LDW FOCS LDW FOCS
502 | 702 | 1003 | 1404 M

OWNER MANUAL

LOMBARDINI
BY KOHLER MARINE

Registration of modifications to the document

Any modifications to this document must be registered by the drafting body, by completing the following table.

Released by	Document code	Model n°	Revision	Issue date	Review date	Edited by	Endorsed
Technical Documentation	ED0053031080	51427	03	02/2018	07/2021	Technical Documentation	

TRANSLATED FROM THE ORIGINAL MANUAL IN ITALIAN LANGUAGE.

Data reported in this issue can be modified at any time by Lombardini Marine.

Important

• Connect to **http://iservice.lombardini.it** and download the latest version of this manual onto your device.

NOTA: you can select the desired language before downloading the manual, as shown in the figure below.

1.1 Manual's purpose

- This manual contains the instructions needed to carry out proper use and maintenance of the engine, therefore it must always be available, for future reference when required.
- This manual is an integral part of the engine, in the event of transfer or sale, it must be attached to it.
- Safety pictograms can be found on the engine and it is the operator's responsibility to keep them in a perfectly visible place and replace them when they are no longer legible.
- Information, description and pictures in this manual reflect the state of the art at the time of the marketing of engine.
- However, development on the engines is continuous. Therefore, the information within this manual is subject to change without notice and without obligation.
- Lombardini Marine reserves the right to make, at any time, changes in the engines for technical or commercial reasons.
- These changes do not require Lombardini Marine to intervene on the marketed production up to that time and not to consider this manual as inappropriate.
- Any additional section that Lombardini Marine will deem necessary to supply some time after the main text shall be kept together with the manual and considered as an integral part of it.
- The information contained within this manual is the sole property of Lombardini Marine. As such, no reproduction or replication in whole or part is allowed without the express written permission of Lombardini Marine.

1.2 Glossary and definitions

The paragraphs, tables and figure are divided into chapter with their progressive numbers.

Ex:

Par. 2.3 - chapter 2 paragraph 3.
Tab. 3.4 - chapter 3 table 4.
Fig. 5.5 - chapter 5 figure 5

The references of the objects described in the text and in figure and number are indicated by letters, which are always and only related to the paragraph you are reading unless there are specific references to other figures or paragraphs.

NOTE: All data, measurements and relevant symbols are shown in the glossary section.

1.3 Emission

The power of propulsion engines for marine use is measured in compliance with Directive 2013/53/EU.

1.4 Spare parts order

For spare parts orders, it is necessary to take note and provide the following data:

- Engine model
- Engine serial number

The information can be found on the engine name plate (see **Par. 1.9**)

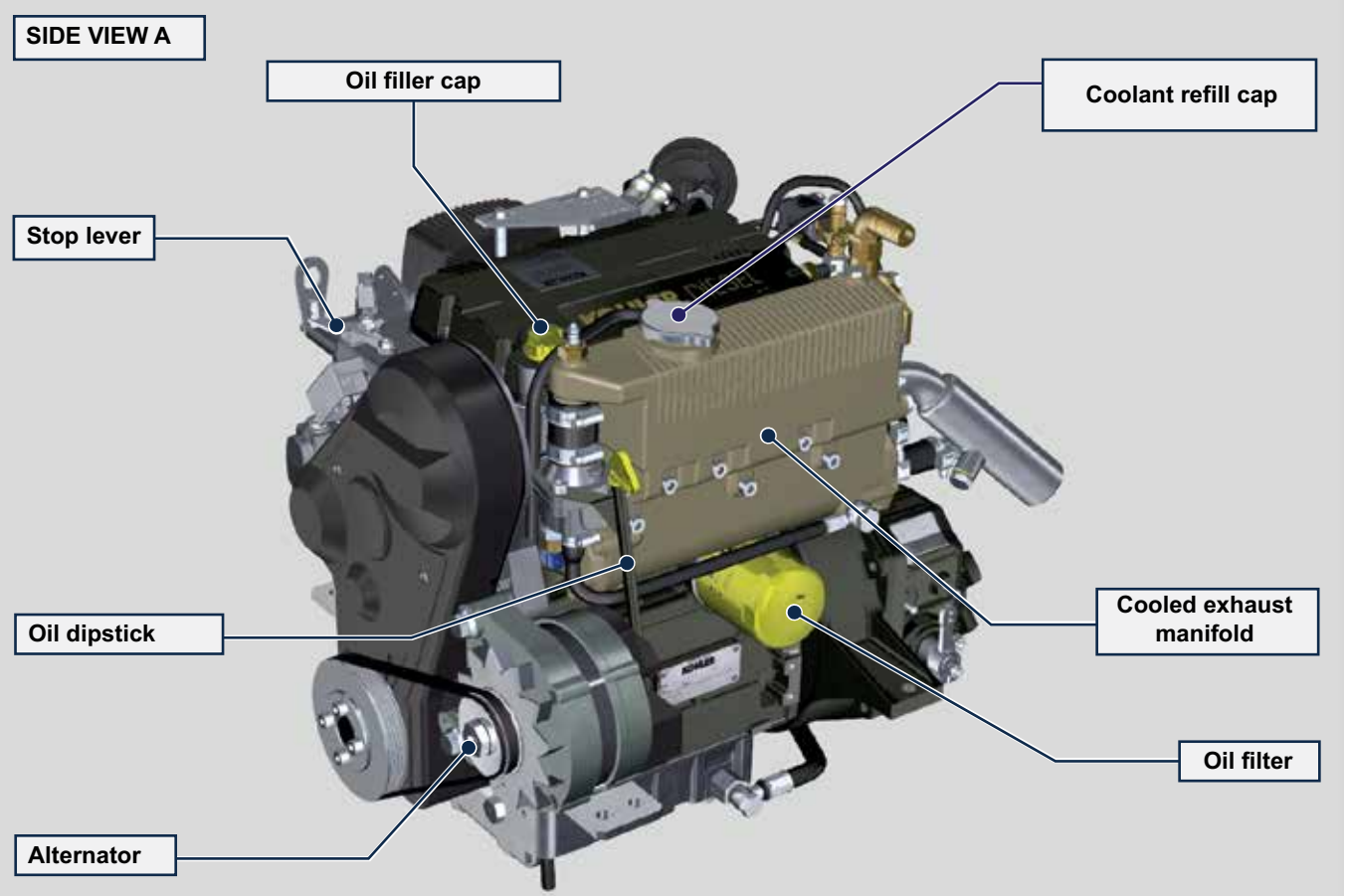
1.5 Service request

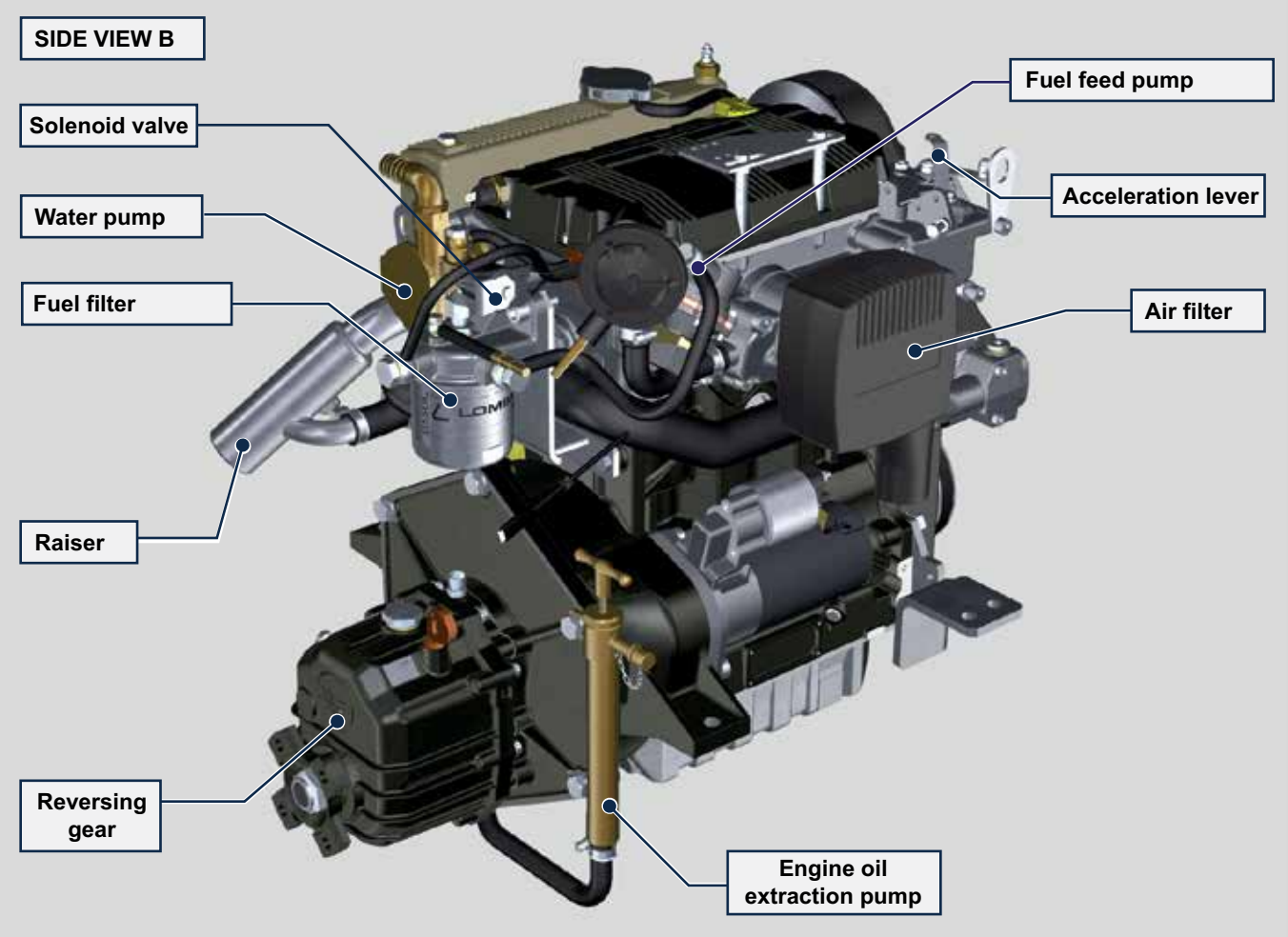
- Authorized service centers can be found on our web site www.kohlerpower.com.
- If you have any questions regarding your warranty rights and responsibilities or the location of the nearest authorised service location go to www.kohlerpower.com.

1.6 Warranty

To read the most recent warranty terms visit the website page at the link: www.kohlerpower.com/en/engines/warranty.

1.7 Engine components identification



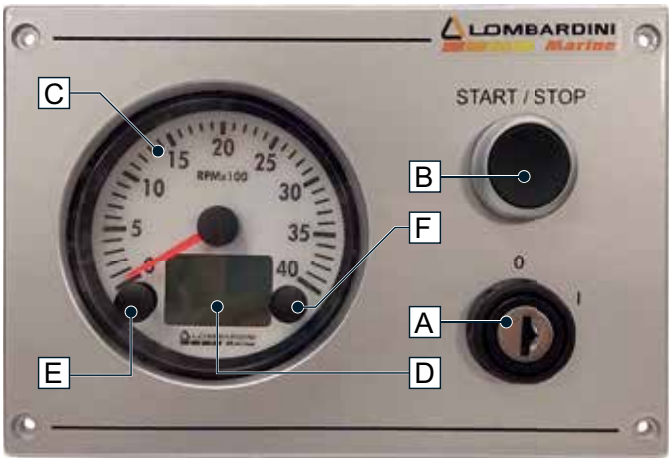


1.8 Control Panel

The table shows the control panel components.

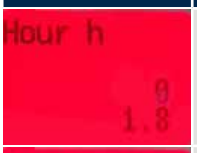
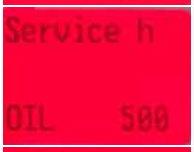
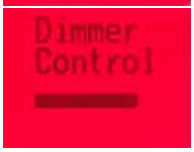
Tab. 1.1

POS.	DESCRIPTION
A	Panel ignition switch with key switch
B	Engine on/off push button
C	Engine rpm indicator
D	Engine data or errors display
E	Engine data or errors push button
F	Maintenance or errors reset push button

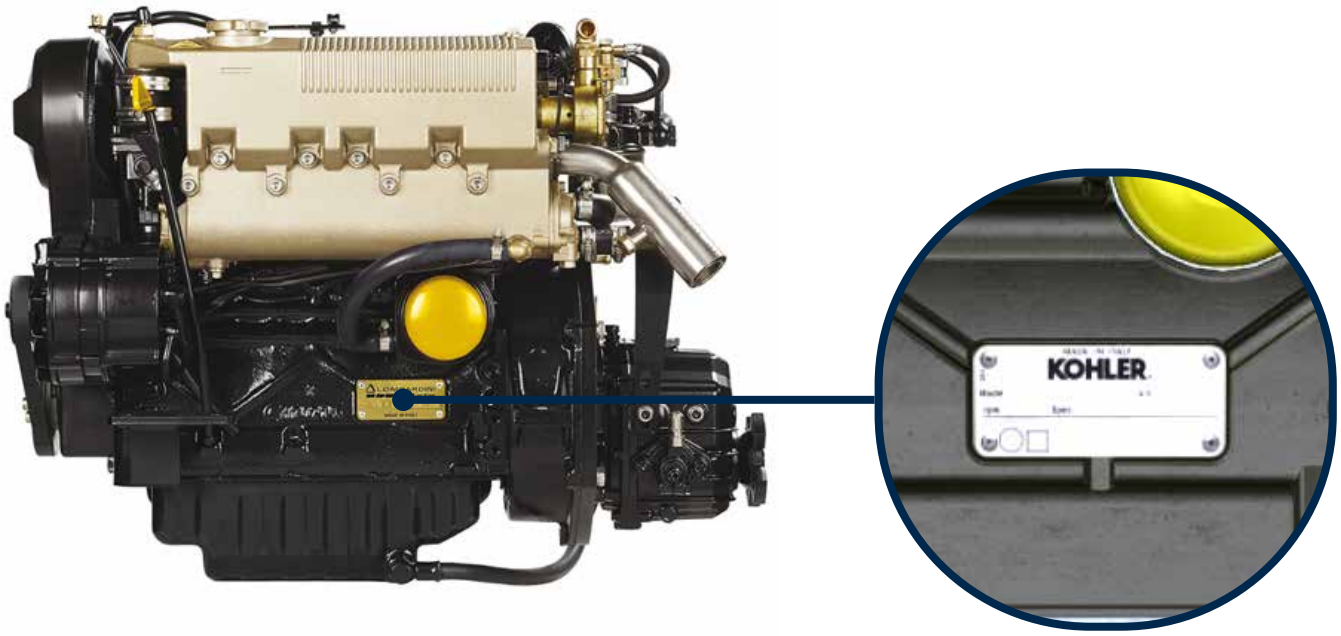


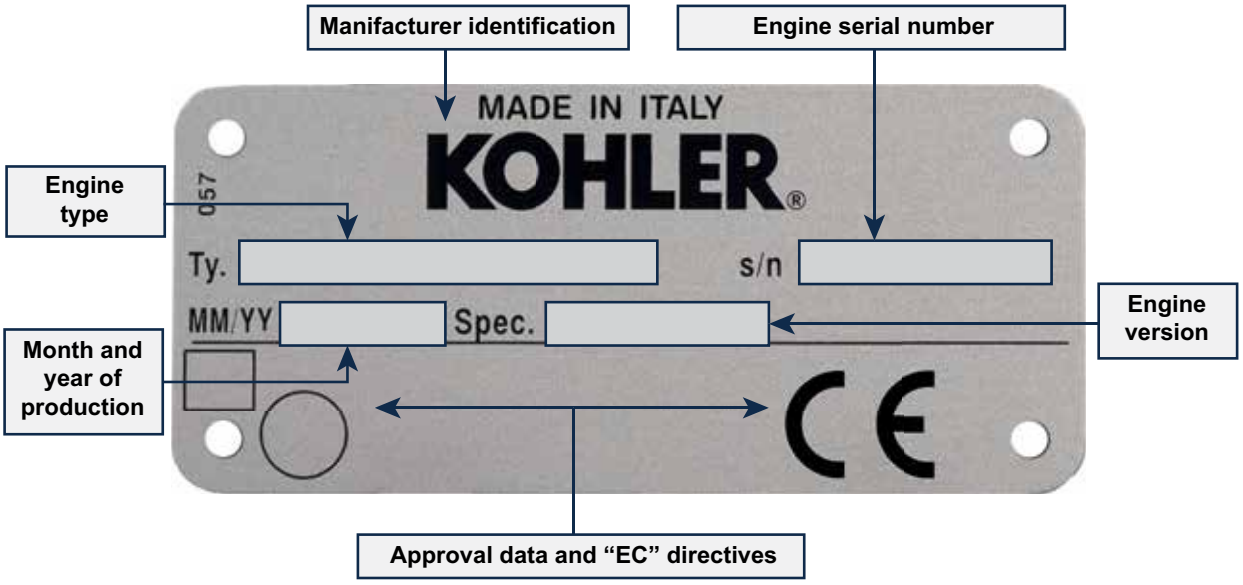
The following table shows data that can be consulted on display **D** by pressing push button **E**.

POS.	DESCRIPTION
	Coolant temperature (°C)
	Oil pressure (bar)
	Battery voltage (V)

POS.	DESCRIPTION
	Total and partial hours of operation (h) - To reset partial hours, simultaneously press push buttons **E** and **F** for **3** seconds
	Hours left for maintenance (h)
	Backlighting adjustment - Press push button **E** for 3 seconds - Press push button **E** to decrease brightness or **F** to increase it

1.9 Manufacturer and engine identification data





2.1 Engine specifications

Tab. 2.1

		LDW 502 M	LDW 702 M	LDW 1003 M	LDW 1404 M
Cylinders	N°	2	2	3	4
Bore	mm	72	75	75	75
Stroke	mm	62	77,6	77,6	77,6
Displacement	cm^3	505	686	1028	1372
Engine oil quantity	*Kg.	1,5	1,5	2,4	3,2
Reversing gear reduction gear oil quantity	Kg.	0,2	0,2	0,2	0,2
Dry weight with reversing gear	Kg.	75	97	110	135
Engine coolant system capacity	Lt.	2	2	3	4,250
MAX. inclination during installation	α	15°	15°	15°	10°
MAX. inclination during operation	α	20°	20°	20°	20°

Warning: oil quantity can vary based on the inclination of the engine.

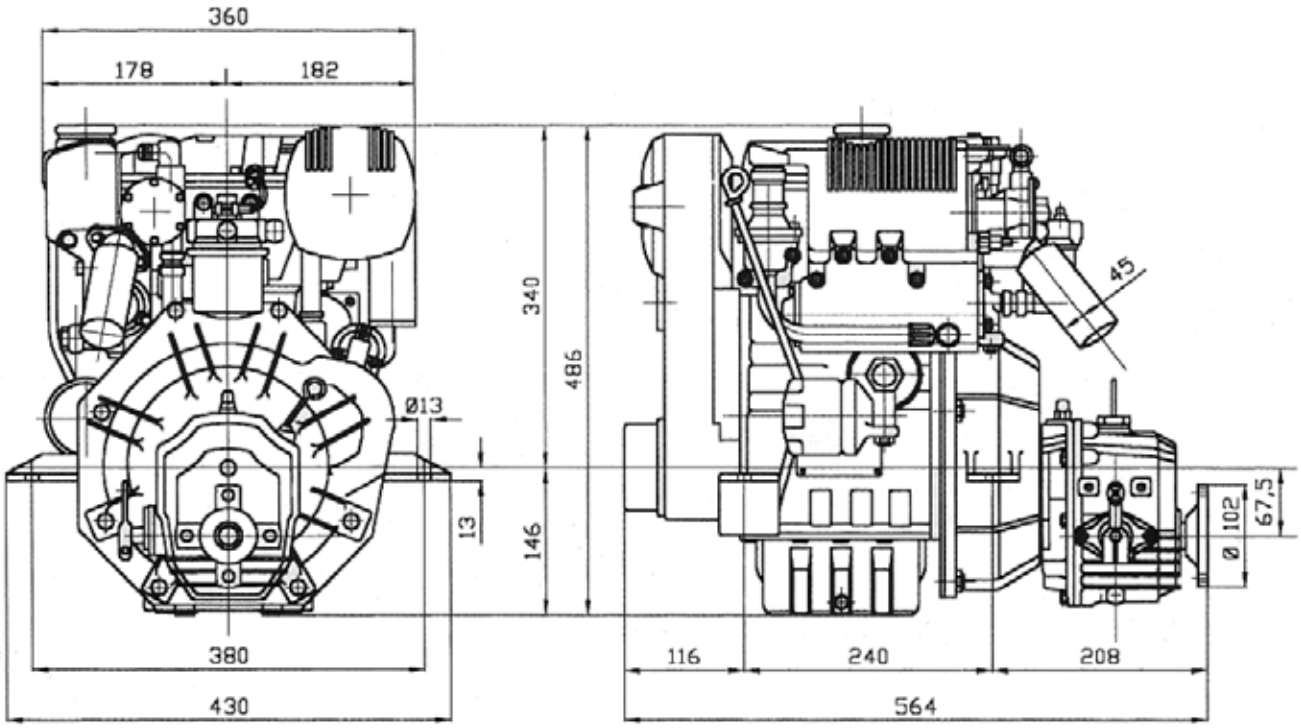
2.2 Recommended batteries

Tab. 2.2

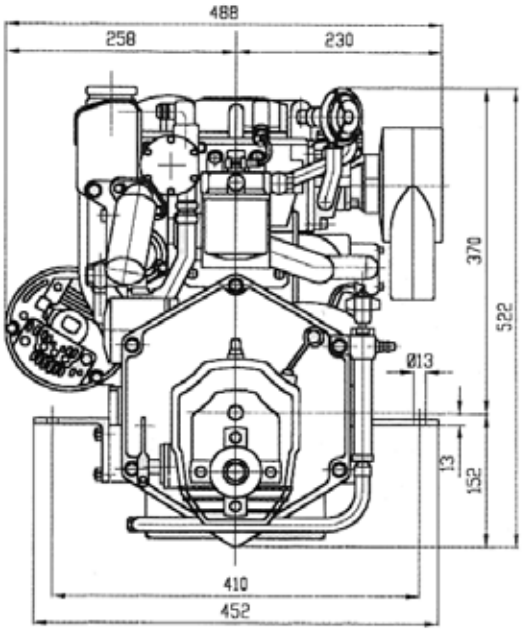
RECOMMENDED BATTERIES	
Ambient temperature	Battery type
> - 15°C	12V 100 Ah - 800 CCA/SAE
-15°c ÷ -25°c	12V 110 Ah - 950 CCA/SAE
< - 25°C	12V 120 Ah - 1000 CCA/SAE

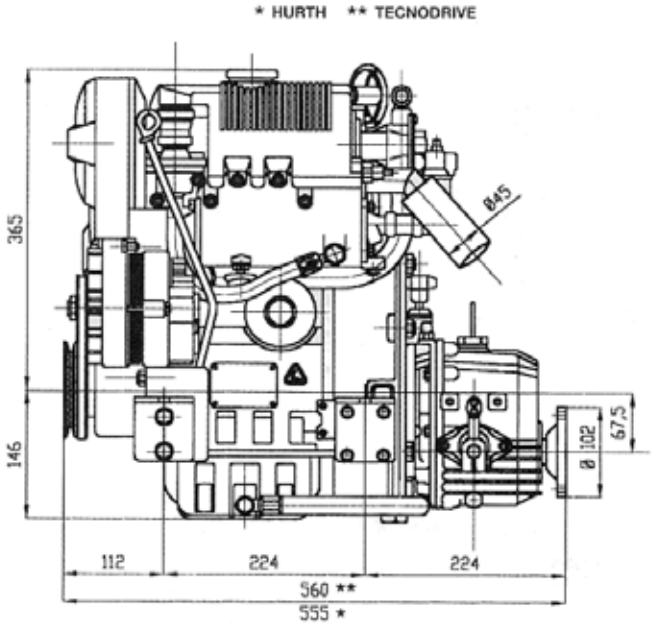
2.3 Engine dimensions

2.3.1 LDW 502 M

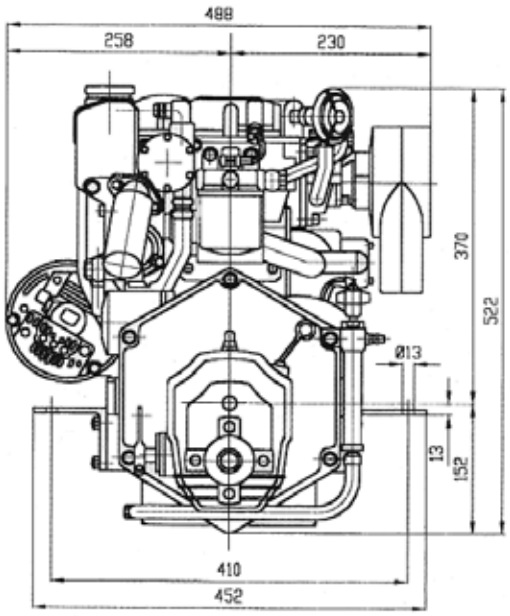


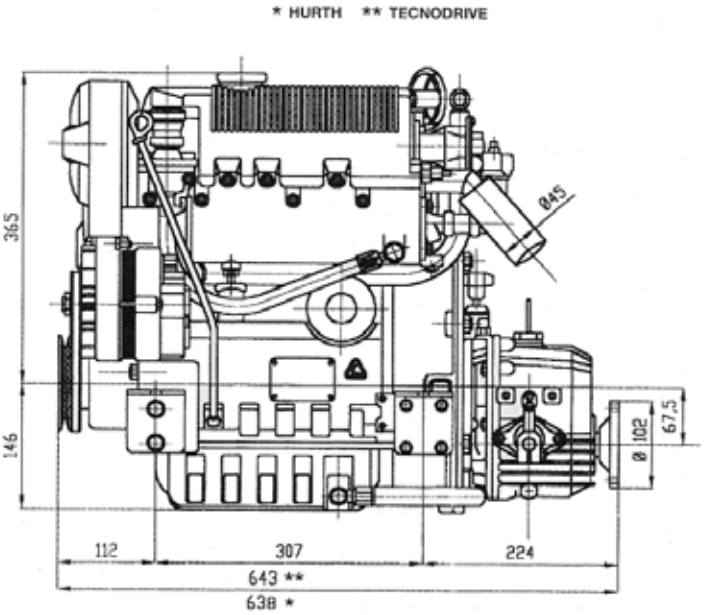
2.3.2 LDW 702 M



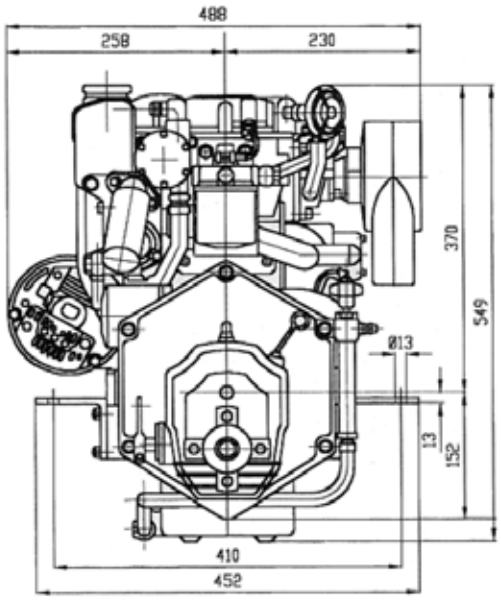


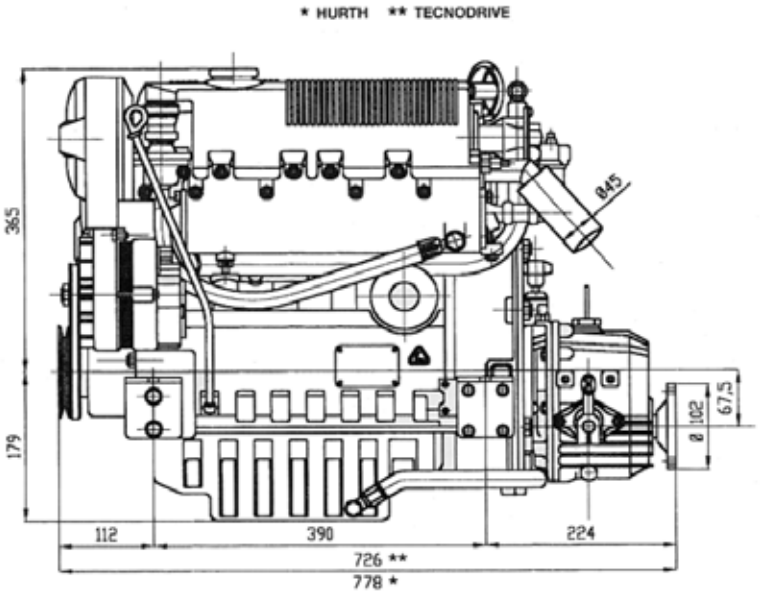
2.3.3 LDW 1003 M





2.3.4 LDW 1404 M





2.4 Recommended oil

Important

- The engine may be damaged if operated with improper oil level.
- Do not exceed the MAX level because a sudden increase in engine rpm could be caused by its combustion.
- Use only the recommended oil to ensure adequate protection, efficiency and service life of the engine.
- The use of lubricants other than recommended may shorten the engine life.

Danger

- Viscosity must be appropriate to the ambient temperature to which the engine is to be exposed (**Par. 2.4.1**).
- Prolonged skin contact with the exhausted engine oil can cause cancer of the skin.
- If contact with oil cannot be avoided, thoroughly wash your hands with soap and water as soon as possible.
- For the exhausted oil disposal, refer to the **Par. 3.6**.

2.4.1 SAE oil classification

- In the SAE classification, oils are identified according to viscosity without considering any other qualitative characteristic.
- The code is composed of two numbers, which indicate, and must correspond to, the ambient temperature in which the engine operates, the first number refers to the viscosity when cold, for use during winter (“W”), while the second number is for viscosity at high temperatures.

Tab. 2.3

RECOMMENDED OIL		
Viscosity	SAE	5W 40 Synthetic
With specifications	API	API SJ/CF 4
		ACEA A3-96 B3-96
		MIL - L-46152 D/E
	ACEA	E7
		E5

- Low S.A.P.S. oils with < 1% sulphated ash cannot be used with fuel whose sulphur content is >50ppm.
- Oil filtration is extremely important for correct operation and proper lubrication; replace the filters regularly as specified in this manual.

2.4.2 Reversing gear oil

NOTE: Refer to the technical documentation of the reversing gear supplied with the engine.

2.5 Fuel

Important

- Use of other types of fuel could damage the engine. Do not use dirty diesel fuel or mixtures of diesel fuel and water since this will cause severe engine damage.
- Any damage resulting from the use of fuels other than recommended will not be covered by warranty.

Danger

- The use of properly filtered fuel prevents clogging of the injection system. Immediately clean up any spillage during refuelling.
- Never store diesel fuel in galvanized containers (i.e. zinc-coated). Diesel fuel and the galvanized coating generates a chemical reaction, producing compounds that quickly clogs filters or cause fuel pump and/or injector failure.

Tab. 2.4

FUEL COMPATIBILITY
EN 590 (biodiesel content max. 7% (V/V))
ASTM D 975 Grade 1-D S15
ASTM D 975 Grade 2-D S15
NATO F-54, equivalent to diesel fuel in accordance with EN 590
EN 590 or ASTM D 975 Grade 1, 2 -D S15 Arctic Diesel
JIS K 2204 N. 1, N. 2

NOTE: In a warranty case the customer must prove by a certificate from the fuel supplier that an allowed fuel was used.
These engines are designed for fuels in accordance with EN 590 e ASTM D975 for a cetane number of at least 45.

2.5.1 Fuel for low temperatures

- When operating the engine in ambient temperatures lower than 0 degrees C, use suitable low temperature fuel normally available from fuel distributors and corresponding to the specifications of **Tab. 2.4**.
- These fuels reduce the formation of paraffin in diesel at low temperatures.
- When paraffin forms in the diesel, the fuel filter becomes blocked interrupting the flow of fuel.

2.5.2 Biodiesel fuel

- Fuels containing 10% methyl ester or B10, are suitable for use in this engine provided that they meet the specifications listed in the **Tab. 2.4**.
- DO NOT USE vegetable oil as a biofuel for this engine.

Tab. 2.5

BIODIESEL COMPATIBILITY
Biodiesel according to EN 14214 (only permissible for mixture with diesel fuel at max. 10% (V/V))
US biodiesel according to ASTM D6751 – 09a (B100) (only permissible for mixtures with diesel fuel at 10% (V/V))

2.5.3 Synthetic fuels: GTL, CTL, BTL, HV

It is a well-known fact that engines which are operated for longer periods with conventional diesel fuel and then converted to synthetic fuels suffer shrinkage of polymer seals in the injection system and thus fuel leaks. The reason for this behavior is that the aromatic-free synthetic fuels can lead to a change in the selling behavior of polymer seals.

Therefore, conversion from diesel fuel to synthetic fuel may only be done after changing the critical seals. The problem of shrinkage does not occur when an engine was operated with synthetic fuel from the start.

2.5.4 Non-Road Fuels

Other non-road fuels may be used if they comply with all the limit values of EN 590 except for the fuel density, the cetane number and the sulfur content.

The following limits apply for these parameters:

Tab. 2.6

FUEL PARAMETER	UNIT	LIMIT VALUE
Cetane number		Min. 49
Fuel density at 15°C	kg/m^3	820 - 860
Sulfur content	mg/kg o ppm	Max. 500

2.6 Coolant recommendation

A mixture of 50% demineralized water and 50% low silicate ethylene glycol based coolant liquid must be used.

Use a Long Life or Extended Life Heavy Duty OAT coolant free of: silicates, phosphates, borates, nitrites and amines.

The following ethylene-glycol based engine coolant for all models within KDI engine family may be used:

- OAT (Organic Acid Technology) Low Silicate: ASTM D-3306 D-6210
- HOAT (Hybrid Organic Acid Technology) Low Silicate: ASTM D-3306 D-6210

The above coolants, in concentrated formulations, must be mixed with distilled, deionized or demineralised water.

The above coolants in concentrated formulation must be mixed with distilled, deionized, or demineralized water. A pre-mixed formulation (40-60% or 50-50%) can be used directly when available.

Important

- Do not mix ethylene glycol and propylene glycol based coolants. Do not mix OAT and HOAT based coolant. OAT performance life can be drastically reduced if contaminated with nitrite-containing coolants.

Test the coolant condition annually with coolant test strips.

HOAT are not all maintenance free and it is recommended to have SCA (Supplemental Coolant Additives) added at the first maintenance interval.

3.1 Safety information

- The intended use of the engine is in conformity with the machine on which it is mounted.
- Any use of the machine other than that described cannot be considered as complying with its intended purpose as specified by KOHLER.
- KOHLER declines all responsibility for any change to the engine not described in this manual made by unauthorized KOHLER personnel.
- A proper use of the engine, a strict observance of the rules listed below and the rigorous application of all these precautions will avoid the risk of accidents or injuries.
- Those who carry out the use and maintenance on the engine must wear the safety equipment and the accident-prevention guards.
- KOHLER declines all direct and indirect liability for failure to comply with the standards of conduct contained in this manual.
- KOHLER cannot consider every reasonably unforeseeable misuse that may cause a potential danger.

3.2 General remarks

3.2.1 Note for OEM/installer

- When installing the KDI engines, always bear in mind that any variation to the functional systems may result serious failures to the engine.
- Before delivery optimization must be checked at KOHLER test rooms.
- Any changes in the installation procedure or engine must be approved by KOHLER. Failure to do so shall not hold it responsible for operation malfunctions and any damage to the engine.
- The engine can only be applied by personnel adequately trained by KOHLER and operating according to the existing manuals.
- The engine has been built according to the specifications of a machine manufacturer, which took all the necessary actions to meet the essential safety and health protection requirements such as required by the laws in force. Any use of the engine other than the one so defined cannot be considered to comply with the use intended by KOHLER, which therefore declines any liability for any accidents resulting from such operation.

3.2.2 Note for end user

- The following indications are dedicated to the user of the machine in order to reduce or eliminate risks concerning engine operation and the relative routine maintenance work.
- The user must read these instructions carefully. Failure to do this could lead to serious danger for his personal safety and health and that of any persons who may be in the vicinity of the machine.
- On starting, make sure that the engine is as horizontal as possible, unless the machine specifications differ.
- Check the stability of the machine to avoid the risk of overturning.
- The engine must not operate in places containing inflammable materials, in explosive atmospheres, where there is dust that can easily catch fire unless specific, adequate and clearly indicated precautions have been taken and have been certified for the machine.
- To prevent fire hazards, always keep the machine at least one meter from buildings or from other machinery.
- Children and animals must be kept at a due distance from operating machines in order to prevent hazards deriving from their operation.
- Thoroughly wash and clean all the external parts of the engine before performing any operation, in order to avoid the accidental introduction of impurities/foreign bodies. Use only water and/or appropriate products to clean the engine. If cleaning engine with a pressure washer or steam cleaner, it is important to maintain a minimum distance of at least 200mm between the surface to be washed and the nozzle. Avoid directing the nozzle on electrical components, cable connections and sealed rings (oil seals etc).
  Thoroughly wash and clean the area surrounding the engine following the instructions provided by machine manufacturer.
- Fuel and oil are inflammable. The tank must only be filled when the engine is off. Before starting, dry any spilt fuel.
- Make sure that any soundproofing panels and the surface on which the machine is located are free of fuel residues.
- Fuel vapour is highly toxic. Only refuel outdoors or in a well ventilated place.
- Do not smoke or use open flames when refuelling.
- During operation, the surface of the engine can become dangerously hot. Avoid touching the exhaust system in particular.

- Before proceeding with any operation on the engine, stop it and allow it to cool.
- Always open the radiator plug or expansion chamber with the utmost caution, wearing protective garments and goggles.
- The coolant fluid is under pressure. Never carry out any inspections until the engine has cooled.
- If an electric fan is provided, do not approach it if the engine is hot because it could start even when the engine is off.

Important

- The oil must be drained whilst the engine is hot. Particular care is required to prevent burns. Do not allow oil to come into contact with the skin because of the health hazards involved. It is recommended to use an oil intake pump.
- During operations that involve access to moving parts of the engine and/or removal of rotating guards, disconnect and insulate the negative wire (-) of the battery to prevent accidental short-circuits and to stop the starter motor from being energized.
- Check belt tension only when the engine is off.
- Fully tighten the tank cap each time after refuelling. Do not fill the tank right to the top but leave an adequate space for the fuel to expand.
- To start the engine follow the specific instructions provided in the engine and/or machine operating manual. Do not use auxiliary starting devices not originally installed on the machine (e.g. Startpilot).
- Before starting, remove any tools that were used to service the engine and/or machine. Make sure that all guards have been refitted.
- Do not mix fuel with elements such as oil or kerosene. Failure to comply with this prohibition will cause the non-operation of the catalyst and non-observance of the emissions declared by KOHLER.
- Pay attention to the temperature of the oil filter when the filter itself is replaced.
- Only check, top up and change the coolant fluid when the engine is off and reached the ambient temperature. Coolant fluid is polluting, it must therefore be disposed of in the correct way.
- Do not use air and water jets at high pressures on cables, connectors and injectors.

3.3 Safety signal description

- To ensure safe operation please read the following statements and understand their meaning.
- Also refer to your equipment manufacturer's manual for other important safety information.
- This manual contains safety precautions which are explained below.
- Please read them carefully.

3.3.1 Adhesive safety plates

The following is a list of the adhesive safety plates that may be found on the engine, which indicate potential points of danger to the operator.

Read the Operation and Maintenance handbook before performing any operation on the engine.

Hot Parts.
Danger of burns.

Presence of rotating parts.
Danger of jamming or cutting.

Presence of explosive fuel.
Danger of fire or explosion.

Presence of steam and pressurized coolant.
Danger of burns.

3.3.2 Safety guards

Hereunder is a list of safety guards that must be worn prior to carrying out any type of operation and to avoid potential harm to the operator.

Use suitable protective gloves before carrying out any type of operation.

Use protective goggles before carrying out any type of operation.

Use earmuffs before carrying out any type of operation.

Lifting point.

Electric shock.
Danger of severe burns or death.

High pressure fluids.
Danger of fluid penetration.

Lethal exhaust gases.
Danger of intoxication or deat

3.3.3 Warnings

Hereunder is a list of safety warnings that may be found in the manual, which advise you to pay attention when carrying out particular procedures that may be potentially dangerous to the operator or things.

Danger

- This indicates situations of grave danger which, if ignored, may seriously threaten the health and safety of individuals.

Important

- This indicates particularly important technical information that should not be ignored.

Warning

- This indicates that failure to comply with it can cause minor damage or injury.

3.4 Information and safety signals

ACCIDENTAL START

Accidental Starts can cause severe injury or death.

Before working on the engine or equipment, disconnect the battery negative (-) wire.

LETHAL EXHAUST GASSES

Carbon Monoxide can cause severe nausea, fainting or death.

Avoid inhaling exhaust fumes and never run the engine in a closed building or confined area.

Carbon monoxide is toxic, odorless, colorless, and can cause death if inhaled.

EXPLOSIVE FUEL

Explosive fuel can cause fires and severe burns.

Fuel is flammable and its vapours can ignite. Store fuel only in approved containers, in well ventilated, unoccupied buildings.

Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition.

Do not start the engine near spilled fuel.

Never use fuel as a cleaning agent.

HIGH PRESSURE FLUID RISK OF PUNCTURE

High Pressure Fluids can puncture skin and cause severe injury or death.

Do not work on fuel system without proper training or safety equipment. Fluid puncture injuries are highly toxic and hazardous.

If an injury occurs, seek immediate medical attention.

ROTATING PARTS

Rotating Parts can cause severe injury.

Stay away while engine is in operation. Keep hands, feet, hair, and clothing away from all moving parts to prevent injury.

Never operate the engine with covers, shrouds, or guards removed.

HOT PARTS

Hot Parts can cause severe burns.

Engine components can get extremely hot from operation.

Do not touch engine while operating or just after stopping.

Never operate the engine with heat shields or guards removed.

EXPLOSIVE GAS

Explosive Gas can cause fires and severe acid burns.

Charge battery only in a well ventilated area. Keep sparks, open flames, and other sources of ignition away from the battery at all times.

Batteries produce explosive hydrogen gas while being charged.

Keep batteries out of the reach of children.

Remove all jewelry when servicing batteries. Before disconnecting the negative (-) ground cable, make sure all switches are OFF.

If ON, a spark will occur at the ground cable terminal which could cause an explosion.

ELECTRICAL SHOCK

Electrical Shock can cause injury.

Do not touch wires while engine is running.

3.5 Safety and environmental impact

Every organisation has a duty to implement procedures to identify, assess and monitor the influence of its own activities (products, services, etc.) on the environment.

Procedures for identifying the extent of the impact on the environment must consider the following factors:

– Liquid waste.
– Waste management.
– Soil and water contamination.
– Atmospheric emission.
– Use of raw materials and natural resources.
– Regulations and directives regarding environmental impact.

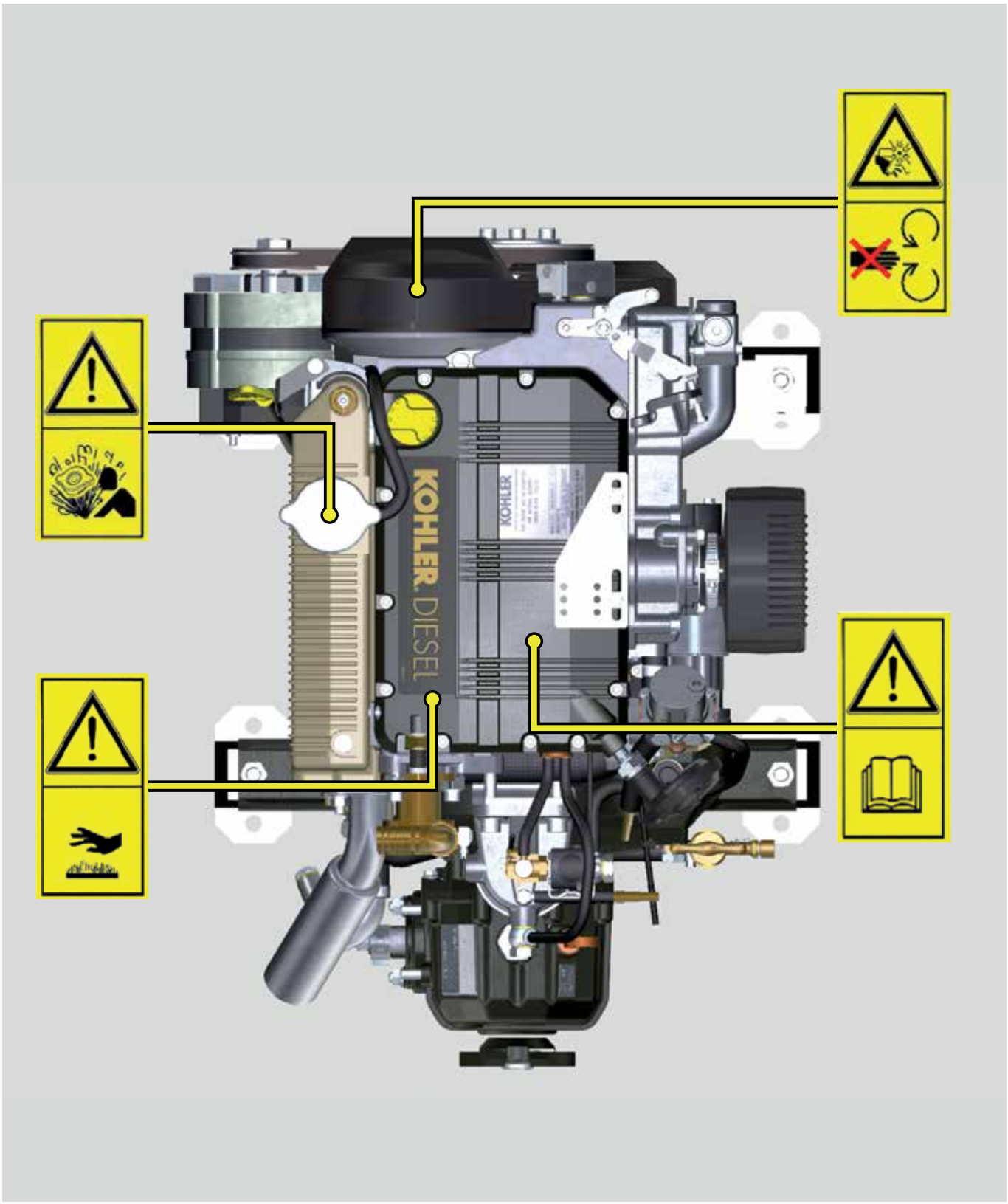
In order to minimise the impact on the environment, Lombardini Marine now provides a number of indications to be followed by all persons handling the engine, for any reason, during its expected lifetime.

– All components and fluids must be disposed of in accordance with the laws of the country in which disposal is taking place.
– Keep the fuel and engine control systems and the exhaust pipes in efficient working order to limit environmental and noise pollution.
– When discontinuing use of the engine, select all components according to their chemical characteristics and dispose of them separately.

3.6 Disposal and scrapping

- In case of scrapping, the engine must be disposed of in adequate landfills, according to the legislation in force.
- Before scrapping, it is necessary to separate the plastic or rubber parts.
- Parts consisting only of plastic, aluminium and steel can be recycled if collected by the appropriate centres.
- Waste oil must properly be recycled and disposed of in the correct way to safeguard the environment. According to the laws in force, it is classified as hazardous waste, therefore it must be collected by the appropriate centers.

3.7 Location of safety labels on engine



4.1 Pre-start check

- Read carefully the following pages and carry out the operations described below in accordance with the instructions specified.

Important

- Non compliance with the operations described in the following pages involves the risk of damages to the engine and vehicle on which it is installed as well as personal and/or property damage.
- Increase the frequency of maintenance operations in heavy working conditions (engine starts but stops, very dusty and hot environments, etc..).

4.2 Refuelling

Important

- Before proceeding with operation, read Par. 3.1

Danger

- Always refuel with the engine switched off.
- The only approved fuels are those listed in Par. 2.5
- In those countries where fuel has a high sulphur content, its is advisable to lubricate the engine with a high alkaline oil or alternatively to replace the lubricating oil recommended by KOHLER more frequently.
- To avoid explosions or fire outbreaks, do not smoke or use open flames during the operations.
- Fuel vapours are highly toxic.Only carry out the operations outdoors or in a well ventilated place.
- Keep your face well away from the fuel fill to prevent harmful vapours from being inhaled.
- Dispose of fuel in the correct way and do not litter as it is highly polluting.
- When refuelling, it is advisable to use a funnel to prevent fuel from spilling out.The fuel should also be filtered to prevent dust or dirt from entering the tank.
- Do not overfill the fuel tank. Leave room for the fuel to expand.

4.3 Oil filling

Important

For safety precautions see Chapter 3.

Before proceeding with operation, read Par. 3.1

Do not use the engine with the oil level below the **MIN.**
See recommended oil type at Par. 2.4

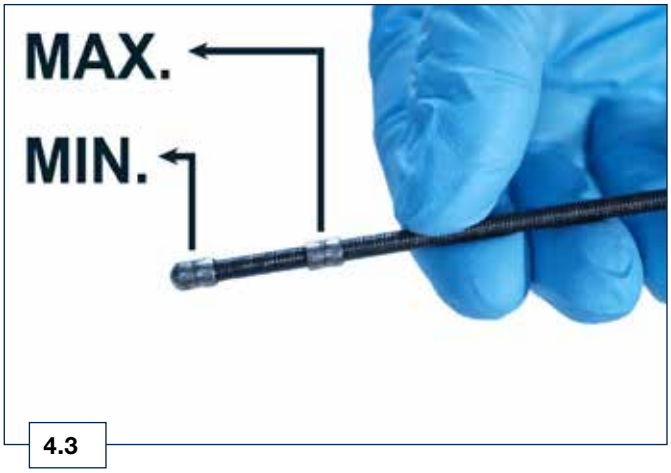
1. Loosen the oil filler cap.

4.1

2. Pour the type of oil recommended.

4.2

3. Before checking the oil level place the engine on a horizontal surface.
4. Remove the oil dipstick B and check that the level is up to but does not exceed the MAX.



4.3

5. If level is not at the MAX. level, add additional oil.

4.4

6. Reinstall the oil dipstick correctly and re-tighten the oil filler cap.

4.5

4.4 Refilling coolant

Important

- Before proceeding with operation, read **Par. 3.1**..

Warning

- It is mandatory to use ANTIFREEZE protective liquid mixed with softened water.
- The freezing point of the cooling mixture depends on the product concentration in water.
- In addition to lowering the freezing point, the permanent liquid also raises the boiling point.
- Therefore, a 50% mixture diluted is recommended, as it ensures a general protection, avoids the formation of rust, galvanic currents and limescale deposits.

NOTE: Before proceeding with any operation on the engine, stop it and allow it to cool.

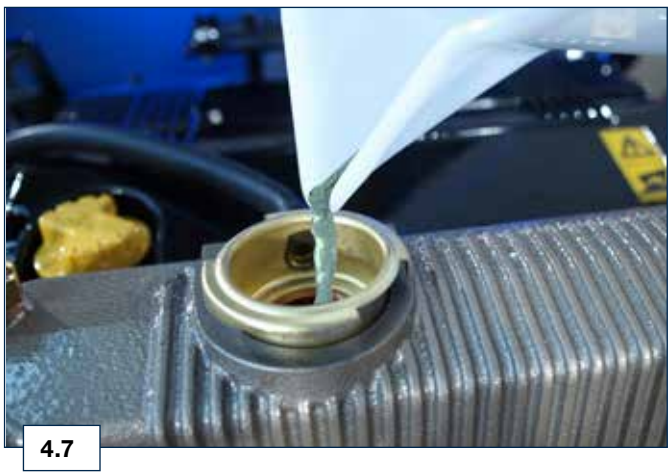
Danger

Presence of steam pressurized coolant.
Danger of burns.

1. Unscrew the radiator plug and refill with:
50% ANTIFREEZE and 50% decalcified water.

4.6

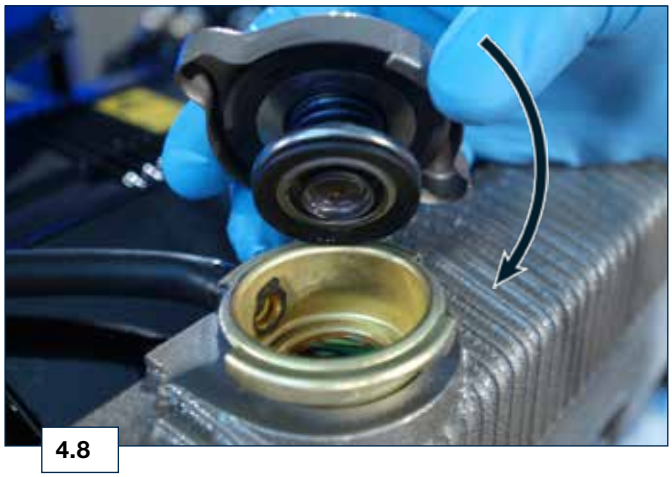
2. Pour in recommended coolant until reaching the MAX. level mark.



4.7

3. Refit the plug firmly.

- After a few hours of use, turn off the engine, let coolant cool down to room temperature and check level again.



4.8

4.5 Reversing gear oil filling

Important

For safety precautions see **Chapter 3**.

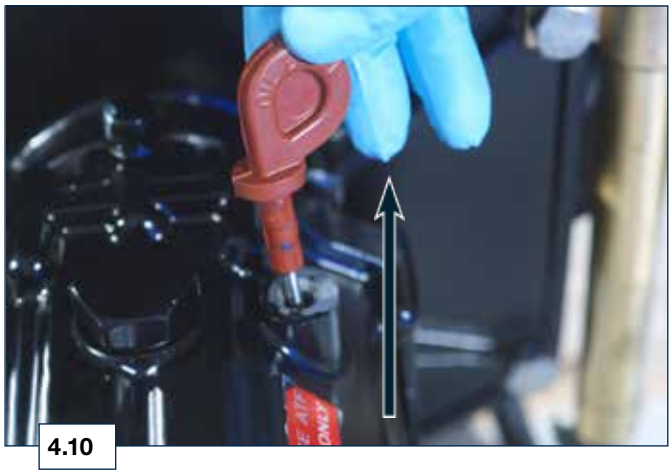
Before proceeding with operation, see **Par. 3.2.2**.

Refill must be done with the engine in horizontal position. Place engine on horizontal surface when filling the oil.

1. Remove oil filler cap.

4.9

2. Remove the oil dipstick.
3. Pour in the oil.



4.10

4. Clean, reinstall and remove the oil dipstick.
5. Check that oil level is up to MAX.

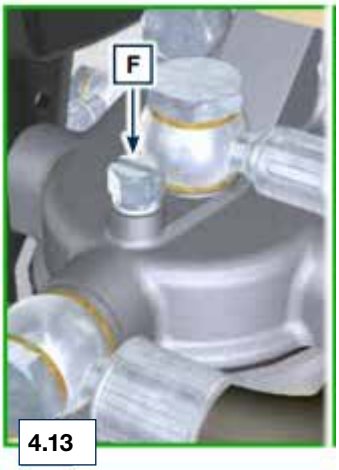
4.11

6. Reinstall the oil dipstick.
7. Re-tighten the oil filler cap.


4.12

4.6 Air bleeding

1. Loosen the air bleeding screw F on fuel filter bracket.
2. Turn the key on the control panel to the ON position.
3. Pump the fuel manually by using the lever on the fuel feed pump.
4. The air inside the circuit and the fuel filter will begin to escape from the screw F.
5. Tighten the bleeding screw F when the fuel begins to flow.



4.13


4.14

4.7 Starting and turning off

4.7.1 Starting

1. Check the level of the engine oil, fuel and coolant and fill if necessary (see Par. 4.4)
2. Open the sea water inlet shut off valve.

4.15

Important

The intake pipes must be perfectly airtight.

Otherwise, the pump may get damaged.

3. Make sure that the stop lever is at the end of its stroke.

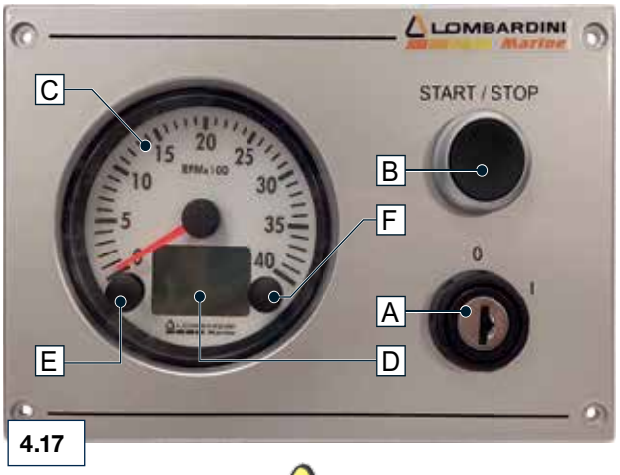
Danger

4. Absolutely do not use spray to facilitate start-up.

4.16

5. Disengage the remote-control lever and accelerate for about 1/3 of the stroke.

6. Turn the key to the first click. Dashboard on.
7. Press the (B) button to start the engine. The engine will automatically start after the ECU on the starting panel will have checked the engine parameters and preheated the glow plugs.



4.17

Warning

Depending on the engine temperature the time that passes between pressing the (B) button and the start of the engine may vary.

Danger

Do not operate on the engine without having first turned the starting key (A) on position 0.
The engine may start automatically.

8. Engine running.

Warning

Check that all the warning lights turn off. If not, stop the engine immediately.

- If engine does not start after two attempts see **Chapter 8** to find the cause.

4.8 After starting

4.8.1 Sea water drain control

Do not perform heating at idle. Keep the engine at 1300 - 1500 rev/1'.

Important

Make sure there is no oil, fuel, or water leaking.

If no water comes out of the drain, accelerate the engine up to 1800 - 2000 rpm to facilitate the priming of the water pump.

1. Heat the engine as described below:

Tab. 4.1

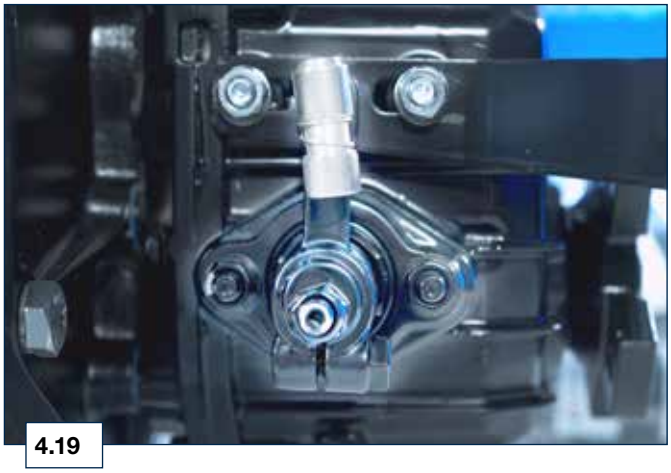
TEMPERATURE	TIME
≤ - 20° C	5'
from 20° C to 10° C	2'
from -20° C to 10° C -10° C - 5° C	1'
≥ 5° C	20"

4.8.2 Manouver positions

- Forward.

4.18

- Neutral.



4.19

- Backward.

4.20

Warning

Sailing. Engine off. Reversing gear in neutral or reverse.

4.8.3 Before turning off

Leave it running at idle speed for a few minutes.

4.8.4 Turning off

1. Pull the stop lever, Turn the key to position “0”.

4.9 After turning off

4.9.1 Check coolant level

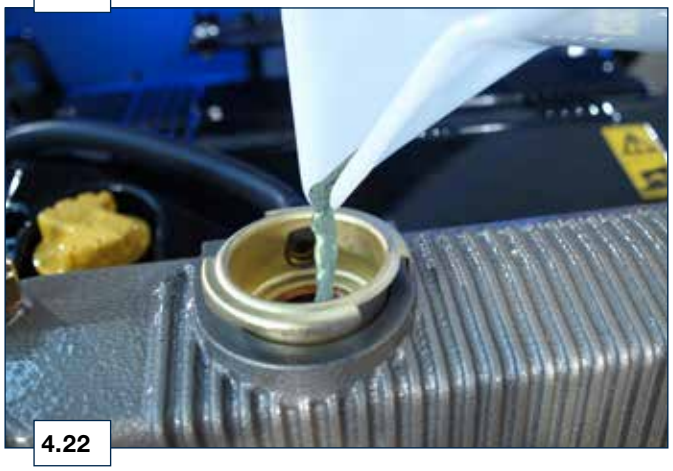
Danger

Carry out the operations with the engine turned off.

1. Unscrew the radiator cap.

4.21

2. If the level is under the MIN. pour in reccommended coolant until reaching the MAX level mark.



4.22

Warning

SPECIAL OPERATION AT TEMPERATURE LOWER THAN 0°C.

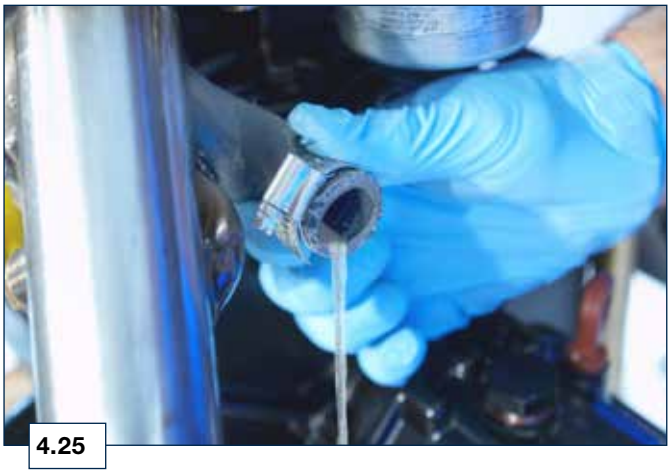
4.9.2 Drain the sea water from the pump.

1. Unscrew the clamp on the delivery hose.

4.23

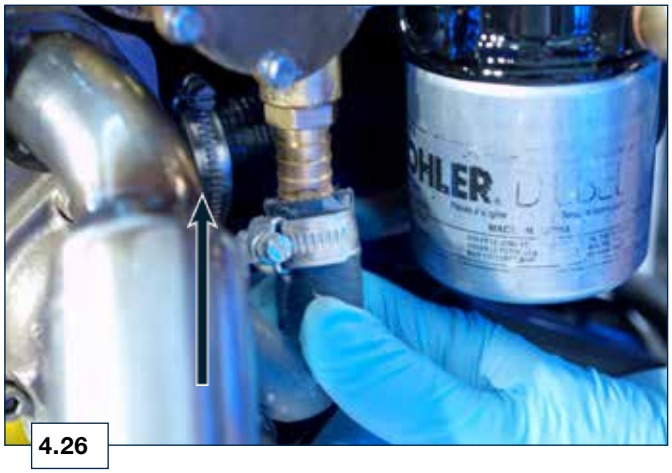
2. Remove the hose and drain the water.

4.24



4.25

3. Reassemble tube and clamp.



4.26

4.27

4.10 Running-in

For the first 50 hours of engine operation, it is advisable not to exceed 70% of the maximum power supplied.

After the first 50 hours of engine operation, at the end of running-in, replace engine oil, oil filter and fuel filter.

5.1 Useful information

- This chapter shows the operations that may, with the appropriate skills, be directly carried out by the user. These operations are described at **Par. 5.2.**
- Periodic inspection and maintenance operations must be carried out as indicated in this manual and are the responsability of the user.
- Failure to comply with these service and maintenance intervals increases the risk of technical damage to the engine. Any non compliance makes the warranty become null and void.
- In order to prevent personal and property damage read carefully the instructions listed below before proceeding with any operation of the engine.

Warning

Carry out any operations when the engine is cold and at room temperature.

- Place engine on level surface to ensure accurate measurement of oil level.
- Before starting, to avoid spillages of oil make sure that:

– The oil dipstick is inserted correctly;

– Oil drain plug is tightened firmly;

– Oil filler cap is tightened firmly.

Important

Before proceeding with operation, read **Par. 3.1**

Danger

For safety precautions see **Chapter 3**

5.2 Table of periodic maintenance

- The intervals of preventive maintenance in the table refer to the engine operating under normal operating conditions with fuel and oil meeting the recommended specifications.
- Using an oil of the type and quantity recommended in the carter is as important as checking the oil level on a daily basis and replacing it regularly. If an incorrect type of oil is used or if impurities are found in the oil can the engine may prematurely wear out and consequently break.

Tab. 5.1

MAINTENANCE LEGEND		
	•	These operations must be carried out by authorized Lombardini Marine workshops.
	(*)	In case of low use: every 3 months
	(**)	In case of low use: every 6 months
	(***)	In case of low use: every 12 months
	(°)	If you are using oil of lower quality than the one required, replace it every 60 hours for the standard sump.
	(□)	When removing the timing belt, it is necessary to replace it even if it has not finished its intended period of motion. In case of low use: every 4 years

Tab. 5.2

CHECKING									
Page	Procedure description	Intervals X hours							
			50*	10	125	250	500	2.500	5.000	10.000
Pag. 35	Oil level check			■						
Pag. 35	Coolant level check			■						
Pag. 36	Alternator belt tension check					■				
Pag. 37	Cooling circuit hoses check					■				
Pag. 37	Zinc anodes check	(*)				■				
Pag. 38	Sea water pump impeller check	(***)				■				
	Fuel hose check					■				
Pag. 45	Heat exchanger tube nest cleaning	(**)					■			
Pag. 52	Valve clearance adjuster	•					■			
Pag. 52	Injectors setting and cleaning	•						■		
REPLACEMENTS										
Pag. 40	Engine oil replacement		■		■					
Pag. 42	Oil filter cartridge replacement		■		■					
Pag. 43	Fuel filter cartridge replacement		■			■				
	Reversing gear reduction gear oil replacement		■				■			
Pag. 44	Coolant replacement	(**)					■			
Pag. 50	Alternator belt replacement						■			
	Timing belt replacement	(□)							■	
MAINTENANCE										
Pag. 52	Partial overhaul								■	
	General overhaul									■

Only the first 50 hours, after the running-in period.

5.3 Oil level check

Important

Before proceeding with operation, read Par. 3.1

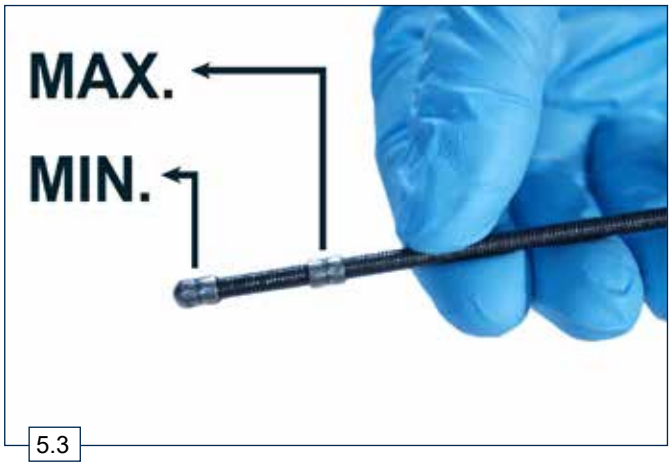
Warning

Do not use the engine with the oil level below the MIN.

1. Remove the oil dipstick.
2. If the level is under the MIN. pour in reccommended oil until reaching the MAX level mark.

Warning

For the oil filling operations see Par. 4.3



5.3

5.4 Reduction gear oil level check

1. For the oil level checking operations see Par. 5.3

5.5 Coolant level check

Important

Before proceeding with operation, read Par. 3.1

Danger

For safety precautions see Chapter 3

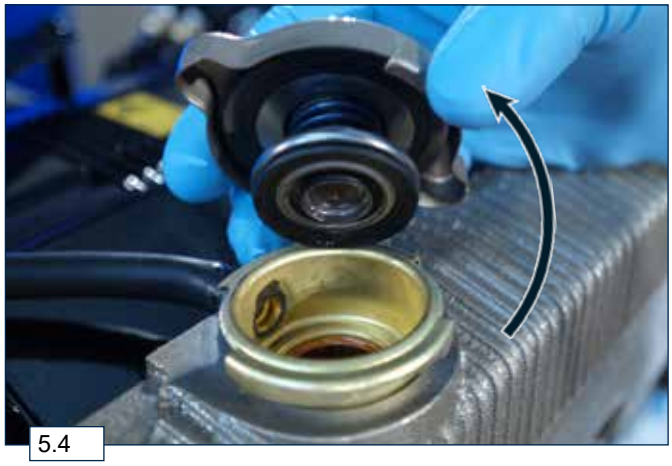
1. Unscrew the radiator cap.
2. If the level is under the MIN. refill coolant following the procedure shown at Par. 4.4.
3. Reinstall the radiator cap.

NOTE: Before proceeding with any operation on the engine, stop it and allow it to cool.

Warning

Presence of steam pressurized coolant.
Danger of burns.

NOTA: Components not necessarily provided by KOHLER.


5.4

5.6 Alternator belt tension check

Danger

For safety precautions see **Chapter 3**.

Carry out the operations with the engine off.

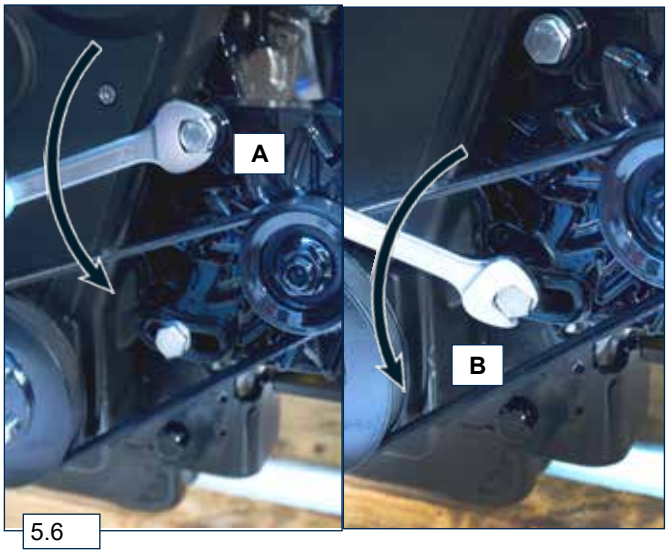
1. Press on the belt (approx. 10 Kg).

If it bends more than 1 cm, tension the belt.

5.5

2. Loosen alternator fixing bolts A and B.

3. Strongly pull alternator externally and tighten fixing bolts.



5.6

4. Using the correct tool, check that the belt tension is within 35 and 40 kg (360-410 N).

5.7

5.7 Cooling circuit sleeves check

1. Squeeze sleeves to check for wear.
2. Replace sleeves if worn out.

5.8

5.8 Zinc anodes check

1. Loosen plug and check for wear.

5.9

2. Throw plug away if worn out and replace with Lombardini Marine genuine plug.
3. Refit the plug. Tighten at 15 Nm.

5.10

5.9 Sea water pump impeller check

1. Remove screws and pump cover.

5.11

5.12

2. Take impeller out.

5.13

3. Replace with Lombardini Marine genuine impeller.

5.14

4. Reassamble the new impeller after lubricating it with the proper oil present in the replacement box.

5.15

5. Close the sea water pump and tighten the screws.

5.16

5.17

5.10 Engine oil replacement

Warning

Use protective gloves and glasses.

Important

For the waste oil disposal, refer to Par. 3.5

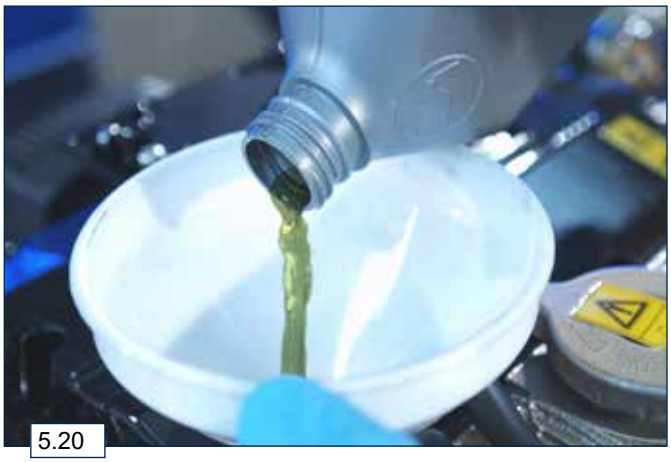
1. Unscrew the oil refill cap.

5.18

2. Extract the oil using the specially provided pump.

5.19

3. Pour oil.

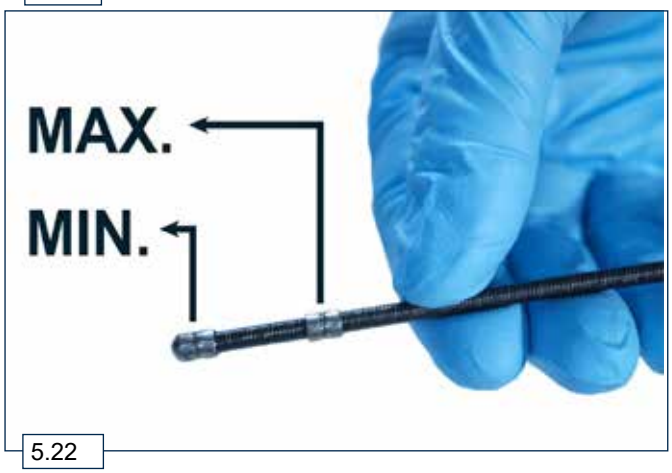


5.20

4. Remove oil dipstick.

5.21

5. Check that the level is up to but does not exceed the MAX.



5.22

6. Refit the oil dipstick correctly and re-tighten the oil filling cap.

5.23

5.11 Oil filter cartridge replacement

Important

Before proceeding with operation, read **Par 3.2.2**.

Warning

For the waste oil disposal, refer to **Par. 3.5**

1. Remove oil filter using the appropriate wrench.

5.24

2. Replace with Lombardini Marine genuine filter cartridge.

5.25

3. Tighten the oil filter with torque wrench (tightening torque at 15 Nm).

5.26

5.12 Fuel filter cartridge replacement

Important

Before proceeding with operation, read **Par. 3.2.2**.

Warning

For the waste oil disposal, refer to **Par. 3.5**

1. Unscrew and remove the filter.

5.27

2. Replace with Lombardini Marine genuine filter cartridge.

5.28

3. Tighten the filter cartridge manually.
4. Follow air bleeding procedure as described in **Par. 4.6**.

Warning

The air bleeding procedure must not be applied to the injection circuit by turning on the starting motor, since this procedure shortens the life of the starting motor.


5.29

5.13 Coolant replacement

Important

Before proceeding with operations, see **Par. 3.2.2**.

Danger

For safety precautions see **Chapter 3**.

Warning

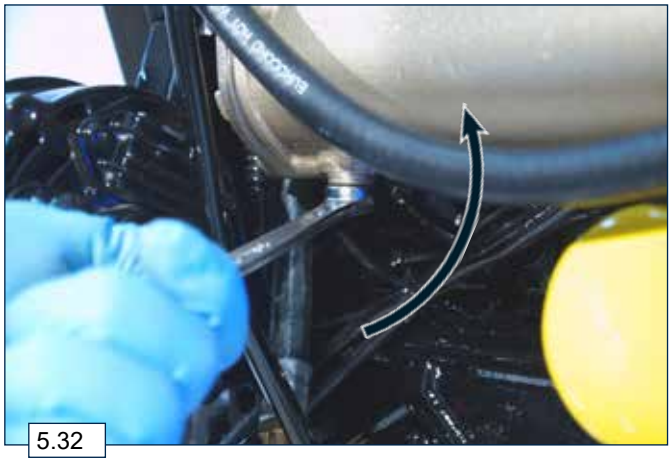
Protect the engine and the radiator from contact with liquids before proceeding with operations.

1. Drain exchanger cooling liquid.

5.30

5.31

2. Close exchanger outlet.
Tighten at 25 Nm.

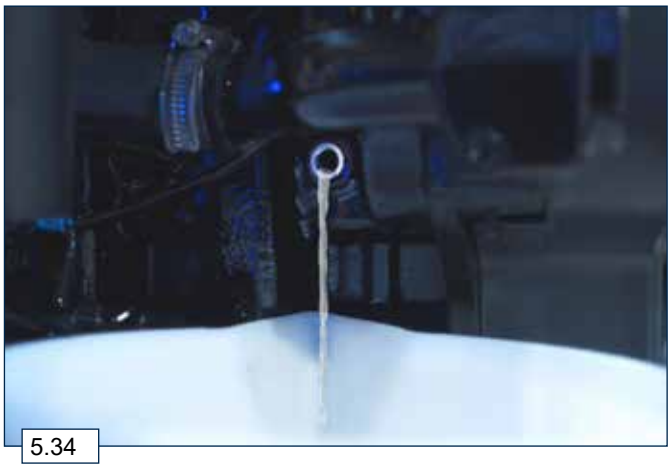


5.32

3. Remove plug from engine.

5.33

4. Drain cooling liquid from the engine.



5.34

5. Retighten the engine cooling liquid plug on the engine at 25 Nm.

5.35

5.14 Heat exchanger tube nest cleaning

1. Remove outlet fastening nuts.

5.36

2. Loosen sleeve fixing bands.

5.37

3. Remove outlet.

5.38

4. Loosen the cover screws.

5.39

5. Remove cover.

5.40

6. Remove O.R. ring.

5.41

7. Take tube nest out.

5.42

8. Dip tube bundle into a solution of:
water 50°C (90%) and hydrochloric acid (10%).

Warning

Use gloves and goggles.

5.43

9. Remove it when effervescence is off.

5.44

10. Rinse in water

5.45

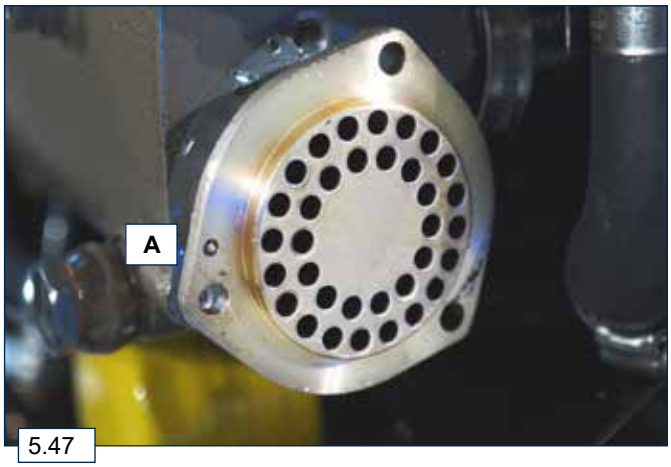
11. Refit tube bundle and O.R. ring.

Warning

If worn out, replace O-ring and gaskets.

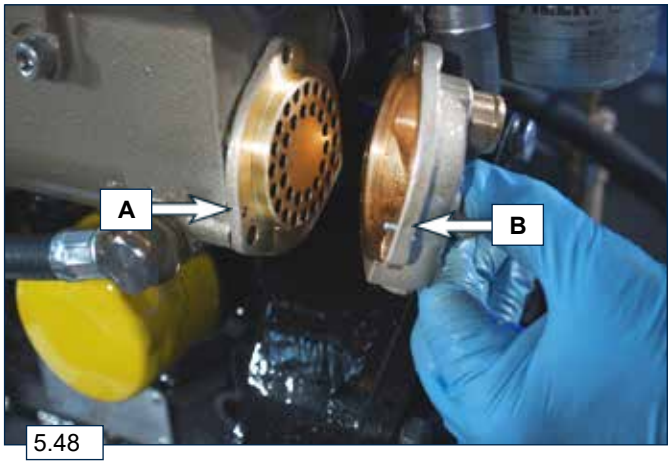
5.46

Make sure the alignment hole A on the flange is oriented outward, as shown in the picture.



5.47

12. Reassamble O.R. ring and cap. paying attention that pin B fits into hole A.



5.48

13. Tighten the screws at 10 Nm.

5.49

14. Refit the drain and water inlet pipe.

5.50

15. Tighten pipe clamps for sea water inlet and outlet.

5.51

16. Tighten drain pipe fastening nuts at 20 Nm.

5.52

17. Remove plug and pour coolant as described in **Par. 4.4**.

Recommended coolant:
50% TOTAL ANTIFREEZE 50% WATER

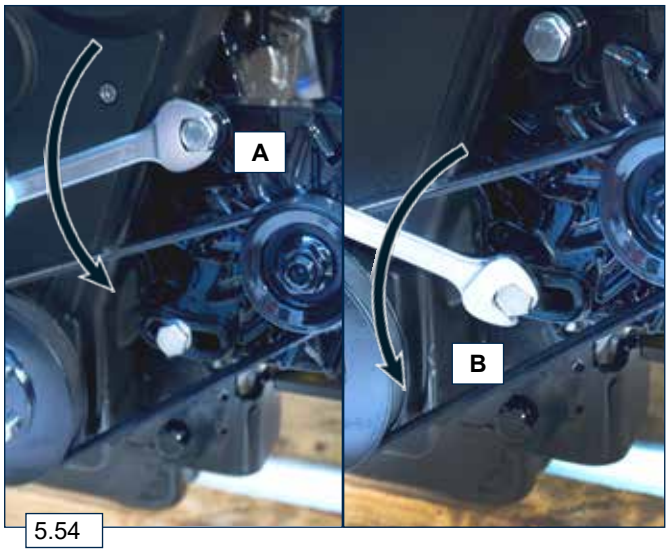
5.53

Danger

Operate on engine at room temperature

5.15 Alternator belt replacement.

1. Loosen alternator fixing belts A and B.



5.54

2. Remove the belt.

5.55

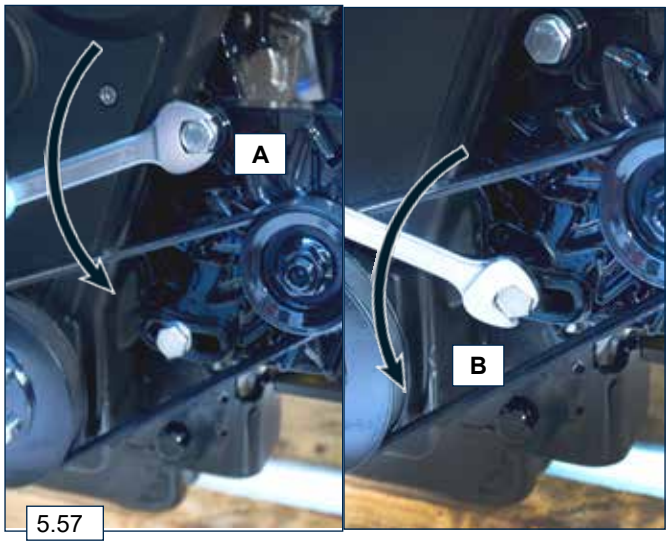
3. Replace the belt with a Lombardini Marine genuine belt.

5.56

1. Press on the belt (approx. 10 Kg).

If it bends more than 1 cm, tension the belt.

2. Loosen alternator fixing bolts A and B.
3. Strongly pull alternator externally and tighten fixing bolts.



5.57

4. Using the correct tool, check that the belt tension is within 35 and 40 kg (360-410 N).

5.58

5.16 Setting rocker arms clearance.

This operation must be carried out by authorized Lombardini Marine workshops.

5.17 Injectors setting and cleaning.

This operation must be carried out by authorized Lombardini Marine workshops.

5.18 Maintenance

This operation must be carried out by authorized Lombardini Marine workshops.

6.1 Product preservation

Important

- If the engines are not to be used for 6 months, they must be protected by carrying out the operations described in Par. 6.1.1.
- If the engine is still not in use after the first 6 months, it is necessary to carry out a further operation to extend the storage period (more than 6 months) (Par. 6.1.2).
- If the engine is not to be used for an extended period, the protective treatment procedure must be repeated within 24 months of the previous one.

6.1.1 Engine storage up to 6 months

1. Sea water drainage from the pump. See procedure at Par. 4.9.2.
2. Engine oil and oil filter replacement. See procedure at Par. 5.10 and at Par. 5.11.
3. Fuel filter replacement. See procedure at Par. 5.12.
4. Close suction and delivery outlets with tape.
5. Protect the engine with an adequate cover from dust, moisture and the weather.

Before storing the engine check that:

- The environments are not humid or exposed to bad weather.
- The place is not near electric lines or sources.
- Avoid storing the packing in direct contact with the ground.

6.1.2 Engine storage over 6 months

Important

These operation must be carried out by authorized Lombardini Marine workshops**.**

6.1.3 Engine starting after storage

1. Remove the protective sheet.
2. Use a cloth soaked in degreasing product to remove the protective treatment from the external parts.
3. Inject lubricating oil (no more than 2 cm^3) into the intake ducts.
4. Refill the tank with fresh fuel.
5. Make sure that the oil and the coolant are up to the MAX. level.
6. Start the engine and keep it idle at minimum speed for a about two minutes.
7. Bring the engine at 3/4 of MAX. rated speed for 5-10 minutes.
8. Stop the engine while the oil is still hot (Par. 5.10), discharge the protective oil in a suitable container.

Warning

- Over time, lubricants and filters lose their properties, so it is important to consider whether they need replacing, also based on the criteria described in Tab. 5.2.

9. Replace the filters (air, oil, fuel) with original spare parts.
10. Pour fresh oil (Par. 4.3) up to the MAX. level.
11. Empty the cooling circuit completely and pour in the new coolant up to the MAX. level (Par. 4.4)

7.1 Application and Validation process for marine engine

Kohler Engines educates his sales and service network in order to carry out the installation and commissioning of the engine with functional checks in respect of the standards established over the years and the requirements set out in the technical documents (owner manuals).

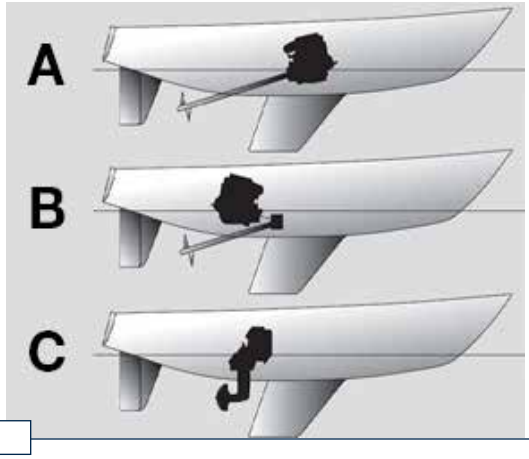
Importante

Installation by unauthorized personnel (end customer or other) is allowed by Kohler Engines just in the case that the instructions given on the technical documents accompanying the engine are observed (owner manual, installation manual provided on request); in case of non-observance of the instructions the warranty is to be considered as not applicable.

The warranty is activated from the sales invoice date to the final customer.

Below you can find some examples of the types of application of a marine engine for propulsion:

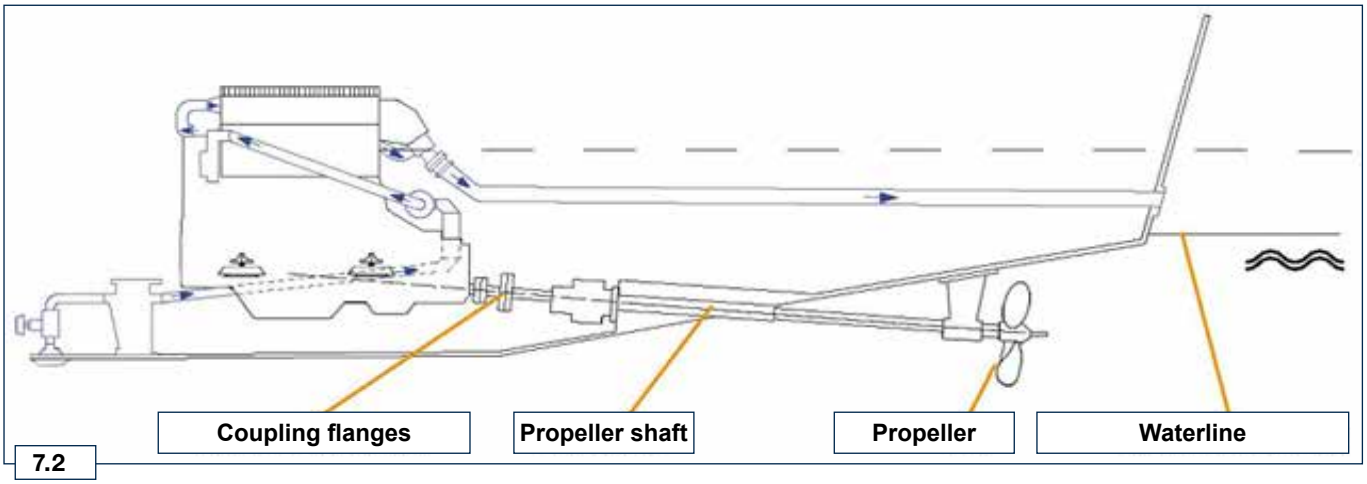
1. The classical transmission in line with the shaft connected to the crosshead;
2. An example of hydraulic transmission;
3. A s-drive transmission.



7.1

Among other differences, note the position of the propeller moved forward and farther than the ship's whee.

The application process (installation on a boat) of a marine engine for propulsion must be carried out respecting some consolidated norms as per the attached scheme:

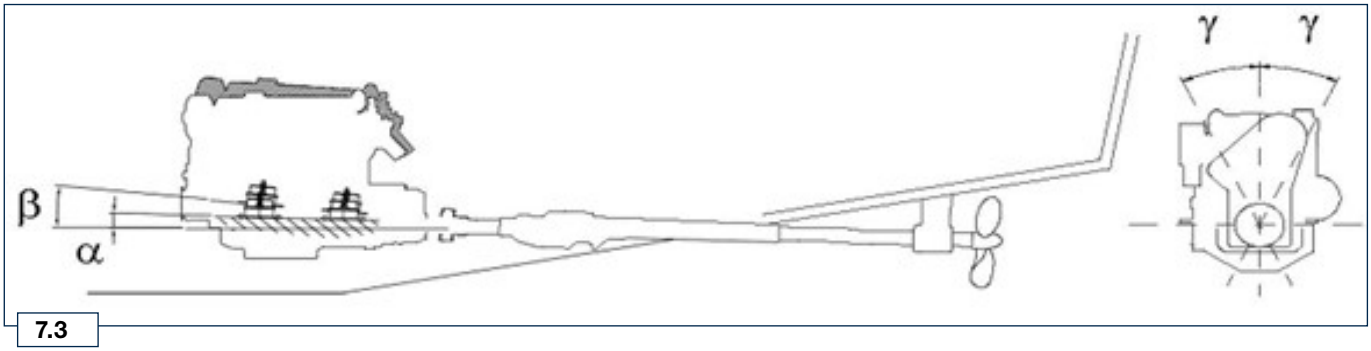


7.2

7.2 Prescriptions to be respected

During the installation operations, the following instructions must be observed:

7.2.1 Compliance with the maximum inclinations permitted (owner manual)

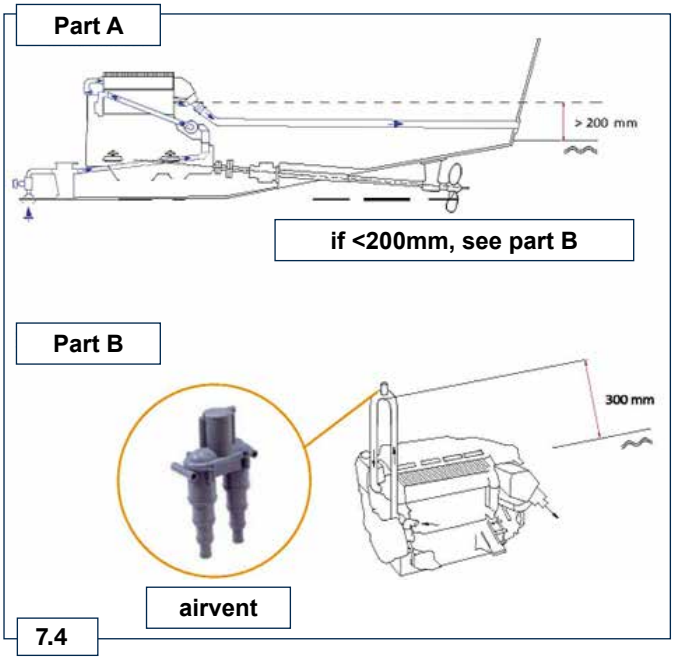


7.3

Engine	α	β	γ
	Maximum installation tilt	Maximum running tilt	Maximum sidetilt

7.2.2 Engine below sea level with airvent valve installation scheme

If sea water outlet is at height of less than 200 mm from the water line, fit an airvent system.

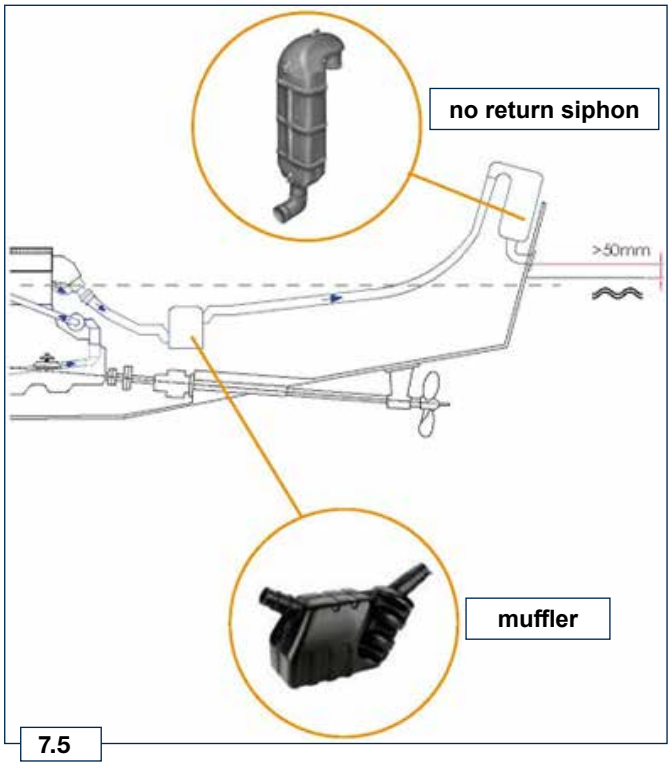


7.4

7.2.3 Exhaust line with muffler and terminal siphon installation scheme

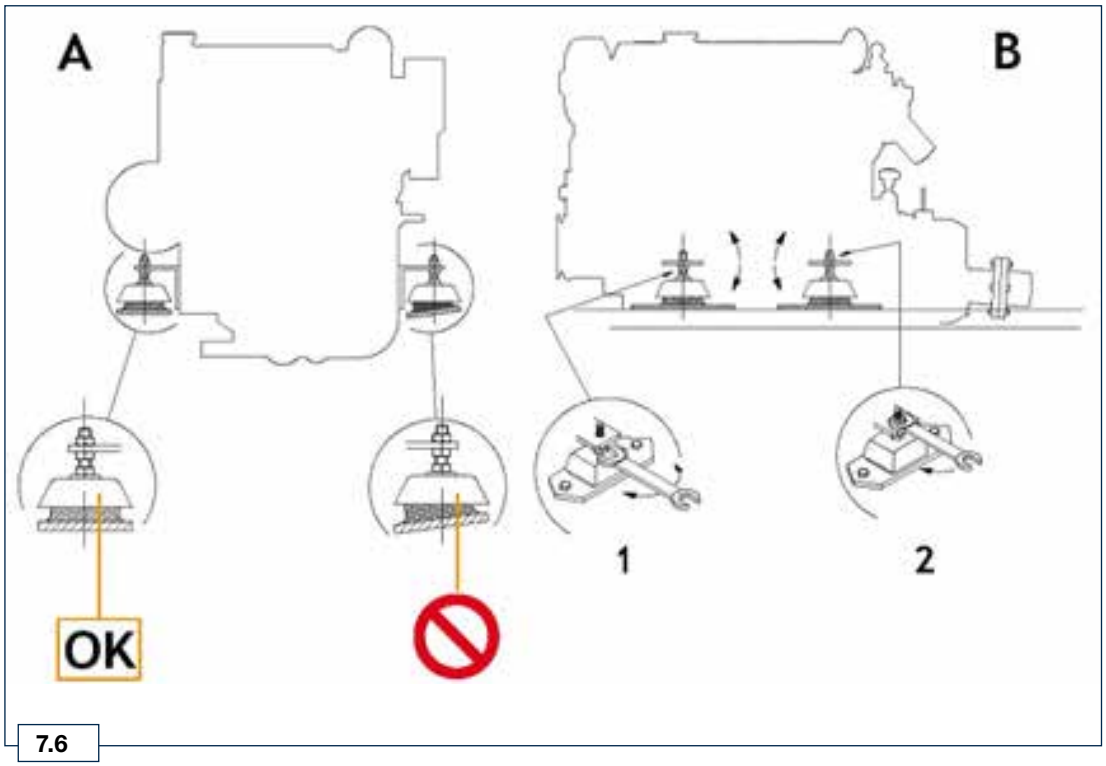
If the exhaust line is ascending and the sea water exit from the engine is under the waterline, install a muffler and a non-return siphon.

Muffler must hold a large volume of water included between the muffler and the exhaust exit.



7.5

7.2.4 Supports anti-vibration position and adjustment scheme



7.6

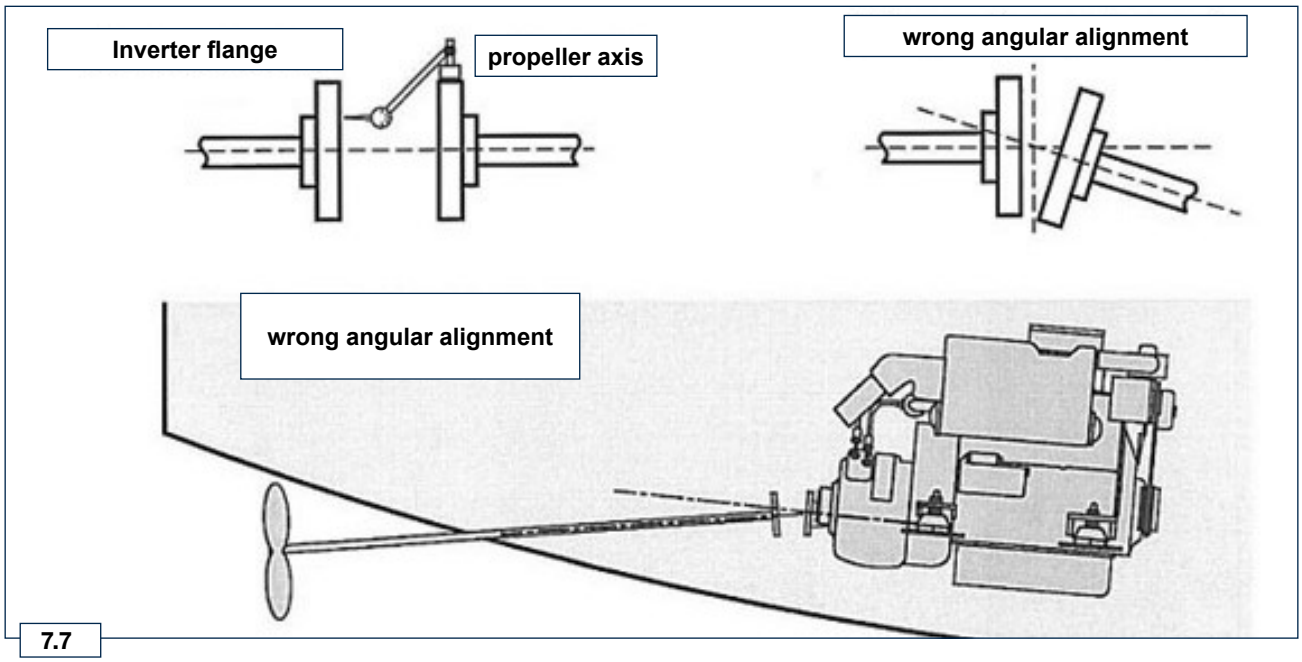
7.2.5 Connection and alignment to the axis line scheme

Accurate alignment is done by adjusting the elastic supports and locking them when the correct position has been found.

Engine and inverter must be aligned with the propeller shaft in two ways.

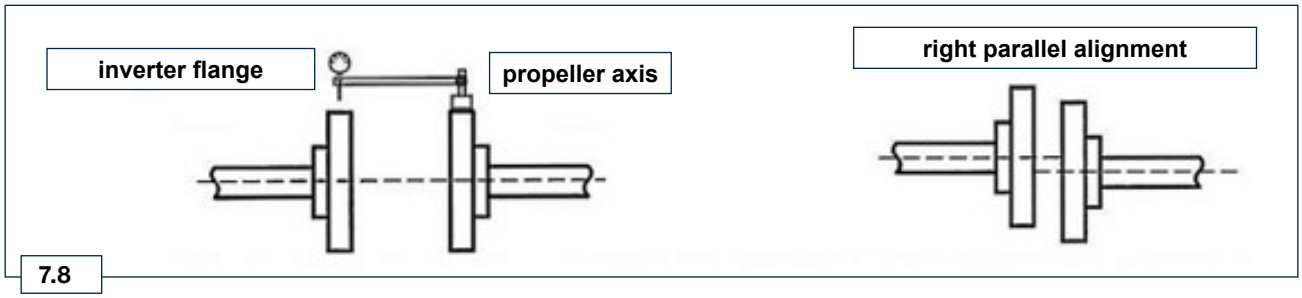
The traditional measurement is made using a thickness gauge and the alignment can be considered correct when the measured value is within 0.125 mm.

Angular alignment



7.7

Parallel alignment



7.8

8.1 Useful information about failures

- This chapter contains information about the problems that may appear during engine operation with its causes and trouble shooting **Tab. 7.2**.
- In some cases, you shall turn off the engine immediately to avoid further damage **Tab. 7.1**.

Tab. 8.1

THE ENGINE MUST BE IMMEDIATELY TURNED OFF WHEN:	
1	The engine rpms suddenly increase and decrease
2	A sudden and/or unusual noise is heard
3	The colour of the exhaust fumes suddenly darkens
4	The oil pressure indicator light turns on while running

Tab. 8.2

	POSSIBLE CAUSE	FAILURE TO START	STARTS AND STOPS	POOR ACCELERATION	UNSTEADY SPEED	BLACK SMOKE	WHITE SMOKE	LOW OIL PRESSURE	HIGH WATER TEMPER-ATURE
Maintenence	Clogged air filter		■			■			
	Excessive idle operation						■		
	Incomplete run-in						■		
	Overloaded			■					
Setting/Repairs	Incorrect injection timing			■					
	Governor linkage wrongly set				■				
	Governor spring broken			■					
	Low idle speed		■						
	Rings worn or sticking						■		
	Worn cylinder						■		
	Valves cylinder	■							
	Worn main con. rods bearings							■	
	Loose cylinder locknuts	■							

	POSSIBLE CAUSE	FAILURE TO START	STARTS AND STOPS	POOR ACCELERATION	UNSTEADY SPEED	BLACK SMOKE	WHITE SMOKE	LOW OIL PRESSURE	HIGH WATER TEMPER-ATURE
Maintenance	Clogged air filter		■			■			
	Excessive idle operation						■		
	Incomplete run-in						■		
	Overloaded			■					
Setting/Repairs	Incorrect injection timing			■					
	Governor linkage wrongly set				■				
	Governor spring broken			■					
	Low idle speed		■						
	Rings worn or sticking						■		
	Worn cylinder						■		
	Blocked valves	■							
	Worn main con. rods bearings							■	
	Loose cylinder locknuts	■							
Fuel system	Obstructed fuel line	■	■						
	Fuel filter clogged	■	■						
	Air leaks in fuel system	■	■						
	Clogged tank vent hole	■							
	Injector sticking	■							
	Injection pump valve sticking	■							
	Injector not adjusted					■			
	Faulty fuel feeding pump	■	■						
	Hardened inj. pump rack			■	■				
	Extra fuel control level sticking					■			

	POSSIBLE CAUSE	FAILURE TO START	STARTS AND STOPS	POOR ACCELERATION	UNSTEADY SPEED	BLACK SMOKE	WHITE SMOKE	LOW OIL PRESSURE	HIGH WATER TEMPERATURE
Cooling circuit	Soft water pump worn out								■
	Tube nest dirty								■
	Sea water pump impeller worn out								■
	Overloaded boat, fouling onbottom					■			
	Obstructed fuel line								■
	Air trapped in the tube between sea water intake and water pump								■
Lubrication	Oil level too high				■		■		
	Oil pressure sticking							■	
	Oil pressure regulator not adjusted							■	
	Worn oil pump							■	
	Air into oil suction line							■	
	Faulty pressure gauge or pressure switch							■	
	Oil suction line clogged							■	
Electrical system	Discharged battery	■							
	Cable connections uncertain or incorrect	■							
	Faulty starting switch	■							
	Faulty starting motor	■							

In case the suggested troubleshooting solutions in Tab. to encountered failures do not resolve the issue, contact an authorized Lombardini Marine workshop.

A	Authorised workshop:	Kohler authorised service centre.
B	Bore	Internal diameter of the cylinder in combustion engines.
C	EC:	“European Community”.
	Combustion:	Chemical reaction of a mixture composed of fuel and fuel (air) inside a combustion chamber.
F	Fig.:	Figure.
G	Galvanised:	Material that has undergone surface protection treatment.
H	Heavy conditions:	Type of extreme condition referred to the work environment in which the engine is used (very dusty - dirty area, or in a contaminated environment due to various types of gas).
M	Maintenance - periodic:	A group of maintenance actions that have the sole objective to control and replace elements on their expiry, without modifying or improving the functions carried out by the system, neither increasing the value nor improving performance.
	MAX:	Maximum.
	Methyl ester:	It is a mixture of products by means of a chemical conversion of oils and animal and/or vegetable fat, which is used to produce Biofuel.
	Min.:	Minutes.
	MIN:	Minimum.
	Model:	Model, engine identification plate, which indicates the engine’s model.
P	Par.:	Paragraph.
	Paraffin:	Fatty and solid substance that may form inside the diesel.
R	Raiser:	Mixing device that reduces the temperature of the exhaust gases by mixing them with the water from the coolant cooling process. The water and gas mixture is then eliminated through the exhaust pipe.
	Ref.:	Reference.
S	s/n:	Serial number (engine identification name plate) indicating the engine identification series/chassis number.
	Sec.:	Seconds
	Spec.:	Specification, (engine identification name plate) indicating the engine version.
T	Tab.:	Table.
	Tightening torque:	A term indicated for installation of threaded components and which is determined by means of a unit of measurement Nm.
U	Used oil:	Oil altered by operation or time, which is no longer compliant for correct lubrication of the components.
Z	Zinc anode:	Element whose purpose is to prevent the corrosion of components due to the water flow from the water pump.

SYMBOLS AND UNITS OF MEASUREMENT			
SYMBOL	**UNIT OF MEASUREMENT**	**DESCRIPTION**	**EXAMPLE**
α	degree	Rotation/inclination angle	1°
cm^2	square centimetre	Area	1 cm^2
Ø	millimetre	Diametre	Ø 1 mm
Nm	newton-metro	Torque	1 Nm
mm	millimetre	Length	1 mm
µm	1/1000 of a millimetre (micron)		1 µm
h	hour	Time	1 h
g/kWh	grams per kilowatt per hour	Specific consumption	1 g/kWh
kg/h	kilogram per hour	Max. flow rate	1 kg/h
Lt./min.	litres per minute	Flow rate	1 Lt./min.
Lt./h	litres per hour		1 Lt./h
ppm	parts per million	Percentage	1 ppm
N	newton	Force	1 N
A	Ampere	Intensity of electrical current	1 A
gr.	gram	Weight	1 gr.
kg	kilogram		1 kg
W	Watt	Power	1 W
kW	kiloWatt		1 kW
pa	pascal	Pressure	1 pa
KPa	kilopascal		1 KPa
bar	barometric pressure		1 bar
mbar (1/1000 bar)	barometric pressure		1 mbar
R	resistance	Resistance to electrical current (referred to a component)	1 Ω
Ω	ohm	Resistance of electrical current	1 Ω
Rpm	revs per minute	Rotation of an axis	1 Rpm
Ra	average roughness expressed in microns	Roughness	Ra = 1
°C	degree centigrade	Temperature	1 °C
°F	degree Fahrenheit		1 °F
V	Volt	Electrical voltage	1 V
⬢	millimetre	Testa vite esagonale	⬢ 1 mm
cm3	cubic centimetre	Volume	1 cm3
Lt.	litre		1 Lt.

WARNING: This product can expose you to chemicals, including carbon monoxide and benzene, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65warnings.ca.gov

WARNING: Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel

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www.lombardinimarine.com

SALES OFFICE

Lombardini Marine
Via Cav. del lavoro A. Lombardini n° 2
42124 Reggio Emilia, Italia
T. +39 0522 389311
F. +39 0522 389298
e-mail: sales@lombardinimarine.com