SERVICE MANUAL

ENGINE

JCB T4F 444 (55kw) Engine (4 Cyl),
JCB T4i 444 Elec Engine (4 Cyl),
JCB T4i 448 Elec Engine (4 Cyl)

EN - 9806/4300 - ISSUE 5 - 09/2018

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.

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01 - Machine

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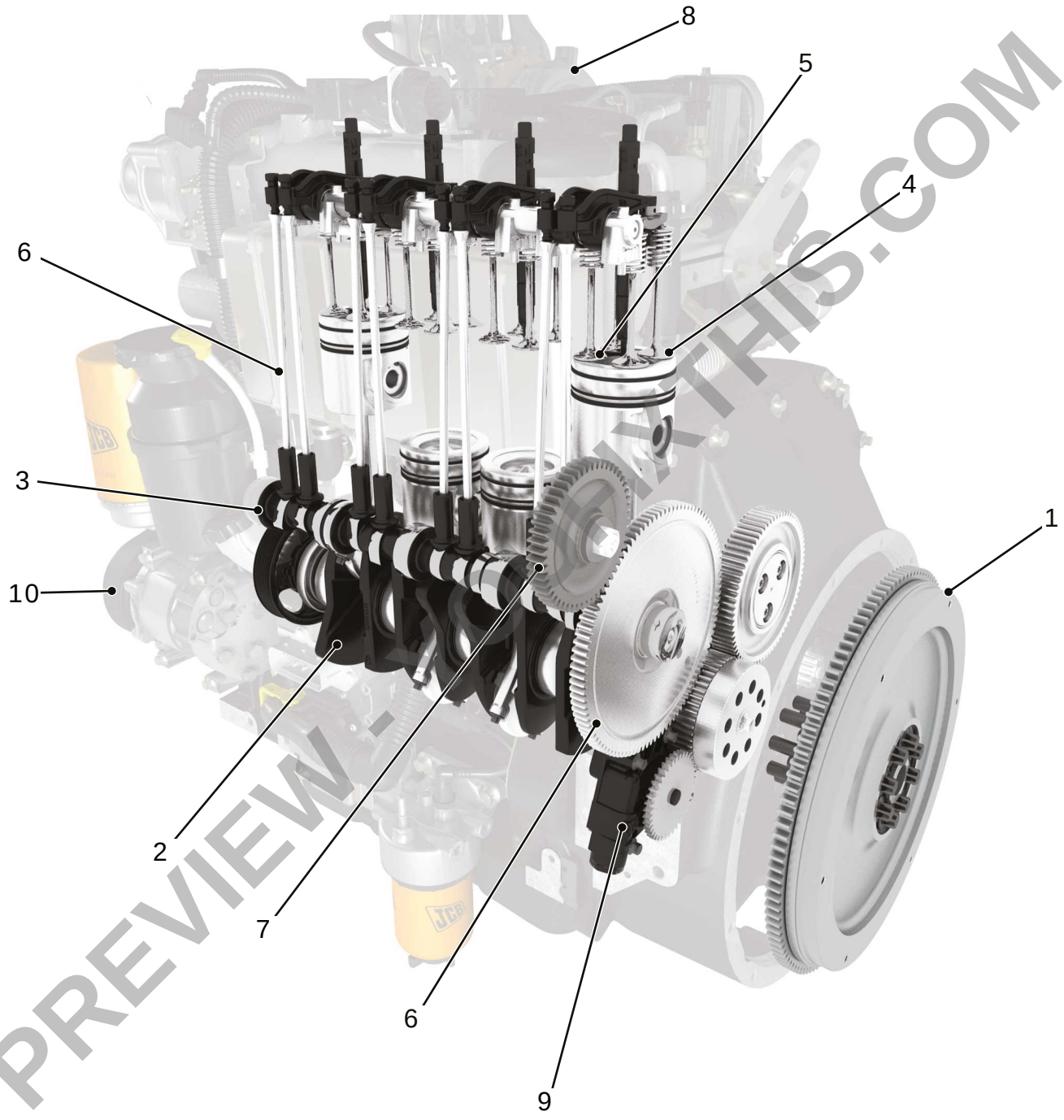
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Figure 3.



1 Flywheel
2 Crankshaft
3 Camshaft
4 Inlet valves (x8)
5 Exhaust valves (x8)
6 Push rods (x8)
7 High pressure fuel pump drive gear
8 Turbocharger
9 Lubrication oil pump
10 Front end drive belt

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Table 31. Torque Table

Item	Torque Value
1-10 (1st Stage)	50N·m
1-10 (2nd Stage)	115N·m
1-10 (Final Stage)	180°
11	24N·m
C	45–55N·m

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Technical Data

Table 147. Engine Fault Codes

J2012 Fault Codes		Lamps				
J2012 P Code (HM Byte)	**J2012 FTB**	**Amber**	**Red**	**DTC Severity as per STD00236**	**Dash Display**	**Fault Description**
P0001	13		Y	SERVICE	P0001-13-Please Contact JCB Dealer	IMV driver fault is detected
P0002	1B		Y	SERVICE	P0002-1B-Please Contact JCB Dealer	Rail pressure control error (pressure error too high).
P0002	1A		Y	SERVICE	P0002-1A-Please Contact JCB Dealer	Rail pressure control error (pressure error too low).
P0002	00		Y	SERVICE	P0002-00-Please Contact JCB Dealer	Rail Pressure Negative Control Error During 'IMV-Only' control. PID controller not able to stabilise the RPC value
P0002	00	Y		CRITICAL	P0002-00-Please Contact JCB Dealer	Rail Pressure Positive Control Error During 'IMV-Only' control. PID controller not able to stabilise the RPC value
P0003	18	Y		CRITICAL	P0003-18-Please Contact JCB Dealer	Rail pressure control feedback low error
P0003	11		Y	SERVICE	P0003-11-Please Contact JCB Dealer	IMV driver fault is detected
P0004	19		Y	SERVICE	P0004-19-Please Contact JCB Dealer	Rail pressure control feedback high error
P0004	12		Y	SERVICE	P0004-12-Please Contact JCB Dealer	IMV driver fault is detected
P007A	00		Y	SERVICE	P007A-00-Please Contact JCB Dealer	Charge Air Cooler Temperature Sensor Circuit
P007C	23		Y	SERVICE	P007C-23-Please Contact JCB Dealer	Charge Air Cooler Temperature Sensor Circuit Low
P007D	24		Y	SERVICE	P007D-24-Please Contact JCB Dealer	Charge Air Cooler Temperature Sensor Circuit High
P0087	23	Y		CRITICAL	P0087-23-Please Contact JCB Dealer	Rail Pressure build low fault
P0087	23	Y		CRITICAL	P0087-23-Please Contact JCB Dealer	Rail Pressure build normal fault

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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. Position the machine on firm level ground. Make the machine safe, refer to (PIL 01-03).
3. Get access to the engine.

Remove

1. Disconnect and remove the battery. Refer to (PIL 33-03).
2. Drain the engine oil. Refer to (PIL 15-21).
3. Drain the engine coolant, remove the cooling pack. Refer to (PIL 21-03).
4. Discharge the hydraulic pressure. Refer to (PIL 30-00).
5. Drain the hydraulic tank. Disconnect and plug the hydraulic suction and delivery lines at the transmission pump and gear pump. Label the hoses to ensure correct reassembly. Refer to (PIL 30-00).
6. Disconnect and plug the hydraulic cooler hoses. Label the hoses to ensure correct reassembly.
7. Disconnect the exhaust system.
8. Label the cab heater hoses at the engine block connectors. Release the hose clips and remove the hoses.
9. Disconnect the wiring connections from the starter motor. Refer to (PIL 15-75).
10. Disconnect the wiring connections from the alternator. Refer to (PIL 15-72).
11. Disconnect the wiring connections from the engine sensors and actuators. Refer to (PIL 15-84).
12. Disconnect the fuel supply line at the fuel lift pump and the spill line at the fuel injection pump. Cap all hoses and ports to prevent ingress of dirt.
13. Disconnect the electrical harness at the engine harness.
14. Uncouple the electrical harness at the ECM (Engine Control Module) machine side connector. Important: Do not touch the connector pins on the ECM or harness connectors. Cover the connectors to prevent contamination.
15. Ensure that all relevant harnesses and hoses are unclipped from the engine and tied out of the way.
16. Disconnect and plug the hoses at the hydraulic pump.
17. Disconnect the wiring to the hydraulic pump.
18. Remove the gearbox to engine retaining bolts, pull the transmission and converter clear of the engine, make sure that the converter stays mounted on the gearbox shaft.
19. Attach slings to the engine lifting eyes.

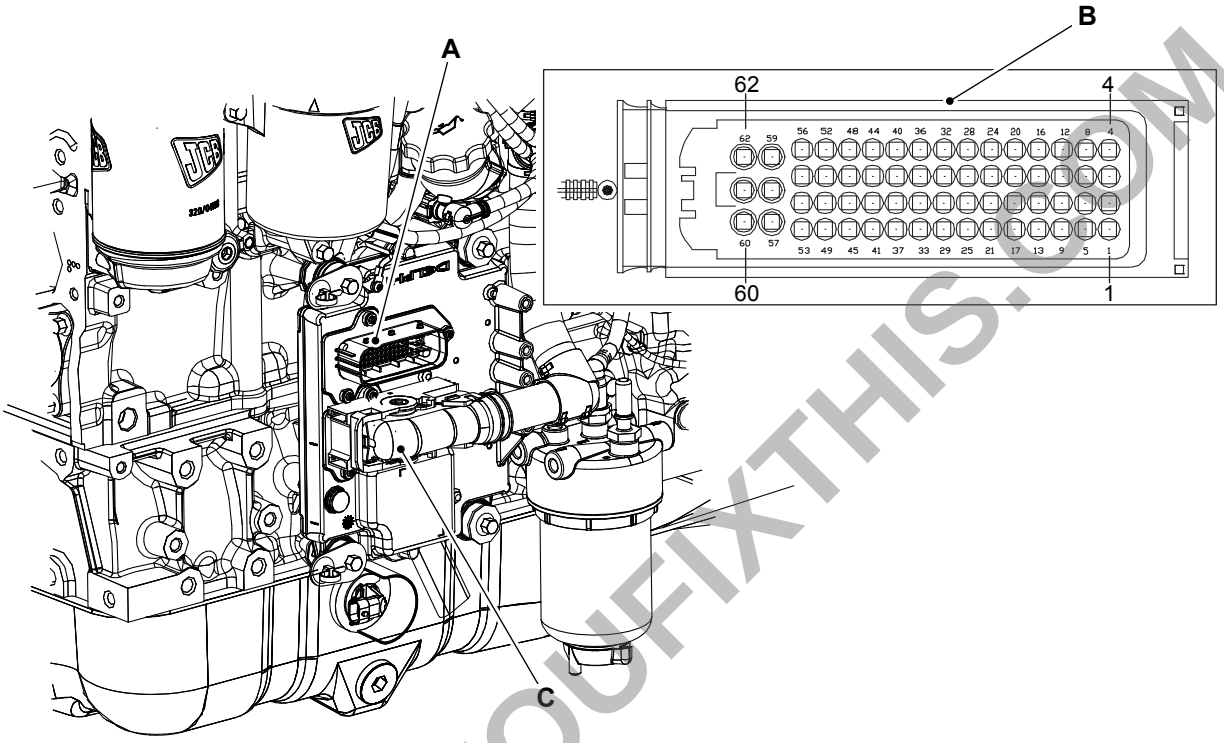
    Special Tool: Lifting Bracket Front (Qty.: 1)
    Special Tool: Lifting Bracket Rear (Qty.: 1)
    Special Tool: Engine Lifting Spreader Bar (Qty.: 1)
20. Take the weight of the engine on the hoist and remove the engine mounting bolts.
21. Withdraw the engine in a level attitude until the hydraulic pump is clear of the chassis. Raise the engine to lift it clear of the machine.
22. Lower the engine into a suitable stand that is capable of supporting the weight of the engine.

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Engine ECU Power Supply

Figure 290. Harness connector MF13



A Connector pins
B Machine harness connector
C Engine harness connector

Table 141. Engine ECU power supply

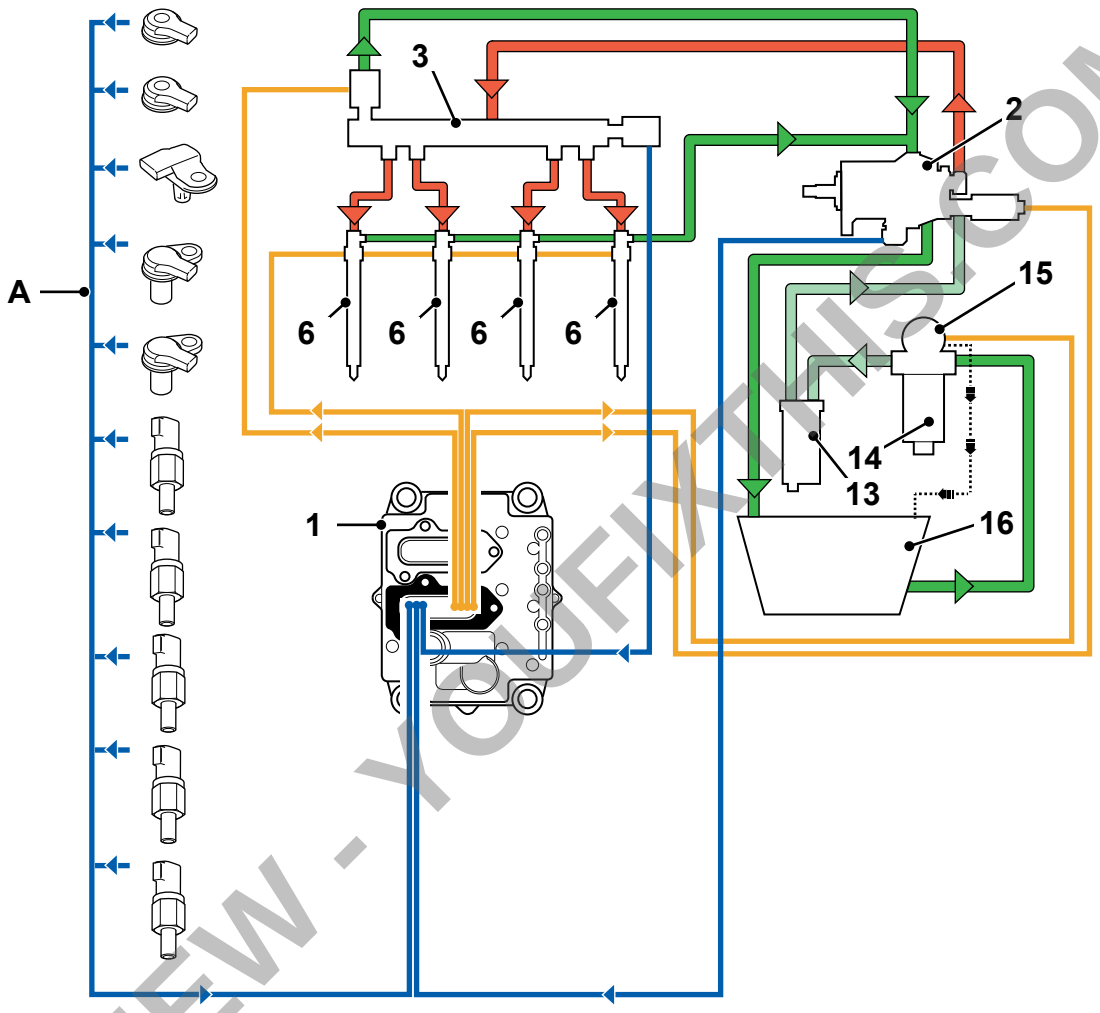
Harness connector MF13					
Connectors	**Pins**				**Details**
MF13	57	60	49	43	Harness connector - engine ECU (grey).
MF06	K	M	N	H	Harness connector - engine fuse/ relay box.

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Component Identification

Figure 164.



1 ECM (Engine Control Module)(refer to PIL 33-45)
2 High pressure fuel injection pump (refer to PIL 18-18)
3 Common fuel rail (refer to PIL 18-18)
6 Fuel injectors (refer to PIL 18-18)
13 Fuel filter (2 micron) (refer to PIL 18-09)
14 Fuel pre-filter and water separator (5 micron) (refer to PIL 18-12)
15 Electric feed pump (refer to PIL 18-21)
A Electrical sensors (refer to PIL 15-84)
B Fuel tank (refer to PIL 18-03)

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Fault-Finding

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Lubricating Oil - Pressure High	Table 24.	Page 15-27

Table 6. Engine - Will Not Start or Difficult to Start (No Exhaust Smoke)

Cause	Remedy
No fuel in supply tank.	Check the level in the fuel tank, use sight gauge or dipstick. Replenish as required.
Ignition switch or starter electrical system failure.	Check the operation of the ignition switch. Check the correct electrical wires for open or short circuits.
Improper starting procedure.	Verify proper starting procedure.
Fuel Filter blocked with water or other contamination.	Drain fuel/water separator or replace fuel filter.
Defective fuel lift pump (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits. Check fuses.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel inlet restriction.	Maximum inlet restriction to fuel lift pump must not exceed 100mm Hg.
Air intake or exhaust system blocked.	Visually check the air intake and exhaust system for blockage or obstruction. Remove as required. Check the air filter elements for signs of blocking. Replace as required.
Fuel drain return line blocked, not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.
One or more fuel injectors worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.

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Technical Data

Table 4.

Description	SL Engine	SH Engine	SM Engine	DH Engine	DM Engine
Engine Variants	Turbocharged with intercooler	Turbocharged with Intercooler	Turbocharged with Intercooler	Turbocharged with Intercooler	Turbocharged with Intercooler
Emission compliance	US-EPA Tier 4 Final, EU Stage IV	US-EPA Tier 4i, EU Stage IIIB	MAR-1 (Brazil)	US-EPA Tier 4i, EU Stage IIIB	MAR-1 (Brazil)
Rated speed	2200 RPM (Revolutions Per Minute)	2200 RPM	2200 RPM	2200 RPM (108kW), 2050 RPM (129kW)	2200 RPM (108kW), 2050 RPM (129kW)
Weight (Dry)	(Dry weight-No cooling fan drive) 496kg	(Dry weight-No cooling fan drive) 496kg	(Dry weight-No cooling fan drive) 496kg	(Dry weight-No cooling fan drive) 496kg	(Dry weight-No cooling fan drive) 496kg
Number of cylinders	4	4	4	4	4
Nominal bore size	103mm	103mm	103mm	106mm	106mm
Stroke	132mm	132mm	132mm	135mm	135mm
Cylinder arrangement	In line	In line	In line	In line	In line
Combustion Cycle	4-stroke	4-stroke	4-stroke	4-stroke	4-stroke
Firing order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Displacement	4.399L	4.399L	4.399L	4.765L	4.765L
Compression ratio	16.7: 1	16.7: 1	16.7: 1	16.7: 1	16.7: 1
Engine Compression	Compression variance between each cylinder should be no greater than 3.5bar (50.7psi)	Compression variance between each cylinder should be no greater than 3.5bar (50.7psi)	Compression variance between each cylinder should be no greater than 3.5bar (50.7psi)	Compression variance between each cylinder should be no greater than 3.5bar (50.7psi)	Compression variance between each cylinder should be no greater than 3.5bar (50.7psi)
Direction of rotation (viewed from front {crankshaft pulley} end)	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise
Valves	4 per cylinder	4 per cylinder	4 per cylinder	4 per cylinder	4 per cylinder
Valve clearances measured at the tappet end of the rockers (measured cold)					
- Inlet	0.15–0.21mm	0.15–0.21mm	0.15–0.21mm	0.15–0.21mm	0.15–0.21mm
- Exhaust	0.43–0.49mm	0.43–0.49mm	0.43–0.49mm	0.43–0.49mm	0.43–0.49mm
Lubricating oil pressure (Dependent on engine temperature and speed)	1.6–6.5bar (23.2–94.2psi)	1.6–6.5bar (23.2–94.2psi)	1.6–6.5bar (23.2–94.2psi)	1.6–6.5bar (23.2–94.2psi)	1.6–6.5bar (23.2–94.2psi)

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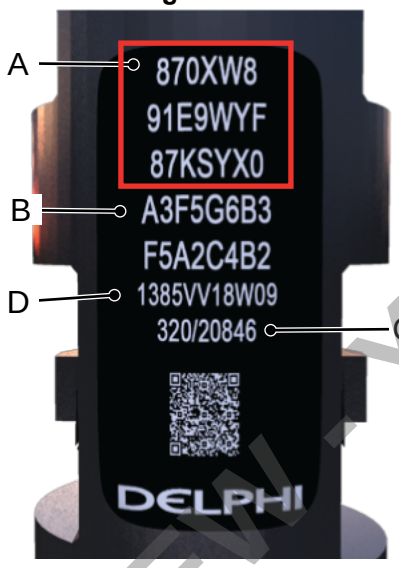
Calibrate

Since the injector operating components are by necessity very small, even the most advanced manufacturing techniques do not ensure consistent injection cycle characteristics between injectors.

For example, small variations in the metering orifice sizes will alter the time durations for the start and stop of fuel injection. The small dimensions involved mean that only a tiny variation will alter the orifice area by a relatively large percentage.

For this reason it is necessary to individually test and record the operating characteristics of each injector assembly at the factory. The results of the test are recorded in the form of a calibration code and attached to the injector body.

Figure 184.



A Calibration code (20 characters)
B Manufacturers reference
C JCB part number
D Injector serial number

The codes for each injector installed to the engine are programmed into the ECM (Engine Control Module). The operating software in the ECM uses the data to adjust the control of the injector solenoid coil accordingly. The injector is therefore effectively re-calibrated by the ECM.

It follows that if injectors are removed they must always be installed in their original positions. If new injectors are installed the ECM must be reprogrammed with the new injector codes as follows.

1. Make the machine safe.
   Refer to: PIL 01-03.
2. Connect Servicemaster and use JCB Ecomax engine setup software to program injector calibration codes as necessary.
   2.1. Change the existing codes to the new ones and then write to the ECM.

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Technical Data

Table 112.

Component	Value
Operating pressure	0.8bar (11.6psi)
Expected minimum free flow delivery	2.5L/min

Table 113. Expected electrical values

Machine Voltage V	Minimum Voltage V	Maximum Voltage V	Minimum Resistance Ohms	Maximum Resistance Ohms	Minimum Current Draw A	Maximum Current Draw A
12	8	16	0.8	1.5	4	8
24	20	30	4.9	5.7	4	5.5

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06 - Pre-start Cold Checks, Service Points and Fluid Levels

Introduction

The following maintenance procedure refers to the JCB engine only. It does not apply to the machine or equipment in which it is installed. Consult the manufacturers operation manual for further information.

Table 174. All Applications Except Generator Set Applications.

Pre-start Cold Checks Service Points and Fluid Levels	Operation	10h	50h	500h	1,000h	1,500h	2,000h	8,000h
ENGINE								
Oil level	Check	O	O	□	□	□	□	□
Coolant Quality/ level	Check	O	O	□	□	□	□	□
Coolant or Oil Leaks	Check	O	O	□	□	□	□	□
Water Sedimenter	Check for Contamination and Drain		O	□	□	□	□	□
Fuel Filter (both machine mounted filter)	Change			□	□	□	□	□
Oil and Filter[1]	Change			□	□	□	□	□
All Hoses - Condition	Check			□	□	□	□	□
Radiator[2]	Clean			□	□	□	□	□
Front End Accessory Drive (FEAD) Belt Condition	Check			□	□	□	□	□
Air Cleaner Outer Element[2]	Change				□	□	□	□
DEF (Diesel Exhaust Fluid) Filter (if installed)[4]	Change				□	□	□	□
Crankcase Ventilation Filter	Change					□	□	□
Air Cleaner Inner Element	Change						□	□
Valve Clearances[3]	Check and Adjust						□	□
Oil Filler and Dipstick O-rings	Change						□	□
Cooling system	Drain and Fill						□	□
Front End Accessory Drive (FEAD) Belt	Change							□
Injectors[3]	Change							□
Injector(s) Leak-Off Rail[3]	Change							□
High Pressure Fuel Lines[3]	Change							□

(1) If operating under arduous conditions, do an engine oil flush (use the normal recommended engine oil) every 250 hours. Change the engine oil and filter every 250 hours.
(2) If operating in dusty adverse working environments, do these jobs more frequently.
(3) These jobs must be done by a qualified engineer.
(4) Change DEF filter more regularly under arduous conditions.

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03 - Maintenance Intervals

Introduction

General

Table 173.

Interval (h)	Calendar Equivalent
10	Daily
50	Weekly
500	6 months
1000	Yearly
2000	2 Years
8000	8 Years

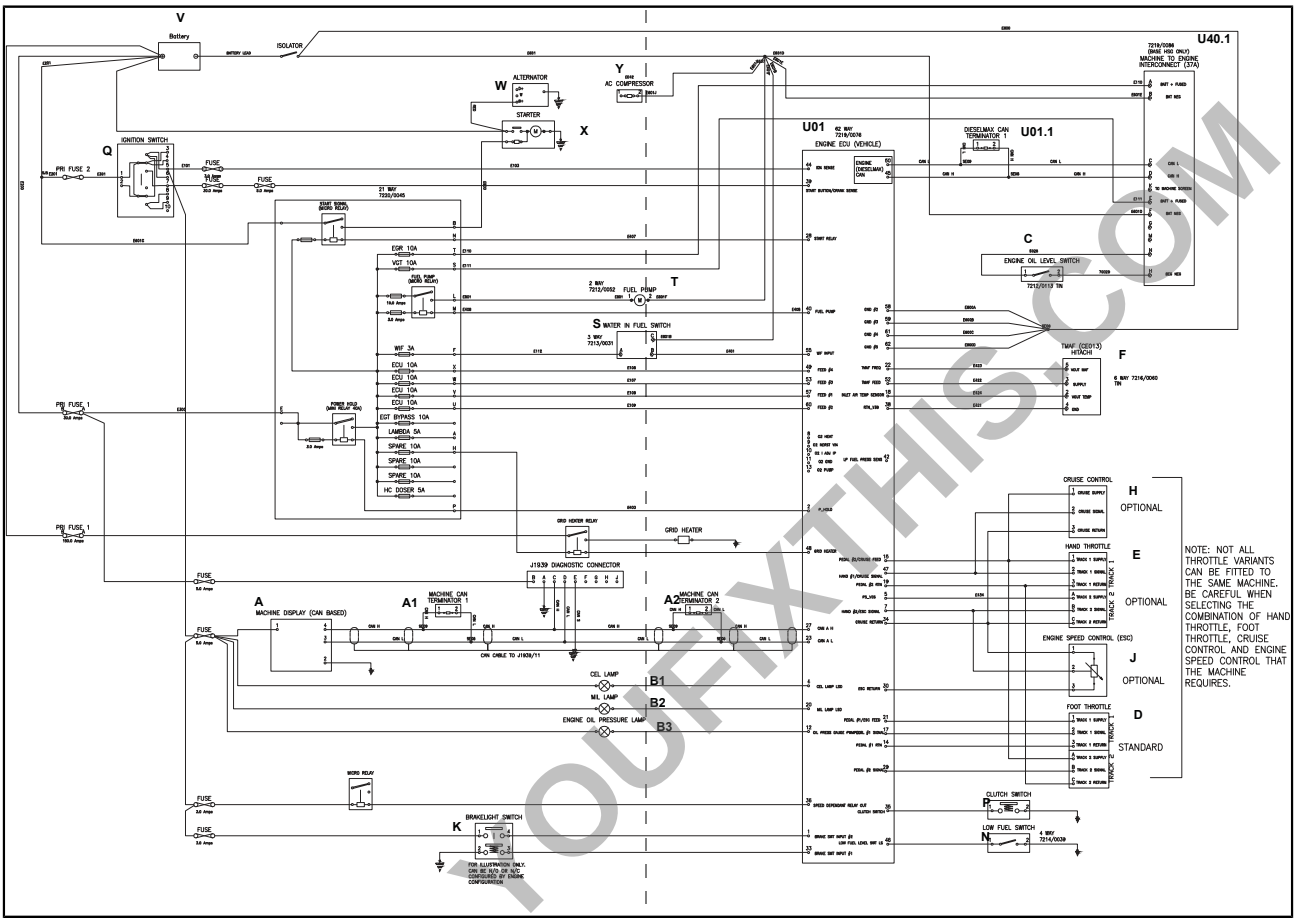
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Page 33-12

Figure 263. Engine Connector (Grey)

Page 33-13



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Notes:

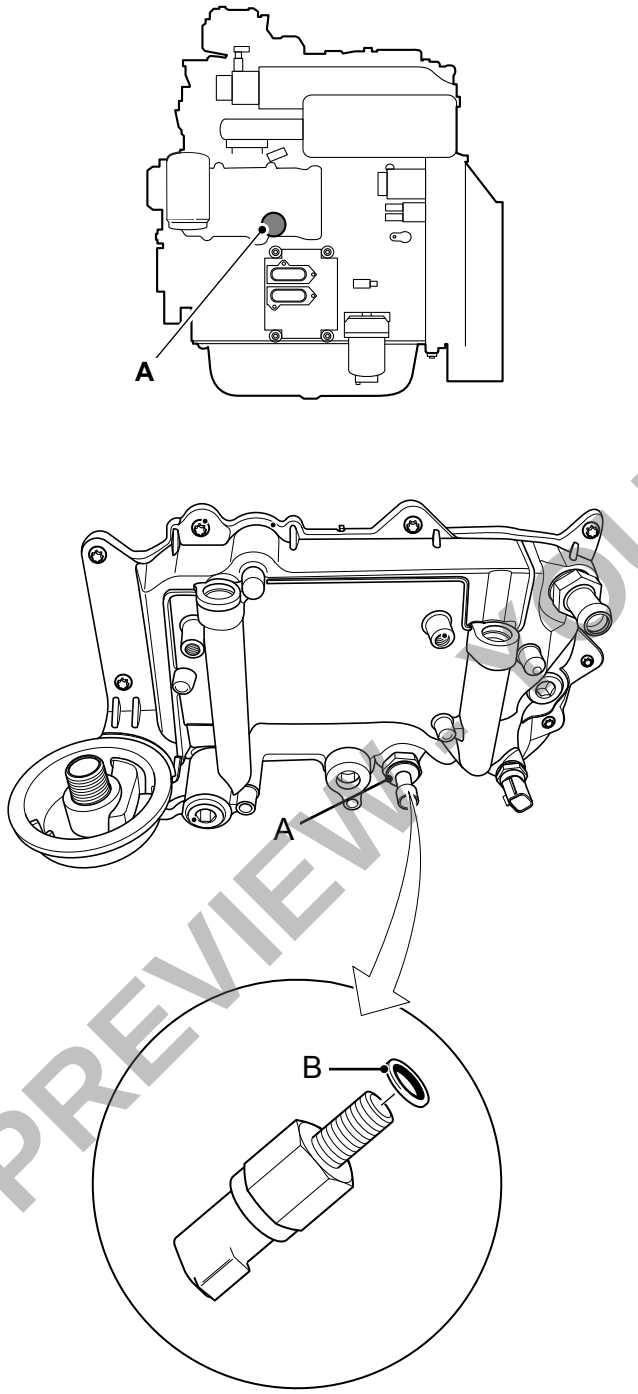
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4. Install a suitable adaptor into the vacant pressure switch port (M10 x 1.5mm thread) and a pressure test gauge. Make sure that the gauge has a sealing washer as shown.

   Special Tool: Pressure Gauge (0-40 Bar) (Qty.: 1)
   Special Tool: Digital Hydraulic Pressure Test Kit (Qty.: 1)

Figure 13.



A Oil pressure switch
B Sealing washer

5. Start the engine and allow a few seconds to gain oil pressure, increase the engine revs to the rated speed. Record the pressure gauge reading, refer to Technical Data (PIL 15-00), for the recommended circuit pressure.

6. Remove the pressure gauge and install the pressure switch.

High Lubrication Oil Pressure

High oil pressure will be evident when starting in cold conditions. Typically the pressure will be 1 to 2 bar and higher in cold operation, the pressure should drop when the engine reaches normal operating temperature.

If the pressure remains high when operating temperature is achieved, check the oil level, if this is correct, suspect the oil pump relief valve is at fault.

Low Lubrication Oil Pressure

Several factors can be the cause of low lubricating oil pressure:

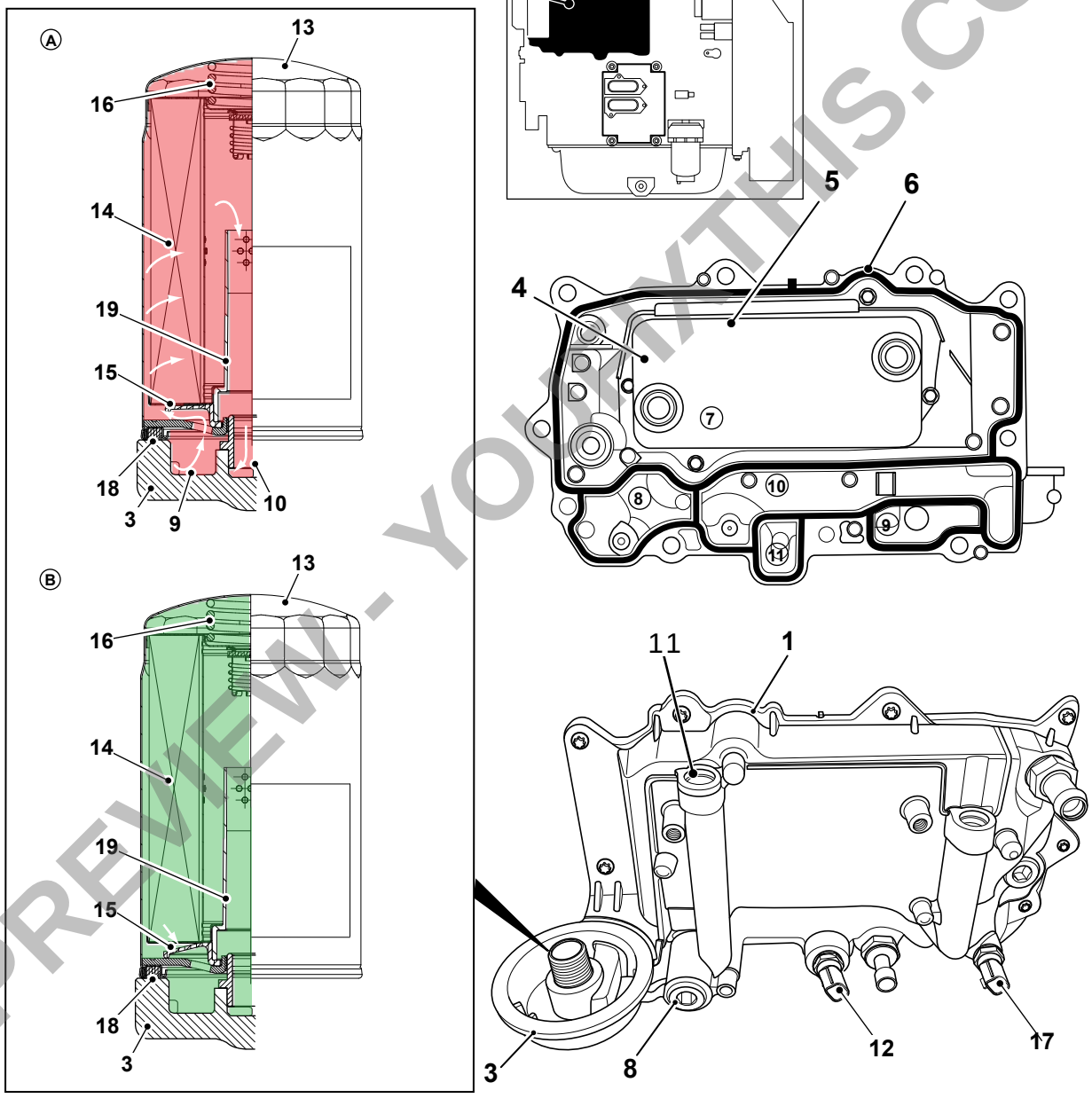
- Low oil level - typically evident as a loss of pressure when operating on uneven ground or on a gradient.
- Blocked oil filter - a blocked filter will show as a gradual loss of pressure.
- Blocked suction strainer (pick-up pipe) - typically evident as low pressure on start up, if the blockage frees itself in the sump, the pressure will pick up to normal.
- Coolant in the oil - coolant in the lubricating oil will show as a milky discolouration of the oil and an increase in oil level. Check for damaged core plugs, lubricating oil cooler, cylinder head and/or gasket.
- Fuel in the oil - fuel in the oil will result in thin' black lubricating oil, the oil will also have a diesel fuel smell. Check the fuel injection pump (FIP) shaft seal refer to (PIL 18-18), piston ring wear, lift pump diaphragm damage or injector leakage if fuel is evident in the oil.
- Damaged oil pump - oil pressure will be high at low oil temperature but fall when oil becomes hotter.

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Component Identification

Figure 59.



1 Oil cooler and filter housing
2 Oil filler cap (not shown)
3 Oil filter head
4 Oil gallery - from pump to cooler
5 Oil cooler matrix
6 Sealing gasket - housing to crankcase
7 Coolant gallery
8 Oil filter drain down plug
9 Oil gallery - from cooler to filter head
10 Oil gallery - from filter head to main oil gallery

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Notes:

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03 - Solenoid

Remove and Install

The solenoid is an integral part of the starter motor, it is designed to relay a large electric current to the starter motor, which in turn sets the engine in motion. The solenoid also engages the starter pinion with the ring gear of the engine.

This part is a non-serviceable part if it fails, replace the complete starter motor.

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Operation

The pump draws fuel from the tank, through the water separator, pumping it through the fuel filter and into the fuel injection pump. The pump has a built in protection against running dry and will shut down after 2min if no fuel is present.

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03 - Radiator

Introduction

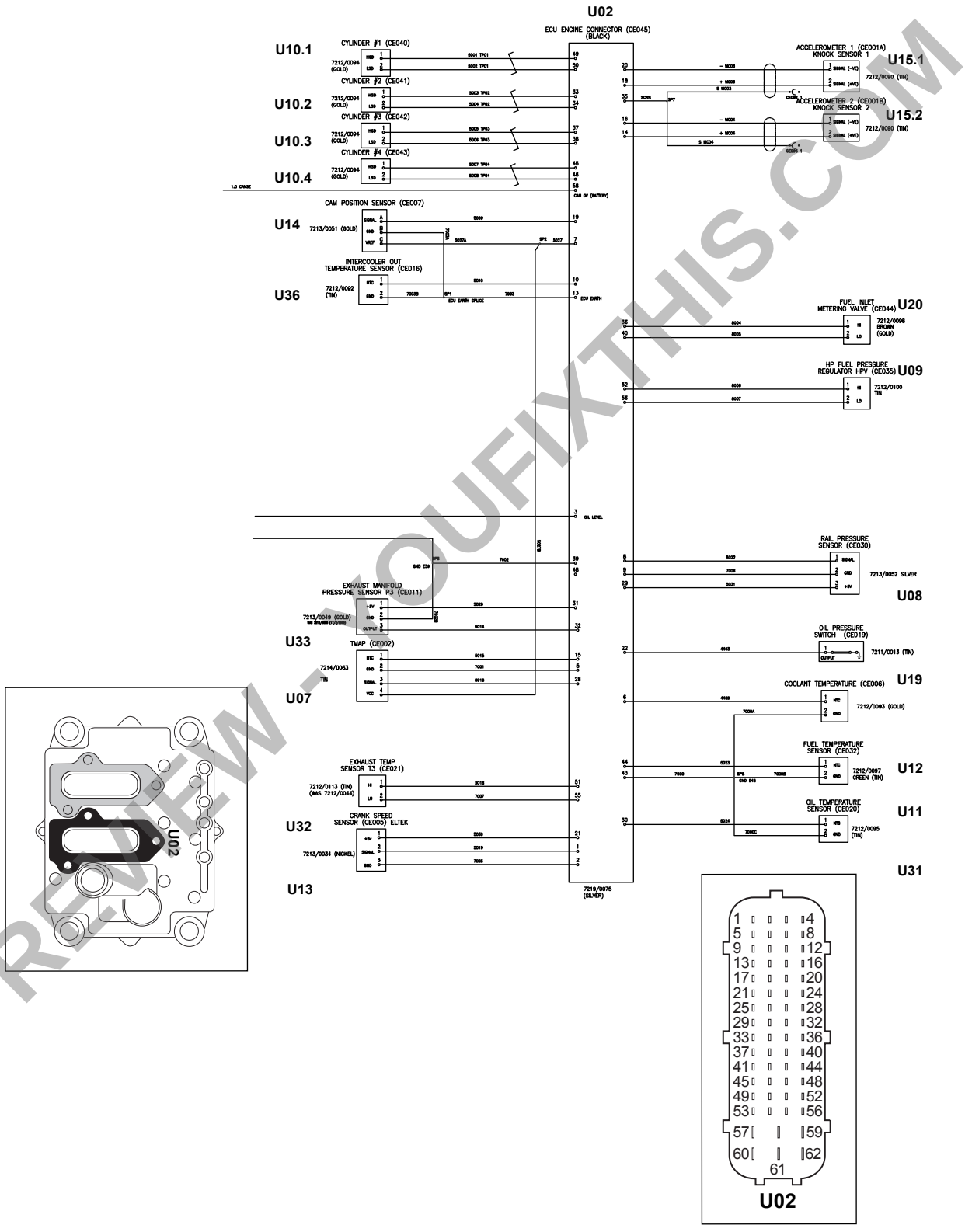
The radiator is a device in the cooling system that removes heat from the coolant passing through it, allowing the coolant to remove heat from the engine.

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Engine Interface Connector

Figure 288.



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Fault Code	Cause	Remedy
C241	Short Circuit to negative connection at Crowd Solenoid	Check Crowd Solenoid
C242	Short Circuit to negative connection at Dump Solenoid	Check Dump Solenoid
C243	Short Circuit to negative connection at Float Transducer	Check Float Transducer
C244	Short Circuit to negative connection at Lower Solenoid	Check Lower Solenoid
C245	Short Circuit to negative connection at Transmission X1F Solenoid	Check Transmission X1F Solenoid
C246	Short Circuit to negative connection at Park brake Transducer	Check Park brake Transducer
C247	Short Circuit to negative connection at Transmission X2F Solenoid	Check Transmission X2F Solenoid
C250	Short Circuit to negative connection at Raise Solenoid	Check Raise Solenoid
C251	Short Circuit to negative connection at Transmission X1R Solenoid	Check Transmission X1R Solenoid
C252	Short Circuit to negative connection at Transmission X2R Solenoid	Check Transmission X2R Solenoid
C256	Short Circuit to negative connection at Starter Relay	Check Starter Relay
C257	Short Circuit to negative connection at Reverse Alarm	Check Reverse Alarm
C258	Short Circuit to negative connection at Brake Light	Check Brake Light
C271	Short Circuit to negative connection at Auxiliary Roller	Check Auxiliary Roller
C285	Short Circuit to negative connection at D+ Terminal	Check D+ Terminal
C296	Short Circuit to negative connection at SRS Solenoid 2	Check SRS Solenoid 2
C297	Short Circuit to negative connection at SRS Solenoid 3	Check SRS Solenoid 3
C298	Short Circuit to negative connection at Reversing Fan Solenoid	Check Reversing Fan Solenoid
C316	Open Circuit at Fan Solenoid	Check Fan Solenoid
C317	Open Circuit at High Flow Solenoid	Check High Flow Solenoid
C319	Open Circuit at Parallel Lift Solenoid	Check Parallel Lift Solenoid
C325	Open Circuit at Implement Pilot Solenoid	Check Implement Pilot Solenoid
C326	Open Circuit at Auxiliary A Solenoid	Check Auxiliary A Solenoid
C327	Open Circuit at Auxiliary B Solenoid	Check Auxiliary B Solenoid
C330	Open Circuit at Quick Hitch A	Check Quick Hitch A
C331	Open Circuit at Quick Hitch B	Check Quick Hitch B
C334	Open Circuit at SRS Solenoid 1	Check SRS Solenoid 1
C335	Open Circuit at Two-Speed Solenoid	Check Two-Speed Solenoid
C336	Open Circuit at LH Turn Signal	Check LH Turn Signal
C337	Open Circuit at RH Turn Signal	Check RH Turn Signal

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