# Operation and Maintenance Instructions Manual

## VMFP MODEL ENGINES FOR FIRE PUMP APPLICATIONS

This manual covers VM Motori 700 Series Engines

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Check factory availability for a manual in one of the following languages:

Spanish	MP-7 C131020
French	MP-7 C131021
German	MP-7 C131022
Italian	MP-7 C131023

#### <u>NOTE</u>

The information contained in this book is intended to assist operating personnel by providing information on the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted practices in the installation, operation, and maintenance of the equipment.

NOTE: CLARKE FPPG Reserves the right to update the contents of this publication without notice.

#### **1.0 INTRODUCTION**

#### SCOPE OF SUPPLY

The following paragraphs summarize the "Scope of Supply" of the Engine:

- The CLARKE Engine supplied has been designed for the sole purpose of driving a stationary Emergency Fire Pump. It must not be used for any other purpose.
- Shall not be subjected to horsepower requirements greater than the certified nameplate rating (for UL/cUL/FM only).
- Derates for elevation and temperature need to be considered for maximum pump power.
- Fuel delivery settings are factory set with-in the injection pump and must not be tampered with or adjusted. Minor RPM adjustments to meet pump requirements are permissible.
- The engine shall be installed and maintained in accordance with the guidelines stated in this manual and technical catalog (C131024).
- Periodic running checks to ensure functionality should be kept to a maximum of <sup>1</sup>/<sub>2</sub> hour per week.

#### 1.1 IDENTIFICATION/NAMEPLATE

- Throughout this manual, the terms "Engine" and "Machine" are used.
- The term "Engine" refers solely to the diesel engine driver as supplied by CLARKE.
- The term "Machine" refers to any piece of equipment with which the engine might interface.

This manual provides all the information necessary to operate your newly acquired engine safely and efficiently, and perform routine servicing correctly. Please read it carefully.

#### MODEL NUMBERING & IDENTIFICATION

There are two identification plates attached to

each engine. Clarke Identification Plate: Engine Model, Serial Number, Rating and Date of Manufacture are shown on this identification plate (*Figure #1*). The Clarke model number appears on the FM/UL identification plate attached to the left side of engine flywheel guard.

#### **Clarke Identification Plates**

Ψ FIR	ma E PROTEI	CLARKE CTION PROD	у UCTS,	INC.
	CI	NCINNATI, DHI	0	
(	U) 'i	CUL		
IN	TERNAL ( FOR I ENTRIFU	COMBUSTION DRIVING JGAL FIRF P		NE
м	DDEL			
SI	MART P/N	۷		
M	FG.SZN _			
	THIS EN FOR AN (	GINE IS PRI JPERATING	IVIDEI RANGE	2
	FROM	BHP@	RPM	1
	UP ТО	BHP@	RPM	1
HORS	SEPOWER	RATINGS W	THIN	
ARE	TO BE DE	ETERMINED	ANGE By the	
USE BE TI	OF LINE.	AR INTERPO		N IPE D
ĀT M	INIMUM	AND MAXIMU	M SPEE	EDS
м	F D	MD	YE	AR
$\oplus$				-0
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Clarke model numbers reflects the base engine type, number of cylinders, cooling system, approval listing and a power rating code.

#### Example: VMFP-04HT

- VMFP = VM Motori Diesel Engines prepared by CLARKE and Certified by FM/UL for Fire Pump Service
- 0 = Basic Build Level, T = Alternate Turbo
- 4 = number of cylinders
- H = D700 Series FM Engine
- T = Turbocharged, (N = Natural, R = Raw Water Aftercooled)

The VM serial number is stamped on an identification plate which is fastened to the rear of cylinder block.

#### 1.2 SAFETY/CAUTION/WARNINGS

ATTENTION: This engine has components and fluids that reach very high operating temperatures and is provided with moving pulleys and belts. Approach with caution. It is the responsibility of the builder of the machine using a Clarke engine to optimize the application in terms of maximum end user safety.

#### **BASIC RULES**

The following recommendations are given to reduce the risk to persons and property when an engine is in service or out of service.

Engines must not be used for applications other than those declared under "Scope of Supply".

Incorrect handling, modifications and use of nonoriginal parts may affect safety. When lifting the engine, take care to use suitable equipment to be applied to the points specially provided as shown on the appropriate Engine Installation Drawing. Engine weights are shown in *figure #2* 

ENGINE MODEL	WEIGHT lbs (kg)
04HN	814 (369)
04HT	831 (377)
06HT, T6HT	1080 (490)
L6HR, T6HR	1140 (516)

Figure	#2
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Figure #3 shows the typical lifting arrangement of an engine only. Note the lifting points on the engine are for lifting the engine only. Caution, when lifting, lift point should always be over the equipment Center of Gravity.



Figure #3

Engine lifting eyes are removed prior to Note: shipment. If engine must be lifted, lifting eyes must be re-installed.

Figure #4 shows the typical lifting arrangement of a base mounted engine and pump set when the base (or module) is furnished with lifting holes.



When Clarke furnishes the base (or module) for the engine and pump set, the combined weight of the engine and base (or module) only will be indicated on the unit. Caution, when lifting, lift point should always be over the equipment Center of Gravity.

Note: The engine produces a noise level exceeding 70 dB(a). When performing the weekly functional test, it is recommended that hearing protection be worn by operating personnel.

#### WHAT TO DO IN AN EMERGENCY

Any user of the Engine who follows the instructions set out in this manual, and complies with the instructions on the labels affixed to the engine are working in safe conditions.

If operating mistakes cause accidents call for help immediately from the EMERGENCY SERVICES. In the event of an emergency, and while awaiting the arrival of the EMERGENCY SERVICES, the following general advice is given for the provision of first aid.

#### FIRE

Put out the fire using extinguishers recommended by the manufacturer of the machine or the installation.

#### **BURNS**

- 1) Put out the flames on the clothing of the burns victim by means of:
  - drenching with water
  - use of powder extinguisher, making sure not to direct the jets onto the face

- blankets or rolling the victim on the ground
- 2) Do not pull off strips of clothing that are sticking to the skin.
- 3) In the case of scalding with liquids, remove the soaked clothing quickly but carefully.
- 4) Cover the burn with a special anti-burn packet or with a sterile bandage.

#### CARBON MONOXIDE POISONING (CO)

Carbon monoxide contained in engine exhaust gases is odorless and dangerous because it is poisonous and with air, it forms an explosive mixture.

Carbon monoxide is very dangerous in enclosed premises because it can reach a critical concentration in a short time.

When attending a person suffering from CO poisoning in enclosed premises, ventilate the premises immediately to reduce the gas concentration.

When accessing the premises, the person providing the aid must hold his breath, not light flames, turn on lights or activate electric bells or telephones so as to avoid explosions.

Take the victim to a ventilated area or into the open air, placing him on his side if he is unconscious.

#### CAUSTIC BURNS

- 1) Caustic burns to the skin are caused by acid escaping from the batteries:
  - remove the clothes
  - wash with running water, being
  - careful not to affect injury-free areas
- 2) Caustic burns to the eyes are caused by battery acid, lubricating oil and diesel fuel.
  - Wash the eye with running water for at least 20 minutes, keeping the eyelids open so that the water runs over the eyeball and moving the eye in all directions.

#### ELECTROCUTION

Electrocution can be caused by:

1) The engine's electrical system (12/24 VDC)

2) The electrical coolant pre-heating system 120/240 Volt AC (if supplied) AC current.

In the first case, the low voltage does not involve high current flows through the human body; however, if there is a short circuit, caused by a metal tool, sparks and burns may occur.

In the second case, the high voltage causes strong currents, which can be dangerous.

If this happens, break the current by operating the switch before touching the injured person.

If this is not possible, bear in mind that any other attempt is highly dangerous also for the person assisting; therefore, any attempt to help the victim must be carried out without fail using means that are insulating.

#### WOUNDS AND FRACTURES

The wide range of possible injuries and the specific nature of the help needed means that the medical services must be called.

If the person is bleeding, compress the wound externally until help arrives.

In the case of fracture do not move the part of the body affected by the fracture. When moving an injured person permission from that person must be received until you can help him. Unless the injury is life threatening, move the injured person with extreme care and then only if strictly necessary.

#### WARNING LABELS

Warning labels, in picture form, are applied to the engine. Their meanings are given below.

**Important Note:** Labels that show an exclamation mark indicate that there is a possibility of danger

#### Heat Exchanger Maximum Working Pressure



#### **Coolant Mixture**



#### **Automatic Start**



#### **Rotating Parts**



#### Air Filter Installation



#### 2.0 INSTALLATION/OPERATION

#### 2.1 TYPICAL INSTALLATION

A typical Fire Pump installation is shown in *Figure #5*.

- 1. Pump/Engine set
- 2. Main Pump Controller
- 3. Pump discharge
- 4. Air louver
- 5. Entrance door with air lourver
- 6. Exhaust silencer

- 7. Exhaust system supports
- 8. Exhaust outlet pipe
- 9. Concrete base
- 10. Exhaust flexible connection joint/pipe



#### 2.2 ENGINE STORAGE

2.2.1 Storage less than 1 year

Storing engines requires special attention. Clarke engines, as prepared for shipment, may be stored for a minimum of one year. During this period, they should be stored indoors in a dry environment. Protective coverings are recommended provided they are arranged to allow for air circulation. The stored engine should be inspected periodically for obvious conditions such as standing water, part theft, excess dirt buildup or any other condition that may be detrimental to the engine or components. Any such conditions found must be corrected immediately.

#### 2.2.2 Extended Storage Maintenance Procedure

After a one year storage period or if the engine is being taken out of service for more than 6 months, additional preservation service must be performed as follows:

- 1) Drain the engine oil and change the oil filter.
- 2) Refill the engine crankcase with MIL-L-21260 preservative oil.
- 3) Change the fuel filter.
- Install the coolant plugs and install coolant in the normal mix percentage of 50% coolant, 50% water, premixed.

- 5) Remove the protection from the intake and exhaust openings.
- Prepare a container as a fuel source using a mixture of Mobilarma or Sta-Bil with Diesel #2 fuel or "Red" diesel fuel (ASTM D-975) or BS2869 Class A2.
- 7) Disconnect the coupling or drive shaft from the pump.
- Start and run the engine at a slow speed for 1-2 minutes being careful not to exceed the normal operating temperature.
- 9) Drain the oil and coolant.
- 10) Replace the protective plugs that were used for shipping and storage.
- 11) Attach to the engine a visible card, specifying "ENGINE WITHOUT OIL" DO NOT OPERATE".

#### 

#### PUTTING ENGINE INTO SERVICE AFTER ADDITIONAL PRESERVATION SERVICE:

To restore the normal operation running conditions of the engine, carry out the following:

- 1) Fill the engine sump with the normal recommended oil, to the required level.
- 2) Remove the protective plugs used for shipping and storage.
- 3) Refill cooling water to proper level.
- 4) Remove the card "ENGINE WITHOUT OIL, DO NOT OPERATE".
- 5) Follow all steps of the Installation Instructions when the engine will be put into service.

#### 2.3 INSTALLATION INSTRUCTIONS

The correct installation of the engine is very important to achieving optimum performance and extended engine life.

In this respect, the engine has certain installation requirements, which are critical to how it performs. These requirements are generally associated with the cooling, exhaust, induction air, and fuel systems.

This section of the manual should be read in conjunction with the relevant Installation and Operation Data Sheets. If there is any doubt about an installation, contact should be made with Clarke Customer Support giving exact details of the problem.

All installations should be clean, free of any debris and dry. Care should be taken to ensure that there is easy access to the engine for maintenance and repair. The safety of personnel who may be in the area of the engine when it is running is of paramount importance when designing the installation layout.

- Secure pump set to foundation and complete installation in accordance with pump manufacturer's instructions. Perform engineto-pump driveshaft alignment. Lubricate driveshaft universal joints with NLGI grade #1 or #2 grease at the (3) zerk fittings.
- 2) Install a heat exchanger discharge pipe. The discharge pipe should be no smaller than the outlet connection on the heat exchanger. Discharge water should be piped to an open waste cone. All plumbing connecting to the heat exchanger must be securely fastened to limit stress and movement by engine vibration. Cooling loop water pressure to the heat exchanger has a limit of 60 PSI.
- 3) Install all engine cooling system draincocks and plugs.

<u>QTY.</u>	DESCRIPTION	LOCATION
1	Electrode plug	bottom of heat
		exchanger
1	1⁄4" brass plug	side of heat
		exchanger
1	1/4" steel plug	side of heater

4) Fill engine cooling system with premixed 50% water/50% coolant solution. Use only coolants meeting ASTM-D4985 specifications for heavy-duty diesel engines. Never use light-duty or automotive coolants in the engine (ASTM-D3306). Fill to bottom of fill neck. Refer to chart below for cooling system capacity.

	<b>CAPACITY</b>
ENGINE MODELS	Quarts (Liters)
04HN, 04HT	6.3 (6.0)
06HT, T6HT, L6HR, T6HR	8.8 (8.5)

5) This engine was shipped from Clarke with crankcase oil installed. If necessary, fill engine crankcase with SAE 15W-40 weight oil meeting API service designation of CF-4. Refer to chart below for lubrication system capacity.

ENGINE MODELS	CAPACITY Quarts (Liters)
04HN, 04HT	7.7 (7.3)
06HT, T6HT, L6HR, T6HR	10 (9.5)

- 6) Connect fuel supply and return line to fuel supply tank plumbing. Reference the Fuel System section of the Installation and Operation Data in the Clarke VMFP Operation and Maintenance Instructions Manual for fuel flow and maximum allowable fuel pump suction requirements. Fill supply tank with #2 diesel fuel, bleed supply system of air and check for leaks. Fuel supply level must meet the requirements of NFPA-20. **Do not** use galvanized material for any component of a diesel fuel system. The fuel will chemically react with the zinc coating, resulting in clogged fuel filters and injector systems.
- 7) Remove protective covering on air cleaner element.
- 8) Connect jacket water heater to AC power source. Electrical supply requirements are indicated on the connection box. Connect to the heater directly at the junction box on the end of the heater only. Supply wiring should **never** be routed through the engine gauge panel. Severe damage to critical engine control components could result. Energize heater only after step #4 is completed.
- 9) Connect exhaust system to flexible connection on the engine. The exhaust system plumbing must be supported by the building structure and not the engine. The exhaust flexible connection is provided only for the purpose of thermal expansion and vibration isolation, not for misalignment or directional change.
- 10) Make electrical (DC) connections between the engine gauge panel terminal strip and the controller per the controller manufacturer's instructions. Note that the "W" terminal is used only for the cooling water solenoid and an internal connection is already made to the solenoid on this engine.
- 11) Fill batteries with electrolyte per battery manufacturer's instructions. Connect cables between engine and batteries **only** after electrolyte is installed. Refer to the wiring diagram inside the engine gauge panel for correct positive and negative connections. Connect negative cables directly to the engine block and the positive cable to the large electrical post of the starter motor.

These engines have a separate starter motor for each battery set.

12) **NOTE:** Clarke Operation and Maintenance Instructions Manual and Clarke parts illustration pages are located inside the engine gauge panel.

For additional technical information, installation drawings, wiring diagrams, and identification of authorized Clarke Service Dealers for start-up inspection and warranty, please refer to the Clarke Fire Protection Products web site: www.clarkefire.com

#### 2.4 SPECIFIC FLYWHEEL COUPLING ALIGNMENT INSTRUCTIONS

#### 2.4.1 Driveshaft

To check the alignment of the pump shaft and engine crankshaft centerlines for proper Parallel Offset and Angular tolerance, the driveshaft must be installed between the flywheel drive disc (no drive disc on JW6H models) and the flanged hub on the pump shaft.

Before removing the driveshaft guard, disconnect the negative battery cable from both batteries.

Before beginning the alignment checks and making any necessary corrections, re-torque all driveshaft connection bolts to the values given in the table below:

		BOLT SIZE	TIGHTENING
	DRIVE	/MATERIAL	TORQUE
MODELS	SHAFT	GRADE	(ft-lbs)
04HN		7/16-20	
04HT	SC41	Grade 8	50 - 55
06HT		(Hi-Tensile)	
T6HT		1/2-20	
L6HR	SC55	Grade 8	75 - 82
T6HR		(Hi-Tensile)	

The following steps describe the proper way to check alignment. A small pocket scale or ruler with millimeter markings is recommended to make all measurements.

- A) To check the Horizontal Parallel Offset, the driveshaft must be in the proper orientation.
  - 1. Rotate the engine shaft manually so the reference "AB" on the flywheel drive disc is in the 12 o'clock position shown on figure# 6.

2. Measure from the rear face of the flywheel drive disc to point A. (Point A is on the bearing bore as shown in *Figure #6* on the instrument panel side of the engine). This measurement must be:

MEASUREMENT	MODELS
58 <u>+</u> 2mm.	04HN 04HT 06HT
68 + 4mm.	T6HT L6HR T6HR

- B) With the driveshaft in the same orientation as the previous step (Step A), check the Horizontal Angular alignment of the shafts.
  - 1. Measure from the front face of the pump shaft flange to point B. (Point B is the bearing bore on the exhaust side of the engine). This measurement should be equal to the measurement at point  $A \pm 1$  mm.
- C) To check the Vertical Parallel Offset, the driveshaft must be re-orientated.
  - 1. Rotate the engine shaft manually  $90^{\circ}$  so the reference "CD" on the flywheel drive disc is in the position shown on *Figure*#7.
  - 2. Measure from the rear face of the flywheel drive disc to point C. (Point C is the same as point A with the driveshaft rotated 90°). The measurement at Point C must be:

MEASUREMENT	MODELS
60 <u>+</u> 1mm.	04HN 04HT 06HT
71 + 1mm.	T6HT L6HR T6HR

- D) With the driveshaft in the same orientation as the previous step (Step C), check the Vertical alignment of the shafts.
  - 1. Measure the front face of the pump shaft flange to point D. (Point D is the same as point B, with the driveshaft rotated 90). The measurement must be equal to the measurement at point  $C \pm 1$  mm.

Move the engine side to side as necessary to correct measurements in Step A and B (refer to *Figure #6*).



Figure #6

Raise the engine in the front and/or rear as necessary to correct measurements in Step C and D (refer to *Figure #7*).

Re-install all guards before re-connecting the battery cables.



Figure #7

#### DRIVE SHAFT MAINTENANCE

- 1. To service the driveshaft disconnect the negative battery cables, remove the top of guard and set aside.
- 2. Rotate engine shaft manually so the u-joint grease fittings are accessible.
- 3. Using a hand held grease gun with N.L.G.I. grade 1 or 2 grease position on grease fitting. Pump with grease until grease is visible at all four cap seals.
- 4. Verify all driveshaft connecting bolts remain tight. Re-torque per 2.4.1 if necessary.
- 5. Reinstall top of guard and connect negative battery cables.

#### 2.5 WEEKLY TEST

It is strongly recommended that an experienced operator be present during the weekly testing.

NOTE: This engine is designed to operate at maximum efficiency and reliability under rated load conditions. Although for testing purposes the engine can be run at lower conditions, running times in any one period should not exceed 30/45 minutes maximum.

Before starting the engine make sure of the following:

- 1) The operator has free access to stop the engine in an emergency.
- 2) The plant room ventilation ducts are open and the engine has good access for air.
- 3) All the guards are in position and, if not, for whatever reason, any rotating parts will be free and clear without restriction.
- 4) Battery covers are in place and there is nothing on top of or touching the engine, which is not part of the original supply specification.
- 5) The water supply for coolant is available again without restriction.

When engine is running make sure that the cooling water temperature and oil pressure are within the limits specified on the relevant Installation & Operation Data Sheet in the Technical Catalog, C131024.

If the cooling water temperature is excessive, check:

- a) Vee-belt tension on water pump-alternator.
- b) Proper functioning of thermostat.
- c) Condition of heat exchanger tube bundle.

#### 2.6 STARTING/STOPPING THE ENGINE

#### 2.6.1 To Start Engine

Use main pump controller for starting. Follow instructions provided by controller manufacturer.

On UL/FM engines, use main pump controller for starting and stopping the engine. Should the main pump controller become inoperable, the engine can be manually started and stopped from the engine gauge panel. For manual starting and stopping of an engine with a gauge panel: Position **MODE SELECTOR** to **MANUAL RUN**. (Refer to *Figure* #8). Lift and hold **MANUAL CRANK** #1, until engine starts, or release after 15 seconds. If unit fails to start, wait for 15 seconds, use **MANUAL CRANK**  **#2** and repeat step. If **COOLING WATER** is not flowing or engine **TEMPERATURE** is too **HIGH**, open cooling system manual by-pass valves.

IMPORTANT: Main pump controller selector should be in the **OFF** position when starting from engine gauge panel. Be sure to return selector on main pump controller and engine gauge panel to **AUTOMATIC** after completing manual run.



Figure #8

- 1 Emergency Operating Instructions
- 2 Automatic-Manual Mode Selector
- 3 Manual Crank Controls

- 4-Overspeed Reset
- 5 Warning Light
- 6 Overspeed Verification

#### 2.6.2 To Stop Engine

If engine is started from main pump controller use main pump controller to stop the engine.

If engine is started from engine gauge panel: Return **MODE SELECTOR** switch to **AUTOMATIC/MANUAL STOP** position, engine will stop. Close cooling system manual by-pass valve if opened.

IMPORTANT: **DO NOT** leave the **MODE SELECTOR** switch in the **MANUAL RUN** position during **AUTOMATIC** operation. (The controller will be unable to stop the engine and **DAMAGE MAY RESULT**).

#### **3.0 ENGINE SYSTEMS**

#### 3.1 FUEL SYSTEM

3.1.1 Bleeding the Fuel System

WARNING: Risk of Hydraulic Oil Under High Pressure Being Injected Underneath the Skin: Escaping fluid under pressure can penetrate the skin causing series injury. Relieve pressure before disconnecting any hoses. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles, which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type injury or gangrene may result.



Figure #9

Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

 Make certain the condition that caused air has been corrected. Do not attempt to loosen fuel injection lines to eliminate air.

- 2) Operate the hand priming pump located on the bottom of the fuel lift pump on the engine's left side.
- Start engine by manual crank SW-#1 or SW-#2, manual start instructions on instrument panel
- 4) If engine fails to start or does start but runs erratic, recheck all fuel lines, connections and filters for something obvious. If a simple solution cannot be located it may be necessary to contact your local Distributor / Dealer for service assistance.



Figure #10

KEY:

- 1) Fuel supply pump 2) Fuel filter
- 3) Injection Pump 4) Injector
- 5) Run Solenoid (04HN, 04HT, 06HT only)

3.1.2 Draining the Condensate from the Fuel Filter

Drain the condensate from the fuel filter. Fuel filter has a drain (B) located at the bottom of (A) *figure#11*, these filters should be drained each week to relieve built up water.



Figure #11

#### 3.1.3 Changing the Fuel Filter Cartridges

Change the cartridge and bleed any air from the fuel system as per instructions given in section 3.1.1. Fuel filter changes should take place as per recommendations and only using approved filters. It may also be necessary to change filters out with the recommendations in the event of:

- 1) The engine has had an overhaul.
- 2) The quality of the fuel is questionable.
- 3) The engine has been subjected to temporary adverse conditions outwith it normal operating parameters.
- 4) The fuel tank condensation trap has not been drained in line with manufacturers recommendations.

Each VMFP engine has a spin-on fuel filter.

- 1) Disconnect the pipe connecting the filter to the injection pump at the pump.
- 2) Replace the cartridge.
- 3) Before reconnecting the cartridge to the filter, allow 2 –3 liters of diesel fuel to flow through the filter and the fuel pipe.
- 4) Before bleeding (Fig. 12) the system, check that the fuel supply pump is primed so it can deliver the maximum quantity of fuel. Prime the pump by operating the priming lever A; the lever will move freely for the initial part of its travel and then will encounter more resistance, confirming the pump is being operated.

Note: If this second working stroke is only short, turn the crankshaft through 180° to release the pump from the pump control cam on the camshaft.

- 5) Bleed air from the fuel filter by loosening off the bleed screw B and operating the lever A until a continuous flow of fuel is obtained at the bleed screw. The injection pump is selfpurging.
- Loosen off the unions of the injector fuel feed pipes.
- Turn the engine over by means of the starter motor until the fuel flowing from the injector feed pipe unions is completely free of air.
- 8) Re-tighten the injector fuel feed pipe unions and start the engine. When the fuel flowing from bleed screw B is free of air, re-tighten the bleed screw.



Figure #12

3.1.4 Fuel Tanks

Keep the fuel tank filled to reduce condensation to a minimum. Open drain at the bottom of the fuel tank once a week to drain off any possible water and/or sediment. Fill tank after each test run.

**Note:** Per NFPA 25 standards, the fuel tank level must never be less than 67% of its capacity.

3.1.5 Cleaning Fuel Supply Pump Strainer

- Remove the cover and seal from the top of the lift pump. (Fig. 13) Remove screen strainer. (Refer to figure #10, item #1) for location of fuel supply pump.
- 2) Carefully wash the screen and lift pump body.
- 3) Reinstall screen being careful to align the hole.
- 4) Install cover and seal making sure it is seated properly, if not leaks will occur and pump will not function. Do not over tighten cover screw.
- 5) Operate the hand priming pump to purge air from the system. (Fig. 14) Item 1.



Figure #13



Figure #14

#### 3.2 AIR/EXHAUST SYSTEM

#### 3.2.1 Ambient Conditions

Clarke engines are tested in accordance with SAE J1349 (Clarke USA) or ISO 3046 (Clarke UK). In this capacity they may be derated to meet certain site conditions, failure to do so can seriously impede the performance of the engine and could lead to premature failure.

#### 3.2.2 Ventilation

The engine must be provided with adequate ventilation to satisfy the requirements of the combustion system, radiator cooling systems where fitted, and allow adequate dissipation of radiated heat and crankcase emissions. For all this data refer to Installation & Operation Data in Technical Catalog, C131024. This data can be used for proper sizing of inlet and outlet louvers.

#### 3.2.3 Standard Air Cleaner

The standard air cleaner is a reusable type. Should a situation occur where the air cleaner becomes plugged with dirt (starving the engine of air), loss of power and heavy black smoke will result; the air cleaner should be serviced immediately. See *figure* #30 for air cleaner part numbers by Clarke Engine Model.

**CAUTION:** Do not attempt to remove the air cleaner while an engine is running nor run the engine while the air cleaner is off. Exposed components could cause severe injury to personnel and major internal engine damage could occur should any foreign matter be drawn into the engine.

The air cleaner manufacturer recommends the following:

- 1. The pre-oiled reusable elements are serviced with a special oil. The elements can be serviced or replaced.
- 2. *Figure #15* shows the air filter service instructions.
- 3. When servicing the element is not practical, you can improve filter efficiency by respraying with oil.

**NOTE:** Do not attempt this while engine is running **NOTE:** Do not over oil the reusable element

#### <u>AIR FILTER SERVICE INSTRUCT</u>IONS **1. PRE-CLEANING** 2. SPRAY ON CLEANER Tap the element to dislodge any large embedded dirt, then gently brush with a Spray K&N air filter cleaner liberally onto the entire element and let soak for 10 soft bristle brush. (Note: If complete cleanminutes ing is not practical at this time, re-oil the element and re-install in your vehicle.) **3. PAN CLEANING 4. CLEANING HINTS** Large K&N elements can be rolled or soaked in a shallow pan of K&N air filter Use only K&N air filter cleaner cleaner. Remove immediately and let soak NO gasoline cleaning. for approximately 10 minutes. NO steam cleaning. NO caustic cleaning solutions. NO strong detergents. NO high pressure car wash. NO parts cleaning solvents. Any of these NO's can cause harm to the cotton filter media, plus shrink and harden the rubber end caps. 5. RINSE OFF **6. DRYING HINTS** Rinse off the element with low pressure water. Tap water is OK. Always flush from the clean side to dirty side. This removes Always dry naturally. After rinsing, shake off all excess water and let the element dry naturally the dirt and does not drive it into the filter DO NOT USE COMPRESSED AIR DO NOT USE OPEN FLAME DO NOT USE HEAT DRYERS EXCESS HEAT WILL SHRINK THE COTTON FILTER MEDIA. COMPRESSED AIR WILL BLOW HOLES IN THE ELEMENT. 7. AEROSOL OILING 8. SOUEEZE BOTTLE OILING After cleaning air filter always re-oil before using. **Spray K&H** air filter oil down into each pleat with one pass per pleat. **Wait** 10 minutes and reoil any white spots still After cleaning air filter always re-oil before using. Squeeze K&N air filter oil down into the bottom and along each pleat — only one pass per pleat. Let oil wick into cotton for 20 minutes. Re-oil any white spots still showing. nowing.

Figure #15

#### 9. OILING HINTS

Never use a K&N air filter without oil. (The filter will not stop the dirt without the oil.) Use only K&N formulated air filter oil.
K&N air filter oil is a compound of mineral and animal oil blended with special polymers to form a very efficient tack barrier. Red dye is added to show just where you have applied the oil. Eventually the red color will fade but the oil will remain and filter the air.
NEVER USE Automatic Transmission Fluid.

NEVER USE Motor Oil. NEVER USE Diesel Fuel. NEVER USE WD-40, LPS, or other light weight oils.

Figure #15 cont'd

#### 3.2.4 Crankcase Ventilation

All VMFP Engine Models utilize a closed loop system and do not vent to atmosphere. There is no required maintenance (Figure #16).



Figure #16

#### 3.2.5 Exhaust System

Excessive back pressures to the engine exhaust can considerably reduce both engine performance and life. It is therefore important that exhaust systems should be the proper diameter and be as short as possible within the minimum amount of bends. Refer to Installation & Operating Data in Technical Catalog C131024 for exhaust data.

The installation of the exhaust system should consist of the following:

- Personnel protection from hot surfaces.
- Adequate supports to prevent strain on the engine exhaust outlet and minimize vibration.
- Protection against entry of water and other foreign matter.

While the engine is running inspect exhaust pipe outlet outside of the pump room itself for

environmental hazards such as excessive smoke conditions. The following could be used as a guide for general engine operating conditions.

- 1) Blue Smoke Possible engine oil consumption.
- White Smoke Possibility of water in cylinders Source – Possible water in fuel or internal engine problem.

#### 3.3 LUBRICATION SYSTEM

3.3.1 Checking Sump Oil

#### OIL LEVEL DIPSTICK

On all VMFP engines, the dipstick is located on the left side of the engine. Oil level can only be checked when the engine is not running and has been off for at least 10 minutes. See Page 17 for lube oil requirements if additional oil is needed.

This level must always be between the dipstick marks Min. and Max. with the engine not running.



Figure #17



Figure #18

- 1) Operate the engine until it is warm. Refer to Page 10 "Manual Starting Instructions" for instructions.
- 2) Stop the engine. Remove the sump drain plug and drain lubricating oil from the sump. Fit the drain plug and tighten the plug to 34 Nm (25 ft-lb).
- 3) Fill the sump to the "MAX" mark on the dipstick (Fig. 17) with new and clean lubricating oil of an approved grade.
- Return the unit back into service by returning the AEC selector to "automatic" position and the manual operating lever to manual stop position. Close cooling system manual bypass valve.
- 5) Dispose used oil properly.

#### 3.3.3 Changing Oil Filter Cartridge

- 1. Turn engine off by referring to Page 12 "Important" for proper engine shutdown procedure.
- 2. Put a tray under the filter to retain spilled lubricating oil.
- Remove the filter with a strap wrench or similar tool (Fig. 18). Ensure that the adaptor (Fig. 19) is secure in the engine block (Fig. 19, item D). Then dispose of the filter properly.
- 4. Clean the filter head.
- 5. Lubricate the top of the filter seal with clean engine lubricating oil.
- 6. Fit the new filter and tighten it by hand only. Do not use a strap wrench.
- 7. Ensure that there is lubricating oil in the sump.
- 8. Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump, if necessary.
- 9. Return the unit back into service by returning the AEC selector to "automatic" position and the manual operating lever to AUTO-OFF position.



3.3.4 Oil Specification



Figure #20

3.3.5 Oil Capacities (Including Filter)

ENGINE	OIL CAPACITY		
MODEL	QUARTS (LITERS)		
04HN, 04HT	7.7 (7.3)		
06HT, T6HT, L6HR, T6HR	10 (9.5)		
Figure #21			

#### **3.4 COOLING SYSTEM**

#### 3.4.1 Engine Coolant

The following information is provided as a guide for VMFP Engine users in the selection of a suitable coolant.

The water/ethylene glycol/inhibitor coolant mixture used in VMFP engines must meet the following basic requirements:

- Provide for adequate heat transfer.
- Provide protection from cavitation damage.
- Provide a corrosion/erosion-resistant environment within the cooling system.
- Prevent formation of scale or sludge deposits in the cooling system.

- Be compatible with engine hose and seal materials.
- Provide adequate freeze and boil over protection.

#### WARNING

A water and anti-freeze solution is required for pump installations. Premixing this solution prior to installing is required. This prevents possible pure anti-freeze chemical reactions to block heater elements which can burnout the element. Please see the technical data section for proper cooling system capacities of each model.

#### 3.4.2 Water

Water can produce a corrosive environment in the cooling system, and the mineral content may permit scale deposits to form on internal cooling surfaces. Therefore, inhibitors must be added to control corrosion, cavitation, and scale deposits.

Chlorides, sulfates, magnesium and calcium are among the materials which make up dissolved solids that may cause scale deposits, sludge deposits, corrosion or a combination of these. Chlorides and/or sulfates tend to accelerate corrosion, while hardness (percentage of magnesium and calcium salts broadly classified as carbonates) causes deposits of scale. Water within the limits specified in *figure* #22 is satisfactory as an engine coolant when properly inhibited. Use of distilled water is preferred.

Materials	Parts per Million	Grains per Gallon
Chloride (Max.)	40	2.5
Sulfates (Max.)	100	5.8
Total Dissolves Solids		
(Max.)	340	20
Total Hardness (Max.)		
	170	10
	1100	

Figure #22

#### 3.4.3 Coolant Capacities

Use an ethylene glycol coolant (low silicate formulation) that meets the standard of either the GM 6038-N formulation (GM1899-M performance) or **ASTM D4985** requirements.

A 50% coolant water solution is recommended. Concentration over 70% are not recommended because of poor heat transfer capability, adverse freeze protection and possible silicate dropout. Concentrations below 30% offer little freeze, boil over or corrosion protection.

#### **IMPORTANT**

Never use automotive-type coolants (such as those meeting only ASTM D3306 or ASTM D4656). These coolants do not contain the correct additives to protect heavy-duty diesel engines. They often contain a high concentration of silicates and may damage the engine or cooling system.

ENGINE MODEL	COOLANT CAPACITY QUARTS (LITERS)		
04HN, 04HT	6.3 (6.0)		
06HT, T6HT, L6HR, T6HR	8.8 (8.5)		
Figure #23			

#### 3.4.4 Coolant Inhibitor

The importance of a properly inhibited coolant cannot be over-emphasized. A coolant which has insufficient or no inhibitors at all, invites the formation of rust, scale, sludge and mineral deposits. These deposits can greatly reduce the cooling systems efficiency and protection capabilities.

Recommended supplemental coolant inhibitors are a combination of chemical compounds which provide corrosion protection, cavitation suppression, pH controls and prevents scale. These inhibitors are available in various forms, such as liquid packages or integral parts of anti-freeze.

It is imperative that supplemental inhibitors be added to all engine systems. A pre-charge dosage must be used at the initial fill and the maintenance dosage used at each service interval. Serious damage will occur unless inhibitors are used. Some of the more common corrosion inhibitors are borates, nitrates and silicates.

Inhibitors become depleted through normal operation; additional inhibitors must be added to the coolant as required to maintain original strength levels. Refer *Figure #24* for proper concentrations of inhibitors.

	Min.	Max
	PPM	PPM
Boron (B)	1000	1500
Nitrite (NO <sup>2</sup> )	800	2400
Nitrates (NO <sup>3</sup> )	1000	2000
Silicon (Si)	50	250
Phosphorous (P)	300	500
PH	8.5	10.5

Figure #24

Do not use soluble oils or chromate inhibitors in engines. Detrimental effects will occur.

To properly check inhibitor concentrations it may be necessary to contact your local Service/Dealer for assistance. Refer to Parts Information Section to obtain the part number for the factory Coolant Analysis Kit. This kit can be purchased for a nominal fee for analyzing the conditions of the engine's coolant.

#### 3.4.5 Procedure for Filling Engine

During filling of the cooling system, air pockets may form. The system must be purged of air prior to being put in service. This is best accomplished by filling with a pre-mix solution up to the filler neck. Install the pressure cap, start and run engine until the temperature stabilizes at approximately  $160^{\circ} - 200^{\circ}$  F (71° - 93° C). During this warming process, you may see coolant coming from the overflow tube attached at the pressure cap location. This is a normal condition since the coolant expands as it heats up. When the overflow ceases, stop the engine.

To verify that the coolant is at a safe operating level, it's best to wait until the engine temperature drops to approximately 120°F (49°C), or lower, before removing the pressure cap. After the cap is removed, fill as necessary up to the bottom of the fill neck. **Caution:** Do not remove pressure cap while coolant is at normal operating temperatures. Possible personal injury could result from the expulsion of hot coolant.

#### 3.4.6 Cooling Water Supply (cooling loop)

This system is provided as part of the engine assembly. Components for the cooling water supply are selected to ensure adequate flow through the heat exchanger as required by the engine at a specific cooling water temperature. The cooling water supply is generally referred to as the "cooling loop". A typical cooling loop includes the following components as shown in Fig. 25.

The heat exchanger discharge line must be a minimum of one pipe size larger than the supply line. Discharge is to be made to an open waste cone as specified in NFPA-20.

**CAUTION:** Damage to the heat exchanger may result if cooling water plumbing (discharge) weight or stress is applied to the heat exchanger.

The solenoid valve may be omitted on vertical turbine pump installations where no static pressure exists in the heat exchanger supply line while the engine is not running. Each engine has a minimum requirement of cooling water flow. Correct flow through the heat exchanger is critical for maintaining the proper engine operating temperature.

Engine coolant temperature can be adversely affected by insufficient cooling water flow or excessive ambient temperature of the cooling water. See the technical data Section 5 for each engine model's minimum cooling water flow requirements at 60° F (16° C) and 95° F (35° C) at specified engine RPM ranges. Do not exceed cooling water pressure or maximum flow allowance for the heat exchanger

**NOTE:** Although engine operating temperature may appear normal, engine cooling may be compromised and possible engine damage will result if cooling water flow is reduced.



Figure #25

#### Key:

- 1 Indicating manual valves
- 2 Water strainers
- 3 Pressure regulators
- 4 Solenoid valve (DC) (on horizontal pumps)
- 5 Pressure gauges

#### 3.5 ELECTRICAL SYSTEM

3.5.1 Wiring Diagrams (Only with Engine Gauge Panel)

Run/Stop	Drawing	Description	Reference
Solenoid	No.	(DC Voltage)	Document
		NFPA-20 and	See
		UL/FM	Technical
ETR	C07671	engine gauge	Catalog
		panel	C131024
		-	

ETR = Energized to Run

Drawing No.	Description	Reference	
	(AC Voltage)	Document	
		See Technical	
C07651	Engine Jacket	Catalog	
	Water Heater	C131024	
Figure #26			

3.5.2 Checking Drive Belt Tension and Adjustment

All drive belts must be adequately tightened to secure that both the engine water pump and battery charging alternator (when fitted) are operating efficiently. Refer to *Figure #27*.



Figure #27

To adjust Belt Tension:

Check belt tension:

- Give at arrow must be .4"- .6" (10-15mm).

To increase tension of the water pump driving belts:

- Loosen alternator mounting bolts A and B.
- Adjust to proper belt tension.
- Tighten mounting bolts A and B.

#### 3.5.3 Speed Switch

In the event of an engine overspeed, the speed switch signals the main pump controller and also affects an engine shutdown. The OVERSPEED RESET (*figure# 8*) switch is included on the instrument panel. Should an overspeed condition occur, investigate the cause and make necessary corrections before placing engine back in service. The OVERSPEED RESET must be manually lifted to reset.

NOTE: This reset operation must be completed to allow a restart. If not, the engine will not start thru the main pump controller or manually.

#### OVERSPEED VERIFICATION

Hold the OVERSPEED VERIFICATION switch in the "up" position. This will provide the main pump controller with an overspeed signal and engine shutdown at 67% of the set overspeed RPM. Start the engine via the main pump controller; the speed switch will generate an overspeed signal and shutdown protecting both the engine and pump.

#### EXAMPLE

Rated Speed: 3000 RPM Overspeed Shutdown: 3600RPM (120% of 3000 RPM) Verification Shutdown: 2412 RPM (67% of 3000 RPM)

**CAUTION-**after verification of overspeed, lift the OVERSPEED RESET switch and reset the main pump controller to re-instate normal operation of the engine and speed switch.

#### 3.5.4 Magnetic Pick-Up

A magnetic pick-up, mounted in the flywheel housing, provides the input signal for the tachometer overspeed switch, and/or the main pump controller. There should be a 0.03" air gap between the top of the ring gear and the center of the magnetic pick-up. With one tooth centered in the magnetic pick-up hole, thread the pickup in until it touches the gear tooth and then back it out 1/2 turn. Tighten jam nut while holding the pickup in position. Reconnect to wiring harness.



Figure #28

#### 3.6 ENGINE SPEED ADJUSTMENT

A mechanical governor controls the engine speed. The governor is built into the fuel injection pump. All governors are adjusted to the rated speed at nameplate power or maximum allowed pump load before leaving Clarke. During Start-Up Inspection or when placing reconditioned units into service, some minor speed adjustment may be required. It is recommended that this adjustment be performed by the authorized Service Dealer representative.

To adjust the speed of the engine:

- A. Start engine by following the "Important" instructions on Page 9 and manual starting instructions on Page 10.
- B. Let the engine warm-up. Loosen the jam nut (A) (Fig. 29).
- C. While observing the instrument panel tachometer rotate the long adjustor clockwise to lower the RPM and counter clockwise to raise the RPMs, until desired speed is obtained (B) (shown in *Figure 29*).
- D. Holding secure the long adjustor with a wrench tighten the jam nut.
- E. Stop engine by following "To Stop Engine" on Page 12.



Figure #29

#### 4.0 MAINTENANCE SCHEDULE

#### **4.1 ROUTINE MAINTENANCE**

NOTE: The following Routine Maintenance schedule is based on an engine usage rate not exceeding 2 hours per month. Maintenance schedule complies with NFPA25 Requirements.

#### LEGEND:

- □ Check
- Clean
- ➢ Replace
- o Lubricate
- WEEKLY
  - □ Air Cleaner

- □ Battery
- Coolant Hoses
- Coolant Levels
- **Gooling Water Solenoid Valve**
- □ Exhaust System
- □ Fuel Tank
- □ General Inspection
- □ Governor Run-Stop Control
- Jacket Water Heater
- □ Lubrication Oil Level
- Operating Gauges
- □ Remove Water from Fuel Filter
- Run Engine
- □ Warning Light
- EVERY 6 MONTHS
  - ✤ Batteries
  - Battery Charging Alternator
  - □ Belts
  - ✤ Cooling Water Strainers
  - Driveshaft U-Joints
  - □ Fuel Lines
- EVERY 1 YEAR
  - ✤ Air Cleaner
  - Fuel Lift Pump Strainer
  - □ Coolant Inhibitor
  - □ Crankcase Vent System
  - Driveshaft U-Joints
  - ➢ Fuel & Oil Filters
  - □ Heat Exchanger Electrode
  - Lubricating Oil
  - □ Mounting Isolators
  - □ Wiring System

#### EVERY 2 YEARS

- > Air Cleaner
- Batteries
- ➤ Belts
- Coolant Hoses
- Coolant

IMPORTANT: Set main pump controller to "OFF" while servicing engine. Before turning the main pump controller to the "OFF" position, check with the maintenance and security supervisors to verify that all the departments concerned will be alerted of the temporary interruption of their fire protection equipment for normal maintenance or testing. Also, alert the local fire department in the event that the main pump controller is connected by silent alarm to headquarters. When servicing is complete, return main pump controller selector to "Automatic" position and the mode selector on the engine to "Automatic" position. Advise the appropriate personnel the engine has been returned to the "Automatic".

#### 5.0 TROUBLE SHOOTING

Consult Clarke Service Dealer or Factory. Service dealers can be located by going to our website: <u>www.clarkefire.com</u>.

#### 6.0 PARTS INFORMATION

#### 6.1 SPARE PARTS

To ensure best operation and efficiency of all engine components, always use genuine Clarke spare parts.

Orders should specify:

- Engine Model Number See Engine General
- Engine Serial Number Specification
- Part Number(s) Refer to Engine Maintenance Parts List section 6.2 or Parts Illustration in Technical Bulletin in C13886.

Contact numbers for spare parts:

• www.clarkefire.com

• Phone USA: (513) 771-2200 Ext. 427 (calling within USA)

- Phone UK: (44) 1236 429946 (calling outside USA)
- Fax USA: (513) 771-5375 (calling within USA)
- Fax UK: (44) 1236 427274 (calling outside USA)
- E-Mail USA: parts@clarkefire.com
- E-Mail UK: <u>dmurray@clarkefire.com</u>

#### 6.2 ENGINE MAINTENANCE PARTS LIST

ENGINE MODEL	OIL FILTER	FUEL FILTER PRIMARY	AIR FILTER
04HN, 04HT	41152002A	45310071A	C03396
06HT	41150066A	45310071A	C03281
TH6T, L6HR, T6HR	41150066A	45310071A	C03249

ENGINE MODEL	Cleaning	Air Filter	
	Agent	Oil	
All	C121158	C121157	
E: #20			

Figure #30

#### 7.0 OWNER ASSISTANCE

Consult Clarke Service Dealer or Factory. Service Dealers can be located by going to our website: <u>www.clarkefire.com</u>.

#### 8.0 WARRANTY

#### 8.1 GENERAL WARRANTY STATEMENT

The satisfactory performance of Clarke engines and the goodwill of owners / operators of Clarke engines are of primary concern to the Engine Manufacturer, the Engine Service Dealer and Clarke. All provide support of these products after final installation of the complete fire pump and sprinkler system.

Warranty responsibility involves both Clarke and the VM Motori service organizations worldwide.

The Engine Manufacturer (Motori) provides Warranty for the basic engine components and Clarke provides warranty on the accessories added to meet the NFPA-20 specifications and FM/UL certification requirements.

#### 8.2 CLARKE WARRANTY

All Clarke warranted components have warranty duration of 12 months beginning at the Start-up date of the fire pump system. The warranty coverage includes replacement of the part and reasonable cost of labor for installation. Components failed due to improper engine installation, transportation damage, or misuse is not covered under this warranty.

For additional warranty details, see the specific warranty statement "VM Motori Engine Warranty" on the following page. Also contact Clarke direct if you have any questions or require additional information.

Clarke is not responsible for incidental or consequential costs, damage or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty.

#### 8.3 VM MOTORI

#### **Terms of Coverage:**

#### Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new VM Series D700 Engines (referred to as Engine) manufactured or supplied by VM Motori (referred to as VM) which are used in standby pump applications operated in North American or Europe and delivered on or after January 1, 1995.

#### Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

#### Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized VM service outlet. Only new genuine parts or components supplied or approved by VM will be used. VM may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair. Repairs will be performed during normal business hours. The owner is responsible for the percentage of repair costs shown under WARRANTY PERIOD.

#### Warranty Period

The WARRANTY PERIOD begins on the date the Engine is delivered to the first retail purchaser, or put in use prior to sale at retail, whichever date occurs first, and ends at the time limits shown below:

WARRANTY PERIOD				
Warranty LimitationsItem(Whichever Occurs First)		Repair Charge To Be Paid By The Owner		
	Months		Parts	Labor
	Hours	Engine		
Engine	0 - 24	0 - 1,500	No Charge	No Charge
Accessories	0 - 12	0 - 1,500	No Charge	No Charge

#### **Service Supplies**

The cost of service supplies such as coolant, oil and filters which are not reusable due to needed repairs is covered by this warranty.

#### Like Replacement Engine

Engine(s) supplied by VM as a replacement for an Engine still under warranty will assume the identity of the Engine being replaced and be entitled to the remaining warranty coverage.

#### **Mechanic's Travel Expenses**

VM will pay reasonable travel expenses for the repairing mechanic to travel to and from the repair site.

#### This Warranty Does Not Cover:

**Repairs Due To Accidents, Misuse, Storage Damage, Negligence Or Certain Modifications** 

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding VM specifications, are not covered by this warranty.

#### **Engine Removal And Reinstallation**

Labor and material costs for engine removal and reinstallation, when necessary to make a warranty repair, are not covered by this warranty.

#### **Non-VM Supplied Components**

VM is not responsible for repair of components and/or assemblies which are manufactured or supplied by another manufacturer, such as power take-offs, intake and exhaust systems. Such items are covered by the equipment manufacturer.

#### Maintenance

VM is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services or the failure to use fuel, oil, lubricants and coolant meeting VM-recommended specifications. Performance of required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. See the Operator's Guide for full details.

#### **Incidental or Consequential Damages**

VM is not responsible for incidental or consequential costs or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty, such as communication expenses, meals, lodging, overtime, towing, loss of use of the Engine or equipment, loss of time, inconvenience, cargo loss or damage, and other similar costs and expenses.

#### **Other Limitations**

The performance of REPAIRS is the exclusive Owner's remedy under this warranty. VM does not authorize any person to assume or create for it any other obligation or liability in connection with the Engine.

THIS WARRANTY IS THE ONLY WARRANTY APPLICABLE TO THE ENGINE AS USED IN STAND-BY PUMP APPLICATIONS. VM MOTORI MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. VM MOTORI SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

VM Motori S.p.A. Via Ferrarese, 29 44042 Cento – (Ferrara) Italy Tel: (051) 6837890Fax: 6837702Telex: 511642

#### 9.0 INSTALLATION & OPERATION DATA (See Technical Catalog C131024)

10.0 WIRING DIAGRAMS (See Technical Catalog C131024)

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