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# Marine diesel engines

Operator's manual

SK-60

U\_SKA1\_EN  
Revision 3



## Introduction

### Presentation

Dear Customer,

First of all, 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 engine, 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.

# Table of contents

## Table of contents

<b>Introduction .....</b>	<b>3</b>
<b>Table of contents.....</b>	<b>4</b>
<b>Safety precautions and instructions .....</b>	<b>6</b>
<b>Solé Diesel warranty .....</b>	<b>10</b>
<b>Section 1 – Engine information.....</b>	<b>13</b>
1.1. Engine identification .....	13
1.2. Engine parts identification.....	14
<b>Section 2 – Transport, handling and storage.....</b>	<b>15</b>
2.1. Reception .....	15
2.2. Transporting and handling the packed engine .....	15
2.3. Transporting and handling the unpacked engine .....	16
2.4. Storage of packed and unpacked engine.....	16
<b>Section 3 – Installation .....</b>	<b>17</b>
3.1. Angle of installation .....	17
3.2. Engine installation .....	17
<b>Section 4 – Operation .....</b>	<b>18</b>
4.1. Prestart checklist .....	18
4.2. Cranking the engine.....	18
4.3. Stopping the engine.....	19
4.4. Engine Operation at Low Temperatures .....	19
4.5. Winterzation and Preservation.....	20
4.6. Maintenance during the storage.....	21
4.7. Restoration of Operational Conditions.....	21
<b>Section 5 – Systems and scheduled maintenance .....</b>	<b>22</b>
5.1. Operating description .....	22
5.2. Periodic maintenance schedule.....	22
5.3. General.....	24
Maintenance task. Screw tightening, fasteninat .....	24
Maintenance task. Valve clearance inspection.....	24
Maintenance task. Compression pressure inspection .....	25
5.4. Lubrication system.....	26
Circuit description.....	26
Oil specifications .....	26
Maintenance task. Oil filter change.....	26
Maintenance task. Oil level check.....	27
Maintenance task. Oil fill/change .....	27
5.5. Fuel system .....	28
Circuit description.....	28
Fuel specifications.....	28
Maintenance task. Fuel level inspection.....	28
Maintenance task. Fuel tank clean .....	28
Maintenance task. Water separator filter purge .....	28
Maintenance task. Fuel filter change.....	29
Maintenance task. Injection pump inspection.....	29
Maintenance task. Injector inspection .....	29

# Table of contents

Maintenance task. Bleeding air from the fuel system .....	30
5.6. Cooling System.....	30
Coolant specifications .....	31
Maintenance task. Coolant check .....	31
Maintenance task. Coolant fill / change .....	31
Maintenance task. Seawater filter inspection .....	31
Maintenance task. Seawater pump impeller inspection.....	32
Maintenance task. Zinc anode inspection .....	32
5.7. Inlet and Exhaust System .....	33
Exhaust circuit description .....	33
Maintenance task. Air filter inspection .....	34
Maintenance task. Exhaust gas, noise and vibrations inspection .....	34
Exhaust system inspection points .....	34
5.8. Electrical System.....	34
Panel .....	34
Battery .....	34
Circuit protection .....	34
Maintenance task. Incandescent glow plug inspection .....	35
Maintenance task. Starter motor inspection .....	35
Maintenance task. Alternator belt tension inspection .....	35
Maintenance task. Battery level .....	35
<b>Section 7 – Technical specifications .....</b>	<b>41</b>
<b>Section 8 – Tightening Troques .....</b>	<b>43</b>
<b>Section 9 – Wiring Diagrams .....</b>	<b>44</b>
<b>Section 10 – Overall dimensions.....</b>	<b>47</b>
<b>Section 11 - Instructions to Replace and Remove .....</b>	<b>49</b>
<b>Section 12 – Inspection prior to the delivery of propulsion engines .....</b>	<b>51</b>
<b>Section 13 – Declaration of conformity for recreational Craft Propulsion Engines.....</b>	<b>53</b>
<b>Maintenance log .....</b>	<b>56</b>

# Safety precautions and instructions



## 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 injury 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 engine 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 engine 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 engine with the air cleaner/silencer removed.

# Safety precautions and instructions



## ⚠ WARNING

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



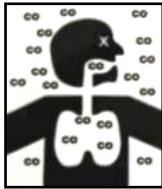
Engine fuels, fuel vapours and combustible materials are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher.

In case of fire do not open sound shield compartment and follow these instructions:

- Shut down engine(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.**



Engine 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 engine 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 engine is running. Replace guards, screens and covers before operating the engine.

# Safety precautions and instructions



## ⚠ CAUTION

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



Set the engine controller 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 engine by engine controller, remote start/stop switch, or engine start command from a remote computer.

## ⚠ CAUTION



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

## ⚠ NOTICE

**Read the engine operator's manual and understand it** before operation and maintenance of the engine, 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 engine 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 engine 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.).



# Safety precautions and instructions



## Engine labels

**⚠ CAUTION - AVISO ⚠**

- Over cranking can cause engine water ingestion.

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

If the engine does not start after several attempts to crank may cause water entering the engine. 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 engine 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 engine 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 engine operator's manual and understand it** before any operation and maintenance of the engine, to ensure that it continues operating practices and maintenance procedures insurance.

**⚠ CAUTION - AVISO - ATTENTION ATTENZIONE - ACHTUNG ⚠**

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

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

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

**Heavy material.** Engine 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 engine damage plus cause undesired operation.

CONNECT THE POSITIVE CABLE HERE  
CONECTE AQUÍ EL CABLE POSITIVO

+

CONNECT THE NEGATIVE CABLE HERE  
CONECTE AQUÍ EL CABLE NEGATIVO

-

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

## **⚠ NOTICE**

**Engine exhaust line installation label,** 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) To validate the warranty is necessary fill and send the inspection prior to the delivery of propulsion engines or genset to Solé Diesel through an official installer. See SECTION 12.
- b) The warranty covers any failure of the product under normal operating conditions caused by a defect in manufacturing.
- c) 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.
- d) 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 doesn't will be effective if don't filled correctly and send the inspection prior to the delivery of propulsion engines and genset to Solé through an official installer. SECTION 12.
- c) 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.
- d) 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.
- e) 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.
- f) Faults due to negligence, lack of service, accidents, abnormal use and inadequate service or installation.
- g) Faults due to the use of components not manufactured or sold by Solé Diesel.
- h) Faults due to electrical installations that do not comply with Solé Diesel design specifications or are not expressly approved by Solé Diesel.
- i) Faults due to the use of and operation with fuels, oils or lubricants that are not authorised by Solé Diesel
- j) Faults due to water entering the cylinder(s) through the exhaust system.
- k) 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).
- l) Failure for general omission of the procedures described in the User and Maintenance Manuals.
- m) Components subjected to normal operating wear and tear.
- n) 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 a proof of purchase and date of purchase by presenting the invoice to the authorized dealer for the purchase of the product served or a copy of it. 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.

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

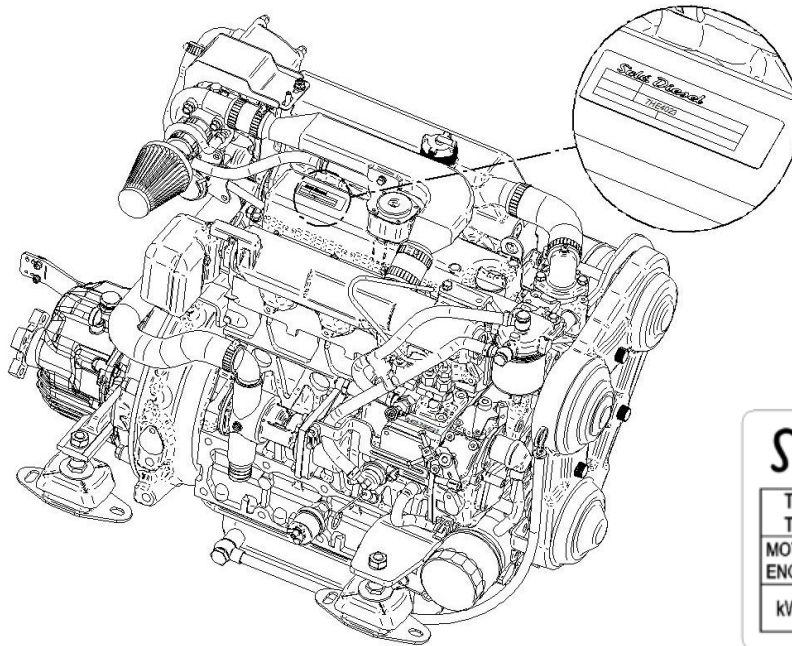
# Engine identification

## Section 1 – Engine information

### 1.1. Engine identification

#### Identification label:

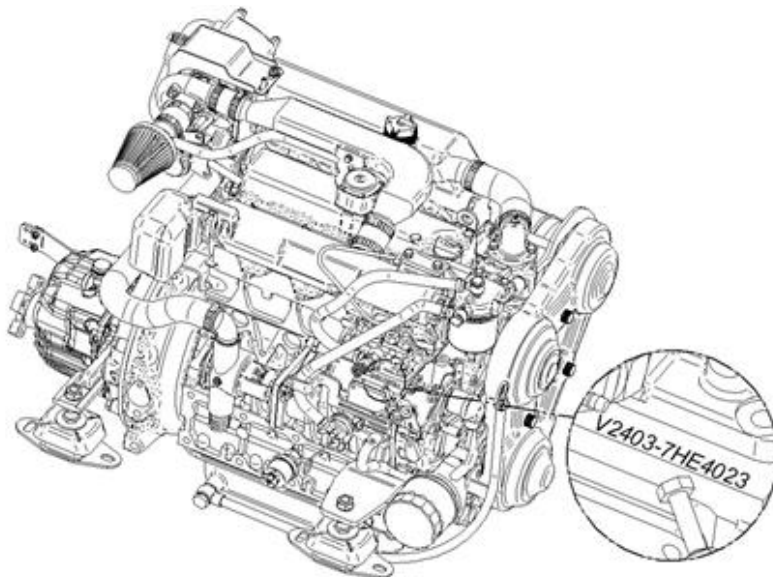
The nameplate is located top of the rocker cover.



<i>Solé Diesel</i>		MADE IN SPAIN
TIPO TYPE		
MOTOR Nº ENG No.		
kW	R.P.M.	

#### Engine serial number:

In addition, all engines are marked with the serial number on the block, on the fuel injection pump.



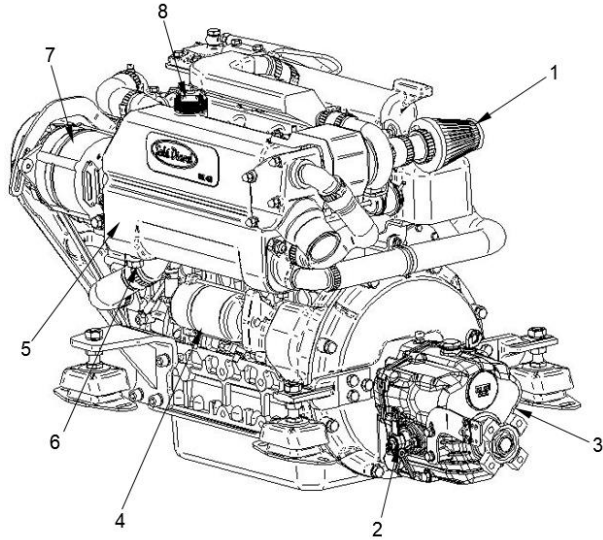
#### **▲ NOTICE**

The standard engine can operate at temperatures between -18 °C and +45 °C.

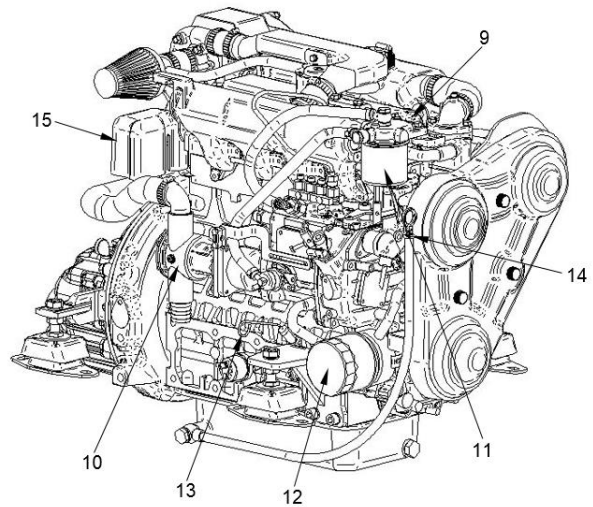
# Engine identification

## 1.2. Engine parts identification

PIECE	ELEMENT
1	AIR FILTER
2	GEARBOX CONTROL LEVER
3	GEARBOX
4	STARTER
5	COOLING SYSTEM
6	COOLING DRAIN PLUG
7	ALTERNATOR
8	COOLANT FILLER CAP



PIECE	ELEMENT
9	OIL FILLER CAP
10	SEA WATER PUMP
11	FUEL FILTER
12	OIL FILTER
13	OIL DIPSTICK
14	OIL DRAIN PLUG
15	RELAYS COVER



## Section 2 – Transport, handling and storage

### 2.1. Reception

When the engine 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 engine 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 Diesel 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 Diesel S.A., preferably by mail ([info@solediesel.com](mailto:info@solediesel.com)).

### 2.2. Transporting and handling the packed engine

When lifting and transporting the engine 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 engine.

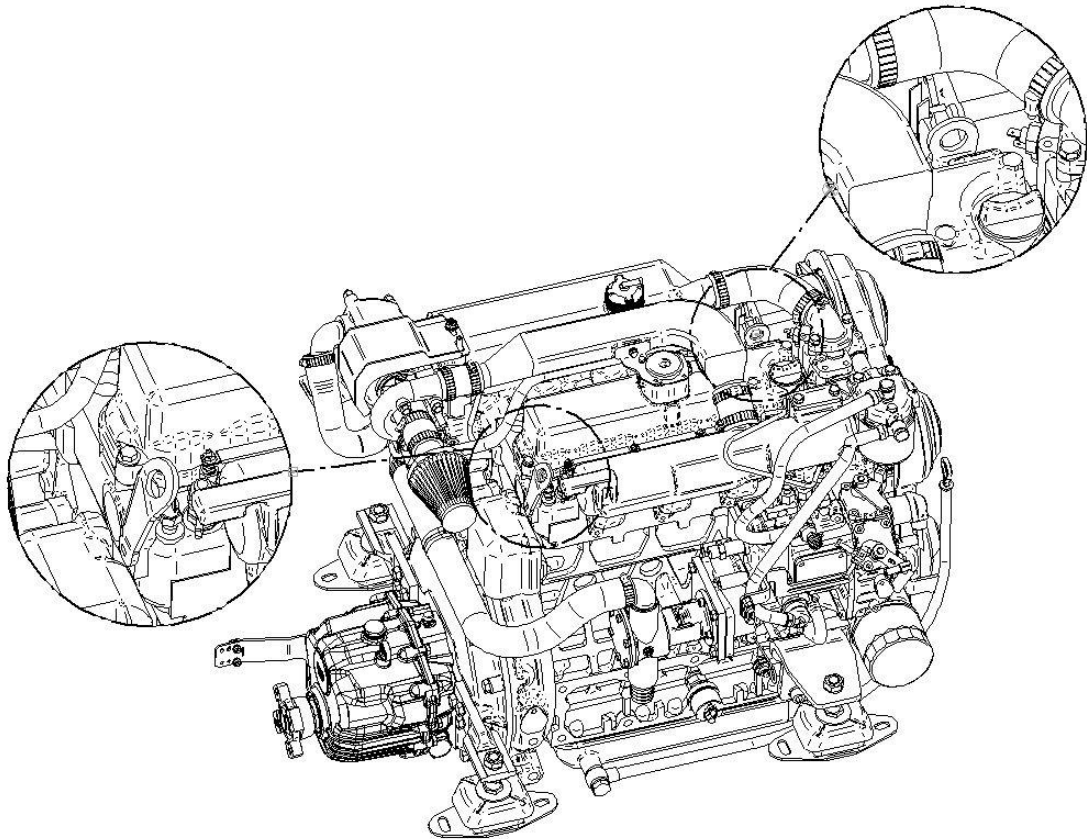
To unpack the engine, you must follow these steps:

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



## 2.3. Transporting and handling the unpacked engine

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



## 2.4. Storage of packed and unpacked engine

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

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

The treatment of the engine for storage is guaranteed for 6 months after the time of delivery.

### **▲ NOTICE**

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



# Installation

## Section 3 – Installation

### 3.1. Angle of installation

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

	Continuously	Temporary
SK-60	20°	30°

If the engine operates in these conditions, check section 5.4 Lubrication system.

### 3.2. Engine installation

Follow these steps to install the engine:

1. *FIX ENGINE.* See Section 10 Overall Dimensions and Section 8 Tightening torques.
2. *ENGINE COUPLING.* Couple the motor to the inverter, hydraulic pump, alternator or power extraction mechanism correctly.
3. *CONNECT EXHAUST OUTLET.* See Section 10 Overall Dimensions.
  1. *WET EXHAUST OUTLET.*
  2. *DRY EXHAUST OUTLET + SEAWATER OUTLET.*
4. *CONNECT SIPHON BREAKER.* (if installed) See Section 10 Overall Dimensions.
5. *CONNECT SEAWATER INLET.* See Section 10 Overall Dimensions.
6. *CONNECT FUEL INLET.* See Section 10 Overall Dimensions.
7. *CONNECT LEAK COOLANT OUTLET.* See Section 10 Overall Dimensions.
8. *FILL WITH OIL.* See 5.4 Lubrication System.
9. *FILL WITH COOLANT.* See 5.6 Cooling System.
10. *CHECK EACH PIPE CONNECTION* for oil or coolant leaks.
11. *PRIME THE FUEL SYSTEM.* See 5.5 Fuel System.
12. *CONNECT TO PANEL.* See the Panel operator's manual.
13. *CONNECT TO BATTERY.* Follow label battery connection into the engine.

#### **▲ NOTICE**

It is necessary to install a waterlock (supplied as accessory) in the exhaust system to avoid water ingestion (See section 5.7).

# Operation

## Section 4 – Operation

### 4.1. Prestart checklist

Follow these checks and inspections to ensure the correct engine 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 engine.

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

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

**COOLANT LEVEL:** Check the coolant level according to coolant circuit capacity.

**DRIVE BELTS:** Check the belt condition and tension of the coolant pump and battery charging alternator belt.

**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:

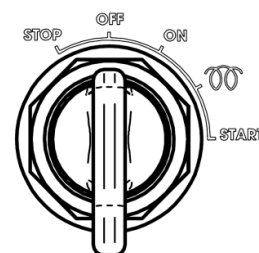
- Close the seacock
- Remove the hose from the seawater-filter outlet
- Fill the hose and seawater pump with clean water
- Reconnect the hose to the water filter outlet

- Open the seacock

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

### 4.2. Cranking the engine

1. **TURN ON THE KEY POSITION.** To start all instruments with fuel pump.
2. **TURN THE KEY TO PREHEATING POSITION.** To heat the engine for a few seconds before the start.
3. **TURN THE KEY TO STARTER POSITION.** To feed the starter and start the engine.



### **NOTICE**

If the engine doesn't start after several attempts to start, may cause water entering in the engine. See warning label on the engine.

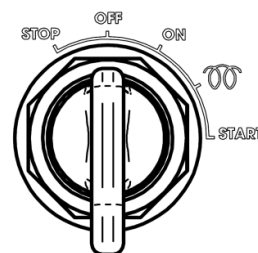
After starting up the engine, check the following points. If you find anything wrong, immediately stop the engine, and then investigate the cause.

# Operation

1. Lubrication oil pressure should be from 0,19 to 0,39 MPa (2 to 4 kgf/cm<sup>2</sup>) (2 to 4 bar) at nominal speed.
2. Coolant temperature should be 75 to 85°C.
3. Oil temperature should be 60 to 95°C.
4. Check for leakage of oil, coolant and fuel.
5. Knocking should die away as coolant temperature rises. No other defective noise should be heard.
6. Check for exhaust colour and abnormal odours

## 4.3. Stopping the engine

1. **REMOVE ENGINE LOAD.** Before turning off the engine, it must be freed of all charges (disengaged gearbox to neutral)
2. **TURN THE KEY TO STOP POSITION.** The key automatically returns to the OFF position. All instruments are off.
3. **CLOSE THE SEACOCK.**



### **▲ NOTICE**

If the needle of tachometer is marking counter rpm when the engine is off, turn the key back to ON and then OFF again.

The engine has a **MANUAL STOP** system. For it, follow the instructions below:

1. Move the speed control lever (2) and run the engine at idle.
2. Set the engine stop lever (1) to position (A).
3. With the contact key in the OFF position, remove the key. Don't keep the stop lever into the position (A) after stop the engine, so that it be prepared to the next start.

### **▲ NOTICE**

In engines with turbocharger, stop the engine after being warming for 5 minutes. If the engine stops suddenly after being working in an overloading state, the turbocharger could be damage5.4. Engine Operation at Low Temperatures

## 4.4. Engine Operation at Low Temperatures

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

- The cooling liquids 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 engine has difficulty in starting.
- The fuel loses fluidity.

# Operation

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

4. Use special low temperature coolant or suitable anti-freezing agent concentration.
5. Close the seawater cock, when the engine is stopped. Open the seawater filter cover and start the engine adding a mixture of freshwater and suitable anti-freezing agent concentration (see package labels) until the seawater circuit is filled completely. Stop the engine and replace the seawater filter cover. Before starting the engine again, open the seawater cock. Repeat this operation whenever the engine is used at temperatures below 0°C.
6. Use oil with suitable quality and viscosity. SAE 15W40 is recommended. Under extreme conditions contact with technical support.
7. 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.
8. When starting the engine, make sure that the glow plugs become hot enough.
9. 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 engines 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.

## **4.5. Winterzation 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. If there is no care, the inside parts can oxidize and cause damage on the engine. When the engine is stored, steps indicated below have to be followed:

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 and refill the heat exchanger to the maximum level with a mixture of fresh water and anti-freezing agent.
5. Renew the oil in the engine.
6. Cover the air intake.
7. 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.
8. Clean and dry the area where the engine is installed.
9. Loosen the belts.
10. Apply dielectric spray on the electrical connection, disassemble the battery and charge it several times during the time it is not being used.
11. Apply moisture repellent spray on the motor.

## 4.6. Maintenance during the storage

During the long engine storage, it has to be stored inside a ventilated area and free of humidity.

When the engine stay stopped for 3 months or more, inside parts can be oxidize and lost the oil film. As a result, the engine could to size up after the storage. To avoid this, the engine must work periodically during the storage.

Realize the following steps at least once per month:

1. In case that has a battery next to the engine, check the electrolyte level and fill it.
2. Start the engine during approximately 10 seconds.
3. Stop the engine during 1 minute. Repeat this action two or three times.
4. Be sure that oil pressure of the engine increase.
5. Get the engine work during 5 or 10 minutes without load, as maintenance operation.

## 4.7. Restoration of Operational Conditions

When starting up the engine 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 engine.
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

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 engine is hot. Wear suitable safety clothing.
- ✓ It is strictly forbidden to clean the engine 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 burns.

### 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 observed.

# Systems and scheduled maintenance

	Inspection Item	Intervals							Winter storage and Preservation
		Daily	1st 20h-50h	Every 200h	Every 400h	Every 800h	Every year	Every 2 years	
<b>General</b>	Screw tightening, fastening.		I		I				
	Engine block.								CL
	Valve clearance.				I				
	Exhaust gas, noise and vibrations.	I							
	Compression pressure.					I			
<b>Lubrication system*</b>	Engine 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
	Coolant.	I						C	C
<b>Cooling system</b>	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			

\*Use oil with 15W40 viscosity and no less than ACEA E5 or API CH-4/SJ quality.

I: Inspect, adjust or fill. E: Empty. C: Change. CL: Clean.

## 5.3. General

Solé Diesel offers, for these engine models, the several Pack, consult on the web.



- Welcome pack.
- On board pack.
- Maintenance pack 50 hours.
- Maintenance pack 1600 hours.
- Maintenance pack 3000 hours.

## Maintenance task. Screw tightening, fasteninat

For details of tightening troques see section 8 Troques.

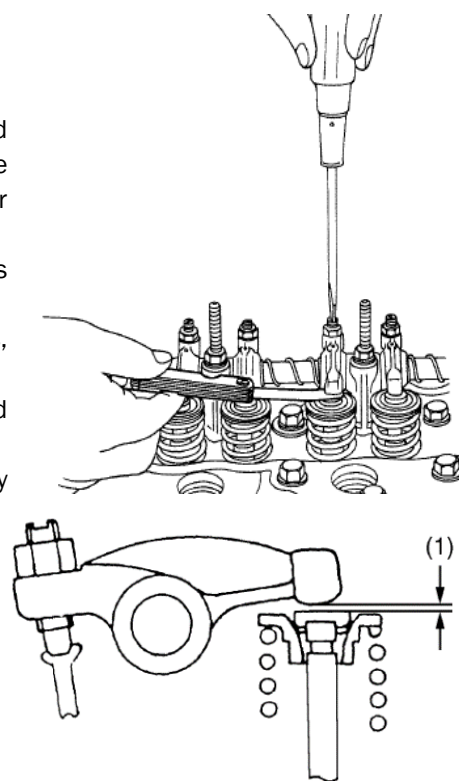
## Maintentance task. Valve clearance inspection

The rocker cover must be dismantled to check the valve clearance. This operation must be carried out when the engine is cold.

Item		Assembly Standard
Valve clearance (cold setting)	Inlet exhaust	0,18 to 0,22 mm

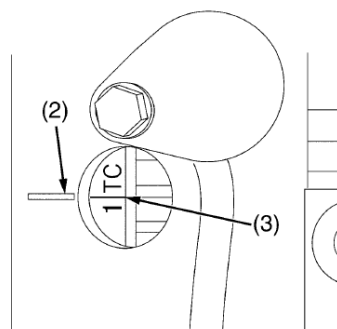
### Inspection

1. Remove the cap from the cylinder head.
2. Align the "1TC" mark (3) on the steering wheel and the protuberance (2) of the housing. Make sure the No. 1 piston comes to the compression position or overlaps with the top dead center.
3. Examine the valve set clearance (1) with a thickness gauge.
4. If clearance is not within the factory specifications, adjust it with the set screw.
  - Valve clearance should be inspected and adjusted when the engine is cold.
  - The "1TC" mark on the steering wheel is only valid for cylinder No. 1. There is no "TC" mark for the other cylinders.
  - Align the "TC" mark with the protuberance (2) in the visor of the steering wheel housing. Piston # 1 is in the top dead center position at this time. Turn the steering wheel 0.26 rad (15 °) to see if the piston is in the position corresponding to the top dead center of your compression stroke or in the overlap position. Refer to the following table to adjust the valve set (1) again. (The piston is in the upper compression dead center when both the ADM and EXHAUST valves do not move. The piston is in the overlap position when both valves move.)





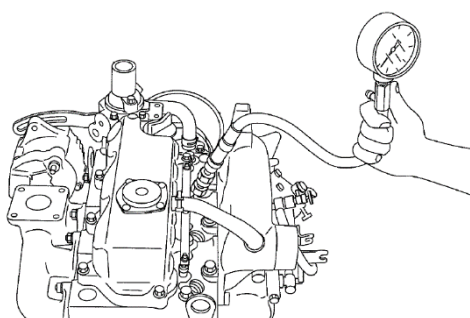
- Turn the steering wheel 6.28 rad (360°) and align the "1TC" mark with the protuberance (2) correctly. Adjust the sets of the other valves, if necessary.
- After turning the steering wheel in the anti-clockwise direction 2 or 3 times, check the valve set (1) again.
- After adjusting the valve set (1), firmly tighten the set screw locking nut.



## Maintenance task. Compression pressure inspection

Start by:

1. Make sure the engine oil level, air cleaner, starting motor and battery are well-conditioned.
2. Start the engine and allow it to warm up thoroughly, until 50°C or more coolant temperature.



Measure the compression pressure on all cylinders:

1. Remove the injection nozzle from the cylinder head where the compression pressure is to be measured.
2. Attach the compression pressure gauge.
3. Disconnect the stop solenoid connector (the fuel supply shut off) and crank the engine by means of the starter, and read the compression pressure gauge indication when the engine is running at specified speed.
4. If the compression pressure is lower than repair limit, check the engine parts affected.

	Engine speed	Compression pressure	Repair limit	Máximum pressure difference between cylinders
SK-60	290 rpm	3,24 to 3,72 MPa 33,03 to 37,93 kgf/cm <sup>2</sup>	2,55 MPa 26 kgf/cm <sup>2</sup>	10% or less

### **NOTICE**

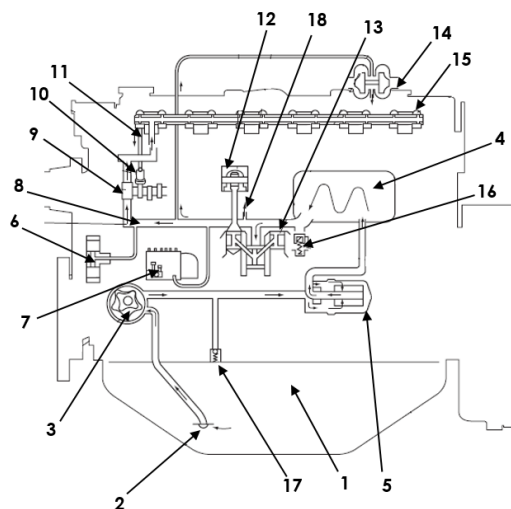
- It is not a good practice to measure the compression pressure on only few cylinders, and presume the compression on the remaining cylinders.
- Compression pressure varies with engine speed. Check engine speed when measuring the compression pressure.
- The compression pressure will be slightly higher in a new or overhauled engine due to new piston rings, valve seats, etc.

## 5.4. Lubrication system

### Circuit description

The lubrication circuit is forced by the trochoid gear pump, and it is composed of the following elements.

PIECE	ELEMENT
1	Oil pan
2	Oil strainer
3	Oil pump
4	Oil cooler
5	Oil filter
6	Intermediate gear
7	Fuel injection pump
8	Oil main gallery
9	Camshaft
10	Tappet
11	Pushrod
12	Piston
13	Crankshaft
14	Turbocharger
15	Valve mechanism
16	Relief valve
17	Safety valve
18	Oil jet



	Oil circuit capacity (l)
SK-60	6

### Oil specifications

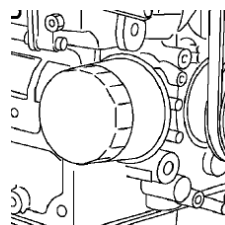
Use oil with 15W40 viscosity (this is an all-season oil for temperatures ranging between -15°C and +40°C) or select the most suitable oil viscosity for the atmospheric temperatures on which the engine is going to be operated. On the other hand, use oil quality no less than ACEA E5/E3 or API CH-4/SJ.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



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

### Maintenance task. Oil filter change

The oil filter is located under inlet manifold of the engine. Remove oil filter with a belt wrench. When fitting a fresh oil filter, smear a small quantity of oil into the annular seal and firmly tighten it with the hand. When this operation is finished, start the engine and check oil is not leaking.



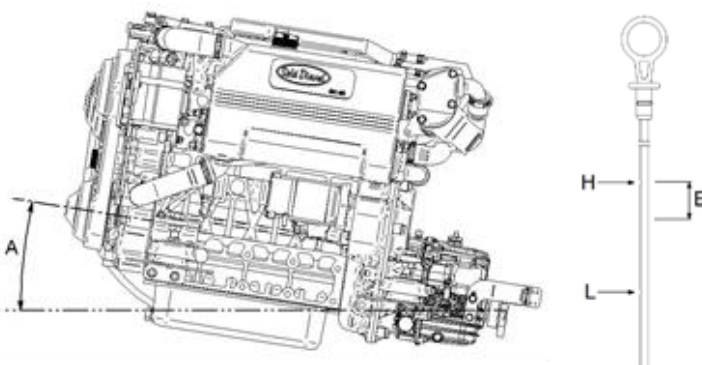
## Maintenance task. Oil level check

Check the oil level in the crankcase daily or before each start-up to ensure that the level is between the upper (Max mark) and lower (Min mark) lines on the dipstick. To check the oil level:

1. Remove the dipstick
2. Wipe the dipstick end
3. Reinsert inside the guide
4. Remove it again to see the oil level

If the engine is fitted inclined, the oil dipstick must be modified to avoid problems of aspiration by the oil pump. See the table enclosed for modification level in dipstick. Decrease High level (H) to E on original oil dipstick.

ENGINE INCLINATION	DIMENSION E SK-60
4°	21 mm
8°	44 mm
12 <sup>a</sup>	71 mm
16°	89 mm
20 <sup>a</sup>	104 mm



### **NOTICE**

Do not operate the engine if the oil level is below the Min mark or above the Max mark. Be careful the oil dipstick marks refer to the engine as a horizontal position. Therefore, check the engine inclination when the oil level is verified.

## Maintenance task. Oil fill/change

Oil must be changed with hot engine so as to be sure the oil is fully drained. The procedure is the following:

1. Drain the oil (follow steps below)
  - a. Stop the engine.
  - b. Disconnect the battery negative (-) terminal.
  - c. Remove the oil drain plug.
  - d. Connect the external oil pump to the end of the oil drain hose. Place the outlet of the pump into an oil collection container.
  - e. Allow time for the engine oil to drain completely.
2. Replace the oil filter.
3. Remove dipstick
4. Fill with oil according to oil capacity circuit.
5. Check for leaks.
6. Check oil level according to the oil level check procedure.



### **NOTICE**

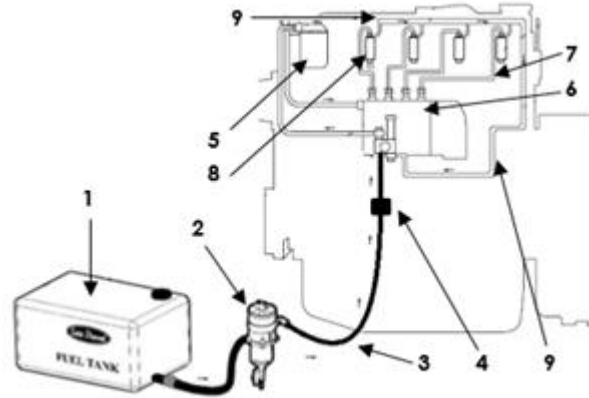
Never overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

## 5.5. Fuel system

### Circuit description

The fuel system is based on a fuel feed pump and an in-line mechanical injection pump.

PIECE	ELEMENT
1	Tank (supplied as accessory)
2	Fuel decanting filter (accessory)
3	Fuel intake pipe (accessory)
4	Injection pump
5	Fuel filter
6	Feed pump
7	Fuel injection pipe
8	Fuel injection Nozzle
9	Leak-off pipe



### Fuel specifications

Use ASTM diesel fuel No.2-D for the best engine performance, to prevent engine damage. Never use kerosene, heavy diesel fuel or biodiesel. It is essential to use clean and filtered diesel oil.

The use of diesel oil that not complies with the technical specifications may affect warranty coverage and cause serious damage in the injection system and internal engine components.

### Maintenance task. Fuel level inspection

Periodically, it is necessary to check the fuel level to assure the operation of the engine. On top of that, if fuel pump sucks air when the fuel level is lower than pump suction, it could break.

Whenever possible, keep the fuel tank full. The temperature changes may cause condensation of the damp air present in the tank and this water accumulates at the bottom. It can cause an increase of corrosion or an impossibility of starting the engine if this water is aspirated by the fuel pump.

### Maintenance task. Fuel tank clean

The fuel impurities could obstruct the suction pump. For this reason, drain out the content of the fuel tank to remove condensate and any foreign material. Then, wash the tank with fuel and refill it.

### Maintenance task. Water separator filter purge

The fuel system has to have a water separator filter (supplied as accessory) to avoid the inlet of water in the fuel circuit. According to the maintenance plan it is necessary to purge the filter to eliminate water periodically. This is the procedure:

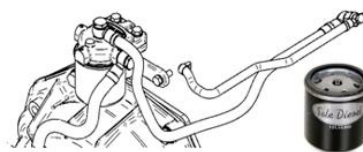
1. Loosen the bottom nut to eliminate water.
2. Shut it off again.
3. Check for any leakage.



## Maintenance task. Fuel filter change

Procedure to change the fuel filter:

1. Remove fuel filter with a belt wrench.
2. Place a new fuel filter and firmly tighten it with the hand.
3. Prime the system.
4. When this operation is finished, start the engine and check that it is not leaking.



### **CAUTION**

Wash hands after any contact with diesel fuel.

## Maintenance task. Injection pump inspection

The injection pump is adjusted at factory and should never be adjusted carelessly. Such adjustment, whenever is required, shall be made by a SOLÉ DIESEL licensed service shop, since a precision pump monitor and skill knowledge are required.

You must check:

- The presence of exhaust smoke color.

Procedure: quickly accelerate engine.

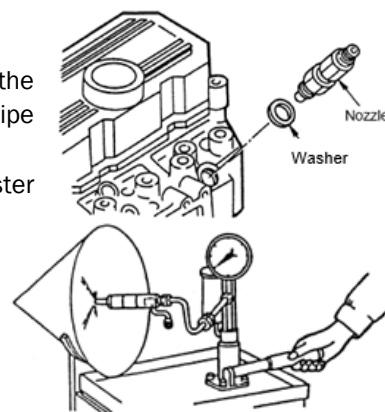
Criteria: no remarkably black smoke exhaust, and correct function of fuel cut-off solenoid

- Any leaks at the body injection pump or fuel lines

## Maintenance task. Injector inspection

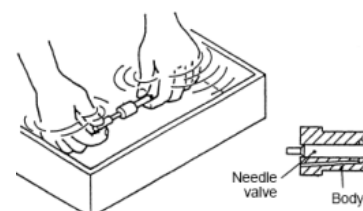
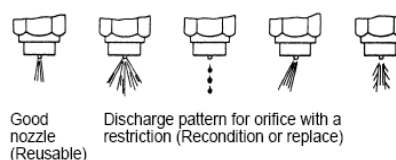
To check the injection pressure of injectors (opening pressure) you have to follow these steps:

1. Remove nozzle and washer.
2. Install the injection nozzle on the tester. Slowly operate the tester handle full strokes to bleed (remove) air from the pipe and nozzle.
3. Make a slow increase in pressure by operating the tester handle at a speed of more than one stroke per second while observing the pressure gauge.
4. The pressure gauge reading will slowly increase and, when the nozzle starts discharging fuel, it will go down fast. Take the gauge reading right then as the injection pressure.



Injection pressure 13,73 MPa (140 kgf/cm<sup>2</sup>)

5. To adjust the injection pressure, increase or decrease the amount of shims fitted to the nozzle holder.
6. Look at the orifice discharge pattern (shape of discharge) when fluid begins to flow through the injection nozzle. The discharge must be finely and uniformly atomized. Any change is an indication of a bad nozzle.
7. If the nozzle is bad, remove the tip from the nozzle and wash needle valve and body in clean washing solution. And if the nozzle is still bad after the tip has been washed, replace the tip.
8. When installing the new tip, remove synthetic resin film from the tip and slide the needle valve in the body in clean diesel fuel to wash off inhibitor completely.
9. The washer shown on figure must be replaced.



## ⚠ WARNING

When testing the injection nozzle, keep its tip pointed away from the operator. Fuel from the orifices in the tip of the nozzle is under high pressure and can cause injury to the operator.

### Maintenance task. Bleeding air from the fuel system

Prime the fuel system to bleed the air from the circuit. Trapped air in the fuel system can cause difficult starting and erratic engine operation. It is necessary to prime the system:

- ✓ Before starting the engine for the first time.
- ✓ After running out of fuel and adding fuel to the tank.
- ✓ After fuel system maintenance such as changing the fuel filter, draining the fuel/water separator, or replacing a fuel system component.

For this operation you have to follow these steps:

1. Loosen all the injection pipes.
2. Start the engine to drive out air in the injection pipes and nozzles automatically.
3. When fuel overflows from an injection pipe, tighten it up and wait until fuel overflows from another one. Repeat it until all injection pipes are tightened.
4. After bleeding, clean up fuel spillage.

## ⚠ CAUTION

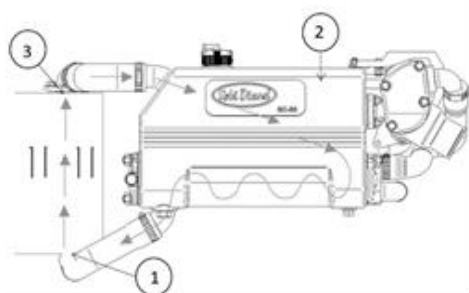
When fuel overflows from the injection pipes, wipe thoroughly with a cloth. Spilled fuel is a fire hazard.

## 5.6. Cooling System

The engine cooling system is based on coolant circulation controlled by centrifugal pump with thermostatic control and heat exchanger, where the coolant is refrigerated by sea water. Moreover, the exhaust manifold is cooled also by sea water.

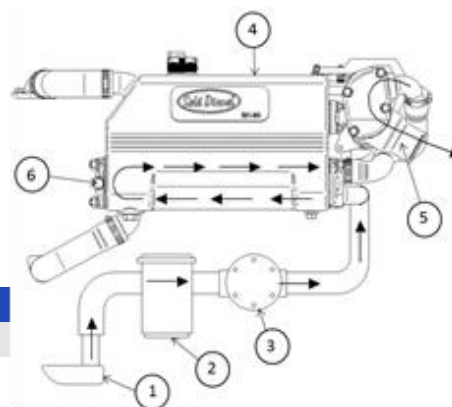
Coolant circuit description

PIECE	ELEMENT
1	Coolant pump
2	Heat exchanger
3	Thermostat



Seawater circuit description

PIECE	ELEMENT
1	Seacock (supplied as accessory)
2	Sea water filter
3	Sea water pump
4	Heat exchanger
5	Wet exhaust elbow
6	Zinc anode



Coolant circuit capacity (L)	
SK-60	8,5

## Coolant specifications

It is recommended use SOLÉ DIESEL50% coolant or another coolant with similar specifications. On the other hand, distilled water with an anti-freezing agent is also suitable. The anti-freezing agent concentration according to operating conditions is specified in anti-freezing agent package labels. It is advisable select the anti-freezing agent concentration based on a temperature approx. 5°C under the actual atmospheric temperature.

Other engine coolants may affect warranty coverage, cause an internal build-up of rust and scale and/or shorten engine life.

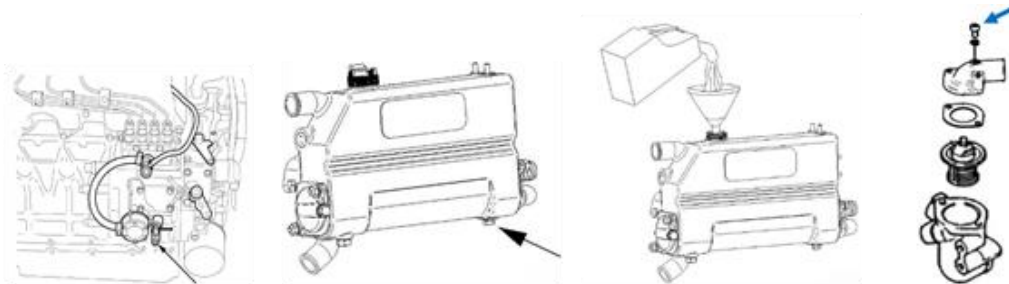
Never mix different types of coolants. This may adversely affect the properties of the engine coolant.

## Maintenance task. Coolant check

Allow the engine to cool. Release pressure from the cooling system before removing the pressure cap. To release pressure, cover the pressure cap with a thick cloth and then slowly turn the cap counterclockwise. Remove the cap after pressure has been completely released and the engine has cooled. Check the coolant level at the tank, the level must be approximately 3/4 full.

## Maintenance task. Coolant fill / change

1. Drain off all the coolant by opening the two drain plugs, one in the heat exchanger and the other in the cylinder block.
2. Close the drain plugs.
3. Remove bleeding bolt of thermostat holder
4. Refill to the hole in the tank cap with coolant



## Maintenance task. Seawater filter inspection

It is important to install a seawater filter (supplied as accessory) between seawater cock and the seawater pump to avoid that any impurity might clog the seawater circuit or seawater pump.

To clean this filter:

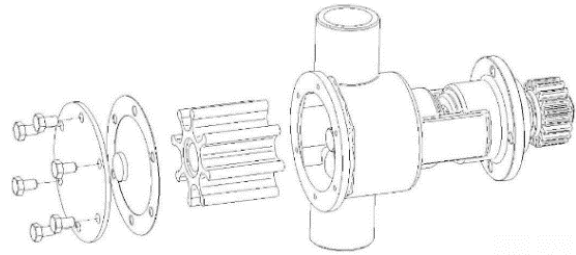
1. Loosen the wing nut.
2. Remove the filtering component.
3. Clean it.
4. Fit it again taking care that the cover is well seated on the o-ring.
5. Start the engine to check seawater leakages.



## Maintenance task. Seawater pump impeller inspection

Seawater pump impeller is neoprene and cannot rotate dried. If operated without water, the impeller can be broken. It is important therefore that a spare impeller is always available. Impeller inspection and replacement procedure:

1. Close the seawater cock.
2. Remove the seawater pump cover plate.
3. Remove the impeller from the shaft.
4. Clean the housing.
5. Inspect the impeller for damaged, cranked, broken, missing or flattened vanes. The impeller vanes should be straight and flexible. If it is damaged replace with a new one.
6. Lubricate the impeller with soapy water before installation.
7. Install the impeller.

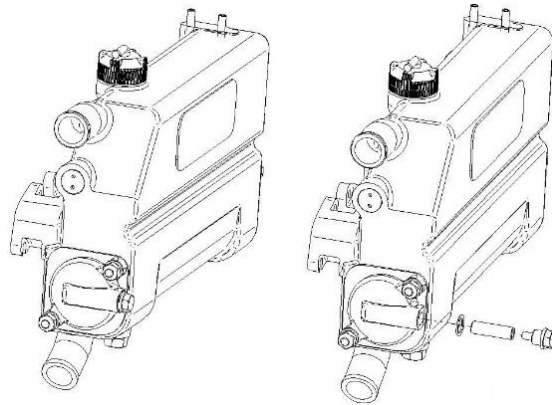


8. During installation push and rotate the impeller in the same direction as the engine rotation until it is thoroughly seated in the impeller housing.
9. Inspect the cover plate and gasket for corrosion and/or damage. Replace components as necessary.
10. Lubricate the gasket with silicon grease and attach the gasket and cover plate to the seawater pump housing.
11. Open the seacock.
12. Start the engine and check for leaks.

## Maintenance task. Zinc anode inspection

In order to avoid the corrosion produced by galvanic currents, the engine is fitted with a zinc anode located on the front lid of the coolant-seawater heat exchanger. Anticorrosion zinc anode inspection and replacement:

1. With the engine cooled, close the seacock, open the coolant drain plug and drain the coolant into a suitable container.
2. Remove the anticorrosion zinc anode (plug) from the heat exchanger.
3. Use a wire brush to remove the loose corrosion on the anticorrosion zinc anode.
4. Clean the threaded hole of the heat exchanger and coat the threads of anticorrosion zinc anode. Install the anticorrosion zinc anode into the heat exchanger.
5. Close the coolant drain plug and open the seacock. Refill the coolant circuit.
6. Start the engine and check for leaks at the anticorrosion zinc anode location. The pump is operating if the seawater flows from the exhaust outlet.





## 5.7. Inlet and Exhaust System

### Exhaust circuit description

There are two possible installations of the exhaust system. You need to check the distance between water injection point and waterline to decide which type of installation you need. This information is specified in the following drawings.

The elements included in the drawing are essential for the correct engine operation:

- Waterlock (supplied as accessory) to prevent seawater from entering inside the engine when it stops.

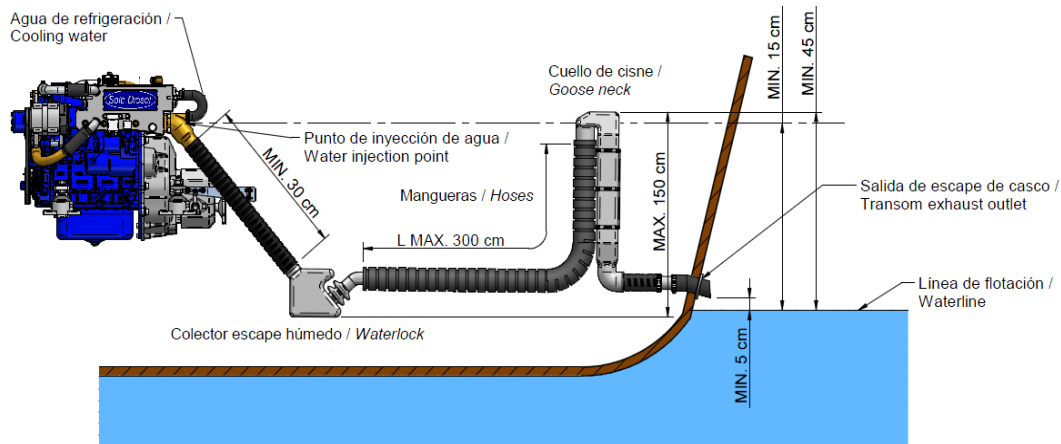
To calculate the required collector capacity, we must follow the following formula:

$$C = \frac{\left(\frac{\pi}{4} D^2 * L\right)}{1000000} * 0.5$$

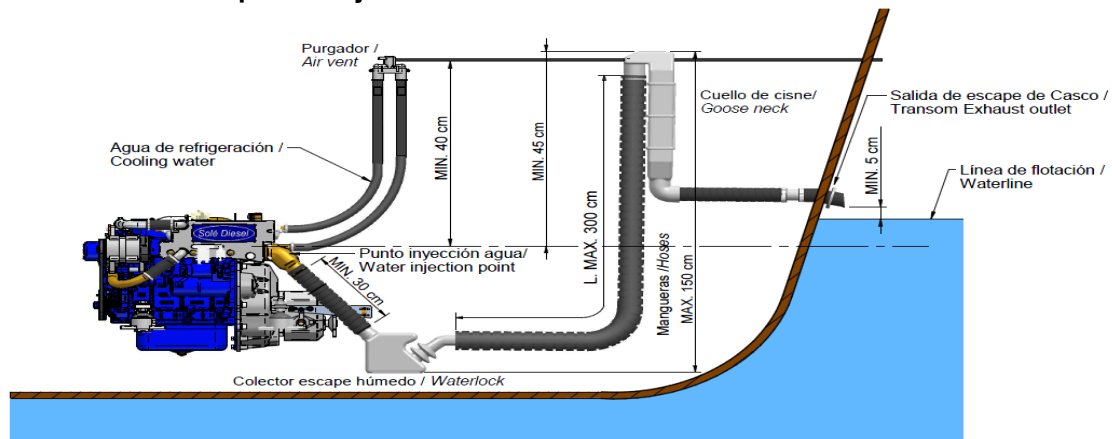
C = collector capacity (L)  
 D = Inside diameter of the tube (mm)  
 L = Tube length (mm)

- Goose neck (supplied as accessory)
- Siphon breaker (supplied as accessory) – needed in case there is less than 150 mm between the water injection point of wet exhaust and the waterline, or if the point of injection is below waterline.

#### Type 1 installation. When between water injection point of wet exhaust and waterline is minimum 150 mm.



#### Type 2 installation. When between water injection point of wet exhaust and waterline there is less than 150 mm or the point of injection is below waterline.



## **NOTICE**

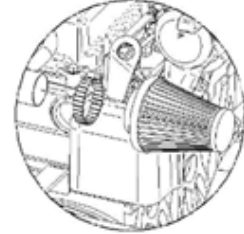
The wet exhaust is the engine's standard equipment. If you want dry exhaust, which is an optional equipment, contact with our dealers.

### Maintenance task. Air filter inspection

Engine is provided with an intake air filter. Examine the element and housing for damage. Replace the complete air filter if necessary.

## **NOTICE**

It is important to ensure that the combustion air is freely supplied and freely expelled from the area.



### Maintenance task. Exhaust gas, noise and vibrations inspection

Inspect the exhaust system components for cracks, leaks and corrosion.

### Exhaust system inspection points

1. Check the hoses for softness, cracks or dents. Replace the hoses as needed.
2. Check for corroded or broken metal parts and replace them as needed.
3. Check for loose, corroded or missing clamps. Tighten or replace the hose clamps and/or hangers as needed.
4. Check that the exhaust outlet is unobstructed.
5. Visually inspect the exhaust system for exhaust leaks. Check for carbon or soot residue on exhaust components. Carbon and soot residue indicate an exhaust leak. Seal leaks as needed.

## **5.8. Electrical System**

### Panel

See the panel operator's manual.

### Battery

The minimum recommended battery capacity is 100-120 Ah. However, this is a general reference value since it is related to the maximum current that can offer for starting the engine.

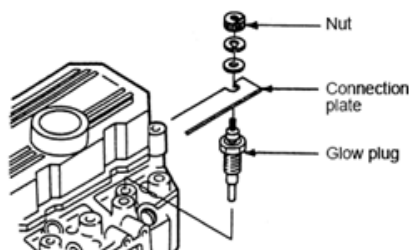
### Circuit protection

The electrical installation of the engine has a fuse that protects all the electronics in case of overload or short circuit. It is located in the wire harness next to the starter motor.

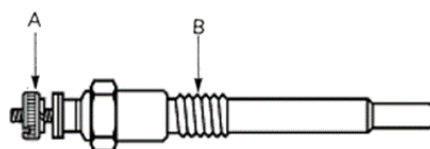


## Maintenance task. Incandescent glow plug inspection

1. Loosen nuts, and then remove connection plate and glow plug.
2. If the glow plugs glow red when the positive (+) wire is connected to the portion A with the portion B grounded, the plug can be used.



Rated voltaje - Current	12 V	10,5-9,7 A
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## Maintenance task. Starter motor inspection

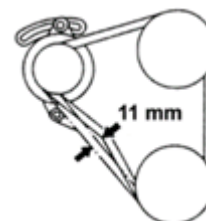
Starter motor:

1. Check if there is any impurity in pinion teeth.
2. Make sure that the pinion shaft turns freely when turned in the direction of driving (clockwise) and it is locked when turned in the opposite direction. If not, replace the overrunning clutch.



## Maintenance task. Alternator belt tension inspection

Push the belt inward with thumb pressure exerted midway between the pulleys, as shown, to check the belt tension (deflection). If the tension is incorrect, loosen the adjusting bracket bolt and mounting bolt, and move the alternator in or out.



Item	Assembly Standard
V-belt deflection	10-12 mm

### **NOTICE**

An excessive tension may cause a quick wear of the belt and alternator bearings. Otherwise, if the belt is excessively loose or has oil and insufficient load, it can cause the belt to skid.

### **CAUTION**

Never adjust the belt tension with engine running or battery connected.

## Maintenance task. Battery level

Battery requires a very careful handling and frequent checking. Proceed as shown below:

1. Keep battery dry and cleaned.
2. Check terminal cleanliness regularly. If dust is settled, terminals should be loosened, cleaned and smeared with a neutral grease layer.
3. Metal objects must not be placed over the battery.
4. Add distilled water if the level is out of range.

## Section 6 - Troubleshooting

If a fault occurs in the engine, proceed as follows:

- ❖ Within the period of warranty

Contact to Sole Diesel Official Service. See SOLÉ DIESEL WARRANTY.

- ❖ Outside the period of warranty

Contact to Sole Diesel Official Service. See SOLÉ DIESEL WARRANTY.

Stop the engine, determine the cause and repair it before continuing driving the motor.

# Technical specifications



ENGINE FAILURE	PROBABLE CAUSES		RECOMMENDED ACTIONS	SECTION
<b>FAILURE TO START</b>	ELECTRICAL SYSTEM ENGINE	Electronic board	Check that goes voltage electronic board to micro relay.	-
		Blown fuse	Replace the controller fuse. If the fuse blows again, troubleshoot the controller.	5.8
		Battery discharged or dead	Recharge or replace the battery.	5.8
		Battery connections loose, corroded or incorrect	Verify that the battery connections are correct, clean and tight.	5.8
		Faulty cranking relay/stop solenoid	Check the cranking relay and the stop solenoid. If necessary, replace.	-
		Faulty starter motor	Replace if it is inoperative.	5.8
	GENERAL	Compression weak	Check the compression.	5.3
	LUBRICATION SYSTEM	Oil viscosity too high	Check the oil viscosity (according to technical specifications).	5.4
	FUEL SYSTEM	Fuel pump faulty or clogged	Check fuel pump inlet.	5.5
		Fuel lines obstructed	Check fuel lines.	5.5
		Fuel filter clogged	Replace fuel filter.	5.5
		Faulty injection pump	Contact with our dealer	-
		Air in fuel system	Bleed fuel system.	5.5
		Fuel injectors dirty or faulty	Clean, test and/or replace the inoperative fuel injector.	5.5
		Fuel injection timing out of adjustment	Adjust the fuel injection timing.	5.5
	Fuel tank empty or fuel valve shut off	Add fuel and move the fuel valve to opened position.	5.5	
INLET AND EXHAUST SYSTEM	Air filter clogged	Replace air filter element.	5.7	

# Technical specifications



ENGINE FAILURE	PROBABLE CAUSES		RECOMMENDED ACTIONS	SECTION
<b>STARTS THEN STOPS</b>	GENERAL	Governor inoperative	Contact with our dealer	-
	FUEL SYSTEM	Fuel pump faulty or clogged	Check inlet of fuel pump.	5.5
		Fuel filter clogged	Replace fuel filter.	5.5
		Air in fuel system	Bleed fuel system.	5.5
		Injection pump incorrectly set	Contact with our dealer	-
		Fuel outlet cock closed	Open fuel outlet cock.	5.5
	COOLING SYSTEM	Coolant level low	Restore the coolant to normal operating level.	5.6
ELECTRICAL SYSTEM ENGINE	Key switch	Check the pin connections. Above all, the pins that give signal to stop solenoid and fuel pump.	-	
<b>BLACK SMOKE</b>	FUEL SYSTEM	Fuel filter clogged	Change fuel filter.	5.5
		Fuel injectors dirty or faulty	Clean, test and/or replace the inoperative fuel injector.	5.5
		Injection pump incorrectly set	Contact with our dealer	-
	INLET AND EXHAUST SYSTEM	Air filter clogged	Replace air filter element.	5.7
	LOAD ENGINE	Propeller too large (not enough rpm)	The power curve of the engine is not adequate. Carry out a propulsive power study.	-
<b>BLUE SMOKE</b>	GENERAL	Valve clearance incorrect	Adjust the valves.	5.3
	LUBRICATION SYSTEM	Oil level too high	Restore the oil to normal operating level.	5.4
<b>LOW OIL PRESSURE</b>	LUBRICATION SYSTEM	Faulty oil pump	Contact with our dealer	-
		Oil pressure relief valve sticking		5.4
		Oil pressure too low	Check oil level.	5.4
		Oil level too low	Restore the oil level. Inspect the engine for oil leaks.	5.4
		Faulty oil pressure valve	Contact with our dealer	-
		Faulty oil pressure gauge or switch	Check and/or replace oil pressure switch.	5.4

# Technical specifications



ENGINE FAILURE	PROBABLE CAUSES	RECOMMENDED ACTIONS	SECTION	
<b>ENGINE OVER-HEATING</b>	GENERAL	Compression weak	Check the compression.	5.3
		Overload	Propeller too large, replace.	-
		Incorrect injection time	Adjust the injection time of the injection pump.	
	LUBRICATION SYSTEM	Faulty oil pump	Contact with our dealer	-
		Oil viscosity too high	Check oil specifications (oil used must be chosen according to Technical Specifications).	5.4
		Oil level too low	Restore the oil level. Inspect the engine for oil leaks.	5.4
	COOLING SYSTEM	Faulty coolant pump	Check coolant pump (impeller, pump sealing).	5.6
		Seawater cock clogged or restricted	Clean the cock, check the seawater pump impeller for damage.	5.6
		Faulty seawater pump	Check seawater pump (impeller, pump sealing).	5.6
		Water cooler clogged	Clean the water cooler and the tube stack fitted in the heat exchanger.	5.6
		Coolant level low	Restore the coolant to normal operating level.	5.6
		Thermostat inoperative	Replace the thermostat.	5.6
	INLET AND EXHAUST SYSTEM	Air filter clogged	Replace air filter.	5.7
<b>NOISY ENGINE</b>	GENERAL	Compression weak	Check the compression.	5.3
		Overload	Reduce the electrical load.	5.3
		Exhaust system leak	Inspect the exhaust system. Replace the inoperative exhaust system components.	5.3
		Vibration excessive	Tighten all loose nuts and bolts.	5.3
		Valve clearance incorrect	Adjust the valves.	5.3
<b>OIL PRESSURE TOO HIGH</b>	LUBRICATION SYSTEM	Oil pressure relief valve sticking	Contact with our dealer	5.4
		Faulty oil pressure valve	Contact with our dealer	-

# Technical specifications



ENGINE FAILURE	PROBABLE CAUSES		RECOMMENDED ACTIONS	SECTION
<b>LOW POWER</b>	GENERAL	Valve clearance incorrect	Contact with our dealer	5.3
	FUEL SYSTEM	Fuel filter clogged	Contact with our dealer	5.5
		Fuel injectors dirty or faulty	Contact with our dealer	5.5
		Water in fuel system	Contact with our dealer	5.5
		Fuel injection timing out of adjustment	Contact with our dealer	5.5
	INLET AND EXHAUST SYSTEM	Air filter clogged	Replace air filter element.	5.7
		Exhaust backfires	Inspect the exhaust system. Replace the inoperative exhaust system components.	5.7
	COOLING SYSTEM	Thermostat blocked at open position	Replace thermostat and check the coolant state.	-
<b>HIGH FUEL CONSUMPTION</b>	GENERAL	Compression weak	Check the compression.	5.3
		Overload	Reduce the electrical load.	5.3
		Governor inoperative	Contact with our dealer	-
	FUEL SYSTEM	Fuel injection timing out of adjustment	Adjust the fuel injection timing.	5.5
	INLET AND EXHAUST SYSTEM	Air filter clogged	Replace air filter.	5.7
COOLING SYSTEM	Thermostat blocked at open position	Replace thermostat and check the coolant state.	-	
<b>BATTERY CHARGE DEFECTIVE</b>	ELECTRICAL SYSTEM (DC)	Battery discharged or dead	Recharge or replace the battery.	5.8
		Battery connections loose, corroded or incorrect	Verify that the battery connections are correct, clean and tight.	5.8
		Governor inoperative	Contact with our dealer	-
		Alternator belt tension	Check belt tension and change it if necessary.	5.8



## Section 7 – Technical specifications

SK-60

DIESEL ENGINE		
General specifications	Type	4 cycle water-cooled, diesel cycle
	Direction of rotation	Anti-clockwise rotation as viewed from flywheel side
	No. of cylinders - arrangement	4 in line
	Allowable Exhaust Back Pressure (kPa)	10,7
	Timing	Pushrod and rocker arm with gear driven camshaft in crankcase
	Bore (mm)	87
	Stroke (mm)	102,4
	Total displacement (c.c.)	2434
	Compression ratio	22,5:1
	Ignition sequence	1-3-4-2
	Fuel injection timing	8,3° before APMS
	Injection pressure (kPa)	13,73 MPa (140 kg/cm <sup>2</sup> )
	Inlet and exhaust valve clearance - cold engine (mm)	0,18 to 0,22
	Power (kW / HP)	44,0 / 59,0
	RPM (rpm)	2700
	Starting system	Electric starting
	Starting aid	Glow plug
Lubrication system	System description	Forced circulation by gear pump
	Oil specifications	Use oil with 15W40 viscosity and no less than ACEA E5/E3 or API CH-4/SJ quality
	Oil pump	Type trochoid gear
	Oil circuit capacity (l)	6
	Lubrication oil pressure - nominal speed (MPa)	0,25 (2,5 kgf/cm <sup>2</sup> ) (2,5 bar)
	Min oil pressure - hot engine (MPa)	0,3 to 0,44 (3 to 4,5 kgf/cm <sup>2</sup> ) (3 to 4,5 bar)
	Oil temperature - nominal speed (°C)	0,05 (0,5 kg/cm <sup>2</sup> ) (0,5 bar)
Fuel system	System description	103
	System description	Electric fuel pump and mechanic injection pump
	Fuel specifications	Diesel fuel ASTM diesel No.2-D
	Fuel injection pump	Mini pump type PFR 4M (Dense)
Fuel injection nozzle	Mini injection nozzle OPD (Dense)	

SK-60

DIESEL ENGINE		
Cooling system	System description	Coolant circulation controlled by centrifugal pump with thermostatic control and heat exchanger. Cooled exhaust manifold.
	Coolant specifications	SOLE DIESEL50%
	Coolant pump	Centrifugal type
	Sea water pump	Centrifugal type
	Coolant circuit capacity (l)	8,5
	Thermostat valve	
	Start opening	+ 69,5 to 72,5°C
	End opening	+ 85°C
	Coolant temperature - nominal speed (°C)	75 - 85
Inlet and Exhaust System	Air supply	Air cleaning by means of a dry-type air filter
	Exhaust System	Cooled exhaust manifold Dry exhaust manifold (optional equipment)
Electrical system	Voltage - Polarity (V)	12 DC
	Alternator DC (A)	120
	Starter motor (kW)	2,0
	Glow plugs (A)	ETR
Installation	Ø Int. Hose, sea water inlet (mm)	32
	Ø Int. Hose, diesel fuel inlet (mm)	8
	Ø Int. Hose, exhaust outlet <sup>1</sup> (mm)	60
	Air admission displacement -max. rpm (m <sup>3</sup> /h)	6,92
	Minimum battery capacity (Ah)	12V, 100 to 120
	Length of battery wire (m)	≤ 1,5
	Minimal section of battery wire (mm <sup>2</sup> )	50

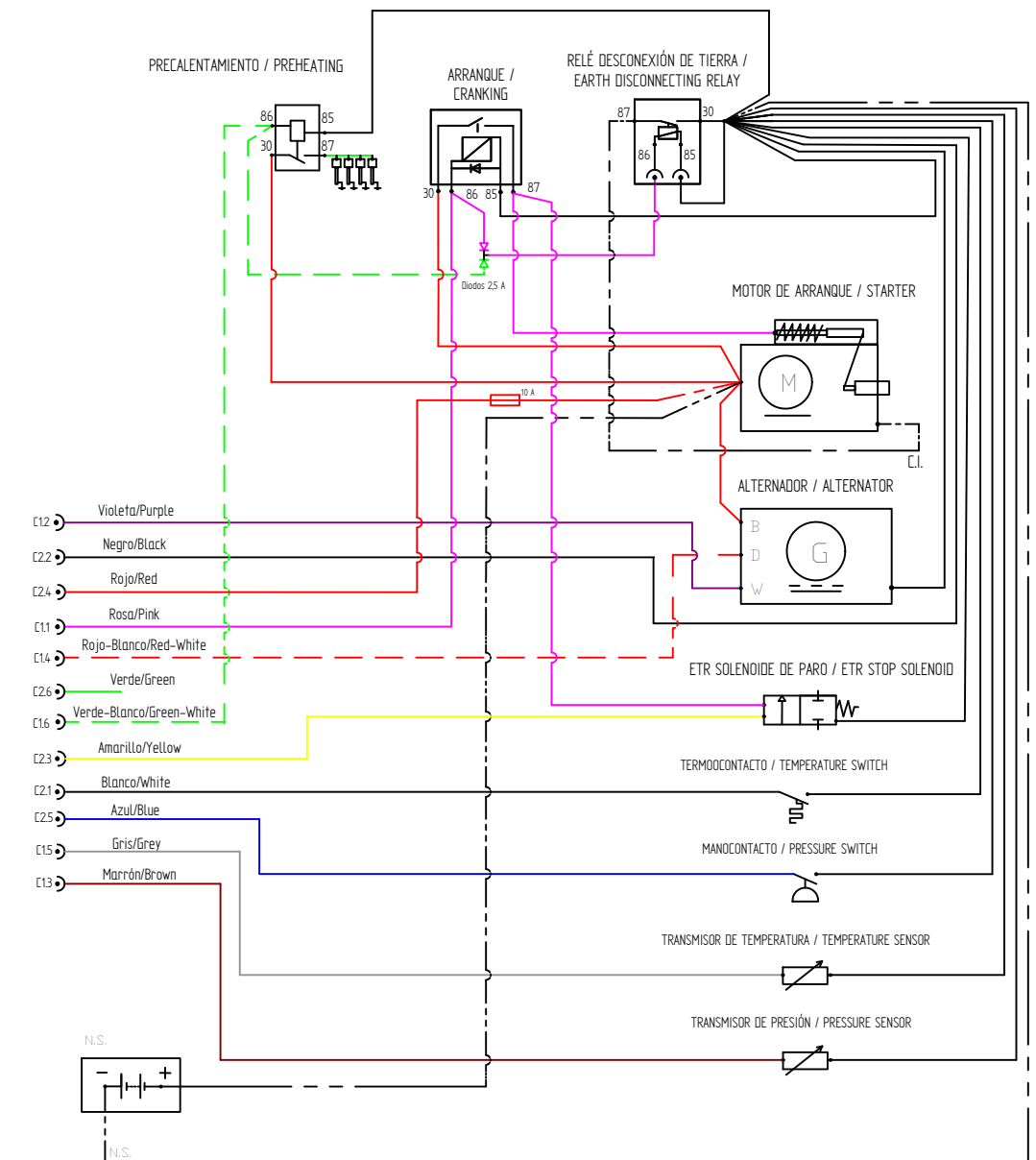
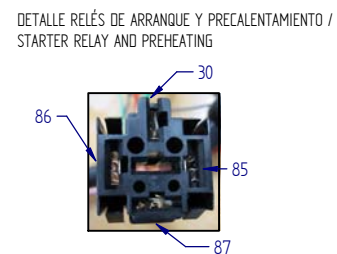
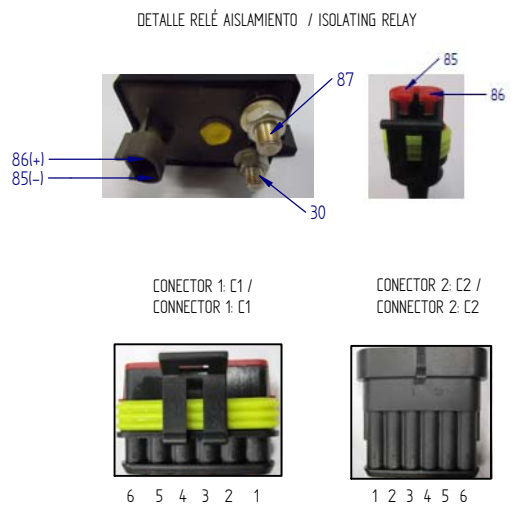
<sup>1</sup> For each curve of 90° of the installation, must increase 10 mm (for lengths superior to 3 m).

## Section 8 – Tightening Troques

Important nuts and screws

TORQUE VALUES	THREAD	SK-60
		N · m (kaf · m)
Bolt of cylinder head cover	M6	6,87 to 11,2 (0,7 to 1,15)
Bolt cylinder head	M11	93,2 to 98,0 (9,5 to 10,0)
Rocker support bolt	M8	24 to 27 (2,4 to 2,8)
Bolt 1 of bearing housing	M9	46 to 50 (4,7 to 5,2)
Bolt 2 of bearing housing	M10	69 to 73 (7,0 to 7,5)
Flywheel	M12	98.1 to 107 (10 to 11)
Connecting rod (old type)	M8	45 to 49 (4,5 to 5,0)
Connecting rod (new type)	M8	41 to 45 (4,1 to 4,5)
Idler gear shaft	M8	24 to 27 (2,4 to 2,8)
Drag pulley	M30	138 to 156 (14,0 to 16,0)
Housing bearing cover	M8	24 to 27 (2,4 to 2,8)
Glow plug	M10	20 to 24 (2,0 to 2,5)
Nozzle holder set (IDI)	M20	49 to 68 (5,0 to 7,0)
Nozzle holder clamp (IDI)	M10	26 to 29 (2,6 to 3,0)
Oil pressure switch	R 1/8	15 to 19 (1,5 to 2,0)
Pipe fastening nut of nozzle (IDI)	M12	25 to 34 (2,5 to 3,5)
Pipe fastening nut of nozzle (IDI)	M12	15 to 24 (1,5 to 2,5)
Retention nut of the overflow pipe set (IDI)	M12	20 to 24 (2,0 to 2,5)
Retention nut of the overflow pipe set (IDI)	M6	9,81 to 11,2 (1,0 to 1,15)
Camshaft stud bolt	M8	24 to 27 (2,4 to 2,8)
Body of high gear empty	M14	45 to 49 (4,5 to 5,0)
Alternator pulley nut	-	58,4 to 78,9 (5,95 to 8,05)
Starter terminal B	M8	5,9 to 11 (0,60 to 1,2)
Oil drain bolt	M14	34,3 to 44,1 (3,5 to 4,5)
Oil filter	-	10,8 to 12,7 (1,1 to 1,3)
Fuel filter	-	21.7 to 24.2 (2.21 to 2.47)
Exhaust elbow	M8	20,0 (2,0)
Plate	M8	20,41 (2,04)
Thermostat cover	M8	8 (2,04)
Engine brackets	M10	80 (8,15)
Cover of the water cooler element	M10	40,22 (4,02)
Standard Bolts	M6	7.85 to 9.80 (0.8 to 1.0)
	M8	14.7 to 21.6 (1.5 to 2.2)
	M10	17.6 to 24.5 (1.8 to 2.5)
	M12	29.4 to 41.1 (3.0 to 4.2)
Standard Studs	M8	4.9 to 5.8 (0.5 to 0.6)
	M10	12.7 to 14.7 (1.3 to 1.5)
Standard Plugs	NPTF 1/6	4.9 a 7.8 (0.5 a 0.8)
	PT 1/8	7.8 a 11.7 (0.8 a 1.2)
	PT 1/4	19.6 a 29.4 (2.0 a 3.0)
	NPTF 1/4	

## Section 9 – Wiring Diagrams



LEYENDA / LEGEND:

- N.S.: NO SUMINISTRADO / NOT SUPPLIED
- OPT.: OPCIONAL / OPTIONAL
- C.I.: CABLE INDEPENDIENTE / SEPARATE CABLE

MODELO MOTOR / ENGINE MODEL:		SK-60 LIBRE MASA / ISOLATED		
VOLTAGE MOTOR / ENGINE VOLTAGE:		12V / 24V		
DIBUJADO D. ROMARTÍNEZ	VERIFICADO RUBEN D.	FECHA CREACIÓN 18/05/2017	ÚLTIMA REVISIÓN	PÁGINA
SOLÉ, S.A.		E1A00B02P_SVT		1 de 1

CONECTOR 1: C1 /  
CONNECTOR 1: C1



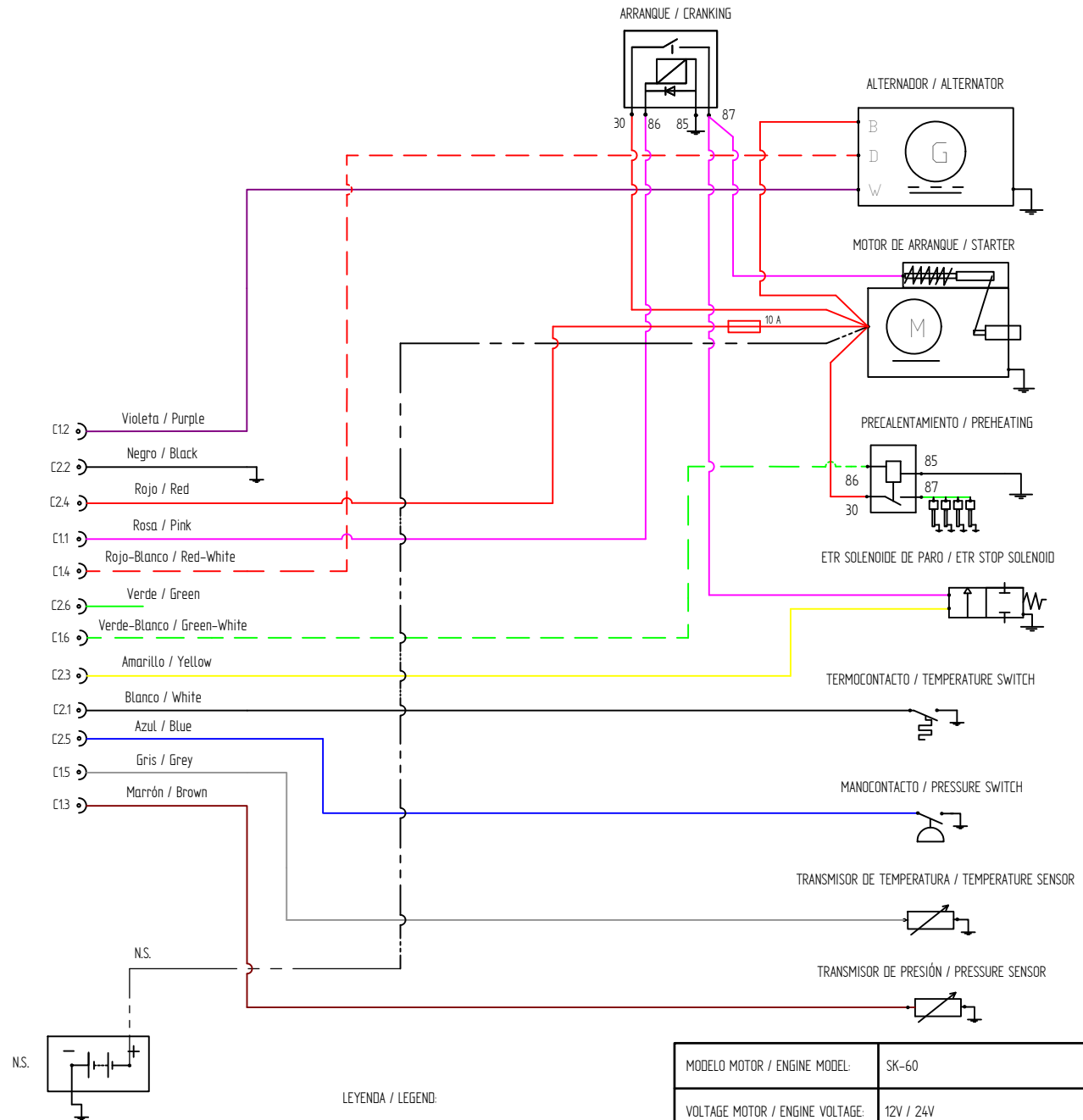
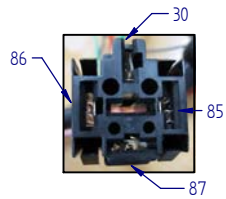
6 5 4 3 2 1

CONECTOR 2: C2 /  
CONNECTOR 2: C2



1 2 3 4 5 6

DETALLE RELES DE ARRANQUE Y PRECALENTAMIENTO /  
STARTER RELAY AND PREHEATING



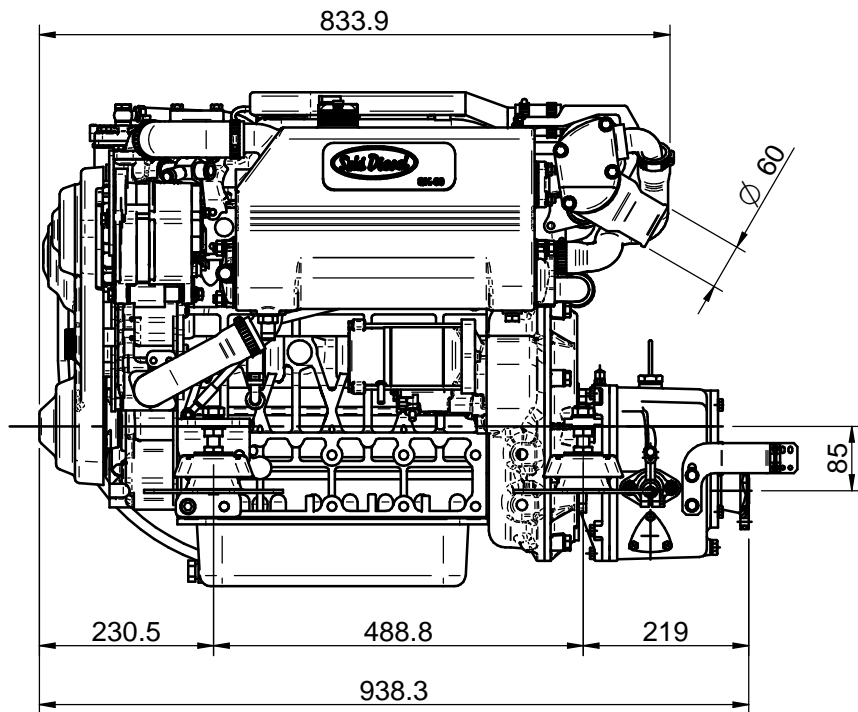
LEYENDA / LEGEND:

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- OPT.: OPCIONAL / OPTIONAL

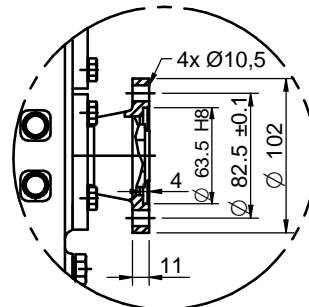
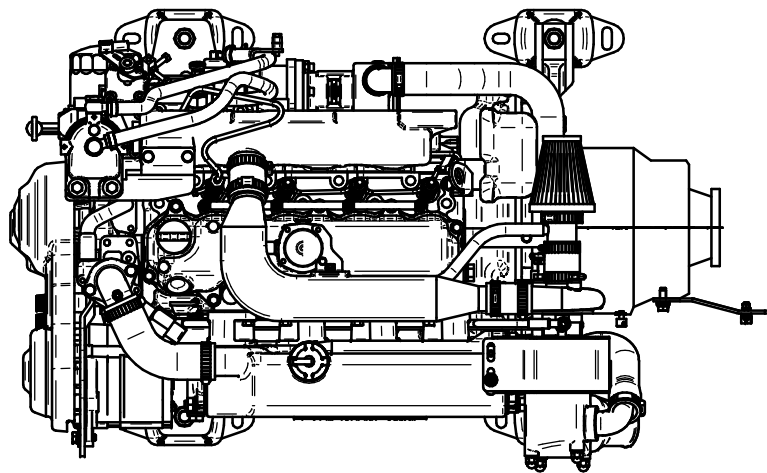
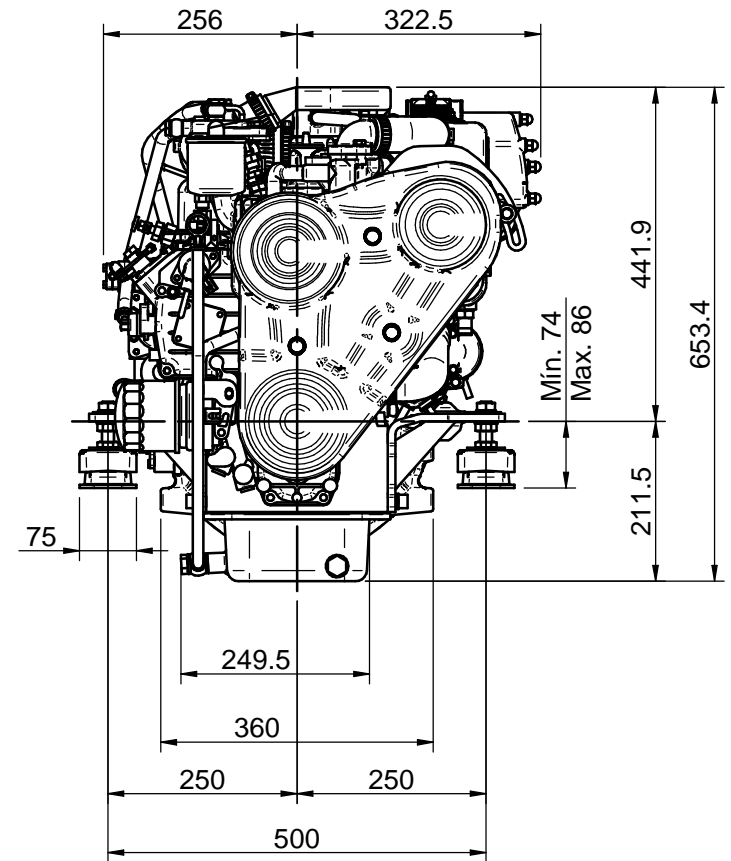
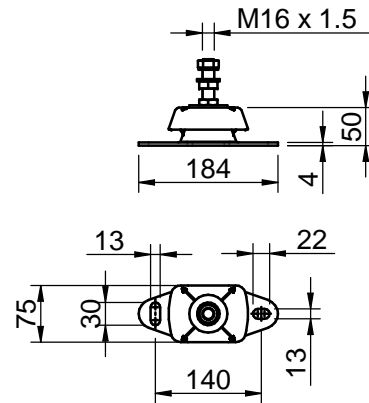
MODELO MOTOR / ENGINE MODEL:		SK-60		
VOLTAGE MOTOR / ENGINE VOLTAGE:		12V / 24V		
DIBUJADO D. ROMÁRTEZ	VERIFICADO RUBEN D.	FECHA CREACIÓN 18/05/2017	ÚLTIMA REVISIÓN	PÁGINA
<b>SOLÉ, S.A.</b>		E1A00E02P_SVT		1 de 1



## Section 10 – Overall dimensions



Supensor/ Engine Mount



Pletina Inv./Gbox flange

**DATOS TÉCNICOS / TECHNICAL DATA**

Manguera agua salada/ Sea water hose: Ø32mm  
 Manguera entrada combustible / Fuel hose intake: Ø8mm  
 Manguera retorno combustible / Diesel Fuel return hose: Ø5mm

**MOTOR SK-60 INV. TMC-260 2,88:1**

**SK-60 ENGINE TMC-260 GBOX 2,88:1**

MATERIAL	ACABADO	TRATAMIENTO	PRESENTACIÓN	ESCALA
DIBUJADO	VERIFICADO	GRADO PRECISIÓN	FECHA CREACIÓN	ÚLTIMA REVISIÓN
J.RODRÍGUEZ			04/04/2017	---



**SOLÉ, S.A.**

**1A036485**



# Instructions to replace and remove



## Section 11 - Instructions to Replace and Remove

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

For more information about the materials they are made of the individual components of the engine, contact Solé Diesel



# Inspection prior to the delivery of the propulsion engines



## Section 12 – Inspection prior to the delivery of propulsion engines

### INSPECTION PRIOR TO THE DELIVERY OF PROPULSION ENGINES

Installer / Marina information				
Installer Company:		Installation Date:		
Contact Tel. no.:		E-mail:		
Owner's Information				
Name and surnames:				
Contact Tel. No.:		Email:		
Engine Information				
Engine model:				
Engine serial number:		Gearbox / Saildrive serial No.:		
Installation Information				
Machine chamber operating temperature:				°C
Angle of the engine (boat moored):				°
Maximum angle of the engine (navigation conditions):				°
Is the wet exhaust elbow above or below the floating line?		above	below	
Propulsion Line Information				
Boat model:		Gearbox / Saildrive transmission ratio:		
Shaft diameter: mm		Shaft length:		mm
Propeller diameter:	mm/inches	Propeller pitch:	mm/inches	No. Of propeller blades:
Exhaus, Cooling and Fuel Line Information				
Int. Diameter of exhaust hose:		mm	Int. Diameter of sea water intake to the pump:	
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?	
		NO		
			YES	
			NO	
Verifications Prior to Start-Up		V/x	Notes	
Correct engine alignment.				
Electrical installation connections.				
Engine oil level.				
Gearbox oil level.				
Coolant level and concentration.				
Control lever operation.				
Transmissions belts and belt tension.				
Airtight sea water cock.				
Verification of Engine No-Load Operations		V/x	Notes	
Unusual noises from the transmission.				
Oil pressure				
Bleed the fresh water cooling system				
Verify the instrument panel: normal indications and alarm operation.				
Water, oil and fuel leaks in the engine or transmission.				

# Inspection prior to the delivery of the propulsion engines



## INSPECTION PRIOR TO THE DELIVERY OF PROPULSION ENGINES

Verification of Engine Operating with Propeller Load	V/x	Notes
Verify maximum engine rpm at full load and with forward gear clutched. This test should be performed with the engine heated up. (If top rpm is not achieved contact Solé to inspect propeller dimensions).	rpm	
Engine rpm with engine idling and clutch out	rpm	
Engine output and gearbox operation. Verify operation of the Trolling valve, if applicable.		
Engine temperature and oil pressure.		
Information for the Owner	V/x	Notes
Delivery of the operator's manual and engine-related documents.		
Review of the engine operator's manual.		
Study the instruments panel functions and the engine control functions.		
Report the first revision date.		
Report the maintenance schedule indicated in the manuals.		

# Declaration of conformity for recreational Craft Propulsion Engines



## Section 13 – Declaration of conformity for recreational Craft Propulsion Engines



**Declaration of Conformity for Recreational Craft Propulsion Engines (inboard engines and stern drive engines without integral exhaust) with the requirements of Directive 2013/53/EU**

Name of engine manufacturer: SOLÉ, S.A.

Address: Ctra. C-243b, Km. 2

Town: Martorell Post Code: 08760 Country: Spain

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Name of Authorised Representative: \_\_\_\_\_

Address: \_\_\_\_\_

Town: \_\_\_\_\_ Post Code: \_\_\_\_\_ Country: \_\_\_\_\_

---

Name of Notified Body for exhaust emission assessment: TÜV Rheinland Industrie Service GmbH

Address: Am Grauen Stein

Town: Köln Post Code: 51105 Country: Germany

ID Number: 0035

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Conformity assessment module used for exhaust emissions:  B+C/C1  B+D  B+E  B+F  G  H

or engine type-approved according to:  Directive 97/68/EC  EC Regulation No 595/2009

Other Community Directives applied: \_\_\_\_\_

**DESCRIPTION OF PROPULSION ENGINE TYPE(S)**

<b>Main Propulsion ExhaustType:</b>	<b>Combustion Type:</b>	<b>Combustion cycle:</b>
<input type="checkbox"/> With integral exhaust	<input checked="" type="checkbox"/> Internal combustion, Diesel (CI)	<input type="checkbox"/> 2 stroke
<input checked="" type="checkbox"/> Without integral exhaust	<input type="checkbox"/> Internal combustion, Petrol (SI)	<input checked="" type="checkbox"/> 4 stroke
	<input type="checkbox"/> Other	

**IDENTIFICATION OF ENGINE(S) COVERED BY THIS DECLARATION OF CONFORMITY**


Name of engine model or engine family:	Unique engine identification number(s) or engine family code(s)	EC Type-examination certificate or type-approval certificate number
SK-60 (V2403_M_T_EU1)		e1*97/68JA*2006/105*0467*02

This declaration of conformity is issued under the sole responsibility of the manufacturer. I declare on behalf of the manufacturer that the recreational craft propulsion engine(s) mentioned above fulfil(s) the requirements specified in Article 4 (1) and Annex I of Directive 2013/53/EU.

Name / function: Sr. Enrique Solé Matas Signature and title: Chief Executive Officer

(identification of the person empowered to sign on behalf of the engine manufacturer or his authorised representative) of the engine manufacturer or his authorised representative) (or an equivalent marking)

Date and place of issue: (dd/mm/yyyy), 26/05/2016






Essential requirements reference to relevant articles in Annex IB & IC of the Directive)	Harmonised standards Full Application	Harmonised standards Partial application, see tech. File	Other reference documents 1 Full Application	Other reference documents Partial Application , see tech. File	Other proof of conformity See technical. File	Specify the harmonised 2 standards or other reference documents used (with year of publication like "EN ISO 8666:2002")
<b>Annex I.A - Design and Construction of Products</b>						
Design and Construction of Products (Annex I A.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Chapter 1.1 (Owner's Manual)
<b>Annex I.B – Exhaust Emissions</b>						
Propulsion Engine Identification (Annex I B.1)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Chapter 1
Exhaust Emission Requirements (Annex I B. 2)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	EN ISO 8178-1:1996
Durability (Annex I B.3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Chapter 7.1 (Owner's Manual)
Owner's manual (Annex I B.4)	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Annex I.C – Noise Emissions</b>	See Declaration of Conformity of the recreational craft in which the engine(s) has (have) been installed					

1. Annex I.C – Noise Emissions
2. Standards published in EU Official Journal









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N° ES065498-1

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Revision 3  
03/2020