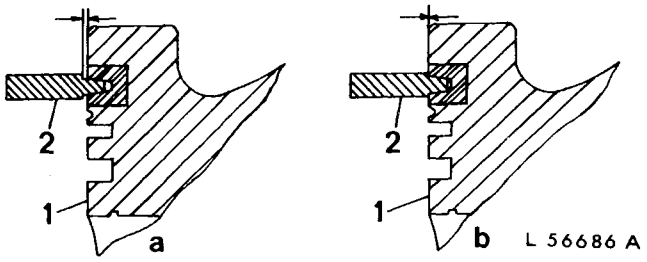


Fig. 1 — Checking Top Piston Groove for Wear

1 Piston
2 Gauge No. 19.58-90.281
a Piston can be used again
b Discard piston and replace

Check piston ring grooves for wear as follows: Clean piston ring grooves carefully. Using gauge 19.58-90.281 (see 2, fig. 1) check the groove of the top compression ring (keystone-shaped) for excessive wear. As long as there is a gap between the shoulder of the feeler gauge and the piston (see "a", fig. 1) the piston can be used again. If shoulder of feeler gauge comes into contact with the piston (see "b", fig.1), wear is excessive and the piston must be replaced. When checking the center piston ring groove, insert a new piston ring. Measure clearance between ring and groove at several points around the ring, using a feeler gauge.

Using a micrometer, measure piston skirt diameter at right angles to the piston pin; piston skirt diameter see Specifications.

Check piston pins and replace them, if excessively worn (see Specifications).

Always use new piston pins when installing new pistons.

## CONNECTING RODS AND BEARINGS

**Replace connecting rod bearings, rod screws and piston pin bushings at every major engine overhaul.**

Connecting rods and rod caps are only available as matched sets. Connecting rod bearing insert halves are available in standard sizes and several undersizes (see Specifications).

**Insert bearing insert halves, install rod cap and tighten old rod screws to the specified torque. Measure each bearing bore and its respective crankshaft journal at several places. The difference between the two measurements in the bearing clearance (see Specifications).**

Check piston pin bushing and replace, if necessary.

*NOTE: Always install a new bushing when installing a new piston pin. Press in new bushing and hone until the respective piston pin can be inserted by "thumb-press" fit.*

## CYLINDER BLOCK

Remove all gaskets and scrape off any residual deposits. Remove O-rings sealing liners from cylinder block grooves and discard.

Thoroughly clean the block outside and particularly inside with cleaning solvent or by pressure steam cleaning. Make sure all passages and orifices are free from sludge, rust and grease and remove all scale or lime deposits.

*On later engines:* Inspect the six jet nozzles in cylinder block and replace, if necessary. Tighten spray jets to specified torque (see Torques for Hardware).

**Replacement cylinder blocks are supplied with jet nozzles and plugs. When old cylinder block is equipped with jet nozzles then install nozzles supplied with replacement block. On earlier engines without jet nozzles install plugs.**

*Valve Seat Bushing of Oil Pressure Regulating Valve*

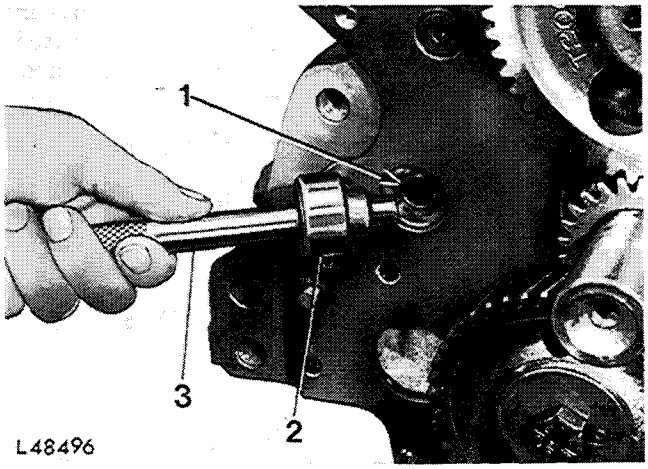


Fig. 2 — Driving in Valve Seat Bushing of Oil Pressure Regulating Valve

1 Valve seat bushing
2 Special tool No. JD 248
3 Special tool (driver) No. 813

Check the bushing with sealing edge for lubricating oil pressure regulating valve located in the front cylinder block for serviceability. If necessary, remove unserviceable bushing from cylinder block and drive in a new bushing until driver contacts cylinder block, using special tools JD 248 and 813 (see fig. 2).

**IMPORTANT: Do not use other unsuitable tools. Above all do not press tool against the slightly protruding inner edge of the bushing since it is a delicate sealing face.**

*Dowel Pins, Plugs and Studs*

Check these parts for tight fit or proper sealing in cylinder block. If necessary, replace by new parts. Coat part to be inserted in cylinder block with a suitable sealant resistant to oil and water.

*Threaded Bushing for Dip Stick*

If the threaded bushing for the dip stick has to be replaced, coat threaded end of new bushing with an oil-resistant sealant. Thread into cylinder block as indicated under Specifications.

*Adapter in Cylinder Block*

If oil filter adapter has to be replaced, press in new adapter so that threaded end faces outward (farthest point from cylinder block).

## CYLINDER LINERS

Measure each cylinder liner as explained below, using a suitable gauge (dimensions see Specifications):

1. Measure liner bore parallel to piston pin at top end of ring travel.

2. Measure bore in same position at bottom end of ring travel.

3. Measure bore at right angles to piston pin at top end of ring travel.

4. Measure bore in same position at bottom end of ring travel.

Compare all four measurements to determine if liner has worn tapered. Maximum taper at the ring land area see Specifications.

If a cylinder liner is excessively worn (see Specifications), the piston, too, may be so worn that it needs replacement.

*Deglazing Cylinder Liner Bores*

*NOTE: Remove cylinder liners and place in a suitable clamping device or in an old cylinder block for deglazing.*

For deglazing cylinder liners 0.0004 to 0.0009 mm (15 to 35 micro-in.) use an 180 grit deglazing tool or a cylinder hone.

When deglazing, move the tool up and down 10 to 12 times and adapted to driving speed of tool, guide the latter so that a 45° criss-cross hone pattern is produced.

*NOTE: For additional information on deglazing cylinder liners see manual: "Fundamentals of Service — Engines".*

Clean cylinders thoroughly. Wipe out cylinder liners with a cloth until a clean white cloth shows no discoloration when wiped through cylinder bore.

## ASSEMBLY

### CONNECTING RODS, PISTONS AND PISTON RINGS

Make sure that the marks for identifying matched pistons and connecting rods, applied prior to disassembly, do tally.

Apply a coat of clean, thin engine oil to the piston pin and insert in piston bore and through connecting rod bushing. A properly fitting piston pin can be positioned by thumb pressure.

*Installing Piston Rings*

*NOTE: New piston rings are furnished with the correct end gap. This should not be altered.*

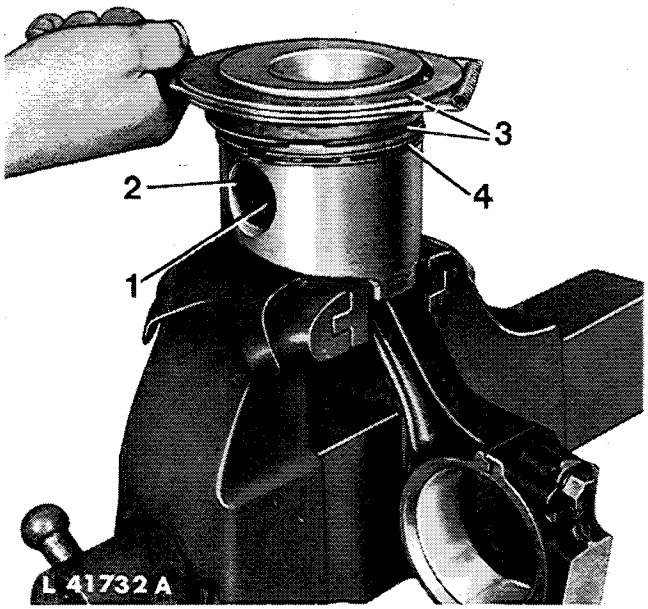


Fig. 3 — Installing Piston Rings

1 Piston pin
2 Snap ring
3 Compression rings
4 Oil control ring

Install piston rings, using a commercial piston ring expander.

1. Install the expander ring in groove of oil control ring so that its gap is over a piston pin bore. Then install oil control ring in ring groove with the gap opposite the expander gap.

2. Install second compression ring in center groove with "TOP" mark facing upward and with its gap shifted 120° from expander ring gap.

3. Then install upper compression ring with its gap shifted 120° from the gap of the second compression ring.

Coat exterior of piston and all piston rings with a film of clean engine oil.

## INSTALLATION

### CYLINDER LINERS

Make sure cylinder block is completely clean and that the O-rings are removed from cylinder block grooves.

Install cylinder liner WITHOUT square packing and secure by means of a washer and cap screw.

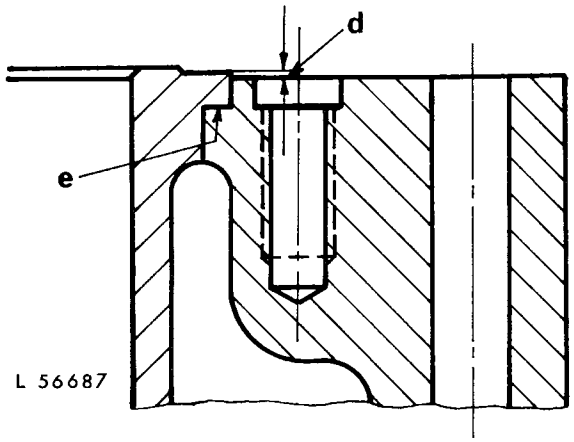


Fig. 4 — Upper Fit and Sealing Face of Cylinder Liner in Cylinder Block

d Check dimension
e Seating area

Measure dimension "d" (see Specifications) shown in fig. 4 by which the sealing face of the cylinder liner protrudes over the cylinder block sealing face. Measure at several places around the circumference and compare measurements to make sure sealing face of cylinder liner is parallel to sealing face of cylinder block.

If the protrusion of the cylinder liner sealing face over the cylinder block sealing face is less than specified, remove liner and install one shim R 46906 (for proper thickness see Specifications) between liner and cylinder block.

Re-install liner with shim but WITHOUT **packing** in cylinder block. Again measure dimension "d" (fig. 4) and record. Remove cylinder liner and shim.

*NOTE: Do not soak packings and O-rings in oil before installing them as they would swell up and could get damaged when installing the cylinder liners.*

Carefully slide new packing 1 (fig. 5), coated with lubricating grease over liner until it contacts liner shoulder. Be sure packing is not twisted or crimped. Also make sure inner flank of packing contacts liner face when packing is installed.

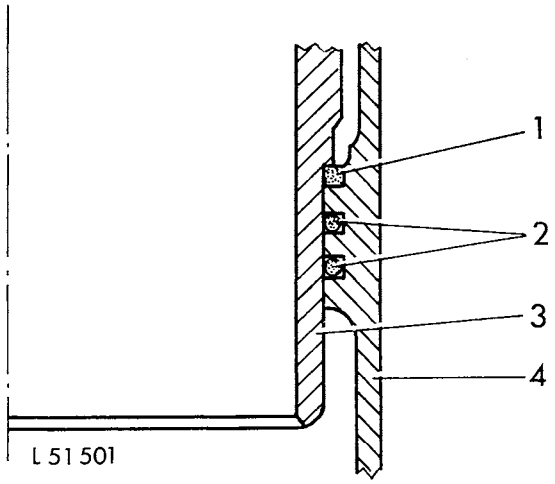


Fig. 5 — Lower Liner Sealing

1 Square-section packing
2 O-rings
3 Cylinder liner
4 Cylinder block

Install two new O-rings coated with lubricating grease in grooves of cylinder block.

*Before installing liner, make sure O-rings are properly seated in cylinder block grooves. If part of an O-ring projects into bore for liner, the O-ring could be pressed onto groove edge, thus getting damaged without the serviceman noticing it.*

Slide liner with shim into its bore in cylinder block. Observe the mark applied during disassembly to identify the liner and its corresponding bore in the block. Work the liner gently in by hand. Finally use a block of hardwood to drive the liner into its proper position by tapping lightly with a hammer.

**IMPORTANT: Do not yet compress packing.**

The cylinder liner will now protrude over the sealing surface of the block by slightly more than dimension "d" (see fig. 4).

Measure protrusion and record. Subtract dimension "d" (with shim, but without packings) measured above from amount of protrusion. The difference indicates how much the liner packings will be compressed. The minimum dimension is given under "Specifications".

If this dimension is not attained, the check must be repeated with another cylinder liner.

If the minimum dimension can still not be attained, replace the cylinder block. Do not place more than one shim between liner and cylinder block under any circumstances.

## PISTON WITH CONNECTING ROD

Retain all cylinder liners in the block, using large washers and cap screws.

Coat pistons and cylinder liners with a film of thin engine oil.

*NOTE: Observe the identification marks which were applied to the pistons and connecting rods during removal and insert them into the liners from which they were removed.*

*Make sure that the "FRONT" mark which is stamped into the head of each piston and into the shaft of each connecting rod faces toward the radiator before installing them.*

Be sure piston rings and oil control ring are still in the original position.

Apply a film of thin engine oil to bore of 19.58—90.616 ring compressor.

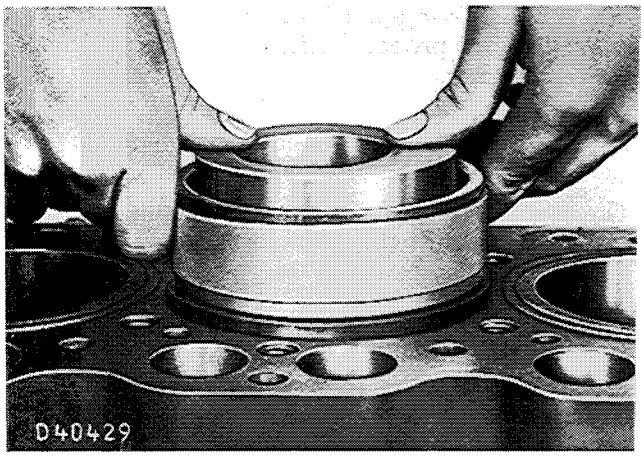


Fig. 6 — Installing Piston, Using Ring Compressor 1958-90.616

Position ring compressor 19.58-90.616 exactly in the middle of the cylinder bore. Insert connecting rod and piston through this tool until piston rings touch the tool. Then press or tap piston downward until all piston rings are in the cylinder liner. Remove the special tool.

Apply a film of clean, thin engine oil to the bearing inserts and crankshaft rod journals. Install bearing inserts (if used bearings are reinstalled, observe the identification marks applied during removal). Make sure small tangs on each half of the inserts fit in recesses in rod and cap.

Install cap so that large slot in cap fits large tang on connecting rod and small slot in cap fits small tang on rod. Install new cap screws, coated with a film of oil. First tighten them alternately, and finally to specified torque.

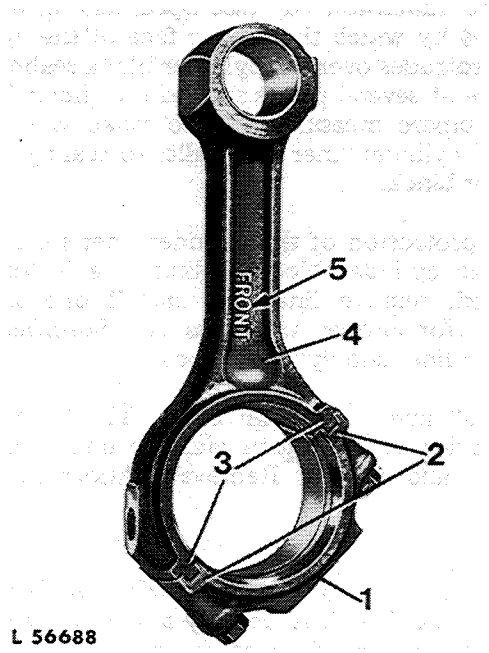


Fig. 7 — Installing Connecting Rod Caps

1 Connecting rod cap
2 Slots
3 Tangs
4 Connecting rod
5 "FRONT" mark

Rotate the crankshaft several revolutions to make sure there is no binding of parts or unusual resistance.

Install oil pan and cylinder head. Fill crankcase with oil of proper viscosity. Fill cooling system with clean soft water or with antifreeze and corrosion inhibitor solution (see Operator's Manual).

## INSTALLING REPLACEMENT PISTONS

**IMPORTANT: Two types of pistons marked "B" and "H" on their top faces are available as replacement parts. To determine the piston type to use, proceed as follows:**

1. Install liners in cylinder bores.

2. Install a "B" type piston with its connecting rod and secure with cap.

3. Using a dial indicator measure protrusion of each piston (at TDC) above top face of cylinder block center line as shown by 1, fig. 8).


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