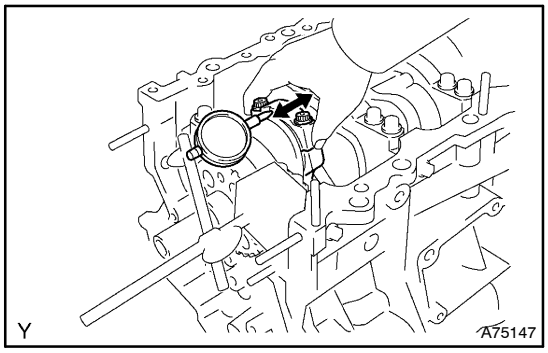
1415L–01

# OVERHAUL




**1. INSPECT CONNECTING ROD THRUST CLEARANCE**

(a) Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.
**Standard thrust clearance:**
**0.15 – 0.30 mm (0.0059 – 0.0118 in.)**
**Maximum thrust clearance: 0.35 mm (0.0138 in.)**

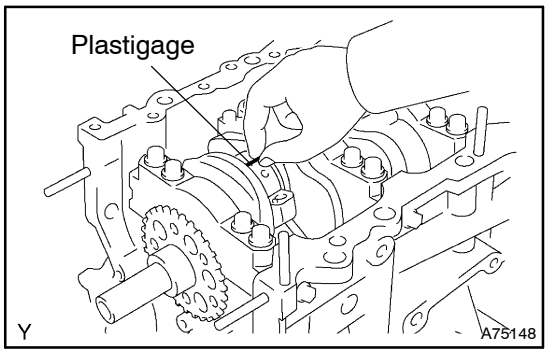
**2. INSPECT CONNECTING ROD OIL CLEARANCE**

(a) Check the match marks on the connecting rod and cap are aligned to ensure correct reassemble.

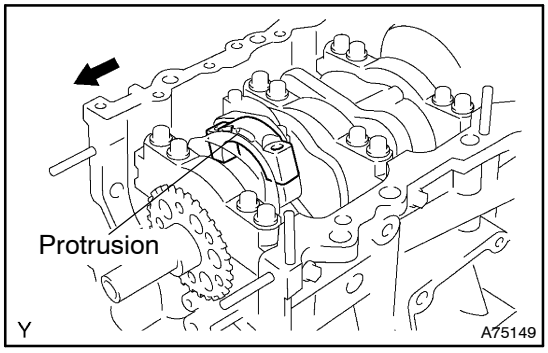
(b) Using SST, remove the 2 connecting rod cap bolts.
SST 09011–38121

(c) Clean the crank pin, bearing and connecting rod.

(d) Check the crank pin and bearing for pitting and scratches.

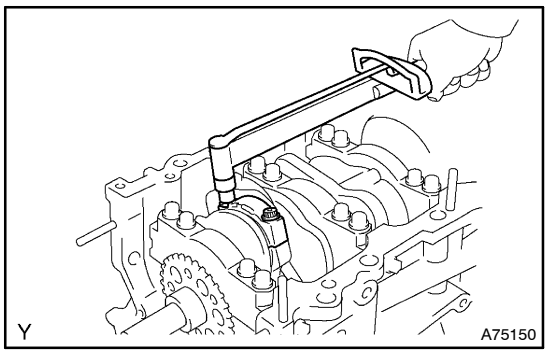



(e) Lay a strip of plastigage across the crank pin.

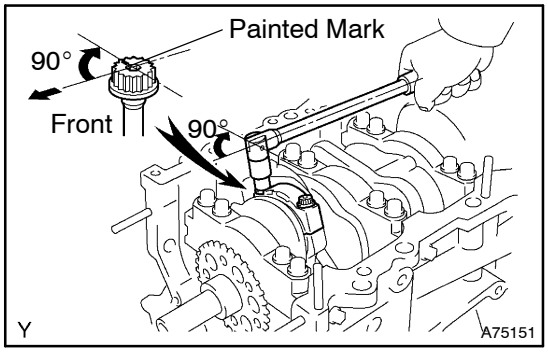



(f) Check that the protrusion of the connecting rod cap is facing in the correct direction.

(g) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.




(h) Using SST, tighten the bolts in several passes by the specified torque.
SST 09011–38121
**Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)**



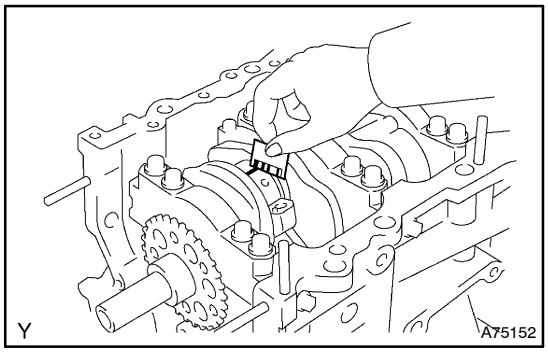

(i) Mark the front side of the each connecting cap bolt with paint.

(j) Retighten the cap bolts by 90° as shown in the illustration.

**NOTICE:**

**Do not turn the crankshaft.**

(k) Remove the 2 bolts, connecting rod cap and lower bearing.




(l) Measure the plastigage at its widest point.

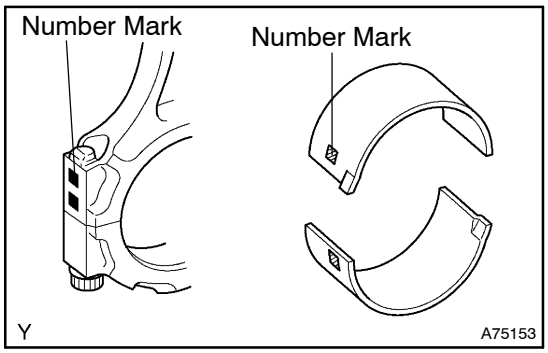
**Standard oil clearance:**

**0.026 – 0.046 mm (0.0010 – 0.0018 in.)**

**Maximum oil clearance: 0.066 mm (0.0025 in.)**

**NOTICE:**

**Completely remove the plastigage.**

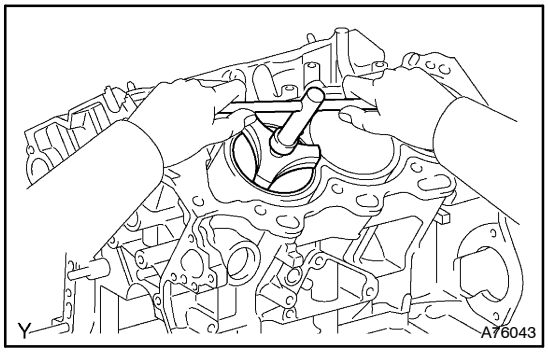



(m) If replace the bearing, replace it with one having the same number as marked on the connecting rod. There are 4 sizes of standard bearings, marked "1 ", "2", "3" and "4" accordingly.

HINT:

Standard bearing center wall thickness

| Mark | mm (in.) |
|---|---|
| "1" | 1.484 – 1.487 (0.0584 – 0.0585) |
| "2" | 1.487 – 1.490 (0.0585 – 0.0587) |
| "3" | 1.490 – 1.493 (0.0587 – 0.0588) |
| "4" | 1.493 – 1.496 (0.0588 – 0.0589) |




### 3. REMOVE PISTON SUB–ASSY W/CONNECTING ROD

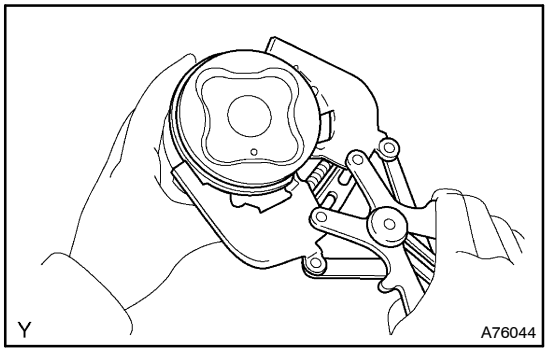
(a) Using a ridge reamer, remove all the carbon from the top of the cylinder.

(b) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

HINT:

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

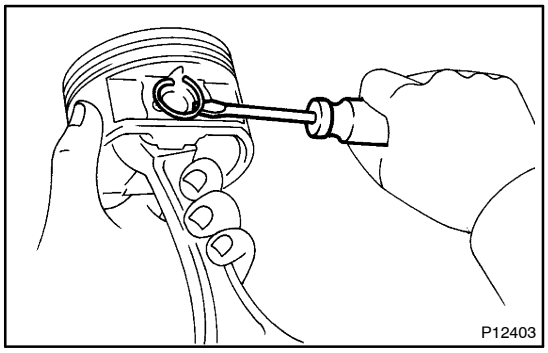
### 4. REMOVE CONNECTING ROD BEARING




**5. REMOVE PISTON RING SET**

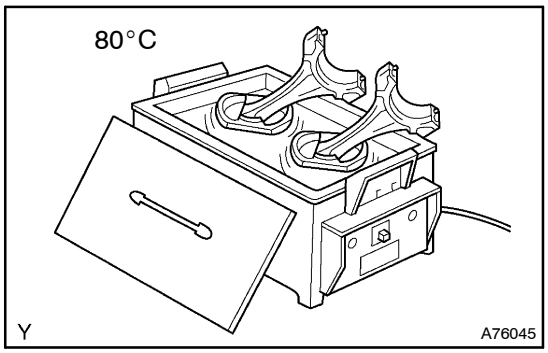
(a) Using a piston ring expander, remove the 2 compression rings.

(b) Remove the 2 side rails and oil ring by hand.



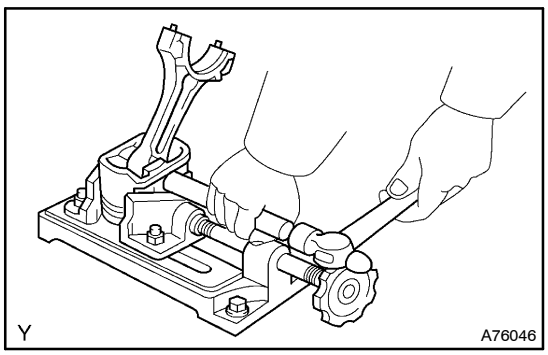

**6. REMOVE PISTON PIN HOLE SNAP RING**

(a) Using a small screwdriver, pry out the 2 snap rings.




**7. REMOVE W/PIN PISTON SUB–ASSY**

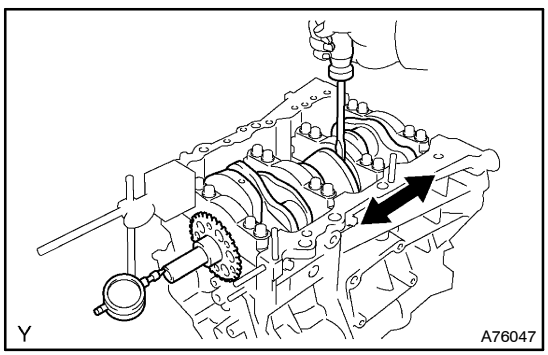
(a) Gradually heat the piston to approx. 80°C (176°F).




(b) Using a plastic–faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.

HINT:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.




**8. INSPECT CRANKSHAFT THRUST CLEARANCE**

(a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

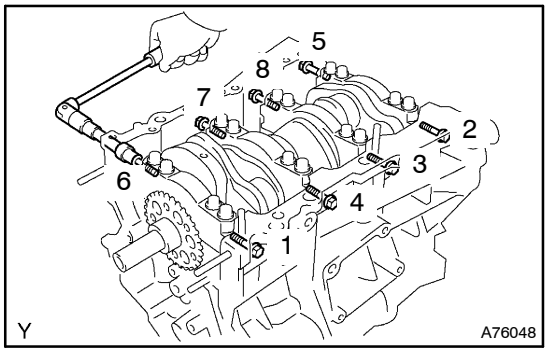
**Standard thrust clearance:**

**0.04 – 0.24 mm (0.0016 – 0.0094 in.)**

**Maximum thrust clearance: 0.30 mm (0.0118 in.)**

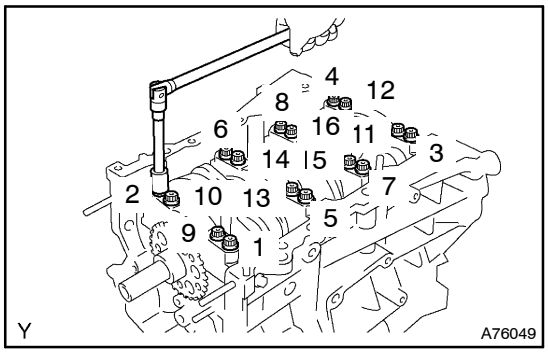
If the thrust clearance is greater than maximum, replace the thrust washers as a set or a crankshaft.

HINT:
Thrust washer thickness 1.93 – 1.98 mm (0.0760 – 0.0780 in.)

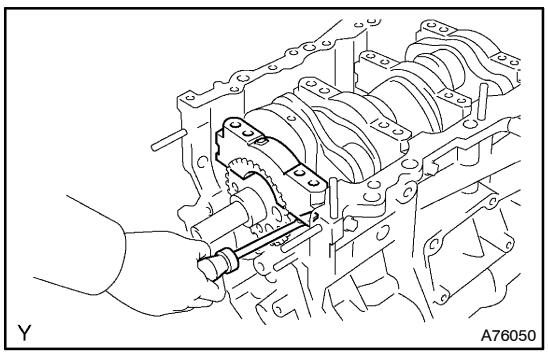



**9. REMOVE CRANKSHAFT**

(a) Uniformly loosen and remove the 8 main bearing cap bolts and seal washers in the several passes, in the sequence shown.



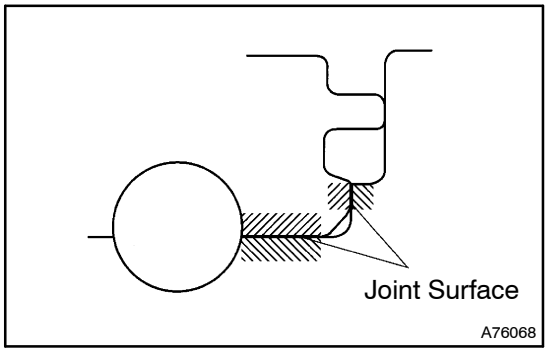

(b) Uniformly loosen and remove the 16 main bearing cap bolts in several passes, in the sequence shown.




(c) Using a screwdriver, pry out main bearing caps. Remove the 4 main bearing caps and lower bearings.

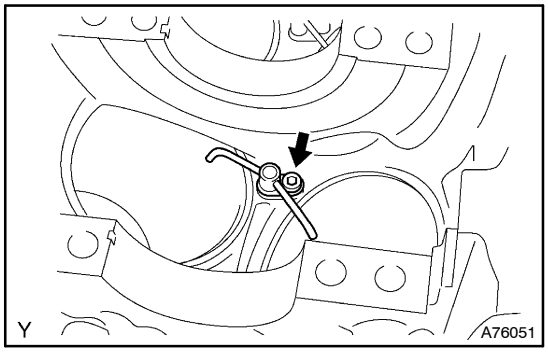
**NOTICE:**

- **Pull up the main bearing cap little by little to the right and the left by turns.**
- **Be careful not to damage the joint surface of the cylinder block and the main bearing cap.**



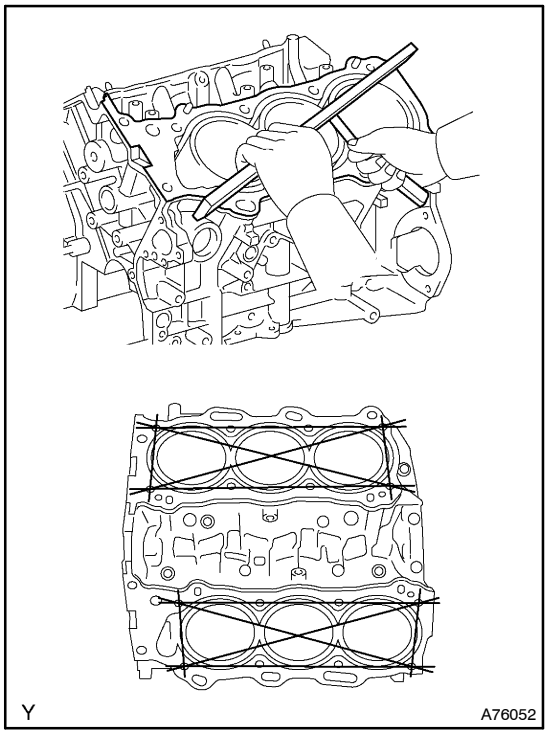

**10. REMOVE CRANKSHAFT THRUST WASHER SET**

**11. REMOVE CRANKSHAFT BEARING**




**12. REMOVE SUB–ASSY OIL NOZZLE NO.1**

(a) Using a 5 mm socket hexagon wrench, remove the 3 oil nozzles.

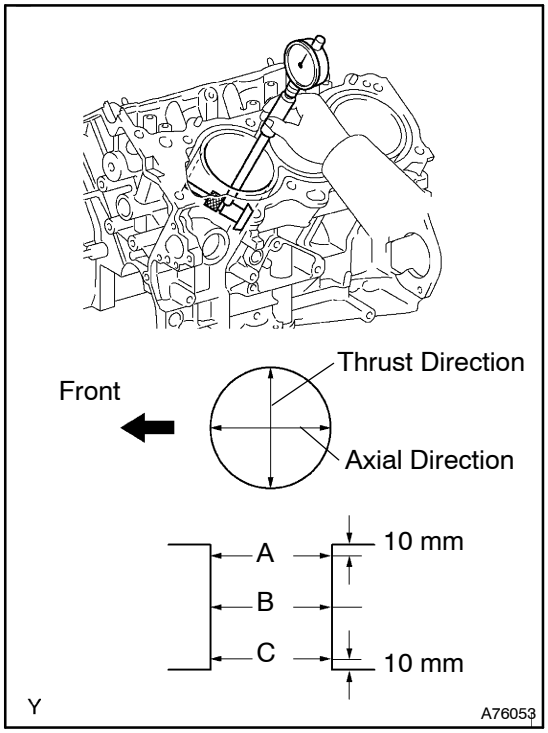



**13. INSPECT CYLINDER BLOCK FOR FLATNESS**

(a) Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

**Maximum warpage: 0.05 mm (0.0020 in.)**

If warpage is greater than maximum, replace the cylinder block.




**14. INSPECT CYLINDER BORE**

(a) Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

(b) Calculate the difference between the maximum diameter and the minimum diameter in the 6 measured values.

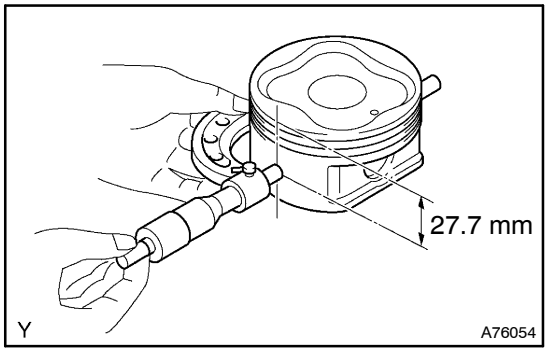
**Difference limit:0.10 mm (0.0039 in.)**

(Reference)

**Standard diameter:**

**94.000 – 94.012 mm (3.7008 – 3.7013 in.)**

If the diameter is greater than limit, replace the cylinder block.




**15. INSPECT W/PIN PISTON SUB–ASSY**

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 27.7 mm (1.091 in.) from the piston head.

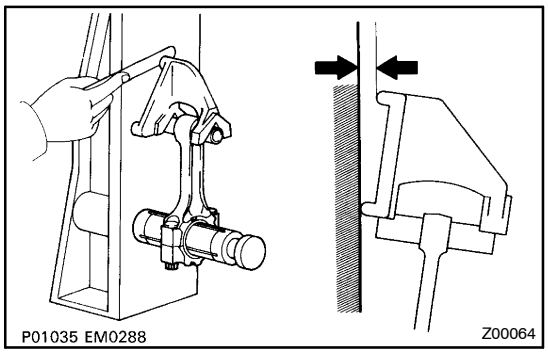
**Piston diameter:**
**93.910 – 93.920 mm (3.6972 – 3.6976 in.)**

**16. INSPECT PISTON OIL CLEARANCE**

(a) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

**Standard oil clearance: 0.080 – 0.102 mm (0.0031 – 0.0040 in.)**
**Maximum oil clearance: 0.13 mm (0.0051 in.)**

If the oil clearance is greater than maximum, replace all the 6 pistons. If necessary, replace the cylinder block.



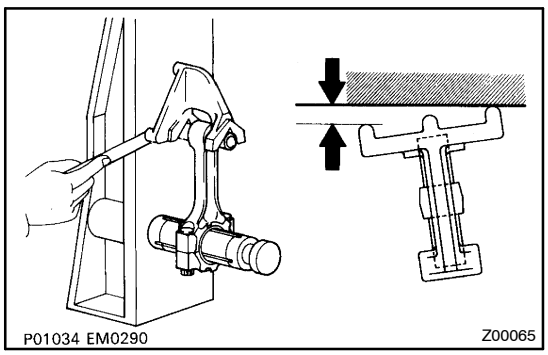

**17. INSPECT CONNECTING ROD SUB–ASSY**

(a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for out–of–alignment.

**Maximum out–of alignment:**
**0.05 mm (0.0020 in.) per 100 mm (3.94 in.)**

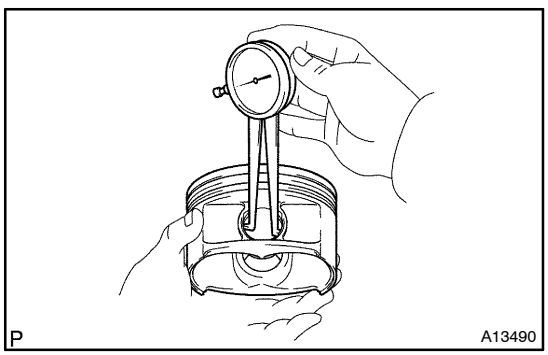
If out–of alignment is greater than maximum, replace the connecting rod assembly.




(2) Check of twist.

**Maximum twist:**
**0.15 mm (0.0059 in.) per 100 mm (3.94 in.)**

If twist is greater than maximum, replace the connecting rod assembly.




**18. INSPECT PISTON PIN OIL CLEARANCE**

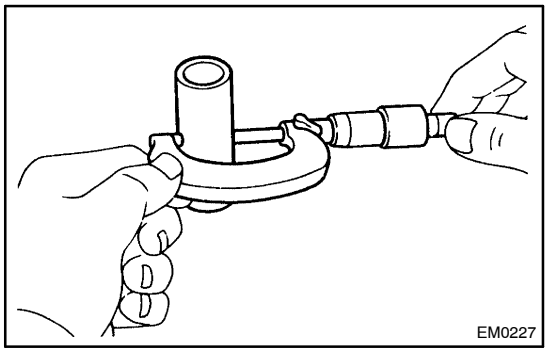
(a) Using a caliper gauge, measure the inside diameter of the piston pin hole.

**Piston pin hole inside diameter:**
**22.001 – 22.010 mm (0.8662 – 0.8665 in.)**

HINT:

**Piston pin hole inside diameter**

| Mark | mm (in.) |
|---|---|
| A | 22.001 – 22.004 (0.8662 – 0.8663) |
| B | 22.005 – 22.007 (0.8663 – 0.8664) |
| C | 22.008 – 22.010 (0.8665 – 0.8665) |




(b) Using a micrometer, measure the piston pin diameter.

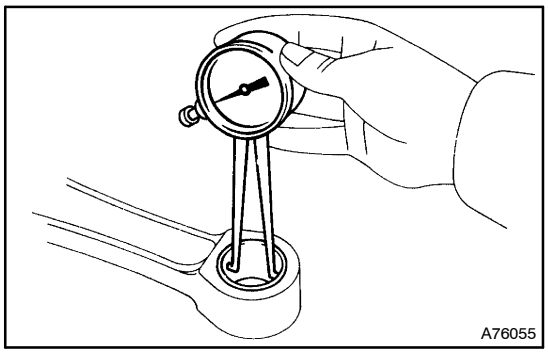
**Piston pin diameter:**

**21.997 – 22.006 mm (0.8660 – 0.8664 in.)**

HINT:

**Piston pin diameter**

| Mark | mm (in.) |
|---|---|
| A | 21.997 – 22.000 (0.8660 – 0.8661) |
| B | 22.001 – 22.003 (0.8661 – 0.8663) |
| C | 22.004 – 22.006 (0.8663 – 0.8664) |




(c) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

**Bushing inside diameter:**

**22.005 – 22.014 mm (0.8663 – 0.8667 in.)**

HINT:

**Bushing inside diameter**

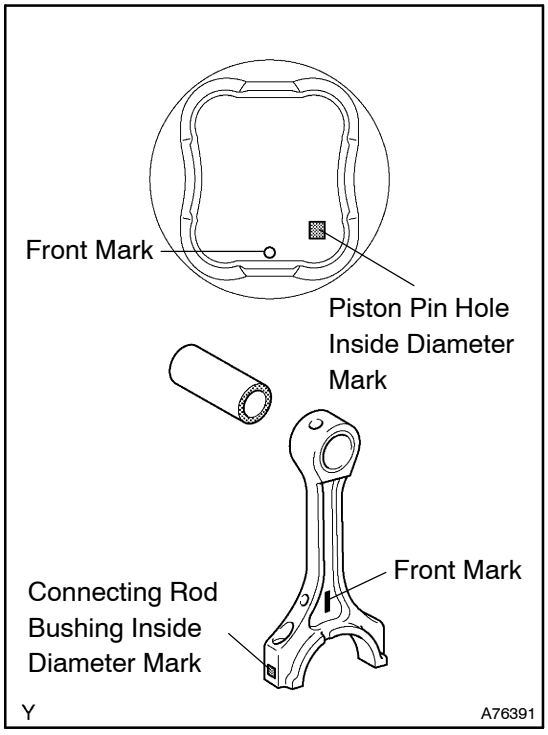
| Mark | mm (in.) |
|---|---|
| A | 22.005 – 22.008 (0.8663 – 0.8665) |
| B | 22.009 – 22.011 (0.8665 – 0.8666) |
| C | 22.012 – 22.014 (0.8666 – 0.8667) |

(d) Subtract the piston pin diameter measurement from the piton pin hole diameter measurement.

**Standard oil clearance:**

**0.001 – 0.007 mm (0.00004 – 0.00028 in.)**

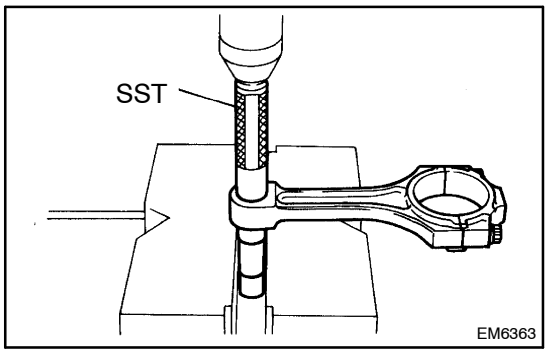
**Maximum oil clearance: 0.040 mm (0.0016 in.)**




(e) If the oil clearance is greater than maximum, replace the bushing. If necessary, replace the piston and piston pin as a set.

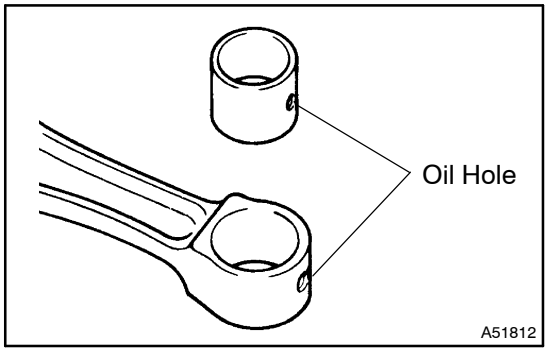
(f) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.
**Standard oil clearance:**
**0.005 – 0.011 mm (0.0002 – 0.0004 in.)**
**Maximum oil clearance: 0.050 mm (0.0020 in.)**

(g) If the oil clearance is greater than maximum, replace the bushing. If necessary, replace the connecting rod and piston pin as a set.



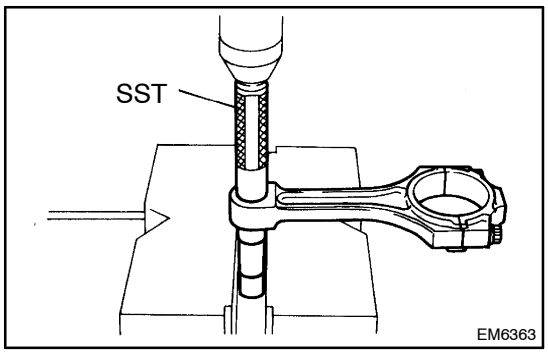

**19. REMOVE CONNECTING ROD SMALL END BUSH**

(a) Using SST and a press, press out the bushing.
SST 09222–30010

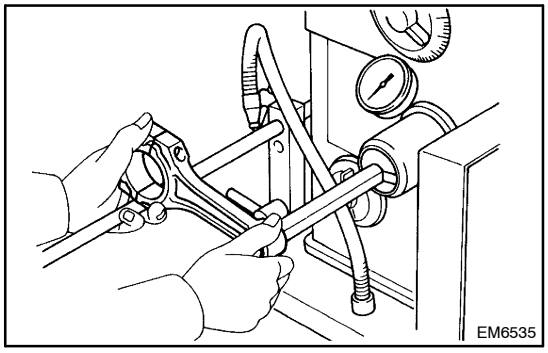



**20. INSTALL CONNECTING ROD SMALL END BUSH**

(a) Align the oil holes of a new bushing and the connecting rod.



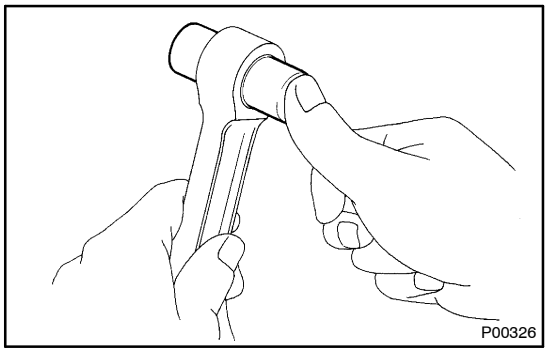

(b) Using SST and a press, press in the bushing.
SST 09222–30010

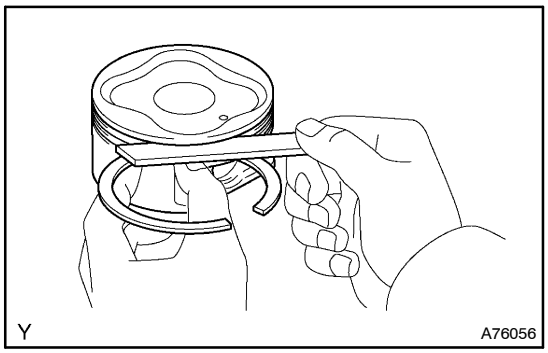



(c) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance between the bushing and piston pin.

**Standard oil clearance:**
**0.005 – 0.011 mm (0.0002 – 0.0004 in.)**

HINT:
Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with thumb.

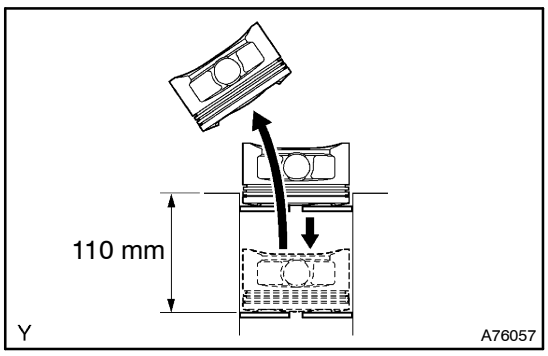



**21. INSPECT RING GROOVE CLEARANCE**

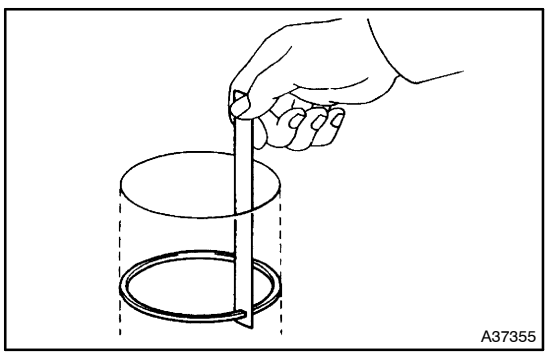
(a) Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

**Ring groove clearance:**
**No.1 0.02 – 0.07 mm (0.0008 – 0.0028 in.)**
**No.2 0.02 – 0.06 mm (0.0008 – 0.0024 in.)**
**Oil 0.07 – 0.15 mm (0.0028 – 0.0060 in.)**



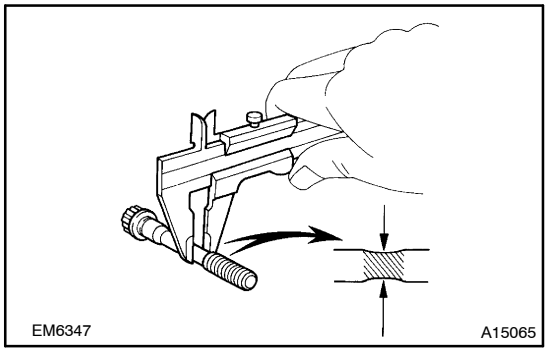

**22. INSPECT PISTON RING END GAP**

(a) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.




(b) Using a feeler gauge, measure the end gap.

**Standard end gap:**
**No. 1 0.30 – 0.40 mm (0.0118 – 0.0157 in.)**
**No. 2 0.40 – 0.50 mm (0.0157 – 0.0197 in.)**
**Oil (Side rail) 0.10 – 0.40 mm (0.0039 – 0.0157 in.)**
**Maximum end gap:**
**No. 1 1.0 mm (0.039 in.)**
**No. 2 1.1 mm (0.043 in.)**
**Oil (Side rail) 1.0 mm (0.039 in.)**



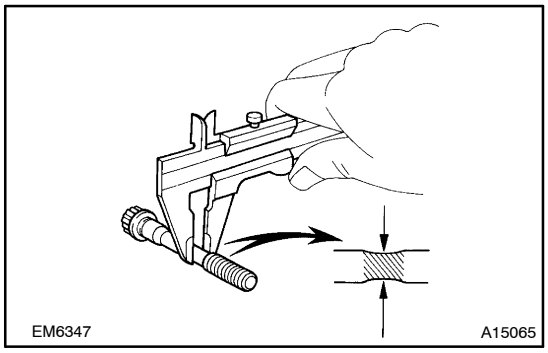

**23. INSPECT CONNECTING ROD BOLT**

(a) Using a vernier caliper, measure the tension portion diameter of the bolt.

**Standard diameter: 7.2 – 7.3 mm (0.283 – 0.287 in.)**

**Minimum diameter: 7.0 mm (0.276 in.)**

If the diameter is less than minimum, replace the bolt.



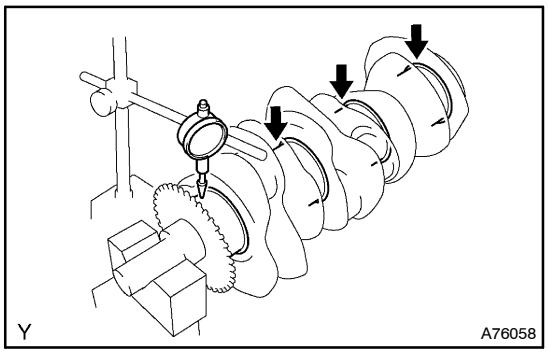

**24. INSPECT CRANKSHAFT BEARING CAP SET BOLT**

(a) Using a vernier caliper, measure the tension portion diameter of the bolt.

**Standard diameter:**

**10.0 – 10.2 mm (0.393 – 0.402 in.)**

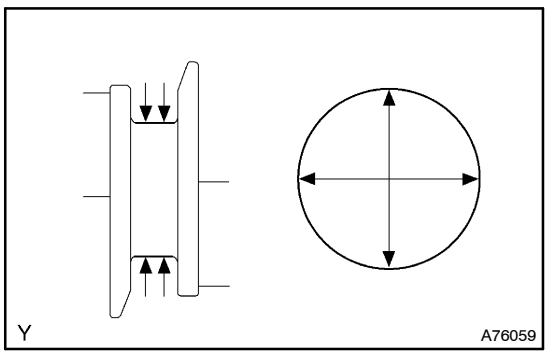
If the diameter is less than minimum, replace the bolt.




**25. INSPECT CRANKSHAFT**

(a) Using a dial indicator and V–blocks, measure the circle runout, as shown in the illustration.

**Maximum circle runout: 0.06 mm (0.0024 in.)**



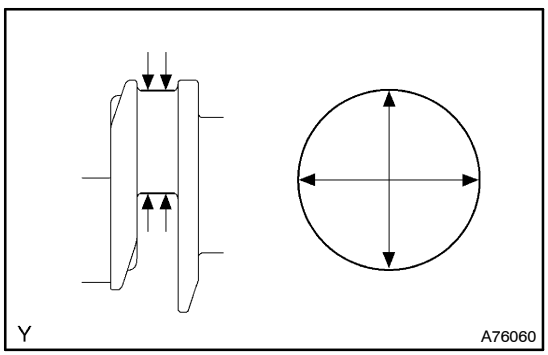

(b) Using a micrometer, measure the diameter of each main journal.

**Diameter: 71.988 – 72.000 mm (2.8342 – 2.8346 in.)**

(c) Check each main journal for taper and out–of–round as shown.

**Maximum taper and out–of–round:**

**0.02 mm (0.0008 in.)**



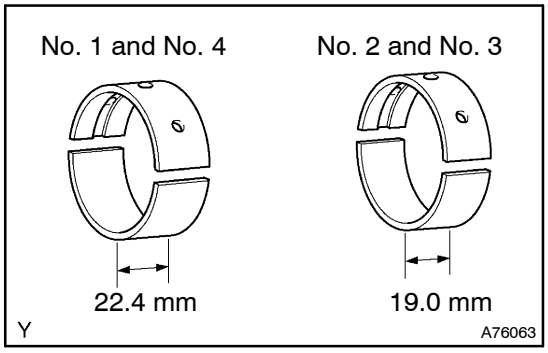

(d) Using a micrometer, measure the diameter of each crank pin.

**Diameter: 55.992 – 56.000 mm (2.2044 – 2.2047 in.)**

(e) Check each crank pin for taper and out–of–round as shown.

**Maximum taper and out–of–round:**

**0.02 mm (0.0008 in.)**

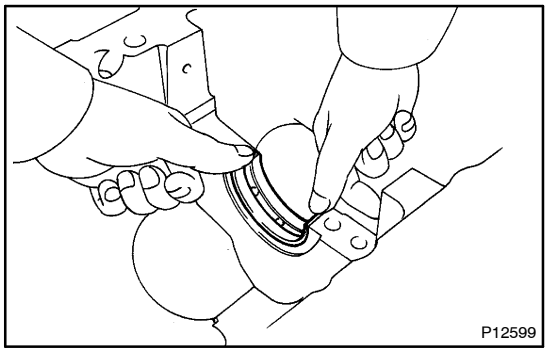



**26. INSPECT CRANKSHAFT OIL CLEARANCE**

HINT:

Main bearings come in widths of 19.0 mm (0.748 in.) and 22.4 mm (0.882 in.). Install the 22.4mm (0.882 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing cap. Install the 19.0 mm (0.748 in.) bearings in the No. 2 and No. 3 positions.

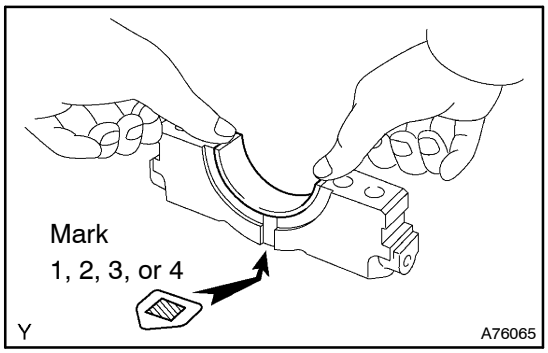
(a) Clean each main journal and bearing.




(b) Align the bearing claw with the claw groove of the cylinder block, and push in the 4 upper bearings.

**NOTICE:**

**Do not apply engine oil to the bearing and its contact surface.**




(c) Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.

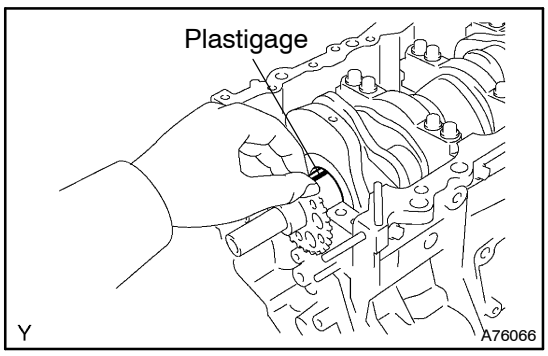
**NOTICE:**

**Do not apply engine oil to the bearing and its contact surface.**

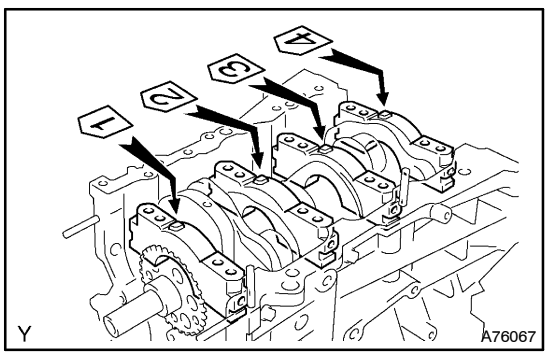
HINT:

A number is marked on each main bearing cap to indicate the installation position.

(d) Place the crankshaft on the cylinder block.



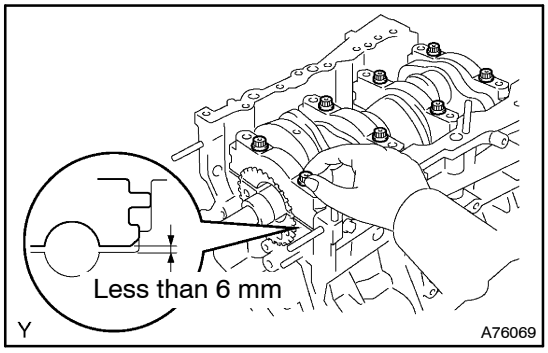

(e) Lay a strip of plastigage across each journal.



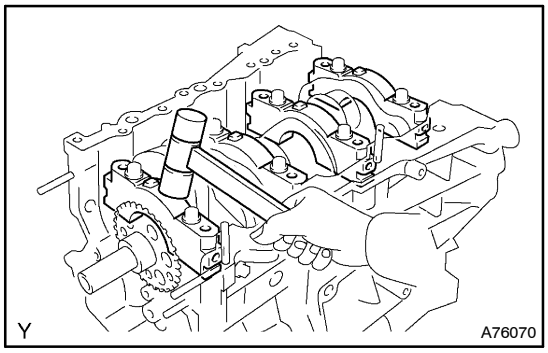

(f) Examine the front marks and numbers and install the bearing caps on the cylinder block.

(g) Apply a light coat of engine oil on the threads and under the head of bearing cap bolts.

(h) Temporarily install the 8 main bearing cap bolts to the inside positions.

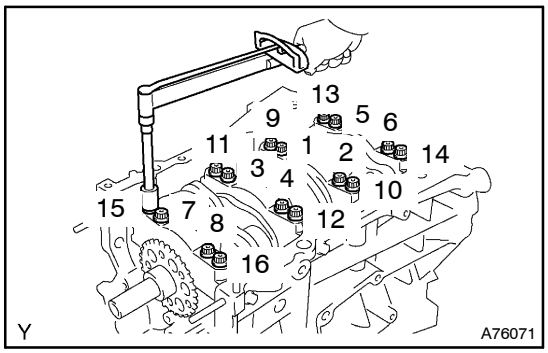



(i) Insert the main bearing cap with hand until the clearance between the main bearing cap and the cylinder block will become less than 6 mm (0.23 in.) by making the 2 internal bearing cap bolts as a guide.

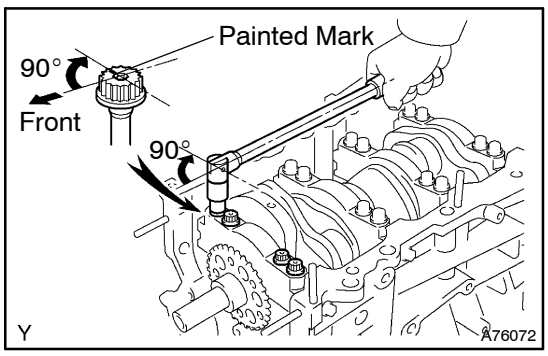



(j) Using a plastic–faced hammer, lightly tap the bearing cap to ensure a proper fit.

(k) Apply a light coat of engine oil on the threads and under the head of main bearing cap bolts.




(l) Install and uniformly tighten the 16 main bearing cap bolts in several passes, in the sequence shown.
**Torque: 61 N·m (622 kgf·cm, 45 ft·lbf)**

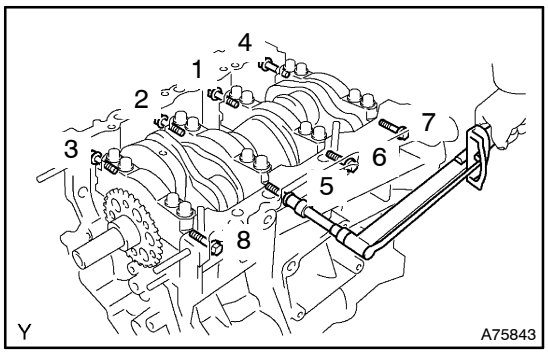



(m) Mark the front side of the bearing cap bolts with paint.

(n) Retighten the bearing cap bolts by 90° in the sequence shown.

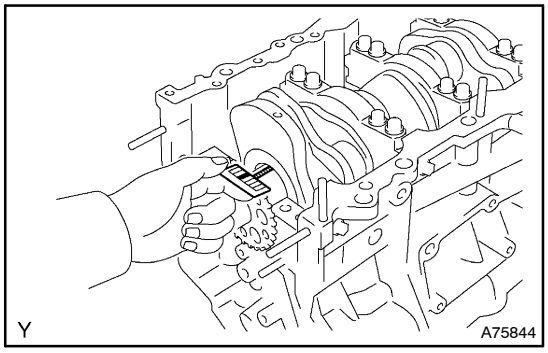
(o) Check that the painted mark is now at a 90° angle to the front.

**NOTICE:**
**Do not turn the crankshaft.**




(p) Install and uniformly tighten the 8 main bearing cap bolts in several passes, in the sequence shown.
**Torque: 35 N·m (357 kgf·cm, 26 ft·lbf)**

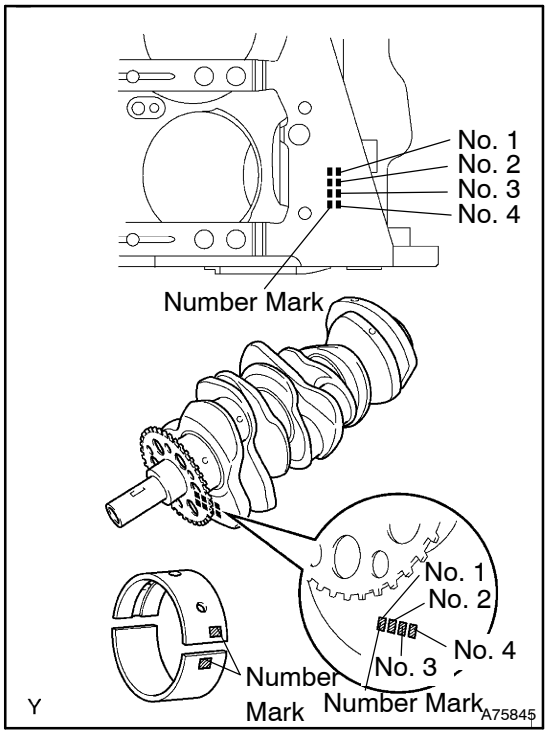
(q) Remove the main bearing caps.




(r) Measure the Plastigage at its widest point.
**Standard oil clearance:**
**0.018 – 0.030 mm (0.0007 – 0.0012 in.)**
**Maximum clearance: 0.046 mm (0.0018 in.)**

If the oil clearance is greater than maximum, replace the bearings. If necessary, replace the crankshaft.

**NOTICE:**
**Completely remove the plastigage.**




(s) If using a bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 size of standard bearings, marked ”1”, ”2”, ”3”, ”4” and ”5” accordingly

**Journal bearings**

| Cylinder block (A) + Crankshaft | 0 – 5 | 6 – 11 | 12 – 17 | 18 – 23 | 24 – 28 |
|---|---|---|---|---|---|
| Use Bearing | ”1” | ”2” | ”3” | ”4” | ”5” |

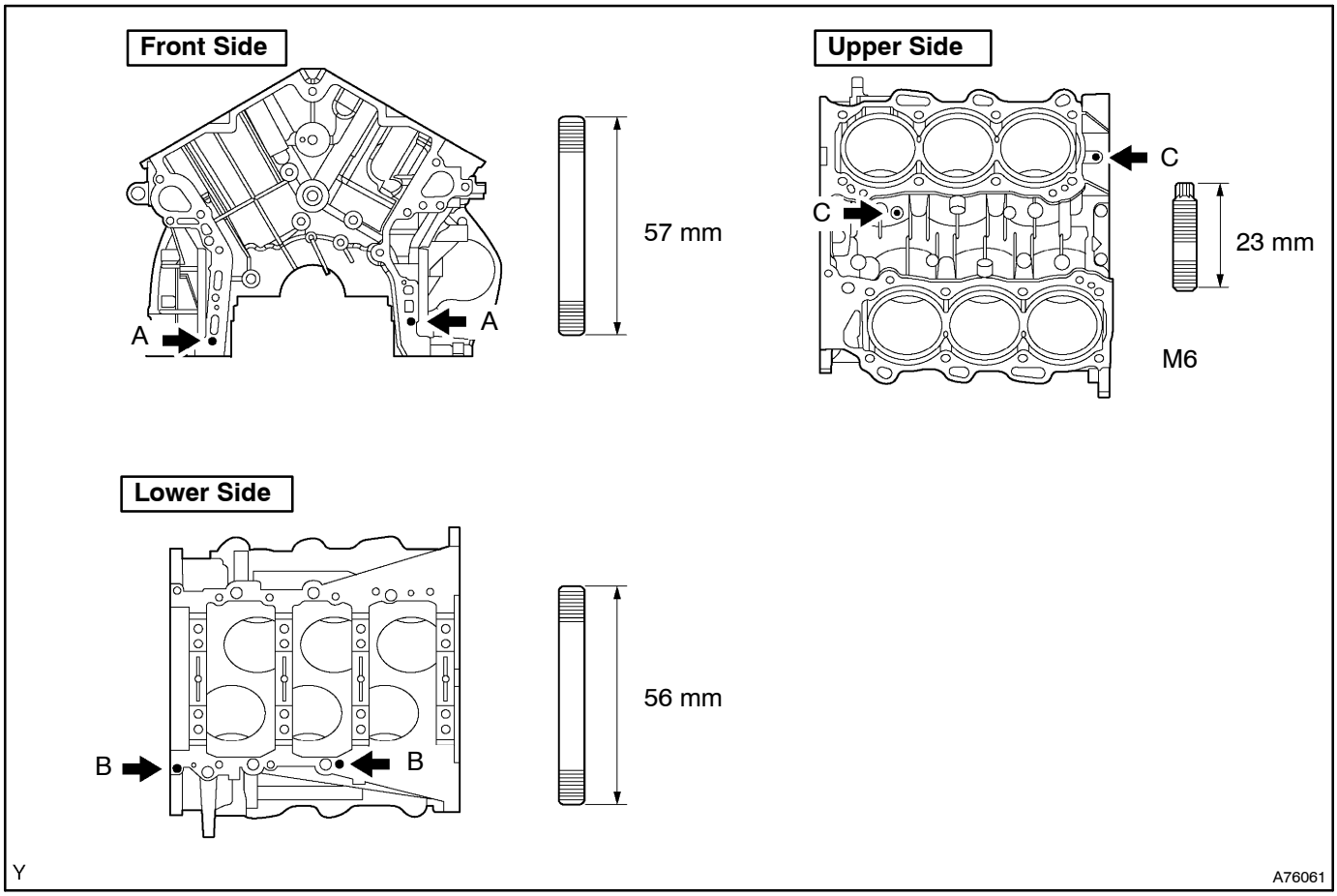
HINT:
EXAMPLE
Cylinder block ”11” (A) + Crankshaft ”06” (B)
=Total number 17 (Use bearing ”3”)

| Item | Mark | mm (in.) |
|---|---|---|
| Cylinder block main journal bore diameter (A) | ”00” | 77.000 (3.0315) |
| | ”01” | 77.001 (3.0315) |
| | ”02” | 77.002 (3.0316) |
| | ”03” | 77.003 (3.0316) |
| | ”04” | 77.004 (3.0317) |
| | ”05” | 77.005 (3.0317) |
| | ”06” | 77.006 (3.0317) |
| | ”07” | 77.007 (3.0318) |
| | ”08” | 77.008 (3.0318) |
| | ”09” | 77.009 (3.0319) |
| | ”10” | 77.010 (3.0319) |
| | ”11” | 77.011 (3.0319) |
| | ”12” | 77.012 (3.0320) |
| | ”13” | 77.013 (3.0320) |
| | ”14” | 77.014 (3.0320) |
| | ”15” | 77.015 (3.0321) |
| | ”16” | 77.016 (3.0321) |
| Crankshaft main journal diameter (B) | ”00” | 71.999 – 72.000 (2.8346 – 2.8346) |
| | ”01” | 71.998 – 71.999 (2.8346 – 2.8346) |
| | ”02” | 71.997 – 71.998 (2.8345 – 2.8346) |
| | ”03” | 71.996 – 71.997 (2.8345 – 2.8346) |
| | ”04” | 71.995 – 71.996 (2.8344 – 2.8345) |
| | ”05” | 71.994 – 71.995 (2.8344 – 2.8344) |
| | ”06” | 71.993 – 71.994 (2.8343 – 2.8344) |
| | ”07” | 71.992 – 71.993 (2.8343 – 2.8343) |
| | ”08” | 71.991 – 71.992 (2.8343 – 2.8343) |
| | ”09” | 71.990 – 71.991 (2.8343 – 2.8343) |
| | ”10” | 71.989 – 71.990 (2.8342 – 2.8343) |
| | ”11” | 71.988 – 71.989 (2.8342 – 2.8342) |
| Standard bearing center wall thickness | ”1” | 2.488 – 2.491 (0.0980 – 0.0981) |
| | ”2” | 2.491 – 2.494 (0.0981 – 0.0982) |
| | ”3” | 2.494 – 2.497 (0.0982 – 0.0983) |
| | ”4” | 2.497 – 2.500 (0.0982 – 0.0984) |
| | ”5” | 2.500 – 2.503 (0.0984 – 0.0985) |

**27. INSTALL STUD BOLT**

(a) Install the stud bolts as shown in the illustration.

**Torque:**
**Stud bolt A 11 N·m (112 kgf·cm, 8.1 ft·lbf)**
**Stud bolt B 4.5 N·m (46 kgf·cm, 40 in.·lbf)**
**Stud bolt C 4.0 N·m (41 kgf·cm, 35 in.·lbf)**



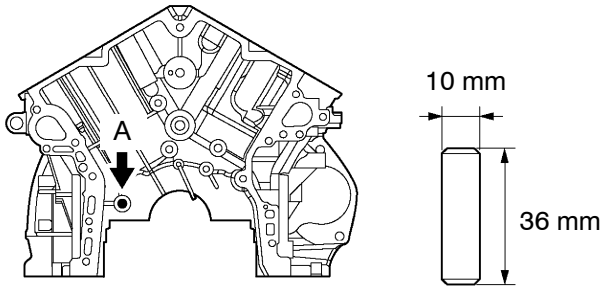
**28. INSTALL STRAIGHT PIN**

(a) Using a plastic–faced hammer, tap into the straight pin.

**Standard protrusion:**

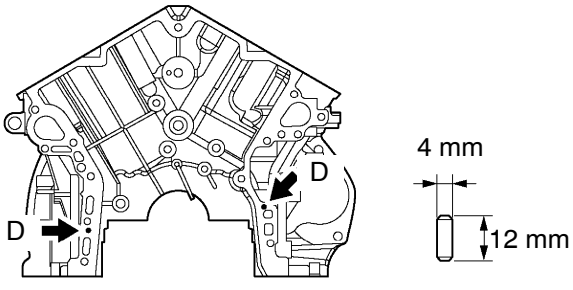
**Pin A 22.5 – 23.5 mm (0.886 – 0.925 in.)**
**Pin B 10.5 – 11.5 mm (0.413 – 0.453 in.)**
**Pin C 8.5 – 9.5 mm (0.335 – 0.374 in.)**
**Pin D 5.5 – 6.5 mm (0.217 – 0.256 in.)**

**Front Side**



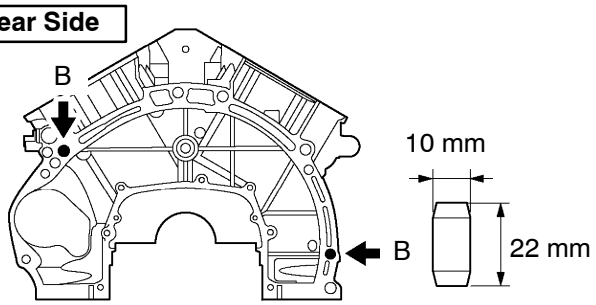

Protrusion Height: 22.5 – 23.5 mm

**Front Side**



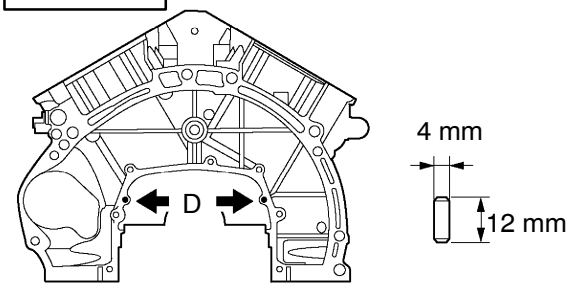

Protrusion Height: 5.5 – 6.5 mm

**Rear Side**



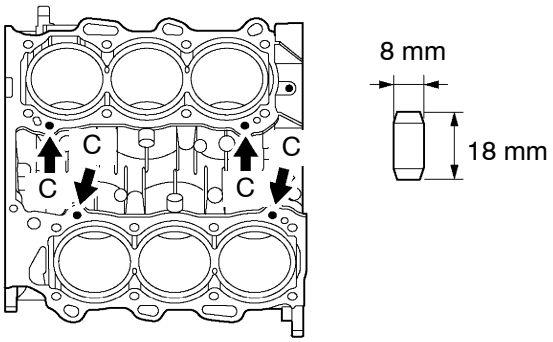

Protrusion Height: 10.5 – 11.5 mm

**Rear Side**



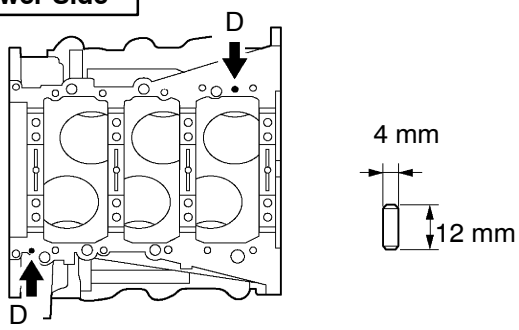

Protrusion Height: 5.5 – 6.5 mm

**Upper Side**




Protrusion Height: 8.5 – 9.5 mm

**Lower Side**




Protrusion Height: 5.5 – 6.5 mm

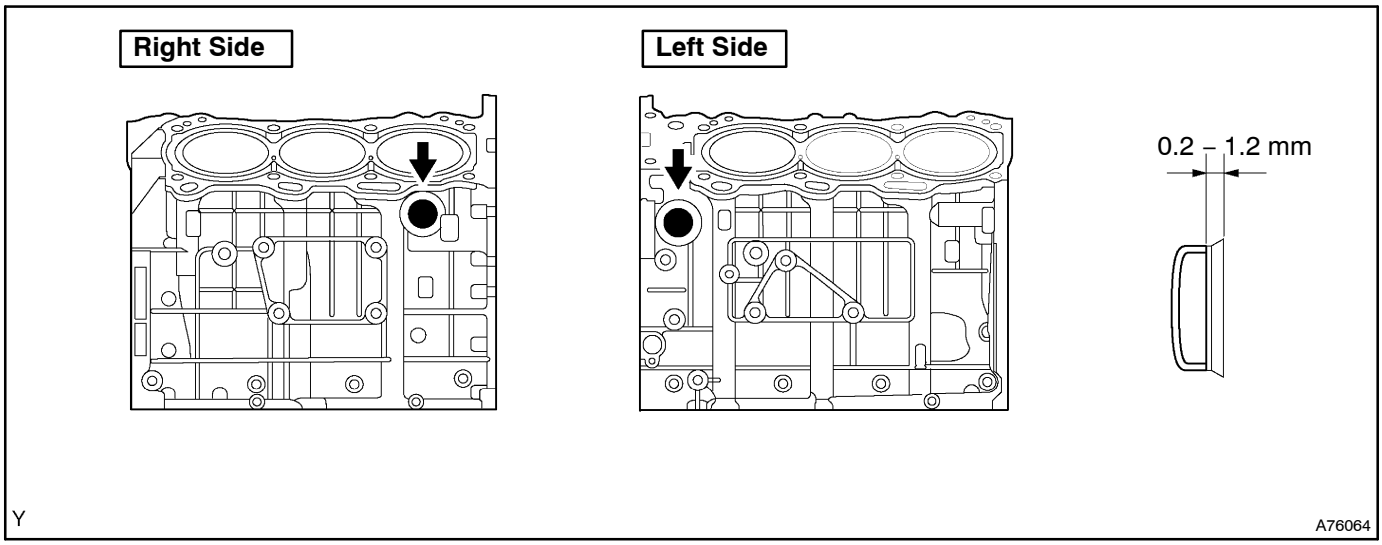
Y

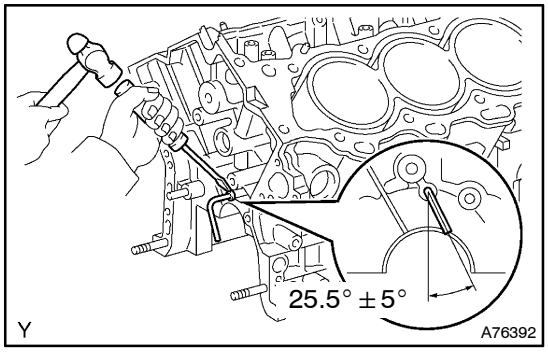
A76062

**29. INSTALL TIGHT PLUG**

(a) Apply adhesive around tight plugs.
**Adhesive: part No. 08833 – 00070, THREE BOND 1324 or equivalent.**

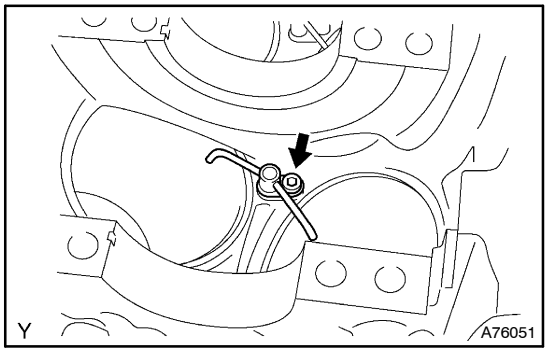
(b) Using SST, into the tight plugs as shown in the illustration.
SST 09950–60010 (09951–00350), 09950–70010 (09951–07150)
**Standard depth: 0.2 – 1.2 mm (0.008 – 0.047 in.)**



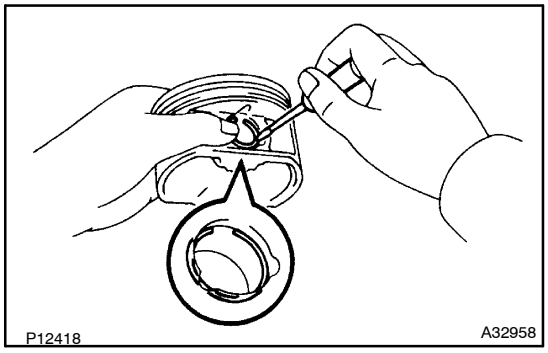

**30. INSTALL OIL JET**

(a) Using a screw driver and hemmer, tap in a oil jet.




**31. INSTALL SUB–ASSY OIL NOZZLE NO.1**

(a) Using a 5 mm socket hexagon wrench, install the 3 oil nozzles.
**Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)**

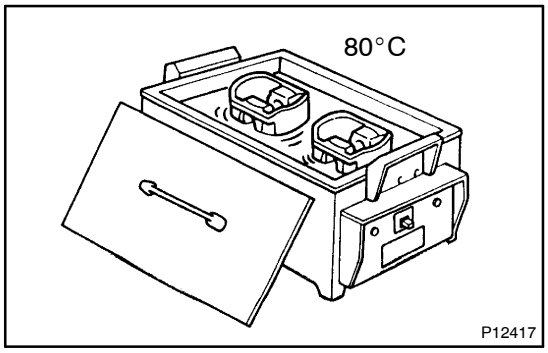



**32. INSTALL PISTON PIN HOLE SNAP RING**

(a) Using a small screwdriver, install a new snap ring at one end of the piston pin hole.

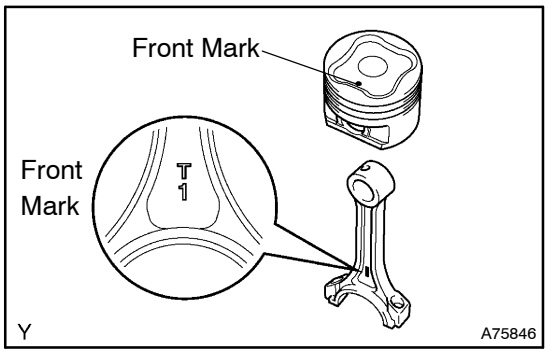
HINT:

Be sure that end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



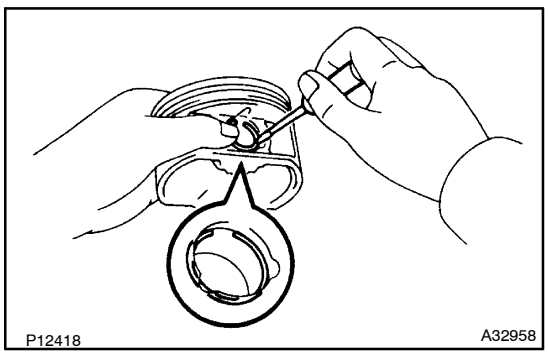

**33. INSTALL W/PIN PISTON SUB–ASSY**

(a) Gradually heat the piston to about 80°C (176°F).




(b) Coat the piston pin with engine oil.

(c) Align the front marks of the piston and connecting rod, and push in the piston pin with thumb.

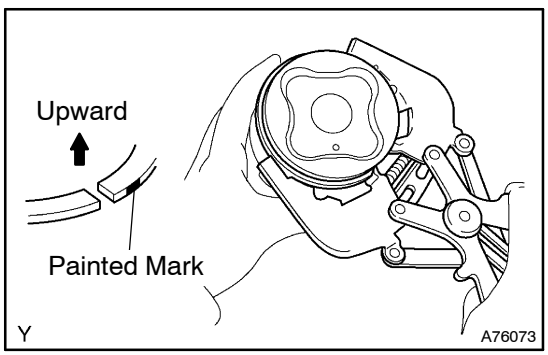



**34. INSTALL PISTON PIN HOLE SNAP RING**

(a) Using a small screwdriver, install a new snap ring on the other end of the piston pin hole.

HINT:

Be sure that end of gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



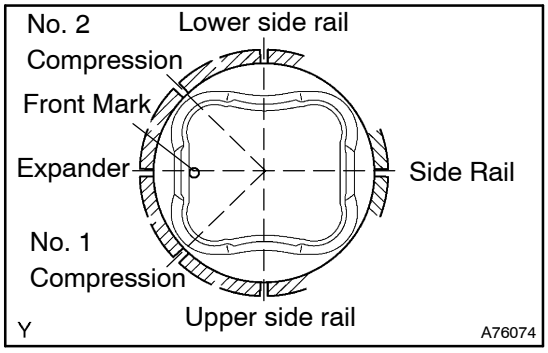

**35. INSTALL PISTON RING SET**

(a) Install the oil ring expander and 2 side rails by hand.

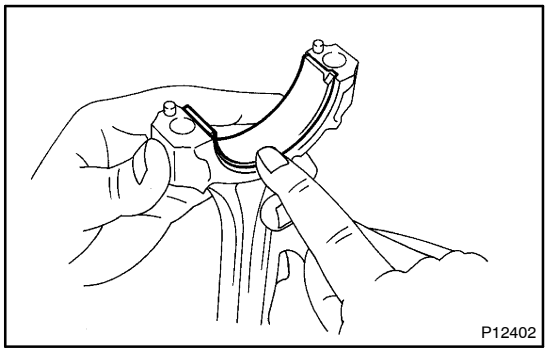
(b) Using a piston ring expander, install the 2 compression rings.

**NOTICE:**

**Install the compression ring No. 2 with the painted mark facing right side.**




(c) Position the piston rings so that the ring ends are as shown.

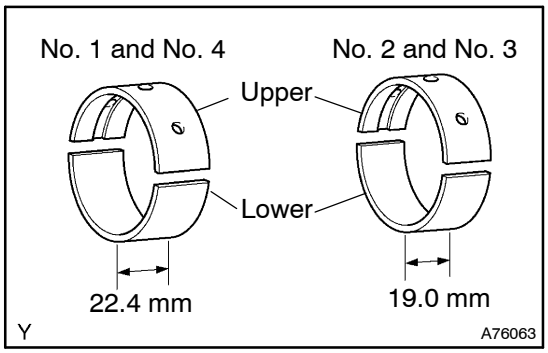



**36. INSTALL CONNECTING ROD BEARING**

(a) Align the bearing claw with the groove of the connecting rod or connecting cap.

**NOTICE:**

**Clean the backside of the bearing and the bearing surface of the connecting rod and let not stick the oils and fats.**

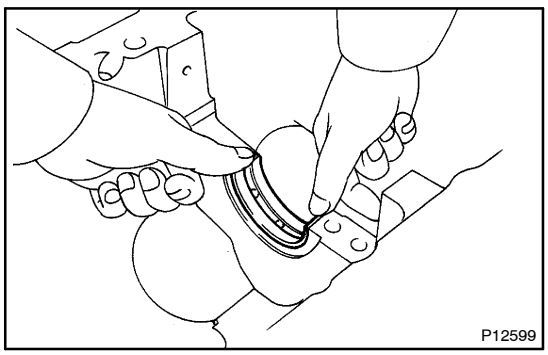



**37. INSTALL CRANKSHAFT BEARING**

HINT:

Main bearings come in widths of 19.0 mm (0.748 in.) and 22.4 mm (0.882 in.). Install the 22.4mm (0.882 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing cap. Install the 19.0 mm (0.748 in.) bearings in the No. 2 and No. 3 positions.

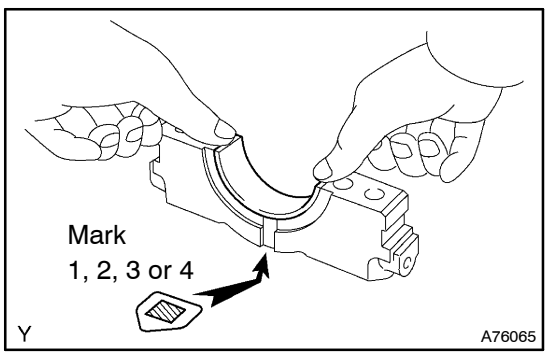
(a) Clean each main journal and bearing.




(b) Align the bearing claw with the claw groove of the cylinder block, and push in the 4 upper bearings.

**NOTICE:**

**Do not apply engine oil to the bearing and its contact surface.**




(c) Align the bearing claw with the claw groove of the main bearing cap, and push in the 4 lower bearings.

**NOTICE:**

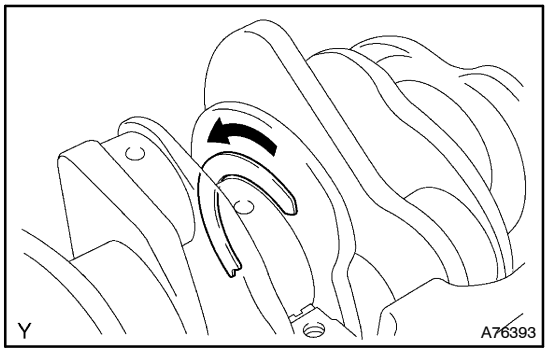
**Do not apply engine oil to the bearing and its contact surface.**

HINT:

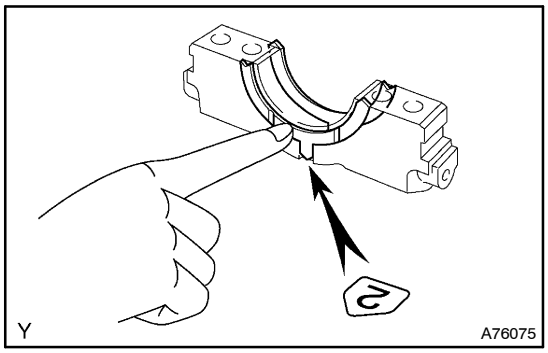
A number is marked on each main bearing cap to indicate the installation position.

**38. INSTALL CRANKSHAFT**

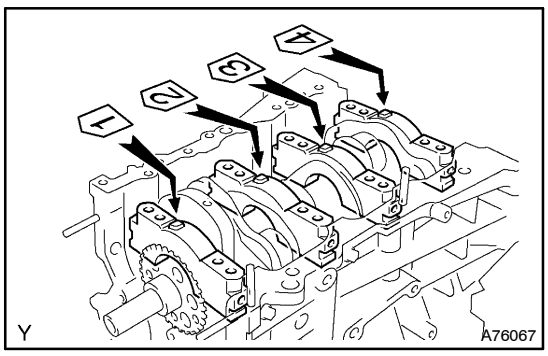
(a) Apply engine oil to upper bearing and install the crankshaft on the cylinder block.



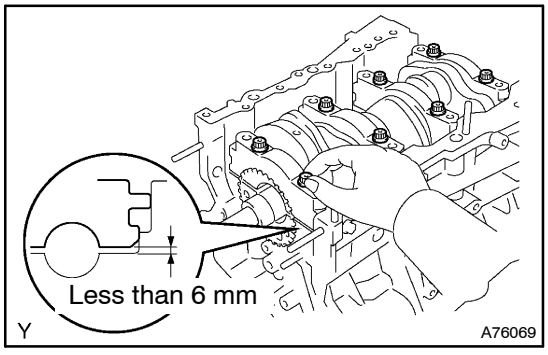

(b) Install the 2 upper thrust washers to the No. 2 journal position of the cylinder block.
  (1) Push the crankshaft toward the front (rear) side.
  (2) Install the 2 upper thrust washers with the oil grooves facing outward.



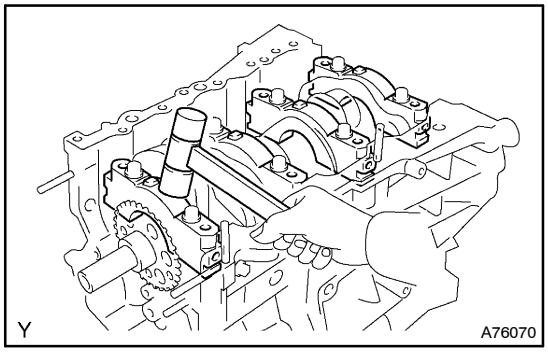

(c) Install the 2 lower thrust washers on the No. 2 bearing cap with the grooves facing outward.




(d) Examine the front marks and numbers and install the bearing caps on the cylinder block.
(e) Apply a light coat of engine oil on the threads and under the head of bearing cap bolts.
(f) Temporarily install the 8 main bearing cap bolts to the inside positions.

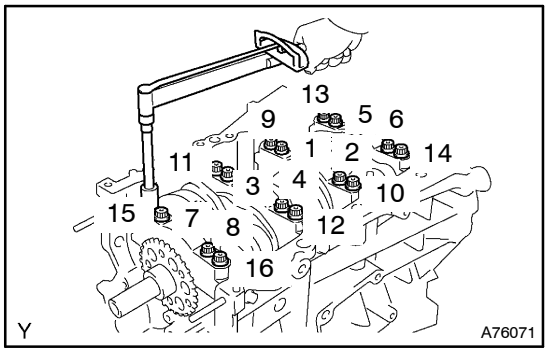



(g) Insert the main bearing cap with hand until the clearance between the main bearing cap and the cylinder block will become less than 6 mm (0.23 in.) by making the 2 internal bearing cap bolts as a guide.

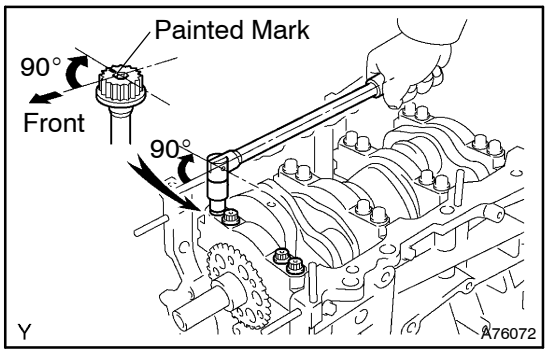



(h) Using a plastic–faced hammer, lightly tap the bearing cap to ensure a proper fit.

(i) Apply a light coat of engine oil on the threads and under the head of main bearing cap bolts.




(j) Install and uniformly tighten the 16 main bearing cap bolts in several passes, in the sequence shown.
**Torque: 61 N·m (622 kgf·cm, 45 ft·lbf)**

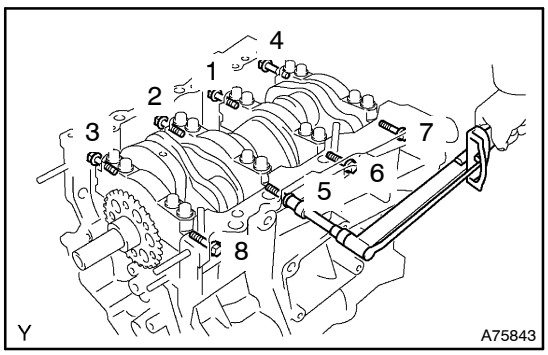



(k) Mark the front side of the bearing cap bolts with paint.

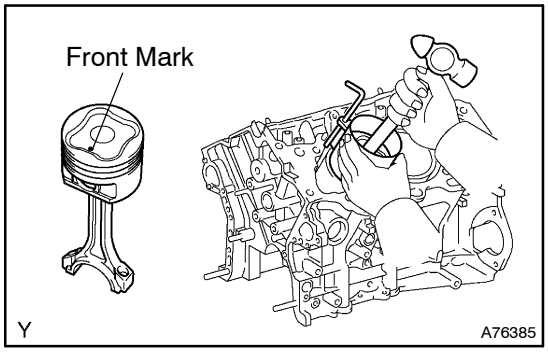
(l) Retighten the bearing cap bolts by 90° in the sequence shown.

(m) Check that the painted mark is now at a 90° angle to the front.

(n) Check that the crankshaft turns smoothly.




(o) Install and uniformly tighten the 8 main bearing cap bolts in several passes, in the sequence shown.
**Torque: 35 N·m (357 kgf·cm, 26 ft·lbf)**




**39. INSTALL PISTON SUB–ASSY W/CONNECTING ROD**

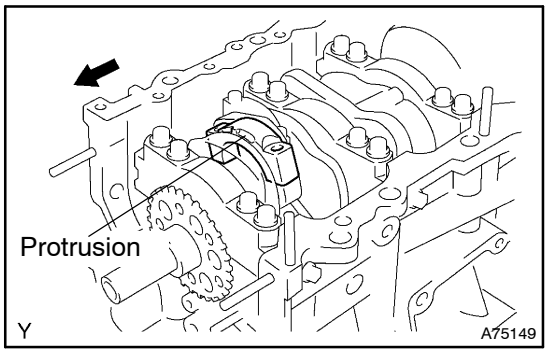
(a) Apply engine oil to the cylinder walls, the pistons, and the surfaces of connecting rod bearings.

(b) Check the position of the piston ring ends.

(c) Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.

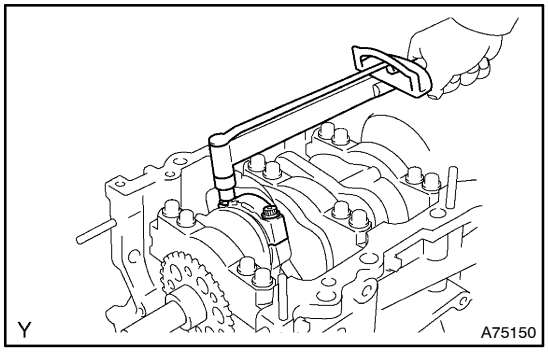
**NOTICE:**

- **Clean the backside of the bearing and the bearing surface of the connecting rod cap and let not stick the oils and fats.**
- **Match the numbered connecting rod cap with the connecting rod.**

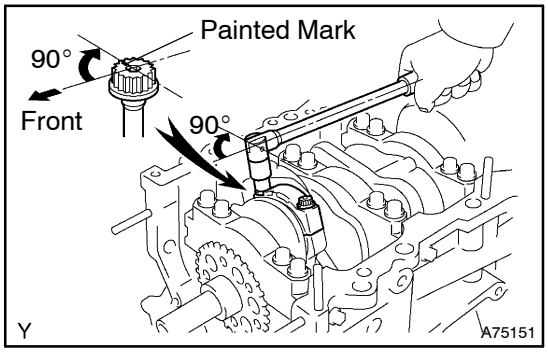



(d) Check that the protrusion of the connecting rod cap is facing in the correct direction.

(e) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.




(f) Using SST, tighten the bolts in several passes by the specified torque.
SST 09011–38121
**Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)**




(g) Mark the front side of the each connecting cap bolt with paint.

(h) Retighten the cap bolts by 90° as shown.

(i) Check that the crankshaft turns smoothly.