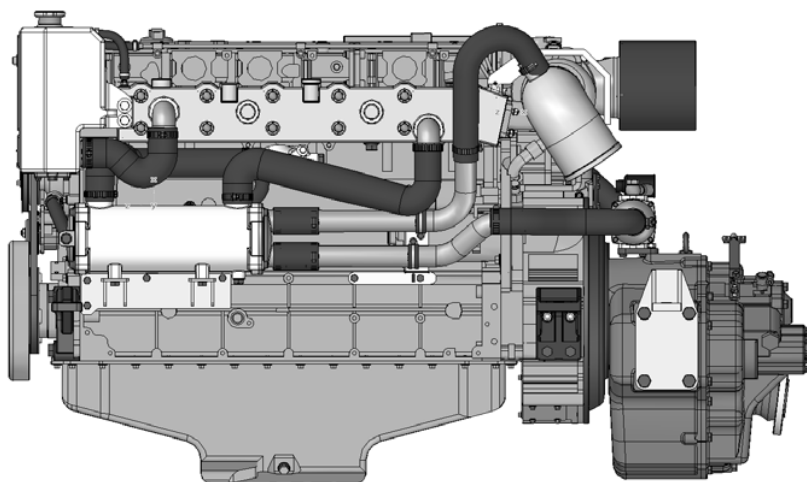


ENGINE INSTRUCTIONS MANUAL

SDZ-165 / SDZ-165G

SDZ-205

SDZ-280



Sole Diesel
MARINE DIESEL ENGINES
MARINE DIESEL GENSETS



This engine instructions manual is also available in the following languages

ENG This operator's manual is available in English. Part no. 03919402.ENG Download from our web page www.solediesel.com or order to oftec@solediesel.com	
SP Este manual de instrucciones puede solicitarse en español. Ref. 03919402.SP Descargar desde nuestra web www.solediesel.com o pedir a través mail oftec@solediesel.com	

"Solé S.A. seeks for the constant improvement of its final products, for that reason the design, description, dimension, configuration and other technical specifications herein, appear just as an informative note that can not be understood as a binding offer referred to the final product. The technical specifications and presentations are subject to variations and modifications without being obliged to proceed with any previous notice".

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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 you use exclusively original spare parts 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 non-original spare parts are utilized, ALL WARRANTY SPECIFICS OF SOLÉ S.A. ARE 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 contact with our nearest official service for any requirements you may have.

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 happy 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.

Deliver 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 USED 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)



PROTECT YOUR EYES (SAFETYGLASSES)



PROTECT RESPIRATORY PASSAGES
(MASK)

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:



DANGER!, (GENERAL DANGERSITUATION
FOR THE SAFETYOF PERSONS AND
PROTECTIONOF THE ENGINE)



DANGER!, (DANGER OFELECTRICAL
DISCHARGES FORTHE SAFETY OF
PERSONS ANDENGINE)



DANGER!, (DANGER FROMSOURCES OF
HEAT FOR THESAFETY OF PERSONS AND
THEENGINE)

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



THE OPERATION INDICATED INTHE TEXT IS
STRICTLYPROHIBITED



IT IS ABSOLUTELYPROHIBITED TO
PERFORMMAINTENANCE WORK IN
THEPRESENCE OF MOVING PARTS



REMOVING OR TAMPERING WITH SAFETY
DEVICES ISSTRICTLY PROHIBITED

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



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

1. GENERAL INFORMACION

1.1 ENGINE MANUFACTURER'S IDENTIFICATION DATA

MANUFACTURER:

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

MODEL:

TRADE DESIGNATION:

SDZ - 165
SDZ - 165G
SDZ - 205
SDZ - 280

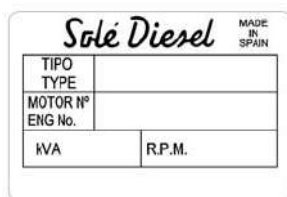


Fig. 1.1a

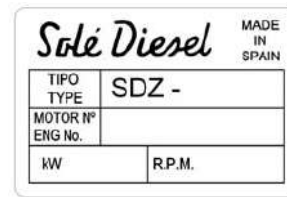


Fig. 1.1b

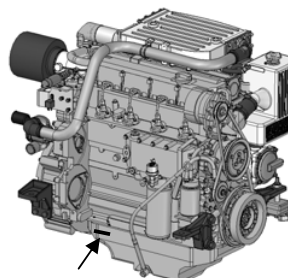


Fig. 1.2

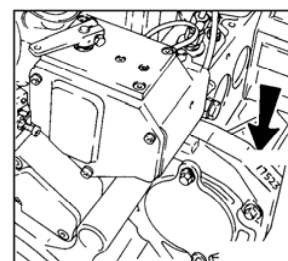


Fig. 1.3.

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

- Check the plaque Fig. 1.1a for genset and the Fig. 1.1b for propulsion engine.
- See the Fig. 1.2 to read the engine identification (see fig. 1.1, detail of the plaque).
- See the fig. 1.3 to read the engine serial number.

1.2 INFORMATION REGARDING TECHNICAL ASSISTANCE AND 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 you use original spare parts.

For WARRANTY terms refer to the WARRANTY MAUAL.

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, chains, bracelets, rings and all other accessories that could become entangled with moving parts..

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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. IS BORNE EXCLUSIVELY BY THE PERSON OR PERSONS WHO CARRY OUT SUCH WORK.

SOLÉ 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 AUTHORIZATION 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 PARTS 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

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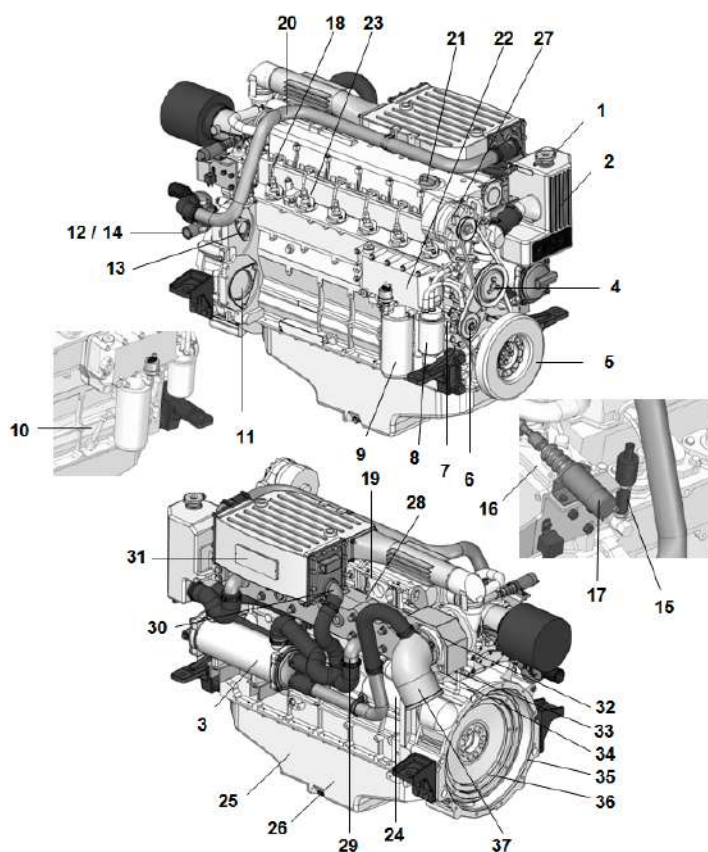
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2. PRELIMINARY INFORMATION ON THE ENGINE

2.1 GENERAL DESCRIPTION

- (1) **Direction of Rotation:** clockwise observing engine from side opposite flywheel. Counter-Clockwise observing engine from flywheel.
- (2) **Timing:** pushrod and rocker arm with gear driven camshaft in crankcase.
- (3) **Air Supply:** air clearing by means of a dry-type air filter. Turbocharger used in all models. SDZ-165, SDZ-165G and SDZ-280 equipped with an intercooler.
- (4) **Fuel System:** equipped with mechanical priming pump.
- (5) **Combustion System:** Direct Injection.
- (6) **Injection Pumps:** Single injection pump for each cylinder integrated in crankcase.
- (7) **Cycle:** diesel 4 stroke. 4 cylinders in-line for SDZ-165 and SDZ-165G and 6 cylinders in-line for model SDZ-205 and SDZ-280.
- (8) **Cooling System:** liquid cooled circulation controlled by centrifugal pump with thermostatic control and heat exchanger. Also, the exhaust manifold is cooled.
- (9) **Lubrication:** forced-feed lubrication by gear-pump.
- (10) **Electrical System:** 24V.



33. Coolant line to turbocharger
35. Flywheel housing (size SAE 3")
37. Elbow, wet exhaust

1. Filler cap for the coolant on the expansion tank
2. Expansion tank
3. Heat exchanger
4. Freshwater pump
5. Vibration damper
6. Fuel feed pump
7. Fuel inlet
8. Fuel filter
9. Lubrication oil filter
10. Oil dipstick
11. Connection power take-off (optional)
12. Seawater pump
13. Plug
14. Inlet seawater pump
15. Fuel overflow valve
16. Governor
17. Stop solenoid
18. Fuel injection line
19. Ventilation line from turbocharger to expansion tank
20. Seawater line to air heat exchanger
21. Oil filler cap
22. Oil cooler, engine
23. Fuel injection pumps
24. Starter motor (4 kW, 28V)
25. Oil sump
26. Oil drain pump
27. Alternator (55 A, 28V)
28. Exhaust manifold
29. Coolant line from charge air cooler to heat exchanger
30. Seawater outlet
31. Charge Air cooler (only model SDZ-165)
32. Turbocharger
33. Coolant line to turbocharger
34. Lubricating line to turbocharger
36. Flywheel (size SAE 11 1/2")

2.2 COOLING CIRCUIT

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2.2.1 COOLING CIRCUIT, COOLANT (Fig. 2.1)



Use anti-freeze as indicated in section 4.2.2 of this manual.

- 1) Expansion tank/coolant pump compensation hose
- 2) "Freshwater" pump.
- 3) Oil cooler (engine)
- 4) Cooling circuit, cylinders
- 4A) Cooling circuit, cylinder head
- 5) Expansion tank
- 6) Exhaust manifold cooled
- 7) Turbo charger
- 8) Heat exchange, anti-freeze
- 9) Pipe, seawater
- 10) Elbow, wet exhaust
- 11) Pipe, inlet freshwater pump
- 12) Thermostat
- 13) Boiler kit (optional)

Thermostat valve operating values:

	All Engines
Start opening at ...	87 °C
Fully opened at ...	102 °C

	CIRCUIT CAPACITY (LIT.)
SDZ – 165	17.5
SDZ– 205	20
SDZ-280	24

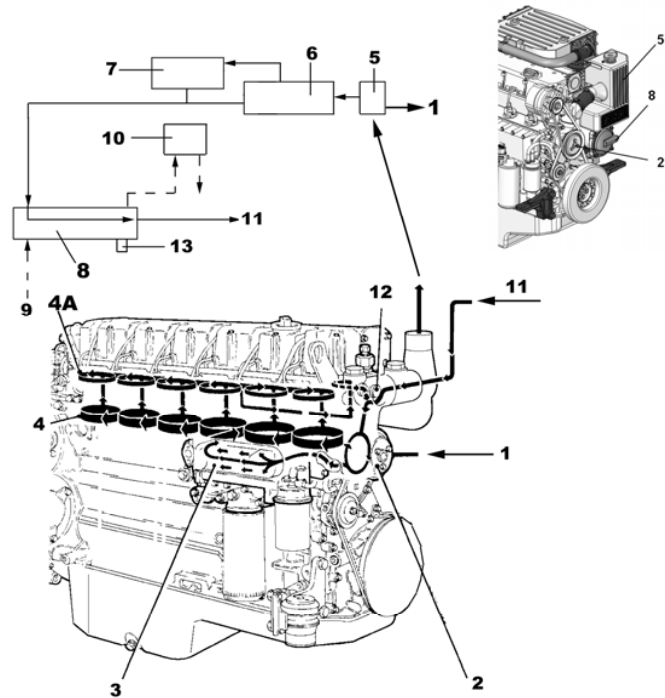


Fig. 2.1

2.2.2 "SEAWATER" COOLINGCIRCUIT (Fig. 2.2)

- 1) Bottom cock
- 2) Intake connection with water filter
- 3) Oil cooler gearbox
- 4) Pipe, inlet seawater pump. For genset connect the inlet seawater Directly to the sea water pump
- 5) Seawater pump
- 6) Intercooler
- 7) Heat Exchange ("freshwater")
- 8) Elbow, wet exhaust

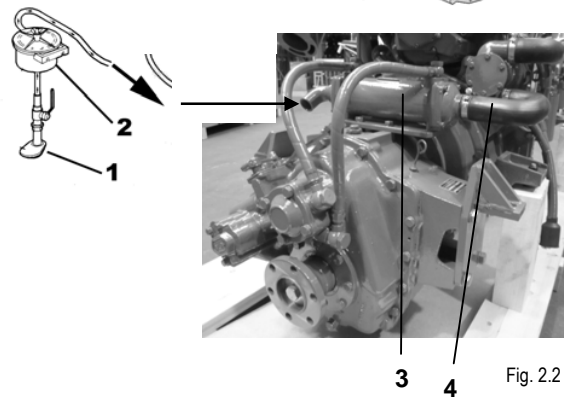
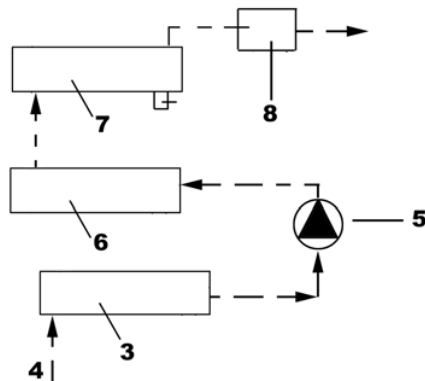


Fig. 2.2

2.3 LUBRICATION CIRCUIT

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2.3.1 ENGINE (Fig 2.3.1)

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.

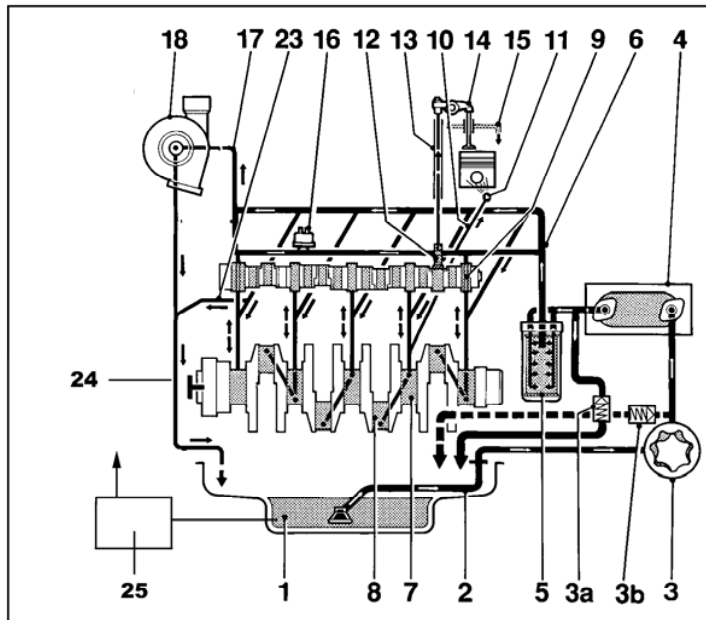


Fig. 2.3.1

- 1) Oil pan
- 2) Scoop
- 3) Oil pump
- 3a) Valve, flow control
- 3b) Valve, maximum pressure
- 4) Oil cooler (engine)
- 5) Oil filter, element
- 6) Oil pipe
- 7) Bearing, crankshaft
- 8) Bearing, connecting rod
- 9) Bearing, camshaft
- 10) Pipe, cooling cylinder
- 11) Pipe, cooling cylinder
- 12) Tappet
- 13) Rod, cooling rocker
- 14) Rocker
- 15) Pipe, to oil pan
- 16) Oil pressure sender

17) Pipe, to turbo charger.

19) Pipe, to compressor or hydraulic pump (optional)

24) Pipe, from turbocharger to oil pan

18) Turbo charger

23) Pipe, to oil pan

25) Pump, oil suction

Oil circuit pressure (with hot engine):

(1) Oil pressure at idling speed = 0.8 kg/cm^2

(2) Oil Pressure at operating speed (1100 rpm or higher) = 4.5 kg/cm^2

ENGINE	OIL CAPACITY (LITERS)
SDZ – 165	10
SDZ – 165G	10
SDZ – 205	21
SDZ-280	21

Engine equipped with Standard oil pan, no engine inclination and with oil filter

2.3.2 GEARBOX



Gearbox has its own lubrication, independent from the engine. See fig. 2.2
Only for propulsion engine

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2.4 FUEL CIRCUIT

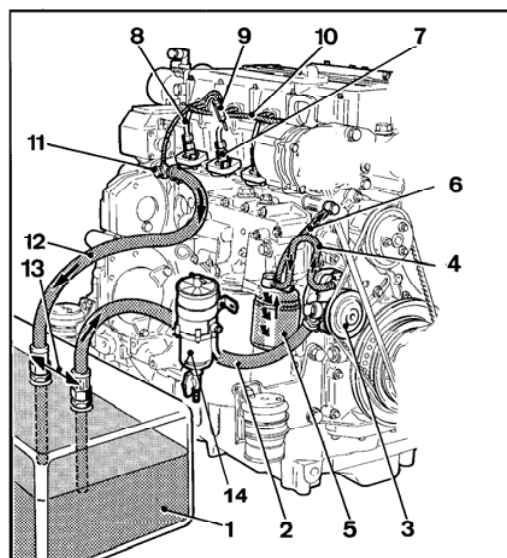


Fig. 2.4

- 1) Fuel tank
- 2) Marine hose fuel (certificated)
- 3) Fuel pump
- 4) Fuel pipe, to fuel filter
- 5) Fuel filter
- 6) Fuel pipe, to the singles injections pumps
- 7) Injections pumps
- 8) Pipe to injectors
- 9) Injectors
- 10) Fuel pipe, return
- 11) Valve
- 12) Marine fuel hose (to the tank)
- 13) Distance between inlet and outlet. It must be bigger
- 14) Fuel filter (water separator).

ENGINE	INJECTORS
SDZ – 165	4
SDZ – 165G	4
SDZ – 205	6
SDZ-280	6

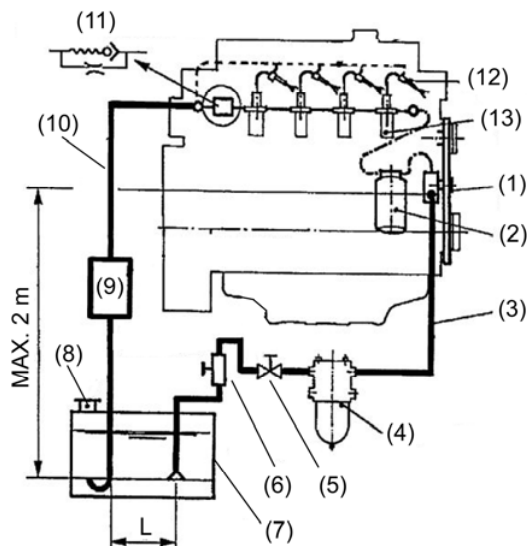


Fig. 2.4

- 1) Fuel pump
- 2) Fuel filter (engine)
- 3) Marine fuel hose. Read the next comment at the bottom of the page.
- 4) Fuel filter (water separator)
- 5) Valve
- 6) Fuel pump, manual. Not supplied (optional, order kit 19424075)
- 7) Fuel tank
- 8) Breather tank
- 9) Fuel cooler** (optional)
- 10) Marine fuel hose, to the tank. Read the next comment at the bottom of the page.
- 11) No-return valve (not supplied)
- 12) Injector
- 13) Fuel pump



Not surpass the 2 m of height between the tank and fuel pump.

The distance L will be the maximum.

For the aspirations and return fuel hose interior diameters (\varnothing) and lengths (L) follow these specifications:

- \varnothing 12 mm when $L < 6$ m
- \varnothing 14 mm when $L < 15$ m
- \varnothing 16 mm when $L < 25$ m

**High pressure injection pumps increase the temperature of fuel. An increase of temperature of 30°C measured between the injection pump inlet and fuel return line may result in a loss of 1.5% of power for each 10°C. Install a fuel cooler of 2-4 kW to reduce this fact. Maximum permissible fuel temperature is 75°C.

2.4.1 INJECTORS

Opening Pressure = 275 bar

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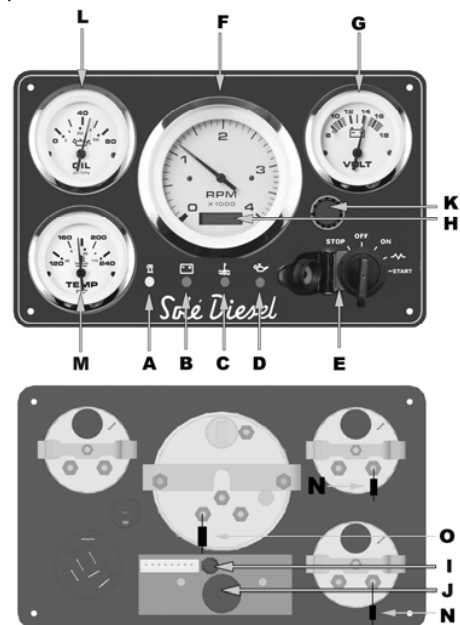
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2.5 ELECTRICAL PLANT

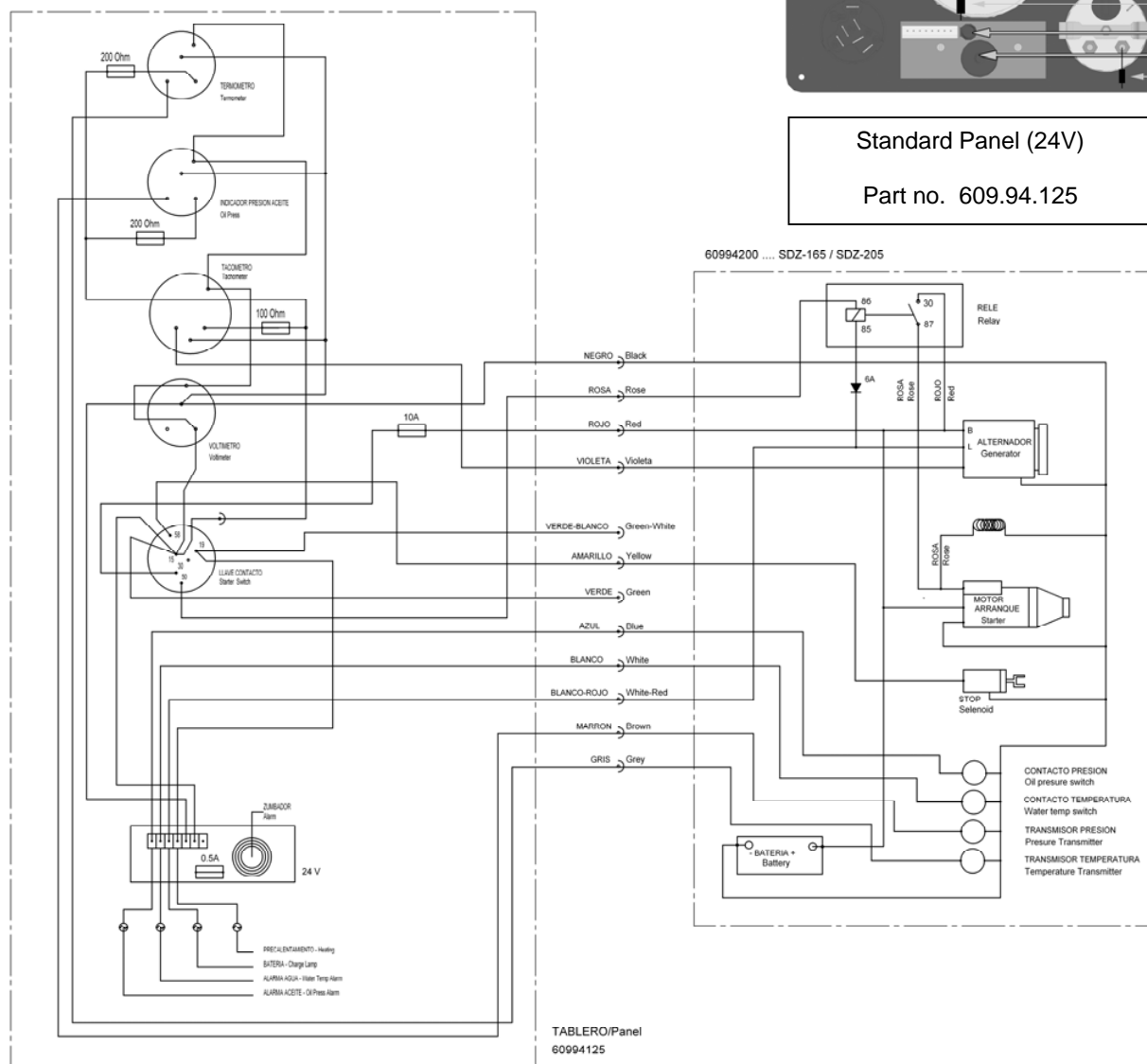
2.5.1 ELECTRICAL PLANT INSTRUMENT PANEL (SDZ-165, SDZ-205, SDZ-280)

	DESCRIPTION
A	GLOW PLUG OPERATION LAMP (not active)
B	BATTERY CHARGE LAMP
C	WATER TEMP. ALARM LAMP
D	OIL PRESSURE ALARM
E	KEY STARTER
F	TACHOMETER
G	VOLTIMETER GAUGE
H	HOUR COUNTER
I	FUSE
J	ALARME
K	FUSE
L	OIL PRESSURE GAUGE
M	COOLANT TEMP. GAUGE
N	RESISTENCE 200 Ω
O	RESISTENCE 100 Ω



Standard Panel (24V)

Part no. 609.94.125



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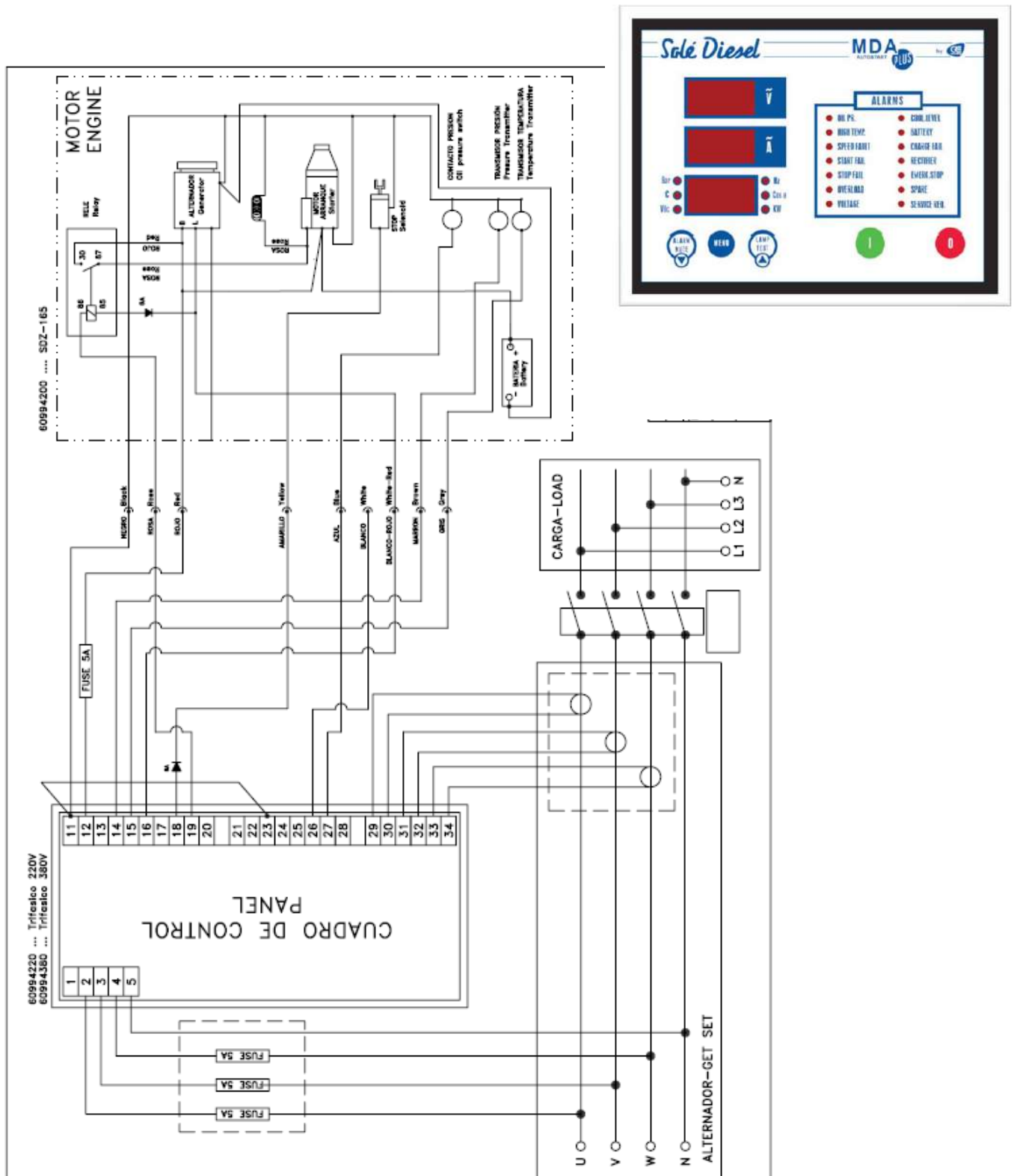
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2.5.2 ELECTRICAL PLANT INSTRUMENT PANEL (SDZ-165G)



Check the panel service manual and the electrical wiring attached with the genset.



2.6 TECHNICAL SPECIFICATIONS

	UNITS	SDZ – 165	SDZ – 205	SDZ – 280	SDZ – 165 (G-71T-15)	SDZ – 165 (G-85T-15)	SDZ – 165 (G-104T-15)
Cylinders Number		4	6	6	4	4	4
Diameter	mm	108	108	108	108	108	108
Bore	mm	130	130	130	130	130	130
Total Displacement	c.c.	4764	7146	7146	4764	4764	4764
Compression Ratio		17.6 : 1	17.6 : 1	17.6 : 1	17.6 : 1	17.6 : 1	17.6 : 1
r.p.m. (idling speed)	r.p.m.	750 ± 5	750 ± 050	750 ± 50	----	----	----
Max. Engine Speed	r.p.m.	2300	2300	2300	1500 ± 25	1500 ± 25	1500 ± 25
Type y Ratio Gear box	TM-170	2.04 : 1 2.5 : 1 2.94 : 1	2.04 : 1 2.5 : 1 2.94 : 1	---			
	TM-170A	2.08 : 1 2.6 : 1	2.08 : 1 2.6 : 1	---			
	TM-265	---	2.09 : 1 2.82 : 1	2.09 : 1 2.82 : 1			
	TM-265A	---	2.09 : 1 2.3 : 1	2.09 : 1 2.3 : 1			
Generator					MeccAlte EC032-3L/4	MeccAlte ECP34-1S	MeccAlte ECP34-2S
Max. continuous working angle	°	10	10	10	---	---	---
Crankshaft Power (1)	kW / CV	118 / 160	145 / 197	200 / 272	87 / 118	87 / 118	87 / 118
Propeller Shaft Power (1)	kW / CV	105 / 144	132 / 180	180 / 245	---	---	---

(1) ISO 8665

Oil Capacity (with filter)	Liters	14	21	21	14	14	14
Oil Capacity (without filter)	Liters	13	20	20	13	13	13
Gearbox oil Capacity (liters)	TM-170	2.5	2.5	----			
	TM-170A	2.5	2.5	----			
	TM-265	----	5.5	5.5			
	TM-265A	----	5.5	5.5			
Min. Oil Pressure (hot engine)	kg/cm ²	0.8	0.8	0.8	0.8	0.8	0.8
Cooling Water Capacity	liters	17.5	20		17.5	17.5	17.5
Injection Pump		BOSCH	BOSCH	BOSCH	BOSCH	BOSCH	BOSCH
Injection Pressure	bar	250 / 275	250 / 275	250 / 275	250 / 275	250 / 275	250 / 275
Ignition Sequence		1-3-4-2	1-5-3-6-2-4	1-5-3-6-2-4	1-3-4-2	1-3-4-2	1-3-4-2
Valve Timing (intake open)							
Valve Clearance - Inlet (cold engine)	mm	0.3	0.3	0.3	0.3	0.3	0.3
Valve Clearance - Outlet (cold engine)	mm	0.5	0.5	0.5	0.5	0.5	0.5
Weight Dry with Gearbox (kg)	TM-170	698	818				
	TM-170A	698	818				
	TM-265	808	928				
	TM-265A	808	928				
	G71T15				978		
	G84T15					1015	
	G104T15						1125
Weight Dry, bobtail version	(kg)	617	737		617	617	617

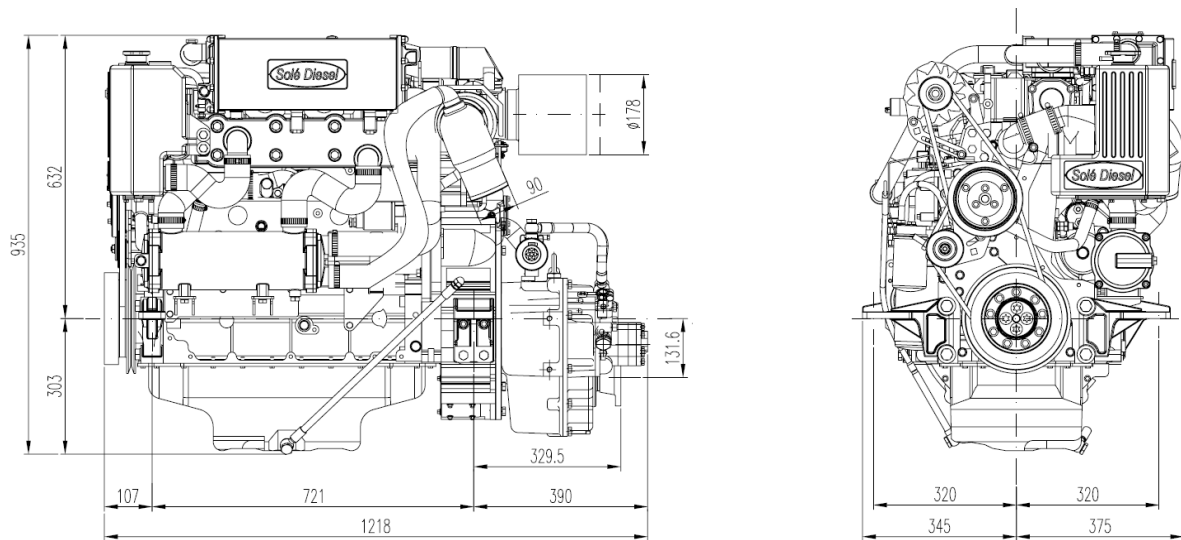
Sole Diesel

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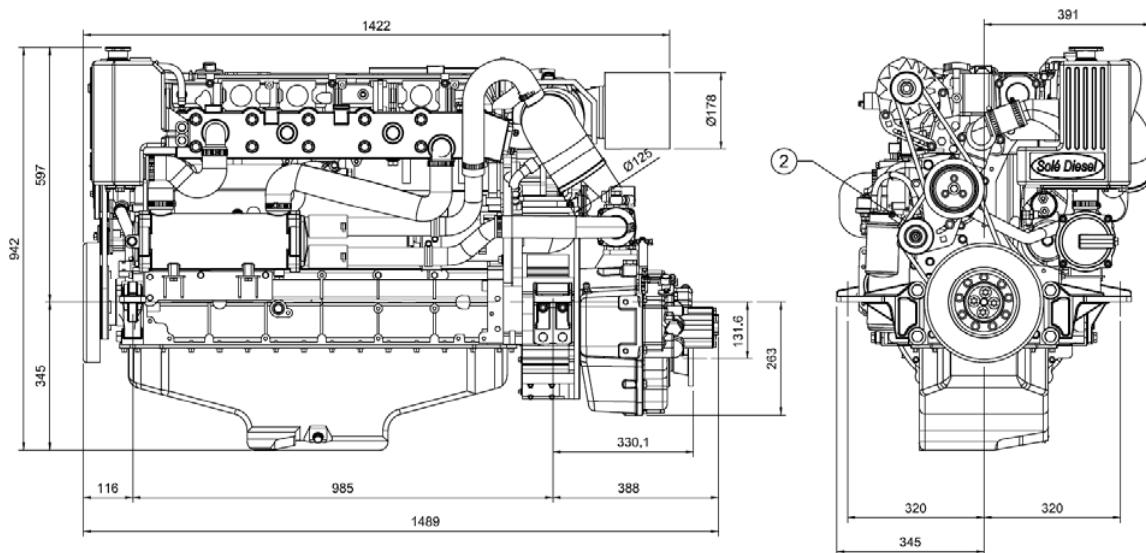
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2.6.1 ENGINE DIMENSIONS

SDZ165 + TM170

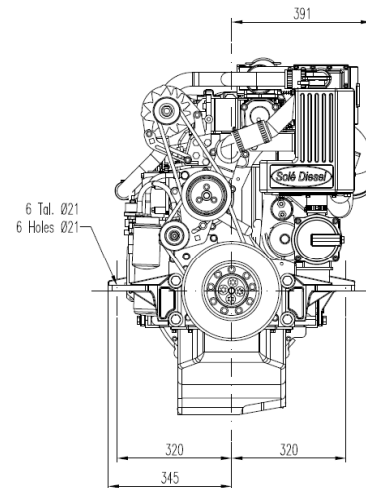
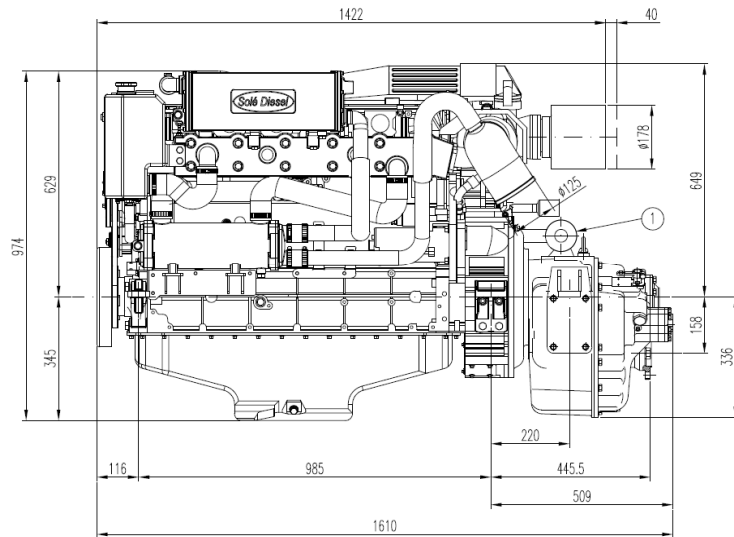


SDZ205 + TM170

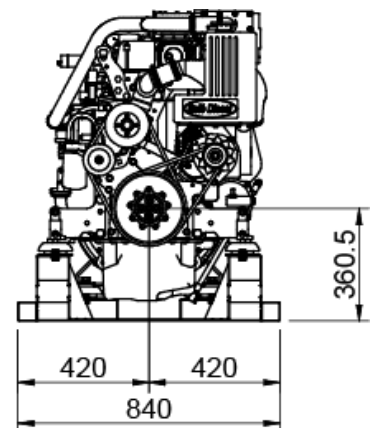
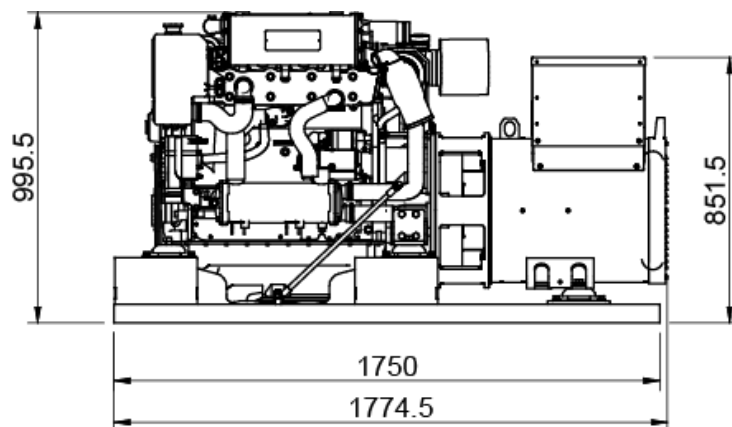


- (1) Hose, Inlet seawater pump (ØInt 42mm).
- (2) Hose, Inlet fuel pump (ØInt 12mm).
- (3) Hose, return fuel pump (ØInt 12mm).

SDZ280 + TM265



2.6.2 GENSET DIMENSIONS.



2.7 GEARBOX (PROPULSION ENGINE) AND GENERATOR (GENSET VERSION)

Check specific manuals for these parts.

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.	Max. 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 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 due to transport. Have the transport company delivery note and inform SOLE S.A.,

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 in question.

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.

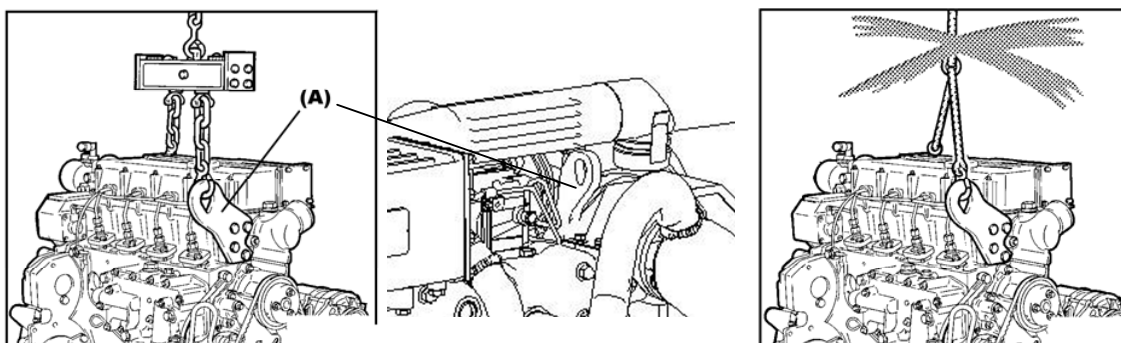


Fig. 3.4

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

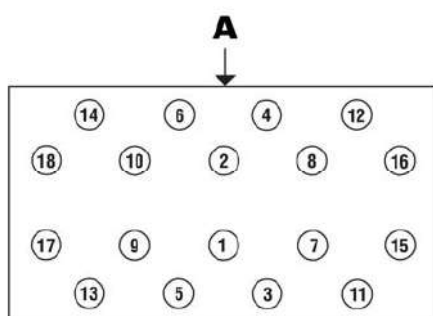
PARES DE APRIETE	(kgf · m)				
	SDZ-165 SDZ-165G	SDZ-205 SDZ-280			
Bolt, cylinder head	13	13			
Bolt, crankshaft pulley	4 – 5	4 - 5	1 st retightening angle 60°, 2 nd angle 30° (60 mm long bolts) 60° (80 mm long bolts)		
Bolt, metal cap	5	5			
Bolt, connecting rod	3	3	For the Connecting Rod Bolts, please read the comment (1) and for the Flywheel bolts, please read the comment (2).		
Bolts, Flywheel (length 30-45 mm)	2 – 3	2 - 3			
Bolts, Flywheel (length 50-85 mm)	3 - 4	3 - 4			
Plug, oil pan	5	5			
Oil filter	1.5	1.5			
Pressure relief valve	4 – 5	4 - 5			
Bolts to fix the Flange injections pumps	5	5			
Glow Plugs	2	2			
Bolt, Stop solenoid	2.1	2.1			
Nut for B terminal of starter	1.1	1.1			
Bolts, reversing gear flange set	12.0	12.0			
Water cooler element locknut	2.3	2.3			
Reversing gear body set screw	5	5			
Oil gearbox drain plug	3.5	3.5			
General tightening torque	M6 1.0 M8 2.5 M10 ... 6.0 M12 ... 10.0	M6 1.0 M8 2.5 M10 ... 6.0 M12 ... 10.0			

Comments:

- (1) 1st tightening angle = 60° // 2nd tightening angle bolts = 60°
- (2) 1st tightening angle bolts 30-85 mm length = 60°
 2nd tightening angle bolts 30mm length = 30° // 2nd tightening angle bolts 35-85mm length = 60°
 Bolts may be used **5x** if evidence can be furnished concerning their use

CYLINDER HEAD BOLTS TIGHTENING SEQUENCE:

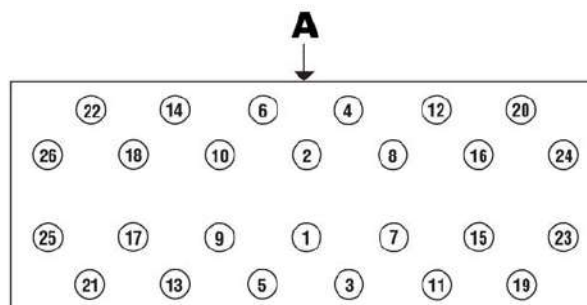
When bolting the cylinder head, clean thoroughly the contact faces and fit the head gasket. Retighten one screw at a time when engine is cold as indicated in the suitable drawing. Loosen must be done using the reverse sequence.



SDZ-165

A = Manifold side

Tightening torque, 1st stage = 50 Nm
 Tightening torque, 2nd stage = 130 Nm
 Tightening angle = 90°



SDZ - 205 / SDZ-280

Cylinder head bolts may be used max. 5 times. If evidence can be furnished concerning their use.

Tighten M8 bolt with a torque of 21 Nm.

Sole Diesel

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4.2 ENGINE SUPPLIES

The engine does not come with its circuits filled with the applicable fluids.

4.2.1 CHANGING OIL

4.2.1.1 CHANGING ENGINE SUMP OIL

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

The oil must be changed with warmed engine, in order to ensure that is emptied. The temperature of the oil will be approximately 80 °C. Stop the engine before doing the oil change.

This operation is done by oil drain pump (see Fig 4.1). Dismount the plug (A) and fit the hand oil pump. Connect a hose from the oil drain pump to a container. Process the old oil in accordance with the local regulations.

When drained, fill with new oil through the filling hole. (Fig. 4.2).

Oil 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 oil dipstick (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 dipstick mark.

The oil level must be between the mark MIN and MAX.

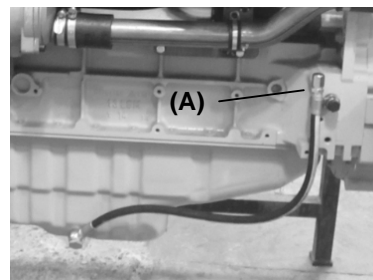


Fig. 4.1

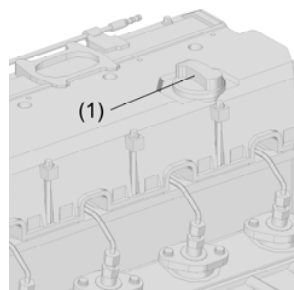


Fig. 4.2

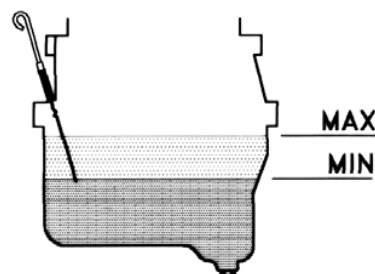


Fig. 4.3



WARNING

The level of oil never to being below the mark MIN of the oil dipstick.

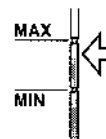


Fig. 4.4



Note that dipstick marks refer to the engine at a horizontal position. Therefore, check the engine inclination when the level is verified.

If the engine is fitted inclined, the marks must be modified. Read the technical annexes to modify the marks. Read the technical specifications to the MAX inclination (page 10).

4.2.1.2 CHANGING GEARBOX OIL

Gearbox has its own lubrication, independent from the engine.



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 utilized to fill the various circuits on the engine

Open de valve (plug) to clean the air (possible air bubbles) during this process.

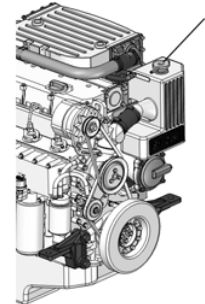
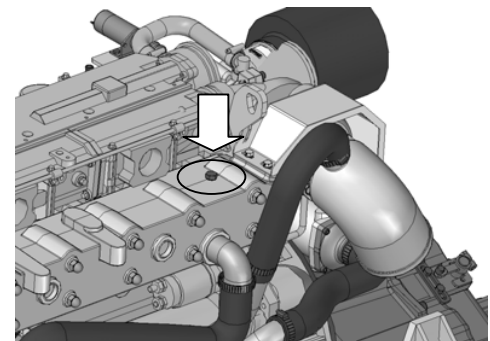


Fig. 4.2.2



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:

Ant freezing liquid concentration (%)	30	40	50	60
Freezing temperature (°C)	-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 normal operation for 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). Read the chapter 7.2 for draining circuit instructions.

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



Warning!

Never open the oil plug (1) when the engine is hot as it can release steam or splashes of hot coolant. Stop the engine and wait until it gets cold to do the coolant change. See fig 4.2.2.



Warning!

After the first 50 hours of engine duty and thereafter at six months or 1000 hours intervals, add rust inhibiting agent AC88 to the coolant in the same proportions as indicated in the table from section 4.2.2. The cooling liquid mixture must be totally drained and replaced every 2 years



Warning!

To use refrigeration liquid that does not match the technical specifications causes damage to the components of the engine, determining the cancellation of the warranty.

4.2.3 REFUELING

Use clean, filtered gas oil of ASTM D 975-88 quality. 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 user 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.** Read the page n°8 to the oil capacity
- (b) **FILLING WITH COOLANT.** Read the page n° 7 to the coolant capacity.
- (c) **REFUELING.** Read the page n° 17. (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 (only for propulsion engine)**

(f.a) Engine control remote connection

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 (Fig. 5.1)

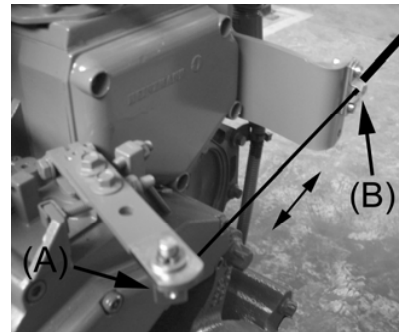


Fig. 5.1

(f.b) Gearbox control remote connection.

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.

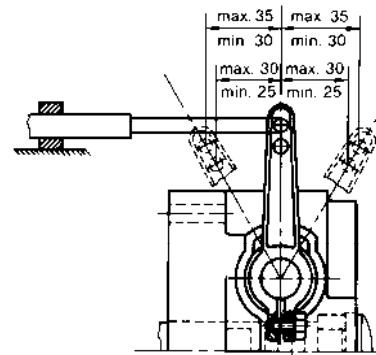


Fig. 5.2

(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 that fuel intake valve located at the tank is open.
- (2) Place a recipient under the fuel return valve (B), remove the plastic cap from the pipe.
- (3) Press, several times, the manual fuel feed pump (A), until the fuel bleeds without air bubbles from fuel return valve (B).
- (4) Connect the fuel return line to the fuel tank
- (5) Start the engine and make sure there are no leaks.

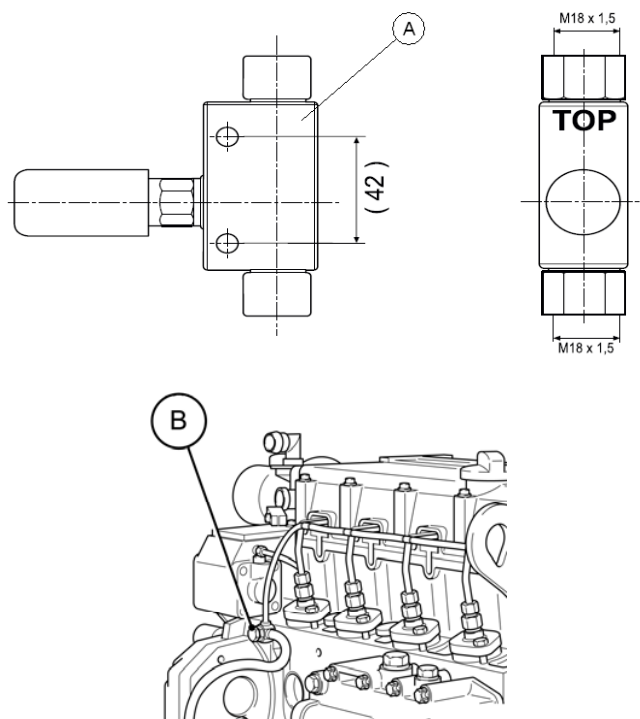


Fig. 5.3



Warning!!
Protect hands. The 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, which 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 is to 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 the working life time 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

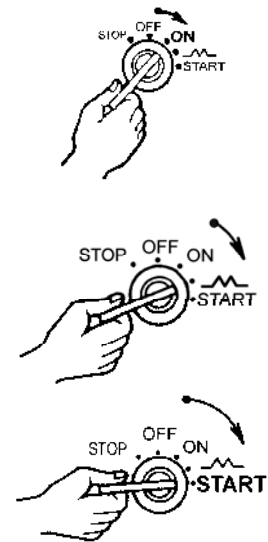
Refer to heading 1.3 for safety information.

6.1 STARTING and STOP (for propulsion engine)

STARTING



- 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.**
This engine is design with a direct injection system. This function is cancelled. Turn the key directly to Start position.
- 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.



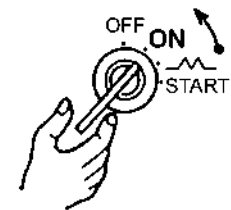
Warning!
Do not run the starter motor for more than 20 seconds at a time

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. In this case, directly rotate the ignition key to the "START" position until the engine is running.

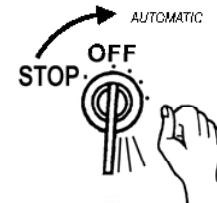


STOP

Allow to run at low speed for 4 or 5 minutes and place the gearbox remote control lever in the neutral position. Turn the starter key to "STOP". The stop solenoid will be actuated and the engine stops.

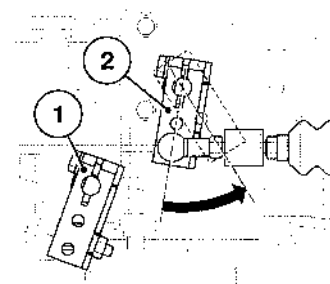
Maintain this position until the engine is fully stopped. With the engine stopped the starter key returns to "OFF" position automatically.

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.



STOPPING THE ENGINE (not using the mechanical system)

Locate the handle of adjustment of revolutions (1) in low speed of turn. Using the hand, drive the handle of shutdown (2) in direction of shoots with an arrow until the engine pauses. Once unemployed the engine, ignites the lights witness of current of load and oil pressure. This method only must use in case exceptional. Use the panel to stop the engine.



To turn the key towards position OFF and to remove it. The lights switch off.

6.2 STARTING and STOP (for GENSET)

Check the Service Manual Panel. Read the chapter written before to stop the gen set not using mechanical system.

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 SOLÉ DIESEL.

6.4 OPERATING THE ENGINE AT LOW TREMPERATURES

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 group 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) Remove the nozzle supports and clean them. If possible, verify the setting of the nozzles at a workshop. Turn the engine without nozzles, using the starter motor, to eliminate the rust inhibitor oil used in the winter. Then install the clean nozzles.
- (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

	Inspection Item	Intervals							Winter storage and Preservation
		Daily	1st 20h-50h	Every 250h	Every 500h	Every 1000h	Every year	Every 2 years	
General	Screw tightening, fastening.		I		I				
	Engine block.								CL
	Valve clearance.				I				
	Exhaust gas, noise and vibrations.	I							
	Compression pressure.					I			
Lubrication System*	Engine oil.	I	C	C			C		C
	Inverter oil (if applicable).	I	C			C	C		C
	Oil filter.		C	C					C
Fuel System	Fuel level.	I							
	Fuel tank.					I		CL	E/CL/I
	Fuel filter (engine).					C			
	Water separator filter (if applicable).		I/E	I/E		C			
	Injection pump.					I			
	Injector.					I			
	Power system bleeding.							I	
Intake System	Air filter.		I	I		C			I
Cooling System	Coolant.	I						C	C
	Salt water circuit.								I/CL
	Water filter.	I	I/CL	I/CL					
	Sea water cock.	I							
	Salt water pump impeller.		I/C		I	C			I/CL
	Zinc anode (if applicable).		I/C	I/C					

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03919402.ENG rev. 0

Electrical System	Instruments.	I	I							
	Incandescent spark plug.				I					
	Starter motor and alternator.				I					
	Alternator belt and tension.		I		I			C		I
	Battery level.		I	I		C				

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

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

EXHAUST PROTECTIONS
Check the protections following the manufacturer comments. For the air vent, in case of blocked passages, disassemble the valves clean with freshwater, and spray with silicone before reassembling the unit

7.2 OPERATIONS DESCRIPTION

(1) Change engine and gearbox oil:

Read heading 4.2.1.

(2) Change oil filter (Fig. 7.2.2):

See the page n°5 to find the filter on the engine.

Change the oil filter after the firsts 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.

(3) Checking valve clearance (see x in Fig. 7.2.2.1)

Do these operations in an authorized Sole Diesel Service. Before adjusting valve clearance, allow the engine to cool for at least 30 minutes. The oil temperature should be below 80°C.

CHECK VALVE CLAREANCE (WITHOUT PRESSURE WASHER)

SOME ENGINES MAY NOT HAVE ELEMENT NUM. 4 OF Fig. 7.2.2.1. THE PROCEDURE IN THIS CASE IS DESCRIBED BELOW

- Loosen ventilation valve and swing it to the side.
- Remove the cylinder head cover.
- Position crankshaft as in the figures 7.2.3. Check valve clearance of the cylinders marked in **black**.
- Check valve clearance (x) between rocker arm and tappet contact face with a gage (6). There should only be slight resistance when feeler blade is inserted. The valve clearances are the followings:

Valve clearance, inlet valve: 0.3mm

Valve clearance, exhaust valve: 0.5mm

ADJUST VALVE CLAREANCE

- Release locknut (2)
- Regulate the adjustment screw (1) by using a screwdriver (7) so that after tightening the locknut, correct valve clearance (1) is achieved.
- Check and adjust the valve clearance on all remaining cylinders.
- Reinstall cylinder head with a new gasket if is necessary.
- Swing ventilation valve into position and fasten.

CRANKSHAFT – POSITION 1

Turn crankshaft until both valves in cylinder n°. 1 overlap (exhaust valve about to close, inlet valve about to open). Adjust clearance of valves **marked in black** on photo 7.2.3. Mark respective rocker arm with chalk to show that adjustment has been carried out

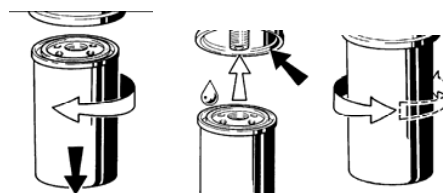


Fig. 7.2.2

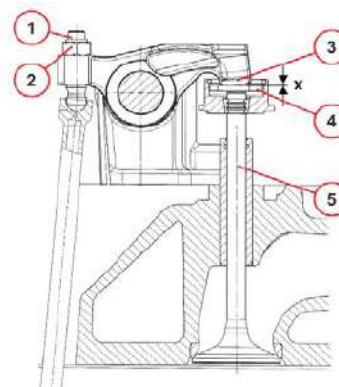


Fig. 7.2.2.1

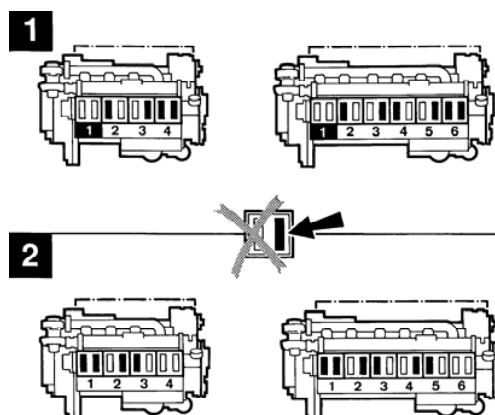
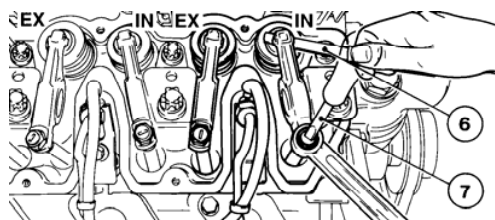


Fig. 7.2.3

CRANKSHAFT – POSITION 2

Turn crankshaft one full revolution (360°). Adjust clearance of valve **marked in black** on photo 7.2.3.

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) Checking valve clearance (WITH PRESSURE WASHER)

FOR ENGINES WITH ELEMENT NUM. 4 OF Fig. 7.2.2.1.

- (1) Loosen ventilation valve and swing it to the side.
- (2) Remove the cylinder head cover.
- (3) Do these operations in an authorized Sole Diesel Service. Before adjusting valve clearance, allow the engine to cool for at least 30 minutes. The oil temperature should be below 80°C.
- (4) Turn crankshaft until both valves in cylinder n° 1 overlap (exhaust valve about to open).
- (5) Locate the crankshaft as showed in the photo 7.2.3. Check valve clearance of the cylinders marked in **black**.
- (6) If is necessary to adjust the clearance, do as the following (see photo 7.2.3 at the top):

(a) Release locknut (2)

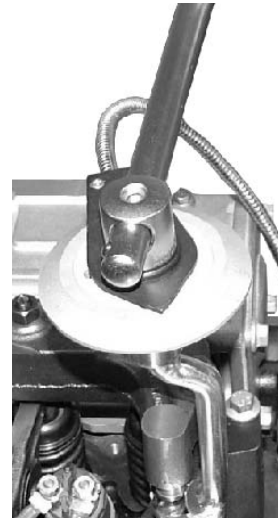


Fig. 7.2.4

- (b) Fix the tool (Fig. 7.2.4) on the adjustment screw (1) and adjust the clearance as follows:
 - Fix the magnet.
 - Turn rotating disk of the tool (7.2.4) until there is no clearance. Turn 90°/150° back depending on the valve, see specifications below:
 - IN = Inlet valve = 90°
 - EX = Exhaust valve = 150°
 - tighten the locknut (2), using a torque tool (torque 20 Nm).
- (c) Repeat the check and adjust the clearance in every cylinder.
- (d) Reinstall cylinder head with a new gasket if is necessary.
- (e) Swing ventilation valve into position and fasten.

(5) 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

$$T = 15 \text{ mm}$$

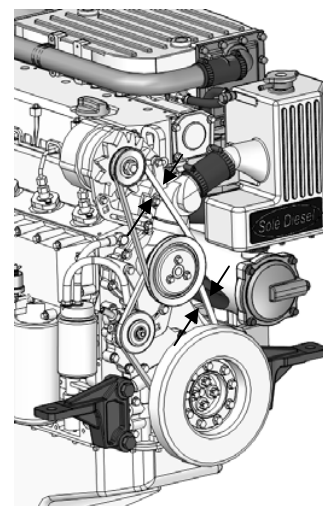


Fig. 7.2.5

(6) **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.

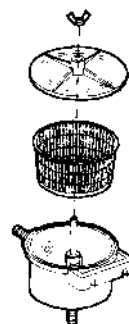


Fig. 7.2.6

(7) **Coolant circuit. Drain.**

Drain off all the circuit coolant opening the drain cocks (in the block and in the body heat exchange). See the photo 7.2.7.

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).

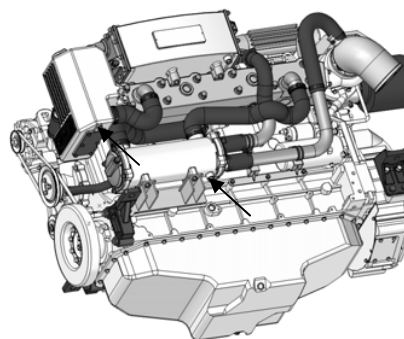


Fig. 7.2.7

(8) **Checking battery electrolyte level and charge**

Batteries require a very careful handling and frequent checks. 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.

(9) **Fuel decanting filter drain and cleaning (supplied as accessory)**

- (1) Close the fuel inlet cock.
- (2) Loosen the bleeding screw (7) and let the fuel bleed.
- (3) Unscrew (left handed) the filter armor (4) with o-ring (3) and retire it.
- (4) Clean all the elements and specially the sedimentation chamber (5). Change the filter if necessary.
- (5) Mount the elements again. Tighten the filter armor at 2.5 kgf-m max.

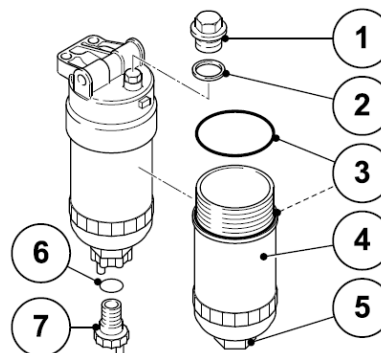


Fig. 7.2.9

(10) **Replace the fuel filter element (engine) and purge the circuit**

See the page nº5 to locate the filter. The fuel filter is closed and cannot be cleaned. It must be replaced at least once every 12 months. To perform the filter change:

Close the inlet cock located at the fuel tank. Unscrew cover filter with a chain spanner. Screw the new filter to the cover with the hand and replace the rubber seals. **Carry out the operations at heading 5.1.1 bleeding air from the fuel system.**

(11) **Injector checking**

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

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

The anti-corrosion protection is not fitted in these engines. The parts of the seawater cooling system are made with materials that protect the cooling system.

(13) **Change air filter**

The engine is provided with an intake air filter. The filter CAN NOT be cleaned, it must be changed. Read the heading 7.1.

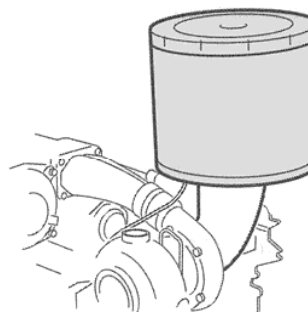


Fig. 7.2.13

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

The engine has an alternator of 28V and 55 Amps, according to the model, 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) **Compression pressure checking.**

Connect compression tester. Crank engine with starter motor. Compression pressure: **30-38 bar**.

The measured compression pressure is dependent on the starting speed during the measuring process and also on the altitude of the engine site. Therefore it is difficult to specify precise limit values. It is recommended to use the compression pressure measurement only for comparison of compression pressures of all cylinders in one engine. If a difference of pressure in excess of **15%** between cylinders is determined, the cylinder unit concerned should be dismantled to establish the cause.

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

Impeller is made of 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. 7.2.14). 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.

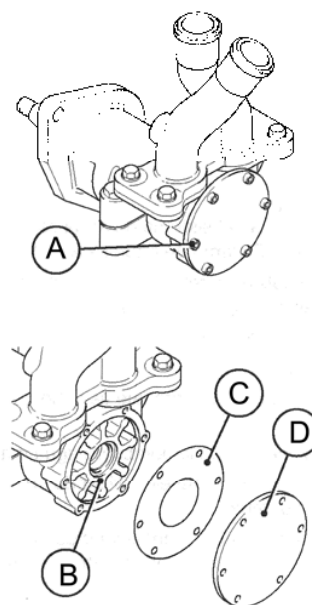
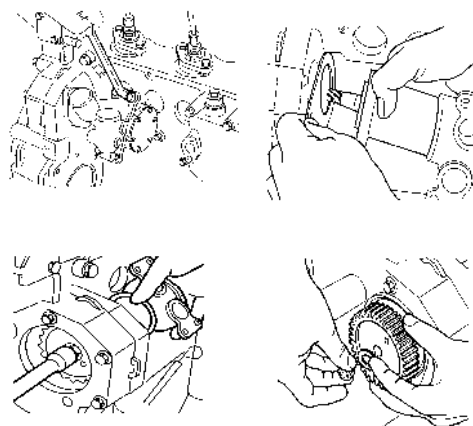


Fig. 7.2.14

Seawater pump. Removal and reassembly

Drain the water from the seawater system. Remove the pipes from the seawater pump. Remove the gear rear cover. Remove the screw cap. Loosen the hex nut from gear of sea water pump. Loosen bolts on seawater pump. Loosen gear from pump shaft by using a plastic hammer.

Install the seawater pump with a new gasket (if is necessary). Fit the gear with a new hex nut. Pay attention that key is fitted. The cones of the gear and the shaft must be free from lubricant, clean and without damage. Fit the screw cap with a new O-ring. Fit the connecting socket with a new gasket. Install the coolant pipes to and from the seawater pump.



(17) **Replace the belts (alternator and fuel pump)**

Slacken V-belt to allow removal (see photo 7.2.17).

Fuel Pump. To adjust the belts, loosen the screws (1) and (2). Push the fuel pump (3) to the left until the belt is correctly tensioned. Tighten the screws.

To change the belts. Loosen screws (1) and (2). Push the fuel pump (3) to the right. Remove the belt and replace it with a new one. Push the fuel pump (3) to the left until the belt is correctly tensioned. Tighten the screws.

Alternator. To adjust, loosen the screw (2). Push the alternator belt pulley (1) to the right until the belt is correctly tensioned. Tighten the screws.

To change the belt. Remove the belt for the fuel pump. Loosen the screw (2). Push the alternator belt pulley (1) to the left and remove the belt. Replace it with a new one. Push the alternator belt pulley (1) to the right until the correct belt tension. Tighten the screw (2).

When the belt is dismantled, 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 as previously explained.

⚠ Always change a belt that appears worn or is cracked. Belts working in pairs must be replaced together.

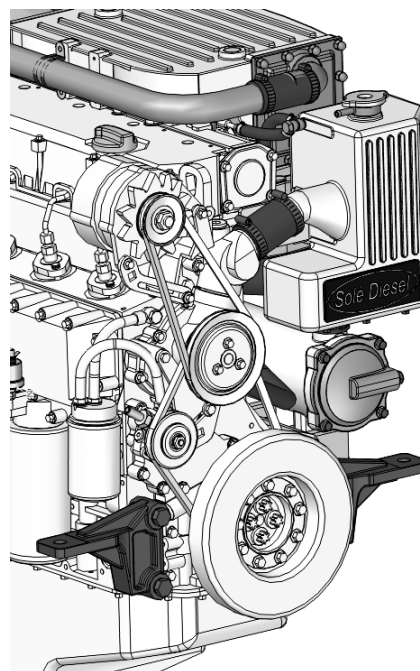
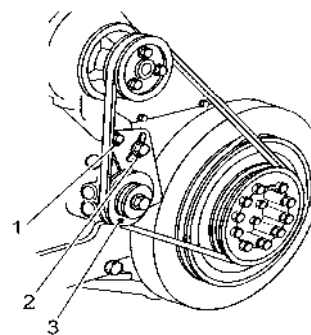


Fig. 7.2.17

(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. Said adjustment, whenever is required, shall be made by a SOLÉ DIESEL licensed service shop, since precision pump monitor and skill knowledge are required.

(19) **Fuse.**

A fuse of 10A is used to protect control panel's instruments. In case the switchboard does not receive power supply check if the fuse is burnt and replace it.

(20) Checking and cleaning turbocharger

To extend turbocharger life and efficiency, some basically important instructions are given below:

(1) Possible causes of turbocharger damaging are essentially three:

a) Lack of lubricant: causes bearing failure with consequent seizure of rotary components.

b) Introduction of external matter: poor servicing of air cleaner will involve the introduction of solid particles which will damage the compressor-impeller blades. Fragments would be carried to the cylinders.

c) Lubricant contamination: this causes scoring of journal bearings, clogs oil passages, wears the seals, with consequent leakages and seizures.

(2) Turbocharger construction simplicity is only apparent: in fact many of its parts are machined to 1/1000 mm tolerances. It is therefore recommended that you entrust any servicing to skilled personnel having availability of special equipment provided by the Sole Diesel service network.

(3) Preventive maintenance will extend the life and efficiency of turbochargers. Watch for loss of lubricant, vibrations or abnormal noises, stop engine immediately. Timely servicing will avoid costly and unexpected repairs.

(4) When the turbocharger is not working properly or for preventive overhaul proceed as follows:

(a) Loosen the ventilation pipe (1) from the air intake (2) and remove the air filter together with the air intake.

(b) Loosen the screws on the compressor housing (3) and remove it carefully.

(c) Immerse complete assy in petrol (gasoline) until all dirt is dissolved.

(d) Clean the housing and compressor wheel (4) from soot, by using a plastic brush or scraper.

(e) Wipe and dry in air making sure that the oil ducts are perfectly clean. (It is better not to use steam which might damage the bearings and the shaft).

(f) Make sure that the intake filter is perfectly clean.

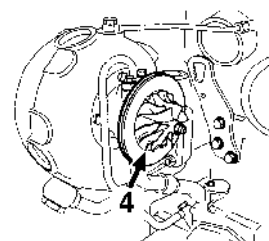
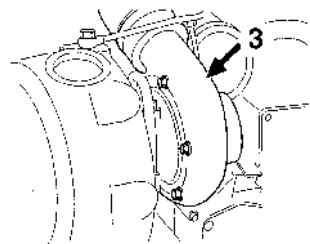
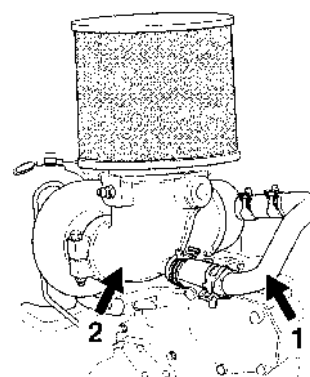


Fig. 7.2.20

NOTE: Every time turbocharger is disassembled and before starting it, make sure to impregnate it with engine oil to prevent damage due to dry running.



Warning!

for better lubrication of the turbocharger we advice to let the engine run at idling speed without load during 30 seconds after starting and 3 minutes before stopping

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.

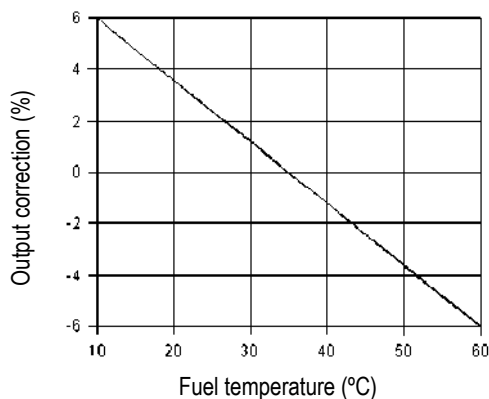
8.2 DERATING OF ENGINE DUE TO FUEL AND COMBUSTION PROPERTIES

FUEL PROPERTIES - Output correction due to fuel properties.

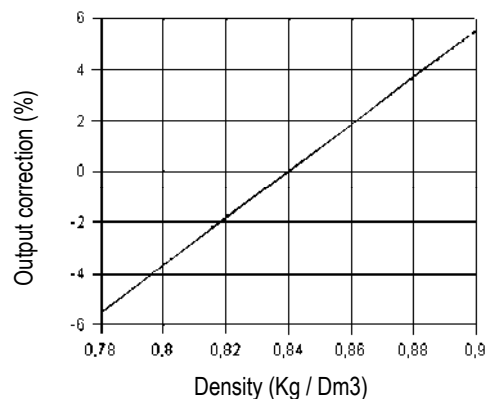
Specified outputs presuppose the following fuel properties (as per ISO 3046):

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

If the fuel derives 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%)



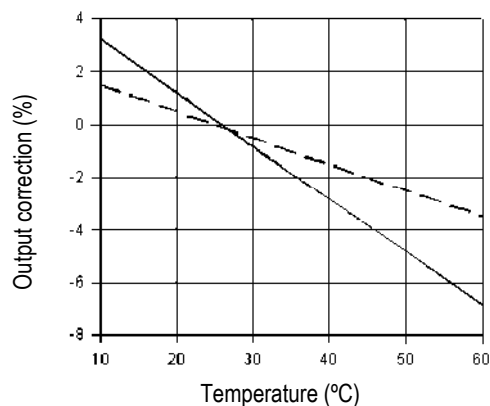
Graph 2
Effect of fuel density on engine output. Normal value is 0.84 Kg/dm³ at +15°C (0%)

AIR PROPERTIES - Output correction due to air properties.

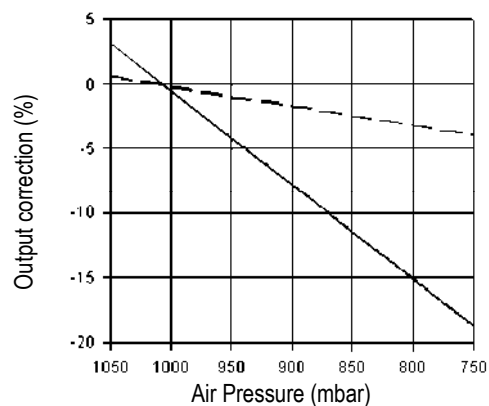
Specified outputs presuppose the following air properties (as per ISO 3046):

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. Its 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/CH-4/SG
MIL-L-2104 E
CCMC D4/G4/P



9.0.2 GEARBOX OIL

Check the gearbox service manual.

9.1 ESPECIFICACIONES FOR ENGINE INSTALLATION

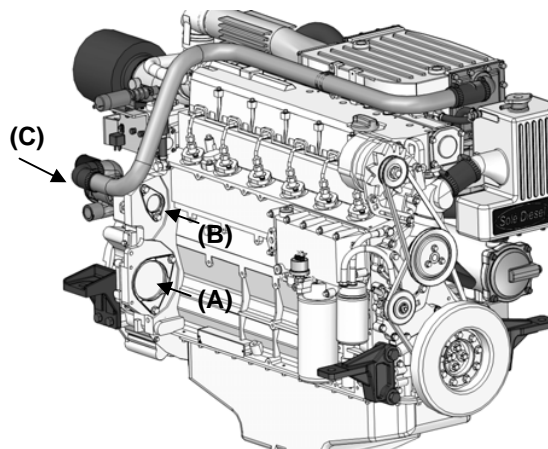
ENGINE	SUPERFICIE MÍNIMA ENTRADA AIRE ASPIRACIÓN	AIR ADMISSION DISPLACEMENT (1)	ØINT EXHAUST HOSE (2)	BATTERY (24V)	CABLE TO BATTERY LENGTH (m)	MINIMAL SECTION CABLE TO BATTERY	Ø INT. FUEL HOSE FROM TANK TO PRIMING PUMP (mm)	Ø INT. FUEL HOSE FROM INJECTION PUMP TO THE TANK (mm)
SD – 165		650 – 700 m³/h	90	160 Ah	≤ 1.5	50 mm²	12	12
SD – 205		1100 – 1200 m³/h	125	160 Ah	≤ 5	70 mm²	12	12

(1) Max. r.p.m.

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

9.2 POWER TAKE-OFF ESPECIFICACIONES (OPTIONALS).

	(A)	(B)	(C)
Ratio (r)	1 : 1.116	1 : 1.297	1 : 1.297
	$\eta_{\text{power take-off}} = 1.1297 \times \eta_{\text{engine}}$		
Rotation	Non-Clockwise Left	Non-Clockwise Left	Clockwise
MAX. OUTPUT	50 kW 187 Nm	20 kW 64.5 Nm	20 kW 64.5



Warning!

Values must be expired: **B + C = 20 kW , 64.5 Nm**

A + B + C = 50 kW, 187 Nm

**If B = C = 0 kW => A = 50 kW (it's depending connection). Contact to
Technical department SoleDiesel.**

Sole Diesel

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MARINE DIESEL ENGINES MARINE DIESEL GENSETS

SOLE S.A.

Ctra. Martorell a Gelida km. 2
08760 Martorell
Barcelona - Spain

Tel. (+34) 93 775 14 00
Fax. (+34) 93 775 30 13

e-mail: sole@solediesel.com
www.solediesel.com



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