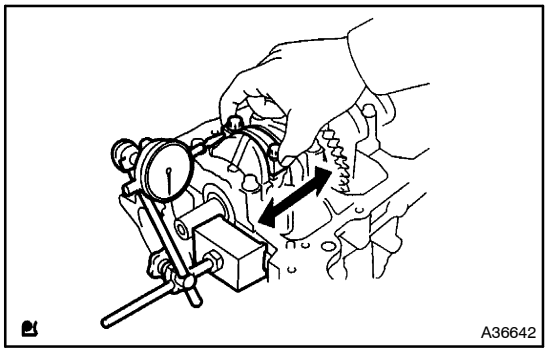
CYLINDER BLOCK (1AZ–FE/2AZ–FE)

OVERHAUL

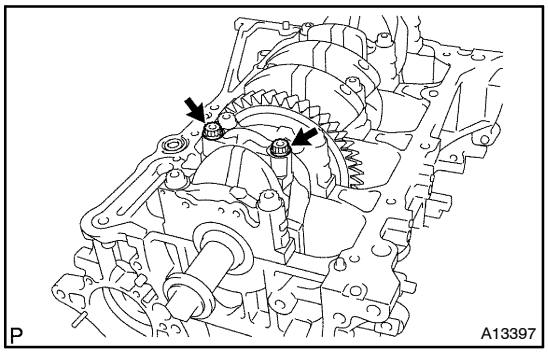
140IC–01



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:
0.160 – 0.362 mm (0.0063 – 0.0143 in.)
Maximum thrust clearance: 0.362 mm (0.0143 in.)

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



2. INSPECT CONNECTING ROD OIL CLEARANCE

HINT:
The connecting rod cap bolts are tightened in 2 progressive steps.

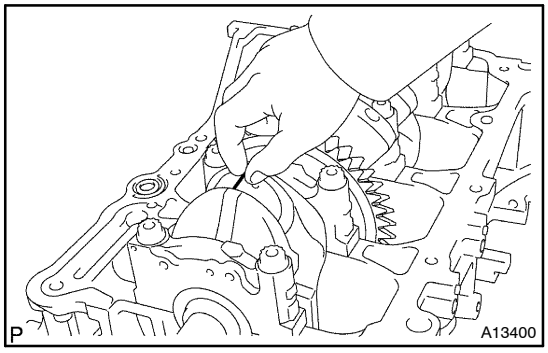
(a) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.

HINT:
The matchmarks on the connecting rods and caps are for ensuring correct reassembly.

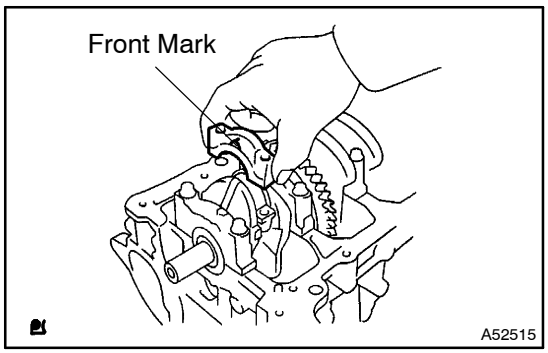
(b) Using a 12 mm socket wrench, remove the 2 connecting rod cap bolts.

(c) Clean the crank pin and bearing.

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



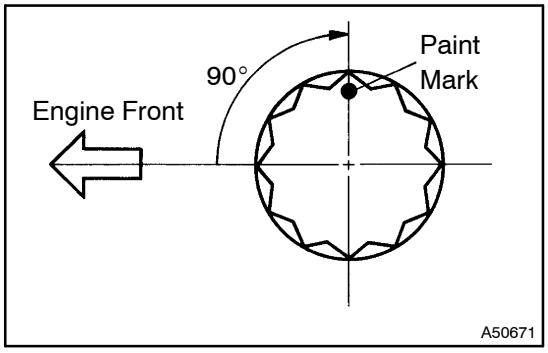
(e) Lay a strip of plastigage on the crank pin.



(f) Check that the front mark 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 a 12 mm socket wrench, tighten the bolts in several passes by the specified torque.
Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)

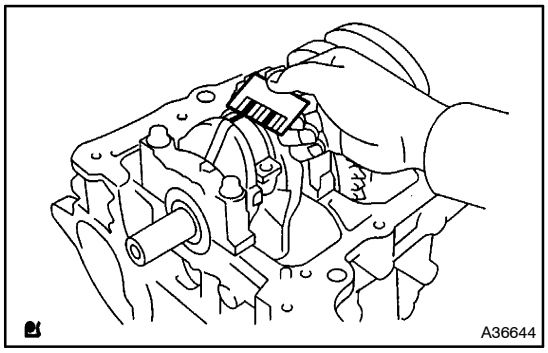


(i) Mark the front of the connecting rod cap bolts with paint.
(j) Retighten the cap bolts by 90° as shown in the illustration.

NOTICE:

Do not turn the crankshaft.

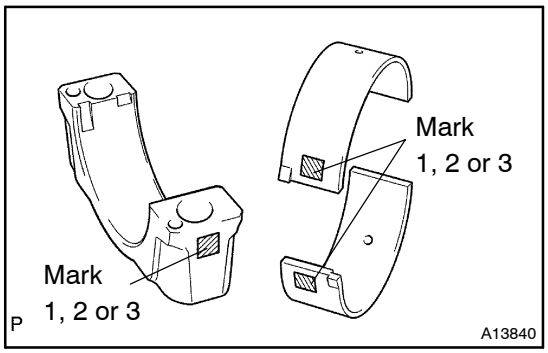
(k) Remove the 2 bolts, connecting rod cap and lower bearing.



(l) Measure the plastigage at its widest point.
Standard oil clearance:
0.024 – 0.048 mm (0.0009 – 0.0019 in.)
Maximum oil clearance: 0.08 mm (0.0031 in.)

NOTICE:

Completely remove the plastigage.

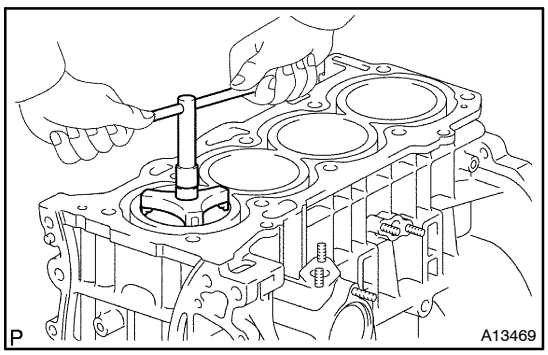


(m) If replacing a bearing, replace it with one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked ”1”, ”2” and ”3” accordingly.

HINT:

Standard bearing center wall thickness.

Mark 1	1.485 – 1.488 mm (0.0585 – 0.0586 in.)
Mark 2	1.488 – 1.491 mm (0.0586 – 0.0587 in.)
Mark 3	1.491 – 1.494 mm (0.0587 – 0.0588 in.)



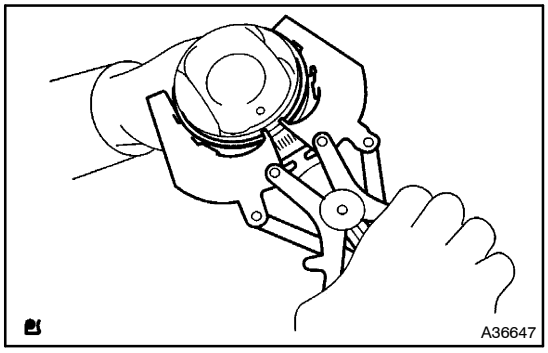
3. REMOVE PISTON SUB–ASSY W/CONNECTING ROD

(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:

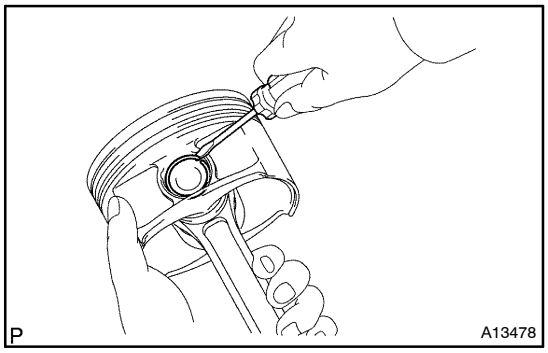
- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

4. REMOVE CONNECTING ROD BEARING



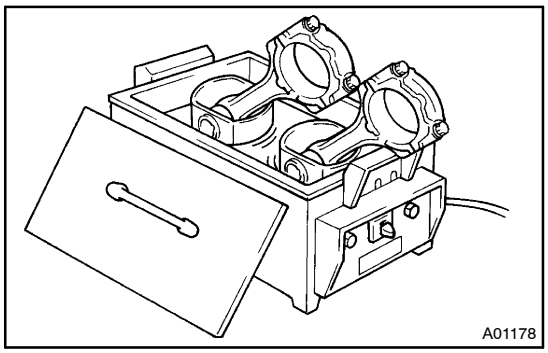
5. REMOVE PISTON RING SET

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



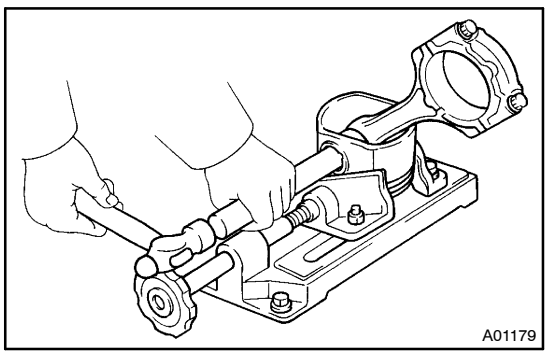
6. REMOVE PISTON PIN HOLE SNAP RING

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



7. REMOVE PISTON

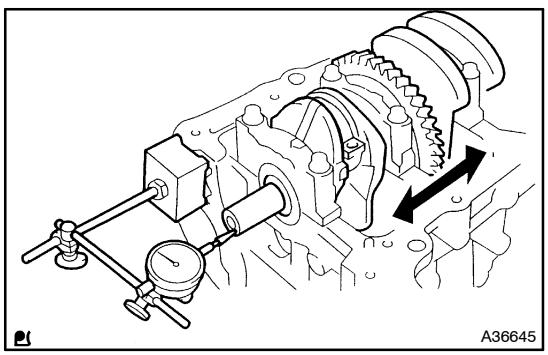
(a) Gradually heat the piston to 80 – 90 °C (176 – 194 °F).



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

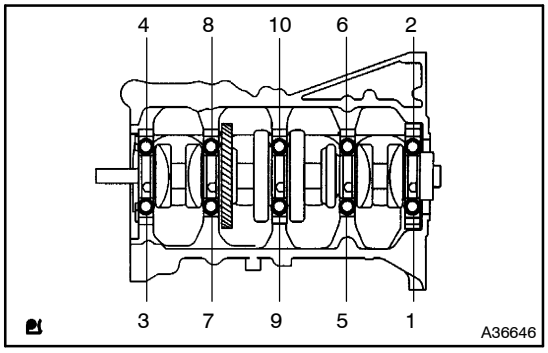
HINT:

- 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:
0.040 – 0.240 mm (0.0016 – 0.0094 in.)
Maximum thrust clearance: 0.30 mm (0.0118 in.)
(b) If the thrust clearance is greater than maximum, replace the thrust washers as a set.
Thrust washer thickness:
1.930 – 1.980 mm (0.0760 – 0.0780 in.)



9. REMOVE CRANKSHAFT

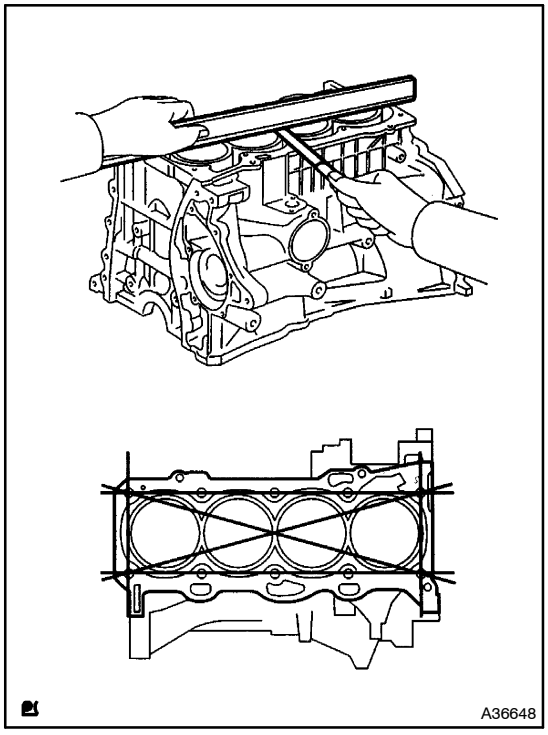
(a) Uniformly loosen and remove the 10 bearing cap sub–assembly bolts, in several passes, in the sequence shown.
(b) Remove the bearing cap and crankshaft.

10. REMOVE CRANKSHAFT THRUST WASHER UPPER

11. REMOVE CRANKSHAFT BEARING

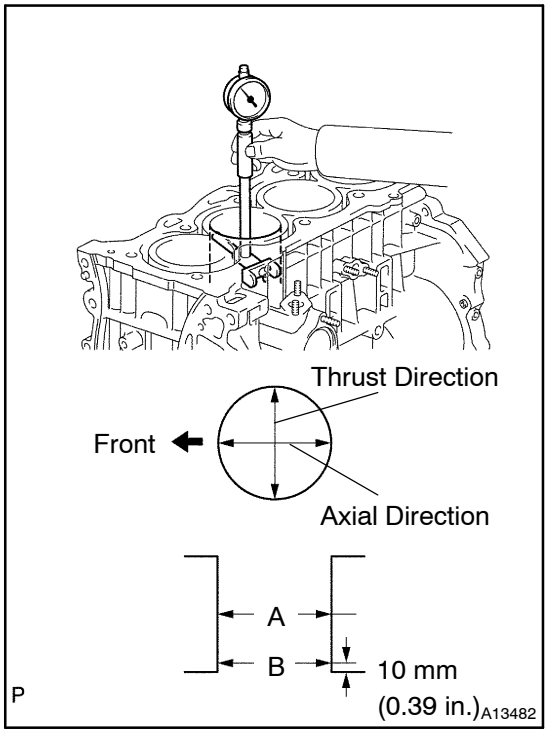
NOTICE:
Arrange the bearings in the correct order.
12. REMOVE CRANKSHAFT BEARING NO.2

NOTICE:
Arrange the main bearings and thrust washers in the correct order.
13. REMOVE STUD BOLT



14. 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.)



15. INSPECT CYLINDER BORE

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

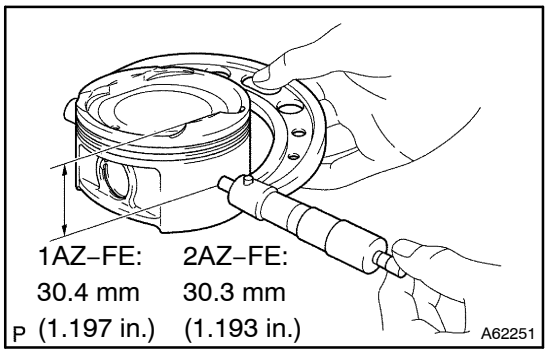
Standard diameter:

1AZ – FE

86.000 – 86.013 mm (3.3858 – 3.3863 in.)

2AZ – FE

88.500 – 88.513 mm (3.4843 – 3.4848 in.)



16. INSPECT PISTON DIAMETER

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 30.4 mm (1.197 in.) for 1AZ–FE or 30.3 mm (1.193 in.) for 2AZ–FE from the piston head.

Piston diameter:

1AZ – FE

85.927 – 85.937 mm (3.3829 – 3.3833 in.)

2AZ – FE

88.439 – 88.449 mm (3.4818 – 3.4822 in.)

17. INSPECT PISTON CLEARANCE

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

1AZ – FE

Standard oil clearance: 0.063 – 0.086 mm (0.0025 – 0.0034 in.)

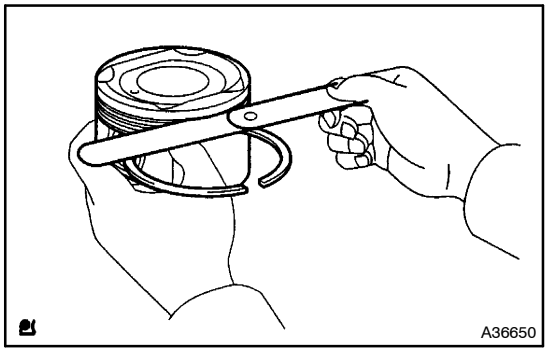
Maximum oil clearance: 0.1 mm (0.0039 in.)

2AZ – FE

Standard oil clearance: 0.051 – 0.074 mm (0.0020 – 0.0029 in.)

Maximum oil clearance: 0.1 mm (0.0039 in.)

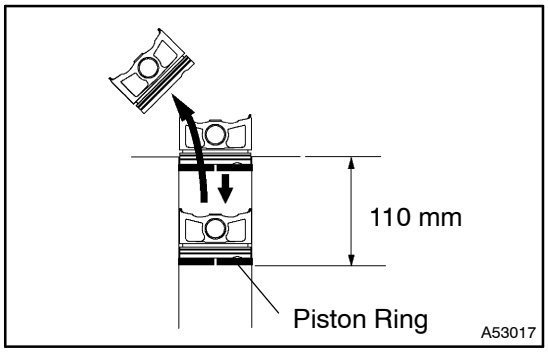
(b) If the clearance is greater than maximum, replace all the 4 pistons. If necessary, replace the cylinder block.



18. INSPECT RING GROOVE CLEARANCE

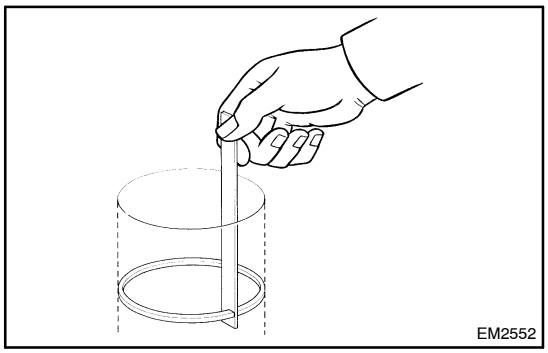
(a) Using a feeler gauge, measure the clearance between the piston ring and the wall of the ring groove.

Ring groove clearance:
1AZ – FE/2AZ – FE
No. 1 0.020 – 0.070 mm (0.0008 – 0.0028 in.)
No. 2 0.020 – 0.060 mm (0.0008 – 0.0024 in.)
Oil ring (side rail)
0.070 – 0.150 mm (0.0028 – 0.0059 in.)



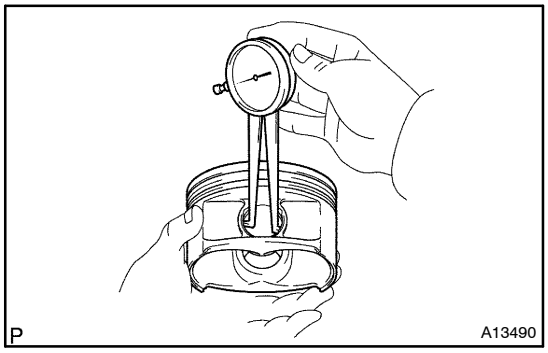
19. INSPECT PISTON RING END GAP

(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:
1AZ – FE
No. 1 0.30 – 0.40 mm (0.0118 – 0.0157 in.)
No. 2 0.47 – 0.62 mm (0.0185 – 0.0244 in.)
Oil (side rail) 0.10 – 0.35 mm (0.0039 – 0.0138 in.)
2AZ – FE
No. 1 0.22 – 0.32 mm (0.0087 – 0.0126 in.)
No. 2 0.50 – 0.60 mm (0.0197 – 0.0236 in.)
Oil (side rail) 0.10 – 0.35 mm (0.0039 – 0.0138 in.)
Maximum end gap:
No. 1 0.89 mm (0.0350 in.)
No. 2 1.35 mm (0.0531 in.)
Oil (side rail) 0.73 mm (0.0287 in.)



20. INSPECT PISTON PIN OIL CLEARANCE

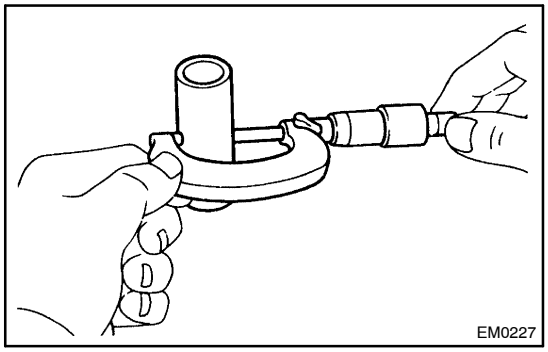
(a) Using a caliper gauge, measure the inside diameter of the piston bushing.

Bushing inside diameter:
22.001 – 22.010 mm (0.8662 – 0.8665 in.)

HINT:

Bushing inside diameter

Mark	mm (in.)
A	22.001 – 22.004 (0.8662 – 0.8663)
B	22.114 – 22.007 (0.8663 – 0.8664)
C	22.007 – 22.010 (0.8664 – 0.8665)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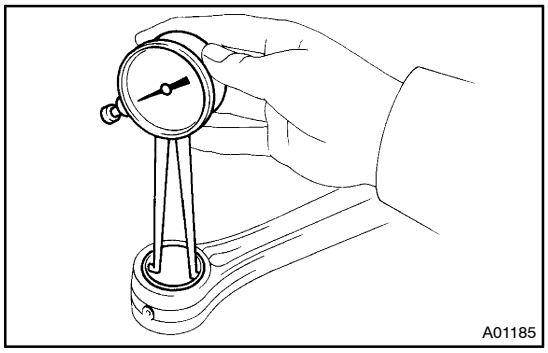
(b) Using a micrometer, measure the piston pin diameter.
Piston pin diameter:
21.997 – 22.009 mm (0.8660 – 0.8665 in.)

HINT:

Piston pin diameter

Mark	mm (in.)
A	21.997 – 22.000 (0.8660 – 0.8661)
B	22.000 – 22.003 (0.8661 – 0.8663)
C	22.003 – 22.006 (0.8663 – 0.8664)
D	22.006 – 22.009 (0.8664 – 0.8665)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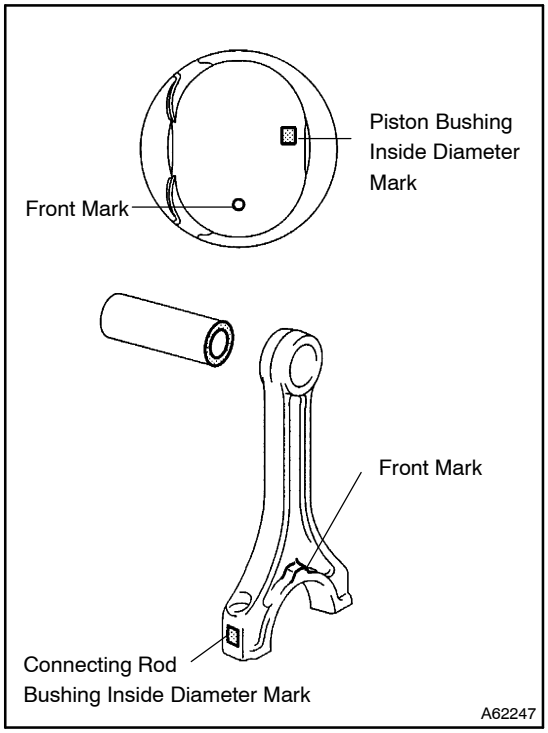
(c) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.
Bushing inside diameter:
22.005 – 22.014 mm (0.8663 – 0.8667 in.)

HINT:

Bushing inside diameter

Mark	mm (in.)
A	22.005 – 22.008 (0.8663 – 0.8665)
B	22.008 – 22.011 (0.8665 – 0.8666)
C	22.011 – 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: 0.010 mm (0.0020 in.)



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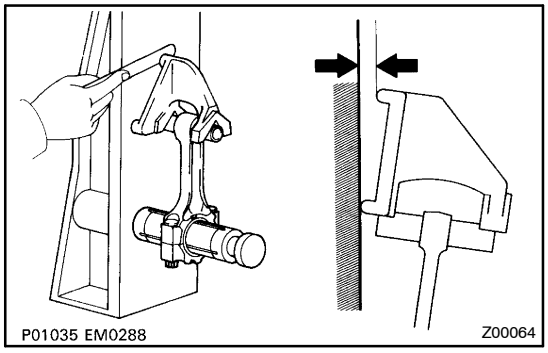
(e) If the oil clearance is greater than maximum, replace the connecting rod. If necessary, replace the piston and piston pin as a set.

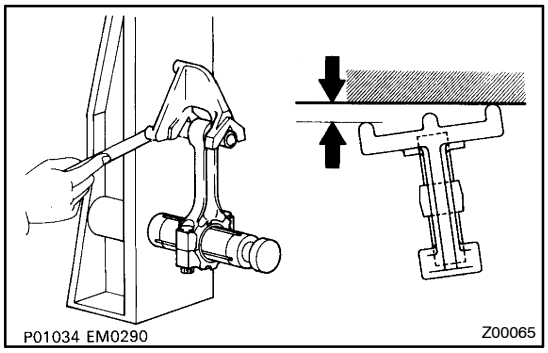
(f) Subtract the piston pin diameter measurement form the bushing inside diameter measurement.
Standard oil clearance:
0.005 – 0.011 mm (0.0002 – 0.0004 in.)
Maximum oil clearance: 0.010 mm (0.0020 in.)

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

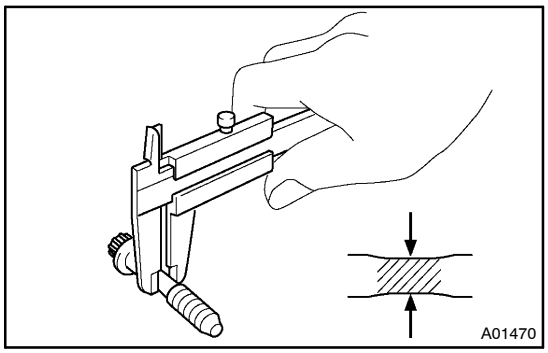


21. INSPECT CONNECTING ROD SUB–ASSY

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

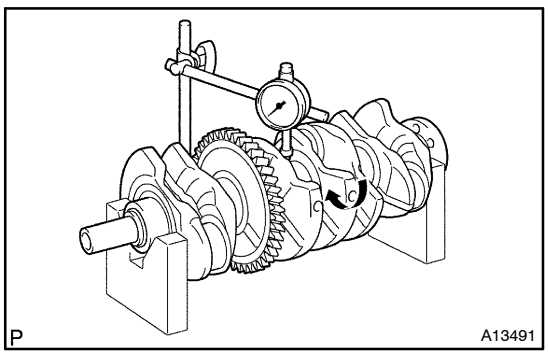


(1) Check for twist.
Maximum twist:
0.15 mm (0.0059 in.) per 100 mm (3.94 in.)
(c) If twist is greater than maximum, replace the connecting rod assembly.



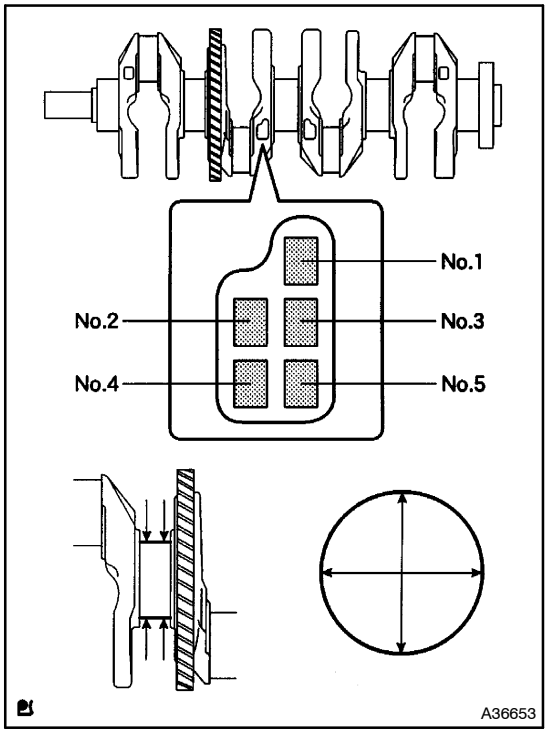
22. INSPECT CONNECTING ROD BOLT

(a) Using a vernier calipers, 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.)
(b) If the diameter is less than minimum, replace the bolt.



23. INSPECT CRANKSHAFT

(a) Using a dial indicator and V–blocks, measure the circle runout, as shown in the illustration.
Maximum circle runout: 0.03 mm (0.0012 in.)

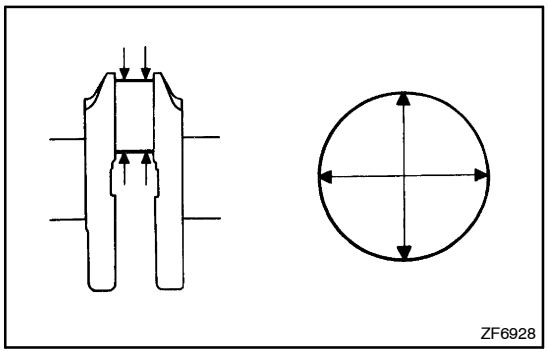


(b) Using a micrometer, measure the diameter of each main journal.
Diameter: 54.988 – 55.000 (2.1648 – 2.06535 in.)

(c) Check each main journal for taper and out–of–round as shown.
Maximum taper and out–of–round:
0.003 mm (0.0001 in.)

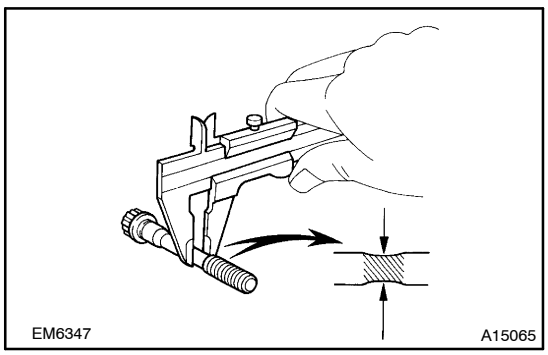
HINT:

Mark	mm (in.)
0	54.998 – 55.000 (2.16528 – 2.16535)
1	54.996 – 54.998 (2.16520 – 2.16528)
2	54.994 – 54.996 (2.16512 – 2.16520)
3	54.992 – 54.994 (2.16504 – 2.16512)
4	54.990 – 54.992 (2.16496 – 2.16504)
5	54.988 – 54.990 (2.16490 – 2.16496)



(d) Using a micrometer, measure the diameter of each crank pin.
Diameter: 47.990 – 48.000 mm (1.8894 – 1.8898 in.)

(e) Check each crank pin for taper and out–of–round as shown.
Maximum taper and out–of–round:
0.003 mm (0.0001 in.)



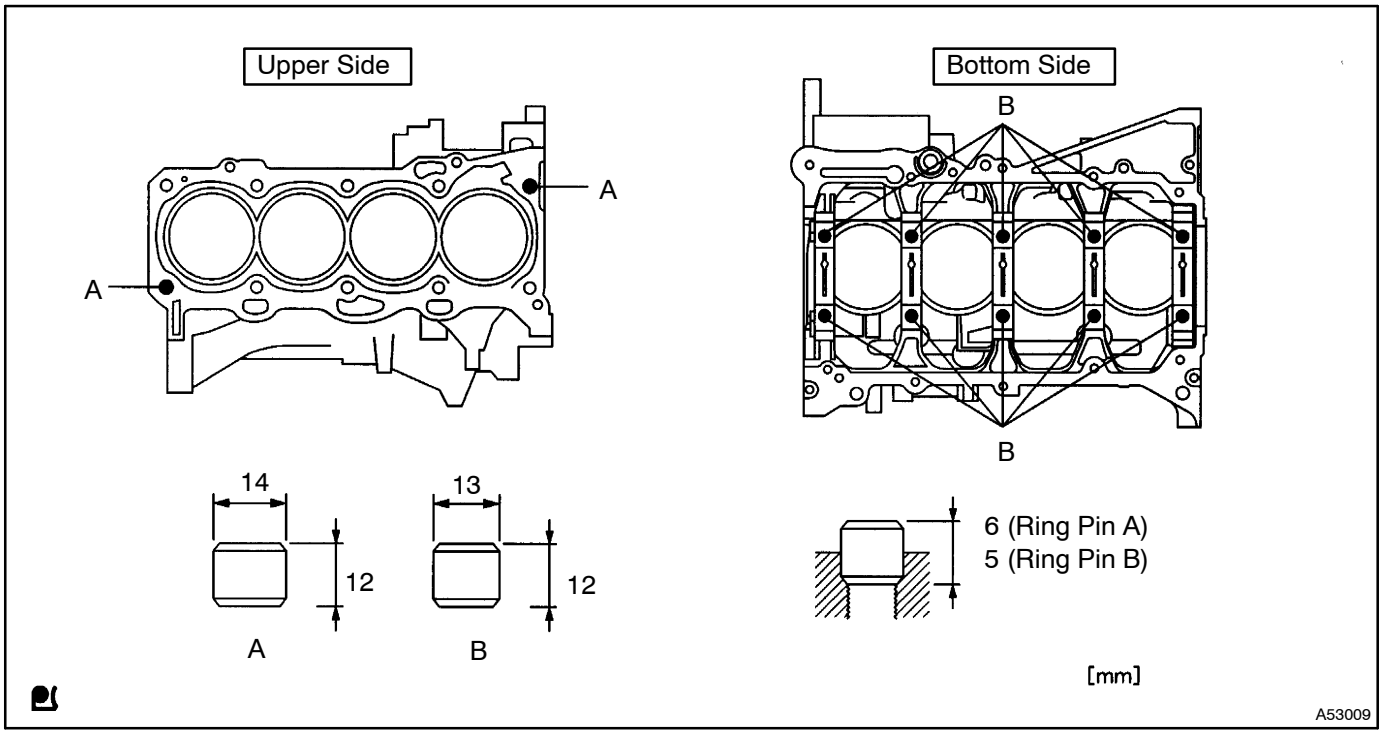
24. INSPECT CRANKSHAFT BEARING CAP SET BOLT

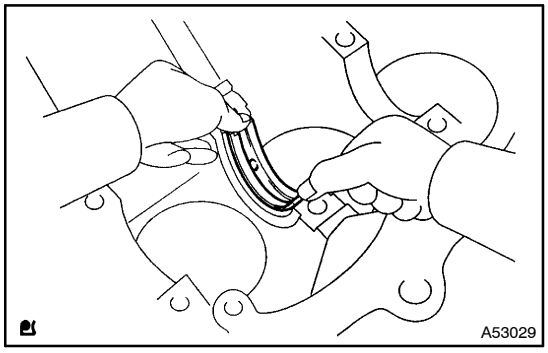
(a) Using vernier calipers, measure the tension portion diameter of the bolt.
Standard diameter: 7.5 – 7.6 mm (0.295 – 0.299 in.)
Minimum diameter: 7.2 mm (0.283 in.)

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

25. INSTALL RING PIN

(a) Using a plastic–faced hammer, tap into the ring pin.
Standard protrusion:
Ring pin A 6 mm (0.236 in.)
Ring pin B 5 mm (0.197 in.)





26. INSPECT CRANKSHAFT OIL CLEARANCE

NOTICE:

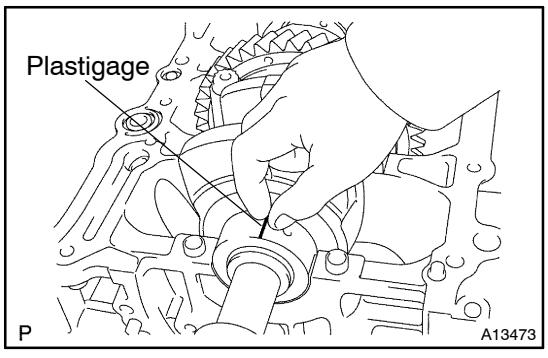
- **Clean the backside of the bearing and the bearing surface of the bearing cap and let not stick the oils and fats.**
- **The bearing cap bolts are tightened in 2 progressive steps.**

(a) Clean each main journal and bearing.

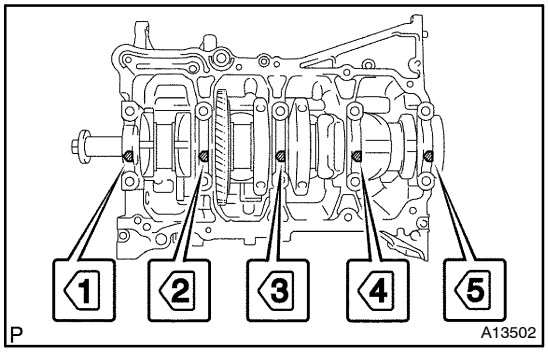
(b) Install the upper bearing with an oil groove on cylinder block.

(c) Install the lower bearing on the bearing cap sub assembly.

(d) Place the crankshaft on the cylinder block.

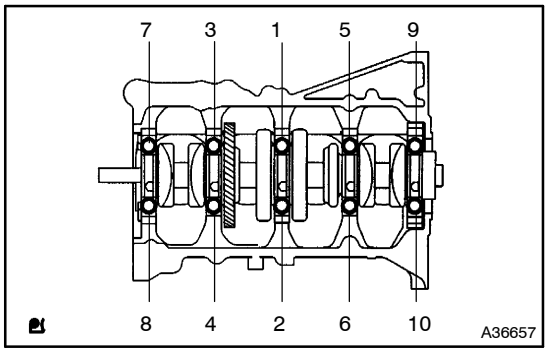


(e) Lay a strip of plastigage across each journal.



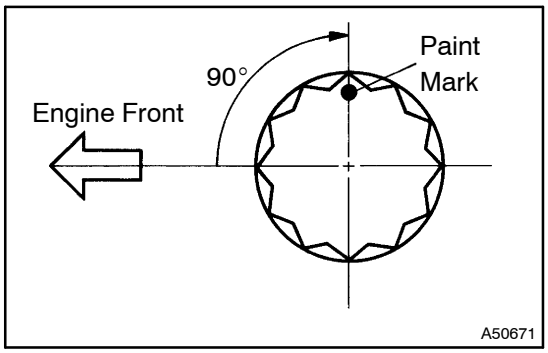
(f) Examine the front marks and install the bearing caps on the cylinder block.

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



(h) Tighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

(i) Retighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 40 N·m (408 kgf·cm, 29 ft·lbf)



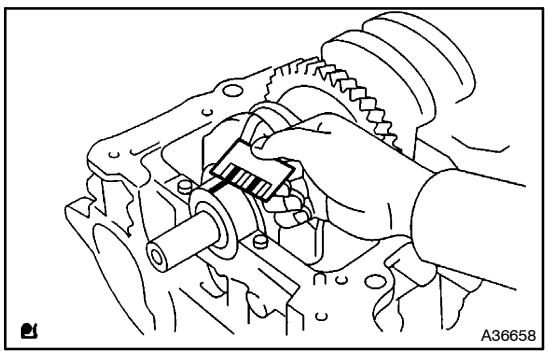
(j) Mark the front of the bearing cap bolts with paint.

(k) Retighten the bearing cap bolts by 90° in the numerical order shown.

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

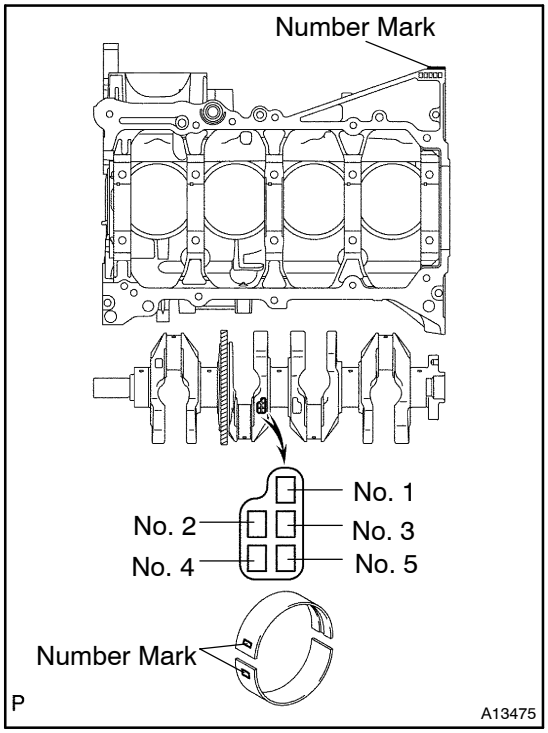
NOTICE:
Do not turn the crankshaft.

(m) Remove the bearing cap.



(n) Measure the plastigage at its widest point.
Standard oil clearance:
0.017 – 0.040 mm (0.0007 – 0.0016 in.)
Maximum oil clearance: 0.07 mm (0.0028 in.)

NOTICE:
Completely remove the plastigage.



(o) If using a standard 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 selecting the bearing with the same number as the total. There are 4 sizes of standard bearings, marked "1", "2", "3" and "4" accordingly.

Cylinder block (A) + Crankshaft (B)	0 – 2	3 – 5	6 – 8	9 – 11
Use bearing	"1"	"2"	"3"	"4"

HINT:
EXAMPLE
Cylinder block "4" (A) + Crankshaft "3" (B) =
Total number 7 (Use bearing "3")

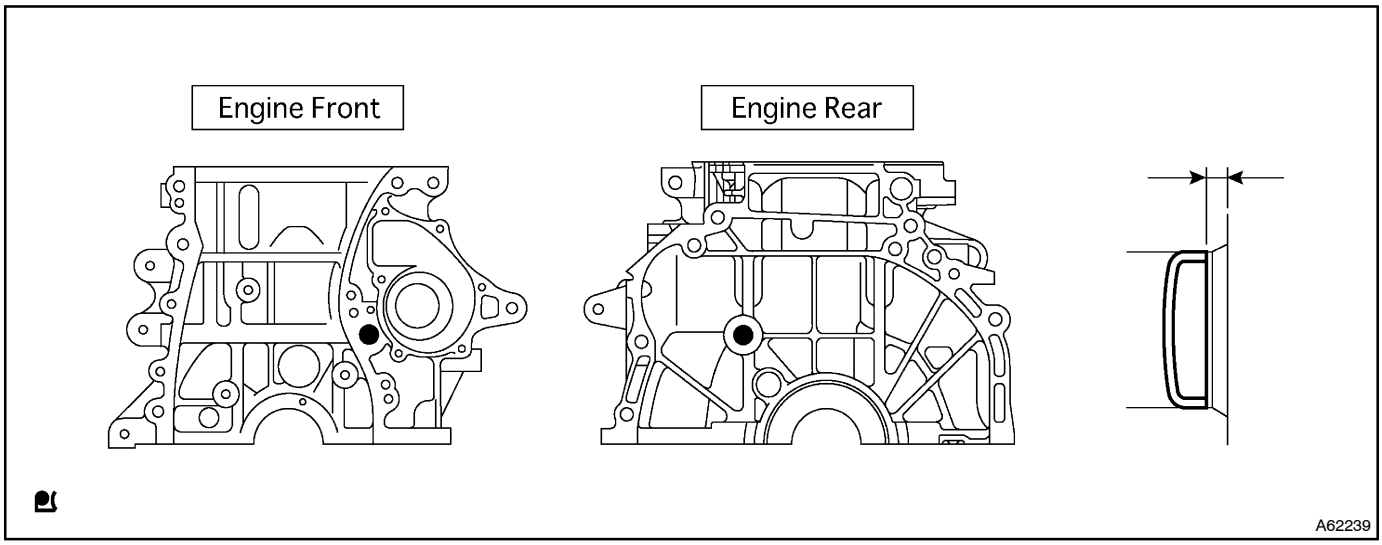
Reference:

Item	Mark	mm (in.)
Cylinder block main journal bore diameter (A)	0	59.000 – 59.002 (2.08683 – 2.32291)
	1	59.003 – 59.004 (2.08694 – 2.32299)
	2	59.005 – 59.006 (2.08701 – 2.32307)
	3	59.007 – 59.009 (2.08708 – 2.32318)
	4	59.010 – 59.011 (2.08718 – 2.32326)
	5	59.012 – 59.013 (2.08725 – 2.32334)
	6	59.014 – 59.016 (2.08733 – 2.32346)
Crankshaft main journal diameter (B)	0	54.998 – 55.000 (1.94528 – 2.16535)
	1	54.996 – 54.998 (1.94521 – 2.16527)
	2	54.994 – 54.996 (1.94514 – 2.16519)
	3	54.992 – 54.994 (1.94507 – 2.16511)
	4	54.990 – 54.992 (1.94500 – 2.16504)
	5	54.988 – 54.990 (1.94493 – 2.16496)
Standard bearing center wall thickness	1	1.993 – 1.996 (0.07846 – 0.07858)
	2	1.996 – 1.999 (0.07858 – 0.07870)
	3	1.999 – 2.002 (0.07870 – 0.07882)
	4	2.002 – 2.005 (0.07882 – 0.07894)

27. INSTALL TIGHT PLUG

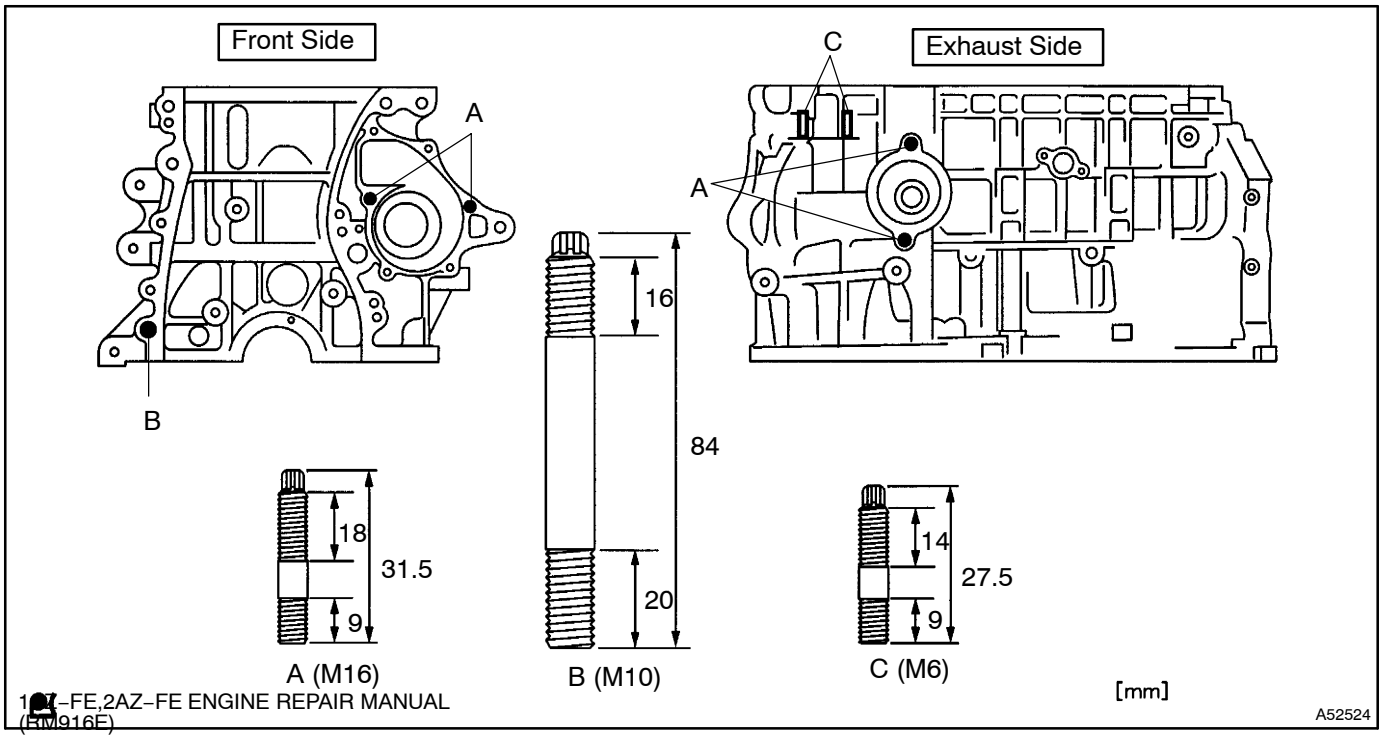
(a) Apply adhesive around tight plugs.
Adhesive: Part No. 08833–00070, THREE BOND 1324 or equivalent.

(b) Using SST, into the tight plugs as shown in the illustration.
SST 09950–60010 (09951–00200), 09950–70010 (09951–07100)
Standard depth:
Engine front 1.7 – 2.7 mm (0.067 – 0.106 in.)
Engine rear 2.2 – 3.2 mm (0.087 – 0.126 in.)



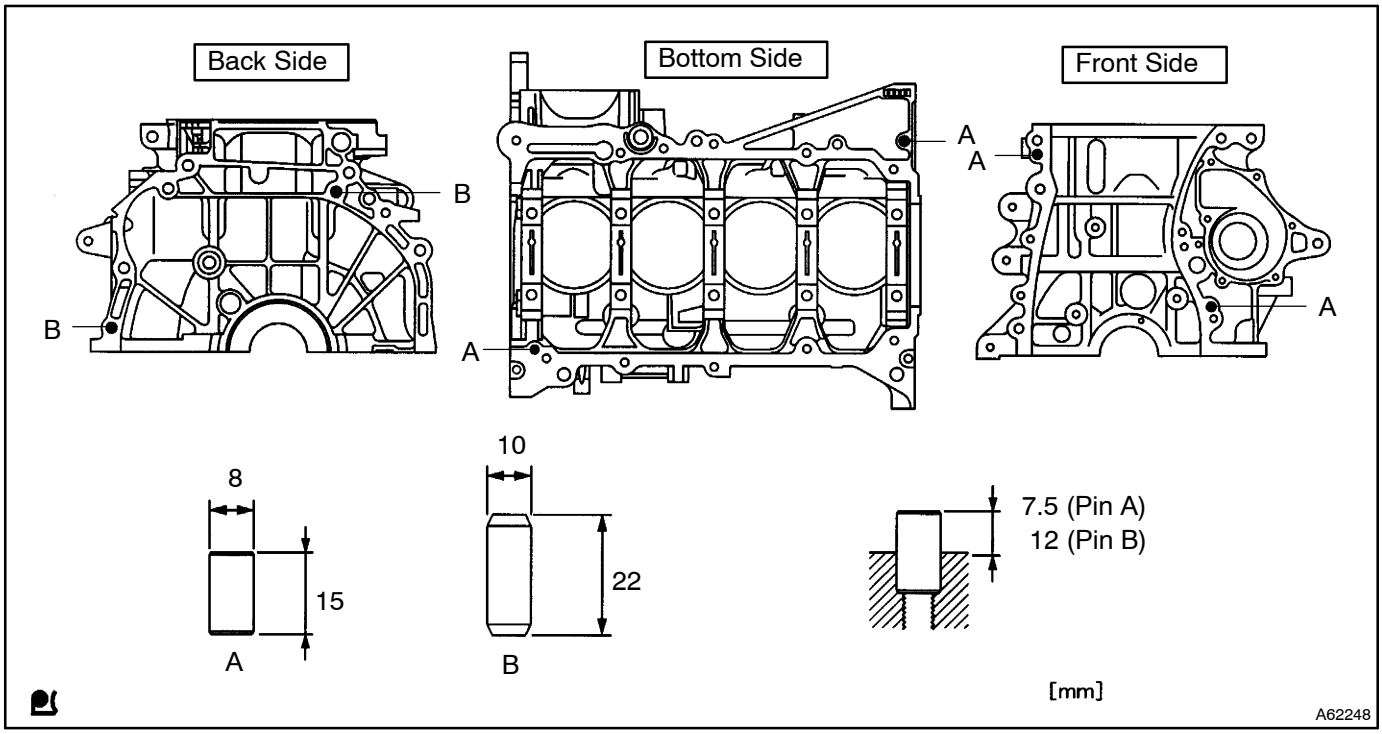
28. INSTALL STUD BOLT

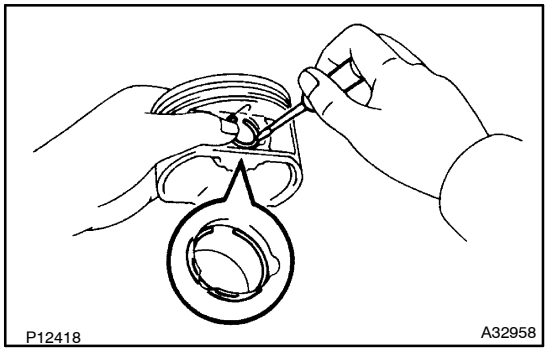
(a) Install the stud bolts as shown in the illustration.
Torque:
Stud bolt A 5.0 N·m (51 kgf·cm, 44 in.·lbf)
Stud bolt B 10N·m (97 kgf·cm, 84 in.·lbf)
Stud bolt C 5.0N·m (51 kgf·cm, 44 in.·lbf)



29. INSTALL STRAIGHT PIN

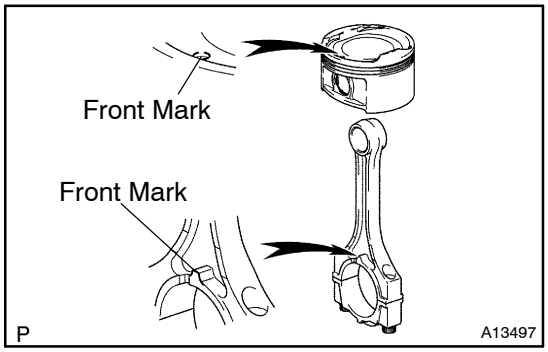
(a) Using a plastic–faced hammer, tap into the straight pin.
Standard protrusion
Pin A 7.5 mm (0.295 in.)
Pin B 12 mm (0.472 in.)



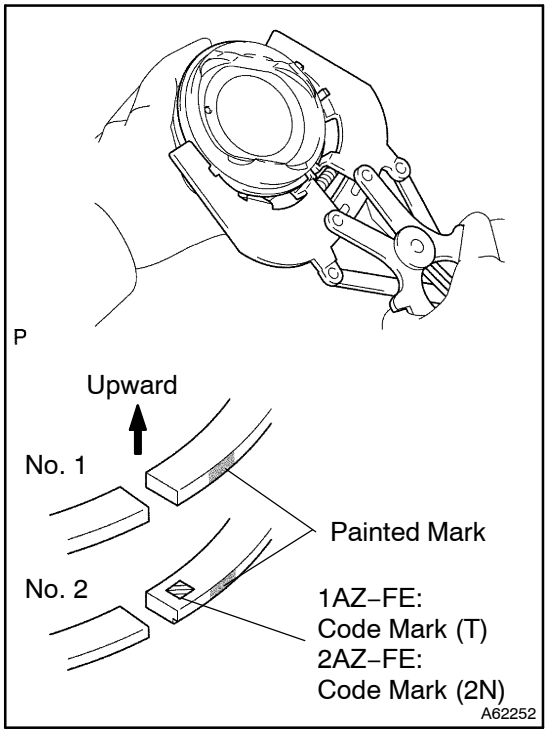


30. INSTALL PISTON

(a) Using a small screwdriver, install a new snap ring at one end of the piston pin hole.
(b) Gradually hat the piston to 80 – 90°C (176 – 194°F).



(c) Align the front marks on the piston with connecting rod, and push in the piston with your thumb.
(d) Using a small screwdriver, install a new snap ring on the other end of the piston pin hole.

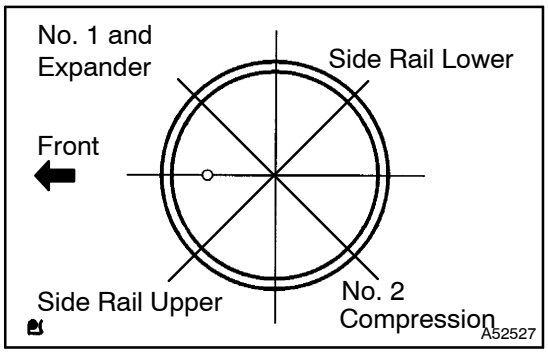


31. INSTALL PISTON RING SET

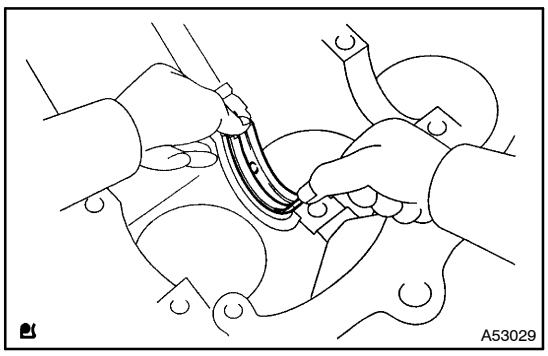
(a) Install the oil ring expander and 2 side rails by hand.
(b) Using a piston ring expander, install the 2 compression rings with the point mark facing right side.

NOTICE:

- **Install the compression ring No. 2 with the code mark (T) facing upward (1AZ–FE).**
- **Install the compression ring No. 2 with the code mark (2N) facing upward (2AZ–FE).**



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

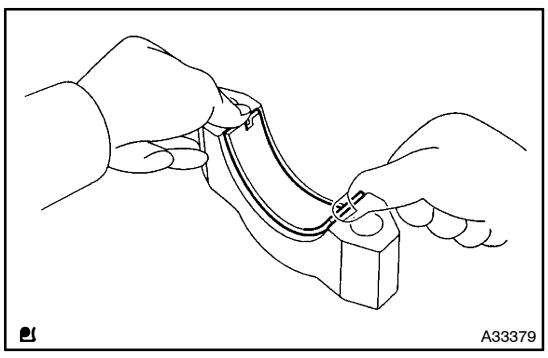


32. INSTALL CRANKSHAFT BEARING

(a) Install the upper bearing with an oil groove on cylinder block.

NOTICE:

Clean the back side of the bearing and the bearing surface of the cylinder block and let not stick the oils and fats.

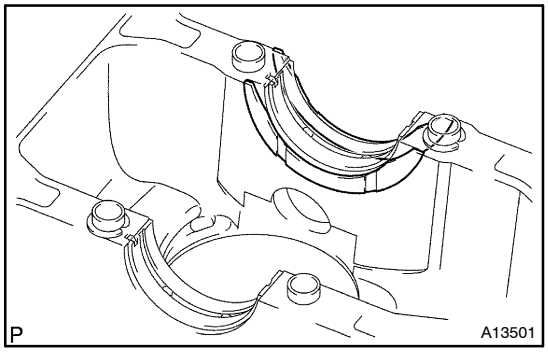


33. INSTALL CRANKSHAFT BEARING NO.2

(a) Install the lower bearing on bearing cap.

NOTICE:

Clean the back side of the bearing and the bearing surface of the bearing cap and let not stick the oils and fats.

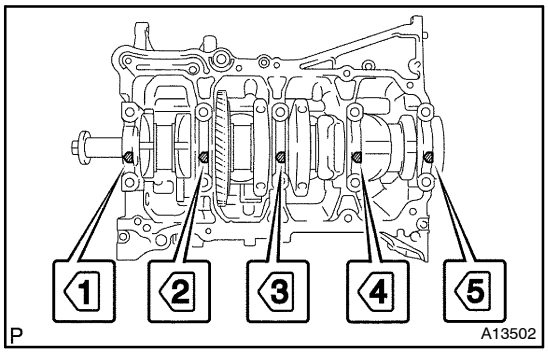


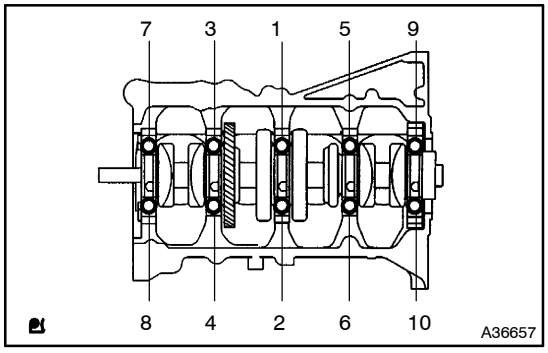
34. INSTALL CRANKSHAFT THRUST WASHER UPPER

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

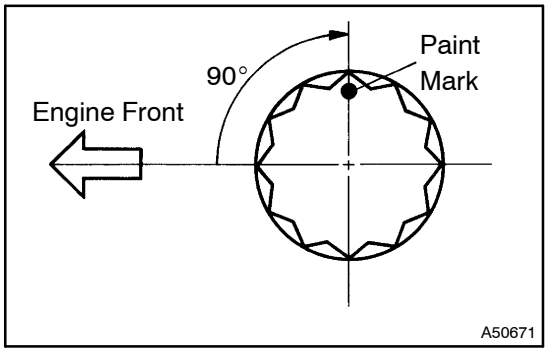
35. INSTALL CRANKSHAFT

(a) Apply engine oil to upper bearing and install the crankshaft on the cylinder block.
(b) Apply engine oil to lower bearing.
(c) Examine the front marks and install the bearing caps on the cylinder block.
(d) Apply a light coat of engine oil on the threads and under the bearing cap bolts.

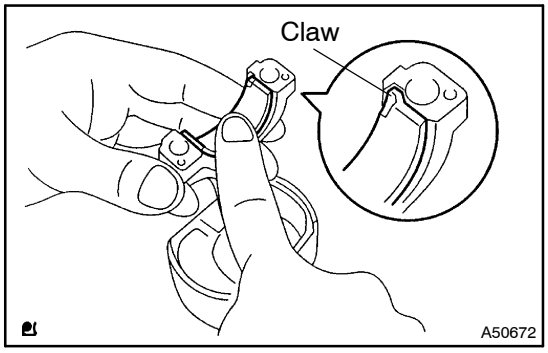




(e) Tighten the blots in several passes, in the sequence shown, by the specified torque.
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)
(f) Tighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 40 N·m (408 kgf·cm, 29 ft·lbf)



(g) Mark the front of the bearing cap bolts with paint.
(h) Retighten the bearing cap bolts by 90° in the numerical order shown.
(i) Check that the painted mark is now at a 90° angle to the front.
(j) Check the crankshaft turns smoothly.



36. INSTALL CONNECTING ROD BEARING

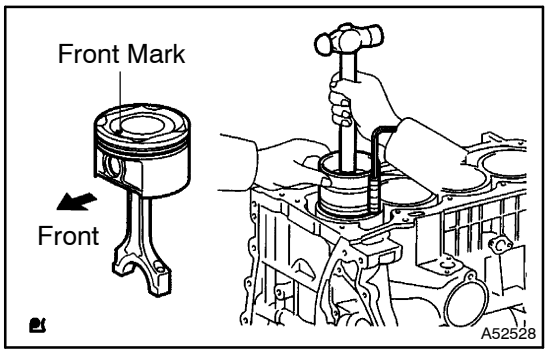
(a) Align the bearing claw with the groove of the connecting rod or connecting cap.

NOTICE:
Clean the back side of the bearing and the bearing surface of the bearing cap and let not stick the oils and fats.

37. INSTALL PISTON

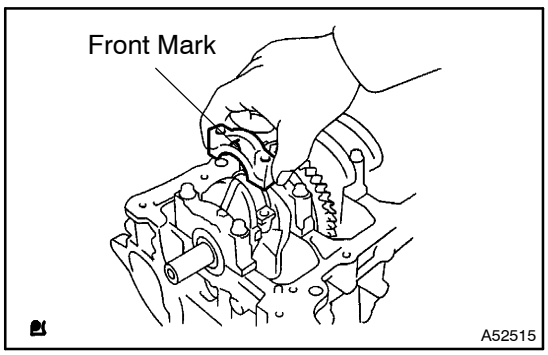
NOTICE:
The connecting rod cap bolts are tightened in 2 progressive steps.

(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.

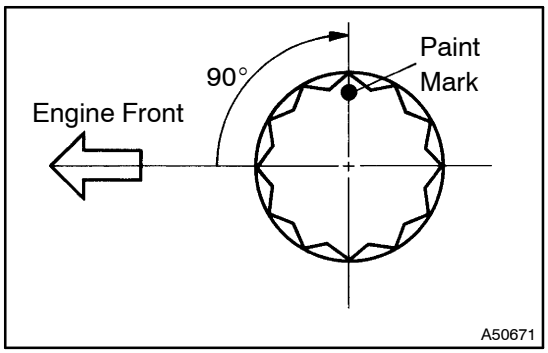


(c) Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.

NOTICE:
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 a 12 mm socket wrench, tighten the bolts in several passes by the specified torque.
Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)
(g) Mark the front of the connecting cap blots with paint.



(h) Retighten the cap bolts by 90° as shown in the illustration.
(i) Check that the crankshaft turns smoothly.