

SERVICE MANUAL

LOADER
TM180, TM220

EN - 9813/3150 - ISSUE 2 - 08/2018

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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.

Contents

- 01 - Machine**
- 03 - Attachments, Couplings and Load Handling**
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Operation

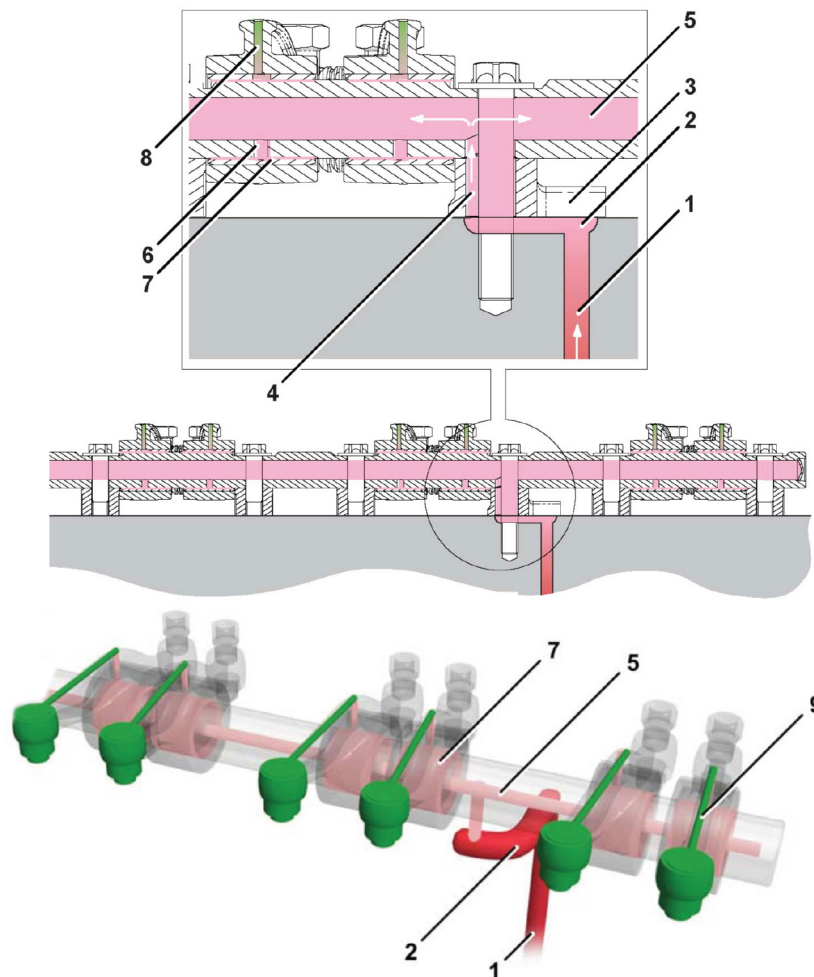
When the camshaft lobe raises the push-rod, the push-rod pushes the rocker arm up. Due to this the rocker arm presses down on the valve stem to open the valve. When the rocker arm returns due to the camshafts rotation, the valve spring closes the valve.

Lubrication

Oil is fed from the main gallery through a drilling which passes up through the crankcase and cylinder

head to a small transfer gallery under the rocker shaft pedestal. The oversize rocker shaft fixing bolt hole allows oil to pass into a drilling in the centre of the rocker shaft. Further cross drillings transfer oil to each of the rocker pivot bushes. A cross drilling in each rocker transfers oil to the top of the rocker where it flows by gravity along a groove to the rocker tip.

Figure 229.



- 1 Main gallery
- 3 Shaft pedestal
- 5 Centre rocker shaft drilling
- 7 Rocker pivot bushes
- 9 Groove

- 2 Small transfer gallery
- 4 Rocker shaft fixing bolt hole
- 6 Cross drillings
- 8 Cross drilling

Check (Condition)

1. Check the rocker shaft and rocker bushings for signs of damage and excessive wear. Measure the rocker shaft diameter and rocker bearing bushes to confirm they are within service limits. Refer to Technical Data. Note: The rocker bearing bushes are not renewable. If a rocker bearing bush is damaged or worn the rocker must be renewed as a complete assembly.

Refer to: [PIL 15-42](#).

2. Make sure that all oil-ways and cross drillings in the rocker shaft, rocker arms and pedestals are clear and free from debris. Use an air line to blow through cross drillings.

Remove and Install

Before Removal

1. 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.
2. Get access to the engine.
3. Disconnect and remove the fuel pipes from the fuel injectors.

Refer to: [PIL 18-96](#).

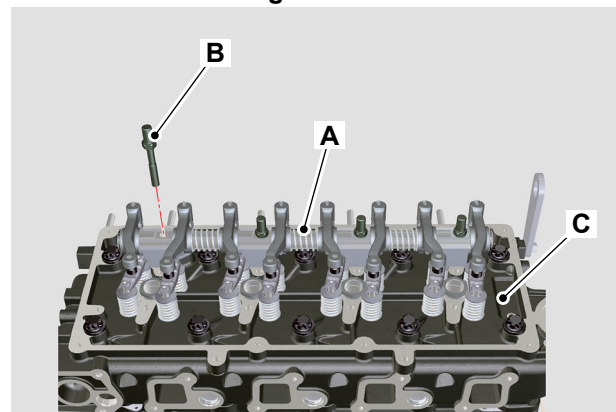
4. Remove the rocker cover.

Refer to: [PIL 15-42-06](#).

Remove

1. Remove the rocker shaft fixing screws.

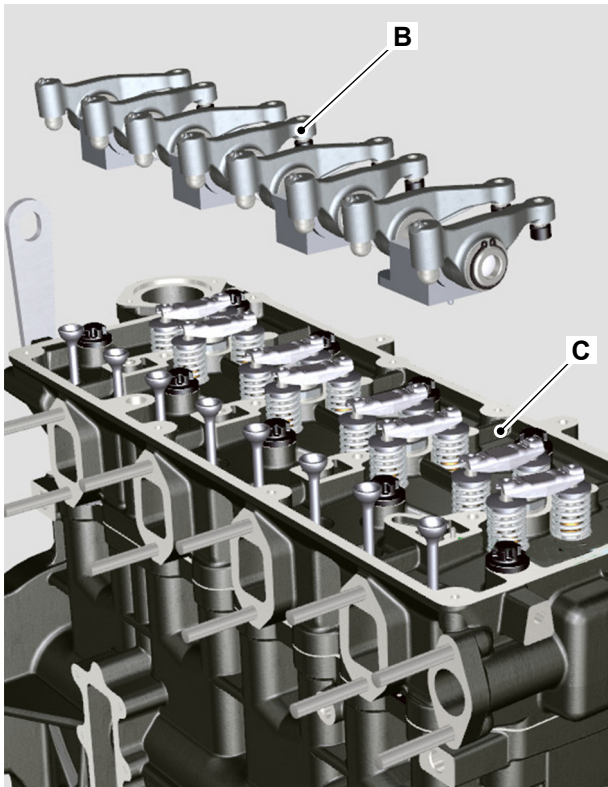
Figure 230.



- A** Rocker shaft fixing screw (x4)
- B** Rocker arm assembly
- C** Cylinder head

2. Make sure that you keep all the fixing screws in their original positions.
3. Lift the rocker arm assembly from the cylinder head completely.

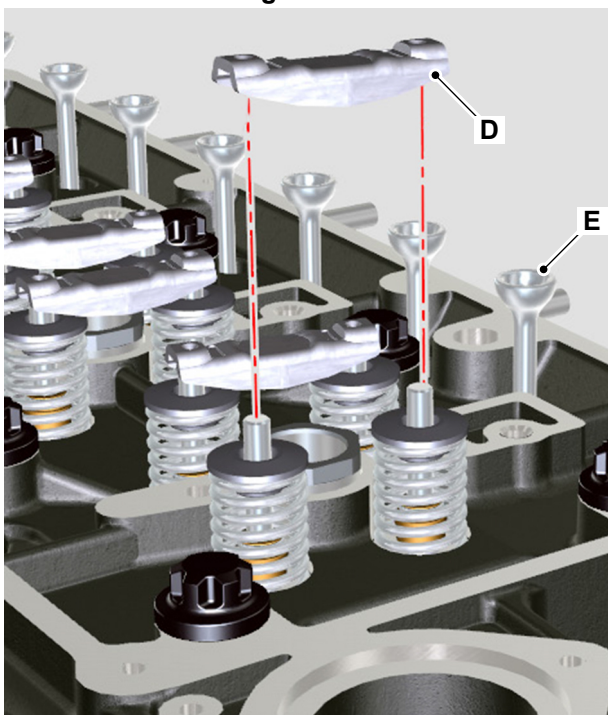
Figure 231.



B Rocker arm assembly
C Cylinder head

4. Lift off the valve bridge pieces from the pairs of inlet and exhaust valves.

Figure 232.



D Valve bridge (x6)
E Push rod (x6)

5. Remove the push rods from the crankcase.

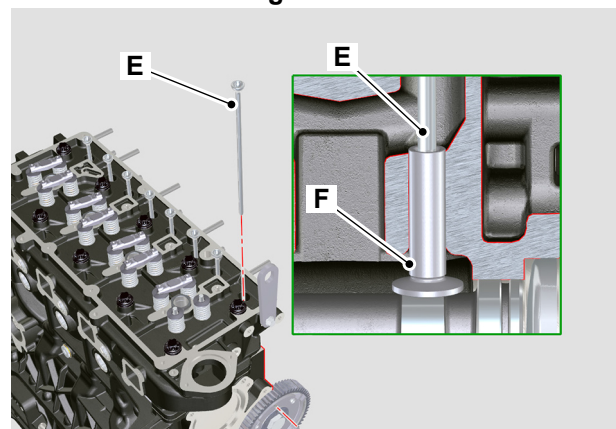
Before Installation

1. Make sure that all items are clean and free from damage and corrosion. If components within the rocker assembly are damaged or worn.
2. Make sure that all oilways and cross drillings in the cylinder head, rocker shaft and pedestals are clear and free from debris. Use an air line to blow through the cross drillings.
3. Use a suitable degreasing agent to clean the top of the cylinder head.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Insert the push rods into the crankcase. Make sure that they engage with the camshaft tappets.

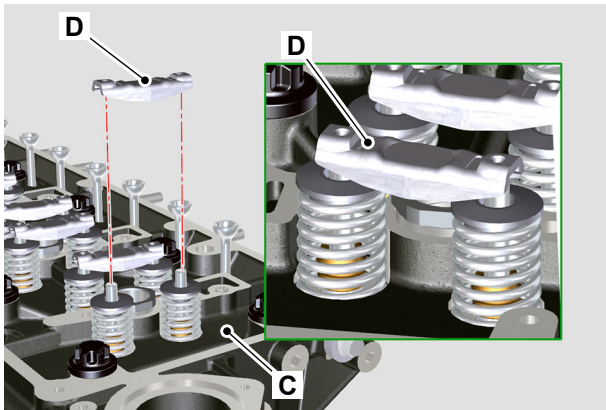
Figure 233.



E Push rod
F Camshaft tappet

3. Install the bridge pieces on to the pairs of inlet and exhaust valves in the cylinder head.

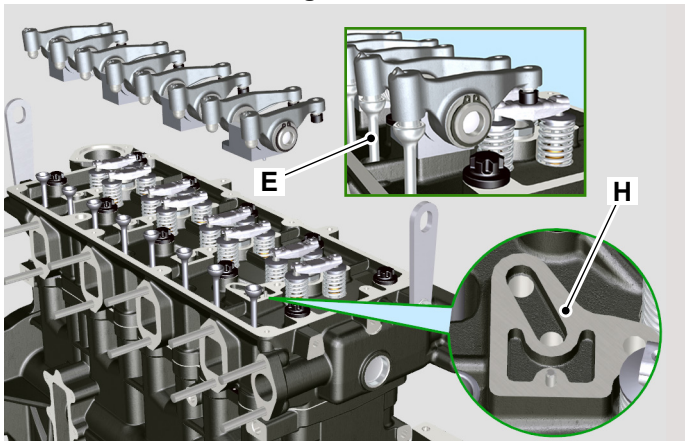
Figure 234.



C Cylinder head
D Valve bridge

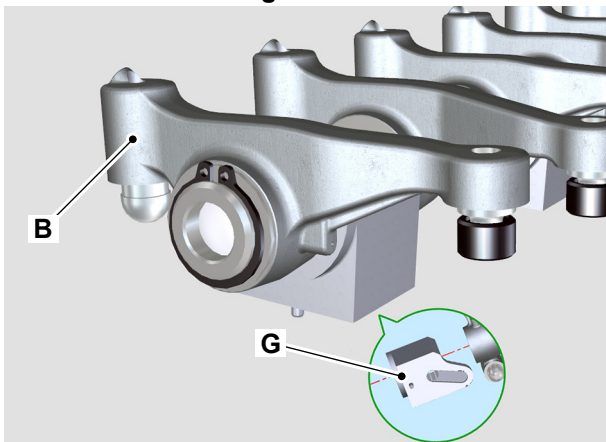
4. Align the rocker arm assembly on a level surface.
5. Make sure that you install the rocker arm assembly on the cylinder head with respect to the plug and the holder.

Figure 235.



E Push rod
H Plug

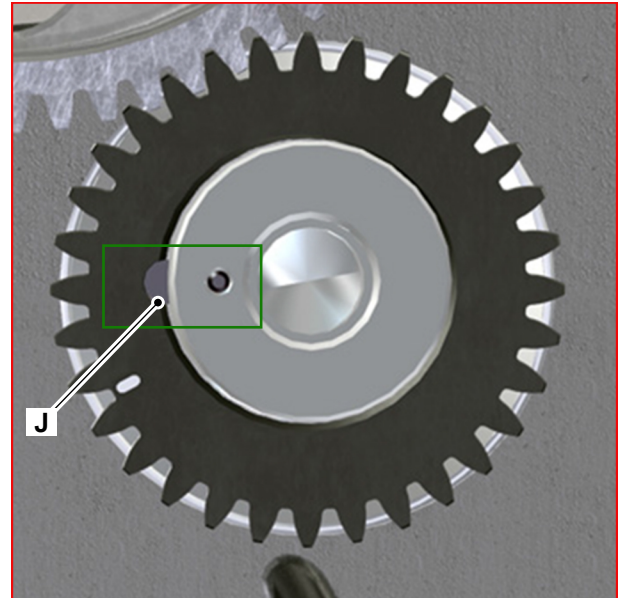
Figure 236.



B Rocker arm assembly
G Holder

6. Make sure that the rocker arm assembly is seated properly on the push rod.
7. Make sure that you put the crankshaft gear key in the position as shown to avoid the rocker arm rod bending at the time of tightening the fixing screws.

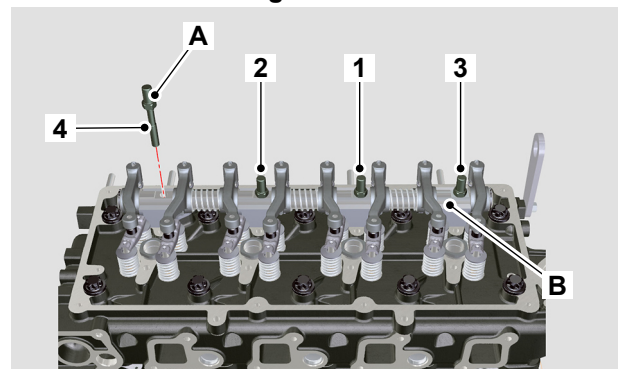
Figure 237.



J Gear key

8. Put the rocker arm fixing screws and tighten the screws in the sequence shown.

Figure 238.



A Rocker shaft fixing screw
B Rocker arm assembly

9. Tighten the screws to the correct torque value.

After Installation

1. Measure and adjust the valve clearances.
[Refer to: PIL 15-30.](#)
2. Install the rocker cover.
[Refer to: PIL 15-42-06.](#)

3. Install and connect the fuel pipes to the fuel injectors.

Refer to: [PIL 18-96](#).

Table 76. Torque Values

Item	Nm
A	25

Disassemble and Assemble

Special Tools

Description	Part No.	Qty.
Insertion Pliers for Hydraulic Tappets	892/12425	1

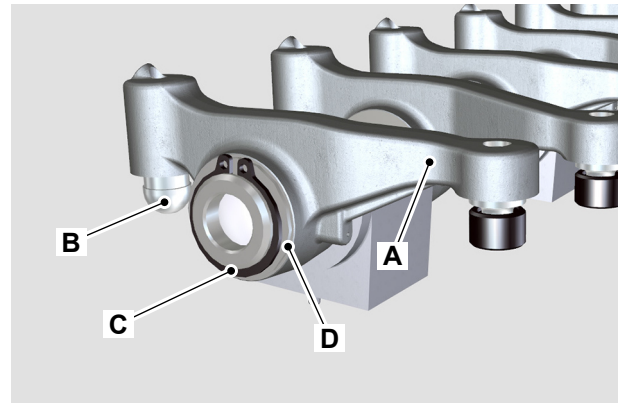
Before Disassembly

1. Remove the rocker cover.
Refer to: [PIL 15-42-06](#).
2. Remove the rocker assembly.
Refer to: [PIL 15-42-00](#).

Disassemble

1. Remove the retainer ring.

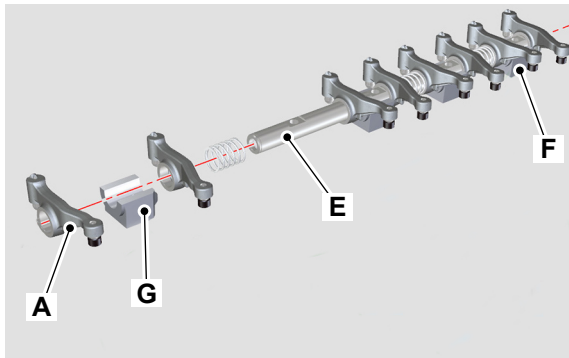
Figure 239.



- A** Discharge rocker arm
- B** Hydraulic tappet
- C** Retainer
- D** Shoulder ring

2. Remove the shoulder ring.
3. Remove the rockers and the holders from the rocker shaft.

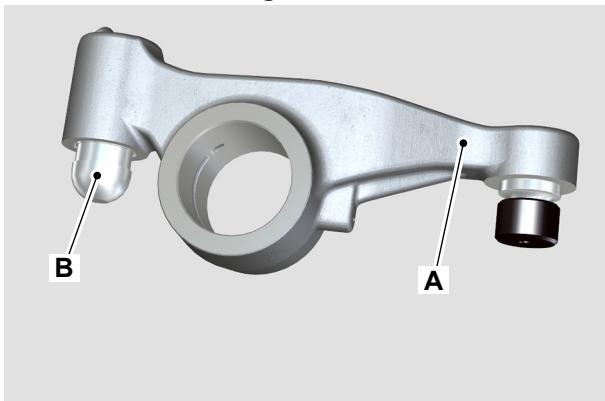
Figure 240.



- A Discharge rocker arm
- E Rocker shaft
- F Holder
- G Holder 1

4. Label the rockers and the holders to make sure that they are installed in the correct positions on assembly.
5. Remove the tappets from the rocker.

Figure 241.



- A Discharge rocker arm
- B Hydraulic tappet

6. Check (Condition) of the rocker arm assembly for signs of damage and excessive wear.

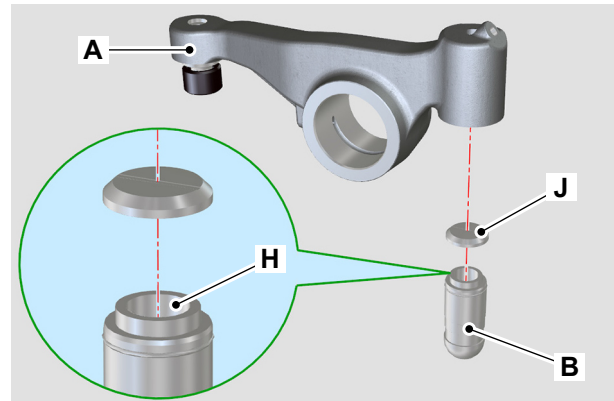
Refer to: [PIL 15-42-00](#).

Assemble

1. The assembly procedure is the opposite of the disassembly procedure. Additionally do the following steps.
2. Install the tappets into the rocker arm.
 - 2.1. Insert the tappets into the hydraulic tappet insertion pliers.

Special Tool: [Insertion Pliers for Hydraulic Tappets \(Qty.: 1\)](#)
 - 2.2. Fill the chamber of the tappet with oil.
 - 2.3. Put the pad on the tappet.

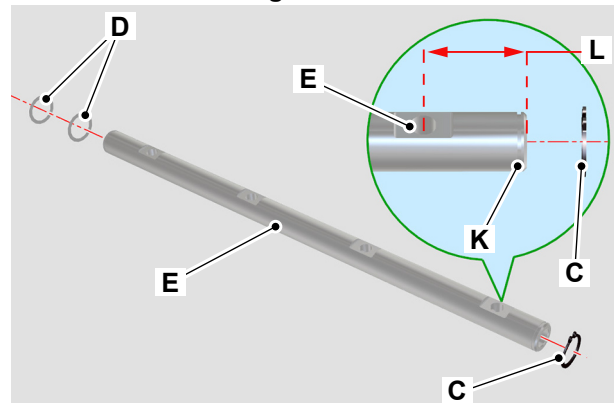
Figure 242.



- A Discharge rocker arm
- B Hydraulic tappet
- H Chamber
- J Pad

- 2.4. Position the rocker arm in the pliers.
- 2.5. Use the pliers to push the tappet through the rocker arm until the tappet is properly inserted.
3. Lubricate the rocker shaft with clean engine oil.
4. Install the rocker arms in the correct position, turn the rocker shaft with the lower height towards the timing gear system side.
5. Put the lock ring into the seat of the rocker shaft.

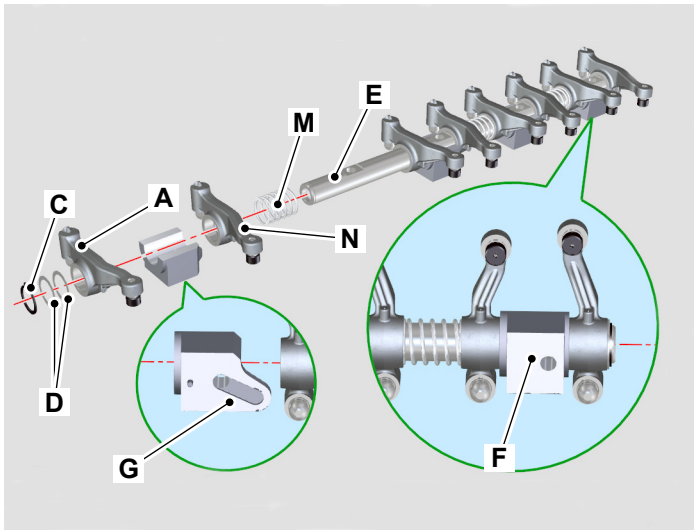
Figure 243.



- C Retainer
- D Shoulder ring
- E Rocker shaft
- K Seat
- L Rocker shaft lower height

6. Position the fixing screw support surface facing upwards.
7. Put the two shoulder rings on the rocker shaft.
8. Sequentially put the suction rocker arm, the holder and the discharge rocker arm on the rocker shaft.

Figure 244.



- A** Discharge rocker arm
- C** Retainer
- D** Shoulder ring
- E** Rocker shaft
- F** Holder
- G** Holder 1
- M** Spring
- N** Suction rocker arm

9. The discharge rocker arm is shorter than the suction rocker arm.
10. Install the spring on the rocker shaft.
11. Do the steps 8 and 10 for all the remaining rocker arms.
12. Install the holder 1 with the last pair of rocker arm towards the flywheel.
13. The spring makes sure that the holder and the holder 1 are kept in place.
14. Make sure that the rockers are installed in their original positions along the rocker shaft.
15. Put the shoulder rings and the lock ring to lock all the components on the rocker shaft.

After Assembly

1. Install the rocker assembly.
[Refer to: PIL 15-42-00.](#)
2. Install the rocker cover.
[Refer to: PIL 15-42-06.](#)

Remove and Install

Special Tools

Description	Part No.	Qty.
Rocker Arm Cover Mounting Studs	892/12426	1

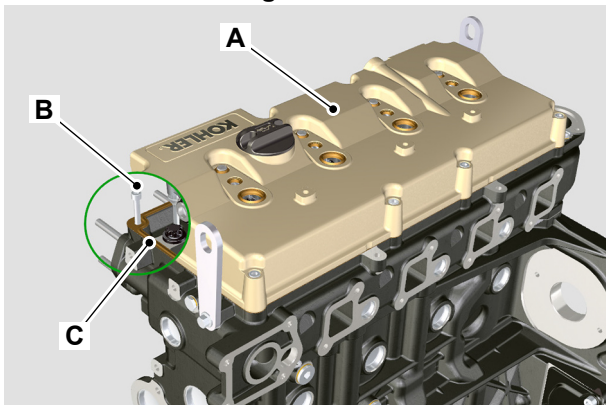
Before Removal

1. 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.

2. Clean the engine.

Refer to: [PIL 15-00-00](#).

Figure 245.

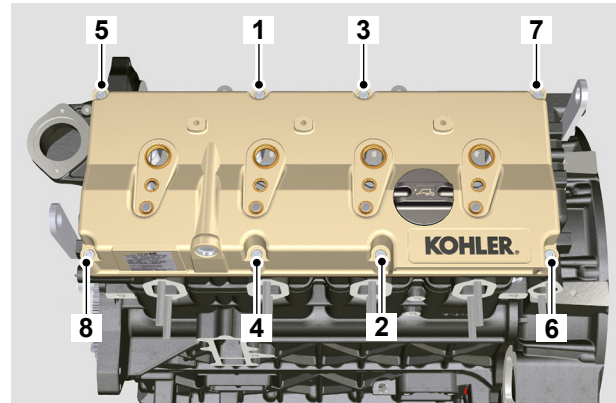


- A Rocker arm cover
- B Screws
- C Gasket

Remove

1. Get access to the engine.
2. Remove the high pressure fuel pipes.
Refer to: [PIL 18-96-03](#).
3. Remove the fuel bleed off fuel pipes.
Refer to: [PIL 18-96-06](#).
4. Disconnect the electrical connectors at the fuel injectors.
Refer to: [PIL 18-18-03](#).
5. Disconnect the electrical connector at the coolant temperature sensor.
Refer to: [PIL 15-84-33](#).
6. Move the electrical harness away from the rocker cover.
7. Progressively remove the rocker arm cover screws from 1 to 8 in reverse order, starting at bolt 8.

Figure 246.



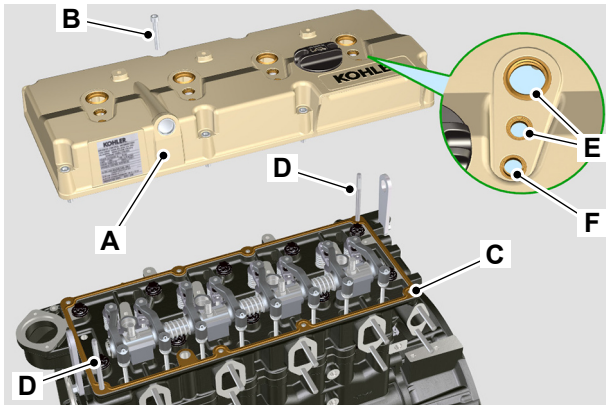
8. Lift the rocker cover from the cylinder head
9. Discard the gasket.
10. The rocker cover injector seals must be replaced.

Refer to: [PIL 18-18-03](#).

Install

1. Remove all oil and sludge contamination from inside the valve chamber.
2. Use a new rocker arm cover gasket.
3. Make sure you align the gasket on the cylinder head with the rocker cover fastening screws.
4. Locate the two guide pins before mounting the rocker arm cover.
Special Tool: [Rocker Arm Cover Mounting Studs](#) (Qty.: 1)
5. Put sleeves/covers on the four injectors to prevent from damage.
6. Apply a Vaseline lubricant to the seals.

Figure 247.



- A Rocker arm cover
- B Screws
- C Gasket
- D Guide pins
- E Seal (lubricate upper part)
- F Seal (lubricate inner part)

7. Install the rocker arm cover and put the screws in sequence from 1 to 8.
8. Tighten the screws to the correct torque value.
9. Remove the sleeves/covers.

After Installation

1. The high pressure fuel pipes must be replaced with new parts.
[Refer to: PIL 18-96-03.](#)
2. Start the engine and check for oil and fuel leaks.

Table 77. Torque Values

Item	Nm
B	10

Technical Data

Tappets Dimensions

Figure 248.

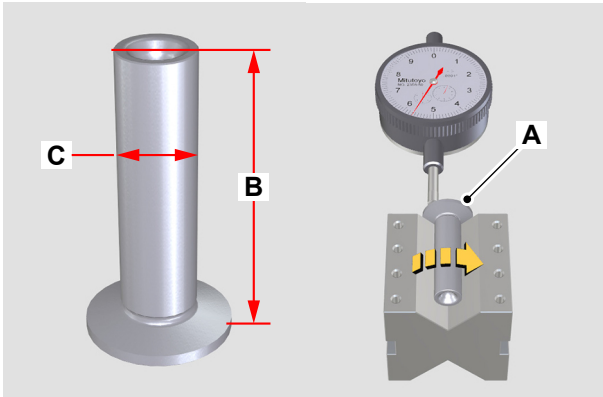
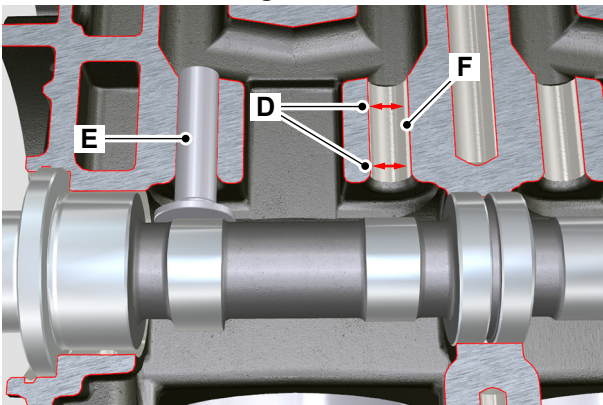


Table 78.

Item	Dimension Aspect	Dimension
A	Perpendicularity	0.02mm (max)
B	Length	46.5 ± 0.2mm

Clearance between Tappet and Housing

Figure 249.



- E Tappet
- F Tappet housing

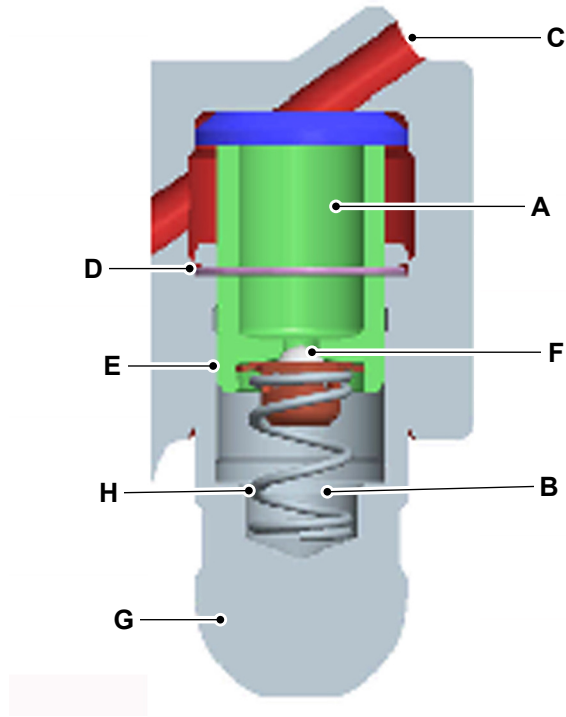
Table 79.

Item	Dimensions	Clearance	Wear Limit
C	11.966-11.984mm	0.060-0.105mm	0.080mm
D ⁽¹⁾	12.000-12.018mm		

(1) Measure the diameter at two points. The difference between the two values measured must not be more than be 0.02mm.

Component Identification

Figure 250.



- A Low pressure chamber
- C Hydraulic tappets oil refill pipe
- E Piston
- G Tappet body

- B High pressure chamber
- D Retaining ring
- F Unidirectional valve
- H Spring

Operation

requires the removal and replacement of oil and hydraulic tappets.

Hydraulic Tappet

The operating principle of the hydraulic tappet is based on the incompressibility of the liquid and on controlled leakage between the piston and the tappet body.

A constant supply of pressurised oil is provided to the low pressure chamber. The pressurized oil can only get the access to the high pressure chamber through the unidirectional (non-return) valve.

The high pressure chamber is filled when the rocker arm is on the base radius of the cam and the spring holds the piston against the valve stem preventing from system play as well as vibration and noise.

Due to the spring movement, the tappet extends. This creates a small pressure decrease in the high pressure chamber to open the non-return valve. Oil is then transferred from the low pressure chamber to the high pressure chamber to restore the proper amount of oil required to eliminate any play in the valves.

Difficult Operating Conditions

For proper operation of the hydraulic tappets it is essential that the low pressure chamber of the piston is always full of oil.

In some conditions this may not occur (due to the fact that oil leaks away when the engine is switched off, which can also partially drain the tappets): this situation will result in play that will occur with a typical noise similar to ticking, not to be confused with the normal ticking of the injectors.

When the engine is cold, the tappet filling time could be very long if the oil used is not suitable for the specific environmental conditions.

If the engine is very hot or at idle speed, oil pressure may be low, and small air bubbles could form in the circuit. Because of this, the lubricant becomes compressible, thus compressing the tappet slightly and producing valve play which is responsible for the ticking sound.

In all cases, the ticking should not last too long (max 5 minutes) if not, the problem will surely be due to the poor quality of the oil, wear or impurities that, transported by the oil, can infiltrate between the ball valve and its seat inside the piston. This affects the operation of the tappet itself. In these cases you must replace the oil or the hydraulic tappets.

Continuous ticking or abnormal sound for prolonged periods is a symptom of a possible malfunction, and

Check (Condition)

Tappets and Tappet Housing Check

1. Put the tappet on a V-notch surface plate.
2. Measure the following dimensions of the tappet and tappet housing.
 - 2.1. Perpendicularity of the base with a dial gauge.
 - 2.2. Length of the tappet to assess the wear.
 - 2.3. Diameter of the tappet housing with an internal dial gauge.
3. Make sure that you measure the housing diameter at two locations and the difference between the two values should not be more than 0.02mm.
4. Measure the clearance between the tappet and the tappet housing from the values derived in step 2.
5. Make sure that all the values are within the allowable limits.

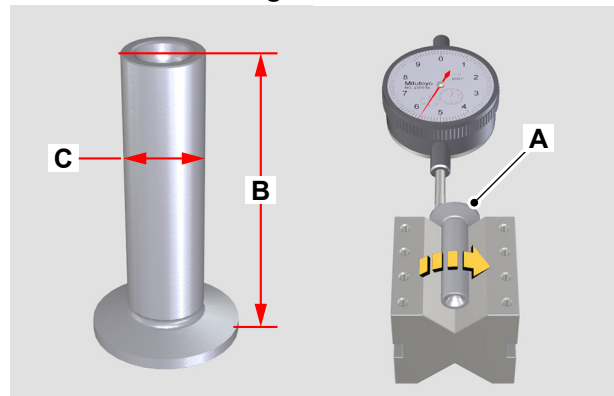
Refer to: [PIL 15-42-21](#).

Calibrate

Tappets Dimensions

Use a surface plate and a dial gauge as shown. Check the perpendicularity of the plate, making the tappet rotate in the direction of the arrow. With a gauge, check the length of the tappet to assess wear. The values measured must be within tolerances. Refer to: [PIL 15-42-21](#).

Figure 251.

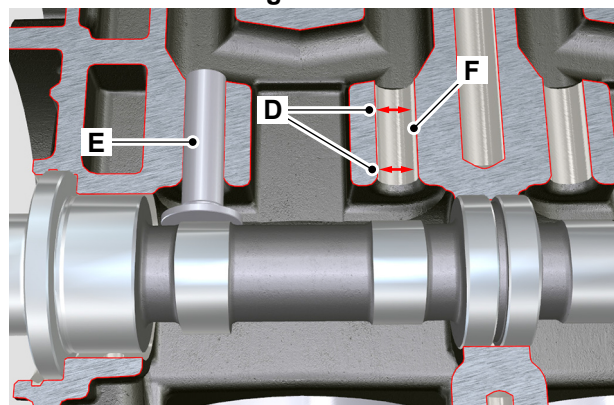


- A Tappet diameter
- B Tappet length
- C Perpendicularity

Clearance between Tappet and Housing

Use an internal dial gauge to measure the diameter of the tappet housings. Measure quota in two different points. The difference between the two values measured must be within tolerance. Refer to: [PIL 15-42-21](#).

Figure 252.



- D Quota
- E Tappet
- F Tappet housing

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