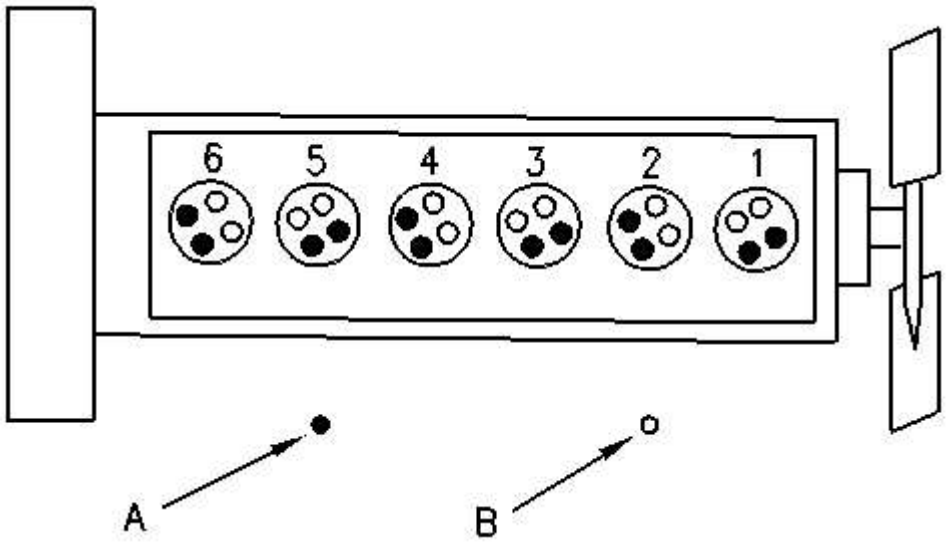



Illustration 1 g00386924
Cylinder And Valve Location

(A) Exhaust valves and (B) Inlet valves

Bore ... 130.0 mm (5.12 inch)

Stroke ... 150.0 mm (5.91 inch)

Displacement ... 12 L (732 cu in)

Cylinder arrangement ... In-line

Valves per cylinder ... 4

In order to check the engine valve lash setting, the engine must be cold and the engine must be stopped.
Engine valve lash settings

Inlet ... 0.38 mm (.015 inch)
Exhaust ... 0.64 mm (.025 inch)

Type of combustion ... Direct Injection

Firing Order ... 1 - 5 - 3 - 6 - 2 - 4

The crankshaft rotation is viewed from the flywheel end of the engine. Crankshaft rotation ... counterclockwise

**Note:** The front end of the engine is opposite of the flywheel end of the engine. The left side of the engine and the right side of the engine are viewed from the flywheel end of the engine. The No. 1 cylinder is the front cylinder.

**S/N -** SDL1-UP

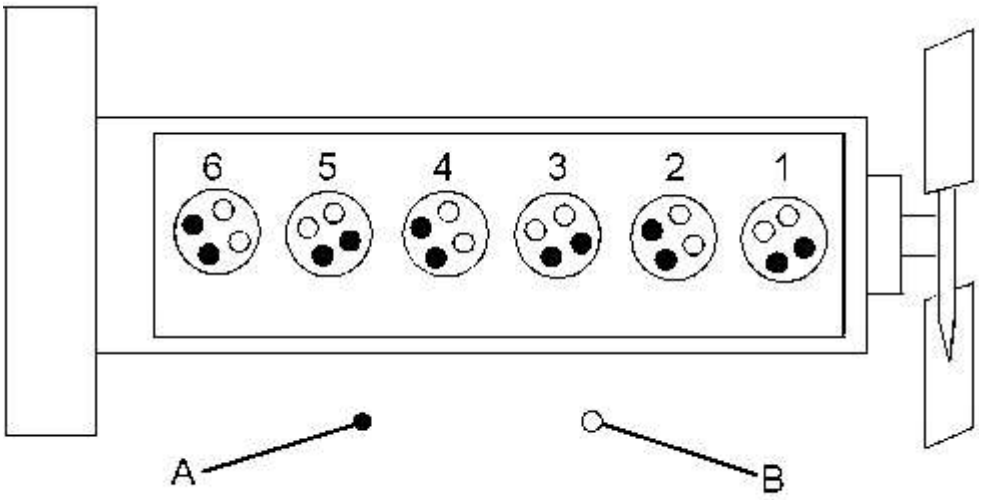



Illustration 1 g01424404
Cylinder and valve location

(A) Exhaust valves

(B) Inlet valves

Bore ... 125.0 mm (4.92 inch)

Stroke ... 140.0 mm (5.51 inch)

Displacement ... 10.3 L (629 cu in)

Cylinder arrangement ... In-line

Valves per cylinder ... 4

**Note:** In order to check the engine valve lash setting, the engine must be cold and the engine must be stopped.

Engine valve lash setting

Inlet ... 0.38 ± 0.08 mm (0.015 ± 0.003 inch)
Exhaust ... 0.64 ± 0.08 mm (0.025 ± 0.003 inch)

Type of combustion ... Direct injection

Firing order ... 1, 5, 3, 6, 2, 4

The crankshaft rotation is viewed from the flywheel end of the engine. Direction of rotation ... Counterclockwise

**Note:** The front end of the engine is opposite to the flywheel end of the engine. The left side of the engine and the right side of the engine are viewed from the flywheel end of the engine. The no. 1 cylinder is the front cylinder.

CATERPILLAR®

**Specifications**
**3176C and 3196 Engines for Caterpillar Built Machines**
**Media Number -RENR1217-09** **Publication Date -01/09/2007** **Date Updated -28/09/2007**

i03475342

# Cylinder Head

**SMCS -** 1100

**S/N -** 1GM1-UP

**S/N -** 1HM1-UP

**S/N -** 1NM1-UP

**S/N -** 1SM1-UP

**S/N -** 2BZ1-UP

**S/N -** 2NW1-UP

**S/N -** 2SW1-UP

**S/N -** 2ZW1-UP

**S/N -** 3MW1-UP

**S/N -** 4GR1-UP

**S/N -** 4SS1-UP

**S/N -** 4SW1-UP

**S/N -** 4XS1-UP

**S/N -** 4XZ1-UP

**S/N -** 5AR1-UP

**S/N -** 5WS1-UP

**S/N -** 6GS1-UP

**S/N -** 6JS1-UP

**S/N -** 6KS1-UP

**S/N -** 6MW1-UP

**S/N -** 6XS1-UP

**S/N -** 7941-UP

**S/N -** 7951-UP

**S/N -** 7961-UP

**S/N -** 7971-UP

**S/N -** 7KS1-UP

**S/N -** 8KW1-UP

**S/N -** 8RW1-UP

**S/N -** 8XZ1-UP

**S/N -** 8ZW1-UP

**S/N -** 9CW1-UP

**S/N -** 9GS1-UP

**S/N -** 9PZ1-UP

**S/N -** 9TZ1-UP

**S/N -** 9XP1-UP

**S/N -** 9YW1-UP

**S/N -** 9YZ1-UP

**S/N -** ABJ1-UP

**S/N -** ACS1-UP

**S/N -** ADW1-UP

**S/N -** AEC1-UP

**S/N -** AFG1-UP

**S/N -** AGD1-UP

**S/N -** AGN1-UP

**S/N -** AGS1-UP

**S/N -** AKJ1-UP

**S/N -** AKX1-UP

**S/N -** ALB1-UP

**S/N -** ALD1-UP

**S/N -** ALL1-UP

**S/N -** ALT1-UP

**S/N -** AMA1-UP

**S/N -** AMD1-UP

**S/N -** AMJ1-UP

**S/N -** AMN1-UP

**S/N -** ANJ1-UP

**S/N -** APB1-UP

**S/N -** AYR1-UP

**S/N -** BFG1-UP

**S/N -** BNM1-UP

**S/N -** BNX1-UP

**S/N -** BPK1-UP

**S/N -** BPT1-UP

**S/N -** BRM1-UP

**S/N -** BRP1-UP

**S/N -** BTH1-UP

**S/N -** CCC1-UP

**S/N -** CDY1-UP

**S/N -** CFJ1-UP

**S/N -** CFM1-UP

**S/N -** CTY1-UP

**S/N -** DCW1-UP

**S/N -** DER1-UP

**S/N -** DSC1-UP

**S/N -** FEE1-UP

**S/N -** JMB1-UP

**S/N -** PEG1-UP

**S/N -** SDL1-UP

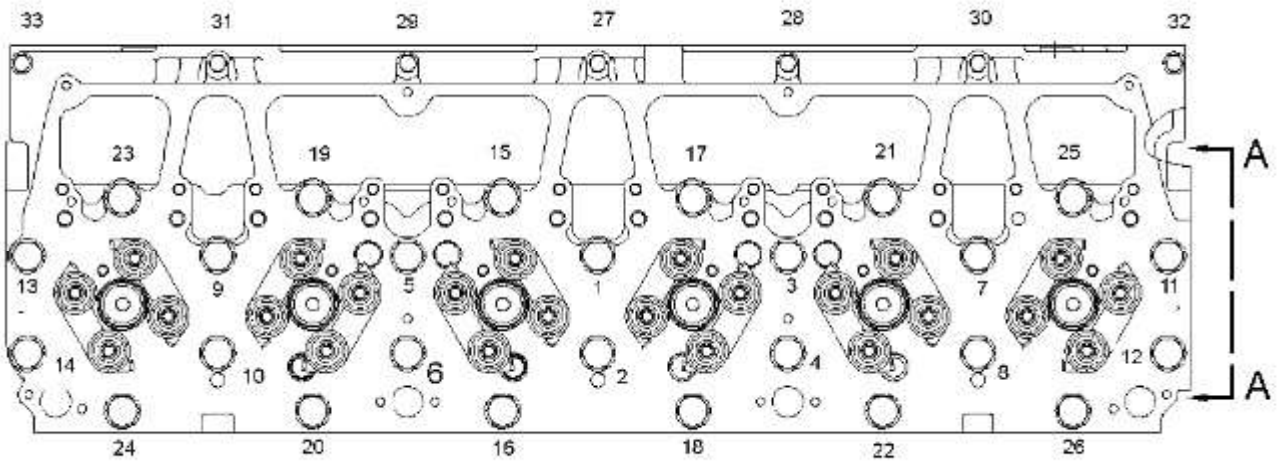



Illustration 1 g01436665

**Note:** When the bolts are removed from the cylinder head the bolts must be replaced with new cylinder head bolts.

**Note:** Lubricate the bolt threads, the underside of the bolt heads, and the washers with **6V-4876** Lubricant prior to assembly.

Use the following procedure in order to tighten the cylinder head bolts:

1. Tighten bolt (1) through bolt (26) in a numerical sequence.

   Tighten the bolts to the following torque. ... 160 ± 15 N·m (120 ± 11 lb ft)

2. Tighten bolt (1) through bolt (26) again in a numerical sequence.

   Tighten the bolts again to the following torque. ... 160 ± 15 N·m (120 ± 11 lb ft)

3. Place a mark on bolt (1) through bolt (26) . Rotate bolt (1) through bolt (26) in a numerical sequence.

   Rotate the bolts in the clockwise direction. ... 90 degrees (1/4 turn)

4. **Loosen bolt (1) through bolt (26) until the washers are loose under the bolt heads.**

5. Tighten bolt (1) through bolt (26) in a numerical sequence.

   Tighten the bolts to the following torque. ... 160 ± 15 N·m (120 ± 11 lb ft)

6. Tighten bolt (1) through bolt (26) again in a numerical sequence.

   Tighten the bolts again to the following torque. ... 160 ± 15 N·m (120 ± 11 lb ft)

7. Place a mark on bolt (1) through bolt (26) . Rotate bolt (1) through bolt (26) in a numerical sequence.

   Rotate the bolts in the clockwise direction. ... 90 degrees (1/4 turn)

8. Tighten bolt (27) through bolt (33) in a numerical sequence.

Tighten the bolts to the following torque. ... 28 ± 7 N·m (20 ± 5 lb ft)

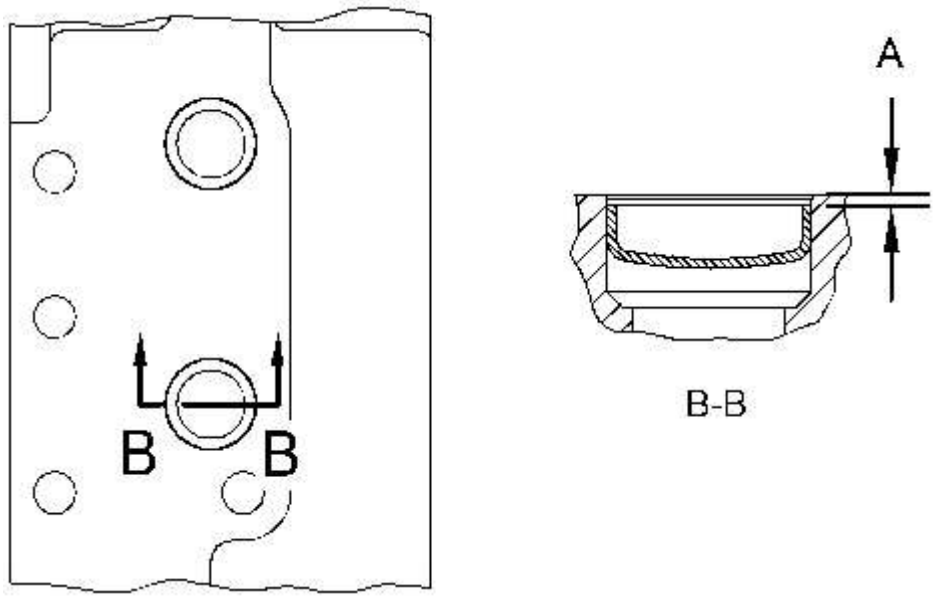



Illustration 2 g01436674
View A-A

(A) The cup plugs are measured from the head face to the top edge of the plug. Depth of installation ... 1.25 ± 0.25 mm (0.049 ± 0.010 inch)

Height of new cylinder head ... 105.00 ± 0.15 mm (4.134 ± 0.006 inch)

Minimum permissible thickness of cylinder head ... 104.35 mm (4.108 inch)

**Note:** The flatness of the cylinder head should be within 0.15 mm (0.006 inch). The flatness should also be a maximum of 0.05 mm (0.002 inch) for any 150.00 mm (5.906 inch) span.

Use the following procedure in order to install the main bearing cap bolts (4) :

1. The main bearing caps are numbered 1 through 7. Ensure that the main bearing caps are in the correct location. The part number on the main bearing cap must face to the right side and toward the front of the block. Orient the main bearing cap correctly in the cylinder block. If caps are oriented correctly, the tab slots that are in the block and in the main bearing caps will be adjacent.

   **Note:** Use SAE 30 oil or molybdenum grease to lubricate the threads and the washer face of the main bearing cap bolts.

2. Torque the main bearing cap bolts to 95 N·m (70 lb ft).

3. Put an alignment mark on each cap and bolt.

4. Rotate the bolts for an additional turn in the clockwise direction to 90 degrees.

(5) Main bearing cap

Width of the main bearing cap ... 175.000 ± 0.020 mm (6.8897 ± 0.0008 inch)
Width of the cylinder block for the main bearing cap ... 175.000 ± 0.018 mm (6.8897 ± 0.0007 inch)

(J) Diameter of the camshaft bores ... 81.000 ± 0.015 mm (3.1890 ± 0.0006 inch)

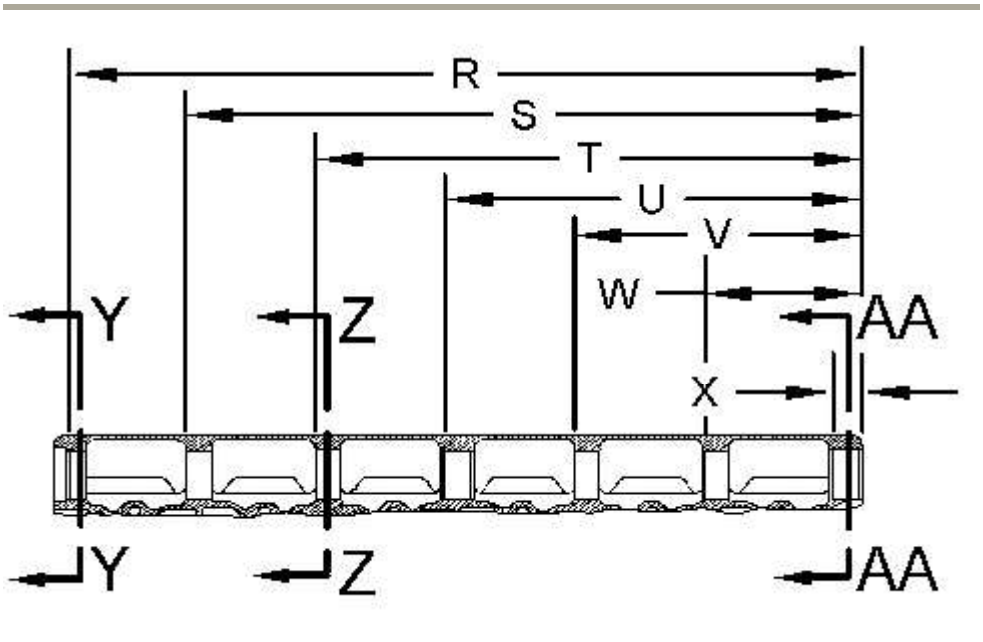
(K) The dowels extend past the top surface of the cylinder block by the following distance. ... 10.0 ± 0.5 mm (0.39 ± 0.02 inch)

(M) Distance from the centerline of the crankshaft bore to the top surface of the cylinder block ... 387.00 ± 0.15 mm (15.236 ± 0.006 inch)

(N) Bore in the cylinder block for the seven main bearings ... 116.000 ± 0.013 mm (4.5669 ± 0.0005 inch)

(P) Distance from the centerline of the crankshaft to the bottom surface of the cylinder block ... 120.0 mm (4.72 inch)

## Camshaft Bearing Position



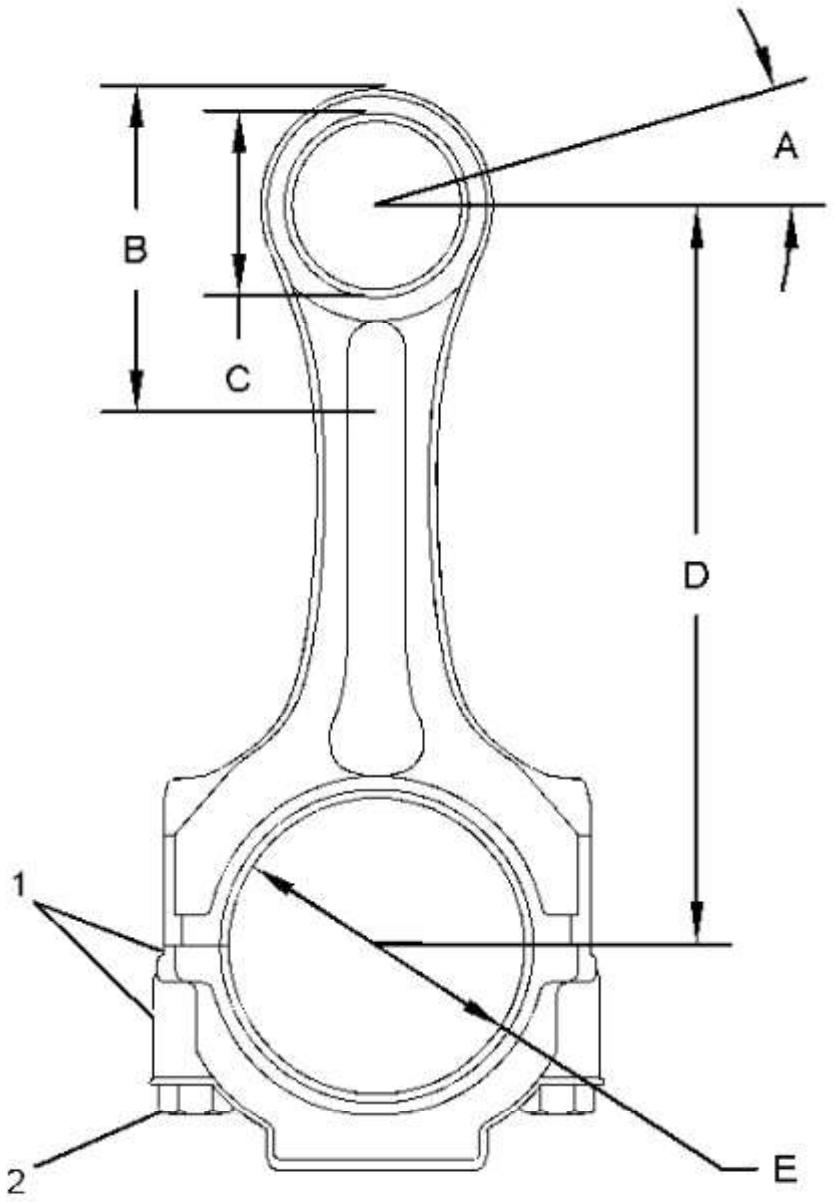



Illustration 1 g01418662

(A) The bearing joint for the piston pin bearing must be positioned to the following angle above the centerline on either side. ... 12.5 ± 5.0 degrees

**Note:** The connecting rod must be heated for the installation of the piston pin bearing. Do not use a torch.

(B) The connecting rod may be heated from 175 to 260 °C (347 to 500 °F) for the installation of the piston pin bearing. Maximum distance for heating the connecting rod ... 85.0 mm (3.35 inch)

**Note:** Thoroughly lubricate the piston pin with clean engine oil prior to assembly of the piston and connecting rod.

(C) Bore in the piston pin bearing after installation of the bearing ... 50.830 ± 0.008 mm (2.0012 ± 0.0003 inch)

Bore in the connecting rod for the piston pin bearing ... 55.435 ± 0.013 mm (2.1825 ± 0.0005 inch)

Diameter of the piston pin ... 50.795 ± 0.005 mm (1.9998 ± 0.0002 inch)

(D) Distance between the center of the bearings ... 247.00 mm (9.724 inch)

(E) Bore in the connecting rod for the bearing for the crankshaft connecting rod journal ... 86.800 ± 0.013 mm (3.4173 ± 0.0005 inch)

(1) Etch the cylinder number on the connecting rod and the cap in this location. Mark the connecting rod and the cap with a number 1 through 6. Mark the numbers on the same side of the connecting rod as the bearing retainer notch.

**Note:** Install the connecting rod in the engine with the part number to the rear of the engine.

Use the following procedure to tighten the connecting rod bolts (2):

1. Lubricate the threads of the bolts and the seating faces of the caps with **4C-5592** Anti-Seize Compound .
2. Torque the bolts to 130 ± 7 N·m (95 ± 5 lb ft).
3. Place an index mark on each connecting rod cap bolt.
4. Rotate each bolt for an additional 60 ± 5 degrees (1/6 of a turn).

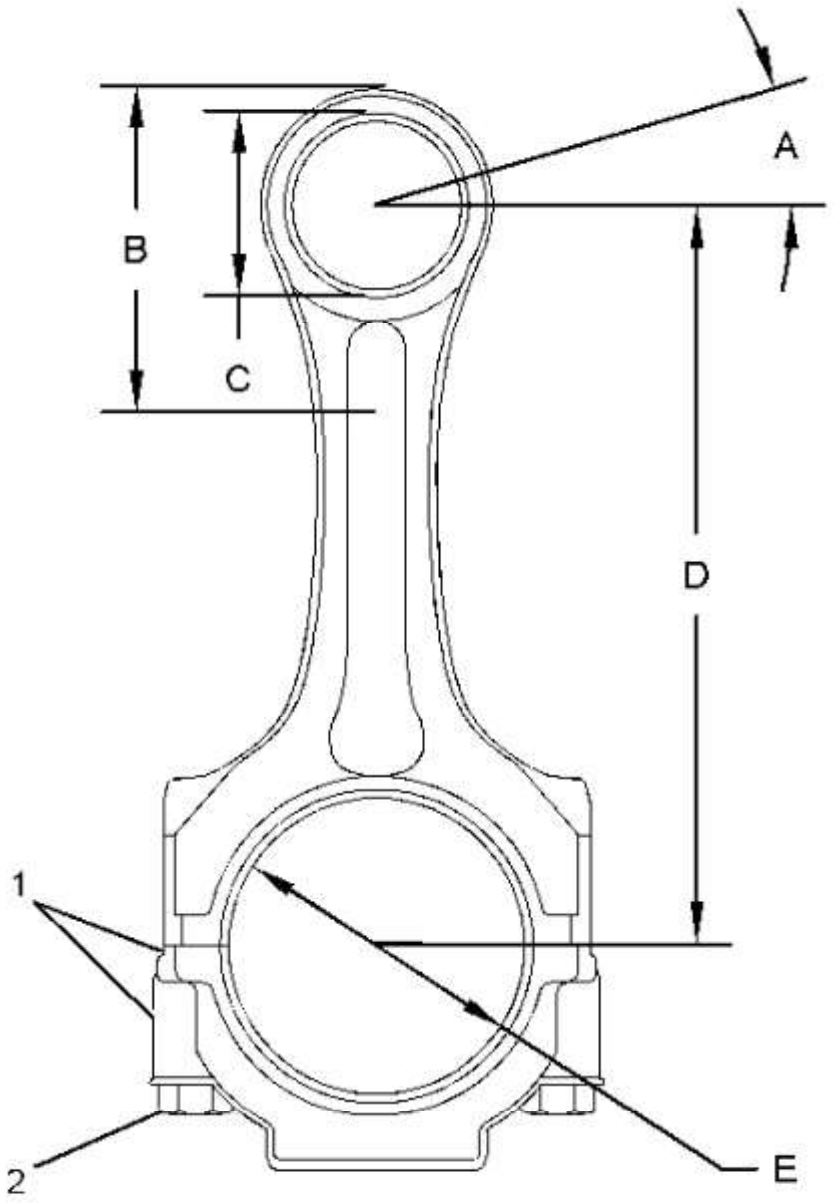



Illustration 1 g01418662

(A) The bearing joint for the piston pin bearing must be positioned to the following angle above the centerline on either side. ... 12.5 ± 5.0 degrees

**Note:** The connecting rod must be heated for the installation of the piston pin bearing. Do not use a torch.

(B) The connecting rod may be heated from 175 to 260° C (347 to 500° F) for the installation of the piston pin bearing. Maximum distance for heating the connecting rod ... 85.0 mm (3.35 inch)

**Note:** Thoroughly lubricate the piston pin with clean engine oil prior to assembly of the piston and connecting rod.

(C) Bore in the piston pin bearing after installation of the bearing ... 53.205 ± 0.008 mm (2.0947 ± 0.0003 inch)

Bore in the connecting rod for the piston pin bearing ... 57.810 ± 0.013 mm (2.2760 ± 0.0005 inch)

Diameter of the piston pin ... 53.170 ± 0.005 mm (2.0933 ± 0.0002 inch)

(D) Distance between the center of the bearings ... 242.5 mm (9.55 inch)

(E) Bore in the connecting rod for the bearing for the crankshaft connecting rod journal ... 93.800 ± 0.013 mm (3.6929 ± 0.0005 inch)

(1) Etch the cylinder number on the connecting rod and the cap in this location. Mark the connecting rod and the cap with a number 1 through 6. Mark the numbers on the same side of the connecting rod as the bearing retainer notch.

**Note:** Install the connecting rod in the engine with the part number to the rear of the engine.

Use the following procedure to tighten the connecting rod bolts (2):

1. Lubricate the threads of the bolts and the seating faces of the caps with **4C-5592** Anti-Seize Compound .
2. Torque the bolts to 130 ± 7 N·m (95 ± 5 lb ft).
3. Place an index mark on each connecting rod cap bolt.
4. Rotate each bolt for an additional 60 ± 5 degrees (1/6 of a turn).