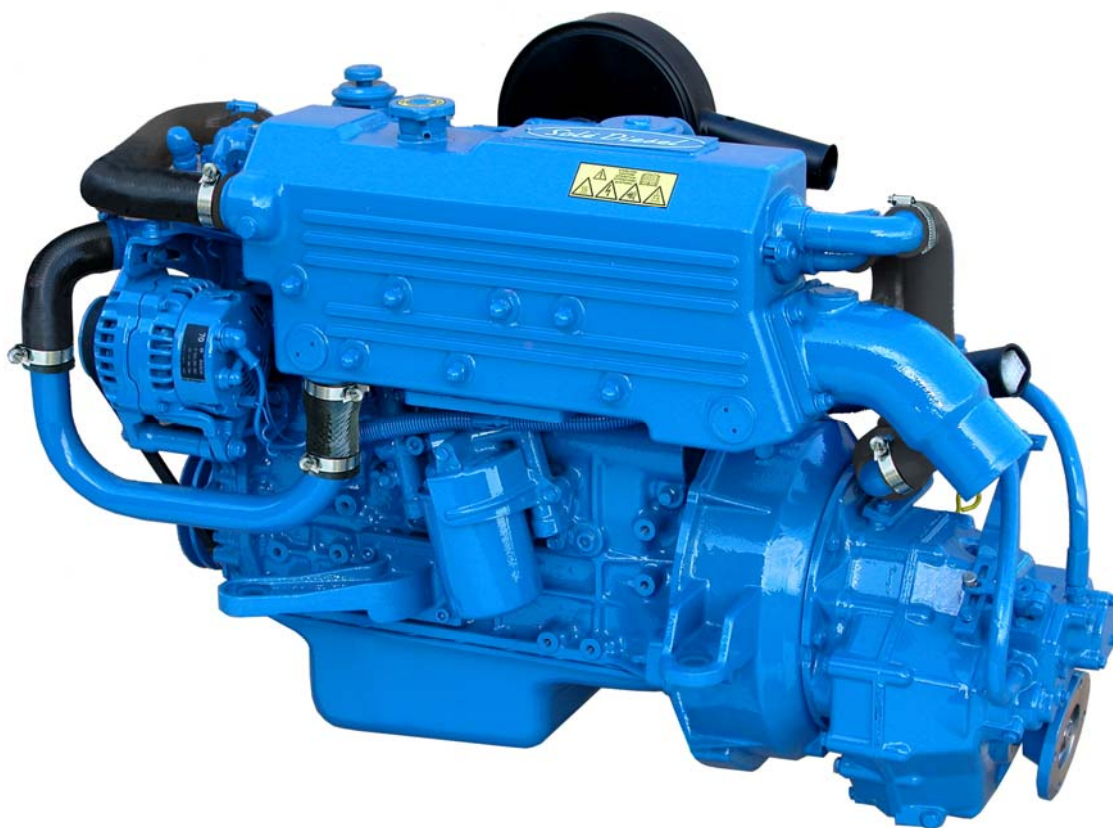


# ENGINE INSTRUCTIONS MANUAL

SN-85  
SN-85L  
SN-110



*Sole Diesel*  
MARINE DIESEL ENGINES



## This engine instructions manual is also available in the following languages

### ENG

This operator's manual is available in English.  
Part no. **03918201.ENG**

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## 0. INTRODUCTION

### 0.0 FOREWORD

Dear client:

The SOLÉ S.A. engine you have purchased is a product of the highest technological quality. Our Service SOLÉ DIESEL department has recently been strengthened to ensure even better service for all our clients. Reliable duty and long life of the engine you have purchased can only be guaranteed if exclusively original spare parts are used, and ensure that the unit is serviced by our specialized personnel.

We therefore recommend that you insist on having your SOLÉ S.A. engine serviced EXCLUSIVELY by our Service SOLÉ DIESEL Department. If engines manufactured by SOLÉ S.A. are serviced by unauthorized technicians, or if non-original spare parts are utilized, ALL GUARANTEE AND TECHNICAL ASSISTANCE OBLIGATIONS OF SOLÉ S.A. WILL BE INVALIDATED.

We are confident that you will understand the importance of these recommendations, which are made for purely technical reasons and serve to defend our clients and ensure their full satisfaction with our products.

Please get in touch with us for any requirements you may have. Best regards.

### 0.1 USING THE INSTRUCTION MANUAL

#### 0.1.1 IMPORTANCE OF THE MANUAL

This INSTRUCTION MANUAL is your guide to the USE and MAINTENANCE of the engine you have just purchased. We strongly recommend that you follow all the advice in the manual meticulously, because the correct operation and lasting reliability of the engine depend on its correct use and the methodical application of the programmed maintenance operations illustrated in these pages.

If you run into difficulties or setbacks, Service SOLÉ DIESEL department will be proud to provide you with the necessary advice and assistance.

This INSTRUCTION MANUAL is an integral part of the product you have acquired. Please conserve it in a safe place for the full working life of the engine.

**SOLÉ S.A. reserves the right to make changes aimed at improving its products without any form of prior notification. Please ensure that you enclose with the original publication of the present manual any amendments or updates that you may receive.**

Pass on this manual to all users of the engine or future owners.

#### 0.1.2 CONSERVING THE MANUAL

When using the manual make sure that it is not damaged or defaced. Do not remove or rewrite any parts of the manual for any reason. Conserve the manual in a dry and heat protected place.

#### 0.1.3 CONSULTING THE MANUAL

This instruction manual comprises:

- COVER PAGE WITH INDICATION OF THE FAMILY TO WHICH YOUR ENGINE BELONGS. The cover page shows the model of the engine described in the manual.
- TABLE OF CONTENTS. Use the contents page to find the page containing information relative to a given argument.
- INSTRUCTIONS AND/OR NOTES ABOUT THE PRODUCT. All the INSTRUCTIONS AND/OR NOTES ON THE PRODUCT are designed to define safety practices, proper procedures and the skills required for correct operation of the engine.

The annexes at the end of this manual are an integral part of the same. Please note that the illustrations in the manual, which have been included to help you identify the parts described in the text, show standard or prototype engines and may therefore differ, in some respects, from the engine in your possession.

### 0.1.4 SYMBOLS IN THE MANUAL

The Safety symbols and notices shown below are used throughout this publication to draw the user's attention to situations or hazardous procedures that could damage the engine or cause personal injury, and to indicate suitable practices to assure the correct operation of the engine.



GENERAL OPERATIONAL NOTE



PROTECT YOUR HANDS (GLOVES)

Prescription-Indication notices (rectangular); it is obligatory to adopt the protective measures shown in the notices to perform the operation in question in total safety<sup>3</sup>



PROTECT YOUR EYES (SAFETY GLASSES)



PROTECT RESPIRATORY PASSAGES (MASK)



DANGER!, (GENERAL DANGERSITUATION FOR THE SAFETY OF ANYONE AND PROTECTION OF THE ENGINE)

Danger Warning-Attention Notices (triangular); General Attention regarding personal safety and protection of the engine.



DANGER!, (DANGER OFELECTRICAL DISCHARGES FOR THE SAFETY OF PERSONS AND ENGINE)



DANGER!, (DANGER FROM SOURCES OF HEAT FOR THE SAFETY OF ANYONE AND THE ENGINE)



THE OPERATION INDICATED IN THE TEXT IS STRICTLYPROHIBITED

Prohibition notices (circular) indicating potentially hazardous situations for personal safety.



IT IS ABSOLUTELY PROHIBITED TO PERFORMMAINTENANCE WORK IN THE PRESENCE OF MOVING PARTS



REMOVING OR TAMPERING WITH SAFETY DEVICES ISSTRICTLY PROHIBITED



PAY ATTENTION TO SYMBOLS AND OBSERVE THE INSTRUCTIONS IN THE ADJACENT TEXT

# 1. GENERAL INFORMATION

## 1.1 ENGINE MANUFACTURER'S IDENTIFICATION DATA

MANUFACTURER:

SOLE, S.A.  
Ctra. de Martorell a Gelida, km 2  
08760 MARTORELL  
(BARCELONA) SPAIN

MODEL:

TRADE DESIGNATION:

SN-85  
SN-85L  
SN-110



Fig. 1.1

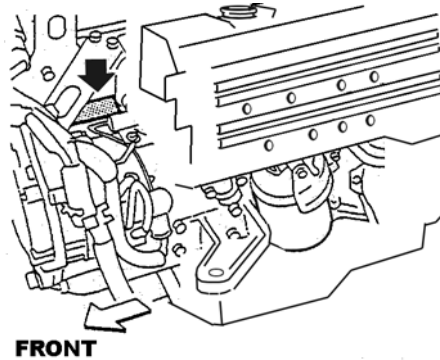


Fig. 1.2

The above data can be quickly identified in the following position:

- Engine nameplate showing identification data (see Fig. 1.1)
- Markings stamped on the engine showing serial number (see Fig. 1.2)

## 1.2 INFORMATION REGARDING TECHNICAL ASSISTANCE / MAINTENANCE OF THE ENGINE

Our after sale service is at your complete disposal to solve any problems that may arise or to supply any information you may need. For ANY explanations refer to the "SERVICE SOLÉDIESEL" address booklet.

Optimal operation and efficiency of your new SOLÉDIESEL engine can only be guaranteed if original spare parts are used.

For "GUARANTEE" terms refer to the "GUARANTEE CARD".

## 1.3 GENERAL SAFETY NOTICES

The engine is designed and built as a power unit for generating mechanical energy: ALL USES OTHER THAN THE PRESCRIBED APPLICATION AUTOMATICALLY RELEASE SOLÉ S.A. FROM LIABILITY FOR DAMAGES THAT MAY ENSUE, in any event, the use of products other than those agreed upon at the time of purchase, RELEASES SOLÉ S.A. FROM ALL LIABILITY FOR DAMAGE TO THE ENGINE OR PROPERTY OR INJURY TO PERSONS.

Although the engine is built in compliance with the most recent safety standards it is advisable to bear in mind that moving parts are always potentially dangerous. Therefore, never attempt to work on parts of the engine while they are in motion and make sure that there are no persons in the vicinity of the engine before starting it.

The standard engine can run at ambient temperatures between -18 °C a +45 °C.

The operator in charge of installing and maintaining the engine must wear suitable CLOTHING for the workplace and the situation; in particular, avoid loose clothes, bracelets, rings and all other accessories that could become entangled with moving parts..

The area in which the operator is working must be kept tidy and free of oil and other liquid spillages and solid waste (metal chips, etc.).

Before starting work the operator must be aware of the position and operation of all commands and the characteristics of the engine; make a daily check of the safety devices on the engine. Disabling or tampering with the safety devices on the engine is strictly prohibited. Do not attempt to perform maintenance work adjustments or reset tings on moving parts on the engine; before performing any of the above operations disconnect the electrical supply to ensure that no other persons can start the engine up in the meantime.

Do not alter any parts of the engine (for example connections, holes, finishes, etc.) to adapt it to the installation of extra equipment or for any other reason; THE RESPONSIBILITY FOR ANY TYPE OF INTERVENTION NOT EXPRESSLY AUTHORISED IN WRITING BY SOLÉ S.A. BELONGS TO THE ONE WHO DEVELOPES SUCH WORK.

**SOLE S.A. DECLARES THAT THE ENGINE CHARACTERISTICS ARE COMMENSURATE WITH THE PARAMETERS PERMITTED BY ESTABLISHED LAW REGULATIONS REGARDING THE EMISSION OF:**

- AIRBONE NOISE
- POLLUTING EXHAUST GAS

WHEN USING THE MOTOR IN A CLOSED ENVIRONMENT THE EXHAUST FUMES MUST BE CONVEYED OUTSIDE.

### 1.3.1 INFORMATION REGARDING RESIDUAL RISKS

The engine must be used in compliance with the manufacturer's prescriptions (technical specifications, safety regulations, etc.). Any modifications you make be previously authorized by the Manufacturer. If you use the engine beyond its application limits and alter in any way the characteristics that are the responsibility of SOLÉ S.A., such use shall be considered improper and SOLÉ S.A. declines all liability for the consequences (see notes regarding intended use in General Safety Notices 1.3).



DO NOT TAMPER WITH OR MODIFY ANY MECHANICAL OR ELECTRICAL COMPONENTS OF THE ENGINE WITHOUT PRIOR WRITTEN AUTHORISATION FROM THE MANUFACTURER

### 1.3.2 SAFETY REGULATIONS



IT'S STRICTLY PROHIBITED TO PERFORM MAINTENANCE WORK WHILE THERE ARE ENGINE PARTS MOVING.



IT'S STRICTLY PROHIBITED TO REMOVE OR TAMPER WITH THE SAFETY DEVICES



WHEN THE ENGINE IS RUNNING IT IS STRICTLY PROHIBITED TO TOUCH ANY PART OF IT



ALWAYS PROTECT THE HANDS WITH SAFETY GLOVES AND HEAT RESISTANT CLOTHING WHEN WORKING ON A HOT ENGINE



PROTECT THE RESPIRATORY PASSAGES WHEN WORKING IN THE VICINITY OF ENGINE EXHAUST GAS



## 2. PRELIMINARY INFORMATION ON THE ENGINE

### 2.1 GENERAL DESCRIPTION

**Direction of rotation:** clockwise observing engine from side opposite flywheel.

**Timing:** pushrod and rocker arm with gear driven camshaft in crankcase.

**Air supply:** air cleaning by means of a dry-type air filter.

**Fuel system:** by injection pump built-in fuel feed pump.

**Combustion system:** Swirl chamber and Indirect injection.

**Cycle:** diesel 4 stroke.

**Cooling:** forced water circulation controlled by centrifugal pump with thermostatic control and heat exchanger. Cooled exhaust collector.

**Injection pump:** Type VE (Bosch type).

**Lubrication:** forced-feed lubrication by gear-pump.

**Electrical system:** 12V.

Alternator: 70A / 110A

Starter motor (2.2 kW)

### 2.2 COOLING CIRCUIT

#### 2.2.1 COOLING CIRCUIT (Fig. 2.1)



use anti-freeze coolant liquid as indicated in section 4.2.2 of this manual

- 1) Water pump.
- 2) Water cooler.
- 3) Thermostat.
- 4) Bypass pipe.
- 5) Boiler connections. Engine hot coolant, outlet to boiler.
- 6) Boiler connections, return from the boiler.

Thermostat valve operating values:

SN- 85 / 85L / 110	
Start opening	+82 °C
End opening	---

CIRCUIT CAPACITY (LIT.)	
SN-85	15.0
SN-85L	15.0
SN-110	15.0

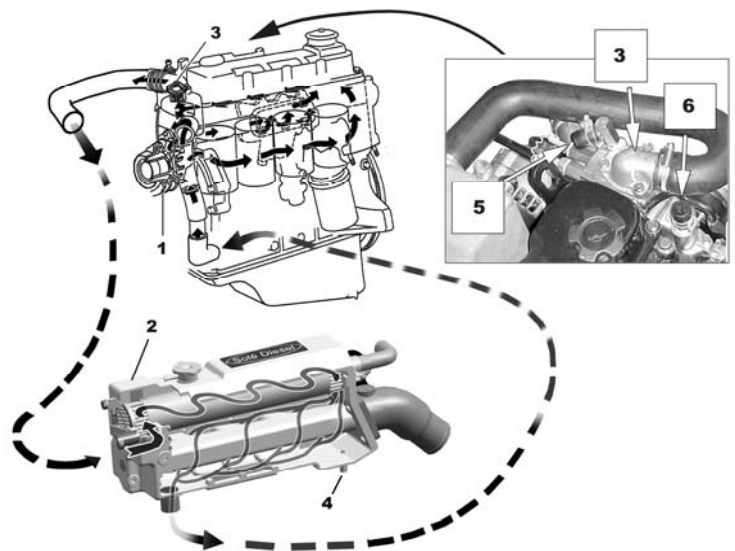


Fig. 2.1

## 2.2.2 "SEAWATER" COOLING CIRCUIT (Fig. 2.2)

- 0) Bottom cock
- 1) Intake connection with water filter
- 2) Water pump
- 3) Water / Water cooler
- 4) Wet exhaust elbow
- 5) Gear box cooler  
(SMI-R3 or other mechanical gearbox)

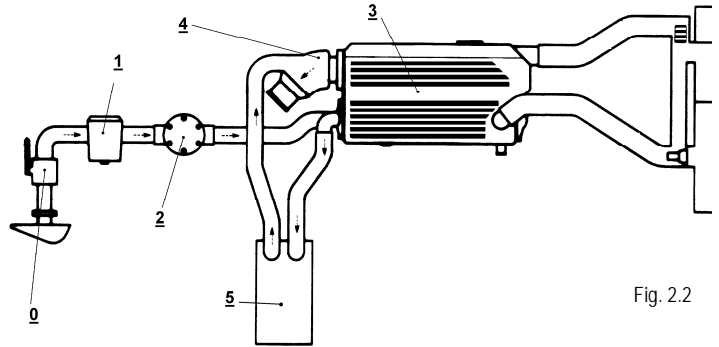


Fig. 2.2

## 2.3 LUBRICATION CIRCUIT

### 2.3.1 ENGINE

Lubrication is forced with a lobe pump and total filtration of the oil pumped to the various lube points on the engine. The oil is forced by the pump through a control valve to the filter, the engine main bearings and, by way of external pipelines, to the rocker arms.

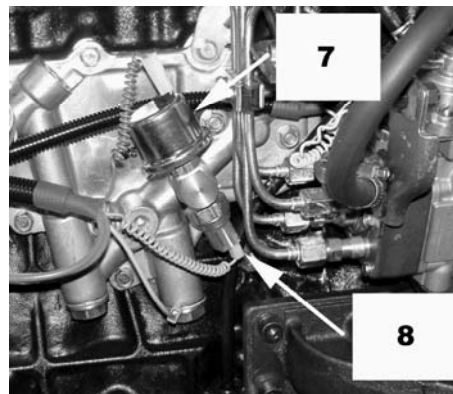
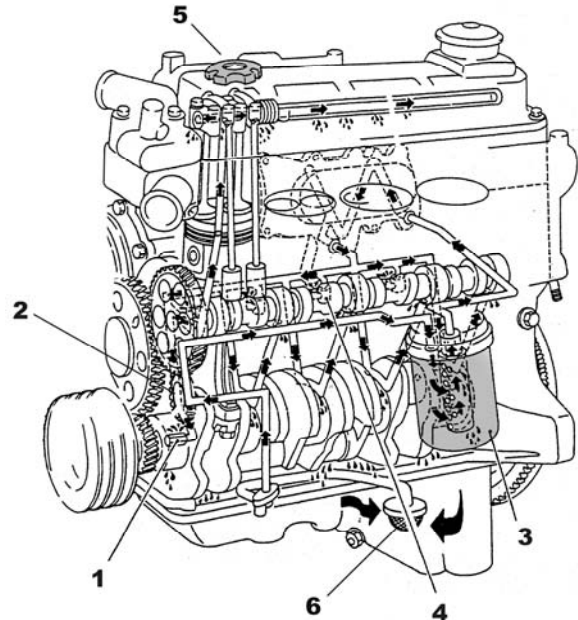
Oil circuit pressure (with hot engine):

min / 800 rpm = 0.8 kg/cm<sup>2</sup> / 11 psi / 78 kPa  
 máx / 3000 rpm = 3 - 4 kg/cm<sup>2</sup> / 43-57 psi / 294-392 kPa

ENGINE TYPE	CAPACITY (1)	CAPACITY (2)
SN - 85	7.5 liters	8.5 liters
SN - 85L	7.5 liters	8.5 liters
SN - 110	7.5 liters	8.5 liters

- (1) without change oil filter (oil pan capacity)
- (2) Total capacity. When the oil and the oil filter are changed.

- (1) Oil pump
- (2) Oil jet (for gear train)
- (3) Oil filter
- (4) Oil pressure switch
- (5) Filter cap
- (6) Oil strainer
- (7) Oil pressure, Transmitter
- (8) Oil pressure, Switch



### 2.3.2 GEARBOX



Gearbox has its own lubrication, independent from the engine.  
 Read its Service Manual.

## 2.4 FUEL CIRCUIT

(1) Fuel injection

Model	Quantity
SN-85	4
SN - 85L	4
SN - 110	4

(2) Fuel leak-off pipe

(3) Fuel intake pipe

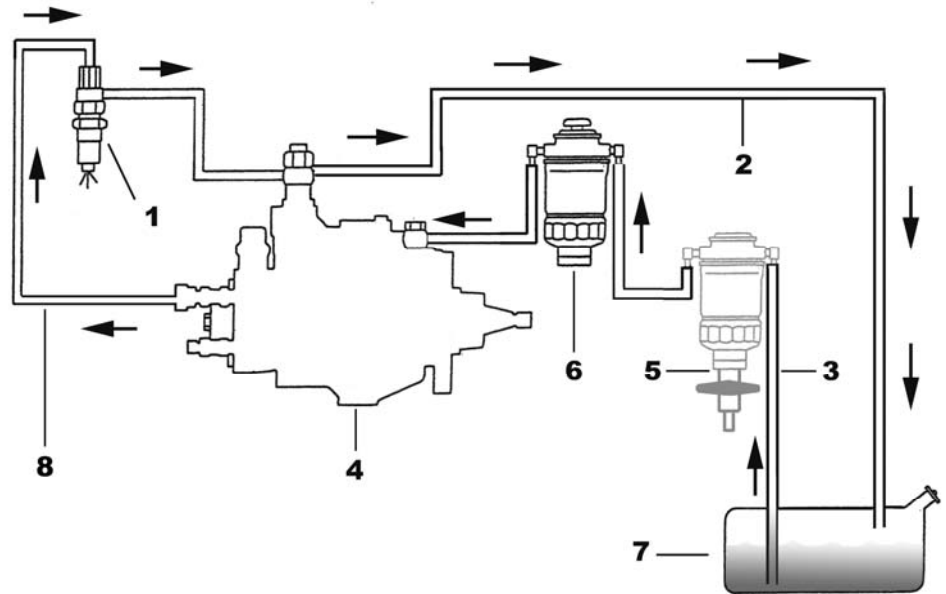
(4) Injection pump

(5) Fuel decanting filter (optional)

(6) Fuel filter

(7) Tank

(8) Fuel injection pipe



### 2.4.1 INJECTION PUMP

Injection pressure = 100-105 kg/cm<sup>2</sup> / 1422-1635 psi

## 2.5 ELECTRICAL PLANT

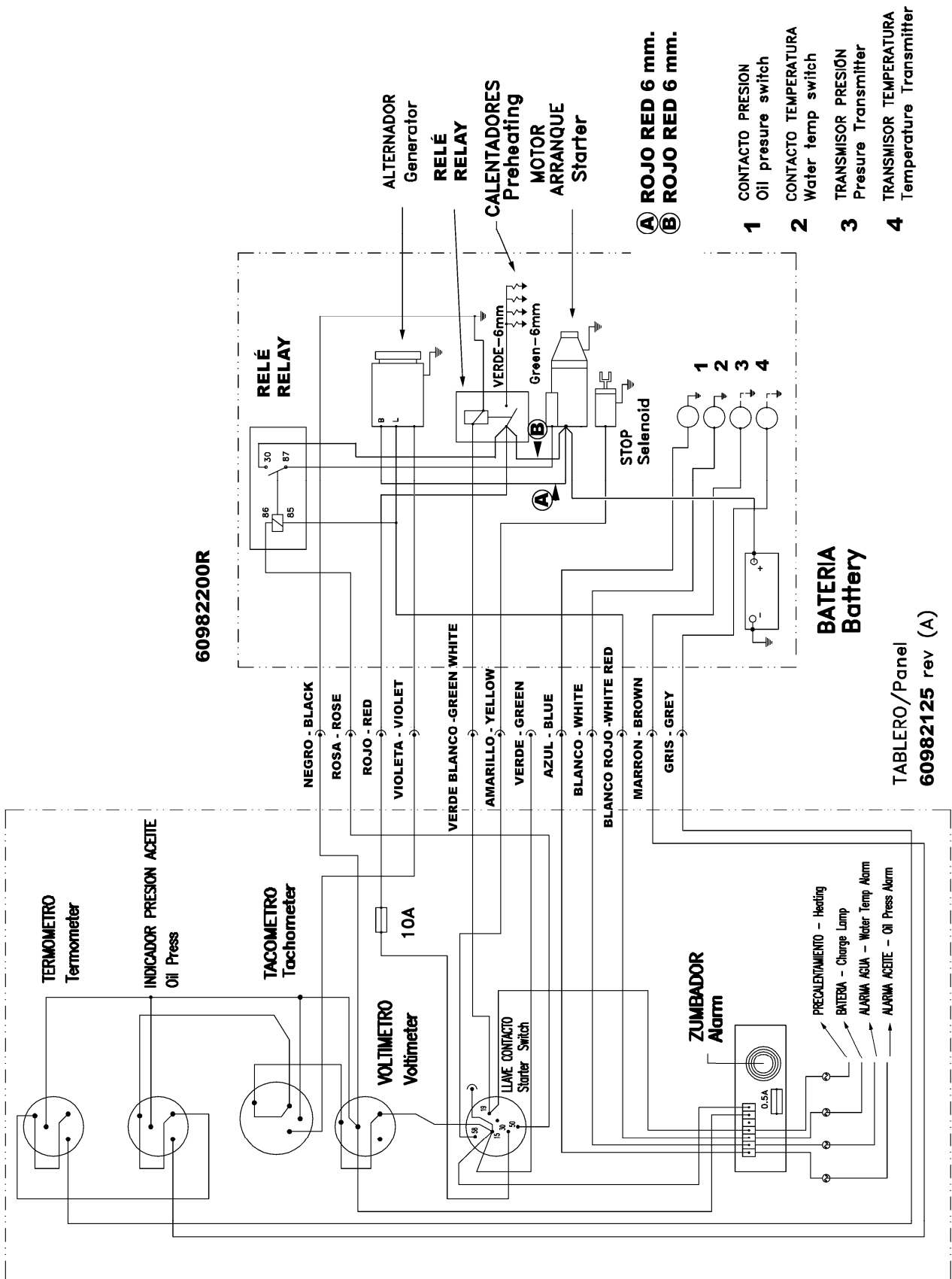
### 2.5.1 ELECTRICAL PLANT AND INSTRUMENT PANEL

	DESCRIPTION
A	GLOW PLUG OPERATION LAMP
B	BATTERY CHARGE LAMP
C	WATER TEMP. ALARM LAMP
D	OIL PRESSURE ALARM
E	STARTER
F	TACHOMETRE
G	VOLTMETER
H	FUSE
I	FUSE
J	BUZZER
K	HOUR COUNTER
L	OIL PRESSURE MANOMETER
M	COOLANT TEMP. GAUGE

ENGINE	Part. No. (PANEL)
SN - 85	609.82.125
SN - 85L	609.82.125
SN - 110	609.82.125



Standard Panel (12V)



Check the electrical diagram insert into the panel box

**Sole Diesel**  
ENG - 8

03918201.ENG rev. 0

## 2.6 TECHNICAL SPECIFICATIONS.

	UNITS	SN 85	SN 85L	SN 110			
Cylinders number		4	4	4			
Bore	mm	96	96	99.2			
Stroke	Mm	92	92	102			
Total displacement	c.c.	2664	3153	2311			
Compression ratio		22:1	22:1	22:1			
Min. lding speed	r.p.m.	800	800	800			
Max engine speed	r.p.m.	3600	2200	3600			
Standard reducer gearbox & ratio							
	SMI-R3	2:1 2.5 : 1	2:1 2.5 : 1	2:1 2.5 : 1			
	TM-345A	1.5 : 1 2 : 1	1.5 : 1 2 : 1	1.5 : 1 2 : 1			
	TM-93 TM-93A	2.09 : 1 2.4 : 1 2.77 : 1	2.09 : 1 2.4 : 1 2.77 : 1	2.09 : 1 2.4 : 1 2.77 : 1			
Max assembly angle	°	20	20	20			
Crankshaft power (1) ISO-8665	kW / CV	61 / 83	40 / 54	74.3 / 101			
Prop shaft power (1)	kW / CV	58.6 / 79.7	38.4 / 51.84	71.33 / 96.96			

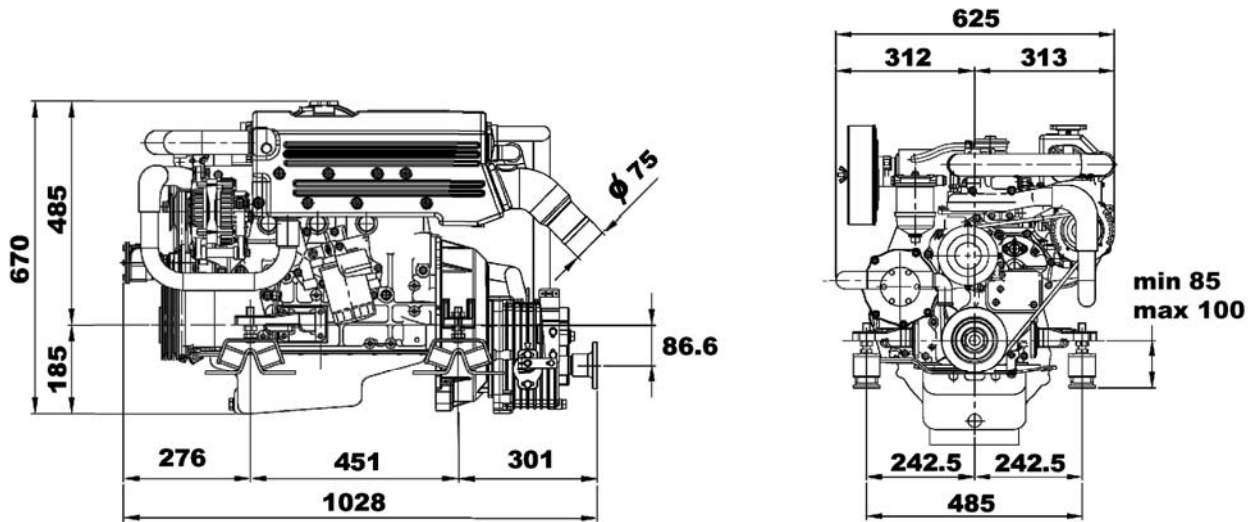
Oil Pan Capacity	liters	7.5	7.5	7.5			
Total Oil capacity (3)	liters	8.5	8.5	8.5			
Gearbox oil capacity (in liters)  (1)							
	SMI-R3	1.3 ATF	1.3 ATF	1.3 ATF			
	TM-345A (2)	1.6 SAE15W40	1.6 SAE15W40	1.6 SAE15W40			
	TM-93/93A (2)	2.4 SAE15W40	2.4 SAE15W40	2.4 SAE15W40			
Min oil pressure (hot engine)	bar (psi)	1.5 (21.3)	1.5 (21.3)	1.5 (21.3)			
Cooling water capacity	liters	15	15	15			
Injection pump		VE	VE	VE			
Injection pressure	bar (psi)	103-113 (1493-1635)					
Ignition sequence		1-3-4-2	1-3-4-2	1-3-4-2			
Valve clearance (cold engine)	mm	0.3 - 0.4					
Ø Int. Hose, Sea Water	mm	30	30	30			
Ø Int. Hose, inlet fueloil	mm	8	8	8			
Ø Int. Hose, return fueloil	mm	7	7	7			
Weight dry with gearbox							
	SMI-R3	288	288	298			
	TM-345A	283	283	293			
	TM-93	311	311	321			

(1) Read heading 9.0.2 for gearbox type SMIR3 to know when the ATP is used.

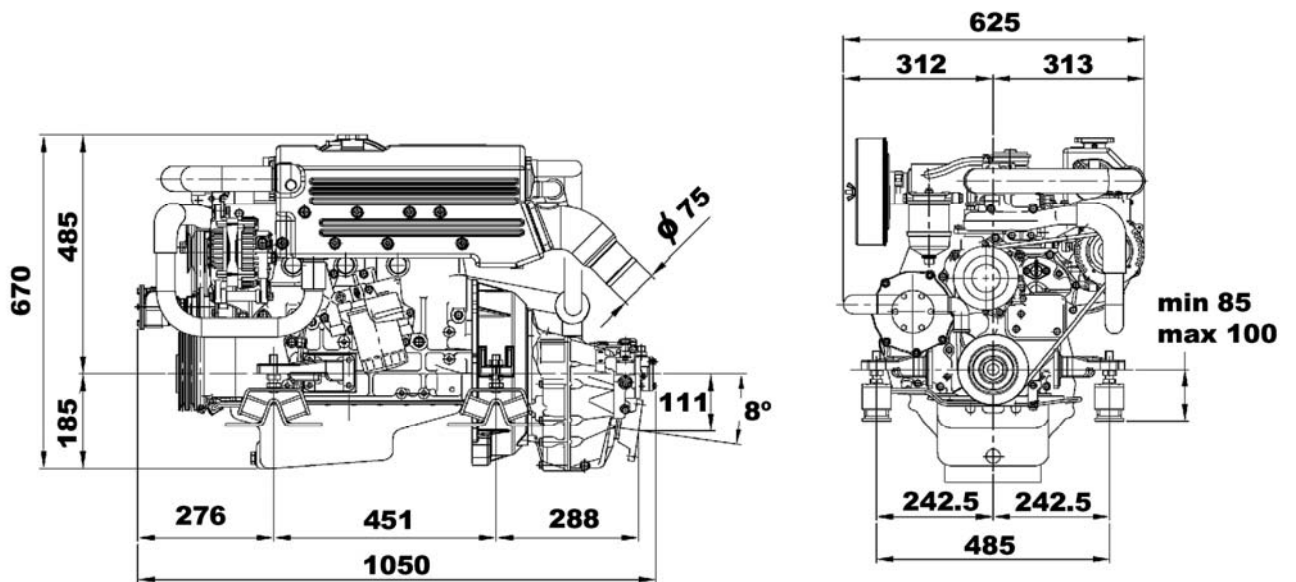
(2) Read the specific gearbox manual attached. (3) Including oil pan, oil filter and pipes.

## 2.6.1 ENGINE DIMENSIONS

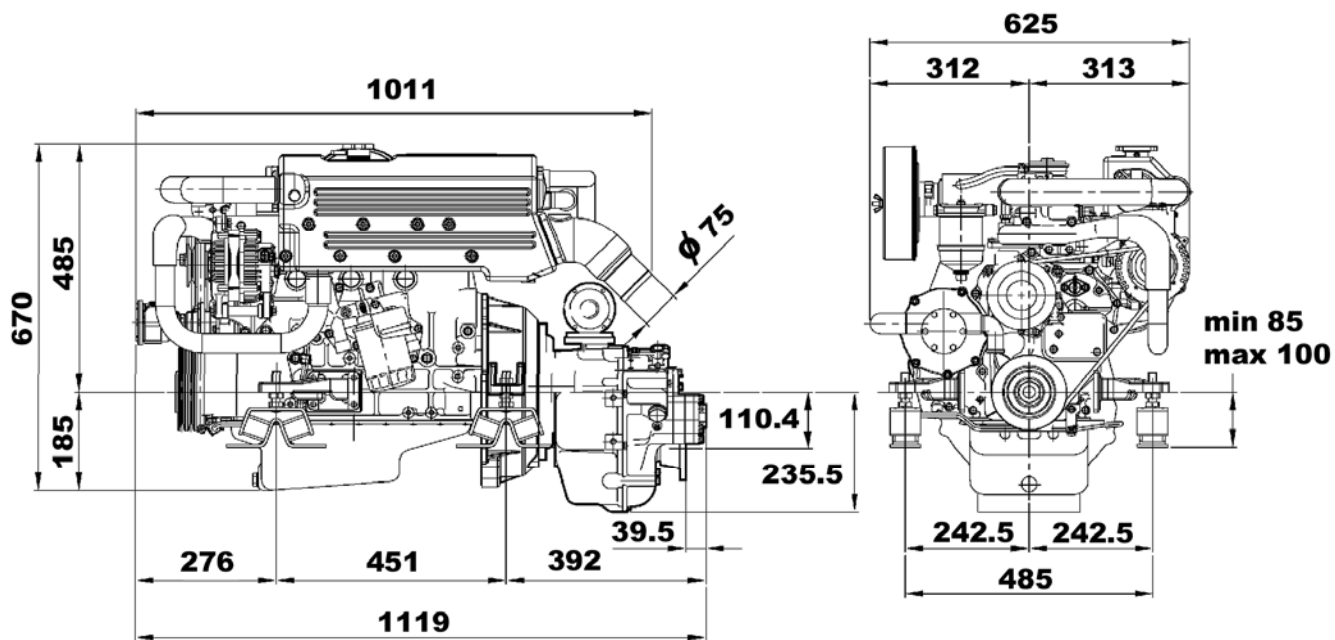
### GEARBOX TYPE SMI-R3



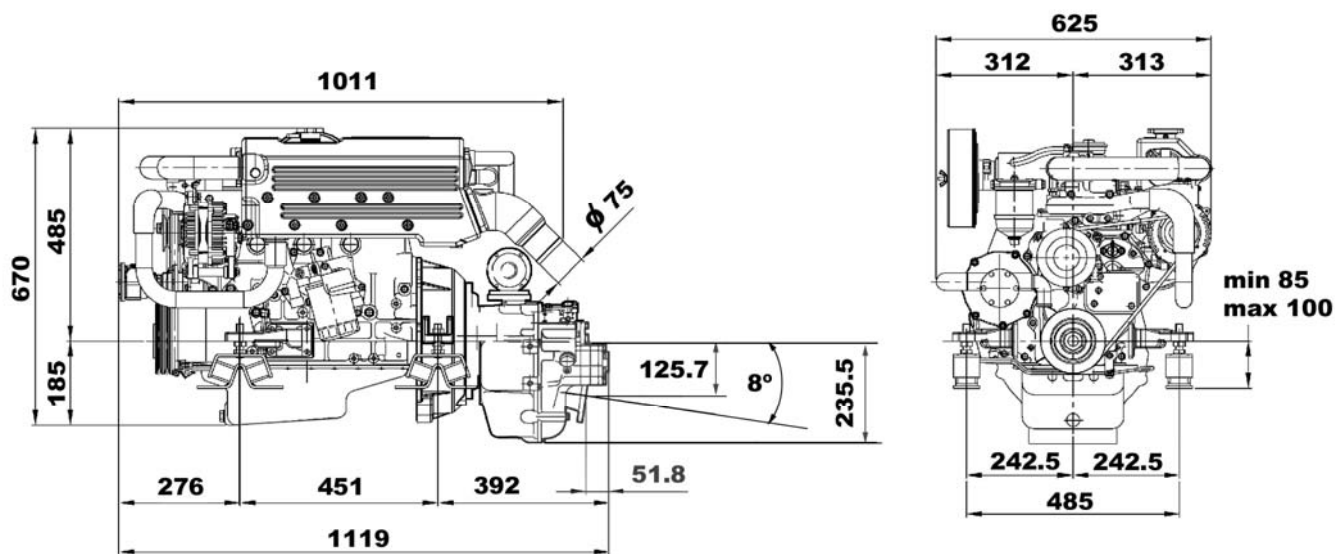
### GEARBOX TYPE TM-345A



### GEARBOX TYPE TM-93



**GEARBOX TYPE TM-93A**



## 2.7 REDUCER GEARBOX

The mechanically driven (SMI-R2 and SMI-R3) gearbox is made with high mechanical and seawater resistance grey cast iron alloy.

Operation: With engine at idle speed, smoothly push forwardly the inverter lever (forward gear) and rearwardly (rear gear) according to the sense wanted.

For the rest of the gearboxes, read the specific gearbox manual attached.

### 3. TRANSPORT, HANDLING, STORAGE

#### 3.0 GENERAL WARNINGS

Refer to heading 1.3 for safety information.

#### 3.1 PACKING AND UNPACKING

The engine is shipped in various types of packing systems:

	STORAGE	STACKING OF PACKS:
Pallet with wooden crate (See heading 3.1.1)	covered area only	Máx. 1+1
Pallet with skeleton crate (See heading 3.1.2)	covered area only	NO
Engine mounting base + plastic packaging(See heading 3.1.3)	covered area only	NO

##### 3.1.1 PACKING AND UNPACKING WITH PALLET AND WOODEN CRATE

Remove the lower nails. Lift the engine using chains with safety hooks and of suitable load capacity. Attach the chain hooks to the engine eyebolts and lift using a forklift or other suitable lifting equipment as described in heading 3.3.

Transfer the engine to the intended position of installation and remove the plastic wrap film. Unscrew screws that secure the engine to the wooden base withdraw the base and proceed with installation operations.

##### 3.1.2 PACKING AND UNPACKING WITH PALLET AND SKELETON CRAT

Remove the lower nails. Lift the engine using chains with safety hooks and of suitable load capacity. Attach the chain hooks to the engine eyebolts and lift using a forklift or other suitable lifting equipment as described in heading 3.3.

Transfer the engine to the intended position of installation and remove the plastic wrap film. Unscrew screws that secure the engine to the wooden base with draw the base and proceed with installation operations.

##### 3.1.3 PACKING AND UNPACKING WITH ENGINE MOUNTING FIXTURE AND PLASTIC PACKAGIN

Lift the engine using chains with safety hooks and of suitable load capacity. Attach the chain hooks to the engine eyebolts and lift using a fork lift or other suitable lifting equipment as described in heading 3.3.

Transfer the engine to the intended position of installation and remove the plastic wrap film. Unscrew screws that secure the engine to the wooden base with draw the base and proceed with installation operations.

#### 3.2 RECEIPT

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.



if you notice damage or missing parts, inform Solé Diesel assistance departments and the carrier immediately and forward photographic evidence of the damage



important:  
After inspecting the goods if you notice damage etc. write a reservation on the delivery note. Have the carrier countersing the note and advise SOLE S.A., preferably by telefax.



### 3.2.1 PACKING LIST

- (1) ASSEMBLED ENGINE
- (2) TECHNICAL DOCUMENTATION



The technical documentation contains: instruction and user manual.

Packing material must be disposed of in compliance with established law in the user's country. Packing materials:  
Wood Steel nails Steel screws Plastic film Cardboard Metal or plastic straps

### 3.3 TRANSPORT AND HANDLING THE PACKED ENGINE

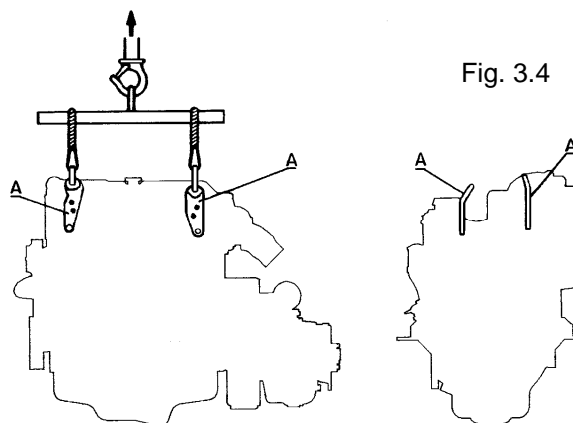
When lifting and transporting the engine use **EXCLUSIVELY** a fork lift or bridge crane of appropriate load capacity, with chains equipped with safety hooks suitable for lifting the load.

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

### 3.4 TRANSPORT AND HANDLING OF THE UNPACKED ENGINE

When the engine is unpacked ready for transport, use **EXCLUSIVELY** the appropriate lifting eyebolts (A), see the picture 3.4.

Choose the lifting equipment with reference to heading 3.3. Para transportar el motor desembalado, servirse **EXCLUSIVAMENTE** de los cáncamos (A) Ver la fig. 3.4.



### 3.5 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 and the type of packing system (base, pallet, etc.).

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..



if the user decides to start the engine after a longer time period, this must be done in the presence of an authorized technician

## 4. INSTALLATION

### 4.0 GENERAL WARNINGS

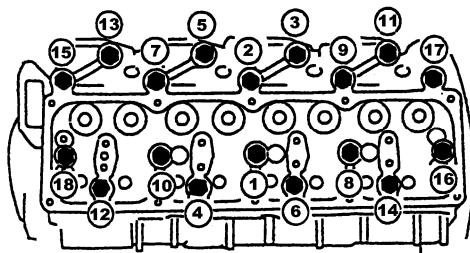
Refer to heading 1.3 for safety information

### 4.1. ASSEMBLY DATA

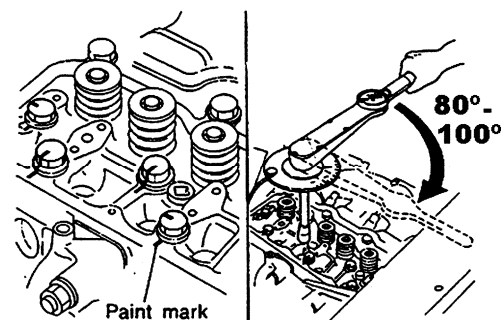
TIGHTENING VALUES	TYPE THREAD	SN – 85 SN – 85L SN – 110	
		(kgf · m)	(lbt · ft)
Cylinder head bolts	M12 x 1.75		
	1 <sup>st</sup> step	4 – 4.5	29 – 33
	2 <sup>nd</sup> strp	6 – 6.5	43 – 47
	3 <sup>rd</sup> step + 90°	+ 90°	+ 90°
Crankshaft pulley to crankshaft Main bearing bolts	M30	30 – 33	217 – 239
	M14x2	17 - 18	123 – 130
Connecting rod bolts Flywheel bolt Rácord cárter vaciado aceite	M10x1.25	8-8.5	58-61
	M12x1.25	15-17	108-123
	M14	5.5-6.0	40-43
Oil filter Pressure relief valve Holder body retaining nuts	---	1.6-2.1	12-15
	M22x1.5	5.0 – 7.0	36.0 - 51
	----	5.5-6.5	40-47
Nozzle holder mounting bolts Glow plug Nut for B terminal of starter	----	3.75	27.0
	M10x1.5	1.5-2	11-14
	M10	1.1	8
Reversing gear flange setscrew Water cooler element locknut Reversing gear body setscrew	M8x1.25	12.0	87.0
	M10	5.0	36.0
	M10	5.0	36.0
Oil gearbox drain plug General tightening torque	M12	3.5	25.0
	M6	0.5 / 0.7	4 / 5
	M8	1.2 / 1.7	9 / 12
	M10	2.2 / 3.4	16 / 25
	M12	3.6 / 6.1	26 / 44

#### CYLINDER HEAD BOLTS TIGHTENING SEQUENCE:

When bolting the cylinder head, clean thoroughly the contact faces and fit the head gasket. Re-tighten one screw at a time when engine is cold as indicated in the suitable drawing. Loosen must be done using the reverse sequence.



1st – 2nd Step



3rd Step

## 4.2 ENGINE SUPPLIES

### 4.2.1 CHANGING OIL

#### 4.2.1.1 CHANGING ENGINE SUMP OIL

Use oil that corresponds to the technical specifications in chapter 9.

Oil shall be changed with a hot engine so as to be sure the oil is fully drained. This is done by removing the stopper and mounting the drain pump. (Fig. 4.1).

When drained, fill with fresh oil through the filler hole.(Fig. 4.2).

Oil sump capacity: see heading 2.6 (technical specifications).

Immediately operate engine at idling for some minutes until the dashboard control light is switched off.

Stop engine. Check filter and engine sealing. Check then oil level, by removing the rod (Fig. 4.3), cleaning it with a rag and repositioning it by retightening.

Remove it again immediately to check oil level and if it does not reach the top sign add carefully more oil through the filler hole (Fig. 4.2) up to the top rod sign.

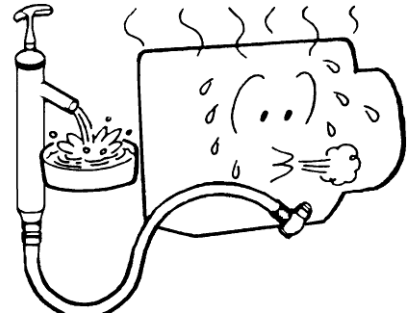


Fig. 4.1

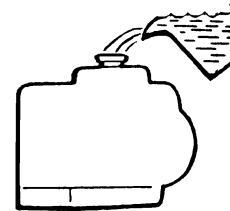


Fig. 4.2

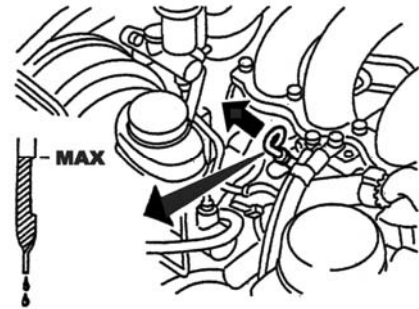


Fig. 4.3



Be careful that any rod marks refer to the engine at a horizontal position. Therefore, check the engine inclination when the level is verified.

#### 4.2.1.2 CHANGING GEARBOX OIL

Gearbox has its own lubrication, independent from the engine. To perform an oil change, drain the used oil by removing the plug located at the lower rear side (Fig. 4.4).When drained, tighten the plug and fill with fresh oil through the hole of the level rod (Fig. 4.5).

Oil gearbox capacity: see heading 2.6 (technical specifications).

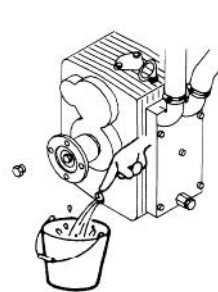


Fig. 4.4

**SMI-R3**

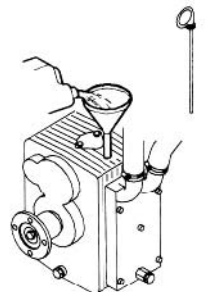


Fig. 4.5



Fig. 4.4

**TM-93 / 93A**

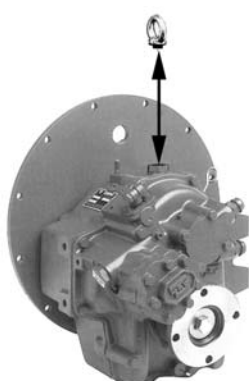


Fig. 4.5



Fig. 4.4

**TM-345 / 345A**



Fig. 4.5



Warning:

The use of oil that does not conform to the technical specifications on chapter 9 will cause serious damage to the engine and invalidate the guarantee.



When supplying the engine never ingest oil, fuel, coolant liquid, etc. These substances are harmful to the personal health of the user if ingested

#### 4.2.2 FILLING THE COOLING CIRCUIT

As a refrigerating liquid, an anti-freeze of the brand **KRAFFT ACU 2300 CC 50% Ref. 1325** or another one with similar specifications must be used.

The incorrect use of water in the refrigeration circuit is extremely harmful, causing corrosion and scaling, while the use of anti-freeze protects the circuit from corrosion, scaling and from freezing in conditions of very low temperature, thus optimizing engine maintenance and reliability.



Warning!

Do not allow AC88 liquid to come into contact with the eyes or the skin



Warning!

Do not ingest any of the liquids utilised to fill the various circuits on the engine

When distilled water is used in the refrigeration circuit, an anti-freeze product must be added, otherwise the expansion of water when it freezes may produce cracks and damage to the refrigerator unit and to the block, and in proportion to the temperatures expected.

The anti-freezing agent manufacturer, in the package labels is giving the instructions to be followed at each case. However, in the following box, suitable rates a reset out in accordance with temperatures:

<b>Ant freezing liquid concentration (%)</b>	30	40	50	60
<b>Freezing temperature (°C)</b>	-10	-20	-30	-45

It is advisable the anti-freezing agent strength is selected based on a temperature which is approx. 5°C under the actual atmospheric temperature.

The anti-freeze solution recommended can be used for a normal operation of 2 years. At the end of this period of time the refrigeration circuit must be emptied and cleaned, then refilled with the predetermined anti-freeze (see 4.2.2).

Run the engine for a few minutes until the cooling circuit is properly filled and free of air pockets. Check the coolant level and replenish if necessary.



Warning!

After the first 50 hours of engine duty and at six months or 1000 hours intervals thereafter, adjust inhibiting agent AC88 to the coolant in the same proportions as indicate earlier. The cooling liquid mixture must be topped up with identical mixture and totally drained and replaced every 2 years.



Warning!

The use of coolants that are not in conformity with the above prescriptions will cause damage to engine components and invalidate the terms of the guarantee.

### 4.2.3 REFUELING

Always use clean, filtered gas oil. Never use either kerosene or heavy oils. On topping up with fuel, use a funnel with a metallic mesh filter, to keep out impurities or foreign bodies which may cause problems in the fuel injection circuit.

Whenever possible, keep the fuel tank full, as temperature changes may cause condensation of the damp air present in the tank so that water accumulates at the bottom, giving rise to corrosion or making it impossible to start the engine if this is aspirated by the fuel pump.

Check all tank filling plugs located at the boat deck are sealed.



Warning!

Do not use diesel fuel mixed with water or any other foreign substances



Warning!

Always use top quality fuel of certified origin. the use of diesel fuel that does not comply with the technical specifications indicated above will cause serious damage to the injection system and hence to the engine and also invalidate the terms of the guarantee

### 4.3. INSTALLATION



Warning!

When water-cooled engines must be located in an enclosed place or protected by guards or a cabinet, it is important to ensure that combustion air is freely supplied and freely expelled from the area

The above recommendation is of primary importance in relation to the perfect operation of the engine because the hot air that it generates must never be routed to the area of the combustion air intake cleaner.

If the users fails to take these precautions, a hot air recirculation system will be formed thus reducing engine power output and obstructing proper cooling.

In these cases it is advised to take steps to avoid taking in engine combustion air from the place in which the engine is installed. This is achieved by placing the suction filter, or a suction prefilter, outside the place in which the engine is installed.

### 4.4 INDICATIONS FOR REMOVAL / DISPOSAL OF WASTE MATERIAL



Warning!

Disposal of waste material must be carried out in conformity with established legislation in the country of installation.

## 5. PREPARING THE ENGINE FOR USE

### 5.0 GENERAL WARNINGS

Refer to heading 1.3 for safety information.

### 5.1 INSTRUCTIONS FOR FIRST STARTING

Do not alter the functioning conditions of the engine by changing the settings of factory sealed parts. Tampering with such parts automatically invalidates the guarantee. Proceed as follows when starting the engine for the first time:

**(a) FILLING WITH OIL** See heading 4.2.1 and heading 2.6 for oil sump capacity.

**(b) FILLING WITH COOLANT** (See heading 4.2.2)

**(c) REFUELING** See heading 4.2.3. Check fuel delivery cock is fully opened.

**(d) OPEN SEAWATER ENTRY COCK**

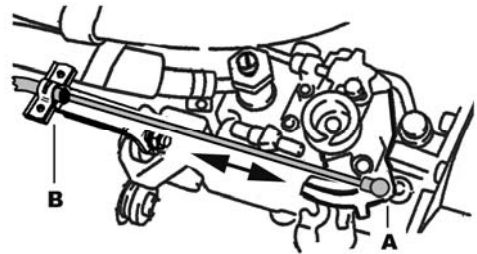
**(e) CONNECT THE BATTERY CONNECTOR**

**(f) REMOTE CONTROL CONNECTION**

(f.a) Engine:

Connect control cable to the ball-joint fitted to the lever (A) and position the cable with the clamp (B).

Adjust in a way that gas is not delivered until the inverter gear is engaged.



(f.b) Gearbox:

Connect control cable to the lever by means of the ball-joint provided for this purpose and position cable with the clamp. When fitted, adjust control in a way that it has the same forward running that rearward and gas is not delivered until the gear is perfectly engaged (Fig.5.2).

To check fitting is correct, proceed as follows: Place the gearbox lever and remote control lever in the position of forward running. Adjustment is made by way of the elongated holes of the control and the elongated holes of the cable attachment support.

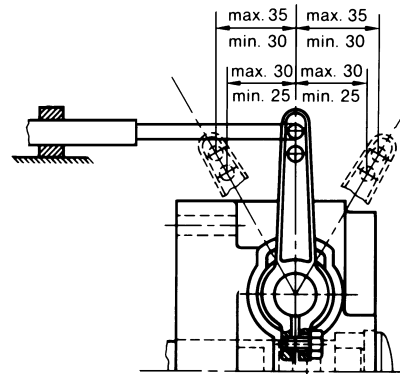


Fig. 5.2

### (g) OTHER CHECKINGS

(g.a) Carefully check the engine positioning points.

(g.b) Check all screws are correctly tightened.

(g.c) Check all water, oil and gas-oil pipe nipples, verifying if all them are well connected and correctly tightened.

(g.d) Check exhaust and transmission systems.

### 5.1.1 BLEEDING AIR FROM THE FUEL SUPPLY SYSTEM

On the first start-up of the engine, and if this has operated with the fuel tank empty, air may enter the feed system, and it is necessary to purge this. To carry out the priming/purge of the fuel system, proceed as follows:

- (1) Check fuel cock located at the tank delivery is open.
- (2) Operate the priming pump (B). The air bleeding from the injection pump and from injectors is automatic, Thus when the fuel flows free of bubbles through fuel leak-off pipe, circuit is air bled.
- (3) Clean up fuel spillage.



Once this operations have been terminated proceed to start the engine (see heading 6.1)



Warning!!  
Protect hands. Fuel can harm the skin.

## 5.2 PRELIMINARY RUNNING TESTS

### 5.2.1 NO-LOAD RUNNING TEST

Run the engine at low speed for a few minutes. Keep a constant check on the oil pressure (see heading 2.3).

### 5.2.2 RUNNING-IN

During initial run-in, may last lasts for the first 50 hours of duty, take into account the following points:

- (1) Daily checking performances must be made without failure.
- (2) Engine must be operated at idle speed and heated up minimum 5 minutes after its starting.
- (3) Avoid a speeded-up acceleration.
- (4) Use the engine at 100% of maximum power for limited periods.
- (5) Carefully comply with the inspection and maintenance instructions shown in this manual.



Warning!  
The longer the initial running-in period with reduced loads, the longer will be the working lifetime of the various parts of the engine with consequent savings in terms of maintenance and running costs.

## 6. USING THE ENGINE

### 6.0 GENERAL WARNINGS

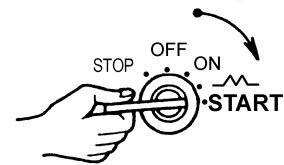
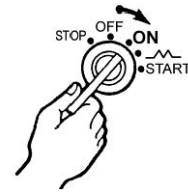
Refer to heading 1.3 for safety information.

### 6.1 STARTING THE ENGINE

For all engines



- a) **Place control lever at the neutral point.**
- b) **Rotate the ignition key to position "ON"**  
Check oil pressure, battery charge lamps are lighted and the alarm is heard (refer to heading 2.5.1 for lamps position).
- c) **Pre-heating of incandescent spark plugs.**  
Rotate ignition key to position "pre-heating" and hold in this position for a maximum of 6 seconds.
- d) **Starting.**  
Place the remote control lever to neutral point and deliver gas up to the half position, rotate the ignition key to the "START" position until the engine starts running. If the engine does not start running, even with the ignition key in the "START" position for 10 seconds, draw your hand out from the key for 30 seconds and then try again to start the engine, if necessary heating again the glow plugs.



**Warning!**  
Do not run the starter motor for more than 20 seconds at a time

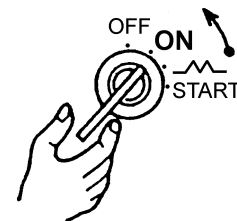
Once the engine has started, release the ignition key, allowing it to automatically return to the "ON" (running) position and disconnecting the starter motor. Immediately adjust the accelerator to prevent the engine reaching high-speed. When the engine is running, do not turn the ignition key to the "START" position as this would seriously damage the starter motor.

After the starting operation, check oil pressure and battery charge lamps are switched off.

- e) **Heating.**

Heat the engine for approx 5 minutes, allowing it to run with no-load at half feed.

If engine is heated, the pre-heating operations should not be done. In this case, directly rotate the ignition key to the "START" position until the engine is running.





## 6.2 STOPPING THE ENGINE

Allow to run at low speed for 4 or 5 minutes and place the remote control lever in the neutral position. Rotate the ignition key to the "OFF" position.

If engine is not to run for a longer period, it is advisable to shut fuel and water cocks and also to disconnect the battery.



## 6.3 USING THE ENGINE INFREQUENTLY

Take special precautions in installations where the engine must cut in rapidly and suddenly after long periods of inactivity (emergency power systems, fire prevention systems and harsh ambient conditions).

For specific application conditions consult SOLÉDIESEL.

## 6.4 OPERATING THE ENGINE AT LOW TEMPERATURES

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

- |  |   |
|--|---|
| (1) The cooling liquids of the engine may freeze.            | (2) The lubricating oil becomes thicker.  |
| (3) There is a drop in the voltage at the battery terminals. | (4) The air inlet temperature is low and the engine has difficulty in starting. |
| (5) The fuel loses fluidity.                                 |   |

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

- (1) Use anti-freeze as indicated in section 4.2.2 of this manual.
- (2) When the engine is to be stopped, close the sea water cock, open the sea-water filter cover and start the engine adding a mixture of fresh water and 30% anti-freeze until the sea-water circuit is filled completely. Stop the engine and replace the sea-water filter cover. Before starting the engine again, open the sea-water cock. Repeat this operation whenever the engine is used at temperatures below °C.
- (3) Make sure that the lubricant oil is good quality and has a suitable viscosity. SAE 10W/30 synthetic oil is recommended.
- (4) Protect the battery against the cold, covering it with an adequate material. Check that the battery is fully charged. It is also advisable to use a dielectric spray on the electrical connections.
- (5) When starting the engine, make sure that the heating plugs become hot enough. Follow the instructions detailed in section 6.1 of this manual.
- (6) If necessary, to replace the fuel with a type more suited to low temperature operation. The accumulation of impurities in the fuel tank could cause faulty firing.



## 6.5 CONSERVATION



### Warning!

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

## 6.6 LONG INACTIVITY INSTRUCTIONS

When the engine is not to be used for a long period of time or during the winter time, certain operations must be carried out to keep it in perfect operating condition. Follow these lay-up instructions carefully.

- (1) Carefully clean the external surface of the engine.
- (2) If very low temperatures are expected, always use liquid anti-freeze in the refrigeration circuit as indicated in section 4.2.2 of this manual.
- (3) In the case of low-capacity fuel tanks, drain completely and clean; refill with a mixture of diesel oil and rust inhibitor oil. For diesel oil in large-capacity fuel tanks, it is enough to add 2% rust inhibitor oil.
- (4) Close the sea-water cock. Connect a hose from the sea water pump to a open bucket. Put 30% anti-freeze mixture to the bucket. Start the engine for a moment. So the sea water system will be filled with anti-freeze mixture. Stop the engine.
- (5) Use a dielectric spray on the electrical connections, disconnect the battery, and charge it several times during the period of inactivity.



## 6.7 RESTORATION OF THE RUNNING 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 oil. Carry out the process for checking the fuel filter. If the filter is clogged, replace the filter cartridge. The diesel oil-rust inhibitor oil mixture placed in the tank for winter lay-up can be used to operate the engine.
- (2) Drain the rust inhibitor oil contained in the crankcase and refill the engine sump with oil according to the instructions on heading 4.2.1.1.
- (3) Check the condition of the fresh-water cooling system rubber hoses.
- (4) Reconnect the battery and apply a layer of neutral Vaseline to the battery terminals.
- (5) Reconnect the battery and apply a layer of neutral Vaseline to the battery terminals.
- (6) Connect the cooling and exhaust system. Open the sea-water cock.
- (7) Verify whether there are any leaks in the fuel and water systems.
- (8) Start up the engine and try out at different speeds, making sure that the water flows correctly. Check again to see if the connectors leak.



## 7. REPAIR AND MAINTENANCE

### 7.0 GENERAL WARNINGS

Refer to heading 1.3 for safety information.

### 7.1 TYPE AND FREQUENCY OF INSPECTIONS AND MAINTENANCE INTERVENTIONS



INCREASE THE FREQUENCY OF MAINTENANCE IN HARSH DUTY CONDITIONS. (FREQUENT STOPS AND STARTS, DUSTY SURROUNDINGS, PROLONGED WINTER SEASON, NO-LOAD RUNNING)



IF POSSIBLE CHECK LEVELS AND REPLENISH SUPPLIES WITH THE ENGINE STOPPED AND AT AMBIENT TEMPERATURE



WARNING!

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

		Service interval					
		Daily	1 <sup>st</sup> 50 hour	200 hour	400 hour	800 hour	Every 2 years
Engine	Screw tightening, fixing		✓		✓		
	Valve play				✓		
	Exhaust gases, noise and vibrations	✓					
	Compression pressure					✓	
Lubrication system	Engine oil	✓	◆	◆			
	Gearbox oil	✓	◆	◆			
	Oil filter		◆	◆			
Fuel system	Fuel	✓					
	Fuel tank						□
	Fuel filter (engine)				◆		
	Decanting filter (if any)	✓	◇		◆		
	Injection pump					✓	
	Injector					✓	
	Bleed fuel system						✓
Intake system	Air filter				◆		◆
Cooling system	Cooling water	✓					◆
	Water filter	✓	□	□			
	Bottom cock	✓					
	Water pump impeller				✓	◆	

□ Cleaning  
◆ Change

✓ Inspection, adjustment or filling  
◇ Drainage

**Sole Diesel**

ENG - 23

03918201.ENG rev. 0

	Inspection concept	Service interval					
		Daily	1 <sup>a</sup> 50 hour	200 hour	400 hour	800 hour	Every 2 years
Electrical system	Every instrument	✓					
	Incandescent spark plug					✓	
	Alternator and starting motor				✓		
	Alternator belt and tension		✓		✓	◆	
	Battery level		✓	✓			

- Cleaning                      ✓ Inspection, adjustment or filling  
 Change                              ◆ Drainage

DAILY CHECKING BEFORE USE OF THE ENGINE
Check oil level in the engine and gearbox. Filling. Filling is not required if level is near to the rod upper line.
Check fuel level and open fuel delivery cock.
Open the water access cock.
Check indicators. After commissioning check oil pressure, water temperature and battery charge. The three lamps must be switched off and the alarm must not be sounded.
Check cooling water is flowing and if some failure is detected in the exhaust gases, noise and vibrations.
Check cooling water level.

AFTER THE FIRST 50 OPERATING HOURS
Change oil engine, gearbox and cover fuel supply pump.
Change oil filter.
Fuel decanting filter drainage ( if equipped )
Control and eventual adjustment of the alternator belt.
Overhaul of the propeller shaft and positioning screw tightening torque.
Clean water filter for impurities.

EVERY 200 OPERATING HOURS
Change oil engine a.
Change oil filter.
Water filter cleaning.
Check battery level.

EVERY 400 OPERATING HOURS
Check the tightening torque of the engine positioning, propeller shaft screw and gas-oil piping nipples.
Adjust valve clearance.
Check incandescent spark plugs in case they might fused or if there is two connections.
Change air filter
Inspect injection pump.
Check condition of sea water pump impeller and its eventual replacement.
Check the alternator and starter.
Control and eventual adjustment of the alternator belt.
Change fuel filter.
Decanting filter component change (if equipped)
Gearbox oil change.

EVERY 800 OPERATING HOURS
Check the starting motor pinion and the flywheel toothed crown.
Change alternator belt.
Check the compression pressure of each cylinder.
Injector checking.

EVERY 2 OPERATING YEARS
Change the refrigeration anti-freeze liquid.
Clean the fuel tank.

## 7.2 OPERATING DESCRIPTION

### (1) Change engine and gearbox oil:

See heading 4.2.1.

### (2) Change oil filter (Fig. 7.1):

The oil filter is located under the air filter. Change the oil filter after the first 50 operating hours and afterwards every 200 hours. The oil filter being a cartridge type of easy handling shall not be cleaned. Change the oil filter cartridge by unscrewing it with a commercially available oil filter 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.

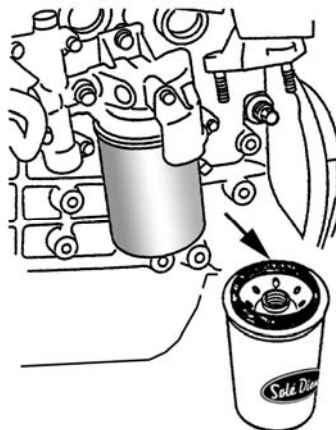


Fig. 7.1

### (3) Checking valve clearance:

Perform this operation when the engine is cold in the following way;

With the rocking cover removed, loosen the rocker nut (1) and while the adjustment screw (2) is rotated, adjust the valve play with a gauge (3) (Fig. 7.2).

**Intake valve play: 0.3 – 0.4 mm**

**Exhaust valve play: 0.3 – 0.4 mm**

With piston n° 1 in the top dead centre of the compression cycle, adjust the play of the intake and exhaust valves of cylinder n° 1. Proceed similarly as with the other cylinders. The position of the BTDC can be confirmed with the lining signs of the distribution or timing cover and the crankshaft pulley.

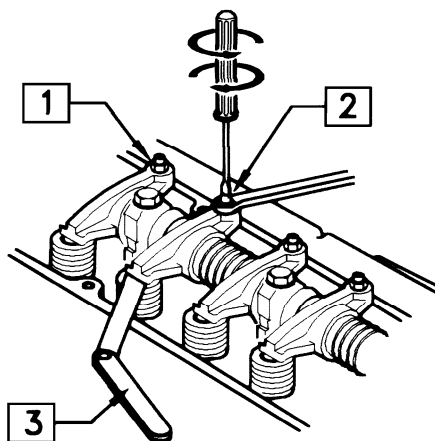


Fig. 7.2

After the adjustment, the rocking nut should be well tightened while the adjusting screw is locked so that it does not rotate.

NOTE: The adjustment of the valve play must be made after the cylinder head screws are again tightened. (Strictly comply with the operation sequence indicated in the heading 4.1)

### (4) Control and eventual adjustment of the alternator belt tension:

Never adjust the belt tension with engine running.

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 due to the belt skidding can be caused.

Check belt tension by pressing on one side with your thumb. Belt deflection should be about **11mm** (Fig.7.3).

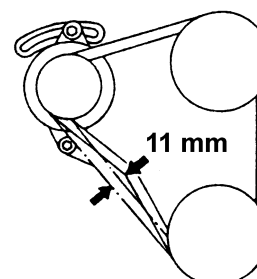


Fig. 7.3

(5) **Water filter cleaning:**

It is important to fit between the engine and the bottom cock a filter to avoid that any impurities existing in these a water might clog the cooling conducts.

Filter shall be cleaned every 200 hours by loosening the wing nut and removing the filtering component. Clean the filter and fit it again taking care the cover is well seated on the O-ring (Fig. 7.4). Then the engine is started to check if water is leaking from the cover.

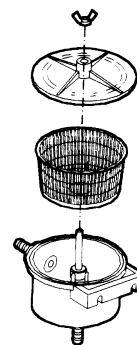


Fig. 7.4

(6) **Change cooling circuit water:**

Drain off all the circuit water by opening the two drain cocks, one in the exchanger and other in the cylinder block (Fig. 7.5).

When in cold climates, if the engine is not to be used for a long period, it is advisable to drain the water circuit.

Once this operation has been completed, close the drain cocks and fill to the hole in the tank cap (see heading 4.2.2 of this manual).

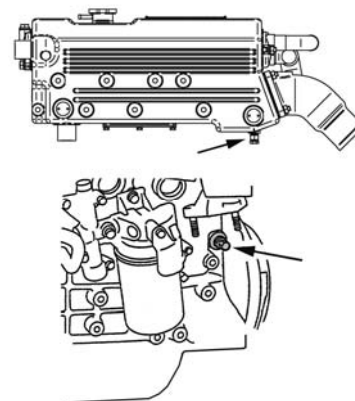


Fig. 7.5

(7) **Checking battery electrolite level and charge:**

Batteries require a very careful handling and frequent checkings. Proceed as shown below:

- (1) Always keep batteries dry and cleaned.
- (2) Regularly check terminal cleanliness. 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) Batteries or containers containing acids should carefully be handled.
- (5) Monthly or every 200 hours check the acid level and supplement it with DISTILLED WATER required. Level should not exceed the battery inside mark.
- (6) Never use open flames to light battery components: there is explosion danger.
- (7) In winter, batteries should be detached and placed following the manufacturer's instructions.

Before battery is charged with an external charger, disconnect both terminals.

(8) **Fuel decanting filter drainage ( optional ):**

Loosen the wing nut (3) (Fig. 7.6) located at the lower side of the glass vessel and let go all the accrued water. Shut again off the wing nut and check it does not drip.

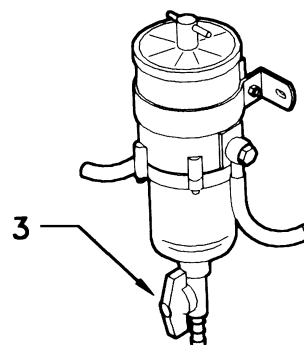


Fig. 7.6

(9) **Replace the fuel filter element (engine):**

The fuel filter is cladded and cannot be cleaned. It must be replaced at least once every 12 months.

To perform the filter change: Shut off the cock located at the tank delivery. Unscrew cover filter with a chain spanner. Screw the new filter to the cover with the hand and at the same time replace the rubber seals. Carry out the operations at heading 5.1.1 bleeding air from the fuel system.

(10) **Injector checking:**

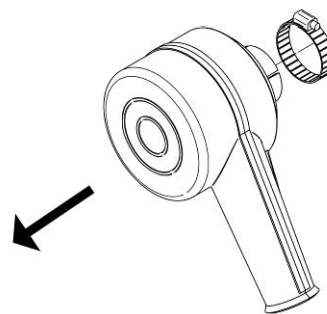
This operation shall be made by a SOLÉ DIESEL service. If a hand-pump is available, monitor the calibration of injectors, by verifying that the pressures are those listed in paragraph 2.6 of this manual.

(11) **Checking incandescent spark plugs:**

Supply power to the glow plugs and make sure that they become incandescent, if not renew them.

(12) **Change air filter. Plastic Air Filer.**

See the picture. Engine is provided with an intake air filtering component. To perform such a change, slacken off the central filter clamp, remove the old filter, byre placing with a new one. The filter and element are an integral unit. The filter CANNOT be cleaned, it must be changed



(13) **Check condition of sea water pump impeller and its eventual replacement:**

Driving 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.

To change the impeller, close water inlet cock, remove pump cover and with two screwdrivers prize it by removing the impeller from the shaft. Clean housing and replace with a new one. Fit cover by placing a new seal (Fig. 7.9). Open bottom cock. If the impeller is broken, when it is changed, be sure all the rubber residues scattered are removed from the water pipes.

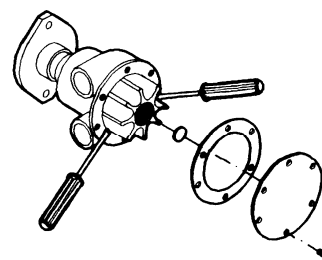


Fig. 7.8

(14) **Check alternator and starting motor:**

The engine has a standard alternator of 12V 70 Amps Or 110A (depending seral number), with an electric regulator incorporated and an output for the revolutions counter.

Regularly check the electrical connections, its relevant positioning and the good terminal contact. For the starting motor, check brush wear and switch sour face roughness. Replace if the service limitation has been reached.

(15) **Cleaning the fuel tank:**

Drain out the contains of the fuel tank to remove condensate and any foreign materials. Wash the tank with fuel (dispose of fuel as described in heading 4.4.

(16) **Replace alternator belt:**

Fully detension old belt so that its removal can be made easily (Fig. 7.9).

When the belt is unfitted, check the condition of the pulley recesses, they shall be dry and clean. Its cleanliness is performed with soap water (never use petrol, gas oil or similar products).

Fit the belt taking care the belt insertion is made with the hand but without damaging it and if required pace it with a tool at least without any cutting edges since otherwise the belt could be damaged and its life shortened. The belt shall be tensioned such as is previously explained.

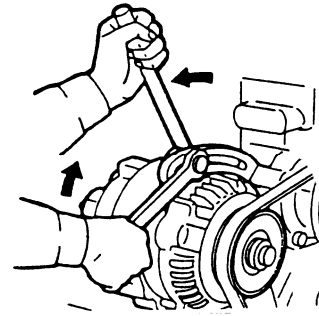
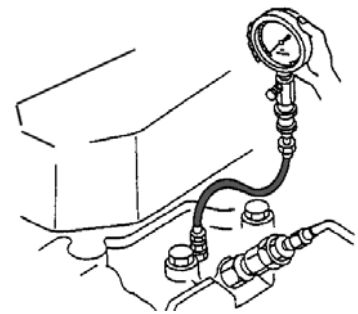


Fig. 7.9

(17) **Check the compression pressure of each cylinder:**

Check each cylinder with the glow plug removed using a compression pressure gauge. If measurement of any cylinder is below 25 kg/cm<sup>2</sup> at 200 rpm, the cylinder must be repaired. The pressure standard at 200 gpm is 30 kg/cm<sup>2</sup>.

Difference in pressure between cylinders must be within 3 kg/cm<sup>2</sup>, at 200 gpm.



(18) **Inspect injection pump:**

The fuel injection pump is one of the most relevant components of a diesel engine and therefore its handling requires the best care. In addition, the injection pump has carefully been 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.

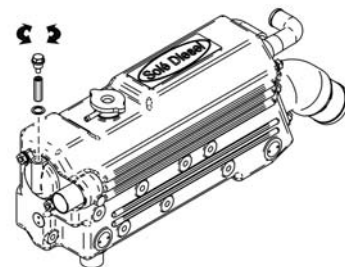
The requirements for the handling of a fuel injection pump are the following: Always use fuel which is without impurities and fuel filter shall be changed at the scheduled time.

(19) **Fuse:**

The switchboard carries as protection a 2 fuses: one with a size 10A to protect the panel's instruments and other to protect the circuit. In case the switchboard does not received power supply check if the switchboard is fused or not and replaced it.

(20) **Checking for anti-corrosion protection.**

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 water-water heat exchanger. Check this every 250 hours and replace the zinc if it is damaged. To replace it, unscrew the plus holding the anode to the front lid of the exchanger, unscrew the damaged anode and replace it by a new one. Then press the anode-holding plug into the lid and check for water leaks.





### 7.3 TROUBLE SHOOTINGS

ENGINE FAILURE	PROBABLES CAUSES
FAILURE TO START	C1 - C2 - C3 - C4 - C5 - C6 - C9 - E1 - E2 - E3 - E4 - E5 M3 - R1 - R3 - L4
STARTS THEN STOPS	C1 - C3 - C5 - C7 - C9 - M5 - R4 - R6
POOR ACCELERATION	C1 - C2 - C3 - C4 - M1 - M2 - M4 - R7
UNEVEN RUNNING SPEED	C4 - L2 - R4 - M1
BLACK SMOKE	C3 - C6 - C7 - M1 - M4 - R1 - R2
BLUE SMOKE	L2 - M5 - R1 - R5 - R6 - R7
ENGINE OVER-HEATING	L1 - L4 - L6 - CR2 - CR3 - CR4 - CR5 - CR6 - M2 - M3 - M4
LOW OIL PRESSURE	L1 - L3 - L5 - L6 - L7 - L8 - R5
NOISY ENGINE	M3 - R5 - R7
OIL PRESSURE TOO HIGH	L3 - L7
LOW POWER	C3 - C6 - C8 - M1 - M7 - R2 - R7
BATTERY CHARGE DEFECTIVE	E1 - E2 - E7 - M6
GEAR DO NOT MESH CORRECTLY	M8 - M9

FUEL SYSTEM	
FAULTY OR CLOGGED FUEL PUMP	C1
OBSTRUCTED FUEL LINES	C2
FUEL FILTER CLOGGED	C3
FAULTY INJECTION PUMP	C4
AIR IN FUEL SYSTEM	C5
INJECTORS NOT SET CORRECTLY OR SEIZED	C6
INJECTION PUMP INCORRECTLY SET	C7
WATER IN FUEL SYSTEM	C8
FUEL OUTLET COCK CLOSED	C9

LUBRICATION	
FAULTY OIL PUMP	L1
OIL LEVEL TOO HIGH	L2
OIL PRESSURE RELIEF VALVE STICKING	L3
OIL VISCOSITY TOO HIGH	L4
OIL VISCOSITY TOO LOW	L5
OIL LEVEL TOO LOW	L6
FAULTY OIL PRESSURE VALVE	L7
FAULTY OIL PRESSURE GAUGE OR SWITCH	L8
OIL SUCTION LINES CLOGGED OR UNIONS LOOSE	L9

ELECTRICAL SYSTEM	
BATTERY DISCHARGED	E1
LOOSEN CABLE CONNECTION	E2
FAULTY STARTING SWITCH	E3
FAULTY STARTER MOTOR	E4
FUSE BURNED OUT	E5
FAULTY SPARK PLUGS	E6
FAULTY ALTERNATOR REGULATOR	E7

COOLING CIRCUIT	
SHORTAGE OF WATER IN FRESH WATER CIRCUIT	CR1
FAULTY FRESH WATER PUMP	CR2
BOTTOM COCK TO WATER FILTER CLOGGED	CR3
FAULTY SALT WATER PUMP	CR4
WATER COOLER CLOGGED	CR5
FAULTY THERMOSTAT	CR6

MAINTENANCE	
CLOGGED AIR FILTER	M1
ENGINE OVERLOADED	M2
TIMING TOO ADVANCED	M3
TIMING TOO RETARDED	M4
LOW IDLE SPEED	M5
ALTERNATOR BELT TENSION	M6
EXHAUST BACKFIRES	M7
REMOTE SHIFT AND REVERSING GEAR CONTROL OUT OF ADJUSTMENT	M8
CLUTCH CONE WORN	M9

REPAIRS	
WORN OR STUCK RINGS	R1
POOR VALVE SEALING	R2
STUCK VALVE	R3
GOVERNOR SPRING BROKEN OR WRONG SPRING	R4
WORN CON. RODS/OR MAIN BEARINGS	R5
WORN CYLINDERS	R6
WRONG VALVE CLEARANCE	R7

## 8. ADDITIONAL INSTRUCTIONS

### 8.0 ADDITIONAL INSTRUCTIONS

Refer to heading 1.3 for safety information

### 8.1 INSTRUCTIONS FOR DECOMMISSIONING, SCRAPPING AND DISPOSAL

When you decide to decommission the engine, please contact SOLÉ S.A., we will provide you with the relevant instructions in relation to the laws in force at the time. When scrapping the entire engine or components of the engine, observe the LAWS IN FORCE IN THE COUNTRY OF INSTALLATION.

For information on the materials of which individual components of the engine are made, contact SOLÉ S.A.

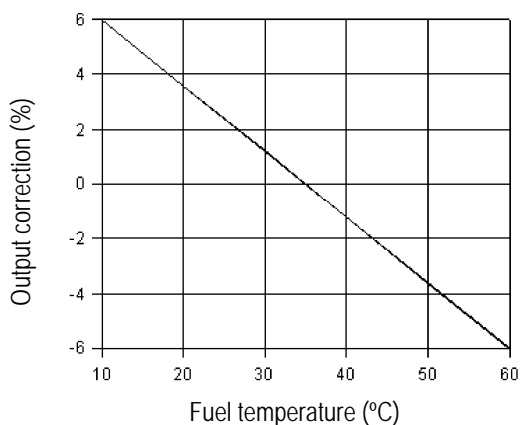
### 8.2 DERATING OF ENGINE DUE TO FUEL AND COMBUSTION PROPERTIES

#### FUEL PROPERTIES - Output correction due to fuel properties.

Specified outputs presuppose the following fuel properties (as per ISO 3046):

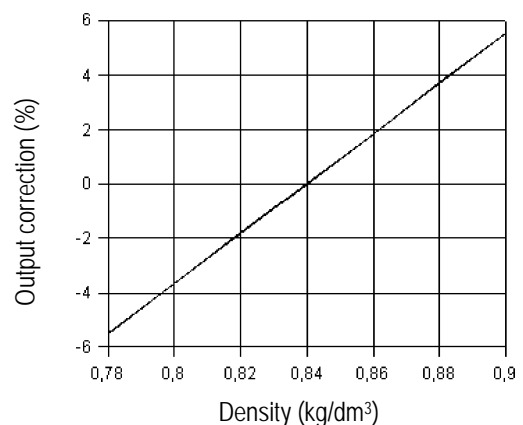
Energy value:	42700 kJ/kg
Temperature, before feed pump:	35°C
Density: (15°C)	0.84 kg/dm <sup>3</sup>

If the fuel deviates from these values, correction factors (in %) are found in the graphs below. Use the correction factors in "calculation of engine output"



Graph 1

Effect of fuel temperature on engine output. +35°C is reference temperature (0%)



Graph 2

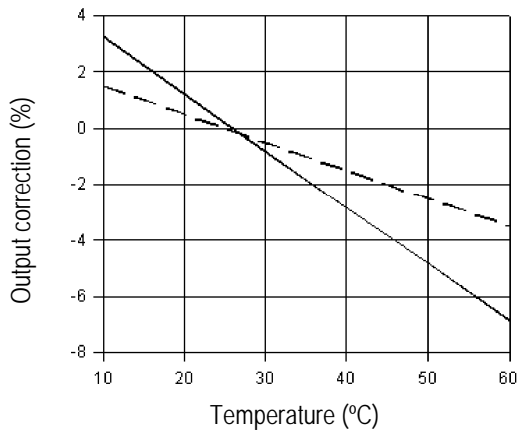
Effect of fuel density on engine output. Normal value is 0.84 Kg/dm<sup>3</sup> at +15°C (0%)

**AIR PROPERTIES - Output correction due to air properties.**

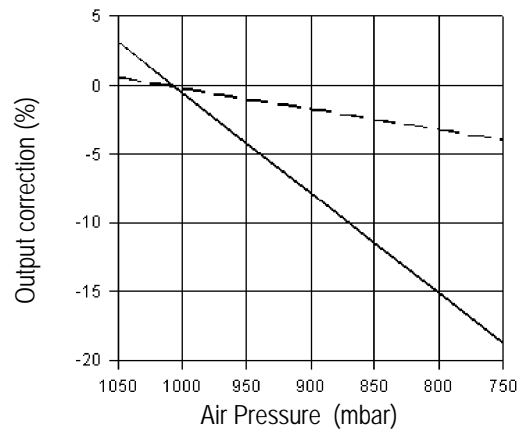
Specified outputs presuppose the following air properties (as per ISO 3046):

Air pressure: 1000 mbar (750 mmHg)  
Air temperature: 25°C  
Humidity: 30%

If the air deviates from these values, correction factors (in %) are found in the graphs below. Use the correction factors in "calculation of engine output"



Graph 3  
Effect of intake air temperature on engine output.  
+25°C is reference temperature (0%).



Graph 4  
Effect of air pressure on engine output. Normal value  
is 1000 mbar (750 mm Hg) (0%).

—— NORMALLY ASPIRATED  
----- TURBOCHARGED

## 9. TECHNICAL ANNEXES

### 9.0 OIL SPECIFICATIONS

#### 9.0.1 ENGINE OIL TO BE USED

Use Sole Diesel SAE 15W/40 oil. Its service classification is as follows: as follows:

##### OIL VISCOSITY:

Select oil viscosity most suitable for the atmospheric temperatures on which the engine should be operated. It's recommended to use Sole Diesel SAE 15W/40 oil in all the seasons due to the minimum change in its viscosity with the temperature changes. This is an all-season oil for temperatures ranging between -15°C and +35°C

API CE/CF-4/SG  
MIL-L-2104 E  
CCMC D4/G4/P



#### 9.0.2 GEARBOX OIL



Attention!

The gearboxes type **SMI-R3**, is necessary to use oil type **ATF**. These new units are identified with a red label near the oil level stick.



Label details:

From serial number indicated in the following table and up, gearboxes require use of automatic transmission oil type ATF (NOT SUPPLIED BY SOLÉ S.A.)

For gearboxes type **TM93 / 93A and TM345 / 345A**, is necessary to use oil type **SAE 15W40**. For another gearboxes, we recommended use the oil that the manufacturer recommends. Read the delivered documentation.

### 9.1 ESPECIFICACIONES FOR ENGINE INSTALLATION

ENGINE	AIR ADMISSION DISPLACEMENT (1)	ØINT EXHAUST HOSE (2)	BATTERY (12V)	CABLE TO BATTERY LENGTH (m)	MINIMAL SECTION CABLE TO BATTERY	Ø INT. FUEL HOSE FROM TANK TO PRIMING PUMP (mm)	Ø INT. FUEL HOSE FROM INJECTION PUMP TO THE TANK (mm)
SN – 85	280 – 300 m <sup>3</sup> /h	75	90 A	≤ 1.5	50 mm <sup>2</sup>	8	7
SN – 85L	280 – 300 m <sup>3</sup> /h	75	90 A	≤ 5	70 mm <sup>2</sup>	8	7
SN – 110	340 – 380 m <sup>3</sup> /h	75	90 A	≤ 10	95 mm <sup>2</sup>	8	7

(1) Max. r.p.m.

(2) for each curve of 90° of the installation, must increase 10 mm (for lengths superiors to 3m)





## MARINE DIESEL ENGINES

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