

Illustration 148

g01311809

4. Place the piston on a suitable surface with the crown upward. Use Tooling (B) in order to remove compression rings (5) and (6), and oil control ring (7) from piston (2).

Note: Identify the orientation of the piston rings for installation.

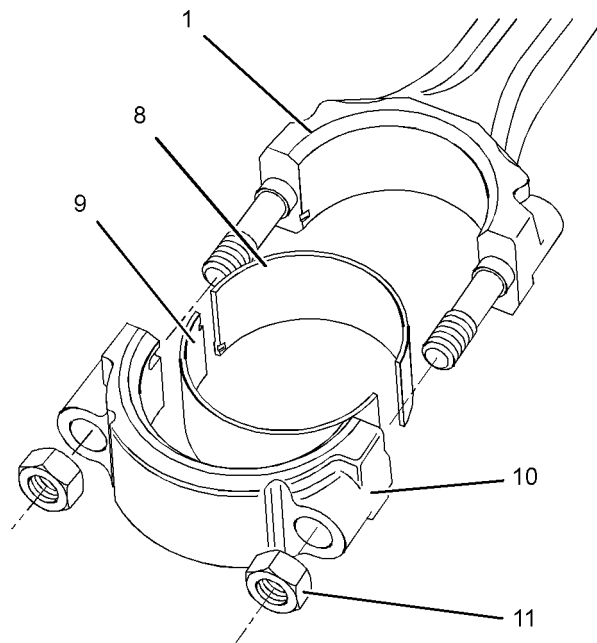


Illustration 149

g01311837

Typical example

5. Remove nuts (11) and connecting rod cap (10) from connecting rod (1).
6. Remove the lower half of connecting rod bearing (9) from connecting rod cap (10). Remove the upper half of connecting rod bearing (8) from connecting rod (1). Keep the bearing shells together.

NOTICE

Removal of the piston pin bushing in the connecting rod must be carried out by personnel with the correct training. Also special machinery is required. For more information refer to your authorized Perkins dealer.

7. Inspect the connecting rod for wear or damage. If necessary, replace the connecting rod or replace the bush for the piston pin.

i02645739

Pistons and Connecting Rods - Assemble

Assembly Procedure

Table 25

Required Tools			
Tool	Part Number	Part Description	Qty
A	-	Retaining Ring Pliers	1
B	-	Ring Expander	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Ensure that all components are clean and free from wear or damage. If necessary, replace any components that are worn or damaged.
2. Follow Steps 2.a through 2.e in order to install the piston rings to the piston.

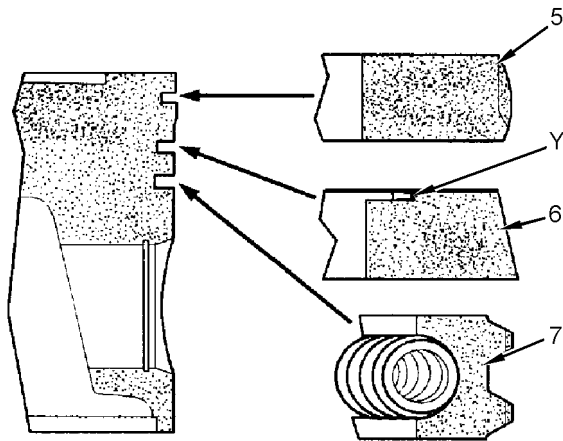


Illustration 150

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- a. Position the spring for oil control ring (7) into the oil ring groove in the piston. The central wire must be located inside the end of the spring.

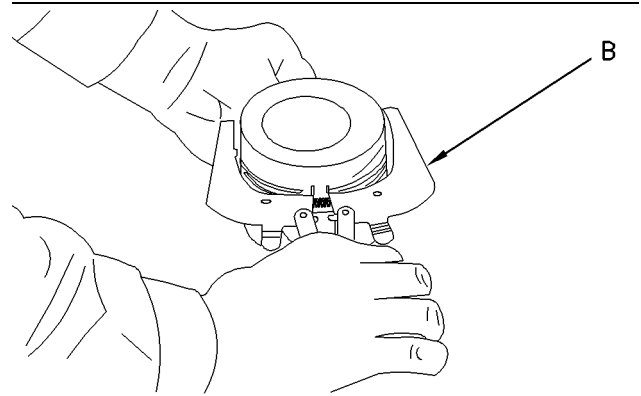


Illustration 151

g00829406

Typical example

- b. Use Tooling (B) to install oil control ring (7) over the spring.

Note: Ensure that the central wire is 180 degrees from the ring gap.

- c. Use Tooling (B) to install intermediate compression ring (6) into the second groove in the piston. The letter "T" and the chamfer (Y) on the inner face of the ring must be upward.
- d. Use Tooling (B) to install top compression ring (5) into the top groove in the piston. The letter "T" must be upward.
- e. Position the piston ring gaps at 120 degrees away from each other.

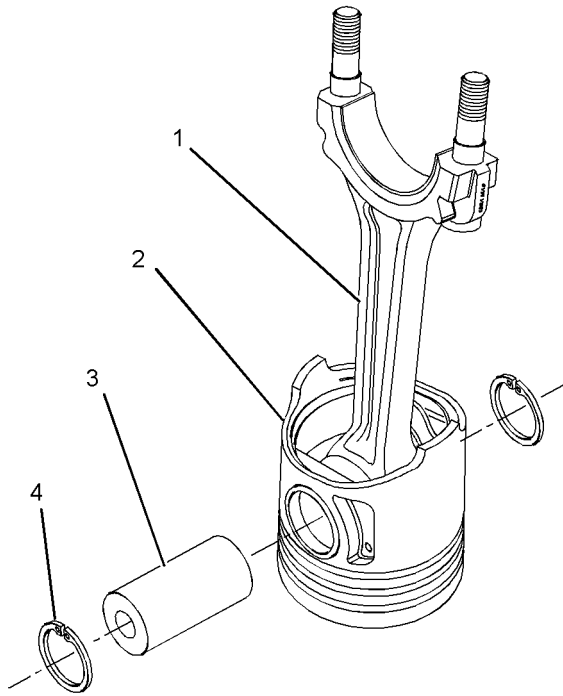


Illustration 152

g01311807

Typical example

3. Lubricate the bush in connecting rod (1) and lubricate the bore for the piston pin in piston (2) with clean engine oil.
4. Place the piston on a suitable surface with the crown downward. Install connecting rod (1) and piston pin (3) to piston (2). The name Shibaura inside the piston must align with the stamped number on the connecting rod. Ensure the correct orientation of the connecting rod in the piston.

Note: If the piston pin cannot be installed by hand, heat the piston to a temperature of $45 \pm 5 \text{ }^\circ\text{C}$ ($113 \pm 9 \text{ }^\circ\text{F}$). Do not use a torch to heat the piston.

5. Use Tooling (A) in order to install retaining rings (4) to the piston pin bore in piston (2).

Note: Ensure that the retaining rings are seated in the grooves in the piston.

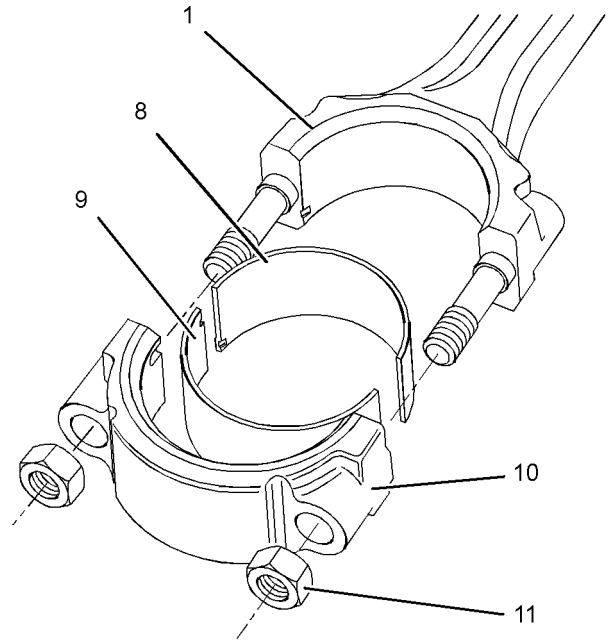


Illustration 153

g01311837

Typical example

6. Install the upper half of connecting rod bearing (8) to connecting rod (1).
7. Install the lower half of connecting rod bearing (9) to connecting rod cap (10).

End By:

- a. Install the pistons and the connecting rods. Refer to Disassembly and Assembly, "Piston and Connecting Rods - Install".

i02961862

Pistons and Connecting Rods - Install

Installation Procedure

Table 26

Required Tools			
Tool	Part Number	Part Description	Qty
A	21825491	Piston Ring Compressor	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. If the connecting rod caps were temporarily installed, remove the connecting rod caps. If necessary, thoroughly clean all of the components.
2. Apply clean engine oil to the cylinder bore, to the piston rings, to the outer surface of the piston and to the connecting rod bearings.

Note: Install the connecting rod bearings dry when clearance checks are performed. Refer to Disassembly and Assembly, "Bearing Clearance - Check". Apply clean engine oil to the connecting rod bearings during final assembly.

3. Rotate the crankshaft until the crankshaft pin is at the bottom center position. Lubricate the crankshaft pin with clean engine oil.
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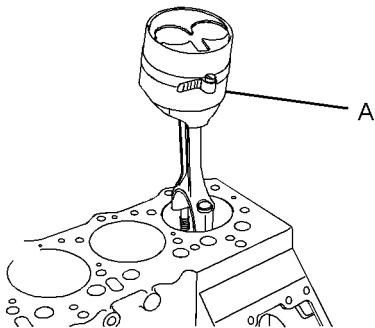


Illustration 154
Typical example

g01311916

4. Ensure that the gaps for the piston rings are at 120 degrees away from each other. Install Tooling (A) onto piston (5). Use tape or rubber tubing on the connecting rod bolts to protect the crankshaft journals.

Note: Ensure that Tooling (A) is installed correctly and that the piston can easily slide from the tool. Ensure that the piston and the connecting rod assembly are installed in the correct cylinder. Align number (X) on the side of the connecting rod to the right side of the cylinder block. The right hand side is determined from the flywheel end of the engine.

5. Carefully push the piston and the connecting rod assembly into the cylinder bore and onto the crankshaft pin.

Note: Do not damage the finished surface of the crankshaft pin.

6. Install connecting rod cap (2) onto connecting rod (4). Ensure that number (X) on the connecting rod cap matches number (X) on the connecting rod. Install nuts (1).

For 402D-05 and 403D-07 engines, tighten nuts (1) to a torque of 23 N·m (16 lb ft).

For 403D-11 and 404D-15 engines, tighten nuts (1) to a torque of 32 N·m (24 lb ft).

For 403D-15, 403D-15T, 403D-17, 404D-22, 404D-22T and 404D-22TA engines, tighten nuts (1) to a torque of 52 N·m (38 lb ft).

7. Repeat Steps 1 through 6 for the remaining pistons and connecting rods.
8. Ensure that the installed connecting rod assembly has tactile side play. Carefully rotate the crankshaft in order to ensure that there is no binding.

End By:

- a. Install the suction pipe. Refer to Disassembly and Assembly, "Engine Oil Pump - Install".
- b. Install the cylinder head. Refer to Disassembly and Assembly, "Cylinder Head - Install".

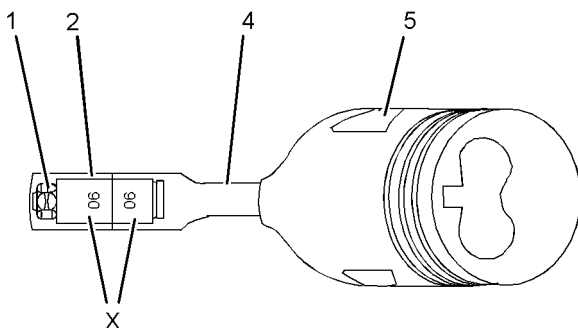


Illustration 155
Typical example

g01311924

i02645659

Connecting Rod Bearings - Remove (Connecting rods in position)

Removal Procedure

Start By:

- a. Remove the suction pipe. Refer to Disassembly and Assembly, "Engine Oil Pump - Remove".

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: If all connecting rod bearings require replacement on a four cylinder engine, the procedure can be carried out on two cylinders at the same time. The procedure can be carried out on the following pairs of cylinders. 1 with 4 and 2 with 3. **Ensure that both pairs of the connecting rod bearings are installed before changing from one pair of cylinders to another pair of cylinders..** Refer to Disassembly and Assembly, "Connecting Rod Bearings - Install".

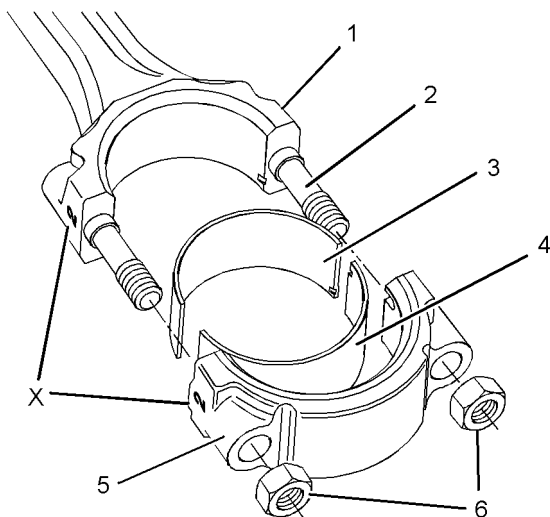


Illustration 156

g01317759

Typical example

Note: The connecting rod and the connecting rod cap should have matching numbers at position (X). If necessary, make a temporary mark on connecting rod (1) and on connecting rod cap (5).

1. Rotate the crankshaft until the piston is at the bottom center position. Remove nuts (6) and remove connecting rod cap (5) from connecting rod (1).
2. Remove lower connecting rod bearing (4) from connecting rod cap (5).
3. Carefully push connecting rod (1) into the cylinder bore. Remove upper connecting rod bearing (3) from the connecting rod.

Note: Use tape or rubber tubing on connecting rod bolts (2) in order to protect the crankshaft journals. The sharp edges of the connecting rod bolts could damage the crankshaft journals.

i02961864

Connecting Rod Bearings - Install (Connecting rods in position)

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Inspect the pins of the crankshaft for damage. If the crankshaft is damaged, replace the crankshaft or recondition the crankshaft. Refer to Disassembly and Assembly, "Crankshaft - Remove" and Disassembly and Assembly, "Crankshaft - Install". Ensure that the connecting rod bearings are clean and free from wear or damage. If necessary, replace the connecting rod bearings.

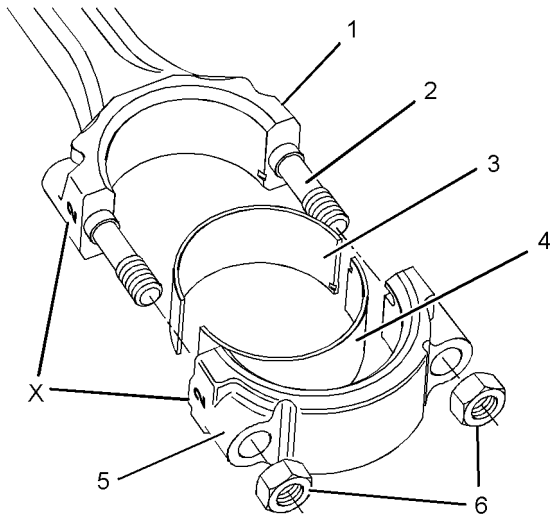


Illustration 157
Typical example

g01317759

2. Clean the bearing surface of connecting rod (1) and connecting rod cap (5). Ensure that number (X) on connecting rod cap (5) aligns with number (X) on connecting rod (1).
3. Install upper connecting rod bearing (3) to connecting rod (1). Lubricate the bearing surface of the connecting rod bearing with clean engine oil.

4. Carefully pull connecting rod (1) against the crankshaft pin.

Note: Use tape or rubber tubing on connecting rod bolts (2) in order to protect the crankshaft journals. The sharp edges of the connecting rod bolts could damage the crankshaft journals.

5. Clean the connecting rod cap. Install lower connecting rod bearing (4) to connecting rod cap (5).
6. Lubricate the pin of the crankshaft and lubricate lower connecting rod bearing (3) with clean engine oil.

NOTICE

When the connecting rod caps are installed, ensure that the identification marks are aligned.

7. Install connecting rod cap (5).
8. Install nuts (4).

For 402D-05 and 403D-07 engines, tighten nuts (4) to a torque of 23 N·m (16 lb ft).

For 403D-11 and 404D-15 engines, tighten nuts (4) to a torque of 32 N·m (24 lb ft).

For 403D-15, 403D-15T, 403D-17, 404D-22, 404D-22T and 404D-22TA engines, tighten nuts (4) to a torque of 52 N·m (38 lb ft).

9. Ensure that the installed connecting rod assembly has tactile side play. Carefully rotate the crankshaft in order to ensure that there is no binding.

Note: If all connecting rod bearings require replacement on a four cylinder engine, the procedure can be carried out on two cylinders at the same time. The procedure can be carried out on the following pairs of cylinders. 1 with 4 and 2 with 3. **Ensure that both pairs of the connecting rod bearings are installed before changing from one pair of cylinders to another pair of cylinders.** Refer to Disassembly and Assembly, "Connecting Rod Bearings - Remove" for more information.

End By:

- a. Install the suction pipe. Refer to Disassembly and Assembly, "Engine Oil Pump - Install".

i02186171

Connecting Rod Bearings - Install

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

When the connecting rod caps are installed, ensure that the identification marks are aligned.

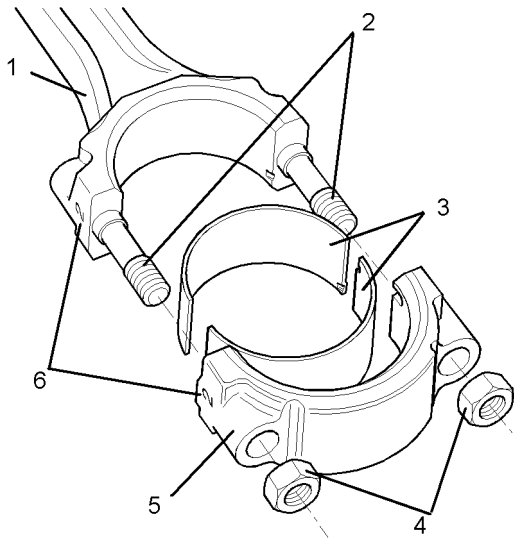


Illustration 158

g01111763

Typical example

1. Check the clearance between the connecting rod bearing and the connecting rod bearing journal of the crankshaft. Install the connecting rod bearings dry when the clearance checks are made. Refer to Disassembly and Assembly, "Bearing Clearance - Check" for information on bearing clearance checks.
2. Clean the bearing surface of the connecting rod (1) and the connecting rod cap (5). Ensure that the number (6) on the connecting rod cap (5) aligns with the number (6) on the connecting rod (1).
3. Clean the upper connecting rod bearing (3) and lubricate the bearing face with clean engine oil.
4. Clean the lower connecting rod bearing (3) and lubricate the bearing face with clean engine oil.

Note: Align the tabs on the back of the connecting rod bearings (3) with the tab grooves in the connecting rod (1) and the tab grooves on the connecting rod cap (5).

5. Install the upper connecting rod bearing (3) to the connecting rod (1).
6. Position the connecting rod (1) against the crankshaft.
7. Install the lower connecting rod bearing (3) in the connecting rod cap (5).
8. Install the connecting rod cap (5) in position on the connecting rod (1) and install the nuts (4) to the connecting rod bolts (2). Refer to Disassembly and Assembly, "Pistons and Connecting Rods - Install" for the correct torque of the connecting rod nuts (4).

Note: The identification marks must face the right hand side of the engine for the correct installation.

9. Repeat Steps 2 through 8 for the installation of the remaining connecting rod bearings.

End By:

- a. Install the oil supply tube. Refer to Disassembly and Assembly, "Crankshaft - Install".
- b. Install the engine oil pan. Refer to Disassembly and Assembly, "Engine Oil Pan - Remove and Install".

i02645668

Crankshaft Main Bearings - Remove

Removal Procedure

Start By:

- a. Remove the crankshaft assembly. Refer to Disassembly and Assembly, "Crankshaft - Remove".

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Crankshaft Main Bearings

1. Ensure that the bearing caps are marked for orientation and the correct position.