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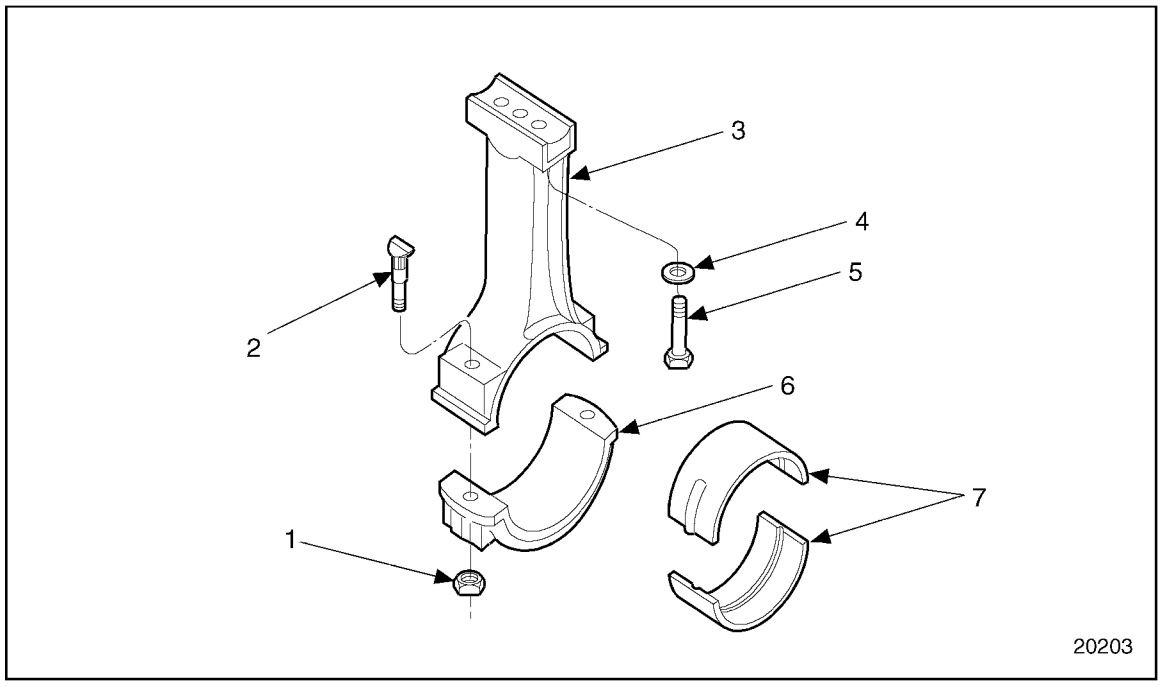
1.19 CONNECTING ROD

Two types of connecting rod are used in Series 60 engines. The open end or saddle type connecting rod is used with cast iron pistons which have bolt-on, style piston pins. The closed end or trunk type connecting rod is used with forged steel pistons which have floating, trunk style piston pins.

NOTICE:
Do not mix forged steel pistons used with closed end connecting rods and cast iron pistons used with open-end connecting rods in the same engine. This will cause severe engine damage.

OPEN-END CONNECTING ROD: The open-end connecting rod is forged to an "I" section with an open or saddle type contour at the upper end and a bearing cap at the lower end. The surface of the connecting rod is shot-peened for added strength. Therefore, no grinding is permitted since it will remove the benefits of shot-peening.

The upper end of the connecting rod is machined to match the contour of the piston pin. The piston pin is secured to the connecting rod with two special bolts and spacers. The lower bearing cap is secured to the connecting rod by two specially machined bolts and nuts. See Figure 1-299.



1. Connecting Rod Nut (2)
2. Notched Bolt (2)
3. Connecting Rod
4. Spacer Washer (2)
5. Piston Pin Bolt (2)
6. Connecting Rod Bearing Cap
7. Bearing Shells

Figure 1-299 Connecting Rod and Bearing Shells (Open-End Rod)

The two special bolts locate the cap relative to the upper end. The assembly is machined as a unit and must not be used in the engine with any other cap or upper end. Orientation of the cap to the upper end is identified by stamped numbers.

NOTE:
The Series 60G engine connecting rod is shorter in length and identified by "Natural Gas" on the side.

The current connecting rods with smaller rod chamfers replaced the former connecting rods, effective with the following engine serial numbers: (listed in Table 1-7.)

Engine Model	Engine Serial Number
6067WK60 (11.1L)	6R184522
6067GK60 (12.7L)	6R188251

Table 1-7 New Connecting Rod Replacements

This change was made to allow installation of new, wider connecting rod bearings that provide improved oil film thickness and reduced bearing pressures.

The rod chamfers on the current connecting rods are smaller than those on the former rods. This has been done to provide proper support for the wider bearings. To conform with this change, new crankshafts with smaller fillet radii have been released. Refer to section 1.7 for information on the new crankshafts.

NOTE:
The current connecting rods, bearings, and crankshafts *must* be used together to ensure interchangeability. Former parts cannot be mixed with new parts in the same engine. The former connecting rods will continue to be available for engines built prior to the unit serial numbers as listed in Table 1-7.

The connecting rod bearing shells are precision made and are of the replaceable type. The upper bearing shell is seated in the connecting rod and a lower bearing shell is seated in the connecting rod cap. These bearings are not identical. The upper and lower bearing shells are located in the connecting rod by a tang at the parting line at one end of each bearing shell. See Figure 1-299.

The tri-metal bearing wear surfaces use a steel backing. First, an optimum composition (copper, tin and lead) lining is bonded to the steel back. A nickel barrier above the lining and the overlay serves to prevent tin migration. A soft lead overlay, 0.025 mm (0.001 in.) thick, provides run-in protection, and an initial wear surface. A flash tin plate, front and back, is for added corrosion protection and resistance during shipping and handling. These bearings are identified by the satin silver sheen of the tin when new, and a dull gray of the overlay after being in service.

The oil hole through the upper bearing shell supplies oil to the oil passage in the connecting rod, thereby providing a supply of lubricating oil from the crankshaft to the connecting rod bearings, piston-pin bushing, and underside of the piston dome. The upper shell is grooved from one edge to the oil hole. The lower shell has a full-length (180 degree) groove. See Figure 1-300.

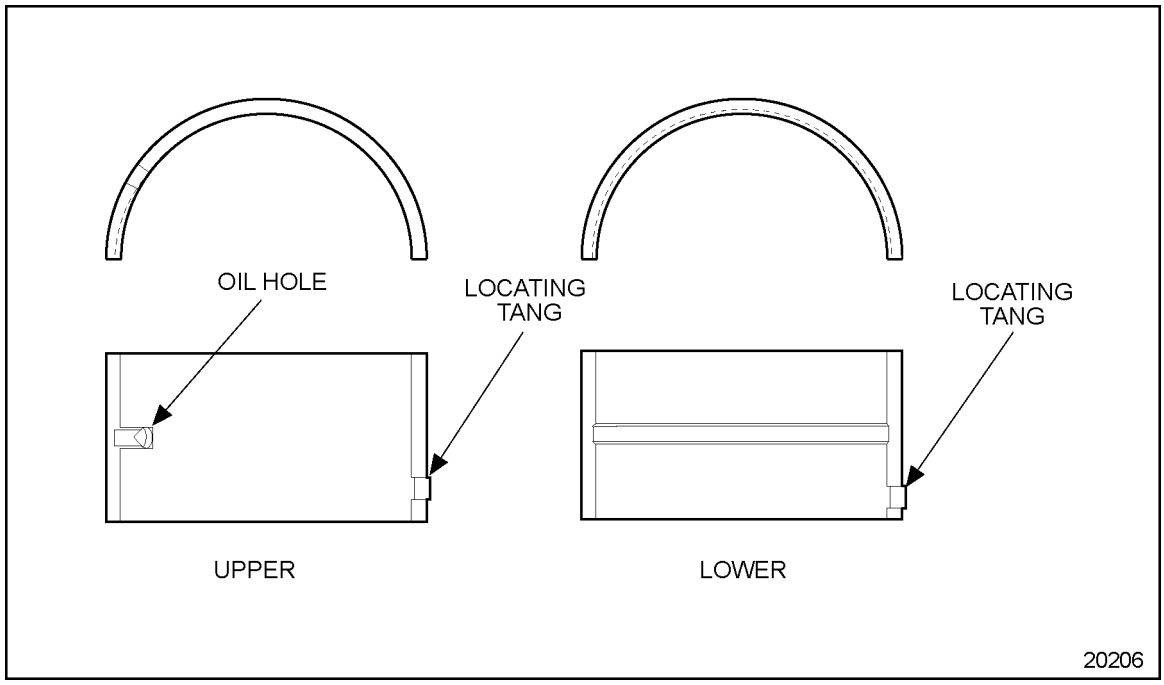


Figure 1-300 Connecting Rod Bearing Detail (Open-End Rod)

The connecting rods bearing caps are numbered according to the cylinder position with matching numbers stamped on the connecting rod tang side.

The current, wider connecting rod bearings replaced the former connecting rod bearings as listed in Table 1-24.

This change was made to improve oil film thickness and reduce bearing pressures. The current bearings are 47.44-47.14 mm (1.868-1.856 in.) wide. The former bearings were 43.44-43.13 mm (1.710-1.698 in.) wide. To provide full support for the wider bearings, new connecting rods with smaller rod chamfers and current crankshafts with smaller fillet radii were also released. Refer to section 1.7 for information on the current crankshafts.

NOTE:
The current connecting rod bearings, connecting rods, and crankshafts *must* be used together to ensure interchangeability. Former parts cannot be mixed with new parts in the same engine. The former bearing shells will be available for engines built prior to the unit serial numbers as listed in Table 1-7.

CLOSED-END CONNECTING ROD: Each connecting rod is forged to an "I" section with a closed hub at the upper end and a bearing cap at the lower end. See Figure 1-302. Unlike the open-end connecting rod, the closed end rod is not drilled prior to model year 2000. Lubrication for the piston and piston pin is supplied by a spray nozzle bolted to the block at the base of each cylinder bore. (Current blocks are drilled and tapped for installation of the cooling nozzles into the main oil gallery.) These nozzles spray crankcase oil upwards onto the piston and piston pin during engine operation, providing the required lubrication and cooling.

NOTE:
The current connecting rod for 14 L engines and model year 2000 12.7 L engines use a drilled passage way through the rod to lubricate the piston pin bushing. These connecting rods can be mixed within an engine with the former non-drilled connecting rod. See Figure 1-301.

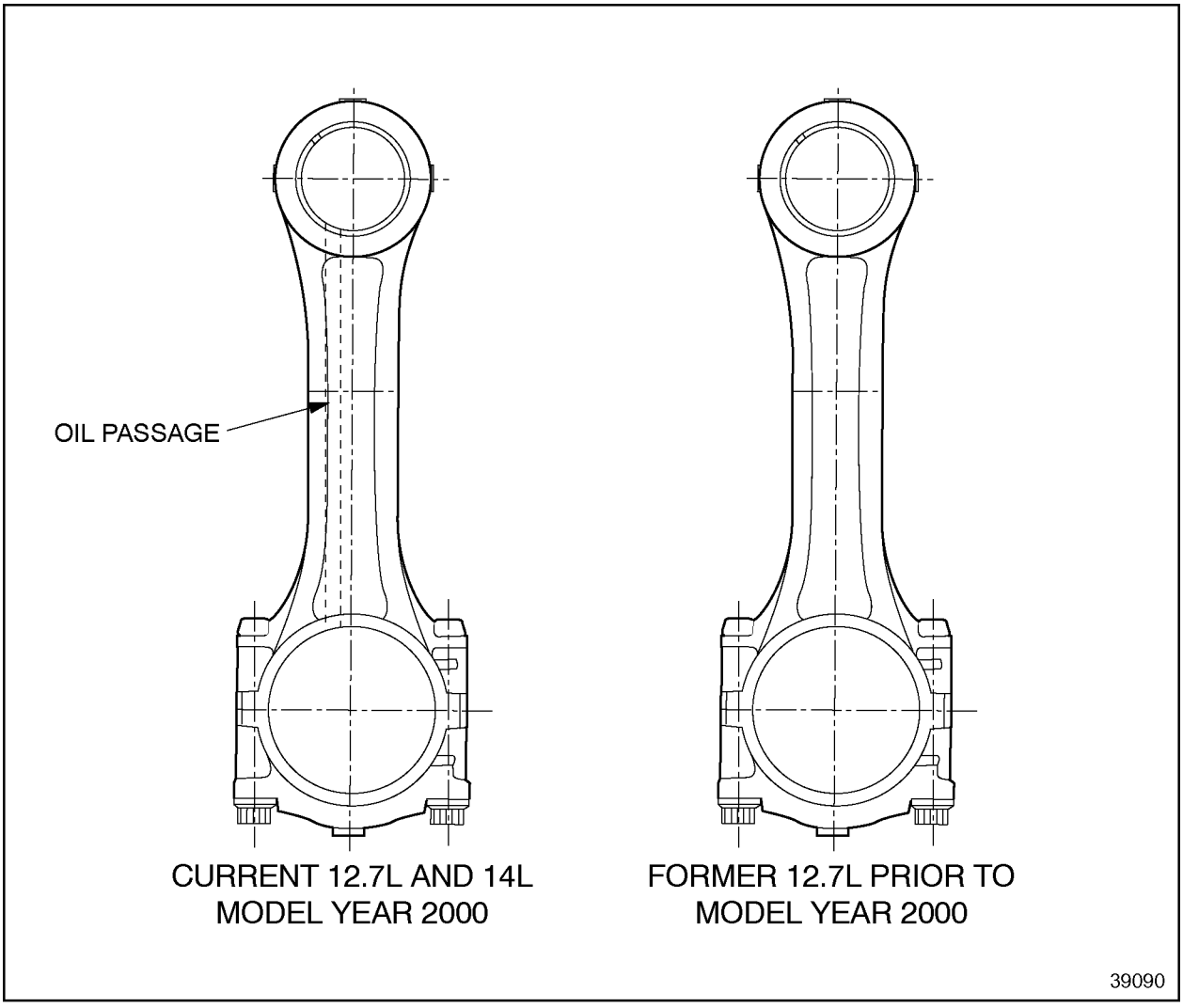
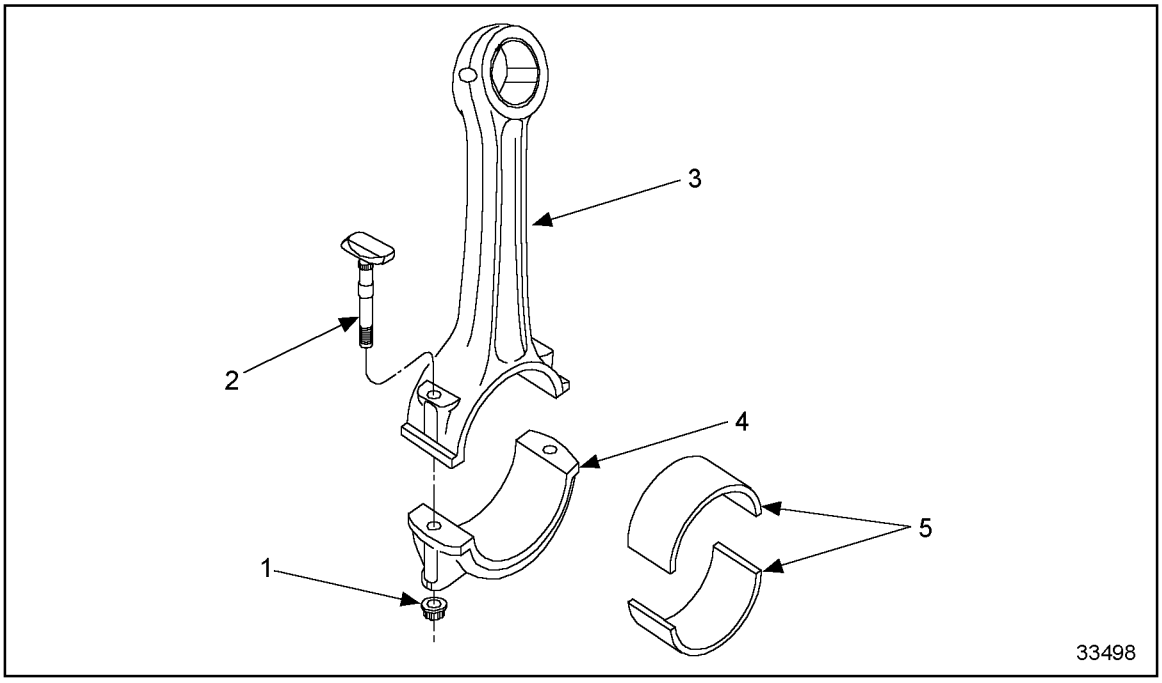


Figure 1-301 Current and Former Closed-End Connecting Rods



1. Connecting Rod Nut (2)
2. Notched Bolt (2)
3. Connecting Rod
4. Connecting Rod Bearing Cap
5. Bearing Shells

Figure 1-302 Connecting Rod and Bearing Shells (Closed-end Rod)

The upper end of the rod has a pressed-in, machined bushing with two scallops, 180 degrees apart. Spray oil entering these scallops lubricates the piston pin and bushing during engine operation. The piston pin floats in the bushings of both the piston and the connecting rod.

The lower bearing cap is secured to the connecting rod by two specially machined bolts and nuts. See Figure 1-302.

The two special bolts locate the cap relative to the upper end. The assembly is machined as a unit and must not be used in the engine with any other cap or upper end. Orientation of the cap to the upper end is identified by stamped numbers.

Closed-end connecting rods prior to model year 2000 have no center-drilled lubricating oil passage. See Figure 1-303, see Figure 1-304 and see Figure 1-305.

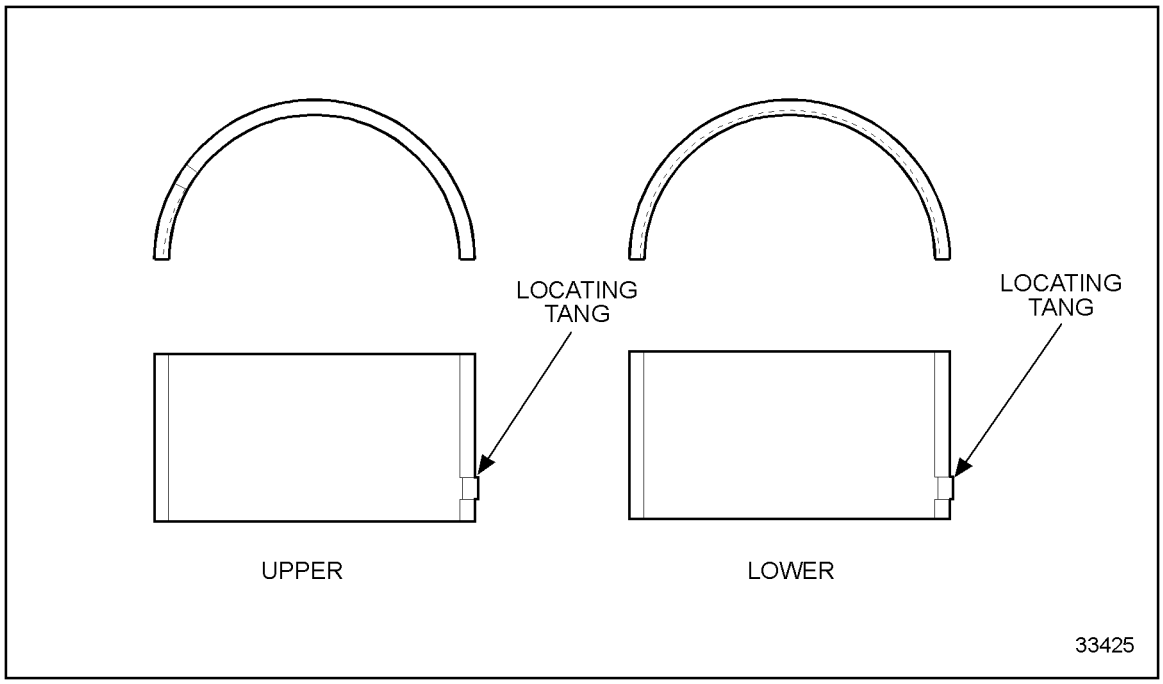


Figure 1-303 Connecting Rod Bearing Detail (Closed End Rod Without a Drilled Passage)

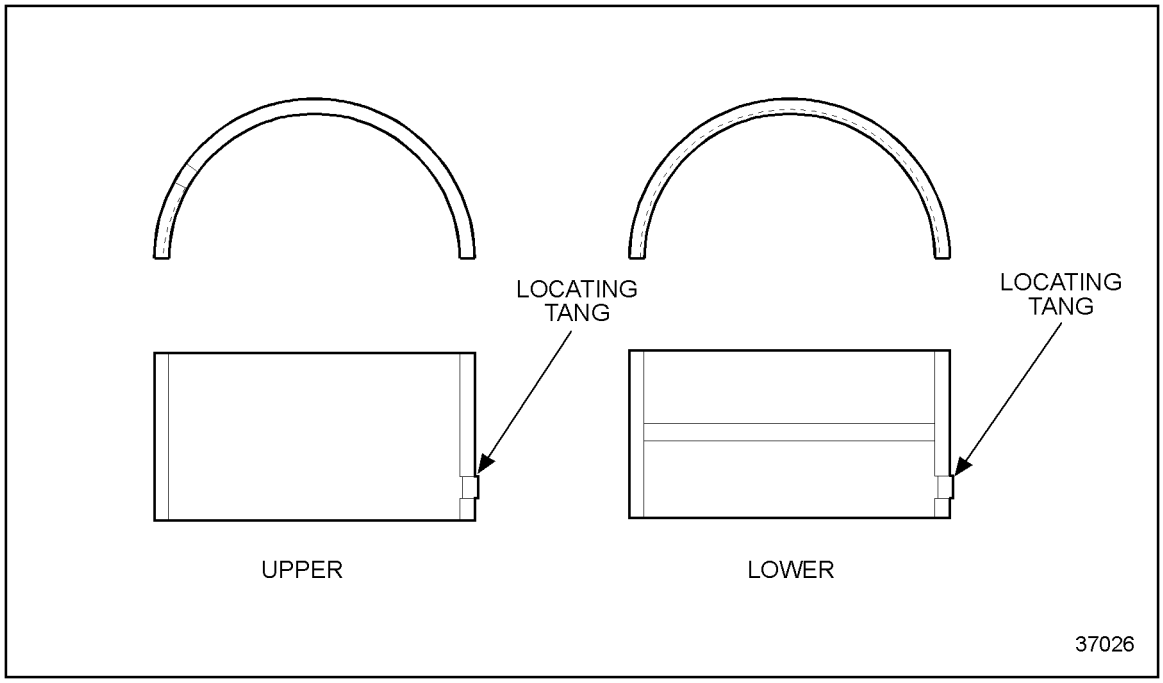


Figure 1-304 Connecting Rod Bearing Detail for Pleasure Craft Marine (Closed End Rod Without a Drilled Passage)

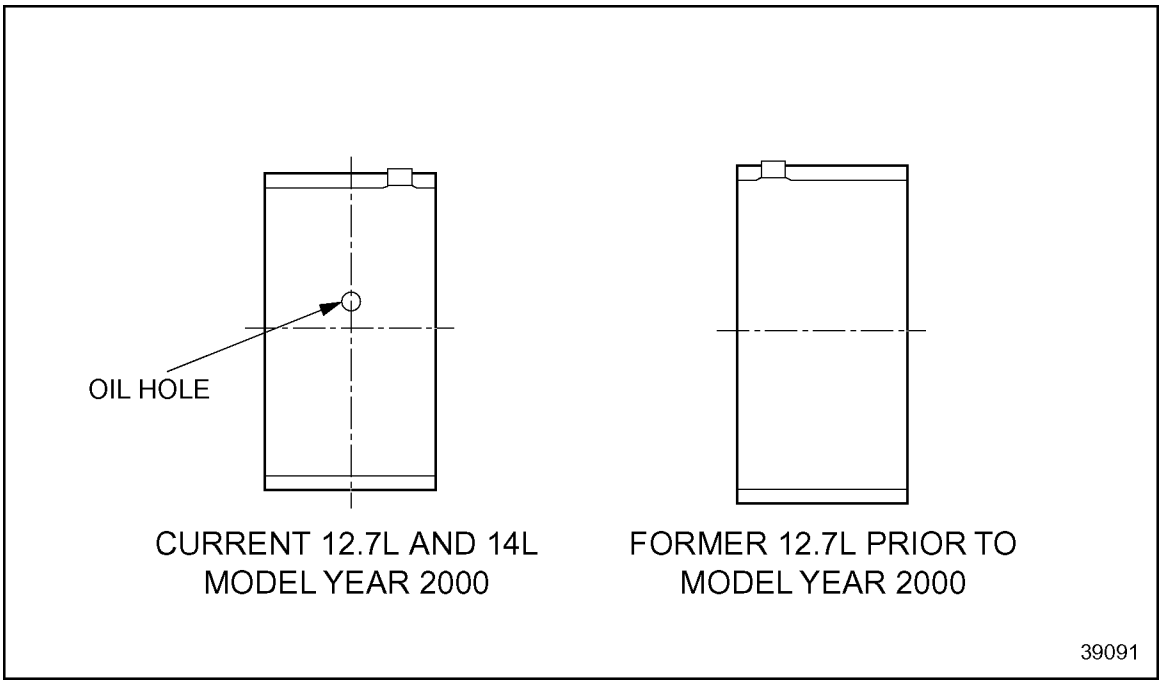


Figure 1-305 Connecting Rod Bearings for 14 L and 12.7 L Engines

The connecting rod bearing caps are numbered according to the cylinder position with matching numbers stamped on the connecting rod tang side.

The connecting rod bearing shells are precision made and are of the replaceable type. The upper bearing shell is seated in the connecting rod and a lower bearing shell is seated in the connecting rod cap. The upper and lower bearings are identical (except for marine applications see Figure 1-304). The upper and lower bearing shells are located in the connecting rod by a tang at the parting line at one end of each bearing shell.

The tri-metal bearing wear surfaces use a steel backing. First, an optimum composition (copper, tin and lead) lining is bonded to the steel back. A nickel barrier above the lining and the overlay serves to prevent tin migration. A soft lead overlay, 0.025 mm (0.001 in) thick, provides run-in protection, and an initial wear surface. A flash tin plate, front and back, is for added corrosion protection and resistance during shipping and handling. These bearings are identified by the satin silver sheen of the tin when new and a dull gray of the overlay after being in service.

1.19.1 Repair or Replacement of Connecting Rod

To determine if repair is possible or replacement is necessary, perform the following procedure. See Figure 1-306.

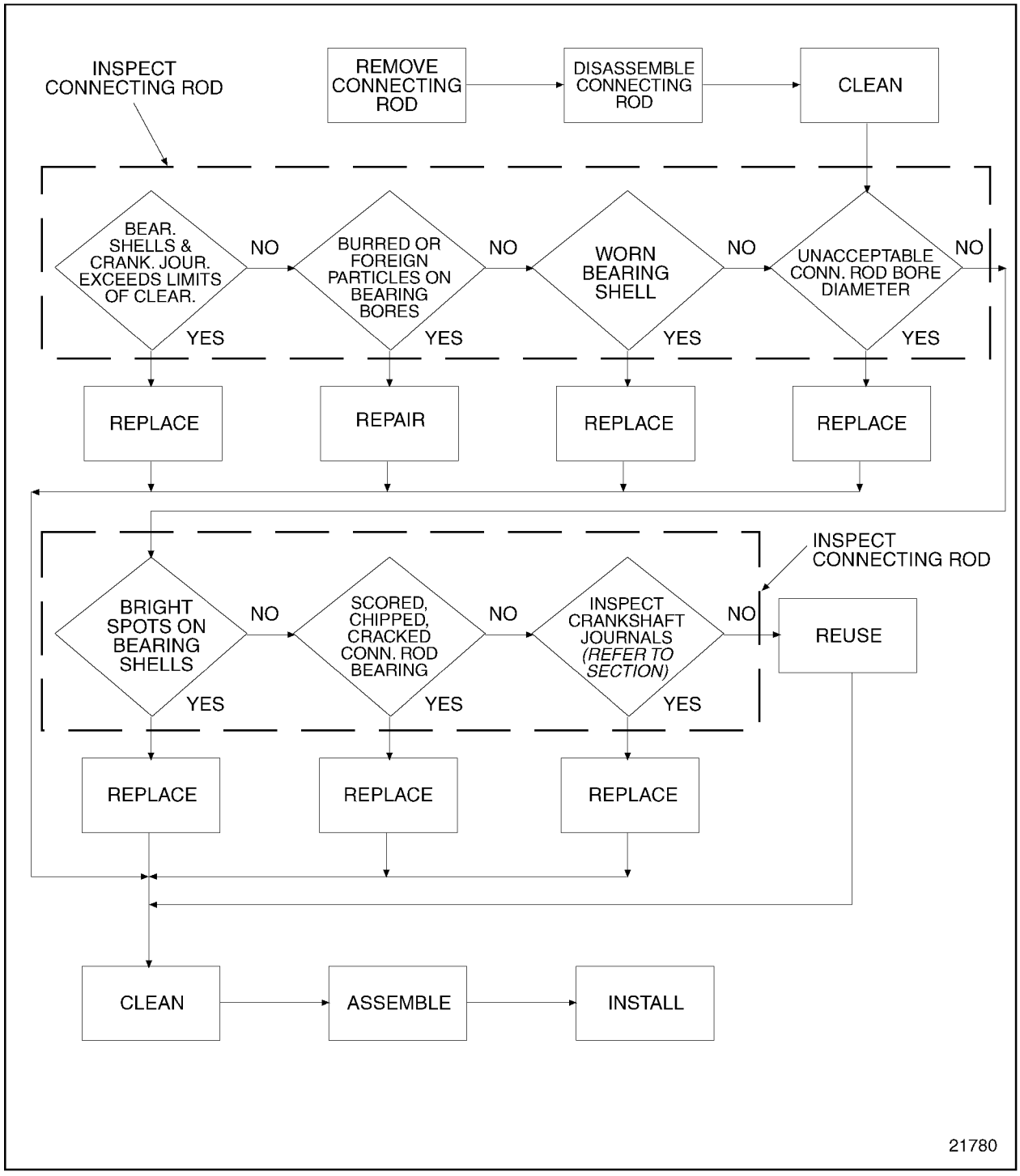


Figure 1-306 Flowchart for Repair or Replacement of Connecting Rod

1.19.2 Removal and Cleaning of the Connecting Rod

Before removal, make sure the connecting rods and caps are stamped with their correct cylinder location. If not marked, stamp location (1-6) on the tang side (cooler side) of the rod and cap.

Refer to section 1.18.2 for piston and connecting rod assembly removal procedure.

1.19.3 Disassembly of Connecting Rod

Disassemble the connecting rod as follows:

NOTE:
It is best to disassemble, inspect and assemble each connecting rod separately. It is very important to keep the connecting rod cap, and the upper and lower bearing shells to the original connecting rod.

1. Loosen and remove the two connecting rod nuts. See Figure 1-299.
2. Remove connecting rod cap and bearings shells. See Figure 1-299.

1.19.3.1 Inspection of Connecting Rod

Clean the bearings prior to inspection as follows:

1. Clean the bearings with fuel oil.

⚠ CAUTION:

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

2. Dry the bearings with compressed air.

Inspect the open-end connecting rod as follows:

1. Inspect the connecting rod saddle at the piston pin contact surface for traces of fretting and corrosion.
2. To repair, wet with fuel oil and smooth with crocus cloth.

Inspect the closed-end connecting rod as follows:

NOTICE:
Reusing a connecting rod with a damaged or loose bushing may result in severe cylinder kit damage.

1. Inspect the piston pin bushing for indications of scoring. If scoring is found, replace the rod.
2. Inspect the piston pin bushing for indications of overheating. A bushing that has overheated may become loose. If a loose bushing is found, the rod *must be replaced.*

1.19.4 Assembly of Connecting Rod

Assemble connecting rod as follows:

1. Install the connecting rod cap with the numbers on the same (oil cooler) side on the connecting rod.
2. Lubricate the bolt threads with clean engine oil.

NOTICE:
Do not over torque the connecting rod bolt nuts. Over torque may permanently distort the connecting rod cap.

NOTICE:
Be sure the connecting rod bolt has not turned in the connecting rod before torque is applied to the nut.

3. Torque the bolt nuts to 160-185 N·m (118-137 lb·ft).

1.19.4.1 Inspection of Assembled Connecting Rod

Measure the connecting rod bearing diameter at five locations. See Figure 1-307.

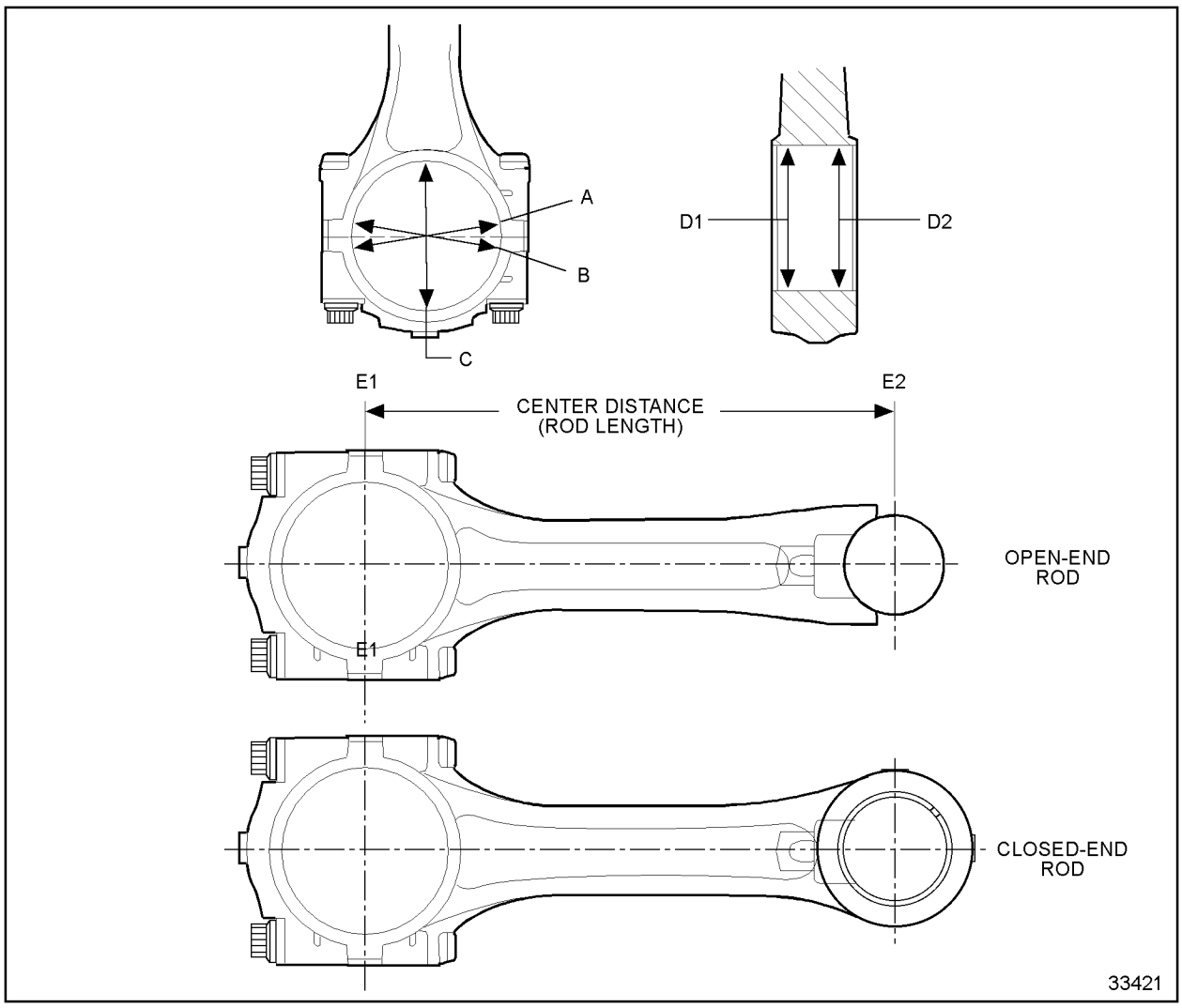


Figure 1-307 Dimensional Inspection of Connecting Rods

1. Calculate size of diameter at split line, W. [W= (A+B) ÷ 2]
2. Calculate the average bore out-of-round, X. [X=W-C] X must be between -0.012 and 0.012 mm (-0.0005 and 0.0005 in.).
3. Calculate the average connecting rod bearing bore size, Y. [Y= (W+X) ÷ 2] Y must be between:
   [a] For 12.7 and 11.1 L; 91.288 and 91.313 mm (3.594 and 3.595 in.).
   [b] For 14L and 12.7 EGR On-Highway; 101.288 and 101.3133 mm (3.988 and 3.989 in.).

4. Determine taper, Z. [Z=D2-D1] Z must be between -0.012 and 0.012 mm (-0.0005 and 0.0005 in.).
5. Determine the rod length by finding the distance between E1 and E2. See Figure 1-307.
   [a] The acceptable rod length specification for 11.1 Liter connecting is: 281.95-282.05 mm (11.1004-11.1043 in.).
   [b] The acceptable rod length specification for both 12.7 Liter and 14 Liter connecting rods is: 269.25-269.35 mm (10.6004-10.6043 in.).
   [c] The acceptable rod length specification for Series 60G Engines is: 262.90-263.00 mm (10.3504-10.3543 in.).
   [d] If the connecting rod bore is not to specifications, the rod must be scrapped and cannot be machined.
6. If a new connecting rod is required, stamp the cylinder number on the connecting rod and cap. Refer to section 1.18.3.

1.19.4.2 Inspection of Connecting Rod Bearings and Bearing Bores

Inspect the connecting rod bearing as follows:

⚠ CAUTION:

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

1. Check connecting rod bearing wear surfaces for scoring, pitting, flaking, chipping, cracking, loss of overlay, or signs of overheating.
   [a] Overlay plated bearings may develop very small cracks or small isolated cavities ("checking") on the bearing surface during engine operation. These are characteristics of and are NOT detrimental to this type of bearing. The bearings should not be replaced for these minor surface imperfections. The upper bearing shells, which carry most of the load, will normally show signs of distress before the lower bearing shells do. If the overlay is worn through to the copper across the bearing shell, all the bearing shells must be replaced.
   [b] If any of these conditions are detected, replace the bearings.

2. Inspect the backs of the connecting rod bearing shells.
   [a] Check for bright spots that indicate shells have been shifting in their bores.
   [b] If bright spots are evident, replace the bearings shells.
3. Inspect the connecting rod bearing bores, if using a service replacement connecting rod, clean rod to remove rust preventative.
   [a] Check large end bore for burrs or foreign particles. If possible use an emery cloth to smooth bore surface, otherwise replace part.

⚠ CAUTION:

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

   [b] Blow compressed air through the drilled oil passage to ensure the passage is clean of obstructions. Make sure the split line (cap to rod) is throughly clean.
   [c] On a closed end rod inspect the piston pin bearing for wear, scoring, surface defects (dents scratches) or out of round condition. Refer to section Specifications.
4. Inspect the bearings shells.
   [a] Measure the thickness of the bearing shells, using a micrometer and ball attachment, J 4757. Refer to section 1.9.2.2. The minimum thickness of a worn standard connecting rod bearing shell should not be less than 3.086 mm (0.1215 in.).
   [b] If either bearing shell is thinner than this dimension, replace both bearing shells.
5. Inspect the bearing shells and the crankshaft journals.
   [a] Check the clearance between the connecting rod bearing shells and the crankshaft journals using a soft plastic measuring strip which is squeezed between the journal and the bearing. Refer to section 1.A, "Checking Bearing Clearances" in "Shop Notes" section.

[b] If the connecting rod bearing-to-journal clearance exceeds 0.152 mm (0.006 in.) with used parts, replace with a new bearing.

NOTE:
The current bearing shells for 14 L engines and 12.7 L engines for model year 2000 have an oil hole in them to allow oil to flow into the connecting rod.See Figure 1-308

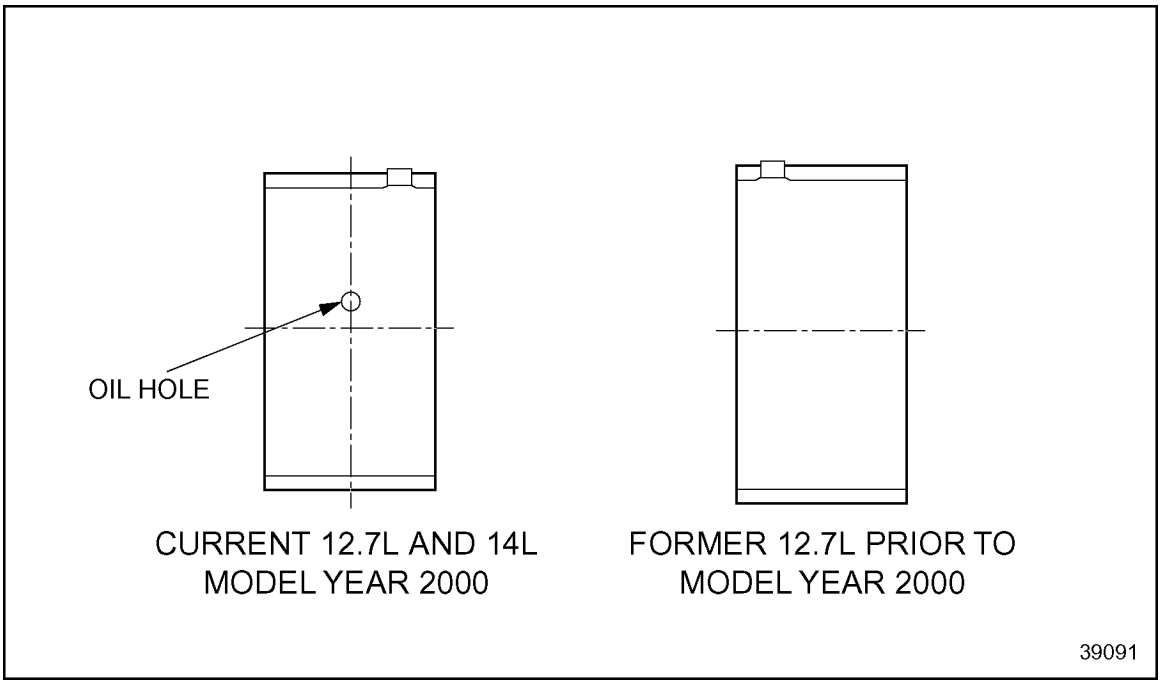


Figure 1-308 Connecting Rod Bearings for 14 L and 12.7 L Engines

NOTE:
Before installing the bearings, inspect the crankshaft journals. Refer to section 1.7.2.4. Do NOT replace one connecting rod bearing shell alone. If one bearing shell requires replacement, install both new upper and lower bearing shells. Also, if a new or reground crankshaft is to be used, install all new bearing shells.

NOTE:
Bearing shells are NOT reworkable from one undersize to another under any circumstances.

Bearing shells are available in 0.254, 0.508 and 0.762 mm (approximately 0.010, 0.020, and 0.030 in.) undersize for service with reground crankshafts. The bearing size specifications are listed in Table 1-24.

1.19.5 Installation of Connecting Rod

Refer to section 1.18.5 to install the piston and connecting rod assembly.

