



# 12. CRANKSHAFT/PISTON

|                              |      |                                   |       |
|------------------------------|------|-----------------------------------|-------|
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## SERVICE INFORMATION

### • WORKING PRACTICE

All bearing inserts are a select fit and are identified by color codes. Select replacement bearing from the color code table. After installing new bearings, recheck them with plastigauge.

Before removing the piston and connecting rod assemblies, clean the top of the cylinder of carbon deposits.

The right piston can be serviced by removing the oil pump and transmission cover. To service the left piston, it is necessary to remove the transmission.

Apply molybdenum disulfide grease to the journals, crankpins and bearings during assembly.

### • SPECIAL TOOLS

Special tools

|                                |               |
|--------------------------------|---------------|
| GEAR HOLDER                    | 07924-4150000 |
| PISTON REMOVER                 | 07941-4150000 |
| CRANK CAP PULLER               | 07935-4150000 |
| CRANK CAP DRIVER               | 07945-4150100 |
| MAIN BEARING DIS/ASSEMBLY TOOL | 07973-4150000 |
| PISTON SLIDER                  | 07755-0010000 |

### • SPECIFICATIONS

| Item        |                               | Standard                            | Service Limit                     |
|-------------|-------------------------------|-------------------------------------|-----------------------------------|
| Crankshaft  | Main journal oil clearance    | 0.020-0.060 mm (0.0008-0.0023 in)   | 0.085 mm (0.0033 in)              |
|             | Crankpin oil clearance        | 0.028-0.052 mm (0.0011-0.0020 in)   | 0.080 mm (0.0031 in)              |
|             | Connecting rod side clearance | 0.150-0.350 mm (0.0059-0.0138 in)   | 0.060 mm (0.024 in)               |
| Cylinder    | I.D.                          | 78.000-78.015 mm (3.0709-3.0715 in) | 78.100 mm (3.0748 in)             |
|             | Warpage                       | —                                   | 0.10 mm (0.004 in)                |
| Piston ring | Ring-to-groove clearance      | Top                                 | 0.015-0.050 mm (0.0059-0.0020 in) |
|             |                               | Second                              | 0.015-0.050 mm (0.0059-0.0020 in) |
| Piston pin  | Ring end gap                  | Top                                 | 0.1-0.3 mm (0.004-0.0118 in)      |
|             |                               | Second                              | 0.1-0.3 mm (0.004-0.0118 in)      |
|             |                               | Oil (side rail)                     | 0.3-0.9 mm (0.004-0.0354 in)      |
|             | Piston O.D.                   | 77.940-77.960 mm (3.0685-3.0693 in) | 77.860 mm (3.0653 in)             |
|             | Piston pin bore               | 21.002-21.008 mm (0.8268-0.8271 in) | 21.040 mm (0.8283 in)             |
|             | Piston pin O.D.               | 20.994-21.000 mm (0.8265-0.8268 in) | 20.984 mm (0.8261 in)             |
|             | Small end I.D.                | 21.020-21.041 mm (0.8276-0.8284 in) | 21.068 mm (0.8294 in)             |
|             | Piston-to-cylinder clearance  | —                                   | 0.10 mm (0.004 in)                |



## TROUBLESHOOTING

### Excessive Noise

1. Crankshaft
  - Worn main bearing
  - Worn rod bearing
2. Piston and Connecting Rod
  - Worn piston or cylinder
  - Worn piston pin or pin hole
  - Worn rod small end

### Low Compression or Uneven Compression

1. Worn cylinder or piston ring

### Excessive Smoke

1. Worn cylinder, piston or piston rings
2. Improperly installed piston rings
3. Damaged piston or cylinder

### Overheating

1. Excessive carbon build-up on piston head
2. Blocked or restricted flow of coolant
3. Sticking thermostat

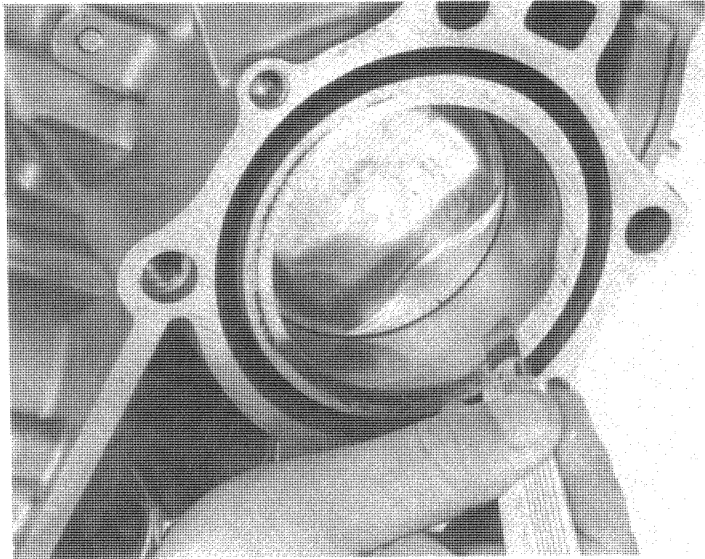
### Knocking or Abnormal Noise

1. Worn pistons and cylinders
2. Excessive carbon build-up on piston head

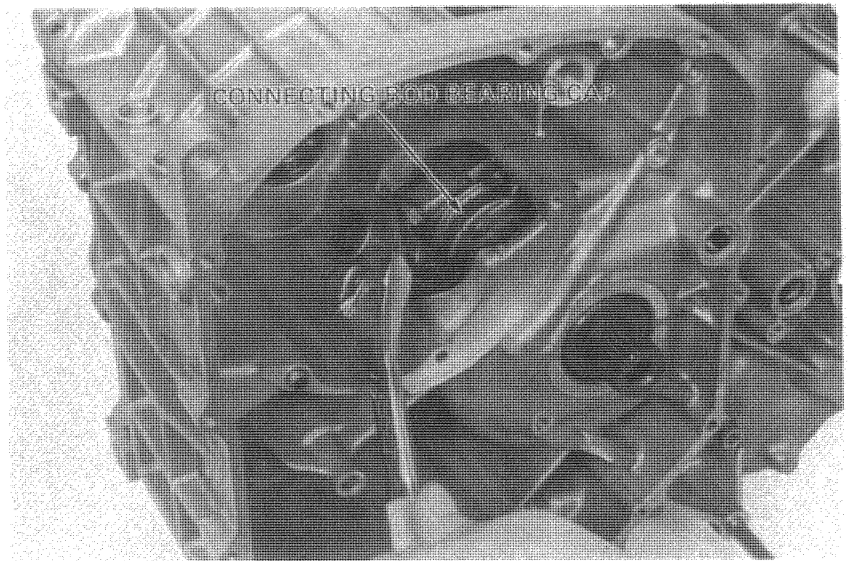


## CONNECTING ROD REMOVAL

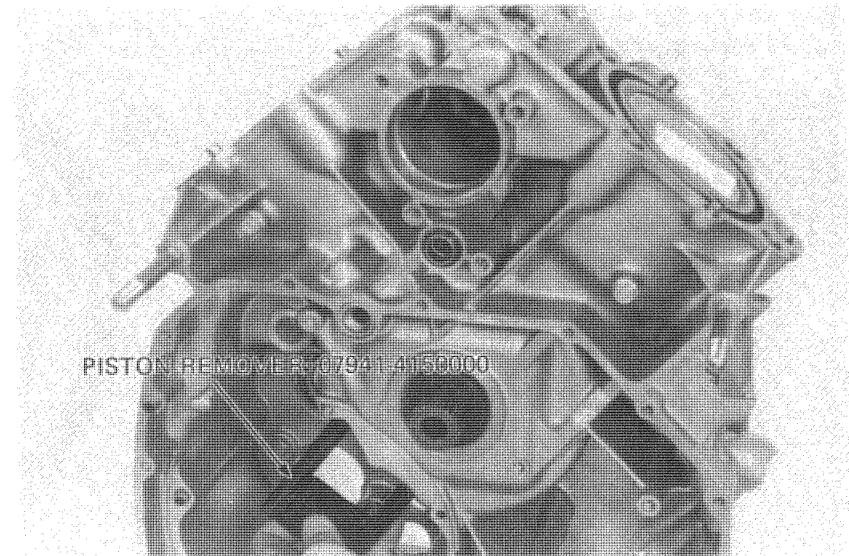
Remove the cylinder head (Page 6-3).  
Remove the oil pump (Page 7-8).  
Remove the transmission (Page 11-4).  
Scrape all deposits from the top of the cylinder.



Turn the crankshaft so that the piston to be removed is at B.D.C. (Bottom Dead Center).  
Remove the bearing cap.  
Mark the bearing caps and rods to indicate cylinder position.  
Remove the left side cap from the transmission side. Work through the hole on the oil pump side to remove the right side cap.



Turn the crankshaft so that the piston is at T.D.C.  
Place the PISTON REMOVER over the rod bolts, and push the piston and rod assembly out.



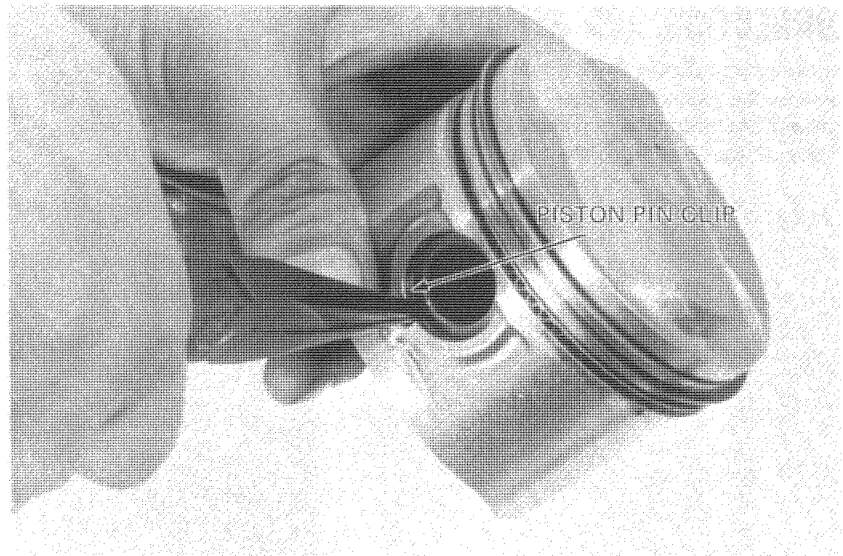


## PISTON REMOVAL

Remove the piston pin clips.  
Remove the pin.

**NOTE**

Mark the pins to indicate the piston position.



### • PISTON INSPECTION

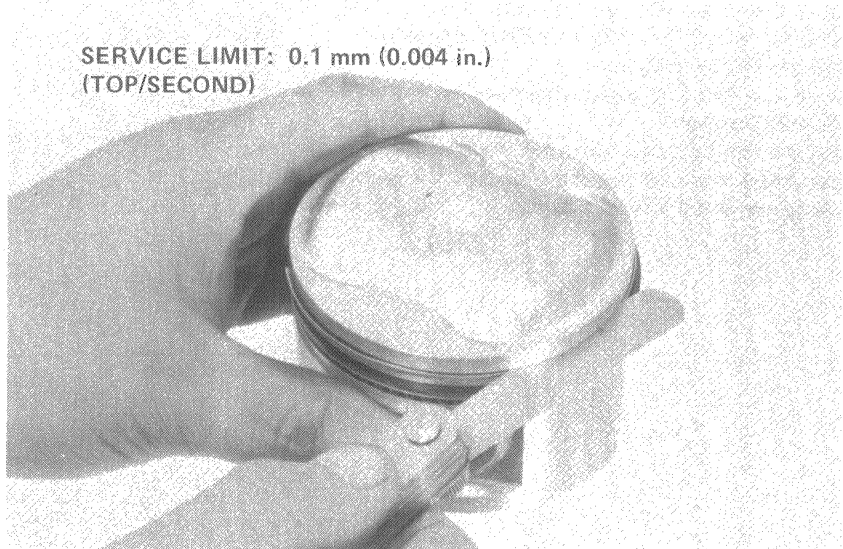
Measure the ring-to-groove clearance.  
Remove the piston rings.

**SERVICE LIMIT: 0.1 mm (0.004 in.)**  
**(TOP/SECOND)**

**NOTE**

Mark the rings so they can be assembled in their original position.

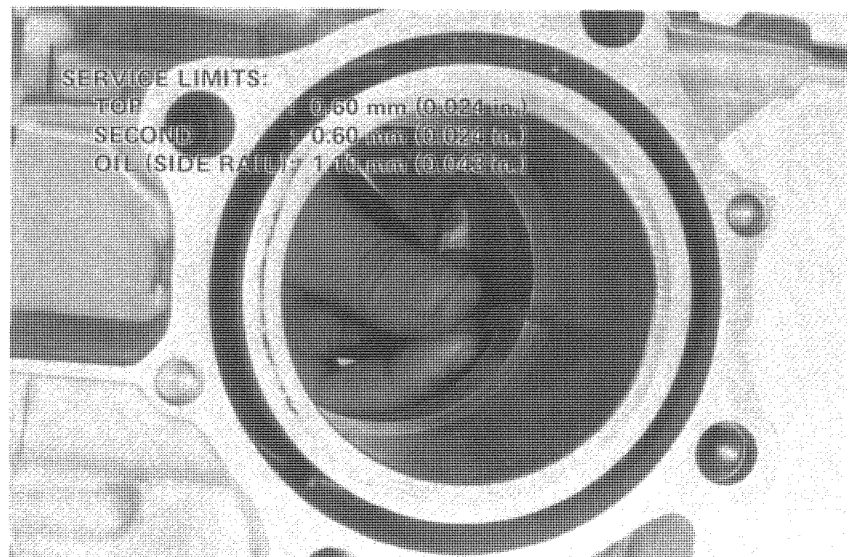
Clean and inspect the piston crown.  
Inspect the piston for damage and cracks; ring grooves for excessive wear.



Insert each piston ring into the cylinder and measure the ring end gap.

**NOTE**

To measure the gap, use a piston and push the ring squarely into the cylinder.



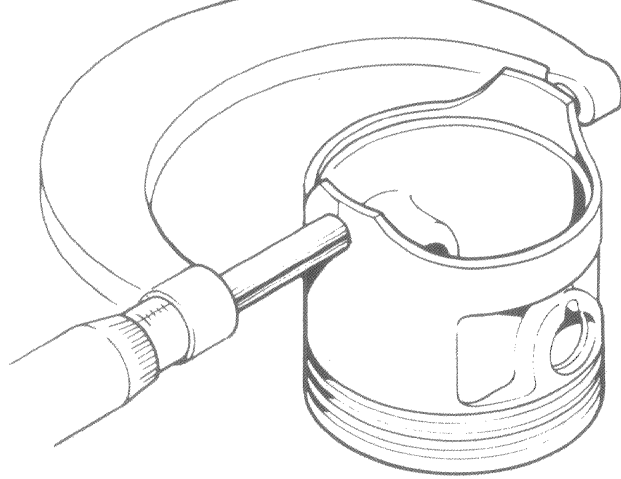


Measure each piston diameter at the skirt. If the pistons show wear beyond limits, replacement is necessary.

### NOTE

Measure the piston diameter 7–10 mm (0.28–0.4 in.) from the bottom of the piston, and 90° to the piston pin hole.

**SERVICE LIMIT: 77.86 mm (3.0653 in.)**



## CYLINDER INSPECTION

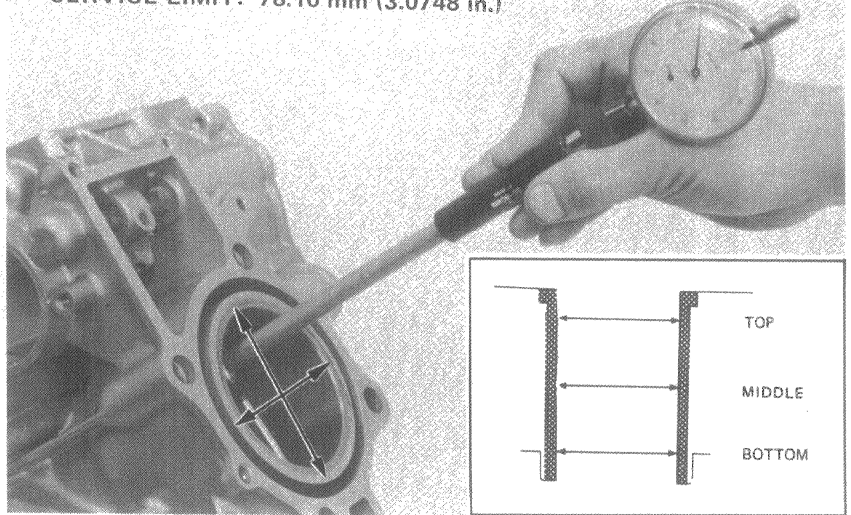
Measure the cylinder I.D.

Calculate the piston to cylinder clearance.

**SERVICE LIMIT: 0.10 mm (0.004 in.)**

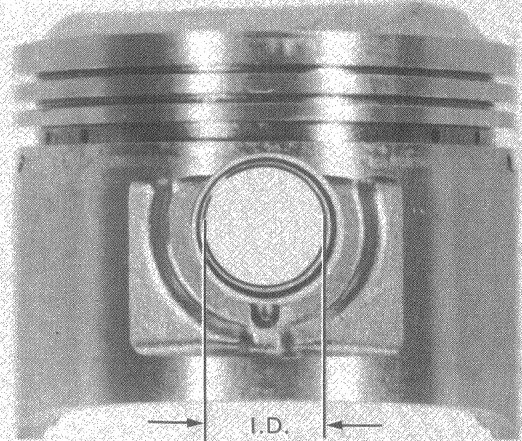
Oversize pistons are available in standard and the following sizes: 0.25 and 0.50 mm.

**SERVICE LIMIT: 78.10 mm (3.0748 in.)**



Measure each piston pin bore.

**SERVICE LIMIT: 21.04 mm (0.8283 in.)**







**CRANKSHAFT/PISTON**

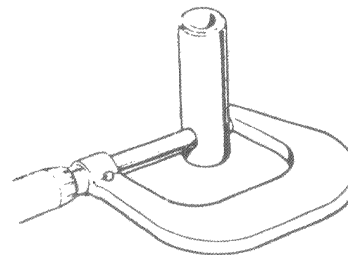
Measure each piston pin O.D.

**SERVICE LIMIT: 20.984 mm (0.8261 in.)**

Calculate the piston pin to piston clearance.

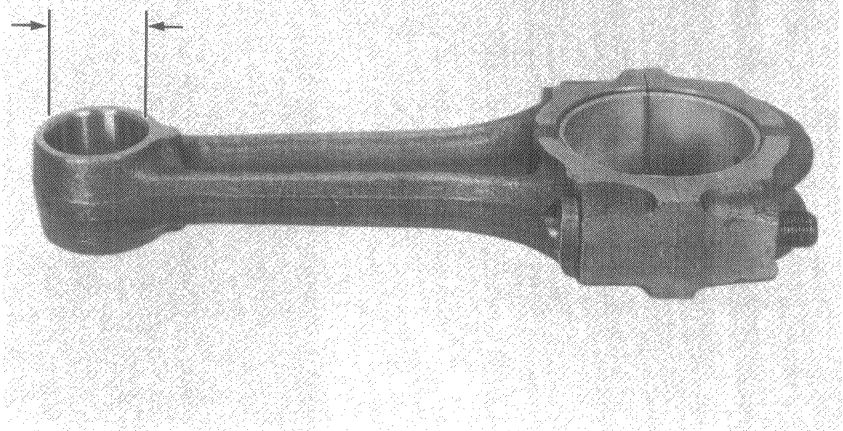
**SERVICE LIMIT: 0.05 mm (0.002 in.)**

**SERVICE LIMIT: 20.984 mm (0.8261 in.)**



Measure the rod end I.D. If the reading exceeds the service limit, replace the rod.

**SERVICE LIMIT: 21.068 mm (0.8294 in.)**





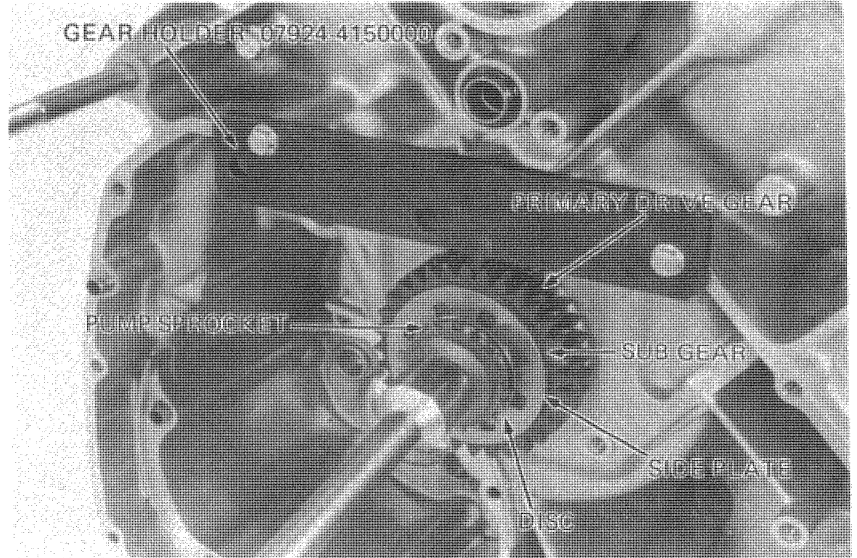
### CRANKSHAFT REMOVAL

Hold the primary drive gear with a GEAR HOLDER.

Remove the 12 mm bolt and the oil pump sprocket, disc spring, side plate, sub gear and primary gear.

**NOTE**

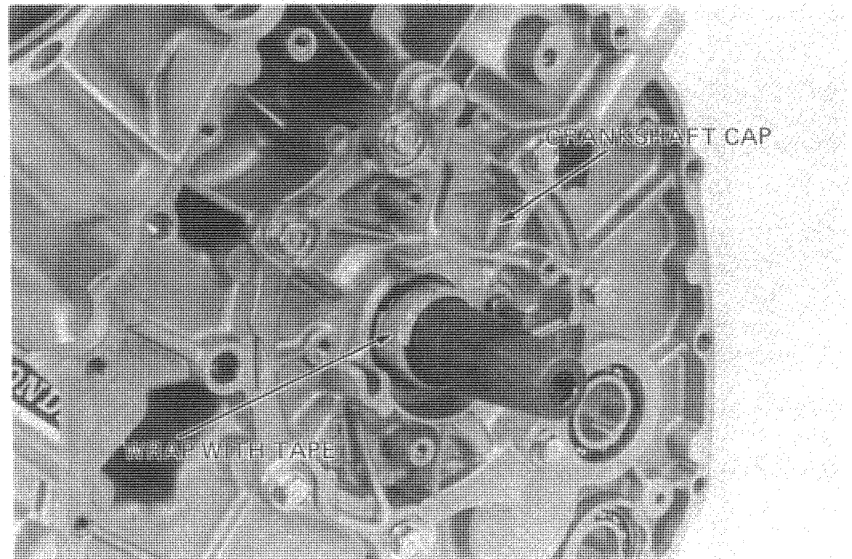
Mark the sub gear and side plate so that they will face the correct direction during reassembly.



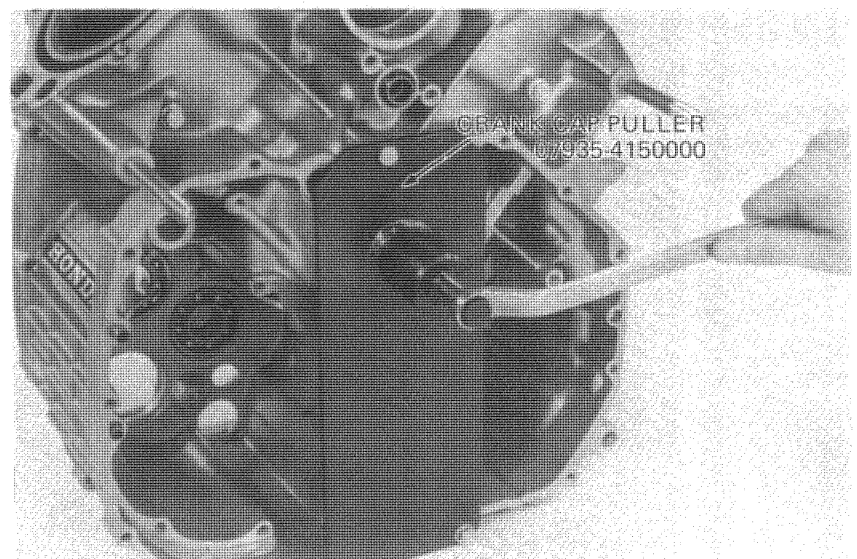
Remove the flywheel and cam chain (Page 10-2).  
Remove the crankshaft cap bolts.

**NOTE**

Before removing the crankshaft, wrap the splines of the primary gear and timing sprocket with vinyl tape to prevent damage to them.



Attach the CRANK CAP PULLER to the front of the engine.



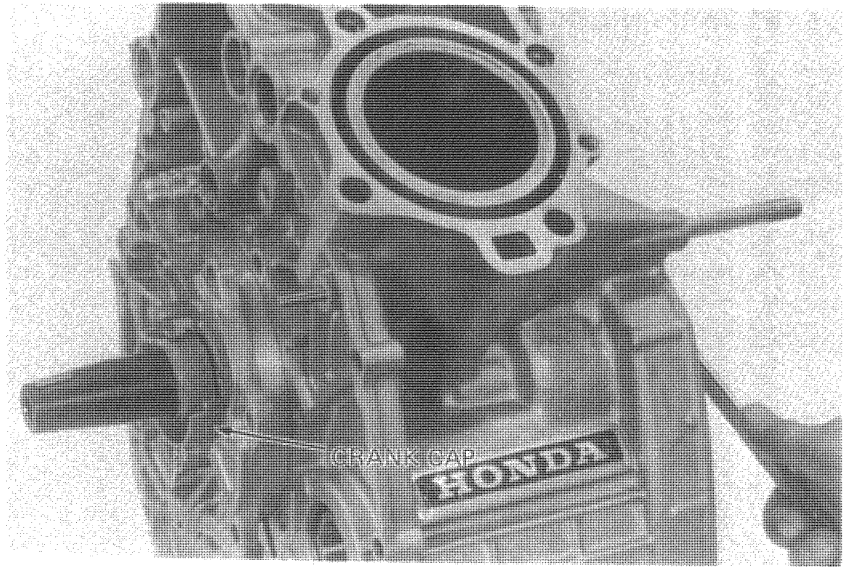


**CRANKSHAFT/PISTON**

Press the crankshaft out by screwing in the REMOVER.

**CAUTION**

*Do not damage the bearing. when removing the crankshaft.*



● **ROD SIDE CLEARANCE INSPECTION**

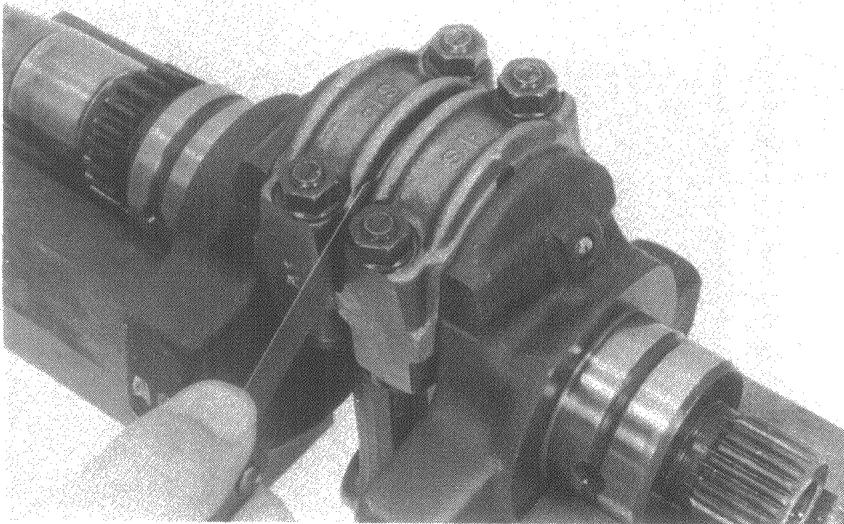
Install each connecting rod and bearing cap in its original position and torque to specifications.  
**TORQUE VALUE: 2.8–3.2 kg–m**  
**(20–23 ft–lbs)**

**NOTE**

- Torque the cap bolts evenly in 2–3 steps.
- Do not rotate the crankshaft during inspection.

Measure the rod side clearance with a feeler gauge.

**SERVICE LIMIT: 0.60 mm (0.024 in)**

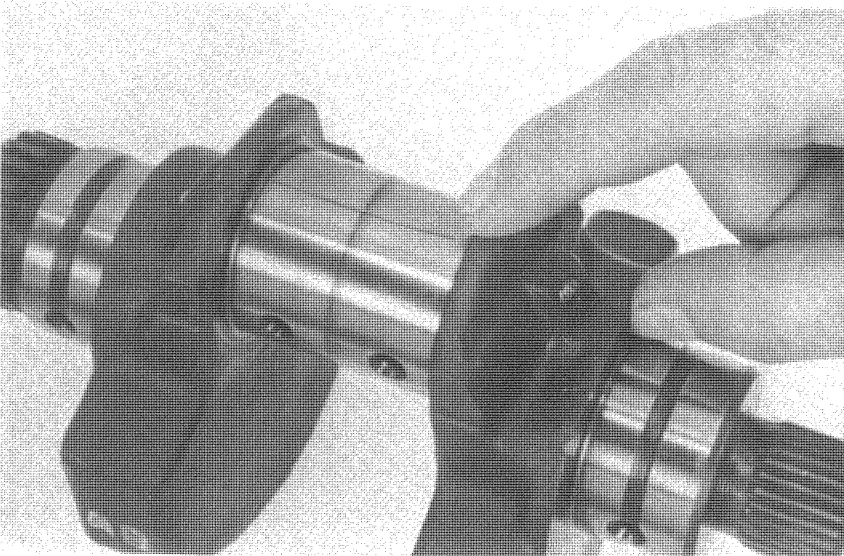


**BEARING INSPECTION/SELECTION**

● **CRANKPIN**

Inspect each bearing insert for separation or other damage.

Put the connecting rod inserts in each rod cap. Place a plastigauge strip across each rod crankpin avoiding the oil hole.



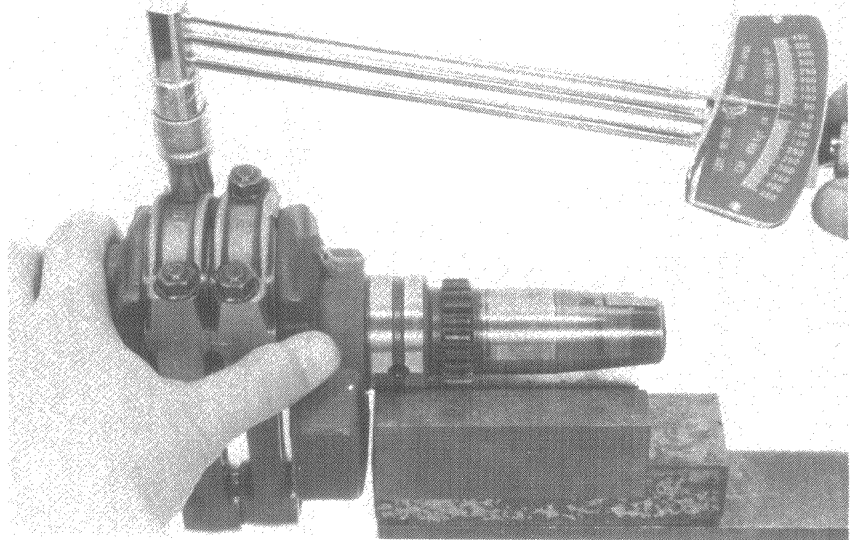




Install each connecting rod and bearing cap in their original positions and torque to specifications.

**NOTE**

- Torque the cap bolts evenly in 2-3 steps.
- Do not rotate the crankshaft during the inspection.

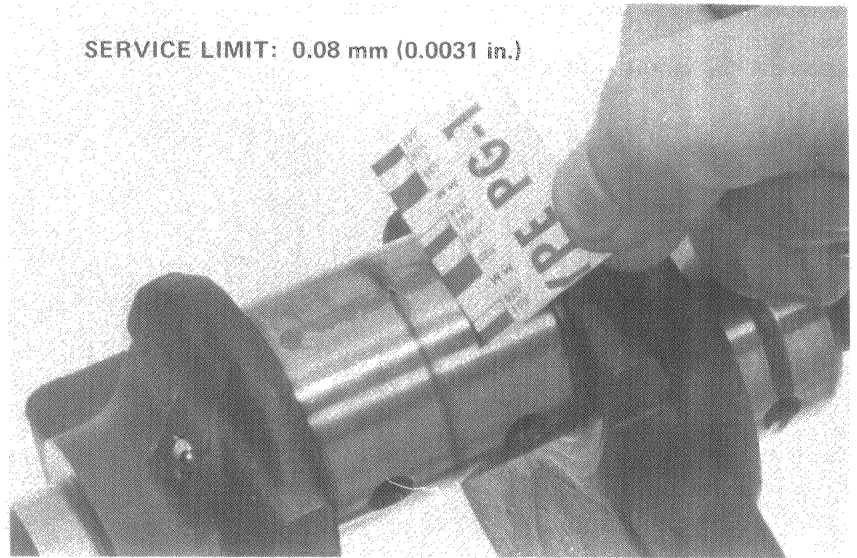


Remove the caps and measure the compressed plastigauge.

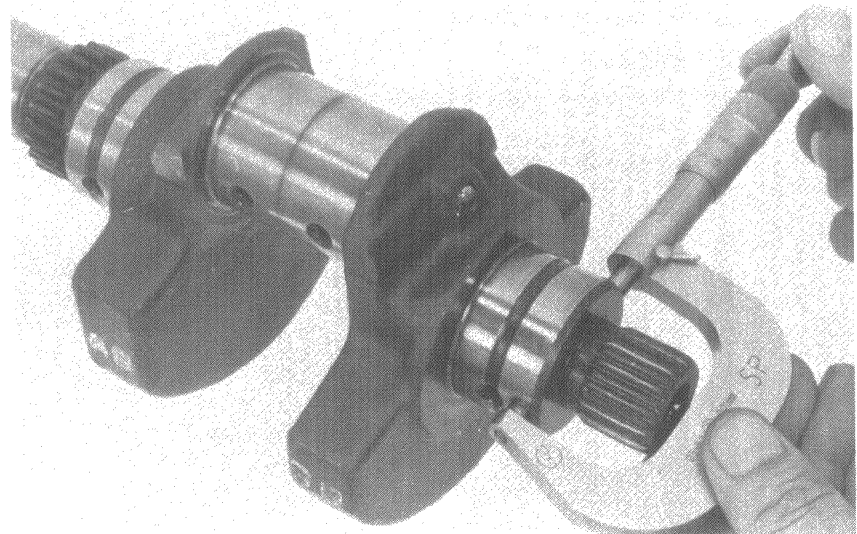
**NOTE**

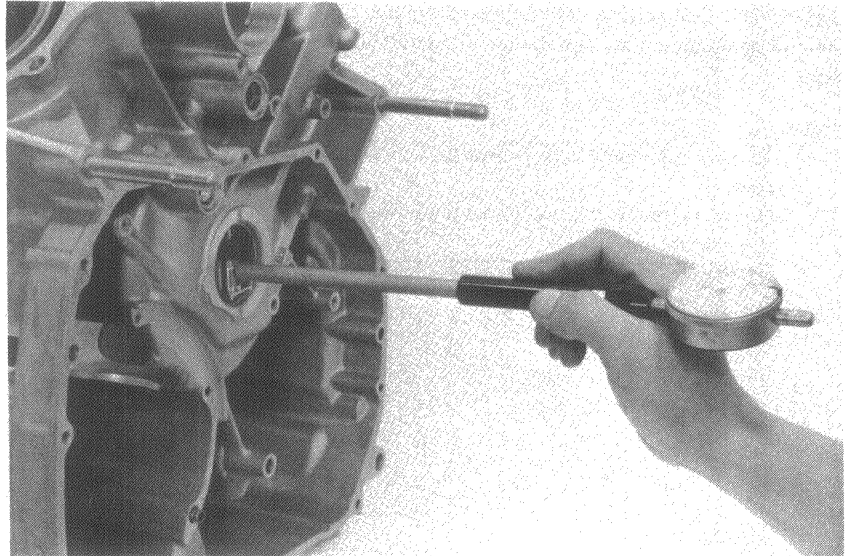
The widest thickness determines the oil clearance.

**SERVICE LIMIT: 0.08 mm (0.0031 in.)**

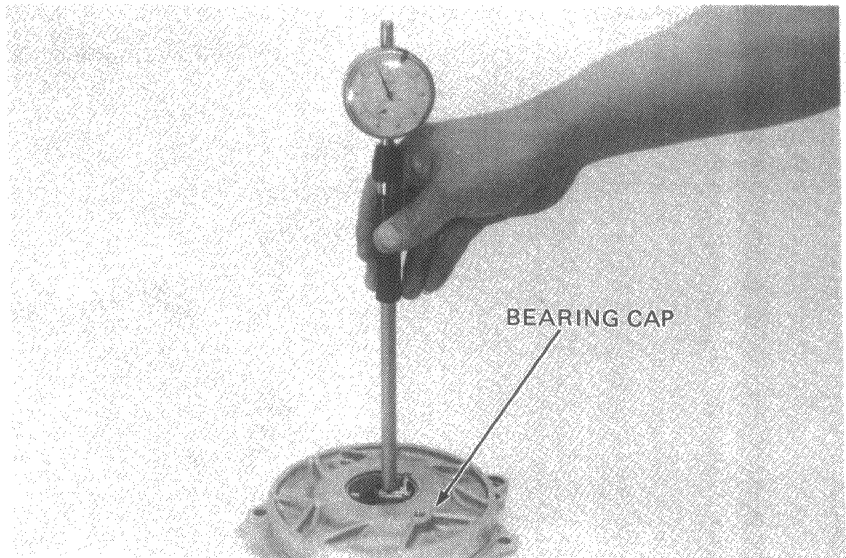


- **MAIN JOURNAL**  
Measure each journal O.D.





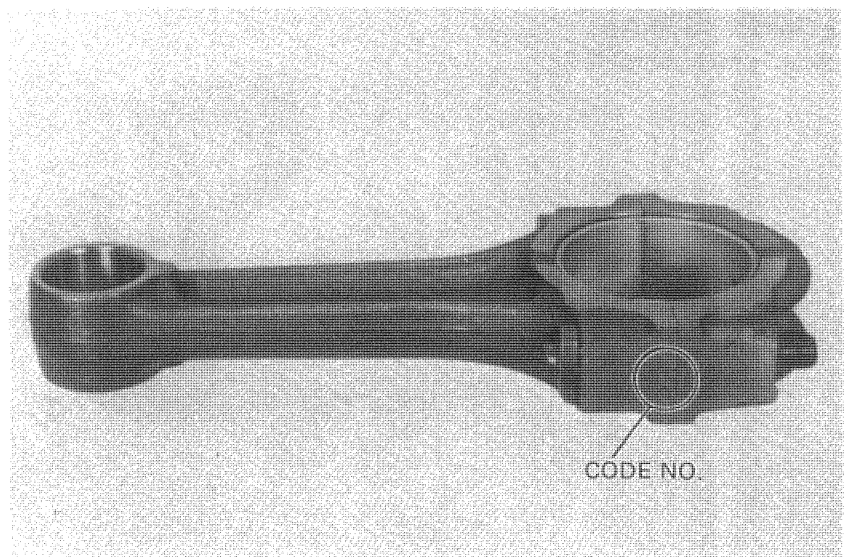
Measure the engine case and crankshaft bearing cap I.D.  
Calculate the journal to bearing cap clearance.



If rod bearing clearance is beyond tolerance, select replacement bearings as follows.

● **ROD BEARINGS**

Determine and record each connecting rod I.D. code number.





Determine and record the corresponding crankpin O.D. code letters.

Cross reference the crank pin and rod codes to determine the replacement bearing color.

**ROD BEARING SELECTION**

| CRANKPIN SIZE CODE LETTER       | A  | B                                       | C                                       |       |
|---------------------------------|--|---|---|-------|
|                                 | 39.982–39.990 mm<br>(1.5741–1.5744 in.)    | 39.974–39.982 mm<br>(1.5738–1.5741 in.) | 39.966–39.974 mm<br>(1.5735–1.5738 in.) |       |
| CONNECTING ROD I.D. CODE NUMBER | COLOR IDENTIFICATION                       |   |   |       |
|                                 | 1. 43.000–43.008 mm<br>(1.6929–1.6932 in.) | PINK                                    | YELLOW                                  | GREEN |
|                                 | 2. 43.008–43.016 mm<br>(1.6932–1.6935 in.) | YELLOW                                  | GREEN                                   | BROWN |
|                                 | 3. 43.016–43.024 mm<br>(1.6935–1.6939 in.) | GREEN                                   | BROWN                                   | BLACK |

**ROD BEARING SIZES**

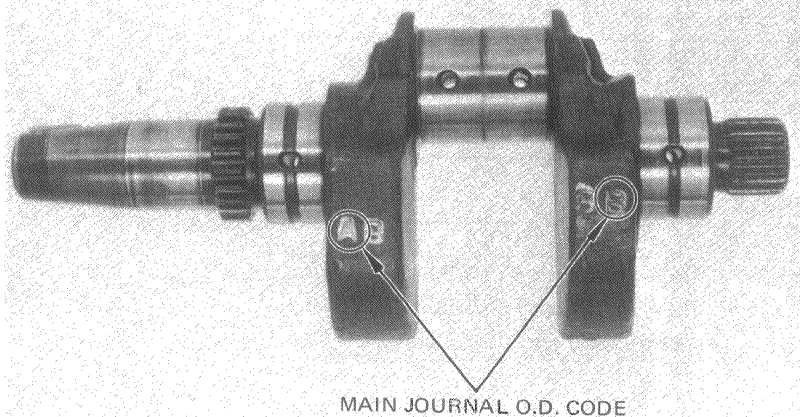
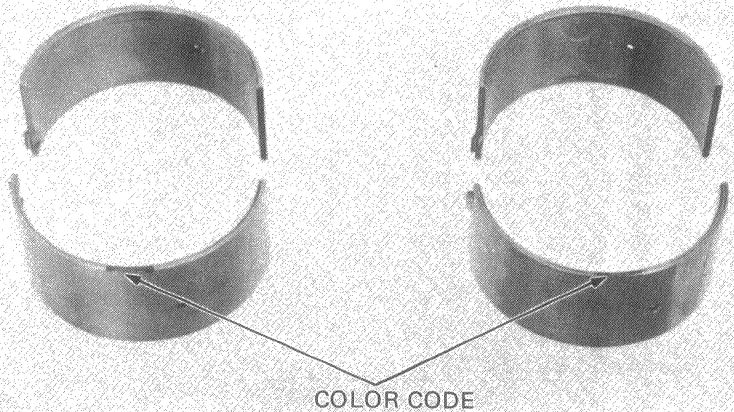
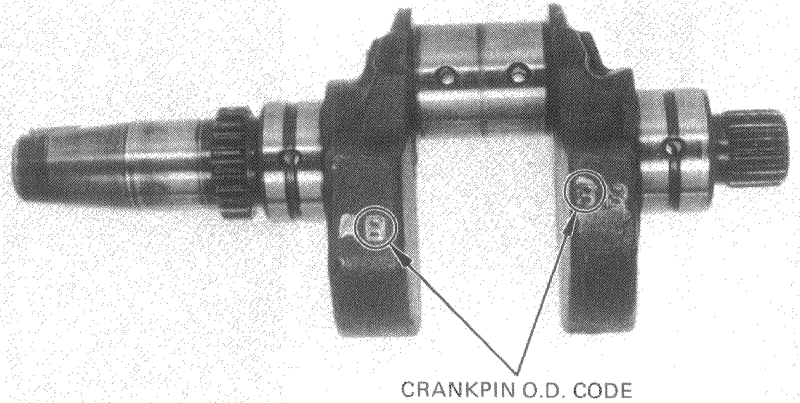
| COLOR  | BEARING THICKNESS |
|--------|-------------------|
| BLACK  | 1.503–1.507 mm    |
| BROWN  | 1.499–1.503 mm    |
| GREEN  | 1.495–1.499 mm    |
| YELLOW | 1.491–1.495 mm    |
| PINK   | 1.487–1.491 mm    |

**NOTE**

After fitting new bearing inserts, they should be rechecked with plastigauge.

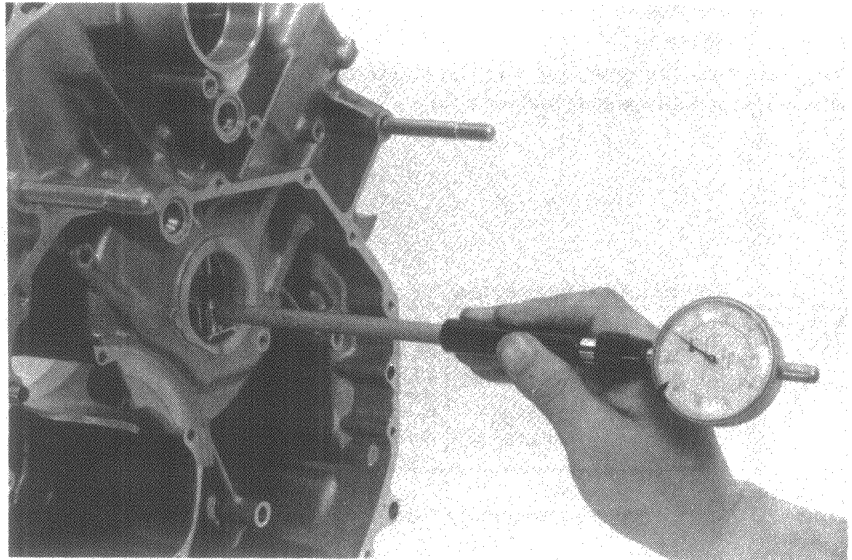
● **MAIN JOURNAL BEARINGS**

Determine and record the main journal O.D. codes.



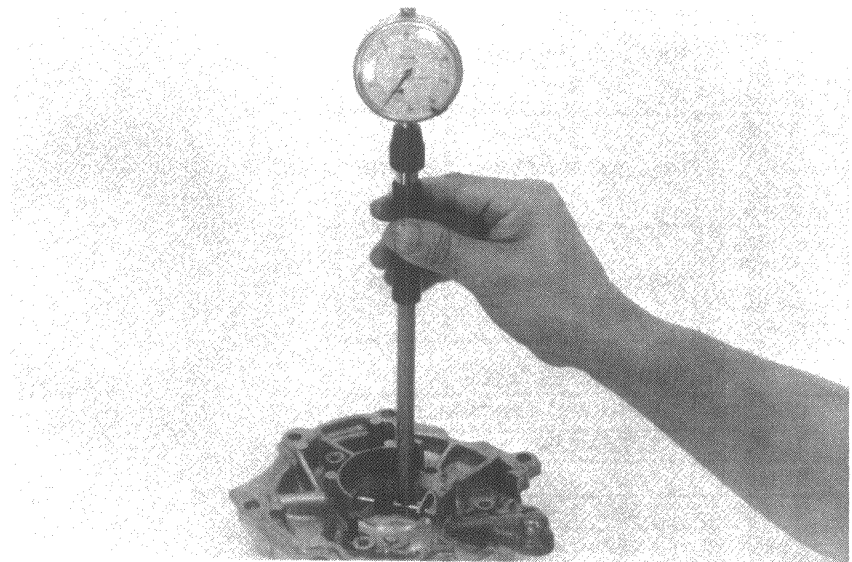
**CRANKSHAFT/PISTON**

Measure the engine case bearing support I.D.



Measure the crankshaft cap bearing support I.D.

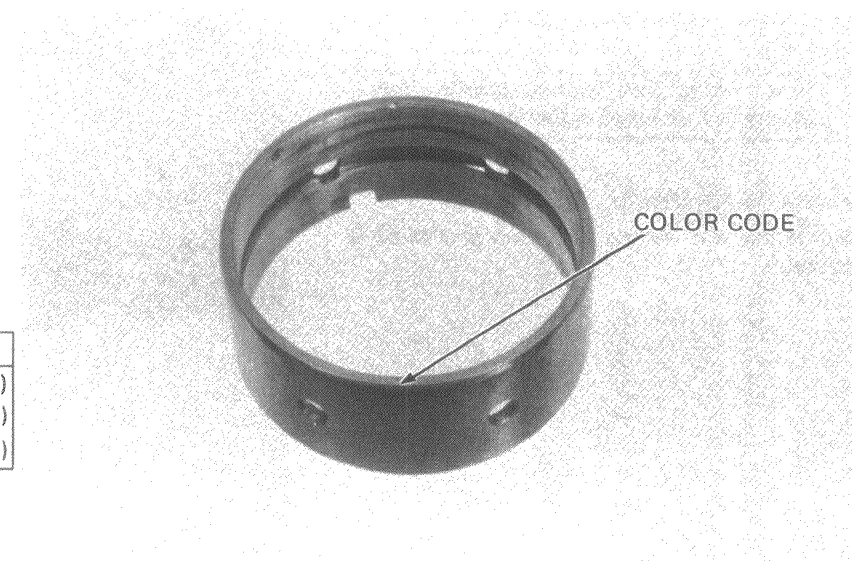
Cross reference the bearing support I.D. and crank journal codes to determine the replacement bearing color.


**MAIN BEARING SELECTION**

|                                      | MAIN JOURNAL SIZE CODES      |       |
|--------------------------------------|------------------------------|-------|
|                                      | A                            | B     |
| CRANKCASE/CAP BEARING SUPPORT I.D.   | BEARING IDENTIFICATION COLOR |       |
| 47.000–47.010 mm (1.8504–1.8508 in.) | BROWN                        | BLACK |
| 47.010–47.020 mm (1.8508–1.8517 in.) | BLACK                        | BLUE  |

**JOURNAL BEARING SIZES**

| COLOR | THICKNESS                          |
|-------|------------------------------------|
| BROWN | 1.989–1.999 mm (0.0783–0.0787 in.) |
| BLACK | 1.994–2.004 mm (0.0785–0.0789 in.) |
| BLUE  | 1.999–2.009 mm (0.0787–0.0791 in.) |





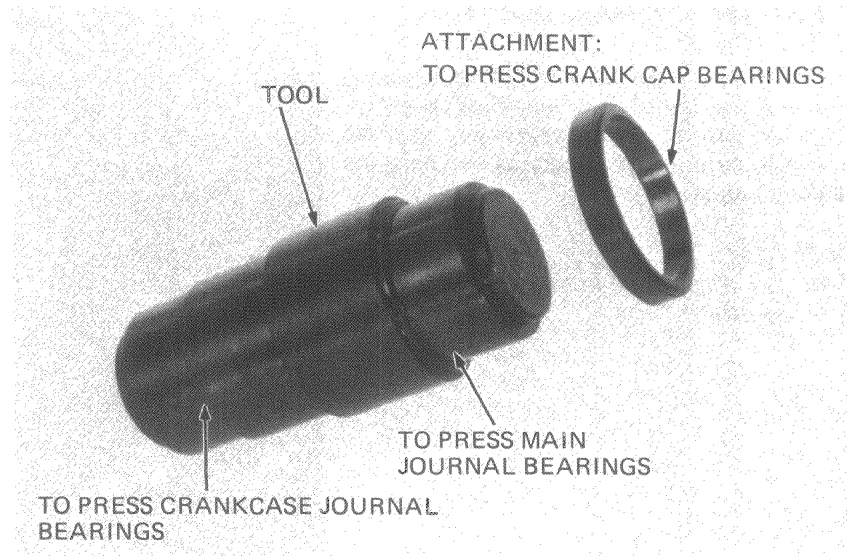
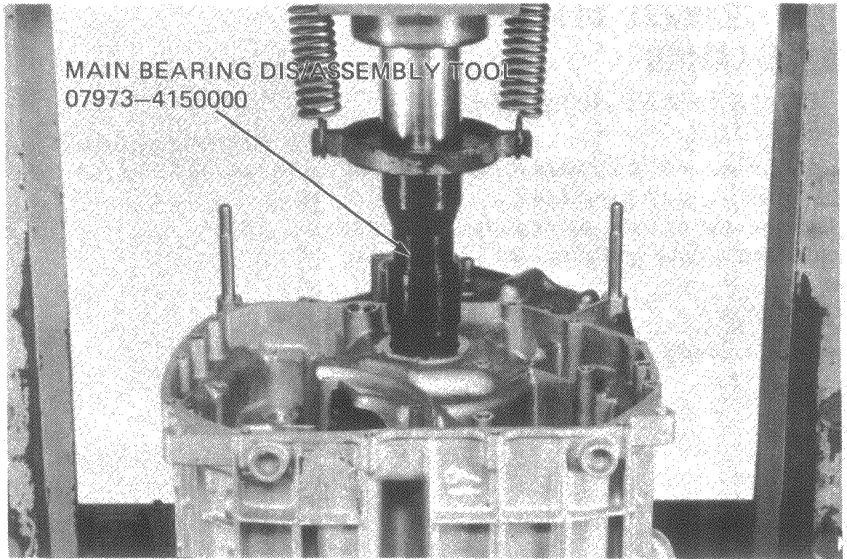


### MAIN JOURNAL BEARING REMOVAL

Press the bearing out with a hydraulic press and bearing DIS/ASSEMBLY tool.

**CAUTION**

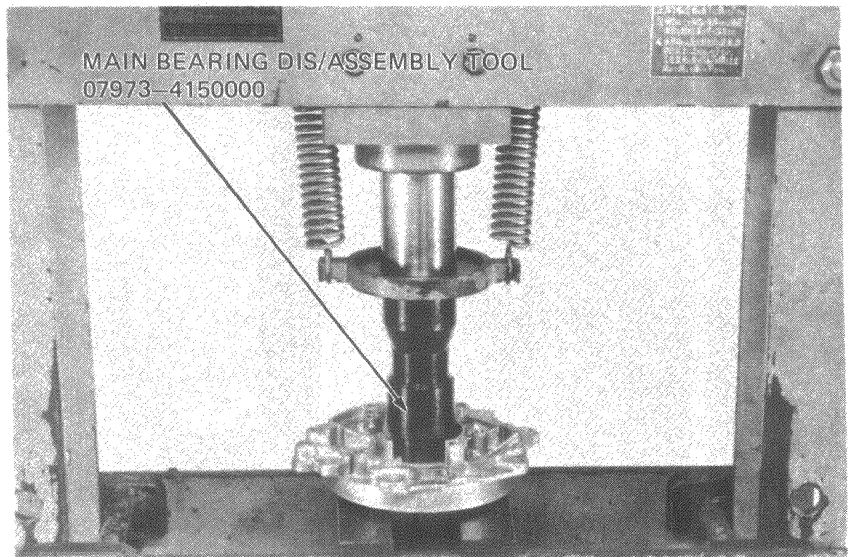
*To prevent engine case damage, always use a hydraulic press and bearing removal tool to remove bearings.*



Press the bearings out of the crankshaft cap bearing support with a hydraulic press and bearing removal tool.

**CAUTION**

*To prevent crankshaft cap damage, always use a hydraulic press and bearing removal tool to remove bearings.*





## MAIN JOURNAL BEARING INSTALLATION

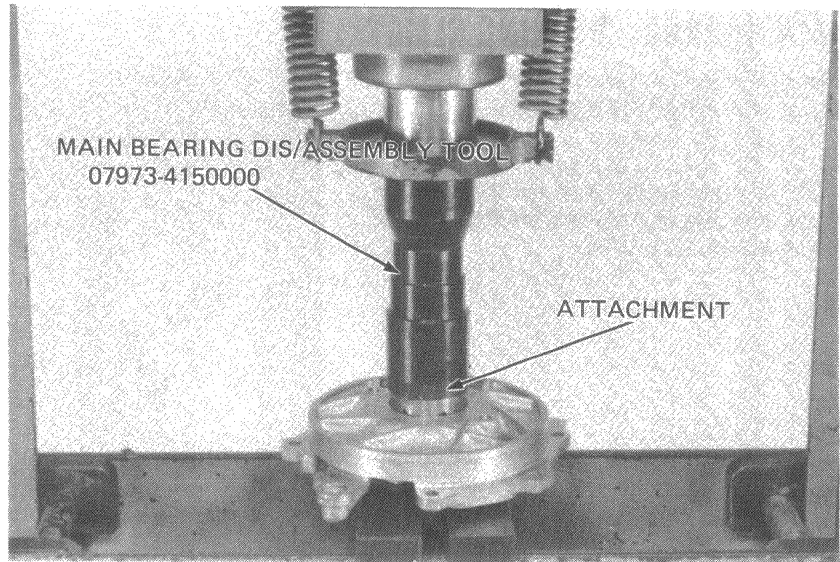
### • CRANKSHAFT HOLDER CAP BEARING

Apply engine oil or molybdenum disulfide grease to the bearing outer periphery.

Align the tab of each bearing insert with the holder cap groove and press the bearings into place.

**CAUTION**

*Do not damage the bearings, when press fitting them.*



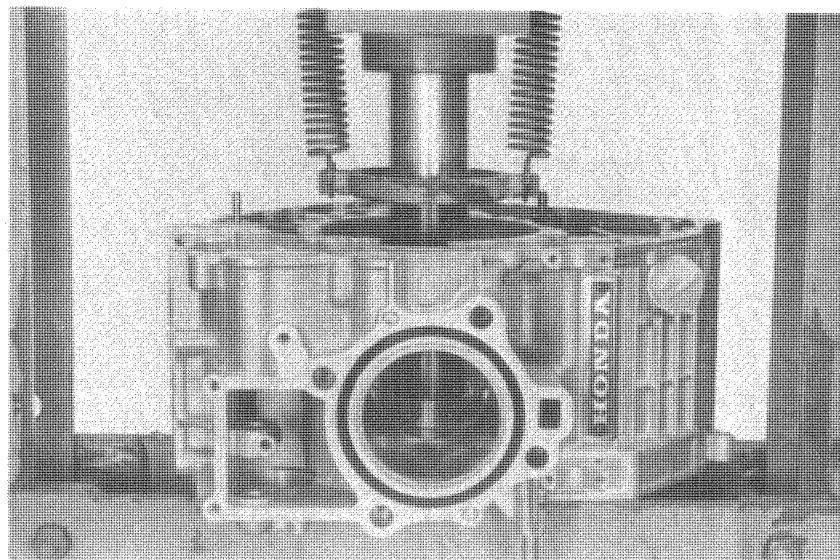
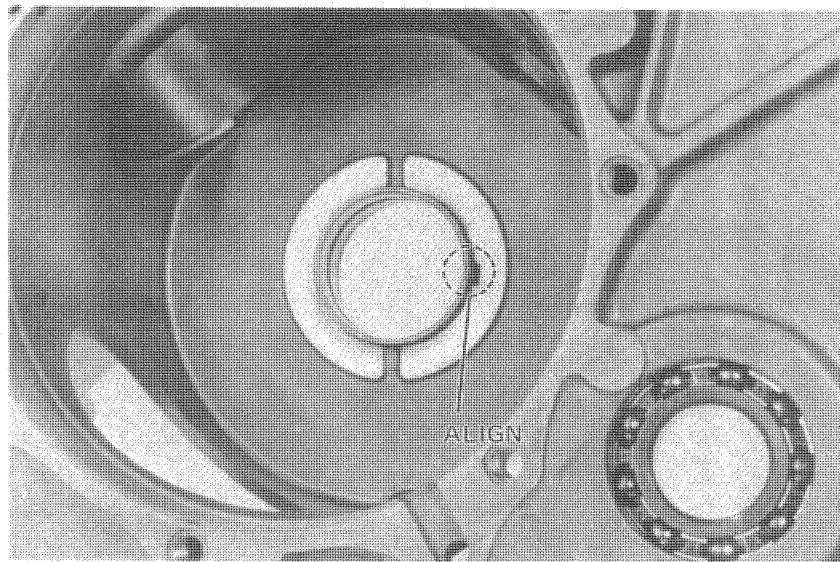
### • CRANKCASE MAIN JOURNAL BEARINGS

Lubricate the outer periphery of each bearing with engine oil or molybdenum disulfide grease.

Align the tab of each bearing insert with the crankcase bearing support groove and press the bearings into place.

**CAUTION**

*Do not damage the bearings, when press fitting them.*



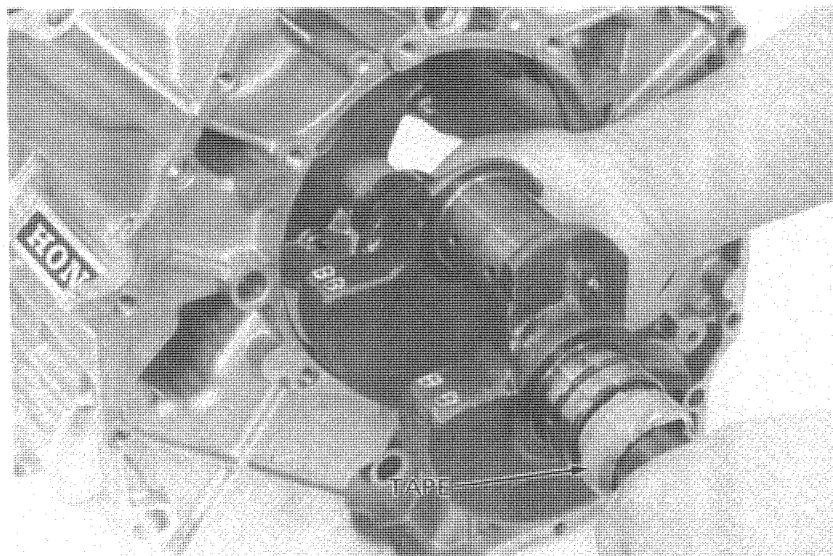


## CRANKSHAFT INSTALLATION

Install the lower main bearing inserts.  
Install the crankshaft.

### NOTE

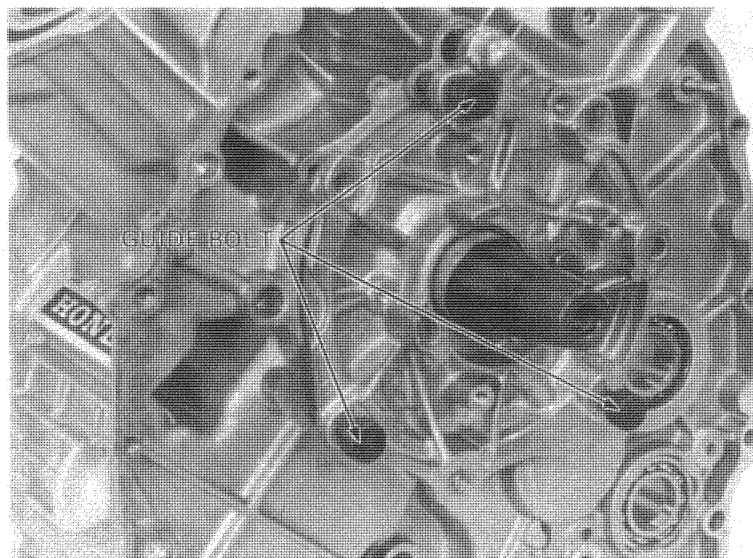
- Lubricate the bearings, main journals and crankpins with molybdenum disulfide grease.
- Wrap the splines of the crankshaft and timing gear area with vinyl tape to prevent damage.



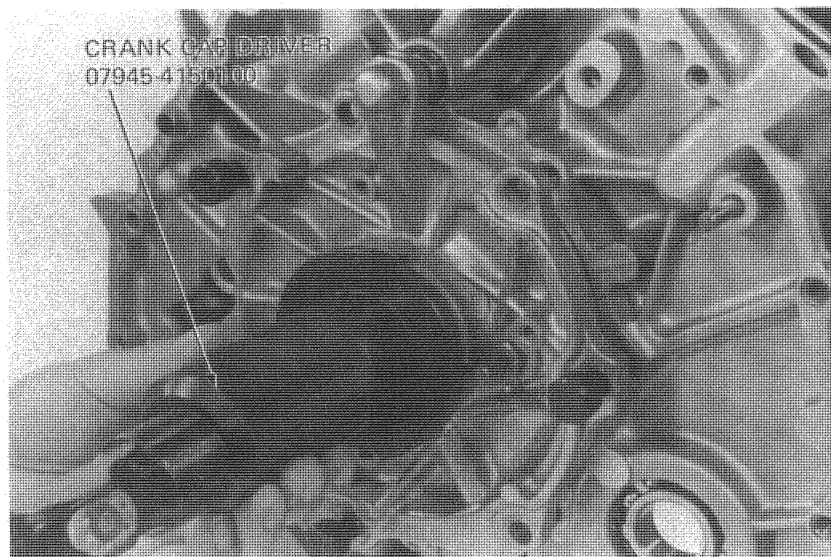
Install the O-ring and collar.  
Install the crankshaft holder cap.  
Install the guide bolts in the crankshaft holder cap as shown.

### NOTE

- Lubricate the bearing with molybdenum disulfide grease.
- Screw in the guide bolts so that the cap is not tilted.



Drive the crankshaft holder cap into place with a hammer and driver.





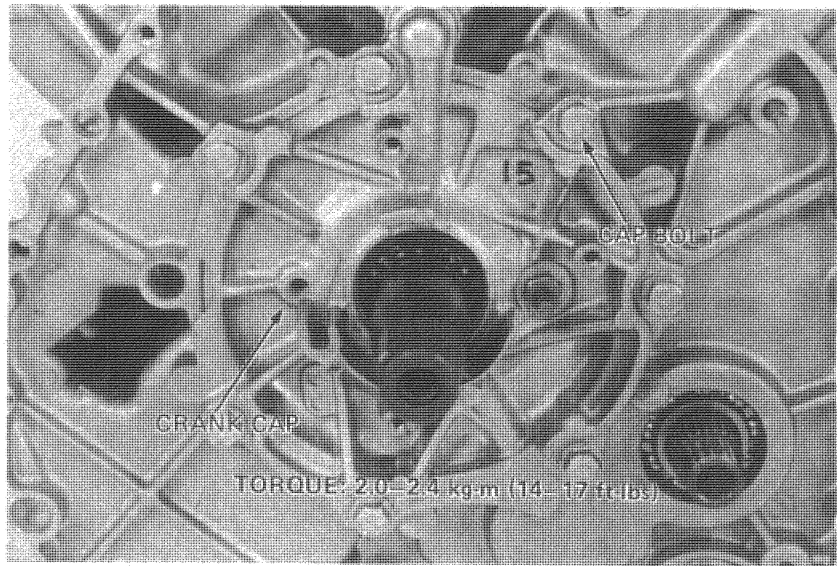


**CRANKSHAFT/PISTON**

Tighten the cap bolts.

**NOTE**

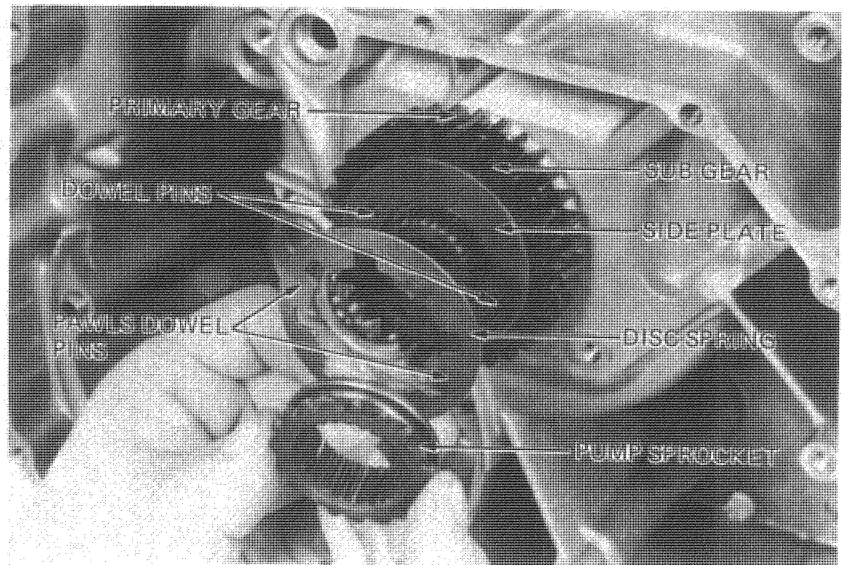
After tightening the bolts, make sure that the crankshaft rotates freely.



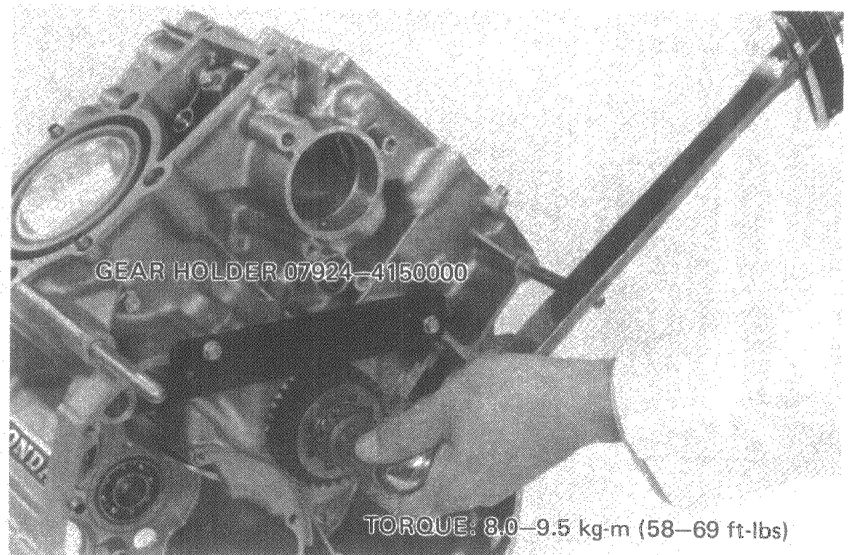
Install the primary gear, primary sub gear, side plate, disc spring and oil pump drive sprocket.

**NOTE**

- Install the dish spring with the pawls placed over the dowel pins to prevent them from coming out during operation.
- Before assembling, lubricate all parts with engine oil.
- Note the primary sub gear and side plate directions by referring to the marks made during disassembly.



Install the DRIVE GEAR HOLDER to prevent the drive gear from turning.  
Torque the primary gear.







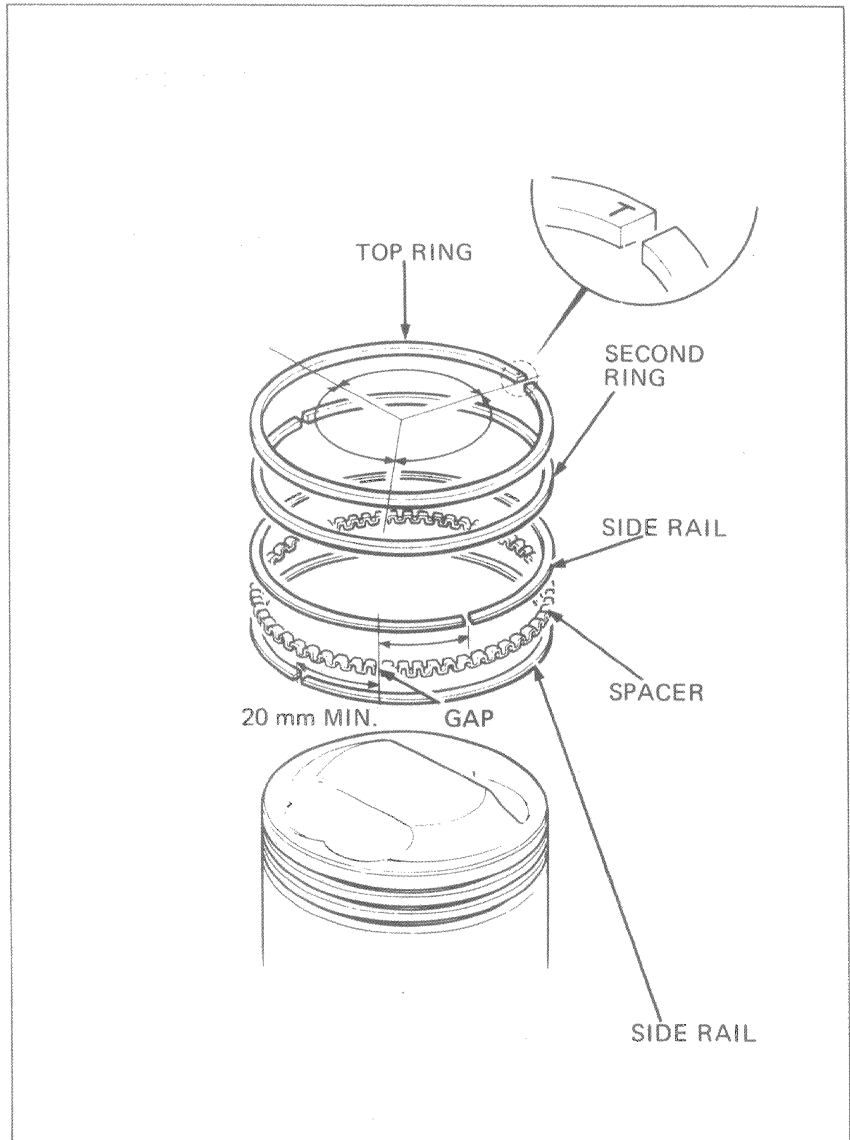
## PISTON INSTALLATION

Clean the piston domes, ring lands, and side faces.

Carefully install the piston rings.

### NOTE

- Do not damage the pistons and piston rings during assembly.
- All rings should be installed with the markings facing up.
- Space the piston ring end gaps 120 degrees apart, avoiding the piston pin and thrust sides.
- Do not align the gap in the oil rings.
- After installing the rings they should be free to rotate.

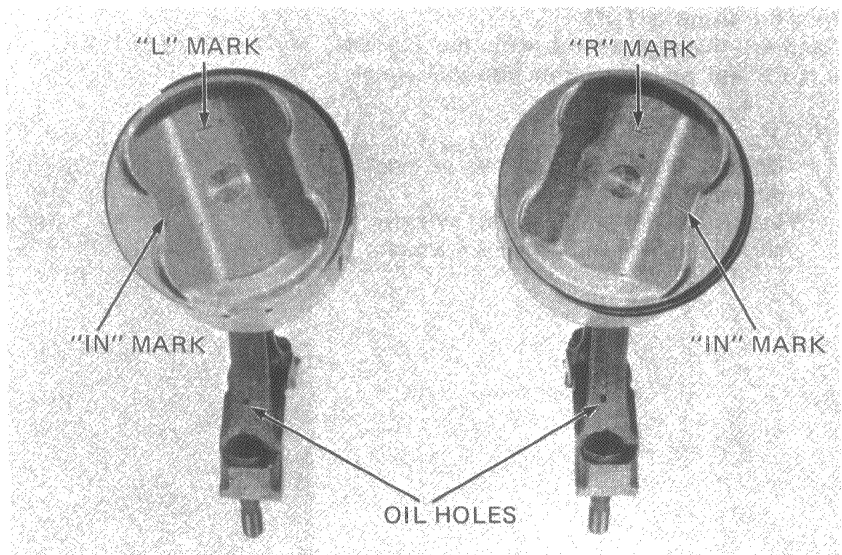


Coat rod small end with molybdenum disulfide grease.

Assemble the pistons and connecting rods with the piston pins and piston pin clips.

### NOTE

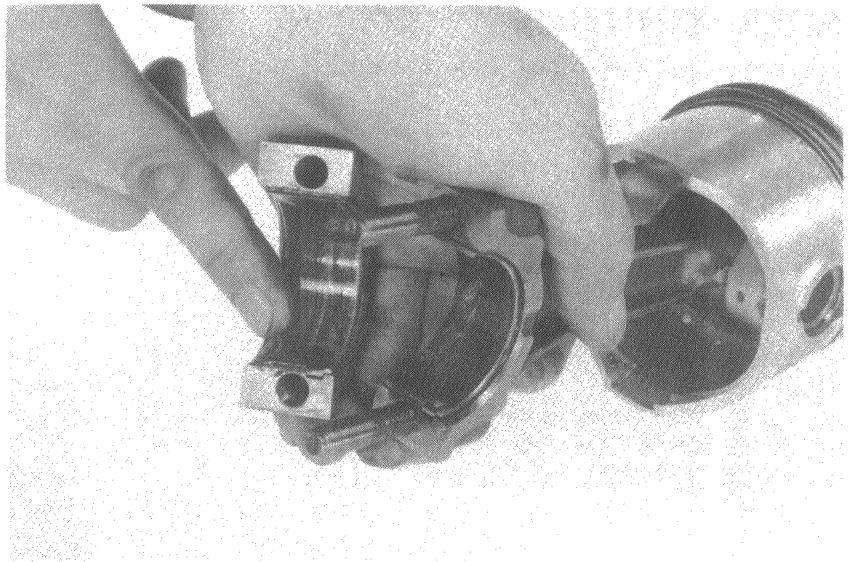
- Do not interchange the pistons, piston pins and connecting rods.
- Make sure that the piston pin clips are properly seated.
- Install the piston with the "L" mark on the left and the piston with the "R" mark on the right.





## CONNECTING ROD INSTALLATION

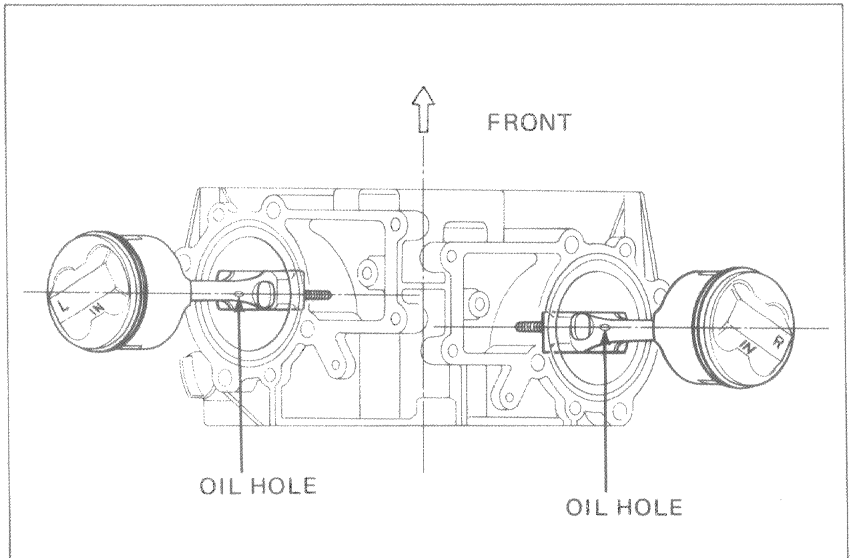
Lubricate the rod bearings with molybdenum disulfide grease.



Install the rod assemblies into the cylinders from the top of the engine case.

### NOTE

- The rod assemblies should be installed with the piston "IN" markings to the rear.
- Lubricate the piston ring grooves and cylinder walls with engine oil.

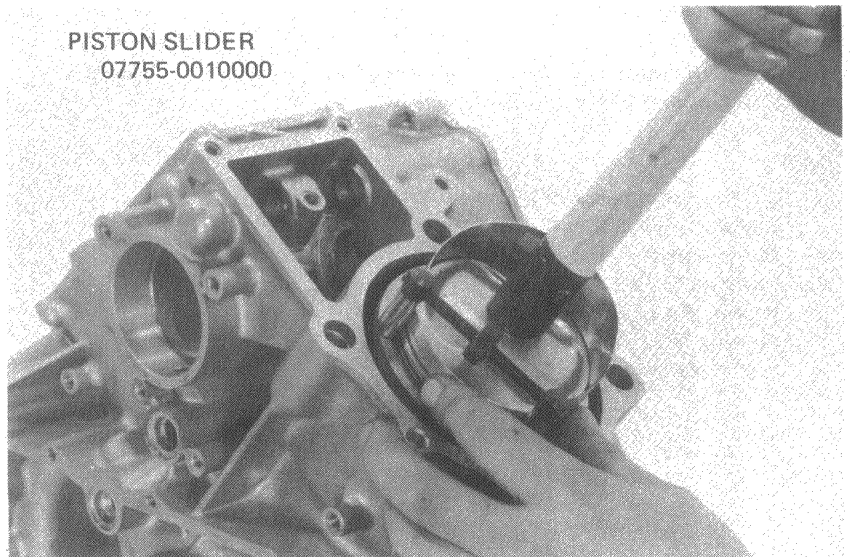


Bring the piston to TDC.  
Compress the piston rings with the PISTON SLIDER and insert the piston into the cylinder.

PISTON SLIDER  
07755-0010000

### NOTE

- Do not damage the pistons or rings during assembly.
- Insert the piston into the cylinder, aligning the big end with the crankpin.





Install the connecting rod caps.

Torque the connecting rod cap bolts.

**TORQUE: 2.8–3.2 kg-m (20–23 ft-lbs)**

**NOTE**

- Be sure the bearing caps are installed in their correct location.
- Turn the crankshaft to make sure the rods rotate freely without binding.
- Torque the bolts evenly in 2–3 steps.

