

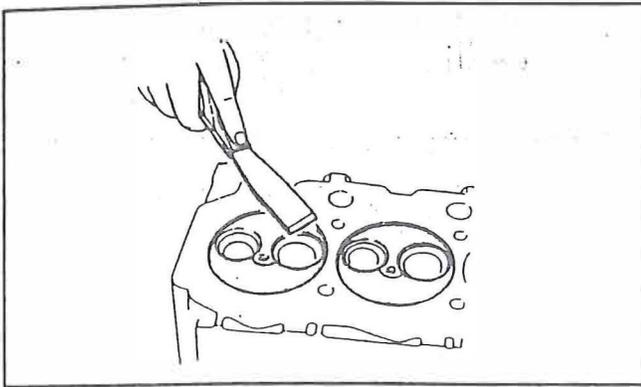
CYLINDER HEAD INSPECTION

1. Thoroughly clean the mating surfaces of the cylinder head, cylinder block, and manifolds with a scraper.



WARNING: The cylinder head is heavy. Be sure that all lifting devices (hoists, cables, chains, slings etc.) are suitable and of adequate capacity to lift the cylinder head. The cylinder head can weigh approximately 33 kg (73 lb).

NOTE: Take care not to scratch the machined surfaces. Wipe off any oil on the mating surfaces with a clean rag.

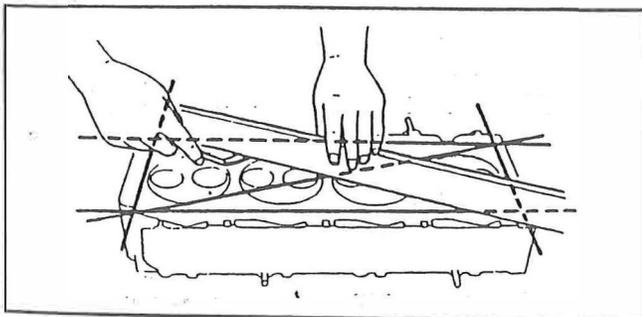


2. Remove the carbon in the combustion chamber with a wire brush. Wash with a light oil.

3. Check for cracks and scratches with the red check (color penetration method). Replace the cylinder head if there are any defects.

4. Check the distortion in the locations shown in the illustration using a straightedge and thickness gauge.

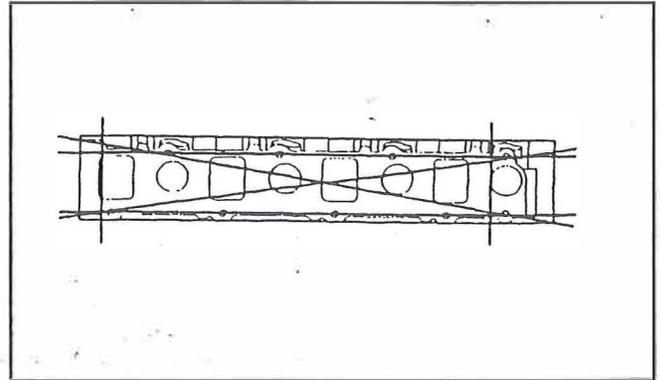
Cylinder block mating surface distortion limit:
 Left to right: 0.10 mm / (.0039 in)
 Front to rear:
 (longitudinal direction) 0.25 mm / (.0098 in)



5. If the distortion exceeds the limit, replace the cylinder head.

6. Check the distortion in the locations shown in the illustration using a straightedge and thickness gauge.

Manifold mating surface distortion limit: .10 mm / (.0039 in)



7. If the distortion exceeds the limit, remove the stud bolts, and polish with a surface grinder, or replace the cylinder head.

CYLINDER HEAD BOLT INSPECTION

1. Measure the length of the shaft on the cylinder head bolts. Reuse the bolt if it is within the limit, and replace it if the limit is exceeded.

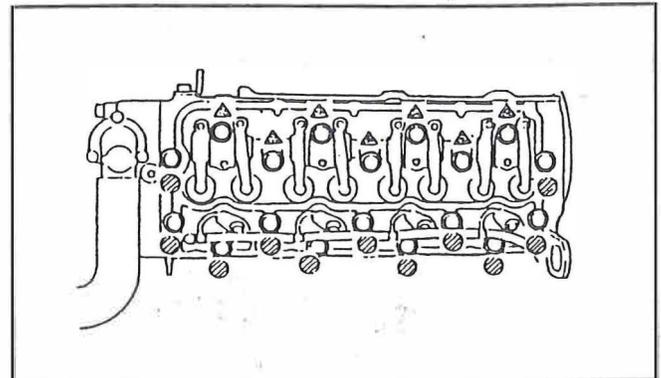
Cylinder head bolt shaft length:

Standard value: 130.2-130.8 mm / (5.126-5.150 in) 

Limit value: 131.5 mm / (5.1772 in)

Standard value: 158.2-158.8 mm / (6.2283-6.252 in) 

Limit value 159.5 mm / (6.2795 in)

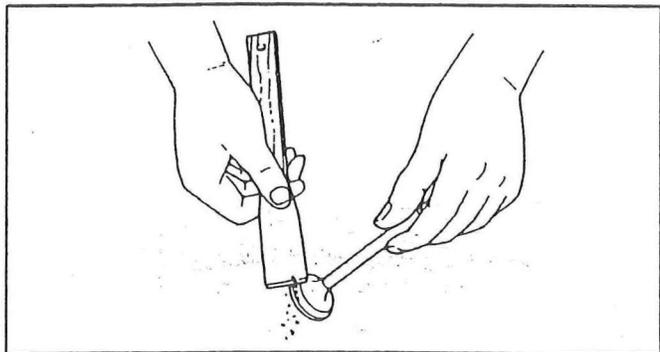


VALVE AND VALVE GUIDE INSPECTION

1. Visually inspect the following points for each valve. Replace the valve if there are any defects.

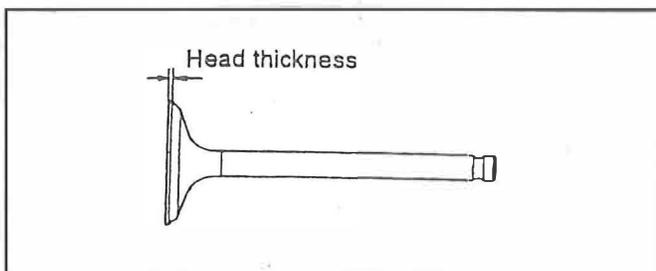
- Damage or eccentric wear of the valve stem at the retainer notch.
- Damage or bends in valve stem.
- Damage of valve face.

2. Carefully remove any carbon from the valve.

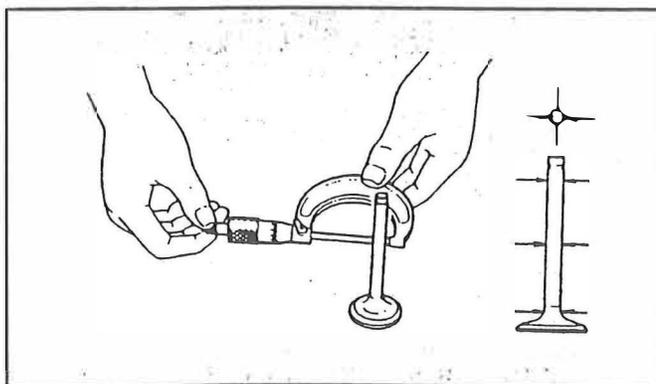


3. Measure the thickness of the valve head with calipers. If the measurement is less than the minimum value, replace the valve.

Minimum thickness value:
intake 1.0 mm / (.0394 in).
exhaust 1.0 mm / (.0394 in)



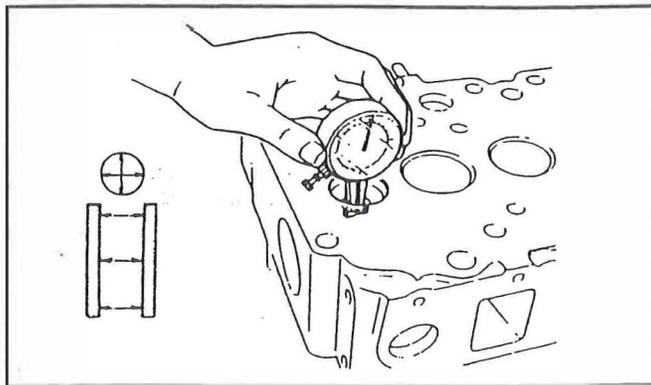
4. Measure the six locations of the valve stem shown in the illustration using a micrometer. If the measurement is less than the limit value, replace the valve.



Intake	Standard value	8.965-8.980 mm (.3530-.3535 in)
	Limit value	8.884 mm (.3498 in)
Exhaust	Standard value	8.945-8.960 mm (.3522-.3528 in)
	Limit value	8.864 mm (.3490 in)

5. Measure the inner diameter of the valve guide with the caliper gauge. If the diameter is not within the standard value, replace the guide.

Standard value for inner diameter of valve guide:
9.018-9.033 mm / (.3550-.3556 in)



6. Measure the maximum value of the valve guide's inner diameter, and the minimum value of the valve stem diameter to obtain the clearance. If the limit value is exceeded, replace the valve or valve guide.

Intake	Standard value	0.038-0.068 mm (.0015-.0027 in)
	Limit value	0.127 mm (.005 in)
Exhaust	Standard value	0.058-0.088 (.0023-.0035 in)
	Limit value	0.127 (.005 in)

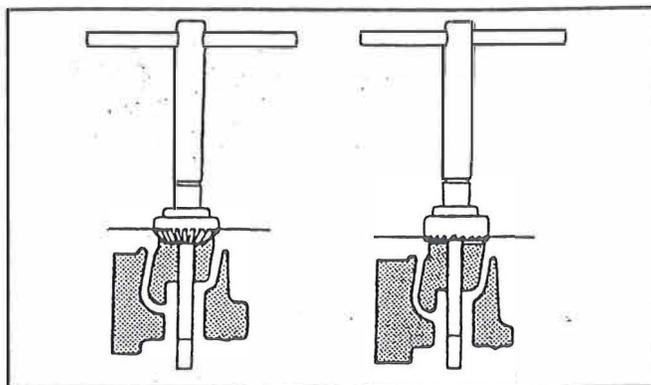
VALVE SEAT INSPECTION

1. Check the contact surface of the valve seat and valve face for wear and damage.

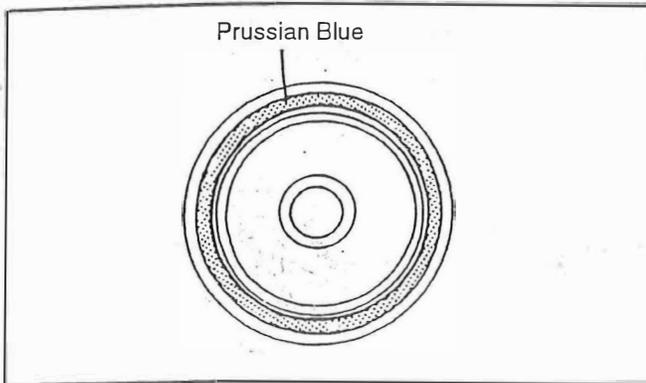
2. If there are any defects, correct with a valve seat cutter.

Intake: 45°

Exhaust: 30°

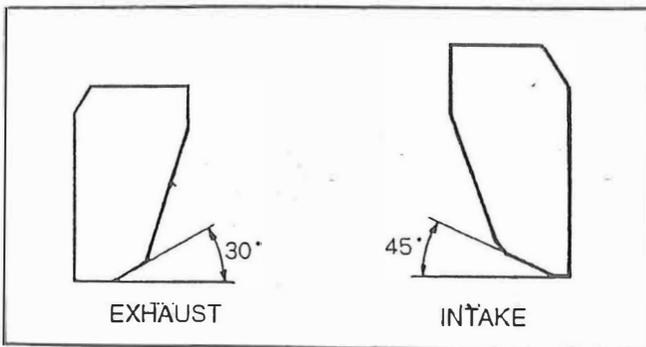


3. Apply a thin coat of prussian blue to the valve face.
4. Press the valve lightly so that the valve seat does not rotate, and check the contact position.
 - a. Replace the valve if the prussian blue is not found on the entire circumference of the valve face as illustrated.

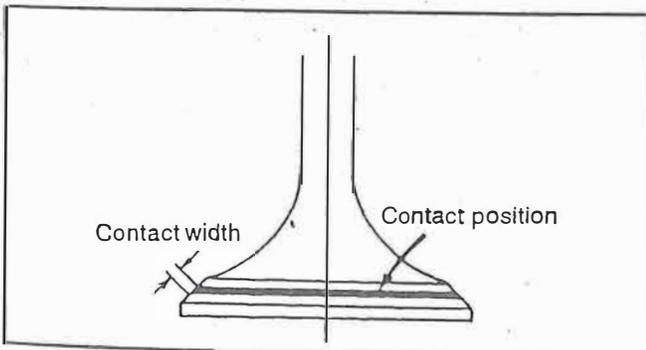


- b. If a contact area is not found on the entire circumference of the valve seat's contact surface, correct the valve seat with a valve seat cutter.

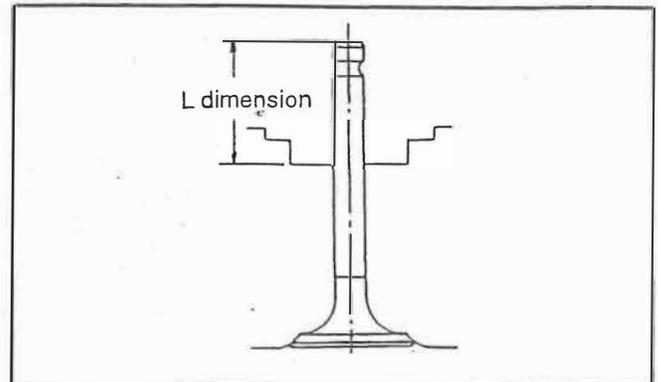
Valve angle:
 Intake: 45°
 Exhaust: 30°



5. Check the contact width of the valve face and valve seat. Standard value of contact width: 1.7 mm / (.067 in)



6. Check that the valve seat contact surface is in the center of the valve face.
 - a. If the contact surface is over the center of the valve face, correct with a 75° valve seat cutter.
 - b. If the contact surface is under the center of the valve face, correct with a 0° valve seat cutter.
7. Using compound and valve lapper, match the valve and valve seat.
8. Check the valve stem's protruding length.



- a. Measure the protruding length ("L" dimension) of the valve stem. Standard "L" dimension:

Intake	48.40 mm / (1.906 in)
Exhaust	48.40 mm / (1.906 in)

NOTE: Install the lower valve spring seat when measuring.

- b. If the "L" dimension is within the range given below, reuse the valve seat.

Intake	48.40-48.90 mm (1.906-1.925 in)
Exhaust	48.40-48.90 mm (1.906-1.925 in)

- c. If the "L" dimension is within the range given below, place a suitable spacer between the lower spring seat and cylinder head, and adjust so that the standard "L" dimension is obtained.

Intake	48.90-49.90 mm (1.925-1.965 in)
Exhaust	48.90-49.90 mm (1.925-1.965 in)

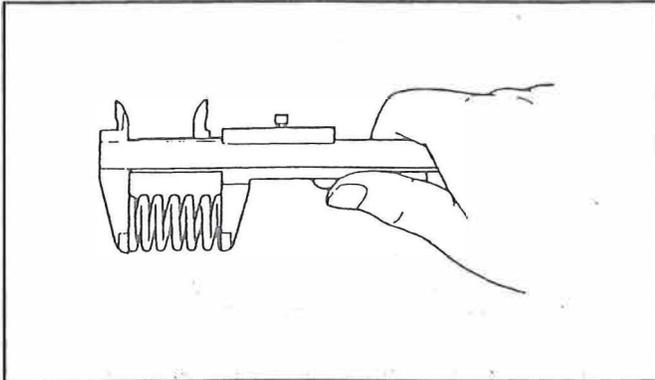
d. If the "L" dimension exceeds the following value, replace the cylinder head.

Intake	49.90 mm / (1.965 in)
Exhaust	49.90 mm / (1.965 in)

VALVE SPRING INSPECTION

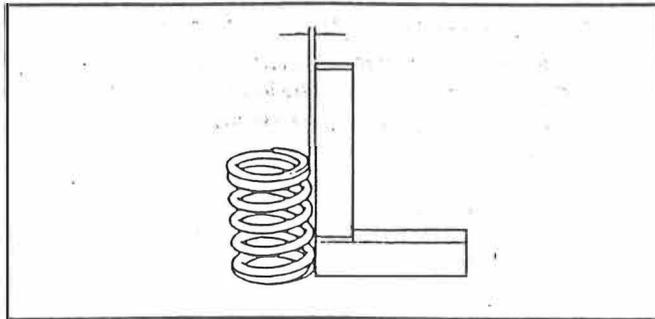
1. Inspect for cracks and damage on the valve spring.
2. Inspect the natural length of the valve spring. Replace the spring if the measurement is less than the limit value.
Spring natural length.

Inner	Standard value	53.84 mm / (2.120 in)
	Limit value	52.84 mm / (2.080 in)
Outer	Standard value	59.47 mm / (2.341 in)
	Limit value	58.47 mm / (2.302 in)



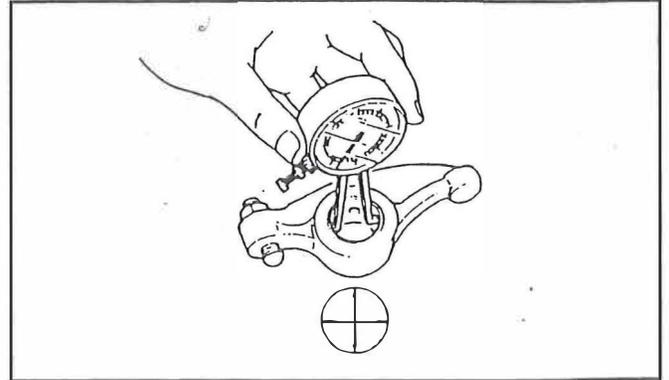
3. Inspect the valve spring squareness (right angle of the valve spring). Replace the spring if the limit value is exceeded.
Spring squareness limit value:

Inner	1.88 mm / (.0740 in)
Outer	2.08 mm / (.0819 in)

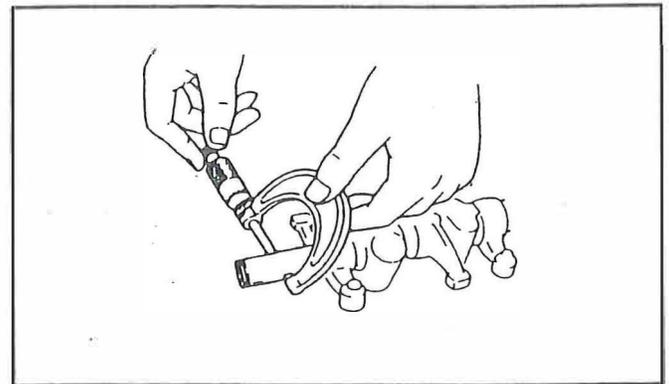


ROCKER ARM AND ROCKER SHAFT INSPECTION

1. Check for wear and damage on the rocker arm and rocker shaft. Replace if defective.
2. Measure the rocker arm and shaft clearance with the following procedure:
 - a. Measure the inner diameter of the rocker arm.
Standard value:
21.000-21.021 mm / (.8268-.8276 in)



- b. Measure the outer diameter of the rocker shaft.
Standard value:
20.959-20.980 mm / (.8252-.8260 in)

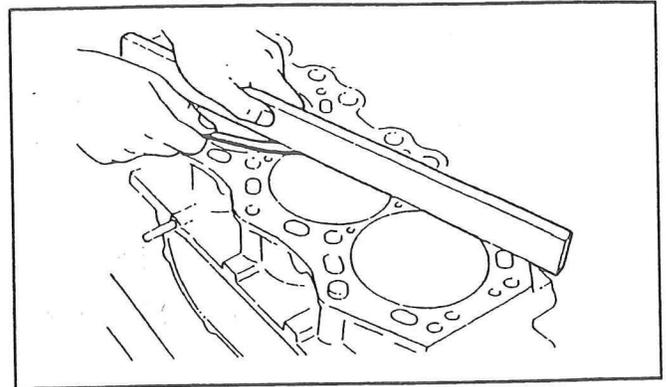
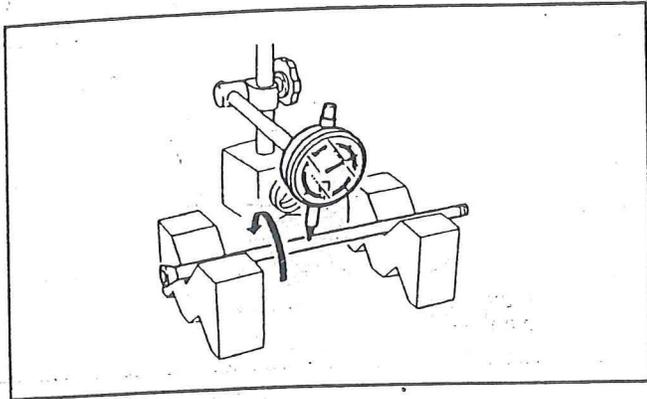


- c. Obtain the clearance between the outer diameter of the rocker shaft and inner diameter of the rocker arm. Replace the rocker shaft and / or rocker arm if the limit value is exceeded.
Standard value:
0.020-0.062 mm / (.0008-.0024 in)
Limit value:
0.07 mm / (.0028 in)

PUSH ROD INSPECTION

1. Check for wear and damage on the push rod.

2. Measure the push rod deflection as shown in the illustration. If the limit value is exceeded, replace the push rod.
Limit value: 0.4 mm / (.0157 in)



Replace the cylinder block if the limit value is exceeded.

2. Measure the bore diameter of each cylinder. A total of six points A, B and C in both the X-X and Y-Y directions are measured as shown in the illustration.

CYLINDER BLOCK INSPECTION



WARNING: The cylinder block is heavy. Be sure that all lifting devices (hoists, cables, chains, slings etc.) are suitable and of adequate capacity to lift the cylinder block. The cylinder block can weigh approximately 87 kg (192 lb).

1. Check the distortion of the cylinder block at the six areas as shown in the illustration.

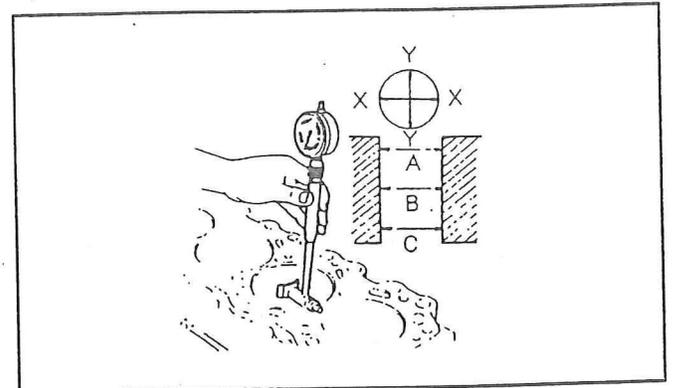
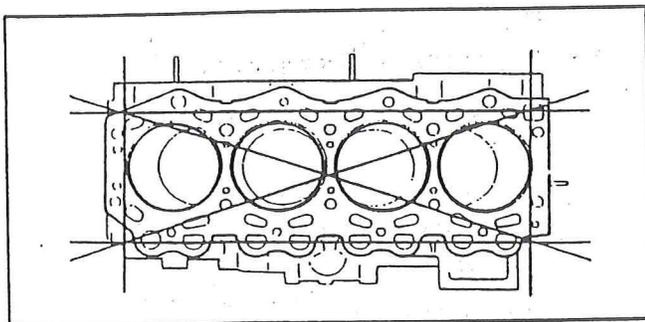
Distortion limit:

Left to right 0.1 mm / (.0039 in),

Front to rear (longitudinal direction) 0.25 mm / (.0098 in)

See: "CYLINDER BLOCK AND LINER DIMENSIONS" for block bore dimensions.

See: "CYLINDER BLOCK AND LINER IDENTIFICATION" for identification mark locations.



CYLINDER BLOCK AND LINER DIMENSIONS

Marking	Stamped "A" / RED mark mm (in)	Stamped "B" / GREEN mark mm (in)
Block Bore Inside Dimension	112.50-112.513 mm (4.4291-4.4296 in)	112.513-112.526 mm (4.4296-4.4302 in)
Cylinder Liner Outside Dimension	112.474-112.487 mm (4.4281-4.4286)	112.487-112.500 mm (4.4286-4.4291)
Cylinder Liner Bore Inside Dimension	109.000-109.013 mm (4.2913-4.2918)	109.013-109.026 mm (4.2918-4.2924)

CYLINDER LINER INSPECTION

1. Measure the outer diameter of the cylinder liner. A total of six points A, B and C in both the X-X and Y-Y directions are measured as shown in the illustration.

Outer diameter standard value:
112.474-112.50 mm / (4.4281-4.4291 in)
Inner diameter standard value:
109.005-109.031 mm / (4.2915-4.2926 in)

See: "CYLINDER BLOCK AND LINER DIMENSIONS" for specific cylinder liner dimensions.

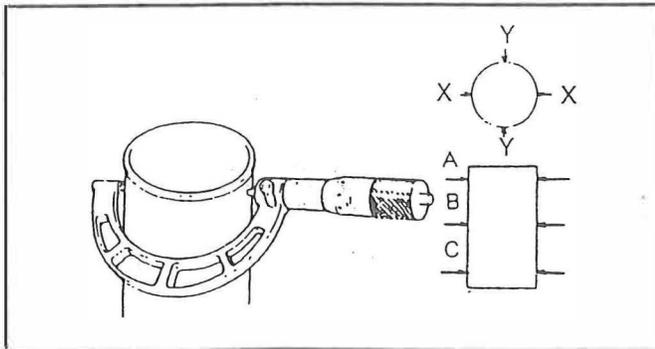
See: "CYLINDER BLOCK AND LINER IDENTIFICATION" for identification mark locations.

2. Obtain the clearance between the cylinder bore and cylinder liner from the data of the cylinder bore and the cylinder liner outer diameter.

Standard value:
0.013-0.039 mm / (.0005-.0015 in)

If the value is not within the standard value, replace the cylinder liner. Be sure that the replacement cylinder liner has the same marking as the cylinder block.

See: "NOTE: Pistons and liners for service parts" (this page).



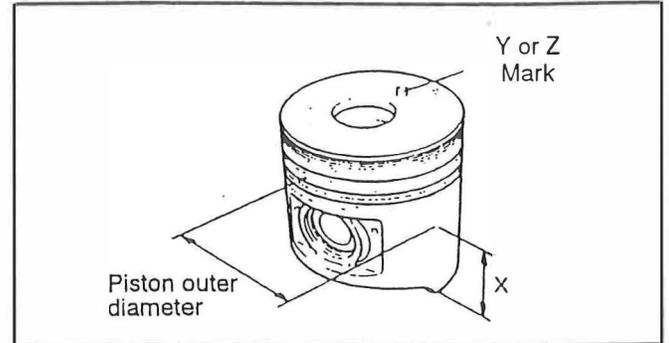
PISTON AND PISTON PIN INSPECTION

NOTE: Do not use a wire brush to clean the piston.

1. Clean the piston.



- a. Remove the carbon from the piston with a scraper.
 - b. Clean the piston ring grooves with an old piston ring.
2. Verify that there is a Y or Z mark on the top of the piston.



3. Measure the piston outer diameter at the X thrust direction position from the piston lower end.

Measurement position X: 22 mm / (.8661 in)
Standard value Mark Y:
108.945-108.958 mm / (4.2892-4.2897 in)
Standard value Mark Z:
108.932-108.945 mm / (4.2887-4.2892 in)

4. Calculate the difference between the minimum diameter of the cylinder liner in the thrust direction, and the outer diameter of the piston ("X" measurement position) to obtain the piston clearance.

Standard value:
0.060-0.086 mm / (.0024-.0034 in)

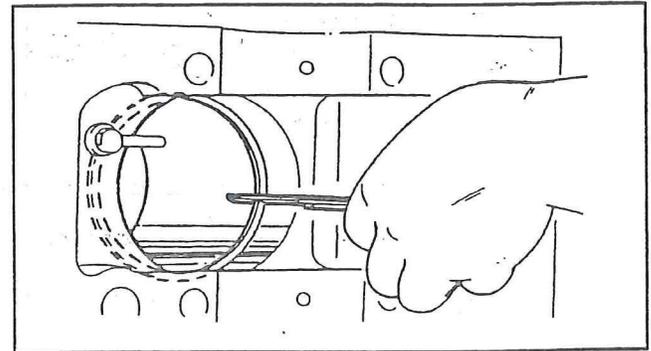
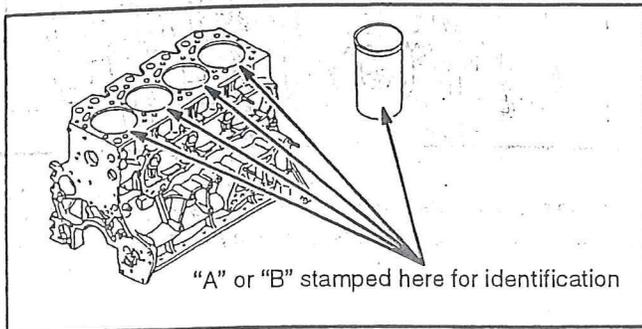
If the standard value is exceeded, replace the piston and/or the cylinder liner. Remeasure the clearance if only one of these is replaced.

NOTE: Pistons and liners for service parts

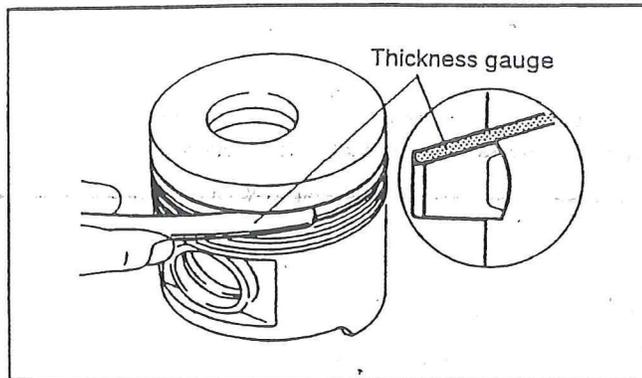
- 1) Pistons and liners for service are manufactured with smaller tolerances. Only one size piston is available for service. The pistons for service parts do not have marks.
- 2) The cylinder block requires two selections of liners. The block and each liner are identified by an "A" or "B" stamp for each cylinder.
- 3) It is possible to have "A" and "B" liners in the same block. Check the marking for each cylinder.
- 4) Service parts are identified with "RED" or "GREEN" markings.
- 5) See: "CYLINDER BLOCK AND LINER IDENTIFICATION" for identification mark locations.

CYLINDER BLOCK AND LINER IDENTIFICATION

Marking	Stamped "A" / RED mark mm (in)	Stamped "B" / GREEN mark mm (in)
Block Bore Inside Dimension	112.50-112.513 mm (4.4291-4.4296 in)	112.513-112.526 mm (4.4296-4.4302 in)
Cylinder Liner Outside Dimension	112.474-112.487 mm (4.4281-4.4286)	112.487-112.500 mm (4.4286-4.4291)
Cylinder Liner Bore Inside Dimension	109.000-109.013 mm (4.2913-4.2918)	109.013-109.026 mm (4.2918-4.2924)



5. Measure the clearance between the piston ring and ring groove around the entire piston using a thickness gauge.



If the limit value is exceeded, replace the piston and piston ring.

Value	Top mm / (in)	Second mm / (in)	Oil mm / (in)
Standard	0.13-0.220 (.0051-.0087)	0.04-0.08 (.0016-.0031)	0.03-0.07 (.0012-.0028)
Limit	0.30 / (.0118)	0.30 / (.0118)	0.30 / (.0118)

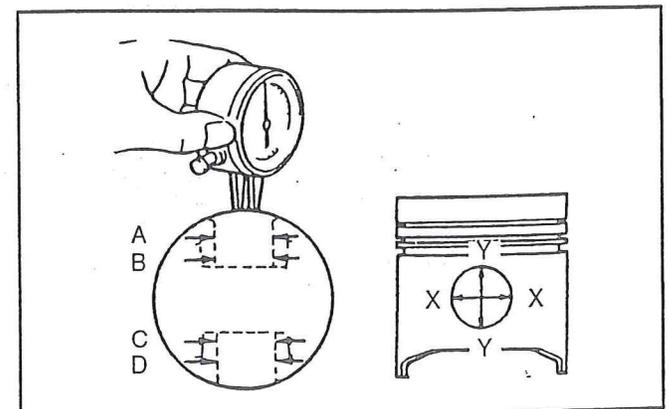
6. To measure the piston ring gap, place the ring in the cylinder liner, and place the piston in reverse. Measure the minimum diameter position of the cylinder.

Value	Top mm / (in)	Second mm / (in)	Oil mm / (in)
Standard	0.30-0.40 (.0118-.0157)	0.40-0.55 (.0157-.0217)	0.20-0.40 (.0079-.0157)
Limit	1.5 / (.0591)	1.5 / (.0591)	1.5 / (.0591)

If the limit value is exceeded, replace the piston ring.

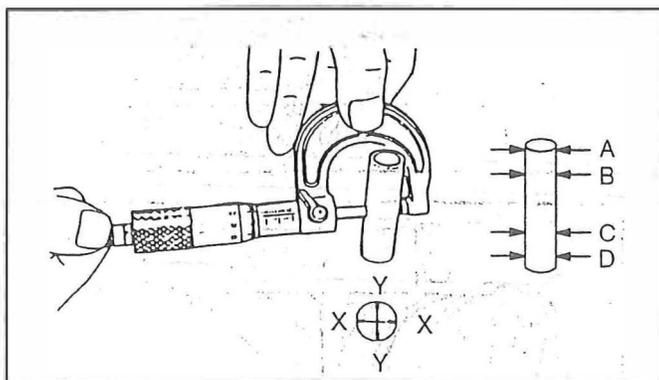
7. Using a caliper gauge, measure the piston pin hole diameter in both the X-X and Y-Y directions. Measure the four positions as shown in the illustration.

Standard value:
34.996-35.008 mm / (1.3778-1.3783 in)



8. Using a micrometer, measure the four positions shown in the illustration of the A, B, C and D piston outer diameters for both the X-X and Y-Y directions.

Standard value:
34.993-35.000 mm / (1.3777-1.3780 in)



9. Obtain the difference between the piston pin hole diameters and piston pin outer diameters. If the press-in amount (matching) is not within the standard value, replace the piston and/or piston pin. Replace the piston or piston pins if not within the standard value.

Standard value:
0.004-0.015 mm / (0.00016-0.0006 in)

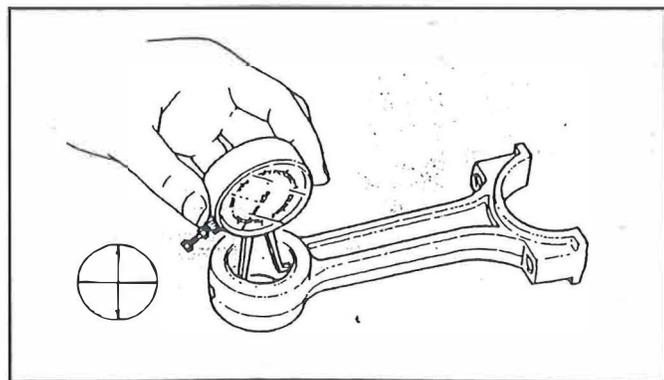
CONNECTING ROD INSPECTION

1. Measure the inside diameter of the bushing in the small end of the connecting rod with a caliper gauge.

Standard value:
35.012-35.033 / (1.3784-1.3792 in)

2. Obtain the difference between the inside diameter of the connecting rod bushing and the outer diameter of the piston pin. Replace the connecting rod bushing or piston pin if the limit is exceeded.

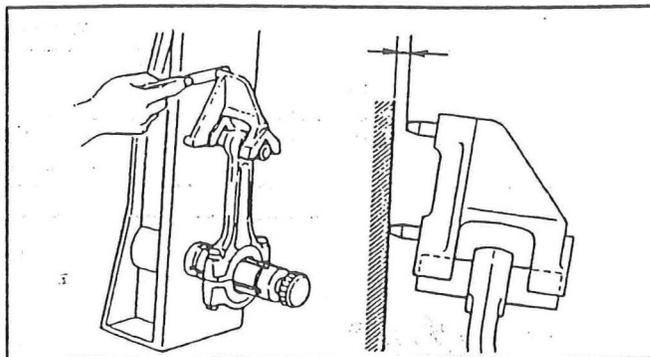
Standard value:
0.012-0.040 mm / (.0005-.0016 in)
Limit: 0.05 mm / (.0020 in)



3. Install the piston pin into the connecting rod. Install the large end of the connecting rod on the shaft of the aligner.

4. Distortion inspection.

To check distortion, place the gauge on the piston pin as shown in the illustration. The three pins of this gauge should contact the flat surface of the aligner evenly.



If the pin section is separated from the flat surface, a bent rod is indicated. Use a thickness gauge to measure this clearance.

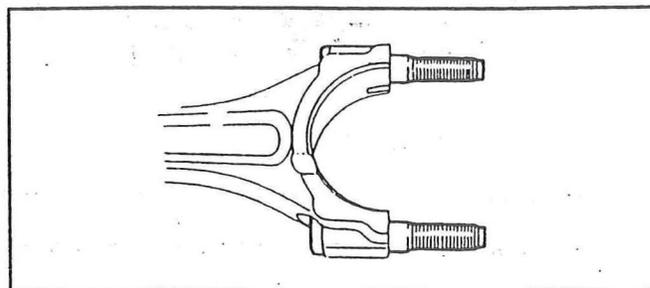
If the bend exceeds the limit value, replace the connecting rod.
Bending limit value:

0.1 mm or less for each 100 mm
(.0039 in or less for each 3.937 in)

Distance between center lines:

187.000-187.050 mm / (7.3622-7.3642 in)

NOTE: The connecting rod and connecting cap have been machined as an assembly. When replacing the connecting rod, also replace the connecting rod cap, connecting rod bolts and nuts. Always replace the connecting rod bolts and nuts even when only disassembling the connecting rod.



CRANKSHAFT INSPECTION



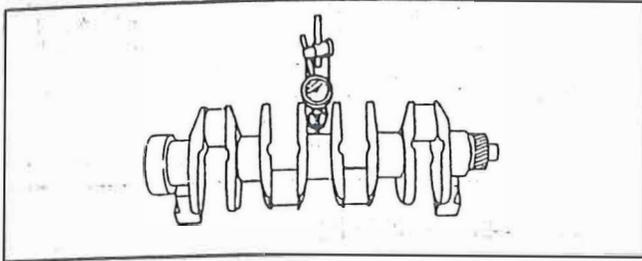
WARNING: The crankshaft is heavy. Be sure that all lifting devices (hoists, cables, chains, slings etc.) are suitable and of adequate capacity to lift the crankshaft. The crankshaft can weigh approximately 38 kg (84 lb).

1. Visually check the crankshaft's journal section, pin section and sliding section of oil seal for damage. Repair or replace if necessary.

- Check the deflection (run-out) of the crankshaft with a V block and dial gauge. Use the number 1 and number 5 journal of the crankshaft as supporting points, and measure the deflection with the number 3 journal.

Deflection limit value: 0.050 mm / (.002 in)

If the limit value is exceeded, replace the crankshaft.



- Measure the main journal diameter and crank pin diameter at the four points shown in the illustrations.

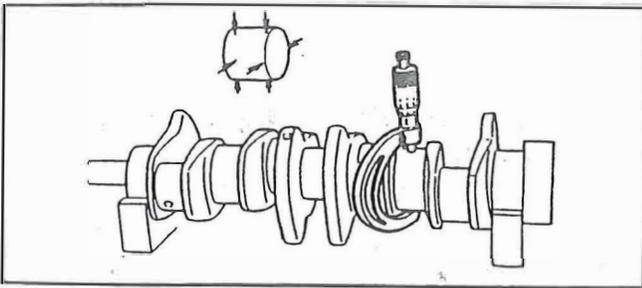
Main journal diameter:

Standard value number 1, 2, 4, 5:
78.980-79.000 mm / (3.1094-3.1102 in)

Standard value number 3:
78.954-78.974 mm / (3.1084-3.1092 in)

Limit value number 1, 2, 4, 5:
78.306 mm / (3.0829 in)

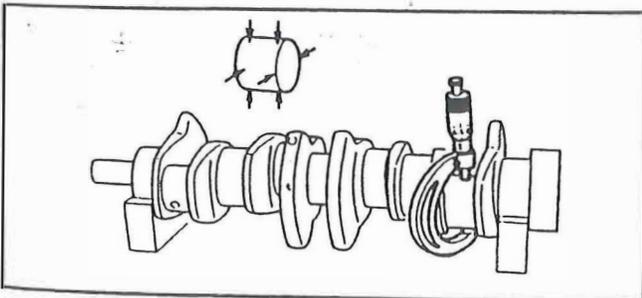
Limit value number 3:
78.280 mm / (3.0819 in)



Crank pin diameter:

Standard value:
63.987-64.00 mm / (2.5192-2.5197 in)

Limit value:
63.75 mm / (2.5098 in)



- If the diameter measurement is less than the limit value, grind the journal and use an undersize bearing.

Undersize bearings: 0.254, 0.508, 0.762 mm / (0.010, 0.020, 0.030 in)

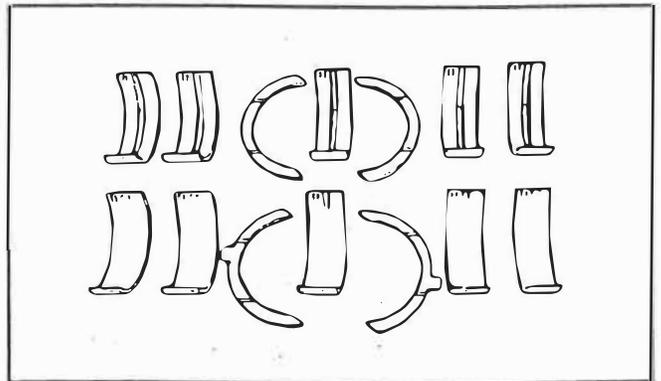
Journal finish dimensions:

Undersize Bearing mm / (in)	Main Journal mm / (in)	Crank pin mm / (in)
0.254 (0.010)	Number 1, 2, 4, 5 78.726-78.746 (3.0994-3.1002)	63.733-63.746 (2.5092-2.5097)
	Number 3 78.700-78.720 (3.0984-3.0992)	
0.508 (0.020)	Number 1, 2, 4, 5 78.472-78.492 (3.0894-3.0902)	63.479-63.492 (2.4992-2.4997)
	Number 3 78.446-78.466 (3.0884-3.0892)	
0.762 (0.030)	Number 1, 2, 4, 5 78.218-78.238 (3.0794-3.0802)	63.225-63.238 (2.4892-2.4897)
	Number 3 78.192-78.212 (3.0784-3.0792)	

NOTE: Do not grind the fillet (chamfered) section.

MAIN BEARING AND CONNECTING ROD BEARING INSPECTION

- Visually check the surface of the main bearings and the connecting rod bearings for separation and scratches. Replace if defective.

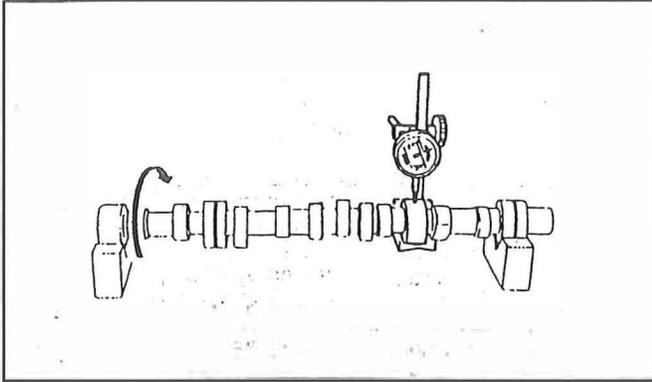


CAMSHAFT INSPECTION

- Position the number 1 and number 4 journals of the camshaft in the V block.

2. Check the camshaft deflection (run-out). Replace if the limit value is exceeded.

Deflection limit value: 0.08 mm / (.0031 in)



3. Check for wear and damage on the cam surface. Replace if defective.

4. Measure the cam height.

Camshaft:

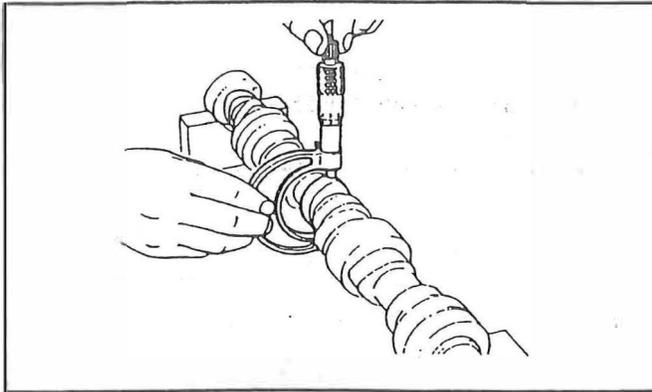
Standard intake value: 48.415 mm / (1.9061 in)

Limit intake value: 47.886 mm / (1.8853 in)

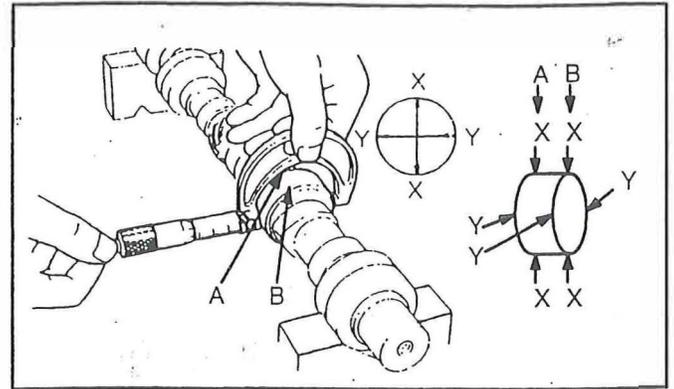
Standard exhaust value: 48.547 mm / (1.9113 in)

Limit exhaust value: 47.996 mm / (1.8896 in)

Replace the camshaft if the cam height is less than the limit value.



5. Measure each journal diameter. Measure the diameters of the "A" and "B" points in the illustration for both the X-X and Y-Y directions. Replace if the wear limit value is exceeded.



Journal diameter mm / (in):

Number 1	Standard value	58.410-58.440 (2.2996-2.3008)
	Wear Limit value	0.08 / (.0031)
Number 2	Standard value	58.160-58.190 (2.2898-2.2909)
	Wear Limit value	0.08 / (.0031)
Number 3	Standard value	57.910-57.940 (2.2799-2.2811)
	Wear Limit value	0.08 / (.0031)
Number 4	Standard value	57.660-57.690 (2.2701-2.2713)
	Wear limit value	0.08 / (.0031)

6. Measure the oil clearance of the camshaft's journal section with the following procedure:

- Thoroughly clean the journal section.
- Measure the inner diameter of the bearing.

