

ENGINE INSPECTION/REPAIR

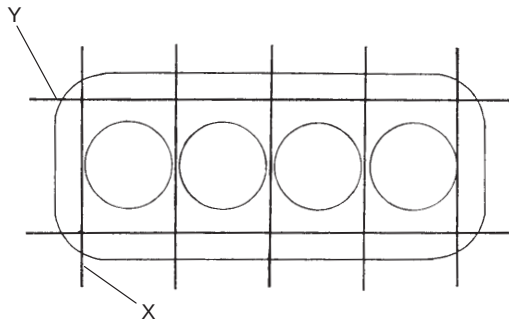
CYLINDER HEAD INSPECTION/REPAIR

1. Carry out cooling flaw detection on the cylinder head surface. Replace the cylinder head if necessary.
2. Inspect for the following and repair or replace.
 - (1) Sunken valve seats
 - (2) Excessive camshaft oil clearance and end play
3. Measure the cylinder head for distortion in the seven directions as shown.

Distortion

X direction: 0.020 mm {0.0008 in} max.

Y direction: 0.050 mm {0.0020 in} max.

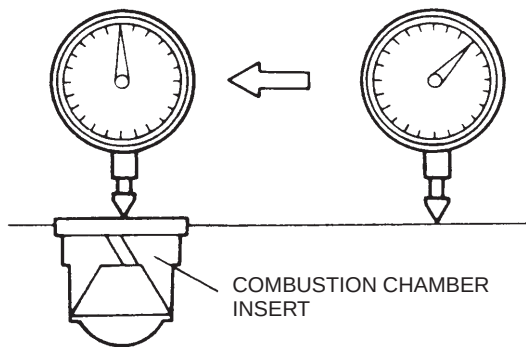


4. If the cylinder head distortion exceeds the maximum, replace the cylinder head. Do not attempt to repair a cylinder head by milling or grinding.
5. Measure the receded or projected amount of combustion chamber insert from cylinder head surface.

Recession: 0.020 mm {0.0008 in} max.

Projection: 0.005 mm {0.0002 in} max.

6. If it exceeds the maximum, replace the cylinder head.

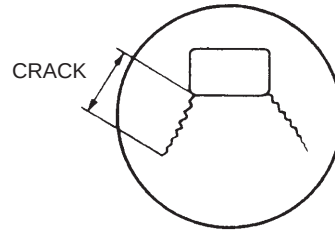


7. Inspect the combustion chamber insert crack.

Crack

Limit: 10.0 mm {0.39 in}

8. If it exceeds the specification, replace the cylinder head.



9. Measure the manifold contact surface distortion as shown.

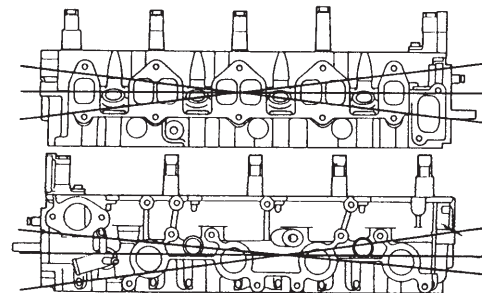
Distortion

0.05 mm {0.002 in} max.

10. If the distortion exceeds the maximum, grind the surface or replace the cylinder head.

Grinding

0.15 mm {0.006 in} max.



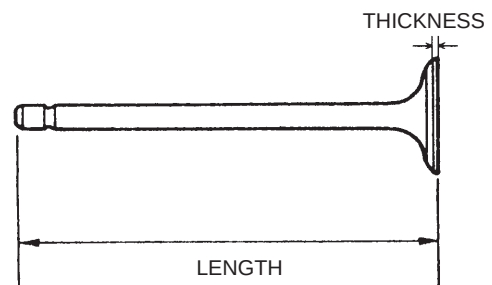
VALVE INSPECTION

1. Measure the valve head margin thickness of each valve. Replace the valve if necessary.

Margin thickness

IN: 1.50 mm {0.059 in}

EX: 0.75 mm {0.030 in}



- Measure the length of each valve. Replace the valve if necessary.

Standard length

IN: 111.60—112.10 mm {4.394—4.413 in}

EX: 111.50—112.00 mm {4.390—4.409 in}

Minimum length

IN: 111.35 mm {4.384 in}

EX: 111.25 mm {4.380 in}

- Measure the stem diameter of each valve in X and Y directions at the three points (A, B, and C) shown. Replace the valve if necessary.

Standard diameter

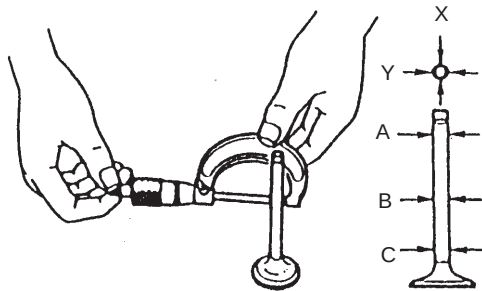
IN: 6.970—6.985 mm {0.2745—0.2749 in}

EX: 6.965—6.980 mm {0.2743—0.2748 in}

Minimum diameter

IN: 6.920 mm {0.2724 in}

EX: 6.915 mm {0.2722 in}

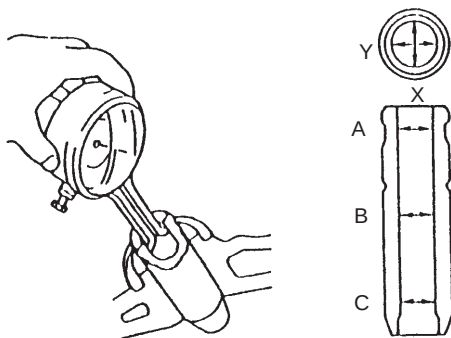


VALVE GUIDE INSPECTION

- Measure the inner diameter of each valve guide in X and Y directions at the three points (A, B, and C) shown. Replace the valve guide if necessary.

Standard inner diameter

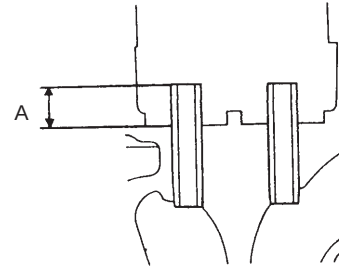
7.025—7.045 mm {0.2766—0.2773 in}



- Measure the protrusion height (dimension A) of each valve guide without lower valve spring seat. Replace the valve guide if necessary.

Standard height

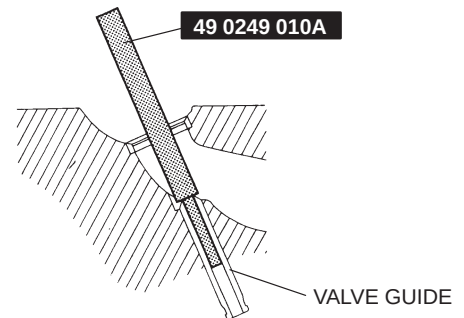
14.0—14.5 mm {0.56—0.57 in}



VALVE GUIDE REPLACEMENT

Valve Guide Removal

- Remove the valve guide from the combustion chamber side by using the SST.

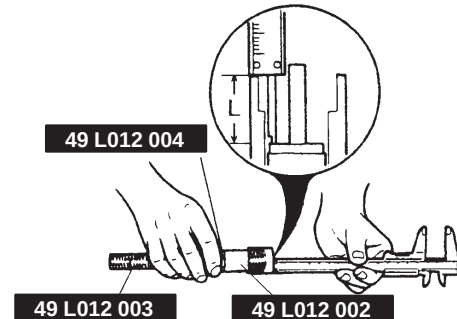


Valve Guide Installation

- Assemble the SSTs so that depth L is as specified.

Depth L

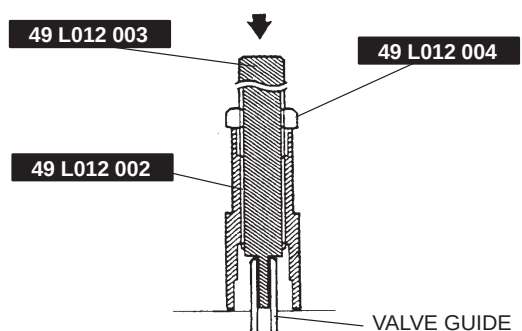
14.0—14.5 mm {0.56—0.57 in}



- Tap the valve guide in from the side opposite the combustion chamber until the SST contacts the cylinder head.
- Verify that the valve guide projection height is within the specification.

Standard height

14.0—14.5 mm {0.56—0.57 in}



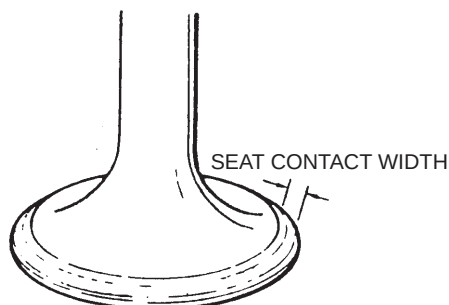
VALVE SEAT INSPECTION/REPAIR

1. Measure the seat contact width. If necessary, resurface the valve seat by using a 45° valve seat cutter and/or resurface the valve face.

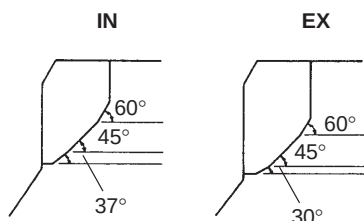
Standard width

IN: 1.6—2.2 mm {0.07—0.08 in}

EX: 1.7—2.3 mm {0.07—0.09 in}



2. Verify that the valve seating position is at the center of the valve face.
 - (1) If the seating position is too high, correct the valve seat using a 60° cutter and a 45° cutter.
 - (2) If the seating position is too low, correct the valve seat using a 37° (IN) or 30° (EX) cutter and a 45° cutter.



3. Measure the receded amount from the cylinder head surface. If it exceeds the maximum, replace the cylinder head.

Recession

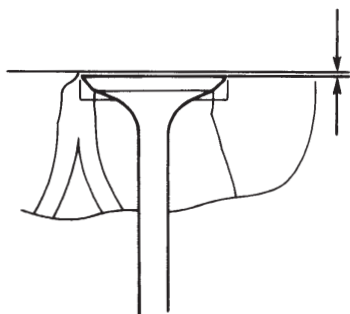
IN: 0.61—1.09 mm {0.025—0.042 in}

EX: 0.71—1.19 mm {0.028—0.046 in}

Maximum

IN: 1.50 mm {0.059 in}

EX: 1.60 mm {0.063 in}



VALVE SPRING INSPECTION

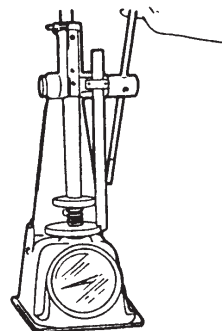
1. Apply pressing force to the pressure spring and check the spring height. Replace the valve spring if necessary.

Pressing force

239—268 N {24.3—27.4 kgf, 53.5—60.2 lbf}

Standard height

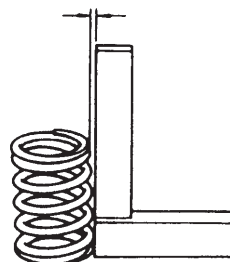
35.5 mm {1.40 in}



2. Measure the out-of-square of the valve spring. Replace the valve spring if necessary.

Valve spring out-of-square

1.70 mm {0.0670} max.

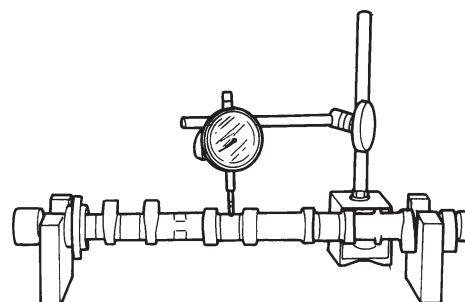


CAMSHAFT INSPECTION

1. Set the No.1 and No.5 journals on V-blocks. Measure the camshaft runout. Replace the camshaft if necessary.

Runout

0.03 mm {0.001 in} max.



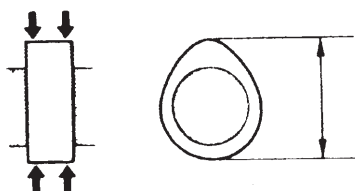
2. Measure the cam lobe height at the two points as shown. Replace the camshaft if necessary.

Standard height

IN: 42.40—42.50 mm {1.670—1.673 in} (WL)
 41.221—41.321 mm {1.623—1.626 in}
 (WL Turbo)
 EX: 42.395—42.495 mm {1.670—1.673 in}

Minimum height

IN: 42.050 mm {1.6555 in} (WL)
 40.871 mm {1.6091 in} (WL Turbo)
 EX: 42.045 mm {1.6553 in}



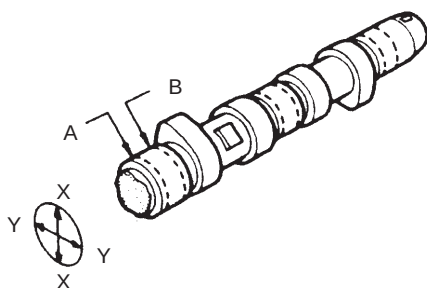
3. Measure the journal diameters in X and Y directions at the two points (A and B) as shown. Replace the camshaft if necessary.

Standard diameter

No.1, No.5:
 25.940—25.965 mm {1.0213—1.0222 in}
 No.2—No.4:
 25.910—25.935 mm {1.0201—1.0210 in}

Minimum diameter

No.1, No.5: 25.890 mm {1.0193 in}
 No.2—No.4: 25.860 mm {1.0181 in}



CAMSHAFT OIL CLEARANCE INSPECTION

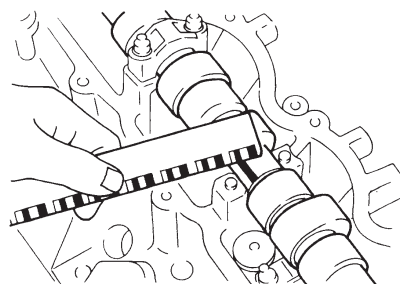
1. Position plastigage atop the journals in the axial direction.
2. Install the camshaft cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER HEAD DISASSEMBLY/ASSEMBLY (II), Camshaft Cap Assembly Note.)
3. Remove the camshaft cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER HEAD DISASSEMBLY/ASSEMBLY (II), Camshaft Cap Disassembly Note.)
4. Measure the oil clearance. Replace the cylinder head if necessary.

Standard clearance

No.1, 5: 0.035—0.081 mm {0.0014—0.0031 in}
 No.2—4: 0.065—0.111 mm {0.0026—0.0043 in}

Maximum clearance

No.1, 5: 0.12 mm {0.0047 in}
 No.2—4: 0.15 mm {0.0059 in}



CAMSHAFT END PLAY INSPECTION

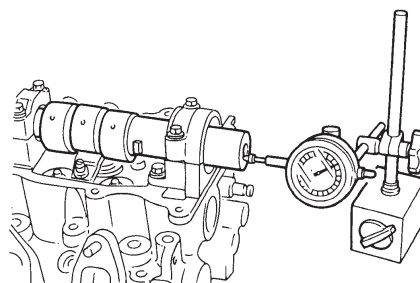
1. Install the camshaft cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER HEAD DISASSEMBLY/ASSEMBLY (II), Camshaft Cap Assembly Note.)
2. Measure the camshaft end play. Replace the cylinder head or camshaft if necessary.

Standard end play

0.030—0.160 mm {0.0012—0.0062 in}

Maximum end play

0.200 mm {0.0078 in}



3. Remove the camshaft cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER HEAD DISASSEMBLY/ASSEMBLY (II), Camshaft Cap Disassembly Note.)

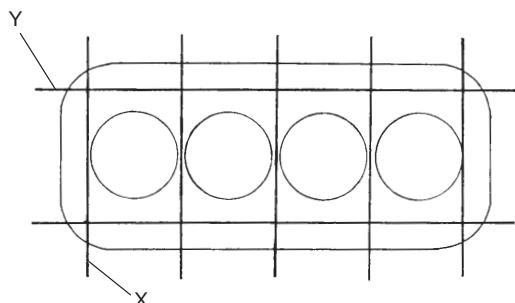
CYLINDER BLOCK INSPECTION/REPAIR

1. Measure the distortion of the cylinder block top surface in the seven directions as shown. Replace if necessary.

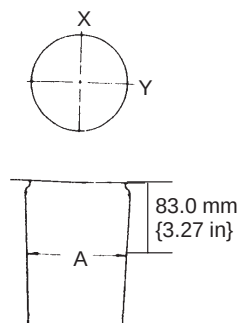
Cylinder block distortion

X Direction: 0.020 mm {0.0008 in} max.

Y Direction: 0.050 mm {0.0020 in} max.



2. Measure the cylinder bores in X and Y directions at three levels A in each cylinder as shown.



3. If the cylinder bore exceeds the wear limit, replace the cylinder block or rebore the cylinder and install the oversize pistons so that the specified piston-to-cylinder clearance is obtained.

Note

- Base the boring diameter on the diameter of an oversize piston. All cylinder must be the same diameter.

Cylinder bore mm {in}

Size	Bore
Standard	93.000—93.022 {3.6615—3.6622}
0.25 {0.01} oversize	93.250—93.272 {3.6713—3.6721}
0.50 {0.02} oversize	93.500—93.522 {3.6811—3.6819}

Wear limit

0.150 mm {0.0059 in}

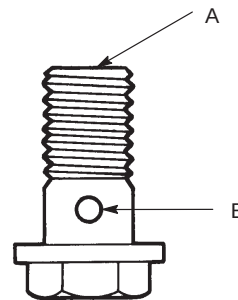
OIL JET VALVE, NOZZLE INSPECTION

1. Apply compressed air to oil jet valve A and verify that air passes through oil jet valve B. If not, replace the oil jet valve.

Air pressure

138—196 kPa {1.4—2.0 kgf/cm², 20—28 psi}

2. Check the oil jet nozzle for clogs. Replace the nozzle if necessary.



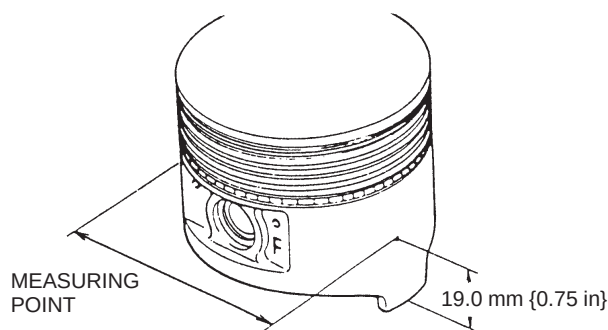
PISTON INSPECTION

- Measure the outer diameter of each piston at right angle (90°) to the piston pin, 19 mm {0.75 in} above the bottom of piston.

Piston diameter

mm {in}

Size	Bore
Standard	92.951—92.977 {3.6595—3.6605}
0.25 {0.01} oversize	93.186—93.212 {3.6688—3.6697}
0.50 {0.02} oversize	93.436—93.462 {3.6786—3.6795}



PISTON CLEARANCE INSPECTION/REPAIR

1. Measure the piston-to-cylinder clearance. Replace the piston or rebore the cylinders to fit oversize piston if necessary.

Standard clearance

0.038—0.056 mm {0.0015—0.0022 in}

Maximum clearance

0.150 mm {0.0059 in}

2. If the piston is replaced, the piston rings must also be replaced.

PISTON RING CLEARANCE INSPECTION

1. Measure the piston ring-to-ring land clearance around the entire circumference. Replace the piston and piston ring if necessary.

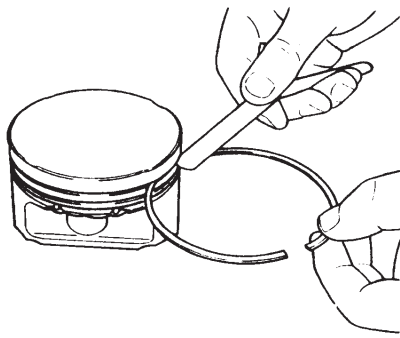
Standard clearance

Top: 0.06—0.10 mm {0.0024—0.0039 in}

Second: 0.04—0.08 mm {0.0016—0.0031 in}

Oil: 0.03—0.07 mm {0.0012—0.0027 in}

Maximum clearance
0.150 mm {0.0059 in}

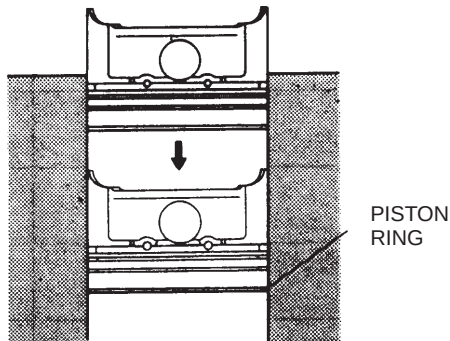


2. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring travel.
3. Measure each piston ring end gap with a feeler gauge. Replace the piston ring if necessary.

Standard end gap

Top: 0.22—0.32 mm {0.009—0.012 in}
Second: 0.32—0.47 mm {0.013—0.018 in}
Oil: 0.22—0.32 mm {0.009—0.012 in}

Maximum end gap
1.00 mm {0.039 in}

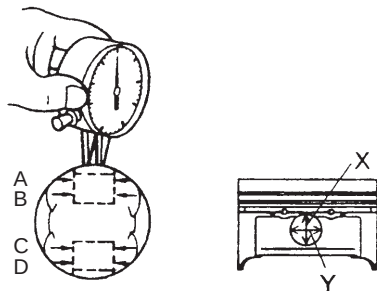


PISTON PIN CLEARANCE INSPECTION

1. Measure each piston pin bore diameter in X and Y directions at the four points (A, B, C, and D) as shown.

Standard diameter

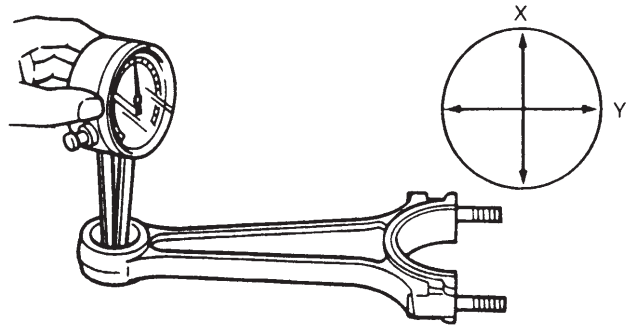
31.997—32.007 mm {1.2598—1.2601 in}



2. Measure each connecting rod small end inner diameter in X and Y directions as shown.

Standard diameter

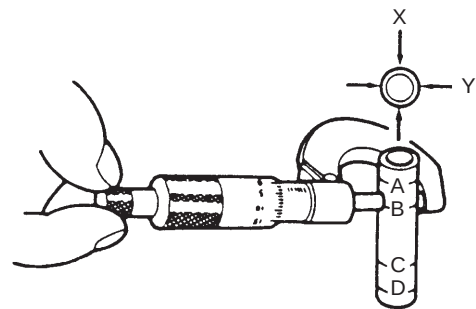
32.012—32.033 mm {1.2604—1.2611 in}



3. Measure each piston pin diameter in X and Y directions at the four points (A, B, C, and D) as shown.

Standard diameter

31.994—32.000 mm {1.2597—1.2598 in}



4. Calculate the piston pin-to-piston pin bore clearance. Replace the piston and/or piston pin if necessary.

Standard clearance

−0.003—0.013 mm {−0.0001—0.0005 in}

5. Calculate the connecting rod small end-to-piston pin clearance. Replace the connecting rod or piston pin.

Standard clearance

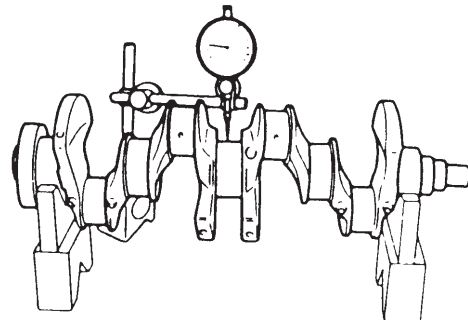
0.012—0.039 mm {0.0005—0.0015 in}

CRANKSHAFT INSPECTION

1. Measure the crankshaft runout. Replace the crankshaft if necessary.

Runout

0.05 mm {0.002 in} max.



2. Measure the journal diameter in X and Y direction at the two points (A and B) as shown. Replace the crankshaft or grind the journal and install the undersize bearing if necessary.

ENGINE INSPECTION/REPAIR

Main journal mm {in}

Bearing	Diameter	
	Journal No. 1, 2, 4, 5	3
Standard	66.937—66.955 {2.6354—2.6360}	66.920—66.938 {2.6347—2.6353}
0.25 {0.01} undersize	66.687—66.705 {2.6255—2.6261}	66.670—66.688 {2.6248—2.6255}
0.50 {0.02} undersize	66.437—66.455 {2.6157—2.6163}	66.420—66.438 {2.6150—2.6156}
0.75 {0.03} undersize	66.187—66.205 {2.6058—2.6064}	66.170—66.188 {2.6052—2.6058}

Wear limit
0.05 mm {0.002 in}

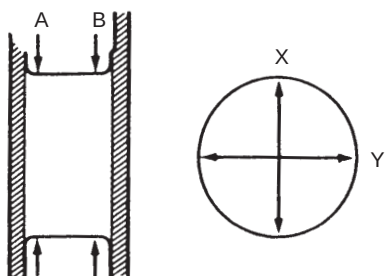
Out-of-round
0.03 mm {0.001 in}

Crank pin mm {in}

Bearing size	Diameter
Standard	54.940—54.955 {2.1630—2.1635}
0.25 {0.01} undersize	54.690—54.705 {2.1532—2.1537}
0.50 {0.02} undersize	54.440—54.455 {2.1434—2.1438}
0.75 {0.03} undersize	54.190—54.205 {2.1335—2.1340}

Wear limit
0.05 mm {0.002 in}

Out-of-round
0.03 mm {0.001 in}



CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR

1. Position Plastigage atop the journals in the axial direction.
2. Install the main bearing cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER BLOCK DISASSEMBLY/ASSEMBLY (III), Main Bearing Cap Assembly Note.)
3. Remove the main bearing cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER BLOCK DISASSEMBLY/ASSEMBLY (III), Main Bearing Cap Disassembly Note.)
4. Measure the main journal oil clearance. If the clearance exceeds the maximum, replace the main bearing or grind the main journal and install the undersize bearings so that the specified oil clearance is obtained.

Standard clearance

No.1, 2, 4, 5:

0.033—0.052 mm {0.0013—0.0020 in}

No.3:

0.050 mm —0.069 mm {0.0020—0.0026 in}

Maximum clearance

0.08 mm {0.003 in}

Bearing size	Diameter mm {in}
Standard	2.003—2.018 {0.0789—0.0794}
0.25 {0.01} undersize	2.121—2.131 {0.0836—0.0838}
0.50 {0.02} undersize	2.246—2.256 {0.0885—0.0888}
0.75 {0.03} undersize	2.371—2.381 {0.0934—0.0937}

CRANKSHAFT END PLAY INSPECTION/REPAIR

1. Install the main bearing cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER BLOCK DISASSEMBLY/ASSEMBLY (III), Main Bearing Cap Assembly Note.)
2. Measure the crankshaft end play. If the end play exceeds the maximum, replace the thrust bearing or grind the crankshaft and install an undersize bearing so that the specified end play is obtained.

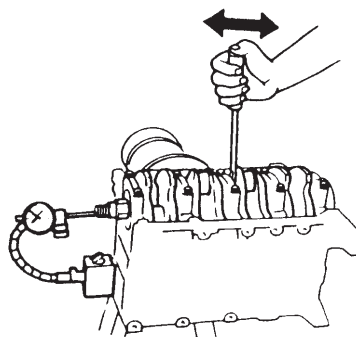
Standard end play

0.040—0.282 mm {0.0016—0.0111 in}

Maximum end play

0.300 mm {0.012 in}

Bearing size	Bearing thickness mm {in}
Standard	2.455—2.505 {0.0967—0.0986}
0.35 {0.014} undersize	2.630—2.680 {0.1036—0.1055}



3. Remove the main bearing cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER BLOCK DISASSEMBLY/ASSEMBLY (III), Main Bearing Cap Disassembly Note.)

CONNECTING ROD INSPECTION

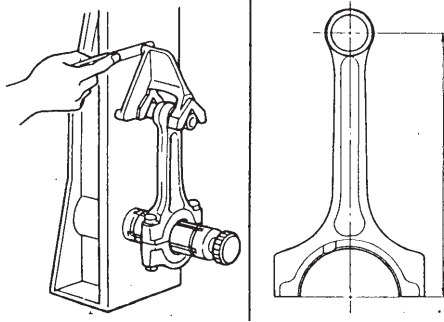
1. Measure each connecting rod for bending and distortion. Replace the connecting rod if necessary.

Bending

0.075 mm {0.0030 in} max. /50 mm {2.0 in}

Center-to-center distance

151.95—152.05 mm {5.983—5.986 in}



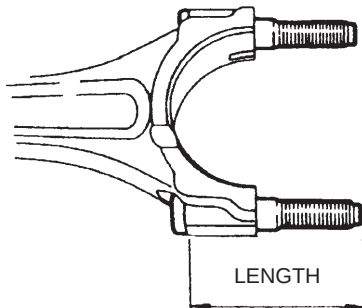
2. Measure the length of connecting rod bolt. Replace the connecting rod and connecting rod cap if necessary.

Standard length

67.5—68.5 mm {2.66—2.69 in}

Maximum length

69 mm {2.7 in}



CONNECTING ROD OIL CLEARANCE INSPECTION/REPAIR

1. Position Plastigage atop the journals in the axial direction.
2. Install the connecting rod cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER BLOCK DISASSEMBLY/ASSEMBLY (III), Piston and Connecting Rod Assembly Note.)
3. Remove the connecting rod cap.
4. Measure the crankpin oil clearance. If the clearance exceeds the maximum, replace the connecting rod bearing or grind the crankpin and use undersize bearings so that the specified clearance is obtained.

Standard clearance

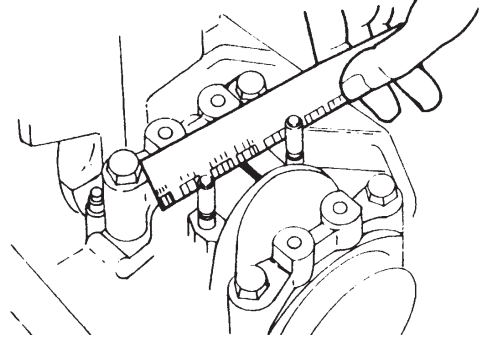
0.031—0.058 mm {0.0013—0.0022 in}

Maximum clearance

0.080 mm {0.003 in}

mm {in}

Bearing size	Bearing thickness
Standard	1.504—1.513 {0.0592—0.0595}
0.25 {0.01} undersize	1.621—1.631 {0.0638—0.0642}
0.50 {0.02} undersize	1.746—1.756 {0.0687—0.0691}
0.75 {0.03} undersize	1.871—1.881 {0.0737—0.0740}



CONNECTING ROD SIDE CLEARANCE INSPECTION

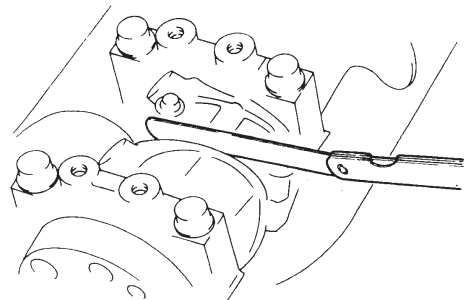
1. Install the connecting rod cap. (Refer to ENGINE DISASSEMBLY/ASSEMBLY, CYLINDER BLOCK DISASSEMBLY/ASSEMBLY (III), Piston and Connecting Rod Assembly Note.)
2. Measure the connecting rod large end side clearance. Replace the connecting rod and cap if necessary.

Standard clearance

0.110—0.262 mm {0.0044—0.0103 in}

Maximum clearance

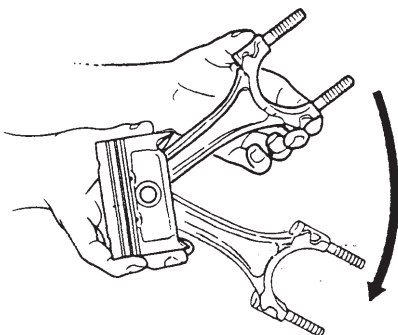
0.350 mm {0.037 in}



3. Remove the connecting rod cap

PISTON AND CONNECTING ROD INSPECTION

- Check the oscillation torque as shown. If the large end does not drop by its own weight, replace the piston or the piston pin.



BALANCE SHAFT INSPECTION (WL Turbo)

1. Install the balance shaft and tighten the thrust plate fitting bolt.

Tightening torque

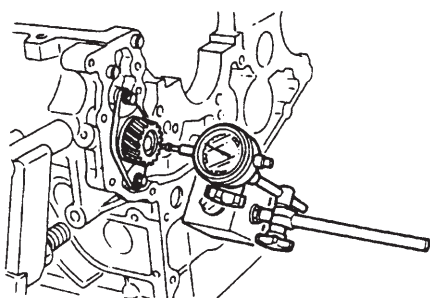
7.9—10.7 N·m

{80—110 kgf·cm, 69.5—95.4 in·lbf}

2. Measure the balance shaft end play. Replace the balance shaft and/or cylinder block if necessary.

Standard end play

0.04—0.16 mm {0.002—0.006 in}



3. Measure the journal diameters in X and Y directions at the two points (A and B) as shown. Replace the balance shaft if necessary.

Standard diameter

Front:

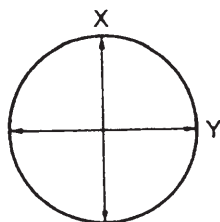
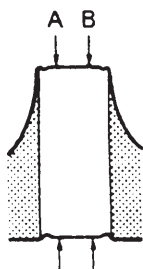
41.945—41.960 mm {1.6514—1.6519 in}

Center:

39.945—39.960 mm {1.5727—1.5732 in}

Rear:

37.975—37.990 mm {1.4951—1.4956 in}



4. Measure the balance shaft bore in the cylinder block. Calculate the clearance between the balance shaft and balance shaft bore. Replace the balance shaft and/or cylinder block if necessary.

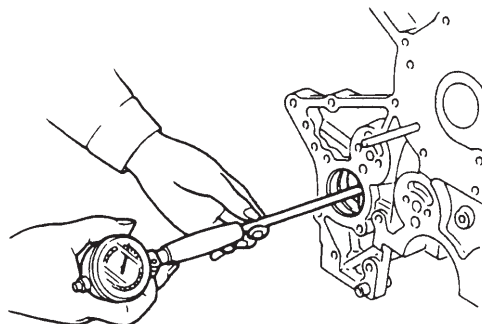
Standard clearance

Front, rear:

0.050—0.115 mm {0.0020—0.0045 in}

Center:

0.080—0.145 mm {0.0032—0.0057 in}



BOLT INSPECTION

- Measure the length of each bolt. Replace the bolt if necessary.

Cylinder head bolt

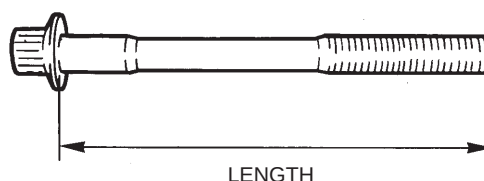
mm {in}

Bolt head mark	Standard length	Maximum length
W	101.2—101.8 {3.985—4.007}	102.5 {4.035}
N	113.2—113.8 {4.457—4.480}	114.5 {4.508}

Main bearing cap bolt

mm {in}

Standard length	84.7—85.3 {3.34—3.35}
Maximum length	86.0 {3.39}

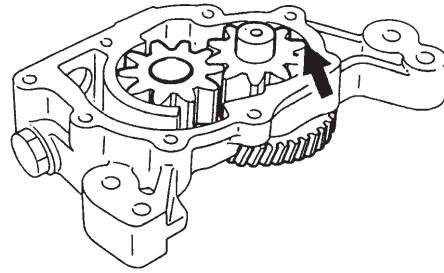
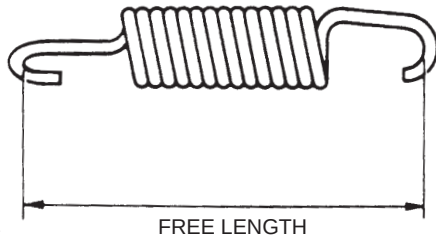


TENSIONER SPRING INSPECTION

- Measure the free length of the tensioner spring. Replace the tensioner spring if necessary.

Free length

63.0 mm {2.48 in}



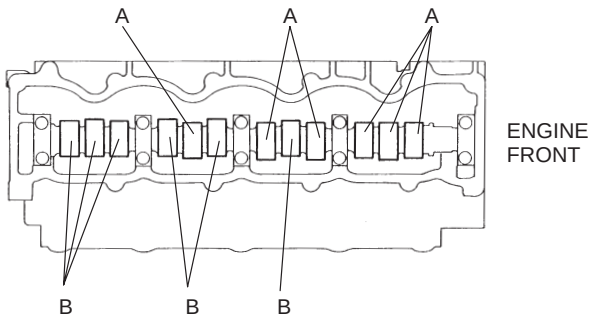
VALVE CLEARANCE INSPECTION

1. Turn the crankshaft and align the timing mark so that the piston of the No.1 or No.4 cylinder is at TDC of compression.
2. Measure the valve clearances A with the No.1 cylinder at TDC of compression, and those of B with the No.4 cylinder at TDC of compression.

Valve clearance [engine cold]

IN: 0.05—0.15 mm {0.0020—0.0059 in}

EX: 0.15—0.25 mm {0.0060—0.0098 in}

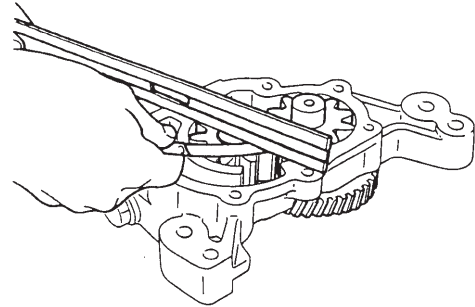


Standard side clearance

0.04—0.09 mm {0.002—0.003 in}

Maximum side clearance

0.15 mm {0.006 in}



PLUNGER SPRING INSPECTION

- Measure the free length of the pressure spring. Replace the plunger spring if necessary.

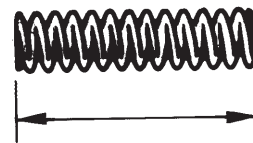
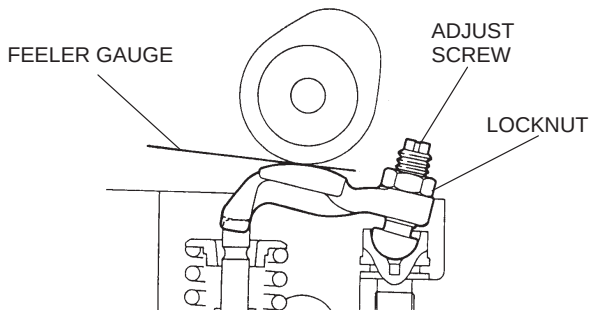
Free length

43.8 mm {1.72 in}

3. If it is not within the specification, adjust and recheck the valve clearance.
4. Turn the crankshaft one full turn and measure the remaining valve clearances. Adjust if necessary.

Tightening torque (locknut)

16—20 N·m {1.6—2.1 kgf·m, 12—15 ft·lbf}



GEAR CLEARANCE INSPECTION

- Measure the following clearance. Replace the gear and/or pump body if necessary.

Standard clearance

0.10—0.19 mm {0.004—0.007 in}

Maximum clearance

0.20 mm {0.008 in}