

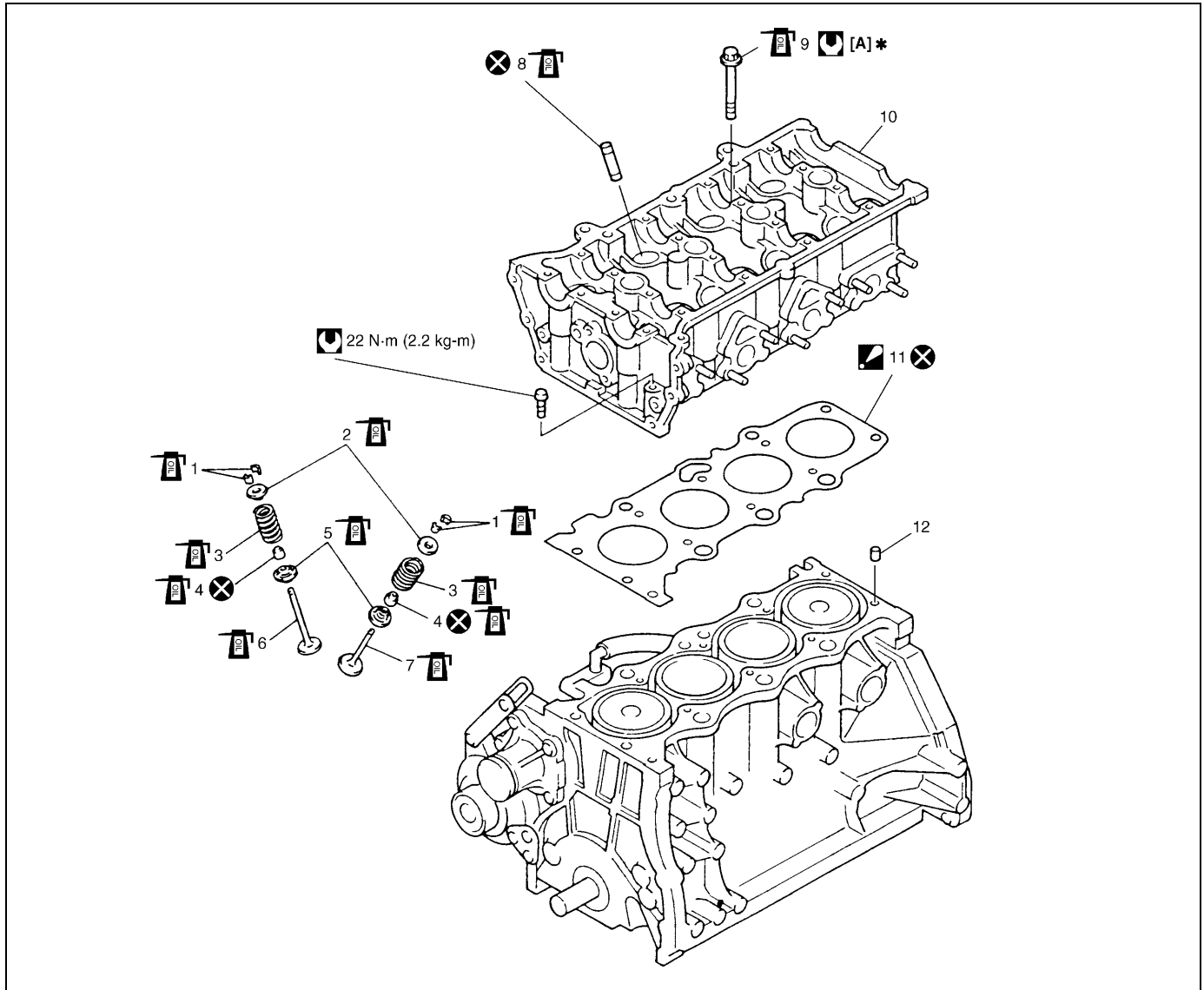
- 5) After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by the following numerical order in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.





Tightening torque

Camshaft housing bolts (a) : 11 N·m (1.1 kg-m, 8.0 lb-ft)

- 6) Install timing chain with crankshaft sprocket referring to "TIMING CHAIN AND CHAIN TENSIONER".
- 7) Install timing chain cover referring to "TIMING CHAIN COVER".
- 8) Check valve lashes as previously outlined.
- 9) Perform Steps 3) to 8) of "INSTALLATION" of "TIMING CHAIN COVER" in this section.

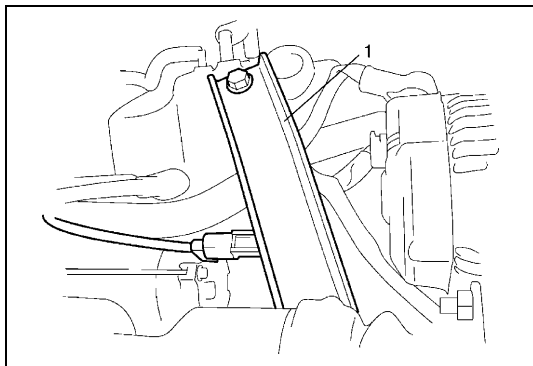
Valves and Cylinder Head



| | | |
|--|---|---|
| [A]* 1) Tighten all bolts at 40 N-m (4.0 kg-m) 2) Turn all bolts at 60° 3) Then, Turn all bolt at 60° once again | 6. Intake valve | 12. Knock pin |
| 1. Valve cotter | 7. Exhaust valve |  Tightening torque |
| 2. Valve spring retainer | 8. Valve guide |  Do not reuse. |
| 3. Valve spring | 9. Cylinder head bolt |  Apply engine oil to sliding surface of each part. |
| 4. Valve stem seal | 10. Cylinder head | |
| 5. Valve spring seat |  11. Cylinder head gasket : "TOP" mark provided on gasket comes to crankshaft pulley side, facing up. | |

REMOVAL

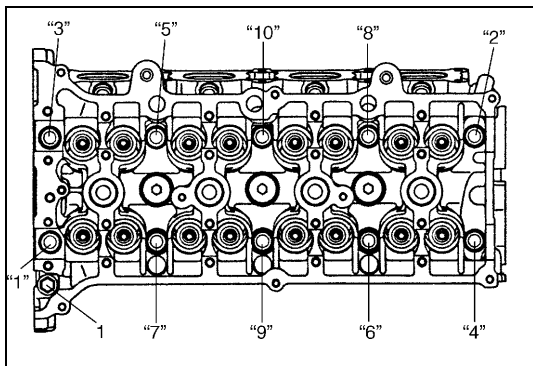
- 1) Remove engine assembly from vehicle referring to "REMOVAL" of "ENGINE ASSEMBLY" in this section.
- 2) Remove intake manifold stiffener (1).



- 3) Remove oil pan.
- 4) Remove cylinder head cover.
- 5) Remove timing chain cover referring to Steps 2) to 7) of "REMOVAL" in "TIMING CHAIN COVER".
- 6) Remove timing chain referring to Steps 2) to 6) of "REMOVAL" in "TIMING CHAIN AND CHAIN TENSIONER".
- 7) Remove intake and exhaust camshafts referring to Steps 3) to 7) of "REMOVAL" in "CAMSHAFT, TAPPET AND SHIM".
- 8) Loosen cylinder head bolts in such order as indicated in figure by using a 12 corner socket wrenches and remove them.

NOTE:

Don't forget to remove bolt (M8) (1) as shown in figure.



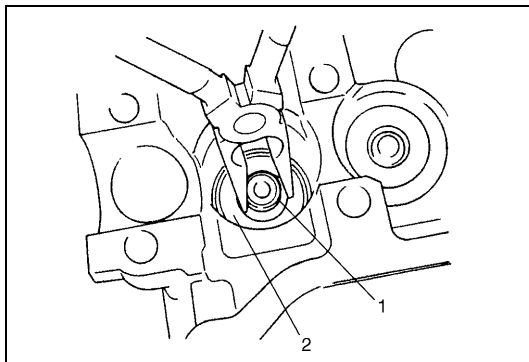
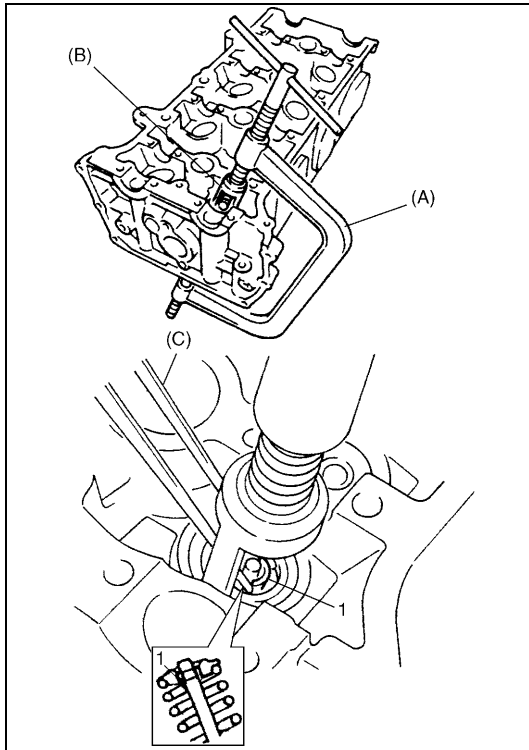
- 9) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
- 10) Remove exhaust manifold, if necessary, referring to "EXHAUST MANIFOLD".
- 11) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

DISASSEMBLY

- 1) For ease in servicing cylinder head, remove intake manifold, injectors and exhaust manifold from cylinder head.
- 2) Using special tools (Valve lifter), compress valve spring and then remove valve cotters (1) by using special tool (Forceps).

Special tool**(A) : 09916-14510****(B) : 09916-14910****(C) : 09916-84511**

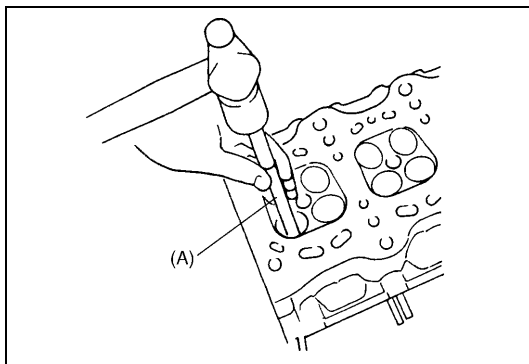
- 3) Release special tool, and remove spring retainer and valve spring.
- 4) Remove valve from combustion chamber side.



- 5) Remove valve stem seal (1) from valve guide, and then valve spring seat (2).

NOTE:

Do not reuse seal once disassembled. Be sure to use new oil seal when assembling.



- 6) Using special tool (valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

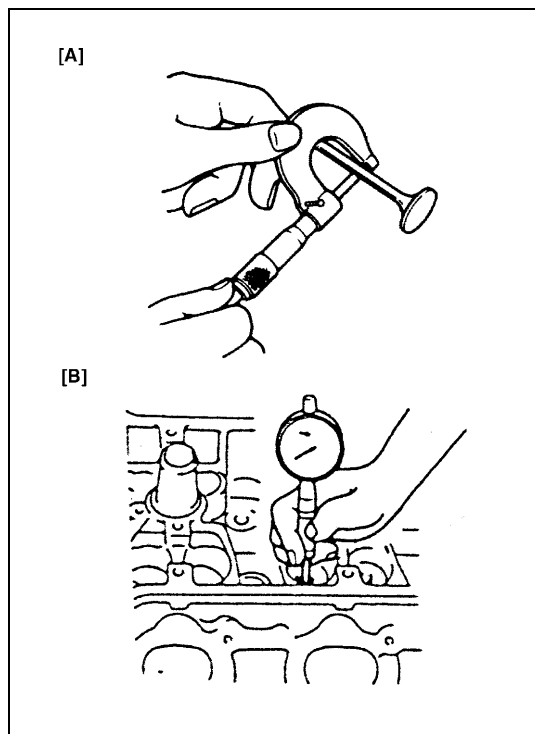
Special tool**(A) : 09916-44910****NOTE:**

Do not reuse valve guide once disassembled. Be sure to use new valve guide (Oversize) when assembling.

- 7) Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original position.

INSPECTION

Valve guides



Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance. Be sure to take reading at more than one place along the length of each stem and guide.

If clearance exceeds limit, replace valve and valve guide.

Valve stem-to-guide clearance

| Item | Standard | Limit |
|------|---|-------------------------|
| In | 0.005 – 0.045 mm (0.0002 – 0.0017 in.) | 0.07 mm (0.0028 in.) |
| Ex | 0.03 – 0.07 mm (0.0012 – 0.0027 in.) | 0.09 mm (0.0035 in.) |

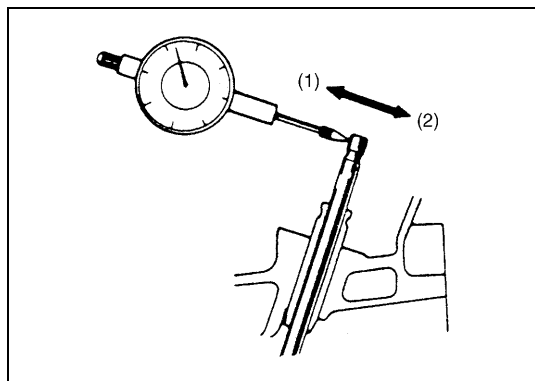
Valve stem diameter [A] standard

In : 5.465 – 5.480 mm (0.2150 – 0.2157 in.)

Ex : 5.440 – 5.455 mm (0.2142 – 0.2148 in.)

Valve guide bore [B] standard

In and Ex : 5.485 – 5.51 mm (0.2160 – 0.2170 in.)



If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.

Move stem end in directions (1) and (2) to measure end deflection.

If deflection exceeds its limit, replace valve stem and valve guide.

Valve stem end deflection limit

In : 0.14 mm (0.005 in.)

Ex : 0.18 mm (0.007 in.)

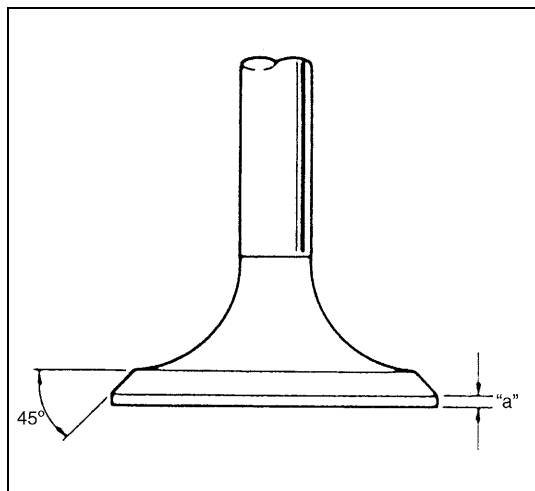
Valves

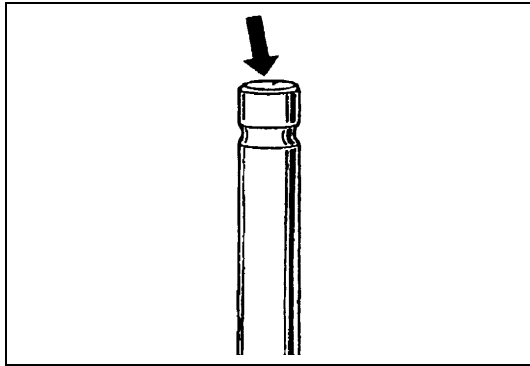
- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem end, as necessary, replace it.
- Measure thickness “a” of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness (In and Ex)

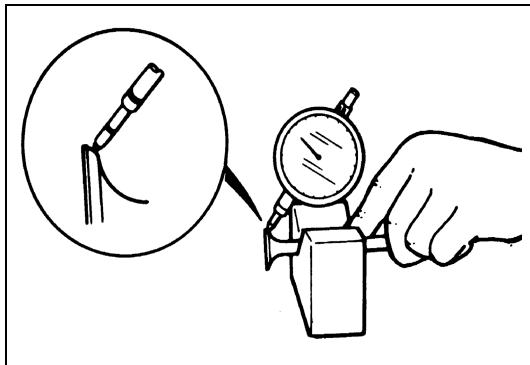
Standard : 1.25 – 1.55 mm (0.049 – 0.061 in.)

Limit : 0.9 mm (0.035 in.)



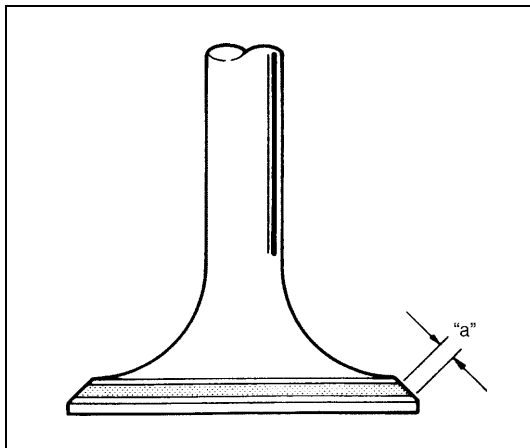


- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not too much to grind off its chamber. When it is worn out too much that its chamber is gone, replace valve.



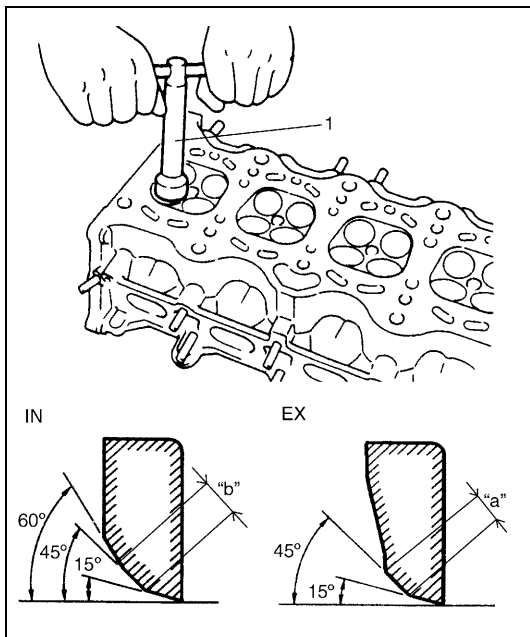
- Check each valve for radial runout with a dial gauge and "V" block. To check runout, rotate valve slowly. If runout exceeds its limit, replace valve.

Limit on valve head radial runout
0.08 mm (0.003 in.)



- Seating contact width:
 Create contact pattern on each valve in the usual manner, i.e. by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.
 Pattern produced on seating face of valve must be a continuous ring without any break, and the width of pattern must be within specified range.

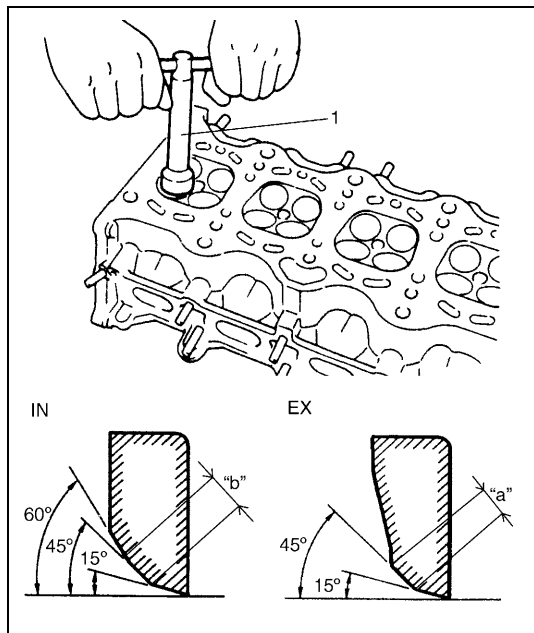
Standard seating width "a" revealed by contact pattern on valve face
In and Ex : 1.1 - 1.3 mm (0.0433 - 0.0512 in.)



- Valve seat repair:
 A valve seat not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

- a) EXHAUST VALVE SEAT : Use valve seat cutters (1) to make two cuts as illustrated in figure. Two cutters must be used: the first for making 15° angle, and the second for making 45° angle. The second cut must be made to produce desired seat width.

Seat width for exhaust valve seat
"a" : 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

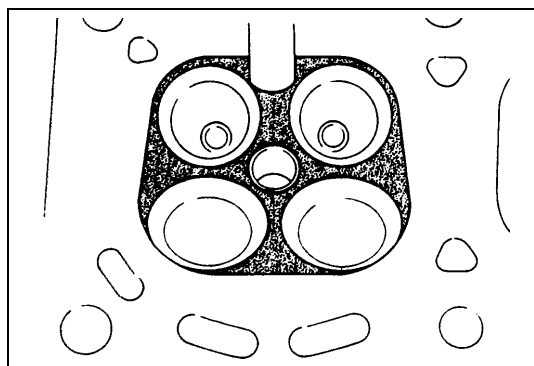


- b) **INTAKE VALVE SEAT** : Use valve seat cutters (1) to make three cuts as illustrated in figure. Three cutters must be used: the 1st for making 15° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

Seat width for intake valve seat

"b" : 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

- c) **VALVE LAPPING** : Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.

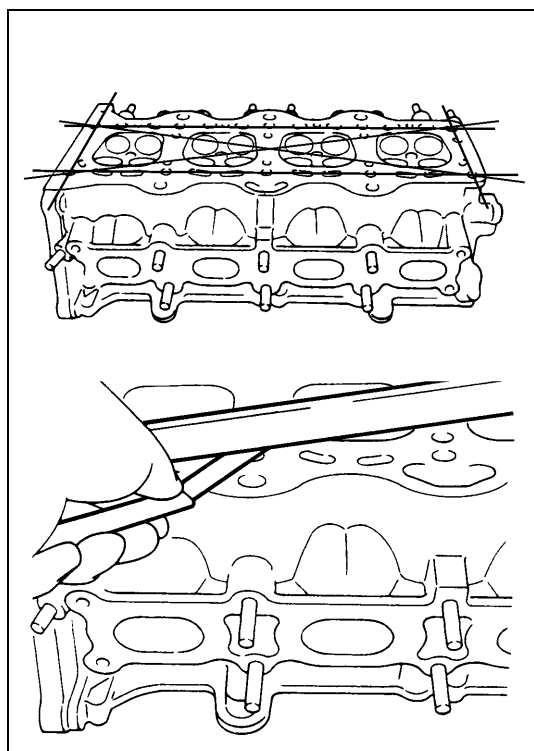


Cylinder head

- Remove all carbon deposits from combustion chambers.

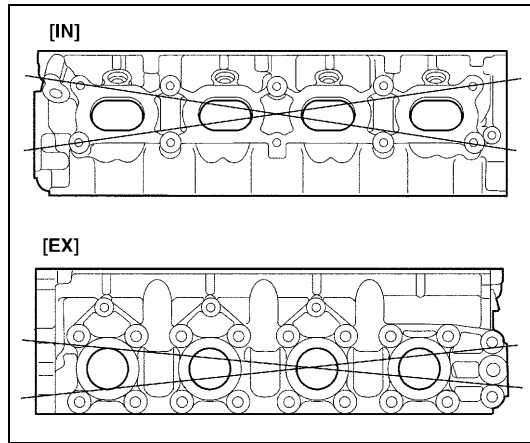
NOTE:

Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface.
Using a straightedge and thickness gauge, check flatness of gasketed surface at a total of 6 locations. If distortion limit, given below, is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head.
Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

Limit of distortion for cylinder head surface on piston side : 0.03 mm (0.001 in.)

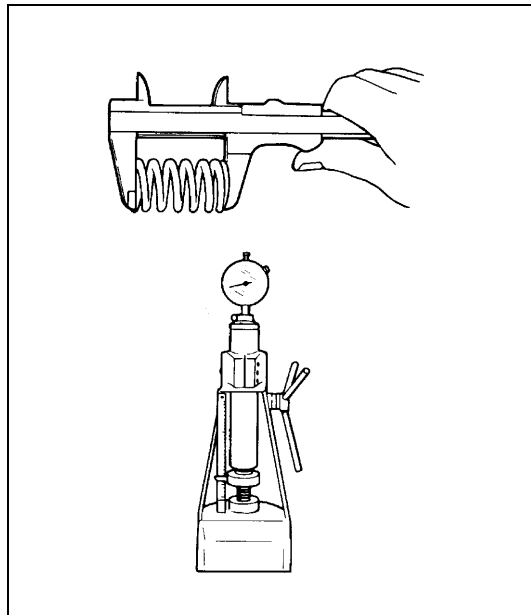


- Distortion of manifold seating faces:

Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

Limit of distortion for cylinder head surface on intake and exhaust manifold

0.05 mm (0.002 in.)



Valve springs

- Referring to data given below, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Valve spring free length

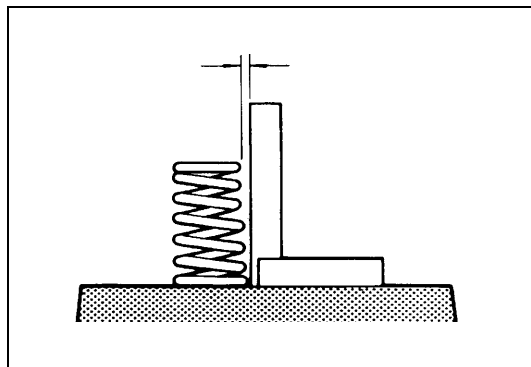
Standard : 36.83 mm (1.450 in.)

Limit : 35.83 mm (1.411 in.)

Valve spring preload

Standard : 107 – 125 N (10.7 – 12.5 kg) for 31.50 mm (23.6 – 27.6 lb/1.240 in.)

Limit : 102 N (10.2 kg) for 31.5 mm (22.5 lb/1.240 in.)

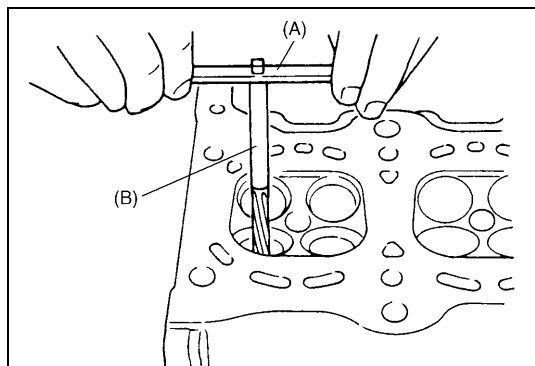


- Spring squareness:

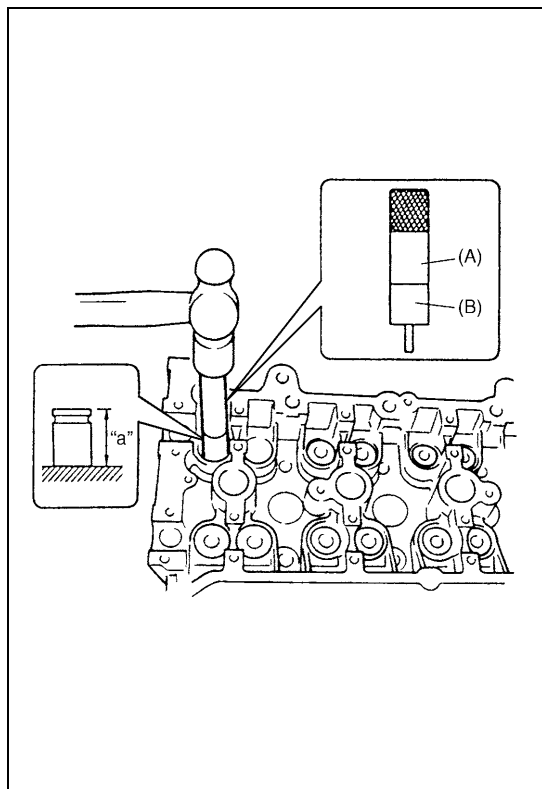
Use a square and surface plate to check each spring for squareness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit given below must be replaced.

Valve spring squareness limit

1.6 mm (0.079 in.)

ASSEMBLY

- 1) Before installing valve guide into cylinder head, ream guide hole with special tool (10.5 mm reamer) so as to remove burrs and make it truly round.

Special tool**(A) : 09916-34542****(B) : 09916-37320**

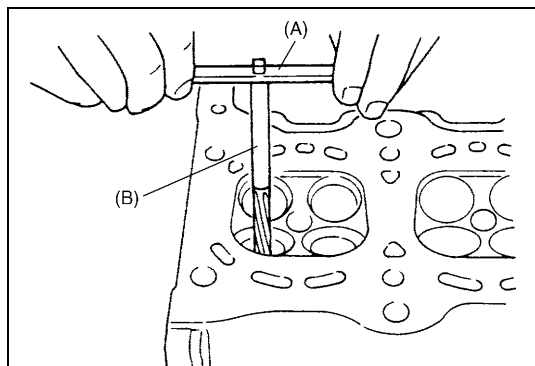
- 2) Install valve guide to cylinder head.

Heat cylinder head uniformly to a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools. Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.

After installing, make sure that valve guide protrudes by specified dimension "a" from cylinder head.

Special tool**(A) : 09916-56011****(B) : 09916-58210****NOTE:**

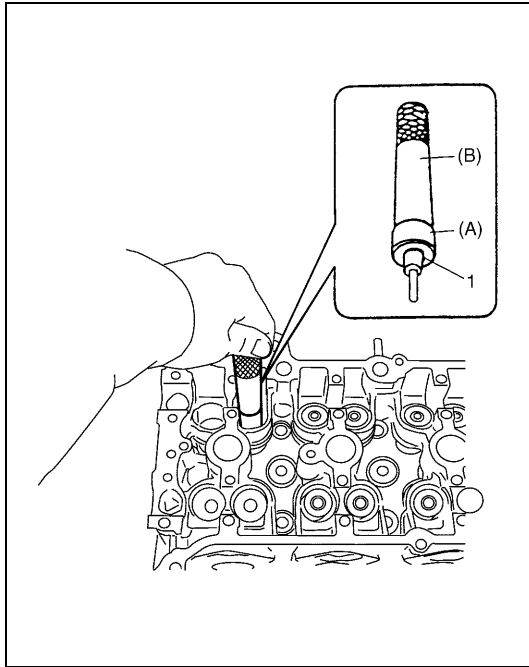
- **Never reuse once-disassembled valve guide.**
Make sure to install new valve guide.
- **Intake and exhaust valve guides are identical.**

Specification for valve guide protrusion "a"**Intake side : 11.3 mm (0.44 in.)****Exhaust side : 11.3 mm (0.44 in.)**

- 3) Ream valve guide bore with special tool (5.5 mm reamer).
After reaming, clean bore.

Special tool**(A) : 09916-34542****(B) : 09916-34550**

- 4) Install valve spring seat to cylinder head.



- 5) Install new valve stem seal (1) to valve guide.

After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand.

After installing, check to be sure that seal is properly fixed to valve guide.

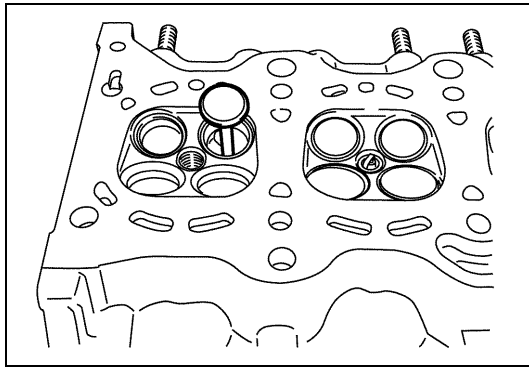
Special tool

(A) : 09917-98221

(B) : 09916-58210

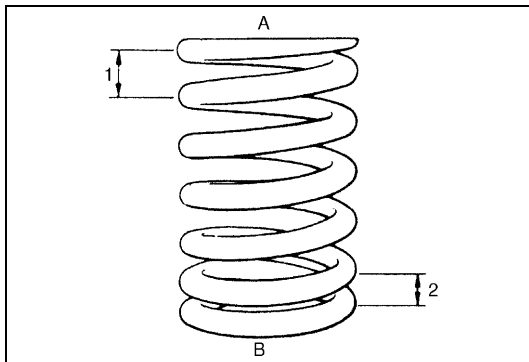
NOTE:

- Do not reuse once-disassembled seal. Be sure to install new seal.
- When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.



- 6) Install valve to valve guide.

Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore and valve stem.

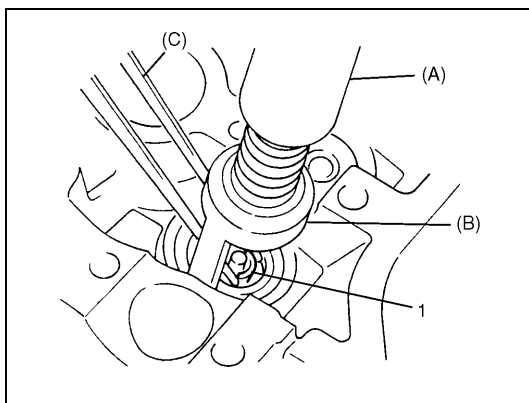


- 7) Install valve spring and spring retainer.

Each valve spring has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).

| |
|--------------------------------|
| A : Valve spring retainer side |
|--------------------------------|

| |
|----------------------------|
| B : Valve spring seat side |
|----------------------------|



- 8) Using special tools (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

Special tool

(A) : 09916-14510

(B) : 09916-14910

(C) : 09916-84511

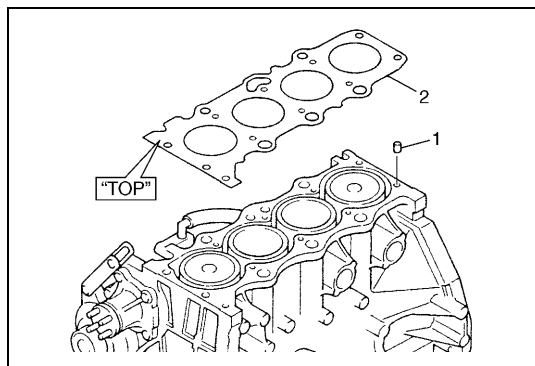
NOTE:

When compressing the valve spring, be carefully to free from damage in inside face of tappet installing hole.

- 9) Install intake manifold, injectors and exhaust manifold to cylinder head.

INSTALLATION

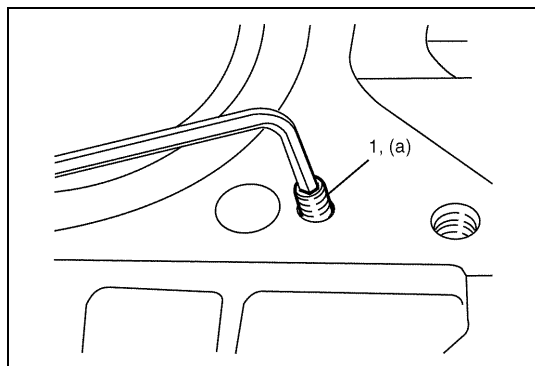
- 1) Clean mating surface of cylinder head and cylinder block.
Remove oil, old gasket and dust from mating surface.
- 2) Install knock pins (1) to cylinder block.
- 3) Install new cylinder head gasket (2) to cylinder block.
“TOP” mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).



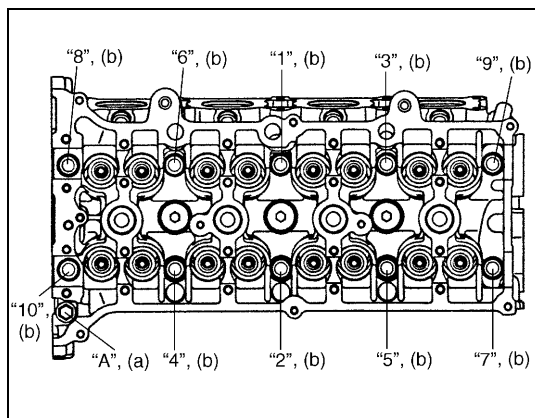
- 4) Make sure that oil jet (venturi plug) (1) is installed and if it is, that it is not clogged.
When installing it, be sure to tighten to specified torque.

Tightening torque

Venturi plug (a) : 5 N·m (0.5 kg-m, 3.5 lb-ft)



- 5) Install cylinder head to cylinder block.
Apply engine oil to new cylinder head bolts and tighten them gradually as follows.
 - a) Tighten cylinder head bolts (“1” – “10”) to 20 N·m (2.0 kg-m, 14.5 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
 - b) In the same manner as in Step a), tighten them to 40 N·m (4.0 kg-m, 29.0 lb-ft).
 - c) Turn all bolts 60° according to numerical order in figure.
 - d) Repeat Step c).
 - e) Tighten bolt “A” to specified torque.

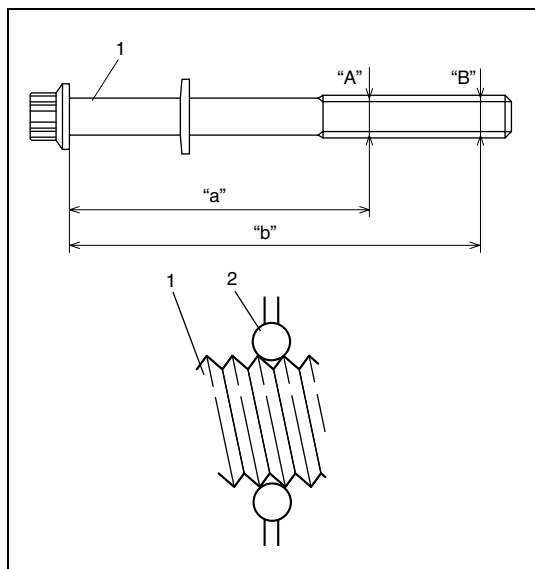


NOTE:

Use new cylinder head bolts. If they are reused, check thread diameters of cylinder head bolt for deformation according to the follows and replace them with new ones if thread diameter difference exceeds limit.

Measure each thread diameter of cylinder head bolt (1) at “A” on 83.5mm(2.81in.) from seat side of flange bolt and “B” on 115mm(4.53in.) from seat side of flange bolt by using a micrometer (2).

**Then calculate difference in diameters (“A” – “B”).
If it exceeds limit, replace with new one.**



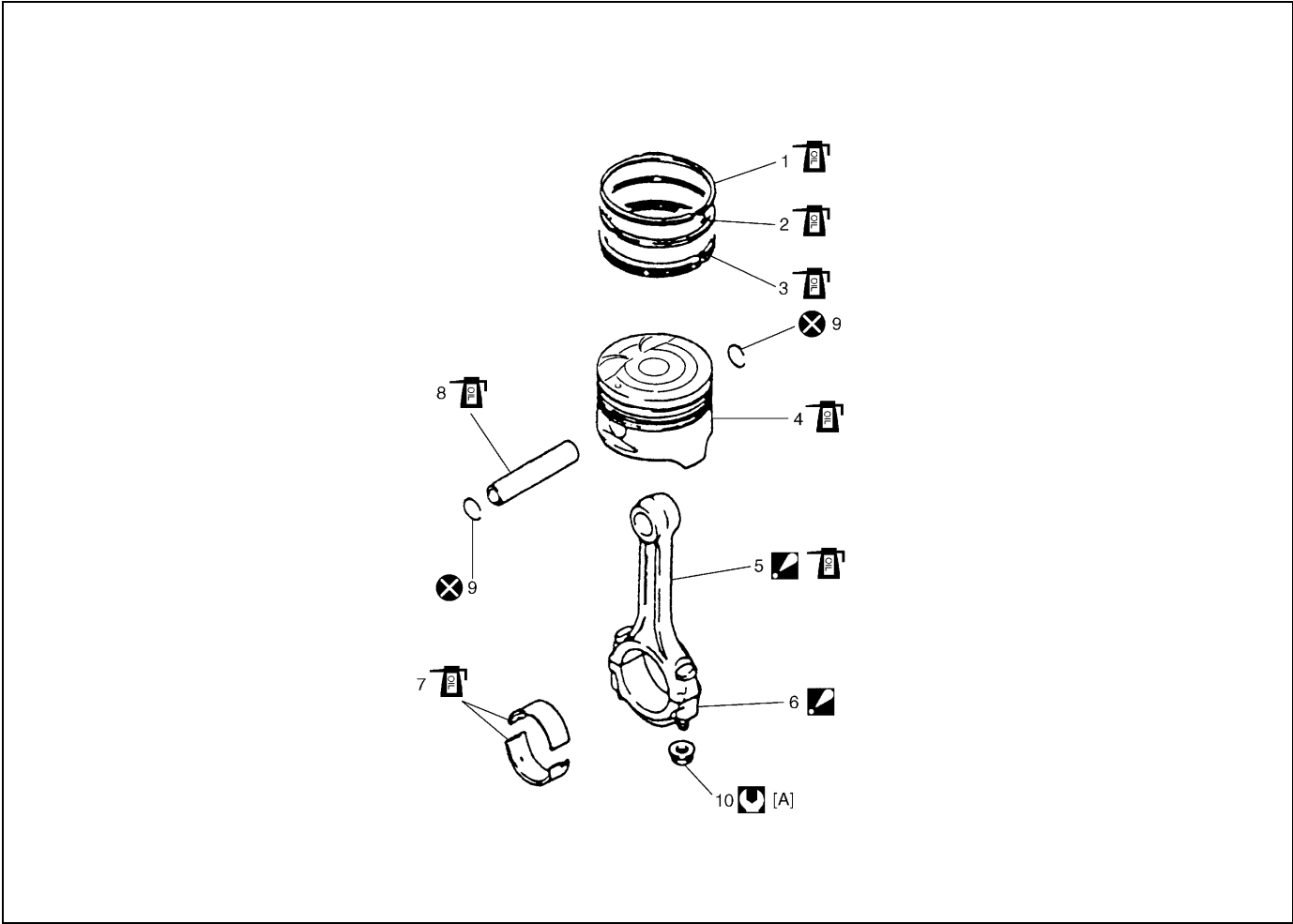
Cylinder head bolt diameter measurement points**“a” : 83.5mm (2.81in.)****“b” : 115mm (4.53in.)****Cylinder head bolt diameter difference (deformation)****Limit (“A” – “B”) : 0.1mm (0.004in.)****NOTE:**






Be sure to tighten M8 bolt (“A”) after securing the other bolt.

Tightening torque**Cylinder head bolt for M8 (a) : 22 N·m (2.2 kg-m, 16.0 lb-ft)****Cylinder head bolts for M10****(b) : 40 N·m (4.0 kg-m, 29.0 lb-ft) and then turn to 60° twice**

- 6) Install exhaust manifold stiffener.
- 7) Install camshafts, timing chain and chain cover as previously outlined.
- 8) Install cylinder head cover and oil pan.
- 9) Install intake manifold stiffener and connect each hoses.
- 10) Perform Steps 3) to 8) of “INSTALLATION” of “TIMING CHAIN COVER” in this section.

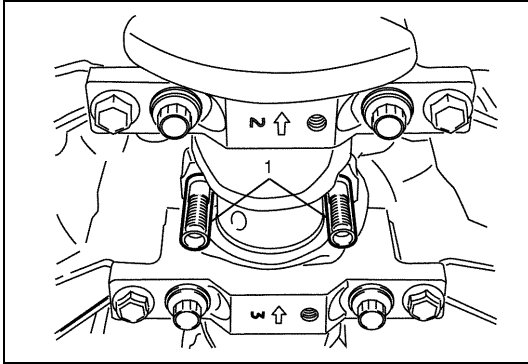
Pistons, Piston Rings, Connecting Rods and Cylinders



| | | |
|--|--|--|
| [A] : 1) Tighten all nuts to 15 N·m (1.5 kg·m) 2) Turn all nuts to 45° 3) Then, Turn all nuts to 45° once again | | 7. Connecting rod bearing |
| 1. Top ring | | 8. Piston pin |
| 2. 2nd ring | | 9. Piston pin circlip |
| 3. Oil ring | | 10. Bearing cap nut |
| 4. Piston | |  Tightening torque |
|  5. Connecting rod : Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Make sure rod bolt diameter when reuse it due to plastic deformation tightening. Refer to "INSPECTION" of "CONNECTING ROD". | |  Apply engine oil to sliding surface of each parts. |
|  6. Connecting rod bearing cap : Point arrow mark on cap to crankshaft pulley side. | |  Do not reuse. |

REMOVAL

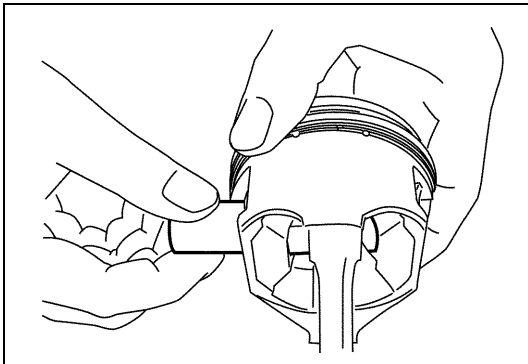
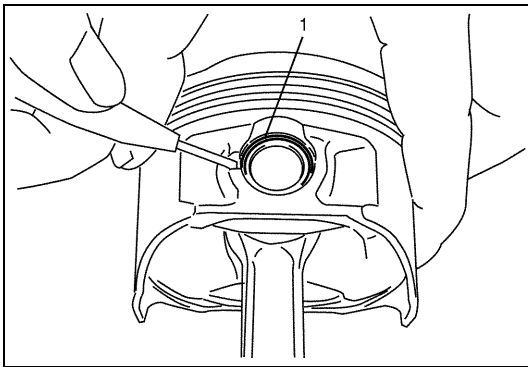
- 1) Remove engine assembly from vehicle referring to "REMOVAL" of "ENGINE ASSEMBLY" in this section.
- 2) Remove cylinder head referring to "VALVES AND CYLINDER HEAD".
- 3) Mark cylinder number on all pistons, connecting rods and connecting rod caps using silver pencil or quick drying paint.
- 4) Remove rod bearing caps.



- 5) Install guide hose (1) over threads of rod bolts.
This prevents damage to bearing journal and rod bolt threads when removing connecting rod.
- 6) Decarbonize top of cylinder bore before removing piston from cylinder.
- 7) Push piston and connecting rod assembly out through the top of cylinder bore.

DISASSEMBLY

- 1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
- 2) Remove piston pin from connecting rod.
 - Ease out piston pin circlips (1), as shown.



- Force piston pin out.

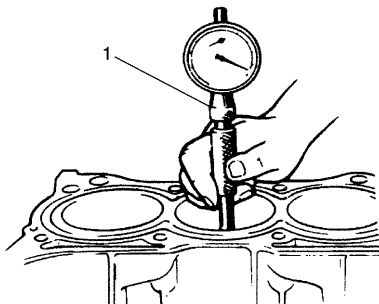
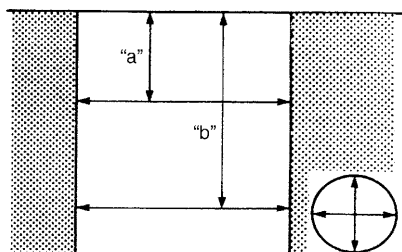
CLEANING

Decarbonize piston head and ring grooves, using a suitable tool.

INSPECTION

Cylinder

- Inspect cylinder walls for scratches, roughness or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched or ridged, rebore cylinder and use over-size piston.



- Using a cylinder gauge (1), measure cylinder bore in thrust and axial directions at two positions ("a" and "b") as shown in figure.

If any of the following conditions is noted, rebore cylinder.

- 1) Cylinder bore dia. exceeds limit.
- 2) Difference of measurements at two positions exceeds taper limit.
- 3) Difference between thrust and axial measurements exceeds out-of-round limit.

Cylinder bore diameter

Standard : 78.00 – 78.014 mm (3.0709 – 3.0714 in.)

Limit : 78.114 mm (3.073 in.)

Cylinder taper and out-of-round

Limit : 0.10 mm (0.004 in.)

| |
|------------------------|
| "a" : 50 mm (1.96 in.) |
|------------------------|

| |
|------------------------|
| "b" : 95 mm (3.74 in.) |
|------------------------|

NOTE:

If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.

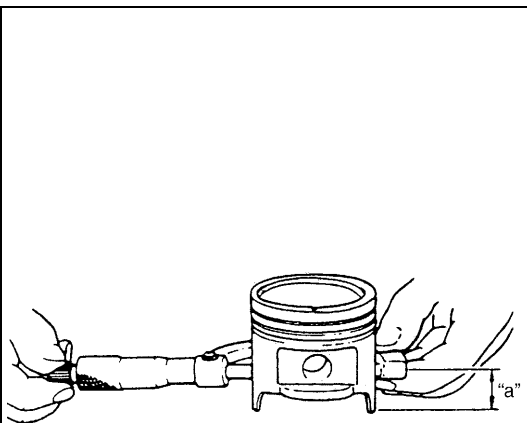
Pistons

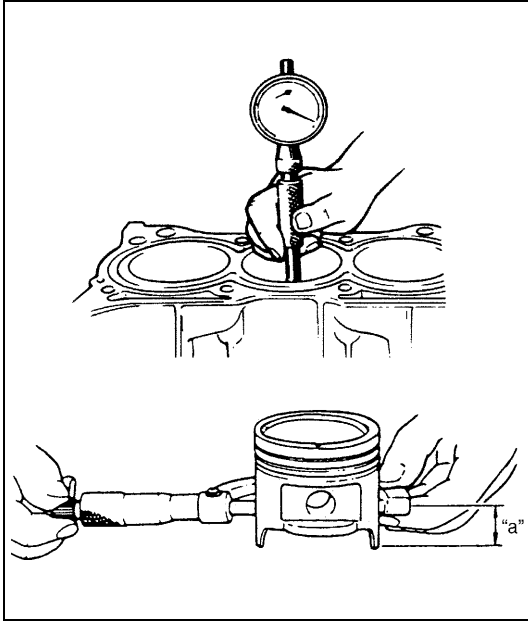
- Inspect piston for faults, cracks or other damaged. Damaged or faulty piston should be replaced.
- Piston diameter :
As indicated in figure, piston diameter should be measured at a position 19.5 mm (0.77 in.) from piston skirt end in the direction perpendicular to piston pin.

Piston diameter specification

| | |
|--|--|
| Standard size | 77.953 – 77.968 mm (3.0690 – 3.0696 in.) |
| | new one (with coating) 77.969 – 77.984 mm (3.0696 – 3.0702 in.) |
| Oversize 0.25 mm (0.0098 in.) | 78.203 – 78.218 mm (3.0789 – 3.0794 in.) |
| Oversize 0.50 mm (0.0196 in.) | 78.453 – 78.468 mm (3.0887 – 3.0893 in.) |

| |
|--------------------------|
| "a" : 19.5 mm (0.77 in.) |
|--------------------------|





- **Piston clearance:**

Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as given below. If it is out of specification, rebore cylinder and use oversize piston.

Piston clearance

Standard : 0.032 – 0.061 mm (0.0013 – 0.0024 in.)

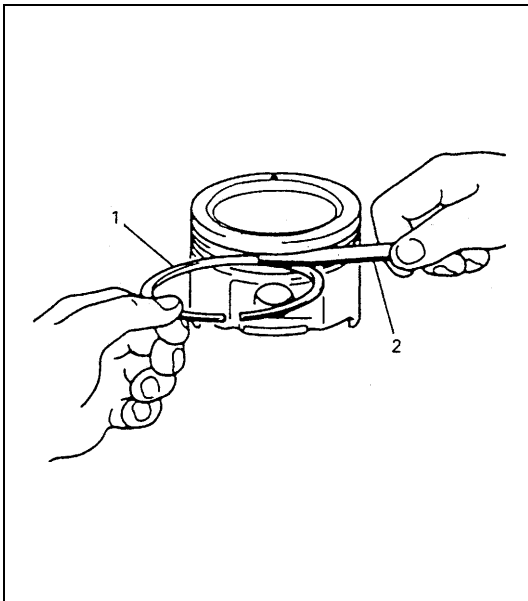
Standard : 0.016 – 0.045 mm (0.0006 – 0.0018 in.) piston with coating (new one)

Limit : 0.161 mm (0.0065 in.)

NOTE:

Cylinder bore diameters used here are measured in thrust direction at two positions.

"a" : 19.5 mm (0.77 in.)



- **Ring groove clearance:**

Before checking, piston grooves must be clean, dry and free of carbon deposits.

Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of limit, replace piston.

Ring groove clearance

Top ring

Standard : 0.03 – 0.07 mm (0.0012 – 0.0028 in.)

Limit : 0.12 mm (0.0047 in.)

2nd ring

Standard : 0.02 – 0.06 mm (0.0008 – 0.0024 in.)

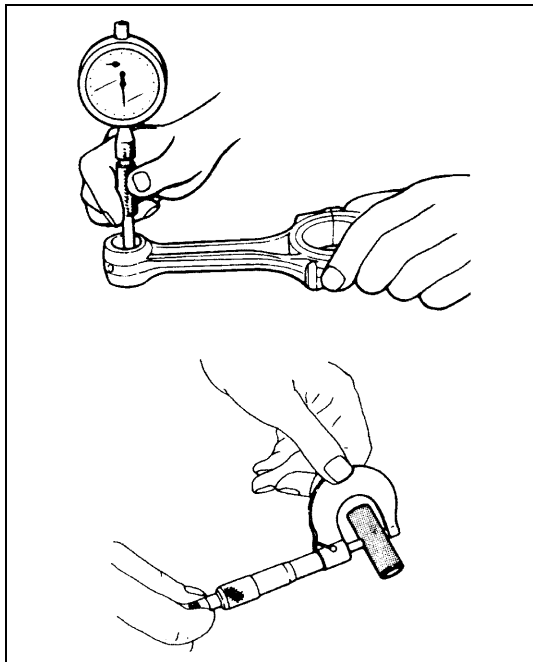
Limit : 0.10 mm (0.0039 in.)

Oil ring

Standard : 0.03 – 0.17 mm (0.0012 – 0.0067 in.)

Piston pin

- Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod and/or piston.



- **Piston pin clearance :**

Check piston pin clearance in small end and piston. Replace connecting rod and/or piston if its small end is badly worn or damaged or if measured clearance exceeds limit.

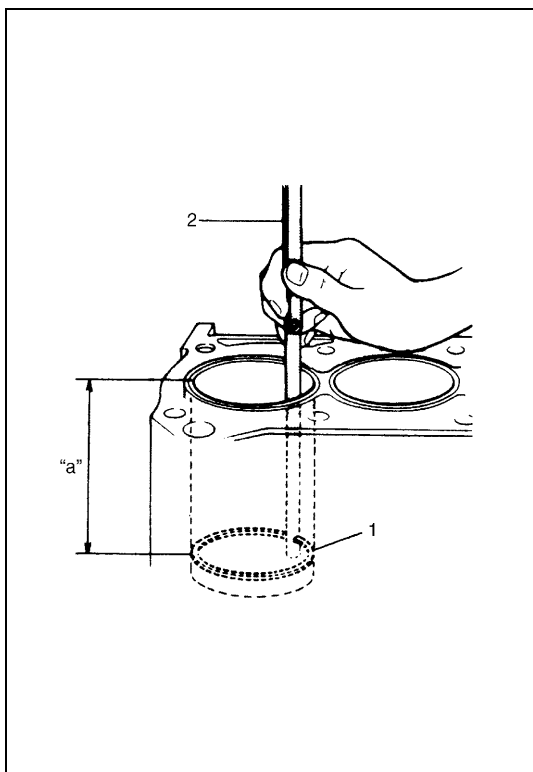
Piston pin clearance in connecting rod small end
0.003 – 0.014 mm (0.0001 – 0.0006 in.)

Piston pin clearance in piston
0.006 – 0.017 mm (0.00024 – 0.00067 in.)

Small-end bore
20.003 – 20.011 mm (0.7875 – 0.7878 in.)

Piston pin dia.
19.997 – 20.000 mm (0.7873 – 0.7874 in.)

Piston bore
20.006 – 20.014 mm (0.7876 – 0.7880 in.)



Piston rings

To measure end gap, insert piston ring (1) into cylinder bore and then measure the gap by using thickness gauge (2).
If measured gap is out of specification, replace ring.

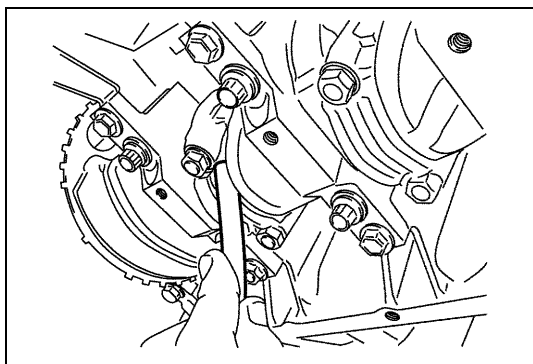
NOTE:

Decarbonize and clean top of cylinder bore before inserting piston ring.

Piston ring end gap

| Item | Standard | Limit |
|----------|---|------------------------|
| Top ring | 0.20 – 0.35 mm (0.0079 – 0.0138 in.) | 0.7 mm (0.0276 in.) |
| 2nd ring | 0.30 – 0.45 mm (0.0118 – 0.0177 in.) | 1.0 mm (0.0394 in.) |
| Oil ring | 0.20 – 0.70 mm (0.0079 – 0.0276 in.) | 1.5 mm (0.0591 in.) |

"a" : 120 mm (4.72 in.)

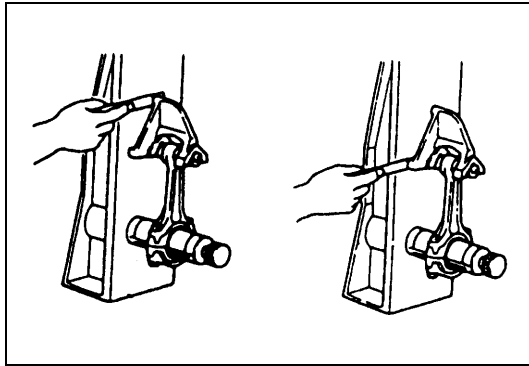


Connecting rod

- **Big-end side clearance:**

Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

Big-end side clearance
Standard : 0.25 - 0.40 mm (0.0098 - 0.0157 in.)
Limit : 0.55 mm (0.0217 in.)

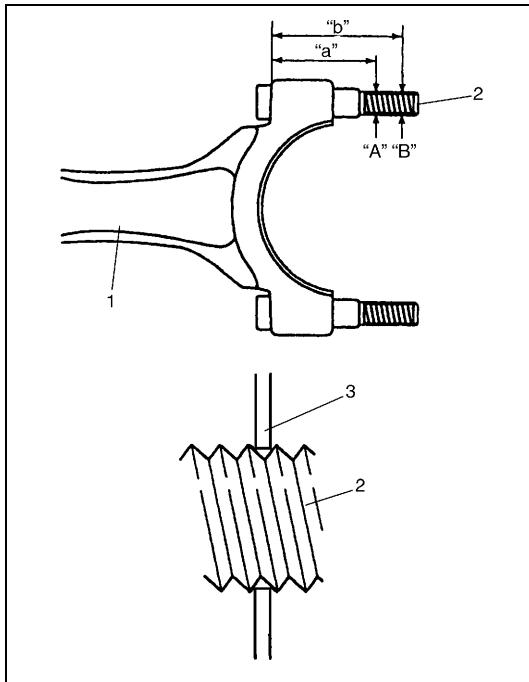


- Connecting rod alignment :
Mount connecting rod on aligner to check it for bow and twist. If limit is exceeded, replace it.

Connecting rod alignment

Limit on bow : 0.05 mm (0.0020 in.)

Limit on twist : 0.10 mm (0.0039 in.)



- Connecting rod bolt deformation (Plastic deformation tightening bolt)

Measure each thread diameter of connecting rod (1) bolt (2) at "A" on 32 mm (1.25 in.) from bolt mounting surface and "B" on 40 mm (1.57 in.) from bolt mounting surface by using a micrometer (3).

Calculate difference in diameters ("A" – "B"). If it exceeds limit, replace connecting rod.

Connecting rod bolt measurement points

"a" : 32 mm (1.25 in.)

"b" : 40 mm (1.57 in.)

Connecting rod bolt diameter difference

limit ("A" – "B") : 0.1 mm (0.004 in.)

Crank pin and connecting rod bearings

- Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged or out-of round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use under-size bearing.

Crank pin diameter

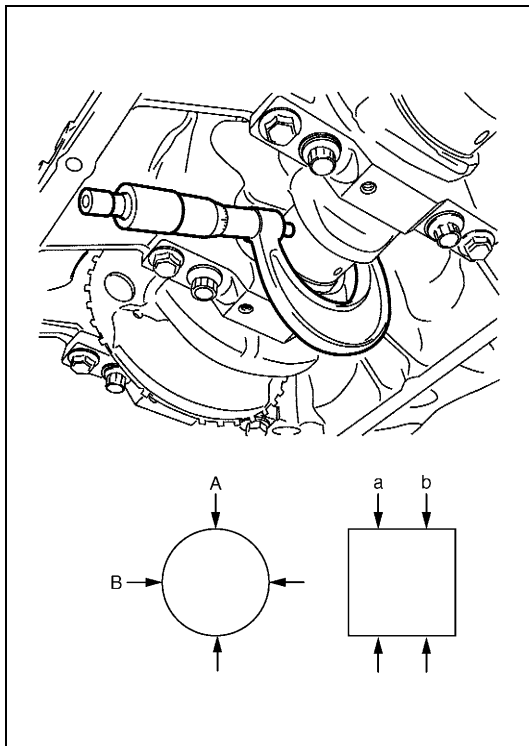
| Connecting rod bearing size | Crank pin diameter |
|-----------------------------------|---|
| Standard | 41.982 – 42.000 mm (1.6528 – 1.6535 in.) |
| Undersize 0.25 mm (0.0098 in.) | 41.732 – 41.750 mm (1.6430 – 1.6437 in.) |

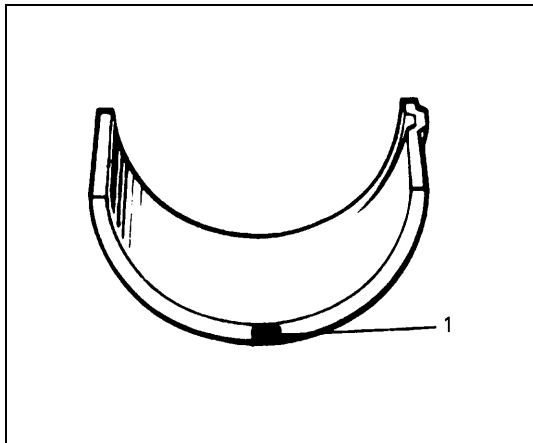
Crank pin taper and out-of-round

Limit : 0.01 mm (0.0004 in.)

Out-of-round : A – B

Taper : a – b



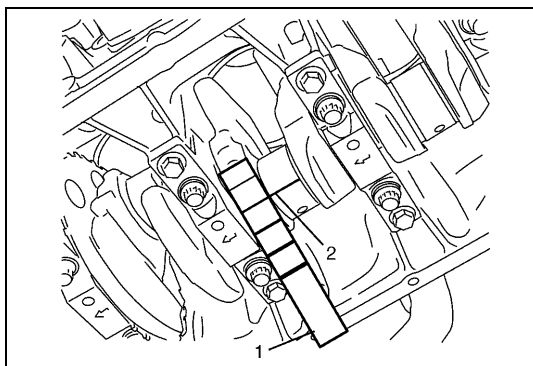
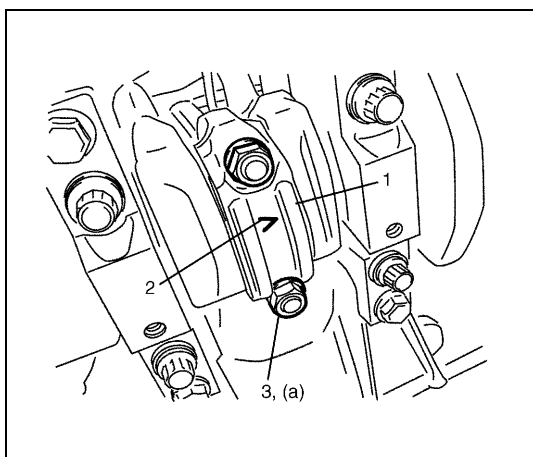
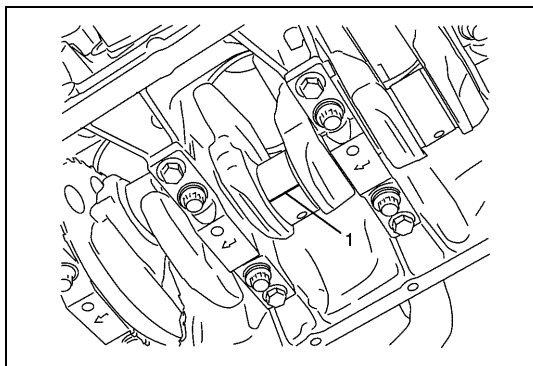


- Rod bearing :

Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

Two kinds of rod bearing are available; standard size bearing and 0.25 mm (0.0098 in.) undersize bearing. For identification of undersize bearing, it is painted red at the position as indicated in figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.

1. Red paint



- Rod bearing clearance :

- 1) Before checking bearing clearance, clean bearing and crank pin.
- 2) Install bearing in connecting rod and bearing cap.
- 3) Place a piece of gaging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.

- 4) Install rod bearing cap (1) to connecting rod.

When installing cap, be sure to point arrow mark (2) on cap to crankshaft pulley side, as shown in figure. After applying engine oil to rod bolts and tighten cap nuts (3) gradually as follows.

- a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
- b) Retighten them to 45°.
- c) Repeat step b) once again.

Tightening torque

Connecting rod bearing cap nuts

(a) : 15 N·m (1.5 kg-m, 11.0 lb-ft) and extra tighten 90°

- 5) Remove cap and using a scale (1) on gaging plastic (2) envelope, measure gaging plastic width at the widest point (clearance).

If clearance exceeds its limit, use a new standard size bearing and remeasure clearance.

Connecting rod bearing clearance

Standard : 0.029 – 0.047 mm (0.0011 – 0.0019 in.)

Limit : 0.065 mm (0.0026 in.)

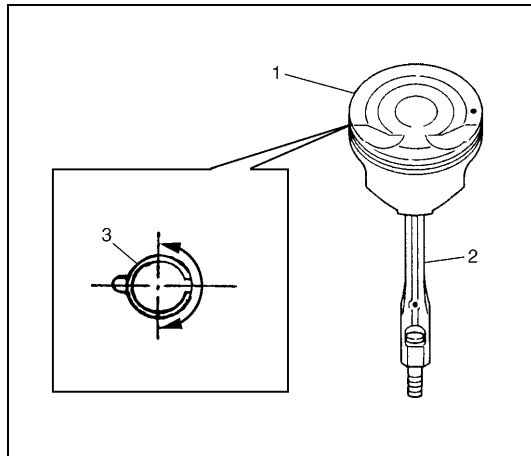
- 6) If clearance can not be brought to within its limit even by using a new standard size bearing, regrind crankpin to undersize and use 0.25 mm undersize bearing.

NOTE:

After checking the rod bearing clearance, make sure that checking for Connecting rod bolt deformation.

Refer to “INSPECTION” of “CONNECTING ROD”.

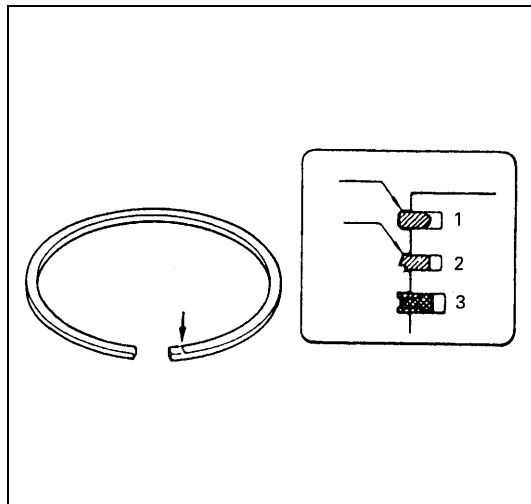
ASSEMBLY



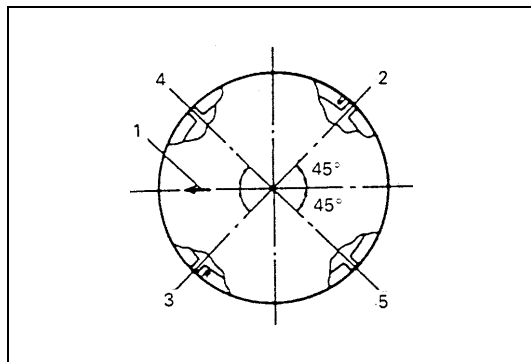
- 1) Install piston pin to piston (1) and connecting rod (2) :
 - a) After applying engine oil to piston pin and piston pin holes in piston and connecting rod.
 - b) Fit connecting rod as shown in figure.
 - c) Insert piston pin to piston and connecting rod.
 - d) Install piston pin circlips (3).

NOTE:

Circlip should be installed with its cut part facing as shown in figure. Install so that circlip end gap comes within such range as indicated by arrow.



- 2) Install piston rings to piston :
 - a) As indicated in figure, 1st and 2nd rings have “T” mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
 - b) 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall. Distinguish 1st ring from 2nd ring by referring to figure.
 - c) When installing oil ring (3) install spacer first and then two rails.



- 3) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in figure.

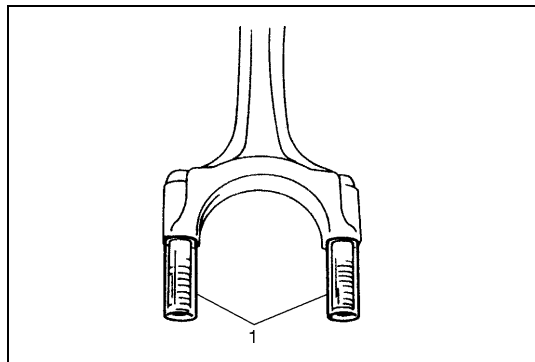
| |
|---|
| 1. Arrow mark |
| 2. 1st ring end gap |
| 3. 2nd ring end gap and oil ring spacer gap |
| 4. Oil ring upper rail gap |
| 5. Oil ring lower rail gap |

INSTALLATION

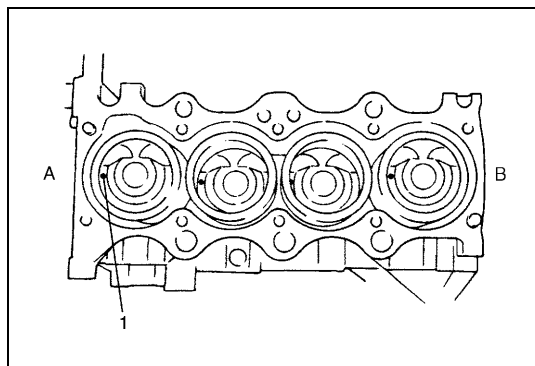
- 1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crankpins.

NOTE:

Do not apply oil between connecting rod and bearing or between bearing cap and bearing.



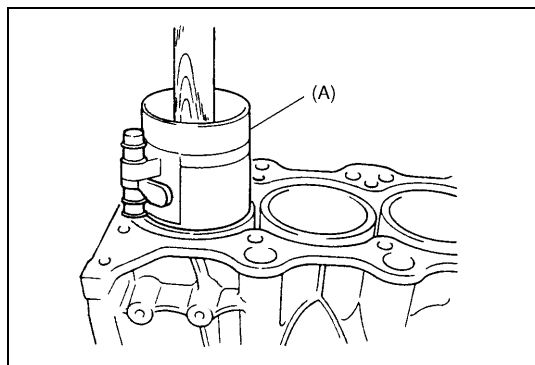
- 2) Install guide hoses (1) over connecting rod bolts.
These guide hoses protect crank pin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



- 3) When installing piston and connecting rod assembly into cylinder bore, point front mark (1) on piston head to crankshaft pulley side.

A : Crankshaft pulley side

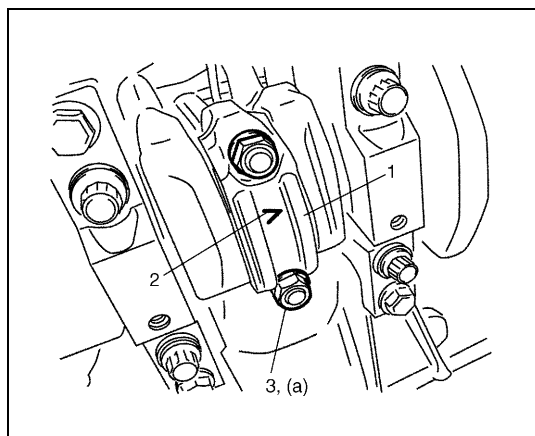
B : Flywheel side



- 4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft.
Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

Special tool

(A) : 09916-77310



- 5) Install bearing cap (1):
Point arrow mark (2) on cap to crankshaft pulley side.
After applying oil to rod bolts and tighten cap nuts (3) gradually as follows.
 - a) Tighten all cap nuts to 15 N·m (1.5 kg-m, 11.0 lb-ft).
 - b) Retighten them to 45°.
 - c) Repeat Step b) once again.

Tightening torque

Connecting rod bearing cap nuts

(a) : 15 N·m (1.5 kg-m, 11.0 lb-ft) and then turn to 45° twice.

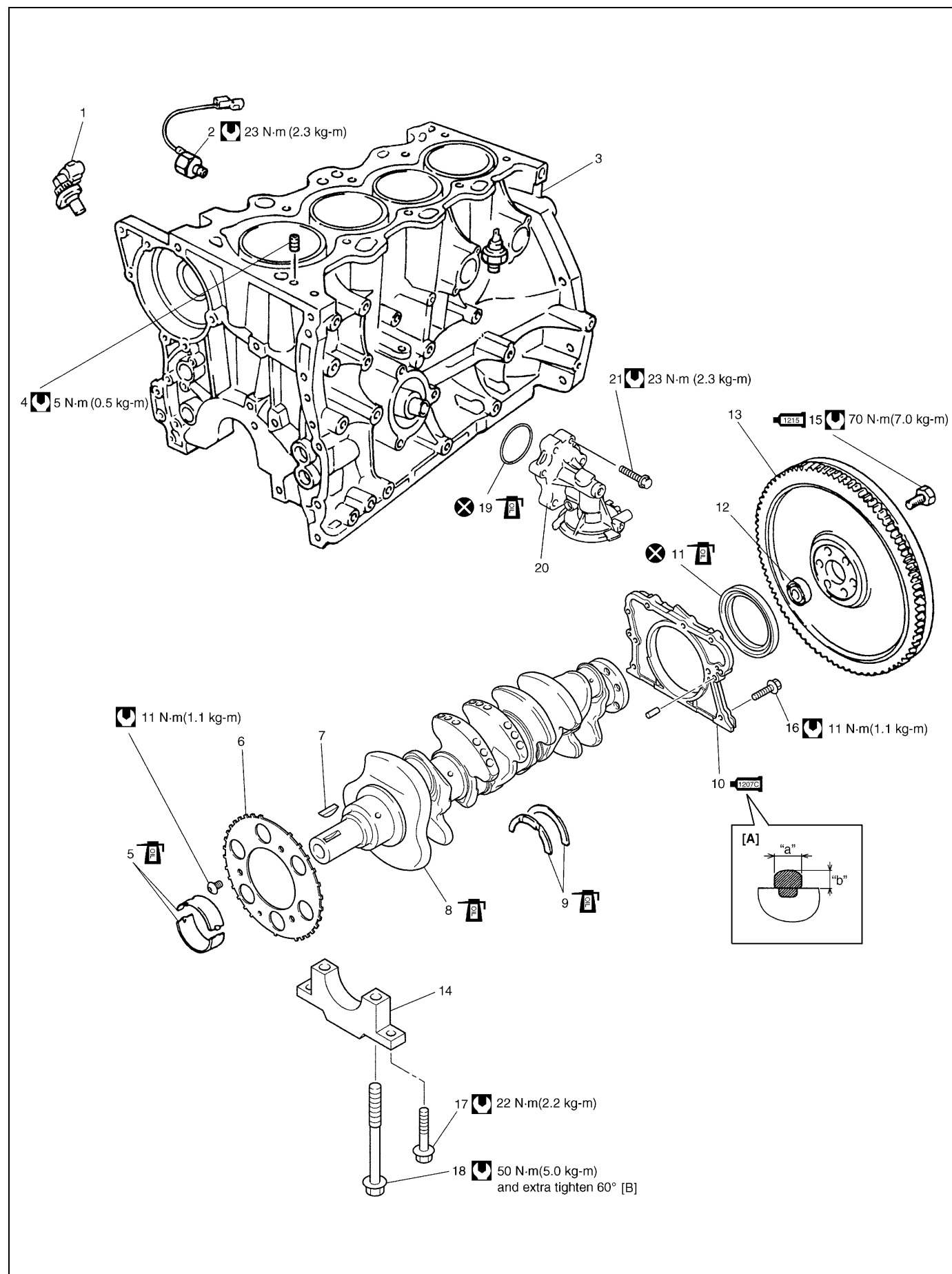
NOTE:







Before installing bearing cap, make sure that checking for connecting rod bolt deformation.

Refer to “INSPECTION” of “CONNECTING ROD”.

- 6) Reverse removal procedure for installation as previously outlined.
- 7) Perform Steps 3) to 8) of “INSTALLATION” of “TIMING CHAIN COVER” in this section.

Main Bearings, Crankshaft and Cylinder Block



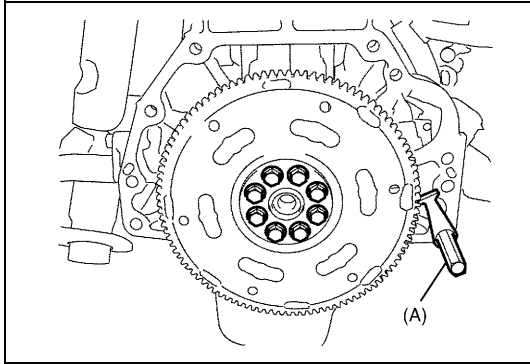
| | | |
|--|--|--|
| [A] : Sealant application amount | 4. Venturi plug | 14. Main bearing cap |
| [B] : 1) Tighten all bolts to 50 N·m (5.0 kg-m) 2) Then, turn all bolts to 60° | 5. Main bearing |  15. Flywheel mounting bolt : Apply sealant 99000-31110 to thread part. |
|  Tightening torque | 6. Sensor plate | 16. Rear oil seal housing mounting bolt |
|  Do not reuse. | 7. Crankshaft timing sprocket key | 17. Main bearing mounting No.2 bolt |
|  Apply engine oil to inside / sliding surface. | 8. Crankshaft | 18. Main bearing mounting No.1 bolt |
| "a" : 3 mm (0.12 in.) | 9. Thrust bearing | 19. O-ring |
| "b" : 2 mm (0.08 in.) |  10. Rear oil seal housing : Apply sealant 99000-31150 to mating surface. | 20. Oil filter adapter case |
|  1. CKP sensor (if equipped) : When installing CKP sensor, use new sensor mounting bolt. | 11. Rear oil seal | 21. Oil filter adapter bolt |
| 2. Knock sensor | 12. Input shaft bearing | |
| 3. Cylinder block | 13. Flywheel | |

REMOVAL

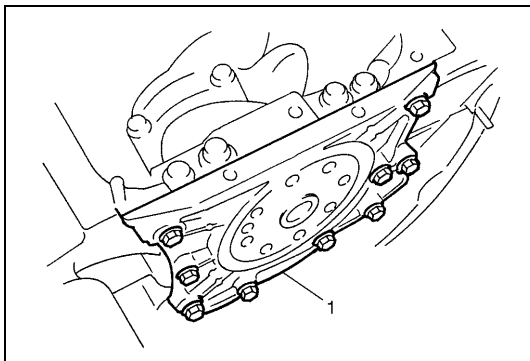
- 1) Remove engine assembly from vehicle as previously outlined.
- 2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T) by using special tool.

Special tool

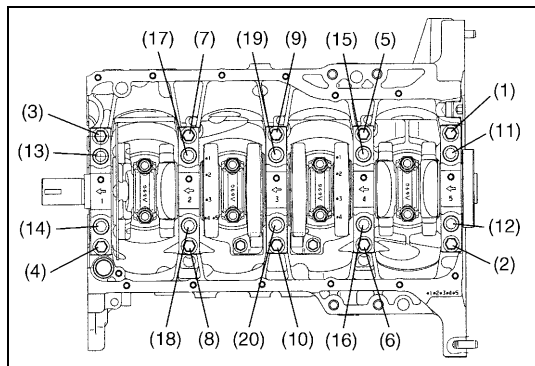
(A) : 09924-17810



- 3) Remove the following parts from engine as previously outlined.
 - Oil pan and oil pump strainer
 - Intake manifold and exhaust manifold
 - Cylinder head cover
 - Timing chain cover
 - Timing chain guide, chain tensioner adjuster, chain tensioner, timing chain and crankshaft timing sprocket
 - Camshaft, tappet and shim
 - Cylinder head assembly
 - Piston and connecting rod

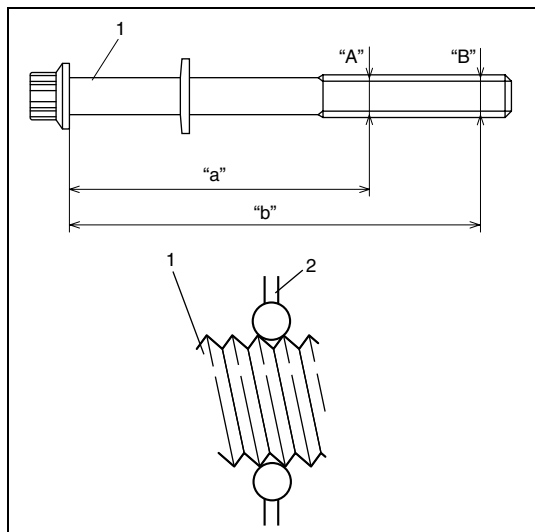


- 4) Remove rear oil seal housing (1).



- 5) Loosen bearing cap No.1 and No.2 bolts in such order as indicated in figure and remove them.
- 6) Remove crankshaft from cylinder block.

INSPECTION



Measure each thread diameter bearing cap bolts (1) at "A" on 60mm(2.36in.) from seat side of flange bolt and "B" on 90mm(3.54in.) from seat side of flange bolt by using a micrometer (2).

Calculate difference in diameters ("A" – "B").

If it exceeds limit, replace with new one.

Bearing cap No.1 bolt diameter measurement points

"a" : 60mm (2.36in.)

"b" : 90mm (3.54in.)

Bearing cap No.1 bolt diameter difference

Limit ("A" – "B") : 0.2mm (0.008in.)

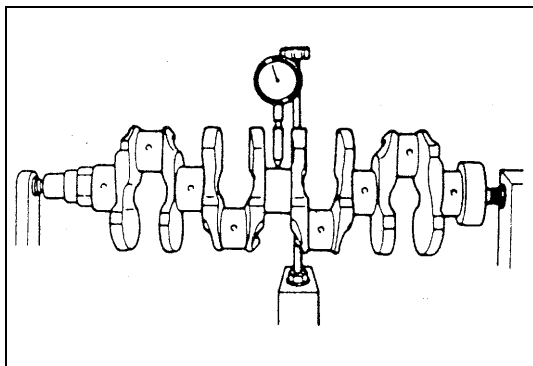
Crankshaft

Crankshaft runout

Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

Crankshaft runout

Limit : 0.04 mm (0.0016 in.)



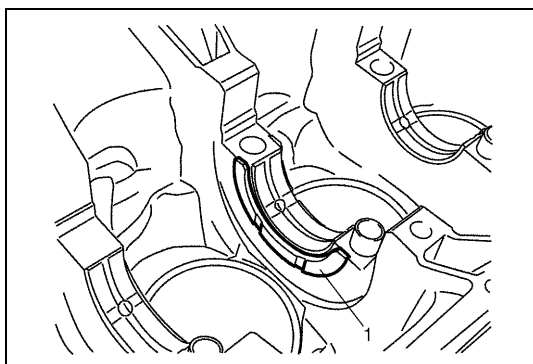
Crankshaft thrust play

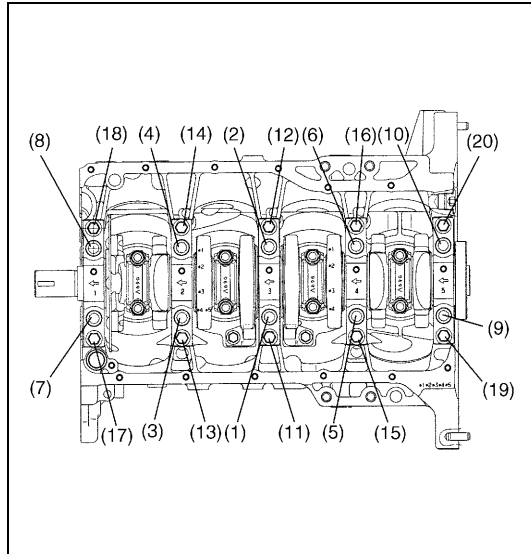
Measure this play with crankshaft set in cylinder block in the normal manner, that is with thrust bearing (1) and journal bearing caps installed.

Thickness of crankshaft thrust bearing

Standard : 2.500 mm (0.0984 in.)

Oversize (0.125 mm (0.0049 in.)) : 2.563 mm (0.1009 in.)





Tighten bearing cap No.1 bolts (1) – (10) and No.2 bolts (11) – (20) gradually as follows.

- 1) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
- 2) In the same manner as in Step 1), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
- 3) In the same manner as in step 1), retighten them to 60°.
- 4) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order in figure.

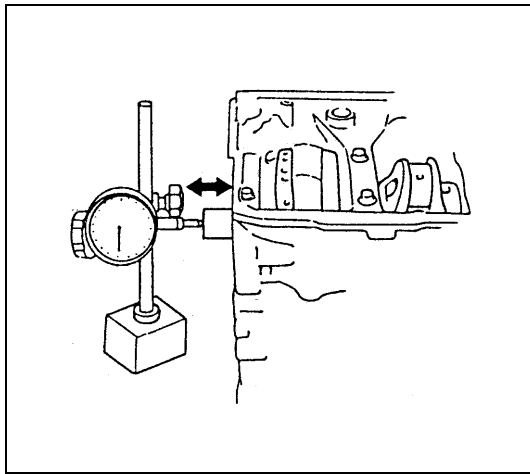
Tightening torque

Crank shaft bearing cap No.1 bolts (1) – (10) :

50 N·m (5.0 kg-m, 36.5 lb-ft) and extra tighten 60°

Crank shaft bearing cap No.2 bolts (11) – (20) :

22 N·m (2.2 kg-m, 16.0 lb-ft)



Use a dial gauge to read displacement in axial (thrust) direction of crankshaft.

If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

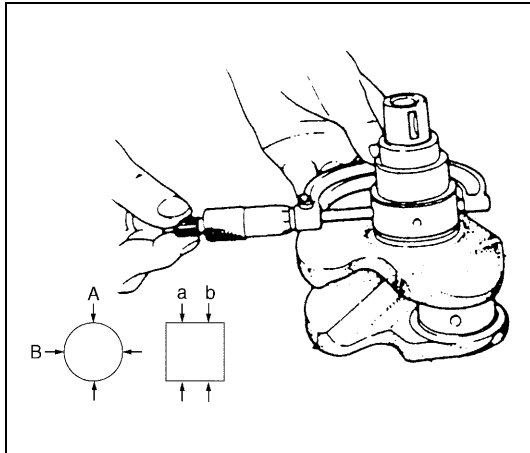
Crankshaft thrust play

Standard : 0.11 – 0.31 mm (0.0043 – 0.0122 in.)

Limit : 0.35 mm (0.0138 in.)

NOTE:

After checking the thrust play, make sure that thread deformation of each bearing cap No.1 bolt according to previous mentioned “Bearing Cap No.1 Bolt” once again.



Out-of-round and taper (uneven wear) of journals

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense explained below exceeds its limit, regrind or replace crankshaft.

Crankshaft out-of-round and taper

Limit : 0.01 mm (0.0004 in.)

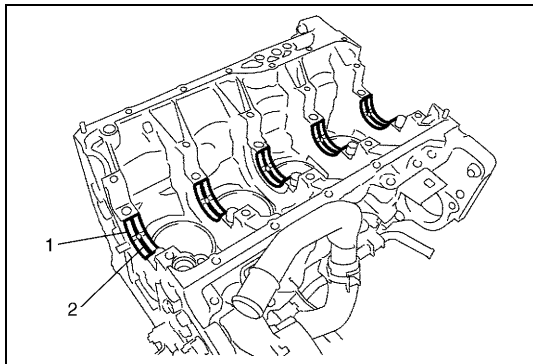
Out-of-round : A – B

Taper : a – b

Main bearings

General information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and each of them has 5 kinds of bearings differing in tolerance.



- Upper half of bearing (1) has an oil groove (2) as shown in figure.
Install this half with oil groove to cylinder block.
- Lower half of bearing does not have an oil groove.

Visual inspection

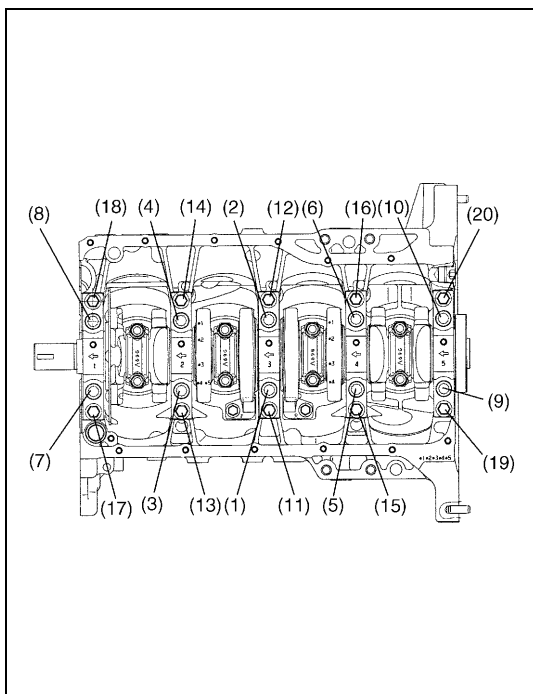
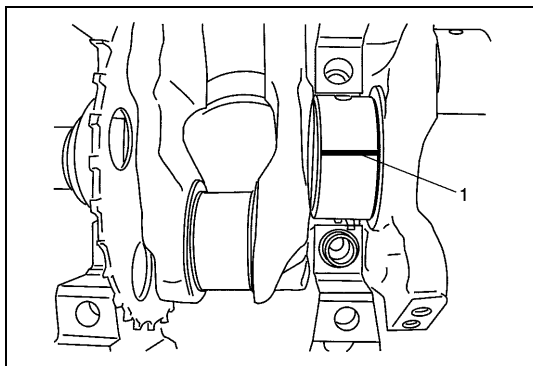
Check bearings for pitting, scratches, wear or damage.

If any malfunction is found, replace both upper and lower halves.
Never replace either half without replacing the other half.

Main bearing clearance

Check clearance by using gaging plastic according to the following procedure.

- 1) Remove bearing caps.
- 2) Clean bearings and main journals.
- 3) Place a piece of gaging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



- 4) Tighten bearing cap No.1 bolts (1) – (10) and No.2 bolts (11) – (20) gradually as follows.
 - a) Tighten bolts (1) – (10) to 30 N·m (3.0 kg-m, 22.0 lb-ft) according to numerical order in figure.
 - b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kg-m, 36.5 lb-ft).
 - c) In the same manner as in step a), retighten them to 60°.
 - d) Tighten bolts (11) – (20) to 22 N·m (2.2 kg-m, 16.0 lb-ft) according to numerical order in figure.

Tightening torque

Crank shaft bearing No.1 bolts (1) – (10) :

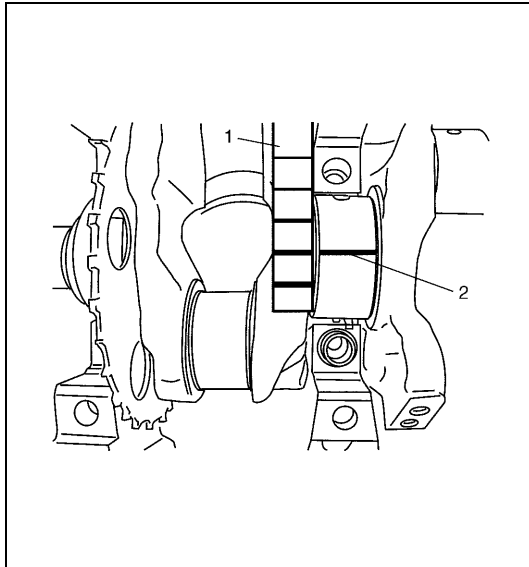
50 N·m (5.0 kg-m, 36.5 lb-ft) and extra tighten 60°

Crank shaft bearing No.2 bolts (11) – (20) :

22 N·m (2.2 kg-m, 16.0 lb-ft)

NOTE:

Do not rotate crankshaft while gaging plastic is installed.



- 5) Remove bearing caps and using scale (1) on gaging plastic (2) envelop, measure gaging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.

A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.

After selecting new bearing, recheck clearance.

Main bearing clearance

Standard : 0.025 – 0.045 mm (0.0010 – 0.0018 in.)

Limit : 0.065 mm (0.0026 in.)

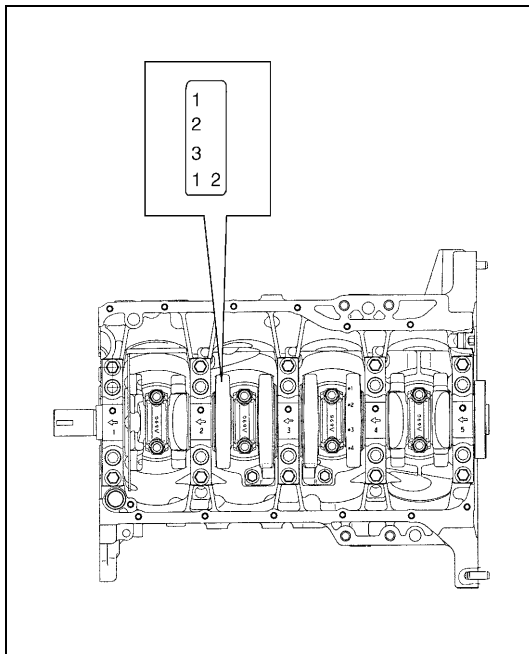
NOTE:

After checking the bearing clearance, make sure that thread deformation of each bearing cap No.1 bolt according to previous mentioned Step 4) once again.

Selection of main bearings

STANDARD BEARING :

If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.



- 1) First check journal diameter. As shown in figure, crank web No.2 has stamped numbers.

Three kinds of numbers ("1", "2" and "3") represent the following journal diameters.

Stamped numbers on crank web No.2 represent journal diameters marked with an arrow in figure respectively.

For example of M13 engine, stamped number "1" indicates that corresponding journal diameter is 44.994 – 45.000 mm (1.7714 – 1.7717 in.).

Crankshaft journal diameter

| Engine model | Stamped numbers | Journal diameter |
|--------------|-----------------|--|
| M13 engine | 1 | 44.994 – 45.000 mm (1.7714 – 1.7717 in.) |
| | 2 | 44.988 – 44.994 mm (1.7712 – 1.7714 in.) |
| | 3 | 44.982 – 44.988 mm (1.7709 – 1.7712 in.) |
| M16 engine | 1 | 51.994 – 52.000 mm (2.0470 – 2.0472 in.) |
| | 2 | 51.988 – 51.994 mm (2.0468 – 2.0470 in.) |
| | 3 | 51.982 – 51.988 mm (2.0465 – 2.0468 in.) |