



SERVICE MANUAL

55Z-1, 57C-1

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Foreword

The Operator's Manual

⚠
You and others can be killed or seriously injured if you operate or maintain the machine without first studying the Operator's Manual. You must understand and follow the instructions in the Operator's Manual. If you do not understand anything, ask your employer or JCB dealer to explain it.

Do not operate the machine without an Operator's Manual, or if there is anything on the machine you do not understand.

Treat the Operator's Manual as part of the machine. Keep it clean and in good condition. Replace the Operator's Manual immediately if it is lost, damaged or becomes unreadable.

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Introduction

The valve train system opens and closes the valves with correct timing in relation to the piston movements. The valve train system controls the flow of air into the cylinders and out of the cylinders during engine operation. The cylinder head assembly has two valves for each cylinder. Each valve has one valve spring. The ports for the inlet valve and the exhaust valve are on the left side of the cylinder head.

Each push rod has one end in a valve tappet and the other end under a rocker arm.

The valves extend through the cylinder head. The valves are made from a special metal to provide a long service life. Damaged or worn valves cannot be lapped or reground and must be replaced with new ones. Each valve stem has an oil seal.

The Valve seat inserts are pressed into the cylinder head. The seat inserts are also made from a special metal to provide for a long service life. Damaged or worn valve seat inserts can be removed and replaced with new ones.

The valve moves along a steel valve guide. These valve guides are installed in the cylinder head and can be replaced.

Technical Data

Table 53.

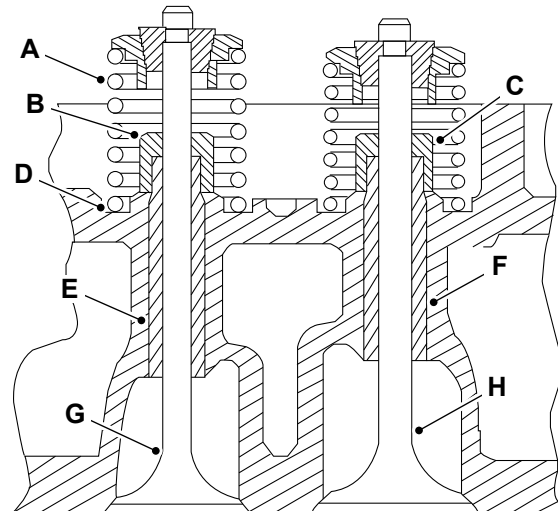
Description	Data	
	Inlet valve	Exhaust valve
Number of valves per cylinder	1	1
Valve lash	0.2mm	0.2mm
Valve guide seal	Black garter spring with a label "EX"	Silver garter spring
Valve seat angle Refer to Figure 122.	45°	45°

Table 54.

Description	Data	
	Standard	Service limit
Valve spring free length	35mm	33.5mm
Valve spring test force	79N	68.6N
Valve spring length under test force	30.4mm	-
Clearance between the exhaust valve and the valve guide Refer to Figure 119.	0.05–0.075mm	0.25mm
Clearance between the inlet valve and the valve guide Refer to Figure 119.	0.03–0.06mm	0.2mm
Diameter of the exhaust valve stem	6.94–6.955mm	6.84mm
Diameter of the inlet valve stem	6.955–6.97mm	6.89mm
Thickness of the valve head Refer to Figure 120.	0.925–1.075mm	0.5mm
Valve depth below the cylinder head face Refer to Figure 121.	0.65–0.95mm	1.8mm

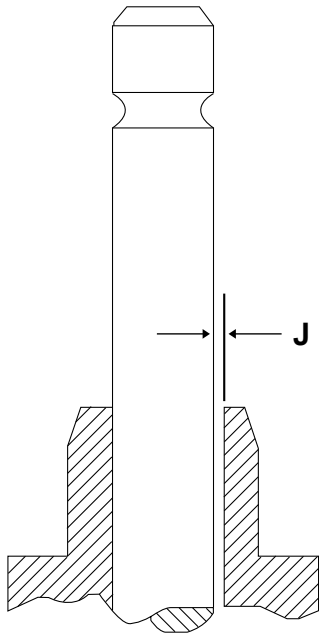
Description	Data	
	Standard	Service limit
Contact face exhaust valve Refer to Figure 122.	1.94–2.16mm	2.5mm
Contact face inlet valve Refer to Figure 122.	1.5–2mm	2.5mm

Figure 118.



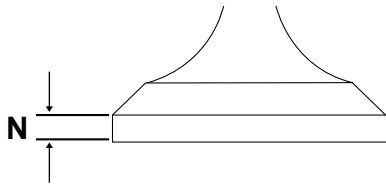
- A** Valve spring
- B** Exhaust valve guide seal
- C** Inlet valve guide seal
- D** Valve spring recesses
- E** Exhaust valve guide
- F** Inlet valve guide
- G** Exhaust valve stem
- H** Inlet valve stem

Figure 119.



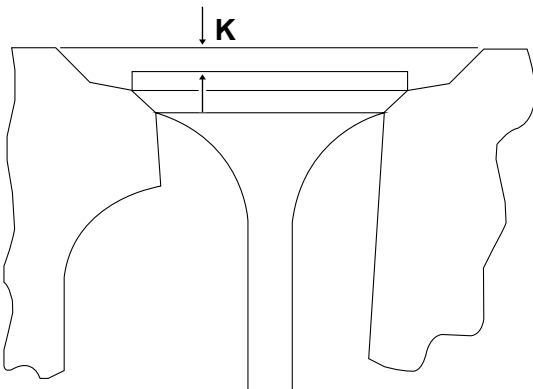
J Valve - valve guide clearance

Figure 120.



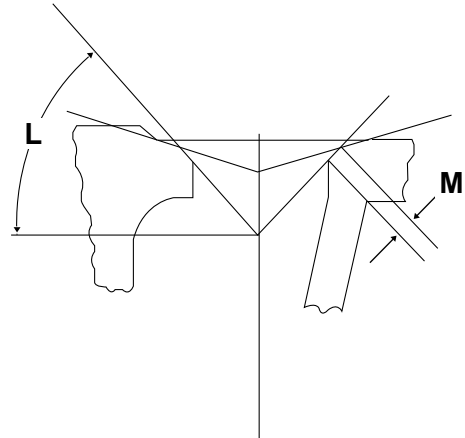
N Valve head thickness

Figure 121.



K Valve depth

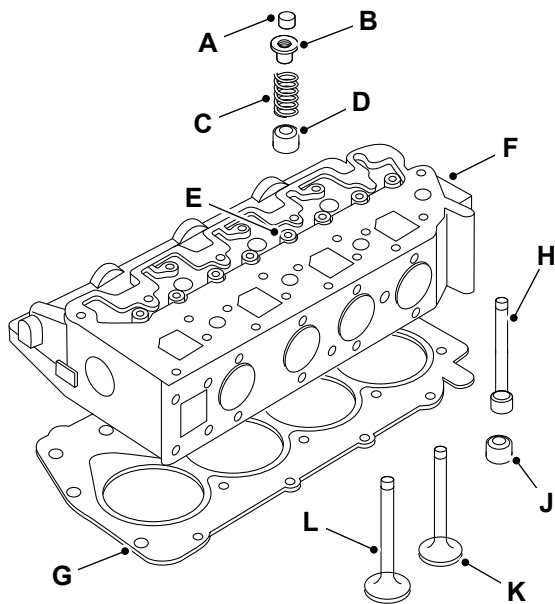
Figure 122.



L Valve seat angle
M Contact face

Component Identification

Figure 123.



- A Collets
- B Valve spring retainer
- C Valve spring
- D Valve seal
- E Valve guide
- F Cylinder head
- G Cylinder head gasket
- H Push-rod
- J Tappet
- K Exhaust valve
- L Inlet valve

Operation

The inlet valve and the exhaust valve are opened and closed by the rotation and movement of the following components:

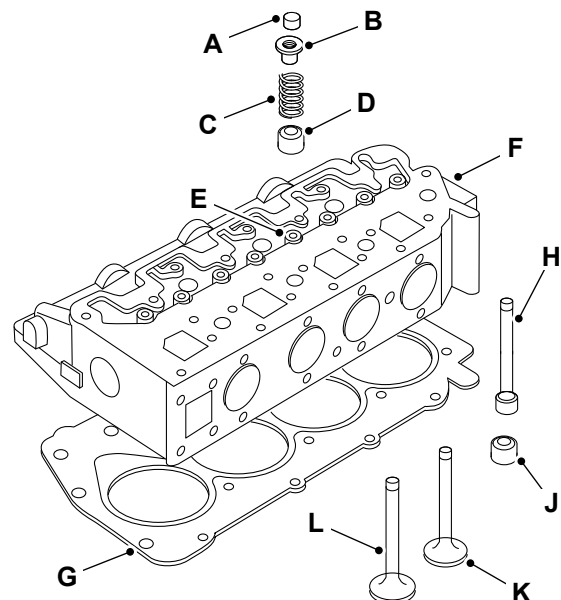
- Crankshaft
- Idler gear
- Camshaft
- Valve tappets
- Push-rods
- Rocker arms
- Valve springs

The camshaft drive gear is driven by the idler gear at half the speed of the crankshaft. The camshaft gear, the idler gear and the crankshaft gear are timed together. The camshaft lobes, two for each cylinder, (operating exhaust and inlet valves) actuate the valve tappets.

When the camshaft rotates the cam lobes act on the tappets. The push rods act on the rockers which pivot on the camshaft.

Each valve has a compression spring. The function of the spring is to close the valve and at the same time return the rocker arm and push rod to ensure that the tappets follow the camshaft lobes. The spring is located on the valve stem by a retainer and collets.

Figure 124.



- A Collets
- B Valve spring retainer
- C Valve spring
- D Valve seal
- E Valve guide
- F Cylinder head
- G Cylinder head gasket
- H Push-rod

J Tappet
K Exhaust valve
L Inlet valve

Check (Condition)

Valve Lash Setting

The valve lash setting given below is applicable only when the engine is cold.

Table 55.

Inlet valve	0.2 ± 0.05mm
Exhaust valve	0.2 ± 0.05mm

Valve Lash Inspection

If the valve lash requires adjustment several times in a short period of time, excessive wear exists in a different part of the engine. You must repair the problem to prevent further damage to the engine.

Not enough valve lash can cause rapid wear of the camshaft and the valve tappets. Not enough valve lash can indicate that the valve seats are worn. The valves become worn due to the following causes:

- Incorrect operation of the fuel injectors.
- Excessive dirt and oil are present in the inlet air filter.
- Incorrect fuel settings on the fuel injection pump.
- The load capacity of the engine is frequently exceeded.

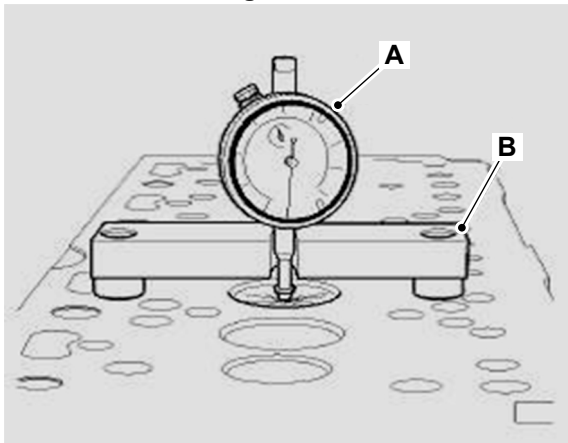
The excessive valve lash can cause broken valve stems, springs and the spring retainers. This excessive valve lash can be an indication of the following problems:

- Worn camshaft and valve tappets.
 - Worn rocker arms.
 - Bent push-rods.
 - Broken socket on the upper end of a push-rod.
 - Loose the adjustment screw for the valve lash.
1. If the camshaft and valve tappets show rapid wear, look for fuel in the lubrication oil or dirty lubrication oil as a possible cause.
 2. The valve lash is measured between the top of the valve stem and the rocker arm lever.
 3. Remove the rocker cover and perform the adjustment procedure to adjust the valve lash. Refer to (PIL 15-30).
 4. Inspect the valves for the cracks and other damage.
 5. Check the valve stems for wear.
 6. Check that the valve springs are the correct length under the test force. Refer to Valve-Technical Data (PIL 15-30).

Valve Depth Check

1. Use the DTI (Dial Test Indicator) with the DTI holder to check the depths of the inlet valves and the exhaust valves below the face of the cylinder head.
2. Use the cylinder head face to zero the DTI.
3. Position the DTI holder and the DTI and measure the valve depth.

Figure 125.



- A** DTI
B DTI holder

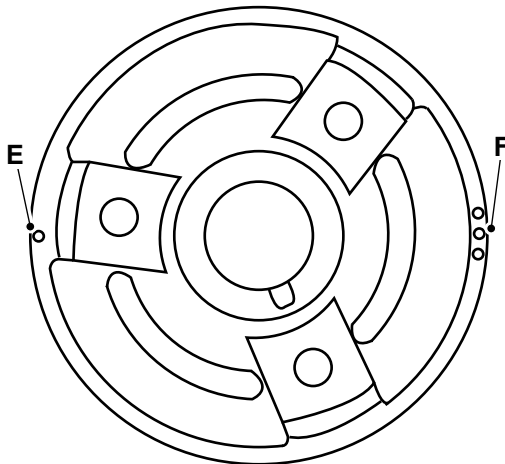
4. Measure the depth of the inlet valve and the exhaust valve before the valve springs are removed.
5. Make sure that the valve depth is within the specified limits. Refer to Valve- Technical Data (PIL 15-30).
 - 5.1. If the valve depth below the cylinder head face exceeds the service limit, replace the valve and check the valve depth.
 - 5.2. If the valve depth still exceeds the service limit, renew the cylinder head or if installed, renew the valve seat inserts.

Adjust

Valve Lash Adjustment

1. Make the machine safe. Refer to (PIL 01-03).
2. Remove the timing gear front case. Refer to (PIL 15-51).
3. Rotate the crankshaft in a clockwise direction (viewed from the front of the engine).
4. When the inlet valve of the No. 4 cylinder has started to open and the exhaust valve of the No. 4 cylinder has not completely closed, make sure that the "Top" mark on the timing case aligns with the "Single dot" on the crankshaft pulley.

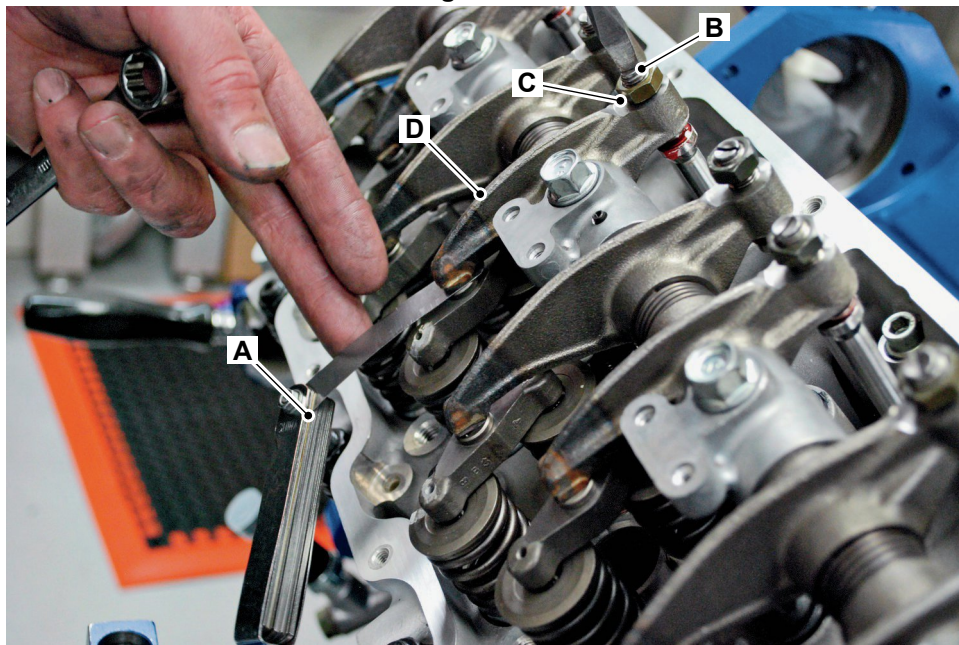
Figure 126.



- E** Single dot on crankshaft pulley
F Middle dot on crankshaft pulley

- 4.1. The "Single dot" on the crankshaft pulley is the reference point for the TDC (Top Dead Centre) position of No. 1 and No. 4 cylinders.
- 4.2. The "Middle dot" on the crankshaft pulley is the TDC reference point for No. 2 and No. 3 cylinders.
5. Check the valve lash of the inlet valve and the exhaust valve of the No. 1 cylinder.
6. If necessary, make an adjustment as follows:
 - 6.1. Loosen the locknut from the adjustment screw.
 - 6.2. Place the appropriate feeler gauge between the rocker arm and the valve.

Figure 127.



A Feeler gauge
C Locknut

B Adjusting screw
D Rocker arm

- 6.3. Hold the locknut and turn the adjustment screw.
- 6.4. Adjust the valve lash until the correct specification is achieved.
- 6.5. After each adjustment, hold the adjusting screw and tighten the locknut.
7. Rotate the crankshaft in a clockwise direction to the specified angle.
Angle: 180°
8. When the inlet valve of the No. 2 cylinder has started to open and the exhaust valve of the No. 2 cylinder has not completely closed, make sure that the "Top" mark on the timing case aligns with "Middle dot" on the crankshaft pulley.
9. Check the valve lash of the inlet valve and the exhaust valve of the No. 3 cylinder. If necessary, do the step 6
10. Rotate the crankshaft in a clockwise direction to the specified angle.
Angle: 180°
11. When the inlet valve of the No. 1 cylinder has started to open and the exhaust valve of the No. 1 cylinder has not completely closed, make sure that the "Top" mark on the timing case aligns with "Single dot" on the crankshaft pulley.
12. Check the valve lash of the inlet valve and the exhaust valve of the No. 4 cylinder. If necessary, do the step 6
13. Rotate the crankshaft in a clockwise direction to the specified angle.
Angle: 180°
14. When the inlet valve of the No. 3 cylinder has started to open and the exhaust valve of the No. 3 cylinder has not completely closed, make sure that the "Top" mark on the timing case aligns with "Middle dot" on the crankshaft pulley.
15. Check the valve lash of the inlet valve and the exhaust valve of the No. 2 cylinder. If necessary, do the step 6
16. Install the timing gear front case. Refer to (PIL 15-51).

Remove and Install

▲ WARNING Personal injury can result from being struck by parts propelled by a released spring force. Make sure to wear all necessary protective equipment. Follow the recommended procedure and use all recommended tools to release the spring force.

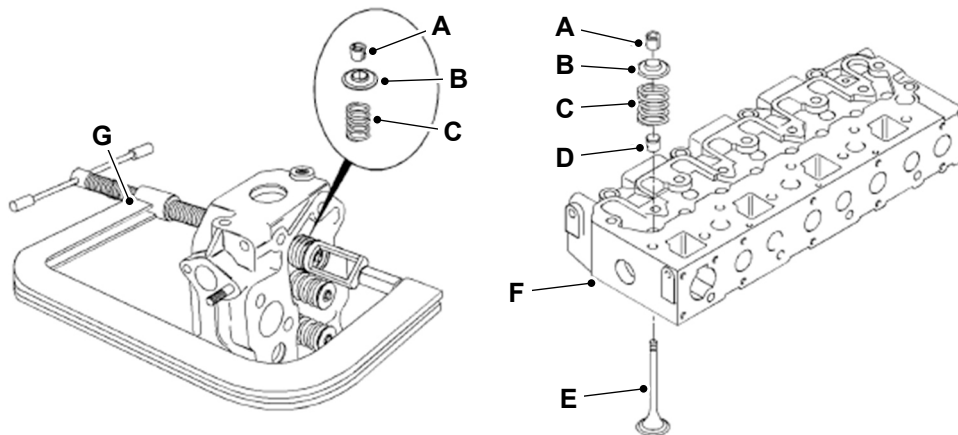
WARNING The valve spring keepers can be thrown from the valve when the valve spring compressor is released. Make sure that the valve spring keepers are properly installed on the valve stem. To help prevent personal injury, keep away from the front of the valve spring keepers and valve springs during the installation of the valves.

Remove

1. Make the machine safe. Refer to (PIL 01-03).
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Remove the cylinder head. Refer to (PIL 15-06).
4. Clean the bottom face of the cylinder head.

5. Check the depth of the valves below the face of the cylinder head before you remove the valve springs.
6. Mark the heads of the valves to help installation. Do not stamp the heads of the valves, this can cause the valves to fracture.
7. Compress the valve spring with the valve spring compressor tool.
8. Make sure that you compress the valve spring squarely or damage to the valve stem may occur.
9. Remove the valve keepers.
10. Do not compress the valve spring so that the valve spring retainer touches the valve stem seal.
11. Remove the valve spring compressor tool.
12. Remove the valve spring retainer.
13. Remove the valve spring.
14. Remove the valve.
15. Remove the valve stem seal.
16. Do the step 7 to step 15 for the remaining valves.

Figure 128.



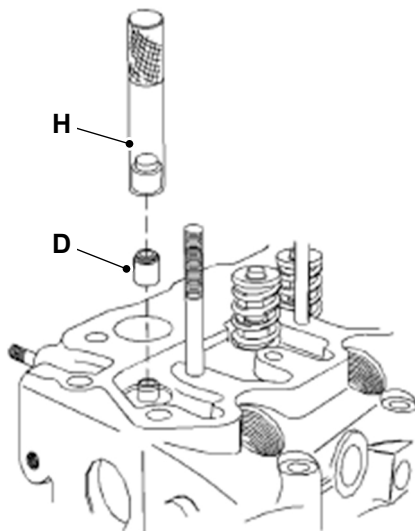
- A** Valve keeper
- C** Valve spring
- E** Valve
- G** Valve spring compressor tool

- B** Spring retainer
- D** Valve stem seal
- F** Cylinder head

Install

1. Clean all components of the cylinder head assembly.
2. Make sure that all ports, all coolant passages and all lubrication passages in the cylinder head are free from debris.
3. Do the step 3.1 to step 3.5 to inspect the components of the cylinder head assembly. Replace any components that are worn or damaged.
 - 3.1. Check the condition of the cylinder head. Refer to (PIL 15-06).
 - 3.2. Check the condition of the valve seats.
 - 3.3. Check the condition of the valve guide. Refer to (PIL 15-30).
 - 3.4. Check the condition of the valves.
 - 3.5. Check the condition of the valve spring. Make sure that its length is correct.
4. Make sure that the outer face of the valve guide is clean and dry.
5. Install the new valve stem seals on each of the valve guides with the valve stem seal installation tool.

9. Install the valve spring into the cylinder head. Position the valve spring retainer on the valve spring.
10. Compress the valve spring with the valve spring compressor tool.
11. Make sure that you compress the valve spring squarely or damage to the valve stem may occur.
12. Install the valve keepers.
13. Remove the valve spring compressor tool.
14. Do the step 7 to step 13 for the remaining valves.
15. Keep the cylinder head on a suitable support.
16. Make sure that the heads of the valves are not obstructed.
17. Gently hit the top of the valves with a soft hammer and make sure that the valve keepers are correctly installed.
18. Install the cylinder head. Refer to (PIL 15-06).

Figure 129.


- D** Valve stem seal
H Valve stem seal installation tool

6. Lubricate the valve stem with clean engine oil.
7. Install the valve in the correct position in the cylinder head.
8. Check the depth of the valve below the face of the cylinder head. Refer to (PIL 15-30).

12 - Valve Spring

Remove and Install

▲ WARNING Personal injury can result from being struck by parts propelled by a released spring force. Make sure to wear all necessary protective equipment. Follow the recommended procedure and use all recommended tools to release the spring force.

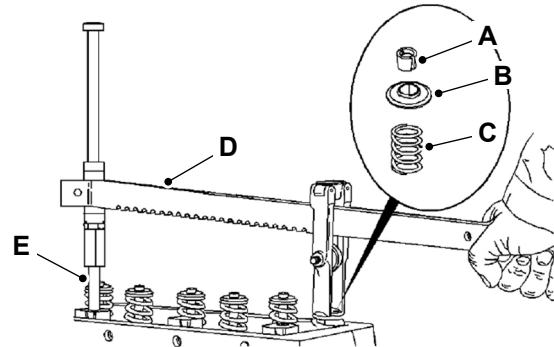
WARNING The valve spring keepers can be thrown from the valve when the valve spring compressor is released. Make sure that the valve spring keepers are properly installed on the valve stem. To help prevent personal injury, keep away from the front of the valve spring keepers and valve springs during the installation of the valves.

Remove

1. Make the machine safe. Refer to (PIL 01-03).
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Remove the rocker shaft assembly. Refer to (PIL 15-42).
4. Make sure that the appropriate piston is at TDC (Top Dead Centre) before you remove the valve spring.
5. Position the appropriate piston at TDC as follows:
 - 5.1. Install the tool1 and tool2 in position on the cylinder head to compress the valve spring.
 - 5.2. Compress the valve spring with the tool1 and open the valve slightly.
 - 5.3. Do not compress the spring so that the valve spring retainer touches the valve stem seal.
 - 5.4. Rotate the crankshaft carefully until the piston touches the valve.
 - 5.5. Do not use excessive force to turn the crankshaft. The use of force can bend the valve stems.
 - 5.6. Continue to rotate the crankshaft and gradually release the pressure on tool1 until the piston is at TDC. The valve is now held in position that allows the valve spring to be safely removed.
 - 5.7. Make sure that you compress the valve spring squarely or you may damage the valve stem.
6. Compress the valve spring with the tool1 and remove the valve keepers.

7. Do not turn the crankshaft when the valve springs are removed.
8. Slowly release the pressure on the tool1.
9. Remove the valve spring retainer and remove the valve spring.
10. Remove the tool1 and the tool2.

Figure 130.



- A** Valve keepers
- B** Spring retainer
- C** Valve spring
- D** Tool1
- E** Tool2

Install

1. The installation procedure is the opposite of the removal procedure.

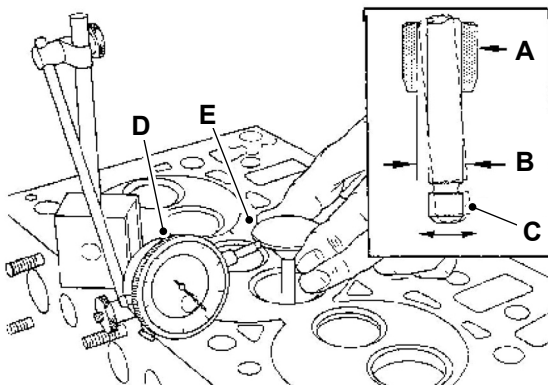
15 - Valve Guide

Check (Condition)

1. Make the machine safe. Refer to (PIL 01-03).
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Remove the cylinder head. Refer to (PIL 15-06).
4. Place a new valve in the valve guide.
5. Place the DTI (Dial Test Indicator) with the magnetic base on the face of the cylinder head.
6. Lift the edge of the valve head to the specified distance.
 Length/Dimension/Distance: 15mm
7. Move the valve in a radial direction away from the DTI.
 - 7.1. Make sure that the valve moves away from the DTI as far as possible.

- 9.1. Make sure that the clearance of the valve in the valve guide is within the specified limit. Refer to Valve- Technical data (PIL 15-30).
- 9.2. If the clearance of the valve in the valve guide is within the specified limit, replace the valve guide. Refer to (PIL 15-30).

Figure 131.



- A** Valve guide
- B** Radial movement of the valve in the valve guide
- C** Valve stem
- D** DTI
- E** Valve head

- 7.2. Position the contact point of the DTI on the edge of the valve head.
- 7.3. Set the position of the needle of the DTI to zero.
8. Move the valve in a radial direction towards the DTI as far as possible.
9. Make a note of the distance of movement which is indicated on the DTI.

Technical Data

Table 56. Diameter of connecting rod bearing journal

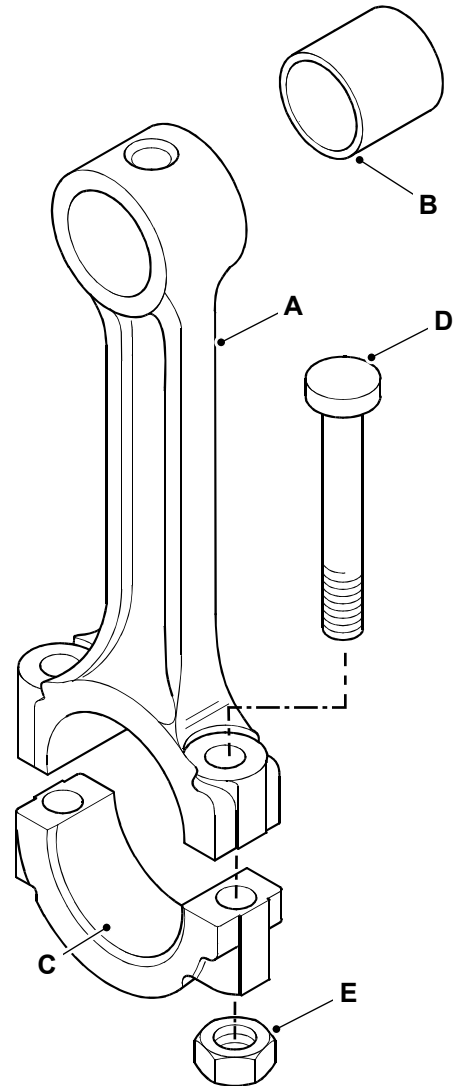
Journals	Diameter	Service limit
Standard	51.964–51.975mm	51.9mm
Undersize 0.25mm	51.714–51.725mm	51.65mm
Undersize 0.5mm	51.464–51.475mm	51.4mm

If the diameter of the connecting rod bearing journal is less than the maximum undersize service limit, then the crankshaft must be replaced.

Table 57. Clearances

Description	Data	
	Standard clearance	Service limit
Clearance between the connecting rod bearing and the connecting rod bearing journal	0.035–0.085mm	0.2mm
Clearance between the piston pin and the piston pin bearing	0.01–0.025mm	0.1mm
Clearance between the connecting rod bore and the connecting rod bearing	0.1–0.3mm	0.7mm

Figure 132.



- A Connecting rod
- B Piston pin bearing
- C Connecting rod bearing
- D Bolt
- E Nut

Table 58. Torque Values

Item	Description	Nm
D	Bolt	52

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