Operation and Maintenance Instructions Manual

DDFP SERIES ENGINES FOR FIRE PUMP APPLICATIONS

This manual covers Detroit Diesel engines
modified by Clarke DD-A
for fire pump service

UL LISTED FM APPROVED ULC LISTED

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ABBREVIATIONS

AC	Alternating Current
AEC	Automatic Engine Controller
API	American Petroleum Institute
CCW	Counter-clockwise engine rotating (front view)
CDD-A	Clarke Detroit Diesel-Allison
CW	Clockwise engine rotation (front view)
DC	Direct Current
DDC	Detroit Diesel Corporation
DDFP	Detroit Diesel Engines approved for Fire Pump Service as certified by FM/UL/ULC for Clarke Detroit Diesel-Allison
FM	Factory Mutual Research
GM	General Motors Corporation
ID	Identification
IP	Instrument Panel
I-53	In-Line Cylinder arrangement 53 Series DDC Engine
I-71	In-Line Cylinder arrangement 71 Series DDC Engine
NA	Naturally Aspirated
NC	Normally Closed
NO	Normally Open
NFPA	National Fire Protection Association
P/N	Part Number
PSI	Pounds Per Square Inch
PTO	Power Take Off
RPM	Revelutions Per Minute
SAE	Society of Automotive Engineers
S/N	Serial Number
T	Turbocharged
TA	Turbocharged and Aftercooled
UL	Underwriters Laboratories Inc.
ULC	Underwriters Laboratories of Canada
V-92	Vee cylinder arrangement 92 Series DDC engines
V-71	Vee cylinder arrangement 71 Series DDC engines

TABLE OF CONTENTS

SUBJECT PAGE

PRINCIPLES OF OPERATION

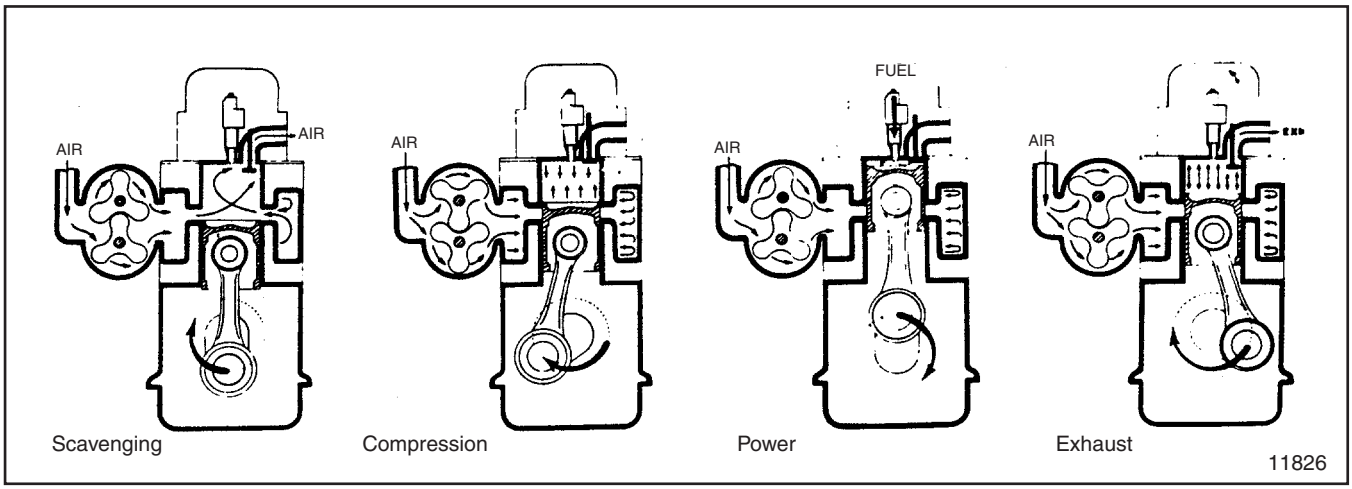

Fig. 1 - In-Line Cylinder Arrangement

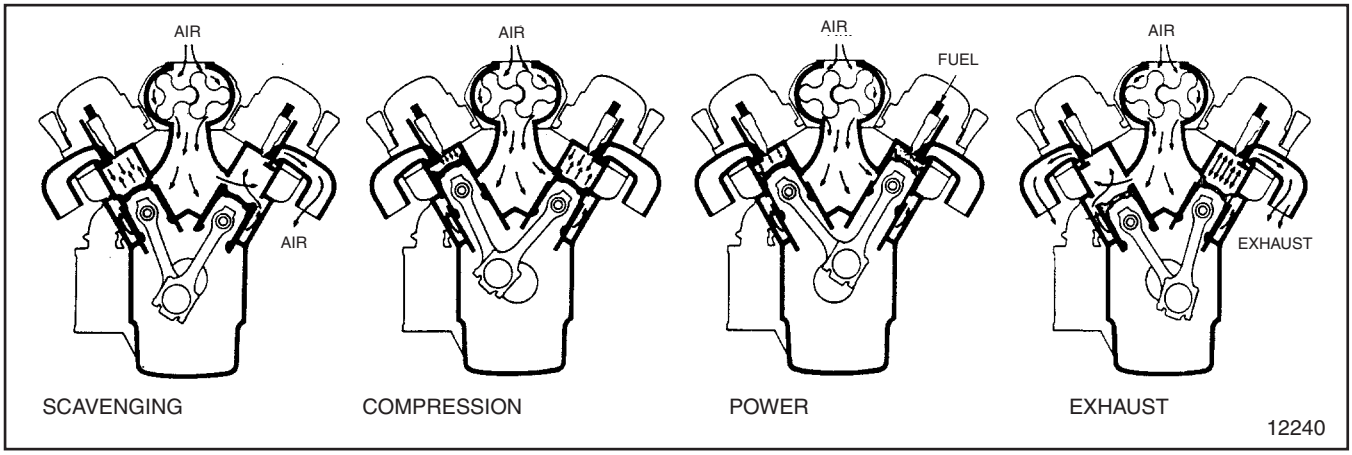

Fig. 2 - Vee Block Cylinder Arrangement

The diesel engine is an internal combustion power unit, in which the heat of fuel is converted into work in the cylinder of the engine.

In the diesel engine, air alone is compressed in the cylinder; then, after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition is accomplished by the heat of compression.

The Two-Cycle Principle

In the two-cycle engine, intake and exhaust functions take place during part of the compression and power strokes respectively (Fig. 1) or (Fig. 2). In contrast, a four-cycle engine requires four piston strokes to complete an operating cycle; thus, during one half of its operation, the four-cycle engine functions merely as an air pump.

A blower is provided to force air into the cylinders for expelling the exhaust gases and to supply the cylinders with fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit the air from the blower into the cylinder as soon as the rim of the piston uncovers the ports (Fig. 1 & 2 - Scavenging).

The unidirectional flow of air toward the exhaust valves produces a scavenging effect, leaving the cylinders full of clean air when the piston again covers the inlet ports.

As the piston continues on the upward stroke, the exhaust valves close and the charge of fresh air is subjected to compression (Fig. 1 & 2 - Compression).

Shortly before the piston reaches its highest position, the required amount of fuel is sprayed into the combustion chamber by the unit fuel injector (Fig. 1 & 2 - Power). The intense heat generated during the high compression of the air ignites the fine fuel spray immediately. The combustion continues until the fuel injected has been burned.

The resulting pressure forces the piston downward on its power stroke. The exhaust valves are again opened when the piston is about half way down, allowing the burned gases to escape into the exhaust manifold (Fig. 1 & 2 - Exhaust). Shortly thereafter, the downward moving piston uncovers the inlet ports and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft, or, in other words, in two strokes; hence, it is a "two-stroke cycle".

DESCRIPTION

Introduction

NFPA Pamphlet 20 states "The compression ignition diesel engine has proved to be the most dependable of the internal combustion engines for driving fire pumps." The diesel engine will operate under emergency power conditions where loss of utility or stand-by electric power renders electric motor driven pumps useless. The diesel driven fire pump system is preferred by most insurance companies.

This manual covers Detroit Diesel engines. These engines have been manufactured with specific options to function integrally with an automatic engine controller for stand-by fire protection service and to meet NFPA-20 requirements. These systems are designed to function under emergency conditions and to assist in holding fire damage to a minimum. Complete understanding of the operation and maintenance of this fire protection system is essential to achieve this objective.

A separate manual covers the operation and maintenance of the Automatic Engine Controller (AEC).

The two-cycle engines covered in this manual are produced with various cylinder arrangements. The same bore and stroke and many of the major working parts such as injectors, pistons, connecting rods, cylinder liners and other parts are interchangeable within each engine series. The engines are either naturally aspirated (NA) or turbocharged (T) and some units are turbocharged and aftercooled (TA).

The engines have either an in-line or a vee type cylinder arrangements. The engine may have clockwise (CW) or counter-clockwise (CCW) rotation. Rotational reference is made from a front view of the engine to determine the rotation of the output shaft. All other engine references, (*right* or *left* side) are made from a rear view of the engine, looking at the flywheel.

All DDFP engines are Underwriters Laboratories (UL) listed, Underwriters Laboratories of Canada (ULC) listed and/or Factory Mutual (FM) approved and meet the requirements of the National Fire Protection Association (NFPA) standard 20.

Each engine is equipped with an oil cooler, lubricating oil filter, fuel filters, air cleaner, heat exchanger, starting motor, alternator, instrument panel and engine jacket water heater.

Full lubrication oil pressure is supplied to all main, connecting rod and camshaft bearings, and to other moving parts within the engine. A gear type pump draws oil from the oil pan through an intake screen, through the oil filter and then to the oil cooler. From the oil cooler the oil enters a longitudinal oil gallery in the cylinder block where the supply divides and is channeled to the turbocharger (if included), to the cam and balance shaft end bearings and cylinder head, with the remainder going to the main bearings and connecting rod bearings via the drilled crankshaft. The oil then drains back into the oil pan.

Coolant is circulated through the engine by a centrifugal-type water pump. Heat is removed from the coolant as it circulates in a closed system through the heat exchanger. Control of the engine temperature is accomplished by a thermostat which regulates the flow of the coolant within the cooling system. Raw water from the fire pump passes through a tube bundle in the heat exchanger to remove the heat from the engine coolant.

Fuel is drawn from the supply tank through a strainer by a gear-type fuel pump. It is then forced through a filter and into the fuel inlet gallery in the cylinder head and to the injectors. Excess fuel is returned to the supply tank through the fuel outlet gallery and connecting lines. Since the fuel is constantly circulating through the injectors, it serves to cool the injectors and purges the system of air.

Air for scavenging and combustion is supplied by a blower which pumps air into the engine cylinders via the air box and cylinder liner ports. All air entering the blower first passes through an air cleaner. Turbocharges, when included, are located between the air cleaner and the blower. Some engines also include an after cooler which cools the air prior to entering the cylinders.

Engine starting is usually provided by an electric starting system. The electric starting motor is energized by a storage battery. A battery-charging alternator, with a built-in voltage regulator, serves to keep the battery charged while the unit is running. At rest, a battery charger in the AEC keeps batteries charged.

Engine speed is regulated by a mechanical type engine governor with a tamper proof speed control device.

Model Numbering & Identification

Two model numbers are shown on this product. First is the Clarke FM/UL/ULC approved model number showing the prefix *DDFP*. Figure 3 explains the identification system on *DDFP* units. Second is the DDC basic engine model number using eight digits. Figure 4 provides details for understanding the significance of each digit.

The DDFP model number appears on the FM/UL/ULC tag attached to the right rear of the engine flywheel housing. The DDC basic engine model number appears on the engine rocker cover. The engine S/N should be the same at both locations.

On some engines, you may find different engine rated horsepower and operating RPM on the rocker cover name plate than on the FM/UL/ULC tag attached to the flywheel housing. The FM/UL/ULC tag is the official power data and takes presi-dence over the rocker cover data.

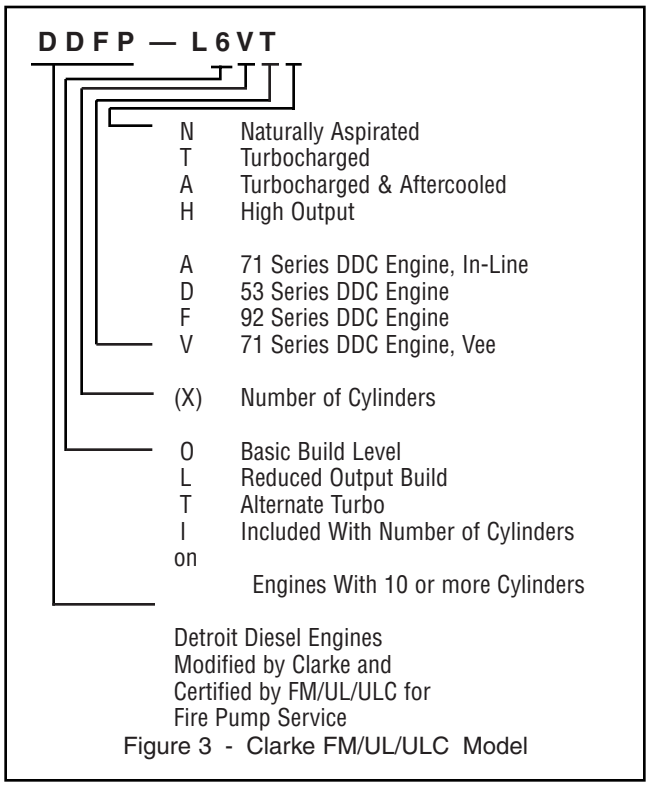

Figure 3 - Clarke FM/UL/ULC Model

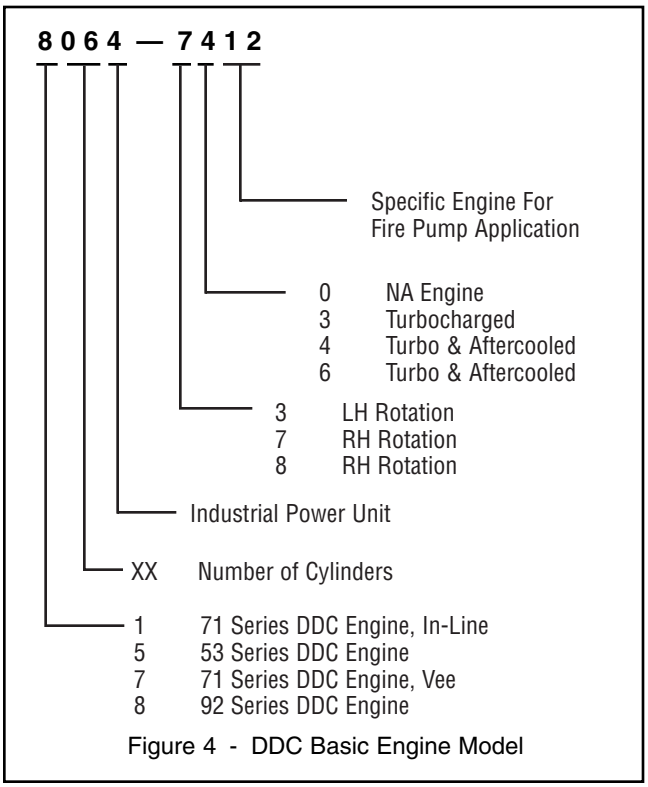

Figure 4 - DDC Basic Engine Model

(See Page 1)

DDFP STANDARD ENGINE EQUIPMENT LIST

—Air cleaner, oiled gauze or dry type for protected environment.

—Battery charging alternator (12 or 24V-DC) negative ground

—Engine coolant heater with AC power connection (120, 208 or 240V)

—Engine oil cooler

—Electric starting motor (12 or 24V-DC)

—Exhaust manifold insulation or heat shield

—Fuel inlet check valve

—Fuel filters - Primary and Secondary

—Governor speed control
(10% No Load to Full Load)

—Heat Exchanger with pressure cap

—High water temperature switch

—Instrument panel with water temperature, oil pressure and voltmeter

—Junction box (DC control) for connection to engine controller

—Low oil pressure switch

—Manual over-ride of automatic operations including instruction plate

—Manual start contactors - two provided on each engine

—Oil filter(s) full flow with by-pass

—Oil pan heater (optional)

—Overspeed control and reset switch

—Solenoid Run/Stop control-signal from AEC

—Direct mounted engine half of Falk coupling

—Tachometer with hour meter

—Tamper proof throttle control factory preset

—Wiring harness for DC control

FM/UL/ULC CERTIFICATION NAME PLATE

The standard nameplate (Fig. 5) contains the follo wing information: FM/UL certified model number; Clark e specification number; production date; rated horsepower; full load engine speed; basic engine serial number (S/N). The name plate is located on the right rear of the engine and attached to the flywheel housing.

The DDC model and S/N are found on the manuf acturer's I.D. label (Fig. 6) on the v alve rocker cover. This model is also stamped on the engine block.

On the Inline engines, the model number is stamped into the cylinder block casting on a machined pad abo ve and to the right of the engine blower. On the VEE engines, the number is stamped at the right front of the block just behind the water pump.

When requested, a ULC nameplate is provided in addition to the FM & UL nameplate. This plate is mounted separately on the engine.

Figure 5

Figure 6

General Specifications - DDFP Models				
Type	**03DN 03DT L3DT T3DT 2 Cycle**	**03AN 2 Cycle**	**04AN 04AT 2 Cycle**	**L6VT T6VT 2 Cycle**
Number of Cylinders	3	3	4	6
Bore (inches)	3.875	4.25	4.25	4.25
Bore (mm)	98	108	108	108
Stroke (inches)	4.5	5	5	5
Stroke (mm)	114	127	127	127
Compression Ration (T Eng)	18.7:1	– –	17:1	17:1
Compression Ration (N Eng)	21.0:1	18.7:1	18.7:1	– –
Total Displacement (cub. in.)	159	213	284	426
Total Displacement (liters)	2.61	3.49	4.66	6.99
Number of Main Bearings	4	4	5	4

General Specifications - DDFP Models						
Type	**06FA 2 Cycle**	**06FH 2 Cycle**	**L8FA 08FA 2 Cycle**	**08FH 2 Cycle**	**12FT 2 Cycle**	**12FH 2 Cycle**
Number of Cylinders	6	6	8	8	12	12
Bore (inches)	4.84	4.84	4.84	4.84	4.84	4.84
Bore (mm)	123	123	123	123	123	123
Stroke (inches)	5	5	5	5	5	5
Stroke (mm)	127	127	127	127	127	127
Compression Ratio	17:1	15:1	17:1	15:1	17:1	15:1
Total Displacement (cubic inches)	552	552	736	736	1104	1104
Total Displacement (liters)	9.05	9.1	12.07	12.07	18.1	18.1
Number of Main Bearings	4	4	5	5	8	8

For Specific Operational Data For Each Engine Model, Refer To Technical Data Section 5.