

Section E6

Connecting rods and Pistons

Connecting rods

The connecting rods (see Fig. E14) are 'H' section forgings of either chrome molybdenum or low nickel chrome molybdenum steel. They are accurately balanced before fitting to the engine by machining excess metal from the balance pad on the large end and from the boss on the small end.

Drillings in the crankshaft webs carry oil from the main bearings to the big-end journals, for the lubrication of the big-end bearings. Oil splash and mist collecting under the crown of the piston falls onto the connecting rod small-end boss and then passes through a recessed drilling in the boss and hole in the bush, to provide lubrication for the gudgeon pin and small-end bush.

The detachable big-end bearings are split steel backed shells, copper-lead lined with a lead-tin overlay or lead-bronze lined with either a lead-indium or a reticular aluminium tin overlay.

The small-end bush which is pressed into the small-end boss, is split and has a steel backing lined with lead-bronze. After being pressed into the small-end boss, the bush is reamed out to the final diameter.

Pistons

The pistons are manufactured from 12% silicon aluminium alloy. They are cam ground to provide an ideal bearing surface that will maintain an adequate oil film and minimise the possibility of 'scuffing' under adverse operating conditions. The pistons are finally tin-plated to a depth of 0,0076 mm. (0.0003 in.).

Each piston has three rings (two compression and one oil control), a gudgeon pin that is off-set from the centre line of the piston and a full skirt which is shaped to allow for clearance with the crankshaft web.

The top piston ring is an internally stepped type of compression ring and manufactured from cast-iron. Dependent upon the engine specification the periphery of this top ring is either chromium plate for a minimum depth of 0,152 mm. (0.006 in.) or molybdenum sprayed for a depth of 0,10 mm. (0.004 in.). This provides the ring with a hard wear resistant face.

The second ring is basically a compression ring although it does combine these duties with that of an auxiliary oil scraper ring. This ring is 'internally stepped' and manufactured from cast iron. It is granolite treated to provide additional lubrication for the ring during the initial running-in period.

The oil control (scraper) ring comprises top and

bottom steel rails that are chromium plate on the periphery to a minimum depth of 0,125 mm. (0.005 in.). The equaliser (expander and centre spacer) is manufactured from carbon steel.

Further details of the piston rings are given in Figure E15.

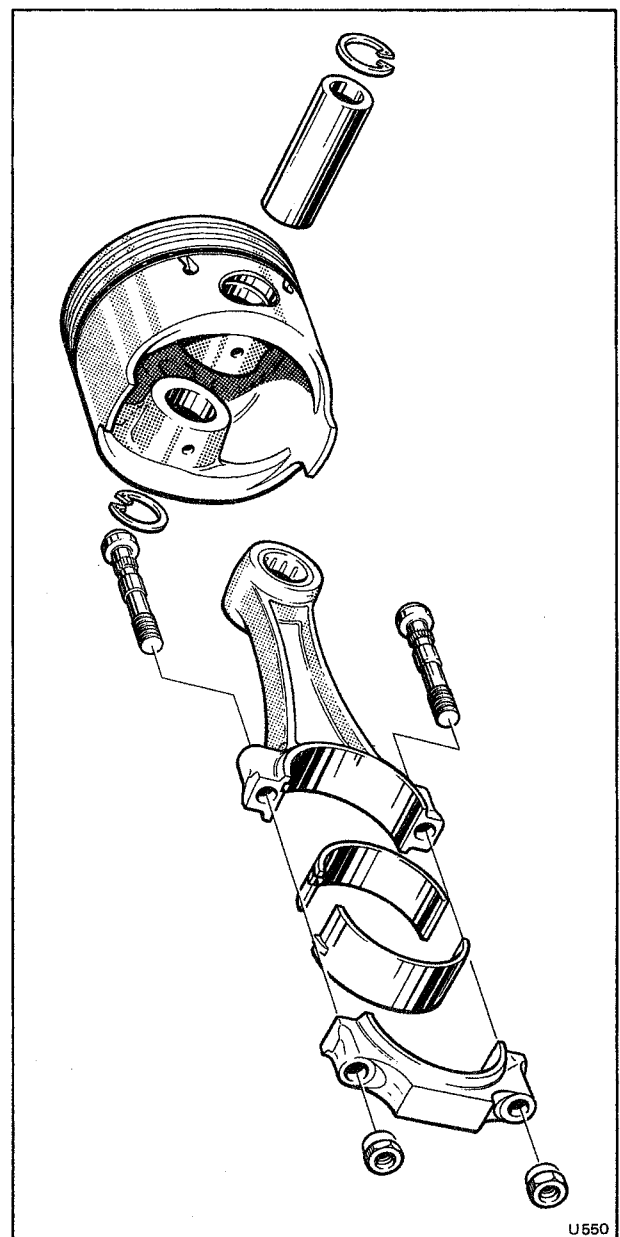


Fig. E14 Connecting rod and piston

Compression ratio

Australia, Canada, Japan and the U.S.A.

- *Early engines 7.3:1
- *Late engines 8:1 (California with fuel injection)
7.3:1

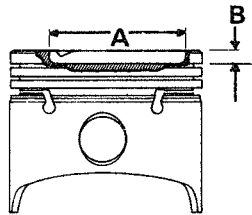
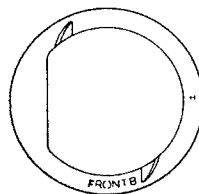
All other countries

- 8:1
- 9:1 (S.U. HIF7 carburetters)
- 8:1 (Solex 4 A1 carburetter)

Pistons

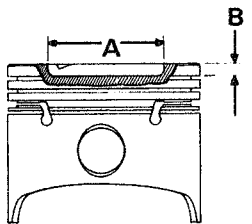
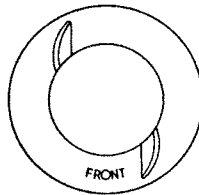
Compression ratio Piston

7.3:1



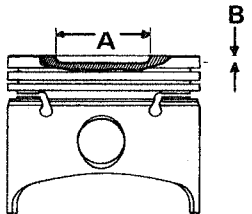
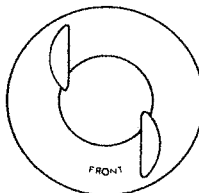
- A 83,19 mm. (3.275 in.)
- B 6,48 mm. (0.255 in.)

8:1



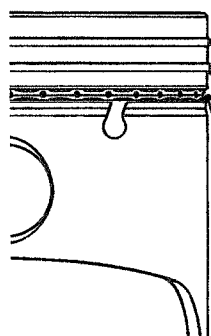
- A 62,23 mm. (2.45 in.)
- B 6,48 mm. (0.255 in.)

9:1

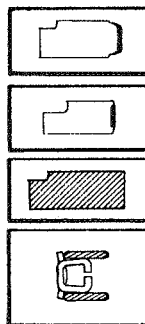


- A 50,80 mm. (2.00 in.)
- B 3,61 mm. (0.142 in.)

Piston rings



- 1st Compression ring
 - *Early engines and all 7.3:1 engines
 - *Late engines except 7.3:1 engines
- 2nd Compression ring
- Oil control ring



- Edge of ring chromium plated to a depth of 0,152 mm. (0.006 in.) min.
- Edge of ring molybdenum sprayed to a depth of 0,10 mm. (0.004 in.) min.
- Produced from cast iron and Granolite treated
- Steel rails chromium plated to a depth of 0,125 mm. (0.005 in.) min.
- Centre equaliser produced from high carbon steel

Note Compression ratio is changed by the shape of the piston crown
*Refer to Section E1 Introduction for identification of engines

Fig. E15 Details of pistons

Compression ratio

Early engines have a compression ratio of either 8:1 or 7.3:1. Late engines have compression ratios of either 9:1, 8:1 or 7.3:1 dependent upon specification. The compression ratio is determined by the type of pistons. All pistons have recessed crowns and the shape and size of the recess determines the compression ratio of the engine. Details of the compression ratios are given in Figure E15.

To maintain valve to piston clearances shaped depressions are machined in the piston crowns. Machining two depressions enables the pistons to be initially used in either 'A' bank or 'B' bank. The only exceptions are the 7.3:1 pistons which due to the special shape of their piston crown recess are handed and can only be used in the bank of

cylinders for which they are designed. The cylinder number is stamped on top of the piston.

Gudgeon pin

The piston is carried on the connecting rod by a gudgeon pin. This pin is fully floating when the engine is running under normal conditions.

Two Seeger circlips are used to retain the gudgeon pin (see Fig. E14).

The gudgeon pin is case hardened to a depth of between 0,254 mm. and 0,508 mm. (0.010 in. and 0.020 in.).

Connecting rod bearings - To remove

The big-end bearing can be renewed whilst the engine is fitted in the car. To undertake this exercise, carry out the usual workshop safety

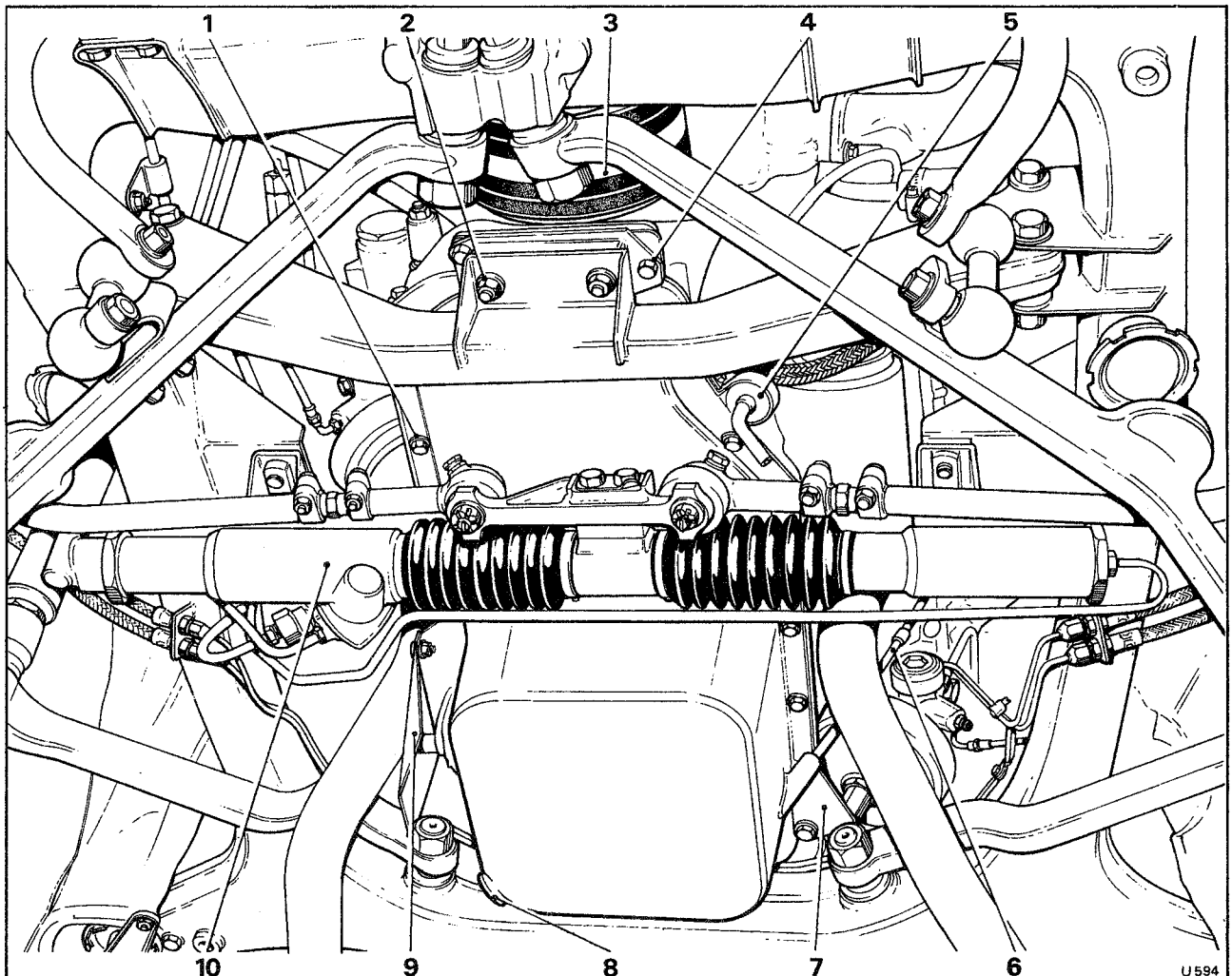


Fig. E16 Removing the engine sump

- | | |
|--------------------------------|--------------------------------|
| 1 Sump setscrew | 6 Dipstick tube |
| 2 Lower half mounting nut | 7 Accumulator bracket |
| 3 Crankshaft pulley | 8 Engine oil drain plug |
| 4 Upper half mounting setscrew | 9 Oil level transmitter shield |
| 5 Fuel drain valve | 10 Steering rack |

precautions and proceed as follows.

1. Place the car on a ramp beneath an overhead pulley.
2. Firmly apply the parking brake and chock the road wheels.
3. Disconnect the battery leads.
4. Drain the engine oil into a suitable container. Fit the sump plug.

Refer to Figure E16 for identification of the components to be removed.

5. Remove the steering rack assembly (see Chapter N).
6. Suitably position a sling around the upper front of the engine. Connect the sling to the overhead pulley and 'take the weight' of the engine.

Do not 'take the weight' of the engine on the crankshaft damper and pulley assembly.

7. Remove the two nuts and bolts securing the lower half of the front engine mounting. Collect the washers.
8. Remove the two setscrews securing the upper half of the front engine mounting. Collect the washers and withdraw the rubber mounting assembly and engine stop plate.
9. Remove the engine oil level transmitter shield and disconnect the electrical lead.
10. On cars fitted with hydraulic systems that contain RR 363 brake fluid (i.e. Cars prior to serial number 50001), remove the bracket connecting each

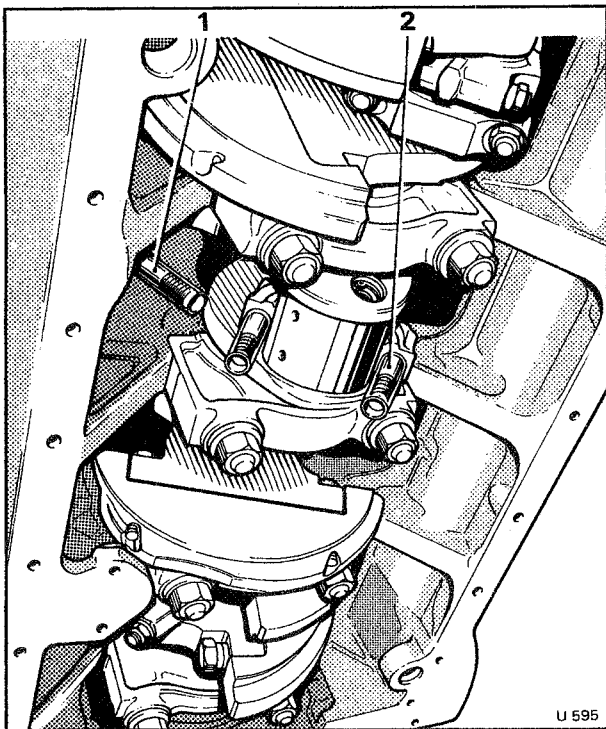


Fig. E17 Removing the big-end bearing shells
 1 Conn-rod bolt pushed away from the crankshaft
 2 Conn-rod bolt fitted with protective rubber sleeve

accumulator to the sump.

On cars fitted with hydraulic systems that contain hydraulic system mineral oil (i.e. Cars from serial number 50001), remove the bracket connecting the rear accumulator to the sump.

11. Remove the sump setscrews retaining the fuel drain valve in position. Secure the valve away from the area of the engine sump.
12. Unscrew and remove the nut, bolt and setscrew securing the dipstick tube to the engine. Withdraw the dipstick and tube assembly.
13. Raise the engine and using a suitable universal joint type of socket spanner unscrew the retaining setscrews from the rear of the engine oil sump.

Some difficulty may be encountered when removing the setscrews due to the close proximity of the sub-frame crossmember.

14. Remove the remainder of the sump retaining setscrews, ensuring that the sump is supported before all the setscrews are withdrawn.
 15. 'Break' the seal that will have formed between the engine oil sump and the crankcase bottom face.
 16. Carefully withdraw the sump assembly.
 17. Remove the oil pedestal and fine mesh strainer.
 18. Remove the sparking plugs (this will facilitate easier rotation of the crankshaft assembly).
 19. Rotate the crankshaft until one pair of connecting rod caps are at their lowest point.
 20. Unscrew the cap retaining nuts and carefully 'ease off' the cap.
 21. Fit protective rubber sleeving over the connecting rod bolts to prevent damage to the crankshaft (see Fig. E17). Do not remove the connecting rod bolts.
 22. Push the connecting rod and piston assembly upwards away from the crankshaft, to facilitate removal of the shell bearing.
 23. Collect the shell bearing from the connecting rod and cap.
 24. Repeat Operations 20 to 23 inclusive to the other connecting big-end bearing on the crankpin.
- Only one pair of big-end bearings should be dismantled at any one time. The position of the bearing shells should be noted so that if the bearings are to be used again, they can be fitted in their original position.

Crankpins and bearings - To inspect

1. Thoroughly clean each crankpin with a lint free cloth. Measure each crankpin diameter for wear and ovality (see Section E5, Crankshaft - To regrind).
2. The running clearance between the connecting rod big-end bearing and the crankpin is 0,032 mm. to 0,076 mm. (0.0015 in. to 0.003 in.). The size and wear tolerances are given in Section E3, Dimensional data.

New bearing shells should be fitted if the specified limits of the originals are exceeded due to wear or if the bearing shells are scored.

Connecting rod bearings - To fit

Fit protective sleeves to the connecting rod bolts.

1. If the upper and lower halves of a shell bearing are considered serviceable they can be used again provided that each is kept in its original position.
2. Before fitting new bearings to the connecting rods and caps, etch the cylinder number onto the outside of the locating tang.
3. Thoroughly clean the shells and the crankpin. Ensure that the crankpin oil feed holes from the main bearings are not blocked by sludge or dirt.
4. Lightly smear the upper half of the shell bearing surface with clean engine oil and fit it into the connecting rod.
5. Fit protective sleeves to the connecting rod bolts. Pull the connecting rod downwards onto the crankpin. Ensuring that the rod bolts do not damage the crankpin.
6. Remove the protective sleeving from the connecting rod bolts.
7. Fit the lower half of the shell bearing into the connecting rod and lightly smear it with clean engine oil.
8. Ensure that the tang on each half of the shell bearing is located correctly in its respective recess.
9. Place the cap onto the rod, ensuring that the two tangs are on the same side of the crankpin (see Fig. E21).

If necessary, carefully tap the cap into position until it is fully seated. **Take care to ensure that neither the shell bearing nor the connecting rod bolts become displaced during this operation.**

10. Using a micrometer, measure the overall length of the connecting rod bolts. These should have an overall length of between 71,95 mm. and 72,01 mm. (2.833 in. and 2.835 in.).

Any bolt not conforming to the dimensions quoted, should be carefully removed from the connecting rod (use a hide mallet) and a new bolt fitted.

11. Ensure that the shell bearings are correctly positioned then fit the cap to the connecting rod.
12. Lubricate the connecting rod bolt threads with engine oil and screw the retaining nuts onto the bolt threads. Each nut should be 'screwed on' by hand and lightly 'nipped' using a handbrace and socket.

The nuts should be easy to 'screw on', if effort is required the threads should be examined for burrs, damage or malformation and the offending parts replaced.

13. Torque tighten the nuts to obtain a bolt stretch of between 0,1524 mm. and 0,3810 mm. (0.006 in. and 0.015 in.). This bolt stretch range should be achieved between 4,83 kgf.m. and 6,21 kgf.m. (35 lbf.ft. and 45 lbf.ft.).

14. If any bolt has not been stretched sufficiently increase the torque tightness to 6,90 kgf.m. (50 lbf.ft.) and again check the bolt stretch.

15. If any bolt is still under stretched, slacken both nuts of the connecting rod and measure the free length of the offending bolt. If this measurement is outside the limits quoted in Operation 10, fit a new bolt.

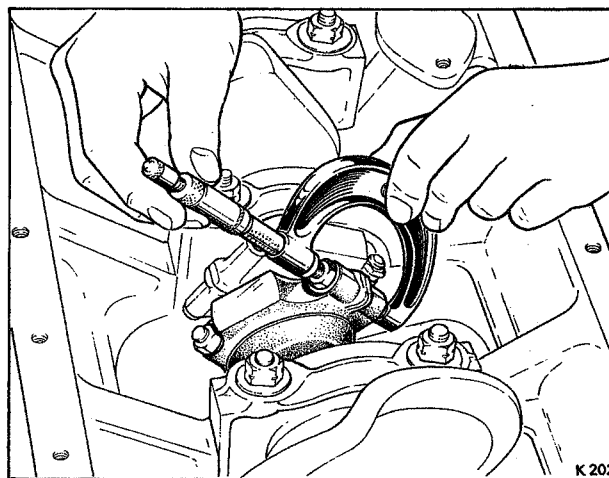


Fig. E18 Checking connecting rod bolt stretch

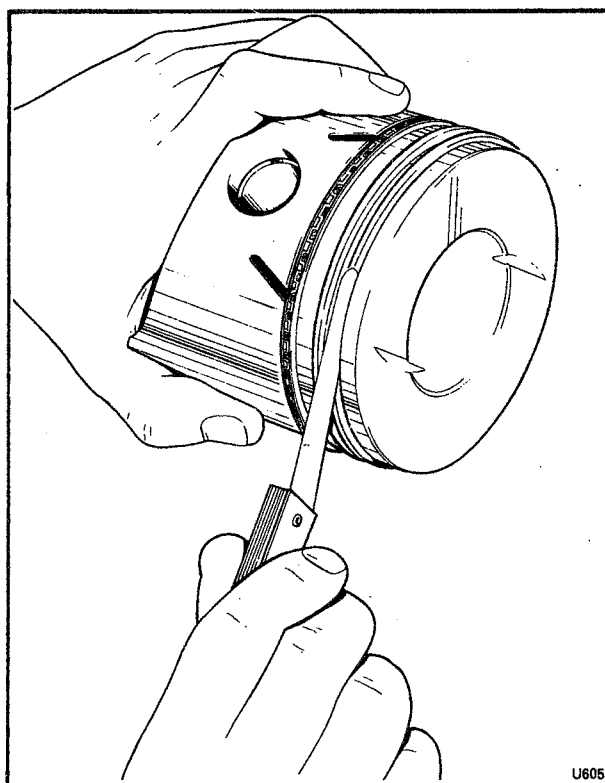


Fig. E19 Checking the piston ring clearance

Should this measurement be inside the limits quoted in Operation 10, repeat Operations 12 and 13. Again measure the bolt stretch. If the bolt now conforms it is acceptable, if not slacken both nuts and replace the suspect bolt with a new one.

Repeat Operations 10 to 13 inclusive.

16. If any bolt has been over stretched when tightening, slacken both nuts on the connecting rod and replace the offending bolt.

17. Repeat Operations 10 to 16 inclusive to the remainder of the connecting rod big-end bearings.

18. Fit the engine sump using a new gasket.

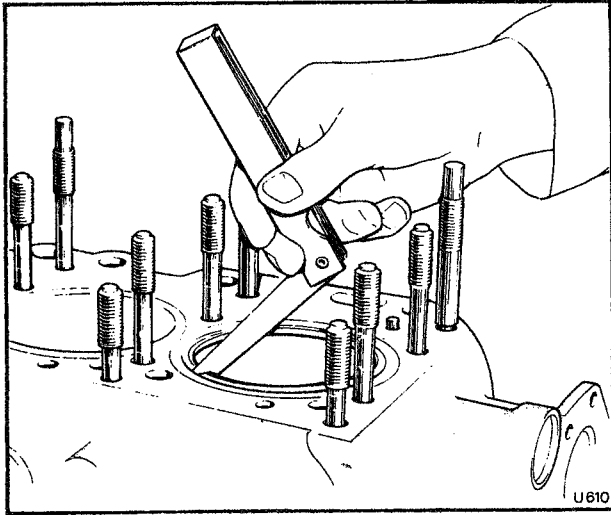


Fig. E20 Checking the piston ring gap

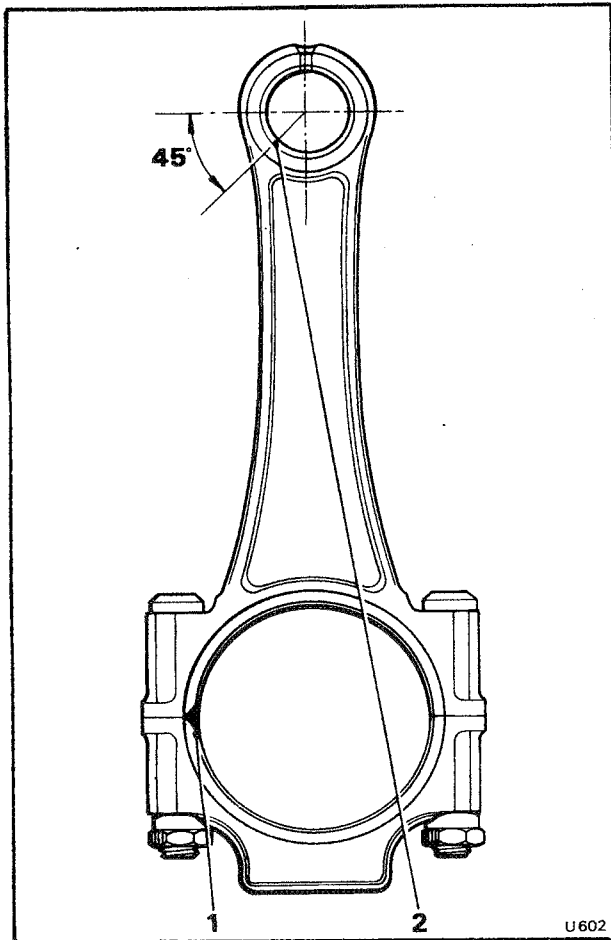


Fig. E21 Position of small end bush

- 1 Tangs
- 2 Split in bush

19. Fit all other parts by reversing the procedure given for their removal (see Connecting rod bearings - To remove).

20. Set the engine stop plate gap (see Section E12, Engine removal and installation).

Connecting rod and piston - To remove

1. Remove the cylinder head (see Section E8, Cylinder heads - To remove).
2. Remove the connecting rod cap from the big-end bearing (see Connecting rod bearing - To remove).
3. Push the connecting rod upwards so that the piston and connecting rod assembly can be withdrawn from the top face of the crankcase.
4. Repeat these operations to the remaining piston and connecting rod assemblies.

Connecting rod and piston - To dismantle

1. Remove the circlip from the piston. The circlips are located one at either end of the gudgeon pin bore.
2. Thoroughly warm the piston assembly. This can be achieved by either immersing the piston in a bath of hot oil or placing the piston crown on a hot plate.
3. When the piston is thoroughly warm, push the gudgeon pin out using a suitable guide.

Piston - To inspect

1. Remove the rings from the piston using a suitable expander tool.
2. Remove the carbon deposits from the rings and pistons. Ensure that all the deposit is removed from the piston ring grooves.
3. Thoroughly clean all components.
4. Check that the clearance of the piston rings in their respective grooves is as given in Section E3, Dimensional data (see Fig. E19).
5. Check the compression rings in either a 10,41 cm. (4.10 in.) diameter ring gauge or an unworn part of the cylinder (see Fig. E20). If the rings are in good condition no light should show around the circumference of the rings.
6. Check the closed gap of each compression ring whilst it is fitted into either the ring gauge or the unworn part of the cylinder bore (see Section E3, Dimensional data).
7. Visually check the condition of the oil control ring.
8. Check the dimension of the piston across the thrust axis. The measurement should be taken at the piston grading point which is 2,3 cm. (0.906 in.) above the bottom of the skirt. The measurement and grade of the pistons are given in (Section E3, Dimensional data).

Small end bush - To inspect and renew

1. Check the diameter of both the gudgeon pin and the small end bush. If the clearance exceeds 0,013 mm. (0.0005 in.) renew the bush.

2. Using a suitable drift, remove the small-end bush.
3. Visually inspect the condition of the connecting rod small-end.
4. Measure the internal diameter of the connecting rod small-end.
5. Measure the external diameter of the new small-end bush.
6. Compare the measurements obtained in Operations 4 and 5. An inference fit between the new bush and small-end of 0,051 mm. to 0,089 mm. (0.002 in. to 0.0035 in.) is essential.
7. Position the new bush so that the chamfered edge is towards the connecting rod. Also ensure that the split in the bush is 45° away from the centre axis of the rod and on the same side of the rod as the locating recesses for the big-end bearing shells (see Fig. E21). In this position the oil hole in the bush should line up with the oil hole in the small-end boss.
8. Press the small-end bush into position until it is flush with the connecting rod boss.
9. Finally, either diamond bore or ream the bush to the finished diameter quoted in Section E3, Dimensional data. The gudgeon pin fit in the small-end bush should be from a size fit to 0,00635 mm. (0.00025 in.) clearance.

Connecting rods - To check alignment and twist

The correct alignment of a connecting rod is of the utmost importance and any connecting rod that has had a new bush fitted and bored must be checked for alignment using a reliable alignment fixture.

Connecting rods that are bent will cause uneven and premature wear between the cylinder walls and pistons.

If an alignment fixture is not available the **alignment** and **twist** of the connecting rods can be checked as follows.

Alignment

1. Fit the gudgeon pin to the small-end bush.
2. Fit a mandrel to the big-end.
3. Mount the connecting rod on an inspection surface table as shown in Figure E22.
4. Using a dial indicator gauge, take a reading at both ends of the gudgeon pin.

The difference between the two readings must not exceed 0,025 mm. (0.001 in.) per 25,40 mm. (1.00 in.) length of the gudgeon pin.

Twist

1. Fit the gudgeon pin to the small-end bush.
2. Fit a mandrel to the big-end.
3. Mount the connecting rod on an inspection surface table as shown in Figure E23.
4. Using a dial test indicator gauge, take a reading at both ends of the gudgeon pin.
5. The difference between the two readings must not exceed 0,076 mm. (0.003 in.) per 25,40 mm. (1.00 in.) length of gudgeon pin.

Connecting rods and pistons - To assemble

To assemble the connecting rods to the pistons

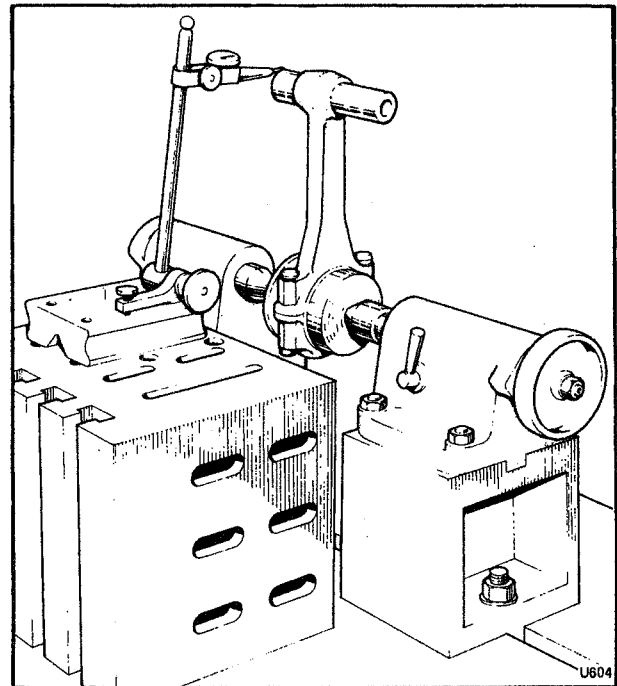


Fig. E22 Checking the connecting rod alignment

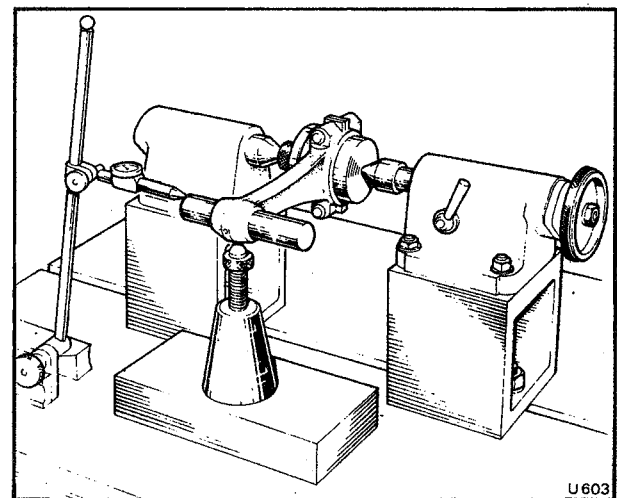


Fig. E23 Checking the connecting rod for twist

reverse the procedure given for dismantling noting the following points.

1. Pistons and gudgeon pins are supplied as an assembly, the gudgeon pin being a selective fit. On no account must pistons and gudgeon pins be interchanged.
2. When fitting the rings to the piston, fit the oil control (scraper) ring assembly first. This ring consists of two thin rails and a centre equaliser. Fit the centre equaliser first.

Fit the two compression rings as shown in Figure E15.

3. To ensure that the gudgeon pin, piston and connecting rod are always assembled the same way,

fit the pin to the piston so that the cylinder number on the pin is on the same side as the cylinder number on the piston. The tangs on the connecting rod and cap should always be nearest the camshaft (see Fig. E24).

Connecting rods and piston - To fit

To fit the connecting rods and piston assemblies to the engine reverse the procedure for removal noting the following points.

1. Space the ring gaps around the piston.
2. Liberally cover the pistons with either graphogen

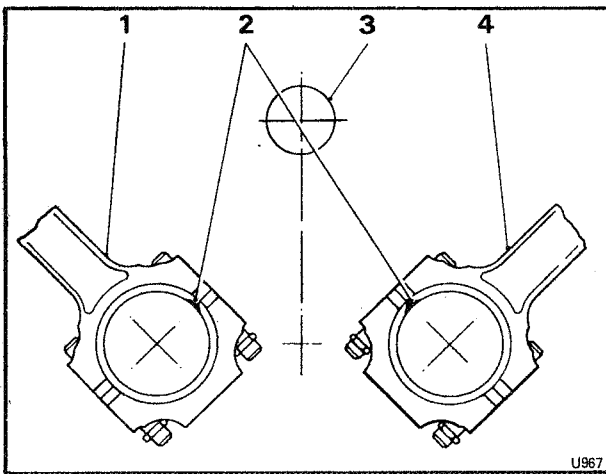


Fig. E24 Position of the connecting rod tangs

- 1 'A' bank connecting rod
- 2 Position of tangs
- 3 Camshaft
- 4 'B' bank connecting rod

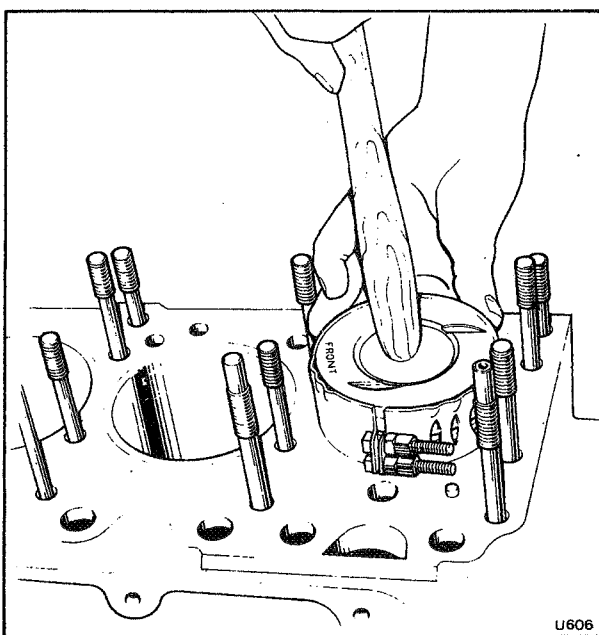


Fig. E25 Fitting a piston

or clean engine oil and then fit a ring compressor over the piston rings.

3. Ensure that the head of each connecting rod bolt is seated on the connecting rod, if not, carefully tap the head of the bolt into position. Fit a protective rubber sleeve to each bolt before fitting the piston and connecting rod assembly to the engine.

4. Ensure that the shell bearings are correctly located in both the connecting rod and cap.

5. Fit the piston and connecting rod assembly into the cylinder bore from the top.

6. Tighten the piston ring compressor, hold it against the cylinder liner and push the piston into the bore (see Fig. E25).

7. Carefully position the connecting rod onto the crankshaft big-end journal. Remove the protective sleeving from the bolts, finally check the location of the big-end bearing shells and fit the cap.

8. Fit the nuts to the connecting rod bolts and tighten them in accordance with the procedure given in Connecting rod bearings - To fit.