



SERVICE MANUAL

EXCAVATOR
JCB305, JS305

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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

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Check (Condition)

1. Check the bearing shell surfaces for signs of damage and excessive wear.
2. Measure the crank pin diameters to confirm they are within service limits, refer to Technical Data (PIL 15-33).
3. Renew any parts that are worn or not within the specified tolerances.

Remove and Install

Special Tools

Tool Category	Description	Part No.	Qty.
Special Tool	Torque Wrench (10-100Nm)	993/70111	1

Before Removal

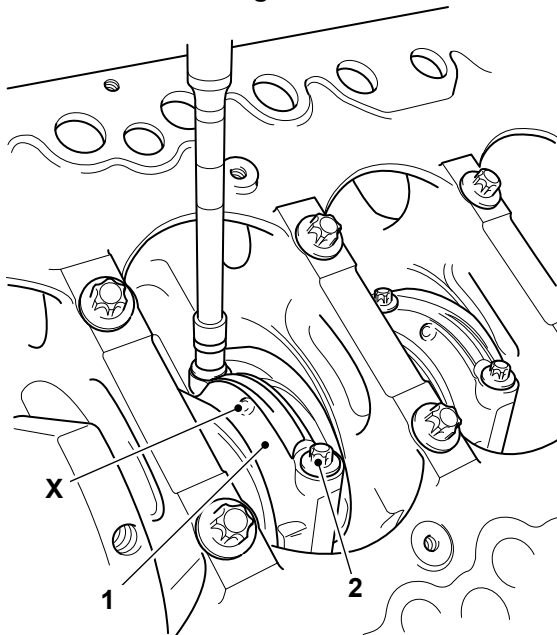
1. This procedure requires service parts. Make sure you have obtained the correct service parts before you start, refer to Parts Catalogue.
2. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
3. Get access to the engine.
4. Disconnect and remove the fuel pipes from the injectors, refer to (PIL 18-96).
5. Remove the rocker cover, refer to (PIL 15-42).
6. Remove the fuel injectors, refer to (PIL 18-18).
7. Drain the oil from the engine, refer to (PIL 15-21).
8. Remove the oil sump, refer to (PIL 15-45).
9. Position the engine upside down in a suitable jig or fixture, supported at the front of the crankcase.

The connecting rod and the big-end bearing cap have been fracture split and must be kept together as a set. Care must be taken to avoid contamination and or damage to the fracture split surfaces.

Remove

1. It is recommended that the big-end bearing caps are removed in pairs, cylinders 1 and 4 and cylinders 2 and 3. Rotate the crankshaft so that the big-end bearing caps on cylinders 2 and 3 are positioned as shown.
2. Remove the bolts and lift off the big-end bearing caps from the connecting rods. The bolts must not be re-used, discard the bolts.

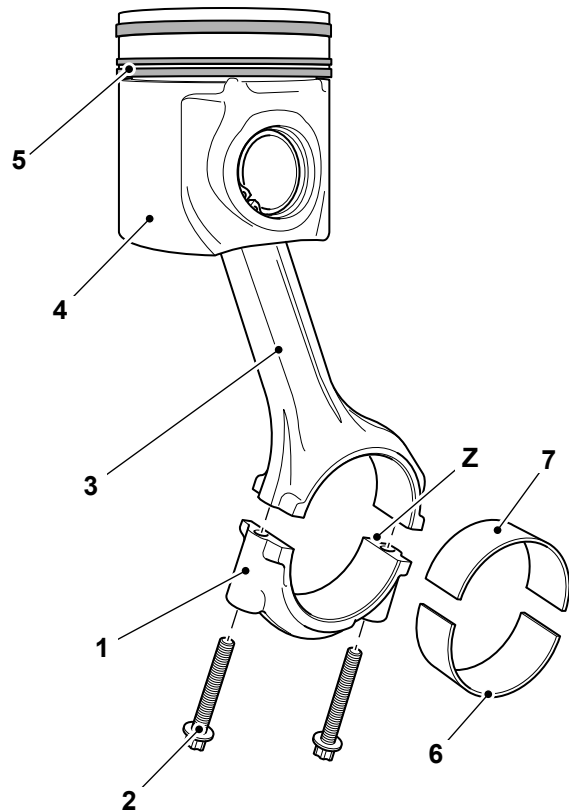
Figure 148.



- 1 Big-end bearing caps
- 2 Big-end bearing cap bolts
- X Cast notch

3. Lift out the bearing shells from the bearing caps. Carefully rotate the crank to disengage from the connecting rods and get access to the upper bearing shells. Lift out the upper bearing shells. It is recommended that the bearing shells are renewed. If they are to be reused, label the bearing shells to make sure that they are installed in their original positions on assembly.

Figure 149.



- 1 Big-end bearing cap
- 2 Bolts
- 3 Connecting rod
- 4 Piston
- 5 Piston rings
- 6 Lower bearing shell
- 7 Upper bearing shell
- Z Fracture split surfaces

4. Carefully rotate the crankshaft to position the big-end bearing caps of cylinders 1 and 4. Make sure that the crank does not foul the connecting rods of cylinders 2 and 3. Remove the bearing caps and bearing shells as described in previous steps.
5. Inspect the big-end bearings for signs of damage and excessive wear, refer to Check Condition (PIL 15-12).

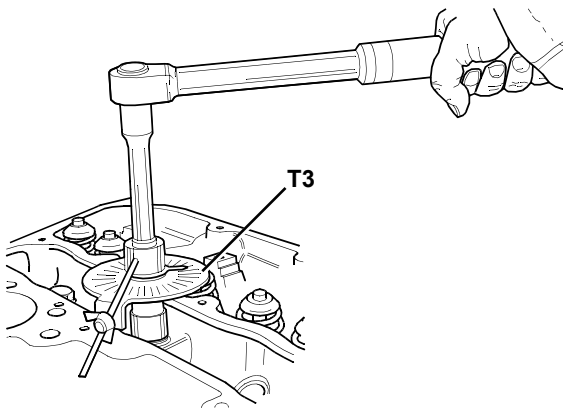
Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that all items are clean and free from damage and corrosion.

3. Install the upper bearing shell to the connecting rod. Lubricate the bearing shell with clean engine oil.
4. Install the lower bearing shell to the big-end bearing cap. Lubricate the bearing shell with clean engine oil. Install the big-end bearing cap to the connecting rod. Make sure that the cast notch on the bearing cap faces to the front of the engine. Use compressed air to clean the fracture surfaces before assembly.
5. Install new fixing bolts. Tighten the new bolts in three stages to the correct torque value.

Special Tool: Torque Wrench (10-100Nm) (Qty.: 1)

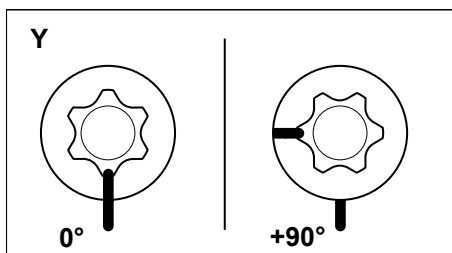
Figure 150.



T3 Angle gauge (obtain locally)

6. The bolts are tightened using a torque and angle method, refer to Fasteners and Fixings, General, Introduction (PIL 72-00).

Figure 151.



After Installation

1. Carry out the procedures listed, Before Removal in reverse order.

Table 65.

Item	Torque Value
2 - 1st Stage	35N·m
2 - 2nd Stage	65N·m
2 - Final Stage	90°

Technical Data

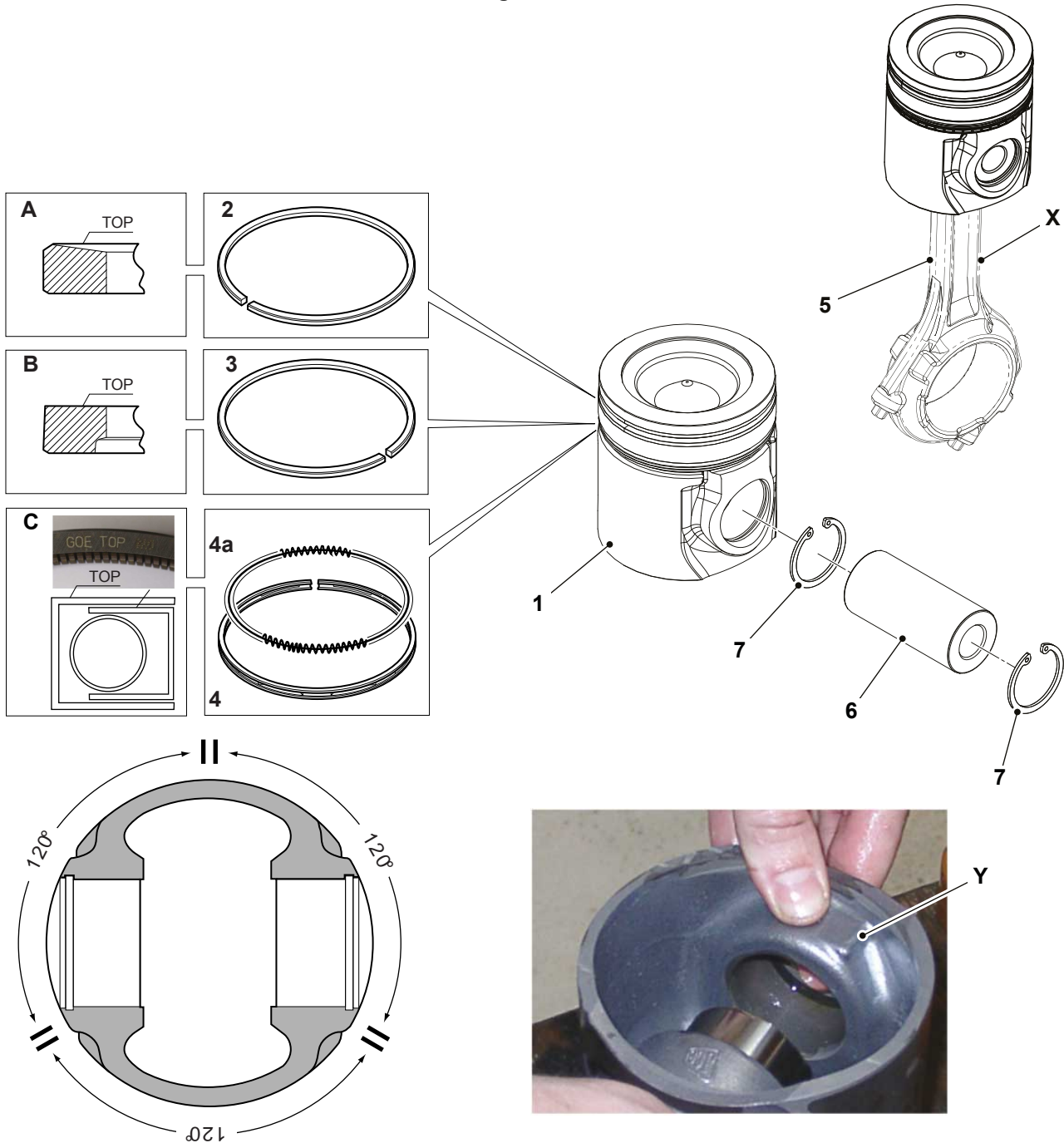
Table 66.

Engine	444 - SE Engine	444 - excluding SE engine	448, 672
Gudgeon pin bore diameter			
- min.	4.0008mm	40.01mm	42.008mm
- max.	40.013mm	40.015mm	42.013mm
Piston ring clearance			
- Top ring	Half keystone ring	Full keystone ring	Full keystone ring
- Middle ring	0.11–0.07mm	0.125–0.08mm	0.125–0.08mm
- Bottom (oil) ring	0.09–0.05mm	0.09–0.05mm	0.09–0.05mm
Piston ring gap			
- Top ring	0.3–0.5mm	0.3–0.4mm	0.3–0.4mm
- Middle ring	0.55–0.8mm	0.55–0.8mm	0.55–0.8mm
- Bottom (oil) ring	0.25–0.5mm	0.25–0.5mm	0.25–0.5mm
Piston height above crankcase (cold)	0.0375–0.3385mm	0.00025–0.36825mm ⁽¹⁾	0.00025–0.36825mm ⁽¹⁾
Piston groove width			
- Top ring	3.108–3.133mm	3.114–3.134mm	3.114–3.134mm
- Middle ring	2.56–2.58mm	2.575–2.595mm	2.575–2.595mm
- Bottom (oil) ring	4.04–4.06mm	4.04–4.06mm	4.04–4.06mm
Piston skirt	-	102.853–102.871mm	105.851–105.869mm
Piston pin	-	39.994–40mm	41.994–42mm

(1) Nominal measurement is 0.03325mm

Component Identification

Figure 152.



- 1 Piston
- 3 Piston ring - compression No.2
- 4a Spiral wire - oil control ring
- 6 Piston pin
- X Connecting rod - longest side

- 2 Piston ring - compression No.1
- 4 Piston ring - oil control ring
- 5 Connecting rod
- 7 Retaining circlip (x2)
- Y Cast boss - piston

Operation

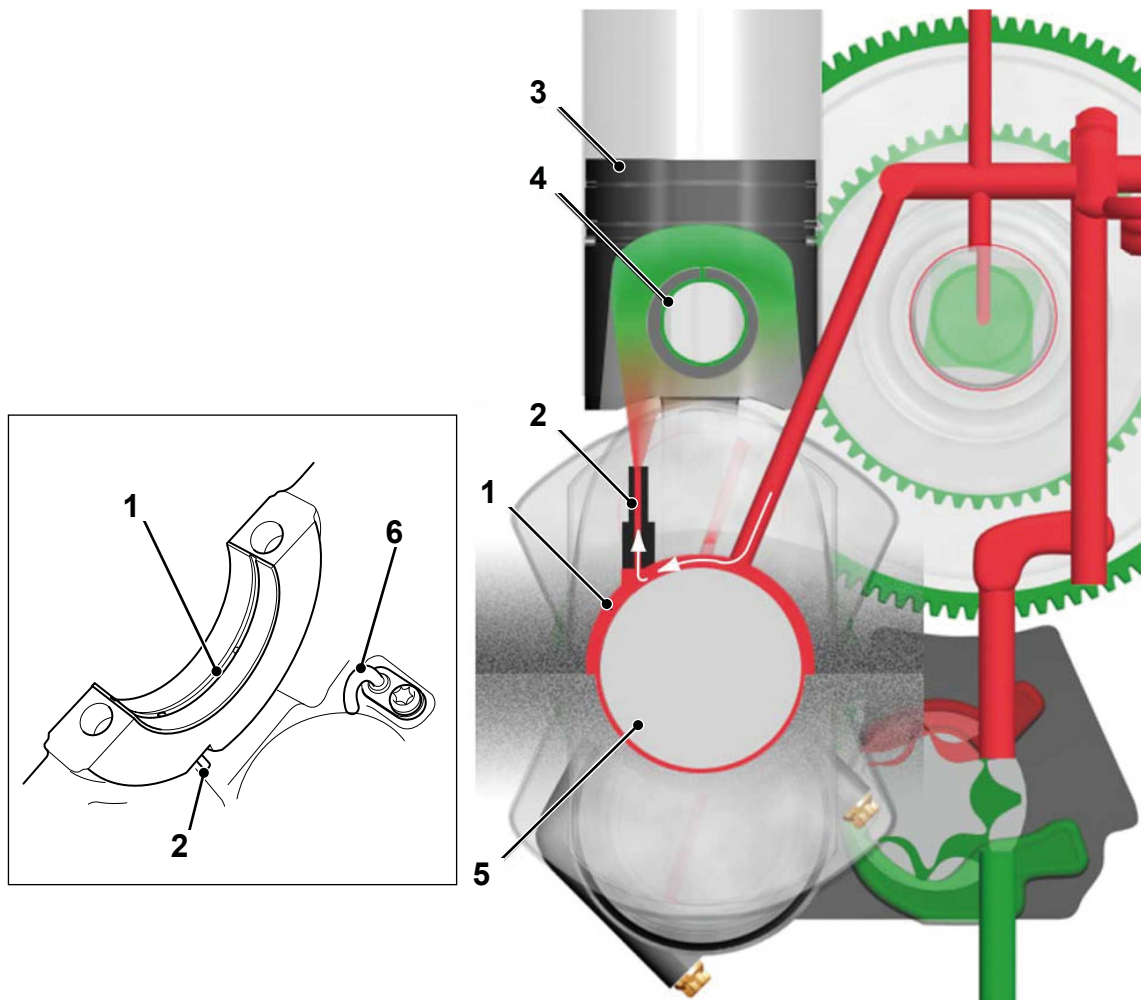
The groove around the diameter of the upper main bearing shells allows oil transfer to an oil jet located in the crankcase bearing saddle. Jets are installed at the main bearing positions.

The jets spray oil directly to the under side of the pistons effectively transferring heat away from the

top of the pistons. Oil spray also enters the small end bearing bushes via a feed hole on the top of each connecting rod.

Note: On turbocharged engines additional J-jets are installed. Oilways connect the J-shaped jets fixed to the crankcase at the underside of each cylinder bore.

Figure 153.



- 1 Groove
- 3 Pistons
- 5 Crankshaft

- 2 Oil jet
- 4 Bearing bushes
- 6 J shaped jets

Check (Condition)

1. Check the piston for signs of damage and excessive wear. Measure the piston skirt diameter, piston pin bore and the clearance in the piston ring grooves to confirm they are within service limits. Refer to Piston, Technical Data (PIL 15-36).
2. Check the piston pin for signs of damage and excessive wear. Measure the pin diameter to confirm it is within service limits. Refer to Piston, Technical Data (PIL 15-36).

The connecting rod small end bearing bush is not renewable. If the small end bearing bush is damaged or worn the connecting rod must be renewed as a complete assembly.

Calibrate

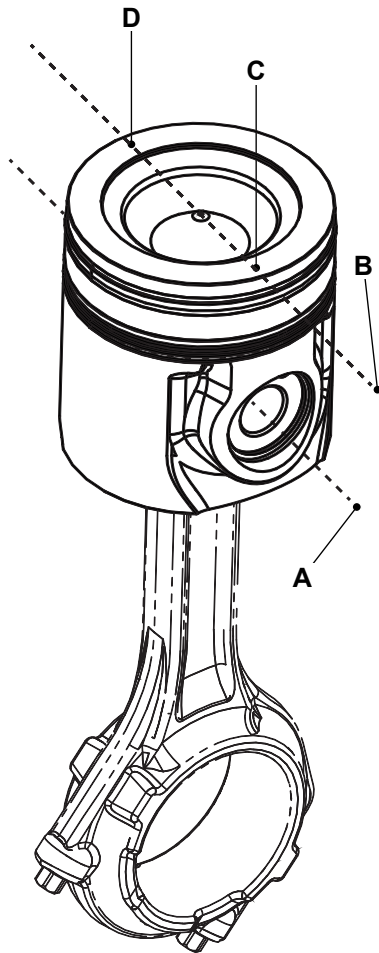
Piston Height Measurement Above Cylinder Block- DTI Method

Refer to engine, piston, technical data, (PIL 15-36-00).

In the event of sufficient liquid entering the engine, a hydraulic lock can occur. This may result in bending of one or more of the connecting rods. Bending of the connecting rod(s) can occur even when the engine is cranked by the starter motor.

Bending of the connecting rod may be very slight and can be checked by carrying out this procedure prior to a full strip down:

1. With the cylinder head removed, make sure the surface of the engine block and piston are clean.
2. Zero a DTI (Dial Test Indicator) on the top face of the cylinder block adjacent to the area on the piston to be measured. The aim of the procedure is to use the DTI to take a measurement across 2 locations on the piston that are on the axis of the gudgeon pin. This will be towards the front and rear of the engine.
3. Rotate the engine and bring the piston up until it is 3mm below the engine block face. Carefully reposition the zeroed DTI above the area of the piston to be measured.
4. Rotate the engine to bring the piston up to exactly TDC (Top Dead Centre) and record the measurement at position 1.
5. Repeat steps 2 to 4 for position 2.
6. Calculate the average of the 2 readings to give a figure of the piston height above the cylinder block.
7. Compare the reading obtained to the technical data.
 - 7.1. If the reading obtained is lower than zero, the connecting rod may be bent.
 - 7.2. If the reading obtained is equal to the range stated in technical data, the connecting rod is not bent.
8. Repeat steps 2 to 7 to check all connecting rods/pistons.
9. If any connecting rods are bent, strip the engine and check for further damage.
10. If the engine is serviceable, any connecting rod that is bent must be replaced.

Figure 154. DTI Measurement


- A Gudgeon pin axis
- B Line of measurement above gudgeon pin axis
- C Piston measurement point 1
- D Piston measurement point 2

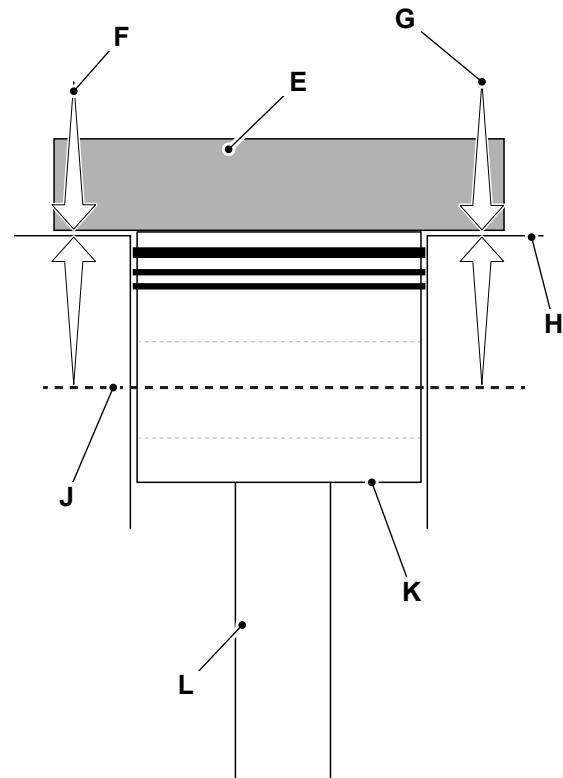
Piston Height Measurement Above Cylinder Block- Straight Edge Method

Refer to engine, piston, technical data, (PIL 15-36-00).

If a DTI is not available, a calibrated straight edge may be used to take a measurement. The measurement will be less accurate.

1. With the cylinder head removed, make sure the surface of the engine block and piston are clean.
2. Rotate the engine until the piston to be measured is at TDC.
3. Position the straight edge on top of the piston along the axis of the gudgeon pin.
4. Use feeler gauges to measure the gap between the cylinder block face and underside of the straight edge on both sides, position 1 and position 2.

5. Calculate the average of the 2 readings to give a figure of the piston height above the cylinder block.
 - 5.1. If the reading obtained is lower than zero, the connecting rod may be bent.
 - 5.2. If the reading obtained is equal to the range stated in technical data, the connecting rod is not bent.
6. Repeat steps 1 to 5.2 to check all connecting rods/pistons.

Figure 155. Straight Edge Measurement


- E Straight edge
- F Measurement position 1
- G Measurement position 2
- H Cylinder block- top face
- J Gudgeon pin axis
- K Piston
- L Connecting rod

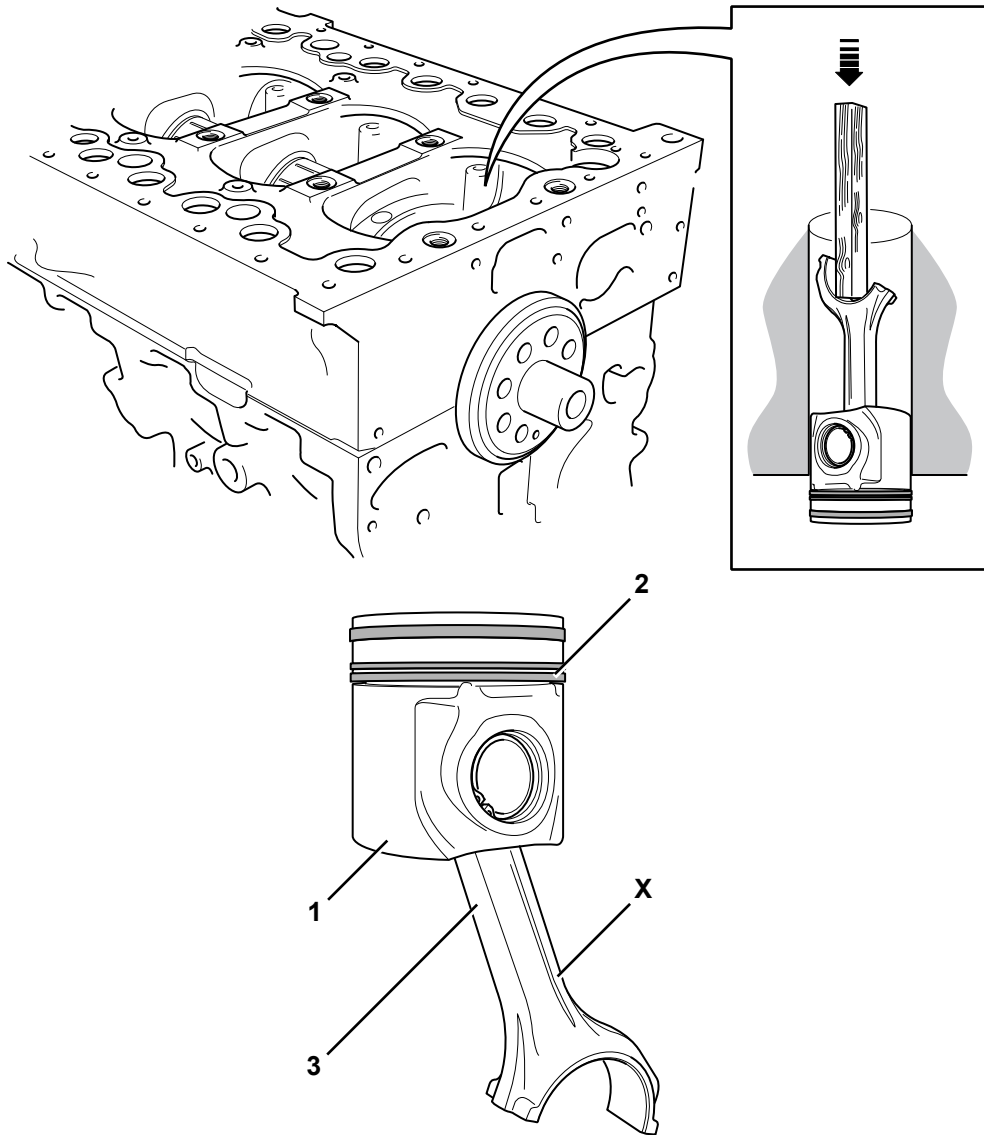
Remove and Install

Before Removal

The following procedure is for one piston and connecting rod assembly. Note that each assembly must be replaced in the same cylinder bore. Label each piston and connecting rod assembly to make sure it is installed in the correct position on assembly.

1. This procedure requires service parts. Make sure you have obtained the correct service parts before you start, refer to Parts Catalogue.
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. Get access to the engine.
4. Disconnect and remove the fuel pipes from the injectors, refer to (PIL 18-96).
5. Remove the rocker cover, refer to (PIL 15-42).
6. Remove the fuel injectors, refer to (PIL 18-18).
7. Remove the cylinder head assembly, refer to (PIL 15-06).
8. Remove the oil sump, refer to (PIL 15-45).
9. Remove the big end bearing caps, refer to (PIL 15-12).

Figure 156.



- 1 Piston
- 3 Connecting rod

- 2 Piston ring
- X Longest side of connecting rod

Remove

The piston and connecting rod assemblies are removed through the top of the crankcase.

1. Use a suitable scraper and wire wool to clean off the carbon deposits from around the top of the cylinder bore. Take care not to scratch or damage the cylinder bore.
2. Use a hammer and a short length of wood to tap the piston from the connecting rod side. Take care not to scratch or damage the cylinder bore or the connecting rod bearing surface.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Make sure that all items are clean and free from damage and corrosion.
3. If the upper big end bearing shell has been removed replace it, refer to (PIL 15-12).
4. Lubricate the cylinder bore with clean engine oil.
5. Use a suitable compressor tool to compress the piston rings.
6. Insert the piston and connecting rod assembly into the cylinder bore, make sure that the longest side of the connecting rod is on the exhaust side of the crankcase. Take care not to damage the cooling jets when you guide the connecting rod down the cylinder bore and over the crank pin diameter.

After Installation

1. Install the big end bearing caps, refer to (PIL 15-12).
2. Carry out the procedures listed under Before removal in reverse order.

Disassemble and Assemble

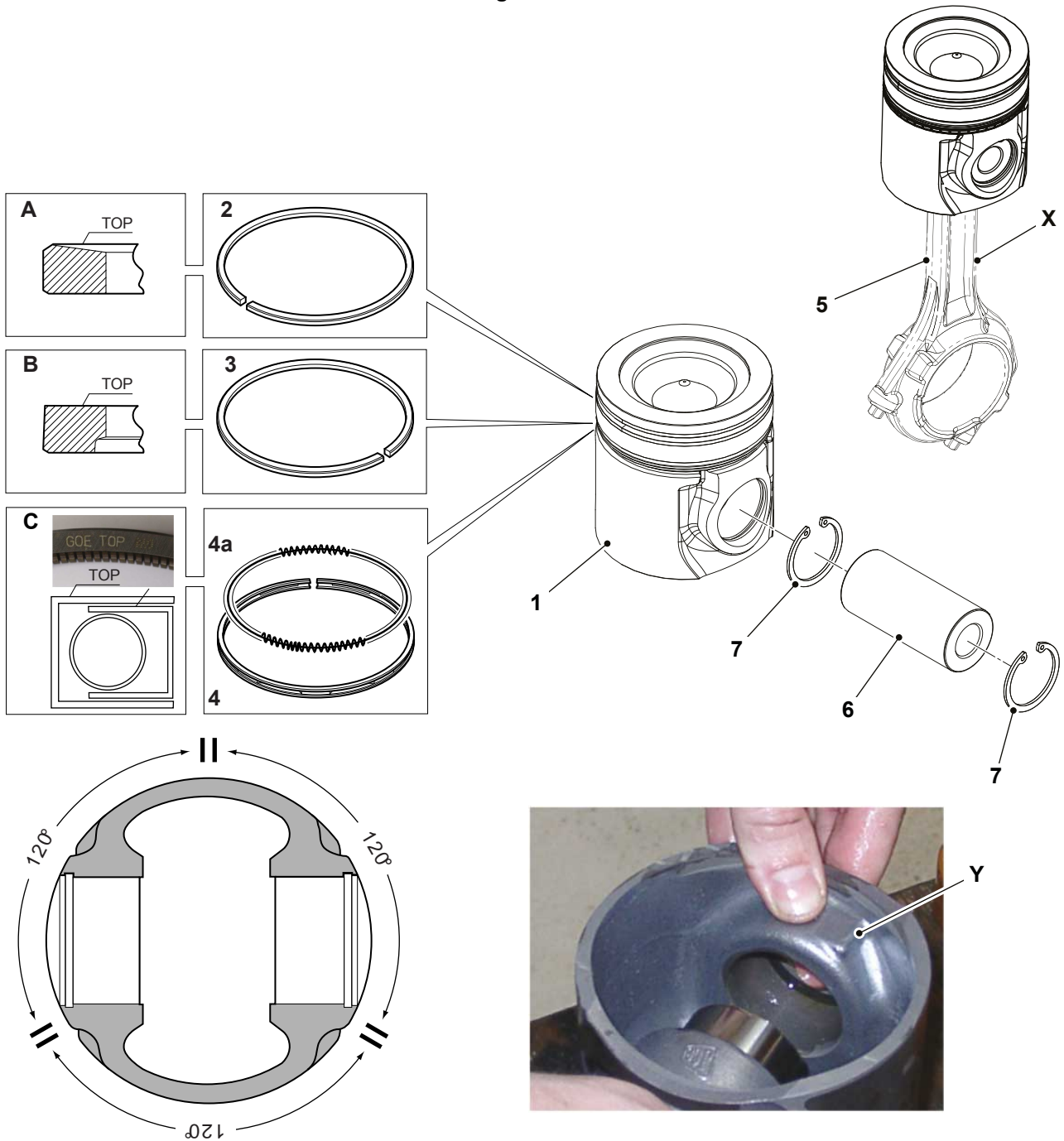
Dismantle

1. Clamp the connecting rod in a vice. Take care not to damage the connecting rod.
2. It is recommended that the piston rings are renewed. If they are to be reused, label the rings to ensure they are installed in the correct positions and the correct way up on assembly.

Carefully remove the piston rings from the piston. To avoid damage or distortion to the rings, use a suitable piston ring expander tool. Note that the oil control ring is installed with a spiral wire. Pull the wire apart and remove it.

3. Remove the circlips and push out the piston pin.
4. Use a suitable cleaning agent, clean the carbon deposits from the piston.

Figure 157.



- 1 Piston
- 3 Piston ring - compression No.2
- 4a Spiral wire - oil control ring
- 6 Piston pin
- X Connecting rod - longest side

- 2 Piston ring - compression No.1
- 4 Piston ring - oil control ring
- 5 Connecting rod
- 7 Retaining circlip (x2)
- Y Cast boss - piston

Inspect

1. Inspect the pistons for signs of wear or damage. Refer to Check (Condition) (PIL 15-36-00).

Assemble

1. The assembly procedure is the opposite of the disassemble procedure. Additionally do the following steps.
2. Make sure that all items are clean and free from damage and corrosion.
3. Lubricate the piston pin with clean engine oil. Assemble the connecting rod to the piston and insert the piston pin. Make sure that the long side of the connecting rod is on the same side as the internal cast boss in the piston.
4. Install new circlips. Make sure that they are installed correctly in the groove in the piston.
5. Lubricate the piston with clean engine oil. Install the piston rings to the piston in sequence as follows:
 - 5.1. Install the spiral wire for the oil control ring in the bottom groove and locate the locking wire inside both ends of the spiral as shown. Using a piston ring expander tool to install the oil control ring in the bottom groove and locate the locking wire inside both ends of the spiral as shown. Ensure that the ring gap is positioned 180° to the locking wire. Note: The correct ring orientation can also be determined from the profile shape of the ring as shown at C.
 - 5.2. Install the No.2 compression ring into the middle groove. Note that new rings have a reference number etched on one face. Make sure that this face is installed uppermost in the piston groove. Note: The correct ring orientation can also be determined from the profile shape of the ring as shown at B.
 - 5.3. Install the No.1 compression ring into the top groove. Note that new rings have a reference number etched on one face. Make sure that this face is installed uppermost in the piston groove. Note: The correct ring orientation can also be determined from the profile shape of the ring as shown at A.
6. Rotate the piston rings so that the ring gaps are 120° apart as shown.

03 - Piston Ring

Introduction

Gas sealing inside the piston is achieved by the use of piston rings. The rings are loosely installed into grooves in the piston. The rings are split at a point in the rim, to allow them to press against the cylinder with a light spring pressure.

Two types of ring are used:

- Upper rings have solid faces and provide gas sealing
- Lower rings have narrow edges and have a U-shaped profile, to act as oil scrapers.

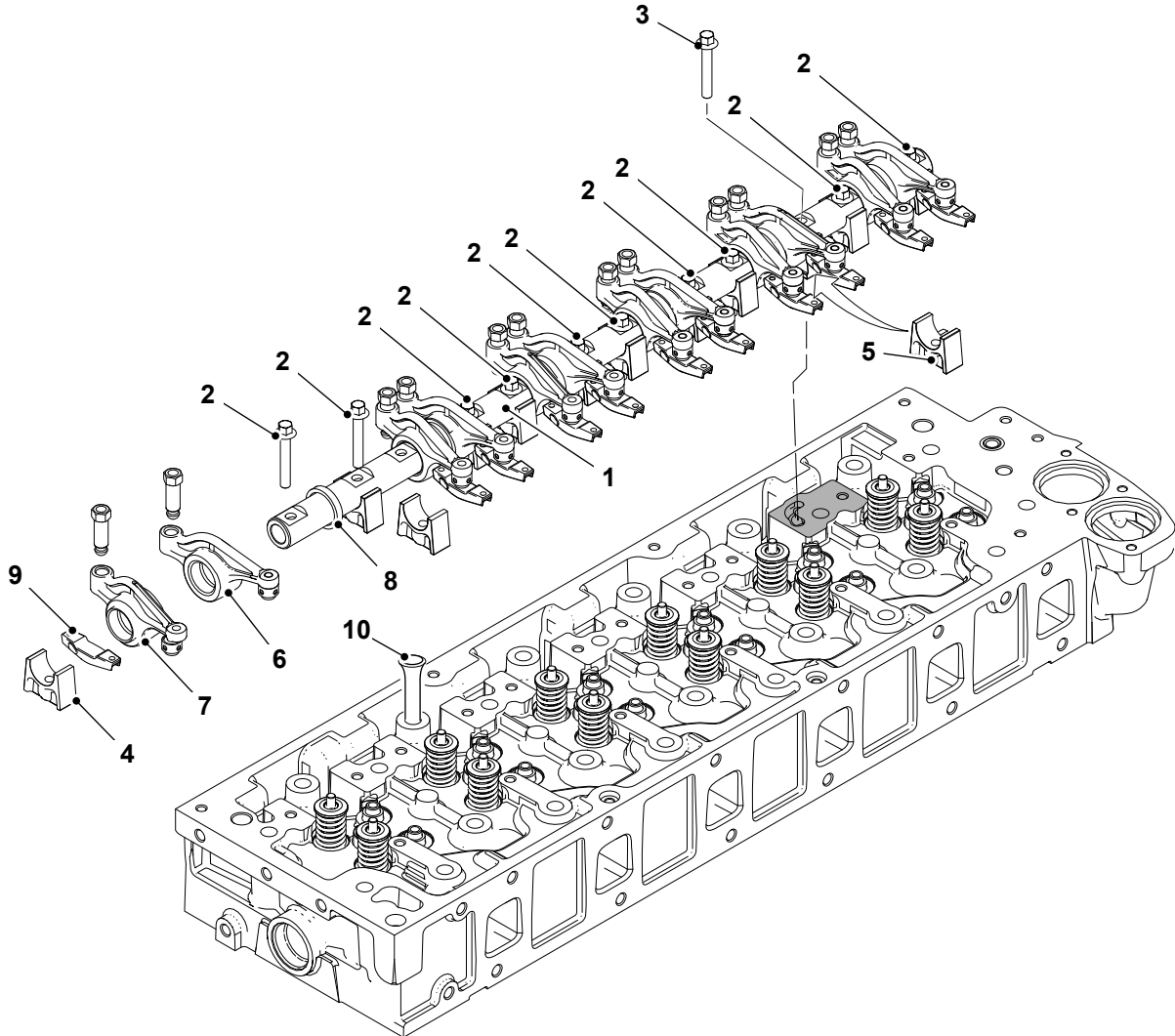
Technical Data

Table 67. Rocker Levers, Rocker Shafts and Tappets Data

Valve clearances measured at the valve bridge piece tip of the rockers (measured cold):	
- Inlet	0.19–0.27mm
- Exhaust	0.56–0.64mm
Rocker clearances measured at the adjusting screw tip of the rockers (measured cold):	
- Inlet	0.15–0.2mm
- Exhaust	0.43–0.5mm
Rocker lever bore diameter	
- min	26.058mm
- max	26.092mm
Rocker shaft diameter	
- min	26.003mm
- max	26.021mm
Tappets stem diameter	
- min	19.975mm
- max	19.985mm
Tappet bore diameter	
- min	20mm
- max	20.021mm
Tappet height (maximum)	55.25mm

Component Identification

Figure 158.



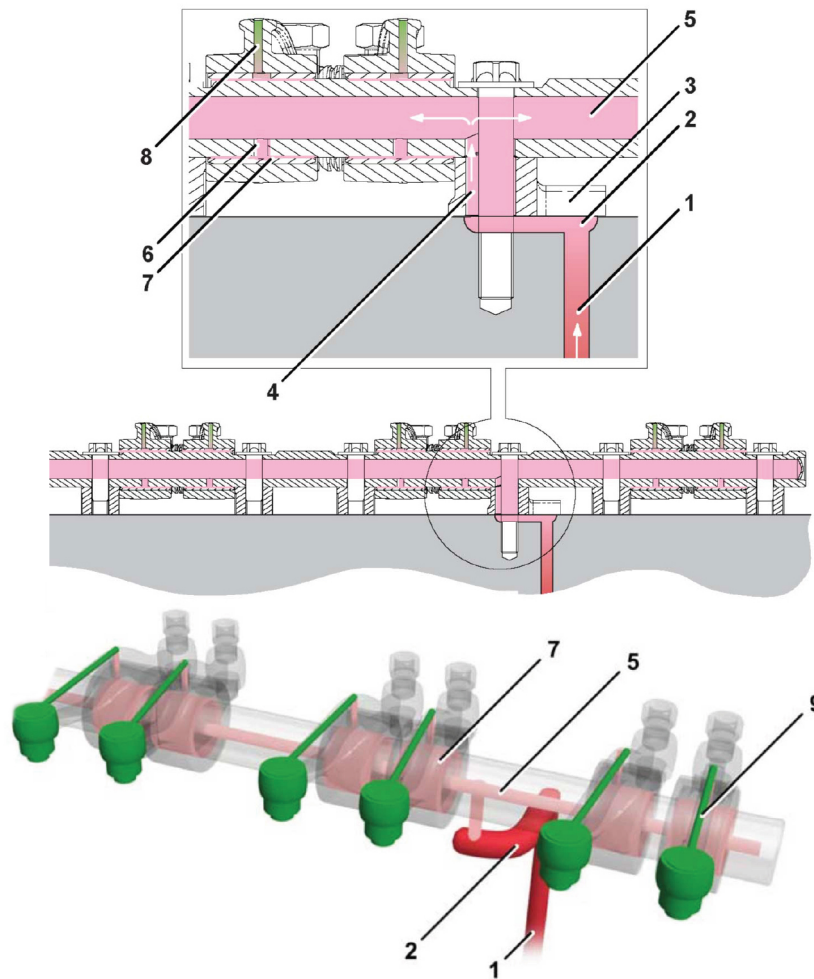
- | | | | |
|---|---|----|---------------------------------|
| 1 | Rocker assembly | 2 | Rocker shaft fixing bolts (x11) |
| 3 | Rocker shaft - oil feed pedestal fixing bolt (x1) | 4 | Pedestals (x11) |
| 5 | Oil feed pedestal (x1) | 6 | Rockers - exhaust (x6) |
| 7 | Rockers - inlet (x6) | 8 | Wave washers (x6) |
| 9 | Bridge pieces (x12) | 10 | Push rods (x12) |

Operation

When the camshaft lobe raises the outside of the rocker arm, the inside presses down on the valve stem to open the valve. When the outside of the

rocker arm is permitted to return due to the camshaft's rotation, the inside rises to allow the valve spring to close the valve.

Figure 159.



- 1 Oil feed from 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

Lubrication

Oil is fed from the main gallery via a drilling which passes up through the crankcase and the cylinder head to a small transfer gallery under the rocker shaft pedestal. The oversized 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.

Check (Condition)

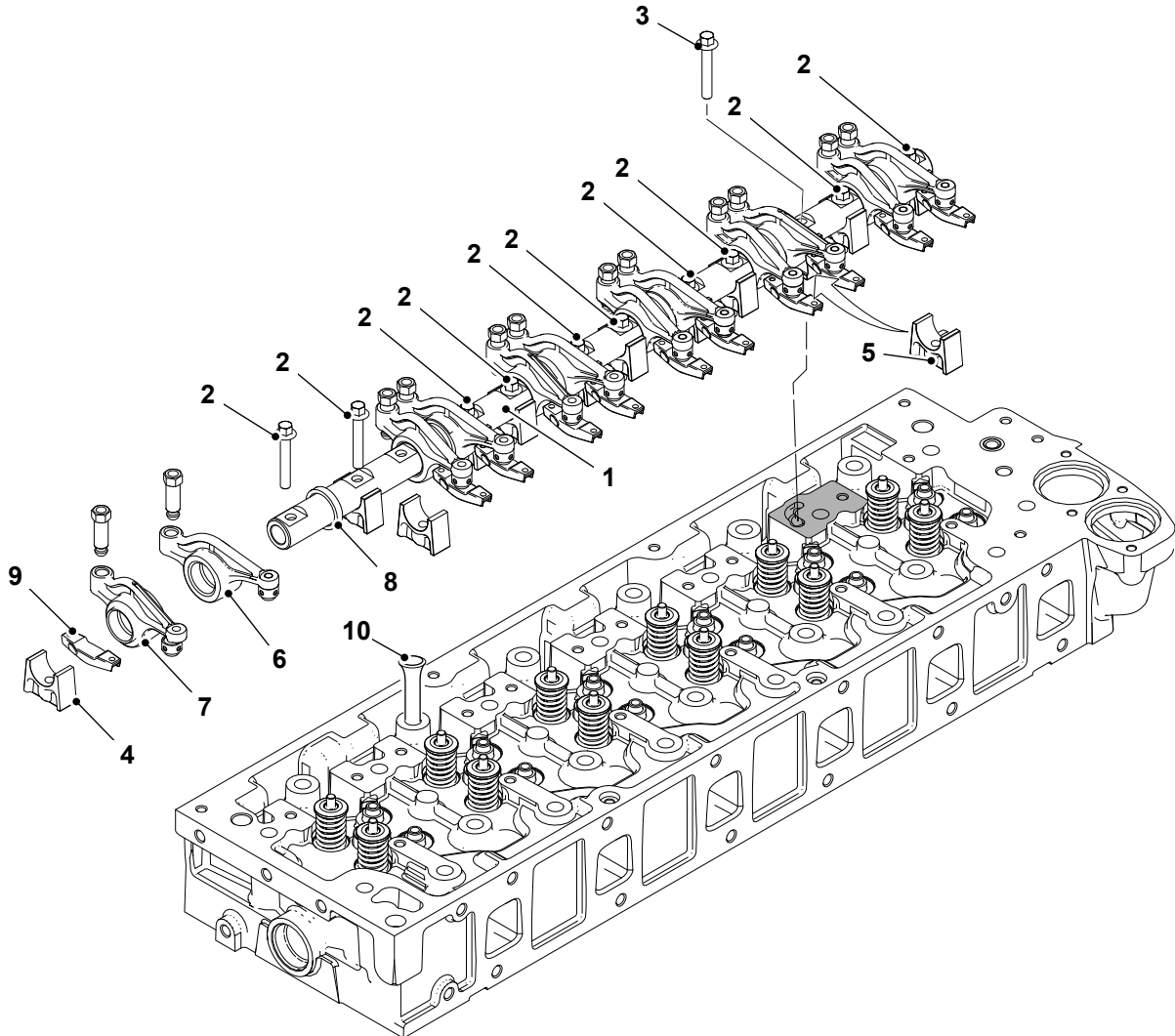
1. Check the rocker shaft and rocker bushings for signs of damage and excessive wear. Measure the rocker shaft diameter and rocker bearing bushes to confirm they are within service limits, refer to Technical Data (PIL 15-42). Note: The rocker bearing bushes are not renewable. If a rocker bearing bush is damaged or worn the rocker must be renewed as a complete assembly.
2. Make sure that all oil-ways and cross drillings in the rocker shaft 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 Fuel pipes (PIL 18-96).
4. Remove the rocker cover, refer to (PIL 15-42).

Figure 160.



- | | | | |
|---|---|----|---------------------------------|
| 1 | Rocker assembly | 2 | Rocker shaft fixing bolts (x11) |
| 3 | Rocker shaft - oil feed pedestal fixing bolt (x1) | 4 | Pedestals (x11) |
| 5 | Oil feed pedestal (x1) | 6 | Rockers - exhaust (x6) |
| 7 | Rockers - inlet (x6) | 8 | Wave washers (x6) |
| 9 | Bridge pieces (x12) | 10 | Push rods (x12) |

Remove

1. Remove the rocker shaft fixing bolts. DO NOT withdraw the bolts. Lift the rocker shaft assembly from the cylinder head complete with pedestals still attached. Important: Keep all pedestals and fixing bolts in their original positions.
2. Lift off the bridge pieces from the pairs of inlet and exhaust valves.
3. Withdraw the push rods from the cylinder block.

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. Refer to Check (Condition) (PIL 15-42).
2. Make sure that all oil-ways 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.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Use a suitable degreasing agent to clean the top of the cylinder head.
3. Install the bridge pieces on to the pairs of inlet and exhaust valves in the cylinder head.
4. Insert the push rods into the cylinder block. Make sure that they engage with the camshaft tappets.
5. Install the rocker shaft assembly into the cylinder head. Make sure that the pedestals are located in their original positions. Note the position of the oil feed pedestal and the longer bolt. Make sure that the push rods engage with the tappet adjusters and that the rockers are located over the bridge pieces.
6. Tighten the bolts to the correct torque value.

After Installation

1. Measure and adjust the valve clearances, refer to (PIL 15-30).

Table 68. Torque Values

Item	Nm
2	24
3	24



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aservicemanualpdf@yahoo.com