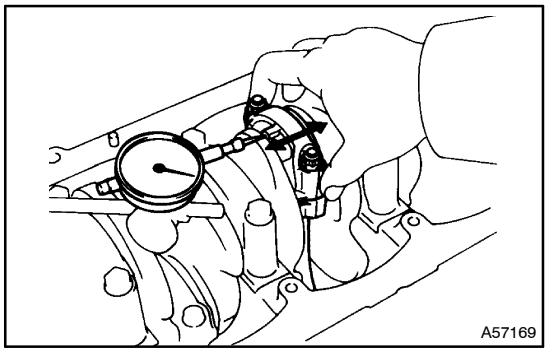
14113–01

OVERHAUL

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O–rings and oil seals with new parts.

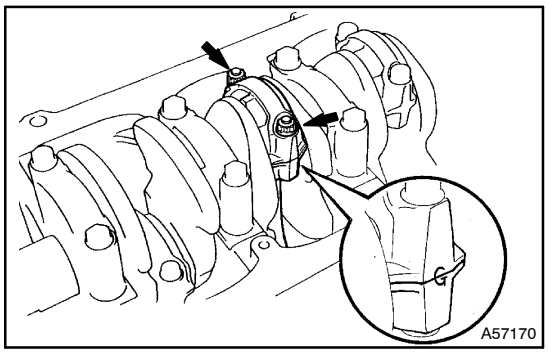


1. INSPECT CONNECTING ROD THRUST CLEARANCE

(a) Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.080 – 0.300 mm (0.0031 – 0.0118 in.)
Maximum thrust clearance: 0.35 mm (0.0138 in.)

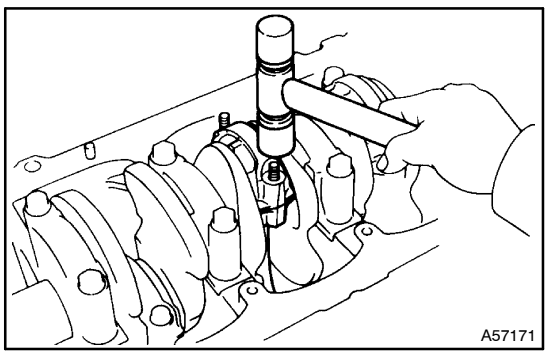
If the thrust clearance is greater than maximum, replace the connecting rod assembly. If necessary, replace the crankshaft.



2. INSPECT CONNECTING ROD OIL CLEARANCE

(a) Check the matchmarks on the connecting rod and cap to ensure correct reassembly.

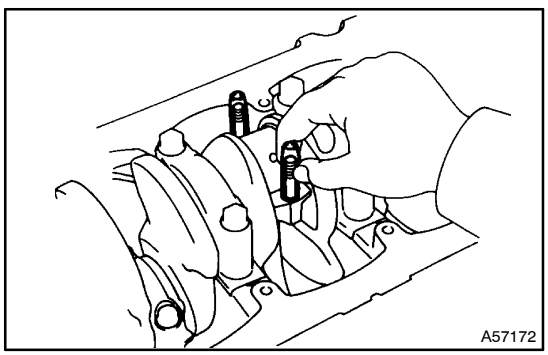
(b) Remove the 2 connecting rod cap nuts.



(c) Using a plastic–faced hammer, lightly tap the connecting rod bolts and lift off the connecting rod cap.

HINT:

Keep the lower bearing inserted with the connecting rod cap.

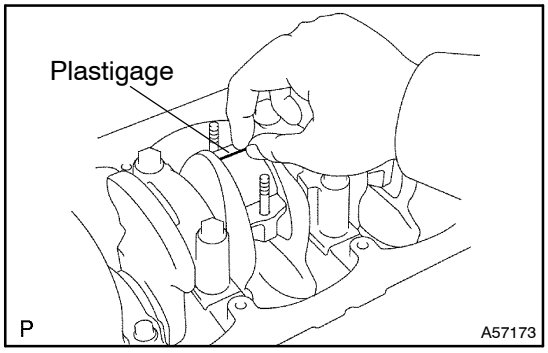


(d) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft from damage.

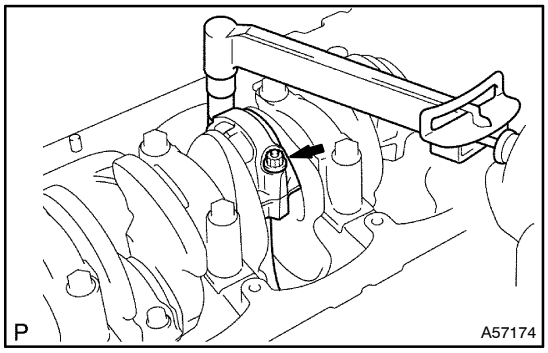
(e) Clean the crank pin and bearing.

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

If the crank pin or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.



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

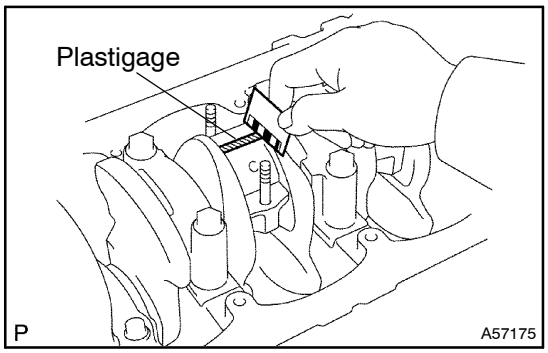


(h) Install the connecting rod cap with the 2 nuts (See step 40).

NOTICE:

Do not turn the crankshaft.

(i) Remove the 2 nuts, connecting rod cap and lower bearing (See procedure (b) and (c) above).



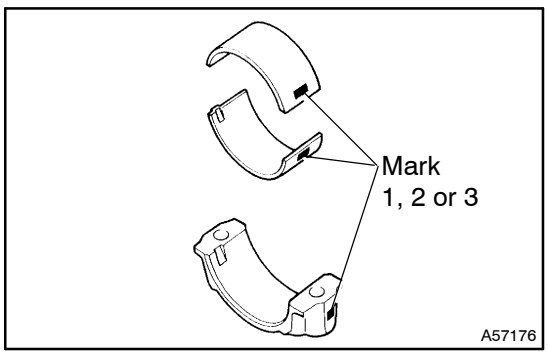
(j) Measure the plastigage at its widest point.

Standard oil clearance:

STD	0.036 – 0.064 mm (0.0014 – 0.0025 in.)
U/S 0.25, U/S 0.50	0.033 – 0.079 mm (0.0013 – 0.0031 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

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



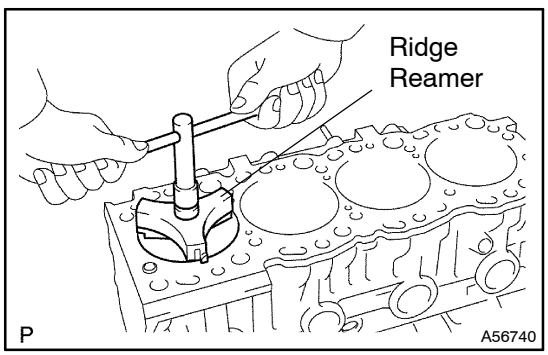
HINT:

If using a standard bearing, replace it with one having the same number marked on the connecting rod cap. There are 3 sizes of standard bearings, marked 1, 2 and 3 accordingly.

Standard sized bearing center wall thickness:

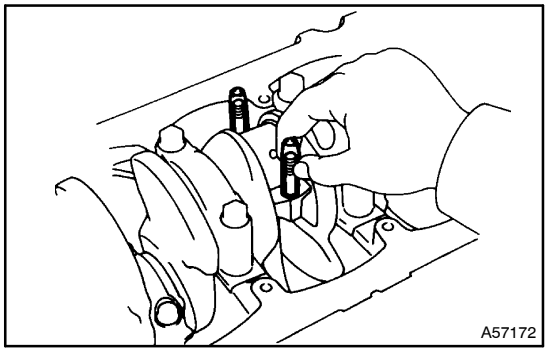
Mark 1	1.478 – 1.482 mm (0.0582 – 0.0583 in.)
Mark 2	1.482 – 1.486 mm (0.0583 – 0.0585 in.)
Mark 3	1.486 – 1.490 mm (0.0585 – 0.0587 in.)

(l) Completely remove the plastigage.



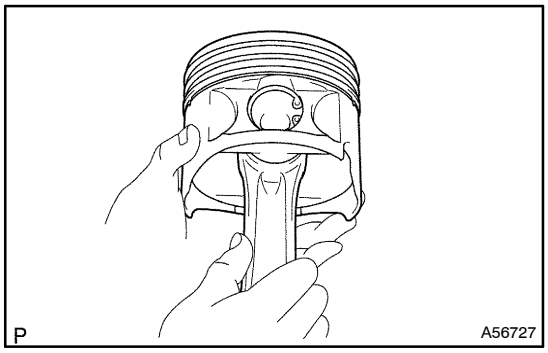
3. REMOVE PISTON AND CONNECTING ROD

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



(b) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft from damage.
(c) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

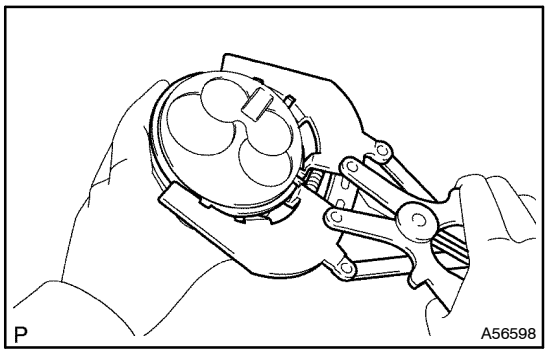
HINT:
- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in correct order.



4. REMOVE W/PIN PISTON SUB–ASSY

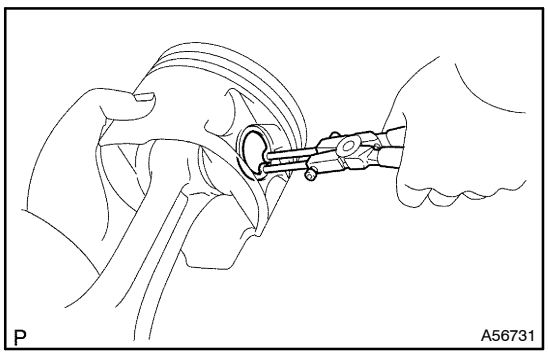
(a) Check fit between the piston and piston pin.
(1) Try to move the piston back and forth on the piston pin.

If any movement is felt, replace the piston and pin as a set.

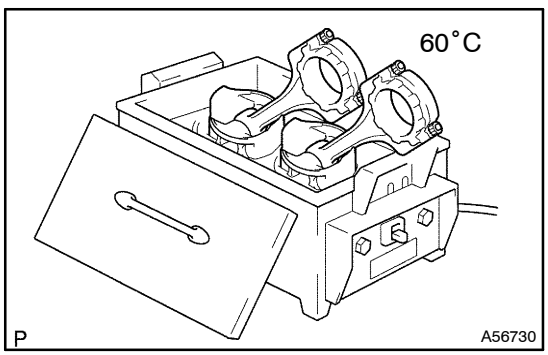


(b) Remove the piston rings.
(1) Using a piston ring expander, remove the 2 compression rings.
(2) Remove the oil ring and coil by hand.

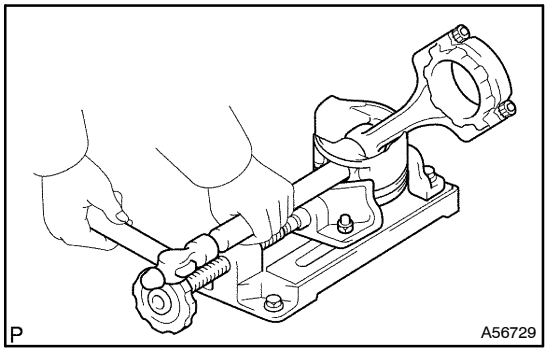
HINT:
Arrange the piston rings in correct order only.



(c) Disconnect the connecting rod from the piston.
(1) Using snap ring pliers, remove the snap rings.



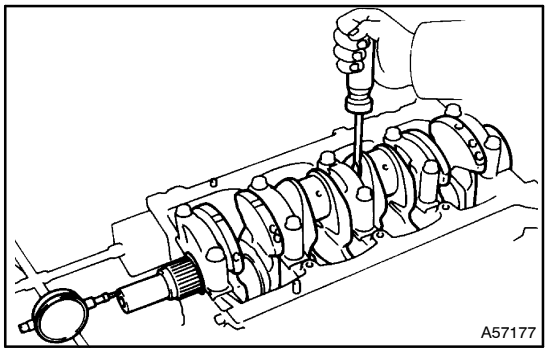
(2) Gradually heat the piston to approx. 60˚C (140˚F).



(3) Using a plastic–faced hammer and brass bar, lightly tap out the piston pin and 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 correct order.



5. INSPECT CRANKSHAFT THRUST CLEARANCE

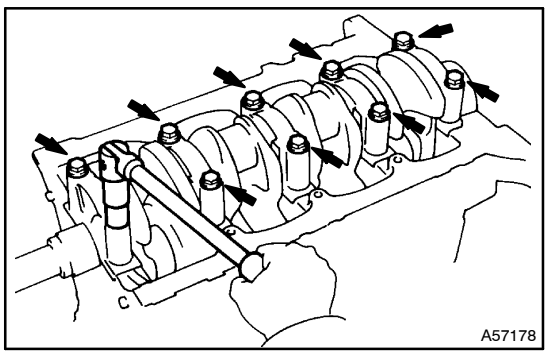
(a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:
0.040 – 0.250 mm (0.0016 – 0.0098 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.

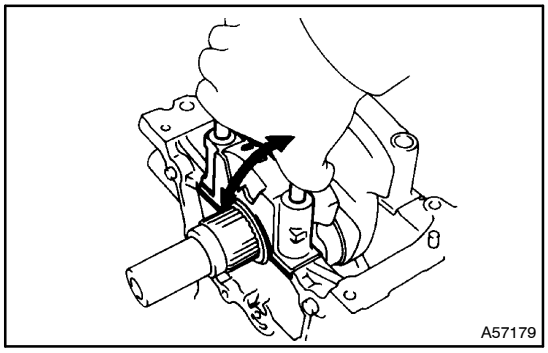
Thrust washer thickness:

STD	2.430 – 2.480 mm (0.0957 – 0.0976 in.)
O/S 0.125	2.493 – 2.543 mm (0.0981 – 0.1001 in.)
O/S 0.250	2.555 – 2.605 mm (0.1006 – 0.1026 in.)



6. INSPECT CRANKSHAFT OIL CLEARANCE

(a) Remove the 10 crankshaft bearing cap bolts.



(b) Using the removed crankshaft bearing cap bolts, pry the cap back and forth, and remove the crankshaft bearing caps, lower bearings and lower thrust washers (No. 3 crankshaft bearing cap only).

HINT:

- Keep the lower bearing and crankshaft bearings cap together.
- Arrange the thrust washers in correct order.

(c) Lift out the crankshaft.

HINT:

Keep the upper crankshaft bearings and upper thrust washers together with the cylinder block.

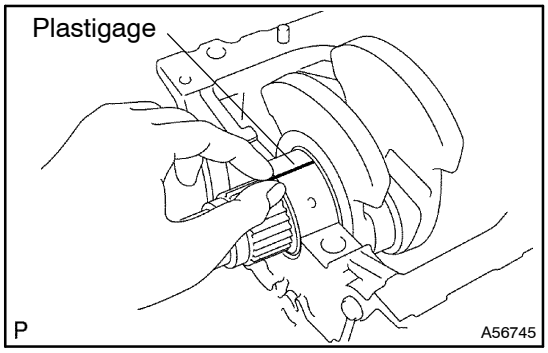
(d) Clean each main journal and bearing.

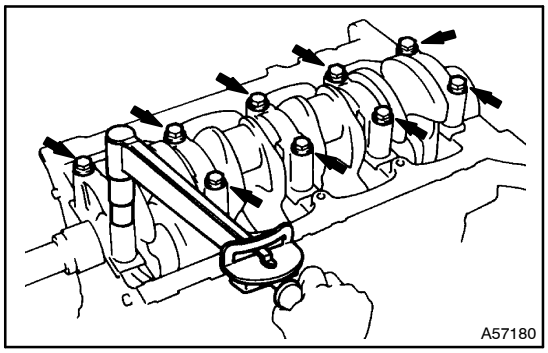
(e) Check each main journal and bearing for pitting and scratches.

If the journal or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.

(f) Place the crankshaft on the cylinder block.

(g) Lay a strip of Plastigage across each journal.



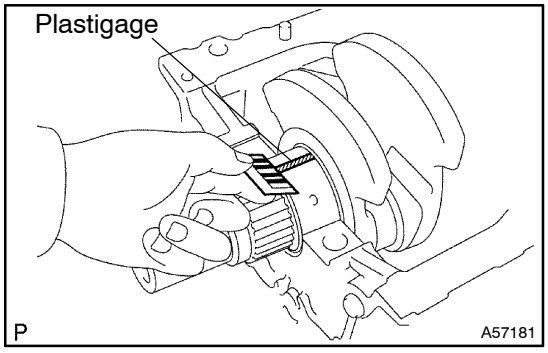


(h) Install the 5 crankshaft bearing caps with the 10 bolts (See step 39).

NOTICE:

Do not turn the crankshaft.

(i) Remove the 10 bolts and 5 crankshaft bearing caps (See procedure (a) and (b) above).



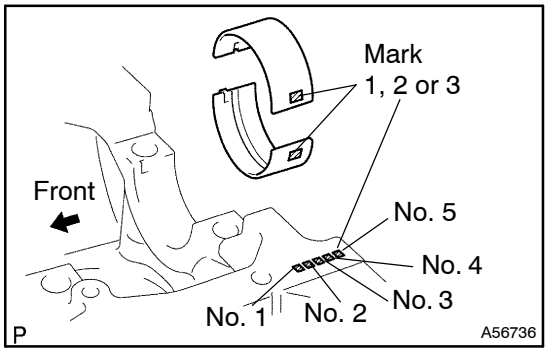
(j) Measure the plastigage at its widest point.

Standard oil clearance:

STD	0.034 – 0.065 mm (0.0013 – 0.0026 in.)
U/S 0.25, U/S 0.50	0.033 – 0.079 mm (0.0013 – 0.0031 in.)

Maximum clearance: 0.10 mm (0.0039 in.)

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



HINT:

If using a standard bearing, replace it with one having the same number marked on the connecting rod cap. There are 3 sizes of standard bearings, marked 1, 2 and 3 accordingly.

Standard sized bearing center wall thickness:

Mark 1	1.979 – 1.983 mm (0.0779 – 0.0781 in.)
Mark 2	1.983 – 1.987 mm (0.0781 – 0.0782 in.)
Mark 3	1.987 – 1.991 mm (0.0782 – 0.0784 in.)

(k) Completely remove the plastigage.

7. REMOVE CRANKSHAFT

(a) Lift out the crankshaft.

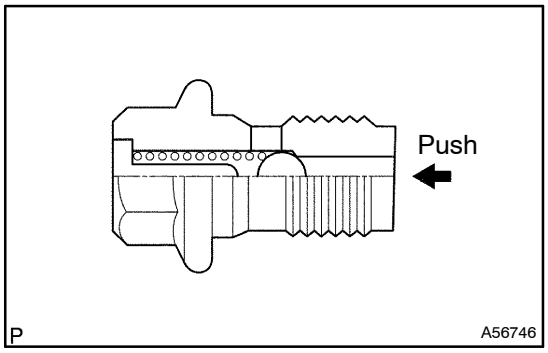
(b) Remove the upper bearings and upper thrust washers from the cylinder block.

HINT:

Arrange the crankshaft bearing caps, bearings and thrust washers in correct order.

8. REMOVE SUB–ASSY OIL NOZZLE NO.1

(a) Remove the 4 check valves and oil nozzles.



9. INSPECT OIL CHECK VALVE SUB–ASSY

(a) Push the valve with a wooden stick to check if it is stuck.

If stuck, replace the check valve.

10. INSPECT SUB–ASSY OIL NOZZLE NO.1

(a) Check the oil nozzles for damage or clogging.

If necessary, replace the oil nozzle.

11. REMOVE CYLINDER BLOCK OIL ORIFICE

(a) Using a 6 mm hexagon wrench, remove the oil orifice.

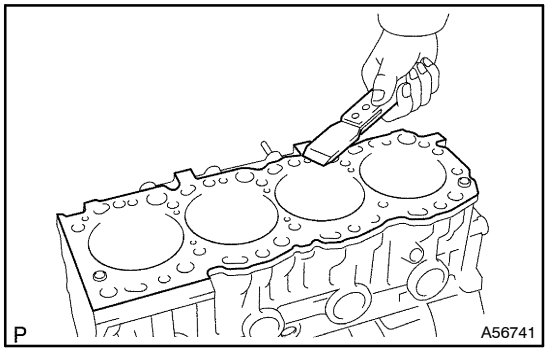
12. INSPECT CYLINDER BLOCK OIL ORIFICE

(a) Check the oil orifice for damage or clogging.

If necessary, replace the oil orifice.

13. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB–ASSY

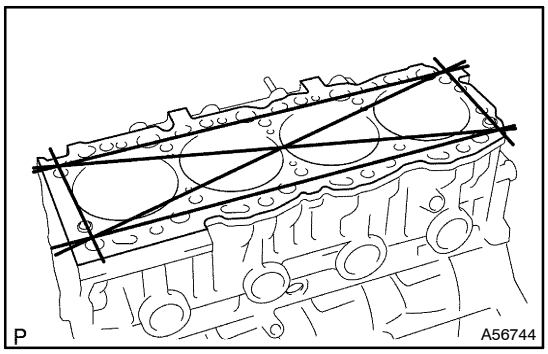
14. REMOVE W/HEAD TAPER SCREW PLUG NO.1



15. CLEAN CYLINDER BLOCK SUB–ASSY

(a) Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

(b) Using a soft brush and solvent, thoroughly clean the cylinder block.



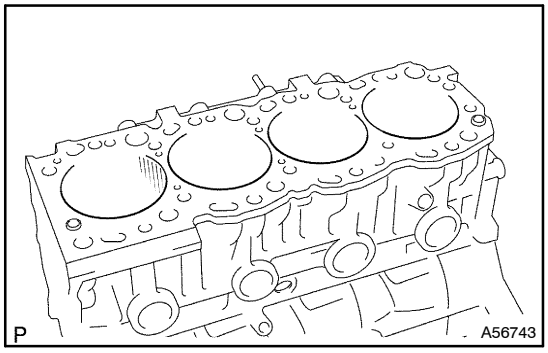
16. INSPECT CYLINDER BLOCK SUB–ASSY

(a) Inspect for flatness.

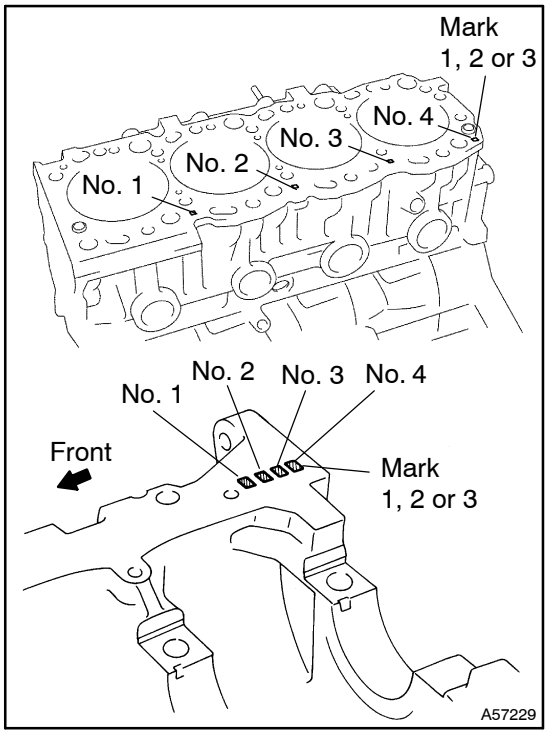
(1) Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head cap for warpage.

Maximum warpage: 0.20 mm (0.0079 in.)

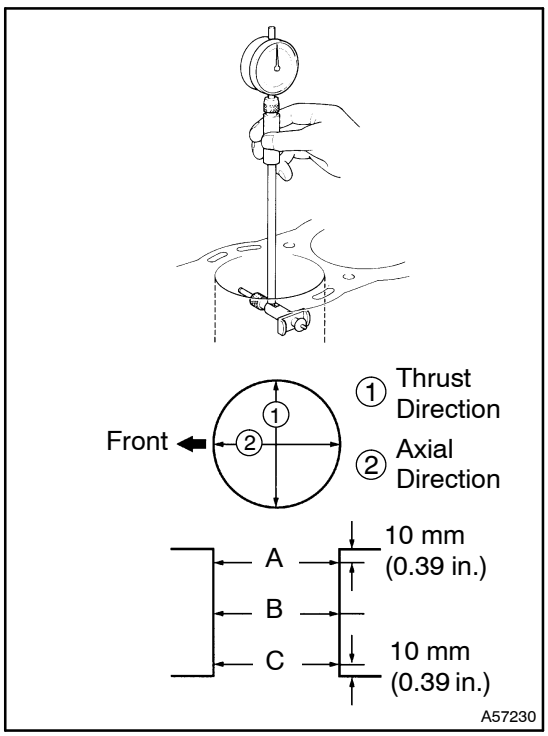
If warpage is greater than maximum, replace the cylinder block.



(b) Visually check the cylinder for vertical scratches.
If deep scratches are present, rebore all the 4 cylinders. If necessary, replace the cylinder block.



(c) Inspect the cylinder bore diameter.
HINT:
There are 3 sizes of the standard cylinder bore diameter, marked 1, 2 and 3 accordingly. The mark is stamped on the lower left rear of the cylinder block.



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

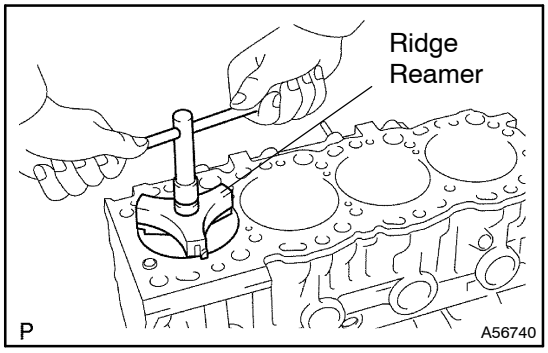
Standard diameter:

Mark 1	99.500 – 99.510 mm (3.9173 – 3.9177 in.)
Mark 2	99.510 – 99.520 mm (3.9177 – 3.9181 in.)
Mark 3	99.520 – 99.530 mm (3.9181 – 3.9185 in.)

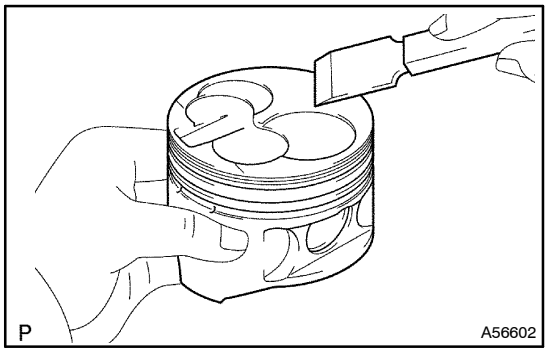
Maximum diameter:

STD	99.73 mm (3.9264 in.)
O/S 0.50	100.23 mm (3.9461 in.)

If the diameter is greater than maximum, rebore all the 4 cylinders. If necessary, replace the cylinder block.

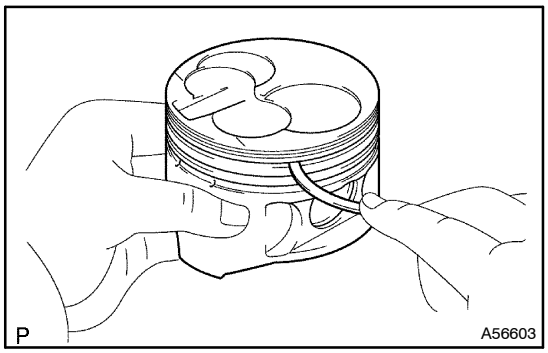


(d) Remove the cylinder ridge.
If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.

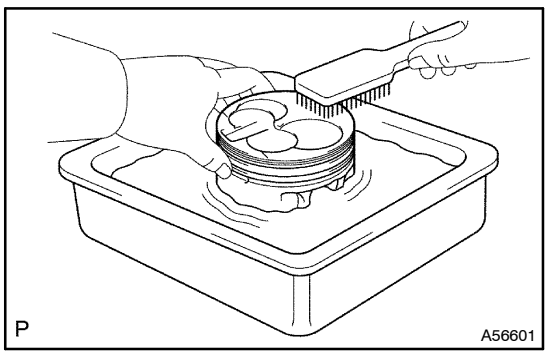


17. CLEAN W/PIN PISTON SUB–ASSY

(a) Using a gasket scraper, remove the carbon from the piston top.

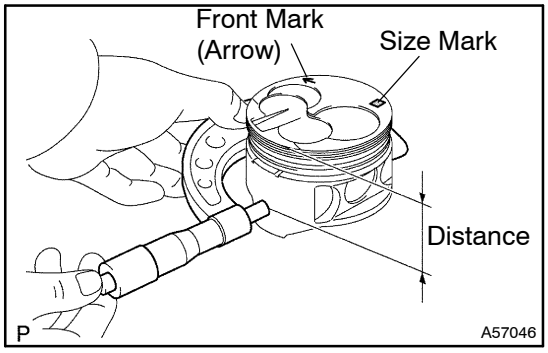


(b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



(c) Using solvent and a brush, thoroughly clean the piston.

NOTICE:
Do not use a wire brush.



18. INSPECT W/PIN PISTON SUB–ASSY

(a) Inspect the piston oil clearance.

HINT:

There are 3 sizes of the standard piston diameter, marked ”1”, ”2” and ”3” accordingly. The mark is stamped on the piston top.

(1) Using a micrometer, measure the piston diameter at right angles to the piston center line, the indicated distance from the piston head.

Distance: 61.27 – 61.33 mm (2.4122 – 2.4146 in.)

Piston diameter:

STD	Mark 1	99.450 – 99.460 mm (3.9153 – 3.9157 in.)
	Mark 2	99.460 – 99.470 mm (3.9157 – 3.9161 in.)
	Mark 3	99.470 – 99.480 mm (3.9161 – 3.9165 in.)
O/S 0.50		99.950 – 99.980 mm (3.9350 – 3.9362 in.)

(2) Measure the cylinder bore diameter in the thrust directions (See step 16).

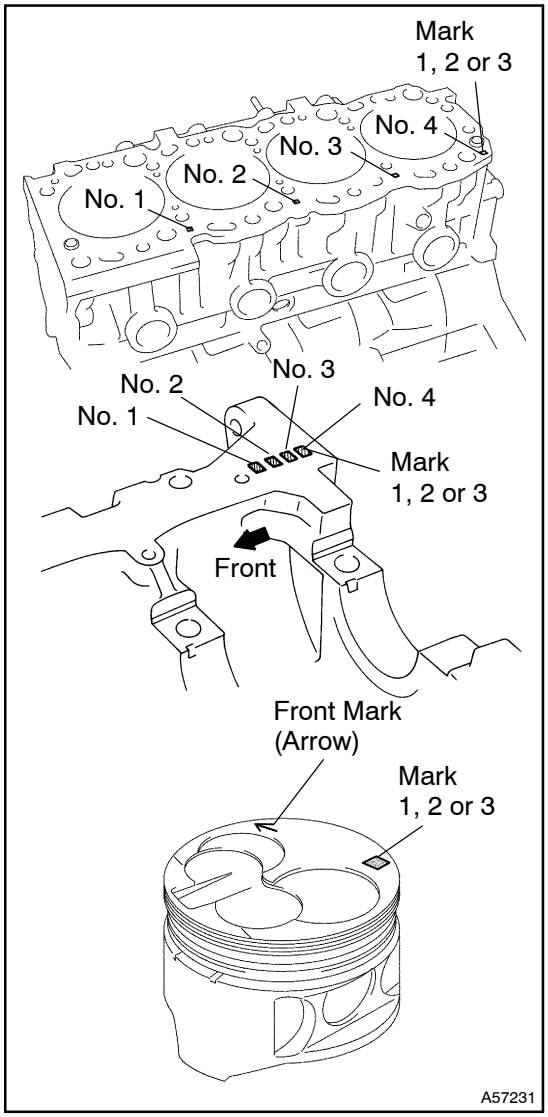
(3) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:

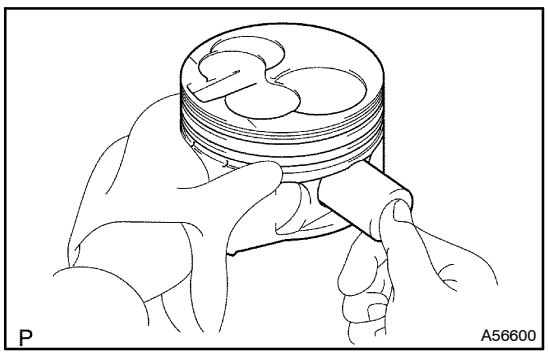
0.040 – 0.060 mm (0.0016 – 0.0024 in.)

Maximum oil clearance: 0.13 mm (0.0051 in.)

If the oil clearance is greater than maximum, replace all the 4 pistons and rebore all the 4 cylinders. If necessary, replace the cylinder block.

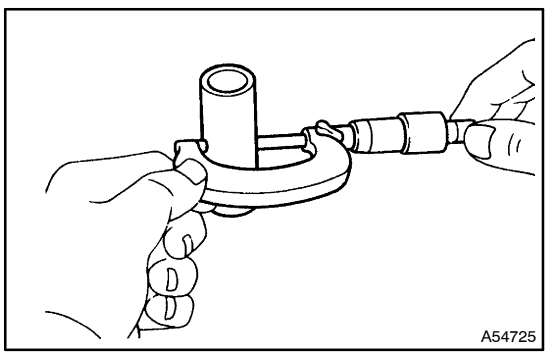


HINT:
Use a piston with the same number mark as the cylinder bore diameter marked on the cylinder block.

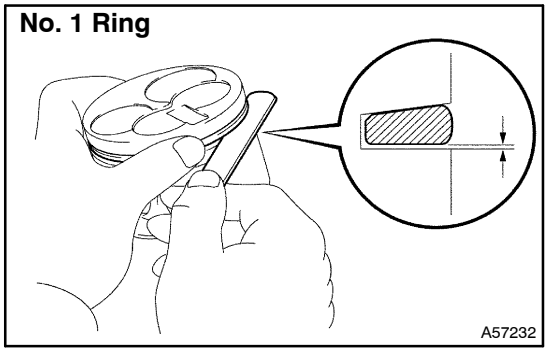


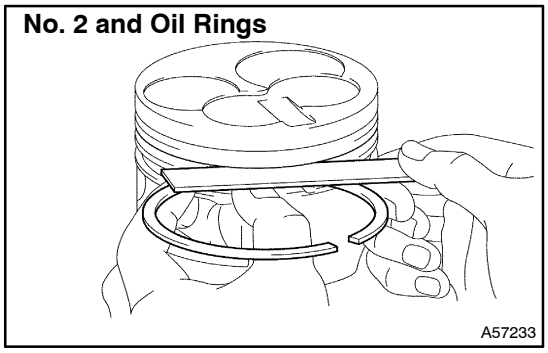
(b) Inspect the piston pin fit.
(1) At 60°C (140°F), you should be able to push the piston pin into the piston pin hole with your thumb.

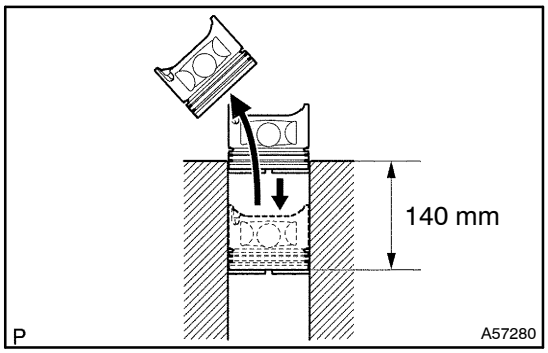
If the pin can be installed at a lower temperature, replace the piston and pin as set.

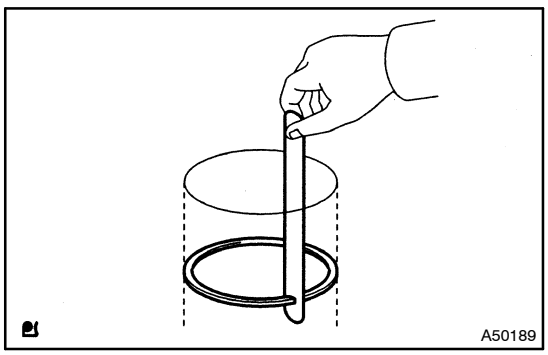


(c) Using a micrometer, measure the piston pin diameter.
Piston pin diameter:
29.000 – 29.012 mm (1.1417 – 1.1422 in.)









19. INSPECT PISTON RING SET

(a) Inspect the piston ring groove clearance.

(1) No. 1 Ring:

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

Standard groove clearance:

0.057 – 0.101 mm (0.0022 – 0.0040 in.)

Maximum groove clearance: 0.20 mm (0.0079 in.)

If the clearance is greater than maximum, replace the piston.

(2) No. 2 and Oil Rings:

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

Standard groove clearance:

No. 2	0.060 – 0.100 mm (0.0024 – 0.0039 in.)
Oil	0.030 – 0.070 mm (0.0012 – 0.0028 in.)

Maximum groove clearance: 0.20 mm (0.0079 in.)

If the clearance is greater than maximum, replace the piston.

(b) Inspect the piston ring end gap.

(1) Insert the piston ring into the cylinder bore.

(2) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 140 mm (5.51 in.) from the top of the cylinder block.

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

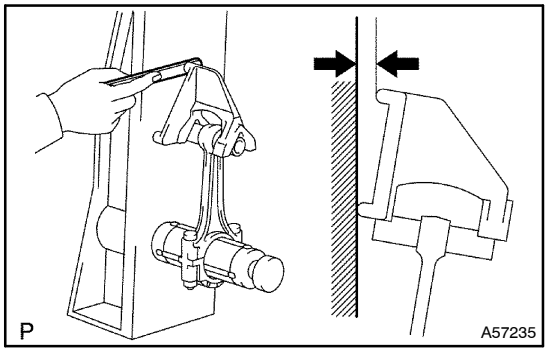
Standard end gap:

No. 1	0.350 – 0.590 mm (0.0138 – 0.0232 in.)
No. 2	0.470 – 0.720 mm (0.0185 – 0.0283 in.)
Oil	0.200 – 0.520 mm (0.0079 – 0.0205 in.)

Maximum end gap:

No. 1	1.29 mm (0.0508 in.)
No. 2	1.42 mm (0.0559 in.)
Oil	1.22 mm (0.0480 in.)

If the end gap is greater than maximum, replace the piston ring.
If the end gap is greater than maximum, even with a new piston ring, rebore all the 4 cylinders or replace the cylinder block.



20. INSPECT CONNECTING ROD SUB–ASSY

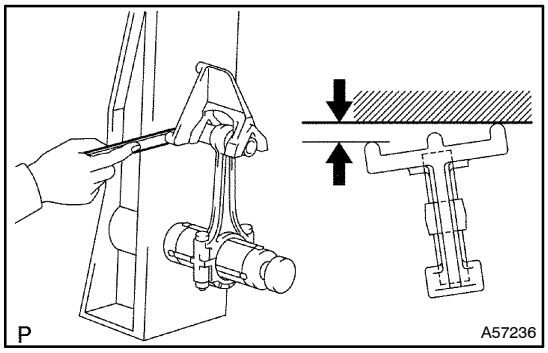
(a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for bend.

Maximum bend:

0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

If bend is greater than maximum, replace the connecting rod sub–assy.

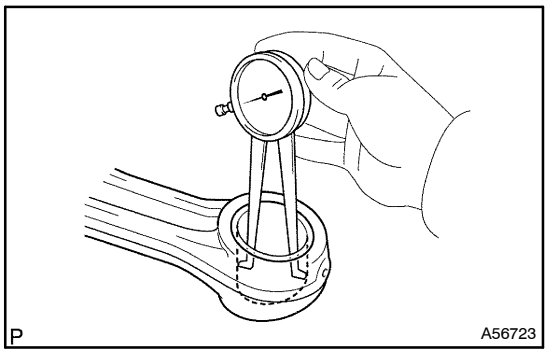


(2) Check for twist

Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

If twist is greater than maximum, replace the connecting rod sub–assy.



21. INSPECT PISTON PIN OIL CLEARANCE

(a) Inspect the piston pin oil clearance.

(1) Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Bush inside diameter:

29.008 – 29.020 mm (1.1420 – 1.1425 in.)

(2) Subtract the piston pin diameter measurement (See step 18) from the bush inside diameter measurement.

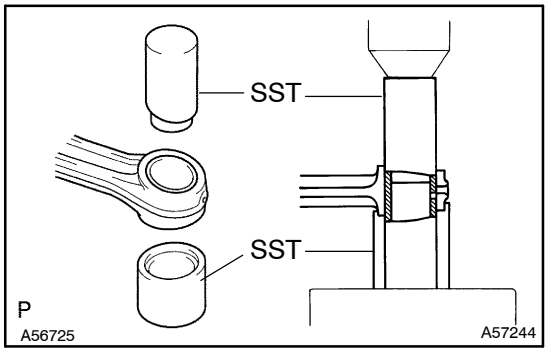
Standard oil clearance:

0.004 – 0.012 mm (0.0002 – 0.0005 in.)

Maximum oil clearance: 0.05 mm (0.0020 in.)

If the oil clearance is greater than maximum, replace the bush.

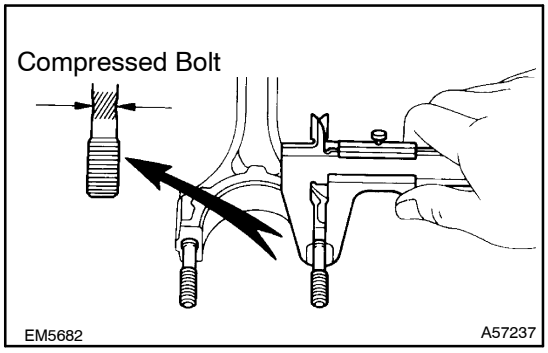
If necessary, replace the piston and piston pin as a set.



22. REMOVE CONNECTING ROD SMALL END BUSH

(a) Using SST and a press, press out the bush.

SST 09222–54011 (09222–03016, 09222–03026)

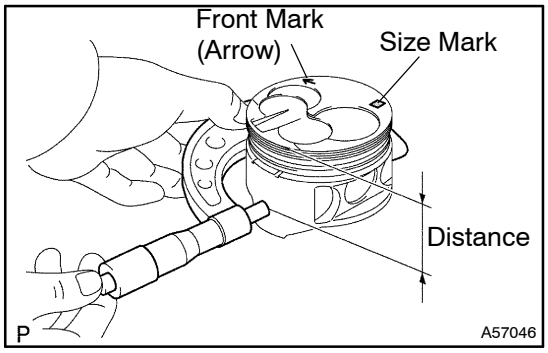


23. INSPECT CONNECTING ROD BOLT

(a) Using vernier calipers, measure the tension portion of the connecting rod bolt.

Standard diameter:
8.400 – 8.600 mm (0.3307 – 0.3386 in.)
Minimum diameter: 8.20 mm (0.3228 in.)

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



24. BORE CYLINDER

HINT:

- Bore all the 4 cylinders for the O/S piston outside diameter.
- Replace all the piston rings with ones to match the O/S pistons.

(a) Keep 4 new O/S pistons.

O/S 0.50 piston diameter:
99.950 – 99.980 mm (3.9350 – 3.9362 in.)

(b) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, the indicated distance from the piston head.

Distance: 61.27 – 61.33 mm (2.4122 – 2.4146 in.)

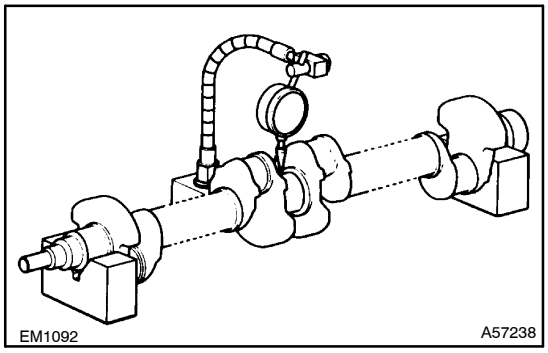
(c) Calculate the amount each cylinder is to be rebored as follows:

Size to be rebored = P + C – H
P = Piston diameter
C = Piston clearance:
0.040 – 0.060 mm (0.0016 – 0.0024 in.)
H = Allowance for honing: 0.02 mm (0.0008 in.) or less

(d) Bore and hone the cylinders to calculated dimensions.

Maximum honing: 0.02 mm (0.0008 in.)

NOTICE:
Excess honing will destroy the finished roundness.



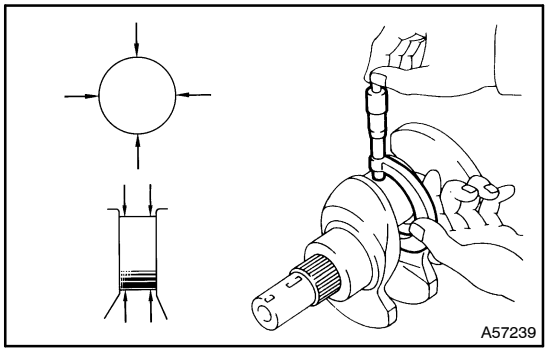
25. INSPECT CRANKSHAFT

(a) Inspect for circle runout.

(1) Place the crankshaft on V–blocks.
(2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.06 mm (0.0024 in.)

If the circle runout is greater than maximum, replace the crankshaft.



(b) Inspect the main journals and crank pins.

(1) Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter:

STD	61.985 – 62.000 mm (2.4403 – 2.4409 in.)
U/S 0.25	61.745 – 61.755 mm (2.4309 – 2.4313 in.)
U/S 0.50	61.495 – 61.505 mm (2.4211 – 2.4215 in.)

Crank pin diameter:

STD	54.988 – 55.000 mm (2.1649 – 2.1654 in.)
U/S 0.25	54.745 – 54.755 mm (2.1553 – 2.1557 in.)
U/S 0.50	54.495 – 54.505 mm (2.1455 – 2.1459 in.)

If the diameter is not as specified, check the oil clearance (See steps 2 and 6). If necessary, grind or replace the crankshaft.

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

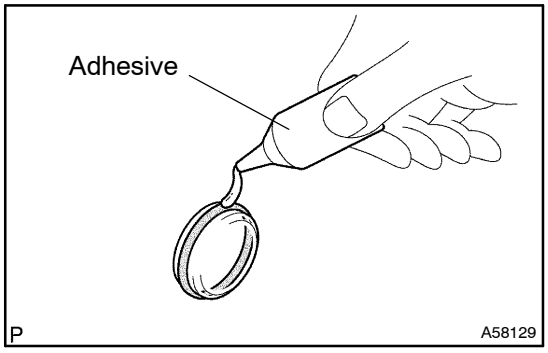
Maximum taper and out–of–round:
0.02 mm (0.0008 in.)

If the taper and out–of–round is greater than maximum, replace the crankshaft.

(c) If necessary, grind and hone the main journals and/or crank pins.

(1) Grind and hone the main journals and/or crank pins to the finished undersized diameter (See procedure in step (b) above).

(2) Install new main journal and/or crankshaft pin undersized bearing.



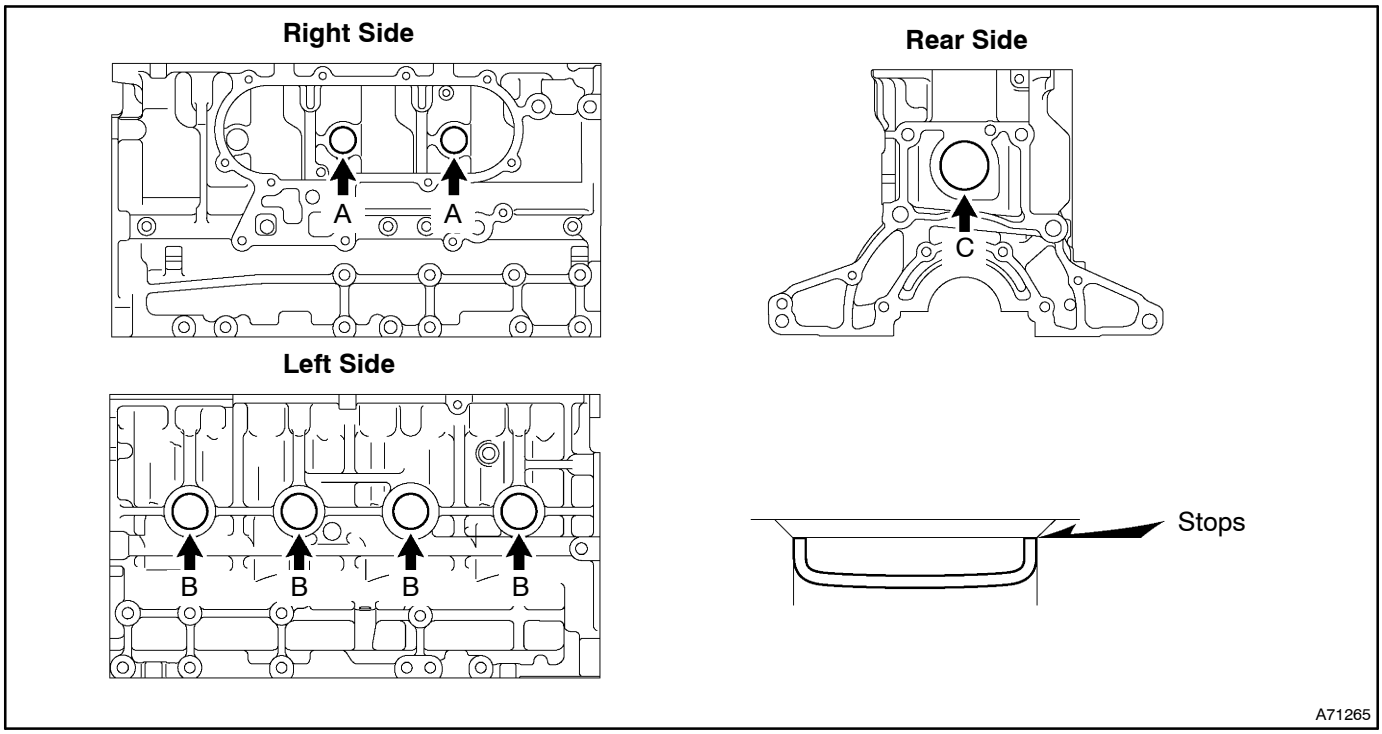
26. INSTALL TIGHT PLUG

(a) Apply adhesive to a new tight plug.

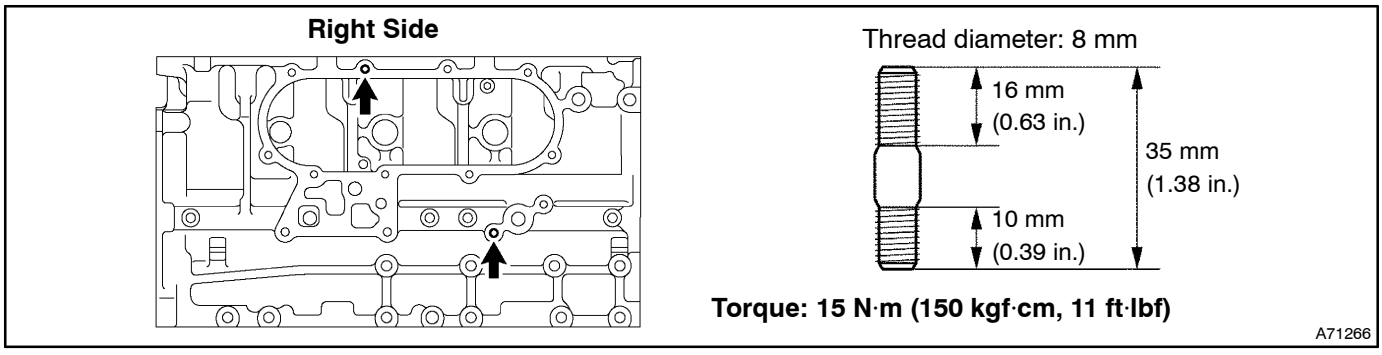
Adhesive:
Part No. 08833–00070, THREE BOND 1324 or equivalent

(b) Using SST and a hammer, tap in the tight plug as shown in the illustration.

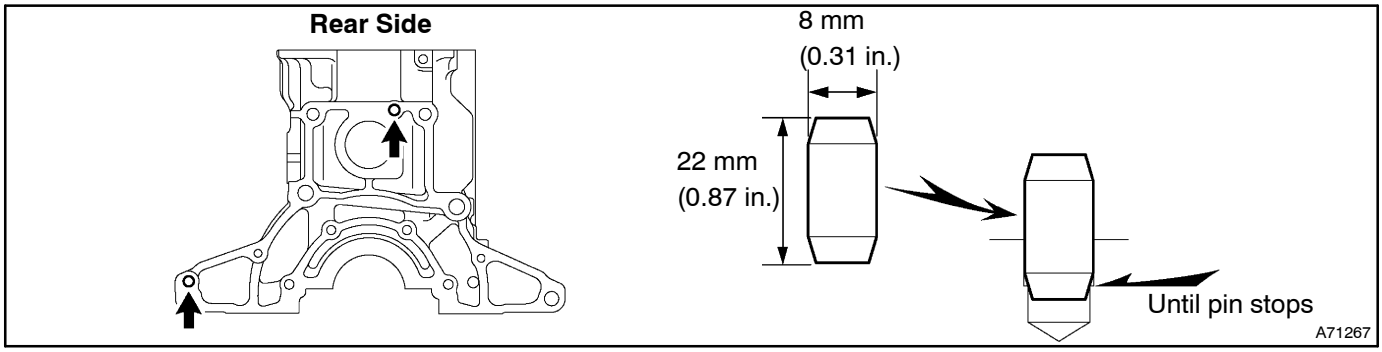
SST Position A:
09950–60010 (09951–00250), 09950–70010 (09951–07100)
Position B:
09950–60010 (09951–00350), 09950–70010 (09951–07100)
Position C:
09950–60010 (09951–00500), 09950–70010 (09951–07100)



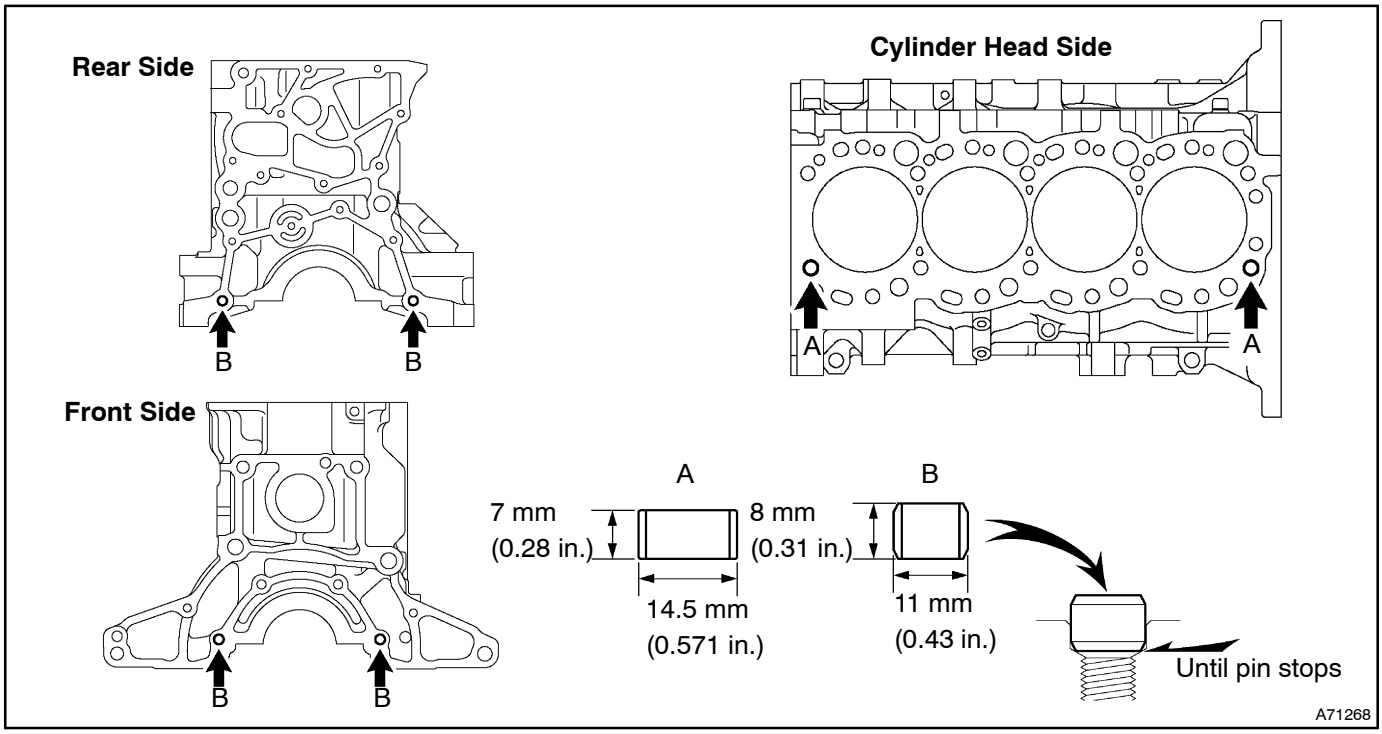
27. INSTALL STUD BOLT

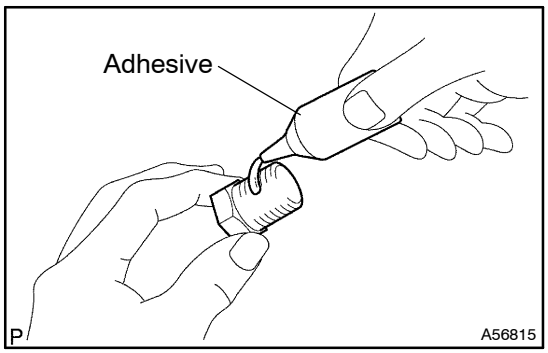


28. INSTALL STRAIGHT PIN



29. INSTALL RING PIN

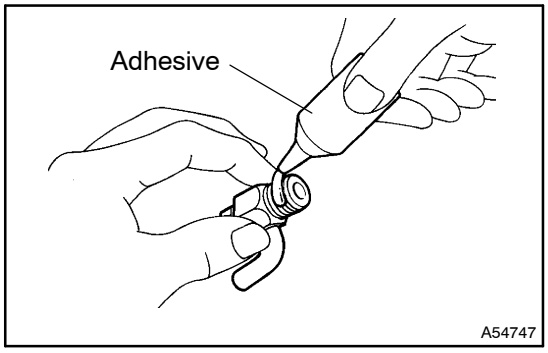




30. INSTALL W/HEAD TAPER SCREW PLUG NO.1

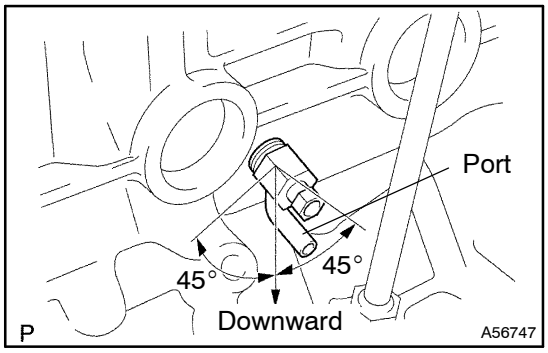
(a) Apply adhesive to 2 or 3 threads.
Adhesive:
Part No. 08833–00070, THREE BOND 1324 or equivalent

(b) Install the screw plug.
Torque: 20 N·m (200 kgf·cm, 14 ft·lbf)



31. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB–ASSY

(a) Apply adhesive to 2 or 3 threads.
Adhesive:
Part No. 08833–00070, THREE BOND 1324 or equivalent



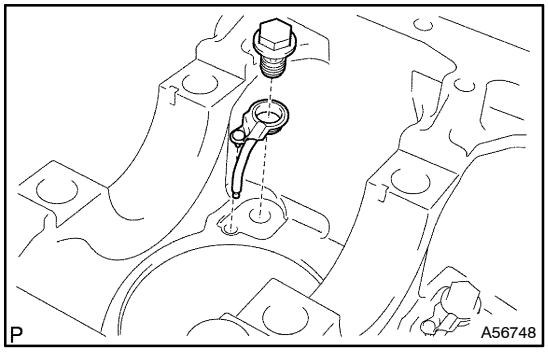
(b) Install the drain union.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

HINT:

- After applying the specified torque, rotate the drain union clockwise until its drain port is facing downward.
- The drain port may be set within 45° of either side of the prescribed position.

32. INSTALL CYLINDER BLOCK OIL ORIFICE

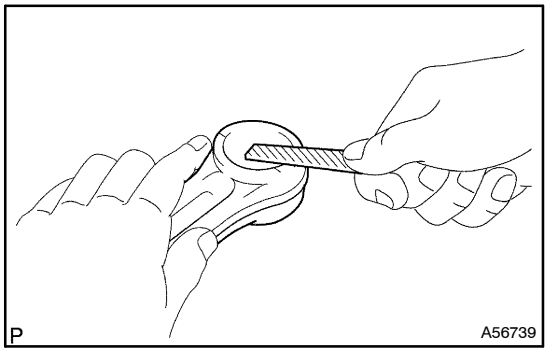
(a) Using a 6 mm hexagon wrench, install the oil orifice.
Torque (Reference): 11 N·m (110 kgf·cm, 8 ft·lbf)



33. INSTALL SUB–ASSY OIL NOZZLE NO.1

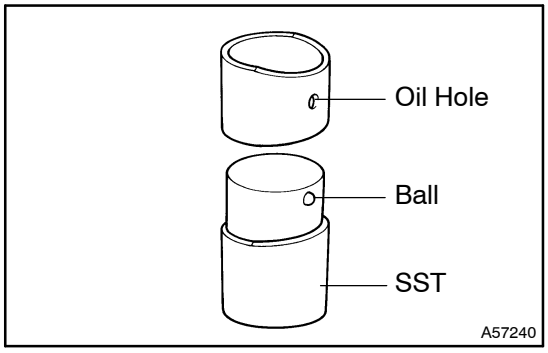
(a) Align the pin of the oil nozzle with the pin hole of the cylinder block.

(b) Install the oil nozzle with the check valve. Install the 4 oil nozzles and check valves.
Torque: 26 N·m (260 kgf·cm, 18 ft·lbf)

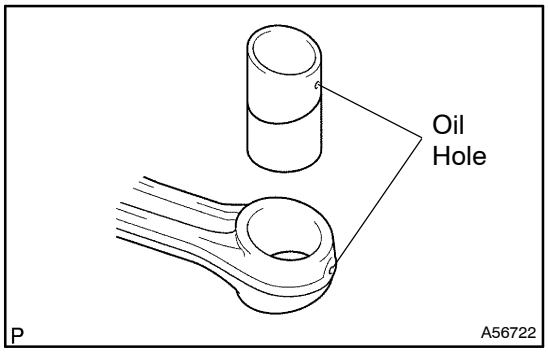


34. INSTALL CONNECTING ROD SMALL END BUSH

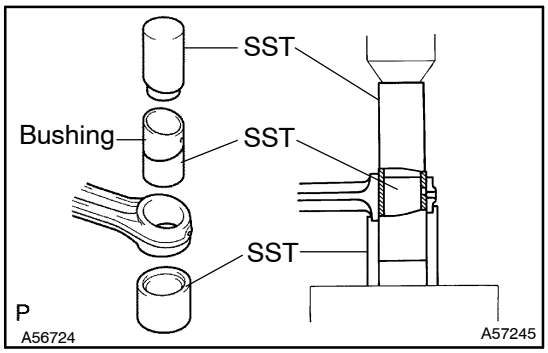
(a) Using a round file, lightly file off any roughness from the small end of the connecting rod.



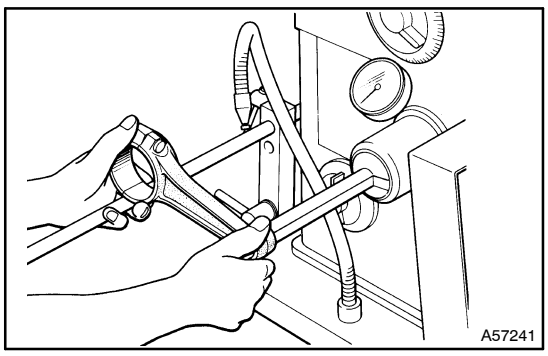
(b) Attach a new bush to SST with the ball of SST inside the oil hole of the bush.
SST 09222–54011 (09222–03021)



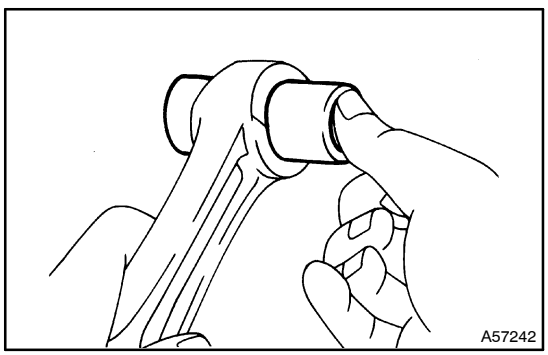
(c) Align the oil holes of the bush and connecting rod.



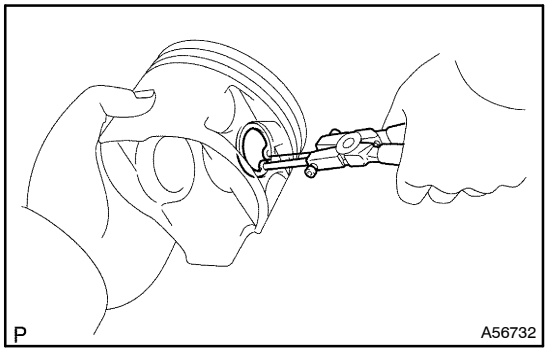
(d) Using SST and a press, press in the bush.
SST 09222–54011 (09222–03016, 09222–03021, 09222–03026)



(e) Using a pin hole grinder, hone the bush to obtain the standard specified clearance (See step 21) between the bush and piston pin.



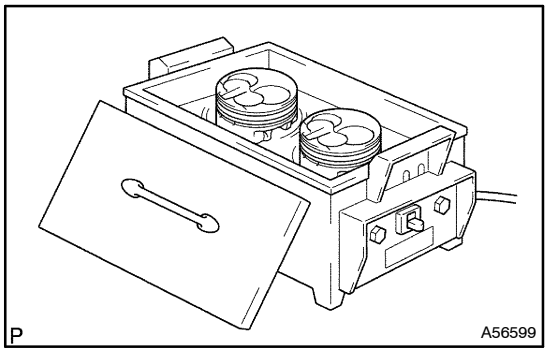
(f) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.



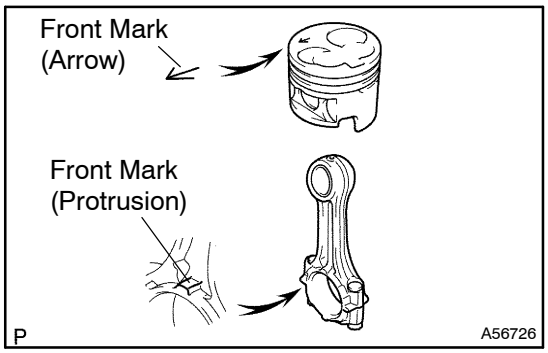
35. INSTALL W/PIN PISTON SUB–ASSY

(a) Assemble the piston and connecting rod.

(1) Using snap ring pliers, install a new snap ring on one side of the piston pin hole.

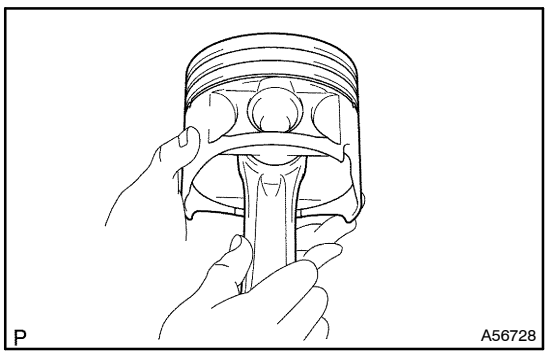


(2) Gradually heat the piston to about 60˚C (140˚F).



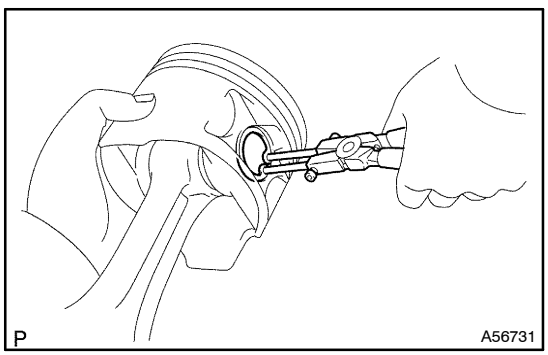
(3) Coat the piston pin with engine oil.

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

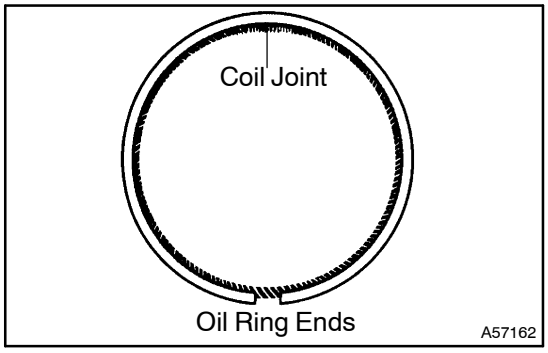


(5) Check fit between the piston and piston pin.

- Try to move the piston back and forth on the piston pin.



(6) Using snap ring pliers, install a new snap ring on the other side of the piston pin hole.

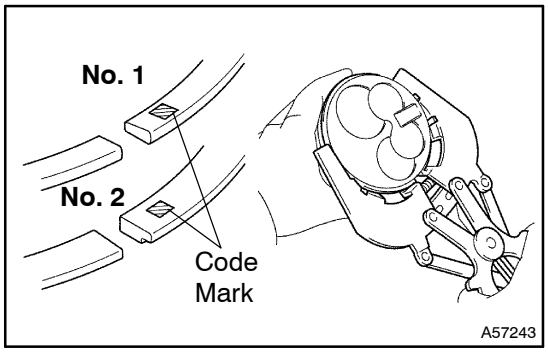


(b) Install the piston rings.

(1) Install the coil and oil ring by hand.

HINT:

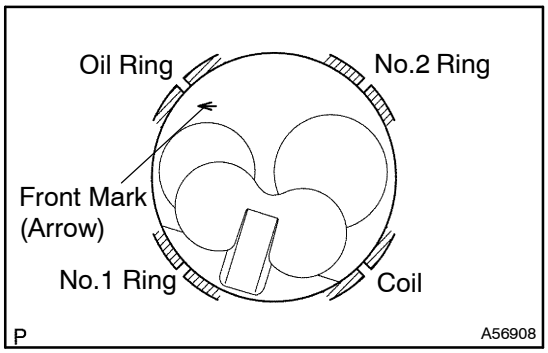
Face the end gap of the oil ring in the opposite direction coil joint.



(2) Using a piston ring expander, install the No. 1 and No. 2 piston rings with the code mark facing upward.

Code mark:

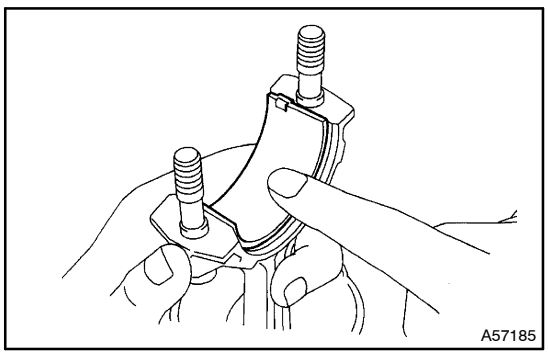
No. 1	1N
No. 2	2N



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

NOTICE:

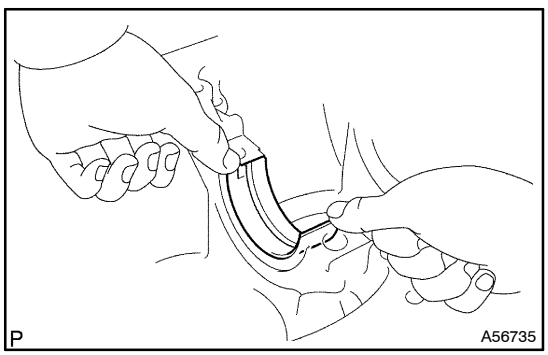
Do not align the ring ends.



36. INSTALL CONNECTING ROD BEARING

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

(b) Install the bearings in the connecting rod and connecting rod cap.

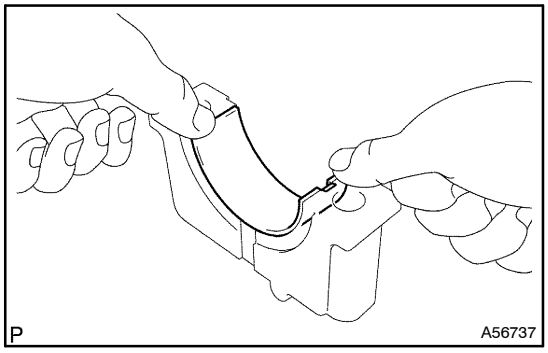


37. INSTALL CRANKSHAFT BEARING

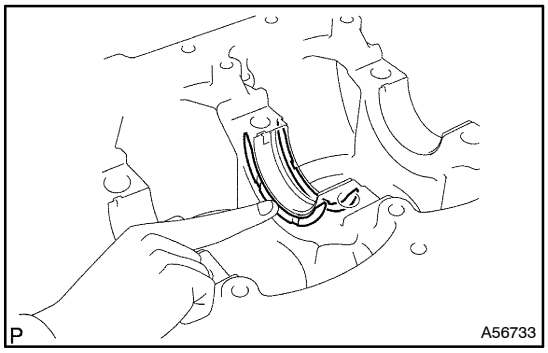
HINT:

Upper bearings have an oil groove and oil hole; lower bearings do not.

(a) Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

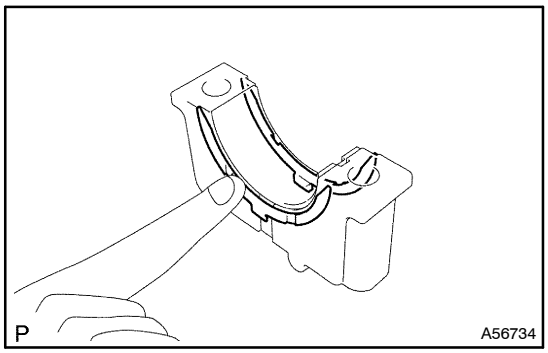


(b) Align the bearing claw with the claw groove of the crankshaft bearing cap, and push in the 5 lower bearings.

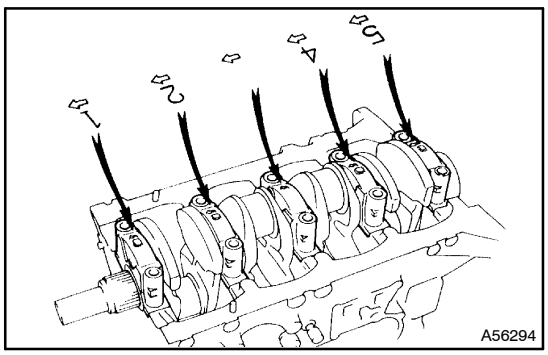


38. INSTALL CRANKSHAFT THRUST WASHER SET

(a) Install the 2 thrust washers under the No. 3 journal position of the cylinder block with the oil grooves facing outward.



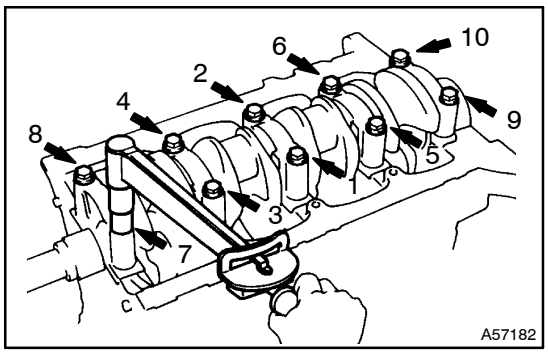
(b) Install the 2 thrust washers on the No. 3 crankshaft bearing cap with the grooves facing outward.



39. INSTALL CRANKSHAFT

(a) Place the crankshaft on the cylinder block.

(b) Install the 5 crankshaft bearing caps in their proper locations.



(c) Install the crankshaft bearing cap bolts.

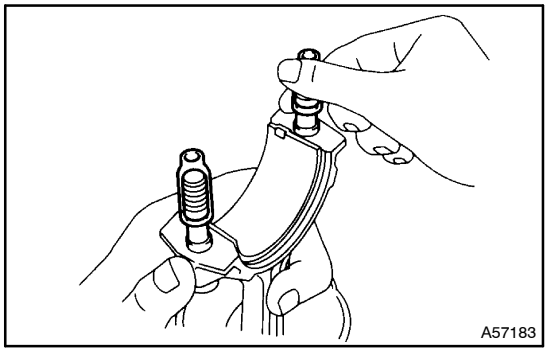
(1) Apply a light coat of the engine oil on the threads and under the bolt heads of the crankshaft bearing caps.

(2) Install and uniformly tighten the 10 bolts of the crankshaft bearing caps, in several passes, in the sequence shown.

Torque: 105 N·m (1,050 kgf·cm, 77 ft·lbf)

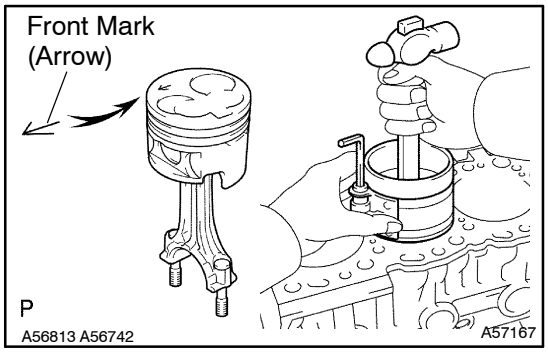
(d) Check that the crankshaft turns smoothly.

(e) Check the crankshaft thrust clearance (See step 5).

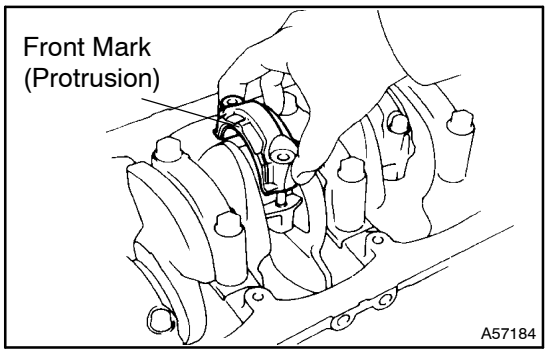


40. INSTALL PISTON AND CONNECTING ROD

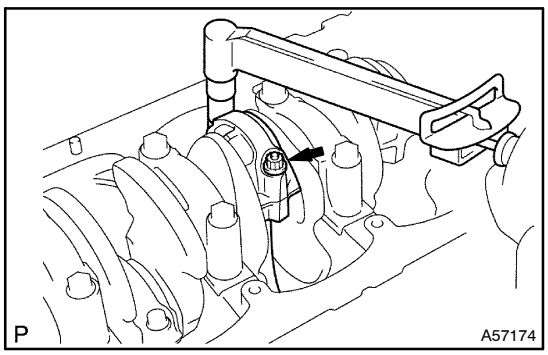
(a) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft and cylinder bore from damage.



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



(c) Place the connecting rod cap on the connecting rod.
   (1) Match the numbered connecting rod cap with the connecting rod.
   (2) Install the connection rod cap with the front mark facing forward.



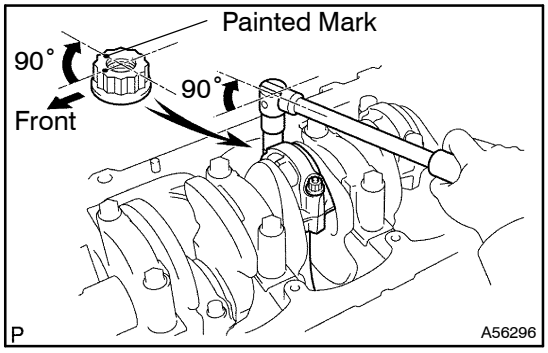
(d) Install the connecting rod cap nuts.

HINT:

- The connecting rod cap nuts are tightened in 2 progressive steps (steps (2) and (4)).
- If any connecting rod bolt is broken or deformed, replace it.
   (1) Apply a light of engine oil on the threads and under the heads of the connecting rod cap nuts.
   (2) Install and alternately tighten the nuts of the connecting rod cap in several passes.

Torque: 54 N·m (550 kgf·cm, 40 ft·lbf)

If any one of the connecting rod cap nuts does not meet the torque specification, replace the cap nuts.



(3) Mark the front of the connecting rod cap nuts with paint.
(4) Retighten the connecting rod cap nuts 90° as shown.
(5) Check that the painted mark is now at a 90° angle to the front.

(e) Check that the crankshaft turns smoothly.
(f) Check the connecting rod thrust clearance (See step 1).