

USE AND MAINTENANCE
USO E MANUTENZIONE
UTILISATION ET ENTRETIEN
BETRIEB UND WARTUNG
USO Y MANTENIMIENTO

C90 SERIES

MARINE ENGINES



C90 SERIES

C87 ENT M38.10

C87 ENT M62.10

USE AND MAINTENANCE

FOREWORD

Thank you for choosing FPT and congratulations for your choice of engine.

Before carrying out any operation involving the engine and its equipment, please read carefully the instructions contained in this manual. Compliance with them is the best way to guarantee a perfect and durable operation of your engine.

The contents of this manual only refer to the standard configuration of the engine and the pictures are given only as an indication. Some instructions provided describe the sequence to be applied in order to obtain engine's and relevant equipment's expected performance. In some cases they depend upon the configuration of controls and fittings of the boat on which the engine is installed. Although they may differ from the contents of this manual, please refer to yard instructions or to a specific manual thereof.

The information contained herein are updated as of the date of their publishing.

The Manufacturer reserves the right of applying changes without notice and at any time, for technical or commercial reasons and in order to make engines compliant with the law requirements of the different countries.

The Manufacturer waives any liability for any errors or omissions.

The FPT Customer Service Network competence and professionalism of the Customer Service Network is always available wherever you are.

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■ GENERAL

GUARANTEE

In order to obtain the engine best performance and to make use of FPT guarantee it is necessary to strictly observe the instruction contained in this manual. Failure to do so may cause the guarantee to become invalid.

SPARE PARTS

In order to maintain the original integrity of the engine, it is essential to use only FPT genuine spare parts. Using non genuine spare parts may cause the guarantee to decay and waives any FPT liability for the entire life of the engine.

LIABILITIES

The Manufacturer's liability is subject to the execution of the control and maintenance interventions contained and described in this manual, the performance of which shall be duly proven. Should any extraordinary maintenance intervention be required, it shall be carried out by qualified staff at FPT shop, using the specific instruments and equipment.

SAFETY

The following information is provided in order to bring the attention to the use of the engine in order to prevent any damage to people and properties arising out of misconduct.

- ❑ Engines should be used exclusively for the applications stated by the manufacturer.
- ❑ Any tampering, modifications, or use of non-original parts may jeopardize the safety of service personnel and boat users; **absolutely avoid** any change to cables or units of the engine or to connect it to foreign electric networks.
- ❑ Pay attention to the moving parts of the engine, to those with high temperature and to the circuits with pressurized fluids, as the electric equipment is subject to voltage and electric currents.
- ❑ Engine exhaust gases can be dangerous for health.
- ❑ Engine displacement should take place with suitable lifting means, using the special eyelets provided.
- ❑ Do not commission the engine before having met the safety requirements provided for the boat on which it has been installed and observe local rules and regulations.
- ❑ Any required intervention in order to improve use and conservation of the engine should be carried out exclusively by FPT approved staff.

See INSPECTIONS AND MAINTENANCE for further safety recommendations.

ENGINE TECHNICAL DATA C87 ENT M38.10

The technical acronym and the serial number are specified on the nameplate which - based on the model - can be found on different parts of the engine: flywheel casing, tappet cover, coolant pan.

Acronym	C87 ENT M38.10
Engine family	F2C
Cycle	4-Stroke Diesel
Number and arrangement of cylinders	6, in line
Stroke boring	117 x 135 mm
Total displacement	8,710 cm ³
Air supply	Boosted (TC)
Injection method Direct	Direct/Common rail electronically managed
Engine rotation direction	Counterclockwise (from flywheel side)
Weight without liquids	970 kg
Electrical system	24 V
Battery/ies capacity	120 Ah or higher
breakaway current	2x900 A or higher

Available ratings (*)	C87 ENT M38.10
C	301 kW (410 HP) @ 2000 rpm
D	280 kW (380 HP) @ 2000 rpm

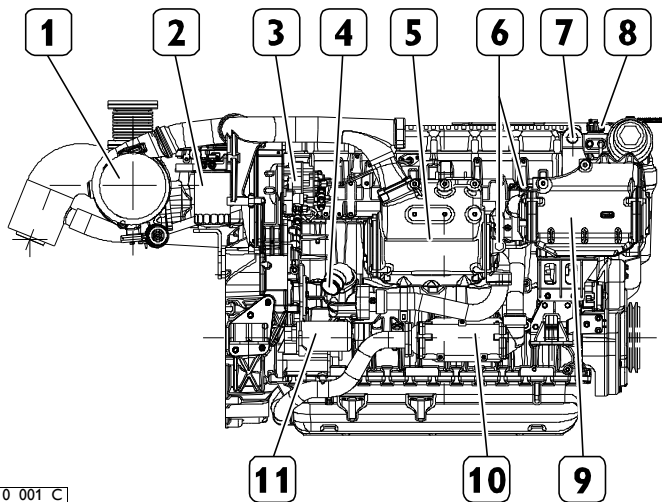
(*) Flywheel net power compliant with ISO 3046-1 standard. Testing conditions: T 25 °C; atmospheric pressure 100 kPa; relative humidity 30%.

C = Medium duty. Full throttle operation < 25% of use period. Cruising speed at engine rpm < 90% of rated speed setting - Maximum useage 3000 hours per year.

D = Heavy duty. Maximum rating utilisation up to 100% of use period for unlimited hours per year.

WARNING

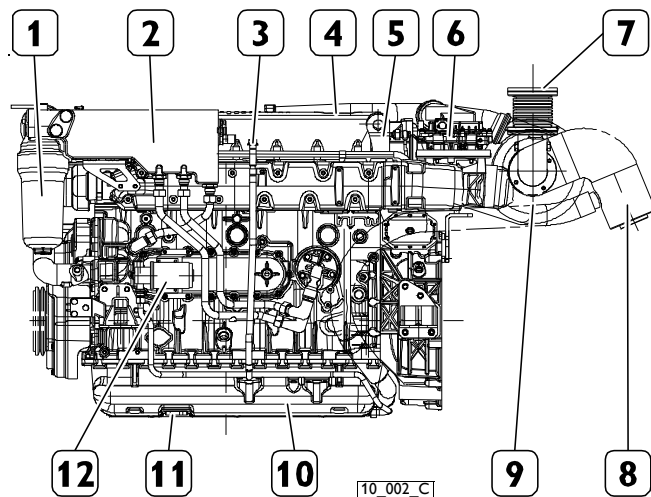
It is strictly forbidden to alterate the above mentioned features and more specifically to change the information stored in the electronic units of the injection system or the engine and relevant fitting features. Any non observance of the above shall null any warranty and FPT liability.



10_001_C

C87 ENT M38.10

1. Air filter – 2. Fuel filter – 3. High-pressure pump for common rail system – 4. Sea water pump inlet – 5. Air/sea water heat exchanger – 6. Sacrificial anode – 7. Lifting U-bolt – 8. Coolant refill cap – 9. Engine coolant-sea water heat exchanger – 10. Inverter oil heat exchanger – 11. Electrical starter motor



10_002_C

C87 ENT M38.10

1. Switchable oil filters (only for version C87 ENT M38.10) – 2. Coolant expansion tank – 3. Oil dipstick – 4. Oil filler cap – 5. Lifting U-bolt – 6. Electronic control unit – 7. Chimney exhaust gas (pot.) – 8. Exhaust gas and sea water discharge – 9. Turbocharger – 10. Oil sump – 11. Oil discharge plug – 12. Oil sump emptying pump.

ENGINE TECHNICAL DATA C87 ENT M62.10

The technical acronym and the serial number are specified on the nameplate which - based on the model - can be found on different parts of the engine: flywheel casing, tappet cover, coolant pan.

Acronym	C87 ENT M62.10
Engine family	F2C
Cycle	4-Stroke Diesel
Number and arrangement of cylinders	6, in line
Stroke boring	117 x 135 mm
Total displacement	8,710 cm ³
Air supply	Boosted (TC)
Injection method Direct	Direct/Common rail electronically managed
Engine rotation direction	Counterclockwise (from flywheel side)
Weight without liquids	970 kg

Electrical system	24 V
Battery/ies capacity	120 Ah or higher
breakaway current	2x900 A or higher

Available ratings (*)	C87 ENT M62.10
A1	426 kW (580 HP) @ 2530 rpm
A1	456 kW (620 HP) @ 2530 rpm
A2	405 kW (550 HP) @ 2530 rpm
B	368 kW (500 HP) @ 2530 rpm
C	331 kW (450 HP) @ 2530 rpm

(*)Flywheel net power compliant with ISO 3046-1 standard. Testing conditions: T 25 °C; atmospheric pressure 100 kPa; relative humidity 30%.

A1 = High performance crafts.

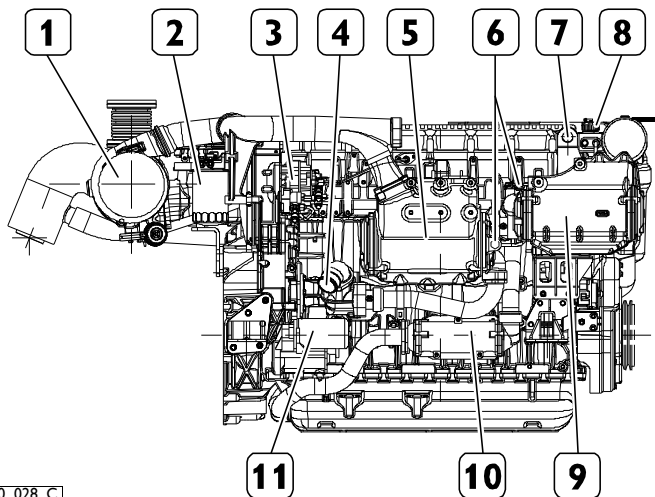
A2 = Pleasure/commercial vessels. Full throttle operation restricted within 10% of total use period. Cruising speed at engine rpm < 90% of rated speed setting - Maximum usage: - 300 hours per year (A1 service); - 1000 hours per year (A2 service).

B = Light duty. Full throttle operation restricted within 10% of total use period. Cruising speed at engine rpm < 90% of rated speed setting - Maximum usage 1500 hours per year.

C = Medium duty. Full throttle operation < 25% of use period. Cruising speed at engine rpm < 90% of rated speed setting - Maximum usage 3000 hours per year.

WARNING

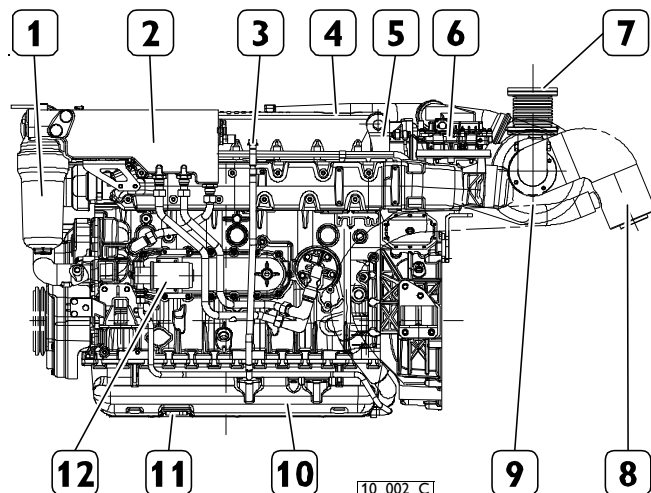
It is strictly forbidden to alterate the above mentioned features and more specifically to change the information stored in the electronic units of the injection system or the engine and relevant fitting features. Any non observance of the above shall null any warranty and FPT liability.



10_028_C

C87 ENT M62.10

1. Air filter – 2. Fuel filter – 3. High-pressure pump for common rail system – 4. Sea water pump inlet – 5. Air/sea water heat exchanger – 6. Sacrificial anode – 7. Lifting U-bolt – 8. Coolant refill cap – 9. Engine coolant-sea water heat exchanger – 10. Inverter oil heat exchanger – 11. Electrical starter motor



10_002_C

C87 ENT M62.10

1. Oil filter – 2. Coolant expansion tank – 3. Oil dipstick – 4. Oil filler cap – 5. Lifting U-bolt – 6. Electronic control unit – 7. Chimney exhaust gas (pot.) – 8. Exhaust gas and sea water discharge – 9. Turbocharger – 10. Oil sump – 11. Oil discharge plug – 12. Oil sump emptying pump.

LABELS

Below you can find the explanation of the caution labels located on the engine.

NOTE: Labels with an exclamation point highlight a potential danger.



Lifting point (engine only).



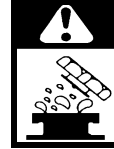
Fuel refill plug
(on tank, if available).



Lubricant refill plug.



Lubricating oil dipstick.



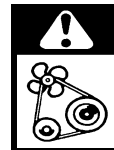
Burn hazard:
Pressurised hot water expulsion.



Burn hazard:
High temperature parts.



Fire hazard:
Fuel presence.



Hazard of collision and contact
with moving parts:
Presence of fans, pulleys, belts or other.

■ USE

PRELIMINARY TESTING

Before each engine startup:

- ❑ Make sure that the sea water intake valve is open. Dry operation of the pump would cause in few seconds irreparable damages to the internal rotor.
- ❑ Check technical fluids level (fuel, engine oil and coolant).

WARNING!



Before starting up the engine make sure no comburent vapour or gas is in the engine room.

STARTING AND STOPPING THE ENGINE

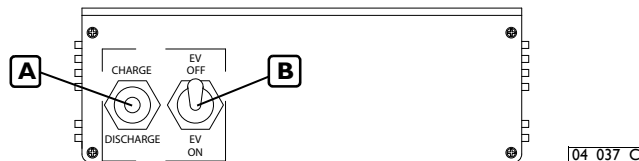
For boats equipped with instrument panel not manufactured by FPT

Start-up and shut-down modes described on the following pages are applicable if an FPT instrument panel is installed on board. Should the boat be equipped with a customized dashboard which has been manufactured at the Yard or by the Boat builder, such procedures may change based on the panel's specific features. In such cases please observe the Yard's startup/stop sequences and read the indication instruments as specified in the relevant documentation.

Engines equipped with pre-lubrication electric system

The pre-lubrication feature is started by acting on the power switch of the electrical system and the relevant warning light lits up.

The engine startup sequence described in the following pages shall take place after the required pre-lubrication time has elapsed and the warning light is turned off or only after the warning light has gone out.



04_037_C

- Electronic pre-lubrication and transfer unit -

Pre-lubrication of engine parts can also be carried out in manual mode. If necessary, proceed as follows:

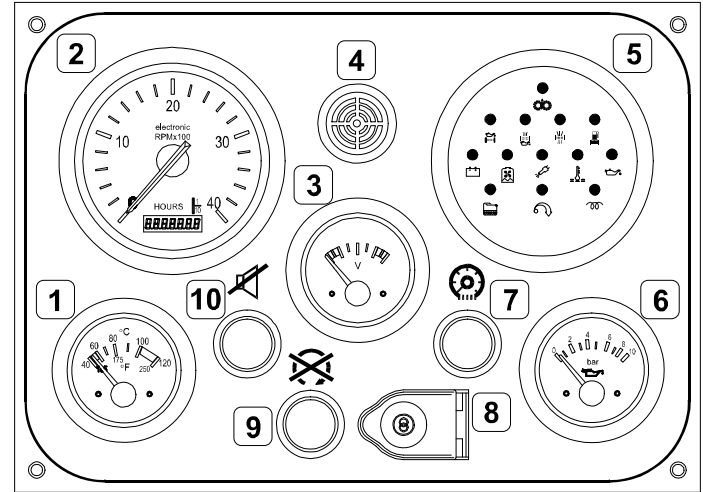
1. Ensure that the ignition key switch is turned off (STOP).
2. Check that switch **B** on the pre-lubrication electronic unit is in "EV OFF" position, then press the adjacent pushbutton **A** towards "DISCHARGE".
3. Keep the pushbutton pressed long enough to allow complete pre-lubrication.
4. Start the engine as described on the following pages.

ENGINE START-UP AND SHUT-DOWN FROM FPT ANALOGUE INSTRUMENT PANEL

Start-up procedure from main panel

Make sure that the electric switch with ENGINE ROOM - BRIDGE label on the Relay box unit, (usually located in the engine room) is turned to BRIDGE, then proceed as follows:

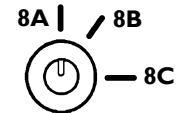
1. Lift the key switch safety cover (8), insert the key and turn it to the right, to **8B** position.
2. Check that the analog instruments provide acceptable reading with the values of the relevant physical parameters (temperature, battery voltage and oil pressure).
3. Wait for the acoustic alarm to stop and that the alarm warnings (5) on the signaling module are switched off (except for "alternator anomaly" and "oil low pressure"). At the same time check that testing of indicators is successful (see relevant section as regards test reading and module indication instructions).
4. Turn the key to **8C** position and release it without accelerating when the engine has started.
5. Check that the analog instruments provide acceptable reading with the new values of the relevant physical parameters (temperature, battery voltage and oil pressure).
6. In case startup fails, you can resume startup position only after releasing the key and after turning the switch **8A** to the stop position.



08_057_C

1. Coolant temperature indicator - 2. Tachometer and hour counter - 3. Voltmeter - 4. Horn - 5. Alarms and signaling module 6. Engine oil pressure indicator - 7. Panel instruments light switch - 8. Key switch for engine startup/stop - 9. Engine stop push button - 10. Horn silencing push button.

Switch key detail



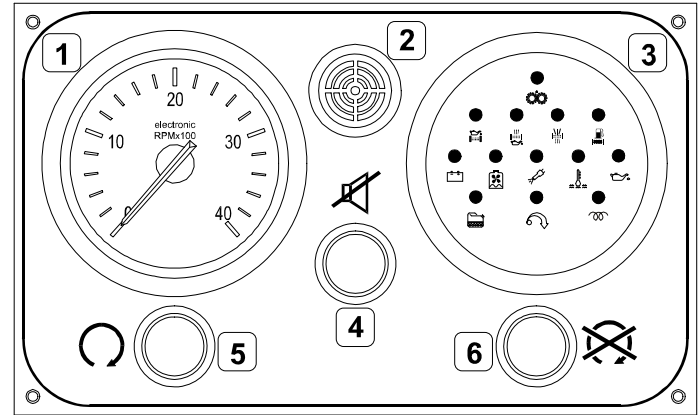
04_356_N

WARNING

For the onboard control panels to fully perform their relevant operations during navigation, it is essential that the engine startup is done only after the completion of warning lights and horn testing.

Start-up procedure from secondary panel (fly-bridge)

- 1 **Enable the secondary panel operation by turning the key switch on the main panel to 8B position** (see instructions and procedure described in the previous paragraph).
2. Wait for the acoustic alarm to stop and that the warning lights (3) on the signaling module are switched off (except for "alternator recharge" and "oil low pressure"). At the same time check that testing of indicators is successful (see relevant section as regards test reading and module indication instructions).
3. Press the green push button (5) and release it upon startup.
4. Check that the revolution indicator reading is acceptable.



08_056_C

1. Rev counter - 2. Horn - 3. Alarms and signaling module - 4. Horn silencing push button - 5. Engine Start push button - 6. Engine stop push button.

Engine stop

Before stopping the engine it is recommended to keep it running at idle and unloaded for few minutes; this will allow for a uniform reduction of temperature and avoid harmful thermal shocks.

- A. You can choose between two different procedures to stop the motor from the **main FPT panel**:
- Turn the key switch from + 15 to OFF (**8A**);
 - Press the motor stopping button (9) (the stop button cuts off the power supply to the coil of a relay), then turn the key switch to OFF. When the button is released the system checks all the functions connected to the panel.



For RINA homologated systems only:

Turn the key switch to OFF (**8A**), then press the motor stopping button (9) (the motor stopping button will excite the coil of a relay).

NOTE: In the case of emergency braking or dangerous situations, press the buttons to stop the engine. Then, to stop the supply to the engine control unit, turn the ignition switch to the OFF (**8A**) position and press the RINA (9) stop button.

- B. To stop the **FPT secondary panel** press the red push button (6) located on it.

To restart the engine from the main panel:

1. Turn the key switch to the stop position **8A** to reset any panel operation enabled.
2. Proceed as shown.

To restart the engine from the secondary panel:

1. Make sure the panel is enabled (key switch on the main panel turned to **8B**).
2. Press the green push button (5) and release it when it has started, making sure that the revolution indicator reading is acceptable.

RECOGNIZING ALARM STATUSES

FPT onboard panels equipped with analog instruments include an electronic module with indicator lights and interface circuits, timing and saving of alarms.

The figure shows the module quadrant and the legend contains the meaning of the alarm pictorial corresponding to each light indicator; in some engine type and relevant fitting are not equipped with all of the features mentioned herein.

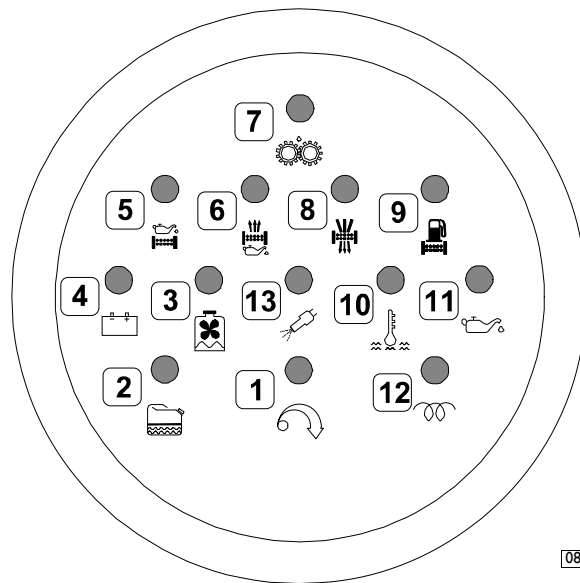
Moreover these instructions may change based on the technical features provided by the boat manufacturer.

Operation

By rotating the key switch to **8B** position the alarms and signaling module performs a 5 seconds efficiency test of all light indicators, except for those concerning "Pre-lubrication", "Pre-post heating", "EDC system fault", and the horn beeps.

The beep may be silenced before the end of the test, by pushing the relevant button.

During the startup phase and for the next 15 seconds, any alarm function is inhibited; after such time interval each alarm condition detected by sensors on the engine causes the relevant indicator to blink and a simultaneous sound signal. The horn silencing obtained by pressing the relevant push button causes the non-blinking indicator to turn on and saves the alarm until the next engine stop.



08_058_C

1. Maximum allowed speed (on request) - 2. Water in the fuel pre-filter- *3. Engine coolant low level - 4. Alternator anomaly - *5. Oil filter clogging - *6. Oil vapors filter clogging - *7. Pre-lubrication running - 8. Air filter clogging - *9. Fuel filter clogging - 10. Coolant high temperature - 11. Oil low pressure - *12. Pre-post heating - 13. EDC injection system fault.

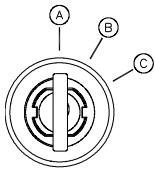
*Alarm features not available with standard fitting.

STARTING AND STOPPING THE ENGINE FROM THE DIGITAL INSTRUMENT PANEL

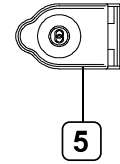
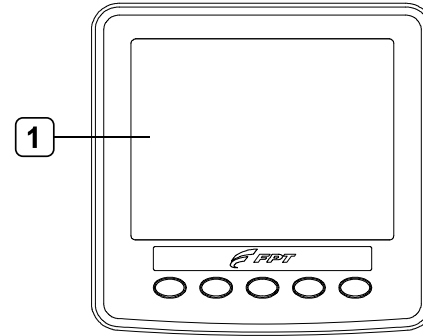
Starting procedure from main FPT panel

Make sure that the electric switch with the words ENGINE ROOM - BRIDGE in the relay box (normally located in the machine room) is in the BRIDGE position, then proceed as follows:

1. Lift up the protective cover for the ignition switch (5), introduce the key and turn it to the right to position B.
2. Check that the panel readings are plausible with the physical parameter figures.
3. Wait for the acoustic alarm signal to stop, except for "Alternator faulty" and "Loe oil pressure" and, at the same time check that the outcome of the test is positive (see RECOGNITION OF ALARM STATES section).
4. Turn the key to position C; once the engine is started, release it avoiding accelerating.
5. Check that the readings are plausible with the new physical parameter figures (temperature, oil pressure and voltage).
6. If starting fails, after having released the key it will only be possible to return to the starting position after having placed the switch in rest position A.



View of switch with key



08_019_N

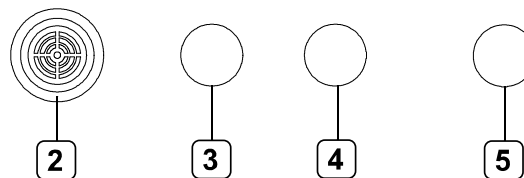
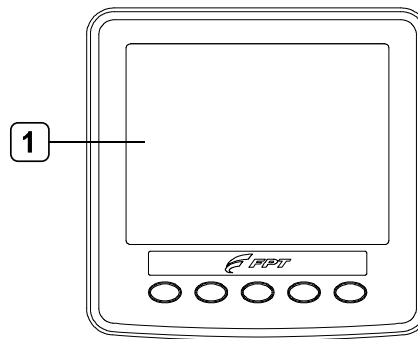
1. Engine control panel - 2. Horn / Horn relay - 3. Horn inhibitor button - 4. Energizing cut out button - 5. Ignition switch for starting/stopping engine

The elements described above are supplied loose by FPT and it will be the responsibility of the Shipyard or the Fitter to position them in the instrument panel.

Starting procedure from secondary FPT panel or fly-bridge

(supplied on request)

1. Enable the secondary panel for operation by placing the ignition switch for the main panel in position B (instructions and procedure in the next paragraph).
2. Wait for the alarm to stop and the alarm indicators to go out except for the "Alternator faulty" and "Low oil pressure" (see RECOGNITION OF ALARM STATES section).
3. Press the green START button (3) and after starting release it checking that the readings are plausible with the new physical parameters.



[08_020_N]

1. Engine control panel - 2. Horn - 3. Engine starting button - 4. Horn inhibitor button - 5. Engine cut out button (energizing or de-energizing).

The elements described above are supplied loose by FPT and it will be the responsibility of the Shipyard or the Fitter to position them in the instrument panel.

Stopping the engine

Before stopping the engine it is advisable to keep it turning over for several minutes idling in no load conditions; this will allow a uniform reduction of the temperature and prevent damaging thermal shock.

A. **From the main FPT panel:** on standard systems the engine is stopped by turning the ignition key to the rest position **A**..



For RINA homologated systems only:

Turn the key switch to OFF (**A**), then press the motor stopping button (4) (the motor stopping button will excite the coil of a relay).

NOTE: In the case of emergency braking or dangerous situations, press the buttons to stop the engine. Then, to stop the supply to the engine control unit, turn the ignition switch to the OFF (**A**) position and press the RINA (4) stop button.

B. From the **secondary FPT panel:** the engine is stopped by pressing the red STOP button (5).

To restart the engine from the main panel:

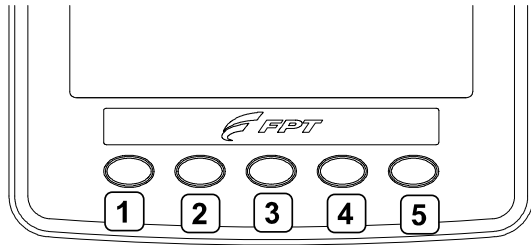
1. Turn the ignition key to the rest position **A** to reset all the functions carried out by the control panels.
2. Proceed as described in the appropriate paragraph.

To restart the engine from the secondary panel:

1. Make sure that the panel is enabled (main panel ignition switch in position **B**).
2. Press the green START button (3) and after starting release it checking that the readings are plausible.

DIGITAL MONITOR FOR READING ENGINE PARAMETERS AND DISPLAYING ALARMS

The digital monitor for reading the engine operating parameters has an instrument bar at the bottom of the screen that summarizes the structure displayed by each individual button in the form of a symbol. The choice of function is made by pressing the corresponding button, from left to right. The instrument bar disappears after 5 seconds of inactivity.



08_021_N

Button 1	Button 2	Button 3	Button 4	Button 5
Display of parameters in three independent windows	Display of parameters in four independent windows	Graphic display of parameters time progress in one single window	Alarm display.	Monitor adjustment and contrast or, if pressed for 3 seconds, access to configuration menu







When the display is turned on an initial screen with the FPT logo appears for about 7 seconds. The display will carry out an autodiagnosis at the same time. If the display gives a "beep" for more than a second this means that the autodiagnosis has failed.















As soon as the initial screen with the FPT logo disappears, the monitor will show the readings of its virtual indicators (Tri screen). A few moments later the last screen displayed before switching off will appear.

Display of engine version parameters (in standard configuration)

The table lists the parameters transmitted by the CAN line (J1939) and displayed on the control monitor in the modes described previously: screen with one, three or four windows. The DB in the table indicates the internal data base that stores all the data transmitted by the engine. The complete list of the internal data base can be consulted, on the monitor, by means of the configuration menu under the item "DB Viewer". If the parameter requested is not available it will not be possible to select it and if it becomes unavailable during the display the following will be shown on the monitor "- - -".

SYMBOL	PARAMETER	Datalinks		Screen windows			
		J1939	3	4	I	DB	
ELECTRICAL SECTION Volt or Ampere							
	Battery voltage	√	√	√	√	√	√
Fuel (L, Gal, lGal) o (L/h, Gal/h, lGal/h) o (km/L, MPG, o lMPG)							
	Residual fuel with GPS	√	√				√
	Instantaneous Fuel Economy	√	√				√
Distance (km, milia, o Nmilia)							
	Remaining distance with GPS	√	√	√			

SYMBOL	PARAMETER	Datalinks		Finestre schermo			
		J1939	3	4	I	DB	
Pressure (kPa, PSI o bar)							
	Barometric pressure	√	√	√			√
	Turbocharging pressure	√	√	√			√
	Engine oil pressure	√	√	√	√	√	√
Temperature (°C o °F)							
	Engine coolant temperature	√	√	√	√	√	√
	Fuel temperature	√	√				√
	Exhaust gas temperature	√	√	√	√	√	√
Percentage (%)							
	Acceleration position	√	√	√	√		
	Refrigerant level	√	√	√	√		
	Engine torque current percentage	√	√	√	√		
	Engine torque at rpm	√	√	√	√		
Speed (RPM, km/h, MPH o KTS)							
	Engine speed	√	√	√	√	√	√
Time (h)							
	Total hours of engine operation	√	√				

Alarm display



When an active alarm is received by the monitor a flashing window or a general alarm symbol appears depending on the control unit setting, superimposed on the screen in use at the time with the failure warning. A warning sound is activated at the same time.

TOTAL ALARMS : 10		FAIL MODE
SRC	DESCRIPTION	
10	ENG OIL PRESS. ENG HRS : 1257 SPN : 100 OCC CNT : 8	TOO LOW MS FMI : 1
9	AIR INLET PRESS. ENG HRS : 1257 SPN : 106 OCC CNT : 10	FMI : 2B
8	AIR INLET TEMP. ENG HRS : 1257 SPN : 105 OCC CNT : 9	UNKNOWN FMI : 11

The list of active alarms is accessed by pressing any of the buttons. The alarms that have not yet been recognized are grey on a black background.

TOTAL ALARMS : 10		FAIL MODE
SRC	DESCRIPTION	
10	ENG OIL PRESS. ENG HRS : 1257 SPN : 100 OCC CNT : 8	TOO LOW MS FMI : 1
9	AIR INLET PRESS. ENG HRS : 1257 SPN : 106 OCC CNT : 10	FMI : 2B
8	AIR INLET TEMP. ENG HRS : 1257 SPN : 105 OCC CNT : 9	UNKNOWN FMI : 11

After recognizing the alarms the screen returns to black characters on a grey background and the possibility of exiting the screen returns ("door open" symbol).

WARNING

The seriousness of the alarm is displayed in the flashing window:

MS: VERY SERIOUS

MOD: MODERATELY SERIOUS

LS: LESS SERIOUS

Memorizing alarms

When accessing the list of alarms memorized the display automatically shows the most recent alarm. It is possible to scroll through the list using buttons 1 and 2 under the arrows (↓ and ↑). It is not possible to exit this screen until all the alarms have been recognized. Recognition of the alarms takes place by pressing button 3 (under the HOLD RESET symbol). The alarms are automatically cancelled when no alarm signal is transmitted to the monitor for a long time.

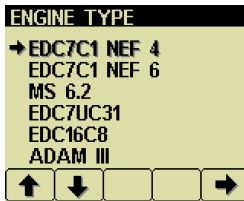
TOTAL STORED ALARMS : 7		
SRC	DESCRIPTION	FAIL MODE
6	ENG OIL FILTER PRESS. SPN : 99 OCC CNT : 5	DISCONNECTED FMI : 5
5	ENG OIL LEVEL SPN : 98 OCC CNT : 4	VOLTAGE LOW FMI : 4
4	WATER IN FUEL SPN : 97 OCC CNT : 3	VOLTAGE HIGH FMI : 3

The alarms memorized can be displayed by pressing button 4. If no alarm is memorized an error message is displayed.

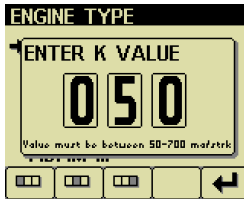
All the alarms memorized in the monitor can be deleted by pressing button 3.

Initial launch of engine control monitor

The FPT monitor for reading parameters can operate with 6 different types of engines. It will be the fitter or the rigger's job to programme the correct operating modes for the specific type of engine. The information relating to fuel consumption requires the correct programming of the maximum introduction data relating to the performance of the engine. Proceed as follows:



Using the buttons underneath the arrows (↓ and ↑) select the engine control unit. Once it is set, the screen for the engine control unit will not be displayed during the normal operation of the monitor.

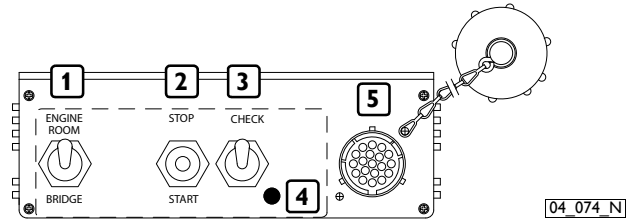


Keep the standard basic set value

MANAGING ENGINE FROM RELAY BOX

The engine fitting includes a "Box relay" unit which is usually located near the engine room and which provides management of the following functions:

- Start and stop.
- Control post selection: bridge or engine room.
- Revolution speed increasing and decreasing.
- Self-diagnosis test (only for Customer Service Network).



1. Control post selection - 2. Start/stop and manual speed-up control - 3. This button is not active - 4. Led not used with this fitting - 5. Diagnosis tool connector.

WARNING!



When the engine is rotating, do not operate the ENGINE ROOM / BRIDGE switch.

Startup procedure

1. Turn the switch to **1** ENGINE ROOM. The START-STOP (2) push button nearby is enabled; **this action disables any function of on board panels located on the bridge.**
2. Press the **2** push button to START position and release it until startup is obtained.
3. To speed down: press and hold the **2** button in the START position until the required speed is reached, then release; if repeated action toggles speed up and speed down. The speed reached at each change will be maintained until the next change or the engine stop.

Stop procedure

1. Press the **2** push button to STOP position until the engine is completely stopped.
2. Bring the switch **1** back to BRIDGE position to allow for the use of controls located on the on board bridge panels and to inhibit the use of the START-STOP button of the "Relay box".

FOR A CORRECT USE OF THE ENGINE

- Do not extend the startup control when the engine is started.
- Do not remain at the quay to wait for engine warm-up. After startup slowly start navigation. The correct operating temperatures are reached with the engine running at medium power.
- Do not proceed too long at slow speed as it enhances the production of harmful engine emissions and does not guarantee its better performance.
- Engine speed-up and speed-down should be performed gradually in order to allow a regular combustion and a better performance of all engine organs.
- Cruising maximum speed should not exceed 90% of maximum power (see ENGINE TECHNICAL DATA).
- During navigation check that:
 - Engine coolant temperature does not reach alarm thresholds.
 - Oil pressure is kept within the normal values provided.

SPECIAL WARNINGS

Coolant high temperature

In case the temperature on the instrument is excessive or an alarm is off, reduce speed and return to the harbor and check the sea water intake and cooling circuits status. The following should also be checked:

- water and alternator belts tensioning.
- thermostatic valve operation.
- cleaning of heat exchangers.

WARNING!



When the engine is hot, inside the cooling circuits a pressure is generated which can cause the sudden exit of the hot liquid, generating burn hazards. Open the coolant pan refill cap only if necessary and exclusively when the engine is cold.

Low lubricant pressure

In case the pressure reading on the instrument is considered not sufficient or if a "Low oil pressure" led turns on, stop the engine and check the oil level. Refill if necessary (see section CHECKS and MAINTENANCE).

Should signaling persist, return at low speed and contact an Customer Care Center.

Water in the fuel pre-filter

It's a good habit to drain the water inside filters before the relevant led turns on.

Avoid using the engine when the tank contains only the reserve fuel; such condition fosters the formation of condensation and the suction of sludge or air, causing the engine to stop.

WARNING!



Use the utmost care when refueling and avoid liquid or solid polluting agents to enter the tank. It is reminded that smoking or ignition of flames is prohibited during refueling.

Air filter clogging and inefficient exhaust circuit

Regularly inspect the cleaning of air suction inlets and exhaust piping. Maintenance intervals contained in this manual only take into account the performances of the engine parts and not of those parts manufactured at the Yard or any other external intervention.

WARNING!



Visually check that the exhaust circuit is not obstructed or damaged in order to avoid formation of hazardous fumes inside the hull.

Battery or alternator recharging fault

Periodically check or have checked the cleaning, wear and tensioning condition of the tensioning belt.

WARNING!



Tensioning parts are protected with safety casing. Remove them only when the engine is not running.

Anomalies in the electrical system

Periodically check, especially during the winter, the cleaning and efficiency condition of batteries. Proceed by checking and refilling as detailed in the CHECK AND MAINTENANCE section and observe the warning therein. In case batteries are replaced, observe the features detailed in GENERAL section.

WARNING!

Contact a specialised office and check battery and recharging system efficiency if the voltmeter indicates a voltage below 11 V (for 12 V rated systems), or 22 V (for 24 V rated systems).

RUNNING-IN

Thanks to the engine construction advanced technology, non special running-in procedure is required. However it is recommended to avoid at least for the first 50 hours, using the engine at high speeds for extended periods of time.

REFUELING

Parts to be refueled	380 HP liters (kg)	620 HP liters (kg)
Cooling circuit ⁽¹⁾	46	46
Cooling circuit ⁽²⁾ : Total capacity ⁽³⁾	29 (26)	28 (25.5)
Periodical replacement		
Oil pan at minimum level	15.5 (14)	15.5 (14)
Oil pan at maximum level	24 (21.5)	24 (21.5)
Fuel tank ⁽⁴⁾	-	-

- (1) Use a water and PARAFU 11 mixture at 50% also during summer. As an alternative to PARAFU 11, use a product complying with SAE J 1034 international standards.
- (2) Use lubricants complying with the following international specifications: ACEA E3 - E5 (high power engines).
The grade of viscosity to be used in relation to environment temperature can be found in the table in the appendix.
The oil consumption is considered as acceptable up to a quantity equal to 0.5% of fuel consumption.
- (3) The quantities shown refer to the first refueling and concern the refilling of engine, oil pan and filter.

- (4) Use only commercially available diesel oil (complying with EN 590 standard). Use of additives is recommended.

WARNING

Refuelling from drums or tanks may pollute diesel oil and therefore damage the injection system. If necessary filter or settle impurities before refueling.

Low temperature diesel oil

The EN 590 distinguished different classes of diesel oil and identified the characteristics of those more suitable for being used at low ambient temperatures.

It is the Oil company's responsibility to observe the regulations governing the distribution of fuels suitable to the climatic and geographic conditions in the different countries.

Marine gear oil refueling

For the quantity and type of oil to be used in the marine gear, consult the manual supplied by the Manufacturer.

■ INSPECTIONS AND MAINTENANCE

MAINTENANCE STAFF

Engine inspection and maintenance interventions described in the following section require training, skills and the observance of the safety regulations provided. Therefore only specialized staff can perform them as specified below.

❑ **Inspections:** shop operators or boat user if necessary.

❑ **Periodical maintenance:** qualified staff, equipped with suitable tools and protection gear. Interventions marked with a wrench (see picture).



❑ **Extraordinary maintenance:** Servicing Centers' qualified staff having the specific technical know-how and equipment. Interventions marked with a wrench (see picture).



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

ACCIDENT PREVENTION

- ❑ Always wear safety shoes and gear.
- ❑ Do not wear loose garments, rings, bracelets and/or necklaces near the engines or moving parts.
- ❑ Wear safety gloves and goggles when:
 - refilling batteries with acid solution

- refueling with inhibitors or deicers
- replacement or refueling of lubricant (hot engine oil can cause burns. Proceed with interventions only when it has reached a temperature lower than 50 °C).
- ❑ When performing interventions inside the engine housing, use utmost care when moving in order to avoid contact with rotating or high temperature items.
- ❑ Wear safety goggles when using compressed air (the maximum cleaning air pressure is 00 kPa (2 bar, 30 psi, 2 kg/cm²).
- ❑ Wear a hard safety hat if you work in an area with suspended loads.
- ❑ Use protective hand cream.
- ❑ Immediately replace wet overalls.
- ❑ Keep the engine always clean and eliminate oil, diesel and coolant stains.
- ❑ Place greasy rags in fireproof containers.
- ❑ Do not leave foreign bodies on the engine.
- ❑ Use suitable and safety container for exhaust oil.
- ❑ When the repair is finished, take the necessary steps to stop engine air suction in case, after start-up, an unrestrained increase of engine revolution occurs.

WARNING!



Avoid performing maintenance near a power source: check that the equipment is efficiently grounded. During diagnosis and maintenance operations make sure hands and feet are dry and always use insulating footboards.

FREQUENCY: 380 HP

Checks during periods of use	Frequency
Engine lubricant level inspection	Daily
Inverter lubricant level inspection	Daily
Engine coolant level inspection	Daily
Exhaust pipe/s integrity inspection	Daily
Water drain from fuel pre-filter	150 hours ⁽¹⁾
Inspection/restoring battery electrolyte solution level and cleaning of terminals	Every six months

The following frequencies take into account use factors that are typical of the different uses of the engine. The most suitable maintenance frequency will be specified by the maintenance staff based on the use and operating conditions of the engine.



Periodical maintenance:

Frequency

Air filter/s cleaning	300 hours ^{(2) (7)}
Zinc anodes corrosion	300 hours ^{(4) (7)}
Oil vapor filter status (an indicator may be available)	300 hours ⁽⁷⁾
Condensation draining/suction from fuel tank/s	300 hours ^{(1) (7)}
Engine lubricant replacement	600 hours ^{(5) (7)}
Unidirectional valve efficiency check pre-lubrication system	at each replacement lubricant
Oil filter/s replacement	600 hours ^{(5) (7) (8)}
Fuel filter/s replacement	500 hours ^{(1) (7) (8)}
Fuel pre-filter/s replacement	500 hours ^{(1) (7)}
Marine gear oil replacement	consult the manufacturer's data
Sea water intake inspection	900 hours
Check belt tension and conditions	every year
Coolant replacement	1200 hours or 2 years
Air filter replacement	2 years
Oil vapor filter replacement	500 hours ⁽⁵⁾



Extraordinary maintenance Frequency

Check sea water pump rotor wear	900 hours
Check the efficiency of the pre-post heating system (if available)	1200 hours or 3 years
Valve-rocker arms play adjustment	1200 hours
Auxiliary elements belt replacement	1200 hours or 3 years
Cleaning of heat exchangers	600 hours ⁽⁶⁾
Supercharger cleaning	900 hours ⁽⁷⁾

- 1) Maximum period for using good quality fuel (EN 590 standard). It is reduced based on the dependency on fuel contamination and on the alarm signals for filter clogging and/or water in the filter. The filter clogging warning requires its replacement. If the water in pre-filter alarm is not disabled after draining, the filter needs to be replaced.
- 2) Frequency is based on ambient and efficiency/wear conditions of the product. If the engine remains unused for long periods, perform the inspection before startup.
- 3) N.C.
- 4) Replace the anode only if corrosion exceeds 50% of zinc volume.
- 5) Frequency applicable to lubricants as provided in REFUELLING table.

- 6) Comburent air/sea water exchanger: clean both air and water sections; engine coolant/sea water exchanger: clean the sea water section; inverter oil/sea water exchanger (if available): clean the sea water section.
- 7) To be performed every year even if the operating hours expected are not met.
- 8) Use only filters with the following features:
 - filtering degree < 10 µm
 - filtering efficiency $\beta > 200$.


WARNING

In case fuel sulfur percentage exceeds 0,5% or oils not meeting the specifications provided in refueling table are used, oil, engine oil filter and oil vapor filter frequencies should be halved or adjusted to the engine use and operating conditions; for more information please refer to maintenance staff.

FREQUENCY: 620 HP

Checks during periods of use	Frequency
Engine lubricant level inspection	Daily
Inverter lubricant level inspection	Daily
Engine coolant level inspection	Daily
Exhaust pipe/s integrity inspection	Daily
Water drain from fuel pre-filter	150 hours ⁽¹⁾
Inspection/restoring battery electrolyte solution level and cleaning of terminals	Every six months

The following frequencies take into account use factors that are typical of the different uses of the engine. The most suitable maintenance frequency will be specified by the maintenance staff based on the use and operating conditions of the engine.

 Periodical maintenance:	Frequency
Air filter/s cleaning	300 hours ^{(2) (7)}
Zinc anodes corrosion	300 hours ^{(4) (7)}
Oil vapor filter status (an indicator may be available)	300 hours ⁽⁷⁾
Condensation draining/suction from fuel tank/s	300 hours ^{(1) (7)}
Engine lubricant replacement	300 hours ^{(5) (7)}
Unidirectional valve efficiency check pre-lubrication system	at each replacement lubricant
Oil filter/s replacement	300 hours ^{(5) (7) (8)}
Fuel filter/s replacement	500 hours ^{(1) (7) (8)}
Fuel pre-filter/s replacement	500 hours ^{(1) (7)}
Marine gear oil replacement	consult the manufacturer's data
Sea water intake inspection	900 hours
Check belt tension and conditions	every year
Coolant replacement	1200 hours or 2 years
Air filter replacement	2 years
Oil vapor filter replacement	300 hours ⁽⁵⁾



Extraordinary maintenance Frequency

Check sea water pump rotor wear	900 hours
Check the efficiency of the pre-post heating system (if available)	1200 hours or 3 years
Valve-rocker arms play adjustment	1200 hours
Auxiliary elements belt replacement	1200 hours or 3 years
Cleaning of heat exchangers	300 hours ⁽⁶⁾
Supercharger cleaning	900 hours ⁽⁷⁾

- 1) Maximum period for using good quality fuel (EN 590 standard). It is reduced based on the dependency on fuel contamination and on the alarm signals for filter clogging and/or water in the filter. The filter clogging warning requires its replacement. If the water in pre-filter alarm is not disabled after draining, the filter needs to be replaced.
- 2) Frequency is based on ambient and efficiency/wear conditions of the product. If the engine remains unused for long periods, perform the inspection before startup.
- 3) N.C.
- 4) Replace the anode only if corrosion exceeds 50% of zinc volume.
- 5) Frequency applicable to lubricants as provided in REFUELLING table.

- 6) Comburent air/sea water exchanger: clean both air and water sections; engine coolant/sea water exchanger: clean the sea water section; inverter oil/sea water exchanger (if available): clean the sea water section.
- 7) To be performed every year even if the operating hours expected are not met.
- 8) Use only filters with the following features:
 - filtering degree < 10 μm
 - filtering efficiency $\beta > 200$.

WARNING

In case fuel sulfur percentage exceeds 0,5% or oils not meeting the specifications provided in refueling table are used, oil, engine oil filter and oil vapor filter frequencies should be halved or adjusted to the engine use and operating conditions; for more information please refer to maintenance staff.

PRESCRIPTIONS

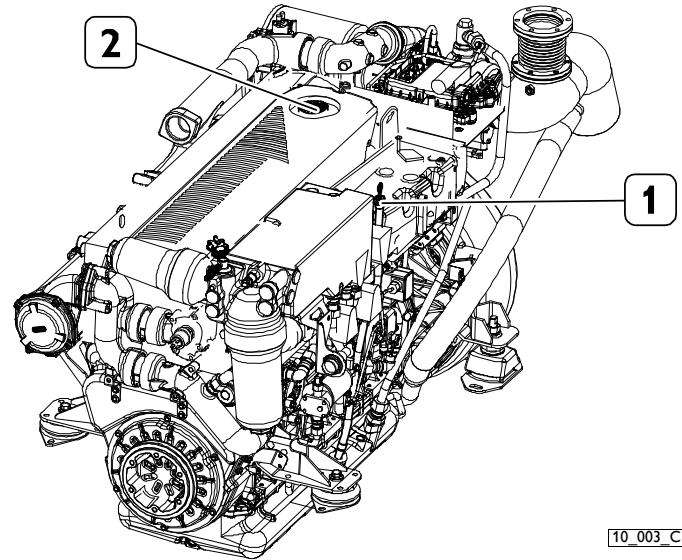
- ❑ Do not disconnect battery power when the engine is running.
- ❑ Do not perform arch soldering near the engine without having removed all electric connections and electronic units.
- ❑ After each service, check that clamps have been securely replaced on terminals after disconnection of the battery.
- ❑ After each maintenance involving disconnection of battery clamps, make sure they have been securely tightened on the relevant poles.
- ❑ Do not start the engine using the battery charger.
- ❑ Disconnect batteries from on board power source while they are being recharged.
- ❑ Do not paint equipment, components and electrical connectors of the engine fitting.
- ❑ Disconnect batteries from power source before any electrical intervention.
- ❑ Before on board installation of any electronic equipment, contact the Yard (two-way radio, echo sounder).

HOW TO

Engine lubricant level inspection

To avoid risk of burns only proceed when the engine is not running and is cool.

- ❑ Using the dip stick (1), that the oil quantity is included between "Min" and "Max" limits.
- ❑ Refill if level is insufficient, using the hole on top of cylinder head. Remove the cap (2)



10_003_C

WARNINGS

- ❑ After refilling make sure oil level does not exceed "Max" on the stick.
- ❑ Insert the dip stick all the way down and tighten the cap by turning it clockwise until it comes to a full stop.

Marine gear lubricant level inspection

Check oil level in the marine gear. Follow the instructions provided in the manual provided by the marine gear manufacturer.

Coolant level inspection

Proceed only with engine not running and at low temperature to avoid any risk of burns.

- ❑ Remove the filling pan pressure cap.
- ❑ Visually check that the fluid level is a few centimetres below the filler hole.
- ❑ If necessary, top up the reservoir using a mixture as shown in the REFUELING table. Do not completely fill the reservoir.

Exhaust pipe/s integrity inspection

Visually check that the discharge system of exhaust gases is not clogged not damaged.

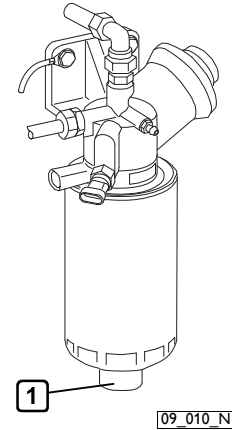
- ❑ Make sure there is no dangerous fumes inside the hull. Contact the Yard if necessary.

Water drain from fuel pre-filter

The high risk of refueling with fuel polluted with foreign bodies and water requires inspections to be performed even if no alarm is triggered on the on board panel.

Proceed with engine not running.

- ❑ Place a basin under the pre-filter in order to collect liquids.
- ❑ Unscrew the cock plug (1) located in the pre-filter lower section; in some fittings the plug includes the diesel oil water sensor.
- ❑ Drain the liquid until it is detected as "diesel oil" only.
- ❑ Manually close the plug by screwing completely.
- ❑ Dispose drained liquids observing current regulations in force.



Check the electrolyte solution level in batteries

Proceed by placing the batteries on an horizontal plane.

- ❑ Visually inspect that the liquid level is included between "Min" and "Max". If no reference marks is available, check that the liquid covers the lead plates in the elements by approximately 5 mm (0.20 in).
- ❑ If necessary refill only with distilled water those elements whose level is lower than the minimum.
- ❑ Check that terminals and clamps are clean, securely tight and protected with petroleum oil.

WARNING!

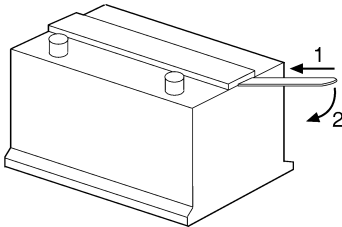
If all battery elements need topping up with a considerable quantity of distilled water, contact a specialised office and check battery and recharging system efficiency.

WARNING!



- ❑ Batteries contain sulfuric acid which is highly caustic and corrosive. Wear safety gloves and goggles when refilling. If possible, request specialized staff to perform the check.
- ❑ Do not smoke nor start flames near the batteries during checks and make sure the room is suitably ventilated.

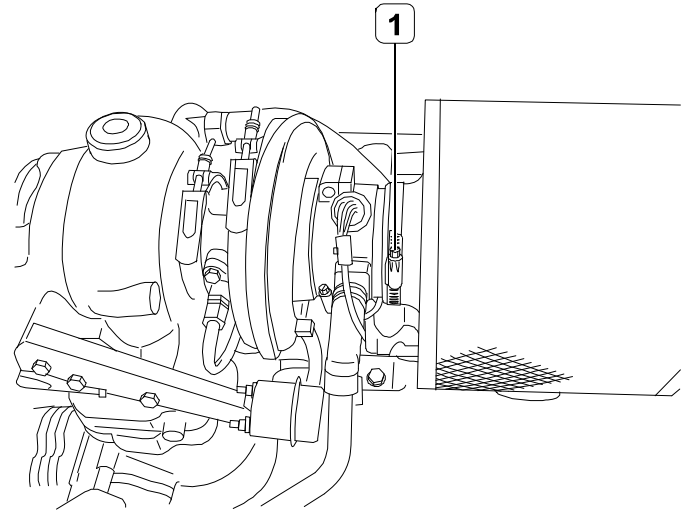
Some battery types are equipped with single cover for inspection plugs. To access the items, use a lever as shown in the figure.



04_362_N

Air filter/s replacement

- ❑ Remove the collar (1) shown in picture then remove the filter.
- ❑ Replace.
- ❑ Restore regular operating conditions after having placed the filter in its housing.



10_004_C

Zinc anodes corrosion inspection

Proceed with engine not running and at low temperature:

- Place the necessary basins in order to avoid water to spill off during removal of anodes.
- Unscrew and remove anodes (se relevant location in ENGINE TECHNICAL DATA).
- Make sure corrosion does not involve over 50 % of zinc volume. Otherwise replace them.
- Replace anodes in their housing and tighten to the required torque.

Oil vapor filter status

Proceed only with engine not running and at low temperature to avoid any risk of burns.

With choke sensor:

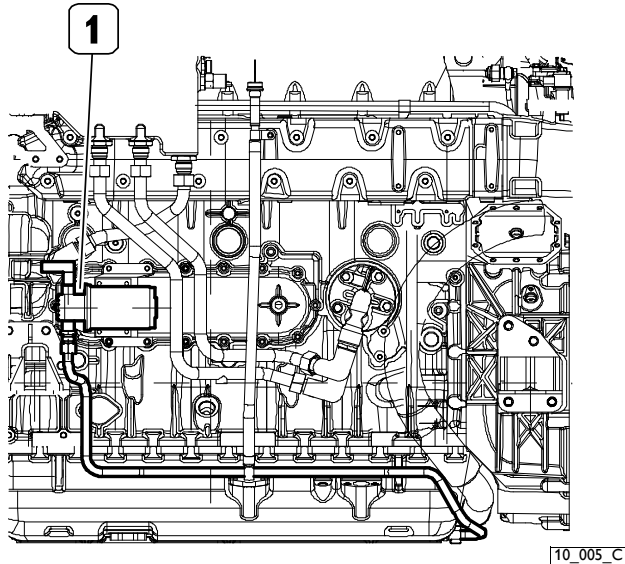
- If the sensor indicates that the filter is clogged, replace the filter as indicated in this document.

Without choke sensor:

- Carry out disassembly as instructed for replacement..
- Check that the filter element is free of deposits. Replace with a new element if deposits are present.
- Refit the filter in its seat as described for replacement.

Engine lubricant replacement

Proceed only with engine not running and at low temperature to avoid any risk of burns.



The above operations can be performed by acting on the push button located on the electronic module. For safety reasons controls are enabled only when the key switch is turned to **8A** (stop).

- Place under the cock (1) a container to collect the exhaust oil.
- Open the cock and press (A) towards DISCHARGE, until it is fully empty.



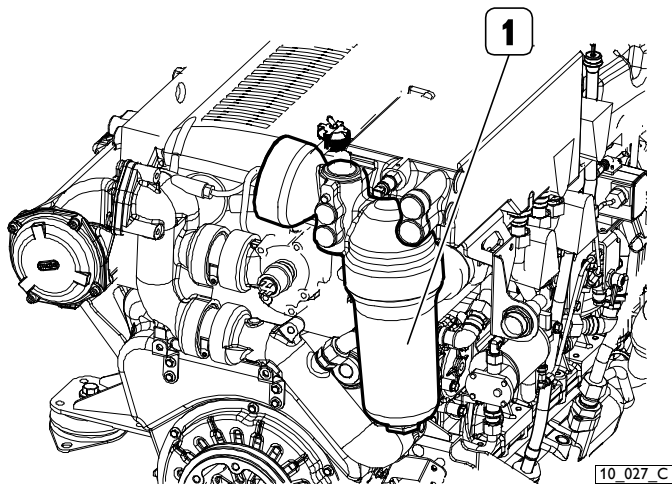
- Connect the cock to the new oil container and press the button towards CHARGE until filling is completed.
- Close again the charge/discharge tap and check - using the oil dipstick - that the oil level in the oil sump is between the range MIN e MAX.
- Dispose oil observing current regulations in force.

Oil filter replacement

Use only filters with filtering degree equal to the above ones (see FREQUENCY).

With traditional filter support

Proceed only with engine not running and at low temperature to avoid any risk of burns, after emptying exhaust oil.



- Place under the cock a container to collect the exhaust oil.
- Remove filters.
- Accurately clean surfaces.
- Moist seals of the new filters with some oil.

- Manually tighten until contact is made, then tighten again for 3/4 of turn.
- Dispose drained liquids observing current regulations in force.

WARNING!

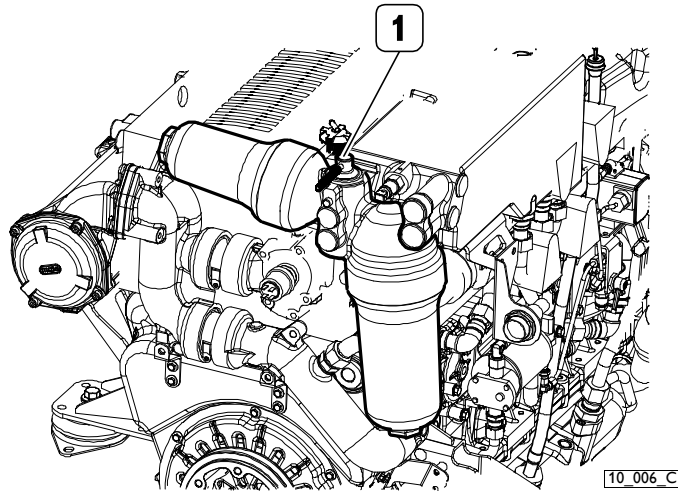


Proceed with utmost care, considering the fluid high temperature and the presence of moving parts. Always wear suitable personal protection equipped.

Filter support with exclusion levers

The support with exclusion lever allows replacing the filter also with running engine.

Under normal conditions, the selector (1) lever should be on the left. Only in the event of replacement should it first be positioned in the centre then on the right to allow the small (emergency) filter to operate.



Turn the lever (1) in the direction of the filter you want to exclude:

- Place under the cock a container to collect the exhaust oil.
- Remove filters.
- Accurately clean surfaces.
- Moist seals of the new filters with some oil.
- Manually tighten until contact is made, then tighten again for 3/4 of turn.
- Dispose drained liquids observing current regulations in force.

Put the lever back into its original position

WARNING!



Do not exclude both filters at the same time to avoid any damage.

WARNING!



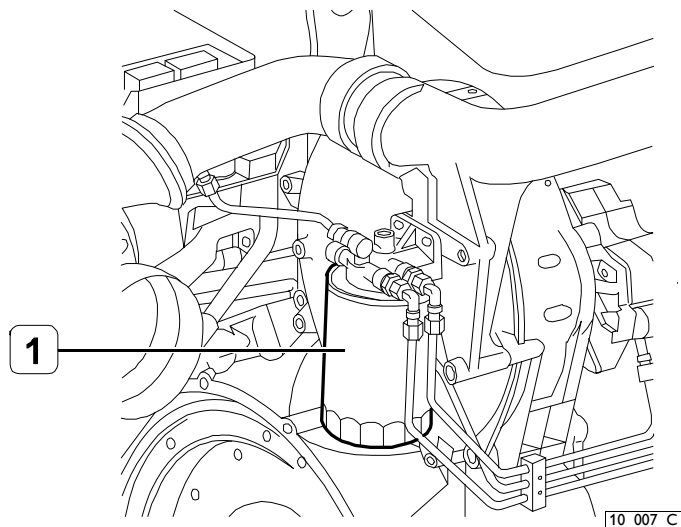
Proceed with utmost care, considering the fluid high temperature and the presence of moving parts. Always wear suitable personal protection equipped.

Fuel filter/s replacement

Proceed only with engine not running and at low temperature to avoid any risk of burns.

Use only filters with filtering degree equal to the above ones (see FREQUENCY).

- Loosen the bleeding connection on the filter support and act on the hand pump of the pre-filter until fuel flows out without air.
- Tighten the connection and start the engine acting on the pump, also during the first startup phases.



- Remove filter (1) by unscrewing it.
- Moist seals of the new filters with diesel or engine oil.
- Manually tighten until contact is made, then tighten again for 3/4 of turn.

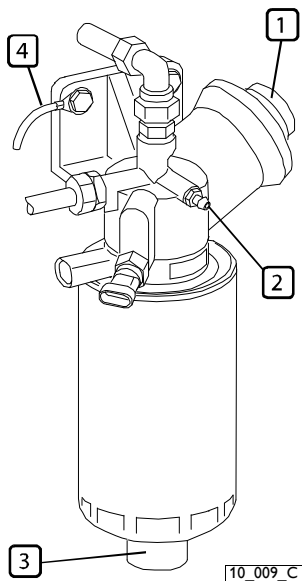
WARNING

Do not fill the new filter before placing in on the support, to avoid allowing impurities to enter and damage the circuit and the injection system.

Fuel pre-filter/s replacement

Proceed only with engine not running and at low temperature to avoid any risk of burns.

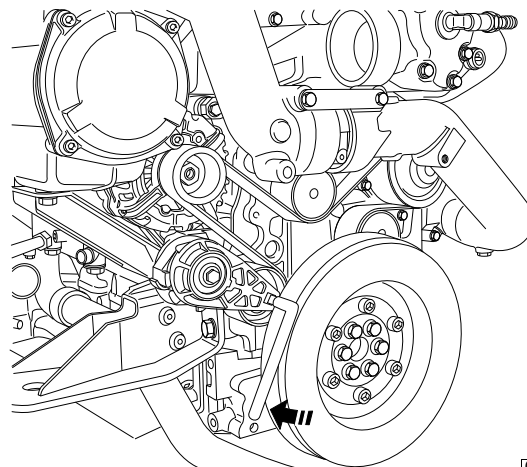
- ❑ Remove water presence sensor (3).
- ❑ Unscrew the water sensor (3) from the old pre-filter.
- ❑ Check that the new filter matches the engine requirements.
- ❑ Moist seals of the new filters with diesel or engine oil.
- ❑ Manually tighten until contact is made, then tighten again for 3/4 of turn.
- ❑ Replace the water sensor and check that threads match.
- ❑ Unscrew the bleeding connection (2) act on the manual pump (1) on the pre-filter support until the circuit is full.
- ❑ Start the engine and keep it running at idle to remove air excess.
- ❑ Check pre-filter support (4) grounding.



Check tension and conditions of auxiliary parts belt

Proceed only with engine not running and at low temperature to avoid any risk of burns.

- ❑ Remove pulley protection.
- ❑ Check that there are no tears in the belt and that it shows no obvious signs of wear and tear or of soiling from oil or fuel. Replace belt if these signs are present.
- ❑ Check tensioner efficiency by applying the tool to the tensioner as shown in the figure.
- ❑ Replace casing and tighten fastenings.



Coolant replacement

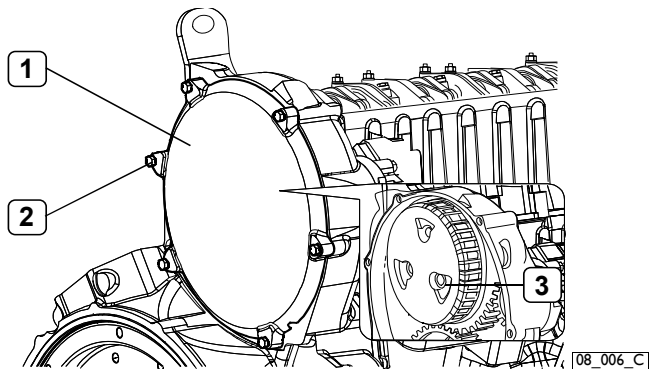
Proceed only with engine not running and at low temperature to avoid any risk of burns.

- ❑ Use basins to avoid coolant dispersion in the environment.
- ❑ Remove plugs on the circuit and wait for it to bleed completely (see ENGINE TECHNICAL DATA for location). When empty, replace the plugs back in their seats replacing the gaskets.
- ❑ Refill the circuit as described in REFILLING table.
- ❑ Degas and refill the circuit as instructed in section PRESCRIPTIONS FOR FIRST START-UP.

Replacing the blow-by filter

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

- ❑ Unlock screws (1) and remove cover (2). Remove the centrifugal filter (3) underneath and replace it.

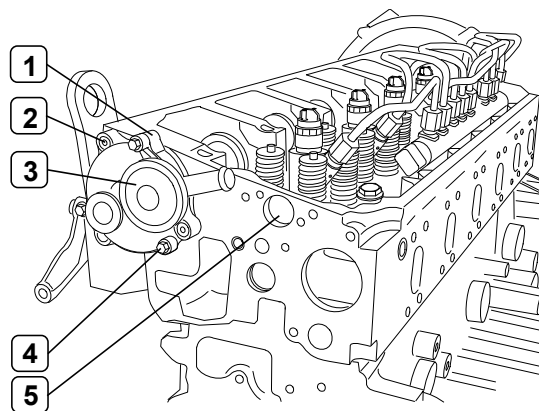


WARNING!



The blow-by casing should be fitted perfectly aligned with the camshaft in order not to damage the gasket.

- ❑ Install blow-by body (1) with related seal and lock screws (2) at required torque.
- ❑ Install cover (3) and lock screws (4) at required torque.





WARNING

Only FPT Servicing Centers or Yard staff may perform the following operations.

Please refer to the relevant technical and repair manuals.

Condensation draining/suction from fuel tank/s

Sea water intake inspection

Check sea water pump rotor wear

Check the efficiency of the pre-post heating system

Valve-rocker arms play adjustment

Cleaning of heat exchangers

Supercharger cleaning

See the marine gear Manufacturer's handbook.

MOVING THE ENGINE

Only Servicing Center staff can perform such operations.

To lift **only the engine** use the eyelets specified herein in the ENGINE TECHNICAL DATA section.

Lift using a rocker arm and keep ropes parallel, using the eyelets provided simultaneously. Use in smaller quantities than specified is not permitted. The engine lifting system should be suited to the engine weight and clearance. Make sure there is no interference between the lifting system and engine organs.

Do not lift the engine before removing its transmission organs.

EXHAUST PARTS DISMISSAL

The engine assembly includes parts and items which may cause ecological damages if released in the environment.

The materials listed should be delivered to special collection centers. Current regulations in different countries provide for severe punishment of transgressors.

- Start-up batteries.
- Exhaust lubricant oils.
- Water and deicer mixtures.
- Filters.
- Cleaning auxiliary material (ex. greaser rugs or soaked with fuel).

■ LONG ENGINE INACTIVITY

ENGINE PREPARATION FOR LONG INACTIVITY PERIODS

In case of prolonged inactivity and order to avoid oxidation of internal parts of the engine and of some components of the injection system, prepare the engine as follows:

1. Drain the lubricant oil from the pan, after warming up the engine.
2. Fill with 30/M protective oil (or an oil compliant with MIL 2160B type 2 specifications) until "minimum" level is reached on the dip stick. Start the engine and keep it running for 5 minutes.
3. Bleed the fuel from the injection circuit, the filter and from the injection pump piping.
4. Connect the fuel circuit to a tank containing protective liquid CFB (ISO 4113) and run the engine for 2 minutes after cutting out the injection system. This can be done by energizing terminal 50 on the starter with positive voltage equal to the system rate voltage, using a conductor.
5. Spray approximately 90 g of protective oil 30/M (10 g per liter of swept volume) on the supercharger suction intake, during the above motoring.

6. Close with plugs or seal any opening.
7. Drain any residual 30/M oil. Store for future use (enough for 2 preparations).
8. Apply ENGINE WITH NO OIL labels to the engine and on board panel.
9. Drain coolant, and place a label stating the operation has been completed.

In case of extended inactivity, repeat the above every 6 month, as follows:

- A) Drain from 30/M protective oil;
- B) Repeat from step 2.

In case protection of engine external parts is required, spray all unpainted surfaces with OVER 19 AR protection liquid, avoiding belts, cable connections and electric parts.

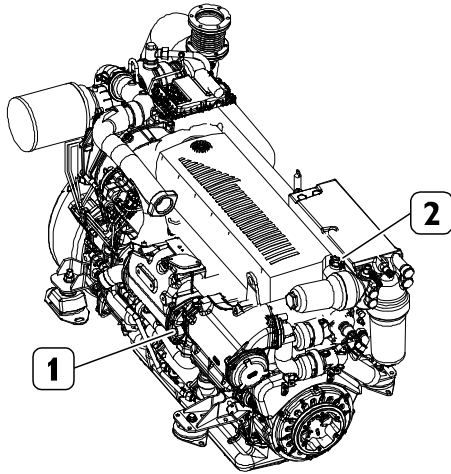
COMMISSIONING AFTER AN EXTENDED PERIOD OF INACTIVITY

1. Drain any residual 30/M protective oil.
2. Fill the engine with lubricating oil as provided in REFUELLING table.
3. Drain any protective liquid from the fuel circuit and follow the instructions provided in point 3 ENGINE PREPARATION FOR LONG INACTIVITY PERIODS.
4. Remove any closing and/or sealant. Connect the supercharger intake to the air filter.
5. Connect fuel circuits to the boat tank and follow the instructions provided in point 4 in ENGINE PREPARATION FOR LONG INACTIVITY PERIODS.

6. Check and refill the engine with coolant, as instructed.
7. Start the engine and keep it running until idle speed is stable.
8. Check that readings are acceptable and that no alarm is on.
9. Stop the engine.
10. Remove ENGINE WITH NO OIL labels from the engine and on board panel.

FIRST START-UP AFTER LONG INACTIVITY PERIODS

1. Refill the engine as provided in REFUELLING table.
2. Remove the sacrificial anode (1) and fill with 1.5 liters of water, in order to start the sea water pump.



3. Place the anode back into its housing and tighten as provided.
4. Degas the cooling circuit as follows:

Leave the engine idling and carefully loosen the screw (2) positioned on the coolant reservoir beside the cap.

After sufficient time, tighten the screws to the recommended torque, shut down the engine and recheck coolant level, topping up if necessary.

Do not disperse in the environment any liquid.

■ ENGINE FAULTS

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 you to navigate 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.

Fault in the accelerator electronic circuit

When the CENTRAL ELECTRONIC UNIT detects any fault, the strategies specified in "Accelerated minimum idle speed" section should be adopted, in order to proceed with emergency navigation.

Available operating modes are:

- A.** Accelerator lever "not responding": revolution sets to 750 rpm to allow slow navigation and maneuvering operating only on the inverter, **without accelerating**.
- B.** The accelerator lever "responds partially": engine speed with the lever at minimum is equal to 750 rpm. If you bring the accelerator to half way of its travel, the speed progressively increases to 2000 rpm. If you bring back the lever, speed will go rapidly back to 750 rpm.

WARNING!



The engine electronic unit may adopt safety strategies any time during navigation, whenever any risk condition for the engine is detected.

When such conditions arise, proceed with utmost care, and check that everyone on board is holding on securely.

NOTE: The "A" mode allows using higher speeds and managing start/stop functions as detailed in ENGINE OPERATION FROM RELAY BOX.

Always, **observe accident prevention** precautions detailed in INSPECTIONS AND MAINTENANCE.

WARNING!



*Engine operation from "Relay box" disables bridge controls; therefore **from the bridge the only way to stop the engine** is to act on the inverter disconnect lever.*

■ EMERGENCY ON BOARD

The boat user, if observing the instructions contained in this manual, will always be acting in safe conditions.

In case of accident, always request the immediate intervention of rescue staff.

The following is to be observed in case of emergency while waiting for rescue staff to arrive.

Engine breakdown

When navigating with broken engine, use utmost care when maneuvering and check that people on board are holding on securely. (see ENGINE BRAKEDOWN).

Fire

Extinguish using the equipment on board as required by competent authorities (current safety regulations provide for fire equipment on board).

Burns

1. Extinguish flames on clothing using:
 - water;
 - dust fire extinguisher;
 - blankets or rolling the victim on the floor.
2. Do not remove pieces of fabric from skin.
3. In case of burning from liquids, immediately but carefully remove soaked clothes.
4. Cover the burn with special sterile bandaging.

Carbon oxide intoxication (CO)

Carbon oxide contained in exhaust gases can be very dangerous.

In closed rooms it is very dangerous because it can reach dangerous concentration in a short time.

In case of intoxication in a closed environment:

1. Immediately vent the room.
2. Hold your breath when entering the room, do not turn on light, or activate any electric device including phones, to avoid explosions.
3. Bring the injured person outside.

Electrocution

The electric system does not involve electrocution however in case of short circuit, some risk of burn may arise. In such case:

1. Turn away the tool causing the short circuit using suitably thermally insulated means.
2. Turn off the mains, if available.

Injuries or fractures

Seek for immediate medical help.

1. In case of strong bleeding, press the wound until first aid arrives.
2. In case of fractures, do not move the part of the body involved and transfer the patient very carefully, and only if extremely necessary.

Skin burns

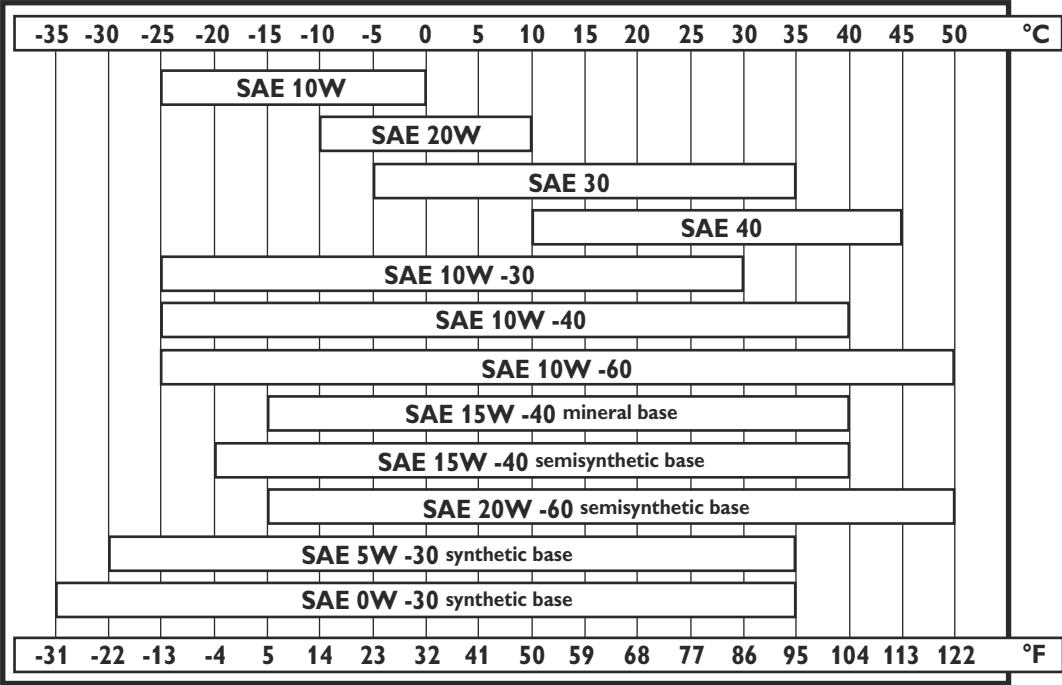
This may result from contact with acid substances.

This usually happens when liquid flows out of the battery. In such case:

1. Remove any soaked clothing.
2. Wash thoroughly with water only the parts involved.

In case of eye contact with battery acid or lubricant or diesel oil: wash the eye with water for at least 20 minutes keeping your eyelids wide shut so that water flows over the ocular bulb (move the eye to every direction for better washing).

OIL VISCOSITY LEVEL ACCORDING TO SURROUNDING TEMPERATURES



ON BOARD PANELS REQUIREMENTS

The following refers to the original configuration of FPT equipment.

The requirements and technical features of customizations may be different. Refer to the original manufacturer for further information.

FPT on board panels	With analog instruments	With digital instruments
Operating ambient conditions		
Operating temperature range	-10°C to +60°C	-10°C to +60°C
Temperature limits during parking	min. -20°C / max. +75°C	min. -20°C / max. +75°C
Dust and rain protection degree (frontal)	IP 65 – DIN 40050 – IEC 529	IP 66
Salt mist resistance (reference standard)	IEC 60068-2-52	IEC 60068-2-52
Electric and electromagnetic characteristics		
Operating voltage (excluding polarity inversions)	min. 9 V / max. 32 V (*)	min. 9 V / max. 32 V (*)
Maximum allowed over-voltage	60 V per 1 ms	60 V per 1 ms
Main panel maximum absorbed power	1.1 A (12 V) – 1 A (24 V)	310 mA (12 V) – 200 mA (24 V)
Secondary panel maximum absorbed power	400 mA (12 V) – 400 mA (24 V)	310 mA (12 V) – 200 mA (24 V)
Electromagnetic compatibility (reference standard)	IEC 945	IEC 945
Cabling connectors requirements (reference standard)	MIL 1344/1001	MIL 1344/1001
Cables requirements (reference standard)	CEI 20/22 - CEI 20/38 - CEI 2000/532/CE	
Mechanical features		
Resistance to vibrations (expressed in gravity acceleration)	1 g eff. max. -25-500 Hz	(2g) 0.07 oz eff. max. -25-500 Hz
Resistance to shocks (expressed in gravity acceleration)	15 g - 1,5 ms - semi-sinusoidal wave	15 g - 1,5 ms - semi-sinusoidal wave

(*) min. 9 V/max. 16 V referring to equipment for which only 12 V nominal voltage is provided.

