



Service Repair Manual

Models

163H NA Motor Grader

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Product: MOTOR GRADER

Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN5598-09

Publication Date -01/01/2013

Date Updated -25/01/2013

i00976704

Pistons and Connecting Rods - Install

SMCS - 1225-012

Installation Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	5P-3525	Piston Ring Compressor	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Rotate the crankshaft until the bearing journals are at the bottom center. The bearing journals that are at the bottom center are for the piston installation.
 2. Put clean engine oil on the crankshaft journals and on the inside of the cylinder liners. Put clean engine oil on the piston rings and the connecting rod bearings.
 3. Move the piston rings on the pistons until the ring openings are separated by approximately 120 degrees.
-



Illustration 1

g00483337

- Put the piston in the cylinder liner with the "V" mark on the piston in alignment with the "V" mark on the cylinder block. Put tool (A) in position on the cylinder block and compress the piston rings.

NOTICE

The "V" mark must be visible on the piston and the cylinder block. If the "V" mark is not visible, the piston must be installed with the relief for the valve positioned toward the pushrod opening in the cylinder block. Damage may result if the pistons are not installed properly.

- Push the piston into the cylinder liner and out of the ring compressor.

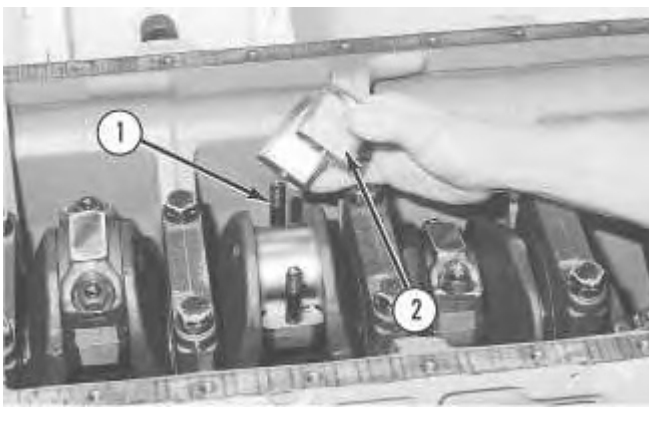


Illustration 2

g00483701

- Guide connecting rod (1) into position on the crankshaft.
- Put clean engine oil (SAE 30) on the lower half of the connecting rod bearing and on the connecting rod bolts.

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NOTICE

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

8. Install connecting rod cap (2) and the nuts that secure the connecting rod cap. Torque both of the nuts to 40 ± 4 N·m (30 ± 3 lb ft). Mark the position of the nuts. Tighten each nut for an additional 90 degrees (1/4 turn).
9. Repeat Steps 1 through 8 for the remainder of the piston and connecting rods.

End By:

- a. Install the engine oil pump. Refer to Disassembly and Assembly, "Engine Oil Pump - Install".
- b. Install the engine oil pan plate. Refer to Disassembly and Assembly, "Engine Oil Pan Plate - Remove and Install".
- c. Install the spacer plate. Refer to Disassembly and Assembly, "Spacer Plate - Remove and install".

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Product: MOTOR GRADER

Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN95598-09

Publication Date -01/01/2013

Date Updated -25/01/2013

i00987487

Connecting Rod Bearings - Remove

SMCS - 1219-011

Removal Procedure

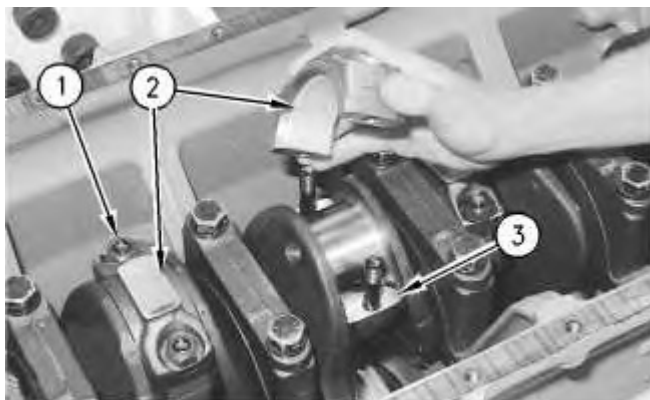
Start By:

- A. Remove the engine oil pump. Refer to Disassembly and Assembly, "Engine Oil Pump - Remove".
- B. Remove the oil pan plate. Refer to Disassembly and Assembly, "Engine Oil Pan Plate - Remove and Install".

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.



1. Turn the crankshaft until two of the pistons are at the bottom center. Remove connecting rod nuts (1) from the connecting rod. Remove connecting rod cap (2) for each connecting rod.

Note: The connecting rod bolts can fall out of the connecting rods when the connecting rod nuts are removed.

2. Remove the lower half of the connecting rod bearing from connecting rod cap (2) .
3. Carefully push the connecting rod into the cylinder liner for bearing removal. Remove the upper half of the connecting rod bearing from the connecting rod.
4. Repeat Steps 1 through 3 for the remaining connecting rod bearings.

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Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN5598-09

Publication Date -01/01/2013

Date Updated -25/01/2013

i00987670

Connecting Rod Bearings - Install

SMCS - 1219-012

Installation Procedure

Table 1

Tool	Part Number	Part Description	Qty
A	-	Plastigage	-

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: Install the connecting rod bearings dry when the clearance checks are made. Put clean engine oil on the connecting rod bearings for final assembly.

1. Install the upper half of the connecting rod bearing in the connecting rod.
2. Install the lower half of the connecting rod bearing in the connecting rod.

Note: Align the tabs on the back of the connecting rod bearings with the tab grooves in the connecting rod.

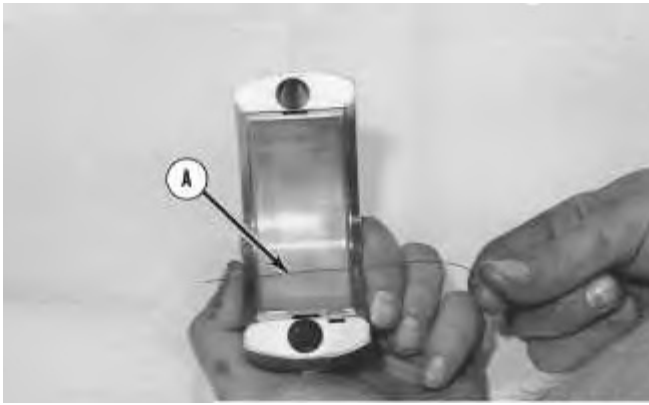


Illustration 1

g00487493

3. In order to check the connecting rod bearing clearance, put Tool (A) on the connecting rod bearing, as shown.
4. Put clean engine oil (SAE 30) on the connecting rod bolts.

NOTICE

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

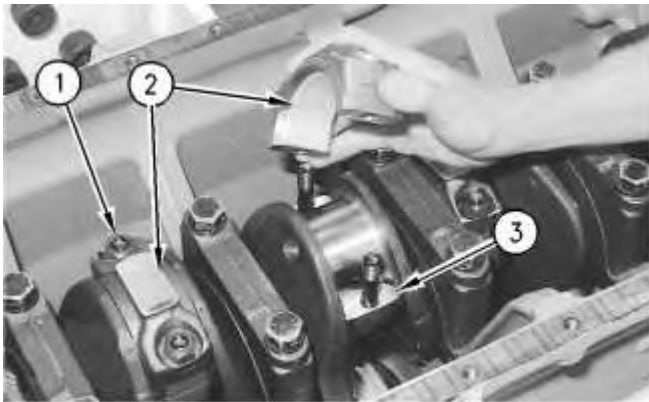


Illustration 2

g00487412

Note: Do not turn the crankshaft when Tool (A) is positioned.

5. Ensure that connecting rod (3) is in position on the crankshaft. Install connecting rod cap (2) and connecting rod nuts (1) on connecting rod (3) .
-

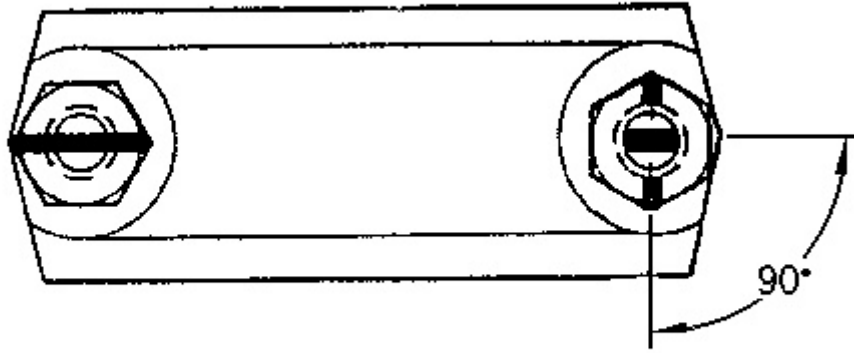


Illustration 3

g00287852

6. Tighten the connecting rod nuts to a torque of 40 ± 4 N·m (30 ± 3 lb ft). Mark the position of the nuts. Tighten each nut for an additional 90 degrees ($1/4$ turn).
7. Remove the connecting rod cap. Measure Tool (A) on the bearing surface before Tool (A) is removed. The clearance between the connecting rod bearing and a new crankshaft should be 0.076 to 0.168 mm (.0025 to .0066 inch). The clearance between the connecting rod bearing and a used crankshaft should be 0.25 mm (0.01 inch).
8. Install connecting rod cap (2) and connecting rod nuts (1) on connecting rod (3). Repeat Step 6 in order to tighten the nuts.
9. Repeat Steps 1 through 8 for the remaining connecting rod bearings.

End By:

- a. Install the oil pan plate. Refer to Disassembly and Assembly, "Engine Oil Pan Plate - Remove and Install".
- b. Install the engine oil pump. Refer to Disassembly and Assembly, "Engine Oil Pump - Install".

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Product: MOTOR GRADER

Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN5598-09

Publication Date -01/01/2013

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i00990466

Crankshaft Main Bearings - Remove

SMCS - 1203-011

Removal Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	2P-5518	Bearing Tool	1

Start By:

- A. Remove the engine oil pump. Refer to Disassembly and Assembly, "Engine Oil Pump - Remove".
- B. Remove the oil pan plate. Refer to Disassembly and Assembly, "Engine Oil Pan Plate - Remove and Install".

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

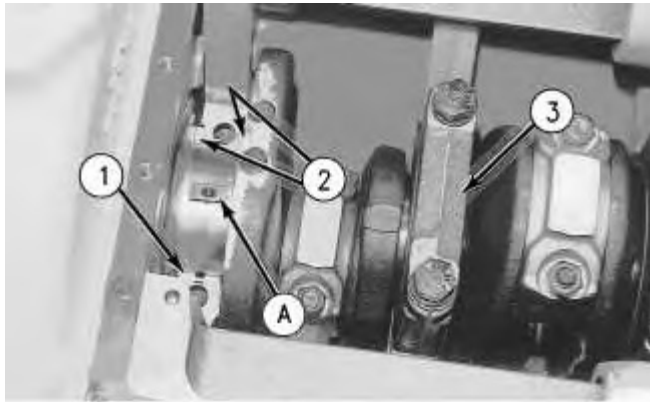


Illustration 1

g00479056

1. Remove No. 1, 3, 5 and 7 main bearing caps (3). Remove the lower halves of the main bearings from the main bearing caps.

Note: If the crankshaft is turned in the wrong direction, the tab on the bearing will be pushed between the crankshaft and the bearing area in the cylinder block. This can result in damage to the cylinder block and/or the crankshaft.

2. Install Tool (A) in the oil hole in the crankshaft journal. Turn the crankshaft in order to remove the upper halves of main bearings (1) .

3. Remove crankshaft thrust plates (2) from the crankshaft.

4. Install No. 1, 3, 5, and 7 main bearing caps (3). Refer to Disassembly and Assembly, "Crankshaft Main Bearings - Install".

5. Remove the remaining main bearing caps (No. 2, 4 and 6) (3). Remove the lower halves of the main bearings from the main bearing caps.

Note: If the crankshaft is turned in the wrong direction, the tab on the bearing will be pushed between the crankshaft and the bearing area in the cylinder block. This can result in damage to the cylinder block and/or the crankshaft.

6. Install Tool (A) in the hole in the crankshaft journal. Turn the crankshaft in order to remove the upper halves of main bearings (1) .

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Product: MOTOR GRADER

Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN5598-09

Publication Date -01/01/2013

Date Updated -25/01/2013

i03706647

Crankshaft Main Bearings - Install

SMCS - 1203-012

Installation Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	2P-5518	Bearing Tool	1
B	-	Plastigage	-
C	8T-5096	Dial Indicator Group	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: Install the main bearings dry when the clearance checks are made. Put clean engine oil on the main bearings for final assembly.

Note: Ensure that the upper halves and the lower halves of the main bearings are installed so that the bearing tabs fit into the notch in the cylinder block and in the main bearing caps.

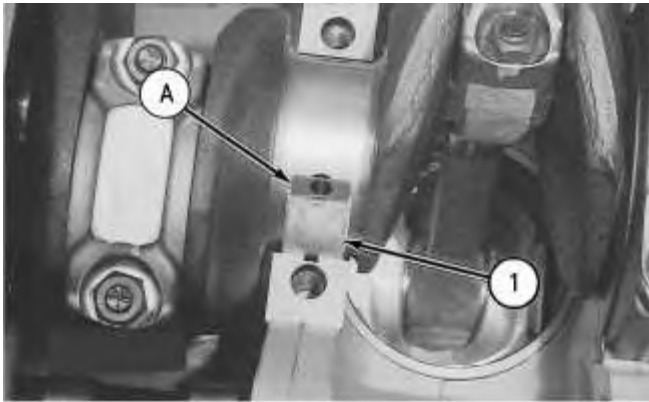


Illustration 1

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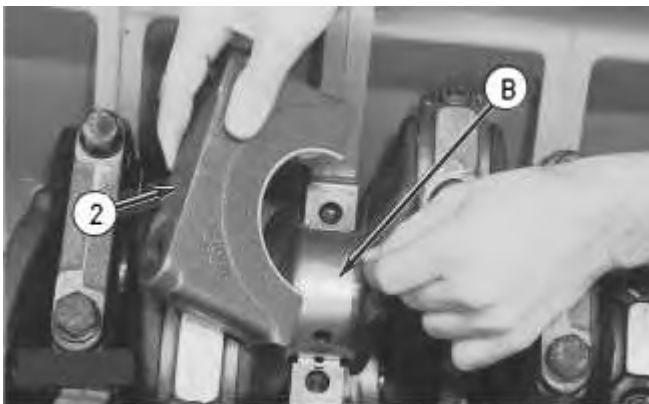


Illustration 2

g00479171

1. Use Tooling (A) and install the new upper halves of main bearings (1) in the cylinder block. Install new lower halves of main bearings (1) in main bearing caps (2) .

Note: When the bearing clearance is checked and the engine is in an upright position or on the engine's side, the crankshaft must be supported against the upper halves of the main bearings. This is done in order to get a correct measurement with Tooling (B) . If the crankshaft is not supported, the weight of the crankshaft will cause an incorrect reading. If the engine is not in an upright position or on the engine's side, it is not necessary to support the crankshaft. Do not rotate the crankshaft when Tooling (B) is positioned.

Note: Refer to Guideline For Reusable Parts, SEBV0544, "Engine Bearings and Crankshafts" for complete details concerning the measurement of bearing clearances.

2. Check the main bearing clearance with Tooling (B) , as follows:
 - a. Put a piece of Tooling (B) on the crankshaft journals, as shown.

Note: Make sure that the part number on the main bearing cap is facing toward the front of the engine. Also, make sure that the number on the main bearing cap matches the number on the cylinder block on the left side of each main bearing cap.

- b. Put main bearing caps (2) in position in the engine. Put **4C-5593** Anti-Seize Compound on the bolt threads and the face of the washers. Install the bolts and tighten the bolts to torque of 40 ± 4 N·m (30 ± 3 lb ft).
- c. Put a mark on each bolt and main bearing cap. Tighten the bolts for an additional 90 degrees (1/4 turn).
- d. Remove the main bearing caps and measure Tooling (B) in order to find the bearing clearance. The main bearing clearance for new bearings must be 0.076 to 0.165 mm (0.0030 to 0.0065 inch). The maximum permissible clearance with used bearings is 0.25 mm (0.010 inch).

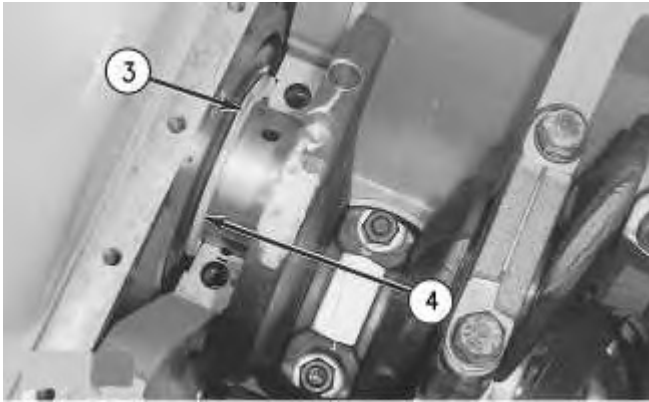


Illustration 3

g00479203

3. Put clean oil on thrust plate (4) and install a new thrust plate for the rear main bearing. Install the new thrust plate so that the mark that is identified as the "BLOCK SIDE" faces toward the cylinder block and toward the tabs on the thrust plates in the machined area on the cylinder block. Tabs (3) on thrust plate (4) will not allow the thrust plate to be installed backward.

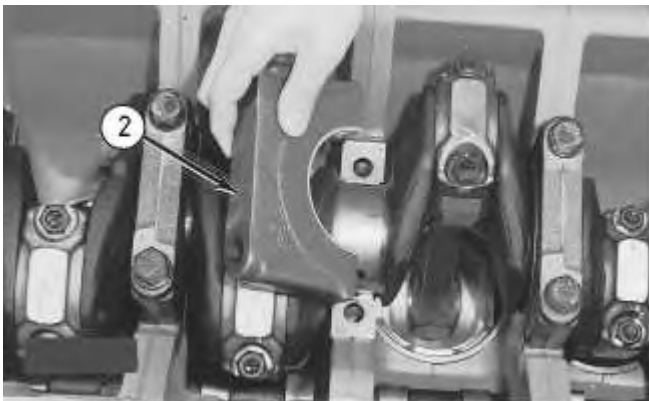


Illustration 4

g00479205

4. Install main bearing caps (2) . Use the same procedure that is described in Step 2.b and Step 2.c.
5. Remove the remainder of the main bearing caps. Perform Steps 1, 2 and 4 again.

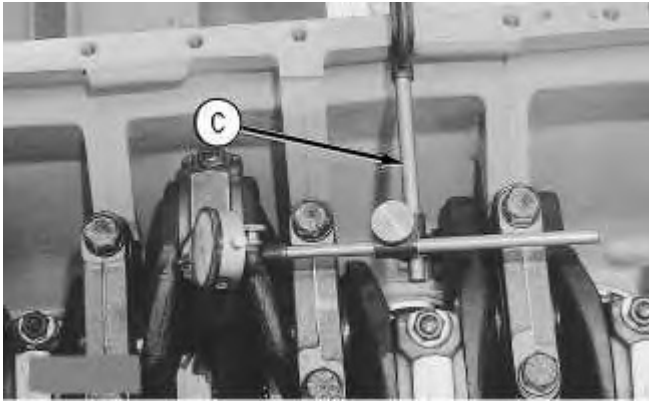


Illustration 5

g00479212

6. Use Tooling (C) in order to check the crankshaft end play. The end play is controlled by the thrust plates on the rear main bearing. End play with new bearings must be 0.122 to 0.579 mm (0.0048 to 0.0228 inch).

End By:

- a. Install the oil pan plate. Refer to Disassembly and Assembly, "Engine Oil Pan Plate - remove and install".
- b. Install the engine oil pump. Refer to Disassembly and Assembly, "Engine Oil Pump - Install".

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Product: MOTOR GRADER

Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN5598-09

Publication Date -01/01/2013

Date Updated -25/01/2013

i01112752

Crankshaft - Remove

SMCS - 1202-011

Removal Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	138-7575	Link Bracket	2
B	8B-7551	Bearing Puller	1
	8B-7549	Puller Leg	2
	3H-0465	Push-Puller Plate	4
	1B-4207	Full Nut	2
	8B-7560	Step Plate	1
	1P-0820	Hydraulic Puller	1
	9U-6600	Hand Hydraulic Pump	1

Start By:

- A. Remove the front housing. Refer to Disassembly and Assembly, "Front Housing - Remove".
 - B. Remove the flywheel housing. Refer to Disassembly and Assembly, "Flywheel Housing - Remove and Install".
 - C. Remove the engine oil pump. Refer to Disassembly and Assembly, "Engine Oil Pump - Remove".
 - D. Remove the oil pan plate. Refer to Disassembly and Assembly, "Engine Oil Pan Plate - Remove and Install".
-

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

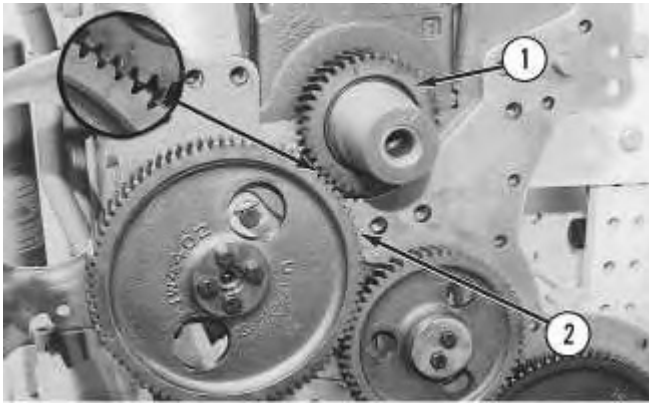


Illustration 1

g00503163

1. Turn the crankshaft until timing mark "C" on crankshaft gear (1) is aligned with timing mark "C" on camshaft gear (2) .

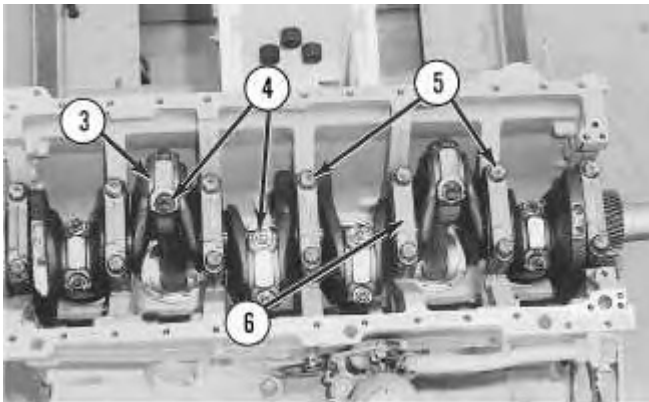


Illustration 2

g00503180

2. Remove connecting rod nuts (4) and connecting rod caps (3) from the connecting rods.
-

NOTICE

Damage may occur to the fuel injection nozzle or the piston if the piston and connecting rod are pushed too far down in the cylinder liners.

Note: The piston will be difficult to push down into the cylinder when the inlet valves and exhaust valves are closed.

3. Push down on the pistons that are not at the top center position in order to clear the crankshaft.
4. Remove main bearing cap bolts (5) and main bearing caps (6) from the cylinder block.

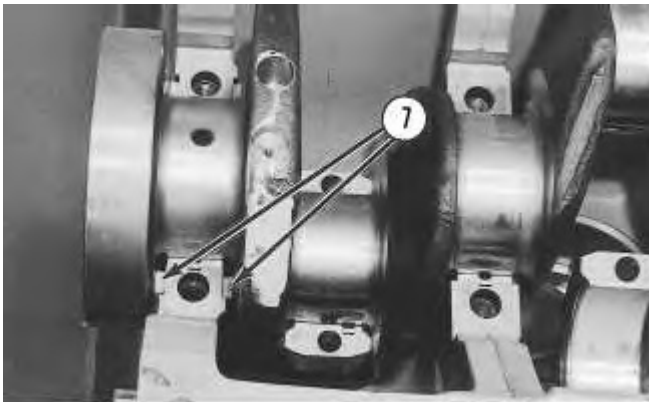


Illustration 3

g00503320

5. Remove thrust plates (7) from the rear main bearing.

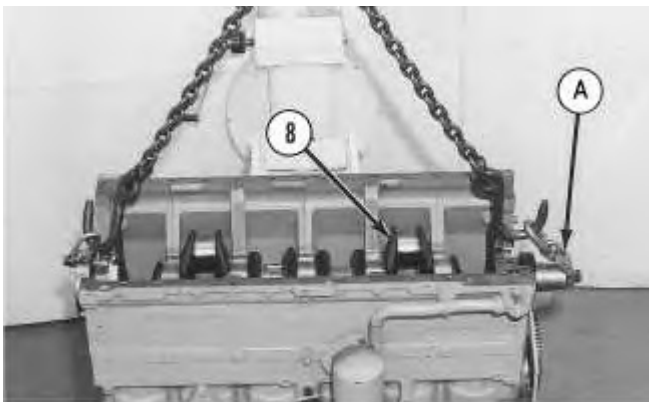


Illustration 4

g00503353

6. Install Tool (A) and a suitable lifting device on crankshaft (8), as shown. Lift the crankshaft straight up from the cylinder block. The weight of the 3304B crankshaft is 65 kg (143 lb). The weight of the 3306B crankshaft is 95 Kg (210 lb).

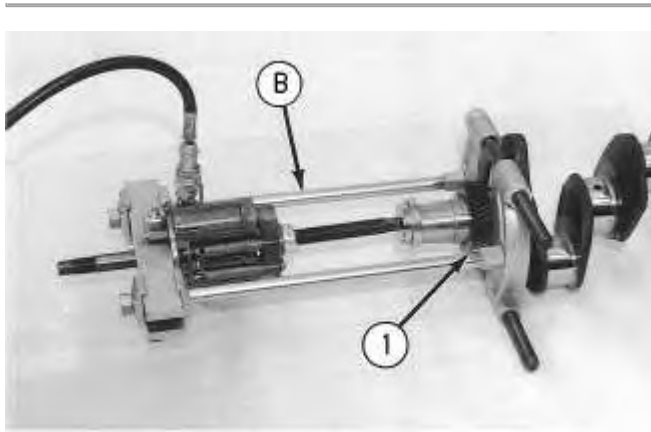


Illustration 5

g00503384

7. Use Tool (B) in order to remove the crankshaft gear and the oil seal wear sleeve from the crankshaft.

Note: Put identification marks on the bearings and on the bearing caps prior to removal.

8. Remove the main bearings from the main bearing caps and from the cylinder block.
Remove the connecting rod bearings from the connecting rods and from the connecting rod caps.

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Product: MOTOR GRADER

Model: 163H NA MOTOR GRADER 5AK

Configuration: 163H Motor Grader 5AK00001-UP (MACHINE) POWERED BY 3306 Engine

Disassembly and Assembly 3304B and 3306B Engines for Caterpillar Built Machines

Media Number -SEN5598-09

Publication Date -01/01/2013

Date Updated -25/01/2013

i03706543

Crankshaft - Install

SMCS - 1202-012

Installation Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	138-7575	Link Bracket	2
B	-	Plastigage	-
C	8T-5096	Dial Indicator Group	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: Install the main bearings dry when the clearance checks are made. Put clean engine oil on the main bearings for final assembly.

Note: Ensure that the upper halves and the lower halves of the main bearings are installed so that the bearing tabs fit into the bearing tab grooves in the cylinder block and in the main bearing caps.

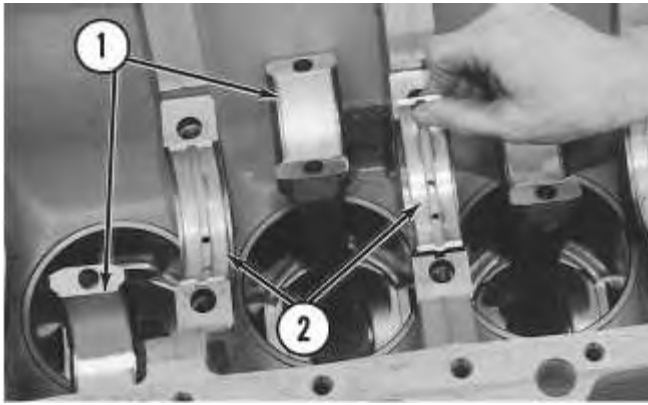


Illustration 1

g00503582

1. If the bearings were removed from the engine, clean the bearing surfaces in the cylinder block and the main bearing caps. Install the upper halves of connecting rod bearings (1) and main bearings (2) .



Illustration 2

g00503642

 **WARNING**

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

2. Heat crankshaft gear (3) to a maximum temperature of 315 °C (600 °F). Install crankshaft gear (3) on the crankshaft.



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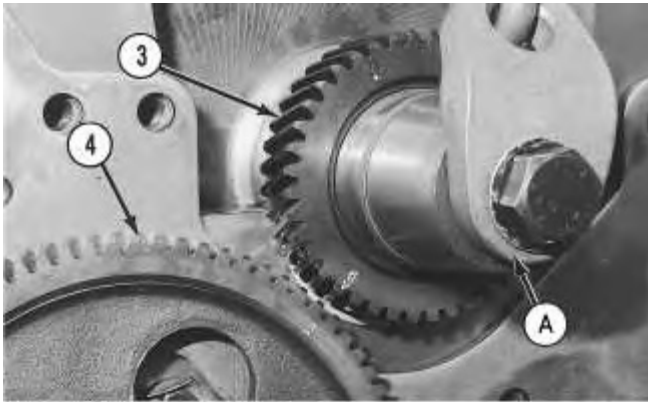


Illustration 3

g00503668

3. Install Tooling (A) on the ends of the crankshaft and use a hoist to lower the crankshaft into position above the cylinder block. Align the connecting rods with the crankshaft. Align the "C" mark on crankshaft gear (3) with the "C" mark on camshaft gear (4) . Lower the crankshaft into position in the cylinder block.

Note: When the bearing clearance is checked and the engine is in an upright position or on the engine's side, the crankshaft must be supported against the upper halves of the main bearings. This is done in order to get a correct measurement with Tooling (B) . If the crankshaft is not supported, the weight of the crankshaft will cause an incorrect reading. If the engine is not in an upright position or on the engine's side, it is not necessary to support the crankshaft. Do not rotate the crankshaft when Tooling (B) is positioned.

Note: Refer to Guideline For Reusable Parts, SEBV0544, "Engine Bearings and Crankshafts" for complete details concerning the measurement of bearing clearances.

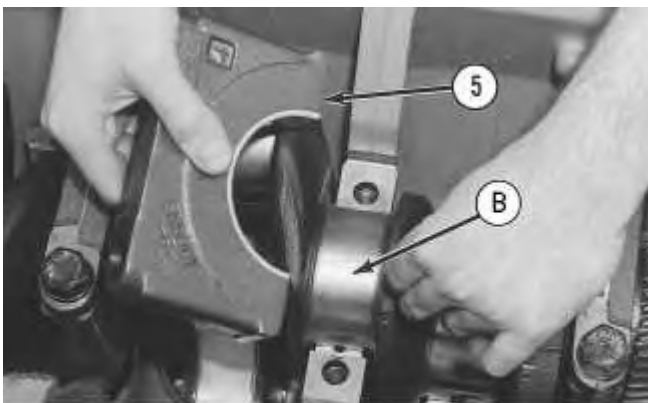


Illustration 4

g00503884

4. Check the main bearing clearance with Tooling (B) , as follows:
 - a. Put a piece of Tooling (B) on the crankshaft journal, as shown.

Note: Make sure that the part number on the main bearing cap is facing toward the front of the engine. Also, make sure that the number on the main bearing cap matches the number on the cylinder block on the left side of each main bearing cap.

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