SERVICE MANUAL

SKIDSTEER LOADER
155, 175

EN - 9813/9800 - ISSUE 1 - 07/2017

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

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

(For: KDI 2504 TCR Elec Engine)

This section contains information about the complete engine assembly. For specific engine technical information refer to the technical data section.

Make sure that the correct engine service tools, consumables and torque figures are used when you perform service procedures.

Replacement of oil seals, gaskets, etc., and any component that show signs of wear or damage, is expected as a matter of course.

It is expected that components will be cleaned and lubricated where required, and that any opened hose or pipe connections will be blanked to prevent excessive loss of hydraulic fluid, engine oil and ingress of dirt.

Basic Description

The Kohler KDI engine is a 4 cylinder diesel engine in which the fuel is ignited by compression ignition (C.I.). The engine operates on a four stroke cycle.

The engine is started by an electric starter motor. The starter motor turns the engine via a pinion and teeth on the engine flywheel.

When the engine runs the crankshaft drives the camshaft though the gears. The camshaft opens and closes the inlet and exhaust valves and through push rods in time with the four stroke cycle. The engine has 16 valves, 2 inlet and 2 exhaust valves for each cylinder.

The crankshaft also drives a mechanical high pressure fuel pump via gears. The pump is part of the electronically controlled common rail fuel injection system.

Air is drawn into the engine through the inlet manifold and exhaust gases exit through the exhaust manifold. The engine uses a variable geometry turbocharger which pressurises the air at the inlet manifold.

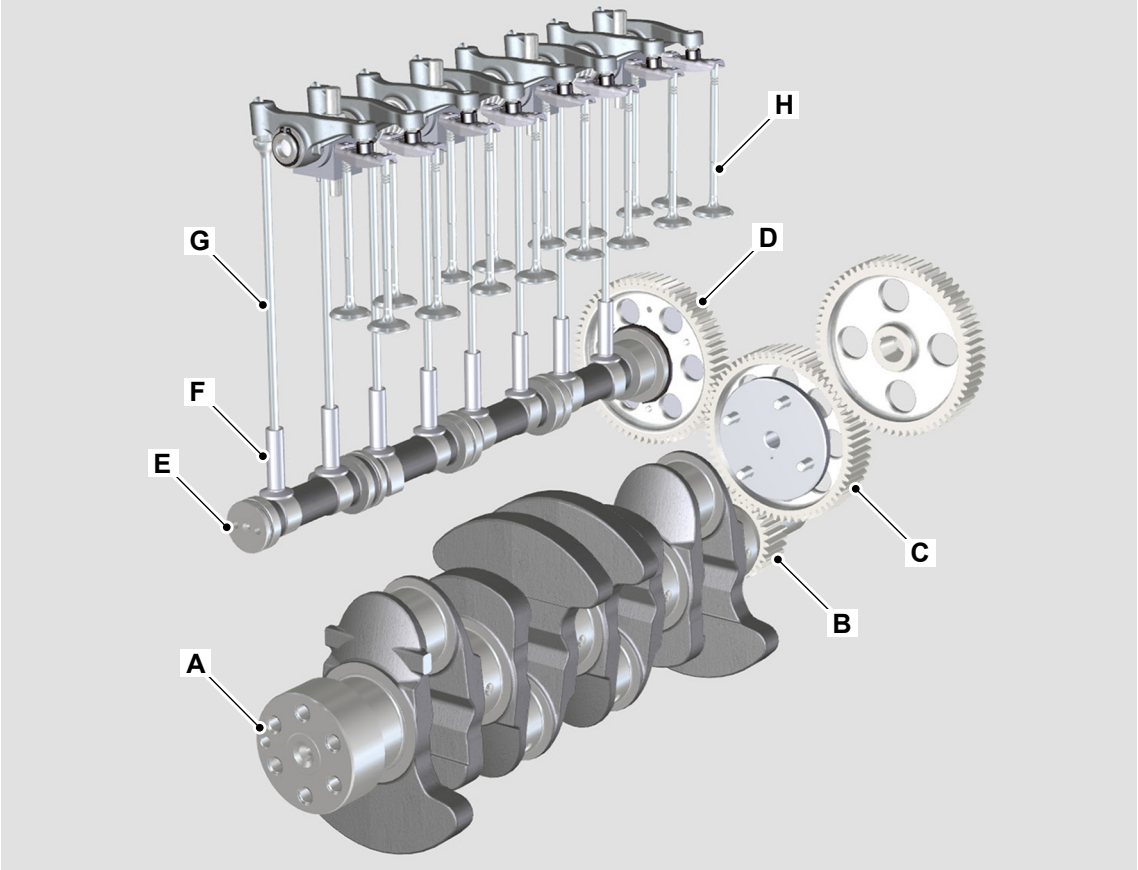
A mechanical lubrication oil pump is driven by the crankshaft through gears. The pump pressurises and circulates oil for engine lubrication and cooling purposes.

A drive belt again driven by the crankshaft, drives a coolant circulation pump and alternator.

Internal

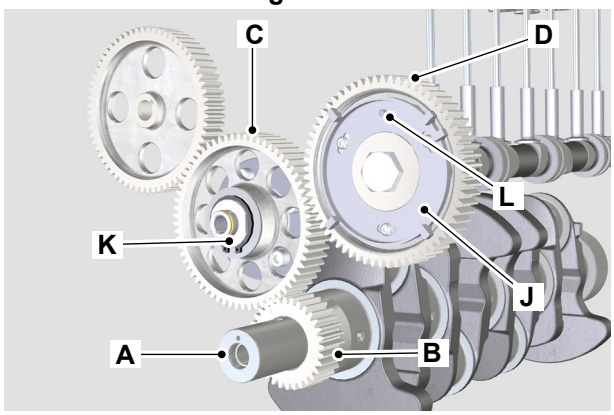
The following identifies the main internal components of a typical engine assembly. Some variants may differ in detail.

Figure 93.



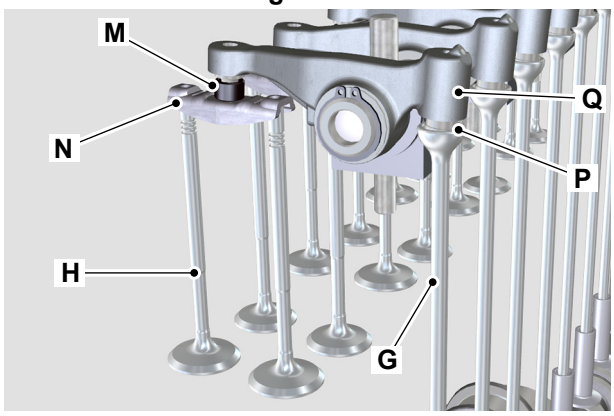
A Crankshaft
B Crankshaft gear
C Intermediate gear
D Camshaft gear
E Camshaft
F Tappet
G Push rod
H Valve

Figure 94.



A Crankshaft
B Crankshaft gear
C Intermediate gear
D Camshaft control gear
J Camshaft phonic wheel
K Intermediate gear pin
L Phonic wheel positioning reference pin on camshaft

Figure 95.



G Rocker arm push rod
H Valve
M Articulation control valve
N Valve control bridge
P Hydraulic tappet
Q Rocker arm

(For: KDI 1903 TCR Elec Engine)

This section contains information about the complete engine assembly. For specific engine technical information refer to the technical data section.

Make sure that the correct engine service tools, consumables and torque figures are used when you perform service procedures.

Replacement of oil seals, gaskets, etc., and any component that show signs of wear or damage, is expected as a matter of course.

It is expected that components will be cleaned and lubricated where required, and that any opened hose or pipe connections will be blanked to prevent excessive loss of hydraulic fluid, engine oil and ingress of dirt.

Basic Description

The Kohler KDI engine is a 3 cylinder diesel engine in which the fuel is ignited by compression ignition (C.I.). The engine operates on a four stroke cycle.

The engine is started by an electric starter motor. The starter motor turns the engine via a pinion and teeth on the engine flywheel.

When the engine runs the crankshaft drives the camshaft though the gears. The camshaft opens and closes the inlet and exhaust valves and through push rods in time with the four stroke cycle. The engine has 12 valves, 2 inlet and 2 exhaust valves for each cylinder.

The crankshaft also drives a mechanical high pressure fuel pump via gears. The pump is part of the electronically controlled common rail fuel injection system.

Air is drawn into the engine through the inlet manifold and exhaust gases exit through the exhaust manifold. The engine uses a variable geometry turbocharger which pressurises the air at the inlet manifold.

A mechanical lubrication oil pump is driven by the crankshaft through gears. The pump pressurises and circulates oil for engine lubrication and cooling purposes.

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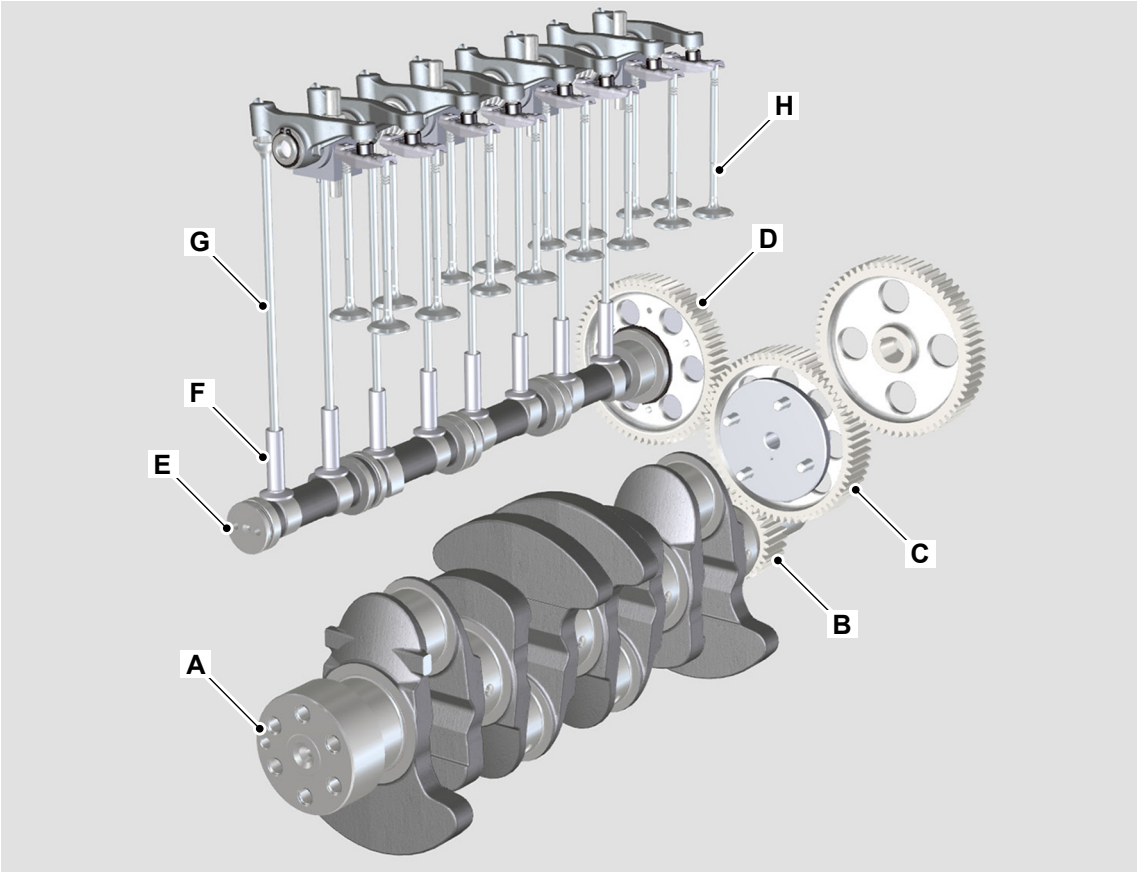
The following identifies the main internal components of a typical engine assembly. Some variants may differ in detail.

Figure 96.



A Crankshaft
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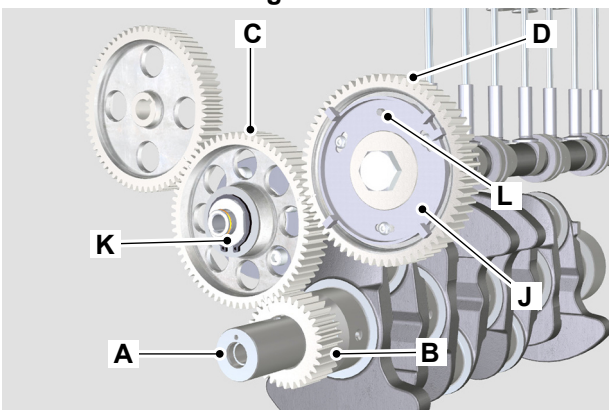
C Intermediate gear
D Camshaft gear
E Camshaft
F Tappet
G Push rod
H Valve

Figure 97.



A Crankshaft
B Crankshaft gear
C Intermediate gear
D Camshaft control gear
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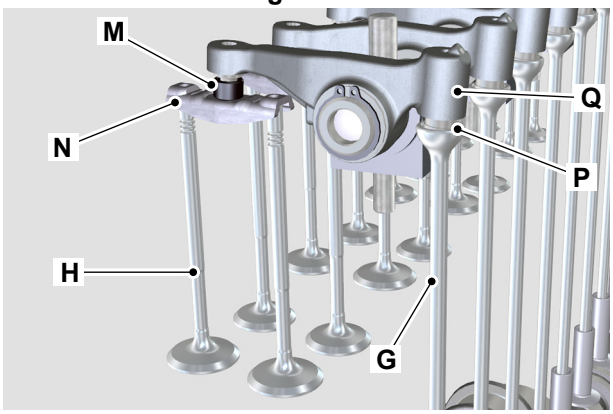
Figure 98.



G Rocker arm push rod
H Valve
M Articulation control valve
N Valve control bridge
P Hydraulic tappet
Q Rocker arm

Health and Safety

Hot Components

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

Turning the Engine

Do not try to turn the engine by pulling the fan or fan belt. This could cause injury or premature component failure.

Notice: *The engine and other components could be damaged by high pressure washing systems. Special precautions must be taken if the machine is to be washed using a high pressure system.Make sure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system. Do not aim the water jet directly at bearings, oil seals or the engine air induction system.*

WARNING! *To bleed the injectors you must turn the engine. When the engine is turning, there are parts rotating in the engine compartment.Before starting this job make sure that you have no loose clothing (cuffs, ties etc) which could get caught in rotating parts.When the engine is turning, keep clear of rotating parts.*

Notice: *Clean the engine before you start engine maintenance. Obey the correct procedures. Contamination of the fuel system will cause damage and possible failure of the engine.*

Notice: *Do not exceed the correct level of engine oil in the sump. If there is too much engine oil, the excess must be drained to the correct level. An excess of engine oil could cause the engine speed to increase rapidly without control.*

WARNING! *The engine has exposed rotating parts. Switch off the engine before working in the engine compartment. Do not use the machine with the engine cover open.*

WARNING! *Hot oil and engine components can burn you. Make sure the engine is cool before doing this job.Used engine crankcase lubricants contain harmful contaminants. In laboratory tests it was shown that used engine oils can cause skin cancer.*

Notice: *A drive belt that is loose can cause damage to itself and/or other engine parts.*

WARNING! *Do not open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.*

CAUTION! *It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.*

Technical Data

(For: KDI 1903 TCR Elec Engine)

Table 16.

Description	Data
Engine Type	KDI 1903 TCR
Emission compliance	US-EPA Tier 4 final, EU Stage IIIB
Max. operating speed	2200 rpm
Power output	42kW at 2200 RPM (Revolutions Per Minute)
Weight (Dry)	233kg
Number of cylinders	3
Nominal bore size	88mm
Stroke	102mm
Cylinder arrangement	In line
Combustion Cycle	4-stroke
Firing order	1-3-2
Displacement	1.861L
Compression ratio	17: 1
Direction of rotation (viewed from flywheel end)	Counterclockwise
Valves	4 per cylinder
Tappets	Hydraulic
Lubricating oil pressure (Dependent on engine temperature and speed)	1–2.8bar (14.5–40.6psi)
Filter type	Screw-on canister
Pressure to open by-pass valve	2.5 ± 0.5bar (36.2 ± 7.2psi)
Oil pressure switch setting	0.8 ± 0.1bar (11.6 ± 1.4psi) falling
Oil pump[(1)]	Integral unit with relief valve
Combustion system	Common rail direct Injection
High pressure fuel pump	High pressure with electronically controlled fuel metering

(1) The oil pump is a non-serviceable part

(For: KDI 2504 TCR Elec Engine)

Table 17.

Description	
Engine Type	KDI 2504 TCR
Emission compliance	US-EPA Tier 4 final, EU Stage IIIB
Max. operating speed	2200 RPM
Power Output	55kW at 2200 RPM
Weight (Dry)	233kg
Number of cylinders	4
Nominal bore size	88mm
Stroke	102mm
Cylinder arrangement	In line
Combustion Cycle	4-stroke
Firing order	1-3-4-2
Displacement	2.482L
Compression ratio	17: 1
Direction of rotation (viewed from flywheel end)	Counterclockwise
Valves	4 per cylinder
Tappets	Hydraulic
Lubricating oil pressure (Dependent on engine temperature and speed)	1–2.8bar (14.5–40.6psi)
Filter type	Screw-on canister
Pressure to open by-pass valve	2.5 ± 0.5bar (36.2 ± 7.2psi)
Oil pressure switch setting	0.8 ± 0.1bar (11.6 ± 1.4psi) falling
Oil pump[(1)]	Integral unit with relief valve
Combustion system	Common rail direct Injection
High pressure fuel pump	High pressure with electronically controlled fuel metering

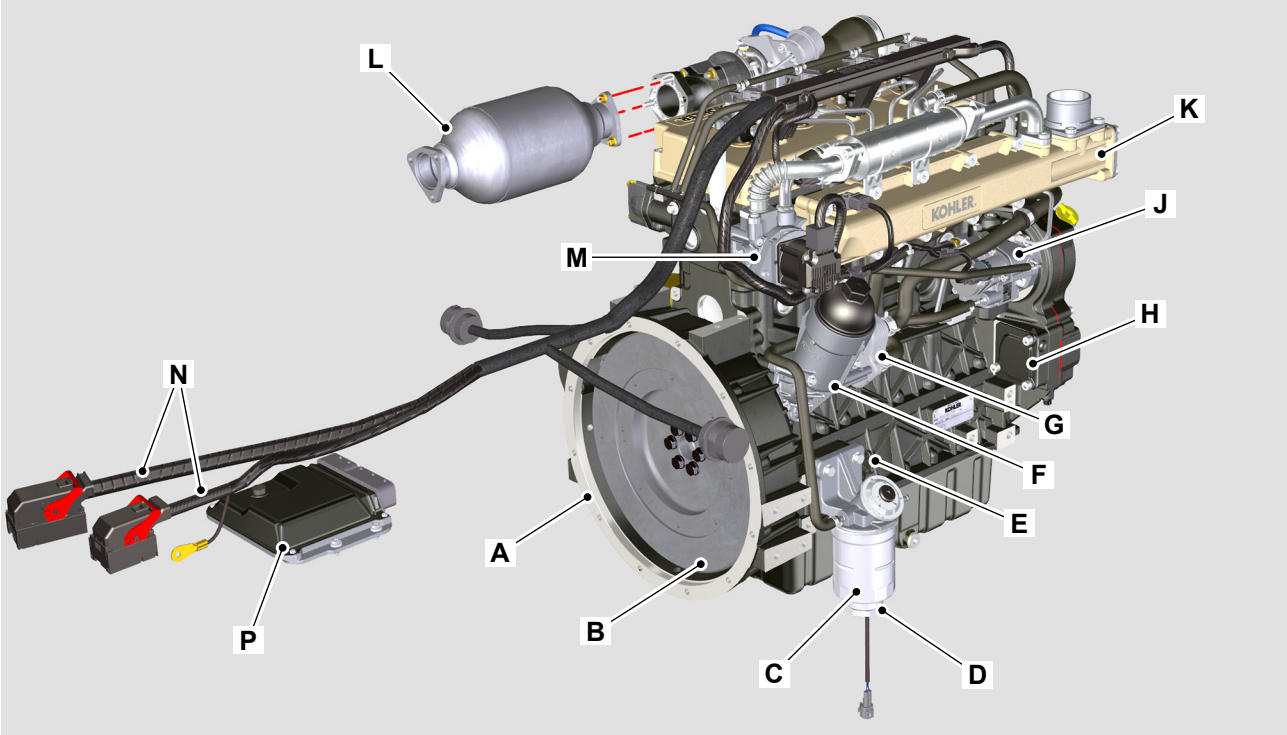
(1) The oil pump is a non-serviceable part

Component Identification

External

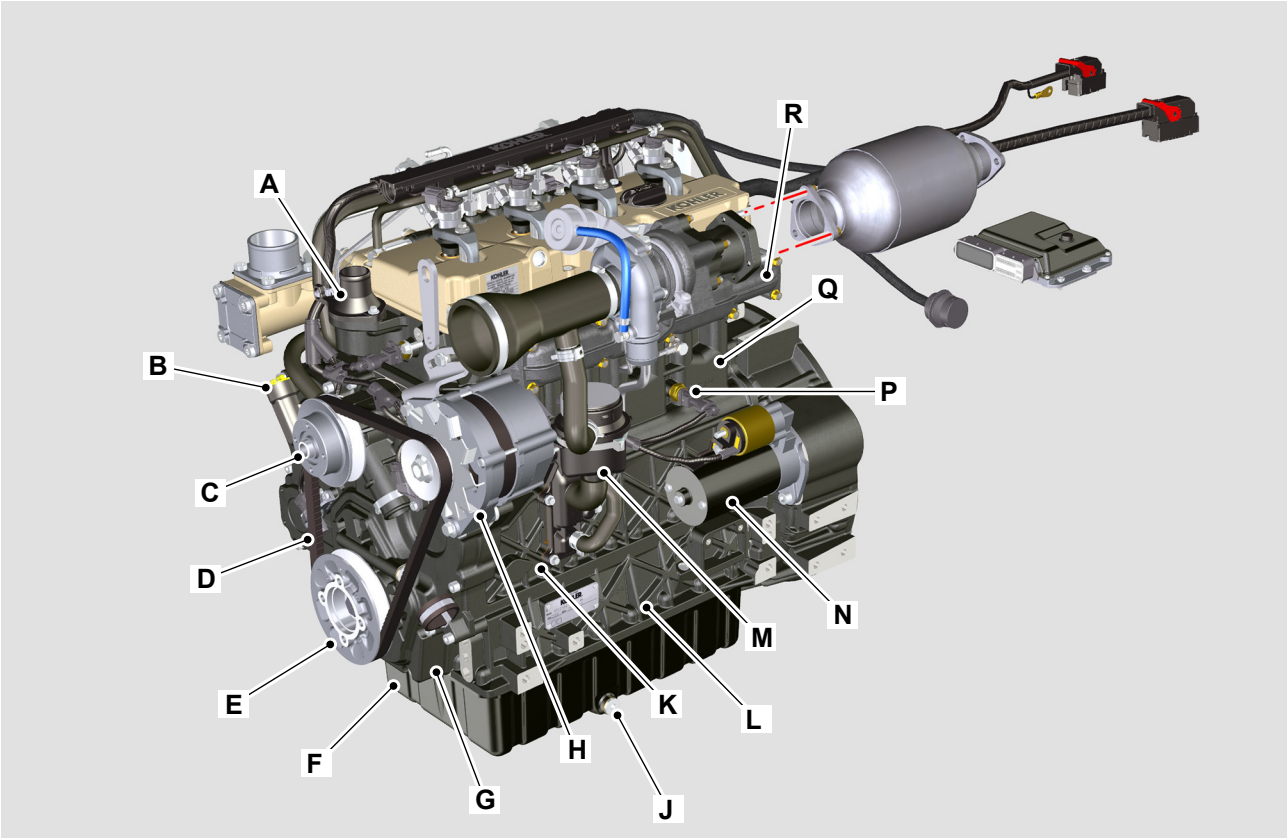
The following identifies the main components of a typical engine assembly visible from the exterior. Some variants may differ in detail.

Figure 99.



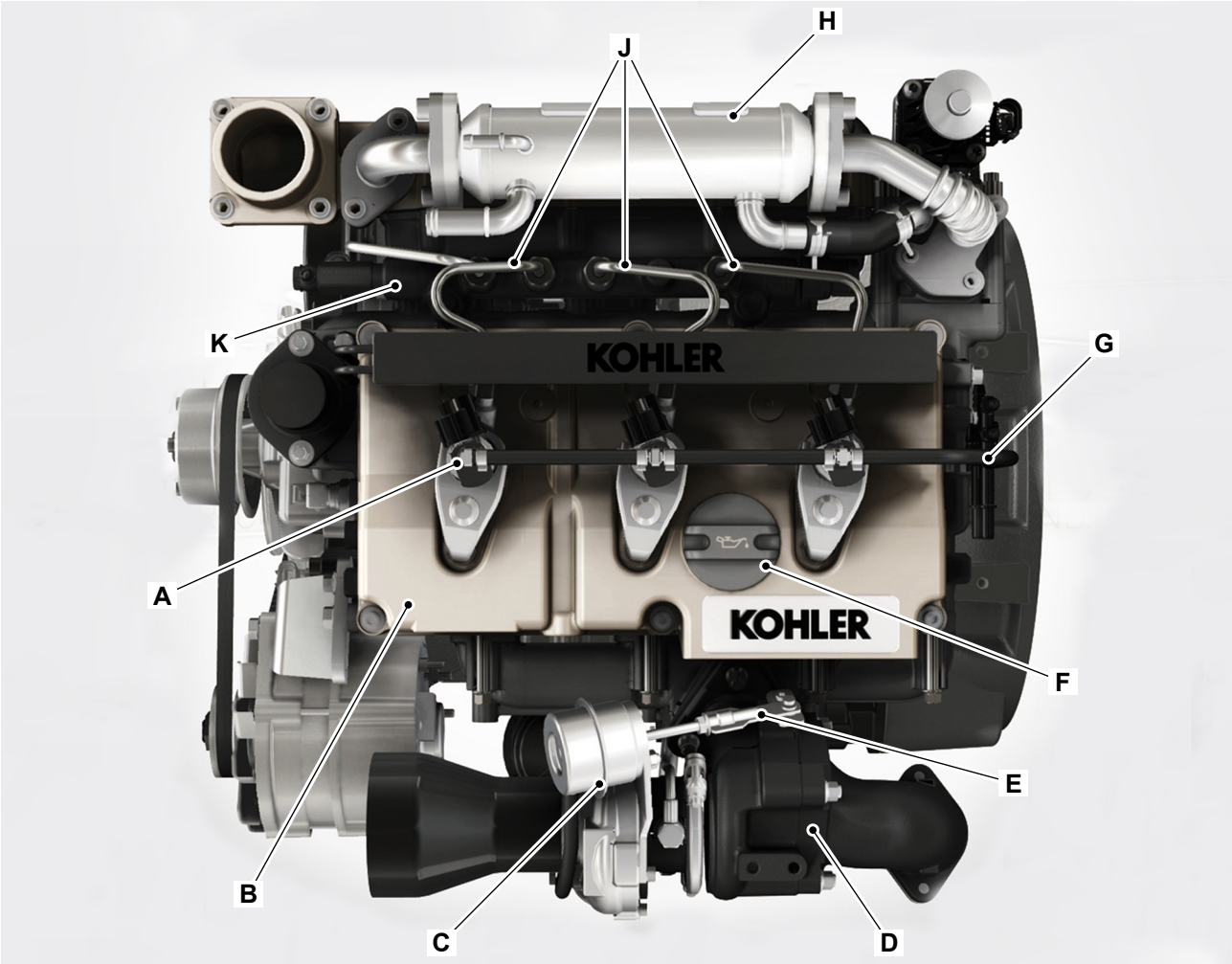
A Flywheel housing (PIL 15-54)
B Flywheel (PIL 15-54)
C Fuel filter (PIL 18-09)
D Fuel filter drain plug (PIL 18-09)
E Dipstick (PIL 15-45)
F Oil filter (PIL 15-21)
G Oil cooler (PIL 15-69)
H PTO (Power Take-Off) cover (If fitted)
J High pressure fuel pump (PIL 18-18-15)
K Inlet manifold (PIL 18-24-03)
L Catalytic converter (PIL 18-24-18)
M EGR (Exhaust Gas Recirculation) valve (PIL 18-27)
N Engine harness (PIL 33-12-09)
P ECM (Engine Control Module)(PIL 33-45-06)

Figure 100.



A Thermostat (PIL 21-12)
B Oil filler cap (PIL 15-57)
C Cooling pump (PIL 21-09)
D Drive belt (PIL 15-18)
E Crankshaft pulley (PIL 15-12)
F Oil sump (PIL 15-45)
G Timing gear case (PIL 15-51)
H Alternator (PIL 15-72)
J Oil sump drain plug (PIL 15-45)
K Crankcase (PIL 15-03)
L Bedplate (PIL 15-09)
M Crankcase ventilation filter (PIL 15-27)
N Starter motor (PIL 15-75)
P Oil pressure sensor (PIL 15-84)
Q Cylinder head (PIL 15-06)
R Outlet manifold (PIL 18-24-04)

Figure 101.



A Injector (PIL 18-18)
B Rocker cover (PIL 15-42)
C Turbocharger actuator (PIL 18-35)
D Turbocharger (PIL 18-35)
E Turbocharger link (PIL 18-35)
F Oil filler cap (PIL 15-57)
G Low pressure fuel return pipes (PIL 18-96)
H EGR cooler (PIL 18-27)
J High pressure fuel pipes (PIL 18-96)
K Fuel rail (PIL 18-18-12)

Operation

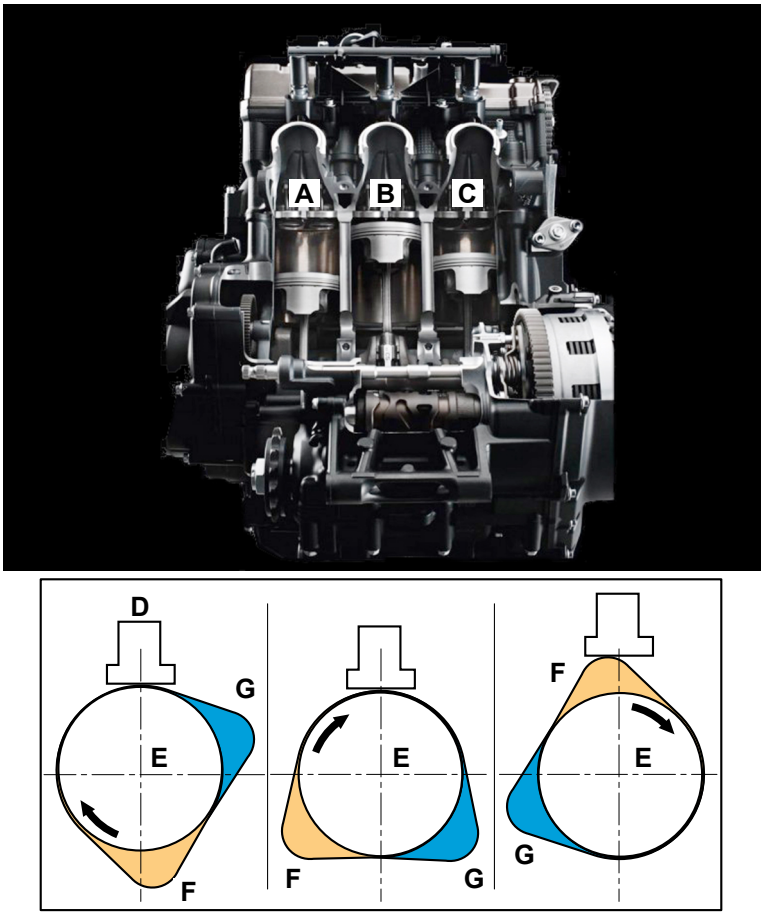
(For: KDI 1903 TCR Elec Engine)

This section describes the cycle sequence for the 3 cylinder engine.

The engine will have a power stroke once every 240° of crankshaft angle (720°/3 = 240°).

Firing Order

Figure 102. Typical Three Cylinder Engine



A Cylinder number 1
B Cylinder number 2
C Cylinder number 3
D Tappet
E Camshaft
F Camshaft lobe - Exhaust valve operation
G Camshaft lobe - Inlet valve operation

A cylinder is said to be firing when the fuel/air mixture ignites and the piston is about to start its power stroke.

With the crankshaft positioned as shown, the piston in number 2 cylinder is at TDC (Top Dead Centre) and pistons in number 1 and 3 cylinders are 32° past bottom dead centre (BDC).

It is important to note that number 2 cylinder is firing and about to start it's power stroke. Rotating the crankshaft a further 360° would position the pistons as described. However the engine would be at a different stage in it's four stroke cycle, with the number 2 cylinder about to start its induction stroke.

From the stages described, it can be seen that the number 2 cylinder will be next to fire. The number 1 cylinder is in the middle of its compression stroke and number 3 cylinder is in the middle of exhaust stroke.

The firing order is therefore; 1, 3, 2.

The stages in the four stroke cycle for each cylinder are as follows:

Table 18. The Four Stroke Cycle

Cylinder number	Piston operation	Valve operation
1	The piston is at the middle of its compression and is next in firing order.	Inlet and exhaust valves closed
2	The piston is at the top of its compression stroke and is about to start its power stroke.	Inlet and exhaust valves closed
3	The piston is at the middle of its exhaust stroke and will start its induction stroke at the top of the exhaust stroke.	Exhaust valves open fully, inlet valves will open soon.

Four Stroke Cycle

Induction

As the piston travels down the cylinder, it draws filtered air at atmospheric pressure and ambient temperature through an air filter and inlet valves into the cylinder.

Compression

When the piston reaches the bottom of its stroke, the inlet valves close. The piston then starts to rise up the cylinder compressing the air trapped in the cylinder. This causes the temperature and pressure of the air to rise. Fuel is injected into the cylinder when the piston is near to TDC.

Power

The piston continues to rise after the start of fuel injection, causing a further increase in pressure and temperature.

The temperature rises to a point at which the fuel/air mixture ignites. A cylinder is said to be firing when the fuel/air mixture ignites.

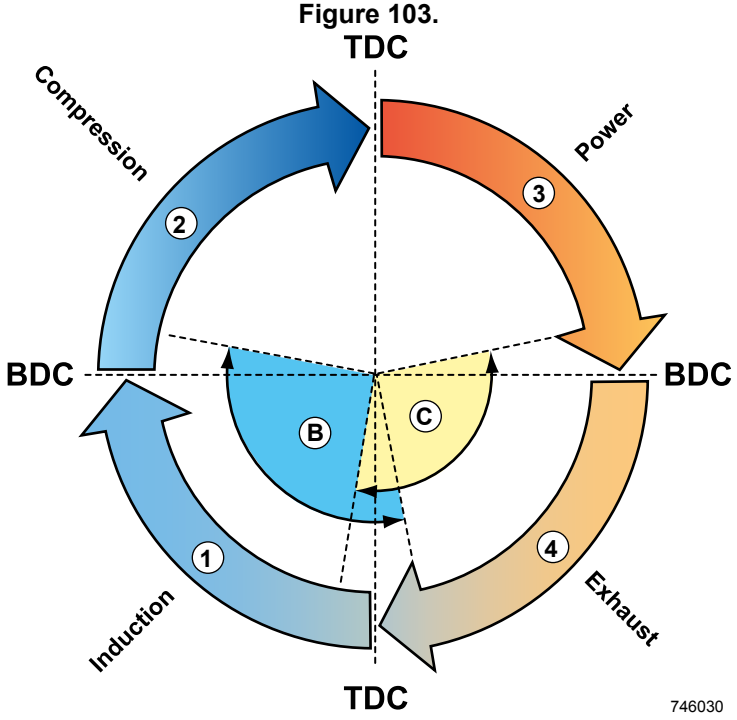
This combustion causes a very rapid rise in both temperature and pressure. The high pressure generated propels the piston downwards turning the crankshaft and producing energy.

Exhaust

Once the piston has reached the bottom of its travel, the exhaust valves open and momentum stored in the flywheel forces the piston up the cylinder expelling the exhaust gases.

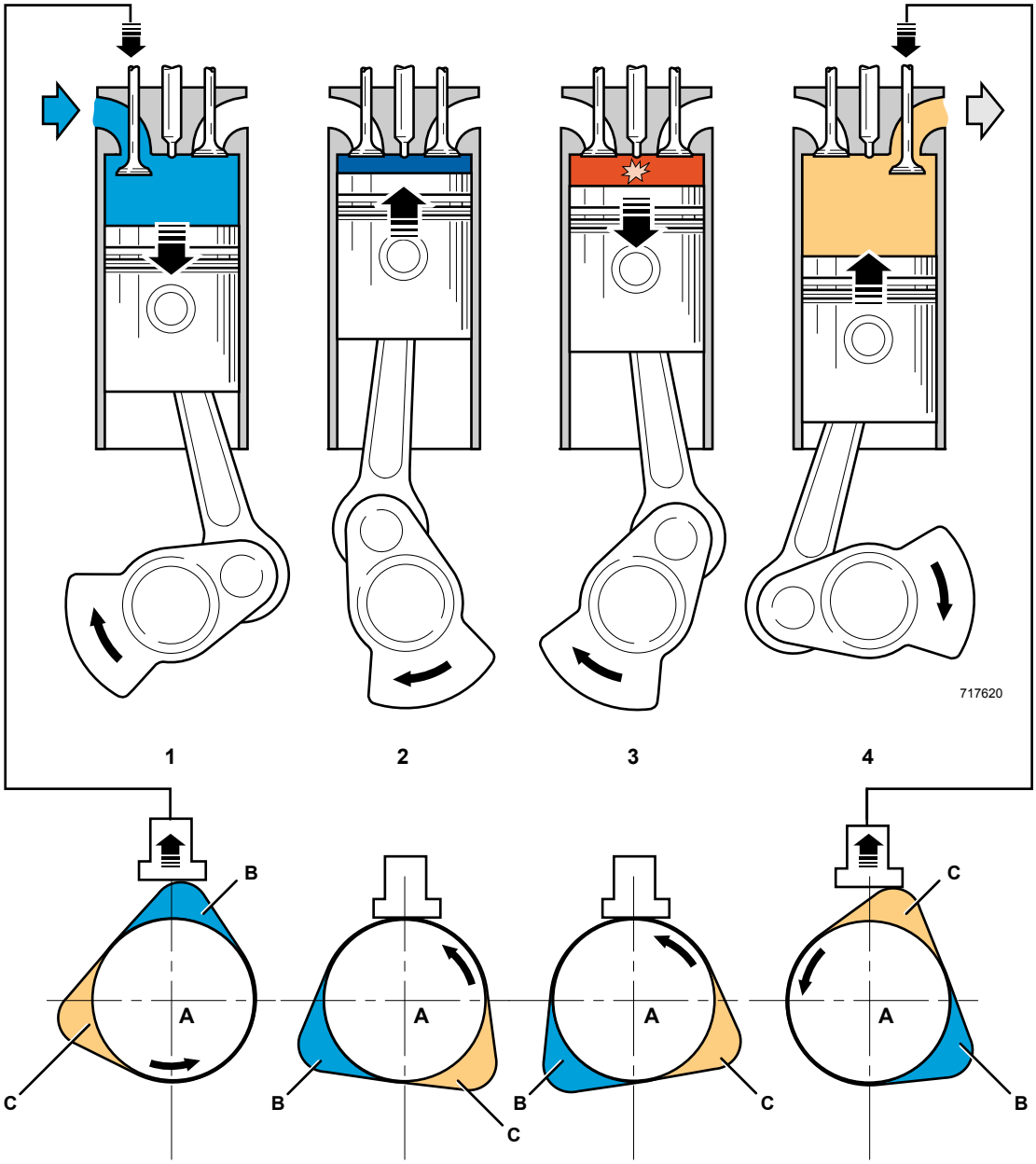
In a running engine, these four phases are continuously repeated. Each stroke is half a revolution of the crankshaft, thus, in one cycle of a four stroke engine, the crankshaft revolves twice.

Figure 103.



1 Induction stroke
2 Compression stroke
3 Power stroke
4 Exhaust stroke
A Camshaft
B Camshaft lobe - Inlet valve operation
C Camshaft lobe - Exhaust valve operation
BDC Bottom dead centre
TDC TDC

Figure 104.



1 Induction stroke
2 Compression stroke
3 Power stroke
4 Exhaust stroke
A Camshaft
B Camshaft lobe - Inlet valve operation
C Camshaft lobe - Exhaust valve operation

(For: KDI 2504 TCR Elec Engine)

The Four Cylinder Cycle

This section describes the cycle sequence for the 4 cylinder engine.

With the crankshaft positioned as shown, the pistons in numbers 1 and 4 cylinders are at top dead centre and pistons in numbers 2 and 3 cylinders are at bottom dead centre.

It is important to note that number 1 cylinder is firing and about to start its Power stroke. Rotating the crankshaft a further full rotation would position the pistons as described but the engine would be at a different stage in its four stroke cycle, with number 1 cylinder about to start its Induction stroke.

Our support email:

ebooklibonline@outlook.com