Unit: mm(in)

9. Cylinder Head/Valve

Services information	9-1	Valve guide replacement	9-7
Troubleshooting	9-2	Valve seat Inspection/Adjustment	9-8
Camshaft Removal	9-3	Cylinder head Assembly	9-11
Cylinder Head Removal	9-5	Cylinder Head Installation	9-12
Cylinder Head Disassembly	9-5	Camshaft Assembly	9-13

Service Information

General Safety

The rocker arm and the camshaft can be serviced without removing the engine. However, the engine must be removed from the frame to maintain the cylinder head.

The oil of camshaft oil is supplied through the cylinder head oil hole. Clean the oil hole prior to assembling the cylinder head.

Item			Standard value	Service limit		
Bocker arm	Rocker arm inner diameter		12.016-12.034(0.4731-04738)	12.060(0.4748)		
	Rocker arm shaft outer diam	eter	11.982-12.000(0.4717-0.4724)	11.950(0.4705)		
Camshaft	Cam height	IN	33.835-33.995(1.321-1.3384)	33.625(1.3234)		
		EX	33.984-34.144(1.380-1.3443)	33.765(1.3293)		
	Camshaft inner diameter		15.005-15.018(0.5907-0.5913)	15.040(0.5921)		
Cylinder head warpage			-	-		
Valve Valve guide	Valve spring free length	IN, EX	37.21(1.465)	36.90(1.4528)		
	Valve stem	IN	4.972-4.984(0.1957-0.1962)	4.920(0.1937)		
		EX	4.952-4.964(0.1950-0.1954)	4.900(0.1929)		
	Valve guide	IN, EX	5.000-5.012(0.1969-0.1973)	5.030(0.1980)		
	Clearance between	IN	0.016-0.040(0.0006-0.0016)	0.090(0.0035)		
	stem and guide	EX	0.036-0.060(0.0014-0.0024)	0.120(0.0047)		
	Valve seat width		0.8~1.0(0.031~0.039)	1.4(0.055)		

Specifications

Torque values

1.0kg-m(10N.m, 7ft-lb)
1.2kg-m(12N.m, 8ft-lb)
2.0kg-m(20N.m, 14ft-lb) - Apply engine oil
1.2kg-m(12N.m, 9ft-lb) - Apply engine oil
0.4kg-m(4N.m, 2.9ft-lb)
0.9kg-m(9N.m, 6.5ft-lb)

Tools

Valve guide reamer Valve guide driver Valve spring compressor Valve seat cutter Seat Cutter IN 37 (21.5mm) EX 37 (18.5mm) IN 45 (22mm) EX 45 (22mm) IN 55 (20mm) EX 55 (20mm)

Troubleshooting

Cylinder head operation problem can be diagnosed, in general, by a compression test, or by checking noises on the top of the engine.

Low compression or uneven compression

Valves

- Faulty hydraulic tappet
- Burned or bent valves
- Incorrect valve timing
- Broken valve spring

Cylinder head

- Leaking or damaged head gasket
- Warped or cracked cylinder head

Cylinder and piston (Refer to Section 10)

Compression too high

- Excessive carbon build-up on piston head or combustion chamber

Excessive noise

Faulty hydraulic valve tappet system

- Low engine oil level
- Contaminated oil
- Low oil pressure
- Damaged hydraulic tappet

Sticking valve or broken valve spring

Damaged or worn camshaft

Loose or worn cam chain

Worn or damaged cam chain tensioner

Worn cam sprocket teeth

Camshaft Removal

Remove the luggage box. (4-5) Remove the center cover. (4-4) Remove the shroud R/L.(8-2) Remove the cylinder head cover bolt and cover.

Remove the fan cover from the R shroud. Turn the crankshaft to the left, and align the "T" mark of the flywheel with the index mark of the R crank case cover.

Verify that the piston is located at the top dead center. (Make all camshaft lobes face downward.) If all camshaft lobes face upward, rotate the crankshaft to the left for 1 turn (360), and align th "T" mark with the index mark once again.

Loosen the four 8mm nuts of the camshaft holder. Remove the camshaft holder from the cylinder head.

Cylinder head cover / 'T" mark Sealing screw Cam chain tensioner

Loosen the four 8mm nuts of the camshaft holder. Remove the camshaft holder from the cylinder head.

Nut

Remove the cam chain from the camshaft.

NOTE

Take precautions not to allow the cam chain to drop into the crank case.

Remove the camshaft.

Insert the 6mm bolt into the rocker arm shaft, and pulling bolts to remove the rocker arm shaft. Remove the rocker arm.

Remove the other side rocker arm shaft and rocker arm in the same sequence.







Check the rocker arm and rocker arm shaft for wear or damage.

Measure the inner diameter of the rocker arm.

Service limit: 12.060mm (0.4748in)

Measure the outer diameter of the rocker arm shaft.

Service limit: 11.950mm (0.4705in)

Check the cam lobes of the camshaft for wear or damage.

Measure the height of the cam lobe. Service limit: IN: 33.615mm (1.3234 in) EX: 33.765mm (1.3293 in)





Manually turn the camshaft bearing outer race, and check if it turns smoothly. Check the bearing for wear or damage.

Cylinder Head Removal

Remove the engine from the frame.(section 5) Remove the camshaft. Remove the cylinder head from the cylinder.

Remove the gasket, dowel pin and cam chain guide from the cylinder.

Cylinder Head Disassembly

Remove the carburetor insulator. Remove the spark plug from the cylinder head.



Remove the valve spring, valve cotter, retainer, spring and valve.

Tool: Valve spring compressor

NOTE

To prevent the loss of tension, do not compress the valve spring more than necessary.

NOTE

Mark the disassembled parts so that they can be reassembled into the original position later.

Remove the valve spring seat and valve stem seal. Remove carbon deposits from the inside of the combustion chamber.

Cylinder Head

Remove gasket marks from the cylinder head gasket.

NOTE

Take precautions not to damage the cylinder head gasket attachment.

Check the spark plug assembling hole and the valve seat for cracks.

Using a square and a feeler gauge, check the cylinder head distortion.

Service limit: 0.1mm(0.004in)

Valve Spring

Measure the free length of the valve spring. **Service limit: 36.90mm(1.4528in)**

NOTE

Replace the valve spring with new one if the length of any one is less than the service limit.

Clearance Between Valve Steam and Guide

Check the valve for bend, seizure, or damage, and check the stem for abnormal wear.

Insert the valve into the valve guide, and check the operation.

Measure, and record, the outer diameter of the valve stem.

Service limit: I N: 4.920mm(0.1937in) EX: 4.900mm(0.1929in)









Insert the valve guide reamer into the combustion chamber, and remove the carbon deposits.

NOTE

Always insert the reamer while turning it right. If it is inserted without turning, or while turning left, interior part of guide will be damaged.

Tool: Valve guide reamer

Measure, and record, the inner diameter of the valve guide.

Service limit: 5.030mm(0.1980in)

Check the clearance between the valve stem and guide.

Service limit: I N: 0.090mm(0.0035in) EX: 0.120mm(0.0047in)

Measure the inner diameter of the new valve guide. If the clearance is not within the service limit, replace the valve.

Valve Guide Replacement

NOTE

After changing the valve guide, make sure to adjust the valve seat.

Heat all cylinder heads uniformly to approximate levels of 130~140

NOTE

Do not allow the temperature to exceed 150

NOTE

Take particular precautions as poor handling may lead to serious burns.

Do not locally heat the cylinder head with a gas burner as it may cause cylinder head distortion.







Support the cylinder head, and strike and remove the valve guide from the combustion chamber by using a valve guide driver.

Tool: Valve guide driver

NOTE

Take precautions not to damage the cylinder head.

Install new O-ring and new valve guide.

Valve guide driver

Insert the valve guide from the top of the cylinder head.

Tool: Valve guide driver

After inserting the valve guide, insert the valve guide reamer through the cylinder head combustion chamber side to trim the valve guide.

CAUTION

Make sure the reamer is not tilted when trimming the valve guide. If the reamer is tilted when cutting, the valve hole will also be tilted, causing the stem seal to leak, or the valve seat border will be expanded excessively to an uncorrectable extent.

Insert the reamer while turning it clockwise. If the reamer is inserted while turning it counterclockwise, or without turning, the guide interior part will be damaged.

Tool: Valve guide reamer

Clean the cylinder head to remove foreign matters.

Check the valve seat border, and adjust properly.

Valve Seat Inspection/Adjustment

Remove carbon deposits from the valve.

Apply a light coating of prussian blue to the cylinder head valve seat.

Gently strike the valve with the valve guide reamer, without turning the valve, to accurately set the fit position.





Remove the valve, and check the status of the seat contact, with a light coating of prussian blue applied to the valve face.

If the valve seat is damage, make necessary repair. If the valve is tilted, check the clearance between the valve guide and stem. Replace the valve guide if the clearance is abnormal.

NOTE

Valve cannot be corrected. If the valve face is seized, excessively worn, and if the contact is poor, change the valve.

Measure the valve seat width.

Standard value: 0.8-1.0mm(0.031-0.039in) Service limit: 1.4mm(0.055in)

Valve Seat Cutter

Repair the damaged valve seat by using valve seat cutters and grinders.

NOTE

Follow the seat cutter user's manual.

Valve Seat Repair

If the seat surface is rough or otherwise damaged, use a 45 cutter to grind the surface.

NOTE

Grind the seat surface after the valve guide is replaced.

Correct the plane slightly using a 37 cutter.









Use a 55 cutter to make minor repairs on the inside.

Use a 45 cutter to make adjustment within the level of prescribed width.



Apply a light coating of prussian blue to the valve seat. Gently strike the valve with a valve guide reamer to check the status of contact, without turning the valve.

If the contact surface is too high, grind the surface with a 37 cutter, and finish to the prescribed width with a 45 cutter.

If the contact surface is too low, grind the surface with a 55 cutter, and finish to the prescribed width with a 45 cutter.





After adjustment, apply compound evenly to the valve seat and set the valve with a valve guide reamer.

NOTE

Do not excessively press and turn the valve to set it as it may cause damage. Gently strike and set the valve. The seat surface may become worn on one side if the valve is set in the same position. Turn the valve slightly when setting it.

Take precautions not to allow compound to get into the clearance between the stem and guide while the valve is being set.

Cylinder Head Assembly

Assemble the valve spring seat and new stem seal. Apply molybdenum grease to the valve stem. Turn valve slowly and insert it into the guide, taking precautions not to damage the stem seal. Verify that valve is moving up and down smoothly.

Assemble the spring with its narrow side pitch facing the cylinder head.

Stem seal Valve Spring Retainer Cotter Narrow side

Assemble the spring retainer.

Compress the valve spring and install the valve cotter.

NOTE

Do not compress the valve spring more than necessary.

Tool: Valve spring compressor



Lightly strike the valve stem end for about 2-3 times to ensure better installation of the valve and cotter.

NOTE

Take necessary precautions not to damage valve.

Apply engine oil to the new O-ring, and assemble it to the carburetor insulator groove.

Tighten the carburetor insulator with mounting bolts.

Install the cam chain tensioner, and assemble pivot bolts.

Torque valve: 1.0kg-m (10N.m, 7ft-lb) Assemble spark plugs. Torque valve: 1.1kg-m (11N.m, 8ft-lb)

Cylinder Head Installation

Clean the gasket marks from the cylinder head gasket.

Assemble the cam chain guide to the cylinder. Assemble the dowel pins and new gaskets.

Assemble the cylinder head. Install the camshaft. Install the engine to the frame. (section 5)





Cam Shaft Assembly

Apply engine oil to the rocker arm shaft, and assemble the rocker arm to the camshaft holder.

Tighten the rocker arm shaft with 6mm bolts, and align the bolt hole of the camshaft holder with the fitting side of the rocker arm shaft.

check the camshaft assembly for abnormal condition, and place it on the cylinder head. Put the cam chain on the cam sprocket.

Slowly turn the crankshaft to the left, and align the "T" mark of the flywheel with the index mark of the R. crank case cover.

NOTE

Take precautions not to allow the cam chain to come off the camshaft timing gear while turning the camshaft



Apply engine oil to the camshaft, and install it on the cylinder head with the cam thread facing downward.

Assemble the cam chain and cam sprocket after matching the cam sprocket timing mark in parallel with the top of the cylinder head.



Install the dowel pins on the cylinder head. Install the camshaft holder.

NOTE

The hole of the camshaft holder and the fitting section of the rocker arm shaft fit section must be in alignment.

Of IN and EX, the shorter rocker arm should be installed on the IN side.

Apply engine oil to the threaded part; install the camshaft holder nut and bolts, and tighten them driving with 2 or 3 times.

Torque values: 8mm nut 2.9kg-m(29N.m, 21ft-lb)

Remove the sealing screws and washers from the cam chain tensioner lifter.

Turn the tensioner shaft to the right with a small driver, and insert the shaft into the body completely.

NOTE

If the cam chain tensioner lifer is dropped, the shaft will advance by the spring force.





Fix the tensioner shaft with a hard clip. assemble a new gasket to the tensioner lifter, and install the tensioner lifter on the cylinder. Tighten the tensioner mounting bolts. **Torque values: 1.2kg-m (12N.m, 9ft-lb)**

Remove the tensioner shaft clip from the tensioner lifter. Assemble sealing washers and screws to the tensioner lifter.

Torque values: 0.4kg-m(4N.m, 3ft-lb)

Fill clean engine oil into the operating parts of the cylinder head.

Adjust the valve clearance. (3-5)





Remove oil from the cylinder head cover grooves, and accurately assemble the gasket to the cover.

Assemble the cylinder head cover.

Tighten the cylinder head cover bolt.

Torque values: 1.3kg-m (13N.m, 9ft-lb)

- Install the R/L shroud. (8-2)
- Install the luggage box. (4-5)
- Install the center cover. (4-4)

