Service Information Bulletin

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SUBJECT: PISTON AND CONNECTING ROD ASSEMBLY

ADDITIONS, REVISIONS, OR UPDATES

<table>
<thead>
<tr>
<th>Publication Number</th>
<th>Platform</th>
<th>Section Title</th>
<th>Change</th>
<th>Page Number(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDC-SVC-MAN-0050</td>
<td>DD13 Workshop Manual</td>
<td>1.15 Piston and Connecting Rod Assembly</td>
<td>The Piston and Connecting Rod Assembly procedure has been revised.</td>
<td>1–98</td>
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</tbody>
</table>

NOTE: Page numbers are based on the most recent version of the individual publication and may be adjusted throughout the annual print cycle.

Table 1
PISTON AND CONNECTING ROD ASSEMBLY

The connecting rods are forged from a high strength powdered steel. A connecting rod bushing is pressed into the connecting rod eye.

Figure 1  Piston and Connecting Rod Assembly
Each piston has a fire ring (6), compression ring (7), and an oil control ring (8).

1. Piston
2. Piston Bowl
3. Piston Dome
4. Top Land
5. Second Land
6. Fire Ring
7. Compression Ring
8. Oil Control Ring
9. Piston Boss
10. Piston Skirt
11. Cover Plate
12. Retaining Ring
13. Piston Pin
14. Cooling Galley

**Figure 2** Piston
REMOVAL AND CLEANING OF PISTON AND CONNECTING ROD ASSEMBLY

Remove the piston and connecting rod assembly as follows:

1. Shut off the engine, apply the parking brake, chock the wheels, and perform any other applicable safety steps.
2. Drain the engine cooling system.
3. Drain the engine oil.
4. Remove the oil pan.
5. Remove the camshaft housing.
6. Remove the cylinder head and gasket.
7. Use Scotch Brite pads to remove any carbon deposits from the upper surface of the cylinder liner.
8. Remove the piston spray nozzles (1) from the base of the cylinder bores. Discard the nozzles.
9. Position the crankshaft for the piston and connecting rod assembly to be removed at bottom dead center.
10. Remove the bearing cap and lower bearing shell from the connecting rod.

<table>
<thead>
<tr>
<th>NOTICE</th>
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<tbody>
<tr>
<td>The connecting rod assembly is a cracked rod design. Ensure when the bearing cap is removed that it is placed on its side. Damage to the bearing cap will occur if it is placed on end; the connecting rod assembly will need to be replaced if the cap is damaged.</td>
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</tbody>
</table>

11. Remove the piston and connecting rod assembly through the top of the cylinder liner.
12. Assemble the connecting rod bearing cap and lower bearing shell to the connecting rod after removal. If not already marked, match-mark the rod and cap (on the tang side) with the cylinder number from where they were removed.
NOTE:
When removed, the bearing cap and the bearing shell must be reinstalled on the original connecting rod before another connecting rod bearing cap is removed.

DISASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY
Piston assembly components should be segregated by cylinder and match-marked during disassembly to ensure they are assembled in the same position and orientation.

<table>
<thead>
<tr>
<th>NOTICE:</th>
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<tr>
<td>Stamping cylinder numbers on the piston assembly will damage the components.</td>
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</table>

Disassemble piston and connecting rod assembly as follows:

1. Place the piston, dome down, on the table.
2. Using the required snap ring pliers, remove the retaining rings from the piston boss.
3. Slide out the piston pin and remove the connecting rod from piston assembly.

INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLY
Inspect as follows:

1. Inspect the connecting rod and bearing cap for damage; replace as necessary.
2. Inspect the piston, pin and rings for damage; replace as necessary.

ASSEMBLY OF PISTON AND CONNECTING ROD ASSEMBLY
Assemble as follows:

1. Using the required snap ring pliers, install one of the retaining rings into a recess in the piston. Orient the snap ring gap (1) to either the 12 o'clock or 6 o'clock position.
2. Liberally lubricate the piston pin bore bushings, the piston pin, and the bushings in the small end of the connecting rod with 80/90w oil (or equivalent).

3. Position the long end of the connecting rod (2) on the same side as the valve relief (1) in the top of the piston.

4. Install piston pin into the pin bores through the rod until it rests against the previously installed snap ring.

5. Using the required snap ring pliers, install the other retaining ring into the recess in the piston to lock the pin in place. Orient the snap ring gap to either the 12 o'clock or 6 o'clock position.

**INSTALLATION OF PISTON AND CONNECTING ROD ASSEMBLY**

1. If the rings have been removed, install them into the grooves of the piston and rotate 120° apart.

2. Allowable new piston ring end gaps for (A), (B) and (C) are listed in the table below.

<table>
<thead>
<tr>
<th>Ring</th>
<th>DD13 Ring End Gap</th>
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<tbody>
<tr>
<td>(A) Fire Ring</td>
<td>.45 - .55 mm (0.01772 - 0.02165 in.)</td>
</tr>
<tr>
<td>(B) Compression Ring</td>
<td>0.9 - 1.1 mm (0.03543 -0.04331 in.)</td>
</tr>
<tr>
<td>(C) Oil Control Ring</td>
<td>0.3 - 0.5 mm (0.01181 - 0.01969 in.)</td>
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</tbody>
</table>
3. Add clean engine oil to a clean pan at least 305 mm (12 in.) in diameter, until the level reaches approximately 76 mm (3 in.).

4. Place the piston and connecting rod assembly into pan, with the dome of the piston on the bottom of the pan.

5. Coat the upper connecting rod bearing shell with clean engine oil.

6. Coat the piston liberally with the engine oil, saturating the piston rings and ring lands.

7. Coat the inside diameter of the piston installer/ring compressor tool (W470589005900) with clean engine oil.

8. Clamp W470589005900 around the piston rings.

9. Once the ring compressor is "clamped," ensure the piston can rotate freely. If rotation is hindered, remove the compressor and reposition the piston and rings, or inspect for ring damage.

10. Lubricate the inside of the cylinder liner with oil.

11. Position the throw of the crankshaft journal to bottom dead center for the cylinder being installed with the piston and connecting rod assembly.

12. Ensure the valve relief located on the top of the piston is orientated towards the exhaust side of the engine during installation and the rod has the serial number printing towards the exhaust side of the engine.

13. Align the ring compressor and piston on top of the cylinder block.

**NOTICE:**

Failure to remove the oil nozzle from the engine block could result in damage to the oil nozzle during installation of the piston and rod assembly. A damaged, bent or loosened nozzle may cause a loss of main gallery pressure. In these cases piston overheating or lack of adequate lubrication may result in severe engine damage.
14. With care and moderate pressure, press the piston into the liner.

15. Remove the ring compressor.

16. Push or tap the piston and connecting rod within the liner until the upper rod bearing is firmly seated on the appropriate crankshaft journal.

17. Lubricate the lower bearing shell with clean engine oil.

18. Install the bearing cap. The number on the cap and rod must be on the same side.

19. Torque the connecting rod bolts alternately to 100 N·m + 90° + 90° torque turn.

20. Check connecting rod side clearance by moving the rod from side to side on the crank journal. If there is no clearance, check for proper bearing cap installation.

21. Install the remaining piston and rod assemblies in the same manner.

22. Install new piston spray nozzles (1) at the base of the cylinder bores. Torque each piston spray nozzle bolt to 30 N·m (22 lb·ft).

23. Using a dial gauge and holder, measure the piston protrusion at top dead center relative to cylinder block deck.
24. Allowable piston protrusion is listed in the following table:

<table>
<thead>
<tr>
<th>Allowable Piston Protrusion</th>
<th>DD13 Engine</th>
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<tbody>
<tr>
<td>Minimum</td>
<td>-0.201 mm (-0.007913 in.)</td>
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<tr>
<td>Maximum</td>
<td>0.2215 mm (0.00872 in.)</td>
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</table>

25. If piston protrusion is between -0.201 mm (-0.007913 in.) minimum and 0.2215 mm (0.00872 in.) maximum then continue to next step. If not within specification, check piston, piston pin, piston pin bushings, connecting rod and crankshaft.

26. Install a new cylinder head gasket.
27. Install the cylinder head.
28. Install the lubricating oil pump inlet pipe and screen assembly, and the lubricating oil pump.
29. Install the oil pan.
30. Complete any other engine assembly as necessary.
31. Prime engine lubrication system.

A = -0.201 mm to 0.2215 mm
    (-0.007913 to 0.00872 in.)
32. Close the drain cocks and fill the engine with the recommended coolant.

**NOTE:**
Coolant system maintenance is very important. Bleed off all the air from the system and top off.

33. Perform the following steps for verifying repairs made to the piston and connecting rod assembly:

[a] If new parts such as pistons, rings, cylinder liners or bearings were installed, operate the engine on the run-in schedule.

[b] If used parts such as pistons, rings, cylinder liners or bearings were installed, verify proper piston and connecting rod assembly installation.
ADDITIONAL SERVICE INFORMATION

Additional service information is available in *Power Service Literature.*