

**MARINE GENERATOR SETS**



**OPERATOR'S MANUAL**

◦ **4 GSCH**

U\_GTA1\_EN  
Rev.0



## Introduction

### Presentation

Dear Customer,

First, we would like to thank you for choosing a Solé Diesel product. We recommend that you read this manual carefully before carrying out any of the operations and keep it close at hand, near the genset, as it can be of great use in the future.

Our goal as a manufacturing company is that you enjoy our product, regardless of the use you make of it. The equipment manufactured in Solé Diesel facilities is designed to offer the highest performance in the most demanding operating conditions.

### **▲ NOTICE**

The images, text and information contained in this manual are based on the product's features at the time of publication. Solé Diesel reserves the right to modify this document without prior notice

### Abbreviations

BTDC: Before Top Dead Center

ATDC: After Top Dead Center

BBDC: Before Bottom Dead Center

ABDC: After Bottom Dead Center

API: American Petroleum Institute

ACEA: European Automobile Manufacturers' Association

ASTM: American Society for Testing Materials

TBD: To Be Determined

### Units of measurement

Measurements are based on the International System of Units (SI), and their converted metric values are indicated in parentheses (). For metric conversion, the following rates are used

- Pressure:  $1 \text{ Pa} = 1,0197 \cdot 10^{-5} \text{ kgf/cm}^2 = 1 \cdot 10^{-5} \text{ bar}$
- Torque:  $1 \text{ Nm} = 0,10197 \text{ kgf} \cdot \text{m}$
- Force:  $1 \text{ N} = 0,10197 \text{ kgf}$
- Power:  $1 \text{ W} = 1,341 \cdot 10^{-3} \text{ HP}$

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## Safety Precautions and Instructions

Solé Diesel is concerned for your safety and your machine's condition. Safety Precautions and Instructions are one of the primary ways to call your attention to the potential hazards associated with our engine operation. Follow the precautions listed throughout the manual before and during operation and maintenance procedures for your safety, the safety of others and the performance of your engine.

Types of Safety Precautions:

### **⚠ WARNING**

Indicates the presence of a hazard that can **cause severe personal injuries, death or substantial property damages.**

### **⚠ CAUTION**

Indicates the presence of a hazard that **will or can cause minor personal injuries or property damages.**

### **⚠ NOTICE**

Communicates installation, operation and maintenance information that is safety related but not hazard related.

### **⚠ WARNING**

**Servicing the fuel system and combustible materials. A flash fire can cause severe injury or death.**



Do not smoke or permit flames or sparks near the fuel injection system, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapours. Never add fuel to the tank while the genset is running because spilled fuel may ignite on contact with hot parts or from sparks.

Catch fuels in an approved container when removing the fuel line or fuel system. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines and use flexible sections to avoid fuel line breakage caused by vibrations.

Keep the compartment and the genset clean and free of debris to minimize the risk of fire.

### **⚠ WARNING**



**Servicing the air cleaner. A sudden backfire can cause severe injury or death.**

Do not operate the genset with the air cleaner/silencer removed.

## **⚠ WARNING**

**Combustible materials. A fire can cause severe injury or death.**

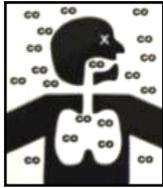


Genset fuels, fuel vapours and combustible materials are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. In case of fire do not open sound, shield compartment and follow these instructions:

- Shut down genset(s).
- Continuously discharge entire contents of a halon or CO<sub>2</sub> portable fire extinguisher (or other provision) immediately.

## **⚠ WARNING**

**Carbon monoxide (CO) can cause severe nausea, fainting or death.**



Genset exhaust gases contains carbon monoxide gas. Carbon monoxide is an odourless, colourless, tasteless, no irritating gas that can cause death if inhaled for even a short time.

Get fresh air and do not sit, lie down or fall asleep if anyone shows signs of carbon monoxide poisoning:

- Light-headedness, dizziness.
- Physical fatigue, weakness in joints and muscles. Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision. Stomachache, vomiting, nausea.

## **⚠ WARNING**

**Keep the area around the battery well ventilated. While the genset is running or the battery is charging, hydrogen gas is produced which can be easily ignited.**



Never allow battery fluid (battery contains sulfuric acid) to come in contact with clothing, skin or eyes. Always wear safety gloves and protective clothing when servicing the battery. If battery fluid contacts the eyes and/or skin, immediately flush the affected area with a large amount of clean water and obtain prompt medical treatment.

## **⚠ CAUTION**



*Moving parts.* Keep hands, feet, hair, clothing and test leads away from the belts and pulleys when the genset is running. Replace guards, screens and covers before operating the genset.

## **⚠ CAUTION**

Before working on the genset or connected equipment, disable the genset as follows:



Set the genset controller (SCO) to OFF Mode.

- (1) Disconnect the power input from battery.
- (2) Disconnect the battery cables. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Follow these precautions to prevent the starting of the genset by genset controller (SCO), remote start/stop switch, or genset start command from a remote computer.

## ⚠ CAUTION



Never remove the cooler cap if the genset is hot. Steam and hot genset coolant will spurt out and seriously burn you. Allow the genset to cool down before you attempt to remove the cooler cap.

## ⚠ NOTICE

Read the genset operator's manual and understand it before operation and maintenance of the genset, to ensure that it continues operating practices and maintenance procedures.

**Hearing protection.** Use to avoid hearing loss when handling the motor.

## ⚠ NOTICE

1. The installer / operator of the genset has to wear suitable CLOTHING for the workplace and the situation; in particular, avoid loose clothes, chains, bracelets, rings and all accessories that could become entangled with moving parts.
2. The installer / operator of the genset has to wear personal protective equipment such as gloves, work shoes, eye and hearing protection as required by the task.
3. The area in which the operator is working has to be kept tidy and free of oil and other liquid spillages and solid waste (metal chips, etc.).

## Genset labels

### ⚠ CAUTION - AVISO ⚠

- Over cranking can cause engine water ingestion.

*Excesivos intentos de arranque pueden provocar entrada de agua en el motor.*

If the genset does not turn after several attempts to crank may cause water entering the genset. In this situation it is recommended:

- 1) Close the seacock.
- 2) Drain the water from the exhaust system in the water trap.
- 3) Do not try to restart the genset until the cause of the start fail is identified.

### ⚠ AVISO ⚠

*El motor y/o el inversor se suministran sin ningún fluido en su interior. Consulte el manual para seguir el procedimiento de instalación y puesta en marcha.*



The genset and the gearbox are supplied without any fluid inside. Consult the manual to follow the installation procedure and commissioning as well as the fluid capacity - coolant, oil and oil of gearbox.

**Read the genset operator's manual and understand it** before operation and maintenance of the genset, to ensure that it continues operating practices and maintenance procedures insurance.



**Dangerous voltage.** Operate the genset only when all guards and electrical panels are ready.

**Hot parts, coolant and steam.** Stop the genset and let it cool down before touching or removing any genset part.

**Moving parts.** Keep hands, feet, hair, clothing and test leads away from the belts and pulleys when the genset is running. Replace guards, screens and covers before operating the genset.

**Heavy material.** Genset is a heavy element, use the right tools for transportation and handling.

**Do not use the motor as a step.** Use it as a step can cause genset damage plus cause undesired operation.



Connection point of the battery cables to the genset. Red cable (positive) and black cable (negative).



Identification on the genset of the coolant fill cap. See section 6.6. Refrigeration system.



Identification on the genset of the lubricating oil fill plug. See section 6.4. Lubrication system.

## **⚠ NOTICE**

**Tag line installation genset exhaust,** above and below the waterline. See 6.7. Intake and exhaust system.

## Solé Diesel warranty

Read the manual and documents delivered with each engine before carrying out any of the operations or presenting any queries. The engine is supplied without any liquids. Ensure that the liquids used match the specifications contained in Solé Diesel manuals.

**The application of the conditions described in this document shall only be effective for engines or generator sets that have been invoiced after January 1, 2012.**

### Solé diesel limited warranty

Solé Diesel guarantees that at the time of shipment all its engines and generator sets comply with the provided specifications and do not have any manufacturing defects.

The limited warranty provided by Solé Diesel enters into force from the time of sale to the first end-purchaser or user of the engine or generator set. In the event that the product is not immediately delivered to the end-customer, the warranty shall enter into force 6 months after the date of sale. Any limited warranty period that has not elapsed can be transferred to the following purchaser (s).

Unless authorised otherwise by Solé Diesel, the warranty periods are applied according to the time elapsed in months from the date of purchase or the limit of hours of operation (whichever occurs first) listed in the following table:

Limited Warranty Coverage Periods				
Product	Pleasure		Work	
	Months	Hours	Months	Hours
Propulsion Engines	24	1000	12	2000
Generator Sets	24	1000	12	1000

### Solé Diesel extended warranty

Solé Diesel an extended period of coverage for the following components: engine block, cylinder head, crankshaft, camshaft, flywheel housing, timing gear housing, timing gear, conrod.

Extended Coverage Periods				
Product	Pleasure		Work	
	Months	Hours	Months	Hours
Propulsion Engines	36	1500	-	-
Generator Sets	36	1000	-	-

## Restrictions

### Coverage:

- a) The warranty covers any failure of the product under normal operating conditions caused by a defect in manufacturing.
- b) The warranty covers the labour costs necessary to replace and/or repair the defective original components, according to Solé Diesel standards of excellence. The time period covered for these operations is limited to 4 hours.
- c) The warranty covers reasonable costs of travel required to carry out the necessary operations. The travel distance is limited to 300 kilometres in conjunction to a travel time of 3 hours.

### Excluded from coverage:

- a) If Solé Diesel products are installed and used alongside other products not designed or manufactured by Solé Diesel that affect their operation, the warranty shall apply exclusively to the Solé Diesel products and shall not apply if the products from another manufacturer are inappropriate for use alongside Solé Diesel products or are the cause of the failure or poor operation of our products.
- b) The warranty shall not apply if the revisions and maintenance services indicated in the User and Maintenance Manuals have not been adhered to properly. In case of implemented warranty, supporting document of the revisions and maintenance service should be exhibited, proving the requirements outlined in the manuals have been followed.
- c) Deterioration resulting from time of storage exceeding 6 months and/or storage conditions that do not comply with the procedures described in the User and Maintenance Manuals.
- d) Deterioration resulting from not complying with the procedure for winter storage while the engine is not in service, as described in the User and Maintenance Manuals.
- e) Faults due to negligence, lack of service, accidents, abnormal use and inadequate service or installation.
- f) Faults due to the use of components not manufactured or sold by Solé Diesel.
- g) Faults due to electrical installations that do not comply with Solé Diesel design specifications or are not expressly approved by Solé Diesel.
- h) Faults due to the use of and operation with fuels, oils or lubricants that are not authorised by Solé Diesel.
- i) Faults due to water entering the cylinder(s) through the exhaust system.
- j) Faults in propulsion engines due to the use of a propeller that is inadequate for the load or application. We recommend contacting Solé Diesel to consult the choice of the correct propeller(s).
- k) Failure for general omission of the procedures described in the User and Maintenance Manuals.
- l) Components subjected to normal operating wear and tear.

- m) Costs due to phone communications, loss of time or money, discomfort, launching, grounding, removal or replacement of vessel parts or materials because the design of the vessel makes it necessary to do so to access the engine, and damage and/or accidents caused as a result of a failure.

## Responsibilities

### Responsibilities of the manufacturer:

The obligations of Solé Diesel are restricted to repairing the defective parts or, IF DEEMED APPROPRIATE BY SOLÉ DIESEL, returning the amount of the purchase or replacing the parts to prevent poor operation resulting from defective materials or faults in the manufacture covered by the warranty.

Solé Diesel reserves the right to modify the design of any of its products without taking on any obligation to modify a product that has been manufactured previously.

This manual, as well as technical documentation, manuals or pamphlets may undergo modifications without prior notice.

### Responsibilities of the purchaser:

The purchaser shall be responsible for the care, operation and maintenance of the product in compliance with the contents of the User and Maintenance Manuals. The purchaser shall provide proof of all the maintenance services performed on the product. The costs of said services and that of the components and liquids replaced during said services shall be at the expense of the purchaser.

The maintenance operations described in this manual shall be performed during the Warranty Contract Periods (Limited and Extended Coverage) by an AUTHORISED SOLÉ DIESEL DEALER. Non-compliance with this condition shall void the warranty in all its terms. In such an event, the materials (oil, filters, etc.) and labour involved shall be at the expense of the purchaser. The purchaser should keep the invoice of the work performed as proof.

If the service is not covered by the warranty, the purchaser must pay for all labour performed, the associated materials and any other expense related to the service.

All shipments of products or components sent by the purchaser for inspection and repair shall be paid in advance by the purchaser.

## After-sales service contact

Claims shall be presented during the warranty period to the nearest authorised Solé Diesel dealer (see chart of Solé Diesel Dealers), who shall take care the service covered by the warranty.

The purchaser must provide proof of purchase and date of purchase by presenting the authorised dealer with an original copy of the Warranty Registry Card. If this is not available, the purchaser must provide a copy of the purchase invoice of the product in question. Claims under warranty shall not be dealt with by the dealer until the date of purchase has been verified.

The following information must also be provided by the purchaser:

- a) Owner's name, address and contact telephone number.
- b) Product model and serial number.
- c) Number of service hours of the product.

- d) Detailed description of the problem.
- e) Information regarding any repair or installation performed by a service not included in the Solé Diesel distribution network, as well as the services performed.

## Service Assistance

For an updated list of our distribution network, visit Dealers section in our web page [www.solediesel.com](http://www.solediesel.com).



Or request this information by contacting Solé Diesel at:

e-mail: [info@solediesel.com](mailto:info@solediesel.com)

Phone: +34 93 775 14 00

## Section 1. Genset Information

### 1.1. Genset Identification

MANUFACTURER:

SOLÉ, S.A.  
 Road from Martorell to Gelida,  
 km 2  
 08760 MARTORELL  
 (BARCELONA) SPAIN

GENSET MODEL:

4 GSCH (3000 rpm)



Genset has a little nameplate located on the canopy and another more descriptive on the main alternator

## 1.2. Technical Specifications

### 4GSCH

<b>DIESEL ENGINE</b>		
General Information	Diesel engine maker	YANMAR ITALY S.P.A.
	Type	Watercooled through stainless steel heat exchanger jacket
	Continuous speed (rpm)	3000
	Specific fuel consumption	0,35 l/kW/h
	Starting system	12V el. Motor remote controlled
	Continuous power (kW) DIN 6271 B	4
Cooling system	Type	Sea water thermostatically controlled
	Cooling pump	Johnson self-priming directly driven
Electrical System	Auxiliary voltage for starting battery	12V 8A
<b>ALTERNATOR</b>		
General Information	Brushless AC generator maker	V.T.E. - Italy
	Generator type	Synchronous, AC - Single phase
<b>GENSET</b>		
General Information	Continuous power	4 kVA
		3,5 kW
	Frequency	50 Hz
	Voltage	230 V self regulated
	Remote control -Panel Solé Diesel - SPA 10-	Fitted with hour meter, load indicator, automatic shut-off device in case of low oil pressure and over temperature, starting motor self disengagement, 10m cable and socket
	Noise level at 7m (dB(A))	53
	Weight (kg)	90

## Sección 2. Transport, Handling and Storage

### 2.1. Receipt

When the genset is delivered make sure that the packing has not been damaged during transport and that it has not been tampered with or that components inside the packing have been removed (see information marked on covers, bases and cartons).

Place the packed genset as close as possible to the place of installation and remove the packing material, checking that the goods supplied correspond to the order specifications.

#### NOTICE

If you notice damage or missing parts, inform SOLÉ S.A. after-sales departments and the carrier immediately and forward photographic evidence of the damage.

After inspecting the goods if you notice damage, write a reservation on the delivery note. Have the carrier countersign the note and advise SOLÉ S.A., preferably by mail (sole@solediesel.com).

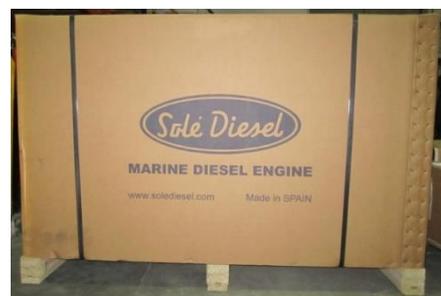
### 2.2. Transporting and Handling the Packed Genset

When lifting and transporting the genset use EXCLUSIVELY a forklift or bridge crane of appropriate load capacity, with chains equipped with safety hooks suitable for lifting the load.

The use of any other system automatically invalidates the insurance guarantee against possible damage to the genset.

To unpack the genset, you must follow these steps:

1. Remove the cardboard crate.
2. Lift the genset using a forklift and suitable chains, which hook to the genset eyebolts.
3. Transfer the genset to the intended position of installation.
4. Remove the wooden base.
5. Begin installation operations.



## 2.3. Transporting and Handling the Unpacked Genset

When the genset is unpacked and ready for transport, use **EXCLUSIVELY** the appropriate lifting eyebolts.



## 2.4. Storage of Packed and Unpacked Genset

If the genset is left idle for prolonged periods, the client must check the possible conditions of conservation in relation to the place of storage.

If the genset is unused for prolonged periods and stored, observe all the relative technical specifications.

The treatment of the genset for storage is guaranteed for 6 months after the time of delivery (as specified in Section 1.3 or in the Warranty Manual).

### NOTICE

If the user decides to start the genset after a long time period, this must be done in the presence of an authorized technician.

## Sección 3. Installation

### 3.1 Angular Operation

Make sure the engine is installed on a level surface. Otherwise, the following angular operation maximum is permitted:

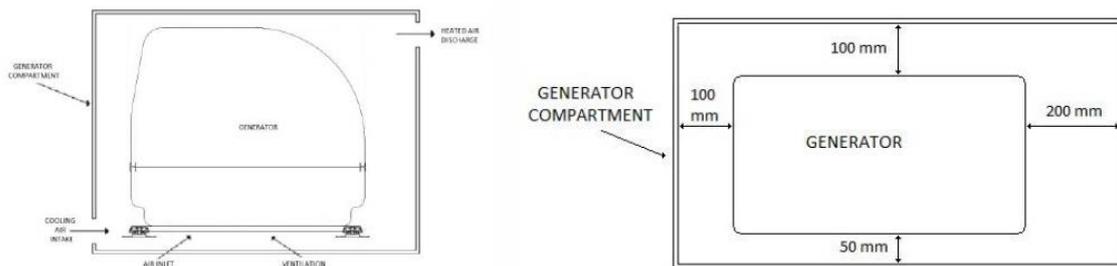
	Lengthwise	Crosswise
Maximal Angle	20° 30° (for 3 minuts)	20° 30° (for 3 minuts)

### 3.2 Genset Installation

Must be kept enough room around the unit for the following operations:

#### 3.2.1. For a correct air replacement

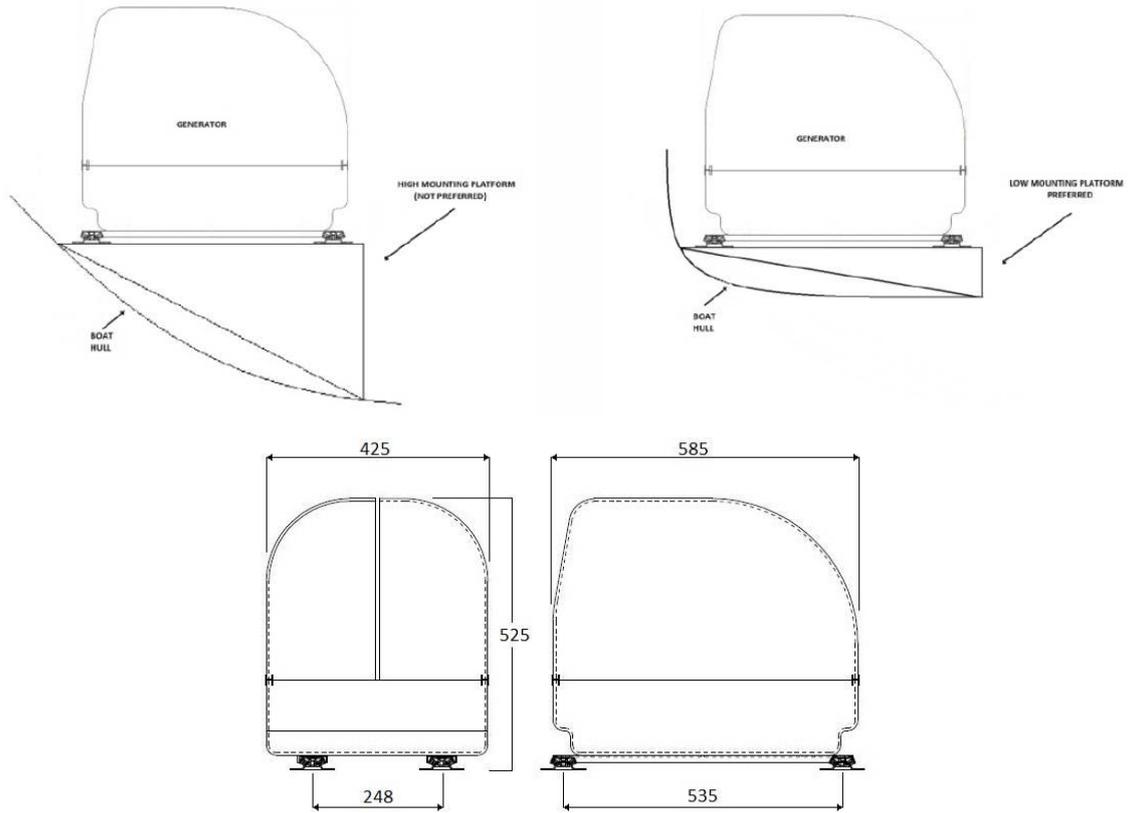
Around the 4GSCH have at least the shown tolerance; of course the ambient have to be naturally vented with more than one external connection.



#### 3.2.2. For fixing the Genset on board

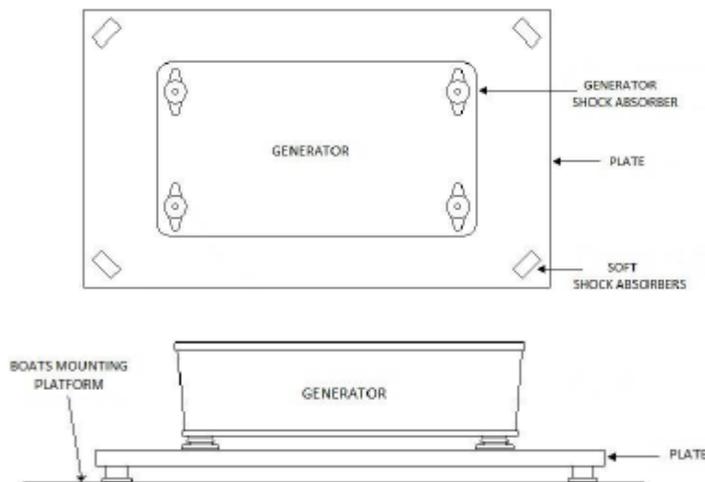
A solid, level mounting platform is very important for the proper operation of your generator. Select a location that will allow adequate space on all sides for ventilation and servicing. Locate the generator away from living quarters, and away from bilge splash and vapors.

The mounting platform may be of wood, metal or fiberglass. It must be horizontal and should be as small as possible to minimize vibrations. A low mounting platform is preferred because it will be stable and easy to build; a higher mounting platform must be very sturdy to avoid resonance and vibrations (see illustrations).



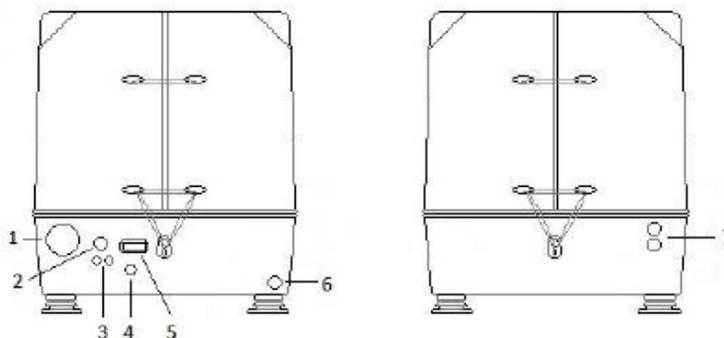
If the vibration-dampening mounts furnished with the generator are not adequate to muffle vibration or resonance in an installation where the mounting surface is not ideal, then adding a plate between the generator and the boat's mounting platform is a possible solution. This will also improve the sound insulation. For this plate, use 3 cm thick wood that weighs 10-15 Kg, and soft mounts that are rectangular. Position these mounts so they are on the diagonal and not aligned with the generator mounts (see illustration).

The generator's mounts may be turned in any direction. Mount the plate to the boat's platform, then mount the generator to the plate.



### 3.2.4. Conexiones externas

- 1- Exhaust outlet
- 2- Battery cables
- 3- Fuel in and fuel return
- 4- Main voltage output
- 5- Control panel
- 6- Raw water intake
- 7- Siphon-break holes



The internal diameter of the pipes has to be respected to avoid untightening and leakage, but the external diameter is important too, because the correct size avoids a noise way-out from the sound-proof capsule.

### 3.2.5. Prestart Checklist

Follow these checks and inspections to ensure the correct genset operation. In addition, some checks require verification after unit starts.

**AIR CLEANER:** Check for a clean and installed air cleaner element to prevent unfiltered air from entering the genset.

**AIR INLETS:** Check for clean and unobstructed air inlets.

**BATTERY:** Check for tight battery connections.

**EXHAUST SYSTEM:** Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.

Check that the exhaust outlet is unobstructed.

**FUEL LEVEL:** Check the fuel level and keep the tank(s) full to ensure adequate fuel supply.

**OIL LEVEL:** Maintain the oil level below dipstick high mark and above dipstick low mark.

**OPERATING AREA:** Check for obstructions that could block the flow of admission air.

**SEAWATER PUMP PRIMING:** Prime the seawater pump before initial startup. To prime the pump:

- Close the seacock
- Remove the hose from the seawater-filter outlet
- Fill the hose and seawater pump with clean water
- Reconnect the hose to the water filter outlet
- Open the seacock

Confirm seawater pump operation on startup as indicated by water discharge from the exhaust outlet.

**FEEDING LINES:** Check valves of the following feeding pipes are properly open:

- cooling sea water
- fuel oil suction
- fuel oil overflow return

**SAFETY SWITCH:** Check that the main AC safety switch is SHUT-OFF

**CHANGEOVER SWITCH (SHORE/GENERATOR):** Check switch position. It prevents simultaneous connection of shore power to generator output.

### 3.2.6. Panel Solé Diesel - SPA 20

It allows start and stop the unit, to verify if there is a cooling or oil pressure failure, (in this case the engine is shut-off automatically) and the power supplied control.

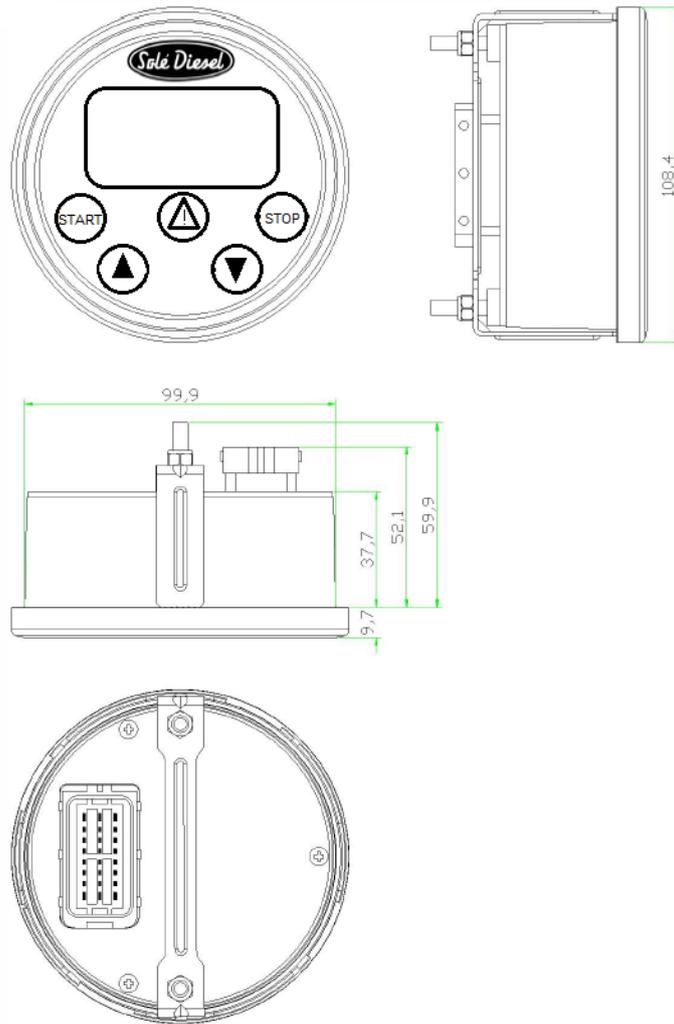
#### NOTICE

The load indicator is designed for avoiding to overcharge the unit feeding too many electrical loads; it begins to show the load after the first half power supplied and has to be considered normal when the bar is green. The last red LED lighted means an overcharge: switch-off the exceeding load to return at normal conditions.

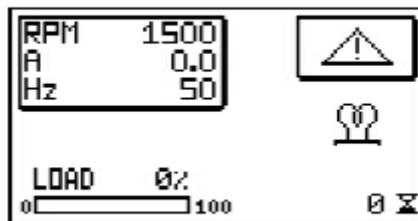
Do not forget the starter knob switched ON if the engine is not running for aborted starting attempt (yellow LED blinking) because the engine shut-off valve remains energized and takes useless power from the starting battery.

If the yellow LED remains flashing when the set normally runs, it means that the internal battery charger protection is shut-off, so the starting battery is no more loaded. In that condition the automatic protection shut-off system is not operative, so do not operate the set with the yellow light flashing. Reset the device pushing the button located on the grey box corner fitted on the set.

If for operator's mistake the starting knob is pushed whilst the engine is already running, an electrical safety device avoids the gears reengagement, protecting the starting motor preventing failures.



### 3.2.7 Display LCD:



The remote control panel es device to star, stop and manage the generator.

The displayed parameters are the following:

- Engine speed (rpm)
- Current supplied (A)
- Frequency (Hz)
- Hour-meter (hourglass)
- Load indicator (% e bar)
- Pre heating (glows)

## Section 4. Operation

### 4.1. Starting Genset

1. **OPEN THE SEACOCK.** Before starting the genset, open the seacock to allow cooling water passage. Failure to do so could damage the seawater pump impeller and cause serious engine overheating damage.
2. **PUSH THE START BUTTON** of the Panel Solé Diesel - SPA 10. The genset takes some seconds to start (this time depends on genset model).



#### 4.1.1. Electrical start

1. All AC loads must be switched off before starting. This precaution will prevent damage caused by unanticipated operation of AC machinery and will prevent a cold engine from stalling.
2. To start the generator, push the START button on the Panel Solé Diesel - SPA 10. This generator has a 12V DC electric starter. The yellow start indicator light will come on and start to blink. Once the engine fires and runs, the yellow start indicator light will go out the green run indicator light will come on.

Si el intento de arranque fracasa, el indicador amarillo continuará parpadeando. Para resetear el circuito, pulse el botón STOP.

Aplice entonces una carga ligera al generador y deje que el motor alcance la temperatura de funcionamiento antes de aplicar cargas más pesadas.



Si el motor está frío, se puede dar un funcionamiento inestable. Esta situación puede mitigarse en cuanto el motor se calienta y luego se aplican las cargas del generador.

## 4.2. Parada del grupo electrógeno

1. UNLOAD THE GENSET.
2. PUSH THE **STOP** BUTTON of the Panel Solé Diesel - SPA 20.
3. CLOSE THE SEACOCK.



## 4.3. Genset Operation at Low Temperatures

Whenever the atmospheric temperature drops below zero, the following series of circumstances occur:

- The cooling liquid (sea water in cooling system) may freeze.
- The oil becomes thicker.
- There is a drop in the voltage at the battery terminals.
- The inlet air temperature is low and the genset has difficulty in starting.
- The fuel loses fluidity.

To prevent the damage caused by low temperature operation, the genset should be prepared:

1. Close the seawater cock, when the genset is stopped. Open the seawater filter cover and start the genset adding a mixture of freshwater and suitable anti-freezing agent concentration (see package labels) until the seawater circuit is filled completely. Stop the genset and replace the seawater filter cover. Before starting the genset again, open the seawater cock. Repeat this operation whenever the genset is used at temperatures below 0°C.
2. Use oil with suitable quality and viscosity. SAE 15W40 is recommended.
3. Cover battery with an adequate material to protect it against the cold. Check that the battery is fully charged.  
It is also advisable to use a dielectric spray on the electrical connections.
4. When starting the genset, make sure that the glow plugs become hot enough.
5. If necessary, replace the diesel oil by a specified diesel oil type for low temperatures. The accumulation of impurities in the fuel tank could cause faulty firing.

### NOTICE

All gensets not in use are subject to rusting and corrosion of machined surfaces that are not protected with a paint coating. The degree of corrosion depends on meteorological changes and climatic conditions. The following recommendations are therefore of a general nature but they will help prevent or reduce the risk of damage due to rusting.

## 4.4. Winterization and Preservation

If the boat is not going to be used for a long period of time or during the winter, certain tasks must be carried out to keep it in perfect operating condition. Follow the steps indicated below carefully:

1. Clean the outer surface of the engine.
2. Bleed the seawater circuit by filling it with fresh water. Fill the seawater circuit again with a mixture of fresh water and anti-freezing agent.
3. Remove the impeller from the seawater pump, clean it with fresh water and store it in place protected from moisture and sunlight.
4. Renew the oil in the engine.
5. Cover the air intake.
6. If the fuel tank is small, empty it completely and clean it; fill it up again with a mixture of diesel and anti-corrosion additive. Solé S.A. recommends DIECYL PLUS. Add one measure of this additive for every 25 liters of diesel. On the other hand, if the fuel tank is large, add 1 liter of this additive for every 500 liters of diesel.
7. Clean and dry the area where the engine is installed.
8. Loosen the belts.
9. Apply dielectric spray on the electrical connection, disassemble the battery and charge it several times during the time it is not being used.
10. Apply moisture repellent spray on the motor.

## 4.5. Restoration of Operation conditions

When starting up the genset again after winter lay-up, certain operations must be performed. Follow these steps:

1. Fill the fuel tank with clean diesel. The mixture of diesel oil and anti-corrosion additive in tank for winter lay-up can be used to operate the genset.
2. Check the fuel filter. If the filter is clogged, replace the filter.
3. Renew the oil in the engine.
4. Check the condition of coolant circuit's rubber hoses.
5. Reconnect the battery and apply a layer of neutral Vaseline to the battery terminals.
6. Remove the nozzle supports and clean them. If possible, verify the setting of the nozzles at a workshop. Then install the clean nozzles.
7. Connect the cooling and exhaust system. Open the seawater cock.
8. Verify whether there are any leaks in the fuel, coolant and oil systems.

## Section 5. Systems and Scheduled Maintenance

### 5.1 Operating Description

In order to carry out the scheduled maintenance it is necessary to remove some covers. For this reason, not all covers are shown in the following figures.

Information of special tools required and basic safety precautions.

Disassembly:

- ✓ Use the correct tools and instruments. Serious injury or damage to the engine can result from using the wrong tools and instruments.
- ✓ Use an overhaul stand or work bench if necessary. Also, use assembly bins to keep the engine parts in order of removal.
- ✓ Lay down disassembled or cleaned parts in the order in which they were removed. This will save you time at reassembly.
- ✓ Pay attention to the marks on assemblies, components and parts for positions or directions. Put on your own marks, if necessary, to aid reassembly.
- ✓ Carefully check each part for faults during removal or cleaning. Signs of abnormal wear will tell if parts or assemblies are functioning improperly.
- ✓ When lifting or carrying heavy parts, get someone to help you if the part is too awkward for one person to handle. Use jacks and chain blocks when necessary.

Reassembly:

- ✓ Wash all engine parts, except oil seals, O-rings, rubber seals, etc. in cleaning solvent and dry them.
- ✓ Use only the correct tools and instruments.
- ✓ Use only good quality lubricating oils and greases. Be sure to apply a coat of oil, grease, or sealant to parts as specified.
- ✓ Use a torque wrench to tighten parts when specified tightening torques is required.
- ✓ Replace all gaskets and packing. Apply appropriate amount of adhesive or liquid gasket when required.

#### NOTICE

- ✓ Increase the frequency of maintenance in harsh duty conditions (frequent stops and starts, dusty surrounding, prolonged winter season, no-load running).
- ✓ Risk of burns during maintenance operations carried out when the genset is hot. Wear suitable safety clothing.
- ✓ It is strictly forbidden to clean the genset with compressed air.
- ✓ It is strictly forbidden to perform maintenance/cleaning operations in the presence of moving parts.

Use gloves, overalls, etc. to protect the body from burn

### 5.2 Periodic Maintenance Schedule

The maintenance and fault diagnostic procedures involve risks that may cause severe injury or even death. These procedures should therefore be carried out solely by qualified electrical and mechanical specialists. Before any maintenance and cleaning work, make sure that there are no moving parts, that the generator housing has cooled to ambient temperature, that the electricity generating set cannot be accidentally started up and that all procedures are strictly observe.

SYSTEMS AND SCHEDULED MAINTENANCE

Intervals									
	Inspection Item	Daily	1st 20h-50h	Every 200h	Every 400h	Every 800h	Every year	Every 2 years	Winter storage and Preservation
<b>General</b>	Screw tightening, fastening.		I		I				
	Genset block.								CL
	Valve clearance.				I				
	Exhaust gas, noise and vibrations.	I							
	Compression pressure.					I			
<b>Lubrication system*</b>	Genset oil.	I	C	C			C		C
	Oil filter.		C	C					
<b>Fuel system</b>	Fuel level.	I							
	Fuel tank.							CL	E/CL/I
	Fuel filter.				C				
	Water separator filter (if applicable).		E		C				
	Injection pump.					I			
	Injector.					I			
<b>Intake system</b>	Air filter.		I		C			C	I
	Turbocharger							I	
<b>Cooling system</b>	Coolant.	I						C	C
	Salt water circuit.								I/CL
	Anode			I/C					
	Water filter.	I	CL	CL					
	Sea water cock.	I							
	Salt water pump impeller.			I/C	I				I/CL
<b>Electrical system</b>	Incandescent glow plug.				I				
	Starter motor and alternator 12/24V.				I				
	Alternator 12/24V belt and tension.		I		I	C			I
	Battery level.		I	I		C			

\*Utilice aceite de viscosidad 15W40 y una calidad no inferior a ACEA E5 o API I: Inspeccionar, ajustar o llenar. V: Vaciar. C: Cambiar. L:

## 5.3. Lubrication System

Oil forced-feed lubrication system with gear pump with no oil filter.

### OIL SPECIFICATIONS

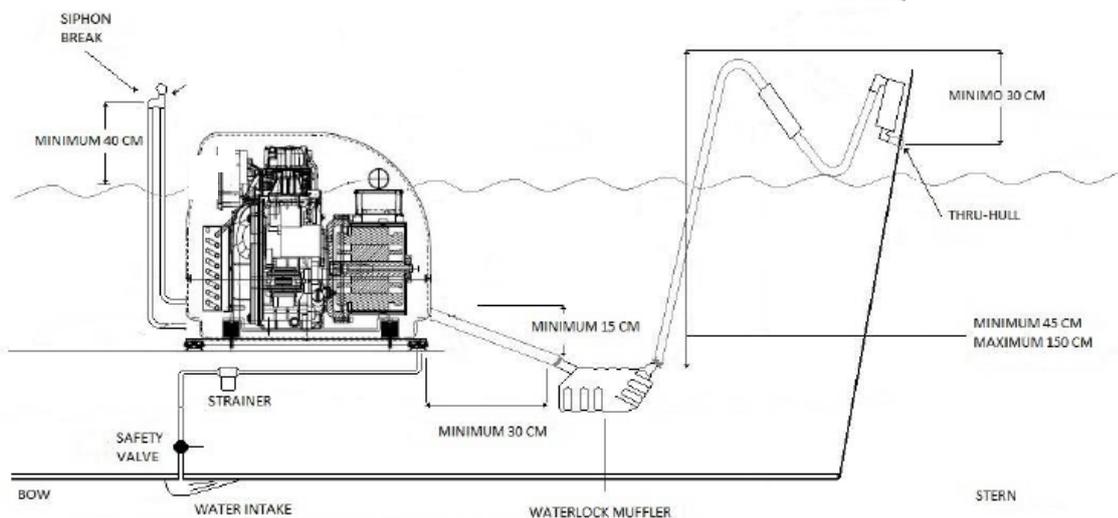
Use oil with 15W40 viscosity (this is an all-season oil for temperatures ranging between  $-15^{\circ}\text{C}$  and  $+40^{\circ}\text{C}$ ) or select the most suitable oil viscosity for the atmospheric temperatures on which the genset is going to be operated. On the other hand, use oil quality no less than ACEA E5/E3 or API CH-4/SJ. Other engine oils may affect warranty coverage, cause internal genset components to seize and/or shorten genset life.



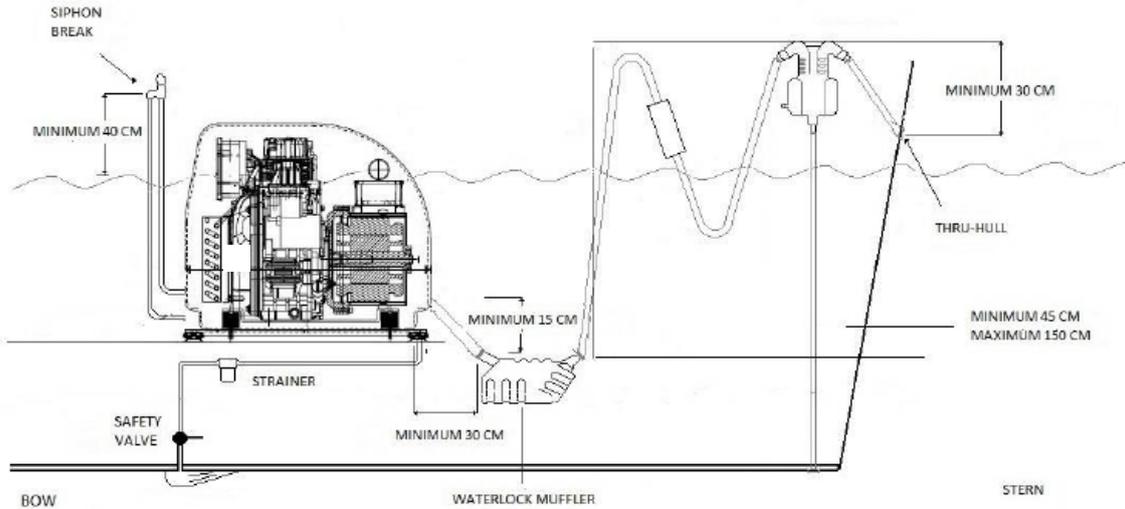
Never mix different types of genset oil. This may adversely affect the lubricating properties of the genset oil.

## 5.4. Exhaust System

**STANDARD SYSTEM:** the best dumping result is obtained fitting the 3 typical exhaust mufflers: the first as water lock avoids the risk of water return into the engine and dumps 50% of noise so it must be installed; the second reduces a further 20% noise and must be fitted with a gradient towards the out let in order to avoid water return; the third dumps a further 10% and avoids the risk of external seawater entrance due to waves.

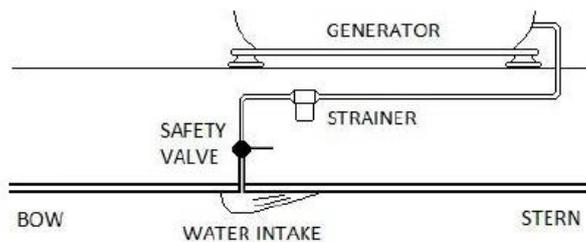


**IMPROVED SYSTEM:** a further improvement in the noise dampening is achieved fitting instead of the third muffler the water separator. The cooling water is separately thrown from a separate hole flowing smoothly, avoiding the noise produced by the water coming alternatively spread from the exhaust pipe.



A wrong installation can cause damages to the engine. See [Warnings](#) section.

## 5.5. Cooling System



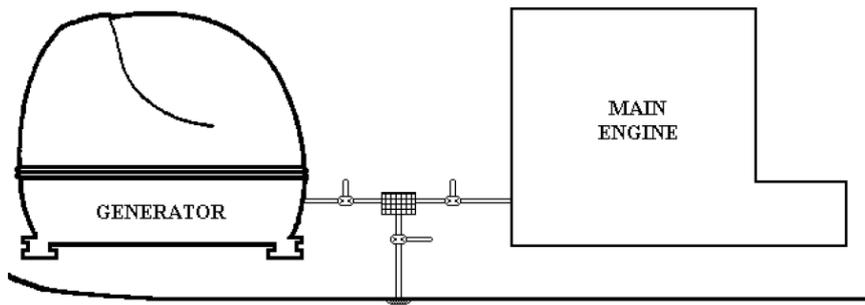
### NOTICE

The unit can be installed below the sea level; in that case the safety cooling vacuum valve has to be fitted on a wall at generator side at least 50 cm above the external sea water line. On the hoods are foreseen two additional holes to be employed for the siphon break pipes.

The sea water intake shape is usually designed asymmetrically, so that depending from the fitting direction can cause, when the boat is sailing, pressure or vacuum in the water circuit connected. For a generator the water intake must be fitted into the direction causing vacuum, because on the contrary a self-water entrance can be caused when the boat is sailing and the set is not running, flooding the exhaust line with water that finally reaches the engine oil sump causing severe damages to the engine.

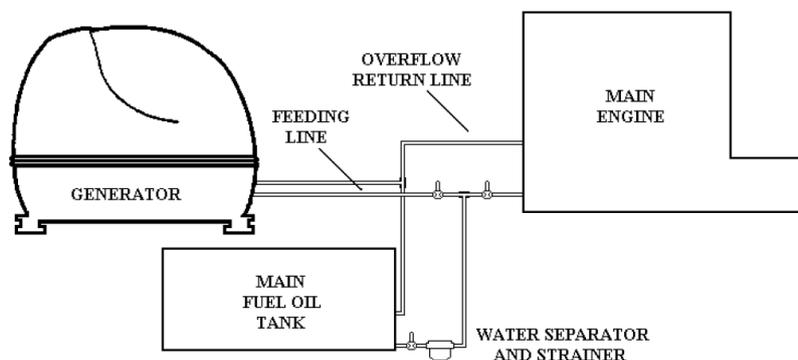
In case the hole in the hull for the water intake is undesired, the water line can be connected in parallel with the water intake of the main engine. In this case a couple of locking valves are necessary, because a failure of the main engine pump can influence the cooling of the set and vice-versa.

A wrong installation can cause damages to the engine. See [Warnings](#) section.



## 5.6. Fuel System

It is usually employed the main fuel tank of the boat: the feeding pump driven by the engine assures suction from a maximal height of 1 m, no length limits. A separate line coming from the tank avoids air bubbles troubles, but in several cases the fuel can be taken from the pipe of the main engine: a couple of locking valve are necessary, because a failure in the non-return valve of the feeding pump of the main engine can influence the set and voiceovers.



### NOTICE

The injection pump of the 4 GSCH is self-bleeding, it means that in case the engine shutoff for lack of fuel, after fuel tank filling up there is no need of disconnecting the pipes for bleeding, because this operation is simply obtained acting by hand on the lever of the feeding pump.

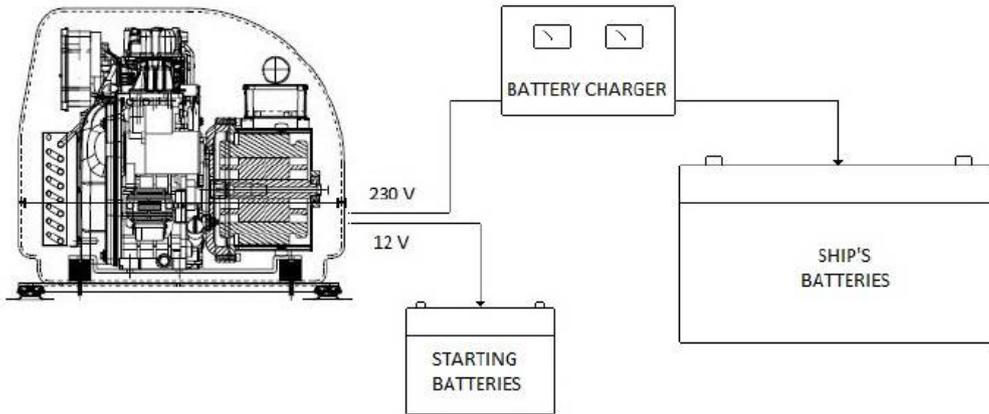
Even if a small fuel filter is contained in the capsule, an external strainer and water separator is suggested to delay the replacement time.

## 5.7. Electrical System

The 4GSCH is negative grounded, and can be connected to the main board batteries 12 V or to a separate small battery 12 V of about 60 Ah; in this second case its internal charging device takes care of feeding the battery with 8 A.



In case of connection to the main board batteries the 8 A are available as well, but are not enough to charge them: a static high power battery charger fed by the 230 V of the set must be present on board (on request).



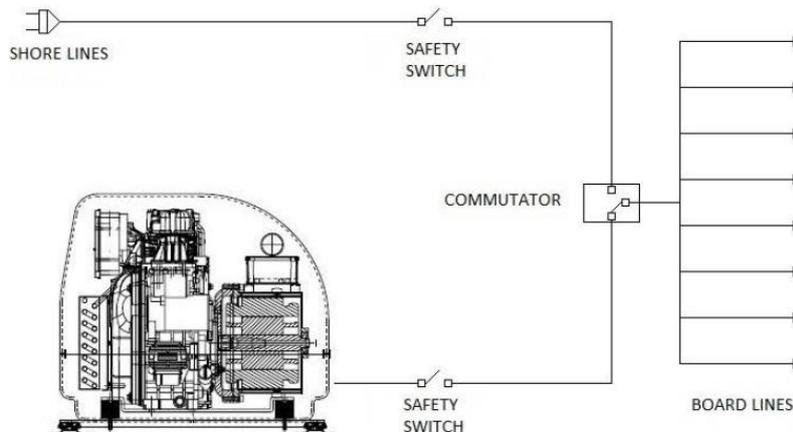
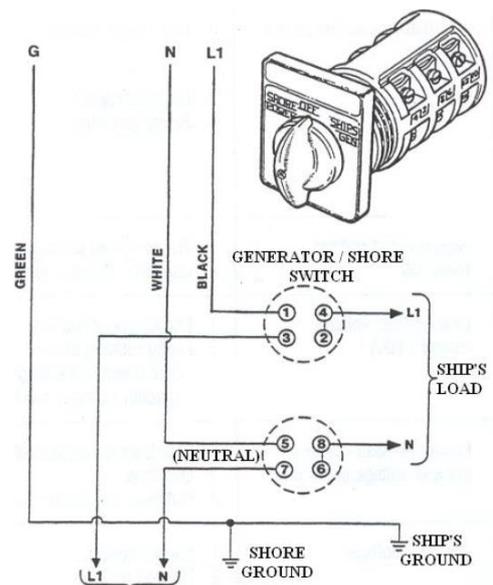
Changeover switch (shore/generator)

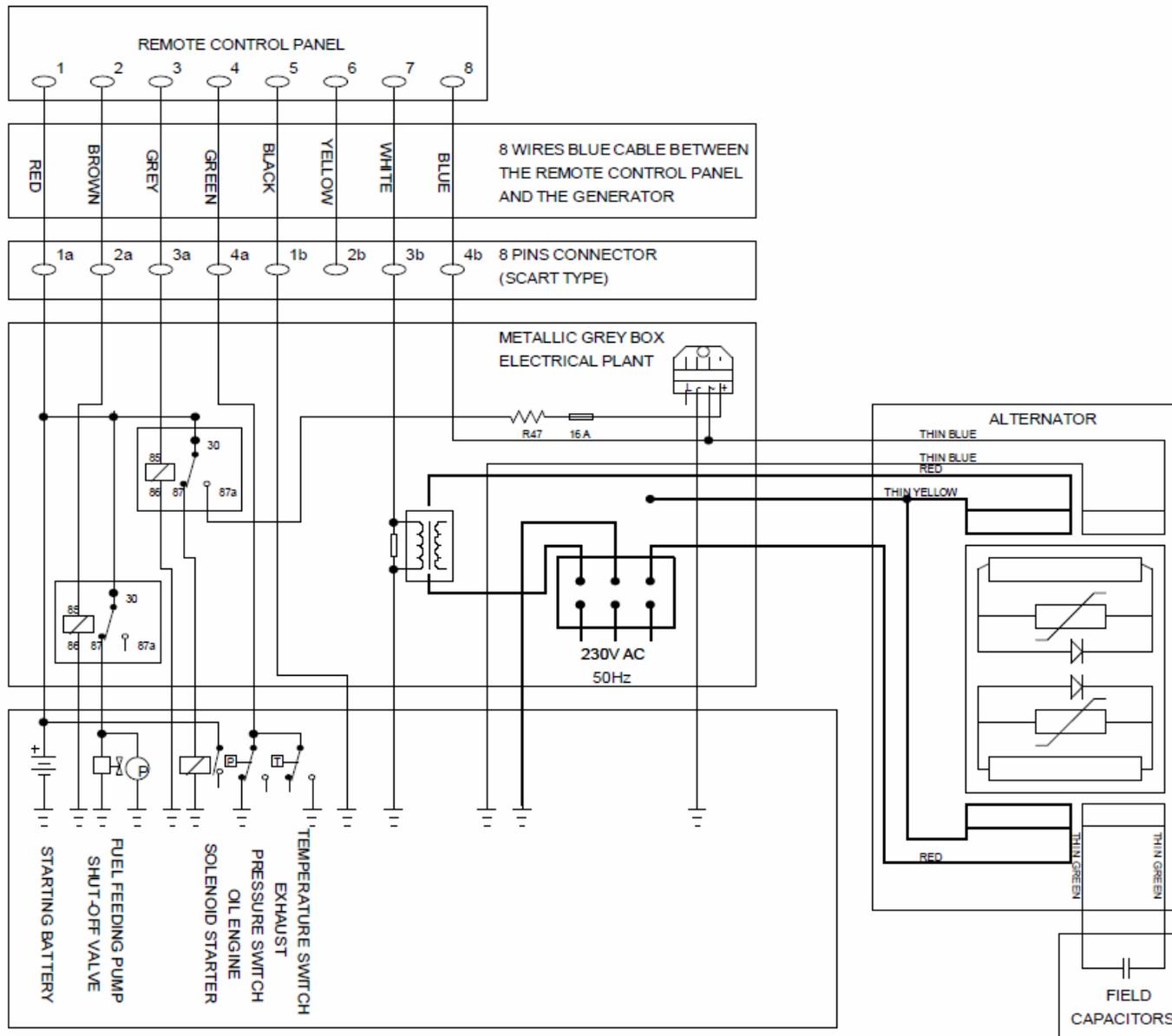
As the most of the boats have installed 230 V feeding line from the shore, it has to be absolutely avoided that the main and the generator remain contemporaneously connected to the boat plant.

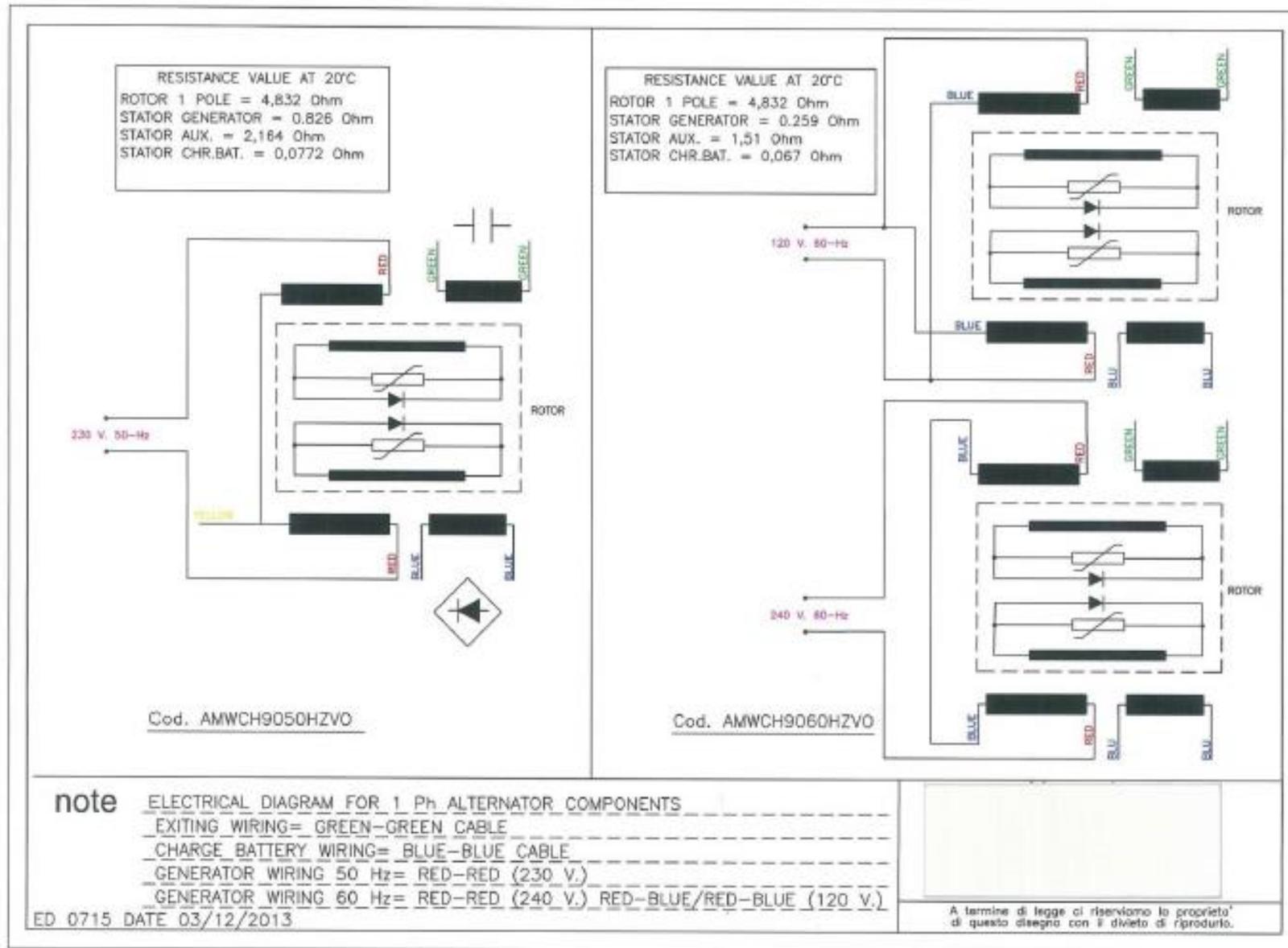
A manual safety commutator (on request), or an automatic safety commutator (on request) has to be provided.

Both the lines or at least the generator line only, have to be protected with a magneto thermic safety switch, fitted on the main board panel.

In any case at the engine grey box side it is located a safety switch on the main 230V that must be considered as last additional protection if that on the board panel is out of order.





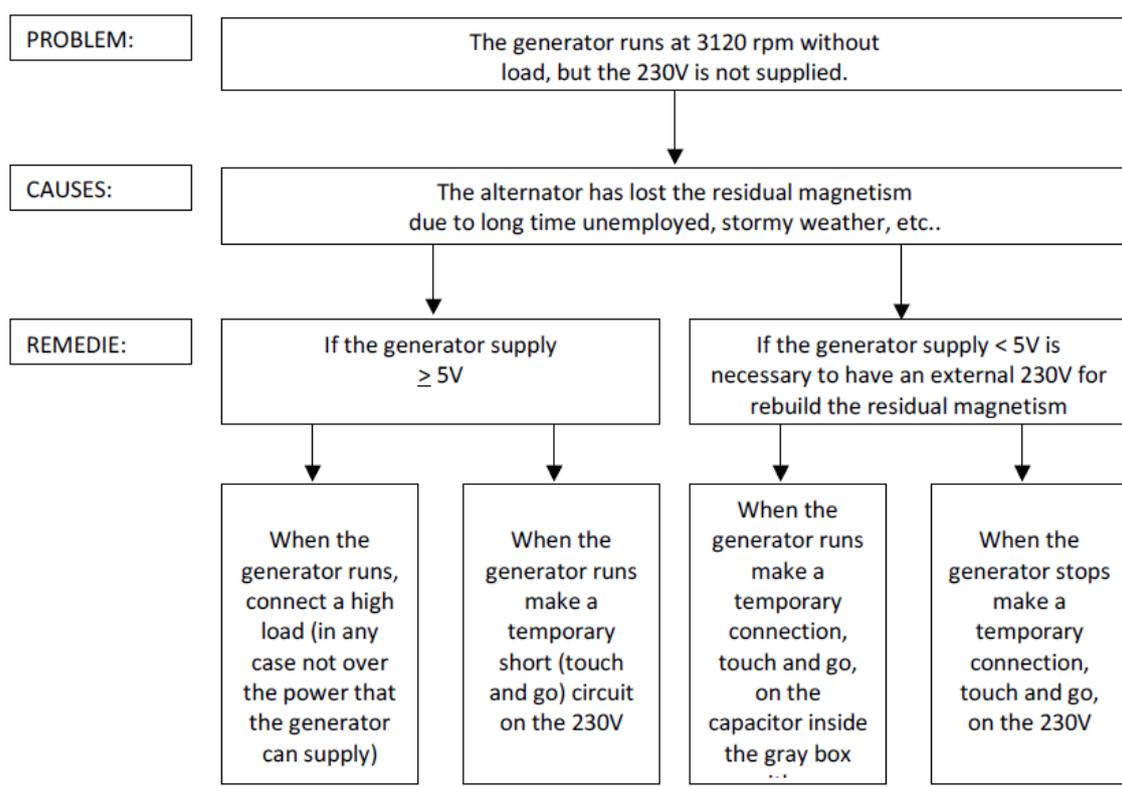


## Section 6 Troubleshooting

Each unit is carefully tested in our factory and the performances are verified; even so a readjustment can be sometime necessary according to the following suggestions.

GENSET FAILURE	PROBABLE CAUSES	RECOMMENDED ACTIONS
Alternator excitation failure	Low engine speed	Check rpm and set at the nominal value of 3100 rpm without load (3700 for 60 cycles)
	Faulty capacitor	Check and replace
	Faulty windings	Check that winding resistance as follows: - STATOR 0.8 Ohm - ROTOR 3.9 Ohm - EXCITATION 3.2 Ohm
High no-load voltage (over 240 V)	Engine speed too high	Check and adjust rpm
	Capacitor with too high capacity	Check and replace
Low no-load voltage (under 230 V)	Engine speed too low	Check and adjust rpm
	Faulty rotating diodes	Check and replace
	Beak down in windings	Check windings resistance as above
	Capacitor with low capacity	Check and replace from 16 to 25 $\mu$ F
Proper no-load but low under load voltage	Low loaded engine speed	Dirty fuel filter
	Overload	Check the load indicator
	Rotating diodes short circuited	Check and replace
Unstable voltage	Loose contacts	Check connections
	Uneven rotation	Check for uniform rotation speed (dirty fuel filter)
Noisy generator	Broken bearings	Replace
	Loose coupling	Check and repair

MAIN VOLTAGE (230V AC) MISSING:

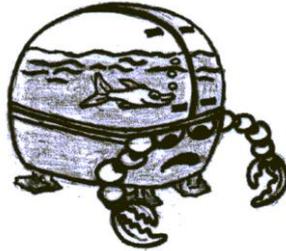


If, after the above operation, the 230V is not present must be replaced the capacitor with the new one.

If nothing of the above operator gives a result the problem is on the rotating diodes and must be replaced

## Section 7. Warnings

A great marine sets number of any type and manufacture, after first installation on board are flooded by sea water causing severe damages to the unit with high replacement or repairing costs, improperly lained in warranty but gently refused, because it always depends from a critical installation, made ompromising some physical rules.

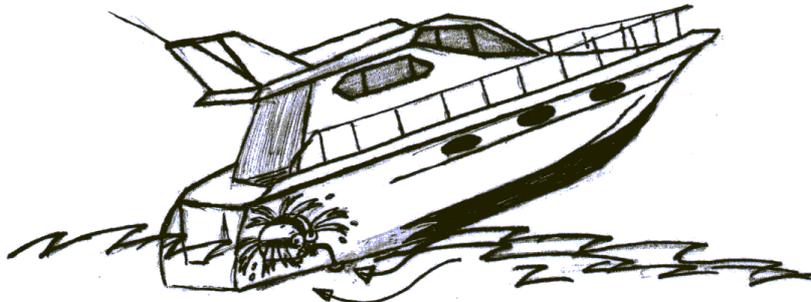


### Sea Water Cock Installation

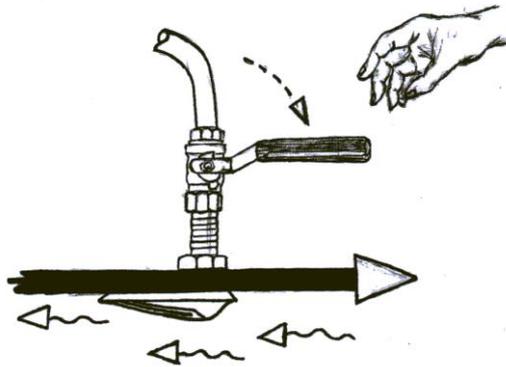
Sea water intake oriented towards sailing direction, causing a dynamical pressure that, when the generator is not running, let flow sea water through the cooling pump, reaching the exhaust pipe and consequently the engine exhaust valve, flooding the cylinder and the oil sump.



On a high speed motorboat, a neutral flush hull mounted water intake can cause as well dynamical pressure due to the hull gradient compared the sea surface or the decreased water line level before reaching the proper trim.



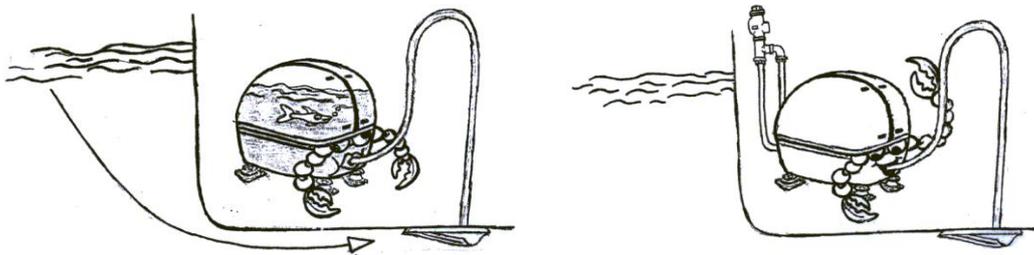
For avoiding the risk, the water intake entrance must be fitted facing the rear position and even so, in critical sailing conditions the internal valve must be closed when the generating set is not in operation.



## Sea Water Intake Installation

Considering the water intake / safety valve / strainer and partially the seawater hose are fitted below the seawater line and inside them remains trapped seawater, must be considered the height between the seawater line and the water pump fitted on the generator that must be **no more than 60 cm**. If it is more, it must be considered either a goose neck long the seawater pipe to trap seawater or install an additional electric seawater pump.

Installation below the sea level without a proper cooling pipe goose neck and vacuum siphon break valve.

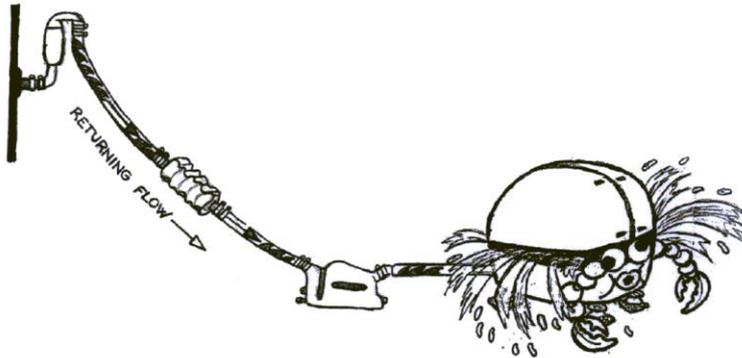


If the set installation surface is just a little below the external sea water level but can be guessed that while sailing the difference is further increased, must be foreseen an external goose neck pipe with siphon break valve, on the contrary drop by drop an internal leakage through the pump clearance, fills the exhaust pipe with the same above explained result. For relevant level difference the leakage occurs when the boat is not sailing too.

The vacuum siphon-break valve must be fitted out of the hood, on a prolonged pipe, as more high as possible and in any case above the sea level, in connection to a cooling pipe at the engine pump delivery side, namely in pressure zone. On the several sets the pipe to be prolonged can be different, but each one chosen at the pump delivery side, is suitable.

## Exhaust Line Installation

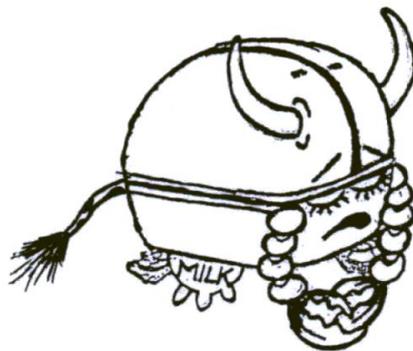
The exhaust line can contain too much water for length excess or negative gradient course that returns back into the engine when the set is shut off.



The first water lock muffler is designed for avoiding that risk, but if fitted not enough lower than the engine manifold either reversing the entrance with the outlet, or of too reduced capacity for the return water volume that has to contain, can be unable avoiding the problem.

Particular care must be taken in designing the exhaust pipe course, preferring the alternatives that keep self-draining towards outside as more pipe stroke as possible.

In any case, to be sure of a correct and safety installation, especially during the first employment season, check often the lubrication oil integrity watching the engine steak level: a transparent yellow oil if new or a black color if old, mean no water entrance, but an emulsion similar to milk white/yellow not transparent or worst an increased level into the sump mean water flooding.



Another water presence signal becomes from starting difficulties as due to some roost on the exhaust valve, the compression does not reach the proper burning value. Spraying some lubricating oil into the cylinder while insisting with the starter, very often the engine can be started. Better if the operation is made acting on the decompression device, for allowing some free engine revolution for better distributing the oil and adding the flywheel cinetic energy. When started the valve self cleans, but in some cases, of too long time water presence, also the piston rings are locked from roost, so the engine must be opened for repairing.

In some cases the engine does not start for external reasons like lack of fuel, air bubbles, too flat battery. While insisting, the water pump deliver a certain quantity of water that is not pushed out by the engine exhaust pressure, remaining trapped into the exhaust pipe even if correctly fitted. If that happens, drain the exhaust pipe when giving up the unsuccessful starting operation.

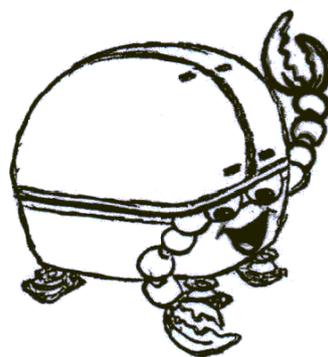
When the installation is correctly planned and carried on, surveying the result during the first operative season, the generator on board give many troubles operative seasons, requiring lubricating oil and fuel filter replacement only, but there is another up keeping operation that prolong considerably the unit life. It consists in a "wintering" but useful in summer too if the set remains unemployed for more than two months.

Due to temperature difference between night and day the water remaining into the exhaust pipe and muffler water lock causes condensation, that on the engine exhaust valve, produces roost.

Spraying into the combustion chamber some lubricating oil, and disconnecting the exhaust pipe, moving the piston position by the handle or a flash starting attempt, avoids completely the roost risk for long time.

Consider that on the marine engines employed for the nautical generating sets, there are no critical connections between cooling water and fire zone, so in case of some gasket breakage there is water sprayed out of the engine, around it into the hood and never water entering into the piston or the sump zone.

Our technical staff is in any case at customer's disposal for additional suggestions or solving out of standard cases for getting the complete satisfaction result, that can be always reached putting more attention on the plant, or adding special accessories like a dry exhaust pipe and similar



## Section 8. Instructions to Replace and Remove

When you decide to replace the genset, please contact SOLÉ DIESELS.A.; will provide relevant instructions regarding the laws in force at the time. When disposing of the whole or parts of this genset, meets LAWS IN FORCE IN THE COUNTRY OF INSTALLATION.

For more information about the materials they are made of the individual components of the generator, contact SOLÉ DIESEL S.A.

INSPECTIONS PRIOR TO THE DELIVERY OF GENERATOR SETS			
<b>Installer / Marina information</b>			
Installer Company:		Installation Date:	
Contact Tel. no.:		E-mail:	
<b>Owner's Information</b>			
Name and surnames:			
Contact Tel. no.:		Email:	
<b>Generator Set Information</b>			
Generator set model:			
Generator set serial number:		Alternator serial n°. (if applicable):	
<b>Installation Information</b>			
Type of electrical installation:		Total power consumption:	
Machine chamber operating temperature:			
Angle of the generator set (boat moored):			
Maximum angle of the generator set (navigation conditions)			
Is the wet exhaust elbow above or below the floating line?		above	below
<b>Exhaust, Cooling and Fuel Line Information</b>			
Int. Diameter of exhaust hose (if applicable):	mm	Int. Diameter of sea water intake to the pump	mm
Int. Diameter of diesel intake:	mm		
Int. Diameter of diesel return intake	mm		
Has an exhaust collector been installed?	YES	Has an air trap been installed?	SI
	NO		NO
<b>Verifications Pior to Start-Up</b>		<b>V/x</b>	<b>Notes</b>
Correct engine alignment.			
Electrical installation connections.			
Engine oil level			
Coolant level and concentration.			
Control panel operation.			
Transmission belts and belt tension.			
Airtight water cock			
<b>Verification of Generator Set N°-Load Operation</b>		<b>V/x</b>	<b>Notes</b>
Oil pressure			
Bledd the fresh waater cooling system.			
Verify the control panel: indications and alamar operation.			
Water, oil and fuel leaks in the engine.			
<b>Verification of Generator Set Operations with Load</b>		<b>V/x</b>	<b>Notes</b>
Verify the electrical power and voltage of the generator set at full load.			
Engine output and alternator operation at variable loat.			
Engine temperature and oil pressure.			
<b>Information for the Ownre</b>		<b>V/x</b>	<b>Observaciones</b>
Delivery of the instructions manual and generator set-related documents.			
Review of the generator set instructions manual.			
Study the generator set control panel functions.			
Report the first revision date.			
Report the maintenace schedule indicated in the manuals.			







C-243 b, km 2. 08760 Martorell. Barcelona  
Tel. +34 93 775 14 00 · Fax +34 93 775 30 13  
www.solediesel.com · info@solediesel.com



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