
Piston and connecting rod assemblies

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General description

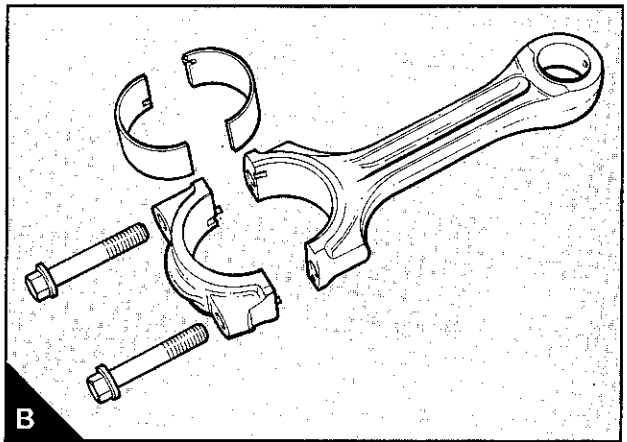
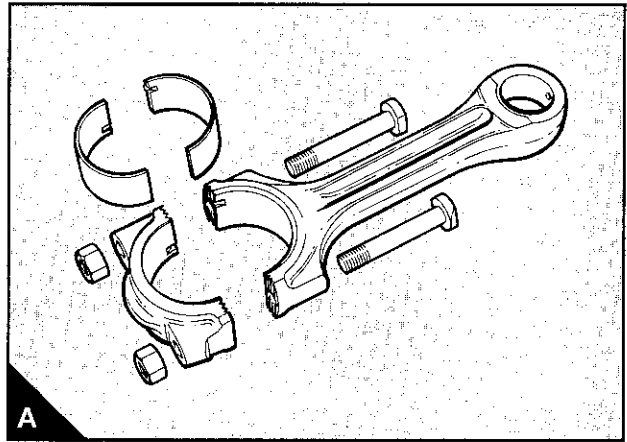
The "Quadram" combustion chamber in the top of the piston is specially designed to give an efficient mix of fuel and air.

The pistons have two compression rings and an oil control ring. The groove for the top ring has a hard metal insert to reduce wear of the groove. Axial location of the fully floating gudgeon pin is by circlips. There is a steel insert in the piston skirt to control piston expansion.

Engine types AB, AC, AD, YB and YD have pistons with a reduced diameter above the groove for the top ring. Engines of these types which are rated higher than 2300 rev/min have an "anodised" area on the top face of the piston.

Engine types AB, AD, YB, YD and some AC engines have cooling jets fitted in the cylinder block to spray lubricating oil onto the inner surface of the piston.

The connecting rods are machined from "H" section forgings of molybdenum steel. Generally, the location of the bearing caps to the connecting rods is made by serrations and the cap is retained by two nuts and bolts (A). For engines types AB, AD, YB and YD used in vehicle applications the location of the bearing cap to the connecting rod is made by dowels fitted in the bearing cap (B). The faces of these connecting rods and caps are flat and the caps are retained by two setscrews. The connecting rods of engine types AB, AC, AD, YB and YD have wedge shaped small ends.



Big end bearing

To remove and to fit

13A-01

To remove

- 1 Drain the engine lubricating oil.
- 2 Remove the lubricating oil sump, operation 19A-03.
- 3 Remove the lubricating oil strainer and suction pipe, operation 19A-04 or remove the balancer unit, operation 14A-10.
- 4 Turn the crankshaft until the relevant connecting rod is at its lowest position.
- 5 Release the nuts and remove the bearing cap. Remove the bolts from the connecting rod. For engines types AB, AD, YB and YD used in vehicle applications: Release the setscrews approximately 4 turns. Then lightly hit the heads of the setscrews with a soft face hammer to separate the connecting rod from the bearing cap. Remove the setscrews and the bearing cap.
- 6 Remove the lower half bearing from the cap but keep it with its relevant cap.
- 7 Carefully push the connecting rod up the cylinder bore just enough to allow access to the upper half bearing. Remove the bearing from the connecting rod. Keep the bearings from the connecting rod and cap together.

Attention: Do not allow the connecting rod to hit the piston cooling jet, if fitted.

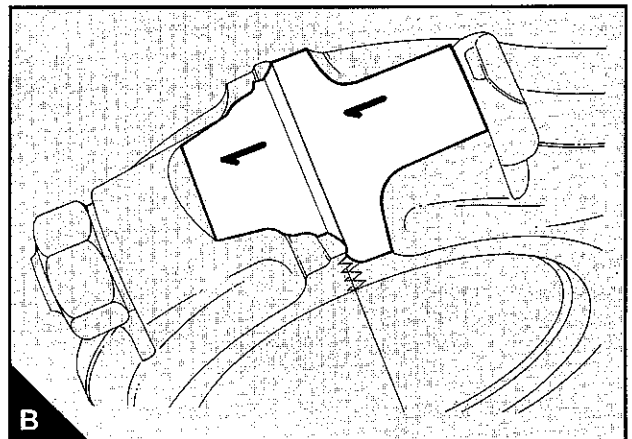
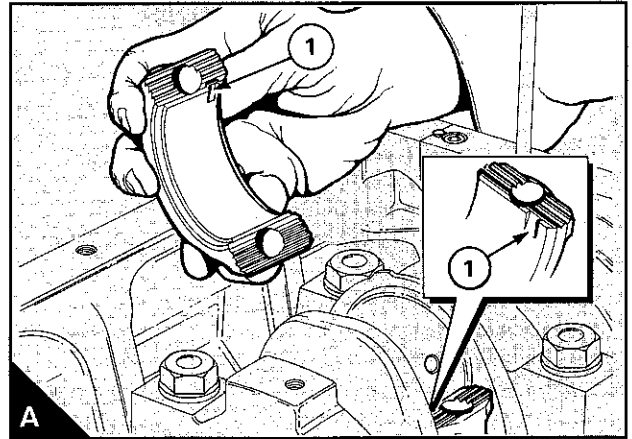
To fit

- 1 Clean the bearing faces of the connecting rod and the crank pin.
- 2 Clean the complete bearing and lubricate the bearing surface and the crank pin with clean engine lubricating oil. Fit the upper half bearing to the connecting rod; ensure that the location tag is fitted correctly in its recess (A1). Fit the connecting rod to the crankpin; ensure that the assembly number on the connecting rod is on the same side as the other connecting rods.
- 3 Clean, lubricate and fit the lower half bearing into the cap; ensure that the location tag is fitted correctly in its recess (A1). Fit the connecting rod bolts with the flat side of the head of the bolts towards the rod. Fit the cap to the connecting rod; ensure that the assembly number on the cap is the same as that on the connecting rod and that both of the assembly numbers are on the same side (B).
- 4 Tighten the fasteners gradually and evenly to the recommended torque of 155 Nm (114 lbf ft) 15,8 kgf m for setscrews, or 125 Nm (92 lbf ft) 12,7 kgf m for nuts.
- 5 Ensure that the crankshaft turns freely.
- 6 Fit the lubricating oil strainer and suction pipe, operation 19A-04 or fit the balancer unit, operation 14A-10.
- 7 Fit the lubricating oil sump, operation 19A-03 and fill the sump to the correct level with lubricating oil of an approved grade.

To inspect

13A-02

Check the bearings and the crank pin for wear or other damage.



Piston and connecting rod assembly

To remove and to fit

13A-03

To remove

- 1 Drain the lubricating oil and the cooling system.
- 2 Remove the cylinder head assembly, operation 12A-07.
- 3 Remove all carbon from the top of the bores of the cylinder liners.
- 4 Remove the lubricating oil sump, operation 19A-03.
- 5 Remove the lubricating oil strainer and suction pipe, operation 19A-04, or remove the balancer unit, operation 14A-10.
- 6 Remove the big end caps and the big end bearings from the connecting rods, operation 13A-01.
- 7 Push the pistons and the connecting rods out through the top of the cylinder liners. Keep the bearings and caps together to ensure that they can be fitted in their original positions.

Attention: Do not allow the connecting rods to hit the piston cooling jets, if fitted. If a cooling jet is hit, check its alignment, operation 13A-10, and renew it, if necessary.

- 8 Inspect the crank pins for damage.

To fit

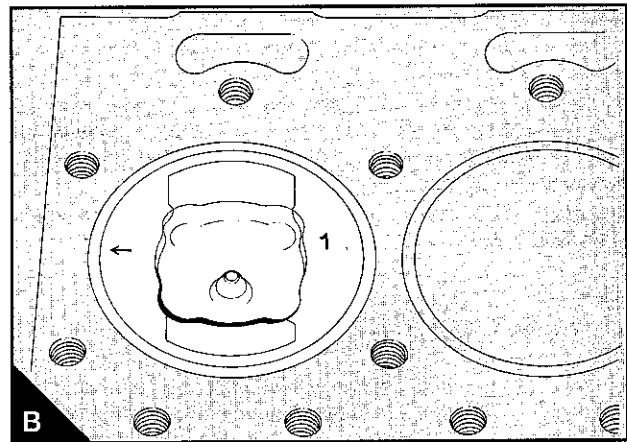
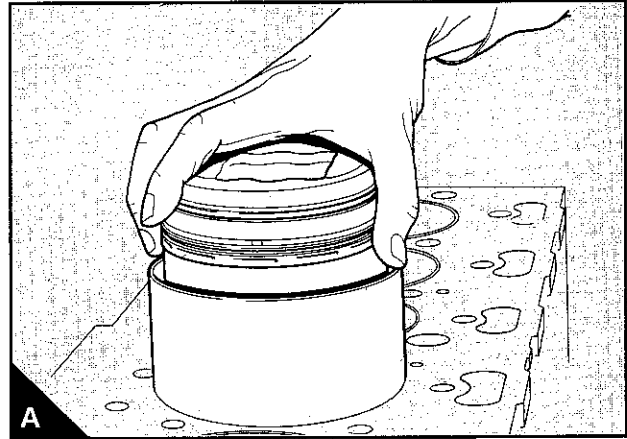
Special tools:

Piston replacer tool, PD.206

Piston height tool, PD.41D

Dial gauge for use with PD.41D, PD.208

- 1 Ensure that the piston, the cylinder bore, the crank pin and the big end of the connecting rod are clean. Lubricate the piston and the cylinder liner with clean engine lubricating oil.
- 2 Turn the crankshaft until the relevant crank pin is at its lowest position. Lubricate the crank pin with clean engine lubricating oil.
- 3 Fit the upper half bearing to the connecting rod. Ensure that the location tag is fitted correctly in its recess. Lubricate the bearing with clean engine lubricating oil.
- 4 Put the piston replacement tool in position at the top of the relevant cylinder. The tool has a tapered bore to compress the piston rings when the piston and connecting rod assembly is fitted. Ensure that the smaller end of the tapered bore is towards the face of the cylinder block.
- 5 Put the piston ring gaps 120° apart. Pass the connecting rod through the piston replacing tool and allow the piston to enter the tool. The arrow or "FRONT" mark on the top of the piston must be towards the front of the engine. In this position the combustion bowl in the top of the piston will be towards the fuel injection pump side of the engine.
- 6 Push the piston and connecting rod assembly through the piston replacing tool (A) and onto the crank pin. If piston cooling jets are fitted, the piston and connecting rod assembly must be turned to ensure that the connecting rod will not hit the piston cooling jet as the assembly is fitted. When the connecting rod has passed the piston cooling jet, turn the connecting rod until the arrow or "FRONT" mark on top of the piston is towards the front of the engine (B).



7 Clean the connecting rod cap and the lower half bearing. Fit the bearing to the cap; ensure that the location tag is fitted correctly in its recess. Lubricate the bearing with clean engine lubricating oil. Fit the cap and ensure that the assembly number is the same as that on the connecting rod and that the numbers are on the same side. Fit the fasteners; ensure that the flat side of the head of the bolts is towards the connecting rod. Tighten the fasteners gradually and evenly to the recommended torque of 155 Nm (114 lbf ft) 15,8 kgf m for setscrews, or 125 Nm (92 lbf ft) 12,7 kgf m for nuts.

8 Check that the crankshaft will turn freely.

9 Check the piston height above the top face of the cylinder block with the piston height tool. Put the tool on the face of the cylinder block and turn the gauge dial to the zero position. Turn the crankshaft until the piston is approximately at top dead centre (TDC). Carefully put the tool over the top of the piston with the plunger of the gauge in contact with the piston above the axis of the gudgeon pin (A). Turn the crankshaft to bring the piston to its highest position and make a note of the gauge indication. The piston height above the face of the cylinder block should be 0,14/0,36 mm (0.005/0.014 in). Two piston heights can be used in the factory: "H" - high, "L" - low. In service only "L" pistons are supplied. If an "L" piston is used instead of an "H" piston, the height may be up to 0,19 mm (0.0075 in) below the bottom limit. The top of the piston must not be machined.

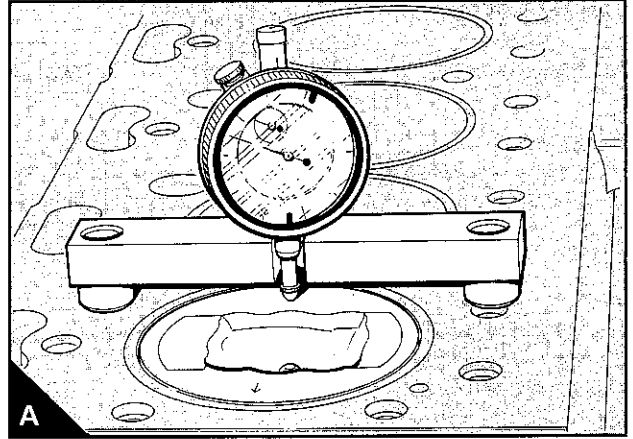
10 Fit the lubricating oil strainer and suction pipe, operation 19A-04 or fit the balancer unit, operation 14A-10.

11 Fit the lubricating oil sump, operation 19A-03.

12 Fit the cylinder head assembly, operation 12A-07.

13 Fill the sump to the correct level with lubricating oil of an approved grade.

14 Fill the cooling system.



Piston rings

To remove and to fit

13A-04

To remove

Remove the piston rings with a suitable ring expander. Only increase the ring gaps enough to ensure that the ends of the rings do not damage the piston. Keep the rings with their relevant piston.

To fit

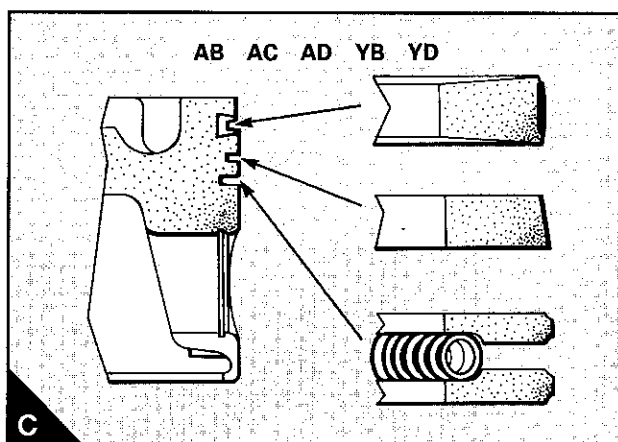
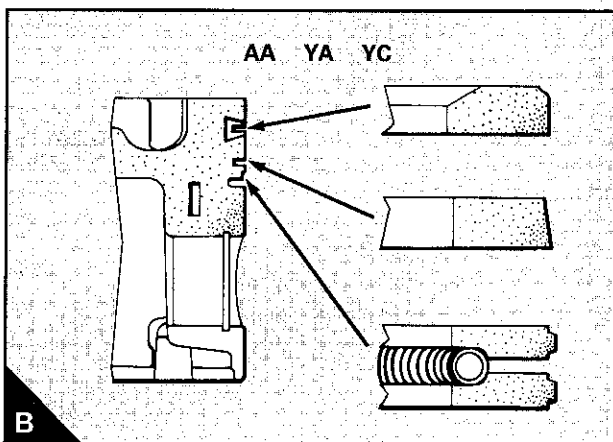
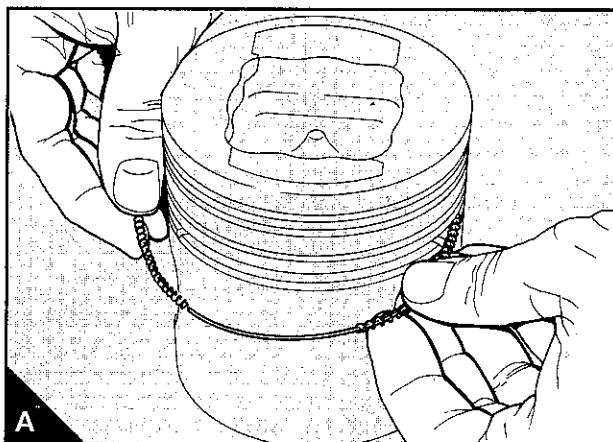
Use a suitable ring expander to fit the piston rings. Only increase the ring gaps enough to ensure that the ends of the rings do not damage the piston.

1 Fit the spring of the oil control ring in the bottom groove with the latch pin inside both ends of the spring (A). Fit the oil control ring over the spring (B or C). Ensure that the ring gap is at 180° to the latch pin.

2 Fit the cast iron ring with the tapered face into the second groove with the word "TOP", or the manufacturer's symbol, towards the top of the piston. New piston rings have a green identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

3 Fit the barrel face ring with the molybdenum insert into the top groove. Engine types AB, AC, AD, YB and YD have a wedge shaped top ring. On engine types AA, YA and YC, the latest top ring has a chamfer on the inner top face. A few earlier rings did not have a chamfer. The word "TOP", or the manufacturer's symbol, must be towards the top of the piston. New piston rings have a red identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

4 Ensure that the ring gaps are 120° apart.



Piston and connecting rod assembly

To dismantle and to assemble

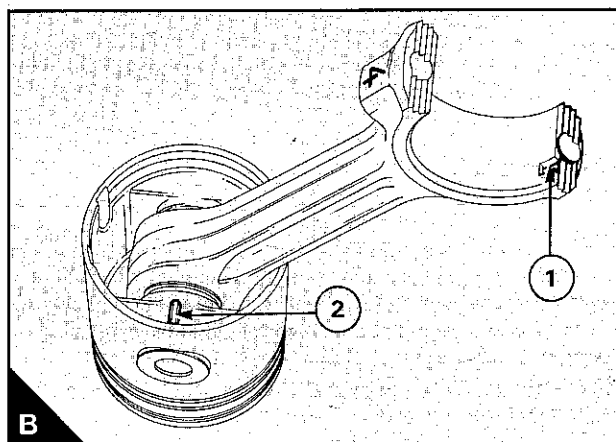
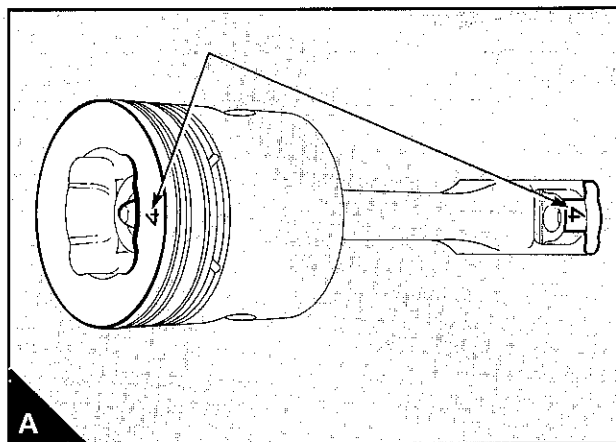
13A-05

To dismantle

- 1 Remove the piston rings, operation 13A-04.
- 2 Remove the circlips which retain the gudgeon pin.
- 3 Put a mark on the piston to indicate the cylinder number as shown on the connecting rod. Put the mark on the piston on the same side as the mark on the big end to ensure that they are assembled correctly (A).
- 4 Push the gudgeon pin out by hand. If the gudgeon pin is tight, heat the piston to 40/50°C (100/120°F) for easy removal of the gudgeon pin.

To assemble

- 1 Clean the bore of the small end bush and lubricate it with clean engine lubricating oil.
- 2 Fit a new circlip in the circlip groove of one of the gudgeon pin bosses. Ensure that it fits correctly in the groove.
- 3 With the piston upside down, put the connecting rod in position with the recess for the location of the big end bearing (B1) on the same side as the lug on the gudgeon pin boss (B2). If the original piston is used, ensure that it is assembled to the correct connecting rod and is used in the original cylinder.
- 4 Lubricate the gudgeon pin bosses with clean engine lubricating oil and push in the gudgeon pin towards the circlip. If the gudgeon pin is a tight fit in the piston, heat the piston to 40/50°C (100/120°F) before the gudgeon pin is fitted.
- 5 Fit a new circlip in the groove in the other gudgeon pin boss. Ensure that it fits correctly in the groove.
- 6 Fit the piston rings, operation 13A-04.

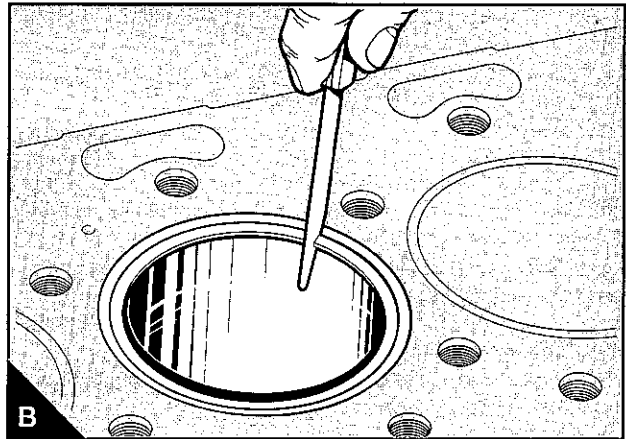
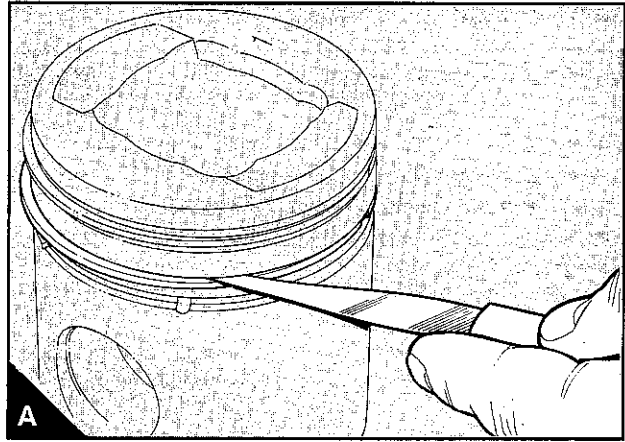


Piston and rings

To inspect

13A-06

- 1 Check the piston for wear and other damage.
- 2 Check that the piston rings are free to move in their grooves and that the rings are not broken.
- 3 Remove the piston rings, operation 13A-04, and clean the piston ring grooves and the piston rings.
- 4 Fit new rings in the grooves and check for wear of the ring grooves with feeler gauges (A). Compare the piston ring clearance in the groove to that given for new components in section 11C and renew the piston, if necessary. The tapered top groove of pistons used on engine types AB, AC, AD, YB and YD cannot be checked by this method.
- 5 Clean all carbon from the top of the cylinder liners. Fit the piston rings in the top part of the cylinder liner and measure the ring gap with feeler gauges (B). The coil-spring must be fitted to the oil control ring when the gap of this ring is measured. The ring gaps for new components are given in section 11C.



Connecting rod

To inspect

13A-07

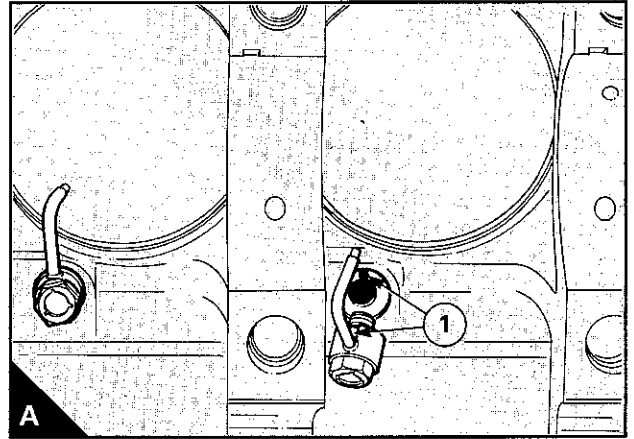
- 1 Check the connecting rod for distortion, see section 11C.
- 2 Check the small end bush for wear or for other damage and renew it, if necessary.
- 3 Check the fit of the gudgeon pin in the small end bush and check the gudgeon pin for wear, see section 11C.

Small end bush

To remove and to fit **13A-08**

- 1 Press out the old bush with a suitable adaptor.
- 2 Clean the connecting rod bore and remove any sharp edges.
- 3 Press in the new bush. Ensure that the lubrication hole in the bush is on the same side as, and is aligned with, the hole in the top of the connecting rod.
- 4 Ream the bush to get the correct clearance between the gudgeon pin and the bush, see section 11C.

For engine types AB, AC, AD, YB and YD, the small end is wedge shaped. After the small end bush has been fitted, machine the bush to the shape of the small end and remove any sharp edges.



Piston cooling jets

Piston cooling jets are fitted to engine types AB, AD, YB, YD and some AC.

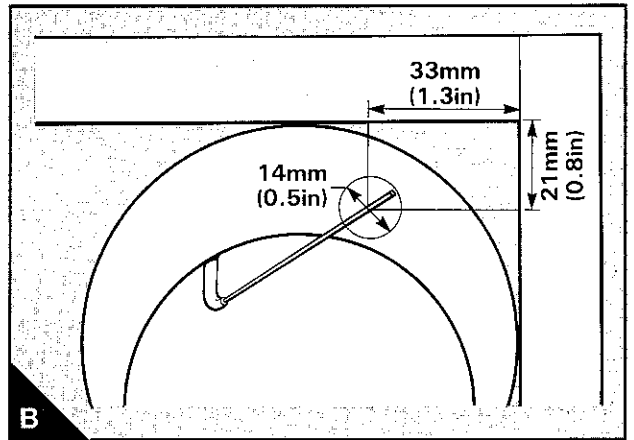
To remove and to fit **13A-09**

To remove

Release the valve assembly and remove the piston cooling jet assembly (A). (The crankshaft is removed in A to show clearly the piston cooling jet).

To fit

- 1 Check that the ball moves freely against spring pressure in the valve assembly and that the jet tube is not damaged. Renew the valve assembly and /or the body as necessary.
- 2 Fit the piston cooling jet; ensure that the assembly is fitted correctly on the dowel in the cylinder block. Tighten the valve assembly to 27 Nm (20 lbf ft) 2,8 kgf m.



To check the jet alignment **13A-10**

Insert a 1,70 mm (0.067 in) diameter rod, of suitable length, into the jet. If a suitable rod is not available, reduce the end of a thicker rod to 1,70 mm (0.067 in) diameter for a length of 16,00 mm (0.630 in). When the rod is inserted into the jet it must extend out of the top of the cylinder within the area shown in B.