

SERVICE MANUAL

LOADALL (ROUGH TERRAIN
VARIABLE REACH TRUCK)
**526-56, 531-70, 535-95, 536-60, 536-70,
536-70LP, 541-70, 550-80, 560-80**

EN - 9813/7600 - ISSUE 3 - 03/2018

This manual contains original instructions, verified by the manufacturer (or their authorized representative).

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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**
- 06 - Body and Framework**
- 09 - Operator Station**
- 12 - Heating, Ventilating and Air-Conditioning (HVAC)**
- 15 - Engine**
- 18 - Fuel and Exhaust System**
- 21 - Cooling System**
- 24 - Brake System**
- 25 - Steering System**
- 27 - Driveline**
- 30 - Hydraulic System**
- 33 - Electrical System**
- 72 - Fasteners and Fixings**
- 75 - Consumable Products**
- 78 - After Sales**

03 - Injector

Introduction	18-60
Component Identification	18-61
Check (Operation)	18-61
Remove and Install	18-62

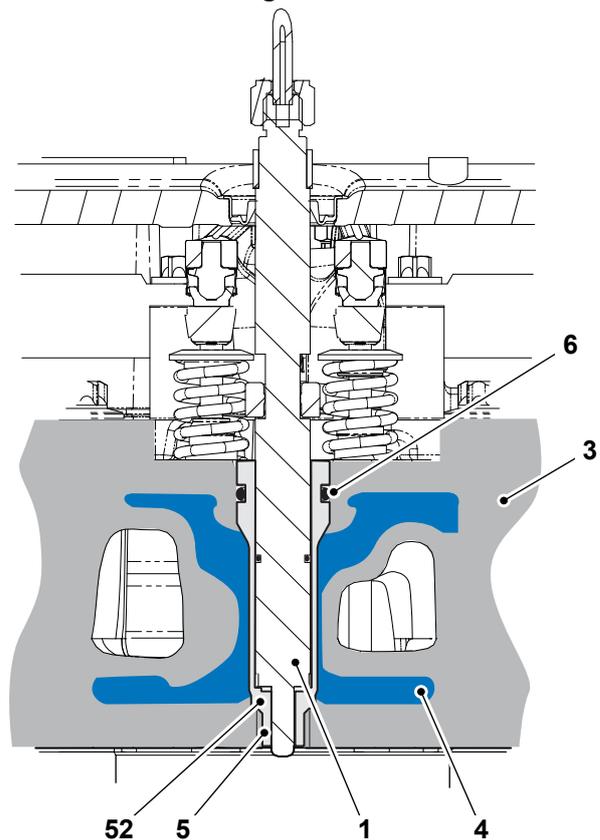
Introduction

The fuel injectors are electronically controlled and incorporate a small solenoid valve. The injectors are supplied with pressurised fuel by the high pressure fuel injection pump and when energised, the injector atomizes the fuel into a fine mist so that it can burn easily by the vehicle's engine.

The fuel injectors are mounted in the inlet manifold so that fuel is sprayed directly at the inlet valves. A fuel supply rail connects all of the fuel injectors to the fuel supply.

The injector tips are located inside the combustion chambers, so effective cooling is essential. A special thin walled sleeve is screwed into the cylinder head which allows a coolant jacket close to the injector. The coolant jacket is sealed at the bottom by sealant on the sleeve thread and at the top by O-ring.

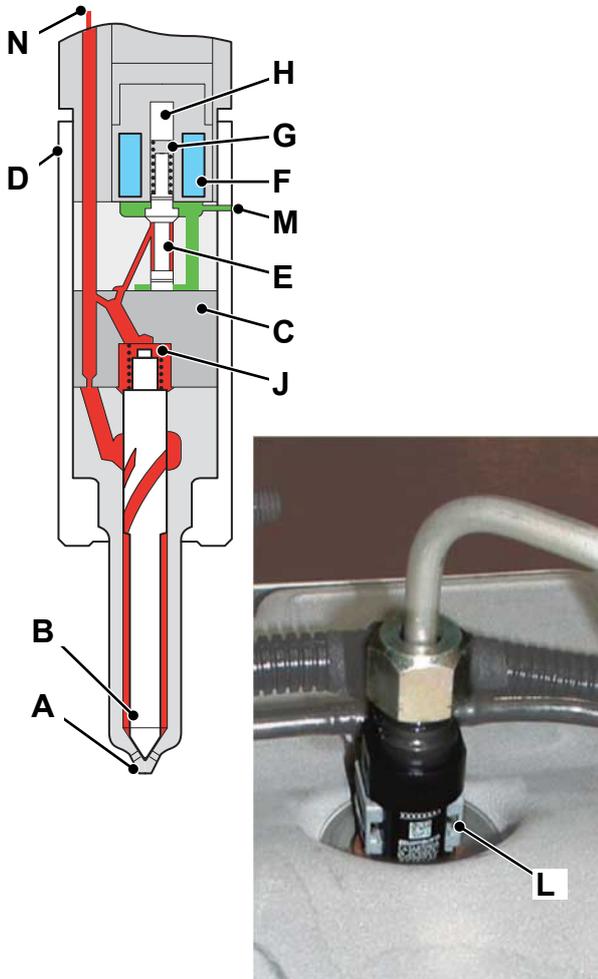
Figure 390.



- 1 Injector
- 2 Sleeve
- 3 Cylinder head
- 4 Coolant jacket
- 5 Sleeve thread
- 6 O-ring

Component Identification

Figure 391.



- A Multi-point injector nozzle
- B Needle
- C Spacer
- D Nut
- E Valve
- F Solenoid coil
- G Valve spring
- H Calibration dowel
- J Injector spring
- L Electrical connector
- M Return port (bleed off)
- N High pressure port and filter element

Check (Operation)

Special Tools

Description	Part No.	Qty.
Injector Leak-off Test Kit ((Electronic Engine))	892/12350	1
Injector Cap Kit	892/12359	1

The injectors can be tested using Servicemaster diagnostics and by means of a leak off test. To test for a defective injector first use Servicemaster to diagnose the problems with the high pressure fuel injection equipment, specifically when the engine does not start.

Leak Off Test

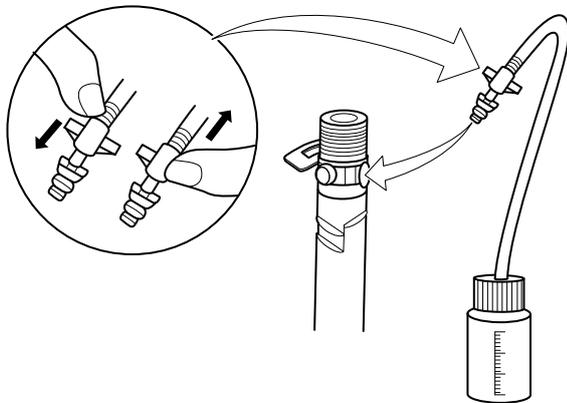
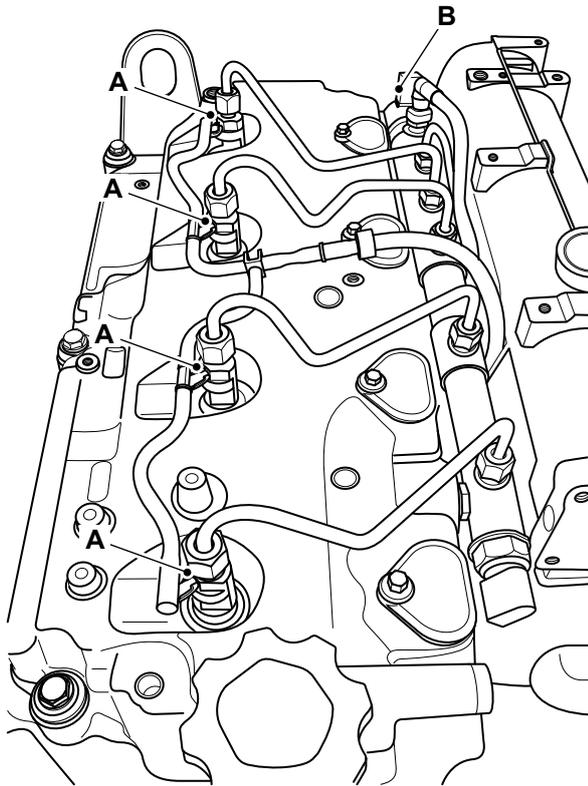
The leak off test kit must be installed on the engine and the ServiceMaster must be used to test the engine.

1. Operate the engine until it reaches its normal operating temperature.
2. Stop the engine. Remove the bleed off pipe at each injector. Refer to (PIL 18-96). Cap the open connectors on the pipes with the caps in the injector leak off test kit.

Special Tool: Injector Leak-off Test Kit ((Electronic Engine)) (Qty.: 1)
Special Tool: Injector Cap Kit (Qty.: 1)

3. Connect the test pipes to the leak off ports on the four injectors.
4. Position the four plastic bottles as upright as possible. Keep the test equipment clear of components that get hot when the engine is operated.
5. Connect a test pipe to the leak off ports on the High Pressure valve outlet. Cap the open pipe.
6. Make sure it is safe to start the engine.
7. Use ServiceMaster to control the tests. Refer to Fuel Injection - Check Operation (PIL 18-18).
 - 7.1. Fuel System Diagnostic Test (Cranking Only).
 - 7.2. Fuel System Diagnostic Tests (Engine Running).
8. Examine the fuel levels in the test bottles. If the difference between any of the levels is more than 10 ml. this indicates that there are one or more defective injectors.
9. Remove the test equipment and replace the bleed off pipes. Refer to (PIL 18-96).

Figure 392.



- A Injectors (x4)
- B HP valve

Remove and Install

The following procedure is for one injector, the procedures are identical for all injectors.

Note: The original injector calibration codes are located on a label on the rocker cover.

Before Removal

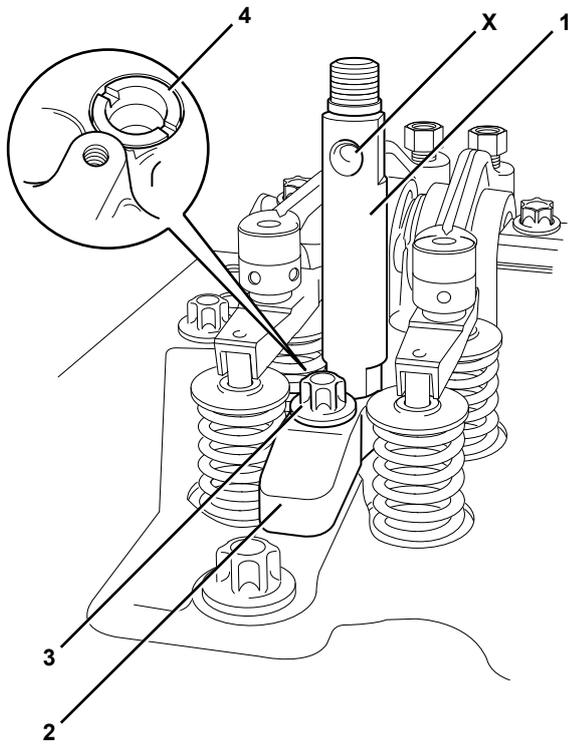
1. Make sure that the engine is safe to work on. If the engine has been running, let it cool before you start the service work.
2. Get access to the engine.
3. Remove the high pressure fuel pipes. Refer to Fuel Pipes (PIL 18-96).
4. Remove the fuel bleed off fuel pipes. Refer to Fuel Pipes (PIL 18-96).
5. Remove the rocker cover, refer to (PIL 15-42).
6. Record which injector is for which cylinder. The injectors must be installed in the same positions.

Note: If a fuel injector is defective, it must be replaced.

Remove

1. Remove the injector clamp retaining bolt and lift the clamp away.

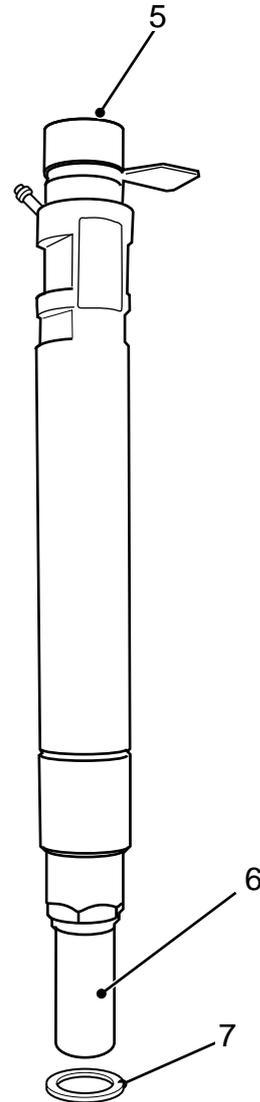
Figure 393.



- 1 Injector
- 2 Injector clamp
- 3 Retaining bolt
- 4 Injector sleeve
- X Injector bleed-off port

2. Remove and discard the sealing washer. Label the injector to make sure it is installed in its original cylinder. Put a clean protective cap over the nozzle of the injector.
3. Remove and discard the O-ring.

Figure 394.



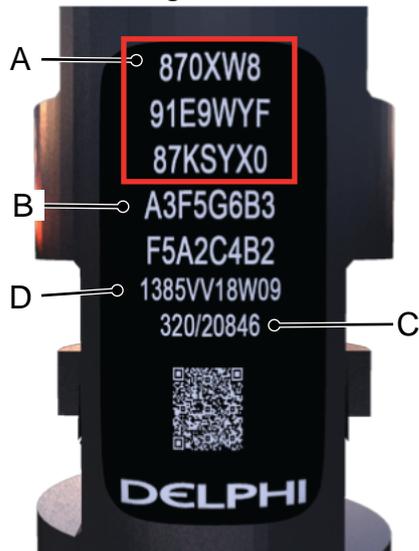
- 5 Protective cap
- 6 Protective cap
- 7 Sealing washer

Install

Important: The fuel injectors are not interchangeable between cylinders or other engines. Make sure you install the injectors in the same positions. If a new or different injector is installed, the engine electronic control unit (ECU) must be re-programmed. Refer to (PIL 33-45), Engine Electronic Control Unit, Vehicle Set Up Data.

When new or different injectors are installed, record the calibration code. Record which cylinder the injector is installed into. Refer to (PIL 33-45), Engine Electronic Control Unit, Vehicle Set Up Data.

Figure 395.



- A** Correction factor (20 characters)
- B** Manufacturers reference
- C** JCB part number
- D** Injector serial number

Table 171. Torque Values

Item	Nm
3	28
4	39

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Clean off any sludge or oil from the inner bore of the injector sleeve. Make sure you do not damage the surface of the bore. Any damage or surface contamination will cause the injector sealing O-ring to fail.
3. Install a new O-ring.
4. Install a new sealing washer.
5. Make sure that the injector is installed in the correct orientation, with the bleed-off port facing the right hand side (exhaust manifold) of the engine. Make sure the injector is pushed fully into the cylinder head.
6. Tighten the injector clamp bolt to the correct torque value.

After Installation

1. Replace the rocker cover, refer to (PIL 15-42).
2. Renew the high pressure fuel pipes, Refer to Fuel Pipes (PIL 18-96).
3. Replace the low pressure fuel pipes, Refer to Fuel Pipes (PIL 18-96).
4. Start the engine and check for fuel leaks.

07 - Injector Seal

Remove and Install

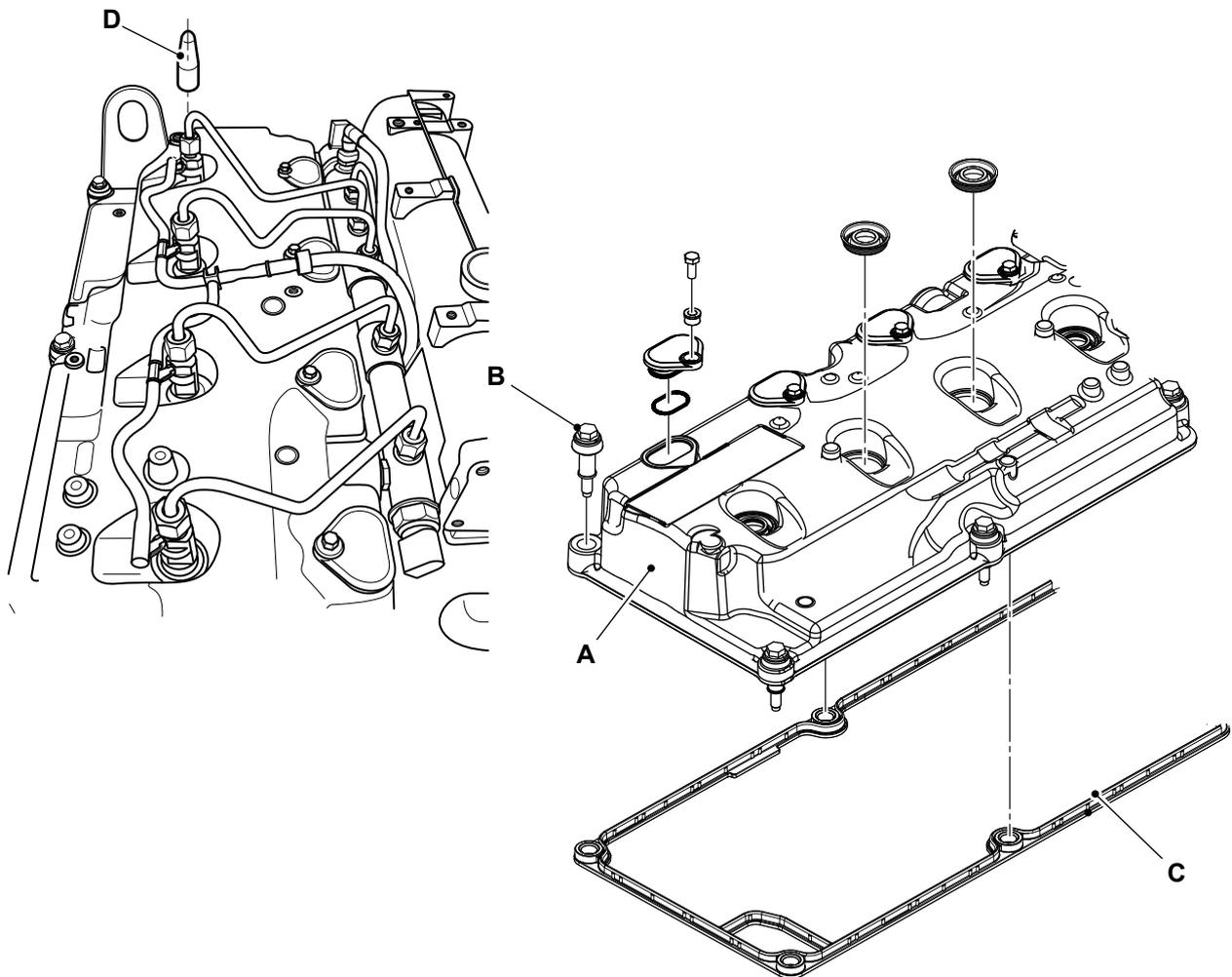
Special Tools

Description	Part No.	Qty.
Injector Seal Installation Tool (Electronic Engine)	892/12346	1
Injector Sleeve Installation/Removal Tool	892/12348	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 Engine- Clean (PIL 15-00).

Figure 396.



A Rocker cover
C Gasket

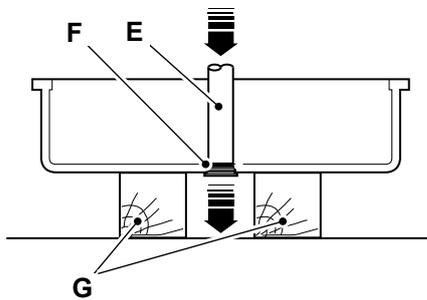
B Bolts
D Injector seals

Remove

1. Get access to the engine.
2. Remove the high pressure fuel pipes. Refer to Fuel Pipes (PIL 18-96).
3. Remove the rocker cover from the cylinder head. Refer to (PIL 15-42).
4. Put wooden supports under the rocker cover and tap out the injector seals using the special tool. Discard the seals.

Special Tool: [Injector Seal Installation Tool \(Electronic Engine\)](#) (Qty.: 1)

Figure 397.



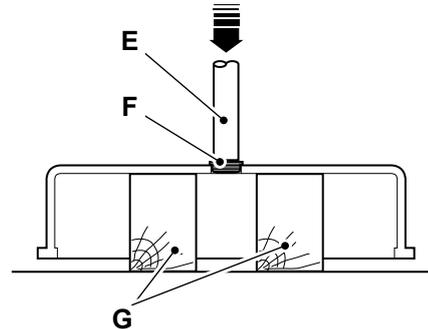
- E** Injector seal installation tool
- F** Injector seals
- G** Wooden supports

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 valve chamber.
3. Renew the injector seals. Put supports under the rocker cover and tap in the new seals using the special tool.

Special Tool: [Injector Seal Installation Tool \(Electronic Engine\)](#) (Qty.: 1)

Figure 398.



- E** Injector seal installation tool
- F** Injector seals
- G** Wooden supports

4. Renew the rocker cover gasket.
5. Prevent damage to the seals. Put sleeves/covers on the injectors. Apply a rubber lubricant to the seals.

Special Tool: [Injector Sleeve Installation/Removal Tool](#) (Qty.: 1)

6. Install the rocker cover. Refer to (PIL 15-42).

After Installation

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

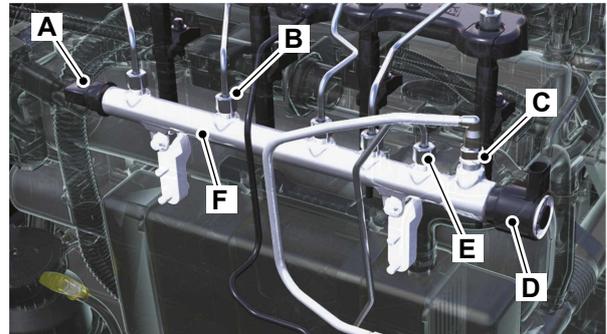
12 - Rail

Introduction	18-67
Remove and Install	18-68

Introduction

The fuel rail also known as a common rail, is a pipe resembling a rail that is used to deliver fuel to individual fuel injectors on internal combustion engines. It is designed to have an outlet for each injector, an inlet for a fuel supply and an outlet for a fuel bleed off.

The fuel rail also incorporates an attached fuel pressure sensor and a fuel valve. DO NOT remove the high pressure fuel valve or the fuel pressure sensor from the rail. If these components are defective replace the complete common rail assembly.

Figure 399.

- A Fuel pressure sensor
- B Outlet
- C Bleed off
- D High pressure fuel valve
- E Inlet
- F Rail assembly

Remove and Install

Before Removal

1. Obey all fuel system health and safety information. Refer to (PIL 18-00).
2. Make sure that the engine is safe to work on. The engine must cool and pressure in the fuel system must decay before you start work. If the engine has been running, wait at least one hour before you start work.
3. Clean the engine. Refer to Engine-Clean (PIL 15-00).
4. Remove the high pressure fuel pipes. Refer to Fuel Pipes (high pressure) - Remove and Install (PIL 18-96).
5. Remove the fuel bleed off pipe at the rail. Refer to Fuel Pipes (low pressure) - Remove and Install (PIL 18-96).

Remove

1. Disconnect the electrical connector at the high pressure fuel valve.
2. Disconnect the electrical connector at the fuel pressure sensor.
3. Remove the bolts and lift off the common rail assembly.

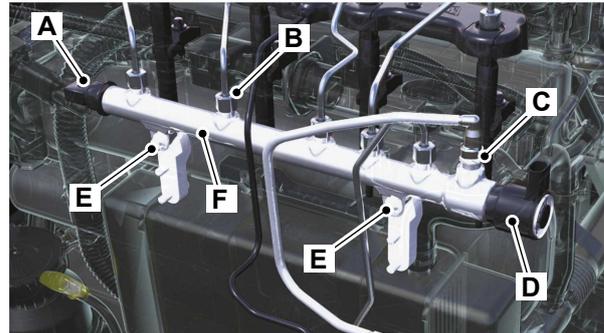
Seal the common rail assembly inside a clean plastic bag until it is ready for use. If the assembly is defective discard it and get a new one.

Install

1. The installation procedure is the opposite of the removal procedure. Additionally do the following steps.
2. Tighten the bolts to the correct torque value.

When renewing the rail assembly make sure to replace all of the high pressure fuel pipes. Refer to (PIL 18-96).

Figure 400.

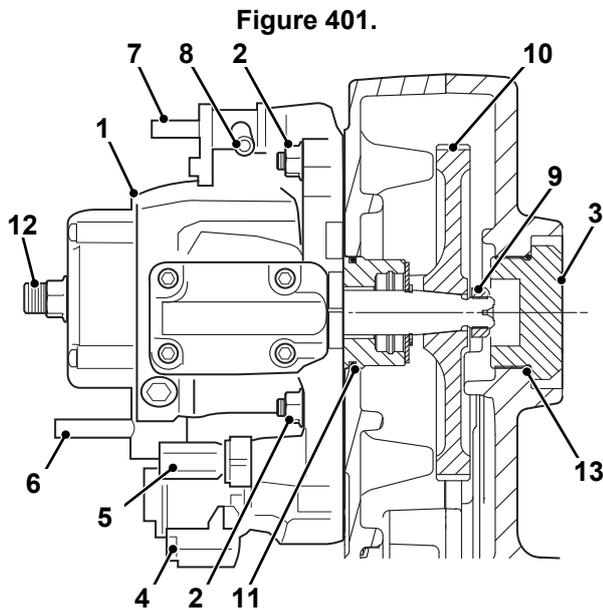


- A** Fuel pressure sensor
- B** High pressure fuel pipe
- C** Fuel bleed off pipe
- D** High pressure fuel valve
- E** Bolts
- F** Rail assembly

Table 172. Torque Values

Item	Nm
C	24

Component Identification



- Figure 401.**
- 1 Fuel injection pump
 - 2 Pump fixing nuts (x3)
 - 3 Injection pump gear cover
 - 4 Inlet metering valve electrical connector
 - 5 Fuel temperature sensor electrical connector
 - 6 Fuel pipe connector (inlet)
 - 7 Fuel bleed-off connector
 - 8 Fuel bleed-off connector, injector bleed off
 - 9 Drive shaft nut
 - 10 Drive gear
 - 11 Injection pump O-ring oil seal
 - 12 High pressure fuel outlet port
 - 13 Gear cover O-ring oil seal

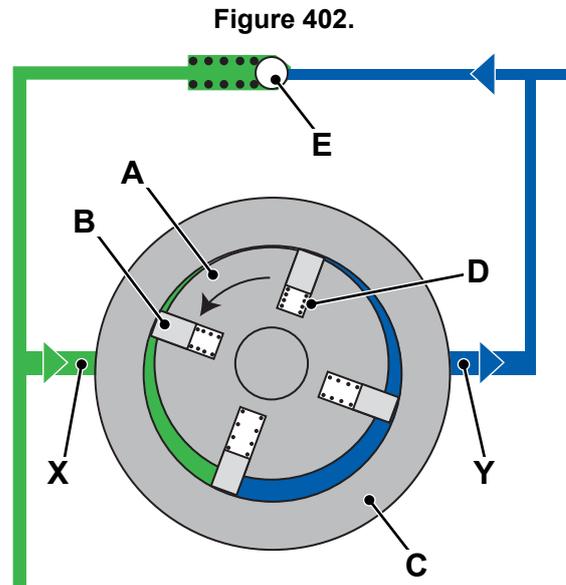
Operation

The high pressure fuel injection pump is driven via a gear on the engine and rotates at half engine speed. The pump comprises of two sections, the transfer pump and the high pressure pump.

Although the pump does not control fuel injection timing, it is still timed in relation to engine phasing. By timing the pump pressure pulses, the load on the engine timing gears is reduced together with reduced mechanical noise.

Transfer Pump Operation

The integral transfer pump is a vane type. An engine driven rotor houses four vanes in slots. The rotor rotates inside an eccentric liner. The vanes are held in contact with the liner by springs. Fuel is drawn into the pump chamber at port X, pressurised by the decreasing volume inside the chamber and expelled at port Y. Fuel pressure generated by the transfer pump is limited to a specified pressure by an integral pressure regulating valve. This pressure is maintained regardless of engine speed. 6bar (87.0psi)



- Figure 402.**
- A Rotor
 - B Vanes (x4)
 - C Eccentric liner
 - D Springs
 - E Regulating valve
 - X Port X
 - Y Port Y

High Pressure Pump Operation

Fuel passes to the high pressure pump via the IMV (Inlet Metering Valve). The ECM (Engine Control

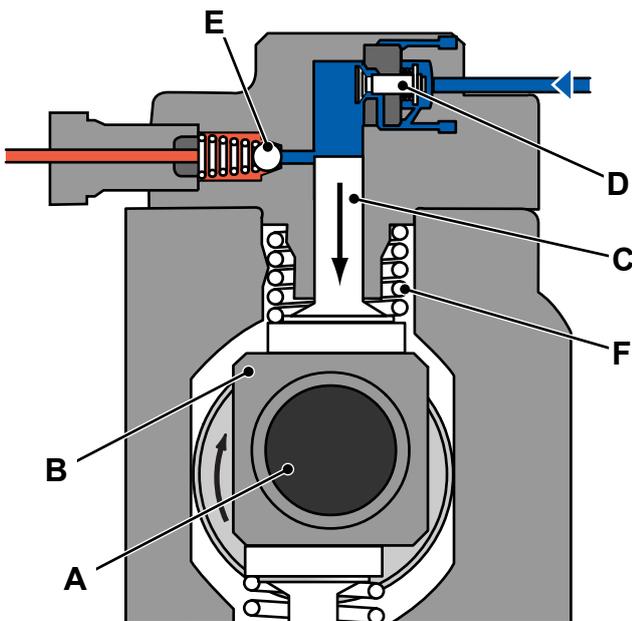
Module) controlled IMV determines the amount of fuel transferred to the high pressure pump. The plunger actuator block is located on the engine driven eccentric shaft. When the shaft rotates the actuator block operates the two plungers. As one plunger is pushed up its chamber the other is pushed down by its spring.

State 1 - Charging

Note: The description is for one plunger. The opposite plunger operates in an identical way. The inlet and delivery ports from each plunger are connected by internal galleries.

When the eccentric shaft is in the position shown force from spring moves the plunger down its chamber. Pressure in the chamber falls below the rail pressure and the delivery valve closes. Transfer pressure is now sufficient to force inlet valve off its seat and allow the fuel to fill the chamber.

Figure 403.



- A Eccentric shaft
- B Actuator block
- C Plunger
- D Inlet valve
- E Delivery valve
- F Spring

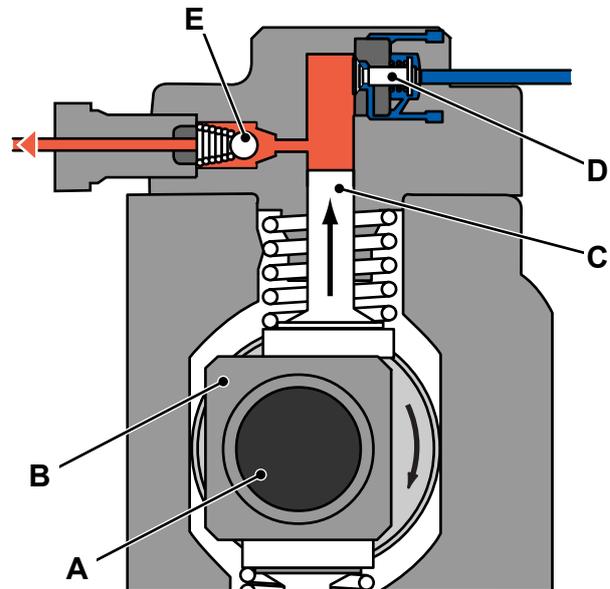
State 2 - Pumping

Note: The description is for one plunger. The opposite plunger operates in an identical way. The inlet and delivery ports from each plunger are connected by internal galleries.

When the eccentric shaft is in the position shown the actuator block moves the plunger up its chamber.

Fuel pressure in the chamber rises and forces the inlet valve on to its seat. As the plunger is pushed further up its chamber the fuel pressure exceeds that of the rail pressure and the delivery valve is forced off its seat. Fuel is forced into the rail at high pressure.

Figure 404.



- A Eccentric shaft
- B Actuator block
- C Plunger
- D Inlet valve
- E Delivery valve

Remove and Install

Special Tools

Description	Part No.	Qty.
Crankshaft Turning Tool (95.25mm PCD)- JCB 4 Cylinder Ecomax and Dieselmax	892/01147	1
Crankshaft / Camshaft Timing Pin (444/448/672 Engine)	892/01148	1
Tamper proof Cover Removal Tool	892/01154	1
Pump Gear Removal Tool	892/01155	1
C-Shaped Ring Spanner	892/01179	1
Torque Wrench (10-100Nm)	993/70111	1

Important: The following procedures include removal and replacement of fuel system components. Before starting the procedures the engine assembly must be cleaned. Clean the engine. Refer to Engine- Clean (PIL 15-00).

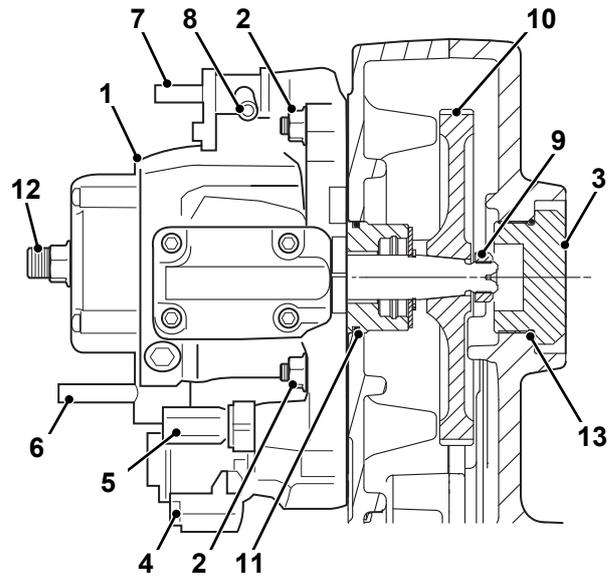
Important: Service procedures on the high pressure fuel pump can only be carried out by specialist personnel with the relevant training and equipment.

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. Remove the high pressure fuel pipe at port 12, refer to Fuel Pipes- Remove and Install. Cap all open ports and pipes, refer to (PIL 18-96).
4. To improve access to the pump, remove the fuel filter, refer to (PIL 18-09).

Important: When removing components dirt and debris may become exposed or dislodged. Stop the removal procedures and clean away the exposed deposits. Refer to Engine- Clean (PIL 15-00).

Figure 405.

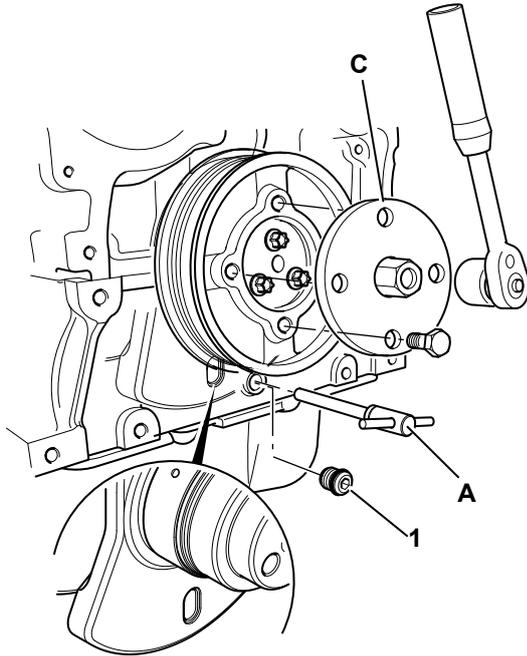


- 1 Fuel injection pump
- 2 Pump fixing nuts (x3)
- 3 Injection pump gear cover
- 4 IMV (Inlet Metering Valve) electrical connector
- 5 Fuel temperature sensor electrical connector
- 6 Fuel pipe connector (inlet)
- 7 Fuel bleed-off connector
- 8 Fuel bleed-off connector, injector bleed off
- 9 Drive shaft nut
- 10 Drive gear
- 11 Injection pump O-ring oil seal
- 12 High pressure fuel outlet port
- 13 Gear cover O-ring oil seal

Remove

1. Release the fuel pipe couplings at the inlet connection 6 and bleed-off connections 7 and 8 on the pump. Cap all open ports and pipes.
2. Uncouple the electrical connectors at the IMV and the fuel temperature sensor.
3. Remove the bedplate plug.

Figure 406.



- 1** Bedplate plug
- A** Crankshaft / Camshaft timing pin
- C** Crankshaft turning tool

4. Use the crankshaft turning tool to turn the crankshaft until the timing pin engages in the crankshaft timing hole.

Special Tool: Crankshaft Turning Tool (95.25mm PCD)- JCB 4 Cylinder Ecomax and Dieselmex (Qty.: 1)

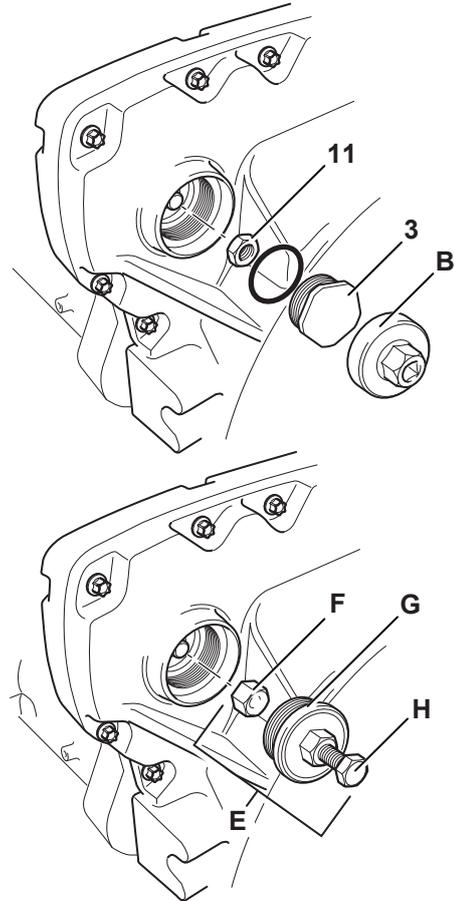
Special Tool: Crankshaft / Camshaft Timing Pin (444/448/672 Engine) (Qty.: 1)

5. Use the gear removal tool and a suitable ratchet drive to remove the fuel injection pump gear cover.

Special Tool: Pump Gear Removal Tool (Qty.: 1)

6. Remove the drive shaft nut.

Figure 407.



- 3** Gear cover
- 11** Drive shaft nut
- B** Gear removal tool
- E** Pump gear removal tool, comprises:
- F** Pump gear removal tool (Reaction cap)
- G** Pump gear removal tool (Body)
- H** Pump gear removal tool (Bolt)

7. Remove the nuts. Use the special C shaped ring spanner to remove the nut closest to the crankcase. Make sure you remove all nuts (X3).

8. Install the reaction cap over the pump shaft. Screw the body to the housing. Use a suitable ratchet drive and socket to screw the bolt in until you feel a slight resistance.

Special Tool: C-Shaped Ring Spanner (Qty.: 1)

Special Tool: Pump Gear Removal Tool (Qty.: 1)

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