

Document Title: Cylinder head, disassembly/assembly	Function Group: 211	Information Type: Service Information	Date: 2014/3/30
Profile: CEX, EW60C [GB]			

Cylinder head, disassembly/assembly

Op nbr 2111

Disassemble in the order of the numbers shown in the illustration. (service point)

1. Remove the alternator assembly. (service point 1)
2. Remove the fan, pulley and V-belt.
3. Remove the thermostat case. (service point 2)
4. Remove the fuel filter and fuel oil piping. (service point 3)
5. Remove the oil level gauge assembly.
6. Remove the oil filter. (service point 4)
7. Remove the fuel injection pipes. (service point 5)
8. Remove the intake manifold assembly.
9. Remove the exhaust manifold assembly.
10. Remove the rocker cover.
11. Remove the rocker shaft assembly, push rods and valve caps. (service point 6)
12. Remove the cylinder head assembly and head gasket. (service point 7)
13. Remove the fuel injection valves and fuel return pipe. (service point 8)
14. Remove the intake/exhaust valves, stem seals and valve springs. (service point 9)
15. Remove the rocker arms from the rocker shaft.
For assembly, reverse the procedure.

Service points

Point 1

Disassembly :

- Loosen the mounting screw while supporting the alternator.

NOTE!

Do not tilt the alternator towards the cylinder block in a haste since it may damage the alternator or pinch a finger.

Reassembly:

- The belt deflection shall be checked according to Inspection after initial 50 hours operation.
- Replace the belt with a new one if cracked, worn or damaged.

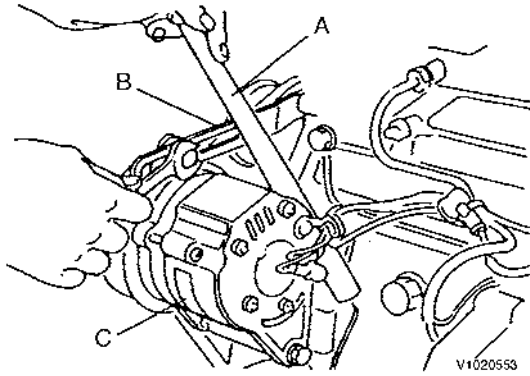


Figure 2
Adjustment, V-belt tension

- A. Bar
- B. Adjuster
- C. Alternator

- Carefully prevent the belt from being smeared with oil or grease.

Point 2

Reassembly :

- Check the thermostat function.

Point 3

Reassemble :

- Replace the fuel filter element with a new one.

Disassemble :

- Cover the fuel pipe opening with tape to prevent intrusion of foreign matters.

Point 4

Reassemble :

- Replace the oil filter with a new one.
- After fully tightening the filter manually, retighten it with a filter wrench by 3/4 turn.

Point 5

Disassemble :

- Cover the fuel injection pipe and pump inlets and outlets with tape or the like to prevent intrusion of foreign matter.

Point 6

Disassemble :

- Keep the removed push rods by attaching tags showing corresponding cylinder numbers.

Reassemble :

- Always apply oil to the contact portions of the push rods and valve clearance adjusting screws.

Point 7

Disassemble :

- Loosen the cylinder head screws in two steps in the illustrated order.

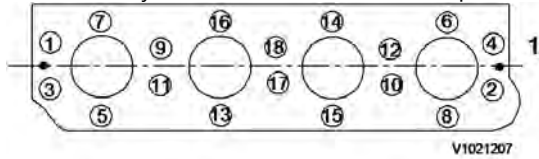


Figure 3
Head screw disassembly order

1. Fan side

- Place the cylinder head assembly on cardboard to prevent any damage to the combustion face.

Reassemble :

- Replace the head gasket with a new one.

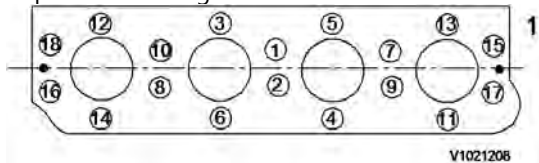


Figure 4
Head screw tightening order

1. Fan side

- Uniformly install the head screws manually after applying oil on the threads and seat portions.
- They shall be tightened in two steps in the reverse of the order for disassembly.

Tightening torque :

- First step : 5 ~ 6 kgf·m (36.1 ~ 43.3 lbf·ft)
- Second step : 10.5 ~ 11.5 kgf·m (75.8 ~ 83.0 lbf·ft)

Point 8

Disassemble :

- Carefully remove the fuel injection valve so as not to leave the tip end protector from being left inside the cylinder.

Reassemble :

- Replace the fuel injection valve protector with a new one.

Point 9

Disassemble :

- When removing each inlet/exhaust valve from the cylinder head, use a valve spring compressor and compress the valve spring and remove the valve cotter.

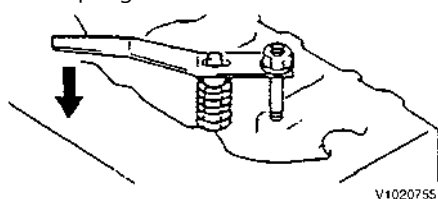


Figure 5
Valve spring compressor

- Keep each removed inlet/exhaust valve after attaching a tag showing the corresponding cylinder number.
- If cotter burr is seen at the shaft of each inlet/exhaust valve stem, remove it with an oilstone and extract the valve from the cylinder head.

Reassemble :

- Replace the stem seal with a new one when an intake/exhaust valve is disassembled.
- Carefully install each valve after oil application so as not to damage the stem seal.
- Different stem seals are provided for the intake and exhaust valves. Do not confuse them since those for exhaust valves are marked with yellow paint.
- After assembling the intake/exhaust valve, stem seal, valve spring, seat, and cotter, tap the head of the valve stem lightly for settling.
- Do not forget to install the valve cap.

Document Title: Cylinder head, parts inspection and measurement	Function Group: 211	Information Type: Service Information	Date: 2014/3/30
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Cylinder head, parts inspection and measurement

Cylinder head

Clean the cylinder head, mainly the combustion surface, valve seats and intake/exhaust ports, remove carbon deposit and bonding agent, and check the surface state.

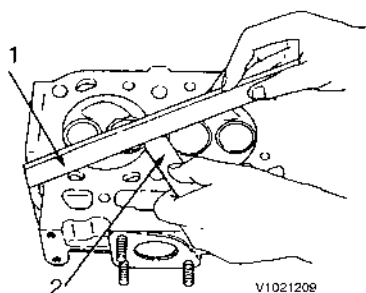


Figure 1

Distortion at combustion surface

1. Straight edge
 2. Feeler gauge
- Appearance check
Check mainly discoloration and cracks. If a crack is suspected, perform dye check.
 - Combustion surface distortion
Apply a straightedge in two diagonal directions and on four sides of the cylinder head, and measure distortion with a feeler gage

Combustion surface distortion, unit: mm (in)

	Standard	Limit
Distortion	0.05 (0.002) or less	0.15 (0.0059)

- Valve sink
Measure with the valve inserted to the cylinder head.

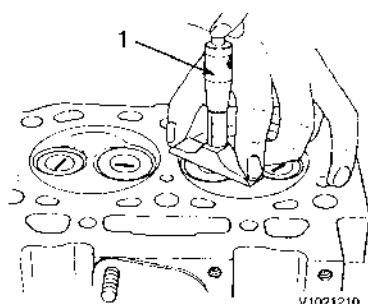


Figure 2
Valve sink

- 1. Depth micrometer

Combustion surface distortion, unit: mm (in)

		Standard	Limit
Valve sink	Inlet	0.36 ~ 0.56 (0.0142 ~ 0.0220)	0.8 (0.0315)
	Exhaust	0.35 ~ 0.55 (0.0138 ~ 0.0217)	0.8 (0.0315)

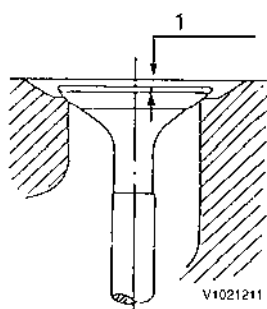


Figure 3
Valve sink depth

- 1. Valve sinking depth
- Seat contact
Apply a thin coat of bluing on the valve seat. Insert the valve in the cylinder and push it against the seat to check seat contact.
Standard : Continuous contact all around

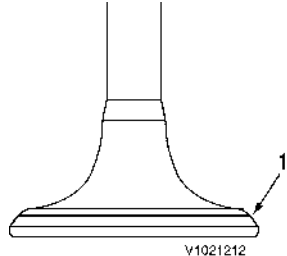


Figure 4
Valve seat contact

- 1. Seat
- Valve guide
Mainly check damage and wear on the inside wall. Apply supply part number 129907-11800 when replacing the part.

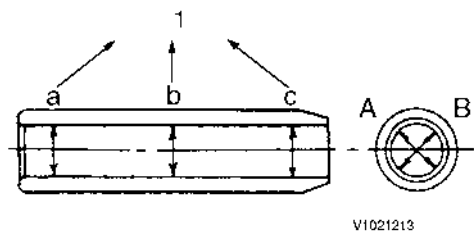


Figure 5

Valve guide inside diameter

1. Measuring positions

- Valve stem clearance

Valve stem clearance, unit: mm (in)

		Standard	Limit
Inlet valve	Stem outside diameter	6.945 ~ 6.960 (0.2734 ~ 0.2740)	6.900 (0.2717)
	Guide inner diameter	7.000 ~ 7.015 (0.2756 ~ 0.2762)	7.080 (0.2787)
	Clearance	0.040 ~ 0.070 (0.0016 ~ 0.0028)	0.170 (0.0067)
Exhaust valve	Stem outside diameter	6.940 ~ 6.955 (0.2732 ~ 0.2738)	6.900 (0.2717)
	Guide inner diameter	7.000 ~ 7.015 (0.2756 ~ 0.2762)	7.080 (0.2787)
	Clearance	0.045 ~ 0.075 (0.0018 ~ 0.0030)	0.170 (0.0067)

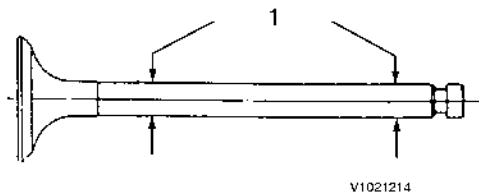


Figure 6

Valve stem outside diameter

- Measuring positions
- Inlet/exhaust valve
Mainly clean and check damage and wear at the valve stem and seat.

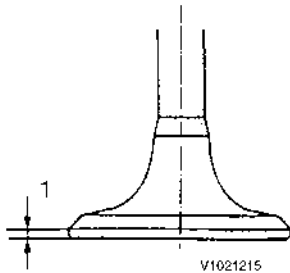


Figure 7

Valve head thickness

- Thickness
- Seat contact : see Seat contact.
 - Stem outside diameter : see Valve stem clearance, unit: mm (in).
 - Valve head thickness

Valve head thickness, unit : mm (in)

	Standard	Limit
Inlet	1.71 (0.0673)	1.00 (0.0394)

Exhaust	1.65 (0.0650)	1.00 (0.0394)
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- Valve stem bend
Limit : 0.01 mm (0.0004 in)

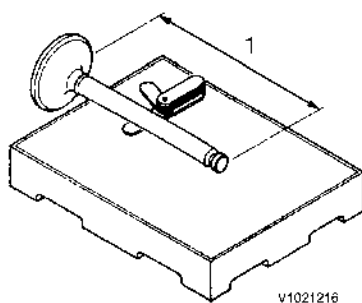


Figure 8
Valve bend and length

1. Length
- Overall length

Valve overall length, unit: mm (in)

	Standard	Limit
Inlet	115 (4.53)	114.5 (4.50)
Exhaust	115 (4.53)	114.5 (4.50)

- Valve spring
Mainly inspect damage and corrosion.

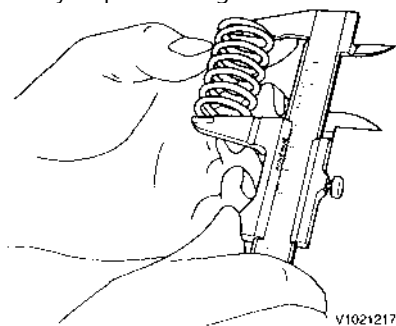


Figure 9
Valve spring free length

Valve spring, unit: mm (in)

	Standard	Limit
Free length	47.5 (1.87)	–
Inclination	–	1.2 (0.047)

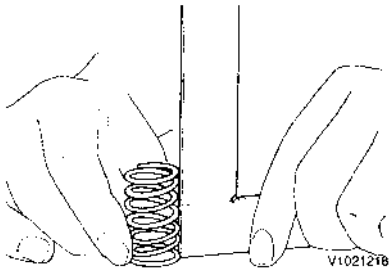


Figure 10
Valve spring inclination

- Valve rocker arm
Mainly inspect valve head cap contact surface, inside surface defects and wear. Slight surface defects shall be corrected with an oilstone

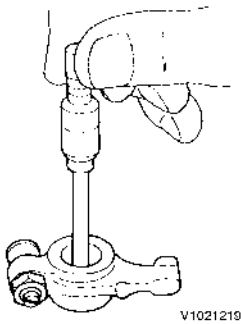


Figure 11
Rocker arm hole diameter

Rocker arm hole diameter, unit : mm (in)

	Standard	Limit
Arm hole diameter	18.50 ~ 18.52 (0.7283 ~ 0.7291)	18.57 (0.7311)
Shaft outside diameter	18.47 ~ 18.49 (0.7272 ~ 0.7280)	18.44 (0.7260)
Clearance	0.01 ~ 0.05 (0.0004 ~ 0.0020)	0.13 (0.005)

- Valve rocker arm shaft
Mainly inspect seizure and wear at the surface in sliding contact with the arm. The rocker shaft diameter shall be as specified in above.

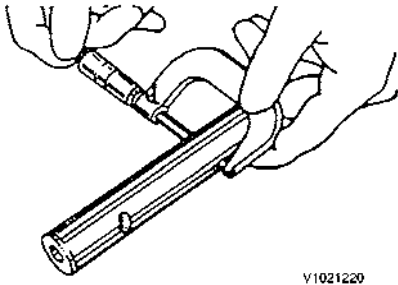


Figure 12
Rocker shaft outside diameter

- Push rod
Mainly inspect the surface in contact with the tappet and adjusting screw. Slight defects shall be corrected with an oilstone.

Bend limit : 0.03 mm (0.0012 in) or less

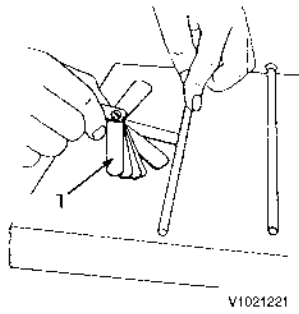


Figure 13
Push rod bend

1. Thickness gauge

- Valve clearance adjusting screw
Mainly inspect the surface in contact with the push rod. Slight defects shall be corrected with an oilstone.
- Rocker arm spring
Mainly inspect surface defects and corrosion.

Valve seat correction

NOTE!

Always check the oil clearance between the valve and valve guide before correcting the valve seat. If it exceeds the limit, replace the valve or valve guide first to make the clearance satisfy the standard. After correction, wash the valve and the cylinder head sufficiently with diesel oil to remove all grinding powder or compound.

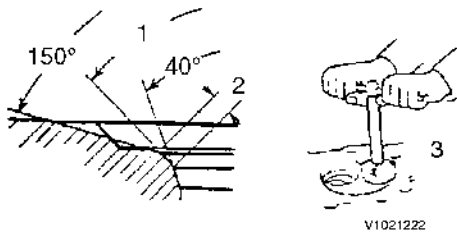


Figure 14
Cylinder head correction angle

1. Seat angle
 2. Seat width
 3. Seat cutter
- If the seat surface is slightly roughened : perform lapping (A) and (B) noted below.

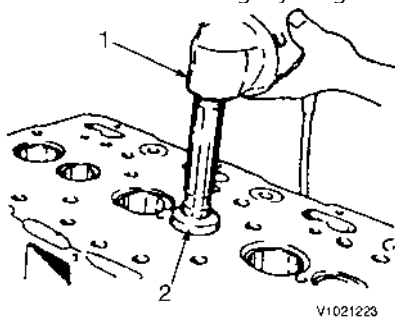


Figure 15
Seat grinder

1. Grinder
2. Grindstone

- If the seat is heavily roughened but the width is almost normal, correct with a seat grinder or seat cutter first. Then perform lapping (A) and (B) noted below.

Seat cutter angle, unit: degree

	Inlet	Exhaust
Seat cutter angle	120	90

- If the seat is heavily roughened and the width is much enlarged, grind the seat inner surface with a seat grinder whose center angle is 40°, then grind the seat outer surface with a grinder whose center angle is 150° to make the seat width match the standard. Then perform seat correction as described above, and then carry out lapping (A) and (B) noted below.

Grinding wheel angle, unit: degree

	θ1	θ2
Grinding wheel angle	40	150

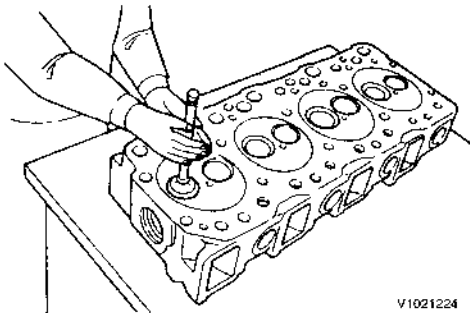


Figure 16
Valve lapping

NOTE!

(A) : Lap the valve and seat with a mixture of valve compound and engine oil.

NOTE!

(B) : Lap with engine oil only.

Valve guide replacement

- Use a valve guide extraction tool and extract the valve guide from the cylinder head.

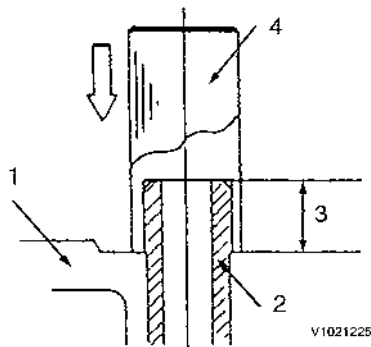


Figure 17
Valve guide replacement

1. Cylinder head
2. Valve guide
3. Projection
4. Valve guide extracting & inserting tool

- Put liquid nitrogen or ether (or alcohol) with dry ice added in a container and put the valve guide for replacement (Part No. 129907~11800) in it for cooling. Then insert it in with a valve guide inserting tool.
- Check the inside diameter and finish to the standard inside diameter as required with a reamer.
- Check the projection from the cylinder head.
Projection: 9.7 ~ 10.0 mm (0.3819 ~ 0.3937 in)

Valve stem seal replacement

Always use a new seal after the intake/exhaust valve disassembly. Since the exhaust valve is marked with yellow paint, do not confuse the intake and exhaust valves.

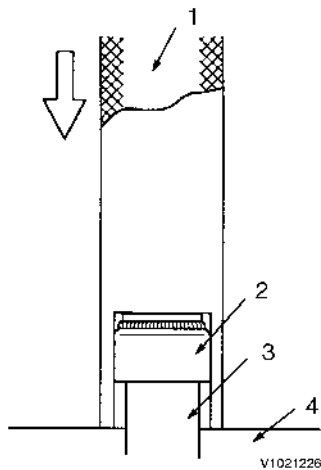


Figure 18
Stem seal insertion

1. Valve stem seal inserting tool
2. Stem seal
3. Valve guide
4. Cylinder head

- Apply engine oil to the lip.
- Push with the inserting tool for installation.
- Measure and check the projection of valve stem seal to keep proper clearance between valve guide and stem seal.
Projection: 11.7 ~ 12.0 mm (0.4606 ~ 0.4724 in)

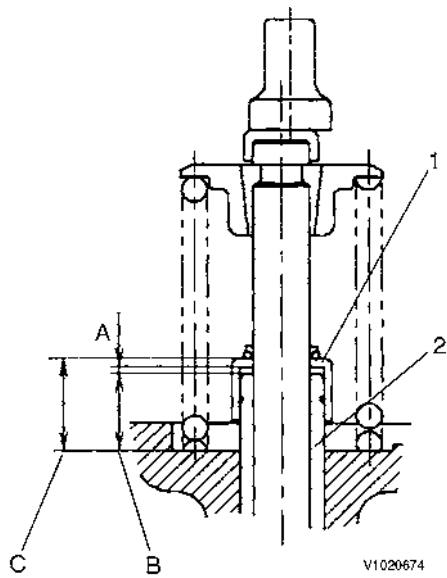


Figure 19
Measurement and check the projection of valve stem seal

1. Stem seal
 2. Valve guide
-
- A. Clearance
 - B. Valve guide projection
 - C. Stem seal projection

Document Title: Cylinder block, description	Function Group: 212	Information Type: Service Information	Date: 2014/3/30
Profile: CEX, EW60C [GB]			

Cylinder block, description

The cylinder block is made of cast iron. To obtain a better noise reduction the cylinder block and the gear case have a high stiffness.

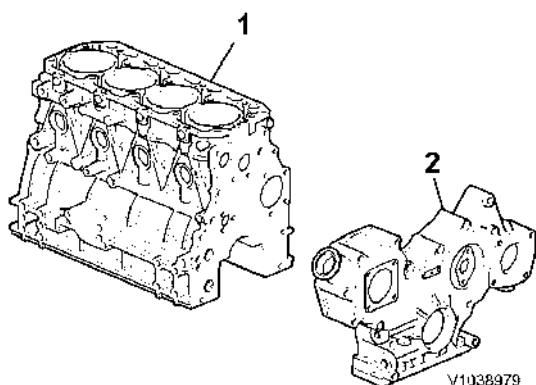


Figure 1
Cylinder block and timing gear casing

1. Cylinder block
2. Timing gear casing

Document Title: Exploded view, cylinder block	Function Group: 212	Information Type: Service Information	Date: 2014/3/30
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Exploded view, cylinder block

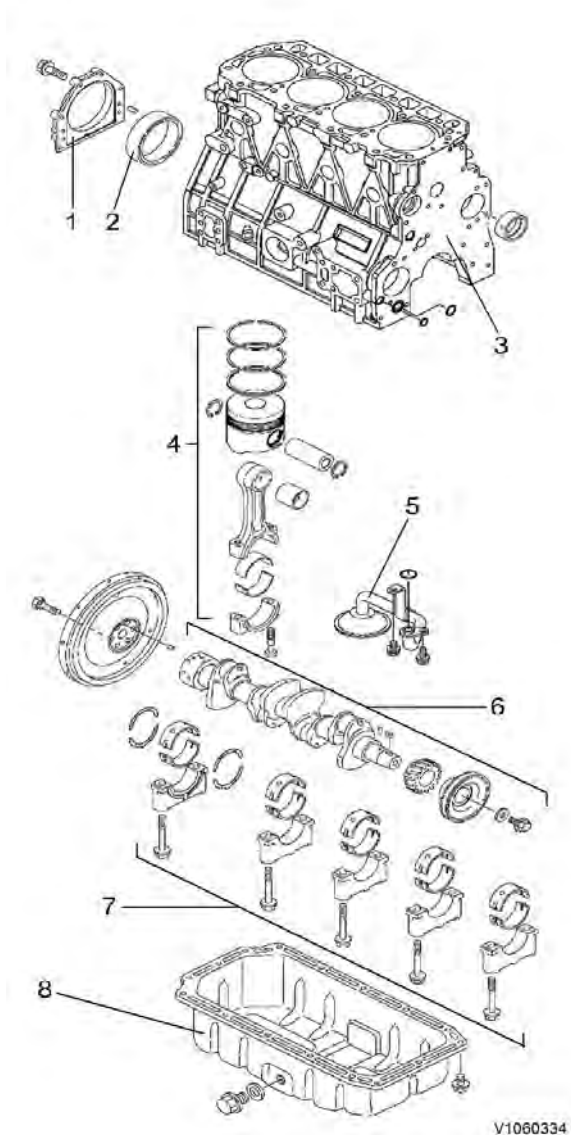


Figure 1
Exploded view, cylinder block

1	Cover	5	Suction pipe
2	Seal	6	Crankshaft
3	Cylinder block	7	Bearing cap
4	Piston & connecting rod assembly	8	Oil pan

Document Title: Cylinder block, disassembly and assembly	Function Group: 212	Information Type: Service Information	Date: 2014/3/30
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Cylinder block, disassembly and assembly

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Disassemble in the order of the numbers in the illustration.

1. Perform steps 1 to 12 in the cylinder head disassembly procedure.
2. Perform steps 1 to 12 in the gear train disassembly procedure.
3. Remove the oil pan. (service point 1)
4. Remove the lubricating oil suction pipe.
5. Remove the piston with rod. (service point 2)
6. Remove the mounting flange. (service point 3)
7. Remove the bearing metal caps. (service point 4)
8. Remove the crankshaft. (service point 5)
9. Remove the tappets.
10. Remove the pistons and rings. (service point 6)
11. Remove the oil seal from the mounting flange. (service point 7)
For assembly, reverse the procedure.

Service points

Point 1 Oil pan

Disassembly :

- Sealant is applied to the oil pan mounting surface on the block. Carefully operate so as not to damage or distort the bonding surface.

Reassembly :

- Apply sealant (Part No. 977770-01212) before reassembly.

Point 2 Piston with rod

Disassembly :

- Measure the connecting rod side gap.
Standard : 0.20 ~ 0.40 mm (0.0079 ~ 0.0157 inch)
- Carefully remove the carbon deposit on top of the cylinder so as not to damage the inner side of the cylinder.

- Set the piston at the BDC (Bottom Dead Center) position and remove the connecting rod cap. Then set the piston at the TDC (Top Dead Center) position, and push the connecting rod big end with the wooden shaft of a hammer. Proceed carefully so as not to cause the cylinder block to catch the rod big end. Set the rod caps and crankpin metals in their correct combinations.

Reassembly :

- Apply oil especially carefully to the sliding contact surfaces of the pistons, rods and rings.
- Use the piston insertion tool to insert each piston with rod in the cylinder block and install the bearing metal cap.
 - Tightening torque (Rod screw): 53.93 ~ 58.83 N m (5.5 ~ 6 kgf m) (39.7 ~ 152.4 lbf ft) (lubrication oil applied)

Point 3 Mounting flange

Disassembly :

- Place the engine on a stable base with the cylinder block upper surface facing down, and remove the mounting flange carefully so as not to damage the combustion surface.

Reassembly :

- Apply sealant (Part No. 977770-01212) and install the mounting flange by matching the two dowel pins. After assembly, raise the engine with its mounting flange on the bottom side.



WARNING

Risk of personal injury. Very heavy object.

Unforeseen injury may arise due to falling or slipping when raising or reversing the engine. Carefully operate so as not to lose balance.

Point 4 Journal bearing cap

Disassembly :

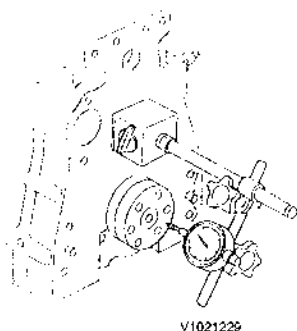


Figure 2

Measurement (1), crankshaft side gap

- Before removing the journal bearing, measure the crankshaft side gap. Measure it in either method because there are the next two methods. Standard : 0.11 ~ 0.21 mm (0.0043 ~ 0.0083 inch)
 1. Install a dial gauge on the cylinder block, and move a crankshaft in front and back, and measure the side gap as shown in the left figure.

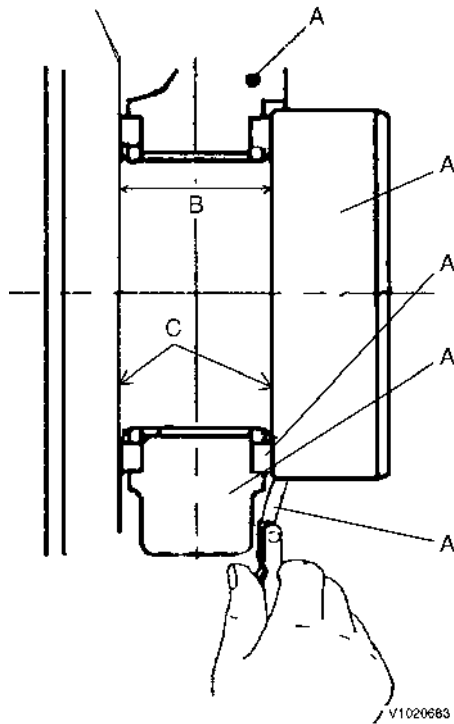


Figure 3
Measurement (2), crankshaft side gap

- A. Cylinder block
- B. Standard width
- C. Thrust face

2. Put a thickness gauge in the clearance between thrust metal and crankshaft directly, and measure it.

Crankshaft side gap, unit: mm (inch)

	Standard	Limit
Crankshaft side gap	0.13 ~ 0.23 (0.0051 ~ 0.0091)	0.28 (0.0110)

Reassembly :

- If the side gap exceeds the standard, replace the thrust metal with an oversize one.

Standard thickness, unit: mm (inch)

0.25 Oversize	129900-02370 (Upper) 129900-02360 (Lower)
Standard thickness, mm (inch)	2.055 ~ 2.105 (0.0809 ~ 0.0829)

Disassembly :

- Remove the bearing caps, cap side bearings, and thrust metals. Place each thrust metal with identification of the position and direction.

Reassembly :

- Carefully install each thrust metal so that the grooved one is positioned away from the cap.
- Do not confuse the upper and lower main bearing metals. The upper main bearing metal (block side) has an oil hole, and the lower one does not. The "wheel and arrow" marks on the cap shall face the flywheel.
- Bearing cap mounting screw tightening torque: 107.87 ~ 117.68 N m (11 ~ 12 kgf m) (79.4 ~ 86.6 lbf ft) (lubrication oil applied)

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