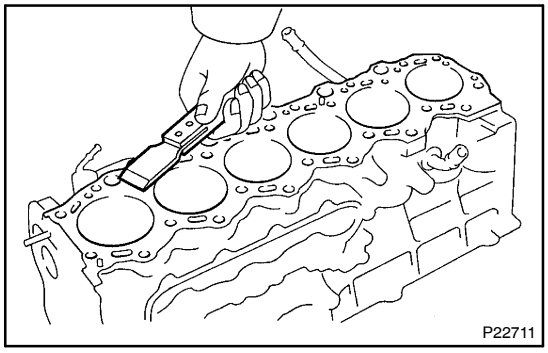
EM0X1–01

INSPECTION



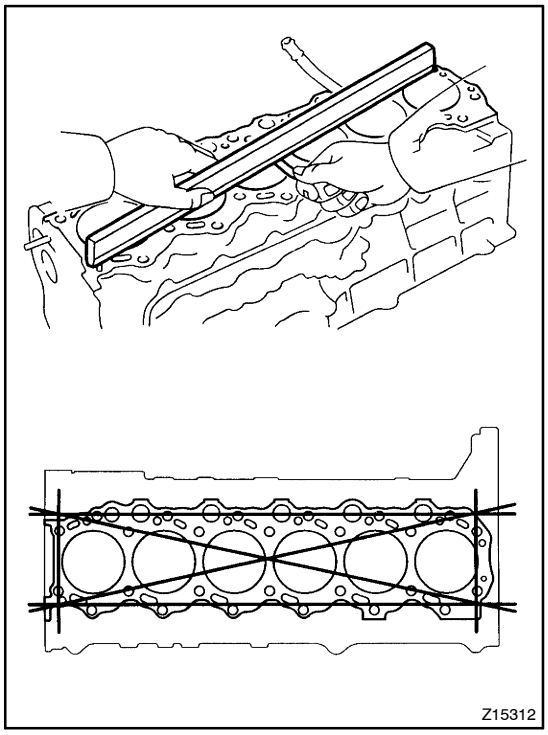
1. CLEAN CYLINDER BLOCK

(a) Remove gasket material

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

(b) Clean cylinder block

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

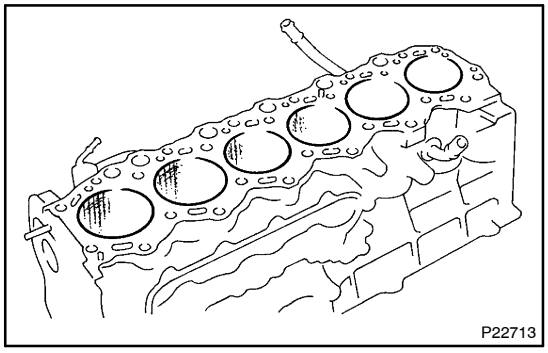


2. INSPECT TOP SURFACE OF CYLINDER BLOCK FOR FLATNESS

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

Maximum warpage: 0.20 mm (0.0079 in.)

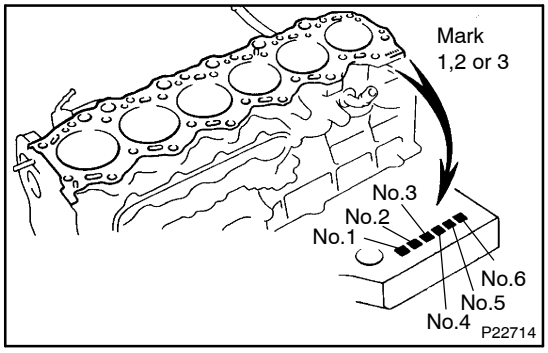
If warpage is greater than maximum, replace the cylinder block.

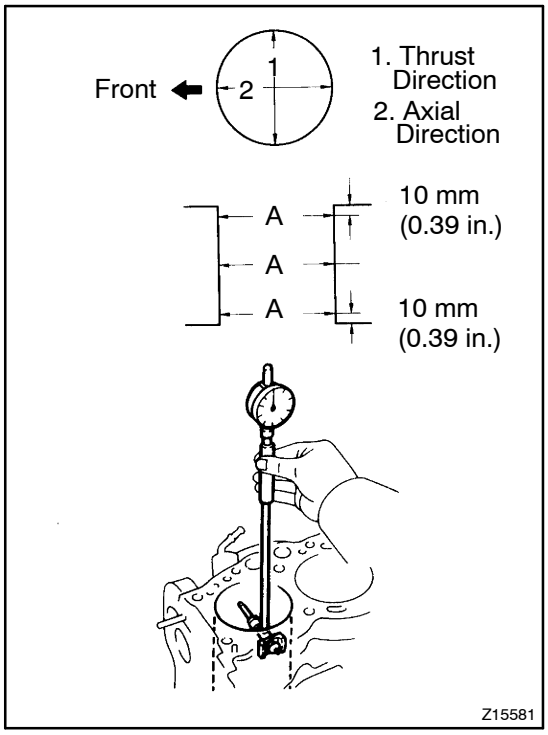


3. INSPECT CYLINDER FOR VERTICAL SCRATCHES

Visually check the cylinder for vertical scratches.

If deep scratches are present, rebore all the 6 cylinders. If necessary, replace the cylinder block.





4. INSPECT CYLINDER BORE DIAMETER

HINT:

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

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

Standard diameter:

STD

Mark ”1”

94.000 – 94.010 mm (3.7001 – 3.7012 in.)

Mark ”2”

94.010 – 94.020 mm (3.7012 – 3.7016 in.)

Mark ”3”

94.020 – 94.030 mm (3.7016 – 3.7020 in.)

Maximum diameter:

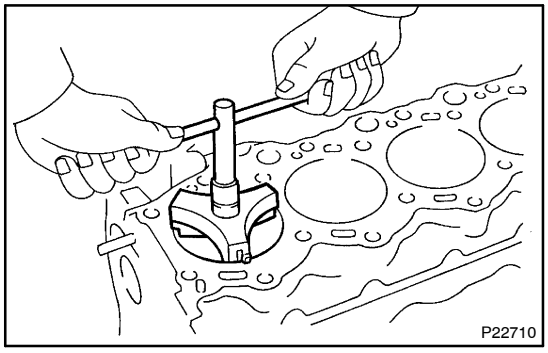
STD

94.23 mm (3.7098 in.)

O/S 0.50

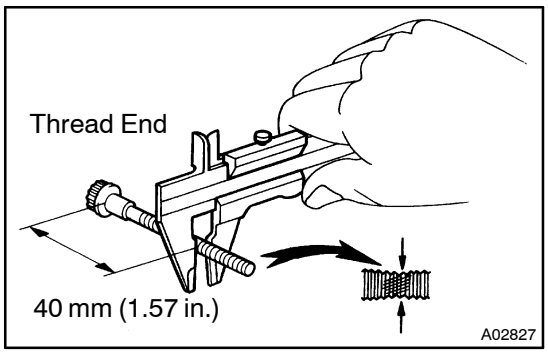
94.73 mm (3.7295 in.)

If the diameter is greater than maximum, rebore all the 6 cylinders. If necessary, replace the cylinder block.



5. REMOVE CYLINDER RIDGE

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



6. INSPECT MAIN BEARING CAP BOLTS

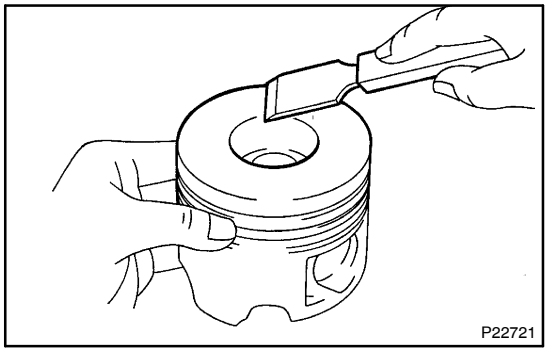
Using vernier calipers, measure the thread outside diameter at the measuring point.

Standard diameter:

11.80 – 12.00 mm (0.4646 – 0.4724 in.)

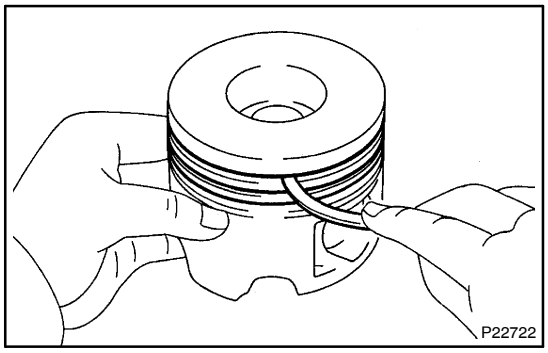
Minimum diameter: 11.50 mm (0.4528 in.)

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

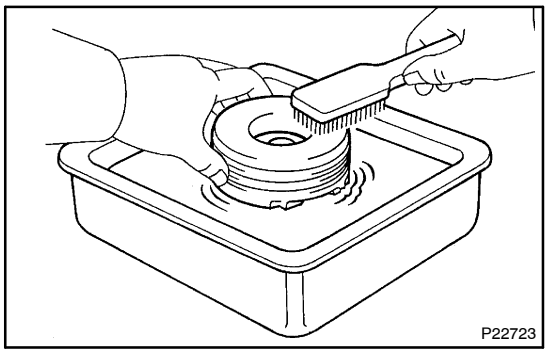


7. CLEAN PISTON

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



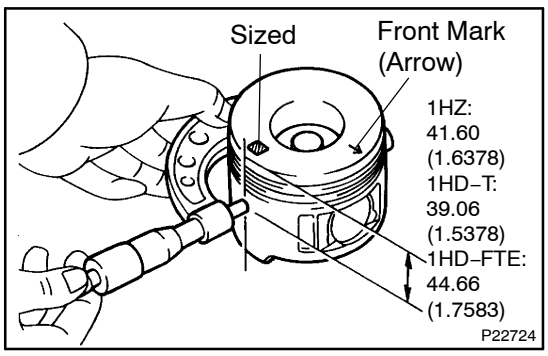
(b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



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

NOTICE:

Do not use a wire brush.



8. INSPECT PISTON AND PISTON RING

(a) Inspect piston diameter and oil clearance

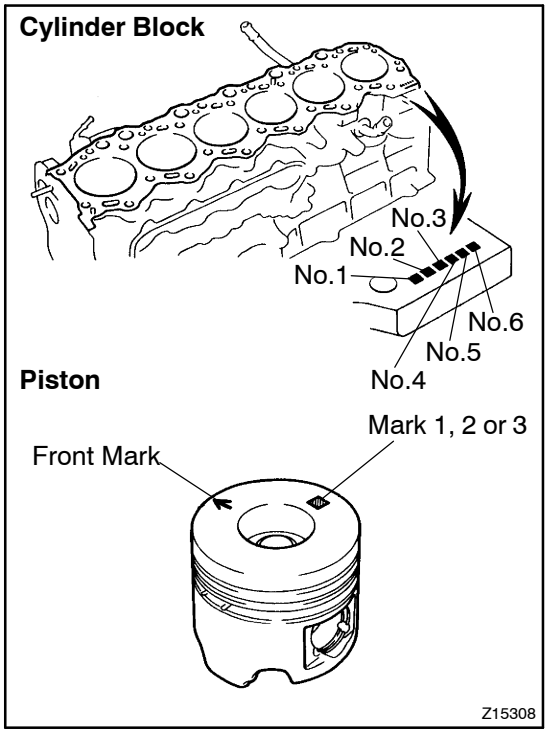
HINT:

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 pin center line from the piston head.

Piston diameter:

–	1HZ	1HD–T	1HD–FTE
Mark1	93.885 – 93.895 mm (3.69625–3.69665 in.)	93.950–93.960 mm (3.69881–3.69921 in.)	93.850–93.860 mm (3.69487–3.69527 in.)
Mark2	93.896–93.905 mm (3.69669–3.69704 in.)	93.961–93.970 mm (3.69924–3.69959 in.)	93.861–93.870 mm (3.69531–3.69566 in.)
Mark3	93.906–93.915 mm (3.69708–3.69743 in.)	93.971–93.980 mm (3.69963–3.69999 in.)	93.871–93.880 mm (3.69570–3.69606 in.)
O/S 0.50	94.385–94.415 mm (3.71594–3.71712 in.)	94.450–94.471 mm (3.71850–3.71932 in.)	94.370–94.100 mm (3.71535–3.71653 in.)



(2) Measure the cylinder bore diameter in the thrust directions. (See step 4)

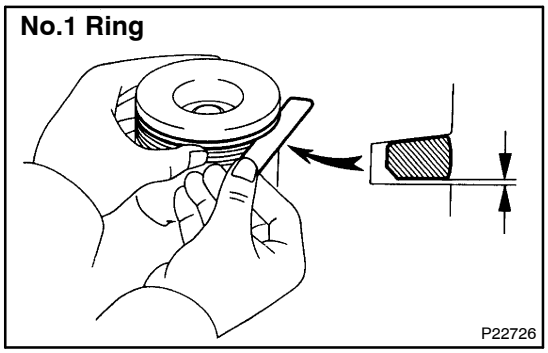
(3) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:
1HZ: 0.105 – 0.125 mm (0.0041 – 0.0049 in.)
1HD–T: 0.040 – 0.060 mm (0.0016 – 0.0024 in.)
1HD–FTE: 0.070 – 0.090 mm (0.0028 – 0.0035 in.)
Maximum oil clearance:
1HZ: 0.125 mm (0.0049 in.)
1HD–T: 0.060 mm (0.0024 in.)
1HD–FTE: 0.090 mm (0.0035 in.)

If the oil clearance is greater than maximum, replace all the 6 pistons and rebore all the 6 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.



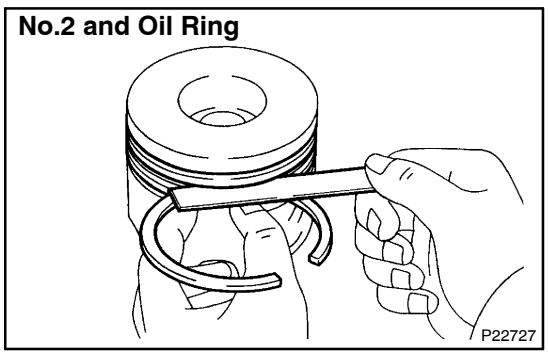
(b) Inspect piston ring groove clearance

(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:
1HZ, 1HD–T: 0.054 – 0.095 mm (0.0021 – 0.0037 in.)
1HD–FTE: 0.070 – 0.110 mm (0.0028 – 0.0043 in.)
Maximum groove clearance: 0.20 mm (0.0079 in.)

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

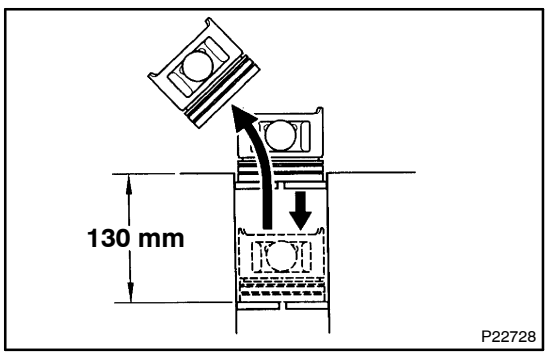


(2) No.2 and Oil Rings:

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

Standard groove clearance:
No.2:
1HZ, 1HD–T: 0.060 – 0.100 mm (0.0024 – 0.0039 in.)
1HD–FTE: 0.040 – 0.080 mm (0.0016 – 0.0031 in.)
Maximum groove clearance: 0.020 mm (0.0079 in.)
Standard groove clearance:
Oil: 0.030 – 0.070 mm (0.0012 – 0.0028 in)
Maximum groove clearance: 0.20 mm (0.0079 in)

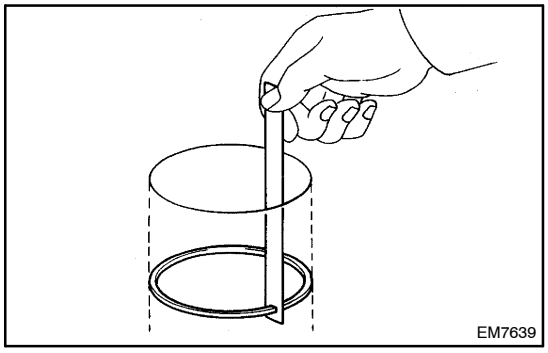
If the clearance is greater than maximum, replace the piston.



(c) Inspect piston ring end gap

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

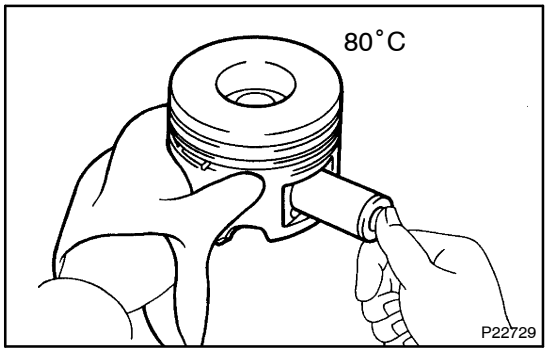
(2) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 130 mm (5.12 in.) from the top of the cylinder block.



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

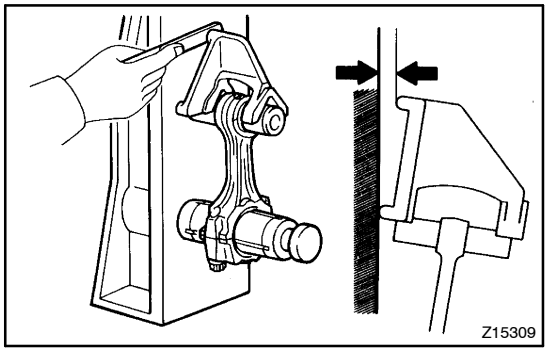
Standard end gap:
No.1:
1HZ, 1HD–T: 0.270 – 0.370 mm (0.0106 – 0.0146 in.)
1HD–FTE: 0.270 – 0.330 mm(0.0106 – 0.0130 in.)
No.2: 0.400 – 0.550 mm (0.0157 – 0.0119 in)
Oil: 0.200 – 0.500 mm (0.0079 – 0.0157 in.)
Maximum end gap:
No.1: 0.850 mm (0.0335 in.)
No.2: 0.900 mm (0.0354 in.)
Oil: 0.880 mm (0.0346 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 6 cylinders or replace the cylinder block.



9. INSPECT PISTON PIN FIT

At 80˚C (176˚F), you should be able to push the piston pin into the piston pin hole with your thumb.



10. INSPECT CONNECTING ROD

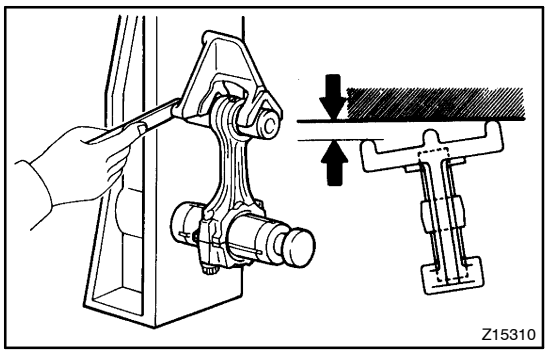
(a) Inspect connecting rod alignment

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

- Check for bend.

Maximum bend:
0.03 mm (0.0012 in.) per 100 mm (3.94 in.)

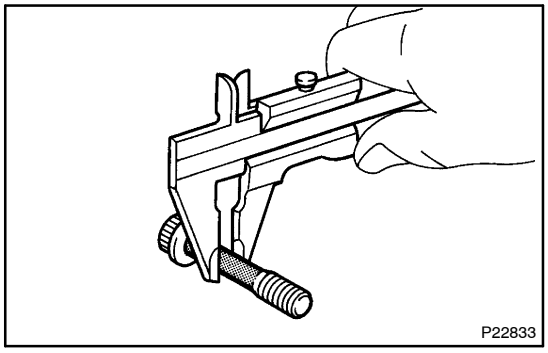
If bend is greater than maximum, replace the connecting rod assembly.



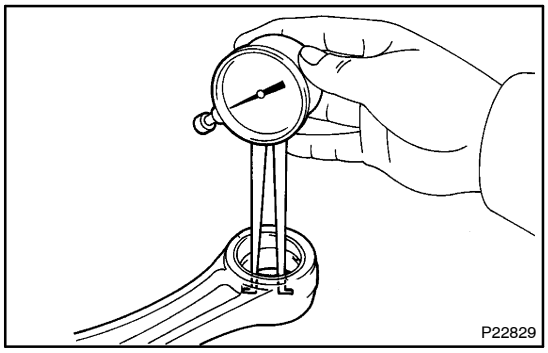
- Check for twist

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

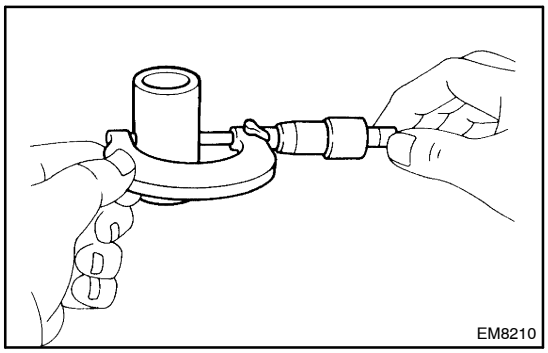
If twist is greater than maximum, replace the connecting rod assembly.



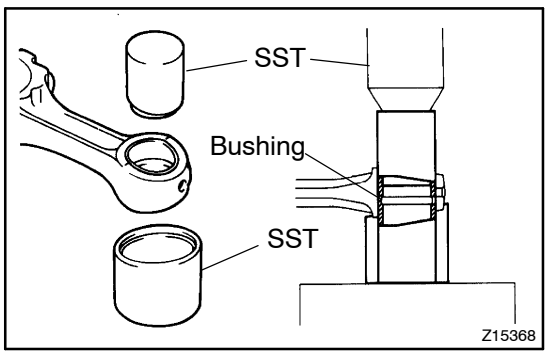
(b) Inspect connecting rod bolts
Using vernier calipers, measure the tension portion diameter.
Standard diameter:
8.300 – 8.400 mm (0.3268 – 0.3307 in.)
Minimum diameter: 7.95 mm (0.3130 in.)
If the diameter is less than minimum, replace the connecting rod bolt.



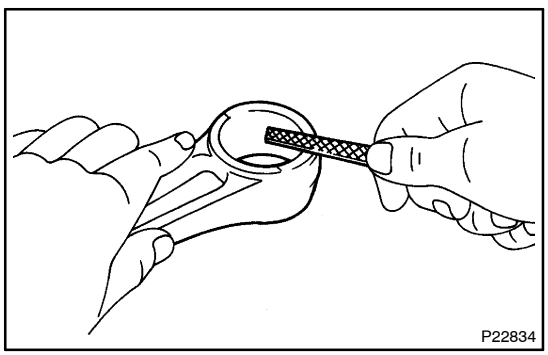
(c) Inspect piston pin oil clearance
(1) Using caliper gauge, measure the inside diameter of the connecting rod busing.
Busing inside diameter:
33.008 – 33.020 mm (1.2995 – 1.3000 in.)



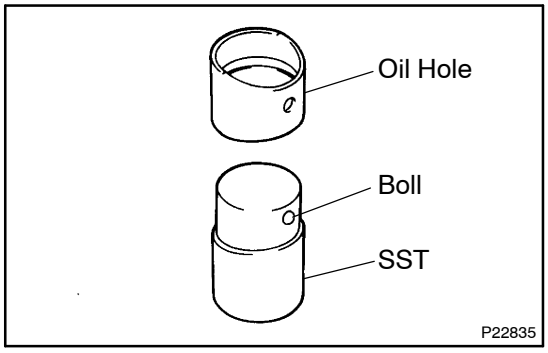
(2) Using micrometer, measure the piston pin diameter.
Piston pin diameter:
33.000 – 33.012 mm (1.2992 – 1.2997 in.)
(3) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.
Standard oil clearance:
0.004 – 0.012 mm (0.0002 – 0.0005 in.)
Maximum oil clearance: 0.030 mm (0.0012 in.)
If the oil clearance is greater than maximum, replace the busing. If necessary, replace the piston and piston pin as a set.



(d) If necessary, replace connecting rod bushing
(1) Using SST and a press, press out the bushing.
SST 09222–17011 (09222–05021, 09222–05041)

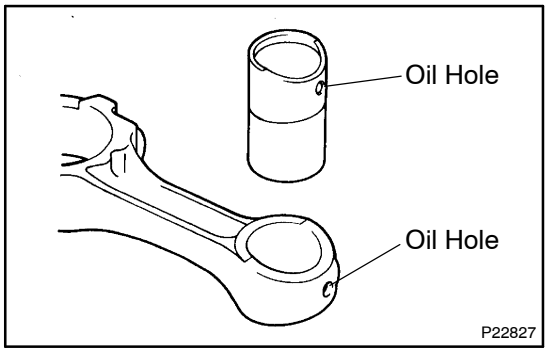


(2) Using a round file, lightly file off any roughness from the small end of the connecting rod.

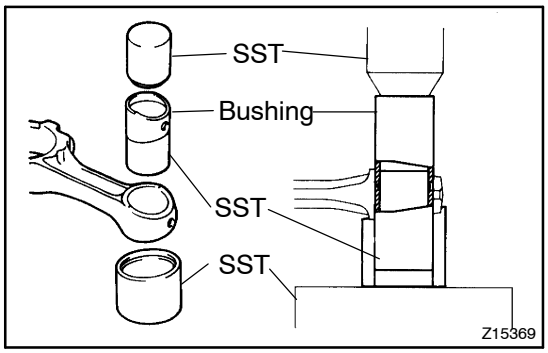


(3) Attach the busing to SST with the ball of SST inside the oil hole of the bushing.

SST 09222–17011 (09222–05031)

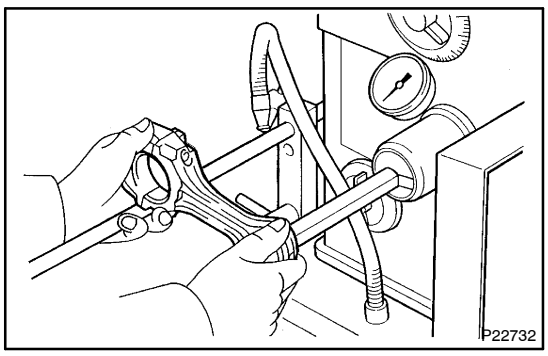


(4) Align the oil holes of t new bushing and the connecting rod.

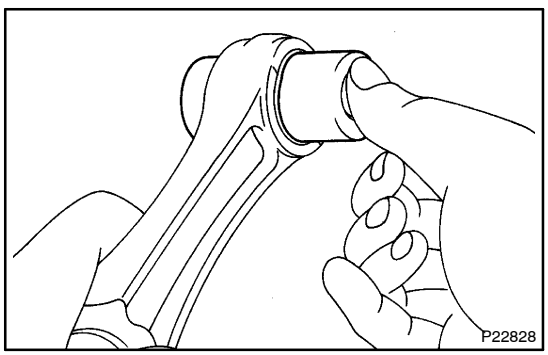


(5) Using SST and a press, press in the bushing.

SST 09222–17011 (09222–05021, 09222–05031, 09222–05041)



(6) Using a pin hole grinder, hone the busing to obtain the standard specified clearance (see item C above) between the busing and piston pin.

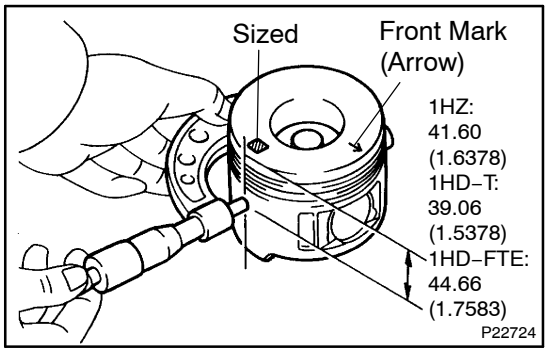


(7) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod engine oil, and push it into the connecting rod with your thumb.

11. CYLINDER BORING

HINT:

- Bore all the 6 cylinders to the oversized piston outside diameter.
- Replace all the piston rings with ones to match the oversized pistons.



12. KEEP OVERSIZED PISTONS

Oversized piston diameter:

O/S 0.50

1HZ: 94.385 – 94.415 mm (3.71594 – 3.71712 in.)

1HD–T: 94.450 – 94.471 mm (3.71850 – 3.71932 in.)

1HD–FTE: 94.370 – 94.400 mm (3.71535 – 3.71653 in.)

13. CALCULATE AMOUNT TO BORE CYLINDERS

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line.

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

Size to be rebored = P + C – H

P = Piston diameter

C = piston clearance

0.145 – 0.165 mm (0.0057 – 0.0065 in.)

H = Allowance for honing

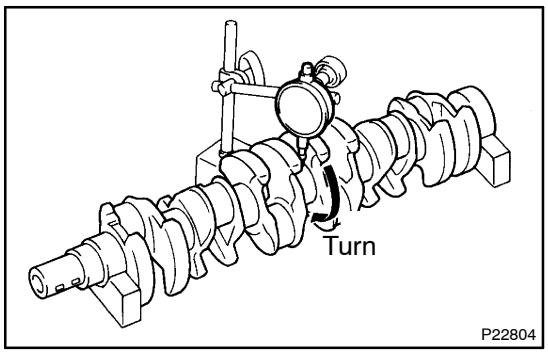
0.02 mm (0.0008 in.) or less

14. BORE AND HONE CYLINDER TO CALCULATED DIMENSIONS

Maximum honing: 0.02 mm (0.0008 in.)

NOTICE:

Excess honing will destroy the finished roundness.



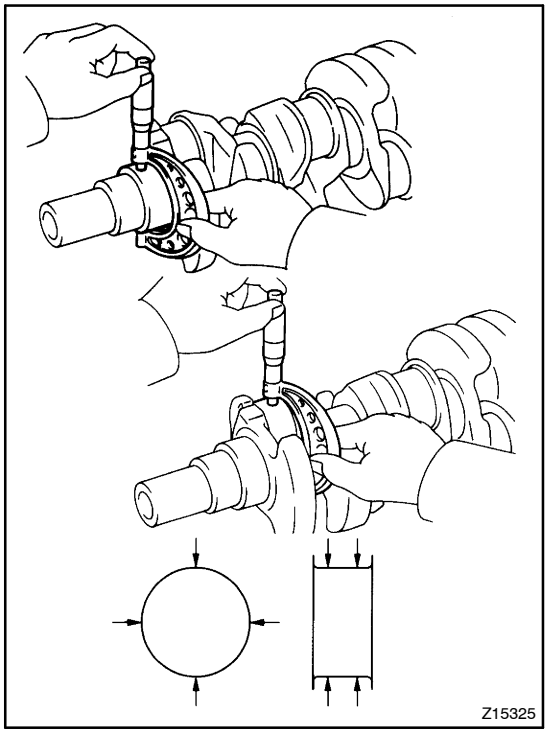
15. INSPECT CRANKSHAFT FOR RUNOUT

(a) place the crankshaft on V– blocks.

(b) 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.



16. INSPECT MAIN JOURNALS AND CRANK PINS

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

Main journal diameter:
STD
66.982 – 67.000 mm (2.6371 – 2.6378 in.)
U/S 0.25
66.745 – 66.755 mm (2.6278 – 2.6281 in.)
U/S 0.50
66.495 – 66.505 mm (2.6179 – 2.6183 in.)
Crank pin diameter:
STD
58.982 – 59.000 mm (2.3221 – 2.3228 in.)
U/S 0.25
58.745 – 58.755 mm (2.3128 – 2.3132 in.)
U/S 0.50
58.495 – 58.505 mm (2.3029 – 2.3033 in.)

If the diameter is not as specified, check the oil clearance. (See page EM–121) If necessary, grind or replace the crankshaft.

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

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

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

17. IF NECESSARY, GRIND AND HONE MAIN JOURNALS AND/OR CRANK PINS

Grind and hone the main journals and/or crank pins to the finished undersized diameter.

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