INTRODUCTION

We would like to thank you for buying an FPT product, and compliment you on your choice of engine. Before you carry out any operation involving the engine or its fittings, please read the contents of this manual carefully; compliance with the instructions provided in the manual is the best way to guarantee trouble-free, long term operation of the engine.

The contents of this manual refer to the standard configuration of the engine, and the illustrations are purely indicative. Some instructions are provided by giving the sequence of operations to be carried out in order to allow the engine and/or its fittings to perform in a certain way. In some cases they will be dependent on the configuration of the commands and the set-up of the generator set on which the engine is installed; for any points that differ from the contents of this manual, please consult the instructions provided by the generator set Manufacturer or a specific manual.

The information provided below was current at the date of publication. The Manufacturer reserves the right to make modifications at any time without prior notice, for technical or commercial reasons or to update the engines to comply with legal requirements in the various Countries. The Manufacturer declines all liability for any errors or omissions.

Please remember that the FPT Technical Service Network is available to offer you its experience and professional skills, wherever you may be.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL INFORMATION</strong></td>
<td>3</td>
</tr>
<tr>
<td>Guarantee</td>
<td>3</td>
</tr>
<tr>
<td>Spare parts</td>
<td>3</td>
</tr>
<tr>
<td>Liability</td>
<td>3</td>
</tr>
<tr>
<td>Safety</td>
<td>3</td>
</tr>
<tr>
<td>Safety warning symbols</td>
<td>4</td>
</tr>
<tr>
<td>Engine technical data</td>
<td>5</td>
</tr>
<tr>
<td>Signs</td>
<td>8</td>
</tr>
<tr>
<td><strong>USE</strong></td>
<td>9</td>
</tr>
<tr>
<td>Preliminary checks</td>
<td>9</td>
</tr>
<tr>
<td>For proper use of the engine</td>
<td>9</td>
</tr>
<tr>
<td>Interconnection electrical unit</td>
<td>10</td>
</tr>
<tr>
<td>Special warnings</td>
<td>13</td>
</tr>
<tr>
<td>Run-in</td>
<td>14</td>
</tr>
<tr>
<td><strong>CHECKS AND MAINTENANCE</strong></td>
<td>15</td>
</tr>
<tr>
<td>Maintenance personnel</td>
<td>15</td>
</tr>
<tr>
<td>Accident prevention</td>
<td>15</td>
</tr>
<tr>
<td>Refilling</td>
<td>16</td>
</tr>
<tr>
<td>Maintenance schedule</td>
<td>19</td>
</tr>
<tr>
<td>Frequency</td>
<td>19</td>
</tr>
<tr>
<td>Requirements</td>
<td>20</td>
</tr>
<tr>
<td>Checks (in period of use)</td>
<td>21</td>
</tr>
<tr>
<td>Periodic maintenance - how to proceed</td>
<td>26</td>
</tr>
<tr>
<td>Extraordinary maintenance - how to proceed</td>
<td>34</td>
</tr>
<tr>
<td>Moving the engine</td>
<td>36</td>
</tr>
<tr>
<td>Disposal of waste</td>
<td>36</td>
</tr>
<tr>
<td><strong>LONG PERIODS OF INACTIVITY</strong></td>
<td>37</td>
</tr>
<tr>
<td>Preparing the engine for a long period of inactivity</td>
<td>37</td>
</tr>
<tr>
<td>Restarting the engine after a long period of inactivity</td>
<td>38</td>
</tr>
<tr>
<td><strong>ENGINE MALFUNCTIONS</strong></td>
<td>39</td>
</tr>
<tr>
<td><strong>BEHAVIOUR IN EMERGENCY</strong></td>
<td>40</td>
</tr>
</tbody>
</table>
GENERAL INFORMATION

GUARANTEE
In order to ensure that your engine gives the best possible performance and to take advantage of the FPT guarantee, you must follow the indications provided in this publication with high attention; failure to do so may result in invalidation of the guarantee.

SPARE PARTS
Always use Original FPT Spare parts. This is essential to keep the engine in original running order. The use of non-original spare parts will not only invalidate the guarantee, but will mean that FPT will not be considered liable in any way during the whole working life of the engine.

LIABILITY
The Manufacturer will only be considered liable subject to performance of the control and maintenance operations indicated and described in this manual; to this effect, proof that these operations have been performed must be provided. Any extraordinary maintenance operations that may be necessary must be carried out by qualified technicians from Workshops in the FPT Network, using the instruments and equipment provided for the purpose.

SAFETY
The following information is intended to encourage caution when using the engine, so as to avoid damage to persons or property as a result of improper or incorrect behaviour.

- The engines must only be used for the purposes indicated by the Manufacturer.
- Any tampering, modification and use of non-original spare parts may compromise proper operation and safe use of the engine; never, under any circumstances make modifications to the wiring and to the units equipping the engine, or connect them to other power systems.
- Pay particular attention to moving parts of the engine, to high temperature components and to circuits containing pressurised fluids; its electrical equipment houses electrical currents and voltage.
- The exhaust fumes produced by the engine are bad for your health.
- The engine must be handled using suitable lifting tackle, making use of the U-bolts provided on the engine for that purpose.
- The engine must not be started up and used until the generator set in which it installed has satisfied all necessary safety requirements, or until the generator set has been guaranteed to comply with local laws and regulations.
- The operations required to guarantee the best possible use and preservation of the engine must only be carried out by persons of proven experience, equipment with tools considered suitable by FPT.

For the purpose of safety, further recommendations are given in the CHECKS AND MAINTENANCE section.
SAFETY WARNING SYMBOLS
You will find these symbols on the following pages; follow the instructions to which they refer, for your own safety and that of your engine.

Risk of injury: failure to comply with these instructions can result in the risk of serious injury.

Risk of serious damage to the engine: the partial or total non-observance of these instructions could cause serious damage to the engine and may nullify the warranty.

General risk: combines the risks of both the signs described above.

Safeguarding the environment: indicates the correct behaviour so that vehicle use is as environmentally friendly as possible.
**ENGINE TECHNICAL DATA**

The technical code and serial number are indicated on a plate, which is located on different parts of the engine, according to the model: flywheel casing, tappet cover, other.

<table>
<thead>
<tr>
<th>Code</th>
<th>NF67TE8W.S550</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine family</td>
<td>F4</td>
</tr>
<tr>
<td>Cycle</td>
<td>Diesel 4-stroke</td>
</tr>
<tr>
<td>Number and arrangement of cylinders</td>
<td>6, in line</td>
</tr>
<tr>
<td>Bore x stroke</td>
<td>104 x 132 mm</td>
</tr>
<tr>
<td>Total displacement</td>
<td>6,728 cm³</td>
</tr>
<tr>
<td>Air system</td>
<td>Turbocharged - with intercooler</td>
</tr>
<tr>
<td>Injection type</td>
<td>Direct - high pressure pump supply and common rail system</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>17.5 : 1</td>
</tr>
<tr>
<td>Cooling</td>
<td>Liquid</td>
</tr>
<tr>
<td>Engine direction of rotation</td>
<td>Anticlockwise (seen from flywheel side)</td>
</tr>
<tr>
<td>Dry weight</td>
<td>~530 kg</td>
</tr>
</tbody>
</table>

**Electrical system**

<table>
<thead>
<tr>
<th>24 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric starter motor</td>
</tr>
<tr>
<td>- Maximum output power</td>
</tr>
<tr>
<td>Alternator</td>
</tr>
<tr>
<td>- Output</td>
</tr>
</tbody>
</table>

**Performance (*)**

<table>
<thead>
<tr>
<th>F4HFA615A*D001</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Hz Stand-by 236 kWm (net) @ 1500 rpm</td>
</tr>
<tr>
<td>60 Hz Stand-by 255 kWm (net) @ 1800 rpm</td>
</tr>
<tr>
<td>Prime 215 kWm (net) @ 1500 rpm</td>
</tr>
<tr>
<td>Prime 231 kWm (net) @ 1800 rpm</td>
</tr>
</tbody>
</table>

(*)Net power to the flywheel in compliance with ISO 8528. Test conditions: temperature 25 °C; atmospheric pressure 100 kPa; relative humidity 30%.

---

Any alteration of the above mentioned characteristics is strictly prohibited, penalty invalidation of the guarantee and absence of all liability on the part of FPT.
NF67TE8W.S550

NF67TE8W.S550
**NF67TE8W.S550**


**NF67TE8W.S550**

SIGNS
Certain warning signs are affixed to the engine by the Manufacturer, and their meanings are indicated below.

N.B. The signs with an exclamation mark on them underline a potential danger.

- **Lifting point (engine only).**

- **Fuel Cap**  
  (on the fuel tank, if there is one).

- **Oil Cap.**

- **Oil dipstick.**

- **Danger of burning:**  
  Expulsion of hot water under pressure.

- **Danger of burning:**  
  Presence of high temperature parts.

- **Danger of fire:**  
  Fuel present.

- **Danger of impact or catching on moving parts:**  
  Presence of fans, pulleys, belts or the like.
**USE**

**PRELIMINARY CHECKS**

Before starting the engine every time:

- Check the level of technical fluids (fuel, engine oil and coolant), and top-up if necessary.
- Make sure that the air intake filter is not obstructed or clogged and check, at the same time, that the visual indicator (1) on the filter is not showing the “red” signal. The air filter clogging visual indicator (1) signals when it is necessary to carry out maintenance in order to protect and optimize filter operation. The sensor (1) remains locked in the alarm position (“red”) until it is reset.
- Make sure that the batteries are efficient and that the terminals are correctly connected.

**Note:** the required procedures for filter cleaning are specified in the CHECKS AND MAINTENANCE section.

**FOR PROPER USE OF THE ENGINE**

- The running speed and power values must comply with the specifications on the technical and commercial documentation.

During use, periodically check that:

- The engine coolant temperature does not reach the alarm threshold.
- The oil pressure remains within normal values.

- Particular attention must be paid to engines that equip the emergency generating units for which frequent efficiency checks are required in order to guarantee their prompt start in all cases when required.

**CAUTION!**

Make sure that no fuel vapours or gasses are present in the area in which the engine should be operated. Ensure that closed areas are adequately ventilated and fitted with a suitable exhaust extraction system.
INTERCONNECTION ELECTRICAL UNIT

In order to allow the unit's correct electrical functioning, an interconnection unit has been fitted to the engine. The engine electronic control system and the power unit system depend from the aforesaid interconnection unit.

Some indications relating to its components and functions controlled by programming commutators are reported here following.
Relay
K1  ATS intelligent sensor
K2  After run B
K3  Run
K4  Starter
K5  SCR heating
K6  Fuel filter heating
K7  Pre-fuel filter heating
K8  Starter control
CN1  Diagnose

Engine speed and accessory functions control
Programming of the functions here following is possible commuting the position of the JP switches.

**JP1 (Engine speed selection) +JX (Connector: Engine speed selection)**

<table>
<thead>
<tr>
<th>RPM</th>
<th>JP1</th>
<th>JX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 rpm. (50 Hz)</td>
<td><img src="image1" alt="JP1 Diagram" /></td>
<td><img src="image2" alt="JX Diagram" /></td>
</tr>
<tr>
<td>1800 rpm. (60 Hz)</td>
<td><img src="image3" alt="JP1 Diagram" /></td>
<td><img src="image4" alt="JX Diagram" /></td>
</tr>
<tr>
<td>IDLE</td>
<td><img src="image5" alt="JP1 Diagram" /></td>
<td><img src="image6" alt="JX Diagram" /></td>
</tr>
</tbody>
</table>

**JP2: Mode selection**

<table>
<thead>
<tr>
<th>Mode</th>
<th>JP2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic position</td>
<td><img src="image7" alt="JP2 Diagram" /></td>
</tr>
<tr>
<td>Working position (default)</td>
<td><img src="image8" alt="JP2 Diagram" /></td>
</tr>
<tr>
<td>JP3: Cold start heater relay</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--</td>
</tr>
<tr>
<td>Connected</td>
<td>JP3</td>
</tr>
<tr>
<td></td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Not connected (default)</td>
<td>JP3</td>
</tr>
<tr>
<td></td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>JP4: Cold start lamp</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected</td>
<td>JP4</td>
</tr>
<tr>
<td></td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Not connected (default)</td>
<td>JP4</td>
</tr>
<tr>
<td></td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>JP5: It CAN line</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected</td>
<td>JP5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Not connected (default)</td>
<td>JP5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SPECIAL WARNINGS

Coolant circuit
When the engine is running, regularly check that the engine coolant temperature does not reach the alarm threshold. In case the temperature detected is excessive, disconnect the load and stop the engine to check the cooling circuit status.

If the temperature is considered too high, reduce speed and stop to check the state of the cooling system circuits. Check the following:

a) the tension of the auxiliary member drive belt;
b) the thermostatic valve’s efficiency;
c) the conditions of the heat exchanger (to be cleaned if necessary).

Lubrication circuit
Regularly check that the oil pressure keeps within normal values. In case the value detected is too low, check the oil level and refill if necessary following the instructions reported in the CHECKS AND MAINTENANCE section. If the condition persists, contact the Authorised Service Centre.

Fuel circuit
Avoid using the engine with small reserve of fuel in the fuel tank. Thus the vapour condensation is encouraged and makes the engine more likely to inhale dirt or air, resulting in engine stoppage.

CAUTION!
When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns. Open the filler cap of the coolant tank only when the engine is cold.

CAUTION!
While refuelling, always pay attention to ensure that no solid or liquid pollutants enter the fuel tank; remember that smoking and live flames are prohibited during refuelling.

CAUTION!
Never loose the high pressure fuel circuit connectors in any way.

Air intake and exhaust gas circuits
Inspect the cleanliness of the air intake circuit on a regular basis. The maintenance intervals indicated in this manual vary according to the conditions in which the engine is operated. In particular dusty environments it is necessary to carry out maintenance within more frequent intervals than indicated in the CHECKS AND MAINTENANCE section.
Electric starter system
Check periodically the cleanliness and efficiency of the batteries, particularly during winter, as indicated in the CHECKS AND MAINTENANCE section. Top up if necessary. In the event of battery replacement, observe the characteristics contained in the ENGINE TECHNICAL DATA chapter.

**CAUTION!**
Visually check that the exhaust circuit is not obstructed or damaged to prevent the formation of noxious and harmful fumes inside the ducts.

**RUN-IN**
Thanks to modern engine design technology, no particular run-in procedure is required. However, for the first 50 hours, it is not recommended to operate the engine at high power for long periods.

Contact a specialised workshop and check battery and recharging system efficiency if the voltmeter indicates a voltage below 11 V (for 12 V rated systems).

The batteries contain an acid solution that will burn the skin and corrode clothing; when checking them, always wear protective clothing, gloves and goggles, do not smoke or use live flames in the vicinity, and make sure that the room they are housed in is adequately ventilated.
CHECKS AND MAINTENANCE

MAINTENANCE PERSONNEL

The engine control and maintenance operations described in the following chapter require training, experience and compliance with current safety regulations. For this reason, the following operations must be carried out by special technicians.

- **Checks in periods of use**: by workshop personnel or if necessary by the generator set user.
- **Periodic maintenance**: by qualified personnel using suitable equipment and adequate means of protection.
- **Extraordinary maintenance**: by qualified personnel from Authorised Service Centres who have detailed technical information and specific equipment.

The most qualified Assistance Centres are those which make up the FPT Technical Assistance Network.

ACCIDENT PREVENTION

- Always wear heavy-duty footwear, gloves and suits.
- Never wear loose, flapping garments, rings, bracelets and/or necklaces close to engines or moving parts.
- Always wear protective gloves and goggles when:
  - filling up batteries with acid solution
  - check cleanliness of battery clamps and terminals
  - refilling with inhibitors or antifreeze
  - replacing or topping up lubricant (hot engine oil may cause burns and scalds. Only carry out these operations when the oil has dropped to a temperature of below 50°C).
- While working in the engine compartment, pay particular attention on movements, to avoid contact with moving parts and high temperature components.
- Wear safety goggles while using compressed air jets. Maximum air pressure used to clean is 200 kPa (2 bar, 30 psi, 2 kg/cm²).
- Wear a protective helmet when working in an area were there are suspended loads or systems installed at/above head-height.
- Use protective hand creams.
- Immediately replace wet gloves.
- Always keep the engine clean removing oil, fuel and coolant stains.
- Store cloths in flame-proof containers.
- Do not leave external objects on the engine.
- Use suitable, safe containers for used oil.
- Once the repair activities are completed, take the necessary steps to stop engine air suction in case of uncontrolled increase in engine speed after start-up.

Do not carry out maintenance operations when the electric power supply is turned on: always check to ensure that the appliances are properly earthed. During diagnosis and maintenance operations, make sure that your hands and feet are dry, and whenever possible use insulating stands.
REFILLING

The conditions that cause an emergency generator set to start can occur suddenly. While performing checks and maintenance, comply strictly with the requirements indicated by the Manufacturer of the generator set and by the Fitter of the electric generation system to ensure maximum safety for maintenance personnel.

(1) The quantities refer to the engine in standard configuration. The coolant should comply with ASTM D-6210 standard. Concentrated coolants should be used as a 50% mixture in water. FPT suggest to use original PETRONAS products.

(2) see 'Main oil features'; recommended brand: PETRONAS
The consumption of oil is considered acceptable up to a quantity of 0.1% of fuel consumption.

(3) The quantities indicated refer to the first filling only and are relative to the engine, oil sump and filter refilling.

(4) Fuel tank not supplied by FPT. Consult supplier / generator set manufacturers data.
Only use fuels which comply with ASTM D975 or EN 590 international standards.

(5) The quantities shown are relative to the total capacity of the G-Drive including engine capacity.

<table>
<thead>
<tr>
<th>Parts to be supplied</th>
<th>NF67TE8W.S550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>litres (kg)</td>
</tr>
<tr>
<td>Cooling circuit: (*)</td>
<td></td>
</tr>
<tr>
<td>motor (4)</td>
<td>10.5 (9.45)</td>
</tr>
<tr>
<td>G-Drive (5)</td>
<td>25.5 (22.95)</td>
</tr>
<tr>
<td>Lubrication circuit: (2)(3)</td>
<td></td>
</tr>
<tr>
<td>total capacity</td>
<td>17.2 (15.48)</td>
</tr>
<tr>
<td>Periodic changing:</td>
<td></td>
</tr>
<tr>
<td>oil sump at minimum level</td>
<td>8 (7.2)</td>
</tr>
<tr>
<td>oil sump at maximum level</td>
<td>12 (10.8)</td>
</tr>
<tr>
<td>Fuel tank (4)</td>
<td>(-)</td>
</tr>
</tbody>
</table>

(*) It is prohibited to mix fluids of different brands and origins inside the circuit.
## Main oil features

<table>
<thead>
<tr>
<th>Oil Quality</th>
<th>SAE grade</th>
<th>Base Stock</th>
<th>International Spec.</th>
<th>Fuel Sulphur Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium</td>
<td>10W-40</td>
<td>Semi Synthetic</td>
<td>API CJ-4 / ACEA E6/E9</td>
<td>&lt; 500 ppm</td>
</tr>
<tr>
<td>Cold Climate</td>
<td>5W-30</td>
<td>Synthetic</td>
<td>API CH-4 / CI-4/CJ-4 ACEA E4/E6</td>
<td>&lt; 500 ppm</td>
</tr>
<tr>
<td>Standard</td>
<td>15W-40</td>
<td>Mineral Semi</td>
<td>API CI-4 / CH-4 ACEA E7 / E5</td>
<td>&lt; 1,000 ppm</td>
</tr>
<tr>
<td></td>
<td>10W-30</td>
<td>Synthetic Semi</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10W-40</td>
<td>Synthetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low specs</td>
<td>15W-40</td>
<td>Mineral</td>
<td>API CF, ACEA E2/E3</td>
<td>&lt; 1,000 ppm</td>
</tr>
<tr>
<td></td>
<td>10W-30</td>
<td></td>
<td>API CF, ACEA E2/E3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10W-40</td>
<td></td>
<td>API CE</td>
<td></td>
</tr>
<tr>
<td>Not Allowed</td>
<td>Monograde</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Interval change

<table>
<thead>
<tr>
<th>Engine/ODI</th>
<th>Premium &amp; Cold Climate</th>
<th>Standard</th>
<th>Low specs</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEF</td>
<td>600 h or 12 months*</td>
<td>500 h or 12 months</td>
<td>300 h or 12 months</td>
</tr>
</tbody>
</table>

* On PowerGeneration application the interval can be extended to 800h pending on field test result and specific selected lube oil be used (high performance, premium quality).
Coolant refilling

For the initial engine start-up and in the cases in which the refilling of the cooling circuit is required with a considerable quantity of coolant, proceed as follows:

- Refill the engine and the exchanger until the exchanger is completely filled.
- With the coolant filler plug open, start the engine and let it idle for approx. 1 minute. This helps to completely bleed the air contained in the cooling circuit.
- Stop the engine and then top up with coolant if necessary.

The failure to observe the aforesaid procedure does not guarantee the presence of the correct quantity of coolant in the engine.

Refuelling

Use only diesel oil in accordance with ASTM D975 or EN 590 standard normally commercially available. Fuel additives are not recommended.

Use of additives can limit the guarantee performance offered for the equipment.

CAUTION!

Pay maximum attention when refuelling, making sure that solid or liquid pollutants do not enter the tank; please remember that smoking is prohibited while refuelling. The couplings of the fuel circuit under high pressure must not be loosened under any circumstances.

Low temperature diesel

At low temperatures the degree of fluidity of the diesel can become low due to the separation of the paraffin resulting in the filters becoming clogged.

ASTM D975 or EN590 specifications distinguish different classes of diesel fuel, identifying the characteristics of those best suited to low temperatures.

It is entirely up to the Oil companies to comply with these regulations, which foresee that fuels suited to the climactic and geographic conditions of the various Countries be distributed.
MAINTENANCE SCHEDULE

The maintenance intervals indicated below take into account the typical working factors for various types of engine use; the most suitable interval for maintenance operations for the various applications will be indicated by the maintenance staff, according to the way and working conditions in which the engine is used.

FREQUENCY

<table>
<thead>
<tr>
<th>Controls in periods of use</th>
<th>Frequency</th>
<th>Hours</th>
<th>Temporal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine lubricant oil level check</td>
<td>-</td>
<td>Daily</td>
<td></td>
</tr>
<tr>
<td>Engine coolant level check</td>
<td>-</td>
<td>Daily</td>
<td></td>
</tr>
<tr>
<td>Engine visual inspection *</td>
<td>50</td>
<td>15 days</td>
<td></td>
</tr>
<tr>
<td>Air filter and housing cleanness check *</td>
<td>-</td>
<td>1 month (1)</td>
<td></td>
</tr>
<tr>
<td>Tension and condition check of auxiliary members' belt *</td>
<td>300</td>
<td>6 months</td>
<td></td>
</tr>
<tr>
<td>Electrolyte level in batteries check *</td>
<td>300</td>
<td>6 months</td>
<td></td>
</tr>
<tr>
<td>Exhaust duct(s) condition check</td>
<td>-</td>
<td>6 months</td>
<td></td>
</tr>
<tr>
<td>Blow-by system condition check *</td>
<td>300</td>
<td>6 months</td>
<td></td>
</tr>
</tbody>
</table>

The maintenance intervals indicated below take into account the typical working factors for various types of engine use; the most suitable interval for maintenance operations for the various applications will be indicated by the maintenance staff, according to the way and working conditions in which the engine is used.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Periodic maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours</td>
<td>Temporal</td>
</tr>
<tr>
<td>Water drainage from the fuel pre-filter*</td>
<td>50</td>
</tr>
<tr>
<td>Condensed water drainage from fuel tank *</td>
<td>50</td>
</tr>
<tr>
<td>Heat exchanger (radiator) cleaning</td>
<td>-</td>
</tr>
<tr>
<td>Turbocharger visual inspection</td>
<td>-</td>
</tr>
<tr>
<td>Engine lubricant oil replacement *</td>
<td>600</td>
</tr>
<tr>
<td>Lubricant oil filter replacement *</td>
<td>600</td>
</tr>
<tr>
<td>Fuel pre-filter replacement*</td>
<td>600</td>
</tr>
<tr>
<td>Fuel filter replacement *</td>
<td>600</td>
</tr>
<tr>
<td>Blow-by filter replacement *</td>
<td>900</td>
</tr>
<tr>
<td>Air filter replacement *</td>
<td>1,200</td>
</tr>
<tr>
<td>Auxilary members' belt replacement</td>
<td>1,200</td>
</tr>
</tbody>
</table>

1. In any case, whenever the indicator is Red.
2. See Main oil features table for recommended products & adjusted service interval.
3. EN 590; ASTM D975
4. Valid only for the recommended fluids.
5. Interval to be halved for ambient condition with high dust concentration.
6. Coolant according to ASTM D 6210 specification; 50% mixture in water in case of concentrated product.
7. Only use filters with the following specifications:
- filtering efficiency: 95% @ 4 μm; 99.5% @ 6 μm
- maximum flow rate: 380 l/h
- operating temperature: -30 °C to 100 °C
- collapse pressure: 1000 kPa
8. Only use pre-filters with the following specifications:
- degree of filtering: 25 μm > 70%, 40 μm > 90%
- nominal flow rate: 100 l/h
- operating temperature: -25 °C to 90 °C
- collapse pressure: >3 bar
* Intervention @ frequencies expressed by hours and Temporal (whichever occurs first).

<table>
<thead>
<tr>
<th>Extraordinary maintenance</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours</td>
</tr>
<tr>
<td>Valves/rocker arms clearance</td>
<td>3,000</td>
</tr>
<tr>
<td>adjustment *</td>
<td></td>
</tr>
<tr>
<td>Engine coolant replacement *</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Intervention @ frequencies expressed by Hours and Temporal (whichever occurs first).

**Requirements**

- Do not disconnect the batteries with the engine running.
- Do not carry out arc welding operations in the vicinity of the engine without first removing electrical cables.
- After each maintenance operation involving disconnection of the battery/batteries, make sure that the terminals have been properly locked onto the poles.
- Do not use battery chargers to start the engine.
- Disconnect the on-board network battery/batteries when recharging.
- Do not paint the appliances, components and electrical connectors equipping the engine.
- Disconnect the battery/batteries before any electrical operations.
- Contact the Manufacturer before installing electronic equipment on board.

The extraordinary maintenance operations described hereunder fall within the exclusive competence of manufacturer’s personnel or specialised personnel having proper working tools and adequate protection devices. The procedure and modality for carrying out these operations are illustrated in the FPT Technical and Repair Manual.

Do not execute any operation which may change the high pressure fuel pump’s calibration.

The high pressure fuel pump’s calibration has been carried out in phase of engine system test based on its final use or destination.
CHECKS (IN PERIOD OF USE)

Engine lubricant oil level check

The check must be executed when the engine is disconnected and possibly cool.
Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- Make sure the generator set is on a flat surface.
- Use the oil dipstick to check that the lubricant oil level is between the "Min" and "Max" limits.
- Whether it should be difficult to make the evaluation, proceed cleaning the oil dipstick using a clean cloth with no rag grinding and put it back in its slot. Draw it off again and check the level.
- If the level is insufficient, it is necessary to top up with lubricant oil which meets the international standards, as indicated in the REFILLING table. Remove the lubricant oil cap (1) and pour engine lubricant oil through the hole.
- Use the oil dipstick to check that the lubricant oil level in the oil sump (2) does not exceed the "Max" limit.

Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction.
Engine coolant level check

Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- Remove the pressurization cap from the expansion tank.
- Check that the coolant in the expansion tank is above the minimum level.
- If necessary, top up the expansion tank with Fluids, as contained in the REFILLING table. Do not fill the expansion tank to the brim.
- When the engine is cold, make sure that the coolant level is a few centimetres below the filling hole.

In the event of an externally located level indicator as regards the heat exchangers, proceed with the top up operation by making sure that the coolant does not overfill the internal volume of the exchanger in order to allow the expansion of coolant volume during increases in temperature.

If the refill operations occur frequently a diagnosis of the cooling circuit is necessary.

CAUTION!

When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns.
Open the filler cap of the coolant tank only if necessary and only when the engine is cold.

Engine visual inspection

It is a good habit to execute, before engine start, a series of simple checks that might represent a valid warranty to avoid inconveniences, even serious, during engine running. Such checks are usually up to the operators and to the equipment’s users.

- Level controls and checks of any eventual leakage from the fuel, cooling and lubricating circuits.
- Notify the maintenance if any inconvenience is detected or if any filling is necessary.

After engine start and while engine is running, proceed with the following checks and controls:

- Check presence of any eventual leakage from the fuel, cooling and lubricating circuits.
- Verify absence of noise or unusual rattle during engine working.
- Verify, using the equipment devices, the prescribed pressure temperature and other parameters.
- Visual check of fumes (colour of exhaust emissions)
- Visual check of cooling liquid level, in the expansion tank.

If the refill operations occur frequently a diagnosis of the cooling circuit is necessary.
Air filter and housing cleanness check

Only proceed when the engine is not running.

- Remove the cover (4) of the air filter after having undone the two quick release clips (3).
- Remove the filter element (5); make sure that dust does not enter the sleeve during this operation.
- Make sure there are no impurities. Otherwise, clean the filter element according to the instructions provided below.
- Blow dehumidified compressed air on the filtering element, working from the inside outwards (maximum pressure 200 kPa).
- Check the condition of the air filter before refitting it. Replace it if broken or torn.
- Check the condition of the gasket at its base.
- Some filter systems are fitted with a second filter element (1) which does not require cleaning.
- Position the filter element (5) in its seat.
- Refit the cover (4) of the air filter and lock it using the two quick release clips (3).

Do not use detergents or diesel to clean the air filter. Never strike the filter element with tools. The imprecise assembly of the air filter may result in the intake of unfiltered air and therefore cause serious damage to the engine.
Tension and condition check of auxiliary member’s belt

Only proceed when the engine is not running and is at low temperature so as not to run the risk of burns.

- Check that the belt (2) is not worn, soiled with oil or fuel, or showing signs of tears. Otherwise replace the belt if necessary.
- Use a ½ inch square wrench to check the efficiency of the automatic belt tensioner (1).

**CAUTION!**

When the engine is off, but still hot, the belt may start to move without warning. Wait for the engine temperature to decrease to prevent serious danger of an accident.
Electrolyte level in batteries check

Place the batteries on a level surface, then proceed as follows.

- Visually check that the fluid level is between the “Min” and “Max” limits; in the absence of references, check that the fluid covers the Lead plates inside the elements.
- Top up with distilled water only those elements in which the level is below the minimum.
- Contact specialised technical staff if the battery needs recharging.
- Have the efficiency of the battery recharging system tested if a voltage of less than 22 V is detected with the engine running.
- On this occasion, make sure that the terminals and clamps are clean, properly locked and protected by vaseline.

**ATTENTION!**

If all the elements of the battery need refilling with a considerable quantity of distilled water, contact specialised technical personnel in order to perform a diagnostic check on the efficiency state of the recharge system and battery.

**ATTENTION!**

The batteries contain sulphuric acid which is highly caustic and corrosive; always wear protective gloves and goggles when topping them up. Whenever possible it is recommended that this control be carried out by specialised personnel. Do not smoke or use live flames near the batteries during the control, and make sure that the room you are working in is adequately ventilated.

Some types of battery have a single cover for all the inspection plugs. To access the elements, use a lever as shown in the figure.
Exhaust duct(s) condition check
Visually check that the exhaust gas system is not blocked, corroded or damaged.
In the event of any problems, perform the operations necessary to restore the exhaust duct.

Blow-by system condition check
Only proceed when the engine is not running.
The filter at issue serves to collect, filter and condense lubrication oil vapours.
The filter body (1) contains filter cartridges (2).
Inspection of the filter elements (2) is performed by disassembling the cover (4) after having unscrewed the fixing screws (5) and extracted the cartridges (2).

PERIODIC MAINTENANCE - HOW TO PROCEED

Water drainage from the fuel pre-filter
The high risk of refuelling with fuel that is polluted by foreign bodies and water makes it advisable to carry out this control every time you refuel.
Proceed with the engine stopped.

- Place a container under the pre-filter to collect the fluid.
- Unscrew the tap plug (3) in the bottom part of the filter; in some lay-outs the plug includes a sensor to detect the presence of water in the diesel.
- Drain off liquid until only “diesel” can be seen.
- Close the plug again, tightening it completely by hand.
- Dispose of the drained fluids according to current requirements.
Condensed water drainage from fuel tank

- Proceed to the drainage / water extraction, condensation and impurities from the fuel tank following the instructions in the manual provided by the manufacturer of the generator.
- Proceed as required by structure or location of the tank: engines that operate in harsh environments and conditions and / or which are supplied by drums or canisters, require more care when cleaning the tank.

The components of the common rail system will be rapidly damaged if the fuel contains water or impurities. Immediately perform the operation on the pre-filter to drain the water present in the fuel supply circuit.
Heat exchanger (radiator) cleaning
Check that the air intake surfaces of the radiators are free of impurities (dust, mud, straw etc.).
Clean them if necessary using compressed air or steam.

Turbocharger visual inspection
Only proceed when the engine is not running. Visually check that the turbine and compressor impellers and the relative inlet and outlet ducts are not obstructed or damaged, otherwise replace them.

Engine lubricant oil replacement
Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

- Place a suitable container for collecting the spent oil under the oil sump (2) next to the lubricant oil drain plug.
- Unscrew the lubricant oil drain plug; afterwards extract the oil level dipstick and remove the lubricant oil cap (1) to assist the flow of the engine lubricant oil.
- Wait until the oil sump (2) has completely emptied, then retighten the lubricant oil drain plug.
- Proceed with the refilling operation through the hole situated on the tappet cover, using lubricant oil that meets the international standards as indicated in the REFILLING table.
- Use the oil dipstick to check that the lubricant oil level does not exceed the "Max" limit.
- Whether it should be difficult to make the evaluation, proceed cleaning the oil dipstick using a clean cloth with no rag grinding and put it back in its slot. Draw it off again and check the level.
- Retighten the lubricant oil cap (1).
- Together with the replacement of the engine lubricant oil it is necessary to replace the oil filter (see LUBRICANT OIL FILTER REPLACEMENT paragraph).

When using compressed air, it is required to use suitable personal protections for hands, face and eyes. The requirements can be found in the ACCIDENT PREVENTION paragraph.
Lubricant oil filter replacement

The filter must also be replaced when the lubricant oil is changed. Only use filters with a filtering degree that is the same as the previous one (see the MAINTENANCE SCHEDULE chapter).

- Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.
- Place a container for collecting the spent oil under the filter support (1).
- Unscrew and remove the filter (3) from its relative support (1) by suitable tool.
- Replace the filter element and the sealing gasket (2) contained inside the filter (3).
- Carefully clean the surfaces of the support (1) in contact with the sealing gasket (2).
- Moisten the sealing gasket (2) of the new filter (3) with a thin layer of engine oil.
- Manually tighten the new filter (3) on the support (1) until it comes into contact with the gasket (2). Additionally tighten it using a specific tool to a torque of 20 ± 2 Nm.
- Operate the engine for a few minutes and then check the oil level using the dipstick. If necessary, top up to compensate for the quantity of oil used to fill up the filtering cartridge.

Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations. The FPT Technical Service Network workshops are equipped for this purpose.

Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction.
Fuel pre-filter replacement

Only proceed with the engine stopped.

- Should the filter be fitted with a sensor to detect the presence of water (3), remove the whole sensor from its seat.
- Remove the pre-filter by unscrewing it.
- Check that the new filter has performance levels that satisfy the needs of the engine (e.g. by comparing them with the old one).
- Damp the new filter seal with diesel or engine oil.
- Hand screw the new filter into place until the seal gasket touches the support, then tighten it to a torque of 20 ± 3 Nm.
- Place the water presence sensor in its seat, taking care to couple the threads correctly.

Given the high operating temperature of the engine, suitable protective gloves should be worn. The engine oil reaches very high temperatures: always wear protective gloves.

The engine oil is highly pollutant and noxious. In case of contact with skin, wash thoroughly with water and detergent. Suitably protect skin and eyes; proceed in accordance with accident prevention standards.

Only use recommended oils or oils with the properties required for proper engine operation. If topping up, do not mix oils with different properties. Failure to observe these standards will invalidate the servicing warranties.

Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations. The FPT Technical Service Network workshops are equipped for this purpose.
Loosen the bleeder screw (1) on the pre-filter support and keep pressing the hand pump (2) until the supply circuit is full. Ensure that any fuel coming out is not dispersed into the environment.

Lock the bleeder screw tightly.

Start the engine and run it at idle for a few minutes to eliminate any residual air.

---

**Fuel filter replacement**

Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- Place a container for collecting the diesel under the filter support (1).
- Remove the filter (4) by unscrewing it from its relative support.
- Replace the filter element and the O-ring seal (3) contained inside the filter (4).
- Carefully clean the surfaces of the support (1) in contact with the O-ring seal (3).
- Moisten the O-ring seal (3) of the new filter with engine oil.
- Manually tighten the new filter (4) onto the support (1) until it comes into contact with the gasket. Additionally tighten it using a specific tool to a torque of 20 ± 2.5 Nm.

After the fuel filter (4) has been replaced it is possible that air bubbles get trapped inside the fuel supply circuit.

- Bleed residual air from the fuel filter (4) by loosing the vent plug (2) connecting it to a suitable container by a transparent flexible hose.
- With the hand pump of the fuel pre-filter pump until fuel completely free of air bubbles flows from the vent plug (2).
- Tighten the vent plug (2) to prescribed torque of 10 ± 2 Nm.
- Start the engine and allow it to run at minimum for a few minutes to expel any remaining air.

---

*If it is necessary to speed up the residual air bleeding phase, use the hand pump also while starting.*
Do not smoke or use open flames during this operation.
Do not inhale the vapours that exit the filter.

Pay attention to the electric fuel pre-heater (if installed) and the relative electrical connection.

Do not fill the new fuel filter before placing it on the support in order to prevent harmful impurities from entering the fuel circuit and the injection system.

Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations. The FPT Technical Service Network workshops are equipped for this purpose.

CAUTION!
Ensure that any fuel coming out of the vent plug or drain screw does not dirty the auxiliary members' drive belt and is not dispersed into the environment. Never lose connectors of the high-pressure fuel pipes and of the common rail in any way.

If it is necessary to speed up the residual air bleeding phase, use the hand pump also while starting.
Blow-by filter replacement

The blow-by filter has been developed and equipped for the collection, filtering and condensation of the lubricating oil vapours. Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- Unscrew the fastening screws (1) and remove the blow-by filter cover (2).
- Replace and install the two cartridge filters (3) included within the filter unit (2).
- Fit the blow-by filter cover (2) and tighten the fastening screws (1).

Air filter replacement

Refer to the Air filter and housing cleanness check procedure.

Auxiliary members' belt replacement

- Pull the automatic belt tensioner (7) by using appropriate tool and remove the auxiliary members' belt (2) from alternator (6), water pump (5), fan control pulley (1), crankshaft pulley with damper (4) and fixed guide roller (3).
- Replace the worn belt (2) with new one.
- Fit the auxiliary members' belt (2) on the pulleys and guide roller.
- Use the appropriate tool on the automatic belt tensioner (7) in order to fit the new belt (2) in the operating position.
- Additional adjustments are not required. The belt (2) tension is adjusted automatically by the calibrated spring in the automatic belt tensioner (7).
- Operate the engine for a few hours and check that the auxiliary members' belt (2) is properly fitted.

CAUTION!

When the engine is shut down, but still hot, the belt may start to move without warning. Wait for the engine temperature to decrease to prevent serious danger of an accident.
EXTRAORDINARY MAINTENANCE - HOW TO PROCEED

Adjustment of valve/rocker arm clearance

The adjustment of the clearance between the rocker arms and the intake and exhaust valve control rods must be strictly carried out using an Allen wrench (1), box-end wrench (3) and a feeler gauge (2). For details refer to the Technical Repair Manual.

The values to be checked are detailed below:
Intake valve: 0.25 ± 0.05 mm
Exhaust valve: 0.50 ± 0.05 mm

Replace the belt if it shows signs of abrasion, cracks or tears or if it is soiled with oil or fuel.
Engine coolant replacement

Only proceed when the engine is not running, and is at low temperature, to avoid the risk of burns.

- Place a container for collecting coolant under the heat exchanger (radiator).
- Remove the pressurization cap (2) from the expansion tank.
- Loosen the retaining elements and remove the sleeves (1) and (3) connecting the engine cooling circuit to the heat exchanger.
- Drain the coolant from the heat exchanger (radiator) and wait until it is completely empty.
- Once emptied, refit the cooling circuit making sure the sleeves (1) and (3) are perfectly sealed.
- Refill the engine and the heat exchanger until the cooling circuit has been completely refilled using fluids, as contained in the REFILLING table. Do not fill the expansion tank to the brim.
- With the coolant cap (2) open, start the engine and let it idle for approx. one minute. This helps to completely bleed the air contained in the cooling circuit.
- Stop the engine and top up with more coolant, if necessary.
- When the engine is cold, make sure that the coolant in the expansion tank is a few centimetres below the filling hole.

In the event of an externally located level indicator as regards the heat exchangers, proceed with the top up operation by making sure that the coolant does not overfill the internal volume of the exchanger in order to allow the expansion of coolant volume during increases in temperature.

CAUTION!

When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns. Open the filler cap of the coolant tank only if necessary and only when the engine is cold.

The failure to observe the aforesaid procedure does not guarantee the presence of the correct quantity of coolant in the engine.
MOVING THE ENGINE

The operations necessary to disconnect and subsequently reconnect the engine must only be carried out by technicians from Authorised Service Centres.
When lifting the engine only, use the lifting eyelets indicated in this manual in the ENGINE TECHNICAL DATA chapter and marked on the engine with special stickers.
Lifting must be carried out using a rocker arm that keeps the metal cables supporting the engine parallel, using all the lifting eyelets provided simultaneously; the use of a lower number of lifting eyelets is not permitted.
The engine lifting system must have a capacity and size suited to the weight and dimensions of the engine; check that there is no interference between the lifting system and the engine components.
Do not lift the engine before removing the transmission members that are coupled to it.

DISPOSAL OF WASTE

The engine is made up of parts and elements that, if discarded, may cause damage to the environment.
The materials listed below must be handed over to specialised Collection Centres:
- Starter batteries.
- Used lubricants.
- Mixtures of water and antifreeze.
- Filters.
- Additional cleaning materials (e.g. greasy or fuel-soaked cloths).
The laws in force in the various countries provide for severe penalties for lawbreakers.
LONG PERIODS OF INACTIVITY

PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY

In order to prevent oxidation of the internal parts of the engine and of certain components in the injection system, when the engine is expected to be inoperative for periods of more than two months, the following operations must be carried out in preparation for this:

1. Drain the lubricant from the sump, after first warming up the engine.
2. Fill the engine with protective oil (complying with MIL-L-2160B type 2 / ISO 3498/6743-4 HM standard), up to the "minimum" level indicated on the dipstick. Start the engine and keep it running for approximately 5 minutes.
3. Drain the fuel from the injection circuit, from the filter and from the injection pump pipes.
4. Connect the fuel circuit to a tank containing CFB (ISO 4113) protective fluid, and feed in the fluid by putting the circuit under pressure and running the engine for approximately 2 minutes, after first disabling the injection system. This operation can be performed by polarising terminal 50 of the starter motor with a positive voltage equivalent to the rated voltage of the system, using a conductor provided for that purpose.
5. Nebulise approximately 67 g protective oil (10 g per litre displacement) into the air inlet manifold, during the pressurised filling operation described in the previous point.
6. Close all the suction, delivery, ventilation and bleeder openings in the engine with suitable plugs, or seal them with adhesive tape.
7. Drain the residual protective oil from the sump. This oil can be used again for a further 2 preparation operations.
8. Fit signs reading "ENGINE WITHOUT OIL" to the engine and to the on-board control panel.
9. Drain the coolant, if it has not been mixed with suitable antifreeze and corrosion inhibitors, and affix a sign to indicate the fact.

In the event of prolonged inactivity, the operations described must be repeated every 6 months, following the procedure given below:

A) drain the protective oil from the sump;
B) repeat the operations described from point 2 to point 7.

Should you intend to protect external parts of the engine, proceed by spraying anti oxidation (Anticorit) protective liquid on unpainted metal parts, such as the flywheel, pulleys and the like, avoiding belts, connector cables and electrical equipment. Protect the connectors and electrical connections with VCI spray. Wrap the Engine in VCI bag with hygroscopic salt bags.
RESTARTING THE ENGINE AFTER A LONG PERIOD OF INACTIVITY

1. Drain the residual protective oil from the sump.

2. Fill the engine, as prescribed, with lubricant of the type and amount indicated in the REFILLING table.

3. Drain the CFB protective fluid from the fuel circuit, carrying out this operation as indicated under point 3 of PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY.

4. Remove the plugs and/or seals from the suction, delivery, ventilation and bleeder openings in the engine, restoring it to a normal state of use. Connect the air inlet tube to the air filter.

5. Connect the fuel circuits to the generator set's fuel tank, completing the operations as indicated in point 4. of PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY. During filling operations, connect the fuel return pipe to a collection tank, so as to prevent any residual CFB protective fluid from flowing into the generator set's fuel tank.

6. Check the engine and fill it up with coolant as prescribed.

7. Start the engine and keep it running at the idling speed.

8. Check that the instruments on the on-board control panel/s are showing plausible values, and that no alarms are shown.

9. Stop the engine.

10. Remove the "ENGINE WITHOUT OIL" signs from the engine.
■ ENGINE MALFUNCTIONS

The electronic unit overseeing management and control of all operation of the engine is capable of recognising any malfunctions that may occur, and of adopting strategies that will allow in order to proceed in full safety.

The event, signalled by light-up of the EDC MALFUNCTION indicator on the on-board control panels, results in programmed limitation of power within certain thresholds, set according to the severity of the case.

In the case of temporary malfunctions the reduction in performance will remain in force until the engine is stopped.
BEHAVIOUR IN EMERGENCY

The user of a generator set that has been constructed according to safety regulations, when following the instructions provided in this manual and the indications given on the engine labels, will be working in safe conditions. Should improper conduct result in accidents, always request the intervention of trained first aid specialists immediately. In an emergency and while awaiting the arrival of first aid specialists, follow the instructions given below.

In case of fire

Extinguish the fire using the fire-fighting equipment foreseen, and in the manner indicated by Fire prevention authorities (fire-fighting equipment for certain generator sets and equipment is compulsory under current safety legislation).

Burns and scalds

- Extinguish any flames on the burned person’s clothing, by:
  - throwing water over them;
  - using a powder fire-extinguisher, without directing the jet at the person’s face;
  - covering with blankets or rolling the victim on the ground.
- Do not attempt to remove pieces of clothing that may have stuck to the skin;
- In the case of scalding, immediately but carefully remove any clothing that may be soaked in the hot liquid;
- Cover the burn with a special burn dressing or sterile bandage.

Carbon monoxide intoxication (CO)

Carbon monoxide from the engine exhaust is without smell, and is dangerous both because it causes intoxication, and because when combined with air it forms an explosive mixture. In closed rooms, carbon monoxide is extremely dangerous, as it can reach critical concentrations within a very short time. When assisting an intoxicated person in a closed room:

- Ventilate the room immediately, to reduce the concentration of gas.
- When entering the room, hold your breath, do not light flames, lights or ring electric doorbells or phones, to avoid the risk of explosion.
- Carry the intoxicated person out into the fresh air or into a well ventilated room, resting on one side if the person is unconscious.
Electrocution
The engine 24 V electrical system does not involve the risk of electrocution, however, in the event of a short-circuit caused, for example, by a metal tool, there is a risk of burning due to overheating of the object through which the electrical current flows. In these circumstances:

- Remove the object that caused the short-circuit, using means that provide sufficient heat insulation.
- Switch off the power at the main switch, if there is one.

Injuries and fractures
The vast number of possible circumstances and the specific nature of operations required means that the intervention of a medical team is necessary.

- In the event of bleeding, keep the edges of the wound pressed together until help arrives.
- If there is any suspicion of a fracture, do not move the injured part and only move the patient if absolutely necessary.

Caustic burns
Caustic skin burns are caused by contact with extremely acid or alkaline substances. For electric maintenance technicians these are typically caused by acid from batteries; in these circumstances, proceed as follows:

- Remove any clothing soaked in the caustic substance.
- Wash the area with lots of flowing water, avoiding parts that have not been burned.

If either battery acid, lubricants or diesel come into contact with the eyes: wash the eyes with water for at least 20 minutes, keeping the eyelids open so that the water flows over the eyeball (move the eye in all directions to wash more thoroughly).