m.) following the sequence given in alphabetical order.
8. Retighten all bolts to 7 to 9 lb. ft. (0.97 to 1.24 kg.m.) following the sequence given in numerical order.
9. Remove the engine from stand and adaptor.

OP 6000-C6 EXTRA: ENGINE REAR OIL SEAL CARRIER AND/OR GASKET - REMOVE AND INSTALL (with flywheel and sump removed)

Tools Required

CP.6173 Crankshaft rear oil seal aligner

To Remove

1. Remove the rear oil seal carrier.

To Install

2. Locate a new gasket on the rear oil seal carrier, using ESEE-M4G-1008A jointing compound at the ends, and fit the carrier to the block rear face using an aligner Tool No. CP.6173. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the aligner.

OP 6000-C7 EXTRA: ENGINE REAR OIL SEAL - RENEW (with rear oil seal carrier removed)

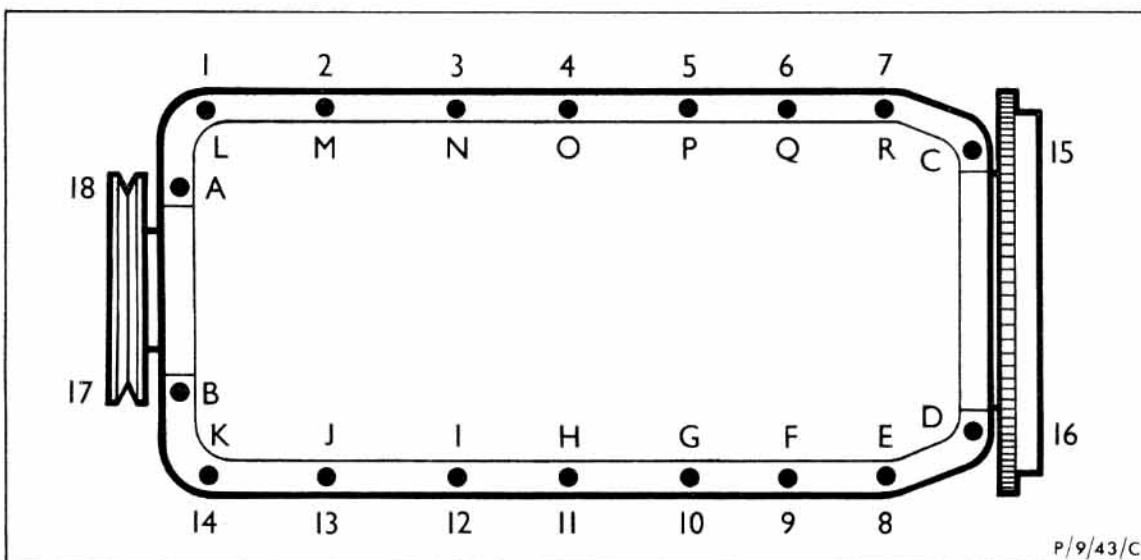
Tools Required

550 Driver handle

P.6165 Crankshaft rear oil seal remover/replacer

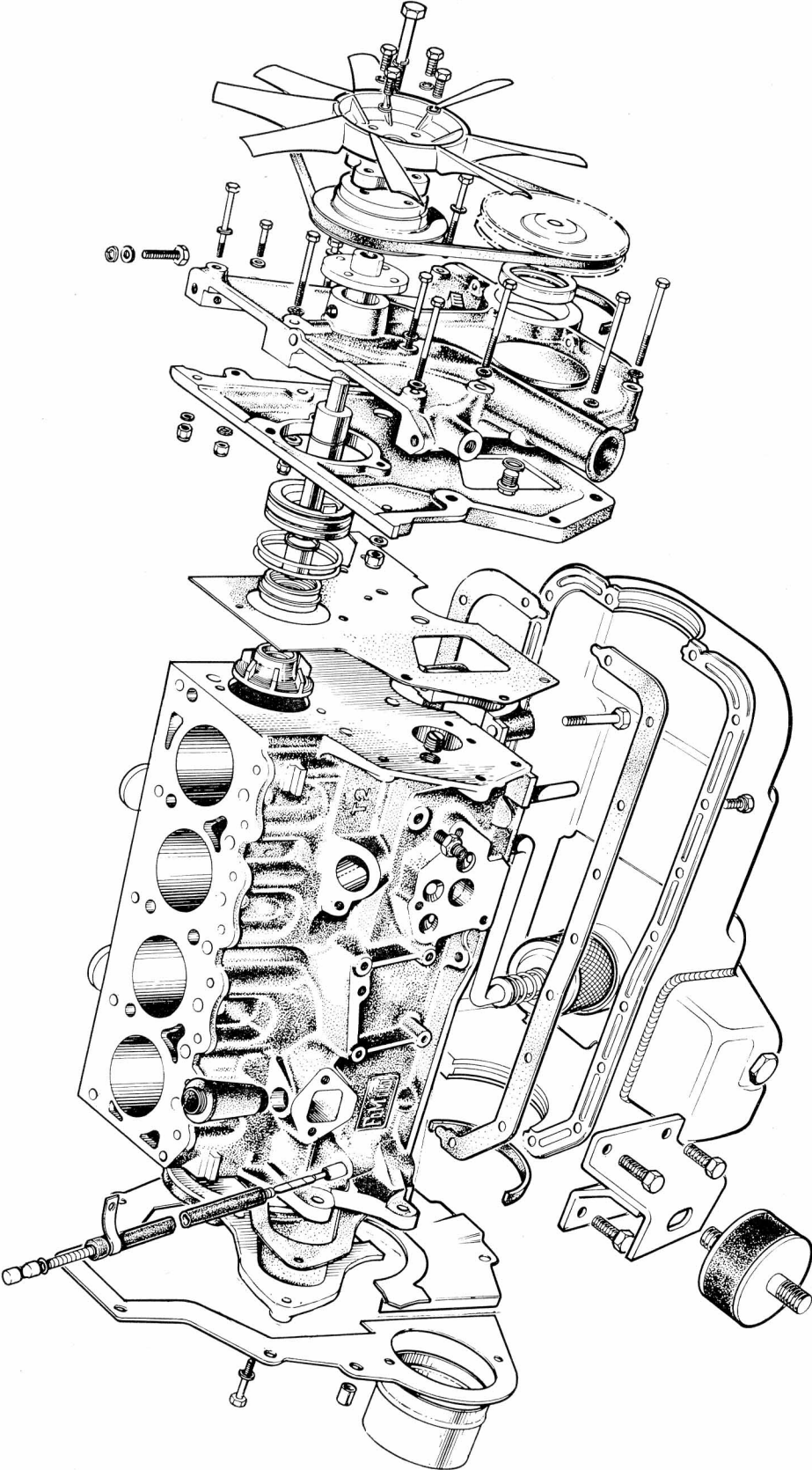
To Remove

1. Suitably support the rear oil seal carrier and remove the oil seal using a remover/replacer Tool No. P.6165 fitted to a 550 handle.



Sump Bolt Tightening Sequence

7/9/342/C



Cylinder Block, Sump and Timing Case Assembly

To Install

2. Invert the remover/replacer Tool No. P.6165 on the 550 handle and with the rear oil seal carrier suitably supported, drive a new seal into the housing.

OP 6000-C8 EXTRA: FRONT COVER AND/OR GASKET - REMOVE AND INSTALL (with sump removed)

Tools Required

550	Driver handle
P.6150	Crankshaft front cover oil seal aligner

To Remove

1. Remove the camshaft cover.
2. Remove the fan belt and then remove the fan and the water pump pulley.
3. Remove the crankshaft pulley, using suitable levers.
4. Remove the timing chain tension adjuster.
5. Remove the camshaft sprockets and disconnect the timing chain.
6. Unscrew the cylinder head bolts evenly and lift off the cylinder head and gasket.
NOTE - **Do not** lay the cylinder head flat on its face as damage to the valves can occur.
7. Remove the front cover.
8. Remove the crankshaft oil slinger.
9. Remove the auxiliary shaft sprocket.
10. Remove the front cover backplate and gasket.

To Install

11. Locate a new gasket on the cylinder block to front cover backplate joint.
12. Fit the front cover backplate. Align the water pump aperture with the front cover and seal aligner Tool No. P.6150 before tightening the single bolt to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.).
13. Fit the auxiliary shaft sprocket. Tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) torque and turn up the locking plate tabs.
14. Locate the timing chain in position around the crankshaft and auxiliary shaft sprockets and around the water pump aperture in the backplate.
15. Locate the crankshaft oil slinger in place.
16. Coat the front cover joint faces with ESEE-M4G-1008A jointing compound. Align the cover in position with Tool No. P.6150. Tighten the $\frac{1}{4}$ in. retaining nuts and bolts evenly to a torque of 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and the $\frac{5}{16}$ in. to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.) and remove the aligner tool. Refer to page 12 for bolt locations.
17. Fit the timing chain tension adjuster and tighten to 45 to 50 lb. ft. (6.22 to 6.91 kg.m.).
18. Fit the crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the retaining bolt to 24 to 28 lb. ft. (3.32 to 3.87 kg.m.).
19. Replace the water pump pulley and the fan. Fit the fan belt and adjust the tension so that there is $\frac{1}{2}$ in. (12.7 mm.) total movement.

20. Locate a new gasket on the cylinder head to timing cover joint.
21. Fit the cylinder head assembly. Locate the cylinder head gasket on the cylinder block using the locating studs Tool No. PT.4063A screwed into diagonally opposite bolt holes in the block face. Fit the cylinder head assembly engaging the breather pipe in its bore. Screw the cylinder head bolts home before removing the locating studs and then tighten in sequence to 60 to 65 lb. ft. (8.29 to 8.98 kg.m.). Tighten the three front cover bolts to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.).
22. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.36 to 4.15 kg.m.).
23. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
24. Fit the camshaft cover, using a new gasket and tighten the retaining nuts evenly.

OP 6000-C9 EXTRA: FRONT COVER OIL SEAL – REMOVE AND INSTALL
(with front cover removed)

Tools Required

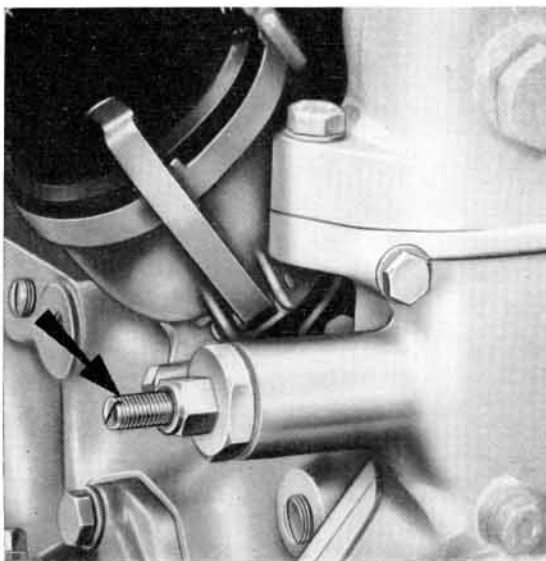
- | | |
|--------|--|
| 550 | Driver handle |
| P.6161 | Crankshaft front oil seal remover/replacer |

To Remove

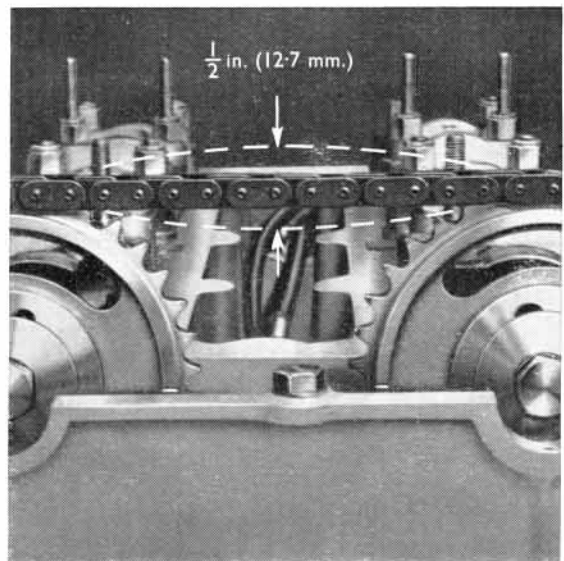
1. Suitably support the front cover and remove the oil seal from the rear, using remover/replacer Tool No. P.6161 fitted to a 550 handle.

To Install

2. Insert the remover/replacer Tool No. P.6161 on the 550 handle and with the front cover suitably supported drive a new seal into the housing.



Timing Chain Tension Adjuster



Timing Chain Tension Adjustment

OP 6000-C10 EXTRA: TIMING CHAIN – REMOVE AND INSTALL
(front cover removed)

To Remove

1. Remove the camshaft sprockets and extract the timing chain.

To Install

2. Locate the timing chain in position.
3. Fit the camshaft sprockets and timing chain ensuring there is a minimum of slack between the exhaust sprocket and the camshaft sprocket.
4. Tighten the retaining bolts to a torque of 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).

OP 6000-C11 EXTRA: CRANKSHAFT SPROCKET – REMOVE AND INSTALL
(with front cover and timing chain removed)

Tools Required

P.6032-B	Crankshaft sprocket replacer
P.6116	Crankshaft sprocket remover

To Remove

1. Remove the oil slinger then the crankshaft sprocket using Tool No. P.6116.

To Install

2. Replace the crankshaft sprocket using replacer Tool No. P.6032-B ensuring that the long boss is towards the main bearing journal.
3. Refit the oil slinger.

OP 6000-C12 EXTRA: CONNECTING ROD LINERS – REMOVE AND INSTALL
(with sump removed)

To Remove

1. Turn the crankshaft to facilitate removal of number one big end cap. Unscrew the big end bolts two or three turns and tap them to release the cap. Completely unscrew the bolts and remove the cap.
2. Remove the upper connecting rod liner from the connecting rod and the lower from the connecting rod cap.

To Install

3. Replace the upper and lower bearing liners in their appropriate locations.
4. Locate the big end caps on the connecting rod and tighten the bolts to a torque of 44 to 46 lb. ft. (6.08 to 6.36 kg.m.).
5. Repeat sub-operations 1 to 4 for the other three connecting rods.

OP 6000-C13 EXTRA: MAIN BEARING CLEARANCES – CHECK
(with sump removed)

Tools Required

Micrometer, or means such as "Plastigage" to measure bearing clearance.

1. Remove the bearing cap and wipe the bearing and journal clean.

2. Place a piece of "Plastigage" on the bearing surface the full width of the bearing cap and about $\frac{1}{4}$ in. (6.4 mm.) off centre.
3. Install the cap and tighten the bolts to a torque of 65 to 70 lb. ft. (8.98 to 9.67 kg.m.). **Do not turn the crankshaft while the "Plastigage" is in place.**
4. Remove the cap and using the "Plastigage" scale check the width of the now compressed "Plastigage" strip.

Check at the widest point to get the minimum clearance.
 Check at the narrowest point to get the maximum clearance.
 The difference between the two readings is the taper.

5. Clean the bearing liner and refit the cap.
6. Check the remaining bearing clearances using the same procedure.

OP 6000-C14 EXTRA: MAIN BEARING LINERS AND THRUST WASHERS - REMOVE AND INSTALL
 (with sump removed)

Tools Required

P.6110 Main bearing liner remover/replacer

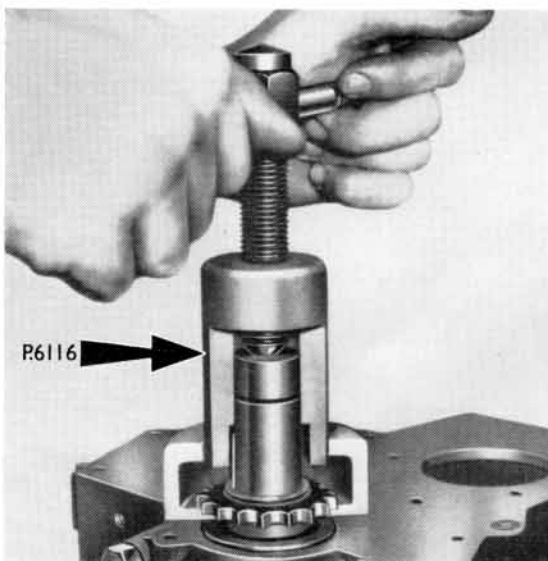
To Remove

1. Remove number one main bearing cap.
2. Remove the upper bearing liner from the cylinder block using Tool No. P.6110 and the lower bearing liner from the cap.

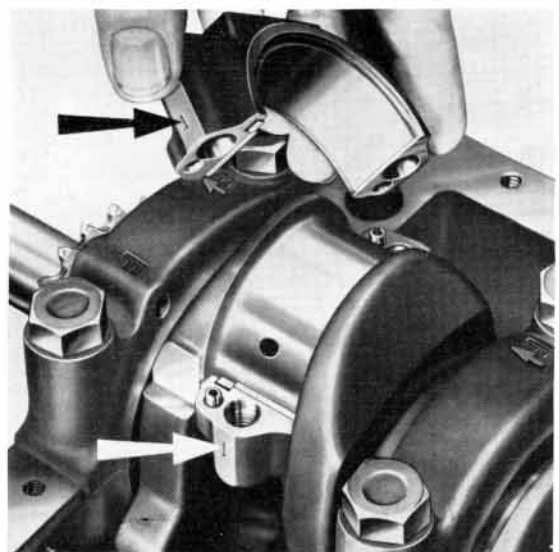
To Install

3. Fit the new upper bearing liner in the cylinder block using Tool No. P.6110 and the new lower bearing liner in the cap.
4. Refit the main bearing cap and tighten the bolts to a torque of 55 to 60 lb. ft. (7.60 to 8.29 kg.m.).

Change the remaining main bearing liners in sequence.



Removing the Crankshaft Sprocket



Fitting a Big End Cap

Intermediate and Rear Main Bearing

5. Complete sub-operations 1, 2, 3 and 4.

Centre Main Bearing

6. Complete sub-operation 1.
7. Remove the thrust washers.
8. Complete sub-operations 2 and 3.
9. Fit new thrust washers.
10. Complete sub-operation 4.

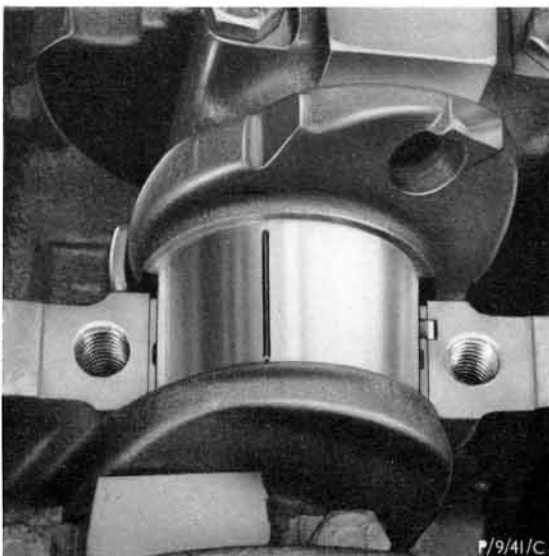
OP 6000-C15 EXTRA: ALL MAIN BEARING LINER AND THRUST WASHERS – CHECK CLEARANCES AND RENEW (with sump removed)

1. Check the clearances, see Operation No. 6000-C13.
2. Remove the bearing liner, see Operation No. 6000-C14 sub-operations 1 and 2.
3. Select bearing liners to give the correct clearance.
4. Fit the bearing liners, see Operation No. 6000-C14 sub-operation 3.
5. Recheck the bearing clearance, see Operation No. 6000-C13 sub-operations 2 to 7.
6. Repeat the procedure for the remaining bearings.

OP 6000-C16 EXTRA: AUXILIARY SHAFT – REMOVE AND INSTALL (engine, timing chain and sprocket removed)

To Remove

1. Remove the distributor (see Operation No. 12100-A).
2. Remove the oil pump and filter assembly.
3. Disconnect the fuel pipes and remove the fuel pump.



Measuring Bearing Clearance with Plastigage

4. Remove the auxiliary shaft sprocket adaptor.
5. Remove the auxiliary shaft thrust plate.
6. Withdraw the auxiliary shaft.

To Install

7. Fit a new dowel to the new shaft.
8. Slide the auxiliary shaft into position.
9. Fit the thrust plate in the auxiliary shaft groove. Tighten the retaining bolts to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and bend up the locking tabs.
10. Check the auxiliary shaft end-float with feeler blades between the thrust plate and the auxiliary shaft flange. This should be between 0.002 and 0.007 in. (0.050 and 0.178 mm.)
11. Refit the auxiliary shaft sprocket adaptor.
12. Fit the fuel pump and connect the fuel pipes.
13. Refit the oil pump and filter assembly, tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) torque.
14. Time the distributor (see Operation No. 12100-A as part of Operation No. 6279-A).

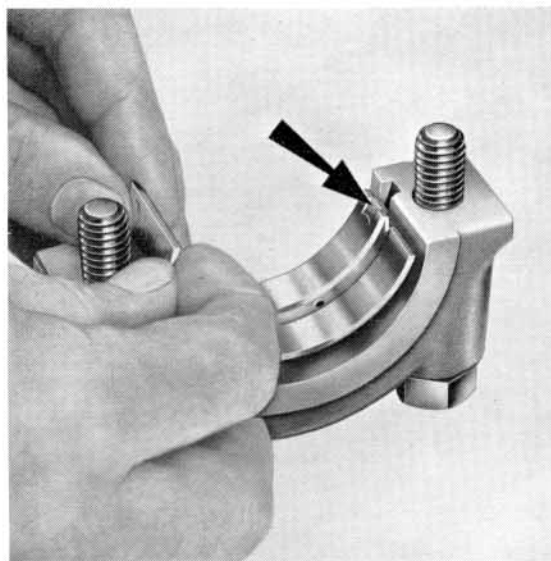
OP 6000-C17 EXTRA: AUXILIARY SHAFT BEARINGS – RENEW
(engine, auxiliary shaft and crankshaft removed)

Tools Required

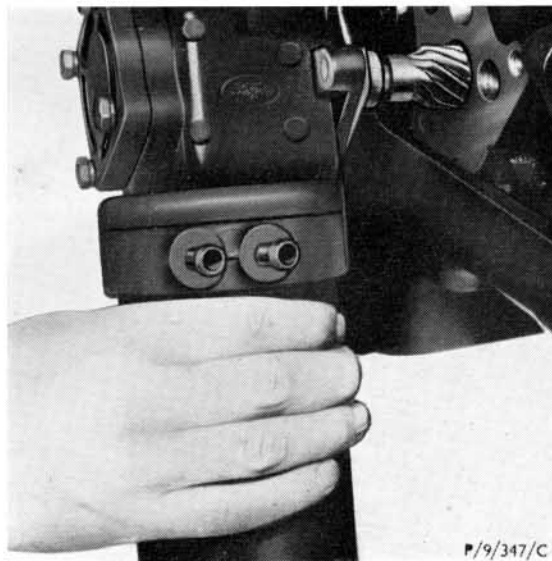
- | | |
|----------|---|
| P.6031 | Auxiliary shaft bearing bush remover/replacer |
| P.6031-3 | Auxiliary shaft bearing bush remover/replacer adaptors. |

To Remove

1. Remove the auxiliary shaft bearing bushes using Tool No. P.6031 with adaptors Tool No. P.6031-3.
2. Check all the oilways to ensure that they are clear, apply EM-4G-52 sealing compound to the oil gallery plugs prior to refitting.



Fitting a Main Bearing Liner



Remove the Oil Pump

To Install

3. Fit new auxiliary shaft bearing bushes again using Tool No. P.6031 and P.6031-3. Ensure that the oil holes in the bushes and cylinder block are aligned. The splits in the bushes should be upwards and outwards at 45° to the vertical.

OP 6000-C18 EXTRA: CRANKSHAFT – REMOVE AND INSTALL
(with sump, front cover, rear oil seal carrier, connecting rods and main bearings removed)

To Remove

1. Lift out the crankshaft and remove the bearing liners and thrust washers.

To Install

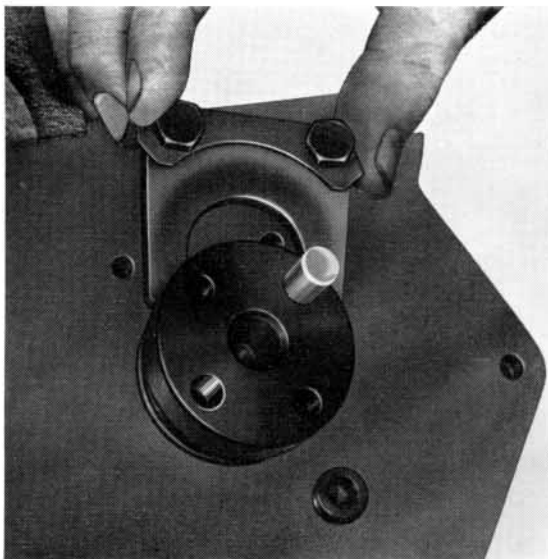
2. Fit a new spigot bearing. Refer to Operation 7000-A3 of Section 7/1.
3. Replace the crankshaft sprocket using replacer Tool No. P.6032A or B.
4. Fit the main bearing liners and replace the crankshaft. Fit the crankshaft thrust washers with the oil grooves facing the crankshaft flange. Refit the main bearing caps and tighten the bolts to 55 to 60 lb. ft. (7.60 to 8.29 kg.m.) torque.
5. Check the crankshaft end-float with feeler blades between the crankshaft and the thrust washers. This should be between 0.003 and 0.008 in. (0.08 and 0.20 mm.).

OP 6000-C19 EXTRA: CYLINDER HEAD AND PISTONS – DECARBONISE
(with engine removed)

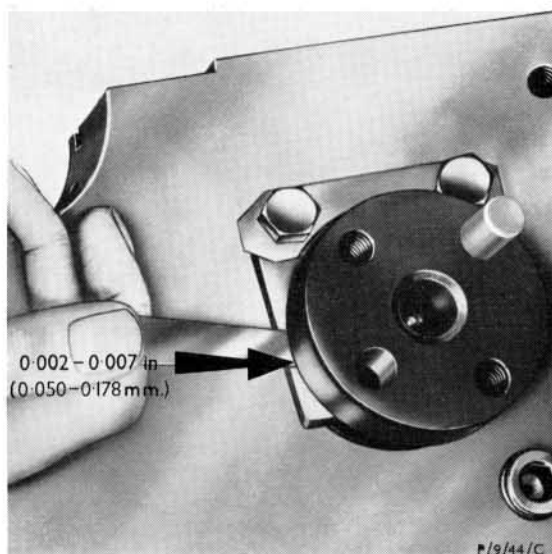
See Operation No. 6051-A, sub-operations 11 to 18 and Operation Nos. 6051-A1 and A2.

OP 6000-C20 EXTRA: VALVES – ALL – REFACE, RESEAT AND GRIND-IN
(with engine removed)
(Includes initial setting of valves, running-up engine and final setting of valve clearances)

See Operation No. 6051-A, sub-operations 11 to 18 and Operation Nos. 6051-A3, A4, A5 and A6.



Fitting the Auxiliary Shaft Thrust Plate



Checking the Auxiliary Shaft End-float

OP 6000-C21 EXTRA: CYLINDER ASSEMBLY – REMOVE AND INSTALL
(with engine and ancillaries removed)

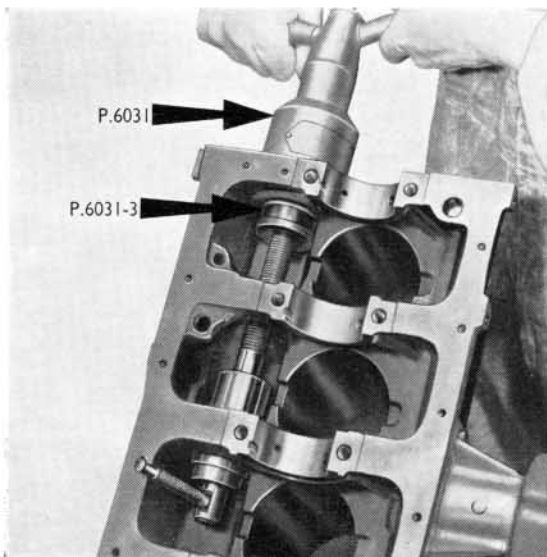
Tools Required

200 A or B	Engine stand
P.4008	Crown wheel and pinion backlash gauge
PT.4063A	Cylinder head gasket locating studs
CP.6032B	Crankshaft sprocket replacer
P.6041	Crankshaft pulley remover
P.6107	Universal stand adaptor
P.6116	Crankshaft sprocket remover
P.6150	Front oil seal aligner
P.6161	Front oil seal remover and replacer
P.7137	Spigot bearing replacer and clutch disc locator

To Remove

1. Fit a universal stand adaptor Tool No. P.6107 and mount the engine on a stand Tool No. 200 A or B.
2. Unscrew the pressure plate bolts evenly and detach the pressure plate and clutch disc.
3. Remove the flywheel.
4. Remove the crankshaft pulley, using remover Tool No. P.6041.
5. Remove the oil pump and filter assembly.
6. Remove the camshaft cover and gasket.
7. Slacken the timing chain tensioner.
8. Remove the camshaft sprockets and disconnect the timing chain.
9. Unscrew the cylinder head bolts evenly and lift off the cylinder head gasket.

NOTE – Do not lay the cylinder head flat on its face as damage to the valves can occur while the camshafts are still fitted.



Fitting the Auxiliary Shaft Bushes

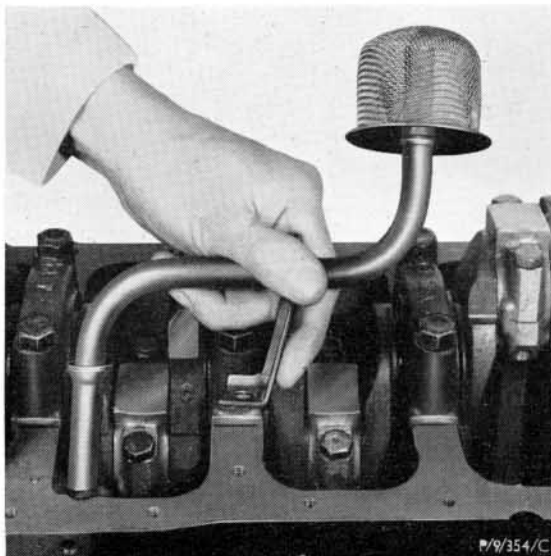


Checking the Crankshaft End-float

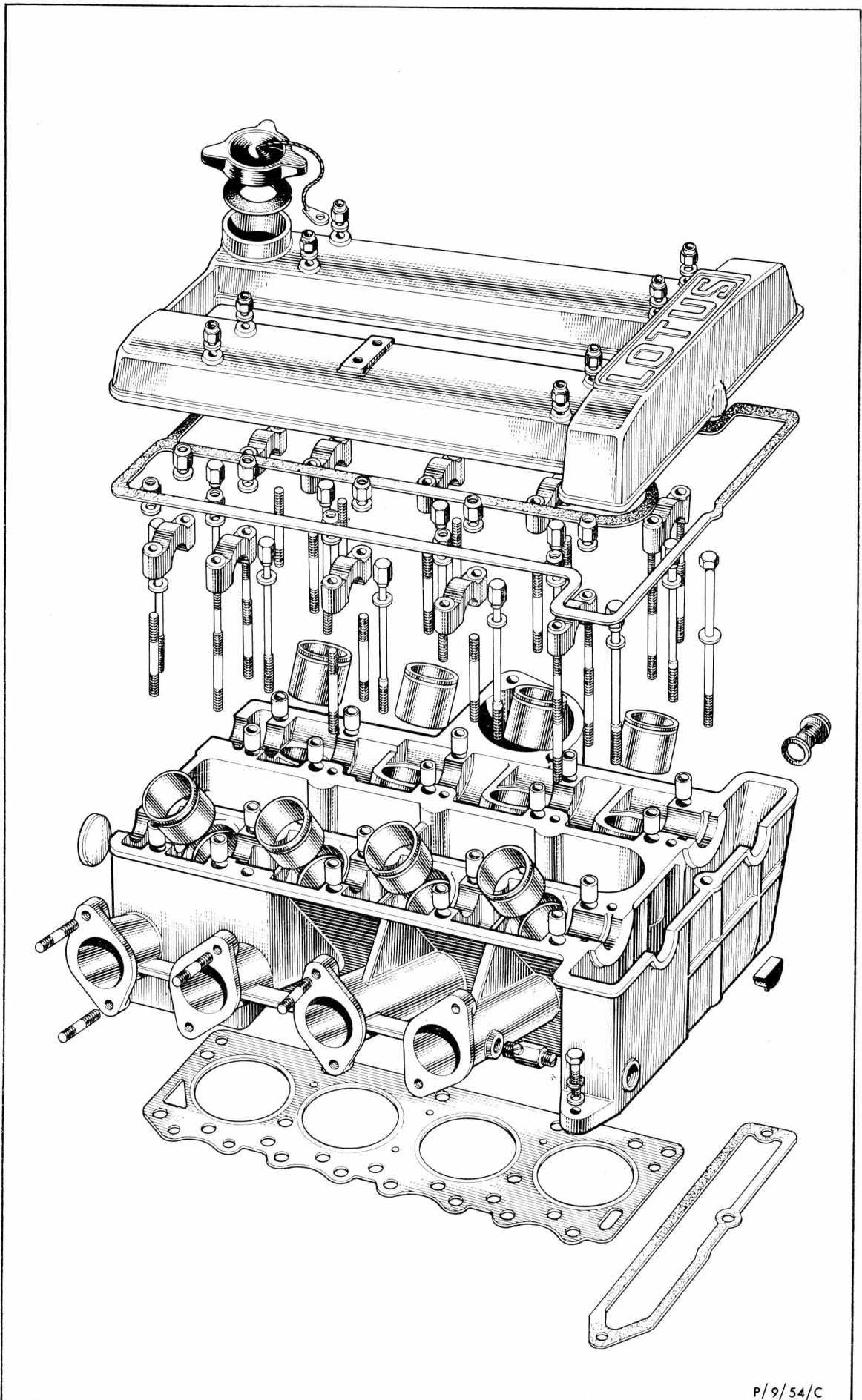
10. Remove the breather pipe.
11. Invert the engine on the stand and remove the sump and gaskets.
12. Remove the front cover.
13. Remove the timing chain.
14. Remove the crankshaft oil slinger.
15. Remove the auxiliary shaft sprocket and adaptor.
16. Remove the front cover backplate.
17. Remove the crankshaft sprocket using Tool No. P.6116 and then extract the key.
18. Remove the oil pump filter gauze.
19. Remove the oil pump inlet tube and oil return pipe.
20. Remove the cylinder assembly from the stand and bolt the adaptor Tool No. P.6107 to the new cylinder assembly. Mount the new cylinder assembly on the universal stand.

To Install

21. Replace the oil pump inlet tube and oil return pipe. Press the pipe fully home to the full depth of the counterbored hole.
22. Fit the filter gauze to the oil inlet tube.
23. Fit the crankshaft key and sprocket to the front end of the crankshaft. Press the sprocket home using replacer Tool No. CP.6032B. Ensure that the long boss is adjacent to the main bearing journal.
24. Fit the front cover backplate. Align the water pump aperture with the front cover and seal aligner Tool No. P.6150 before tightening the single bolt to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) torque.
25. Fit the auxiliary shaft sprocket adaptor followed by the sprocket after first fitting a new dowel, if not already fitted. Tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and turn up the locking plate tabs.
26. Locate the timing chain in position around the crankshaft and auxiliary shaft sprockets and around the water pump aperture in the backplate.
27. Fit the oil slinger to the crankshaft with the dished face away from the sprocket.



Fitting the Combined Oil Pump Inlet Tube and Filter Gauze

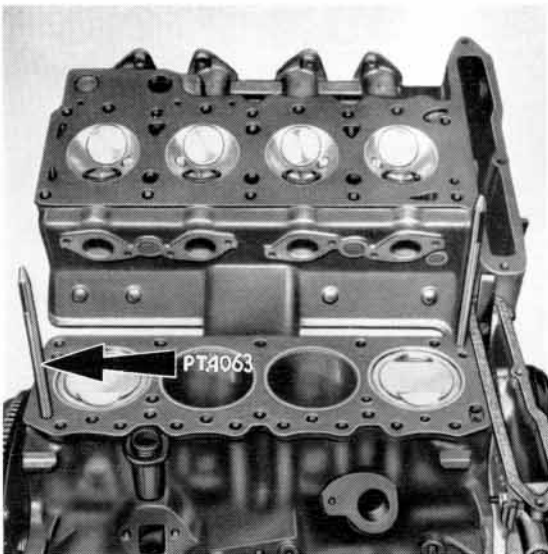


P/9/54/C

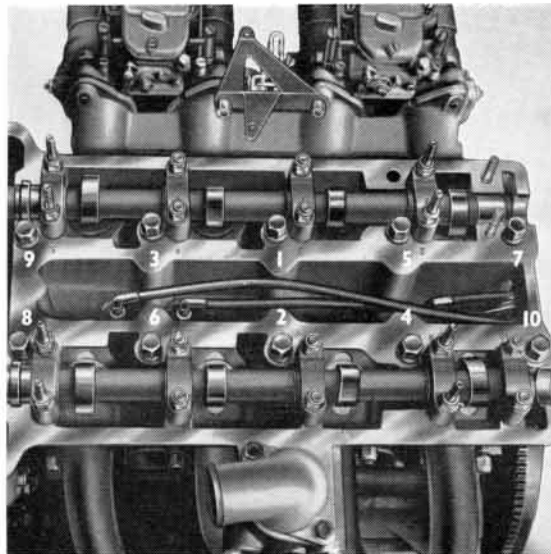
Cylinder Head and Camshaft Cover

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28. Fit a new oil seal to the front cover using Tool No. P.6161 and a 550 handle.
29. Coat the front cover joint faces with ESEE-M4G-1008A jointing compound and fit the front cover, aligning the seal with Tool No. P.6150. Tighten the $\frac{1}{4}$ in. nuts and bolts evenly to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) torque and the $\frac{5}{16}$ in. to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.) and remove the aligner.
30. Fit new gaskets on the block flange using ESEE-M4G-1008A jointing compound at each end on the front cover and rear oil seal carrier. Fit the cork strips again using EM-4G-47. Refit the sump and then tighten the bolts evenly to a torque of 7 to 9 lb. ft. (0.97 to 1.24 kg.m.) in the sequence given on page 28.
31. Fit the crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the retaining bolt to 24 to 28 lb. ft. (3.32 to 3.87 kg.m.).
32. Fit a new clutch pilot spigot bearing using replacer Tool No. P.7137.
33. Locate the flywheel squarely on the crankshaft flange. Tighten the retaining bolts evenly to a torque of 45 to 50 lb. ft. (6.22 to 6.91 kg.m.) for hexagonal bolts and 50 to 55 lb. ft. (6.91 to 7.60 kg.m.) for bi-hexagonal bolts. Check the flywheel run-out using gauge Tool No. P.4008. This should not exceed 0.004 in. (0.10 mm.) total indicator reading.
34. Fit the clutch assembly to the flywheel. Centralise the clutch disc with the hub assembly away from the flywheel using the locator Tool No. P.7137. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.), then remove the clutch disc locator.
35. Locate the breather pipe in its bore in the cylinder block and new gasket on top of the front cover.
36. Fit the cylinder head assembly. Locate the cylinder head gasket on the cylinder block using the locating studs Tool No. PT.4063A screwed into diagonally opposite bolt holes in the block face. Fit the cylinder head assembly engaging the breather pipe in its bore. Screw the cylinder head bolts home before removing the locating studs and then tighten in sequence to 60 to 65 lb. ft. (8.29 to 8.98 kg.m.) torque. Tighten the three front cover bolts to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.) torque.
37. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.) torque.



Fitting the Cylinder Head



Cylinder Head Bolt Tightening Sequence

38. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
39. Fit the camshaft cover and tighten the retaining nuts evenly.
40. Fit the oil pump and filter assembly.
41. Remove the engine from the stand and the adaptor.

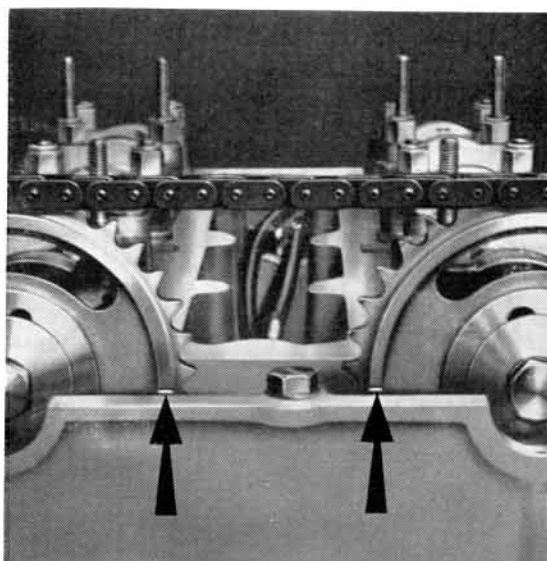
OP 6000-C22 EXTRA: CYLINDER BLOCK – REMOVE AND INSTALL
(cylinder assembly removed)

Tools Required

550	Drive handle
38 U 3	Piston ring squeezer
CP.6173	Crankshaft rear oil seal aligner
P.6165	Crankshaft rear oil seal remover and replacer

To Remove

1. Remove the rear oil seal carrier.
2. Unscrew the bolts several turns and tap them to release the big end caps. Unscrew the bolts completely and remove the caps. Push the pistons out of the bores and withdraw the assemblies.
3. Remove the auxiliary shaft thrust plate and withdraw the auxiliary shaft.
4. Unscrew the main bearing cap bolts evenly and lift off each cap. Lift out the crankshaft and remove the main bearing liners and thrust washers.



Camshaft Sprocket Valve Timing Marks



Crankshaft Valve Timing Mark

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5. Dismantle the piston and connecting rod assemblies. Remove the piston rings and remove the two piston pin circlips. Push the piston pin out of each piston.

NOTE – It is permissible to heat the piston to a temperature of 120°C (248°F) to assist piston pin removal.

To Install

6. Locate the auxiliary shaft thrust plate in the shaft groove and tighten the retaining bolts to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) torque. Check the end-float which should be between 0.002 and 0.007 in. (0.051 to 0.178 mm.). Turn over the locking tabs.
7. Fit the crankshaft main bearing liners and thrust washers. Install crankshaft in cylinder block and refit main bearing caps. Tighten main bearing cap bolts evenly to 55 to 60 lb. ft. (7.60 to 8.29 kg.m.) torque and check crankshaft rotation.
8. Check the crankshaft end-float. Take up the end-float in one direction and insert a feeler blade between the crankshaft and the thrust washer to measure the clearance. The end-float should be between 0.003 and 0.008 in. (0.08 and 0.20 mm.).
9. Select pistons to suit the new cylinder block. Refer to page 20.
10. Locate the piston rings in the cylinder bore and check the ring gaps which should be between 0.009 and 0.014 in. (0.23 and 0.36 mm.) for the compression rings and 0.010 to 0.020 in. (0.25 to 0.51 mm.) for the oil control rings.
11. Check piston ring to groove clearances which should be as follows:—

Upper compression ring	...	...	...	...	0.0016 to 0.0031 in. (0.041 to 0.081 mm.)
Lower compression ring	...	...	...	...	0.0016 to 0.0036 in. (0.041 to 0.091 mm.)
Oil control ring	...	...	...	...	0.0015 to 0.0030 in. (0.04 to 0.076 mm.)
12. Fit the piston rings, fitting the oil control ring first, followed by the lower and then the upper compression rings. Ensure that the compression rings are fitted the correct way up.
13. Assemble the piston to the connecting rod. Ensure that the "FRONT" marking on the connecting rod is on the same side of the assembly as the mark on the piston crown. Heat the piston in water or oil prior to inserting the piston pin. Retain the piston with the circlips.
14. Fit the piston and connecting rod assemblies into the appropriate bores. Position the oil control ring gap to the rear and the compression ring gaps to 150° on either side of this. Compress the rings using Tool No. 38 U 3. Turn the crankshaft as necessary to fit the connecting rod big end caps to the crankpins. Tighten the bolts to 44 to 46 lb. ft. (6.08 to 6.36 kg.m.) torque. Check the big end float on the crankpin, this should be 0.004 to 0.010 in. (0.10 to 0.25 mm.).
15. Fit a new oil seal to the rear oil seal carrier using Tool No. P.6165 and a 550 handle.
16. Fit a new gasket to the rear oil seal carrier using ESEE-M4G-1008A jointing compound at the ends. Secure the carrier to the cylinder block, aligning it with Tool No. CP.6173. Tighten the bolts evenly to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) torque and remove the aligner.

OP 6000-C23 EXTRA: CYLINDER BLOCK – REBORE (with cylinder block removed)

Tools Required

Boring bar

1. Rebore cylinder block using proprietary boring equipment and adhering to the manufacturer's instructions.

OP 6000-C24 EXTRA: CYLINDER BLOCK – REBORE AND FIT LINERS
(with cylinder block removed)

Tools Required

Boring bar

Locally manufactured remover and replacer ring

1. Bore the cylinder block to the specified size for the cylinder liner using a proprietary boring bar.
2. Place the remover adaptor in the replacer ring and locate in the cylinder liner which should be lubricated on the outside with tallow. Press the liner into the bore from the top on a suitable press.
3. Cut the connecting rod clearance slots in the base of the liner and machine the bore to give the correct clearance for the piston being fitted.

OP 6010-A CYLINDER ASSEMBLY – REMOVE AND INSTALL
(Includes OPS 6000-C, C1 and C21)

OP 6010-B CYLINDER BLOCK – REMOVE AND INSTALL
(Includes OPS 6000-C, C21 and C22)

OP 6010-C CYLINDER BLOCK – REBORE
(Includes OPS 6000-C, C1, C21, C22 and C23)

OP 6010-D CYLINDER BLOCK – SLEEVE
(Includes OPS 6000-C, C1, C21, C22, C23 and C24)

OP 6015-A ENGINE ASSEMBLY – FIT NEW, SERVICE, OR RECONDITIONED UNIT
(Includes transferring, but not overhauling, ancillaries, adjusting carburettor and ignition timing, cleaning exterior of ancillaries and checking for water, oil or fuel leaks. Does not include valve adjustment)

1. Remove and install the engine assembly, see Operation No. 6000-C and C1.

OP 6015-A1 EXTRA: ENGINE COMPARTMENT – CLEAN
(with engine removed)

Tools Required

Steam cleaner

Clean engine compartment using proprietary steam cleaner, following manufacturer's instructions.

OP 6015-A2 EXTRA: CLUTCH DISC AND/OR PRESSURE PLATE – REMOVE AND INSTALL
(with engine removed)

To Remove

1. Unscrew the pressure plate bolts evenly and remove the pressure plate and disc.

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To Install

2. Centralise the clutch disc, with the hub assembly away from the flywheel, using Tool No. P.7137. Fit the pressure plate and cover assembly and tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the clutch disc locator.

OP 6015-A3 EXTRA: CLUTCH RELEASE BEARING – RENEW (with engine removed)

To Remove

1. Remove the rubber gaiter.
2. Withdraw the release arm and bearing assembly from the clutch housing.
3. Remove the release arm from the hub and bearing assembly.

To Install

4. Apply a smear of molybdenum based grease to the hub and release arm then engage the arm in the slots in the hub and release bearing assembly.
5. Pass the release arm through the aperture in the clutch housing and slide the release bearing onto the main drive gear bearing retainer.
6. Replace the rubber gaiter.

OP 6015-A4 EXTRA: CLUTCH FORK – REMOVE AND INSTALL (with clutch release bearing removed)

To Remove

1. Remove the rubber gaiter.
2. Withdraw the release arm from the clutch housing.

To Install

3. Pass the release arm through the aperture in the clutch housing and refit the rubber gaiter.

OP 6015-A5 EXTRA: MAIN DRIVE GEAR BEARING RETAINER GASKET AND/OR MAIN DRIVE GEAR OIL SEAL – REMOVE AND INSTALL (with engine and clutch release bearing removed)

See Operation No. 7000-A6 of Section 7/1.

OP 6015-B ENGINE AND GEARBOX ASSEMBLY – REMOVE AND INSTALL (Includes remove assembly, position on blocks on floor and refit assembly)

See Operation No. 6000-C.

OP 6015-B1 EXTRA: ENGINE AND GEARBOX – SEPARATE AND RECONNECT

To Separate

1. Remove the starter motor.

2. Remove the bolts securing the clutch housing to the engine. Note that a top bolt secures the engine steady bracket and clutch fluid supply hose brackets.
3. Remove the bolts securing the lower dust cover and remove the cover.
4. Separate the gearbox and engine.

To Reconnect

5. Offer the gearbox up to the engine so that the main drive gear spigot enters the crankshaft bearing and the splines engage with the clutch disc splines. Turn the mainshaft with the box in gear, if necessary, to engage the splines. Push the gearbox fully home.
6. Refit the clutch housing to engine bolts.
7. Position the lower dust cover and secure with bolts.
8. Refit the starter motor.

OP 6038-A ENGINE FRONT MOUNTING – ONE – RENEW

To Remove

1. Support the engine with a jack or crane.
2. Remove one of the engine mountings.

To Install

3. Replace the engine mounting.
4. Remove the jack or crane supporting the engine.

OP 6038-A1 EXTRA: REMAINING FRONT ENGINE MOUNTING – RENEW

To Remove

1. Remove other engine mounting.

To Install

2. Replace other engine mounting.

OP 6038-B ENGINE FRONT MOUNTINGS – BOTH – RENEW
(Includes OPS 6038-A and A1)

OP 6038-C ENGINE FRONT MOUNTINGS – BOTH – CHECK TORQUE OF BOLTS

OP 6051-A CYLINDER HEAD GASKET – RENEW
(Includes remove and install cylinder head assembly, clean cylinder head and block mating faces. Does not include decarbonise cylinder head or pistons)

Tools Required

PT.4063 Cylinder head gasket locating studs.

To Remove

1. Drain the engine coolant.
2. Remove the carburettor air cleaner and air intake cover.
3. Disconnect the radiator top hose and the heater hose at the cylinder head.
4. Disconnect the brake servo vacuum hose.
5. Disconnect the temperature gauge sender unit.
6. Disconnect the throttle and choke cables and the fuel pipe from the carburettors.
7. Detach the exhaust manifolds and move them clear of the cylinder head.
8. Pull the plug leads off the sparking plugs.
9. Remove the camshaft cover and gasket.
10. Slacken the timing chain tensioner.
11. Remove the camshaft sprockets and disconnect the timing chain.
12. Unscrew the cylinder head bolts evenly and lift off the cylinder head and gasket.

NOTE - **Do not** lay the cylinder head flat on its face as damage to the valves can occur.

To Install

13. Fit the cylinder head assembly. Locate the cylinder head gasket, copper side uppermost, on the cylinder block. Screw the studs Tool No. PT.4063A into diagonally opposite bolt holes on the block face to locate the gasket. Locate a new gasket on top of the front cover. Install the cylinder head assembly, engaging the breather pipe in its bore.
14. Refit the cylinder head bolts before removing the locating studs and then tighten in the sequence shown on page 40 to 60 to 65 lb. ft. (8.29 to 8.98 kg.m.). Tighten the three front cover bolts to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.).
15. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.41 to 4.15 kg.m.). Rotate the engine one revolution in its normal direction of rotation and re-check valve timing.
16. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
17. Fit the camshaft cover plugs and gasket and refit the cover.
18. Check that the plug caps are secure on their respective leads then couple the plug leads to their respective plugs.
19. Position the manifold gaskets on the head and fit the manifolds. Tighten the retaining nuts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.).
20. Reconnect the fuel pipe and the throttle and choke cables to the carburettors.
21. Reconnect the temperature gauge sender unit.
22. Reconnect the brake servo vacuum hose.
23. Reconnect the radiator top hose and the heater hose.
24. Replace the carburettor air intake cover and fit the air cleaner.
25. Refill the cooling system with a 50% solution of Ford Antifreeze Plus.
26. Retime the ignition (see Operation No. 12100-A).
27. If necessary, adjust the timing chain tension dynamically. Refer to Operation No. 6270-A.

OP 6051-A1 EXTRA: CYLINDER HEAD – DECARBONISE
(with cylinder head removed)

1. Remove the carburettors and air intake backplate as an assembly.
2. Remove the sparking plugs.
3. Using a suitable implement, remove all carbon deposits from cylinder head faces, cylinder head ports, valve heads and piston crowns. Care must be taken to ensure that carbon scraped off is prevented from contaminating any parts of the engine.
4. Refit the sparking plugs.
5. Fit the carburettors and backplate assembly. Locate new "O" ring in the spacers and tighten the retaining nuts until there is 0.040 in. (1.02 mm.) clearance between the coils of the double coil spring washers. Connect the fuel pipe and refit the accelerator return spring bracket.

OP 6051-A2 EXTRA: PISTONS – DECARBONISE
(with cylinder head removed)

Using a suitable implement, remove all carbon deposits from the combustion bowl and piston crown. Care must be taken to ensure that carbon scraped off is prevented from contaminating any part of the engine, and that no damage is done to the piston by the scraping tool.

OP 6051-A3 EXTRA: ONE VALVE – REMOVE AND INSTALL
(does not include refacing seat or grind-in valve)

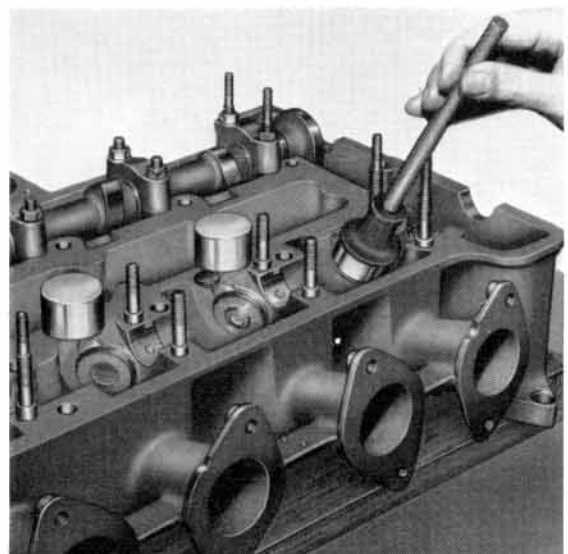
To Remove

1. Extract the tappet and adjustment shim.
2. Compress the valve springs and extract the collets. Remove the valve spring retainer and valve spring.
3. Remove the valve.

To Install

4. Fit the valve springs and retainer and compress to fit the collets.
5. Place the adjustment shim in the retainer recess on top of the valve stem and insert the tappet into its bore.

Removing the Tappets



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6. Refit the camshaft ensuring that the bearing liners are correctly located. Tighten the bearing cap nuts evenly to 9 lb. ft. (1.24 kg.m.).
7. Check and adjust the valve clearance (see Operation No. 6051-A8).

OP 6051-A4 EXTRA: EACH ADDITIONAL VALVE – REMOVE AND INSTALL

Using the procedure in Operation No. 6051-A3 remove and install each additional valve.

OP 6051-A5 EXTRA: EACH VALVE SEAT – RECUT (with valve removed)

Tools Required

316X	Valve seat cutter
316-10	Valve seat cutter pilot
317	Valve seat cutter

1. Recut the valve seat to ensure that the seat is concentric with the valve stem bore. Use cutter Tool No. 317-25 fitted to pilot Tool No. 316-10 in handle Tool No. 316X.

OP 6051-A6 EXTRA: EACH VALVE – GRIND-IN (with valve removed)

Tools Required

Valve lapping dolly

1. Grind or lap in the valves using a suitable grade of grinding paste.

OP 6051-A8 EXTRA: EACH VALVE GUIDE – RENEW (with valve removed)

Tools Required

P.6054	Valve guide remover/replacer
Tap Wrench	
Valve guide reamer (0.3113 to 0.3123 in. (7.907 to 7.932 mm.) diameter).	

To Remove

1. Remove the valve spring lower seat.
2. Remove the valve guide using Tool No. P.6054.

To Install

3. Heat the cylinder head to 100 to 150°C (212 to 303°F) locate a circlip on the new valve guide and press a new guide into the cylinder head up to the circlip.
4. Ream the valve guide bore to 0.3113 to 0.3123 in. (7.907 to 7.932 mm.) using a suitable reamer and tap wrench.
5. Refit the valve spring lower seat.

OP 6051-A9 EXTRA: CYLINDER HEAD – RENEW (with valves removed)

1. Remove the temperature gauge unit and adaptor.

2. Remove the heater valve control assembly.
3. Remove the thermostat housing and thermostat and transfer to the new cylinder head.
4. Fit the heater valve control assembly to the new cylinder head.
5. Replace the temperature gauge sender unit and adaptor on the new cylinder head. Apply EM-4G-52 sealer to the adaptor prior to fitting it to the cylinder head.
6. Remove the manifold studs and accelerator return spring bracket from the head being replaced and fit them to the new cylinder head. Alternatively fit new studs in the new cylinder head.

OP 6051-B CYLINDER HEAD AND PISTONS – DECARBONISE
(Includes OPS 6051-A, A1 and A2)

OP 6051-C VALVE – ONE – REMOVE AND INSTALL
(Includes OPS 6051-A, A1 and A3)
(Does not include reface valve seat or grind-in valve)

OP 6051-D VALVE – ONE – REMOVE AND INSTALL
(Includes OPS 6051-A, A1, A3, A5 and A6)
(Includes reface valve seat and grind-in valve)

OP 6051-E VALVES – ALL – REMOVE AND INSTALL
(Includes OPS 6051-A, A1, A3, A4, A5 and A6)

OP 6051-F DECARBONISE CYLINDER HEAD AND PISTONS AND RESEAT AND GRIND-IN ALL VALVES
(Includes OPS 6051-A, A1, A2, A3, A4, A5 and A6)

OP 6051-I VALVE GUIDE – ONE – RENEW
(Includes OPS 6051-A, A1, A3, A5, A6 and A8)

OP 6051-J VALVE GUIDES – ALL – RENEW
(Includes OPS 6051-A, A1, A3, A4, A5, A6 and A8)

OP 6051-K CYLINDER HEAD – REMOVE AND INSTALL
(Includes OPS 6051-A, A2, A3, A4 and A9)

OP 6051-M CYLINDER HEAD BOLTS – TORQUE
(Includes adjust valve clearances)

Tools Required

P.6129 Cylinder head bolt socket.

1. Raise the bonnet and fit wing covers.
2. Remove the air cleaner.
3. Remove the camshaft cover.
4. Tighten the bolts evenly and in the sequence shown on page 40.
5. Measure and note the clearance for each valve.
6. Slacken the timing chain tensioner.
7. Set the valve timing marks.
8. Remove the camshaft sprockets and disconnect the timing chain.

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9. Remove each camshaft.
10. Remove the tappets, keeping them in their respective order.
11. Remove each tappet adjustment shim in turn and substitute one giving the correct clearance.
12. Refit the tappets in their respective bores.
13. Fit the camshafts, ensuring that the bearing liners are correctly located. Tighten the bearing cap nuts evenly to 9 lb. ft. (1.24 kg.m.).
14. Re-check the valve clearances and readjust if necessary.
15. Fit the camshaft sprockets and timing chain. Align the timing marks on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
16. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots in the chain by turning the engine through several revolutions.
17. Re-time the ignition (see Operation No. 12100-A).
18. If necessary adjust the timing chain tension dynamically. Refer to Operation No. 6270-A.

OP 6068-A ENGINE REAR MOUNTING – RENEW

To Remove

1. With the handbrake applied, jack up the car front end and fit stands.
2. Suitably support the gearbox with a jack.
3. Disconnect the crossmember from the body floor pan.
4. Unscrew the engine rear mounting centre bolt and remove the crossmember.
5. Remove the engine mounting from the crossmember.

To Install

6. Fit the engine mounting to the crossmember.
7. Locate the crossmember on the gearbox extension housing and fit the centre bolt.
8. Fit the crossmember to the body and secure with the four retaining bolts.
9. Remove the jack from under the gearbox.
10. Jack up the car, remove the stands, and lower the car to the ground.

OP 6250-A CAMSHAFT – ONE – AND/OR BEARINGS AND/OR TAPPETS – REMOVE AND INSTALL

To Remove

1. Remove the air cleaner.
2. Remove the camshaft cover.
3. Slacken the timing chain tensioner.
4. Set the engine in the timing position. Remove the camshaft sprocket and disconnect the timing chain.

5. Remove the camshaft.
6. Extract the bearing liners and/or the tappets.

To Install

7. Fit new tappets and/or bearing liners.
8. Fit the camshaft and tighten the bearing cap nuts evenly to 9 lb. ft. (1.24 kg.m.).
9. Check and adjust the valve clearances (see Operation No. 6051-A8).
10. Fit the camshaft sprocket and timing chain aligning the timing marks, as pre-set during removal. Tighten the retaining bolt to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
11. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
12. Refit the camshaft cover.
13. Fit the air cleaner.
14. Re-time the ignition (see Operation No. 12100-A).
15. If necessary adjust the timing chain tension dynamically. Refer to Operation No. 6270-A.

OP 6250-A1 EXTRA: REMAINING CAMSHAFT AND/OR BEARINGS AND/OR TAPPETS – REMOVE AND INSTALL
(Includes adjust valves)

To Remove

1. Remove the camshaft sprocket and disconnect the timing chain.
2. Remove the camshaft.
3. Extract the bearing liners and/or tappets.

To Install

4. Fit new tappets and/or bearings.
5. Fit the camshaft and tighten the bearing cap nuts evenly to 9 lb. ft. (1.24 kg.m.).
6. Check and adjust the valve clearances (see Operation No. 6051-A8).
7. Fit the camshaft sprocket and timing chain, aligning the timing marks. Tighten the retaining bolt to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).

OP 6261-A AUXILIARY SHAFT BEARINGS – REMOVE AND INSTALL
(Includes remove engine)

Tools Required

200 A or B	Engine stand
550	Driver handle
P.4008	Crownwheel and pinion backlash gauge
P.6031	Auxiliary shaft bearing bush remover/replacer
P.6031-3	Auxiliary shaft bearing bush remover/replacer adaptors
CP.6041	Crankshaft pulley remover

P.6107	Engine bracket
CP.6173	Crankshaft rear oil seal aligner
P.6150	Front cover oil seal aligner
P.6161	Front cover oil seal remover/replacer
P.6165	Crankshaft rear oil seal remover/replacer
P.7137	Spigot bearing replacer and clutch disc locator

To Remove

1. Remove the engine assembly as described in Operation No. 6000-C.
2. Fit the bracket Tool No. P.6107 and mount the engine on a stand Tool No. 200 A.
3. Remove the camshaft cover.
4. Remove the timing chain tension adjuster.
5. Remove the crankshaft pulley using Tool No. CP.6041.
6. Remove the oil pump and filter assembly.
7. Remove the camshaft sprockets and disconnect the timing chain.
8. Unscrew the cylinder bolts evenly and lift off the cylinder head and gasket.
NOTE - **Do not** lay the cylinder head flat on its face as damage to the valves can occur.
9. Invert the engine and remove the sump, gaskets and cork packing strips.
10. Remove the front cover.
11. Remove the crankshaft oil slinger.
12. Disconnect the timing chain.
13. Remove the auxiliary shaft sprocket.
14. Remove the front cover back plate and gaskets.
15. Remove the distributor and fuel pump.
16. Remove the auxiliary shaft thrust plate. Withdraw the auxiliary shaft.
17. Unscrew the pressure plate bolts evenly and detach the pressure plate and disc.
18. Remove the flywheel.
19. Remove the crankshaft rear oil seal carrier.
20. Unscrew the bolts several turns and tap them to release the big end caps. Completely unscrew the bolts and remove the caps. Push the pistons up into the cylinder bores.
21. Unscrew the main bearing cap bolts evenly and lift off each cap. Lift out the crankshaft. Remove the thrust washers and bearing liners.
22. Remove the auxiliary shaft bearing bushes using Tool No. P.6031 with adaptors Tool No. P.6031-3.
23. Check all the oilways to ensure that they are clear, apply EM-4G-52 sealing compound to the oil gallery plugs prior to refitting.

To Install

24. Fit new auxiliary shaft bearing bushes again using Tool No. P.6031 and P.6031-3. Ensure that the oil holes in the bushes and cylinder block are aligned. The splits in the bushes should be upwards and outwards at 45° to the vertical.

25. Fit the main bearing liners and replace the crankshaft. Locate the crankshaft thrust washers with the oil grooves facing the crankshaft flange. Refit the main bearing caps and tighten the retaining bolts to 55 to 60 lb. ft. (7.60 to 8.29 kg.m.).
26. Check the crankshaft end-float with feeler blades between the crankshaft and the thrust washers. This should be between 0.003 and 0.008 in. (0.08 and 0.203 mm.).
27. Turn the crankshaft as necessary to fit the connecting rod big ends to the crankpins. Tighten the bolts to a torque of 44 to 46 lb. ft. (6.08 to 6.36 kg.m.).
28. Fit a new crankshaft rear oil seal using remover/replacer Tool No. P.6165 and a 550 handle.
29. Fit a new gasket to the rear oil seal carrier using ESEE-M4G-1008A jointing compound at the ends. Secure the carrier to the cylinder block, aligning it with Tool No. CP.6173. Tighten the bolts evenly to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the aligner.
30. Locate the flywheel squarely on the crankshaft flange. Tighten the retaining bolts to 45 to 50 lb. ft. (6.22 to 6.91 kg.m.) for hexagonal bolts and 50 to 55 lb. ft. (6.91 to 7.60 kg.m.) for bi-hexagonal bolts.
31. Check the flywheel run-out using gauge Tool No. P.4008. This should not exceed 0.004 in. (0.10 mm.) total indicator reading.
32. Centralise the clutch disc with the hub assembly away from the flywheel using Tool No. P.7137 or P.7091-A. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the clutch disc locator.
33. Slide the auxiliary shaft into position. Fit the thrust plate in the auxiliary shaft groove. Tighten the retaining bolts to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and bend up the locking tabs.
34. Check the auxiliary shaft end-float with feeler blades between the thrust plate and the auxiliary shaft flange. This should be between 0.002 and 0.007 in. (0.050 and 0.178 mm.).
35. Locate a new gasket on the cylinder head to timing cover joint.
36. Fit the front cover back plate. Align the water pump aperture with the front cover and seal aligner Tool No. P.6150 before tightening the single bolt to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.)
37. Fit the auxiliary shaft sprocket. Tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and turn up the locking plate tabs.
38. Locate the timing chain in position around the crankshaft and auxiliary shaft sprockets and around the water pump aperture in the back plate.
39. Fit the oil slinger on the crankshaft.
40. Fit a new oil seal to the front cover using Tool No. P.6161 and a 550 handle.
41. Coat the front cover joint faces with ESEE-M4G-1008A jointing compound. Align the front cover with Tool No. P.6150 and tighten the $\frac{1}{4}$ in. nuts and bolts evenly to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and the $\frac{5}{16}$ in. to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.) before removing the aligner.
42. Fit the timing chain tension adjuster and adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
43. Locate a new gasket on the oil pump mounting flange and fit the oil pump and filter assembly. Tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.).
44. Fit new gaskets on the block flange using ESEE-M4G-1008A jointing compound at each end. Fit the cork packing strips, chamfered ends into the groove, again using ESEE-M4G-1008A jointing compound at the ends and refit the sump. Tighten the sump bolts to 7 to 9 lb. ft. (0.97 to 1.24 kg.m.) in the sequence shown on page 28.

45. Fit the crankshaft pulley, aligning the pulley slot with the crankshaft key. Tighten the pulley retaining bolt to 24 to 28 lb. ft. (3.32 to 3.87 kg.m.).
46. Locate a new gasket on the cylinder head to timing cover joint.
47. Fit the cylinder head assembly. Locate the cylinder head gasket on the cylinder block using the locating studs Tool No. PT.4063A screwed into diagonally opposite bolt holes in the block face. Fit the cylinder head assembly engaging the breather pipe in its bore. Screw the cylinder head bolts home before removing the locating studs and then tighten in sequence to 60 to 65 lb. ft. (8.29 to 8.98 kg.m.). Tighten the three front cover bolts to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.).
48. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
49. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
50. Replace the camshaft cover plugs and gasket and refit the cover.
51. Refit the distributor and fuel pump.
52. Remove the engine from the work stand.
53. Refit the engine assembly in the car as in Operation 6000-C.

OP 6270-A TIMING CHAIN TENSION – ADJUST
(dynamic)

With the engine running:

1. Slacken the locknut.
2. Screw the adjuster in until the noise disappears.
3. Tighten the locknut.

NOTE – A tight chain will whine and a slack chain will rattle.

OP 6271-A CAMSHAFT COVER GASKET – RENEW

To Remove

1. Remove the air cleaner.
2. Remove the camshaft cover.

To Install

3. Ensure mating faces are clean.
4. Fit a new gasket to the camshaft cover and refit the cover.
5. Refit the air cleaner.

OP 6271-A1 EXTRA: VALVE CLEARANCES – ADJUST
(camshaft cover removed)

1. Measure and note the clearance for each valve.
2. Slacken the timing chain tensioner.

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3. Set the valve timing marks.
4. Remove the camshaft sprockets and disconnect the timing chain.
5. Remove each camshaft.
6. Remove the tappets, keeping them in their respective order.
7. Remove each tappet adjustment shim in turn and substitute one giving the correct clearance.
8. Refit the tappets in their respective bores.
9. Fit the camshafts, ensuring that the bearing liners are correctly located. Tighten the bearing cap nuts evenly to 9 lb. ft. (1.24 kg.m.).
10. Re-check the valve clearances and readjust if necessary.
11. Fit the camshaft sprockets and timing chain. Align the timing marks on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
12. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots in the chain by turning the engine through several revolutions.
13. Re-time the ignition (see Operation No. 12100-A).

OP 6271-A2 EXTRA: TIMING CHAIN TENSION – ADJUST (Static)

1. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots in the chain by turning the engine through several revolutions.

OP 6271-A3 EXTRA: CAMSHAFT SPROCKETS – REMOVE AND INSTALL (camshaft cover removed)

To Remove

1. Slacken the timing chain tension adjuster.
2. Remove the camshaft sprockets and disconnect the timing chain.

To Install

3. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
4. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
5. Re-time the ignition (see Operation No. 12100-A).

OP 6271-B VALVE CLEARANCES – ADJUST (Includes OPS 6271-A and A1)

OP 6279-A FRONT COVER OIL SEAL, GASKETS AND/OR TIMING CHAIN – RENEW
(Includes, remove radiator, sump, cylinder head and front cover back plate)

Tools Required

550	Driver handle
P.6150	Crankshaft front cover oil seal aligner
P.6161	Crankshaft front oil seal remover/replacer

To Remove

1. Drain the engine coolant by opening the drain plugs on the radiator and cylinder block.
2. Disconnect the radiator hoses at the engine.
3. Remove the radiator assembly.
4. Remove the air cleaner.
5. Remove the camshaft cover.
6. Remove the fan belt and then remove the fan and the water pump pulley.
7. Remove the crankshaft pulley, using suitable levers.
8. Remove the timing chain tension adjuster.
9. Remove the cylinder head. See Operation No. 6051-A.
10. Mark the steering shaft and flexible joint, to ensure correct re-alignment on assembly, and remove the clamp bolt.
11. Disconnect the two multi-plug connectors behind the steering column.
12. Unscrew the two bolts at the lower end of the steering column and two crosshead screws at the top end and withdraw the assembly.
13. Jack up the front of the car and fit stands.
14. Drain the engine oil.
15. Place a sling beneath the inner engine mounting brackets and using a crane support the weight of the engine.
16. Unscrew the two nuts on the engine side of the engine mountings.
17. Unscrew the four bolts securing the crossmember to the chassis and replace each one **in turn** with a three-inch-long bolt and washer. Lower the crossmember the amount afforded by the longer bolts and remove the jack. Remove both bolts securing the starter motor and move it to one side to provide easy access to the sump bolts.
18. Unscrew the sump bolts and allow the sump to rest on the crossmember. Remove the gaskets and packing strips and discard.
19. Remove the front cover.
20. Remove the crankshaft oil slinger.
21. Disconnect the timing chain.
22. Remove auxiliary shaft sprocket.
23. Remove the front cover back plate and gaskets.

To Install

24. Using a new gasket fit the front cover backplate. Align the water pump aperture with the front cover and seal aligner Tool No. P.6150 before tightening the single bolt to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.).

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25. Fit the auxiliary shaft sprocket. Tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and turn up the locking plate tabs.
26. Locate the crankshaft oil slinger in place.
27. Fit a new oil seal, using a remover/replacer Tool No. P.6161 and 550 handle. If required fit a new timing chain vibration damper.
28. Coat the front cover joint faces with ESEE-M4G-1008A jointing compound. Align the cover in position with Tool No. P.6150. Tighten the $\frac{1}{4}$ in. retaining nuts and bolts evenly to a torque of 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and the $\frac{5}{16}$ in. to 10 to 15 lb. ft. (1.33 to 2.07 kg.m.) and remove the aligner tool.
29. Fit the sump. Fit new gaskets on the block flange using ESEE-M4G-1008A jointing compound at each end. Fit the cork packing strips with the chamfered ends into the grooves, again using ESEE-M4G-1008A jointing compound and refit the sump. Tighten the bolts to 6 to 8 lb. ft. (0.83 to 1.11 kg.m.). Replace the starter motor, and secure it with the two bolts.
30. Jack up the front crossmember and replace each of the three-inch-long bolts **in turn** with the original bolts and tighten to a torque of 25 to 30 lb. ft. (3.46 to 4.15 kg.m.). Whilst raising the crossmember, engage the inner mounting bolts with the engine mounting brackets.
31. Lower the engine completely, release the engine sling and remove the crane. Engage and tighten the inside mounting nuts.
32. Engage the steering shaft with the flexible joint, ensuring to align the marks previously scribed and fit and tighten the clamping bolt.
33. Reconnect the two multi-plug connectors behind the fascia panel.
34. Secure the lower half of the steering column with the two hexagon bolts and the upper half with the two crosshead screws.
35. Jack up the car, remove the stands, lower and remove the jack.
36. Fit the crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the retaining bolt to a torque of 25 to 28 lb. ft. (3.32 to 3.87 kg.m.).
37. Locate a new gasket on the cylinder head to timing cover joint. Refit the cylinder head. (See Operation No. 6051-A.)
38. Locate the timing chain around the sprockets ensuring that there is minimum slack between the exhaust camshaft sprocket and the crankshaft sprocket.
39. Fit the timing chain tension adjuster and tighten to 45 to 50 lb. ft. (6.22 to 6.91 kg.m.).
40. Replace the water pump pulley and the fan. Fit the fan and adjust the tension so that there is $\frac{1}{2}$ in. (12.7 mm.) total movement.
41. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
42. Fit the camshaft cover and tighten the retaining nuts evenly.
43. Fit the air cleaner.
44. Replace the radiator assembly.
45. Refit the radiator top and bottom hoses and tighten the clips.
46. Refill the radiator with a 50% solution of Ford Antifreeze Plus.
47. Re-time the ignition (see Operation No. 12100-A).
48. If necessary, set the timing chain dynamically. See Operation No. 6270-A.

OP 6279-A1 EXTRA: AUXILIARY SHAFT – REMOVE AND INSTALL
(front cover assembly removed)
(Includes remove fuel and oil pump and radiator grille)

To Remove

1. Remove the radiator grille. See Operation No. M 1030-A, in Section 12 of the basic Escort manual.
2. Remove the distributor. See Operation No. 12100-A.
3. Remove the oil pump and filter assembly.
4. Disconnect the fuel pipes and remove the fuel pump.
5. Remove the auxiliary shaft sprocket adaptor.
6. Remove the auxiliary shaft thrust plate.
7. Withdraw the auxiliary shaft.

To Install

8. Fit a new dowel to the new shaft.
9. Slide the auxiliary shaft into position.
10. Fit the thrust plate in the auxiliary shaft groove. Tighten the retaining bolts to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and bend up the locking tabs.
11. Check the auxiliary shaft end-float with feeler blades between the thrust plate and the auxiliary shaft flange. This should be between 0.002 and 0.007 in. (0.05 and 0.178 mm.)
12. Refit the auxiliary shaft sprocket adaptor.
13. Fit the fuel pump and connect the fuel pipes.
14. Refit the oil pump and filter assembly, tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.).
15. Time the distributor (see Operation No. 12100-A as part of Operation No. 6279-A).
16. Refit the radiator grille. See Operation No. M 1030-A, in Section 12 of the basic Escort manual.

OP 6279-A2 EXTRA: CRANKSHAFT SPROCKET – REMOVE AND INSTALL

Tools Required

- P.6032 Crankshaft sprocket replacer
P.6116 Crankshaft sprocket remover

To Remove

1. Remove the crankshaft sprocket using Tool No. P.6116.

To Install

2. Fit the crankshaft sprocket. Press the sprocket home using replacer Tool No. P.6032. Ensure that the long boss is adjacent to the main bearing journal.

OP 6280-A AUXILIARY SHAFT – REMOVE AND INSTALL
(Includes OPS 6279-A and A1)

OP 6303-A CRANKSHAFT – REMOVE AND INSTALL
(Includes remove and install engine, connecting rod and main bearing liners and transferring crankshaft sprocket)

Tools Required

200A or B	Engine stand
550	Driver handle
P.4008	Crown wheel and pinion backlash gauge
CP.6041	Crankshaft pulley remover
P.6032B	Crankshaft sprocket replacer
P.6107	Engine bracket
P.6116	Crankshaft sprocket remover
CP.6173	Crankshaft rear oil seal aligner
P.6150	Crankshaft front cover oil seal aligner
P.6161	Front cover oil seal remover/replacer
P.6165	Crankshaft rear oil seal remover/replacer
P.7137	Spigot bearing replacer and clutch disc locator

To Remove

1. Remove the engine assembly as described in Operation No. 6000-C.
2. Fit a bracket Tool No. P.6107 and mount the engine on a stand Tool No. 200 A or B.
3. Remove the camshaft cover.
4. Set the valve timing marks in the timed position.
5. Remove the crankshaft pulley using Tool No. CP.6041.
6. Unscrew the pressure plate bolts evenly and remove the pressure plate and clutch disc.
7. Remove the flywheel.
8. Remove the sump and gaskets.
9. Remove the timing chain tensioner.
10. Remove the camshaft sprockets and disconnect the timing chain.
11. Unscrew the cylinder head bolts evenly and lift off the cylinder head and gasket.
NOTE – **Do not** lay the cylinder head flat on its face as damage to the valves can occur.
12. Remove the front cover.
13. Remove the crankshaft oil slinger.
14. Disconnect the timing chain.
15. Remove the auxiliary shaft sprocket.
16. Remove the front cover backplate and gaskets.
17. Remove the crankshaft sprocket using Tool No. P.6116.
18. Remove the rear oil seal housing.
19. Unscrew the big end bolts two or three turns and tap them to release the caps. Completely unscrew the bolts and remove the caps. Push the pistons up into the cylinder bores.
20. Unscrew the main bearing cap bolts evenly and lift off each cap. Lift out the crankshaft and remove the bearing liners and thrust washers.

To Replace

21. Fit a new spigot bearing into the crankshaft using Tool No. P.7137.
22. Replace the crankshaft sprocket using replacer Tool No. P.6032A or B.
23. Fit the main bearing liners and replace the crankshaft. Fit the crankshaft thrust washers with the oil grooves facing the crankshaft flange. Refit the main bearing caps and tighten the bolts to 55 to 60 lb. ft. (7.60 to 8.29 kg.m.).
24. Check the crankshaft end-float with feeler blades between the crankshaft and the thrust washers. This should be between 0.003 and 0.008 in. (0.08 and 0.20 mm.).
25. Turn the crankshaft as necessary to fit the connecting rod big ends to the crankpins. Tighten the connecting rod bolts to 44 to 46 lb. ft. (6.08 to 6.36 kg.m.) torque. Check the end-float on the crankpin, this should be 0.004 to 0.010 in. (0.10 to 0.25 mm.).
26. Fit a new crankshaft rear oil seal using remover/replacer Tool No. P.6165 and a 550 handle.
27. Locate a new gasket on the rear oil seal carrier using ESEE-M4G-1008A jointing compound at the ends and fit the carrier to the block rear face using an aligner Tool No. CP.6173. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the aligner.
28. Fit the front cover backplate. Align the water pump aperture with the front cover and seal aligner Tool No. P.6150 before tightening the single bolt to 5 to 7 lb. ft. (0.69 to 0.97 kg.m.)
29. Fit the auxiliary shaft sprocket. Tighten the retaining bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and turn up the locking plate tabs.
30. Locate the timing chain in position around the crankshaft and auxiliary shaft sprockets and around the water pump aperture in the backplate.
31. Fit the oil slinger on the crankshaft.
32. Fit a new oil seal to the front cover using Tool No. P.6161 and a 550 handle.
33. Coat the front cover joint faces with ESEE-M4G-1008A jointing compound. Secure the cover in place using an aligner Tool No. P.6150. Tighten the $\frac{1}{4}$ in. bolts evenly to a torque of 5 to 7 lb. ft. (0.69 to 0.97 kg.m.) and the $\frac{5}{16}$ in. to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.), and remove the aligner.
34. Fit the timing chain tension adjuster and tighten to a torque of 45 to 50 lb. ft. (6.22 to 6.91 kg.m.).
35. Locate the flywheel squarely upon the crankshaft flange. Tighten the bolts evenly to 45 to 50 lb. ft. (6.22 to 6.91 kg.m.) for hexagonal bolts and 50 to 55 lb. ft. (6.91 to 7.90 kg.m.) for bi-hexagonal bolts.
36. Check the flywheel run-out using the gauge Tool No. P.4008 at the rim. The flywheel run-out should not exceed 0.004 in. (0.10 mm.) total indicator reading.
37. Centralise the clutch disc, with the hub assembly away from the flywheel using Tool No. P.7137. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.68 to 2.07 kg.m.) then remove the disc locator.
38. Fit the crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the retaining bolt to 24 to 28 lb. ft. (3.32 to 3.87 kg.m.).
39. Fit new gaskets on the block flange using ESEE-M4G-1008A jointing compound at each end. Fit the cork packing strips with the chamfered ends into the grooves, again using ESEE-M4G-1008A jointing compound and refit the sump. Tighten the bolts to 6 to 8 lb. ft. (0.83 to 1.11 kg.m.) in the sequence shown on page 28.

40. Locate a new gasket on the cylinder head cover joint.
41. Fit the cylinder head assembly. Locate the cylinder head gasket, copper side uppermost, on the cylinder block. Screw the studs Tool No. PT.4063A into diagonally opposite bolt holes on the block face to locate the gasket. Locate a new gasket on top of the front cover. Install the cylinder head assembly, engaging the breather pipe in its bore.
42. Refit the cylinder head bolts before removing the locating studs and then tighten in the sequence shown on page 40 to 60 to 65 lb. ft. (8.29 to 8.98 kg.m.). Tighten the three front cover bolts to 10 to 15 lb. ft. (1.38 to 2.07 kg.m.).
43. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.41 to 4.15 kg.m.). Rotate the engine one revolution in its normal direction of rotation and re-check valve timing.
44. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
45. Fit the camshaft cover and tighten the retaining nuts evenly.
46. Remove the engine from the stand and remove the bracket Tool No. P.6107.
47. Refit the engine assembly in the car as described in Operation No. 6000-C.

OP 6312-A CRANKSHAFT PULLEY – REMOVE AND INSTALL (engine in-situ)

To Remove

1. Slacken the generator mounting bolts and remove the fan belt.
2. Unscrew the crankshaft pulley bolt and using suitable levers withdraw the pulley.

To Install

3. Replace crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the retaining bolt to a torque of 24 to 28 lb. ft. (3.32 to 3.87 kg.m.).
4. Replace the fan belt and adjust the tension to give $\frac{1}{2}$ in. (12.7 mm.) total movement. Tighten the generator mounting bolts to a torque of 15 to 18 lb. ft. (2.08 to 2.49 kg.m.).

OP 6335-A CRANKSHAFT REAR OIL SEAL CARRIER – REMOVE AND INSTALL (Includes remove and install engine)

Tools Required

200A or B	Engine stand
P.4008	Crown wheel and pinion backlash gauge
P.6107	Engine bracket
CP.6173	Crankshaft rear oil seal aligner
P.7137	Spigot bearing replacer and clutch disc locator

To Remove

1. Remove the engine assembly as described in Operation No. 6000-C.
2. Fit a bracket Tool No. P.6107 and mount the engine on a stand Tool No. 200A or B.
3. Unscrew the pressure plate bolts evenly and remove the pressure plate and clutch disc.
4. Remove the flywheel.
5. Remove the sump and gaskets.
6. Remove the rear oil seal carrier.

To Install

7. Locate a new gasket on the rear oil seal carrier using ESEE-M4G-1008A jointing compound at the ends, and fit the carrier to the block rear face using an aligner Tool No. CP.6173. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the aligner.
8. Locate the flywheel squarely upon the crankshaft flange. Tighten the bolts evenly to a torque of 45 to 50 lb. ft. (6.22 to 6.91 kg.m.) for hexagonal bolts and 50 to 55 lb. ft. (6.91 to 7.90 kg.m.) for bi-hexagonal bolts.
9. Check the flywheel run-out using the gauge Tool No. P.4008 at the rim. The flywheel run-out should not exceed 0.004 in. (0.10 mm.) total indicator reading.
10. Centralise the clutch disc, with the hub assembly away from the flywheel using Tool No. P.7137 or P.7091A. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.68 to 2.07 kg.m.) then remove the disc locator.
11. Fit new gaskets on the block flange using ESEE-M4G-1008A jointing compound at each end. Fit the cork packing strips with the chamfered ends into the grooves, again using ESEE-M4G-1008A jointing compound and refit the sump. Tighten the bolts to a torque of 6 to 8 lb. ft. (0.83 to 1.11 kg.m.) in the sequence shown on page 28.
12. Remove the engine from the stand and remove the bracket Tool No. P.6107.
13. Refit the engine assembly in the car as described in Operation No. 6000-C.

OP 6335-A1 EXTRA: REAR OIL SEAL CARRIER AND/OR SEAL – RENEW
(with rear oil seal carrier removed)

See Operation No. 6000-C7.

OP 6335-B CRANKSHAFT REAR OIL SEAL AND/OR CARRIER – RENEW
(Includes OPS 6335-A and A1)

OP 6375-A FLYWHEEL ASSEMBLY – REMOVE AND INSTALL
(Includes remove and install gearbox assembly, clutch disc and pressure plate)

Tools Required

- | | |
|--------|---|
| P.4008 | Crown wheel and pinion backlash gauge |
| P.7137 | Spigot bearing replacer and clutch disc locator or P.7091A clutch disc locator. |

To Remove

1. Remove the gearbox as described in Operation No. 7000-A of Section 7/1.
2. Unscrew the pressure plate bolts evenly and remove the pressure plate and disc.
3. Remove the flywheel.

To Install

4. Locate the flywheel squarely upon crankshaft flange and tighten the retaining bolts evenly to a torque of 45 to 50 lb. ft. (6.22 to 6.91 kg.m.) for hexagonal bolts or 50 to 55 lb. ft. (6.91 to 7.90 kg.m.) for bi-hexagonal bolts.
5. Check the flywheel run-out using the gauge Tool No. P.4008 at the rim. The flywheel run-out should not exceed 0.004 in. (0.10 mm.) total indicator reading.
6. Centralise the clutch disc, with the hub assembly away from the flywheel using Tool No. P.7137 or P.7091-A. Tighten the bolts evenly to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.) and remove the clutch disc locator.
7. Replace the gearbox in the car as described in Operation No. 7000-A of Section 7/1.

OP 6375-A1 EXTRA: FLYWHEEL RING GEAR – RENEW
(flywheel removed)

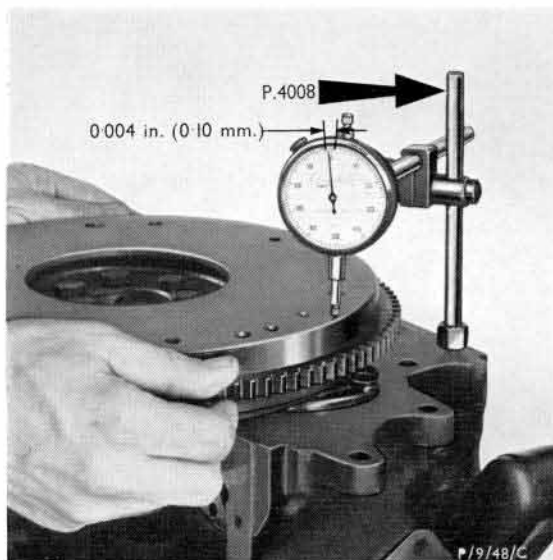
To Remove

1. Cut between two adjacent teeth with a hacksaw and split the flywheel ring gear with a chisel.

To Install

2. Heat the new ring gear evenly to a temperature not exceeding 600°F (316°C) and fit it to the flywheel with the chamfers on the leading faces of the teeth in the normal direction of rotation. Allow the ring to cool naturally in air. **Do not quench.**

OP 6375-B FLYWHEEL RING GEAR – RENEW
(Includes OPS 6375-A and A1)



Checking the Flywheel Run-Out

OP 6450-A CAMSHAFT COVER AND/OR GASKET – REMOVE AND INSTALL
(engine in-situ)

To Remove

1. Remove the air cleaner.
2. Remove the camshaft cover.

To Install

3. Ensure mating faces are clean and free of old gasket material.
4. Fit a new gasket to the camshaft cover and refit the cover.
5. Refit the air cleaner.

OP 6450-A1 EXTRA: ALL VALVE CLEARANCES – ADJUST
(camshaft cover removed)

1. Measure and note the clearance of each valve.
2. Set the valve timing marks.
3. Slacken the timing chain tensioner.
4. Remove the camshaft sprockets and disconnect the timing chain.
5. Remove each camshaft.
6. Remove the tappets keeping them in their respective order.
7. Remove each tappet adjustment shim in turn and substitute one giving the correct clearance.
8. Refit the tappets in their respective bores.
9. Fit the camshafts, ensuring that the bearing liners are correctly located. Tighten the bearing cap nuts evenly to 9 lb. ft. (1.24 kg.m.).
10. Re-check the valve clearances and readjust if necessary.
11. Fit the camshaft sprockets and timing chain. Align the timing mark on the crankshaft pulley with the lower mark on the front cover and the timing marks on the sprockets adjacent to each other and level with the camshaft cover mounting face. Fit the exhaust sprocket first. Tighten the retaining bolts to 25 to 30 lb. ft. (3.46 to 4.15 kg.m.) torque.
12. Adjust the timing chain tension to give $\frac{1}{2}$ in. (12.7 mm.) free movement between the camshaft sprockets. Ensure that there are no tight spots by turning the engine through several revolutions.
13. Re-time the ignition (see Operation No. 12100-A).

OP 6450-B VALVE CLEARANCES – ADJUST
(Includes OPS 6450-A and A1)

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OP 6600-A OIL PUMP ASSEMBLY – REMOVE AND INSTALL (engine in-situ)

To Remove

1. With the handbrake applied, jack up the front of the car and fit stands.
2. Disconnect the oil cooler hoses at the oil filter bowl.
3. Remove the oil pump and filter assembly.

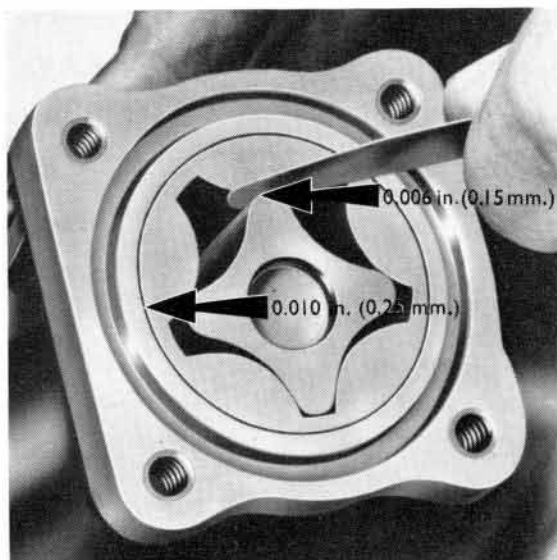
To Install

4. Locate a new gasket on the oil pump mounting flange and fit the oil pump and filter assembly to the cylinder block. Tighten the bolts to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.).
5. Reconnect the oil cooler hoses at the oil filter bowl.
6. Jack up the car, remove the stands and lower to the ground.

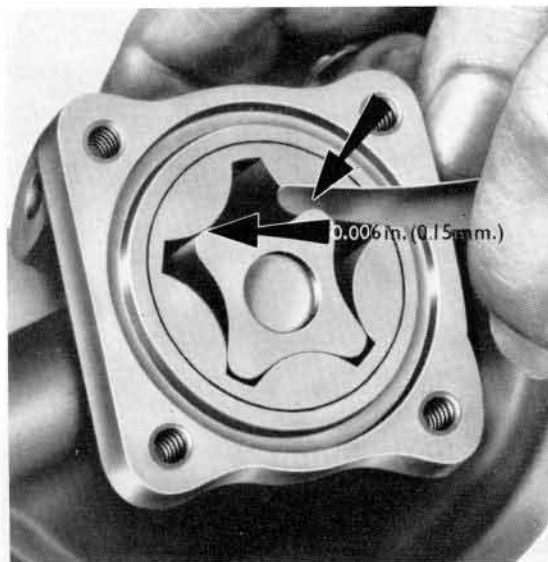
OP 6600-A1 EXTRA: OIL PUMP ASSEMBLY – OVERHAUL (oil pump assembly removed)

To Dismantle

1. Remove the filter body, element and oil cooler adaptor and extract the sealing rings from the groove in the adaptor and pump body.
2. Remove the end plate and withdraw the rubber "O" ring from the groove in the pump body.
3. Check the clearance between the lobes of the inner and outer rotors. This should not exceed 0.006 in. (0.15 mm.). The rotors are supplied as a matched pair only so that if clearance is excessive a new rotor must be fitted.
4. Check the clearance between the outer rotor and the housing, this should not exceed 0.010 in. (0.25 mm.). If clearance between the outer rotor and pump body is excessive a new rotor assembly and/or pump body should be fitted.



Checking the Eccentric Bi-Rotor Clearances



Checking the Eccentric Bi-Rotor Clearances

5. Place a straight edge across the face of the pump body and check the clearance between the face of the rotors and the straight edge. This should not exceed 0.005 in. (0.13 mm.). If this clearance is excessive the face of the pump body can be carefully lapped on a flat surface.
6. If it is necessary to renew the rotor or driveshaft, remove the outer rotor, then drive out the retaining pin securing the skew gear to the driveshaft and pull off the gear.
7. Withdraw the inner rotor and driveshaft.

To Reassemble

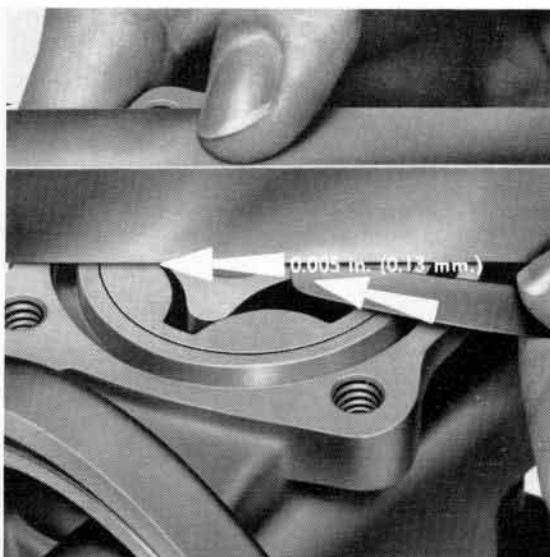
8. If the pump has been completely dismantled, fit the inner rotor and driveshaft assembly to the pump body. Press the skew gear onto the driveshaft end supporting the shaft, at the rotor end, on a suitable spacer. Replace the gear retaining pin and peen over the ends securely.
9. Install the outer rotor with its chamfered face inwards, towards the pump body.
10. Place the rubber "O" ring in the groove in the pump body.
11. Fit the end plate with the machined face towards the rotors.
12. Fit two new oil sealing rings, one in the groove on the underside of the oil cooler adaptor and the other in the pump body. Fit the oil filter assembly and the adaptor to the oil pump. Fit a new aluminium washer to the centre bolt and tighten to 12 to 15 lb. ft. (1.66 to 2.07 kg.m.).

OP 6600-B OIL PUMP – OVERHAUL
(Includes OPS 6000-A and A1)

OP 6675-A SUMP AND/OR GASKET – REMOVE AND INSTALL
(includes remove front suspension assembly)

To Remove

1. Open the boot and disconnect the battery.
2. Open the bonnet and fit wing covers.



Checking the Eccentric Bi-Rotor End-float



Oil Pressure Relief Valve

3. Mark the steering shaft and flexible joint, to ensure correct realignment on assembly, and remove the clamp bolt.
4. Unscrew the two bolts at the lower end of the steering column, the two crosshead screws at the top end, and withdraw the assembly after disconnecting the two multi-plug connectors behind the column shroud.
5. Jack up the front of the car and fit stands.
6. Drain the engine oil.
7. Place a sling beneath the inner engine mounting brackets and, using a crane, support the weight of the engine.
8. Disconnect the two front brake fluid hoses from the main lines beneath the front wheel arches and fit plugs to the open ends to prevent loss of fluid and ingress of dirt.
9. Unscrew the two nuts on the engine side of the engine mountings.
10. Unscrew the four bolts securing the stabiliser bar to the chassis after bending back the locking tabs.
11. Support the engine front crossmember with a jack and remove the four mounting bolts.
12. With assistants supporting each suspension leg, unscrew the three bolts securing the top mounts on either side. Then, taking great care to avoid damage to the bodywork, lower the jack slowly until the whole suspension assembly is clear of the vehicle.
13. Remove the two bolts securing the starter motor, and move it forwards to disengage the pinion after disconnecting the solenoid lead.
14. Unscrew the sump bolts and lower the sump. Remove the gaskets and packing strips and discard.

To Install

15. Clean the sump and cylinder block faces. Fit new gaskets on the block flange, using ESEE-M4G-1008A jointing compound at each end. Fit the cork packing strips, with the chamfered ends into the grooves, again using ESEE-M4G-1008A jointing compound. Refit the sump and tighten the bolts evenly to a torque of 6 to 8 lb. ft. (0.83 to 1.11 kg.m.) in the sequence shown on page 28.
16. Clean and replace the starter motor and secure it with the two bolts. Reconnect the solenoid lead.
17. Locate the suspension assembly beneath the car. Position a jack under the crossmember, and with assistants guiding the suspension legs, carefully raise the jack until the whole assembly is located in position. Care must be taken to ensure that whilst raising the crossmember, the inner engine mounting bolts engage with the mounting brackets.
18. Engage the suspension leg upper mounting bolts and tighten to a torque of 15 to 18 lb. ft. (2.07 to 2.49 kg.m.).
19. Secure the crossmember to the chassis with the four retaining bolts tightened to a torque of 25 to 30 lb. ft. (3.46 to 4.15 kg.m.).
20. Locate the stabiliser bar and brackets in position and engage the retaining bolts. **Do not tighten these bolts until the car is resting on its four wheels.**
21. Lower the engine and remove the sling. Engage and tighten the inner mounting nuts.
22. Reconnect the flexible brake fluid pipes to the main lines beneath the front wheel arches and then bleed the system as described in Operation No. 2000-A of Section 2 in the basic Escort manual.
23. Engage the steering shaft with the flexible joint, ensuring to align the marks previously scribed and fit and tighten the clamping bolt.

24. Reconnect the two multi-plug connectors behind the steering column shroud, and secure the lower end of the column with the two hexagon bolts, and the upper end with the cross-head screws.
25. Jack up the car, remove the stands, and lower to the ground.
26. Tighten the stabiliser bar retaining bolts to a torque of 15 to 18 lb. ft. (2.07 to 2.49 kg.m.).
27. Refill the sump with approved engine oil (see Section 14).
28. Reconnect the battery and close the boot.
29. Start the engine and check for oil and water leaks.

OP 6675-A3 EXTRA: ALL MAIN BEARING CLEARANCES – CHECK
(with sump removed)

See Operation No. 6000-C13, but support the crankshaft with a jack adjacent to the bearing being measured, to transfer the clearance to the bottom of the journal.

OP 6675-A4 EXTRA: ALL MAIN BEARING LINERS AND/OR THRUST WASHERS –
REMOVE AND INSTALL
(with sump removed)

See Operation No. 6000-C14

OP 6675-A5 EXTRA: ALL MAIN BEARING LINERS AND THRUST WASHERS –
CHECK CLEARANCES AND RENEW
(with sump removed)

See Operation No. 6000-C15, but support the crankshaft with a jack adjacent to the bearing being measured, to transfer the clearance to the bottom of the journal.

OP 6675-A6 EXTRA: ALL CONNECTING ROD LINERS – REMOVE AND INSTALL
(with sump removed)

See Operation No. 6000-C12

OP 6675-A7 EXTRA: ONE PISTON, CONNECTING ROD AND RINGS ASSEMBLY –
REMOVE AND INSTALL
(Includes remove and install the cylinder head. Does not include any dismantling of the piston rod and rings assembly. Sump removed.)

Tools Required

- | | |
|----------|-------------------------------------|
| 38 U 3 | Piston ring squeezer |
| PT.4063A | Cylinder head gasket locating studs |

To Remove

1. Lower the jack positioned under the gearbox.
2. Remove the cylinder head (see Operation No. 6051-A).

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3. Unscrew the big end bolts several turns and tap them to release the cap. Completely unscrew the bolts and remove the big end cap. Push the piston out of the bore and withdraw the assembly.
4. Remove the piston rings.
5. Extract the two piston pin circlips and push the pin out of the piston. Separate the piston and connecting rod.

To Install

6. Select a new piston if required to obtain a clearance of 0.003 to 0.0036 in. (0.0762 to 0.081 mm.) between the piston and piston bore.

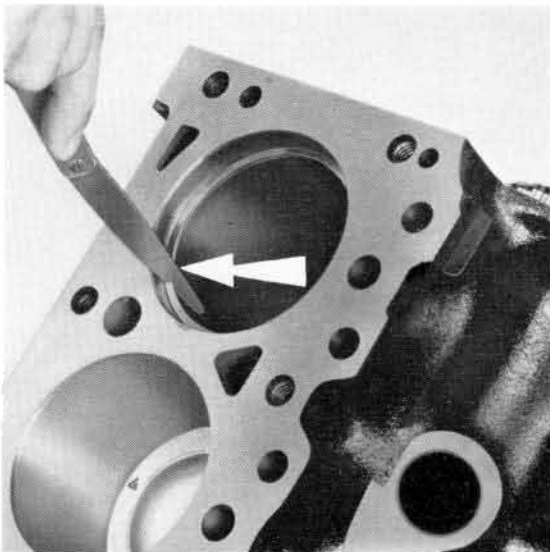
NOTE – Pistons are graded as listed below and the grades are stamped on the crown of the piston.

<i>Grade</i>	<i>Diameter</i>
1	3.2500 to 3.2503 in. (82.550 to 82.557 mm.)
2	3.2503 to 3.2506 in. (82.557 to 82.565 mm.)
3	3.2506 to 3.2509 in. (82.565 to 82.573 mm.)
4	3.2509 to 3.2512 in. (82.573 to 82.580 mm.)

7. Locate the piston rings in the unworn portion of the cylinder bore and check the ring gaps, which should be between 0.009 to 0.014 in. (0.23 to 0.36 mm.) for the compression rings and 0.010 to 0.020 in. (0.25 to 0.51 mm.) for the oil control rings.

8. Check piston ring to groove clearances which should be as follows:—

Upper compression ring	...	...	...	...	0.0016 to 0.0031 in. (0.041 to 0.079 mm.)
Lower compression ring	...	...	...	...	0.0016 to 0.0036 in. (0.041 to 0.091 mm.)
Oil control ring	...	...	...	...	0.0015 to 0.0030 in. (0.040 to 0.076 mm.)



Checking the Piston Ring Gap

9. Fit the piston rings, fitting the oil control ring first, followed by the lower and then the upper compression rings. Ensure that the compression rings are fitted the correct way up.
10. Assemble the piston to the connecting rod. Ensure that the "FRONT" marking on the connecting rod is on the same side of the assembly as the mark on the piston crown. Heat the piston in water or oil prior to inserting the piston pin. Retain the piston pin with the circlips.
11. Position the oil control ring gap to the rear and the compression ring gaps to 150° on either side of this. Compress the rings using Tool No. 38 U 3 and push the piston into its cylinder bore with the arrow on the crown pointing towards the front of the engine. Turn the crankshaft as necessary to fit the connecting rod big end to the crank pin. Tighten the connecting rod bolts to a torque of 44 to 46 lb. ft. (6.08 to 6.36 kg.m.).
12. Refit the cylinder head (see Operation No. 6051-A).
13. Lift the engine on the gearbox jack.

OP 6675-A8 EXTRA: EACH ADDITIONAL PISTON, CONNECTING ROD AND RINGS ASSEMBLY – REMOVE AND INSTALL
(with cylinder head removed)

Repeat sub-operations 3 to 11 of Operation No. 6675-A7 for each additional connecting rod and piston assembly.

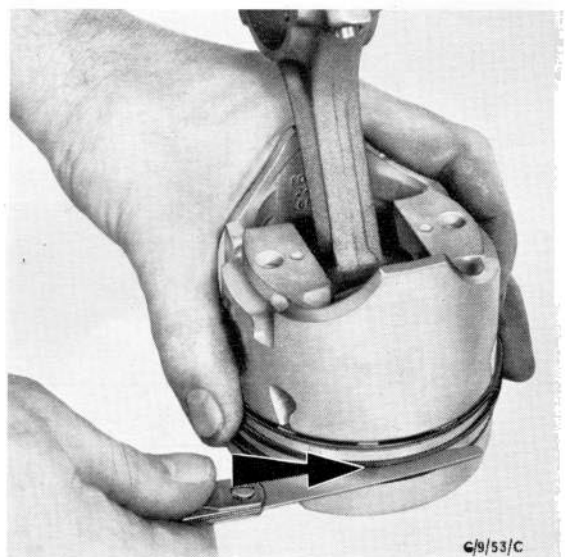
OP 6675-A9 EXTRA: EACH SET OF PISTON RINGS – RENEW
(with piston, connecting rod and rings assembly removed)
(Includes checking ring gaps and cleaning ring grooves)

Tools Required

Piston ring groove cleaner

1. Remove the piston rings.
2. Clean the ring grooves in the piston with a proprietary ring groove cleaner.
3. Locate the piston rings in the unworn portion of the cylinder bore and check the ring gaps, which should be between 0.009 to 0.014 in. (0.23 to 0.36 mm.).

Checking the Piston Ring to Groove Clearance



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4. Fit the piston rings, fitting the oil control ring first, followed by the lower and then the upper compression rings. Ensure that the compression rings are fitted the correct way up.
5. Check piston ring to groove clearances which should be as follows:—

Upper compression ring	...	...	...	...	0.0016 to 0.0031 in. (0.041 to 0.079 mm.)
Lower compression ring	...	...	...	...	0.0016 to 0.0036 in. (0.041 to 0.091 mm.)
Oil control ring	...	...	...	...	0.0015 to 0.0030 in. (0.040 to 0.076 mm.)

OP 6675-A10 EXTRA: EACH PISTON, PIN AND RINGS ASSEMBLY – RENEW
 (with piston, connecting rod and rings assembly removed)
 (Includes checking ring gaps and fitting rings to piston)

1. Extract the two piston pin circlips and push out the piston pin.
 NOTE – It is permissible to heat the piston to a temperature of 120°C (248°F) to assist piston pin removal.
2. Select a new piston as detailed in Operation No. 6675-A7.
3. Select a new piston pin from the grades listed below:—

PISTON PIN

<i>Grade</i>	<i>Diameter</i>
A	0.8121 to 0.8122 in. (20.627 to 20.630 mm.)
B	0.8122 to 0.8123 in. (20.630 to 20.632 mm.)

4. Assemble the piston to the connecting rod. Ensure that the "FRONT" marking on the connecting rod is on the same side of the assembly as the mark on the piston crown. Heat the piston in water or oil prior to inserting the piston pin. Retain the piston with the circlips.
5. Locate the piston rings in the cylinder bore and check the ring gaps which should be between 0.009 to 0.014 in. (0.23 and 0.36 mm.) for the compression rings and 0.010 to 0.020 in. (0.25 to 0.51 mm.) for the oil control rings.
6. Fit the piston rings, fitting the oil control ring first, followed by the lower and then the upper compression rings. Ensure that the compression rings are fitted the correct way up.

OP 6675-A11 EXTRA: EACH CONNECTING ROD AND/OR PISTON PIN – RENEW
 (with piston, connecting rod and rings assembly removed)
 (Includes measuring size of piston pin)

1. Extract the two piston pin circlips and push the pin out of the piston. Separate the piston and connecting rod.
2. Select a new connecting rod from the grades listed below, or alternatively, select a new piston pin from the grades listed in Operation No. 6675-A10 sub-operation 3.

CONNECTING RODS

<i>Grade</i>	<i>Small end bore</i>	<i>Colour Code</i>
A	0.8124 to 0.81255 in. (20.635 to 20.639 mm.)	Silver
B	0.81255 to 0.8127 in. (20.639 to 20.643 mm.)	Green

3. Assemble the piston to the connecting rod. Ensure that the "FRONT" marking on the connecting rod is on the same side of the assembly as the mark on the piston crown. Heat the piston in water or oil prior to inserting the piston pin. Retain the pin with the circlips.

- OP 6675-C** MAIN BEARING CLEARANCES – ALL – CHECK
(Includes OPS 6675-A and A3)
- OP 6675-D** MAIN BEARING LINERS – ALL – RENEW
(Includes OPS 6675-A and A4)
- OP 6675-E** MAIN BEARING LINERS – ALL – CHECK AND RENEW
(Includes OPS 6675-A and A5)
- OP 6675-F** CONNECTING ROD LINERS – ALL – RENEW
(Includes OPS 6675-A and A6)
- OP 6675-G** PISTON RINGS – ONE PISTON – REMOVE AND INSTALL
(Includes OPS 6675-A and A9)
- OP 6675-H** PISTON RINGS – ALL – REMOVE AND INSTALL
(Includes OPS 6675-A, A7, A8 and A9)
- OP 6675-I** PISTON – ONE – REMOVE AND INSTALL
(Includes OPS 6675-A, A7 and A10)
- OP 6675-J** PISTONS – ALL – REMOVE AND INSTALL
(Includes OPS 6675-A, A7, A8 and A10)
- OP 6675-K** CONNECTING ROD AND/OR PISTON PIN – ONE – REMOVE AND INSTALL
(Includes OPS 6675-A, A7 and A11)
- OP 6675-L** CONNECTING RODS AND PISTON PINS – ALL – REMOVE AND INSTALL
(Includes OPS 6675-A, A7, A8 and A11)
- OP 6675-M** SUMP BOLTS – TORQUE
(Includes removing and installing any components necessary to gain access to all the sump bolts)

1. Tighten the sump bolts following the procedure described on page 28.

- OP 6731-A** OIL FILTER ELEMENT – RENEW
(Does not include change engine oil)

1. Unscrew the securing bolt and withdraw the filter assembly and oil cooler adaptor.
2. Remove the sealing rings from the groove in the oil pump and in the lower face of the oil cooler adaptor and the washer from the securing bolt.
3. Thoroughly clean the filter body.
4. Insert the new element into the bowl, fit two new sealing rings (one of which is supplied with the new element), one to the groove in the oil pump body and the other in the lower face of the adaptor.

NOTE – Do not fit the rings at one point and then work them round the groove, as the rubber may stretch, thus leaving a surplus which may cause a leak.

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5. Refit the filter assembly and oil cooler adaptor to the pump body and tighten the securing bolt to a torque of 12 to 15 lb. ft. (1.66 to 2.07 kg.m.).

OP 6731-B OIL FILTER ELEMENT AND ENGINE OIL – RENEW

1. Remove the sump plug and drain the engine oil while it is hot.
2. Renew the oil filter, see Operation No. 6731-A.
3. Refit the sump drain plug and tighten to a torque of 20 to 25 lb. ft. (2.76 to 3.46 kg.m.).
4. Refill the sump with an approved grade of engine oil (see Section 14).

OP 6900-B TEMPERATURE GAUGE SENDER UNIT – REMOVE AND INSTALL

To Remove

1. Disconnect the lead.
2. Ensure that the radiator filler cap is secure and remove the sender unit.

To Install

3. Install the sender unit and top-up the radiator if any coolant has been lost.
 4. Reconnect the lead.
-