SERVICE MANUAL

2TFT, 2THS, 2TST,
3.5TST, 3TFT, 3TST

EN - 9813/5250 - ISSUE 1 - 08/2015

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

Foreword

The Operator's Manual

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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

(For: Kubota V2203-M)

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 Kubota 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.

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.

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: Kubota D1703)

Table 6.

Data	Description
Engine	
Make	Kubota
Model	D1703-M-E
Bore and stroke	87 X 92.4mm
Capacity	1647 cc
Compression ratio	22.6:1
Firing order	1-2-3
Rated speed	2600 RPM (Revolutions Per Minute)
Maximum power at 2800 RPM	25.7kW / 34.5HP
Torque at 2000 RPM	395N·m
Direction of rotation	Counterclockwise (viewed from the fly-wheel side)
Radiator	
Radiator cap pressure	0.9bar (13.0psi)
Thermostat	
Type	Wax element by-pass blanking
Nominal temperature	82°C (179.5°F)
Start to open tempera-ture	79–84°C (174.1–183.1°F)
Fully open temperature	93°C (199.3°F)
Minimum valve lift fully open	10mm

(For: Kubota V2203-M)

Table 7.

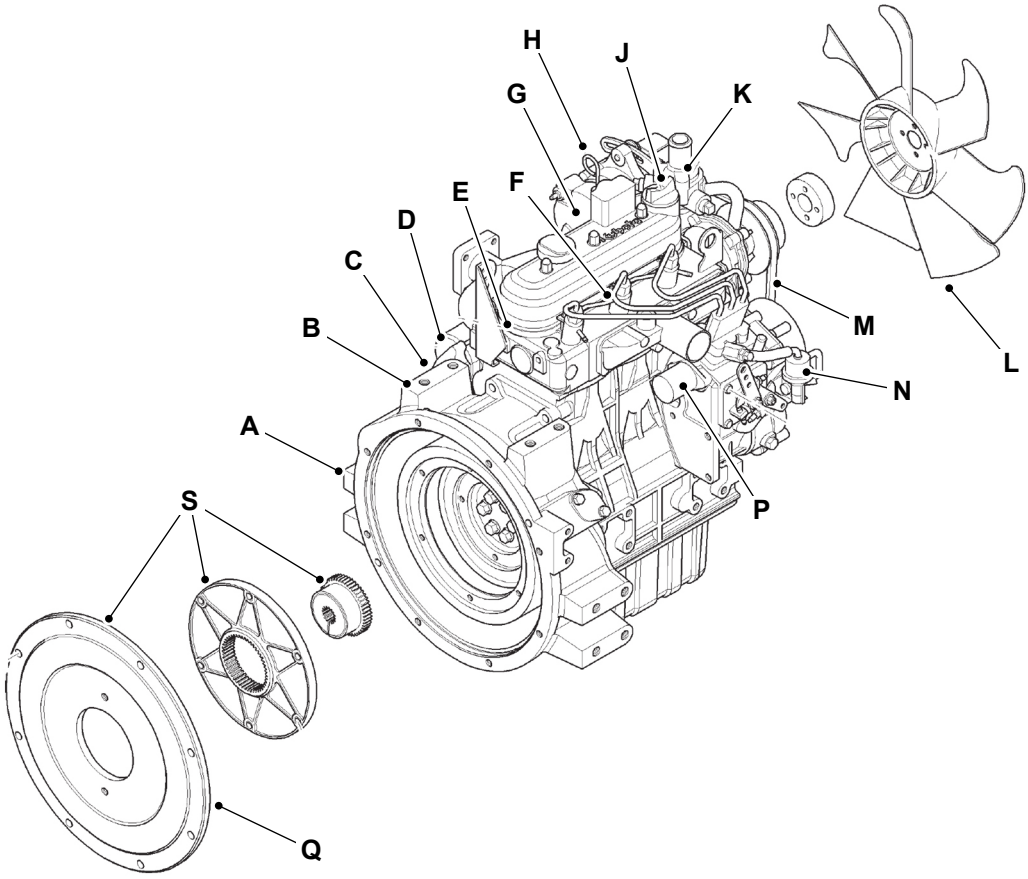
Data	Description
Engine	
Make	Kubota
Model	V2203-M
Bore and stroke	87 X 92.4mm
Capacity	2197 cc
Compression ratio	22.6:1
Firing order	1-3-4-2
Rated speed	2600 RPM
Maximum power at 2800 RPM	32.4kW / 43.5HP
Direction of rotation	Counterclockwise (viewed from the fly-wheel side)

Data	Description
Radiator	
Radiator cap pressure	0.9bar (13.0psi)
Thermostat	
Type	Wax element by-pass blanking
Nominal temperature	82°C (179.5°F)
Start to open temperature	79–84°C (174.1–183.1°F)
Fully open temperature	93°C (199.3°F)
Minimum valve lift fully open	10mm

Component Identification

(For: Kubota D1703)

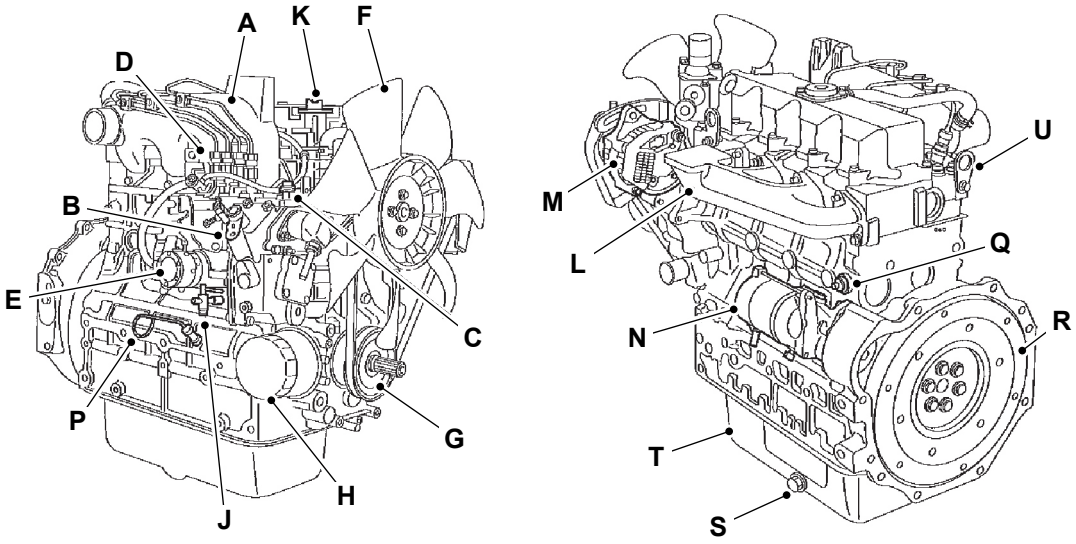
Figure 96.



A	Engine	**J**	Oil filler cap
B	Oil pressure sensor	**K**	Thermostat
C	Oil filter	**L**	Fan
D	Starter motor	**M**	Drive belt
E	Rocker cover	**N**	Fuel pump
F	Glow plug	**P**	ESOS (Engine Shut-Off Solenoid)
G	Alternator	**Q**	Drive Plate
H	Dipstick	**S**	Drive coupling

(For: Kubota V2203-M)

Figure 97.



A	Intake manifold
B	Speed control lever
C	Engine stop lever
D	Injection pump
E	Fuel feed pump
F	Cooling fan
G	Fan drive pulley
H	Oil filter
J	Water drain cock
K	Oil filler cap
L	Exhaust manifold
M	Alternator
N	Starter motor
P	Oil level gauge
Q	Oil pressure switch
R	Flywheel
S	Oil drain plug
T	Oil sump
U	Engine hook

Operation

For: Kubota 4 Cylinder ..... Page 15-9
For: Kubota D1703 ..... Page 15-12

(For: Kubota 4 Cylinder)

The Four Stroke Cycle - 4 Cylinder Engine

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.

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

Table 8. The Four Stroke Cycle

Cylinder number	Piston operation	Valve operation
1	The piston is at the top of its Compression stroke and is about to start its Power stroke.	Inlet and exhaust valves closed
2	The piston is at the bottom of its Power stroke and is about to start its Exhaust stroke.	Inlet valves closed, exhaust valves about to open
3	The piston is at the bottom of its Induction stroke and is about to start its Compression stroke.	Exhaust valves closed, inlet valves about to close
4	The piston is at the top of its Exhaust stroke and is about to start its Induction stroke.	Valve Operation Exhaust valves about to close, inlet valves about to open

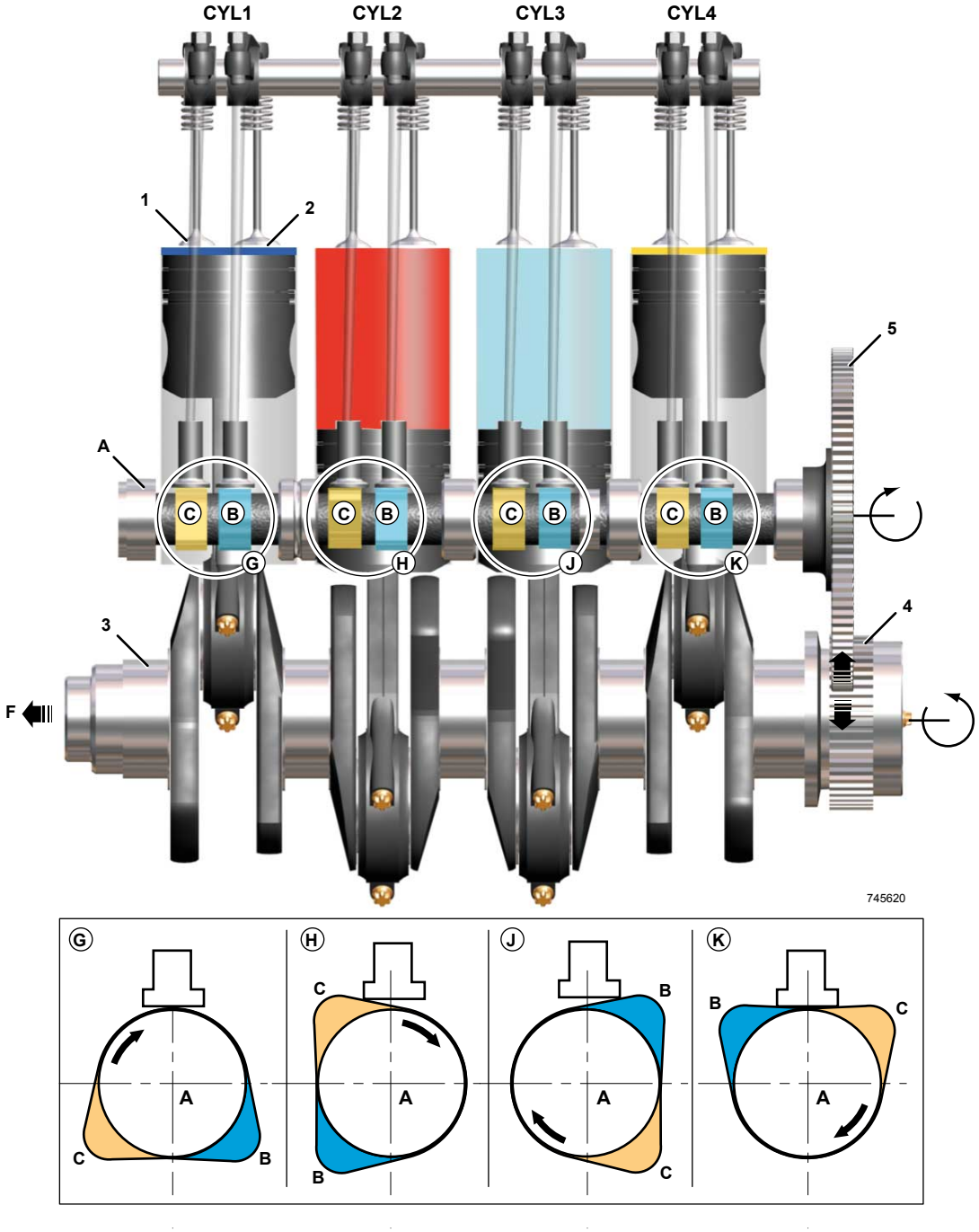
Firing Order

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

From the stages described, it can be seen that number 1 cylinder will be next to fire. Number 3 cylinder is starting its compression stroke and is next in the cycle, followed by cylinders 4 and 2.

The firing order is therefore; 1, 3, 4, 2.

Figure 98.



CYL1 Cylinder number 1
CYL2 Cylinder number 2
CYL3 Cylinder number 3
CYL4 Cylinder number 4
A Camshaft
B Camshaft lobe - Inlet valve operation
C Camshaft lobe - Exhaust valve operation
F Front of engine
1 Exhaust valves
2 Inlet valves
3 Crankshaft
4 Crankshaft gear
5 Camshaft drive gear

Four Stroke Cycle

Induction

As the piston travels down the cylinder, it draws filtered air through 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 top dead centre.

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.

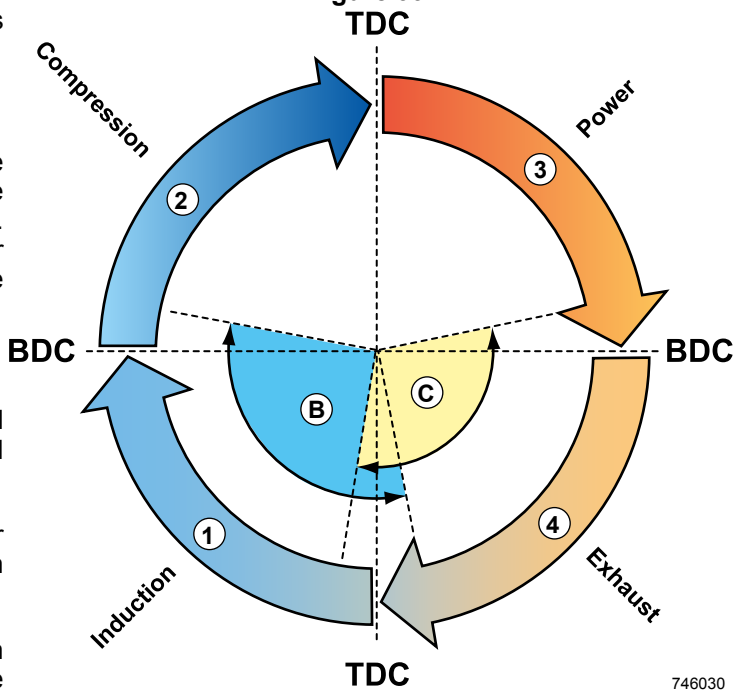
This combustion causes a very rapid rise in both temperature and pressure. The high pressure generated propels the piston downward turning the crankshaft and producing energy.

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.

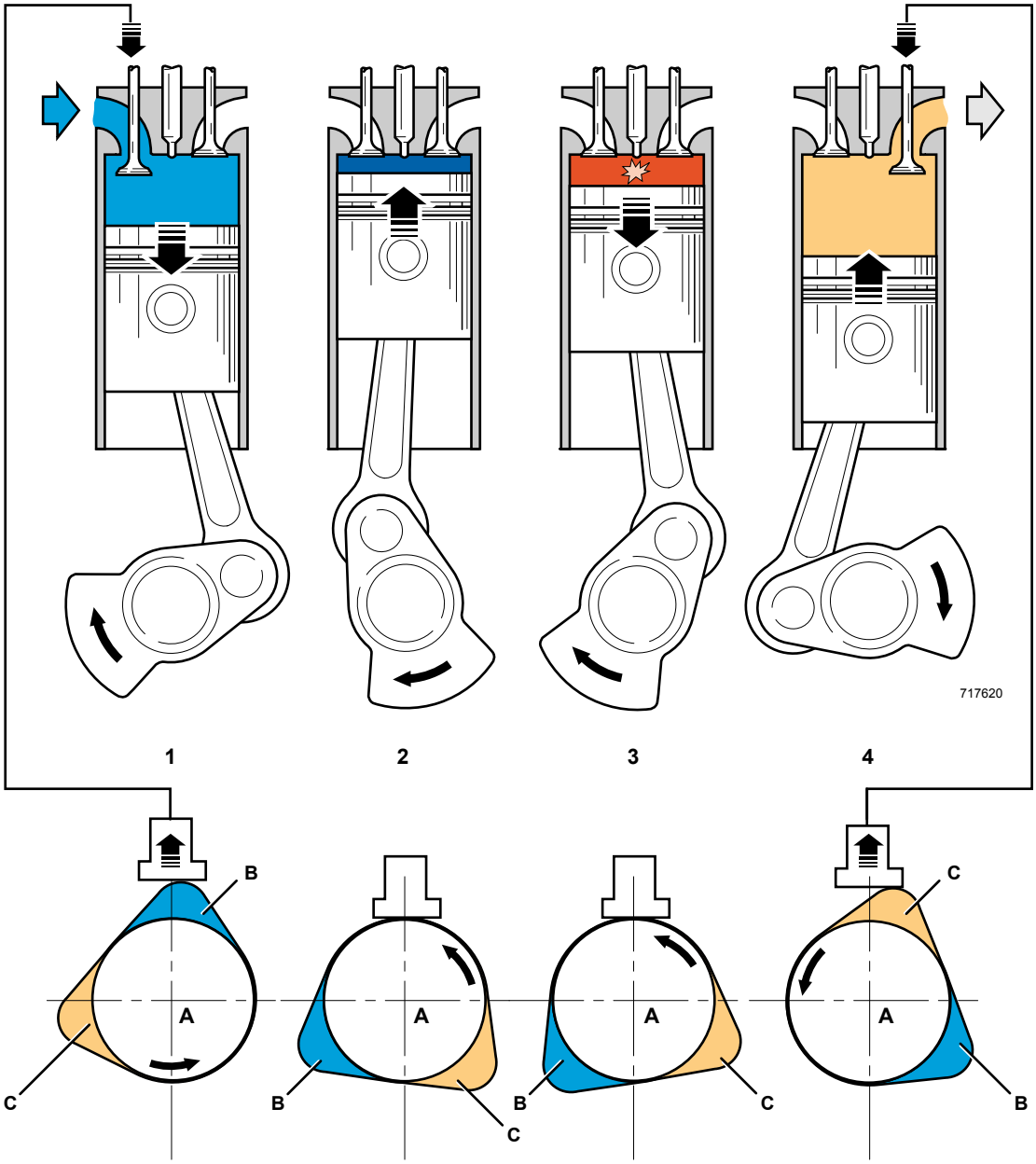
In a running engine these four phases are continuously repeated. Each stroke is half a revolution of the crankshaft, thus, in one cycle of a four stroke engine, the crankshaft revolves twice.

Figure 99.



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 (Top Dead Centre)

Figure 100.



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: Kubota D1703)

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

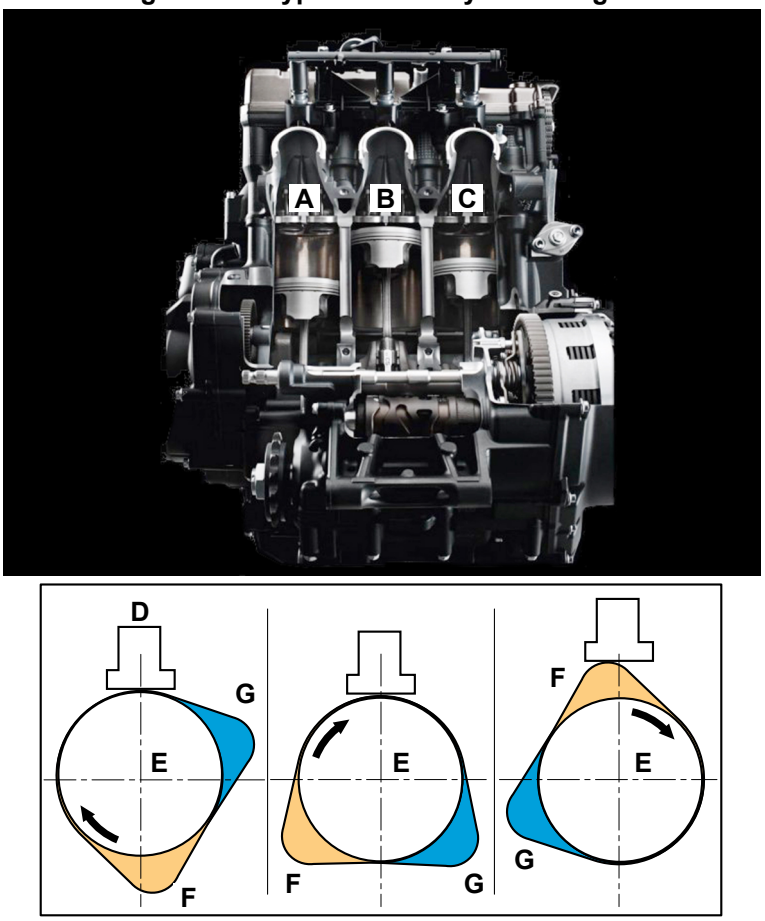
The engine will have a power stroke once every 240° of crankshaft angle (720°/3 = 240°).

With the crankshaft positioned as shown, the piston in number 2 cylinder is at TDC 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.

Firing Order

Figure 101. 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.

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 9. 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.

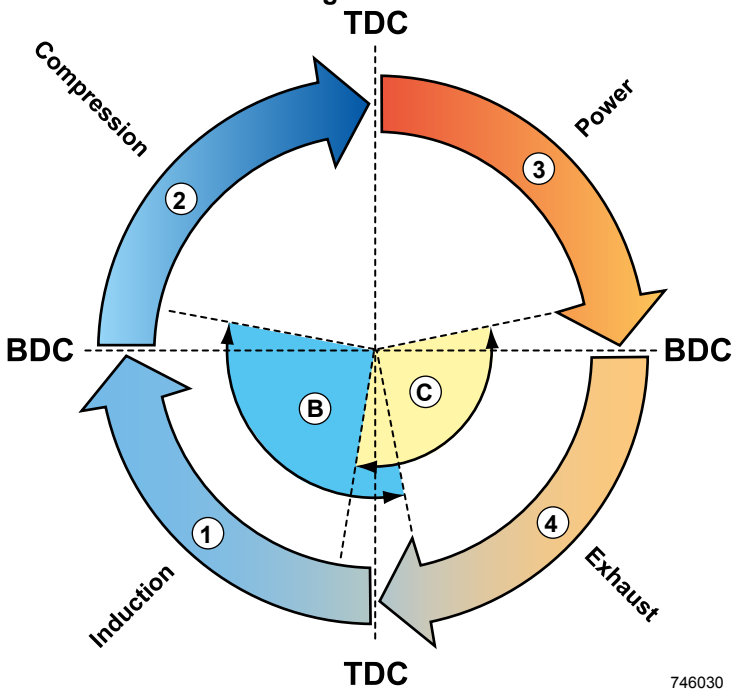
This combustion causes a very rapid rise in both temperature and pressure. The high pressure generated propels the piston downwards turning the crankshaft and producing energy.

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.

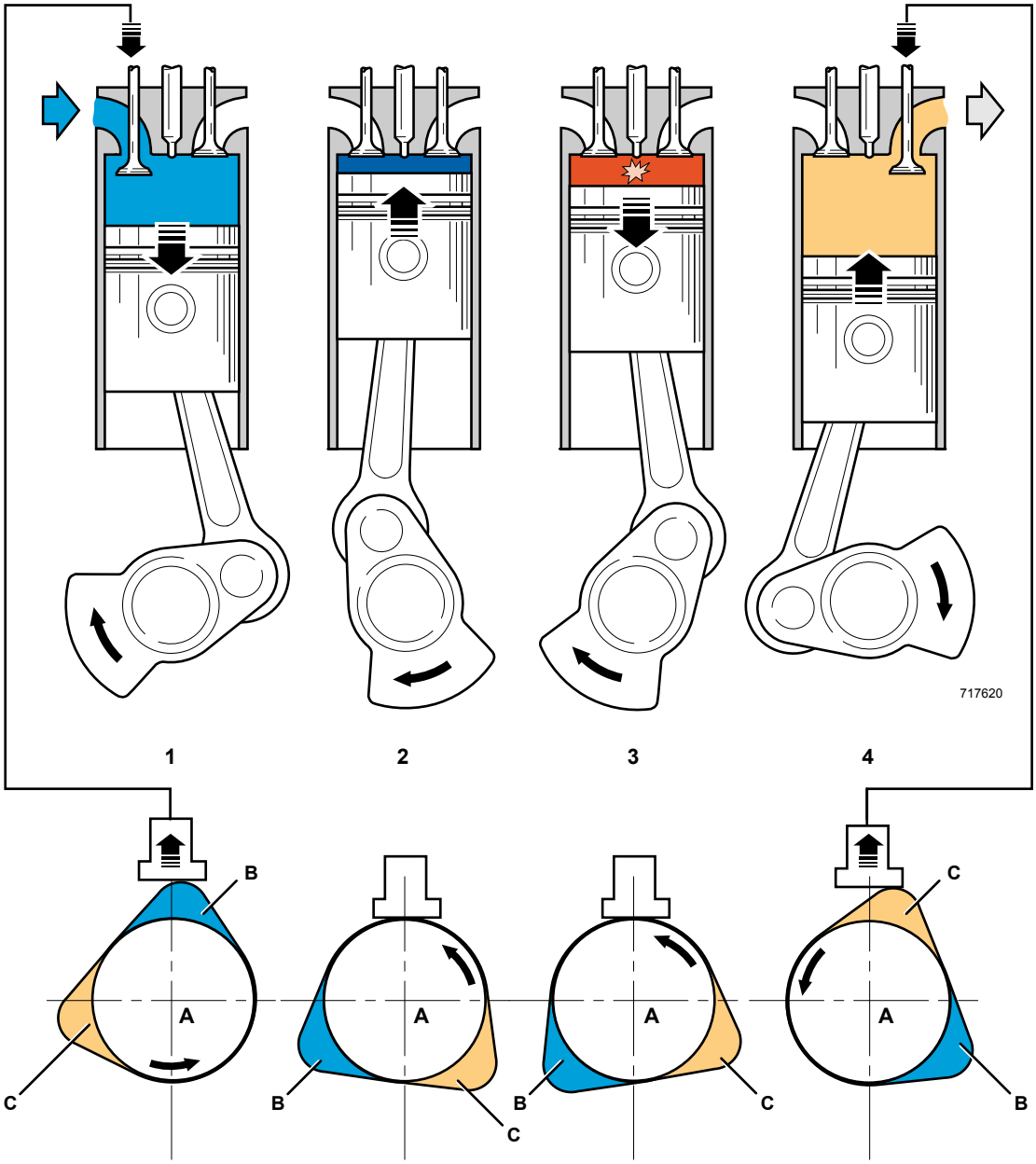
In a running engine, these four phases are continuously repeated. Each stroke is half a revolution of the crankshaft, thus, in one cycle of a four stroke engine, the crankshaft revolves twice.

Figure 102.



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 103.



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

Clean

⚠ **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: 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.

Before carrying out any service procedures that require components to be removed, the engine must be properly cleaned.

Cleaning must be carried out either in the area of components to be removed or, in the case of major work, or work on the fuel system, the whole engine and surrounding machine must be cleaned.

Stop the engine and allow it to cool for at least one hour. DO NOT attempt to clean any part of the engine while it is running.

1. Make sure that the electrical system is isolated.
2. Make sure that all electrical connectors are correctly coupled. If connectors are open fit the correct caps or seal with water proof tape.
3. Cover the alternator with a plastic bag to prevent water ingress.
4. Seal the engine air intake, exhaust and breather system.
5. Make sure that the oil filler caps and dipstick are correctly installed.
6. Use a low pressure water jet and soft bristle brush to soak off caked mud or dirt.
7. Apply an approved cleaning and degreasing agent with a brush. Obey the manufacturers instructions.
8. Use a pressure washer to remove the soft dirt and oil. Important: DO NOT aim the water jet directly at oil seals or electrical and electronic components such as ECU (Electronic Control Unit)'s, alternator or fuel injectors. DO NOT place the jet nozzle closer than 600mm (24 in) to any part of the engine or after treatment system including exhaust sensor ECU (if installed).
9. When the pressure washing is complete move the machine away from the wash area, or alternatively, clean away the material washed from the machine.
10. Before working on specific areas of the engine use a compressed air jet to dry off any moisture. When the area is dry use a soft clean brush to remove any sand or grit particles that remain.
11. When removing components be aware of any dirt or debris that may be exposed. Cover any open ports and clean away the deposits before proceeding

Additional cleaning must be carried out prior to working on the high pressure fuel system, refer to: Fuel System - Clean (PIL 18-00).

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