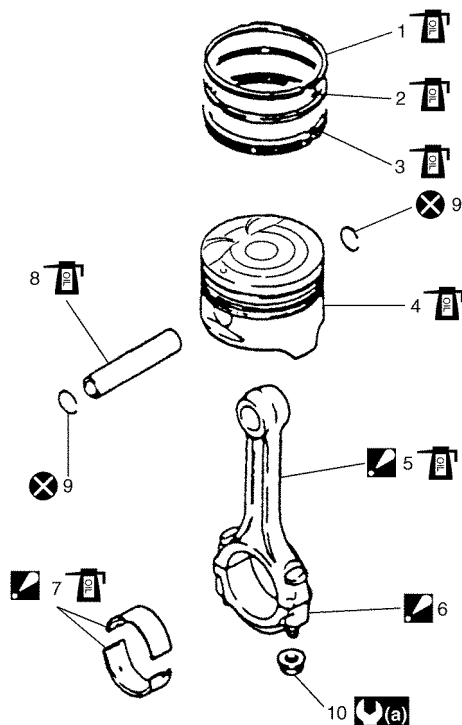


Pistons, Piston Rings, Connecting Rods and Cylinders Components

S6RW0D1406031



I5RW0C140045-01

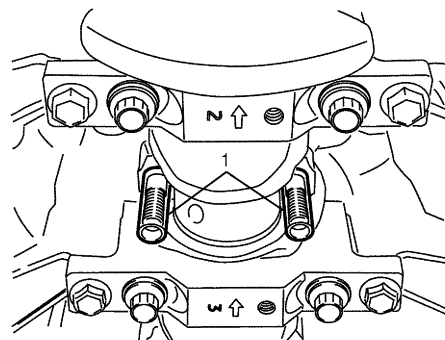
1. Top ring	8. Piston pin
2. 2nd ring	9. Piston pin circlip
3. Oil ring	10. Bearing cap nut
4. Piston	(a) : Tighten 15 N-m (1.5 kgf-m, 11.0 lb-ft), 45° and 45° by the specified procedure.
5. Connecting rod : See "A"	: Apply engine oil to sliding surface of each part.
6. Connecting rod bearing cap : See "B"	: Do not reuse.
7. Connecting rod bearing : See "C"	
"A": 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 "Piston Pins and Connecting Rods Inspection".	
"B": Point arrow mark on cap to crankshaft pulley side.	
"C": Do not apply oil between connecting rod and bearing or between bearing cap and bearing.	

Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation

S6RW0D1406032

Removal

- 1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation".
- 2) Remove cylinder head referring to "Valves and Cylinder Head Removal and Installation".
- 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 crank pin and rod bolt threads when removing connecting rod.



I2RHOB140109-01

- 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.

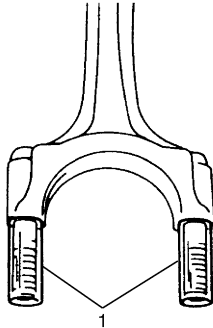
Installation

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

NOTE

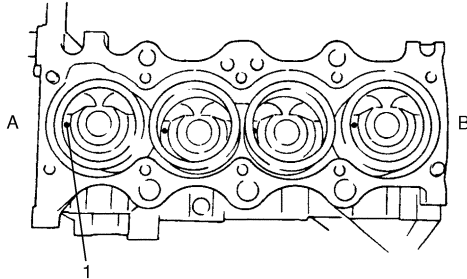
Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

- 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.



I2RH01140147-01

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

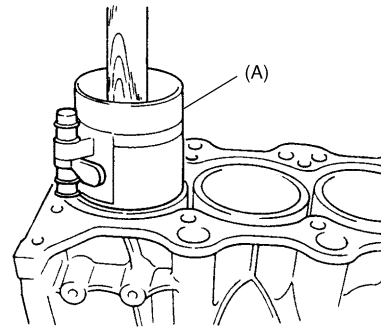


I2RHOB140110-01

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



I2RHOB140111-01

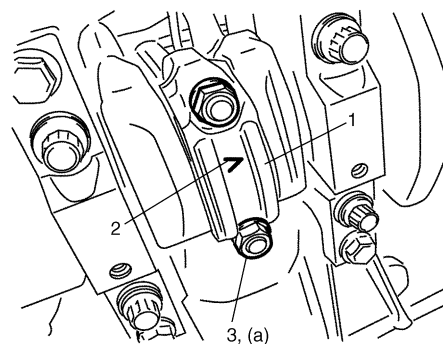
- 5) Install bearing cap (1):
 Point arrow mark (2) on cap to crankshaft pulley side.
 After applying engine oil to rod bolts and tighten cap nuts (3) gradually as follows.
 - a) Tighten all cap nuts to 15 N·m (1.5 kgf-m, 11.0 lb-ft).
 - b) Retighten them to 45°.
 - c) Repeat Step b) once again.

NOTE

Before installing bearing cap, make sure that checking for connecting rod bolt deformation. Refer to "Piston Pins and Connecting Rods Inspection".

Tightening torque

Connecting rod bearing cap nut (a): Tighten 15 N·m (1.5 kgf-m, 11.0 lb-ft), 45° and 45° by the specified procedure



I2RHOB140112-01

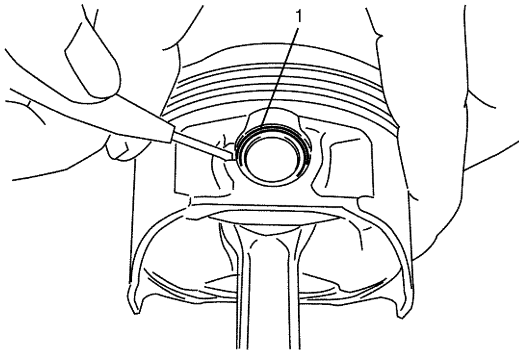
- 6) Install cylinder head referring to "Valves and Cylinder Head Removal and Installation".

Pistons, Piston Rings, Connecting Rods and Cylinders Disassembly and Assembly

S6RW0D1406033

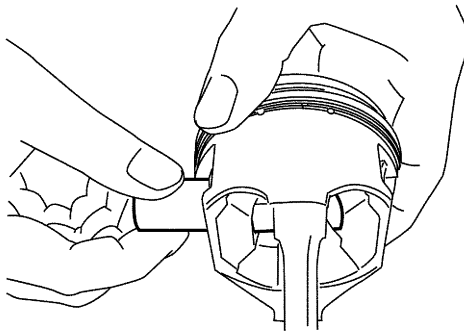
Disassembly

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



I2RH0B140113-01

- b) Force piston pin out.



I2RH0B140114-01

Assembly

- 1) Decarbonize piston head and ring grooves using a suitable tool.
- 2) 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) Installing connecting rod to piston.

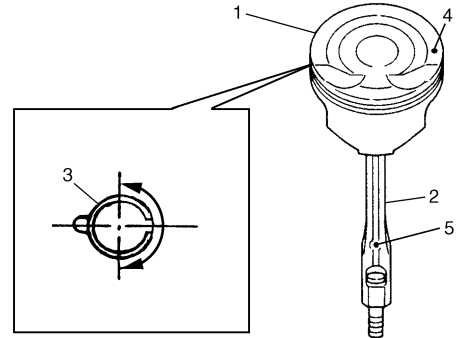
NOTE

Be sure to position front mark (4) on piston and oil hall (5) of connecting rod at specified position as shown in figure.

- c) Insert piston pin to piston and connecting rod.
- d) Install piston pin circlips (3).

NOTE

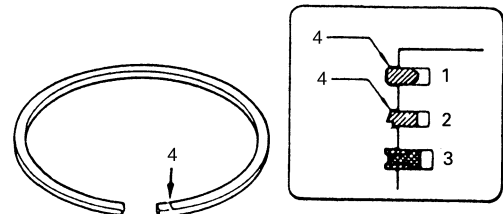
Circlip should be installed with its cut part facing as shown in figure. Install so that circlip end gap comes within such range as indicated by arrow.



I5RW0C140026-01

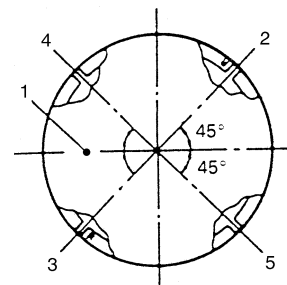
- 3) Install piston rings to piston:

- As indicated in figure, 1st and 2nd rings have "T" mark (4) respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
- 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 the figure.
- When installing oil ring (3), install spacer first and then two rails.



I6RW0B140011-01

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



I5RW0C140046-01

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

Cylinders, Pistons and Piston Rings Inspection

S6RW0D1406034

Cylinder**Visual inspection**

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.

Cylinder bore diameter, taper and out-of-round

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: 78.000 – 78.014 mm (3.0709 – 3.0714 in.)

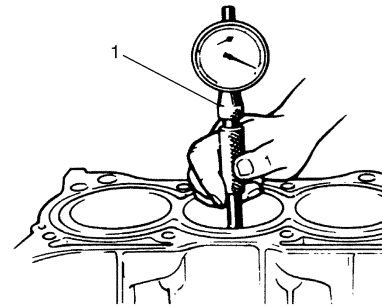
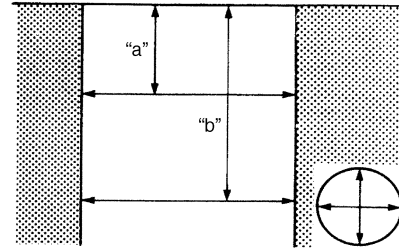
Limit: 78.050 mm (3.073 in.)

Cylinder taper and out-of-round

Limit: 0.10 mm (0.004 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.



I2RH0B140117-01

"a": 50 mm (1.96 in.)
"b": 100 mm (3.94 in.)

Piston**Visual inspection**

Inspect piston for faults, cracks or other damages. 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.) ("a") from piston skirt end in the direction perpendicular to piston pin.

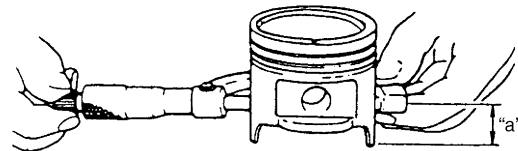
Piston diameter specification

Standard size (used piston): 77.953 – 77.968 mm (3.0690 – 3.0696 in.)

Standard size (new piston with coating): 77.963 – 77.990 mm (3.0694 – 3.0704 in.)

Oversize (0.50 mm (0.0196 in.)) (used piston): 78.453 – 78.468 mm (3.0887 – 3.0893 in.)

Oversize (0.50 mm (0.0196 in.)) (new piston with coating): 78.463 – 78.490 mm (3.0891 – 3.0901 in.)



I2RH01140157-01

Piston clearance

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

NOTE

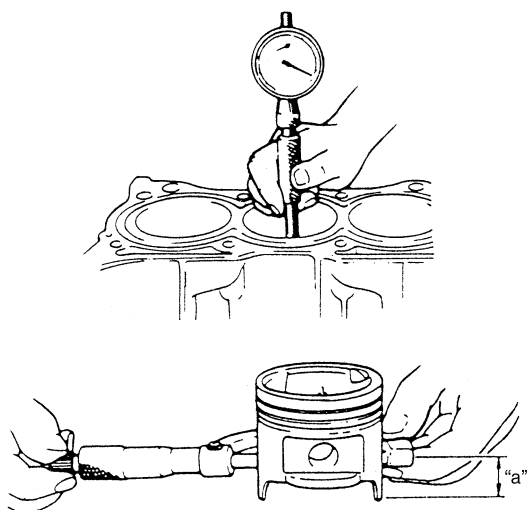
Cylinder bore diameters used here are measured in thrust direction at two positions.

Piston clearance

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

Standard (new piston with coating): 0.010 – 0.051 mm (0.0004 – 0.0020 in.)

Limit: 0.161 mm (0.0065 in.)



I4RS0A140022-01

"a": 19.5 mm (0.77 in.)

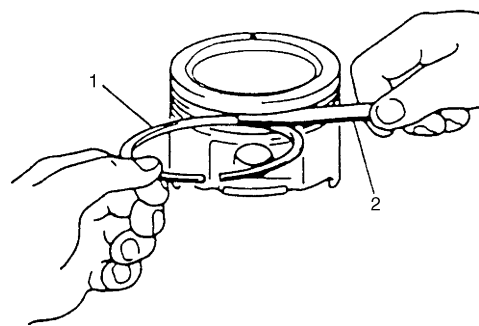
Ring groove clearance

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 specification, replace piston.

Ring groove clearance

	Standard	Limit
Top ring	0.03 – 0.07 mm (0.0012 – 0.0028 in.)	0.12 mm (0.0047 in.)
2nd ring	0.02 – 0.06 mm (0.0008 – 0.0024 in.)	0.10 mm (0.0039 in.)
Oil ring	0.03 – 0.17 mm (0.0012 – 0.0067 in.)	—



I2RH01140159-01

Piston Ring

Piston ring end gap

To measure end gap, insert piston ring (2) into cylinder bore and then measure the gap by using thickness gauge (1).

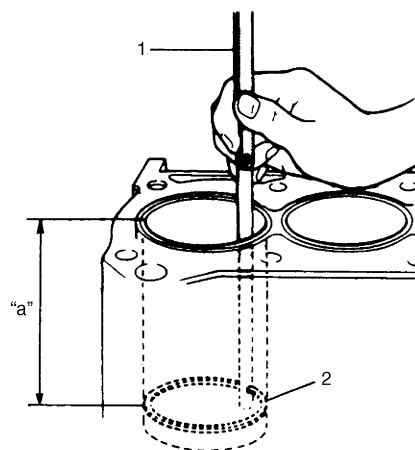
If measured gap exceeds limit, replace ring.

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	0.35 – 0.50 mm (0.0138 – 0.0197 in.)	1.0 mm (0.0394 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0276 in.)	1.2 mm (0.0472 in.)



I2RH01140161-01

"a": 120 mm (4.72 in.)

Piston Pins and Connecting Rods Inspection

S6RW0D1406035

Piston Pin

Visual inspection

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

Standard: 0.003 – 0.014 mm (0.0001 – 0.0006 in.)

Limit: 0.05 mm (0.0020 in.)

Piston pin clearance in piston

Standard: 0.006 – 0.017 mm (0.00024 – 0.00067 in.)

Limit: 0.05 mm (0.0020 in.)

Small-end bore

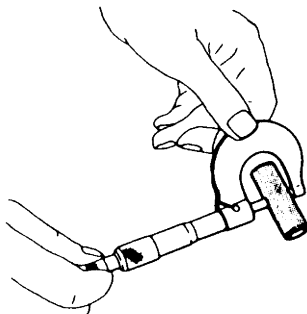
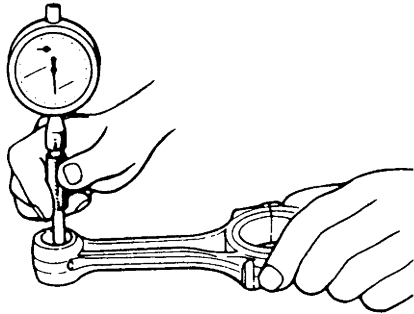
20.003 – 20.011 mm (0.7875 – 0.7878 in.)

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.)



I4RSOA140023-01

Connecting Rod

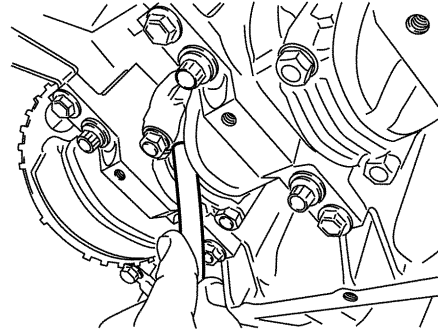
Big-end side clearance

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.)



I2RH0B140148-01

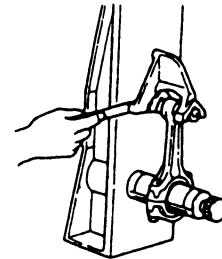
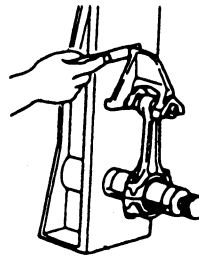
Connecting rod alignment

Mount connecting rod on aligner to check it for bow and twist. If measured value exceeds the limit, replace it.

Connecting rod alignment

Limit on bow: 0.05 mm (0.0020 in.)

Limit on twist: 0.10 mm (0.0039 in.)



I4RH01140053-01

Connecting rod bolt deformation (Plastic deformation tightening bolt)

Measure each thread diameter of connecting rod 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 connected rod (1).

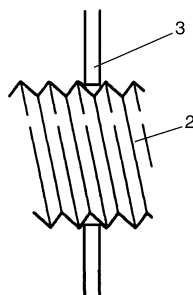
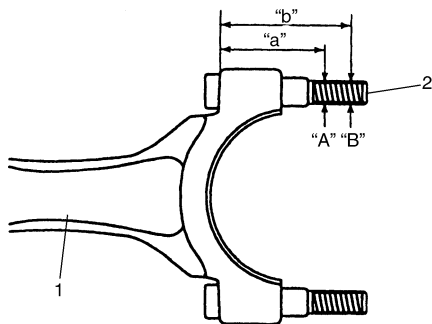
Connecting rod bolt measurement points

"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.)



I2RH0B140119-01

Crank Pin and Connecting Rod Bearings Inspection

S6RW0D1406036

Crank Pin Diameter

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 undersize bearing.

Crank pin diameter

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

Out-of-round

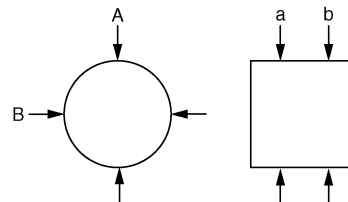
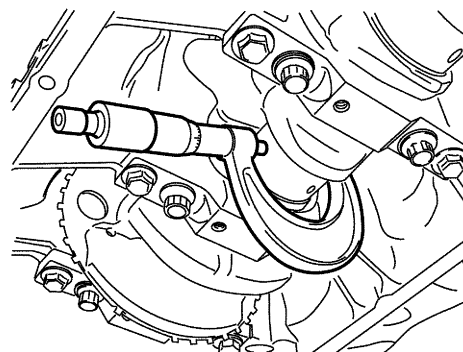
A – B

Taper

a – b

Crank pin taper and out-of-round

Limit: 0.01 mm (0.0004 in.)

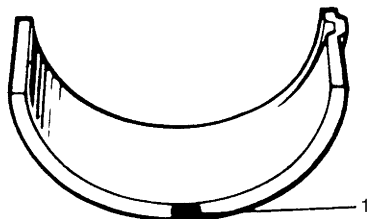


I2RH0B140120-01

Connecting Rod Bearing General Information

Service connecting rod bearings are available in standard size and 0.25 mm (0.0098 in.) undersize bearing, and standard size bearing has 5 kinds of bearings differing in tolerance.

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.



I2RH01140164-01

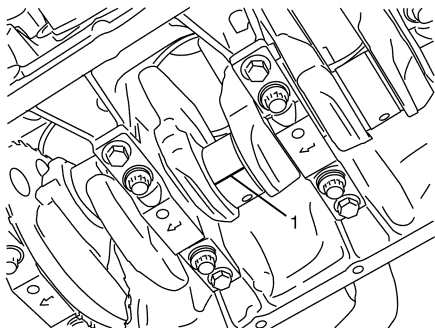
1. Red paint

Connecting Rod Bearing Visual Inspection

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

Connecting 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 gauging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.



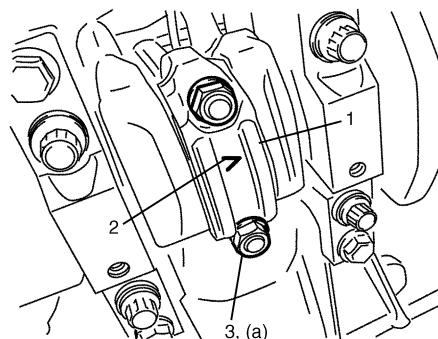
I2RH0B140121-01

- 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, tighten cap nuts (3) gradually as follows.

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

Tightening torque

Connecting rod bearing cap nut (a): Tighten 15 N·m (1.5 kgf·m, 11.0 lb-ft) 45° and 45° by the specified procedure

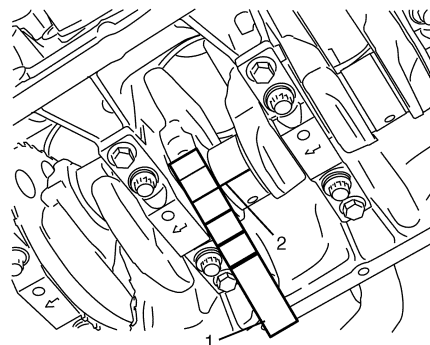


I2RH0B140122-01

- 5) Remove cap and using a scale (1) on gauging plastic envelope (2), measure gauging plastic (2) width at the widest point (clearance). If clearance exceed its limit, use a new standard size bearing referring to "Selection of Connecting Rod Bearings: ". After selecting new bearing, recheck clearance.

Connecting rod bearing clearance

Standard: 0.029 – 0.047 mm (0.0011 – 0.0018 in.)
Limit: 0.065 mm (0.0026 in.)



I2RH0B140123-01

- 6) If clearance can not be brought to its limit even by using a new standard size bearing, use next thicker bearing and recheck clearance or regrind crank pin to undersize and use 0.25 mm undersize bearing.

Selection of Connecting Rod Bearings

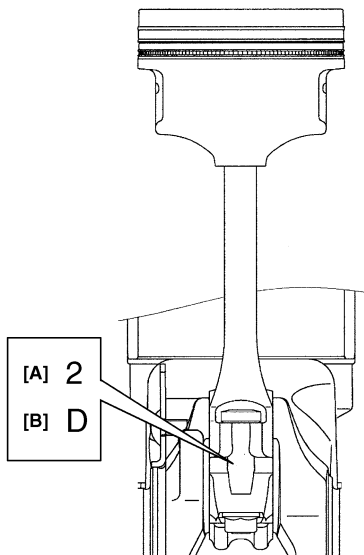
NOTE

- 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.
- When replacing crankshaft or connecting rod and its bearing due to any reason, select new standard bearings to be installed by referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No.3 cylinder.

1) Check stamped numbers on connecting rod and its cap as shown.
 Three kinds of numbers ("1", "2" and "3") represent the following connecting rod big end inside diameters.
 For example, stamped number "1" indicates that corresponding connecting rod big end inside diameter is 45.000 – 45.006 mm (1.7717 – 1.7718 in.).

Connecting rod big end inside diameter

Stamped numbers	Connecting rod big end inside diameter
1	45.0000 – 45.0060 mm (1.7717 – 1.7718 in.)
2	45.0061 – 45.0120 mm (1.7719 – 1.7721 in.)
3	45.0121 – 45.0180 mm (1.7722 – 1.7723 in.)



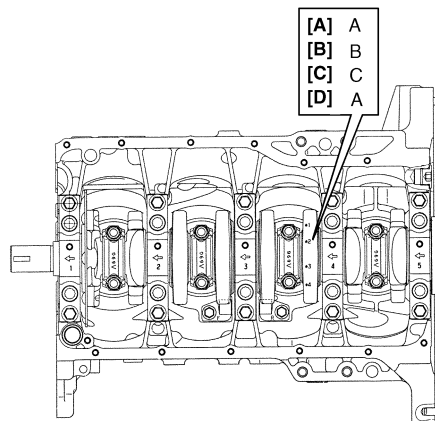
I3RH0A140017-01

[A]: Connecting rod big end inside diameter number
[B]: Weight indication mark

2) Next, check crankshaft pin diameter. On crank web No.3, four alphabets are stamped as shown in figure. Three kinds of alphabet ("A", "B" and "C") represent the following crankshaft pin diameter respectively. For example, stamped "A" indicates that corresponding crankshaft pin diameter is 41.994 – 42.000 mm (1.6533 – 1.6534 in.).

Crankshaft pin outer diameter

Stamped alphabet	Crankshaft pin diameter
A	41.9940 – 42.0000 mm (1.6533 – 1.6534 in.)
B	41.9880 – 41.9939 mm (1.6531 – 1.6532 in.)
C	41.9820 – 41.9879 mm (1.6529 – 1.6530 in.)



I3RH0A140018-01

[A]: Crankshaft pin diameter for No.1 cylinder
[B]: Crankshaft pin diameter for No.2 cylinder
[C]: Crankshaft pin diameter for No.3 cylinder
[D]: Crankshaft pin diameter for No.4 cylinder

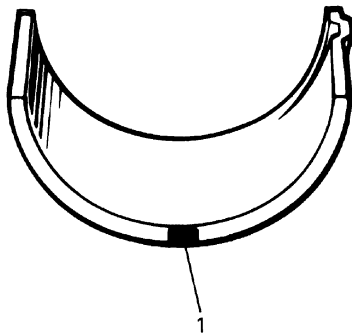
1D-58 Engine Mechanical:

3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure.

Each color indicated the following thickness at the center of bearing.

Standard size of connecting rod bearing thickness

Color painted	Bearing thickness
Blue	1.4991 – 1.5020 mm (0.05902 – 0.05913 in.)
Yellow	1.4961 – 1.4990 mm (0.05890 – 0.05901 in.)
Nothing	1.4931 – 1.4960 mm (0.05878 – 0.05889 in.)
Black	1.4901 – 1.4930 mm (0.05867 – 0.05877 in.)
Green	1.4870 – 1.4900 mm (0.05855 – 0.05866 in.)



1. Paint

I3RH0A140019-01

4) From number stamped on connecting rod and its cap and alphabets stamped on crank web No.3, determine new standard bearing to be installed to connecting rod big end inside, by referring to the table.

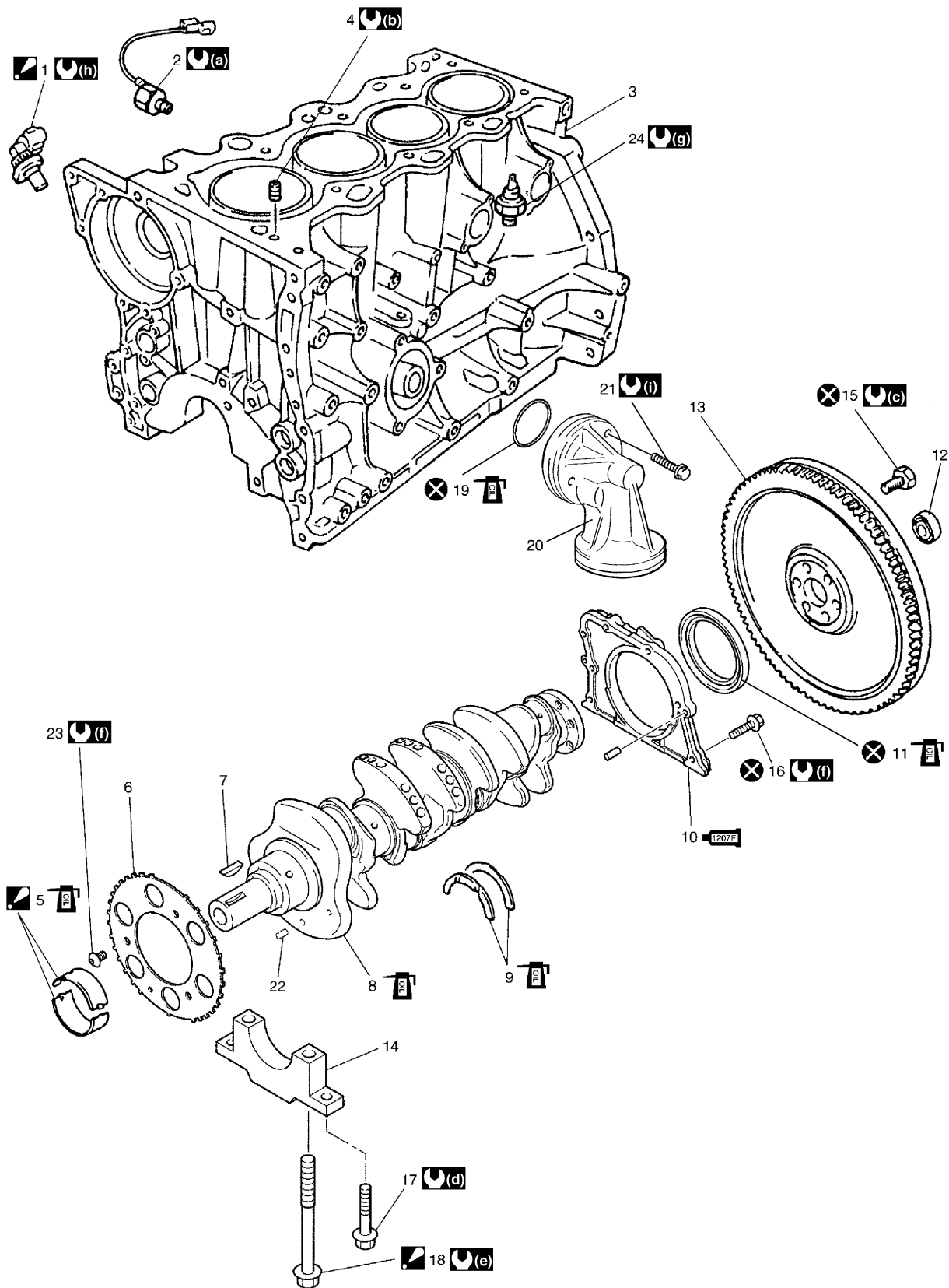
For example, if number stamped on connecting rod and its cap is “1” and alphabet stamped on crank web No.3 is “B”, install a new standard bearing painted in “Black” to its connecting rod big end inside.

Specification of new standard connecting rod bearing size

		Number stamped on connecting rod and its cap (connecting rod big end inside diameter)		
		1	2	3
Alphabet stamped on crank web No.3 (Crankshaft pin diameter)	A	Green	Black	Nothing
	B	Black	Nothing	Yellow
	C	Nothing	Yellow	Blue
		New standard bearing to be installed.		

Main Bearings, Crankshaft and Cylinder Block Components

S6RW0D1406037



I6RW0D140003-01

1. CKP sensor : See "A"	11. Rear oil seal	21. Oil filter adapter bolt
2. Knock sensor	12. Input shaft bearing	22. Spring pin
3. Cylinder block	13. Flywheel or drive plate	23. Sensor plate bolt
4. Venturi plug	14. Main bearing cap	24. Oil pressure switch

5. Main bearing : See "B"	15. Flywheel or drive plate bolt	ⓐ : 22 N·m (2.2 kgf·m, 16.0 lb-ft)
6. Sensor plate	16. Rear oil seal housing mounting bolt	ⓑ : 5 N·m (0.5 kgf·m, 4.0 lb-ft)
7. Crankshaft timing sprocket key	17. Main bearing cap No.2 bolt	ⓒ : 70 N·m (7.0 kgf·m, 51.0 lb-ft)
8. Crankshaft	18. Main bearing cap No.1 bolt : See "D"	ⓓ : Tighten 25 N·m (2.5 kgf·m, 18.0 lb-ft) by the specified procedure.
9. Thrust bearing	19. O-ring	ⓔ : Tighten 30 N·m (3.0 kgf·m, 22.0 lb-ft), 50 N·m (5.0 kgf·m, 36.5 lb-ft) and 60° by the specified procedure.
1207F 10. Rear oil seal housing : See "C"	20. Oil filter adapter case	ⓕ : 11 N·m (1.1 kgf·m, 8.0 lb-ft)
"A": When installing CKP sensor, use new sensor mounting bolt.		ⓖ : 13 N·m (1.3 kgf·m, 9.5 lb-ft)
"B": Upper half of bearing has an oil groove. Do not apply oil between connecting rod and bearing or between bearing cap and bearing.		ⓓⓖ : 10 N·m (1.0 kgf·m, 7.5 lb-ft)
"C": Apply sealant 99000-31250 to mating surface.		ⓓⓖ : 25 N·m (2.5 kgf·m, 18.0 lb-ft)
"D": Make sure main bearing cap No.1 bolt deformation when reuse it due to plastic deformation tightening referring to "Main Bearings Inspection".		ⓧ : Do not reuse.
		ⓓⓖ : Apply engine oil to inside / sliding surface.

Main Bearings, Crankshaft and Cylinder Block Removal and Installation

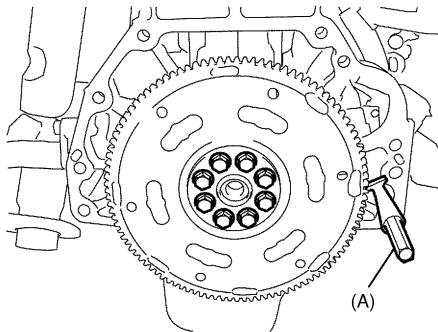
S6RW0D1406038

Removal

- 1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation".
- 2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T) by using special tool.

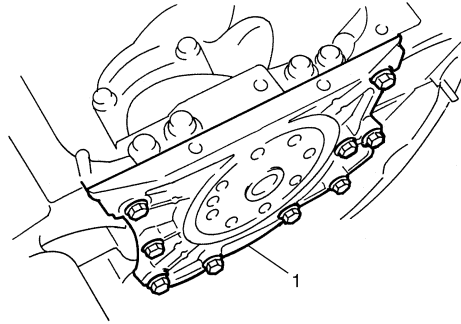
Special tool

(A): 09924-17810



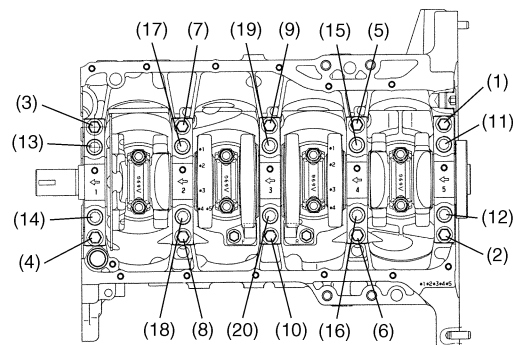
I2RH0B140125-01

- 3) Remove piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation".
- 4) Remove rear oil seal housing (1).



I2RH0B140126-01

- 5) Loosen main bearing cap No.1 and No.2 bolts in such order as indicated in figure and remove them.



I2RH0B140127-01

- 6) Remove crankshaft from cylinder block.
- 7) Remove sensor plate from crankshaft.

Installation

NOTE

- Use new bearing cap No.1 bolts. They are deformed once they are used because they are plastic deformation tightening bolts.
- All parts to be installed must be perfectly clean.
- Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.
- Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.

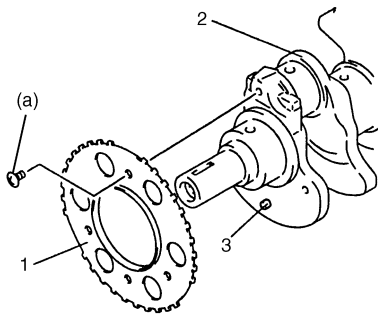
- 1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

NOTE

When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

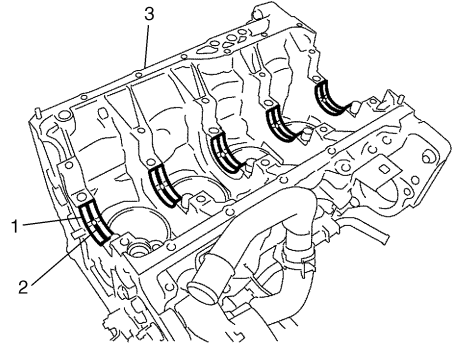
Tightening torque

Sensor plate bolt (a): 11 N·m (1.1 kgf·m, 8.0 lb-ft)



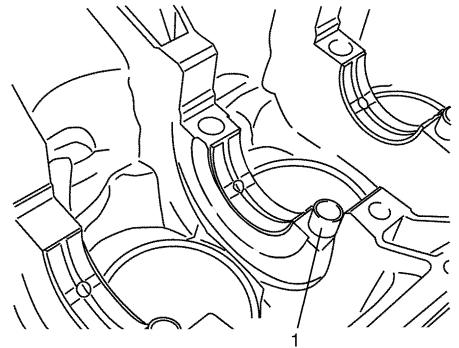
I2RH0B140128-01

- 2) Install main bearings to cylinder block. Upper half of bearing (1), has an oil groove (2). Install it to cylinder block (3), and the other half without oil groove to bearing cap. Make sure that two halves are painted in the same color.



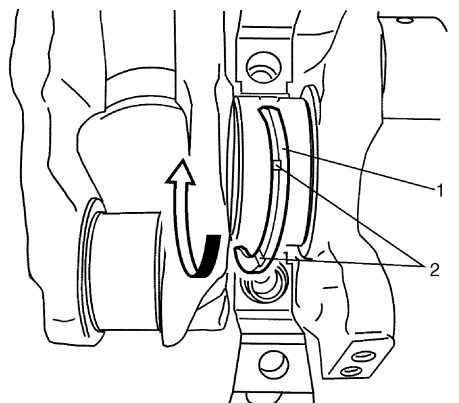
I2RH0B140129-01

- 3) Confirm that dowel pins (1) are installed to intake side of each journal.



I6RW0B140013-02

- 4) Install crankshaft to cylinder block.
- 5) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.



I6RW0B140014-01

6) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side.

After applying engine oil to main bearing cap No.1 bolts ((1) – (10)) and main bearing cap No.2 bolts ((11) – (20)), tighten them gradually as follows.

- Tighten bolts ((1) – (10)) to 30 N·m (3.0 kgf-m, 22.0 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
- In the same manner as in Step a), tighten them to 50 N·m (5.0 kgf-m, 36.5 lb-ft).
- In the same manner as in Step a), retighten them to 60°.
- Tighten bolts ((11) – (20)) to 25 N·m (2.5 kgf-m, 18.0 lb-ft) according to numerical order as shown.

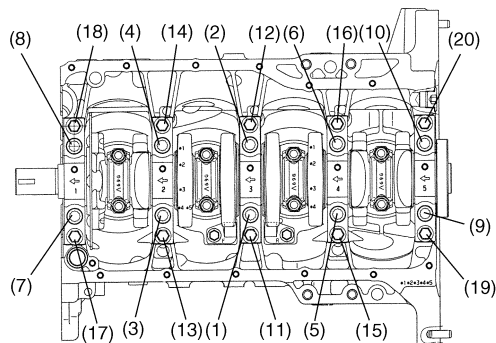
Tightening torque

Main bearing cap No.1 bolt ((1) – (10)):
 Tighten 30 N·m (3.0 kgf-m, 22.0 lb-ft), 50 N·m (5.0 kgf-m, 36.5 lb-ft) and 60° by the specified procedure

Main bearing cap No.2 bolt ((11) – (20)):
 Tighten 25 N·m (2.5 kgf-m, 18.0 lb-ft) by the specified procedure

⚠ CAUTION

After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 12 N·m (1.2 kgf-m, 9.0 lb-ft) torque or below.



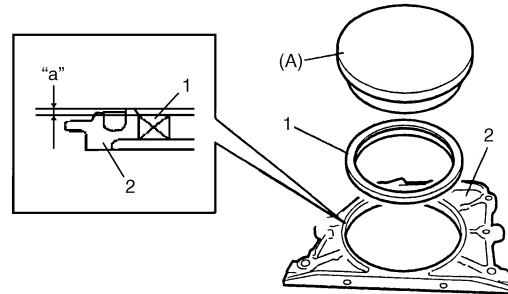
I2RH0B140131-01

7) If necessary, press-fit rear oil seal (1) to oil seal housing (2) by using special tool as shown in figure.

Special tool
(A): 09911-97821

Crank rear oil seal installing position (dimension)

“a”: 2 mm (0.08 in.)



I5RW0C140027-01

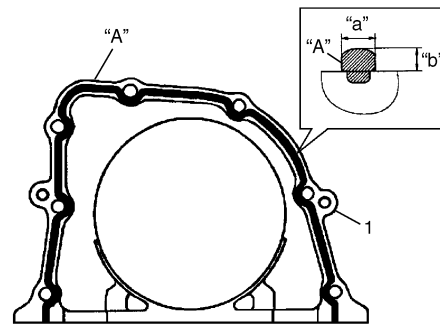
8) Apply sealant to mating surface of rear oil seal housing (1).

“A”: Water tight sealant 99000-31250 (SUZUKI Bond No.1207F)

Sealant amount for rear oil seal housing

Width “a”: 3 mm (0.12 in.)

Height “b”: 2 mm (0.08 in.)



I4RS0A140018-01

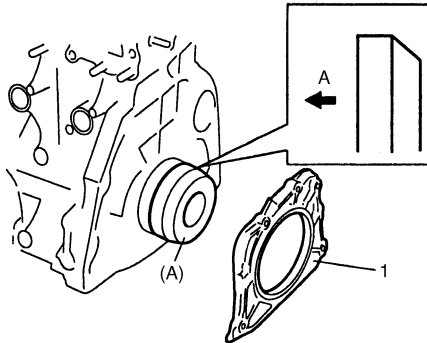
- 9) Install rear oil seal housing (1) and tighten new bolts to specified torque by using special tool.

Special tool

(A): 09911-97720

Tightening torque

Rear oil seal housing bolt: 11 N·m (1.1 kgf-m, 8.0 lb-ft)



I4RS0A140019-01

A: Crankshaft side

- 10) Install flywheel (drive plate for A/T).
Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts to specified torque.

NOTE

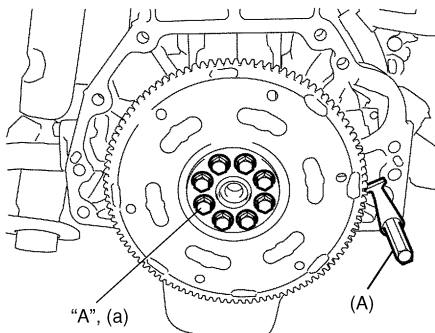
Use new flywheel or drive plate bolts.

Special tool

(A): 09924-17810

Tightening torque

Flywheel or drive plate bolt (a): 70 N·m (7.0 kgf-m, 51.0 lb-ft)



I2RH0B140134-01

- 11) Install piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation".
12) Install cylinder head referring to "Valves and Cylinder Head Removal and Installation".

- 13) Install camshafts, tappet and shim referring to "Camshaft, Tappet and Shim Removal and Installation".
14) Install timing chain referring to "Timing Chain and Chain Tensioner Removal and Installation".
15) Install timing chain cover referring to "Timing Chain Cover Removal and Installation".
16) Install cylinder head cover referring to "Cylinder Head Cover Removal and Installation".
17) Install oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation in Section 1E".
18) Install engine assembly to vehicle referring to "Engine Assembly Removal and Installation".

Crankshaft Inspection

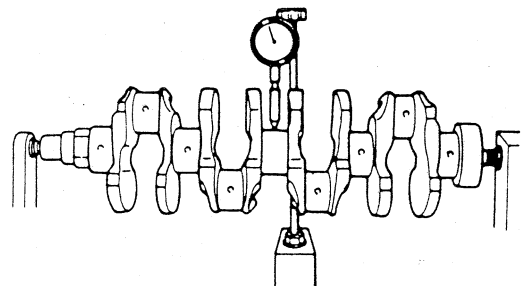
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Crankshaft Runout

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

Crankshaft runout

Limit: 0.02 mm (0.0008 in.)



I2RH0B140135-01

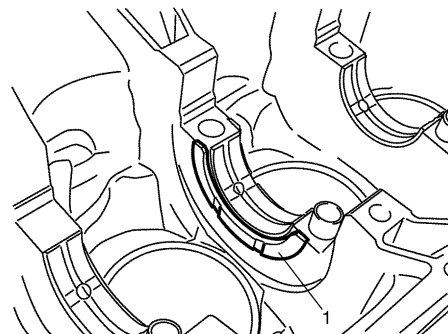
Crankshaft Thrust Play

- 1) 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: 2.470 – 2.520 mm (0.0972 – 0.0992 in.)

Oversize (0.125 mm (0.0049 in.)): 2.533 – 2.583 mm (0.0997 – 0.1017 in.)



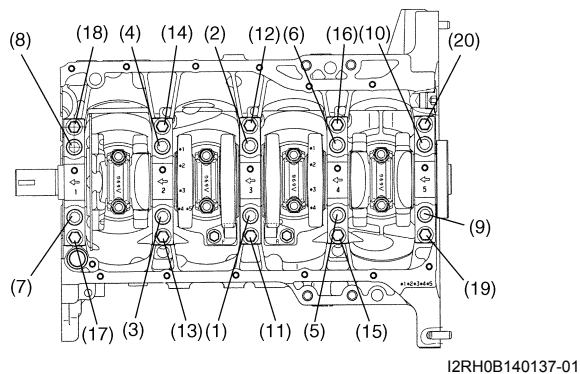
I2RH0B140136-01

- 2) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing cap No.2 bolts (11) – (20) gradually as follows.
 - a) Tighten bolts (1) – (10) to 30 N·m (3.0 kgf-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 kgf-m, 36.5 lb-ft).
 - c) In the same manner as in Step a), retighten them to 60°.
 - d) Tighten bolts (11) – (20) to 25 N·m (2.5 kgf-m, 18.0 lb-ft) according to numerical order in figure.

Tightening torque

Main bearing cap No.1 bolt ((1) – (10)):
 Tighten 30 N·m (3.0 kgf-m, 22.0 lb-ft), 50 N·m (5.0 kgf-m, 36.5 lb-ft) and 60° by the specified procedure

Main bearing cap No.2 bolt ((11) – (20)):
 Tighten 25 N·m (2.5 kgf-m, 18.0 lb-ft) by the specified procedure



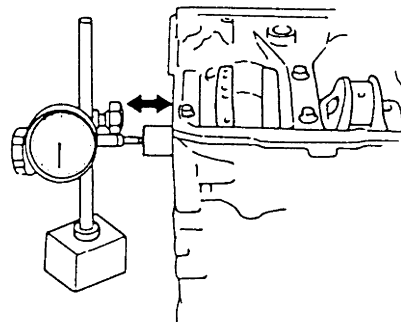
- 3) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft. If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

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 referring to “Main Bearing Cap No.1 Bolt” in “Main Bearings Inspection”.



I2RH01140183-01

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 exceeds its limit, regrind or replace crankshaft.

Crankshaft out-of-round and taper

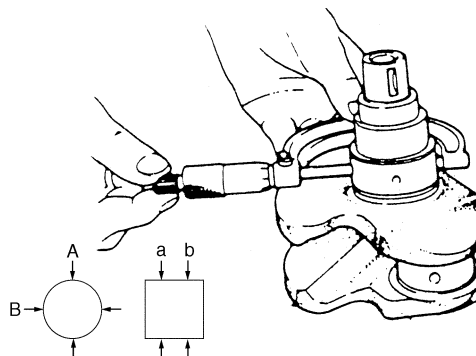
Limit: 0.01 mm (0.0004 in.)

Out-of-round

A – B

Taper

a – b



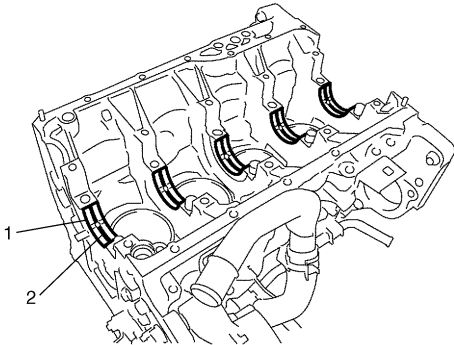
I2RH0B140138-01

Main Bearings Inspection

S6RW0D1406040

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 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.



I2RH0B140139-01

Visual Inspection

Check bearings for pitting, scratches, wear or damage. If any malcondition is found, replace both upper and lower halves. Never replace either half without replacing the other half.

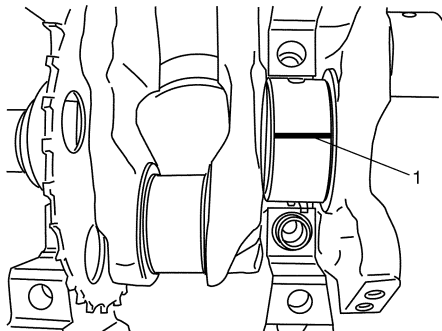
Main Bearing Clearance

NOTE

Do not rotate crankshaft while gauging plastic is installed.

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

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



I2RH0B140140-01

- 4) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing cap No.2 bolts (11) – (20) gradually as follows.
 - a) Tighten bolts (1) – (10) to 30 N·m (3.0 kgf-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 kgf-m, 36.5 lb-ft).
 - c) In the same manner as in Step a), retighten them to 60°.
 - d) Tighten bolts (11) – (20) to 25 N·m (2.5 kgf-m, 18.0 lb-ft) according to numerical order in figure.

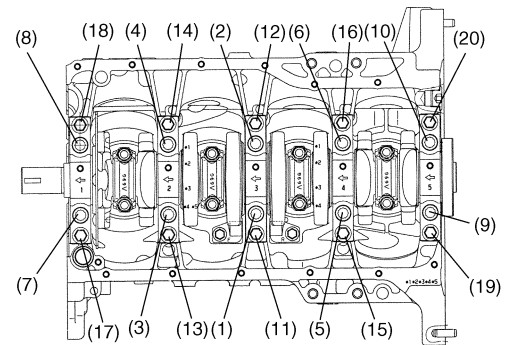
Tightening torque

Main bearing cap No.1 bolt ((1) – (10)):

Tighten 30 N·m (3.0 kgf-m, 22.0 lb-ft), 50 N·m (5.0 kgf-m, 36.5 lb-ft) and 60° by the specified procedure

Main bearing cap No.2 bolt ((11) – (20)):

Tighten 25 N·m (2.5 kgf-m, 18.0 lb-ft) by the specified procedure



I2RH0B140137-01

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

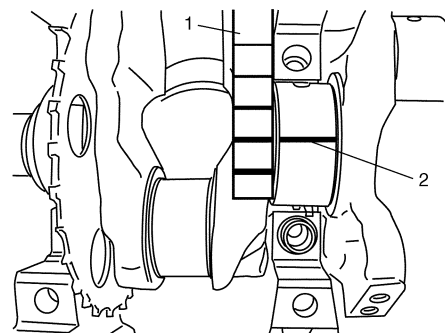
A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.

After selecting new bearing, recheck clearance.

Main bearing clearance

Standard: 0.021 – 0.041 mm (0.0008 – 0.0016 in.)

Limit: 0.054 mm (0.0021 in.)



I2RH0B140141-01

Selection of Main Bearings

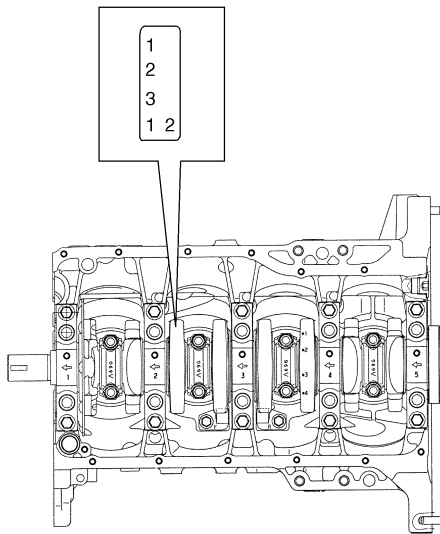
Standard bearing

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 M15 engine, stamped number "1" indicates that corresponding journal diameter is 51.9940 – 52.0000 mm (2.0471 – 2.0472 in.).

Crankshaft journal diameter

Stamped numbers	Journal diameter
1	51.9940 – 52.0000 mm (2.0471 – 2.0472 in.)
2	51.9880 – 51.9939 mm (2.0468 – 2.0470 in.)
3	51.9820 – 51.9879 mm (2.0465 – 2.0467 in.)



I2RH0B140142-01

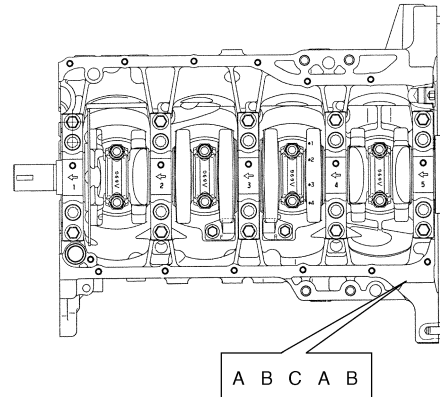
- 2) Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in figure. Three kinds of alphabets ("A", "B" and "C") or numbers ("1", "2" and "3") represent the following cap bore diameters.

Stamped alphabets or numbers on cylinder block represent bearing cap bore diameter marked with an arrow in figure respectively.

For example, stamped "A" or "1" indicates that corresponding bearing cap bore diameter is 56.0000 – 56.0060 mm (2.2048 – 2.2049 in.).

Crankshaft bearing cap bore

Stamped alphabet (number)	Bearing cap bore diameter (without bearing)
A or 1	56.0000 – 56.0060 mm (2.2048 – 2.2049 in.)
B or 2	56.0061 – 56.0120 mm (2.2050 – 2.2051 in.)
C or 3	56.0121 – 56.0180 mm (2.2052 – 2.2054 in.)

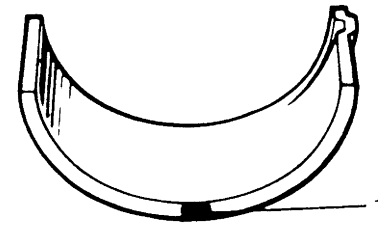


I2RH0B140143-01

- 3) There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in figure. Each color indicated the following thickness at the center of bearing.

Standard size of crankshaft main bearing thickness

Color painted	Bearing thickness
Purple	1.992 – 1.996 mm (0.07843 – 0.07858 in.)
Brown	1.995 – 1.999 mm (0.07855 – 0.07870 in.)
Green	1.998 – 2.002 mm (0.07867 – 0.07882 in.)
Black	2.001 – 2.005 mm (0.07878 – 0.07893 in.)
Colorless (no paint)	2.004 – 2.008 mm (0.07890 – 0.07906 in.)



I2RH01140191-01

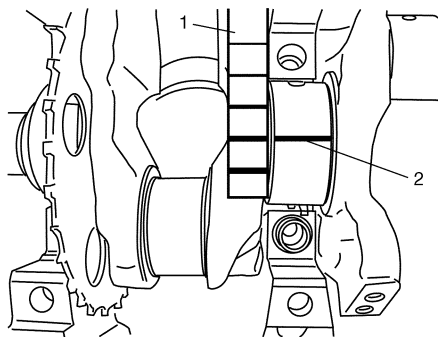
1. Paint

- 4) From number stamped on crank web No.2 and alphabets stamped on cylinder block, determine new standard bearing to be installed to journal, by referring to the table shown. For example, if number stamped on crank web No.2 is "1" and alphabet stamped on cylinder block is "B", install a new standard bearing painted in "Brown" to its journal.

New standard size crankshaft main bearing specification

		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A or 1	Purple	Brown	Green
	B or 2	Brown	Green	Black
	C or 3	Green	Black	Colorless
		New standard bearing to be installed		

5) Using scale (1) on gauging plastic (2), check bearing clearance with newly selected standard bearing. If clearance still exceeds its limit, use next thicker bearing and recheck clearance.



I2RH0B140141-01

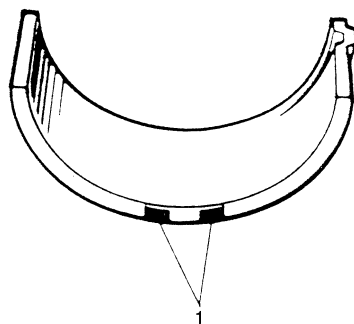
6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new cylinder block.

Undersize bearing (0.25 mm (0.0098 in.))

- 0.25 mm (0.0098 in.) undersize bearing is available, in five kinds varying in thickness. To distinguish them, each bearing is painted in the following colors at such position as indicated in figure. Each color represents the following thickness at the center of bearing.

Undersize of crankshaft main bearing thickness

Color painted	Bearing thickness
Red and Purple	2.117 – 2.121 mm (0.08335 – 0.08350 in.)
Red and Brown	2.120 – 2.124 mm (0.08347 – 0.08362 in.)
Red and Green	2.123 – 2.127 mm (0.08359 – 0.08374 in.)
Red and Black	2.126 – 2.130 mm (0.08371 – 0.08385 in.)
Red only	2.129 – 2.133 mm (0.08382 – 0.08397 in.)



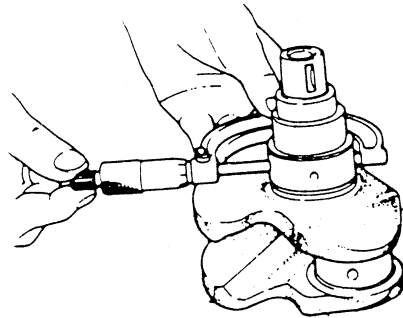
I2RH01140192-01

1. Paint

- If necessary, regrind crankshaft journal and select undersize bearing to use with it as follows.
 - a. Regrind journal to the following finished diameter.

Finished journal diameter
51.7320 – 51.7500 mm (2.0367 – 2.0374 in.)

- b. Using micrometer, measure regrind journal diameter.
 Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
- c. Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to the following table.
 Check bearing clearance with newly selected undersize bearing.



I2RH0B140144-01

New undersize crankshaft main bearing specification

		Measured journal diameter		
		51.7320 – 51.7379 mm (2.0367 – 2.0369 in.)	51.7380 – 51.7439 mm (2.0370 – 2.0371 in.)	51.7440 – 51.7500 mm (2.0372 – 2.0373 in.)
Alphabets stamped on cylinder block	A (1)	Red and Green	Red and Brown	Red and Purple
	B (2)	Red and Black	Red and Green	Red and Brown
	C (3)	Red only	Red and Black	Red and Green
		Undersize bearing to be installed		

1D-70 Engine Mechanical:

Main Bearing Cap No.1 Bolt

Measure each thread diameter main bearing cap No.1 bolts (1) at "A" on 60 mm (2.36 in.) from seat side of flange bolt and "B" on 90 mm (3.54 in.) 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.

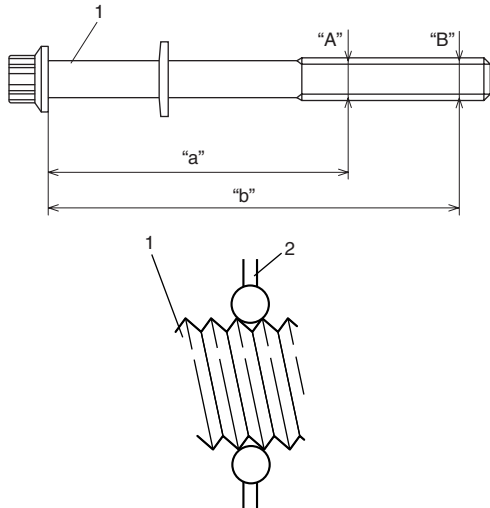
Main bearing cap No.1 bolt diameter measurement points

"a": 60 mm (2.36 in.)

"b": 90 mm (3.54 in.)

Main bearing cap No.1 bolt diameter difference

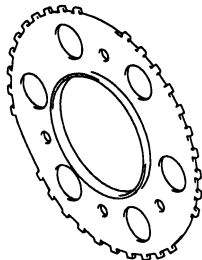
Limit ("A" – "B"): 0.2 mm (0.008 in.)



I2RHOB140145-01

Sensor Plate Inspection

Check sensor plate for crack damage. If malfunction is found, replace it.

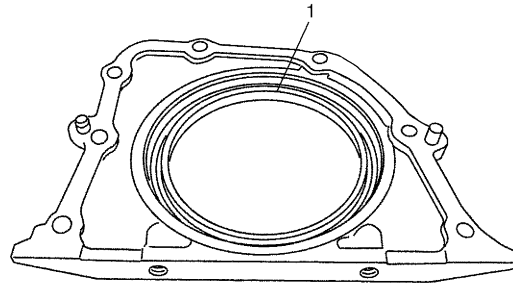


I2RHOB140151-01

Rear Oil Seal Inspection

S6RW0D1406042

Carefully inspect oil seal (1) for wear or damage. If its lip is worn or damaged, replace it.



I4RS0A140020-01

Flywheel Inspection

S6RW0D1406043

Visual Inspection

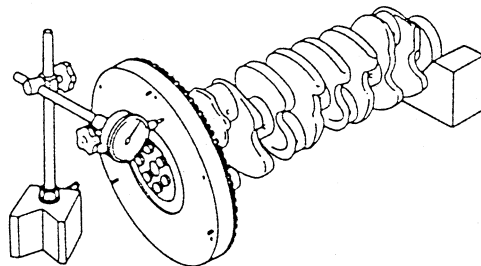
- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.

Flywheel Face Runout

Check flywheel face runout with a dial gauge. If runout exceeds its limit, replace flywheel.

Flywheel face runout

Limit: 0.2 mm (0.0079 in.)



I2RH01140198-01

Cylinder Block Inspection

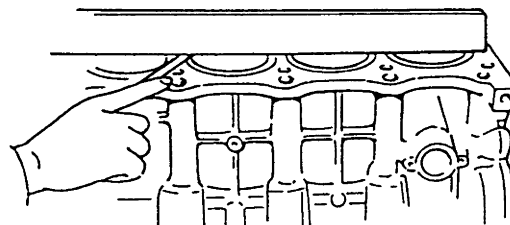
S6RW0D1406044

Distortion of Gasketed Surface

Using straightedge and thickness gauge, check gasketed surface for distortion and, if flatness exceeds its limit, correct it.

Cylinder block flatness

Limit: 0.03 mm (0.0012 in.)



I2RH01140199-01

Honing or Reboring Cylinders

- 1) When any cylinder needs reboring, all other cylinders must also be rebored at the same time.
- 2) Select oversized piston according to amount of cylinder wear.

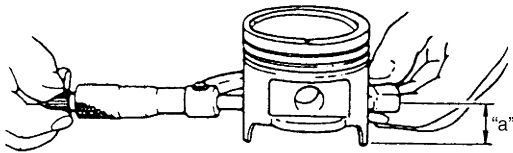
Oversize piston specification

Oversize 0.50: 78.453 – 78.468 mm (3.0887 – 3.0893 in.)

- 3) Using micrometer, measure piston diameter.

Measurement position for piston diameter

“a”: 19.5 mm (0.77 in.)



I2RH01140157-01

- 4) Rebore and hone cylinder to the following dimension.

NOTE

Before reboring, install all main bearing caps in place and tighten to specification to avoid distortion of bearing bores.

Cylinder bore diameter to be rebored

Oversize 0.50: 78.500 – 78.514 mm (3.0906 – 3.0911 in.)

- 5) Measure piston clearance after honing.

Piston clearance

0.032 – 0.061 mm (0.0013 – 0.0024 in.)

Specifications

Tightening Torque Specifications

S6RW0D1407001

Fastening part	Tightening torque			Note
	N·m	kgf·m	lb·ft	
Camshaft housing bolt	Tighten 11 N·m (1.1 kgf·m, 8.0 lb·ft) by the specified procedure			☞ / ☞
EVAP canister purge valve bracket bolt	5	0.5	4.0	☞ / ☞
Cylinder head cover bolt	Tighten 8 N·m (0.8 kgf·m, 6.0 lb·ft) by the specified procedure			☞
Engine right mounting bracket nut	65	6.5	47.0	☞
Engine right mounting bush bolt	55	5.5	40.0	☞
Engine left mounting bush bolt	85	8.5	61.5	☞
Suspension frame mounting bolt	150	15.0	108.5	☞
Front lower cross member bolt	55	5.5	40.0	☞
Starting motor terminal nut	11	1.1	8.0	☞
Generator terminal nut	5	0.5	4.0	☞
Battery ground bolt	25	2.5	18.0	☞
Ground terminal bolt	11	1.1	8.0	☞
Timing chain cover bolt	25	2.5	18.0	☞
Timing chain cover nut	25	2.5	18.0	☞
Cap bolt	25	2.5	18.0	☞
Oil gallery pipe No.2 and No.3 bolt	11	1.1	8.0	☞
Crankshaft pulley bolt	150	15.0	108.5	☞
Oil control valve mounting nut	11	1.1	8.0	☞
Oil gallery pipe No.1 bolt	30	3.0	21.5	☞
Timing chain No.1 guide bolt	11	1.1	8.0	☞
Timing chain tensioner bolt	25	2.5	18.0	☞
Timing chain tensioner adjuster bolt	11	1.1	8.0	☞
Intake cam timing sprocket bolt	60	6.0	43.5	☞
Camshaft housing bolt	11	1.1	8.0	☞
Venturi plug	5	0.5	3.5	☞
Cylinder head bolt for M8	Tighten 25 N·m (2.5 kgf·m, 18.0 lb·ft) by the specified procedure			☞

Fastening part	Tightening torque			Note
	N·m	kgf·m	lb·ft	
Cylinder head bolt for M10	Tighten 20 N·m (2.0 kgf·m, 14.5 lb·ft), 40 N·m (4.0 kgf·m, 29.0 lb·ft), 60° and 60° by the specified procedure			☞
Connecting rod bearing cap nut	Tighten 15 N·m (1.5 kgf·m, 11.0 lb·ft), 45° and 45° by the specified procedure			☞ / ☞
Sensor plate bolt	11	1.1	8.0	☞
Main bearing cap No.1 bolt	Tighten 30 N·m (3.0 kgf·m, 22.0 lb·ft), 50 N·m (5.0 kgf·m, 36.5 lb·ft) and 60° by the specified procedure			☞ / ☞ / ☞
Main bearing cap No.2 bolt	Tighten 25 N·m (2.5 kgf·m, 18.0 lb·ft) by the specified procedure			☞ / ☞ / ☞
Rear oil seal housing bolt	11	1.1	8.0	☞
Flywheel or drive plate bolt	70	7.0	51.0	☞

NOTE

The specified tightening torque is also described in the following.

“Air Intake System Components”

“Engine Mountings Components”

“Timing Chain Cover Components”

“Timing Chain and Chain Tensioner Components”

“Camshaft, Tappet and Shim Components”

“Valves and Cylinder Head Components”

“Pistons, Piston Rings, Connecting Rods and Cylinders Components”

“Main Bearings, Crankshaft and Cylinder Block Components”

Reference:

For the tightening torque of fastener not specified in this section, refer to “Fasteners Information in Section 0A”.

Special Tools and Equipment

Recommended Service Material

S6RW0D1408001

Material	SUZUKI recommended product or Specification		Note
Sealant	SUZUKI Bond No.1217G	P/No.: 99000-31260	☞
Water tight sealant	SUZUKI Bond No.1207B	P/No.: 99000-31140	☞
	SUZUKI Bond No.1207F	P/No.: 99000-31250	☞ / ☞ / ☞

NOTE

Required service material is also described in the following.

“Timing Chain Cover Components”

“Timing Chain and Chain Tensioner Components”

“Camshaft, Tappet and Shim Components”

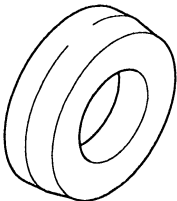
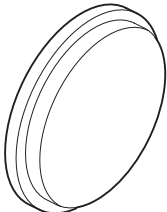
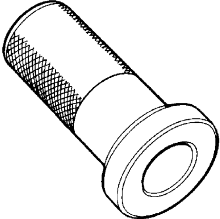
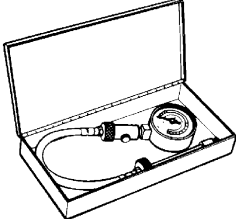
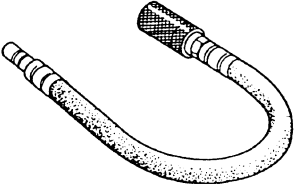
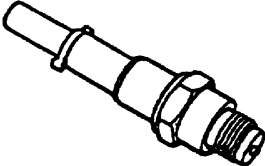
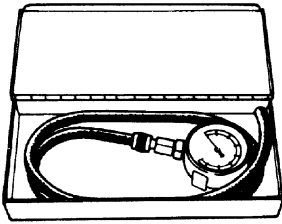
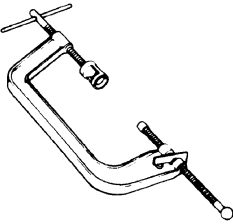
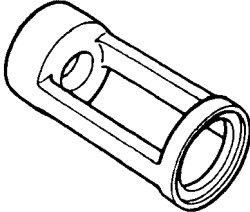
“Valves and Cylinder Head Components”

“Pistons, Piston Rings, Connecting Rods and Cylinders Components”

“Main Bearings, Crankshaft and Cylinder Block Components”

Special Tool

S6RW0D1408002

09911-97720 Oil seal installer ☞		09911-97821 Oil seal installer ☞	
09913-75810 Bearing installer ☞		09915-64512 Compression gauge ☞	
09915-64530 Compression gauge hose ☞		09915-67010 Compression gauge attachment (C) ☞	
09915-67311 Vacuum gauge ☞		09916-14510 Valve lifter ☞ / ☞	
09916-14521 Valve spring compressor attachment ☞ / ☞		09916-34542 Reamer handle ☞ / ☞	