SERVICE MANUAL

BACKHOE LOADER
3DX Super, 3DX Xtra, 4DX

EN - 9823/0000 - ISSUE 1 - 01/2018

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

00 - General

Introduction

The rocker assembly is an indirect valve actuating system consisting of rocker arms and a shaft.

The rocker arm is an oscillating lever that conveys radial movement from the cam lobe into linear movement at the poppet valve to open it. One end is raised and lowered by a rotating lobe of the camshaft via a tappet and push rod while the other end acts on the bridge piece which is connected to the valve stem.

Technical Data

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

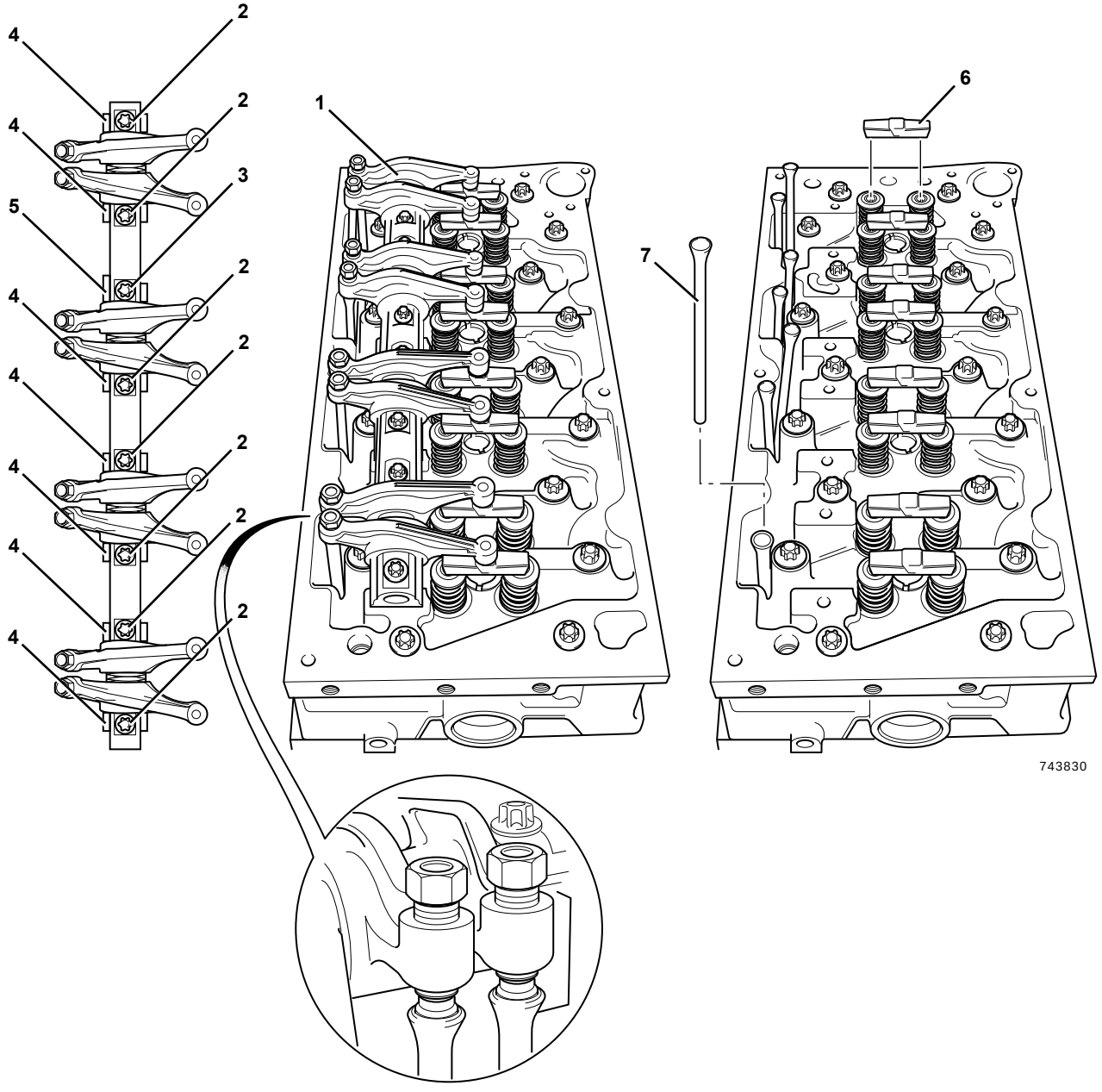
Table 59. Rocker Levers, Rocker Shafts and Tappets Data

Valve tip clearances (measured cold):	
- SA, SB, SC	Inlet: 0.19–0.27mm
	Exhaust: 0.56–0.64mm
- SD, SF	Inlet: 0.35mm
	Exhaust: 0.56–0.64mm
Rocker lever bore diameter	
- min	26.046mm
- max	26.129mm
Rocker shaft diameter	
- min	26mm
- max	26.021mm
Tappets stem diameter	
- min	19.987mm
- max	19.975mm
Tappet bore diameter	
- min	20mm
- max	20.021mm
Tappet height (maximum)	55.25mm

Component Identification

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

Figure 200.

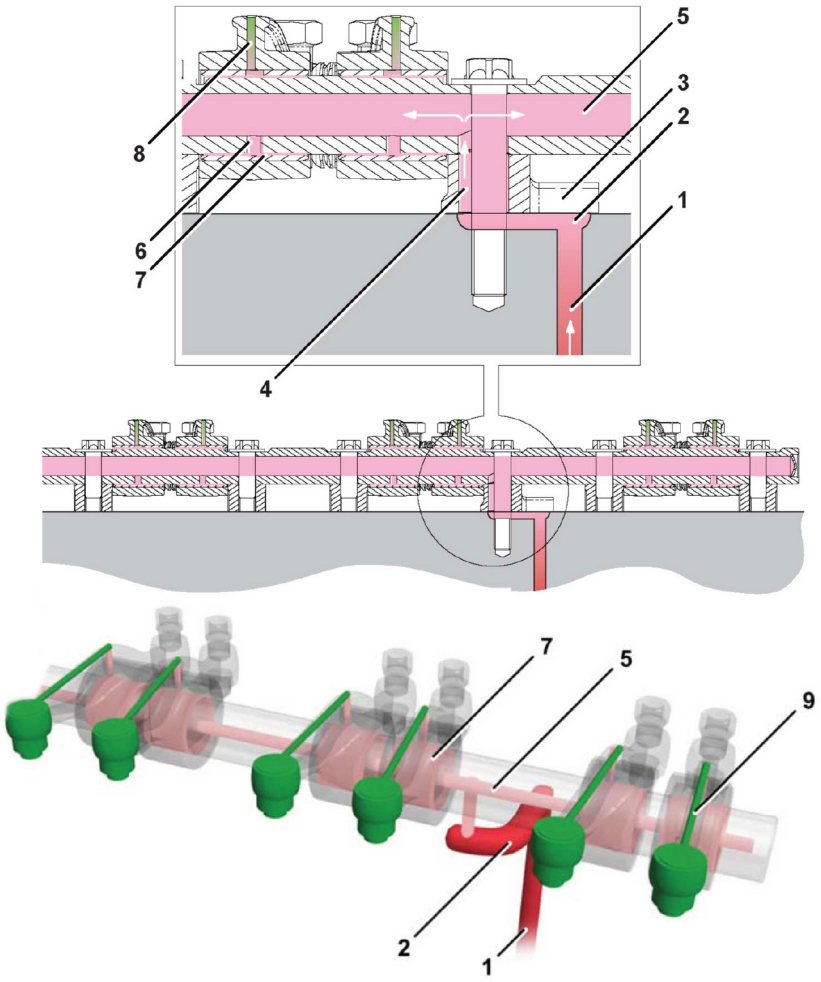


1 Rocker shaft assembly
2 Rocker shaft fixing bolts (x7)
3 Rocker shaft - oil feed pedestal fixing bolt (x1)
4 Pedestals (x7)
5 Oil feed pedestal (x1)
6 Bridge pieces (x8)
7 Push rods (x8)

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 camshafts rotation, the inside rises to allow the valve spring to close the valve.

Figure 201.



1 Oil feed from main gallery
2 Small transfer gallery
3 Shaft pedestal
4 Rocker shaft fixing bolt hole
5 Centre rocker shaft drilling
6 Cross drillings
7 Rocker pivot bushes
8 Cross drilling
9 Groove

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 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.

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.

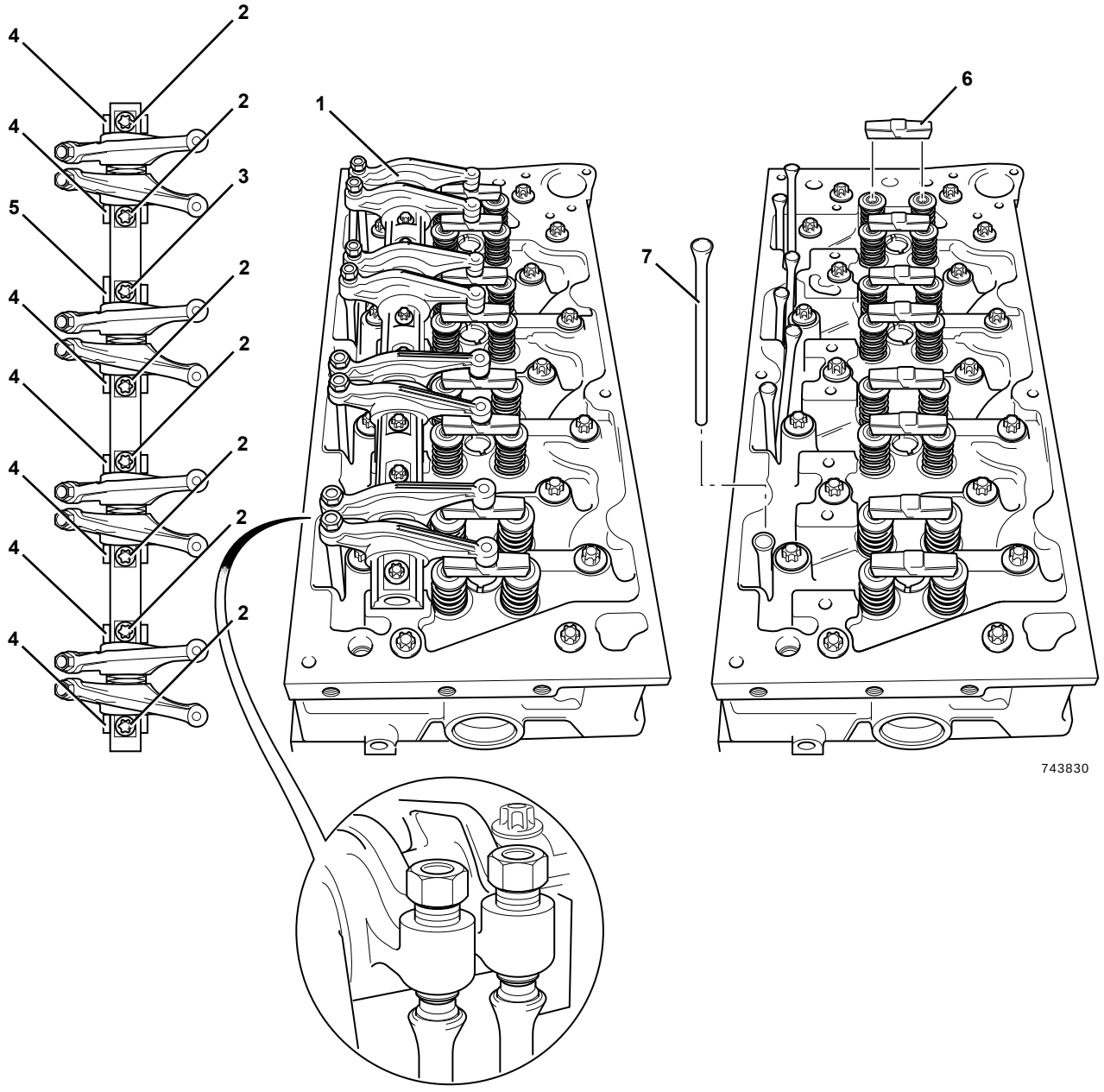
Remove and Install

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

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 202.



1 Rocker shaft assembly
2 Rocker shaft fixing bolts (x7)
3 Rocker shaft - oil feed pedestal fixing bolt (x1)
4 Pedestals (x7)

5 Oil feed pedestal (x1)
6 Bridge pieces (x8)
7 Push rods (x8)

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. 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 60. Torque Values

Item	Nm
2	24
3	24

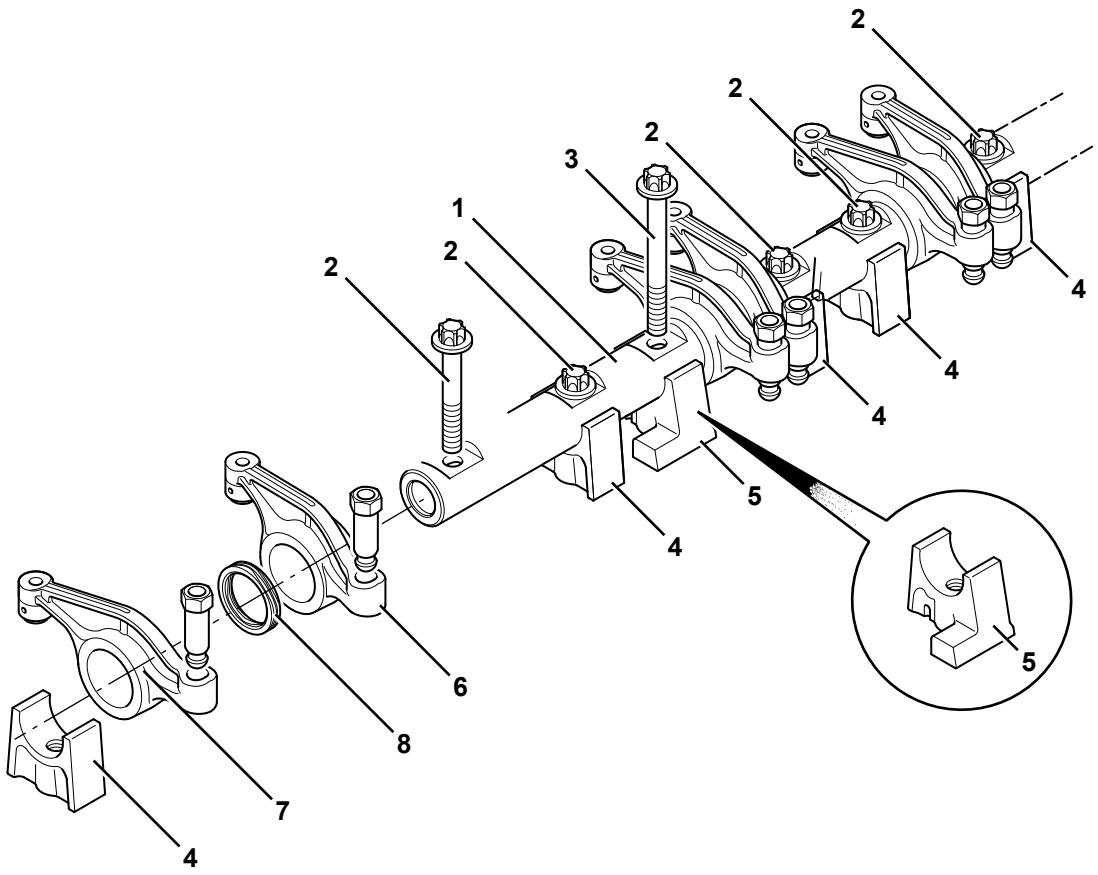
Disassemble and Assemble

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

Before Disassembly

1. Remove the rocker cover. Refer to (PIL 15-42).
2. Remove the rocker assembly. Refer to (PIL 15-42).

Figure 203.



1 Rocker shaft
2 Rocker shaft fixing bolts (x7)
3 Rocker shaft - Oil feed pedestal fixing bolt (x1)
4 Pedestals (x7)
5 Oil feed pedestal (x1)
6 Rockers - inlet (x4)
7 Rockers - exhaust (x4)
8 Wave washers (x8)

Disassemble

1. Lift out the rocker shaft fixing bolts, then slide the pedestals, rockers and wave washers off the rocker shaft as shown. Label the pedestals and rockers to make sure that they are installed in the correct positions on assembly.
2. Check the rocker shaft and rocker bushings for signs of damage and excessive wear. Refer to Check (Condition) (PIL 15-42).

Assemble

1. The assembly procedure is the opposite of the disassemble procedure. Additionally do the following steps.
2. Lubricate the rocker shaft and rocker bearing bushes with clean engine oil.
3. Make sure that the rockers and pedestals are installed in their original positions along the rocker shaft. Note the position of the oil feed pedestal.
4. Insert the rocker shaft fixing bolts to hold the rockers and pedestals loosely in position before fitting the assembly into the cylinder head. Note the position of the longer bolt.

After Assembly

1. Install the rocker assembly. Refer to (PIL 15-42).
2. Install the rocker cover. Refer to (PIL 15-42).

06 - Rocker Cover

Remove and Install

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

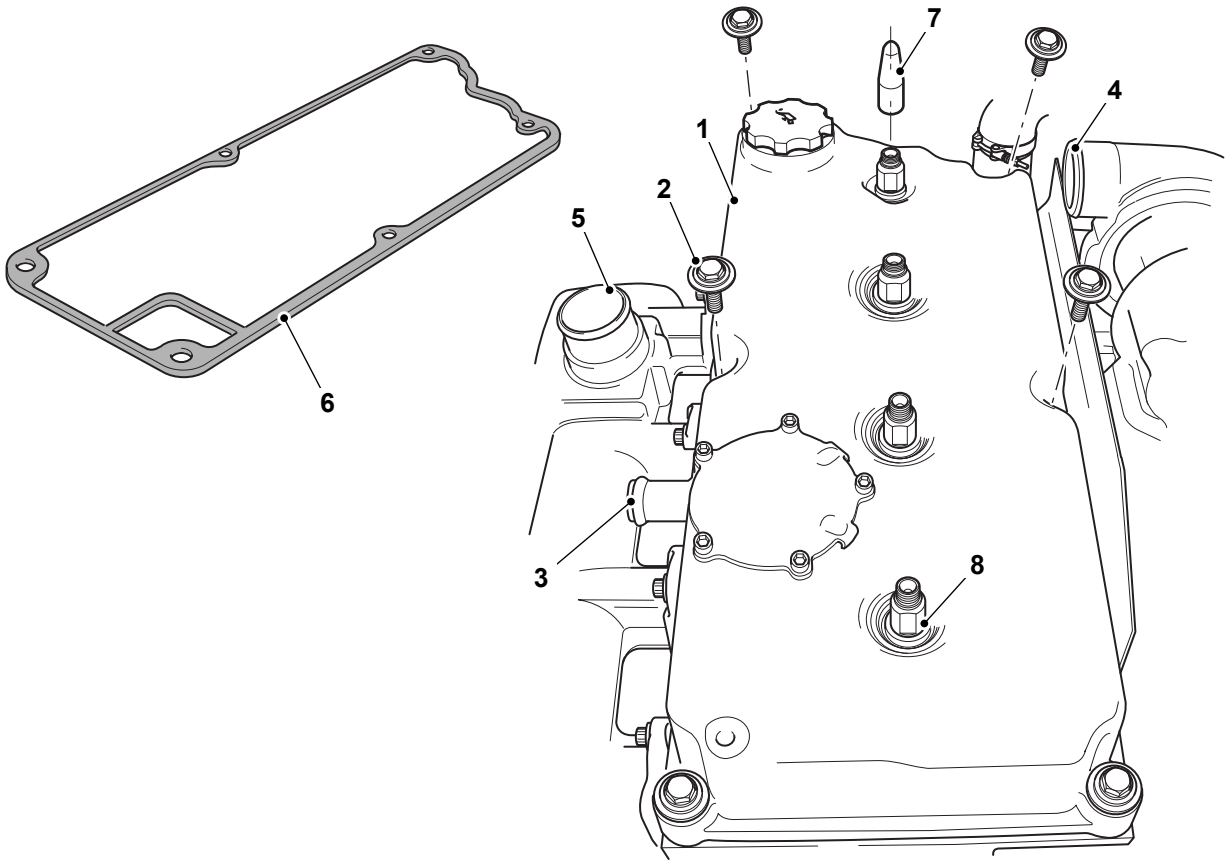
Before Removal

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 top of the rocker cover and around the fuel injectors. Refer to Engine - Clean (PIL 15-00).
3. Disconnect and remove the fuel pipes from the injectors.

   Refer to: PIL 18-96.

   3.1. Caps for blanking the open ends of the fuel pipes are supplied with the rocker cover gasket kit.

Figure 204.



1 Rocker cover
2 Bolts (x6)
3 Pipe stub (breather hose)
4 Turbocharger outlet (Turbocharged engines only) Injector seals
5 Inlet manifold
6 Gasket
7 Injector sleeves/covers
8 Rocker cover injector seals

Remove

1. Get access to the engine.
2. Disconnect the breather hose from the pipe stub.
3. Disconnect the air hose from the turbocharger outlet and inlet manifold. Remove the hose. (For Turbocharged Engine Only)
4. Remove the bolts and lift the rocker cover from the cylinder head.
5. Discard the gasket.
6. Put the sleeves/covers over the injectors.
7. The rocker cover injector seals must be replaced. Refer to Injector seals (PIL 18-18).

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Remove all oil and sludge contamination from inside the rocker chamber.
3. Install new the injector seals. Refer to Injector seals (PIL 18-18).
4. Install new the rocker cover gasket.
5. Prevent damage to the seals. Put sleeves/covers on the four injectors. Apply a rubber lubricant to the seals and then install the rocker cover.
6. Tighten the bolts to the correct torque value.
7. Remove the sleeves/covers.

After Installation

1. Connect the fuel pipes to the injectors.

   Refer to: PIL 18-96.
2. Start the engine and check for oil and fuel leaks.

Table 61. Torque Values

Item	Nm
B	24

21 - Tappet

Remove and Install

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

Special Tools

Description	Part No.	Qty.
Crankshaft / Camshaft Timing Pin (444/448/672 Engine)	892/01148	1

Before Removal

1. Drain the oil from the engine.
2. Disconnect and remove the fuel pipes from the injectors.

   Refer to: PIL 18-96.
3. Remove the rocker cover.

   Refer to: PIL 15-42-06.
4. Remove the fuel injection pump.

   Refer to: PIL 18-18-15.
5. Remove the rocker assembly and push rods.

   Refer to: PIL 15-42-09.
6. Remove the starter motor.

   Refer to: PIL 15-75-00.
7. Remove the oil sump.

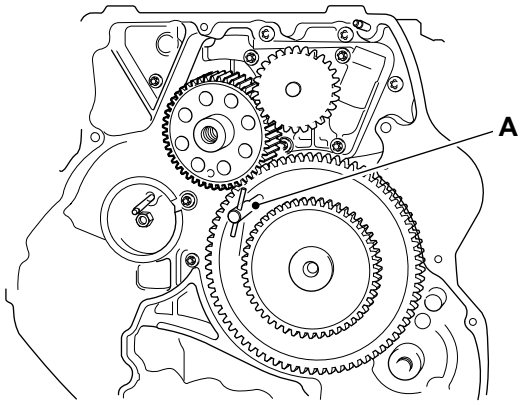
   Refer to: PIL 15-45-00.
8. Remove the flywheel.

   Refer to: PIL 15-54-00.
9. Remove the flywheel housing.

   Refer to: PIL 15-54-03.
10. Rotate the crankshaft until the camshaft timing pin can be inserted through the gear and into the aligning hole in the rear gear case.

    Special Tool: Crankshaft / Camshaft Timing Pin (444/448/672 Engine) (Qty.: 1)

Figure 205.

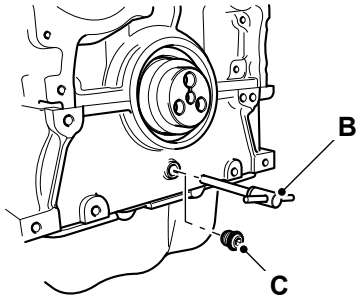


A Timing pin - camshaft

11. Remove the taper blanking plug and insert crankshaft locking pin. The camshaft and crankshaft locking pins must be in position to lock the crankshaft and camshaft before removing the camshaft assembly.

    Special Tool: Crankshaft / Camshaft Timing Pin (444/448/672 Engine) (Qty.: 1)

Figure 206.



B Timing pin- crankshaft
C Blanking plug

12. Remove the fuel injection pump drive gear.

    Refer to: PIL 15-51-09.

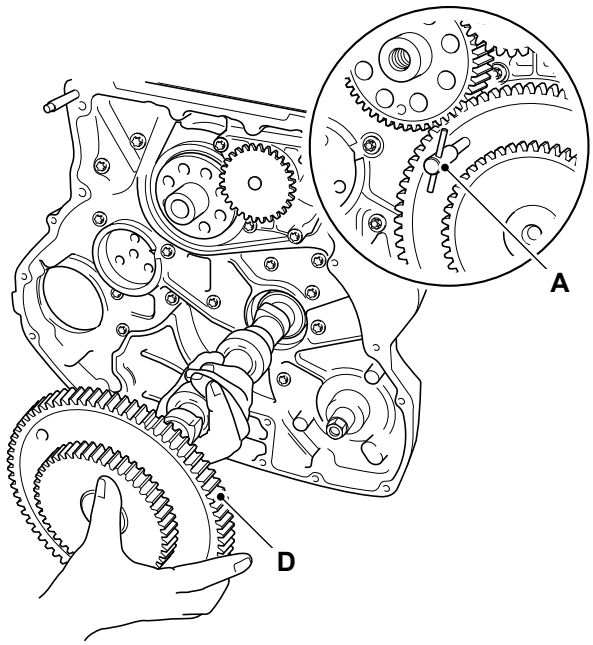
Removal

The engine must be inverted. DO NOT attempt to remove the camshaft and its drive gears with the engine upright. The tappets and push rods will fall into the engine and further dismantling will be required to retrieve them.

1. Remove the camshaft timing pin.

   Special Tool: Crankshaft / Camshaft Timing Pin (444/448/672 Engine) (Qty.: 1)
2. Carefully withdraw the camshaft and gear assembly from the crankcase. Make sure you fully support the camshaft to prevent the lobes contacting the bearing surfaces in the crankcase. The bearing surfaces can easily be damaged by the sharp hard edges on the cam lobes.

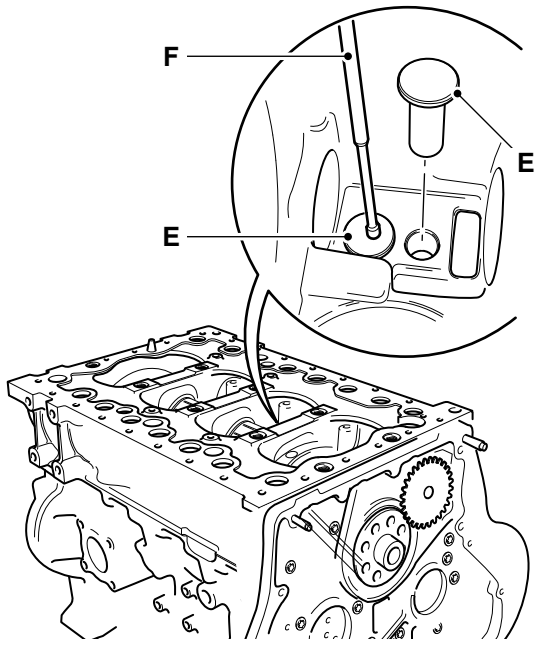
Figure 207.



A Timing pin - camshaft
D Camshaft and drive gear

3. Access the tappets through the apertures in the crankcase bedplate next to the crankshaft. Lift out the tappets from the crankcase using a suitable magnetic probe. Label the tappets to ensure replacement in their original positions.

Figure 208.



E Tappet (8 off)
F Magnetic probe

Inspection

1. Inspect the camshaft gear teeth for signs of damage or excessive wear.
2. Inspect the cam lobes for signs of excessive wear, scoring or pitting.
3. Inspect the cam bearing surfaces for signs of excessive wear, or scoring. Check that the dimensions are within service limits.
4. Inspect the cam bearing surfaces inside the crankcase for signs of excessive wear, or scoring. Check that the dimensions are within service limits.
5. Inspect the bearing surfaces of the tappets for signs of excessive wear or damage. Check that the dimensions are within service limits.
6. Inspect the tappet bores inside the crankcase for signs of excessive wear or damage. Check that the dimensions are within service limits.
7. If any of the camshaft bearings or lobes are worn or damaged then the relative oil feed galleries in the cylinder block and camshaft may be blocked. Make sure all oil ways are clear and free from debris.

Installation

1. Lubricate the tappets and tappet bores inside the crankcase with clean engine oil.
2. Insert the tappets in their original positions in the crankcase using a suitable magnetic probe.
3. Lubricate the camshaft bearing journals inside the crankcase with clean engine oil.
4. Carefully insert the camshaft assembly into the crankcase as shown. Support the camshaft preventing the lobes contacting the bearing surfaces in the crankcase. Before meshing the camshaft gear with the crankshaft gear, rotate the camshaft until the timing hole in the gear aligns with the dowel hole in the gear casing. Insert the camshaft timing pin to lock the camshaft in this position.

After Installation

1. Note that the fuel injection pump drive gear fixing nut is torque tightened as part of the fuel injection pump replacement procedure.

   Refer to: PIL 18-18-15.

2. In reverse order, carry out the procedures in Before Removal.

24 - Tappet Cover

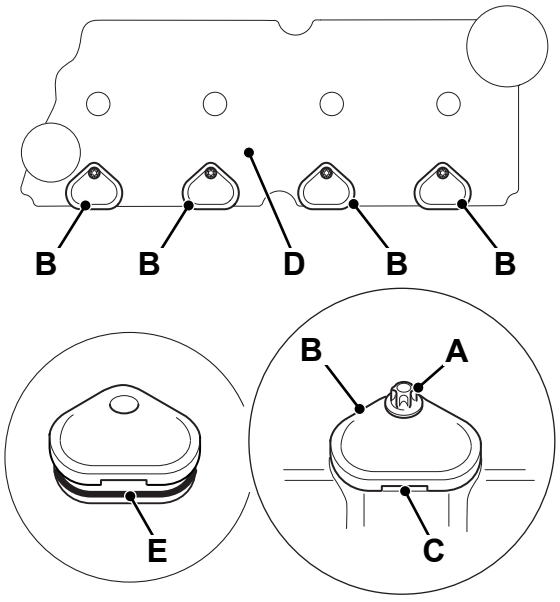
Remove and Install

It is not necessary to remove the tappet covers unless a new rocker cover is to be installed. It is necessary to remove the tappet covers to measure and adjust the valve clearances. Refer to Valve-Adjust, Valve Clearances (PIL 15-30).

Remove

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. Clean the tappet covers and the adjacent areas of the rocker cover. Refer to Engine - Clean. Important: Make sure that the screws do not fall into the engine.
4. Remove the tappet cover screws.
5. Keep the screws away from the engine.
6. Use a screwdriver in the slot to remove the tappet covers. Make sure that dirt or debris does not fall into the engine.

Figure 209.



A Screws
B Tappet covers
C Slot
D Rocker cover
E Tappet cover seals

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Inspect the tappet cover seals for signs of damage. Replace any damaged seals.
3. Install the tappet covers. Tighten the screws to the correct torque value.

Table 62. Torque Values

Item	Nm
A	9

00 - General

Introduction

The lubrication system distributes oil around the engine by a system of galleries and drillings in the crankcase and cylinder head. The oil lubricates and seals the moving parts of the engine, reducing friction and wear. In addition the oil plays an important role in cooling the engine by carrying heat from the engine to the cooler. A piston cooling jet sprays oil onto the underside of the pistons to keep them cool, refer to (PIL 15-36).

Oil is drawn from the oil sump by the integral oil pump via the suction strainer. The strainer prevents any large particles of debris passing through, which may damage the pump.

The oil passes from the outlet side of the pump through a relief valve which limits the maximum oil pressure by venting oil back to the inlet side of the pump, refer to (PIL 15-36).

From the pump the oil passes through the oil cooler and filter, refer to (PIL 15-69 and PIL 15-21).

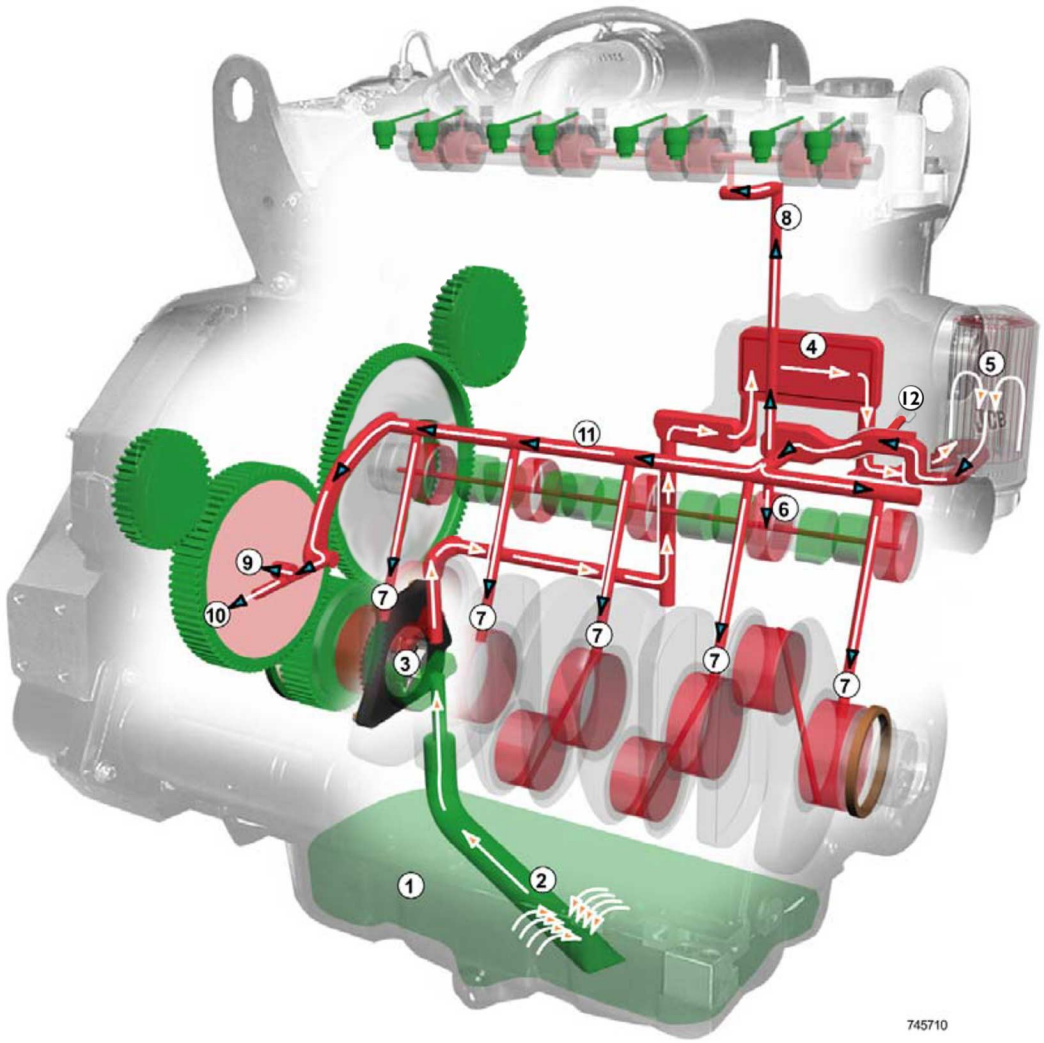
After cooling and filtering, the oil passes into the main oil gallery. An oil pressure switch senses the oil pressure. From the main gallery oil is delivered, via drillings, to the crankshaft main bearings, rocker assembly, camshaft and timing gears. Note that drillings are through the crankcase and cylinder head.

When the high pressure oil has passed through the bearings it reverts to sump pressure and splash lubricates the internal components such as rocker tips, cam lobes and timing gear teeth. Gravity drains the oil via drains into the cylinder head and crankcase, back into the oil sump. A drain slot allows the oil to drain from the timing case back to the oil sump.

Component Identification

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

Figure 210.



1 Oil sump
2 Suction strainer
3 Oil pump
4 Oil cooler
5 Filter
6 Camshaft - high pressure oil feed
7 Crankshaft main bearings - high pressure oil feed
8 Rocker assembly - high pressure oil feed
9 PTO (Power Take-Off) idler gear bearing/ timing case - high pressure oil feed
10 External high pressure oil feed connection (crankcase) - Turbocharger (if installed)
11 Main high pressure oil feed gallery (crankcase)
Green- Oil at sump pressure
Pink- Oil at lower pressure but higher than sump pressure
12 Oil pressure switch
Red- Oil at high pressure

Remove and Install

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

Special Tools

Description	Part No.	Qty.
Template for Sealant Oil Sump - Pressed	892/01149	1
Oil Sump Location Dowel	892/01150	2
Template for Sealant Oil Sump (Cast)	892/12354	1

Consumables

Description	Part No.	Size
Clear Silicone Sealant	4102/0901	0.31L

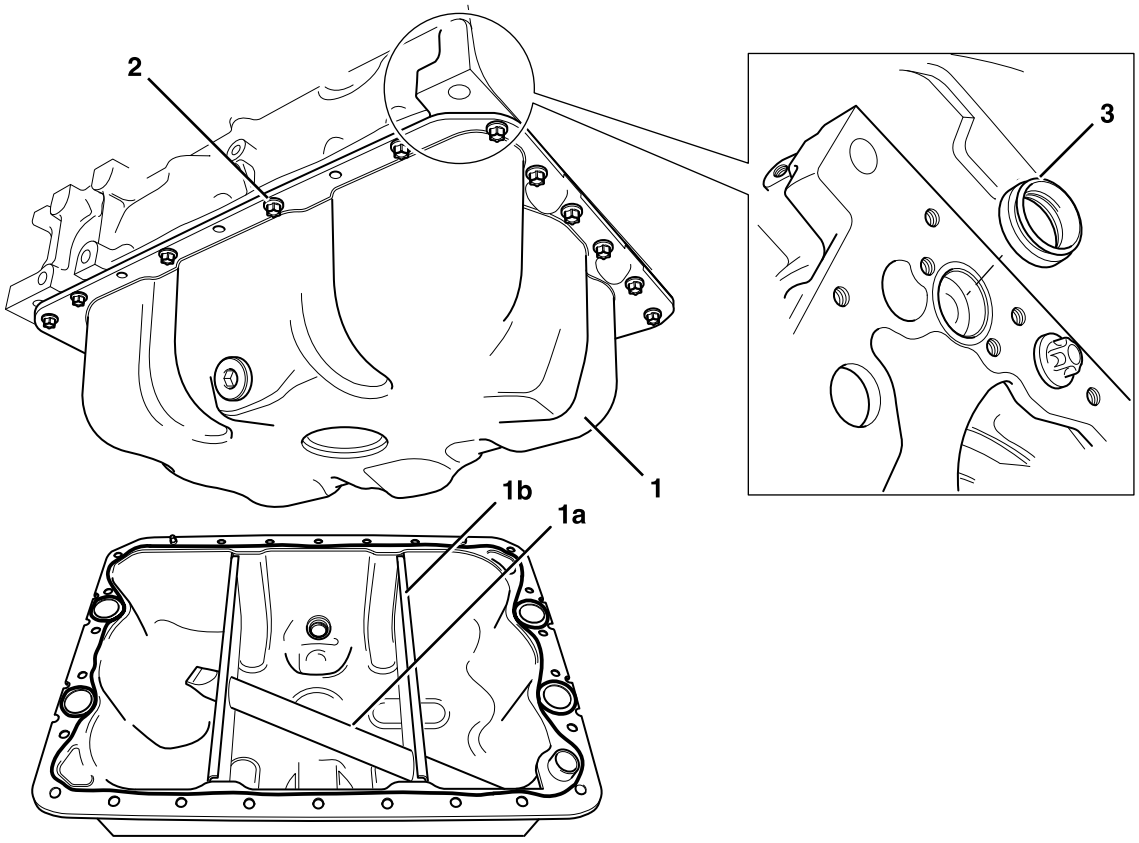
Before Removal

1. Make sure that the engine is safe to work on. If the engine has been running, make sure the engine has cooled sufficiently before you start.
2. Drain the engine oil.

Removal

1. Remove the fixing bolts and remove the oil sump from the engine. The oil sump may be difficult to remove due to adhesion of sealing compound. If necessary, carefully lever the mating flanges apart. Do not use excessive force, the oil sump could be damaged. Be sure to retrieve the oil pick up seal.
2. Use a gasket removal compound, carefully remove all traces of sealing compound from the oil sump and engine mating faces. Do not allow the sealing compound to enter the engine.
3. Use a suitable degreasing agent to thoroughly clean the oil sump.

Figure 211.

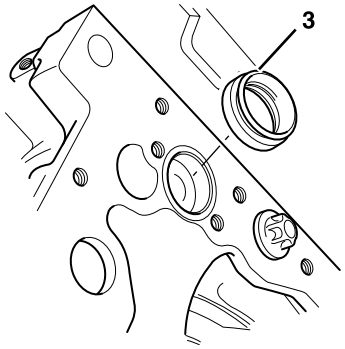


1 Oil sump
1a Integral suction tube
1b Integral baffle plates
2 Oil sump fixing bolts (x20)
3 Oil pick up seal

Installation

1. Lightly smear the new oil pick up seal with oil and install into the bedplate as shown.

Figure 212.



3 Oil pick up seal

2. Install the two guide pins at the oil sump screw holes in the engine.

   Special Tool: Oil Sump Location Dowel (Qty.: 2)

3. Use the fixing bolts to locate the template to the oil sump mating face. Make sure that the template is the correct way round (note that holes are on different centres).

   Special Tool: Template for Sealant Oil Sump (Cast) (Qty.: 1)
   Special Tool: Template for Sealant Oil Sump - Pressed (Qty.: 1)

4. Apply a bead of sealing compound around the oil sump flange using the inside edge of the template as a guide as shown. Note the beads around holes.

   Length/Dimension/Distance: 4mm
   Consumable: Clear Silicone Sealant

5. Carefully remove the template without smudging the sealant beads.

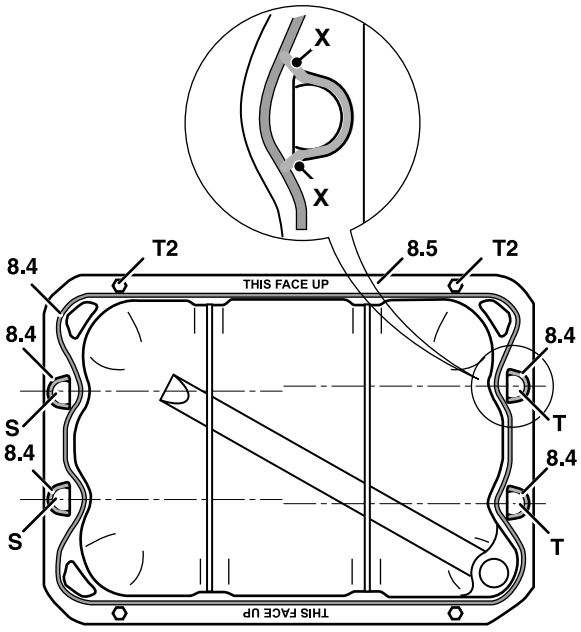
6. Apply a bead of sealant so as to join the sealant beads around holes with the bead around the oil sump flange.

   Length/Dimension/Distance: 4mm

7. After applying the sealing compound, the oil sump must be installed and the bolts torque tightened within

   Duration: 5min

Figure 213.



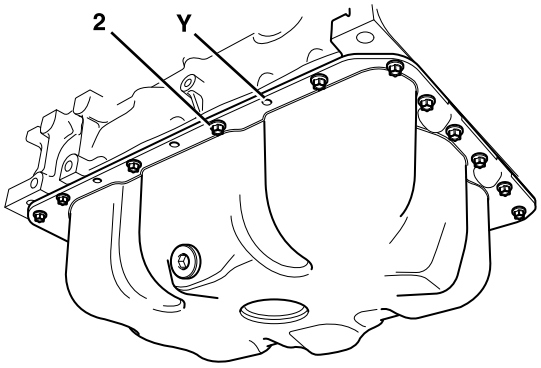
S Hole
T Hole
T2 Guide pins
X 4mm Bead of sealant

8. Position the oil sump with the suction tube outlet aligned with the oil pump inlet port on the engine. Take care not to damage the oil pick up seal when you install the oil sump. Damage to the seal could cause a drop in oil pressure and subsequently damage to the engine.

9. Locate the oil sump on the guide pins on the engine. Avoid smudging the sealant beads. DO NOT remove the guide pins until sufficient bolts have been installed to secure the oil sump.

10. Install the bolts and tighten the bolts to the correct torque value. Note that the bolts are not installed at 6 positions.

Figure 214.



2 Bolts
Y No bolts to be installed at this position (x6)

After Replacing

1. Allow the sealant to cure for

   Duration: 20min

2. Refill the engine with the recommended engine oil. Refer to (PIL 75-00).

3. Start the engine and check for oil leaks.

Table 63. Torque Values

Item	Nm
2	24

51 - Timing Gear

Contents **Page No.**

00 - General

Introduction

The timing gears are located inside a case at the flywheel end of the engine.

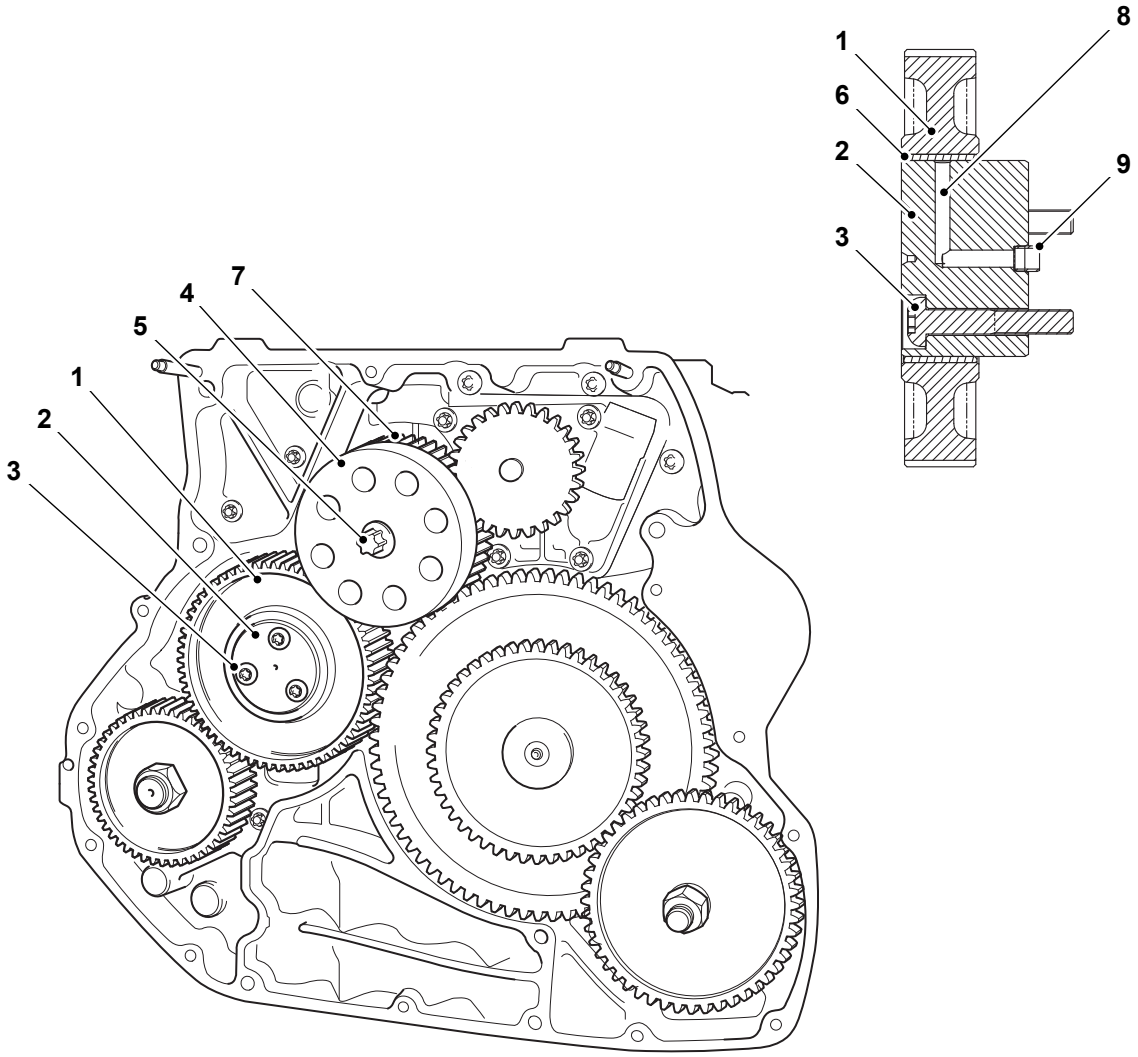
The engine must be timed so that the camshaft operates the valves at the correct times relative to the crankshaft position.

Valve timing is achieved by ensuring that the camshaft drive gear is meshed to the crankshaft gear at their correct angular positions, refer to Engine-General, Operation, The Four Stroke Cycle (PIL 15-00) for more information about valve timing.

Component Identification

(For: JCB Tier 2/3 Mech Engine 4 Cyl)

Figure 215.



1 High duty PTO (Power Take-Off) idler gear
2 Idler gear hub
3 Idler gear hub retaining screws (x3)
4 Flywheel hub
5 Flywheel hub fixing bolt
6 Idler gear bearing bush
7 Crankshaft gear
8 Oil feed drilling
9 Idler gear hub location dowel