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Care and Safety

Important Information

T1-042

The Operator Manual

⚠ WARNING

You and others can be killed or seriously injured if you operate or maintain the machine without first studying the Operator Manual. You must understand and follow the instructions in the Operator Manual. If you do not understand anything, ask your employer or JCB dealer to explain it.

INT-1-4-2

Do not operate the machine without an Operator Manual, or if there is anything on the machine you do not understand.

Treat the Operator Manual as part of the machine. Keep it clean and in good condition. Replace the Operator Manual immediately if it is lost, damaged or becomes unreadable.

Safety Warnings



This safety alert system identifies important safety messages in this manual. When you see this symbol, be alert, your safety is involved, carefully read the message that follows, and inform other operators.

In this publication and on the machine, there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

⚠ DANGER

Denotes an extreme hazard exists. If proper precautions are not taken, it is highly probable that the operator (or others) could be killed or seriously injured.

INT-1-2-1

⚠ WARNING

Denotes a hazard exists. If proper precautions are not taken, the operator (or others) could be killed or seriously injured.

INT-1-2-2

⚠ CAUTION

Denotes a reminder of safety practices. Failure to follow these safety practices could result in injury to the operator (or others) and possible damage to the machine.

INT-1-2-3

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Engine Component Identification

External

The following identifies the main components of a typical engine assembly visible from the exterior. Some variants may differ in detail. ⇨ *Table 1. Engine - As viewed on the left hand side (19)*

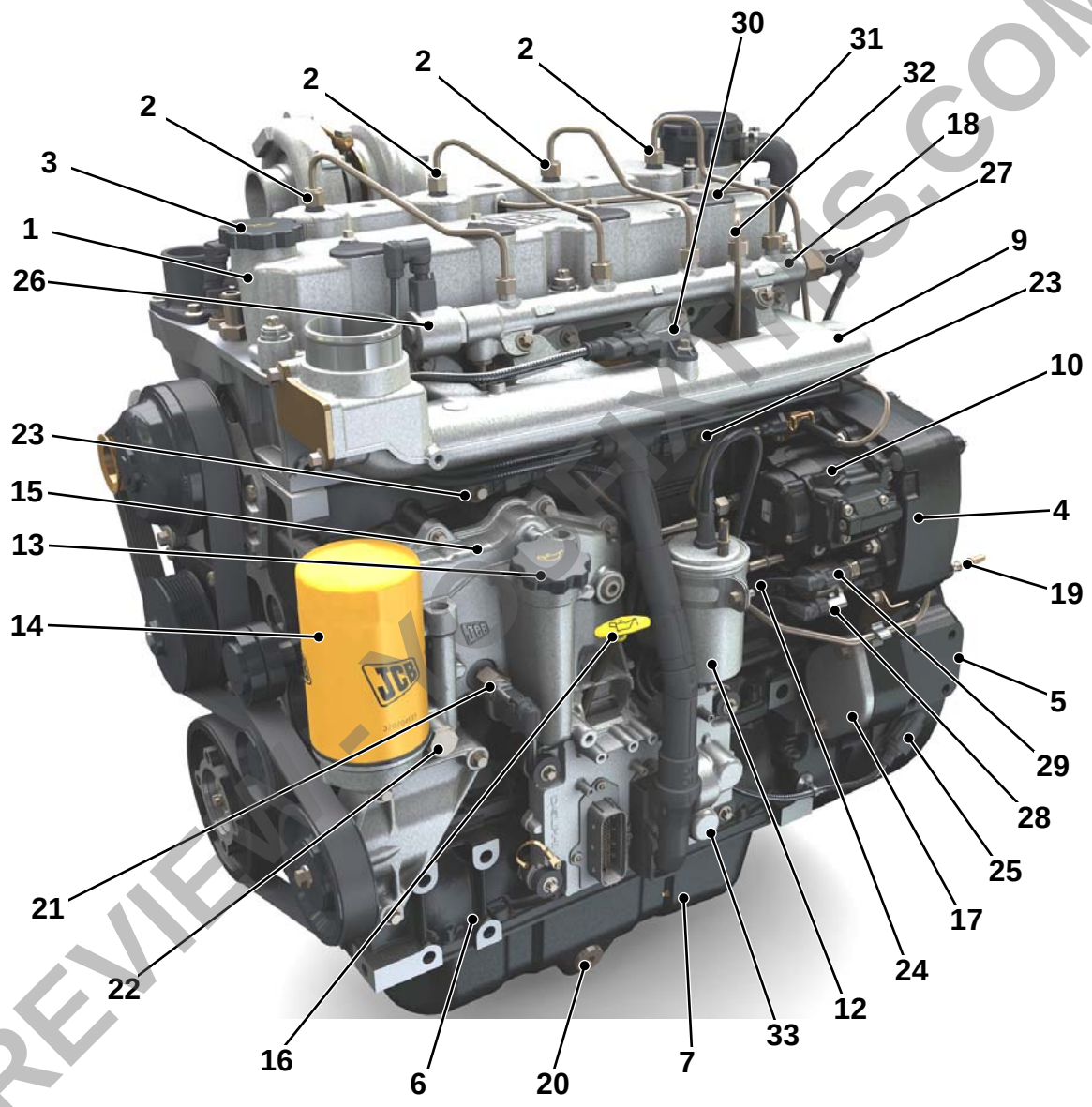


Fig 2. Engine - As viewed on the left hand side

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Operating Procedures

Starting the Engine

Pre-Start Notes

⚠ WARNING

On turbo-charged machines, do not keep the accelerator pedal fully depressed when the engine has started. Do not race the engine until the oil pressure low light has gone out. Racing the engine too soon could damage the turbo-charger due to insufficient lubrication.

16-2-4-1

Several factors will influence the starting performance of the engine, these include:

- The ambient temperatures
- The condition of the battery
- The viscosity of the engine oil
- The condition of the starter motor

The engine does not require any cold starting aids for temperatures down to -18°C.

If the engine is operating in temperatures below -18°C, then a pre-heater is available. The heater fits in the inlet manifold as shown, and is linked into the machine's electrical system.

In severe cold climate conditions, a block heater can be installed.

Make sure that all the necessary machine pre-start checks have been completed, these will include:

- engine oil level
- engine coolant level
- battery connections
- fuel tank has sufficient fuel
- fuel pre-filters drained
- the machine is safe and ready to start

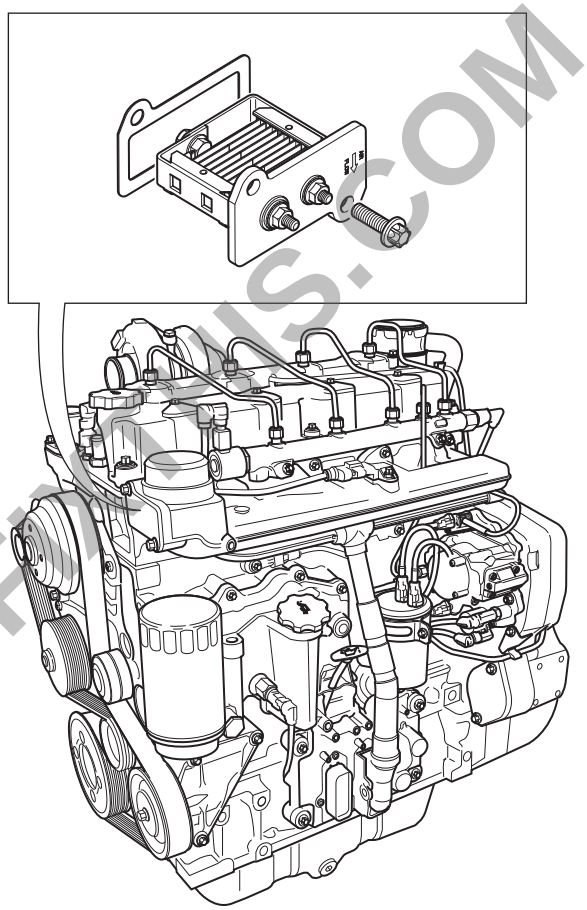


Fig 1.

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made as to the possible effects of running these products with such fuels".

The three most common Fame types are RME - Rapeseed methyl ester (preferred crop in Europe), SME - Soyabean methyl ester (preferred crop in USA). Less common FAME's can be derived from animal fats (e.g. modified beef extracts) and reclaimed cooking oils.

4 Unmodified Vegetable Oils

Burned in diesel engines neat or used as an extender to mineral derived fuel. When these are subjected to heat in the fuel injection system they form sticky deposits that can be found inside the fuel pump and a hard lacquer in the injectors where exposure to even higher temperatures takes place.

Sulphur Content

⚠ CAUTION

A combination of water and sulphur will have a corrosive chemical effect on fuel injection equipment. It is essential that water is eradicated from the fuel system when high sulphur fuels are used.

ENG-3-2

Effects of Fuel Contaminates

The effect of dirt, water and other contaminants in diesel can be disastrous for injection equipment:

– Dirt - A severely damaging contaminant. Finely machined and mated surfaces such as delivery valves and distributor rotors are susceptible to the abrasive nature of dirt particles - increased wear will almost inevitably lead to greater leakage, uneven running and poor fuel delivery.

– Water - Water can enter fuel through poor storage or careless handling, and will almost inevitably condense in fuel tanks. The smallest amounts of water can result in effects that are just as disastrous to the fuel injection pump as dirt, causing rapid wear, corrosion and in severe cases, even seizure. It is vitally important that water is prevented from reaching the fuel injection equipment. The filter/water trap must be drained regularly.

– Wax - Wax is precipitated from diesel when the ambient temperature falls below that of the fuel's cloud point, causing a restriction in fuel flow resulting in rough engine running. Special winter fuels may be available for engine operation at temperatures below 0°C (32°F). These fuels have a lower viscosity and limit wax formation.

Chemical Contamination

It should be noted that exposure of fuel to surfaces containing Copper (Cu), Zinc (Zn) or Lead (Pb) can adversely affect fuel quality and should be minimised.

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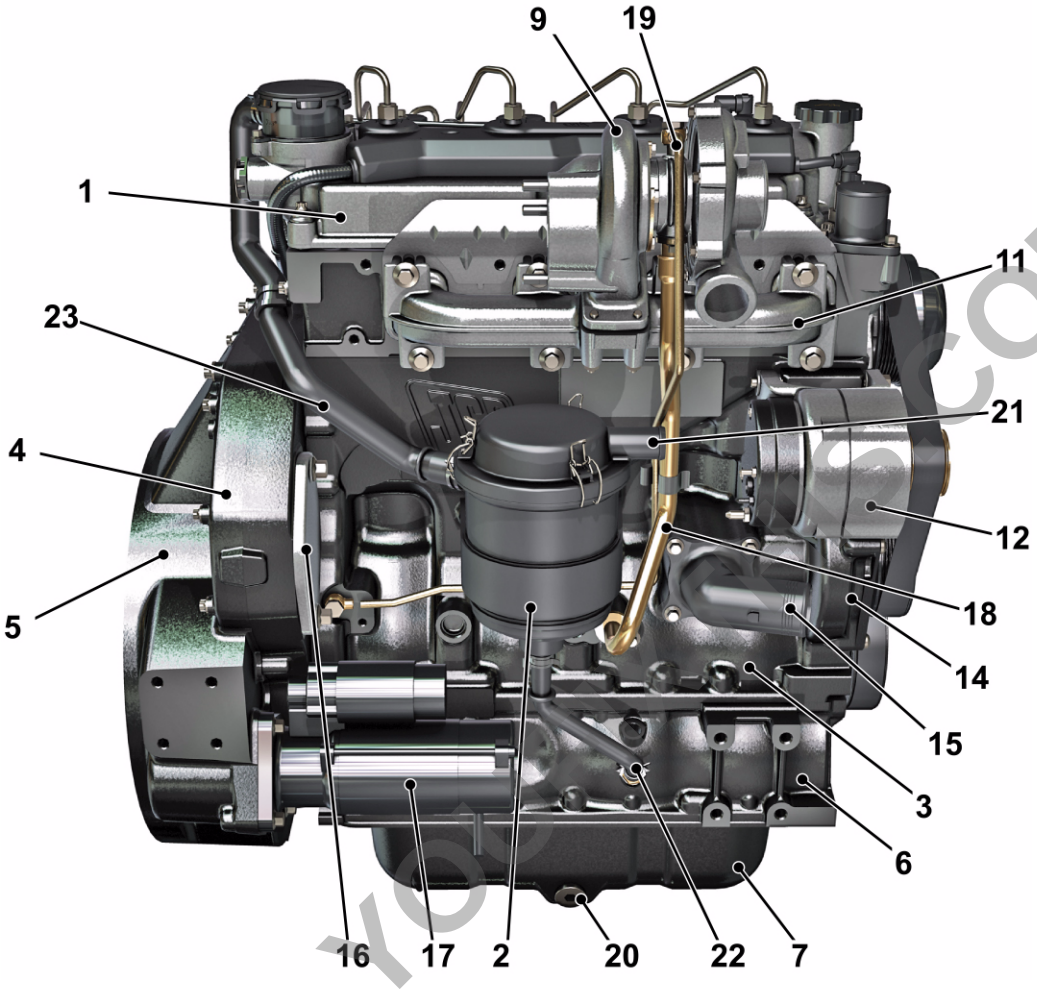


Fig 3. Engine - As viewed on the right hand side

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Setting the Engine

The engine only needs to be set to two positions to measure and adjust all the valves. The tables show which valves are applicable at the engine positions. ⇨ *Table 3. (59)*, ⇨ *Table 4. (59)*.

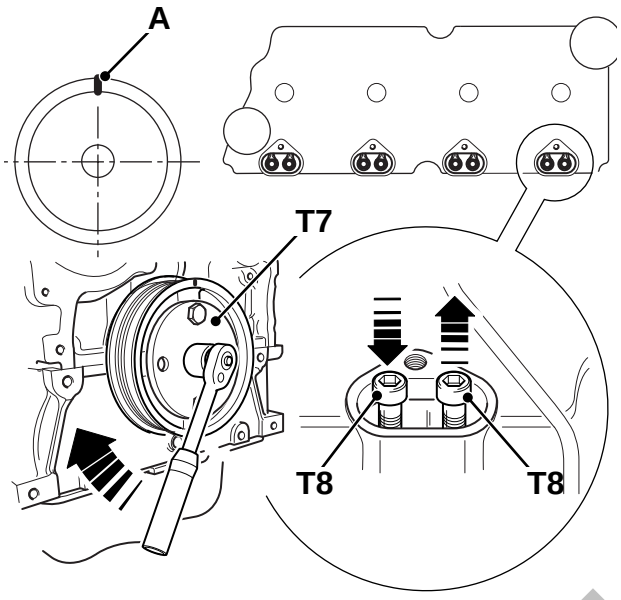


Fig 13.

1 Remove the tappet covers. ⇨ *Removing the Tappet Covers (58)*.

2 Put the indicator pins **13-T8** into the holes inside the tappet adjusters for cylinder number 4. Make sure that the pins do not fall into the engine.

3 Turn the engine crankshaft clockwise using the turning tool **13-T7**. Stop turning the crankshaft when one indicator pin starts to move up after the other pin has moved down. This is the position where the exhaust valve is almost closed and the inlet valve is just starting to open. ⇨ *Fig 13. (59)*.

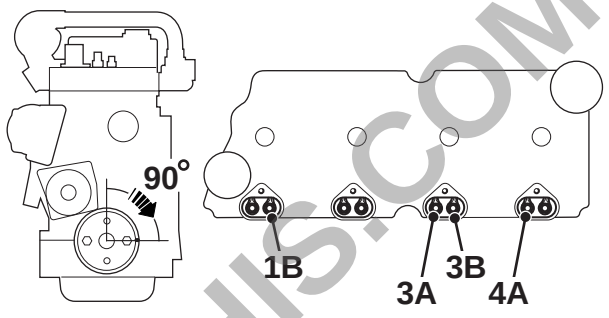
4 Put a mark **13-A** on the crankshaft pulley at the 12 O'clock position.

5 Turn the engine crankshaft 90 degrees clockwise.

6 Measure and, if necessary, adjust the clearances for the correct valves. ⇨ *Table 3. (59)*.

Table 3.

Cylinder	Valve	Tappet adjuster
1	Inlet valve	**1B**
3	Exhaust valve	**3A**
3	Inlet valve	**3B**
4	Exhaust valve	**4A**



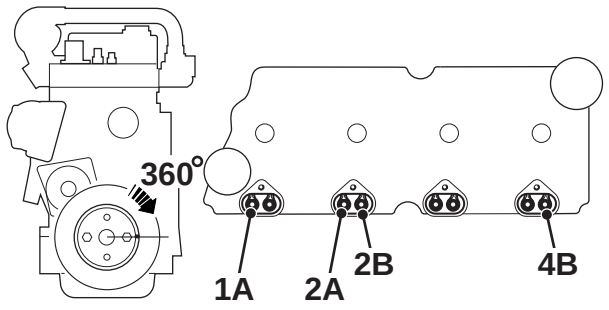
⇨ *Measuring and Adjusting the Valve Clearances (60)*

7 Remove the valve clearance measuring tools. Turn the engine crankshaft 360 degrees clockwise. Use the mark on the crankshaft pulley as a reference.

8 Measure and, if necessary, adjust the clearances for the correct valves. ⇨ *Table 4. (59)*.

Table 4.

Cylinder	Valve	Tappet adjuster
1	Exhaust valve	**1A**
2	Exhaust valve	**2A**
2	Inlet valve	**2B**
4	Inlet valve	**4B**



⇨ *Measuring and Adjusting the Valve Clearances (60)*

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Technical Data and Specifications

Basic Engine Data - 444 Engine

Engine Variants:	
- SE	Turbocharged with Intercooler
Emission compliance	US-EPA Tier 3, EU Stage IIIA
Rated speed	2200 rpm
Weight (Dry):	
- SE	457 kg (1007 lb)(1)
Number of cylinders	4
Nominal bore size	103 mm (4.055 in)
Stroke	132 mm (5.16 in)
Cylinder arrangement	In line
Combustion Cycle	4-stroke
Firing order	1-3-4-2
Displacement	4.40 litres
Compression ratio	
- SE	17.1 : 1
Engine Compression	see Note (2)
Direction of rotation (viewed from front {crankshaft pulley} end)	Clockwise
Valves	4 per cylinder
Valve clearances measured at the pushrod end of the rockers (measured cold):	
- Inlet	0.24 to 0.29 mm (0.009 to 0.011 in)
- Exhaust	0.44 to 0.49 mm (0.017 to 0.019 in)
Lubricating oil pressure (3)	6 bar (87 lb in^2)
Combustion system	Common rail direct Injection
High pressure fuel pump	Piston type, high pressure with electronically controlled fuel delivery.

(1) Dry weight. No cooling fan drive.
(2) Compression variance between each cylinder should be no greater than 3.5 bar (50 lb in2)
(3) Engine at normal operating temperature and maximum revs.

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Fuel

Fuels

Acceptable and Unacceptable Fuels

Important: *No warranty liability will be accepted for engine failures where unacceptable fuel grades (or their equivalent) have been used at any stage.*

Fuel Groups

The major world fuels standards are divided into four categories. Those that are fully accepted as suitable fuels, those that are acceptable from a "warranty" point of view, but may have undesirable affects on the expected life of the engine performance changes from original specification, those that will lead to reduce the expected life, and lastly those that are viewed as unacceptable for use. (Note: fuels shown on the same line as each other are considered equivalents).

The lists below are not exhaustive of all diesel fuel standards encountered in the marketplace. If comment is required on the suitability of fuel standards not on the list, requests with, if possible, specification details showing at least the key characteristics described above should be forwarded to JCB Service for assessment and comment.

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Table 5. Engine - Poor Running

Cause	Remedy
Condition only occurs at idle.	Refer to ⇒ *Table 6. Engine - Poor Running at Idle (71)* for possible poor running at idle faults.
Engine is cold, coolant temperature sensor fault.	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. Check the electronic fault codes ⇒ *Fault Codes (63)*. If engine will not reach operating temperature, ⇒ *Table 24. Coolant - Under Temperature (90)*.
Fuel injection lines leaking.	**STOP THE ENGINE** **WARNING**: DO NOT repair or replace defective high pressure fuel lines. If there is a fuel leak stop the engine and contact your JCB Engine Dealer. **WARNING:** Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.⇒ *Bleeding the Fuel System (55)*.
Fuel lift pump not operating correctly (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.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). ⇒ *Engine Fuel System (52)*. Check fuel lines for restriction.
Fuel is contaminated or incorrect grade diesel fuel used.	**STOP THE ENGINE**. Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. ⇒ *Acceptable and Unacceptable Fuels (34)*. Monitor the engine performance. **WARNING:** Dirty fuel will cause damage to the high pressure fuel pump and injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances. ⇒ *Valve Clearances (58)*.
Engine compression low in one or more cylinders.	Check the engine compression.
ECU or electrical sensor fault.	Check the electronic fault codes ⇒ *Fault Codes (63)*. Check the electrical connections at the ECU and sensors.
Worn or malfunctioning high pressure fuel pump.	Check the electronic fault codes ⇒ *Fault Codes (63)*. Contact your JCB Engine Dealer.
Camshaft or tappets damaged.	Contact your JCB Engine Dealer.

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