INTRODUCTION
Thank you for preferring FPT and we congratulate you on your choice of engine. Before performing any operation that involves the engine or its equipment, please carefully read the instructions contained in this manual; following these instructions is the best way to guarantee that the engine will run perfectly for a long period of time.

The content of this manual refers only to the standard engine configuration and the illustrations are purely indicative. Some instructions are given by describing the sequence of operations that make it possible to obtain the expected behaviour from the engine and/or its equipment. In some cases they depend on the configuration of the controls and versions of the generator set in which the engine is installed; for anything that differs from the content of this manual, refer to the indications of the generator set manufacturer or its specific manual.

The following information is current as of the date of publication. The Manufacturer reserves the right to make changes without notice at any moment for technical or commercial reasons as well as due to adaptations of the engine to the laws of various countries. No liability is accepted for errors or omissions.

Remember that the skills and professionalism of the FPT Technical Service Network will be at your side wherever you are.
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GENERAL INFORMATION

WARRANTY
To ensure the best engine performance and rely on the FPT warranty, the instructions provided in this publication must be followed carefully; failure to observe them or following them incorrectly could invalidate the warranty.

SPARE PARTS
It is required to exclusively use Original FPT Spare Parts to maintain the engine in its original condition. The use of non-original spare parts shall invalidate the warranty and exonerate FPT from all liability for the entire life of the engine.

RESPONSIBILITY
The Manufacturer's responsibility is subordinate to the performance of the check and maintenance operations specified and described in this manual; their performance must be demonstrated for this purpose. Any necessary Extraordinary maintenance operations must be carried out by qualified FPT Network Workshop personnel, using the specifically provided instruments and equipment.

SAFETY
The purpose of the following information is to focus attention on engine use to prevent damage to people and property deriving from improper or incorrect behaviours.

- The engines must only be used for the purposes declared by the Manufacturer.
- Tampering, changing and the use of non-original spare parts could adversely affect the proper operation of the engine and its safety during use; changes must not be made to the wiring and the units that equip the engine as well as its connections to external electrical networks.
- Pay attention to the engine's moving parts, those at a high temperature and the circuits with pressurised fluids; its electrical equipment is a source of electrical voltage and currents.
- The exhaust gas emitted by the engine is harmful to health.
- The engine must only be handled with suitable lifting devices and using the specific eyebolts provided on the engine.
- The engine must not be started and used before satisfying the safety requirements for the generator set in which it is installed and before ensuring compliance of the latter with the standards and local laws.
- The operations required for guaranteeing the best state of use and preservation of the engine must be carried out by personnel with proven experience using instruments considered appropriate by FPT.

Additional safety recommendations can be found in the CHECKS AND MAINTENANCE chapter.
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 power generation use is as environmentally friendly as possible.
## ENGINE TECHNICAL DATA

The technical code and serial number are specified on the nameplate positioned on different parts of the engine, depending on the model: flywheel case, tappet cover, coolant tank, etc.

<table>
<thead>
<tr>
<th>Code</th>
<th>S8031AM1P.S550</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine family</td>
<td>8031</td>
</tr>
<tr>
<td>Cycle</td>
<td>Diesel 4-stroke</td>
</tr>
<tr>
<td>Number and arrangement of cylinders</td>
<td>3, in line</td>
</tr>
<tr>
<td>Bore x stroke</td>
<td>104 x 115 mm</td>
</tr>
<tr>
<td>Total displacement</td>
<td>2,930 cm³</td>
</tr>
<tr>
<td>Air supply</td>
<td>Natural aspiration</td>
</tr>
<tr>
<td>Injection method</td>
<td>Direct</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>17 : 1</td>
</tr>
<tr>
<td>Cooling</td>
<td>Liquid</td>
</tr>
<tr>
<td>Engine rotation direction</td>
<td>Anti-clockwise (flywheel side view)</td>
</tr>
<tr>
<td>Control system</td>
<td>Mechanical pump with electronic regulator</td>
</tr>
<tr>
<td>Dry weight</td>
<td>~370 kg (G-Drive)</td>
</tr>
</tbody>
</table>

### Electric system

<table>
<thead>
<tr>
<th></th>
<th>12 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery capacity</td>
<td>110 Ah</td>
</tr>
<tr>
<td>Pick-up current</td>
<td>60 A</td>
</tr>
<tr>
<td>Maximum input</td>
<td>3 kW</td>
</tr>
</tbody>
</table>

### Performance

<table>
<thead>
<tr>
<th>Without emissions certificate</th>
<th>S8031AM1P.S550</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>50 Hz</strong> Prime 28.1 kWm (net)</td>
<td>50 Hz Prime 28.1 kWm (net)</td>
</tr>
<tr>
<td>Stand-by 31 kWm (net)</td>
<td>1,500 revs/min 1,500 revs/min</td>
</tr>
<tr>
<td>60 Hz Prime 31 kWm (net)</td>
<td>1,800 revs/min 1,800 revs/min</td>
</tr>
<tr>
<td>Stand-by 34 kWm (net)</td>
<td>1,800 revs/min 1,800 revs/min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum engine speed</th>
<th>50 Hz</th>
<th>60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-by</td>
<td>1,500 revs/min</td>
<td>1,800 revs/min</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum engine speed</th>
<th>50 Hz</th>
<th>60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand-by</td>
<td>1,570 revs/min</td>
<td>1,870 revs/min</td>
</tr>
</tbody>
</table>

It is strictly forbidden to alter the aforesaid characteristics and, in particular, to modify the calibration of the injection pump or the characteristics of the engine and its components. Failure to comply with the above shall result in the loss of warranty, in addition to FPT declining all responsibility.

(*) Net power at the flywheel in accordance with the standard ISO 8528-1. Test conditions: T 25 °C; atmospheric pressure 100 kPa; relative humidity 30%.
**S8031AM1P.S550**


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**S8031AM1P.S550**

LABELS

Some warning labels (below the description) are affixed to the engine.

**Note:** labels containing an exclamation mark highlight a potential danger.

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

- **Fuel filling cap**
  (on the tank, if present).

- **Lubricant oil filling cap.**

- **Lubricant oil level dipstick.**

- **Risk of burns:**
  Expulsion of pressurized hot water.

- **Risk of burns:**
  Presence of parts at high temperature.

- **Risk of fire:**
  Presence of fuel.

- **Risk of injury**
  from moving parts:
  Presence of fans, pulleys, belts and other objects.
USE

PRELIMINARY CHECKS

Each time before starting the engine:

- Check and top up the level of the technical fluids, if necessary (fuel, engine oil and coolant).
- 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.

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

ATTENTION!

*Make sure that the environment where the engine will operate is free of combustible vapours or gases. Make sure that there is sufficient ventilation and a suitable exhaust gas extraction system for closed environments.*

ENGINE PRE-HEATING (optional)

The engines which require low start-up temperatures and an immediate delivery of power may be equipped with an electrical heating device enabling an increase in the temperature of the air entering the engine. The device is mounted on the intake manifold and is fitted with a coolant temperature sensor which interrupts the power supply once the required temperature has been reached.
SWITCHING OF OPERATING FREQUENCY

Based on the specific operational requirements of the engine, it is possible to vary the adjustment of the rotary injection pump so as to obtain a different operating frequency:
- 1,500 revs/min @ 50 Hz
- 1,800 revs/min @ 60 Hz

To make the transition from 50 Hz to 60 Hz, the actuator (1) is used. This is controlled by the electronic control unit via the two connectors (2), and acts directly on the rotary fuel injection pump (3).

Switching to 50 Hz and 1500 rpm:
- on the electronic control unit (2), place the STABILITY and GAIN potentiometers in the positions (1, 4) indicated in the figure, at 13 and 15 o’clock respectively;
- turn the SPEED screw (3) anti-clockwise until it reaches the end position; In this position, the GE stabilises at 34 Hz.
- leaving the STABILITY (1) and GAIN (4) potentiometers in the same position, as per the figure, turn the SPEED screw (3) clockwise for 18 turns.

Switching to 60 Hz and 1800 rpm:
- on the electronic control unit (2), place the STABILITY and GAIN potentiometers in the positions (1, 4) indicated in the figure, at 13 and 15 o’clock respectively;
- turn the SPEED screw (3) anti-clockwise until it reaches the end position; In this position, the GE stabilises at 34 Hz.
leaving the STABILITY (1) and GAIN (4) potentiometers in the same position, as per the figure, turn the SPEED screw (3) clockwise for 28 turns.

FOR PROPER ENGINE USE

- Before starting the engine each time, check that the tank contains a sufficient amount of fuel.
- Avoid prolonging the duration of the start control.
- Do not idle for long periods since this increases the production of harmful emissions from the engine and does not guarantee its optimum performance.
- The engine speed must be increased and decreased gradually so as to permit normal combustion and the optimum functioning of all engine components.
- During use, check periodically that:
  - the temperature of the engine coolant does not reach the alarm thresholds;
  - the oil pressure remains within normal values.
- The speed and power values must comply with that specified in the technical-commercial documentation.
- 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.

ATTENTION!

The operation is to be carried out without any electrical load connected to the genset (switch open).
SPECIAL WARNINGS

High coolant temperature

In the event of an excessive temperature or the signalling of the alarm, disengage the load and stop the engine in order to check the condition of the cooling circuit.

Also check and have the following checked:
- the condition of the ancillary belt;
- the operation of the thermostatic valve;
- the cleanliness of the heat exchanger (radiator).

ATTENTION!

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.

Low lubricant oil pressure

Should the pressure indicated by the instrument be considered insufficient or if the “low oil pressure” warning light comes on, stop the engine and check the oil level. If necessary, top up the oil according to the instructions contained in the CHECKS AND MAINTENANCE section. If the fault persists, contact a Service centre.

Presence of water in the fuel filter

It is advisable to drain the water from the filters before the relevant warning light comes on.
Do not use the engine if the tank only contains the quantity of fuel kept as reserve; this condition promotes the formation of condensate and the intake of sludge or air, causing the engine to stop.

ATTENTION!

Refuelling from drums or jerry cans may contaminate the diesel, resulting in problems with the fuel supply system; in these cases it is necessary to carry out adequate filtration or sedimentation of any impurities present.

ATTENTION!

The couplings of the fuel circuit under high pressure must not be loosened under any circumstances.
Intake and exhaust circuit inefficiencies

Regularly inspect the cleanliness of the air intake circuit. The maintenance intervals indicated in this manual change with the conditions of use. Maintenance checks must be performed more frequently in particularly dusty environments with regard to that stated in the CHECKS AND MAINTENANCE chapter.

Electrical start-up system irregularities

Periodically check the cleanliness and efficiency of the batteries, particularly during winter, by performing the checks and top-ups as described in the CHECKS AND MAINTENANCE chapter. In the event of battery replacement, please observe the characteristics contained in the ENGINE TECHNICAL DATA section.

---

**ATTENTION!**

Visually check that the exhaust circuit is not obstructed or damaged to prevent noxious and dangerous fumes.

If the voltmeter indicates a voltage value lower than 11 V (for nominal 12 V systems), or 22 V (for nominal 24 V systems), contact a specialised workshop and have the efficiency of the batteries and charging system diagnosed.

The batteries contain an acid solution, which is caustic to skin and corrosive for garments; while checking them, wear protective garments, gloves and goggles, do not smoke or permit open flames to come near them and make sure that the room where they are located is suitably ventilated.
Battery or alternator recharging faults
Periodically check the cleanliness, condition and correct tensioning of the drive belt.

**ATTENTION!**

*The auxiliary units are located under protective grilles. Their removal must be carried out only when the engine is not running.*

**RUN-IN**

Thanks to modern engine construction technologies, a particular run-in procedure is not required. However, it is recommended to avoid using the engine at high power for long periods during the first 50 hours.

---

**REFILLING**

**S8031AM1P.S550**

<table>
<thead>
<tr>
<th>Parts to be refilled</th>
<th>litres (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling circuit (*)</td>
<td>9 (7.2)</td>
</tr>
<tr>
<td>Radiator and pipes</td>
<td></td>
</tr>
<tr>
<td>Lubrication circuit (2) (*)</td>
<td>8.8 (7.92)</td>
</tr>
<tr>
<td>Periodic replacement:</td>
<td></td>
</tr>
<tr>
<td>Sump at minimum level</td>
<td>5.5 (4.95)</td>
</tr>
<tr>
<td>Sump at maximum level</td>
<td>7.7 (6.93)</td>
</tr>
<tr>
<td>Fuel tank (3)</td>
<td>-</td>
</tr>
</tbody>
</table>

(*) It is prohibited to mix fluids of different brands and origins within the circuit.
(1) The quantities indicated only refer to the engine in its standard configuration. The coolant must comply with ASTM D-6210 standards. Concentrated coolants must be used as a mixture with 50% water. FPT recommends using original PETRONAS products.
(2) Please refer to the "Table of Oils" for details regarding the specific oils and lubricants that must be used. FPT recommends using original PETRONAS products which comply with these specifications.
### Table of Oils

<table>
<thead>
<tr>
<th>Oil quality</th>
<th>SAE grade</th>
<th>Base stock</th>
<th>International specification</th>
<th>Fuel sulphur content</th>
<th>Service interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premium</td>
<td>10W-40</td>
<td>Semi-synthetic</td>
<td>API CJ-4; ACEA E9</td>
<td>&lt; 500 ppm</td>
<td>600 h</td>
</tr>
<tr>
<td>Standard</td>
<td>15W -40</td>
<td>Mineral</td>
<td>API CI-4; ACEA E7</td>
<td>&lt; 1000 ppm</td>
<td>600 h</td>
</tr>
<tr>
<td>Low</td>
<td>15W -40</td>
<td>Mineral</td>
<td>API CF; ACEA E2/E3</td>
<td>&lt; 1000 ppm</td>
<td>300 h</td>
</tr>
<tr>
<td>Low</td>
<td>20W -50</td>
<td>Mineral</td>
<td>API CF; ACEA E2/E3</td>
<td>&lt; 1000 ppm</td>
<td>300 h</td>
</tr>
<tr>
<td>Cold climate</td>
<td>5W -30</td>
<td>Synthetic</td>
<td>API CJ-4; ACEA E6/E9</td>
<td>&lt; 500 ppm</td>
<td>600 h</td>
</tr>
</tbody>
</table>

Oil consumption is considered acceptable up to quantities of 0.5% of fuel consumption.

(3) Only use fuels which comply with ASTM D975 or EN 590 international standards. Instructions regarding the fuel tank capacity are the responsibility of the genset manufacturer since these are subject to change depending on the various generator set configurations.
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.

ATTENTION!

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.

ATTENTION!

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.

Refuelling
Only use diesel which is normally commercially available, and which complies with the ASTM D975 or EN 590 standards. Fuel additives are not recommended. Use of additives can limit the warranty performance offered for the engine.

Diesel oil for low temperatures
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. The ASTM D975 or EN590 standards define the diesel classes, identifying the characteristics of those most suitable for use at low ambient temperatures. It is entirely the responsibility of the oil companies to comply with the regulations regarding the distribution of fuels suitable for the climatic and geographical conditions of the various countries.
Checks and Maintenance

Maintenance Personnel

The engine check and maintenance operations specified in this chapter require preparation, skill and compliance with safety standards; therefore, they must be carried out by responsible personnel, as indicated below.

- **Checks**: by workshop personnel or if necessary by the generator set operator.
- **Periodic maintenance**: by qualified personnel equipped with proper work tools and suitable protections.
- **Extraordinary maintenance**: by qualified Service Centre personnel in possession of precise technical information and specific equipment.

The most qualified Service Centres are those included in the FPT Technical Support Network.

Accident Prevention

- Always wear safety footwear and, gloves and suits.
- Do not wear loose clothing, rings, bracelets and/or necklaces near the engines or moving parts.
- Wear protective gloves and goggles while:
  - filling the batteries with acid solution
  - check cleanliness of battery clamps and terminals
  - filling up inhibitors or antifreeze
  - changing or filling the lubricant oil (hot engine oil can cause burns. It is recommended to perform these operations only when their temperature is lower than 50 °C).
- When working in the engine compartment, pay maximum attention to all movements to avoid coming into contact with rotating or hot components.
- Wear goggles while using compressed air (the maximum air pressure used for cleaning is 200 kPa (2 bar, 30 psi, 2 kg/cm²)).
- Wear a protective helmet if working in an area with suspended loads or overhead systems.
- Use protective creams for hands.
- Immediately replace wet gloves.
- Always keep the engine clean, removing spots of oil, diesel and coolant.
- Return oily rags to fire-proof containers.
- Do not leave foreign objects on the engine.
- Use adequate and safe containers for the used oil.
- At the end of a repair, implement suitable measures to stop air intake by the engine if, after starting, the engine runs at uncontrolled speeds.
The frequencies indicated below take into account factors of use of different engine uses; the most suitable duration of the maintenance intervals for the different applications will be indicated by the maintenance personnel based on the use and operating conditions of the engine.

### Frequencies

**S8031AM1P.S550**

<table>
<thead>
<tr>
<th>Checks</th>
<th>Frequency (****)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the engine lubricant oil level</td>
<td>Daily</td>
</tr>
<tr>
<td>Check engine coolant level</td>
<td>Daily</td>
</tr>
<tr>
<td>Engine visual inspection</td>
<td>50 hours / 15 days</td>
</tr>
<tr>
<td>Air filter check and housing cleaning</td>
<td>Monthly (*)</td>
</tr>
<tr>
<td>Check belt condition and tension</td>
<td>300 hours/six months</td>
</tr>
<tr>
<td>Check electrolyte level of the batteries</td>
<td>300 hours/six months</td>
</tr>
<tr>
<td>Inspection of the exhaust duct/s</td>
<td>Six-months</td>
</tr>
<tr>
<td>Check condition of the blow-by system and clean if necessary</td>
<td>300 hours/six months</td>
</tr>
</tbody>
</table>
### Periodic maintenance

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain the water from the fuel filter</td>
<td>50 hours / 1 week</td>
</tr>
<tr>
<td>Drain the condensate water from the fuel tank</td>
<td>50 hours / 1 week</td>
</tr>
<tr>
<td>Drain the water from the fuel transfer pump/ primer pump</td>
<td>50 hours / 1 week</td>
</tr>
<tr>
<td>Clean the fuel transfer pump/ primer pump</td>
<td>300 hours</td>
</tr>
<tr>
<td>Clean the heat exchanger (radiator)</td>
<td>Six-months</td>
</tr>
<tr>
<td>Engine lubricant oil change</td>
<td>600 hours/1 year</td>
</tr>
<tr>
<td>Oil filter change</td>
<td>600 hours/1 year</td>
</tr>
<tr>
<td>Replacing the fuel pre-filter</td>
<td>600 hours/1 year</td>
</tr>
<tr>
<td>Replacing the fuel filter</td>
<td>600 hours/1 year</td>
</tr>
<tr>
<td>Change air filter</td>
<td>1200 hours/2 years</td>
</tr>
<tr>
<td>Change the ancillary belt</td>
<td>1200 hours/3 years</td>
</tr>
</tbody>
</table>

### Extraordinary maintenance

<table>
<thead>
<tr>
<th>Maintenance Activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean fuel tank</td>
<td>(**)</td>
</tr>
<tr>
<td>Valve/rocker arm clearance adjustment</td>
<td>1200 hours/1 year</td>
</tr>
<tr>
<td>Calibrate injector and replace nozzle if necessary</td>
<td>1200 hours / 2 years</td>
</tr>
<tr>
<td>Change coolant</td>
<td>1200 hours / 2 years</td>
</tr>
</tbody>
</table>

1. These frequencies apply to lubricant oils that meet international standards, as specified in the Refilling section - see "Table of Oils".
2. Only use filters with the following specifications:
   - degree of filtering < 12 μm
   - filtering efficiency 99.5% ($ß > 200$).
3. Maximum period relating to the use of high quality fuel (specification ASTM D975 or EN 590); this is reduced in the event of fuel contamination and alarm signals caused by filter clogging and/or the presence of water in the filter. The filter clogging signal indicates that the filter must be replaced. If the warning light signalling that there is water present in the filter does not go off after drainage, then the filter must be replaced.
4. In ambient conditions characterised by a high concentration of dust, the interval must be halved.
5. Top up after 300 hours.

(*) In any case, when the indicator light comes on
(**) Refer to genset supplier/ manufacturer instructions
(***) When carrying out the interventions above, refer to the hour or time interval, whichever is reached first
The operations described above require the use of specific tools which guarantee safe and effective results. It is recommended that such operations are carried out by qualified personnel of the FPT Technical Service Network.

The unscheduled maintenance operations described in the relative table are under the exclusive responsibility of qualified personnel in possession of suitable technical information and equipped with suitable work tools and protective devices. The instructions for their fulfilment are contained in the FPT technical and repair manuals.

**REQUIREMENTS**

- Do not disconnect the battery supply while the engine is running.
- Do not perform arc welding near the engine without first removing its electrical wiring.
- After all maintenance operations that require disconnection of the batteries, make sure the clamps have been securely reconnected on the poles.
- Do not use a battery charger to start the engine.
- Do not paint the devices, components and electrical connectors of the engine equipment.
- Electrically disconnect the battery/batteries before performing any electrical work.
- Contact the Manufacturer before installing any electronic equipment.

Do not perform any operation that would change the calibration of the injection pump. It was adjusted during the engine test phase and based on its destination.
CHECKS

Check the engine lubricant oil level

Only proceed when the engine is not turning and is at low temperature in order not to run the risk of burns.

- Use the oil level dipstick (1) to check that the lubricant oil level is between the "Min" and "Max" limits (2).
- In cases where it proves difficult to carry out the measurement, proceed with cleaning the oil level dipstick (1) using a clean cloth with no fraying edges 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 that complies with international specifications, as indicated in the Refilling section (see "Table of Oils"): remove the lubricant oil cap and pour engine lubricant oil through the hole.
- Use the oil level dipstick (1) to check that the quantity of lubricant oil does not exceed the "Max" limit (2).

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

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

- 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 fluid, as shown in Refilling section. Do not fill the expansion tank to the brim.
- 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.

If frequent coolant top-ups are necessary, the cooling circuit must be diagnosed.

ATTENTION!

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

After starting the engine and with the engine running, perform the following checks and controls:

- Check for any leaks from the fuel, coolant and lubricant circuits.
- Check that there is no noise or unusual rattling when the engine is functioning.
- Use the power generator devices to check the prescribed pressure, temperature and other parameters.
- Visually inspect the fumes (colour of the exhaust emissions).
- Visually inspect the coolant level in the expansion tank.
Air filter check and housing cleaning

Only proceed when the engine is not turning over.

- Remove the cover (2) of the air filter after having undone the two quick release catches (3).
- Remove the filter element (1); 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.
- Position the filter element (1) in its seat.
- Replace the cover (2) of the air filter and lock it in place using the two quick release catches (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.
Check belt condition and tension

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

- Visually check that the auxiliary unit drive belt (5) is not worn, damaged or soiled (with oil or fuel); if this is the case, it must be replaced.
- The tension value is correct when the belt (5) play (4) is 10 - 11 mm at the centre of the side indicated in the figure.
- Where necessary, adjust the belt tension as indicated below.
- Loosen the nut (1) keeping the alternator (3) fixing screw (6) secured to the tensioning bracket (2).
- Proceed with adjusting the auxiliary unit drive belt (5) tension by tightening the nut (1) on the adjusting screw (6).
- Fully rotate the crankshaft twice to ensure that the new auxiliary unit drive belt (5) has been correctly fitted.
- The tension value is correct when the belt (5) play (4) is 10 - 11 mm.
- Tighten the nut (1) to the torque indicated.
Check electrolyte level of the batteries

The batteries used are of reduced maintenance type. Therefore, under normal conditions of use, no top up of the electrolyte is required. However, the routine checking of the electrolyte level is recommended. Proceed after positioning the batteries on a horizontal surface.

- Visually check that the electrolyte level is between the "Min" and "Max" reference marks on the batteries; in the absence of any reference marks, make sure the liquid covers the lead plates contained in the elements by approx. 5 mm.
- Only use distilled water to top up the elements whose level is below the minimum.
- If the battery must be recharged, contact a specialised workshop.

ATTENTION!

During the checks do not smoke or allow naked flames near the batteries. Ensure that the work area is suitably ventilated.

Some batteries have a single cover for the inspection plugs. To access the elements, use a lever as shown in the figure.

Inspection of the exhaust duct/s

Visually check that the exhaust gas / exhaust system is not obstructed or damaged.
- Make sure that there is no risk of harmful fumes in the environment where the engine is being worked on. Contact the manufacturer if necessary.
Check condition of the blow-by system and clean if necessary

- Only proceed when the engine is not turning over.
- Disconnect the oil vapour recovery pipe from the blow-by (4) by loosening the screw (3).
- Remove the engine breather cap (1).
- Remove the engine breather (2).
- Check that the perforated lower spring seat on the engine breather (2) is not clogged; if it is, clean carefully.
- Carefully clean the remaining contact surfaces.
- Fit the engine breather (2) into its housing on the cylinder heat cover.
- Connect the oil vapour recovery pipe from the blow-by (4) by tightening the screw (3).
- Fit the engine breather cap (1).

PERIODIC MAINTENANCE - HOW TO PROCEED

Drain the water from the fuel filter

In the case of a high risk of refuelling with fuel polluted with foreign agents and water, the following check should be performed at each refuelling.

- Only proceed when the engine is not turning over.
- Place a container for collecting liquids under the fuel filter.
- Unscrew the valve plug (1) located at the bottom of the filter; in some versions, the plug includes the water in diesel sensor.
- Drain the liquid until only “diesel” is released.
- Fully re-tighten the plug manually.
- Dispose of the drained liquids according to the applicable regulations in force.
Drain the condensate water from the fuel tank

Perform the drainage/suction of water, condensation and impurities from the fuel tank/s by following the instructions contained in the manual supplied by the tank manufacturer. Proceed as necessary based on the structure or location of the tank: engines that operate in adverse environments and conditions and/or that are refuelled using drums or jerry cans, require more attention when cleaning the tank.

Clean the fuel transfer pump/ primer pump

Remove the cover (1).
Remove the ring (2).
Remove the filter (1). Clean the filter and its housing.

Place the filter and cover (1) back in position.

Drain the water from the fuel transfer pump/primer pump
Place a container for collecting the diesel under the fuel filter (1). Unscrew the plug (4). Drain off the fuel until the diesel flowing out is free from water residues or impurities. Screw the plug back into position (4). Operate the lever (2) of the fuel primer pump (3) several times.

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.
Clean the heat exchanger (radiator)
The surfaces of the heat exchanger (radiator) come into contact with external air and may be subjected to deposits and impurities (dust, mud, straw, etc.). Clean them if necessary using compressed air or steam.

Engine lubricant oil change
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- Place a suitable container for collecting the spent oil under the oil sump next to the lubricant oil drain plug (see the figures in the ENGINE TECHNICAL DATA section).
- Unscrew the lubricant oil drain plug (4); next, extract the oil level dipstick (1) and remove the lubricant oil cap (3) to assist the flow of the engine lubricant oil.
- Wait until the oil sump has completely emptied, then re-tighten the lubricant oil drain plug (4).
- Re-tighten the lubricant oil cap (3).
- Proceed with the refilling operation through the hole (3), using lubricant oil that complies with the international standards as indicated in the Refilling section (see “Table of Oils”).
- Use the oil level dipstick (1) to check that the quantity of lubricant oil does not exceed the "Max" limit (2).
- When replacing the engine lubricant oil, the oil filter must also be replaced (see paragraph OIL FILTER CHANGE).

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.

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.
Oil filter change

Only use filters with the following specifications (see the FREQUENCIES section):
- degree of filtering < 12 μm
- filtering efficiency 99.5% (β > 200).

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

- Proceed with the emptying of the spent oil (see paragraph ENGINE LUBRICANT OIL CHANGE).
- Place a container for collecting the spent oil under the filter support (2).
- Remove the filter (1) by unscrewing it from its relative support.
- Replace the filter element and the O-ring seal contained inside the filter (1).
- Carefully clean the surfaces of the support (2) in contact with the O-ring seal.
- Moisten the O-ring seal of the new filter with oil.
- Screw the new filter (1) onto the support (2).

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

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.
Fuel filter change

Only use filters with the following specifications (see the FREQUENCIES section):
- degree of filtering < 12 μm
- filtering efficiency 99.5% (β > 200).

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

- Place a container for collecting the diesel under the filter support (1).
- Remove the filter (2) by unscrewing it from its relative support.
- Replace the filter element and the O-ring seal contained inside the filter (2).
- Carefully clean the surfaces of the support (1) in contact with the O-ring seal.

- Moisten the O-ring seal of the new filter with oil.
- Screw the new filter (2) onto the support (1).
Residual air bleeding procedure:

- Loosen the fuel outlet coupling (1) located on the top of the filter.
- Make sure that the discharge of diesel does not soil the ancillary belt and does not leak into the surroundings.
- Operate the lever (3) of the fuel suction pump (2) until the diesel coming out is free from any residual air.
- Correctly tighten the previously loosened coupling.
- Start the engine and let it run idle for a few minutes to remove any residual air.

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.
Change air filter

Only proceed when the engine is not turning over.

- Remove the cover (2) of the air filter after having undone the two quick release catches (3).
- Remove the filter element (1); make sure that dust does not enter the sleeve during this operation.
- Replace the filter element and the relative gasket at its base.
- Position the filter element (1) in its seat.
- Replace the cover (2) of the air filter and lock it in place using the two quick release catches (3).

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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.
Change the ancillary belt

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

- Remove the protective grilles and the fan together with the spacer by undoing the relative fasteners.
- Loosen the nut (1) keeping the alternator (3) fixing screw (6) secured to the tensioning bracket (2).
- Remove the auxiliary unit drive belt (5) and insert the new belt.
- Check that the belt (5) has been positioned correctly inside the alternator pulley (3) of the water pump pulley and the crankshaft pulley.
- The tension value is correct when the belt (5) play (4) is 10 - 11 mm: Proceed with adjusting the auxiliary unit drive belt (5) tension by tightening the nut (1) on the adjusting screw (6).
- Fully rotate the crankshaft twice to ensure that the new auxiliary unit drive belt (5) has been correctly fitted
- Tighten the nut (1) to the torque indicated.
- Reposition the fan, together with spacer, in its seat and the protective grilles and tighten the relative fasteners.

Replace the ancillary belt if it shows signs of abrasions, cracks or tears or if it is soiled with oil or fuel.

ATTENTION!

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.
EXTRAORDINARY MAINTENANCE - HOW TO PROCEED

Cleaning the fuel tank
Refer to genset supplier / manufacturer instructions.

Valve/rocker arm clearance adjustment
The adjustment of the clearance between the valve rocker arms and the intake and exhaust valve control rods must be strictly carried out using a wrench (1) for the rocker arm valve command adjustment screw, a box-end wrench (3) and a feeler gauge (2).

The values to be checked are detailed below:
- Intake valve: 0.30 ± 0.05
- Exhaust valve: 0.30 ± 0.05
Calibrating the injector and replacing the nozzle if necessary

The injectors require periodic cleaning, and the exact injection pressure must be calibrated regularly.

Cleaning the injectors:
Remove the injectors from the cylinder head and clean them; this must be completed by trained personnel using the appropriate special tools.

1. Fuel delivery connector.
2. Fuel reflux screw.
3. Nozzle holes: clean the injectors using a wire brush to remove the carbon deposits from the nozzle tips.

When refitting the injectors, ensure that you lock the fixing bracket nuts in place, using a torque wrench at a torque of 15 ÷ 20 Nm.

Checking operation and calibration of injectors:
A fully-functioning injector should comply with the following requirements:

- Number of jets should be equal to the number of nozzle holes (a total of 5).
- Each jet should deliver the atomised fluid in a regular, efficient flow.
- The injector should not spill or drip.
- The injection needle should be raised under a pressure of 260 ± 12 bar.

Replacing the nozzles:
For instructions regarding replacement of the nozzles, please see the repair and maintenance manual.

The operations described above require the use of specific tools which guarantee safe and effective results.

It is recommended that such operations are carried out by qualified personnel of the FPT Technical Service Network.
**Change the engine coolant**

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

- Place a container for collecting coolant under the heat exchanger (radiator).
- Remove the pressurization cap from the expansion tank.
- Loosen the fastening elements and remove the coupling sleeves 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, restore the integrity of the cooling circuit, by ensuring the perfect seal of the sleeves.
- Top up the engine and the heat exchanger with coolant until the cooling circuit is full, as shown in the Refilling section. Do not fill the expansion tank to the brim.
- With the coolant filler plug 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 then top up with 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.

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**ATTENTION!**

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

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**ATTENTION!**

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 HANDLING
The engine must only be disconnected and reconnected by Service Centre personnel.
For lifting only the engine use the eyelets indicated in this manual in the ENGINE TECHNICAL DATA section and marked on the engine with specific plates.
It must be hoisted using a rocker arm that keeps the wire cables that support the engine parallel, using all the provided eyelets at the same time; The use of a lower number of lifting eyelets is not permitted.
The capacity and dimensions of the engine hoisting system must be suitable for the engine weight and dimensions; make sure there is no interference between the hoisting system and the engine components.
Do not hoist the engine before removing the components coupled to it.

DISPOSAL OF WASTE
The engine consists of parts and elements that can cause ecological damage if disposed of in the environment.
The materials listed below must be delivered to authorised collection centres:
- Starter batteries
- Spent lubricant oil
- Water and antifreeze mixtures
- Filters
- Auxiliary cleaning material (e.g. rags soaked in or moistened with fuel).
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 suitable conductor for that purpose.
5. Nebulise approximately 30 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 table REFILLING.
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.
BEHAVIOURS IN CASE OF EMERGENCY

The user of the generator set, implemented according to safety regulations, following the instructions provided in this manual and with the support of the instructions located on the engine label, operates in safe conditions.

If incorrect behaviours cause accidents, request the immediate help of specialised emergency personnel.

In the case of an emergency and while waiting for emergency personnel to arrive, the following instructions are provided.

Fire

Put out the fire using the foreseen devices and according to the methods indicated by the competent authorities (the fire-fighting equipment for some generator sets has been made mandatory by current safety regulations).

Burns

- Put out the flames on the clothing of the burn victim by means of:
  - flooding with water;
  - use of powder extinguishers, without directing the jet towards the face;
  - covers or rolling the victim on the ground.
- Do not remove the shreds of clothing that adhere to the skin;
- If the burns are caused by liquids, quickly but carefully remove the clothing saturated with the hot liquid;
- Cover the burn with an anti-burn pack or with a sterile bandage.

Carbon monoxide (CO) poisoning

The carbon monoxide contained in the engine's exhaust gas is dangerous both because it causes poisoning as well as because it forms an explosive mixture with the air.

In closed areas, carbon monoxide is very dangerous because it can reach a critical concentration in a short period of time.

If aiding a poison victim in a closed room:

- Immediately ventilate the room to reduce the concentration of gas.
- When accessing the room, the rescuer must hold his/her breath, not light flames, turn on lights or activate electric bells or telephones in order to prevent explosions.
- Bring the poison victim to safety in a ventilated room or in the open air, placing the victim on his/her side if unconscious.
Electrocution
The engine’s 12 V or 24 V electrical system does not involve electrocution risks, however in the case of a short circuit that is caused for example by a metal tool, there are burn risks caused by the heating of the object through which the electric current travels. In that case:
- Remove the object that caused the short circuit by using means that provide sufficient thermal insulation.
- If present, use the main switch to cut off the power supply.
The electric generator systems (generating units) commonly produce high voltages which may result in highly dangerous electrical currents. In the event of electrocution by medium or high voltage:
- Switch off the power supply using the master switch before touching the victim. If this is not possible then safely intervene on the victim using means with sufficient electrical insulation; remember that contact with an electrocution victim is highly dangerous also for the rescuer.
- Proceed according to the prescriptions issued by the competent authorities (cardiac massage, administration of emergency oxygen, etc.).

Injuries and fractures
The magnitude of the cases and the specific nature of the interventions makes it necessary to contact medical structures.
- If the victim is bleeding, compress the injury externally until the rescuers arrive.
- If there is a possibility of fractures, do not move the affected part and transfer the injured person very carefully and only if absolutely necessary.

Corrosion
Skin corrosion is caused by contact with substances with a high degree of acidity or basicity.
For personnel performing maintenance on electrical devices, this is typically caused by acid escaping from the batteries; in this circumstance proceed as follows:
- Remove any clothing saturated with the caustic substance.
- Wash thoroughly with running water, without spraying uninvolved parts.
If battery acid, lubricant oil or diesel has entered the eyes: wash the affected eye with water for at least 20 minutes, keeping the eyelids open so the water flows onto the eyeball (facilitate washing of the eye by moving it in all directions).