PISTONS AND CONNECTING RODS

Special Tools

Engine Stand
Piston ring compressor

To Remove

Remove cylinder head (Refer to sub-section A131).

Remove sump (Refer to sub-section A121).

Remove the two nuts securing the big end cap. Remove cap.

Push piston and connecting rod upwards through the bore, taking care not to damage the bore.

To Dismantle

Remove the two gudgeon pin circlips.

Immerse the piston in boiling water for a short period and drift out the gudgeon pin (fig. 1).

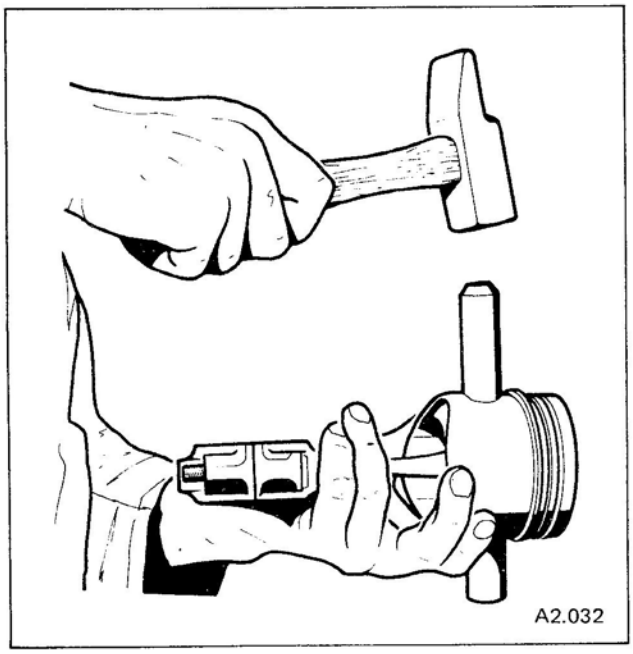

Fig. 1 *Removing gudgeon pin*

Mark the respective positions of the connecting rod and piston, if both these parts are to be re-used, so that they can be refitted in their original positions.

Note: The big end locating projections must be on the same side as the oil filter and the position mark on the piston must face towards the front of the engine, that is to say, the timing gear end (fig. 2).

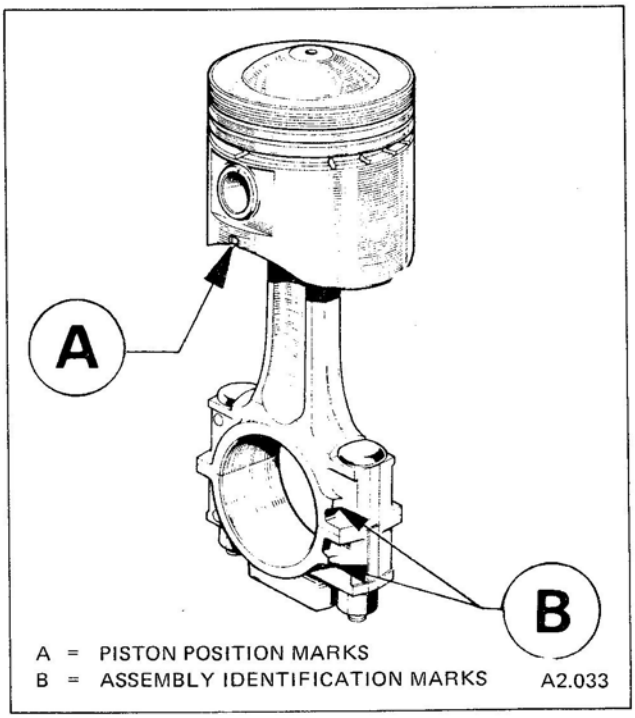

Fig. 2 *Piston assembly identification*

Inspection and Overhaul

Clean off all carbon deposits taking care not to use any implement which could damage pistons. Clean piston ring grooves.

Check pistons for scoring or fracture. Pistons are available in different grades and the grade is stamped on the piston crown during production. The grade is also stamped on the top face of the cylinder block. Grades and sizes available will be found in 'Data'.

Examine gudgeon pin small end bush and gudgeon pin bore in piston for wear. If small end bush is worn the complete connecting rod assembly must be replaced as small end bushes are not supplied separately.

Check piston ring gaps as follows:

Position the rings a short distance down the cylinder and locate squarely by carefully pushing a piston up the bore. Measure the gap with a feeler gauge and check that it is within the limits shown in 'Data'.

Check piston ring grooves by measuring the clearance of new rings in the grooves. If the clearance is outside the limits shown in 'Data' new pistons must be fitted.

Checking the Connecting Rods

The connecting rod can be checked for bow and twist, on a surface plate, using test bars and "V" blocks (figs. 3 and 4).

If renewing connecting rod, end cap or bearing shells, check Data to ensure correct types are fitted.

Note: Service replacement connecting rods are supplied to maximum weight. The boss on the cap must be reduced to bring the assembly within the Data figure.

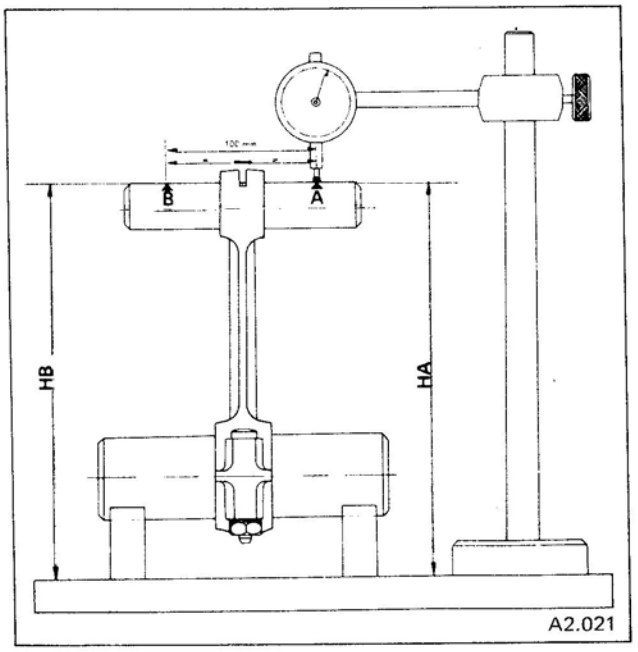

Fig. 3 *Bow-maximum difference between HA and HB 0.08mm (.003in)*

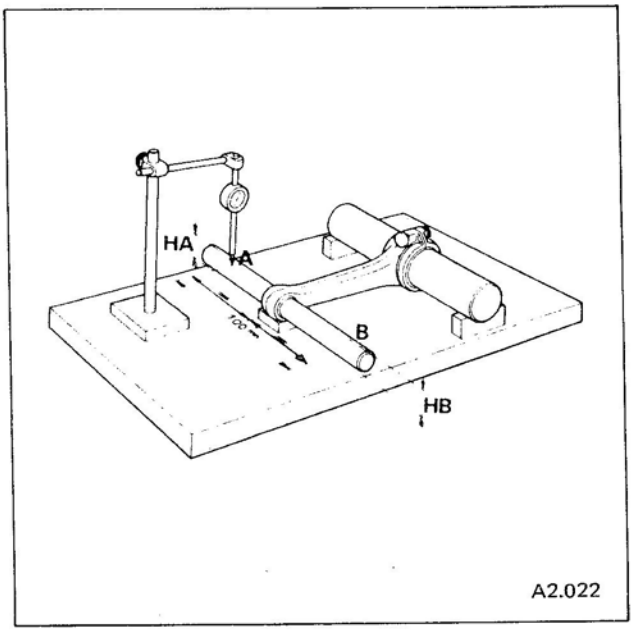

Fig. 4 *Twist-maximum difference between HA and HB 0.20mm (.008in)*

Renewing the Big End Bolts
(with piston removed)

Knock out the worn bolts with a bronze headed hammer, avoiding striking the connecting rod body.

Insert the new bolts, holding the connecting rod in one hand paying particular attention to the positions of the flats on the heads.

Refit the cap and pull the bolts into their final positions by temporarily refitting the old nuts and tightening them down. Do not exceed the specified torque.

To Re-assemble

Fit a circlip to one of the piston grooves.

Heat the piston, either in an oven or by immersing it in boiling water (100°C max.).

Take out the piston, holding it with a cloth.

Oil the gudgeon pin and, by hand, pass it through the piston and the connecting rod, until it makes contact with the circlip.

Fit the second circlip.

The three piston rings must be fitted in the following order: oil control, compression and top.

Fitting the oil control ring

Fit the expander ring, by hand, with the gap in line with the position mark at the bottom of the piston skirt, that is to say in line with the gudgeon pin centre.

Take one of the small steel rings and twist it over the grooves, as shown in figure 5, until it finally comes against the lower face of the expander ring, placing the gap above that of the expander ring.

Fit the upper steel ring in the same way, but, this time, place its gap 180°C away from the other gap, that is to say, on the opposite side.

Note. An oil control ring with a built-in expander may also be fitted in place of that with an expander ring.

Fitting the compression ring

This is done in the usual way, by means of the special grips.

Important: This ring has a position mark TOP on it and this must face towards the piston crown. If it is the wrong way round the oil consumption will be excessive.

Position the gap at 180° to that of the last of the small-steel rings fitted, i.e. still in line with the gudgeon pin.

Fit the top ring with its gap at 180° to that of the compression ring just fitted.

Fig. 5 *Fitting oil control ring*

To Refit

Refit the big end shells to their locations and oil them.

Fit the protectors to the big end studs.

Stagger the ring gaps (fig. 6).

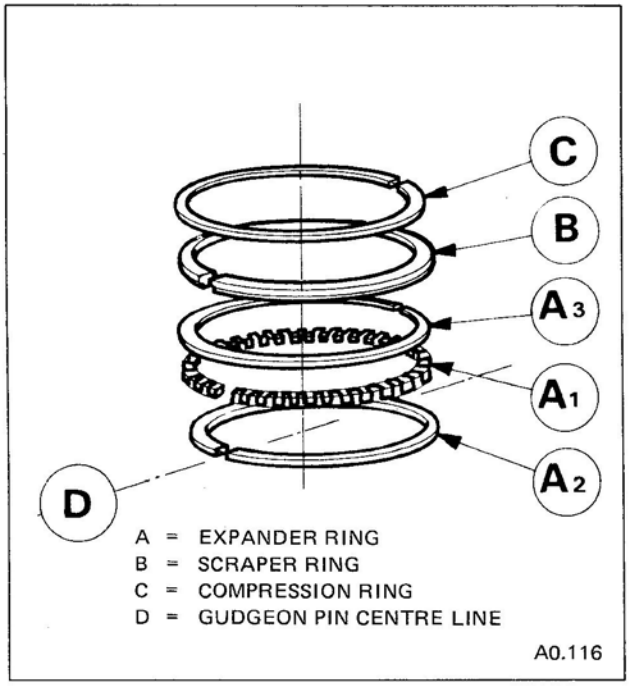

Fig. 6 *Positioning ring gaps*

Oil the crankpins and the cylinder bores. Move the crankpins into the vertical plane.

Oil the pistons and fit each of the connecting rod--piston assemblies into its respective cylinder, compressing the piston rings with a piston ring clamp to do so.

The positioning notch at the bottom of each piston skirt should point towards the front of the engine, that is to say the timing gear side (fig. 7).

Remove the protectors from the big end studs.

Fit the big end caps and secure with the big end nuts. Torque tighten to Data figure.

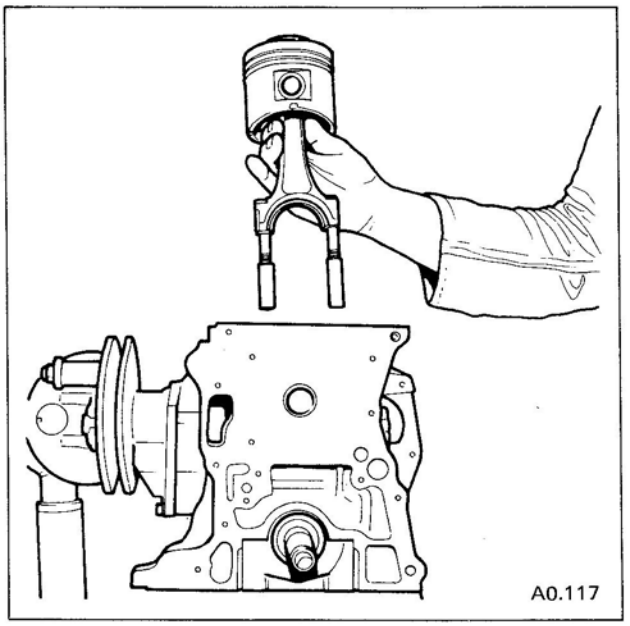

Fig. 7 *Fitting piston assembly*

Warning: the big-end nuts must be fitted the correct way round (fig. 8).

Check that the moving parts turn freely, when rotated by hand (if necessary check the clearances by the method already described).

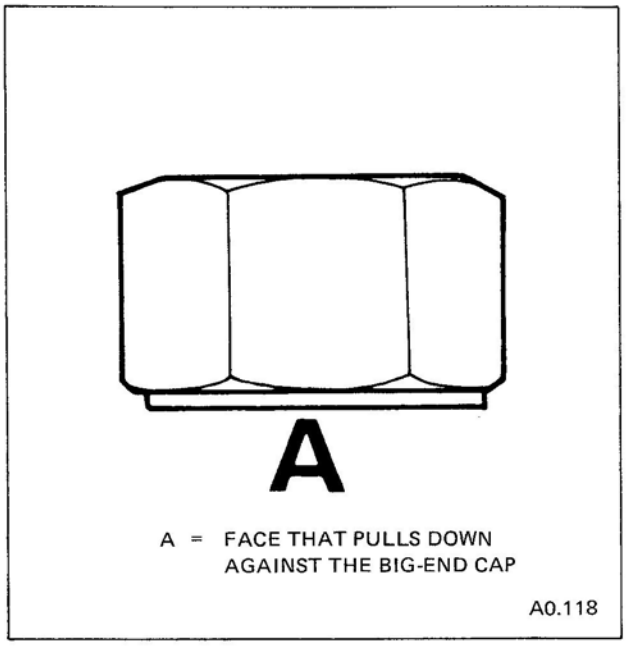

Fig. 8 *Big end nut identification*

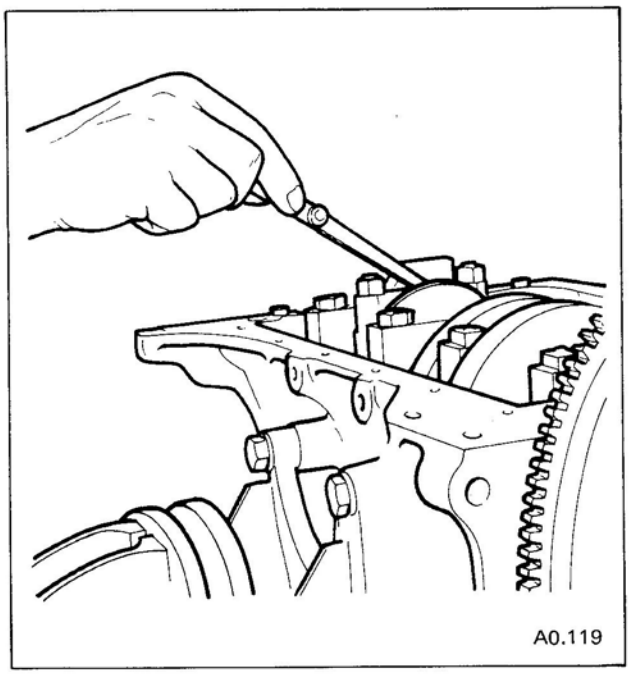

Fig. 9 *Checking connecting rod side play*

Check the connecting rod side play (fig. 9).

Side play tolerances: 0,10 to 0,37 mm (.004 in to .014 in).

Refit sump (Refer to sub-section A121).

Refit cylinder head (Refer to sub-section A132).

Connecting rod bearings

The connecting rod half-bearing shells are in two thicknesses for the standard size and each undersize. The thinner shell is colour coded red on one circumferential edge and the thicker shell is coded blue.

These are provided so that the specified bearing running clearance can be maintained whilst still retaining a reasonable production tolerance on the sizes of the crankpins and connecting rod bores. These sizes are similarly coded red and blue for large and small.

Thus the half-shells in the connecting rod may be the same or different colours. The different colours of red and blue may be upper or lower BUT ARE NOT INTERCHANGEABLE to maintain the correct bearing running clearance.

The colour codes are to be used as follows:—

1. The colour on the big end cap indicates the colour of the half-shell that is to be fitted in the connecting rod—upper half.

2. The colour on the crankshaft web adjacent to the connecting rod crankpin indicates the colour of the half-shell that is to be fitted in the connecting rod cap—lower half.

Fit the recommended half-shells and finally check the bearing running clearance with plastigage.

Bearing running clearance—to check

The recommended method of checking the bearing clearances is with use of 'plastigage'. If Perfect Circle plastigage is used it should be of the type PG1, colour green, suitable for checking clearances from 0,025 to 0,075 mm (.0009 to .0029 in).

Method

The journal and bearing must be dry, as the plastigage is oil soluble.

Cut a length of plastigage the width of the journal to be checked. Immerse it in hot water to soften it then lay it on the journal, lengthwise on the axis.

If the engine is on its side, retain the plastigage with a small dab of grease at each end.

Fit the connecting rod and cap with the appropriate half-shells and tighten the nuts to the specified torque.

Loosen and remove the nuts, remove the cap and connecting rod and measure the width of the crushed strip, using the graduated metric scale on the plastigage packing. Check the indicated clearance against that specified in Data.

Remove the crushed plastic from the journal, wipe it clean and oil it before assembly.

Perfect Circle plastigage is available in the United Kingdom from:

World Radio Ltd.,
950 North Circular Road,
Cricklewood,
London NW2.

SUMMARY OF RULES FOR SELECTIVE ASSEMBLY

If the connecting rod and the crankpin are of the same class (whether blue or red) the big end shells must be both of the same colour class.

- Red connecting rod and crankpin: red shells.
- Blue connecting rod and crankpin: blue shells.

If the connecting rod and crankpin are of different colour classes (blue and red) one blue shell and one red shell must be fitted.

CONNECTING ROD MATCHING CHART

DESCRIPTION	OVERALL DIMENSIONS	CLASS A RED	CLASS B BLUE
Big-end bore	55,977 ~ 55,893 2.1999" ~ 2.2005"	55,877 ~ 55,885 2.1999" ~ 2.2002"	55,885 ~ 55,893 2.2002" ~ 2.2005"
Big end shell thickness	1.932 ~ 1,949 .0760" ~ .0767"	1,932 ~ 1,941 .0760" ~ .0764"	1,940 ~ 1,949 .0765" ~ .0767"
Crankpin diameter	51,951 ~ 51,967 2.0452" ~ 2.0458"	51,959 ~ 51,967 2.0455" ~ 2.0458"	51,951 ~ 51,959 2.0452" ~ 2.0455"

RECOMMENDED ARRANGEMENTS								
SIZE	MIN	MAX	MAX	MIN	MIN	MAX	MAX	MIN
CASE	Case 1				Case 3			
Connecting rod	55,877 2.1999"		55,885 2.2002"		55,885 2.2002"		55,893 2.2005"	
Shells		2 x 1.941 2 x .0764"		2 x 1,932 2 x .0760"		1,941 + 1,949 .0764" + .0767"		1,932 + 1,940 .0760" + .0763"
Crankshaft		51,967 2.0458"		51,959 2.0455"		51, 967 2.0458"		51,959 2.0455"
CLEARANCE	0,028 .0011"		0,062 .0024"		0,028 .0011"		0,062 .0024"	
CASE	Case 2				Case 4			
Connecting rod	55,885 2.2002"		55,893 2.2005"		55,877 2.1999"		55,885 2.2002"	
Shells		2 x 1,949 2 x .0767"		2 x 1,940 2 x .0763"		1,941 + 1,949 .0764" + .0767"		1,932 + 1,940 .0760" + .0763"
Crankshaft		51,959 2.0455"		51,951 2.0452"		51,959 2.0455"		51,951 2.0452"
CLEARANCE	0,028 .0011"		0,062 .0024"		0,028 .0011"		0,062 .0024"	
NON-RECOMMENDED ARRANGEMENTS								
CASE	Case 1				Case 4			
Connecting rod	55,877 2.1999"		55,885 2.2002"		55,877 2.1999"		55,885 2.2002"	
Shells		2 x 1,949 2 x .0767"		2 x 1,940 2 x .0763"		2 x 1,949 2 x .0767"		2 x 1,940 2 x .0763"
Crankshaft		51,967 2.0458"		51,959 2.0455"		51,959 2.0455"		51,951 2.0452"
CLEARANCE	0,012 .0047"		0,046 .0018"		0,020 .0078"		0,054 .0021"	
CASE	Case 2				Case 5			
Connecting rod	55,885 2.2002"		55,893 2.2005"		55,885 2.2002"		55,893 2.2005"	
Shells		2 x 1,941 2 x .0764"		2 x 1,932 2 x .0760"		2 x 1,949 2 x .0767"		2 x 1,940 2 x .0763"
Crankshaft		51,959 2.0455"		51,951 2.0452"		51,967 2.0458"		51,959 2.0455"
CLEARANCE	0,044 .0017"		0,078 .0030"		0,020 .0078"		0,054 .0021"	
CASE	Case 3				Case 6			
Connecting rod	55,885 2.2002"		55,893 2.2005"		55,877 2.1999"		55,885 2.2002"	
Shells		2 x 1,941 2 x .0764"		2 x 1,932 2 x .0760"		2 x 1,941 2 x .0767"		2 x 1,932 2 x .0760"
Crankshaft		51,967 2.0458"		51,959 2.0455"		51,959 2.0455"		51,951 2.0452"
CLEARANCE	0,036 .0014"		0,070 .0027"		0,036 .0014"		0,070 .0027"	