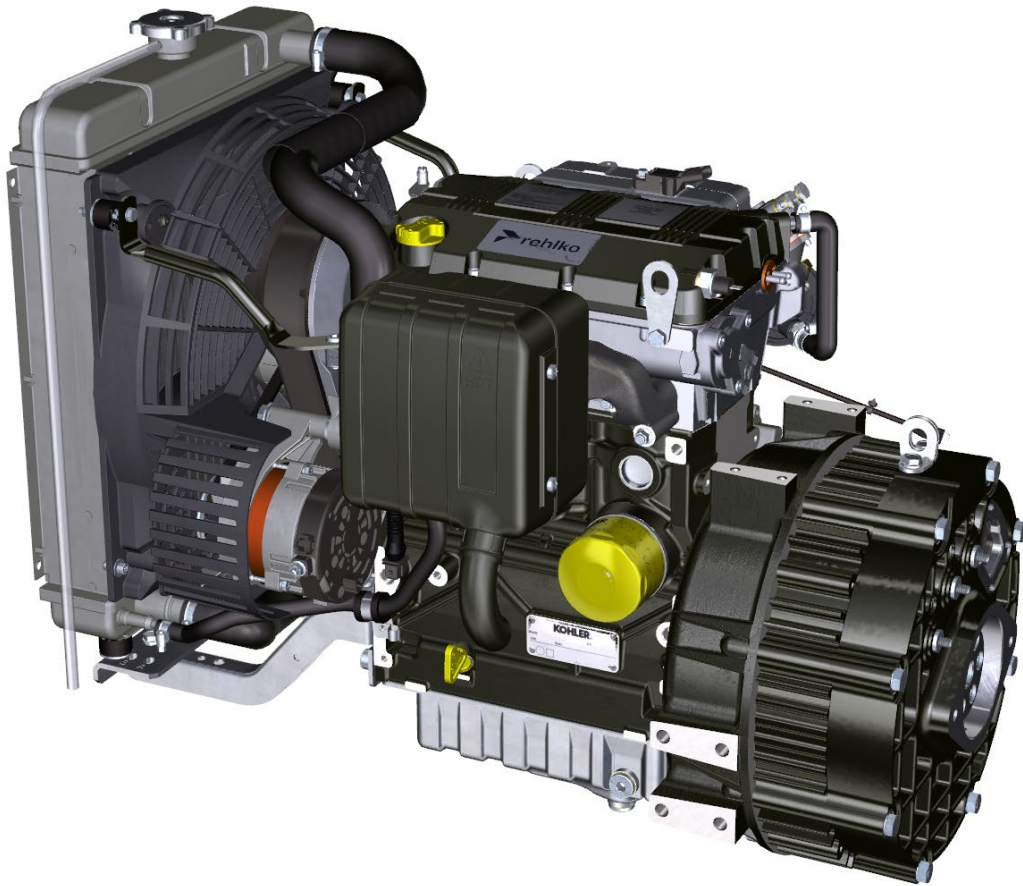


**KDW 502 | 702 | 1003 | 1404
K-HEM 1003**

OWNER MANUAL



 **rehlko**

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	Code	Revision	Release Date	Revision date	Edited by	Endorsed
Technical Publications	ED0053033250-S	03	03/2023	11/2025	C. Accoti	C. Tagliavini

Translated from the original manual in Italian language

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



Important

The latest version of this manual is available on the i-Service website, connect to the following link <https://iservice.lombardini.it>, before downloading the manual, you can select the desired language from the top bar of the site as shown in the figure below.

1	General Information	6
1.1	Manual's Purpose	6
1.2	Glossary and Definitions	6
1.3	Emission-Related Installation Instructions	7
1.4	Service request.....	7
1.5	Manufacturer and engine identification	8
1.6	Homologation labels	10
1.7	Engine component identification	13
2	Technical information	16
2.1	General description of the engine.....	16
2.2	Engine specifications	16
2.3	Engine dimensions (mm)	17
2.4	Oil.....	18
2.5	Fuel	19
2.6	Coolant recommendation.....	21
2.7	Battery recommendation	22
3	Safety information	23
3.1	Safety precautions	23
3.2	General remarks.....	23
3.3	Safety signal description	26
3.4	Information and safety signals	27
3.5	Safety and environmental impact	29
3.6	Location of safety signals on engine	29
4	Information about maintenance	30
4.1	Pre-start check.....	30
4.2	Running-in period	30
4.3	Starting and turning off.....	31
4.4	Periodic maintenance.....	33
4.5	Refuelling	35
4.6	Engine oil and oil filter - filling/checking/replacement.....	35
4.7	Coolant - fill / check / replacement	38
4.8	Air filter cartridge - replacement.....	40
4.9	Fuel filter cartridge - check/replacement	41
4.10	Check of the radiator heat - exchanger surface	42
4.11	Rubber hoses check	43
4.12	Alternator standard belt - check/setting/replacement.....	44
4.13	Product preservation	46
4.14	Engine storage (up to 6 months)	46
4.15	Engine storage over 6 months.....	46

4.16	<i>Engine starting after storage.....</i>	47
4.17	<i>Disposal and scrapping</i>	47
4.18	<i>Unused machine</i>	48
5	Information about failures	49
5.1	<i>Useful information about failures.....</i>	49
6	Information about warranty	51
6.1	<i>Warranty terms.....</i>	51
7	Glossary	55
7.1	<i>Glossary.....</i>	55

1 GENERAL INFORMATION

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.
- **REHLKO** reserves the right to make, at any time, changes in the engines for technical or commercial reasons.
- These changes do not require **REHLKO** to intervene on the marketed production up to that time and not to consider this manual as inappropriate.
- Any additional section that **REHLKO** 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 **REHLKO** . As such, no reproduction or replication in whole or part is allowed without the express written permission of **REHLKO** .

1.2 *Glossary and Definitions*

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

Es: **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-Related Installation Instructions

Failing to follow the instructions in the applications guidebook when installing a certified engine in a piece of nonroad equipment violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act. OEM must apply a separate label with the following statement: “ULTRA LOW SULFUR FUEL ONLY” near the fuel inlet.

Ensure you are installing an engine appropriately certified for your application. Constant speed engines may only be installed on constant speed equipment for constant speed operation.

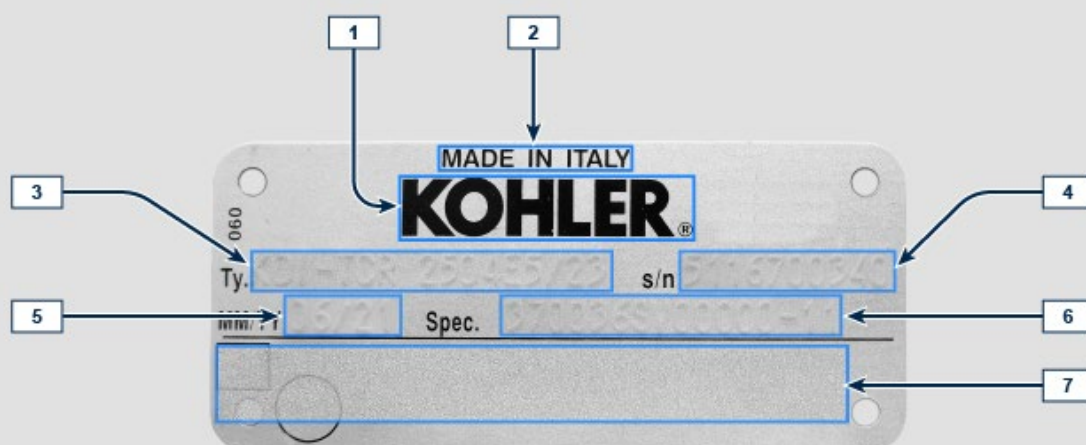
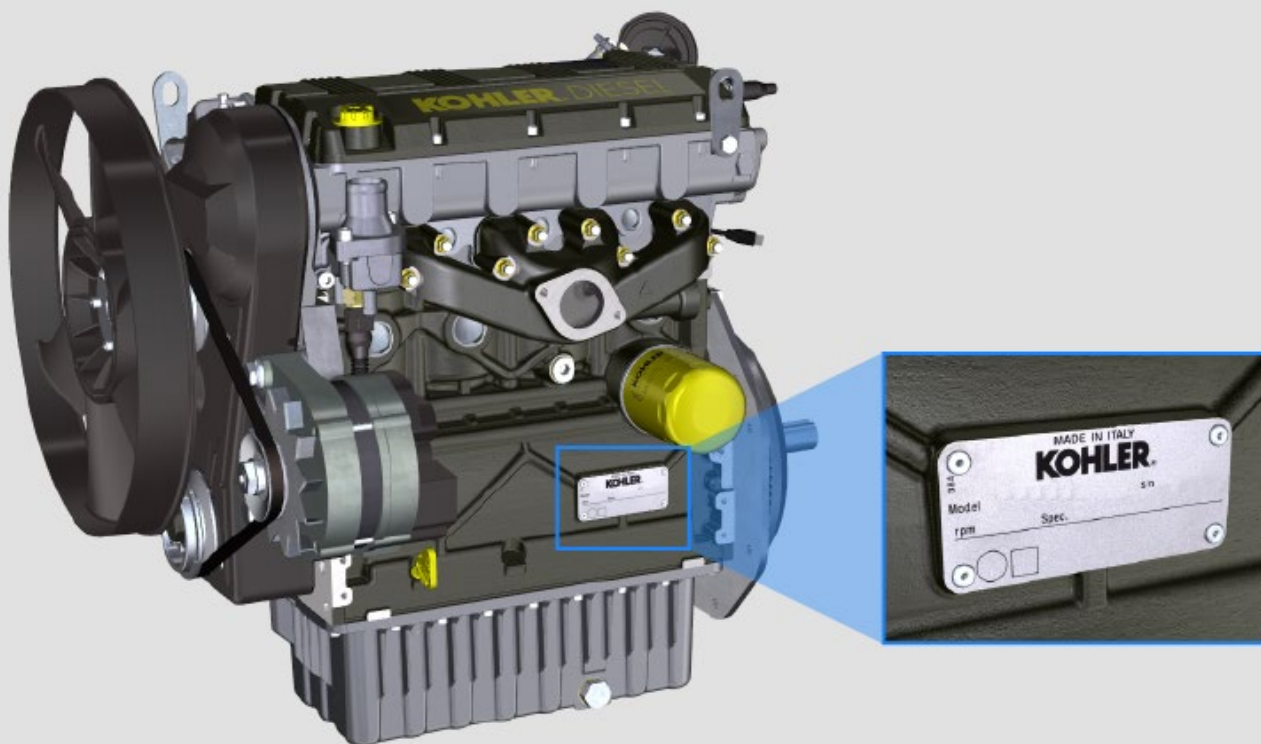
If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment, as described in 40 CFR 1068.105.

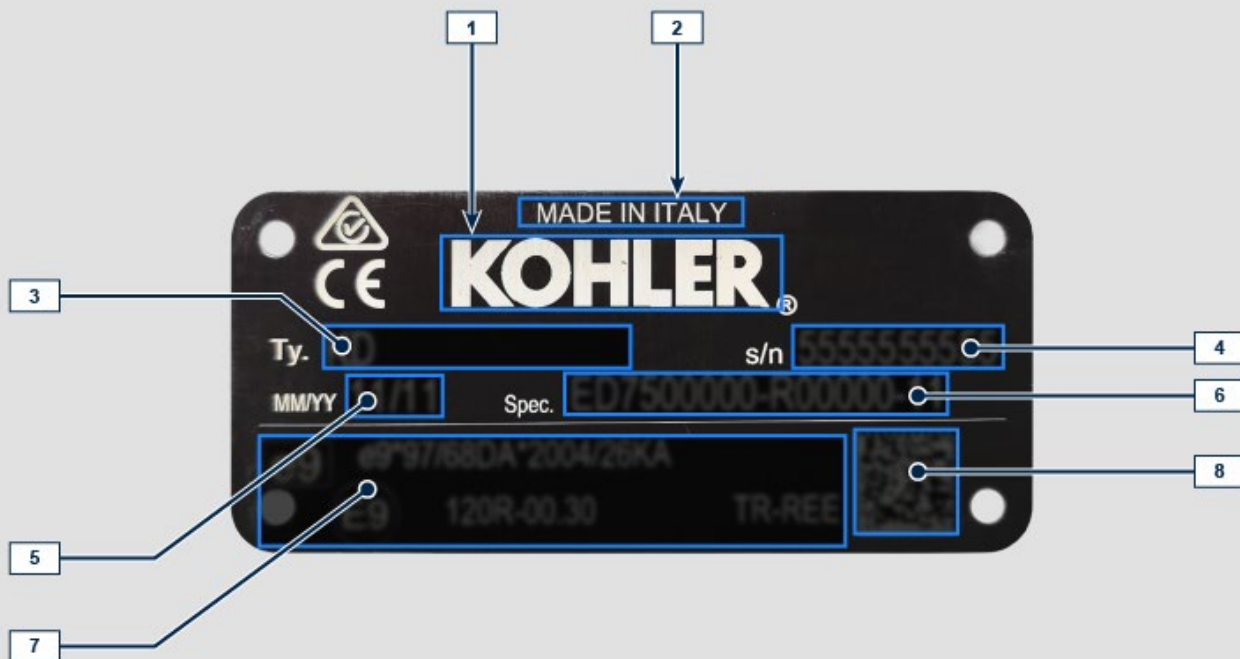
1.4 Service request

- The complete and updated list of authorized **Rehiko** service centers can be found on websites: <https://www.engines.rehiko.com/> & <https://www.engines.rehiko.com/dealers>.
- If you have any questions regarding your warranty rights and responsibilities or the location of the nearest **Rehiko** authorized service location, you should contact **Rehiko** at 1-800-544-2444 or access our website at <https://www.engines.rehiko.com/> (USA and North American).

1.5 Manufacturer and engine identification

The engine identification name plate is situated in the lower part of the crankcase; it is visible from the intake or exhaust side, the name plates that can be present are shown below.



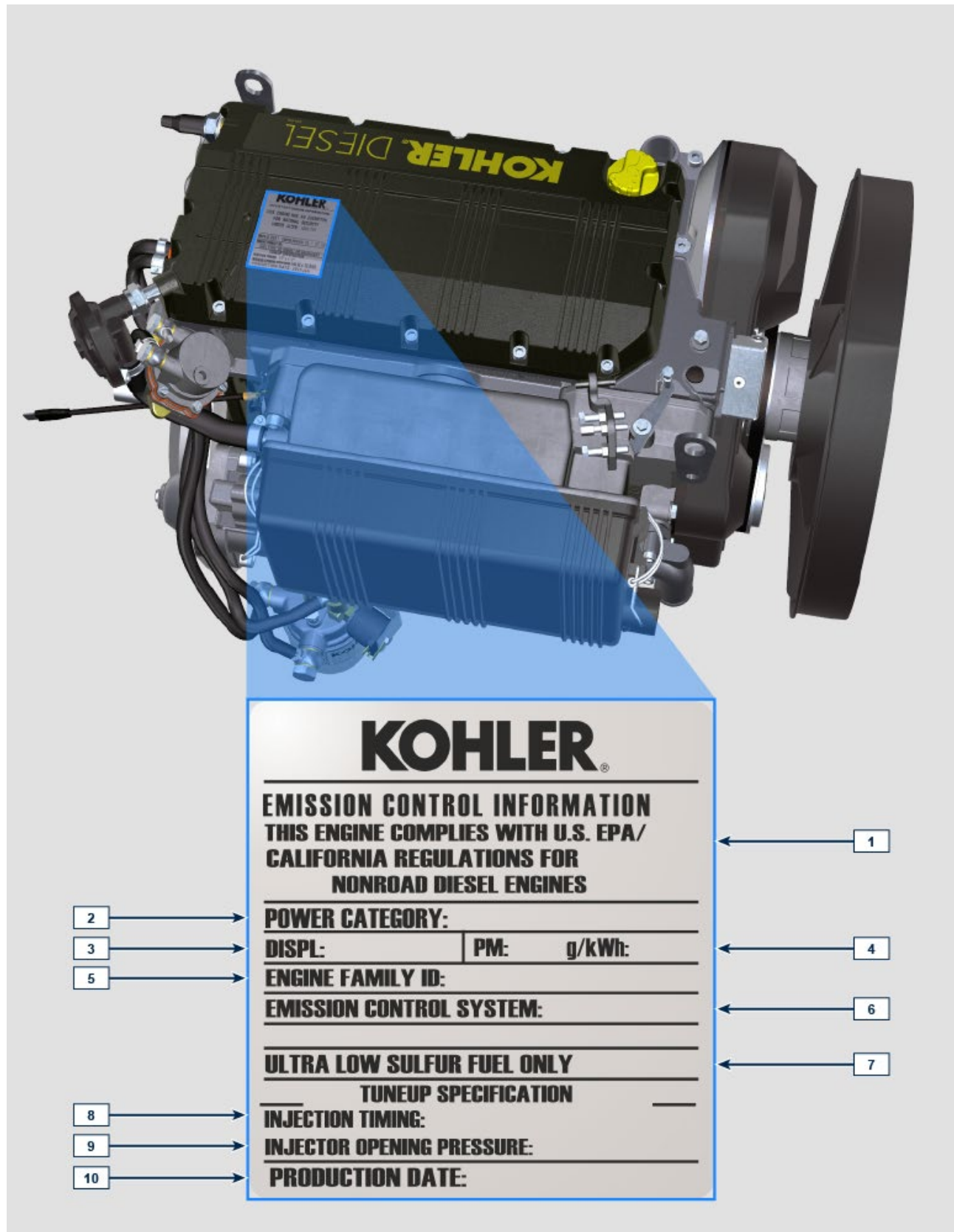


1.1

POS.	DESCRIZIONE
1	Manufacturer
2	Manufacturing place
3	Engine model
4	Serial number
5	Manufacturing date
6	Engine specification
7	Approval data and "CE" directives
8	Data matrix

1.6 Homologation labels

1.6.1 Label for EPA rules (compilation example)



1.2

POS.	DESCRIPTION
1	Model year in compliance with the rules
2	Power category (kW)
3	Engine displacement (L)
4	Particulate emission limit (g/kWh)
5	Engine family ID
6	Emission Control System = ECS
7	Fuel with low sulphur content
8	Injection timing
9	Electronic injector opening pressure (bar)
10	Production date (example: 2013.JAN)

1.6.2 Label for China Standards (compilation example)

KOHLER®

此发动机符合中国非道路移动式机械用柴油机油3标准
This engine compliant with Stage 3 of China Off-road Mobile Machinery Standard GB20891-2014.

1 → 制造商 \ Manufacturer Lombardini srl	机型 \ Engine model	← 2
3 → 生产日期 \ Manufacturing date		
4 → 信息公开 \ Information Disclosure No. CN FC G3 00 0G92000005 000001		
5 → 所属功率范围 \ Power Range 75kW — 100kW	排放阶段 \ Emission Level 国3	← 6
7 → 额定功率 \ Rated Power 100.0kW/2200rpm	后处理系统 \ Aftertreat system 不适用	← 8

1.3

POS.	DESCRIPTION
1	Manufacturer
2	Engine model
3	Manufacturing date
4	Certificate N°
5	Power range (kW)
6	Emission level
7	Rated power
8	Aftertreat system

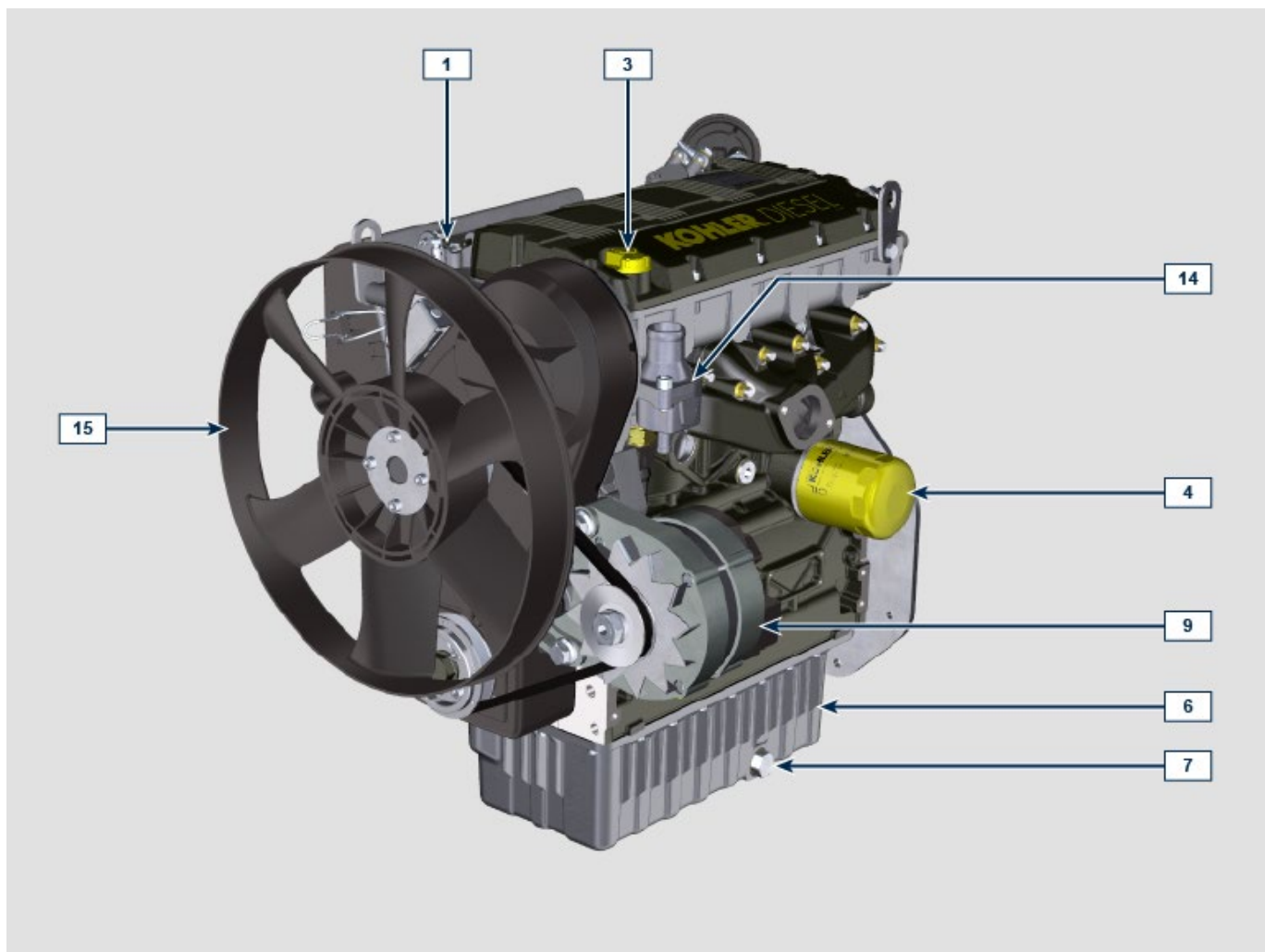
1.6.3 Label for Korea Standards (compilation example)

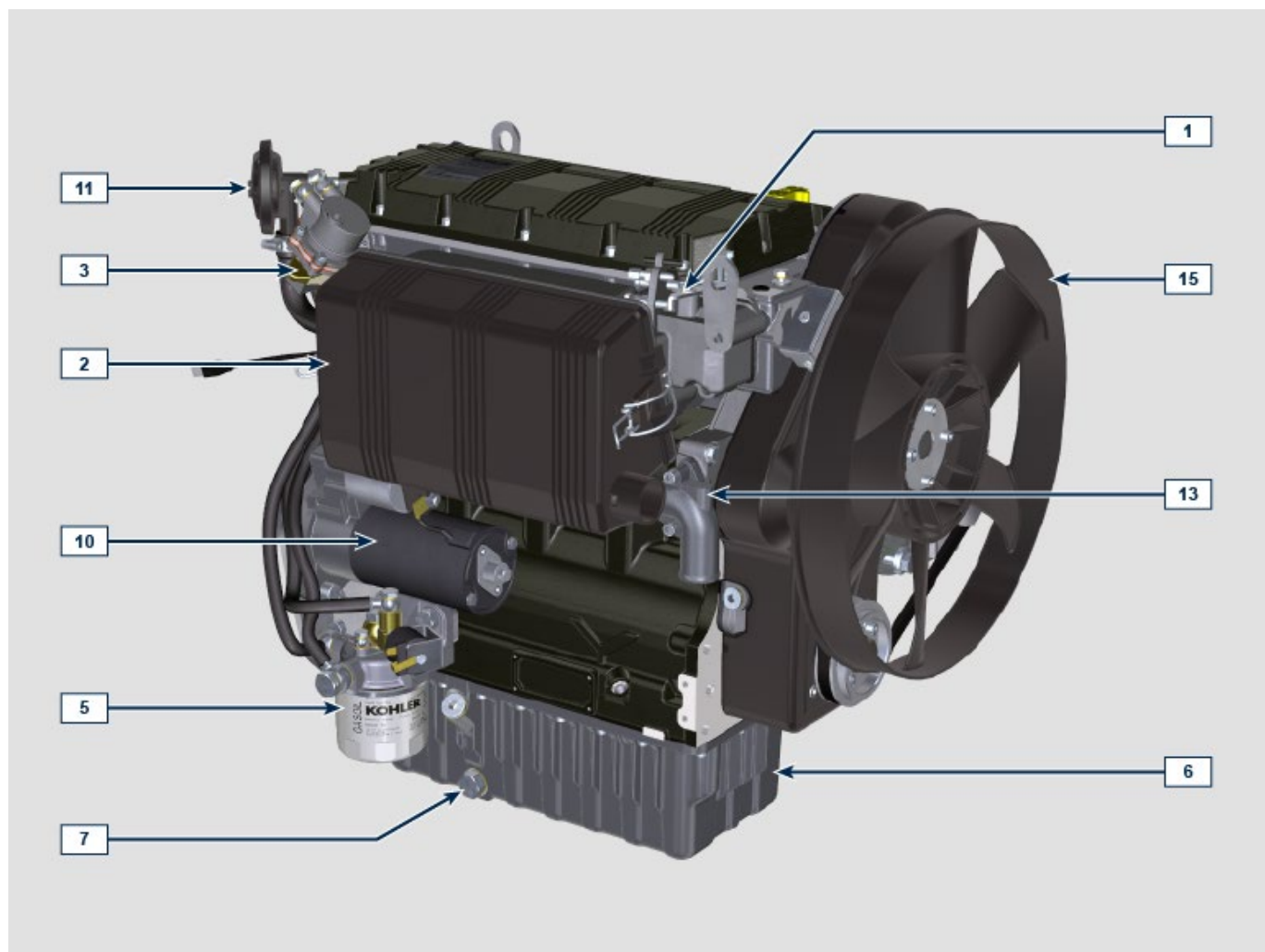


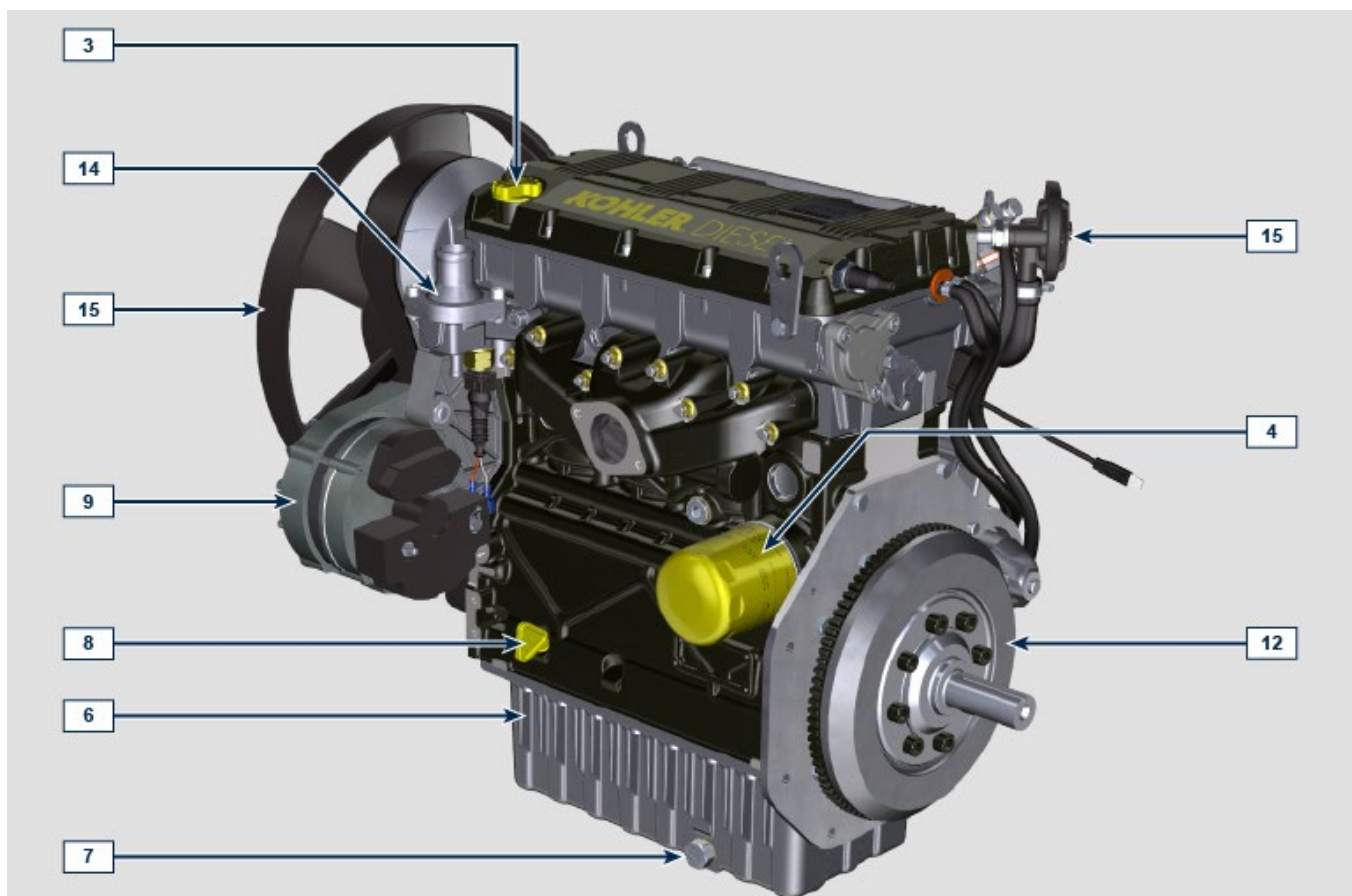
1.4

POS.	DESCRIPTION
1	Tier 4 Final
2	Engine model
3	Manufacturing date and manufacturer code
4	N° Korea emission certificate

1.7 Engine component identification







NOTE: Some components are for illustrative purposes only and may vary or they are not supplied by Rehlko.

POS.	DESCRIPTION
1	Throttle and stop lever
2	Air filter
3	Oil supply plug
4	Oil filter
5	Fuel filter
6	Oil sump
7	Oil drain plug
8	Oil dipstick
9	Alternator
10	Starter motor
11	Oil steam separator
12	Flywheel
13	Coolant pump
14	Thermostatic valve
15	Cooling fan

2 TECHNICAL INFORMATION

2.1 General description of the engine

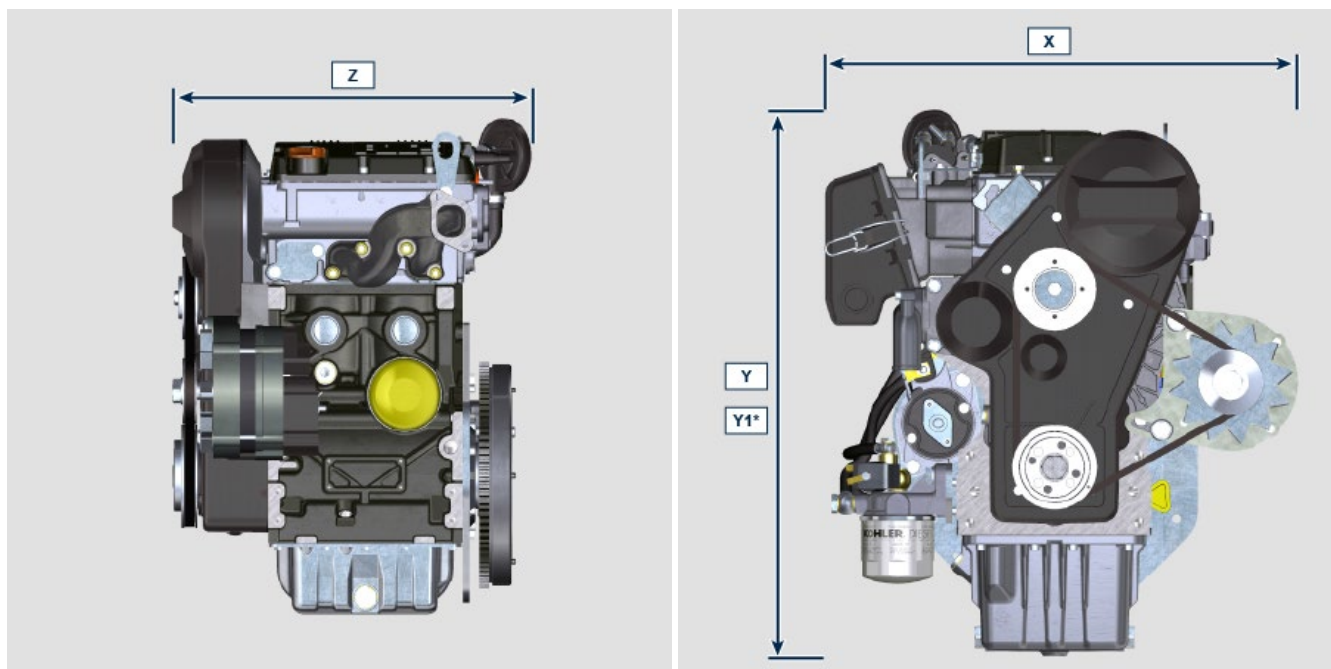
- 4-stroke, in-line cylinders Diesel engine
- Liquid-cooling system
- 2 valves per cylinder
- Indirect injection

2.2 Engine specifications

2.1

TECHNICAL DATA		UNIT OF MEASURE				
Engine type			KDW 502	KDW 702	KDW 1003	KDW 1404
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
MAX INCLINATION DURING OPERATION (even in combined)		α	25° max. 30 min.			
		α	35° max.1 min.			
OIL CAPACITY (MAX level.) - filter included	standard oil sump	lt.	1.5	1.6	2.4	3.2
	enhanced oil sump	lt.	2.5	2.5	3.8	5.2
OIL CAPACITY (MAX level.) - with out filter	standard oil sump	lt.	1.4	1.5	2.3	3.0
	enhanced oil sump	lt.	2.4	2.4	3.7	5.1
DRY WEIGHT		Kg	60	66	87	98

2.3 Engine dimensions (mm)



	KDW 502	KDW 702	KDW 1003	KDW 1404
X	387	412	412	412
Y	490	516	516	516
Z	426	421	513	596
Y1*	$562.35 = (Y + 72.35)$	$588.35 = (Y + 72.35)$	$588.35 = (Y + 72.35)$	$588.35 = (Y + 72.35)$

Y1* = Deep oil sump

NOTE : Dimensions vary according to engine configuration.

2.4 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.
- Viscosity must be appropriate to the ambient temperature to which the engine is to be exposed.



Danger

- 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. DISPOSAL and SCRAPPING**.

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.

Use oil viscosity based on the experienced air temperature range during the period between oil changes as indicated in the table below.

Rehlko X-treme 5W-40 oil is preferred:



Oils meeting the following specifications are also recommended.

2.2

RECCOMENDED OIL		
WITH SPECIFICATIONS	API	SJ/CF 4
	ACEA	A3-96 B3-96
	MIL	L-46152 D/E
VISCOSITY	SAE	5w-40 (-30°C ÷ +40°C)

- Filtration of oils is critical to proper operation and lubrication; always change filters regularly as specified in this manual.

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 serious engine faults.



Warning

- Clean fuel prevents the fuel injectors from clogging. Immediately clean up any spillage during refuelling.
- Never store diesel fuel in galvanized containers (i.e. coated with zinc). Diesel fuel and the galvanized coating react chemically to each other, producing flaking that quickly clogs filters or causes fuel pump and/or injector failure.
- Any failure resulting from the use of fuel other than **Tab. 2.3, 2.4** will not be covered by warranty.

Cetane number of 40 minimum. Cetane number greater than 47 is preferred, especially for temperatures below -20°C (-4°F) or elevations above 1675 m (5500 ft.).

Highly Regulated Engines (EU, USA, CANADA, JAPAN, CHINA, INDIA)

EU EN 590

North America ASTM D975 No. 2-D S15; No. 1-D S15

Japan JIS K 2204 No. 1; No. 2

India BS-V ULSD; BS-VI ULSD

China GB 19147-2016 ULSD; GB 17691—2018 ULSD

HVO EN 15940 or ASTM D975

Military NATO fuel F-54 S < 10ppm

Less or Not Regulated Engines (Rest of the World and Military applications)

Equivalent to all above specification

Equivalent to all above specification but with Sulphur < 500ppm

Equivalent to all above specification but with Sulphur < 2000ppm

F-34/F-35 (kerosene NATO designation) **(1)**

F-44 (kerosene, NATO designation) **(1)**

F-63 (kerosene, NATO designation, equivalent to F-34/F-35 with additives) **(1)**

JP-8 (kerosene, US military designation) **(1)**

JP-5 (kerosene, US military designation) **(1)**

Jet A / A1 (kerosene for civil aviation) **(1)**



(1) Operations with Jet Fuels: The jet fuels can be used but only adopting an additional fuel filter with lubricity doser. Because of lower density and greater leak fuel volume due to lower viscosity, depending on the engine speed and torque, a power loss up to 10% is possible. There are some problematical fuel proprieties amongst the listed jet fuels (viscosity, lubricating capacities and low boiling point). A slight increase in wear in the injection system is to be expected which can lead to a statistically shorter life of these components. Sulphur content must be below 2000ppm

2.5.1 Fuel Additives

To aid in maintaining performance of the engines injection system, Rehiko has developed a family of fuel additives product for North America market.

The Extra Performance Fuel Additive Arctic Formula a fuel conditioner in winter, the Extra Performance Fuel Additive a fuel injector deposit removal and prevention. See your local Rehiko dealer for availability.

2.3

Rehiko Extra Performance Fuel Additive (North America only)	
<p>Use Rehiko Injector Cleaner Diesel Fuel Additive before filling the tank once a year or every 500hrs with summer or winter grade fuel. Formulated to clean deposits from injectors and provide lubrication to high pressure pump and injectors to reduce wear, increasing fuel quality. Compatible with all exhaust emission system, including diesel particulate filters (DPFs). Follow all recommended instruction on product label.</p>	
Rehiko Extra Performance Fuel Additive Arctic Formula (North America only)	
<p>Use Rehiko Extra Performance Fuel Additive Arctic Formula, which contains anti-gel chemistry to treat non-winter grad fuel (No. 2-D in North America) during the cold-weather season. This extends the operability to about 10°C (18°F) below the could point. For operability at even lower temperatures, use winter grade fuel. Treat the fuel when the outside temperature drops below 0°C (32°F). For best results, use untreated fuel and follow all recommended instruction on product label. Cloud point is the temperature at which wax begins to from in the fuel causing filters to plug.</p>	
<p>Fuel additives with biocide/algaecide functions are allowed in case of storage of fuel in the tank for long periods (one year or more).</p>	<p>For suggested brands and types contact Rehiko staff</p>
<p>NOTE: These additives must be diluted in the fuel following the product prescribed percentages when filling the tank.</p>	

2.6 Coolant recommendation

Rehiko Xtended™ prediluted coolant 50% ethylene glycol OAT is preferred.



Coolant meeting the following specifications are also recommended.

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 KDW 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 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.
- Never use automotive-type coolants. These coolants do not contain the correct additives to protect heavy – duty diesel engines.

OAT coolants are maintenance free up to 5 years or 4000hrs of operation , provided that the cooling system is topped up using the same type of coolant. Do not mix different coolant types. 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.

2.7 Battery recommendation

Battery not supplied by Rehiko

2.5

RECOMMENDED BATTERIES		
	IN STANDARD START CONDITIONS	IN HEAVY-DUTY START CONDITIONS
KDW 502	12w-44 Ah / 210 A/DIN 12w-44 Ah / 410 A/EN 12w-44 Ah / 400 A/SAE	12w-55 Ah / 255 A/DIN 12w-55 Ah / 500 A/EN 12w-55 Ah / 485 A/SAE
KDW 702	12w-66 Ah / 330 A/DIN 12w-66 Ah / 650 A/EN 12w-66 Ah / 630 A/SAE	12w-88 Ah / 350 A/DIN 12w-88 Ah / 690 A/EN 12w-88 Ah / 665 A/SAE
KDW 1003-1404	12w-70 Ah / 350 A/DIN 12w-70 Ah / 690 A/EN 12w-70 Ah / 665 A/SAE	12w-92 Ah / 420 A/DIN 12w-92 Ah / 825 A/EN 12w-92 Ah / 800 A/SAE

for **K-HEM** model:

to replace the batteries for the hybrid unit, contact the machine manufacturer.

3 SAFETY INFORMATION

3.1 Safety precautions

- 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 **REHLKO**.
- **REHLKO** declines all responsibility for any change to the engine not described in this manual made by unauthorized **REHLKO** 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 **Par. 3.4.3**.
- **REHLKO** declines all direct and indirect liability for failure to comply with the standards of conduct contained in this manual.
- **REHLKO** cannot consider every reasonably unforeseeable misuse that may cause a potential danger.
- For **K-HEM** model: any work on the hybrid unit is forbidden. In case of malfunction, contact the authorized **REHLKO** workshops.

3.2 General remarks

3.3.1 Note for OEM

- When installing the **KDW / K-HEM** engines, always bear in mind that any variation to the functional systems may involve serious failures to the engine.
- Any improvement must be verified at **REHLKO** testing laboratories before application of the engine.
- In the event **REHLKO** does not approve the type of modification, **REHLKO** shall not be held responsible for any consequential operation anomalies that the engine may undergo and any damage the engine may cause to persons and things.
- The engine may only be assembled on a machine by personnel specifically trained by **REHLKO** and who work in compliance with the existing documentation.
- The engine has been built to the specifications of a machine manufacturer, and it is his responsibility to ensure that all necessary action is taken to meet the essential and legally prescribed health and safety requirements. Any use of the machine other than that described cannot be considered as complying with its intended purpose as specified by **REHLKO**, which therefore declines all responsibility for accidents caused by such operations.

3.3.2 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.
- Make sure that the machine is stable to prevent 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.

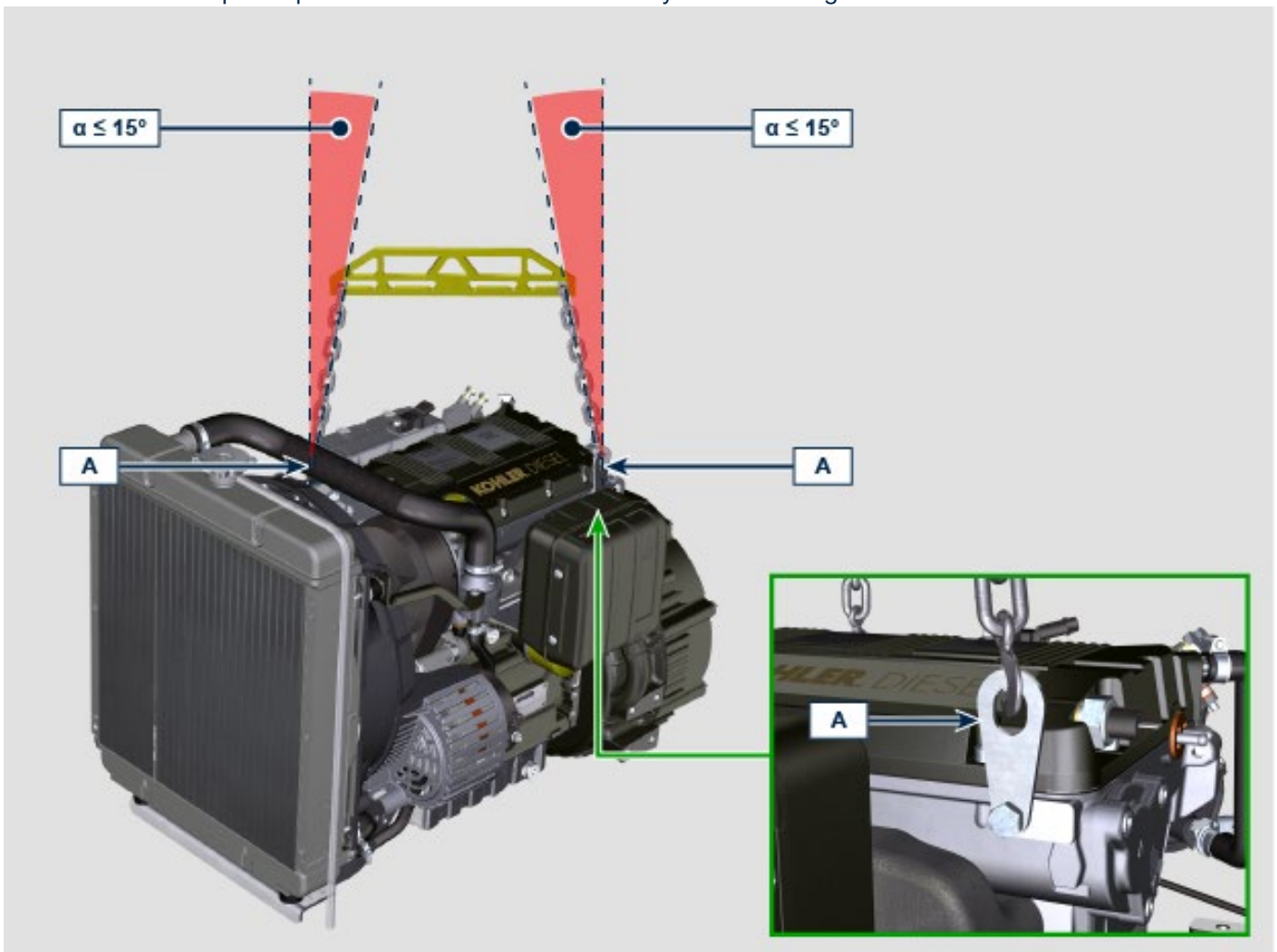
- To prevent fire hazards, always keep the machine at least one meter from buildings or from other machinery.
- Children and animals must be kept at a due distance from operating machines in order to prevent hazards deriving from their operation.
- Thoroughly wash and clean all the external parts of 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 vapour is highly toxic. Only refuel outdoors or in a well ventilated place.
- Make sure that no soundproofing panels and the ground or floor on which the machine is standing have not soaked up any fuel.
- The engine may only be assembled on a machine by personnel specifically trained by **REHLKO** and who work in compliance with the existing documentation.
- The engine has been built to the specifications of a machine manufacturer, and it is his responsibility to ensure that all necessary action is taken to meet the essential and legally prescribed health and safety requirements. Any use of the machine other than that described cannot be considered as complying with its intended purpose as specified by **REHLKO**, which therefore declines all responsibility for accidents caused by such operations.
- 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 there is an electric fan, do not approach the engine when it is still hot as the fan could also start operating when the engine is at a standstill.
- 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 **REHLKO**.
- 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 jets of air and water at high pressure on the cables, connectors and electronic injectors.

- For engines equipped with ATS device, it is necessary to inhibit regeneration if using the engine in environments featuring risk of fire (e.g.: woods, areas containing flammable materials, areas containing flammable gas or liquids and any type of combustible material - if this function is available).



Important

- Only use the eyebolts **A** installed by **REHLKO** to move the engine.
- The angle between each lifting chain and the eyebolts shall not exceed 15° inwards.
- The correct tightening of the lifting brace capscrews is **25 Nm**.
- Do not interpose spacers or washers between the eyebolts and engine head.



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.

3.4.1 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.

3.4.2 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.

3.4.3 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.

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.

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.

HIGH PRESSURE FLUID RISK OF PUNCTURE



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

Work on the injection system must be carried out by suitably trained staff wearing protection equipment. Injuries caused by fluid penetration are highly toxic and dangerous.
If an injury occurs, seek immediate medical attention.

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

**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.

**LETHAL EXHAUST GASES**

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.

**ELECTRICAL SHOCK**

Electrical Shock can cause injury.

Do not touch wires while engine is running.

parts or sparks from ignition. Do not start the engine near spilled fuel. Never use fuel as a cleaning agent.

**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.

**CALIFORNIA WARNING - DECLARATION 65**

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

3.5 Safety and environmental impact

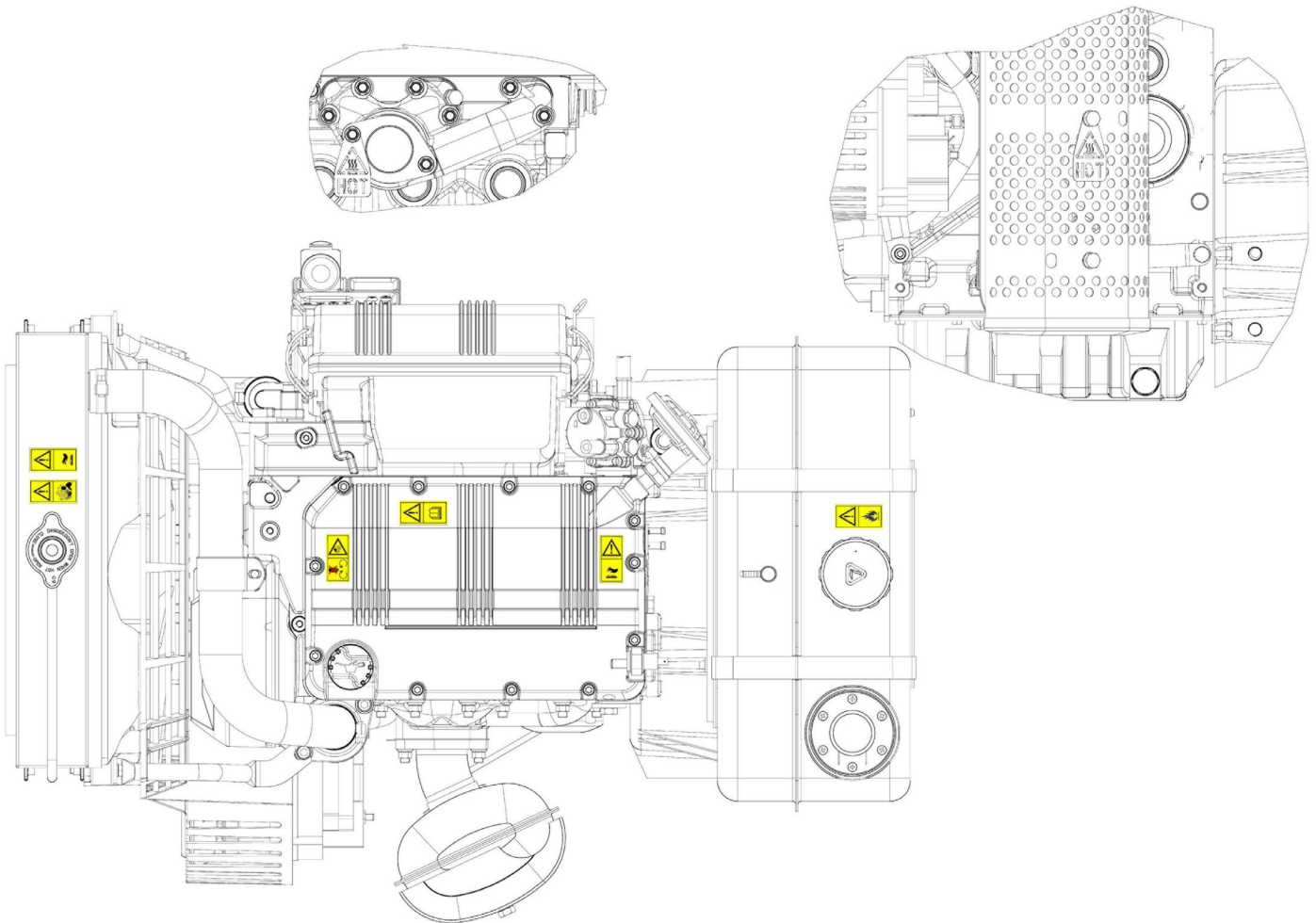
Every organisation has a duty to implement procedures to identify, assess and monitor the influence of its own activities (products, services, etc.) on the environment. Procedures for identifying the extent of the impact on the environment must consider the following factors:

- Disposal of liquids.
- Waste management.
- Soil contamination.
- Atmospheric emissions.
- Use of raw materials and natural resources.
- Regulations and directives regarding environmental impact.

In order to minimize the impact on the environment, **REHLKO** provides some indications to be followed by all those 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 injection system as well as engine management and exhaust pipes in efficient working order to limit environmental and noise pollution.
- When decommissioning the engine, select all components according to their chemical characteristics and dispose of them separately.

3.6 Location of safety signals on engine



4 INFORMATION ABOUT MAINTENANCE

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 *Running-in period*

NOTE: For the first 50 hours of engine operation, it is advisable not to exceed 75% of the maximum power supplied.

4.3 Starting and turning off

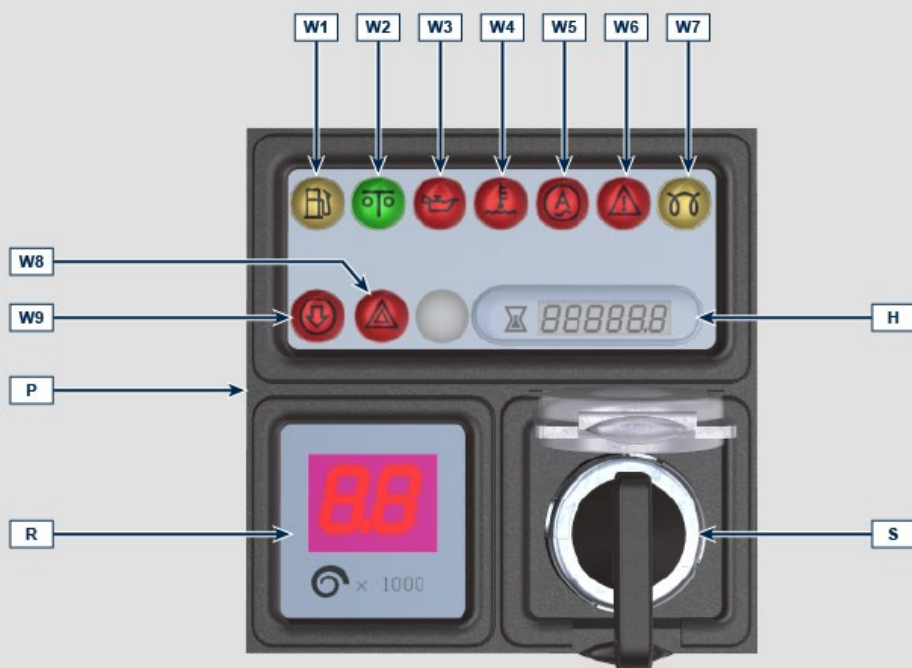
4.3.1 Starting

1. Check the level of the engine oil, fuel and coolant and fill if necessary (**Par. 4.5 - 4.6 - 4.7**).
2. Put the ignition key in the ignition switch (if supplied).
3. Turn the key to **ON** position.
4. Turn the key beyond the **ON** position and release it when the engine starts (the key will return into **ON** position automatically).



Important

- At the first fuelling or if the tank was empty filling the fuel system (**Par. 4.9** from point 4 to point 6).
- Do not actuate the starter for more than 15 seconds at a time. If the engine does not start, wait for one minute before repeating attempt.
- If engine does not start after two attempts see **Tab. 5.2** to found the cause.



Panel **P** can be assembled on the engine or machine. In **Tab. 4.1** are described the main functions are illustrated.

4.1

POS.	DESCRIPTION
H	Hour-meter indicator
R	engine RPM indicator
S	Control switch to start the engine
W1	Warning Light - fuel below MIN level
W2	No fault indicator
W3	Warning Light - engine oil not pressurised
W4	Warning Light - high coolant temperature
W5	Warning Light - battery not charging
W6	Warning Light - machine alarm indicator
W7	Warning Light - glow plugs/heater ignition
W8	Warning Light - alarm general indicator
W9	Warning Light - air cleaner clogged

4.3.2 After starting

**Warning**

- Make sure that all the warning lights on the control panel are off when the engine is running.
- Run at minimum speed for a few minutes according to table (except constant speed engine).

AMBIENT TEMPERATURE	TIME
≤ -20°C	2 minutes
from -20°C a -10°C	1 minutes
from -10°C a -5°C	30 seconds
from -5°C a 5°C	20 seconds
≥ 5°C	15 seconds

4.3.3 Turning off

1. Do not turn off the engine when it is running at the maximum rotation speed (except constant speed engine).
2. Before turning it off, keep it idle at minimum speed for about 1 minute.
3. Turn the key to **OFF** position.

4.4 Periodic maintenance

- This chapter shows all operations described in the **Tab. 4.2, 4.3** . if you have the skills appropriate may be directly carried out by the user.
- Periodic inspection and maintenance operations must be carried out as indicated in this manual and are the responsibility 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

- Inspections must be made when the engine is off and cold.
- 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;
- also check that oil drain plug and oil filler cap are tightened firmly.



Important

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



Danger

- For safety precautions see **Chap. 3**.

The intervals of preventive maintenance in **Tab. 4.2** and **Tab. 4.3** refer to the engine operating under normal operating conditions with fuel and oil meeting the approved specifications.

4.2

CHECKING				
OPERATION DESCRIPTION	PERIOD (HOURS)			
	10	200	500	1000
Engine oil level				
Coolant level				
Cartridge dry-type air filter ⁽³⁾				
Radiator heat-exchange surface and Intercooler				
Standard alternator belt ⁽¹⁾				
Rubber hose (intake air / coolant)				
Fuel hose ⁽¹⁾				
Valve clearance adjustment ⁽⁴⁾				
Injetors cleaning and setting ⁽⁴⁾				
Internal radiator cleaning ⁽⁴⁾				

4.3

REPLACEMENT					
OPERATION DESCRIPTION	PERIOD (HOURS)				
	125	250	500	1000	4000
Engine oil ^{(1) (6)}					
Oil filter cartridge ^{(1) (6)}					
Cartridge dry-type air filter ⁽²⁾⁽³⁾					
Fuel filter ^{(1) (6)}					
Standard alternator belt ⁽²⁾⁽⁴⁾					
Intake manifold hose (air filter - intake manifold) ⁽²⁾⁽³⁾⁽⁴⁾					
Coolant hoses ⁽²⁾⁽³⁾⁽⁴⁾					
Fuel line hose ⁽²⁾⁽³⁾⁽⁴⁾					
Coolant ⁽²⁾⁽⁴⁾					
Timing belt ⁽⁴⁾⁽⁵⁾					

(1) - In case of low use: 12 months.

(2) - In case of low use: 24 months.

(3) - The period of time that must elapse before checking the filter element depends on the environment in which the engine operates.

(4) - Contact authorized **REHLKO** workshops.

(5) - In case of low use: 48 months.

(6) – STD version

4.5 Refuelling



Important

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



Danger

- Fill the engine off.
- The only approved fuels are those listed in **Tab. 2.3**.
 - In those countries where fuel has a high sulphur content, it is advisable to lubricate the engine with a high alkaline oil or alternatively to replace the lubricating oil approved by **REHLKO** 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.

4.6 Engine oil and oil filter - filling/checking/replacement



Important

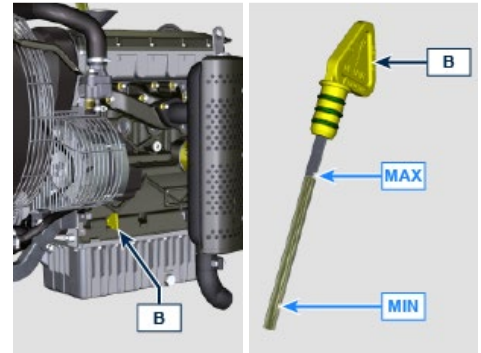
- For safety precautions see **Par. 2.4**.
- Any failure resulting from the use of fuel other than **Tab. 2.3, 2.4** will not be covered by warranty.
- Do not use the engine with the oil level below the **MIN**.
- Do not exceed the **MAX** level on the dipstick.

Filling

1. Loosen the oil filler cap **A**.
2. Add the oil of type recommended (**Tab. 2.2**).



3. Before checking oil engine needs to be level.
4. Remove the oil dipstick **B** and check that the level is up to but does not exceed the **MAX** .
5. If level is not at the **MAX** . level, add additional oil.
6. Re-tighten the cap **A, C** .



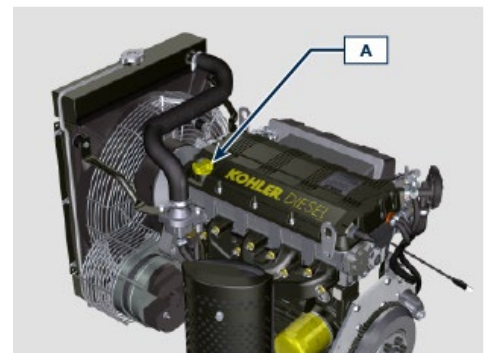
Oil level check

Perform the operations from point 3 to 6.

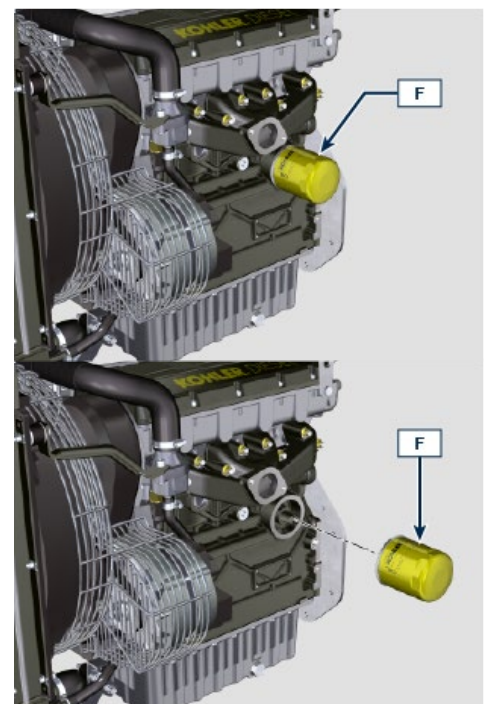
Oil replacement

NOTE : Perform this operation with warm engine, to get a better fluidity of the oil and get a full discharge of oil and impurities contained in it.

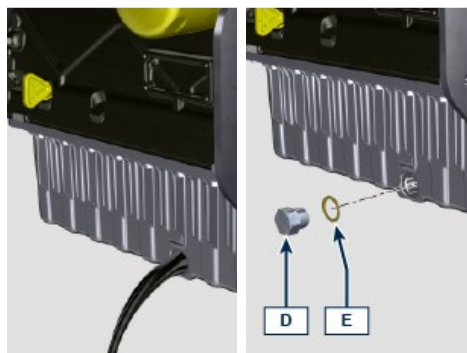
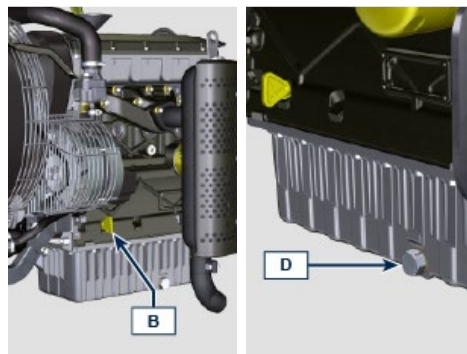
1. Loosen the oil filler cap **A** .



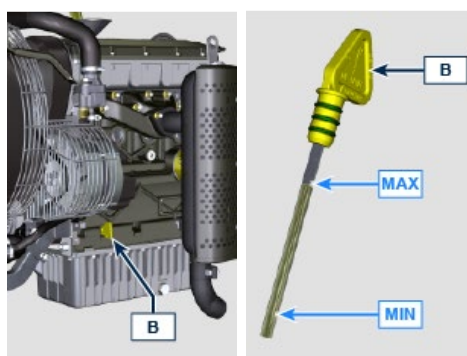
2. Unscrew the oil filter **F** with appropriate wrench.
3. Assembly and tighten the new oil filter cartridge **F** (torque to **15 Nm**).



4. Remove the oil dipstick **B**.
5. Remove the oil drain plug **D** and the gasket **E** (the oil drain plug is on both sides of the oil sump).
6. Drain oil in an appropriate container.
7. Replace gasket **E**.
8. Tighten the drain oil plug **D** (tightening torque at **35 Nm**).



9. Add the type of oil recommended (**Tab. 2.2**).
10. Fit and remove the oil dipstick **B** to check the level.
Pour in fluid until reaching the **MAX** level mark.
11. Upon completion, reinstall the oil dipstick **B** completely.
12. Tighten the cap **A, C**.



4.7 Coolant - fill / check / replacement



Important

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

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



Warning

- Presence of steam pressurized coolant danger of burn.
- The freezing point of the refrigerant mixture depends on the amount concentration in water.
- As well as lowering the freezing point, the antifreeze also raises the boiling point.
- A 50% mixture is recommended to ensure a general level at protection prevents the formation of rust, galvanic currents and calcium deposits.

NOTE : Component not necessarily supplied by **REHLKO**.

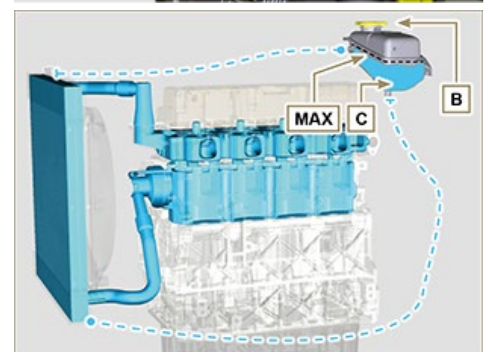
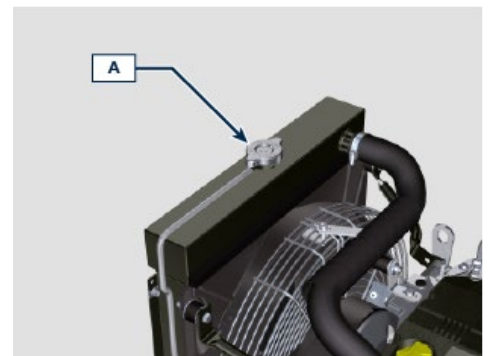
FILLING

1. Loosen the cap **A** and fill the radiator with coolant composed of: 50% ANTIFREEZE and 50% decalcified water.
2. Top liquid up until the pipes inside the radiator are covered by about 5 mm. Do not overfill the radiator, but leave room for the coolant to expand.
3. For engines equipped with expansion tank, pour in fluid until reaching the max level mark.
4. Re-tighten the cap **A**.
5. Keep it running at idle speed until the cooling liquid level goes down and becomes steady (the waiting times varies according to the ambient temperature).
6. Stop the engine and allow it to cool.
7. If there is an expansion tank (**C**) top liquid up to the mark **MAX**.
8. Without expansion tank top liquid up until the pipes inside the radiator are covered by 5 mm. Do not overfill the radiator, but leave room for the coolant to expand.
9. Tighten the radiator cap **A** or the expansion tank (**C**) cap **B**.



Warning

- Before starting make sure that the radiator cap and expansion tank cap, if present, are installed correctly to avoid spillage of liquid or vapour at high temperatures.
- After a few hours of operation stop the engine and allow it to cool. Check and top up the coolant liquid.

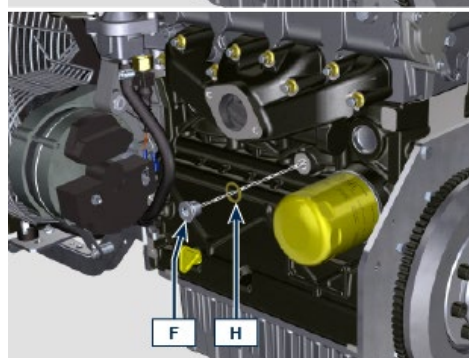
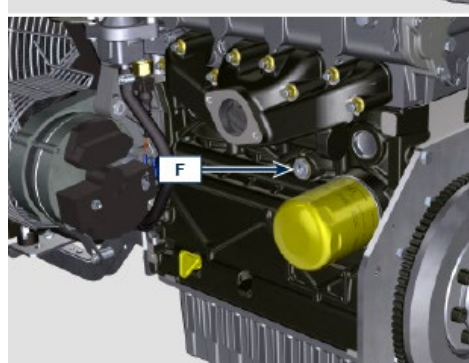
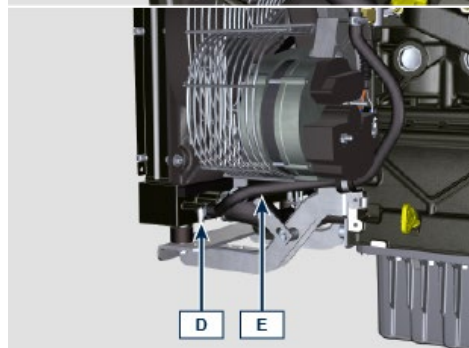
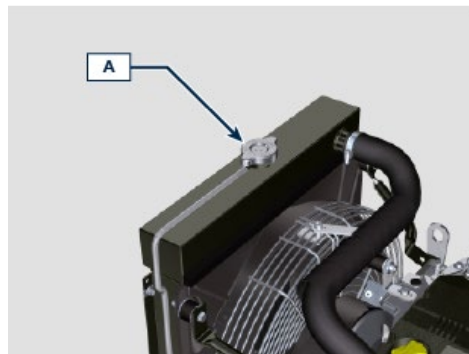


CHECK

1. Perform the operations from point 2 to 9.

REPLACEMENT

1. Undo the cap **A** carefully (circuit under pressure).
2. Loosen clamp **D** and disengage tube **E** from radiator, drain all coolant in radiator into a suitable container and refer to **Par. 3.6**.
3. Undo cap **F**, remove gasket **H**, to drain all liquid from the system contained in the engine crankcase ducts into an appropriate container (**Par. 3.6**).
4. Replace gasket **H**.
5. Tighten the drain oil plug **F** (tightening torque at **35 Nm**).
6. Fasten tube **E** on the radiator using clamp **D**.
7. Fill the radiator.



4.8 Air filter cartridge - replacement



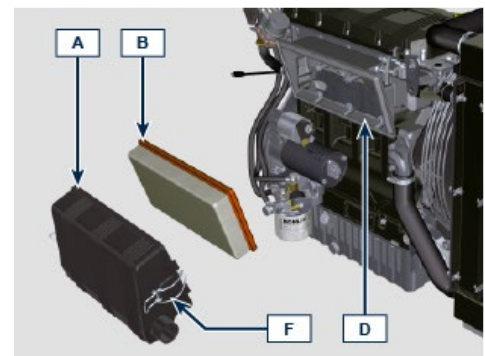
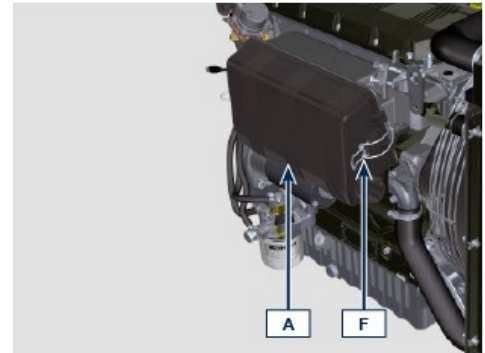
Importante

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

NOTE: Components not necessarily supplied by **REHLKO** .

REPLACEMENT

1. Release the two fastenings **F** of the cover **A** .
2. Remove the cartridge **B**.
3. Clean the inside components **A** and **D** with a damp cloth.
4. Reinstall:
 - the new cartridge **B** .
 - the cover **A** checking the right tightness of fastenings **F** .



4.9 Fuel filter cartridge - check/replacement

Check



Important

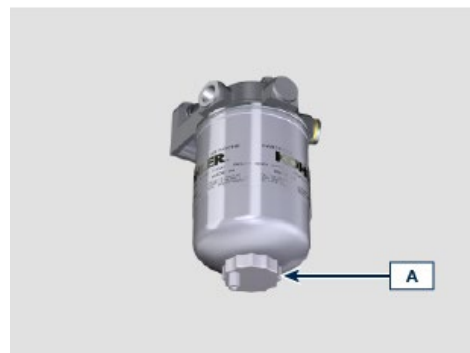
- Before proceeding with operation, read **Par. 3.2.2**.



Danger

- For safety precautions see **Chap. 3**.

1. Gently loosen the water drain plug **A** without removing it.
2. Spill out the water if present.
3. Re-tighten the water drain plug **A** as soon as the fuel spills.



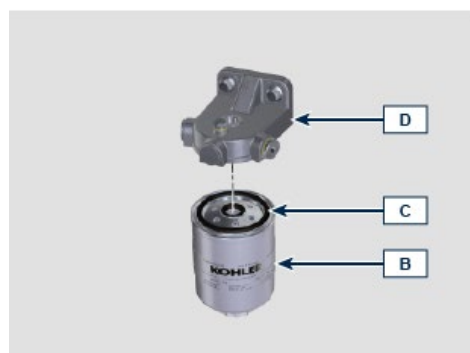
Replacement



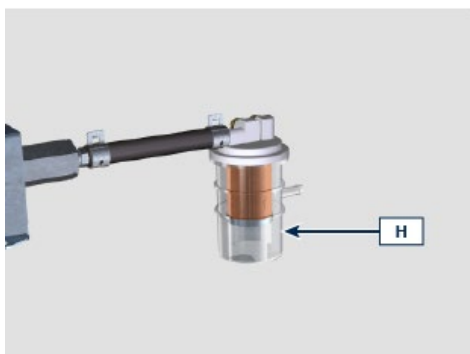
Important

- Do not fill the new cartridge **B** with fuel.

1. Procure a suitable container to collect the fuel.
2. Loosen and remove cartridge **B**.
3. Lubricate the gasket **C**.
Tighten the new cartridge **B** onto support **D** (tighten manually).

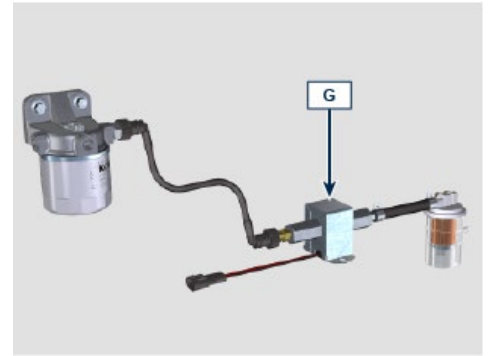


Replace the prefilter **H** if present.



If the engine is equipped with fuel electric pump **G**:

4. Turn the key on the control panel to the **ON** position.
The electric pump **G** sends fuel to the filter **B** and then the injection pump.
5. Loosen the air bleeding screw **F** on fuel filter bracket **B** .
The air inside the circuit and the filter will begin to escape from the screw **F** .
6. Tighten the bleeding screw **F** (tightening torque of **1.5 Nm**)
when the fuel begins to flow.



4.10 Check of the radiator heat - exchanger surface



Danger

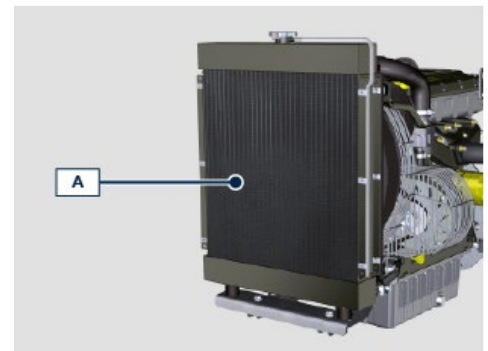
- For safety precautions see **Chap. 3** .

NOTE: Component not necessarily supplied by **REHLKO** .



Important

- Before proceeding with operation, read **Par. 3.2.2** .
 - Wear safety goggles when using compressed air.
 - The radiator heat-exchange surface must be cleaned on both.
1. Check the radiator heat-exchange surface **A** .
 2. Clean the surface with a brush soaked in special detergent if it is clogged.



4.11 Rubber hoses check



Danger

- For safety precautions see **Cap. 3**.

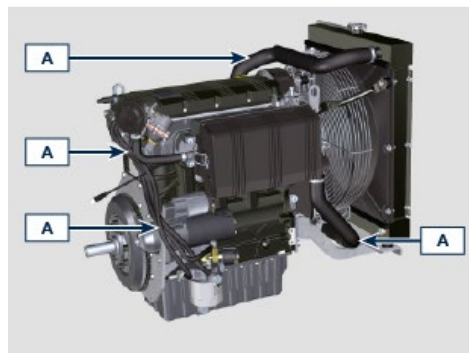
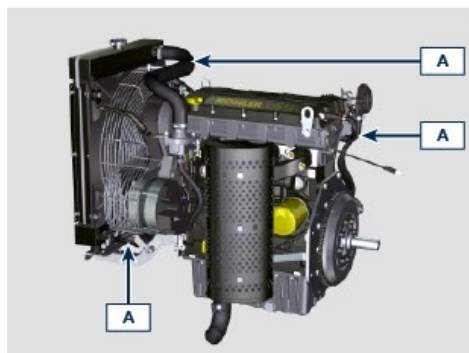
The check is carried out by exerting a slight deflection or bending along the pipe and near the hose clamps. Components must be replaced if they have clear signs of cracks, tears, cuts, leaks and do not retain a certain degree of elasticity.



Important

- Before proceeding with operation, read **Par. 3.2.2**.
- If hoses are damaged contact an authorized REHLKO workshop.
- For other pipes not illustrated refer to the technical documentation of the vehicle.

1. Check the integrity of the pipes and hoses **A**.



4.12 Alternator standard belt - check/setting/replacement



Important

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

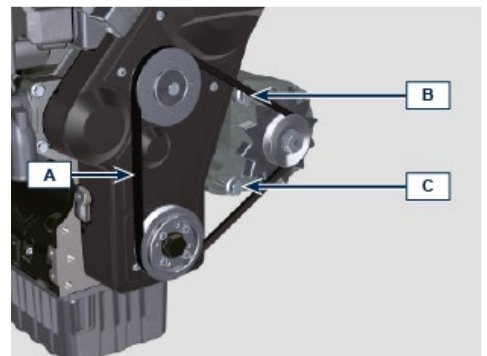
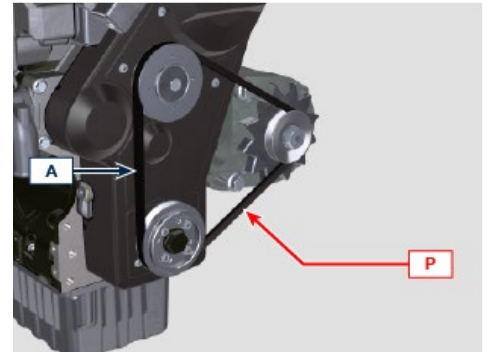
CHECK

1. Check the belt **A** condition, if worn out or deteriorated, replace it.
2. The belt tension can be checked by applying a force of approx' **10kg** on the point **P**. When correctly tensioned the belt must show a movement of less than **10 mm**.

If not adjust it.

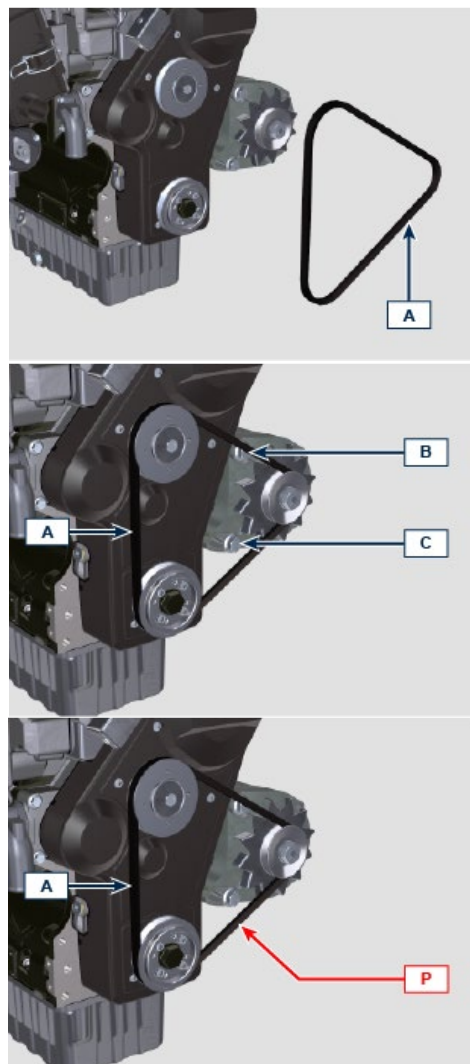
SETTING

1. Loosen the fastening bolts **B e C**.
2. Pull the alternator outwards to tension the belt **A**.
3. Tension the belt **A**, screw the bolts **B**, **C**.
4. Tighten bolts **C**, **B** in sequence (tightening torque **45 Nm [thread M10] - 25 Nm [thread M8]**).
5. The belt tension can be checked by applying a force of approx' **10kg** on the point **P**. When correctly tensioned the belt must show a movement of less than **10 mm**.
6. Let the engine run for some minutes, then let it cool down at ambient temperature and repeat the operations **of SETTING** in case the belt tension results out of the above mentioned values.



REPLACEMENT

1. Loosen the fastening bolts **B e C** .
2. Replace the belt **A** .
3. Pull the alternator outwards to tension the belt **A** .
4. Tension the belt **A** , screw the bolts **B** , **C** .
5. Tighten bolts **C** , **B** in sequence (tightening torque **45 Nm [thread M10] - 25 Nm [thread M8]**).
6. The belt tension can be checked by applying a force of approx' **10kg** on the point **P** . When correctly tensioned the belt must show a movement of less than **10 mm** .
7. Let the engine run for some minutes, then let it cool down at ambient temperature and repeat the operations of **SETTING** in case the belt tension results out of the above mentioned values.



4.13 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 Engine storage (up to 6 months) (**Par. 4.14**).
- 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 protection period (over 6 months) (**Par. 4.15**).
- 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.

4.14 Engine storage (up to 6 months)

Before storing the engine check that:

- The environments are not humid or exposed to bad weather. Cover the engine with a proper protective sheet against dampness and atmospheric contaminants.
- The place is not near electric panel.
- Avoid storing the engine in direct contact with the ground.

4.15 Engine storage over 6 months

Follow the steps described in Par. 4.14 .

1. Engine oil replacement.
2. Refuel with fuel additives for long storage.
3. With expansion tank:
make sure that the coolant is up to the maximum level.
4. Without expansion tank: Top liquid up until the pipes inside the radiator are covered by about 5 mm.

Do not overfill the radiator, but leave room for the fuel to expand.

5. Start the engine and keep it idle at minimum speed for 2 minutes.
6. Bring the engine to 3/4 of the maximum speed for 5÷10 minutes.
7. Turn off the engine.
8. Completely empty the fuel tank.
9. Spray SAE 10W-40 on the exhaust and intake manifolds.
10. Seal the exhaust and intake ducts to prevent foreign bodies from entering.
11. When cleaning the engine, if using a pressure washer or steam cleaning device, avoid directing the nozzle on electrical components, cable connections and sealed rings (oil seals etc).
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 - avoiding absolutely electrical components such as alternators, starter motors and engine control units (ECU).
12. Treat non-painted parts with protective products.

If the engine protection is performed according to the suggestions indicated no corrosion damage should occur.

4.16 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 cm³) 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 two about minutes.
7. Bring the engine to 75% of **MAX** rated speed for 5 to 10 minutes.
8. Stop the engine while the oil is still hot, discharge the protective oil in a suitable container.



Warning

- Over time, lubricants and filters lose their properties, so it is important consider whether they need replacing, also based on the criteria described in **Par. 4.3**.
9. Replace the filters (air, oil, fuel) with original spare parts.
 10. Pour new oil up to the **MAX** level .
 11. Empty the cooling circuit completely and pour in the new coolant up to the **MAX** level.

4.17 Disposal and scrapping

- In case of scrapping, the engine shall be disposed of in appropriate locations, in conformity with the law in force.
- Before scrapping, it is necessary to separate the rubber or plastic parts from the rest of the components.
- The parts only composed of plastic material, aluminium and steel can be recycled if collected by the appropriate centers.
- 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.

4.18 Unused machine

If the machine is not used for a certain amount of time, follow the operations below:

4.18.1 Operations for the engine

POINT	OPERATION	
1	Unused machine up to 2 months	<ul style="list-style-type: none"> The place must be dry and fresh throughout the period in which the machine is not used. Consult the machine's manual to disconnect the battery (before disconnecting the battery, wait for minimum 5 mins after turning off the engine). Make sure the engine is not exposed to direct sunlight. Make sure the engine is not near any heat sources.
	Starting	<ul style="list-style-type: none"> Before starting the engine, check Par. 4.4 for maintenance operations. Consult the machine's manual to connect the battery and start the engine.
2	Unused machine from 2 to 9 months	<ul style="list-style-type: none"> Perform the operations related to unused machine described in point 1. Perform the operations described in Par. 4.11. Start the engine at least every 4 months as per operations described in point 1: Avoid sudden accelerations for the first few minutes. Bring the engine to the working temperature by pressing the accelerator 3/4 from MAX. Leave the engine running at minimum speed for a few minutes and turning off the engine.
	Starting	<ul style="list-style-type: none"> Before starting the engine, check Par. 4.4 for maintenance operations. Consult the machine's manual to connect the battery and start the engine. Avoid sudden accelerations for the first few minutes.
3	Unused machine over 9 months	<ul style="list-style-type: none"> Perform the operations related to unused machine described in point 1 and 2.
	Starting	<ul style="list-style-type: none"> Before starting the engine, check Par. 4.4 for maintenance operations. Check the quality of coolant from the relative testing strips. Consult the machine's manual to connect the battery and start the engine. Avoid sudden accelerations for the first few minutes.

5 INFORMATION ABOUT FAILURES

5.1 Useful information about failures

- This chapter contains information about the problems that may appear during engine operation with its causes and trouble shooting **Tab. 5.2**.
- In some cases, you shall turn off the engine immediately to avoid further damage **Tab. 5.1**.

5.1

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

5.2

TROUBLES	POSSIBLE CAUSE	SOLUTION
The engine does not start	Sulphated battery terminals corroded	Clean the battery terminals
	Battery voltage too low	Recharge the battery or replace it
	Low fuel level	Refuel
	Frozen fuel	Contact REHLKO authorised workshops
	Clogged fuel filter	Replace with a new filter
	Air suction in fuel system	Contact REHLKO authorised workshops
	Clogged air filter	Replace with a new filter
	Clogged pipes	Contact REHLKO authorised workshops
	Open fuse	Replace with a new fuse; if the problem persists, contact REHLKO authorised workshops
	Intake or exhaust system clogged	Contact REHLKO authorised workshops
Engine starts but stops	Inefficient electrical connections	Clean the electrical contacts; if the problem persists, contact REHLKO authorised workshops
	Sulphated battery terminals	Clean the battery terminals
	Clogged fuel filter	Replace with a new filter and clean the tank
	Clogged fuel pipes	Contact REHLKO authorised workshops
RPM instability at idle speed	Clogged fuel pipes	Contact REHLKO authorised workshops
Low idle speed	Clogged fuel pipes	Contact REHLKO authorised workshops
	Poor quality fuel	Clean the tank and refuel with quality fuel
Blue smoke	High oil sump level	Replace the engine oil; if the problem persists, contact REHLKO authorised workshops
	Clogged air filter	Replace with a new filter
	Clogged air filter	Replace with a new filter

Excessive fuel consumption	High oil sump level	Replace the engine oil; if the problem persists, contact REHLKO authorised workshops
Engine lost its initial performance	Clogged air filter	Replace with a new filter
	Clogged fuel pipes	Contact REHLKO authorised workshops
	Cheap fuel	Clean the tank and refuel with quality fuel
	High oil sump level	Replace the engine oil; if the problem persists, contact REHLKO authorised workshops
Slow acceleration	Clogged fuel filter	Replace the fuel filter
Engine jerking	Clogged fuel pipes	Contact REHLKO authorised workshops
Engine overheats	Insufficient coolant level	Fill up to the level
	High oil sump level	Replace the engine oil; if the problem persists, contact REHLKO authorised workshops
	Clogged radiator	Clean the radiator; if the problem persists, contact REHLKO authorised workshops

In the event that the solutions proposed in **Tab. 5.2** do not eliminate the trouble, contact a **REHLKO** authorized workshop.

6 INFORMATION ABOUT WARRANTY

6.1 Warranty terms

REHLKO DIESEL ENGINES GLOBAL WARRANTY TERMS

1. WARRANTY PERIOD

Rehiko warrants to the End User that each Diesel engine will be free from manufacturing defects in materials or workmanship in normal service for the applicable coverage period or operating hours (whichever comes first) set forth below, provided the engine is operated and maintained in accordance with Rehiko's instructions and manuals.

ENGINE SERIES	WARRANTY PERIOD	OPERATING HOURS	WARRANTY COVERAGE
REHLKO Diesel (non KDI)	3 Years	0 – 2.000	100% Parts & Labor
REHLKO KDI	3 Years	0 – 2.000	100% Parts & Labor
		2.001 – 6.000	Major Components Only *
Lombardini Diesel	2 Years	0 – 2.000	100% Parts & Labor

* Major component defects are failures related to crankcase casting, cylinder head casting, crankshaft, crankshaft pulley, camshaft, connecting rod, flywheel, oil pump.

For the Warranty Period stated above, the period begins on the date of purchase of the finished equipment on which the engine is installed. If no hour meter is installed on the application, the Operating Hours will be calculated as 4 hours of use per day for 5 days per week beginning on the date of purchase.

Rehiko's obligation under this warranty is expressly limited, at its option, to an appropriate adjustment, repair or replacement of such part or parts as found to be defective following an inspection by Rehiko or an authorized service facility designated by Rehiko

SPARE PARTS	WARRANTY PERIOD	OPERATING HOURS	WARRANTY COVERAGE
REHLKO and Lombardini Diesel Parts	2 Years	0 – 2.000	100% Parts & Labor

Parts/components that are scheduled to be replaced as part of the required maintenance schedule will be covered under Rehiko's warranty from date of purchase of the part up to the first scheduled replacement point for the subject parts/ components.

All other Spare Parts items are covered by the above warranty provided that the repairs have been executed by Rehiko or by an Authorized Rehiko Service Dealer.

2. EXCLUSIONS

The following items are not covered by this warranty.

- Damage caused by: (i) an accident or casualty; (ii) unreasonable use or neglect; (iii) normal wear; (iv) premature wear from improper maintenance; (v) improper storage; (vi) old or contaminated fuel left within

the fuel system, which includes but is not limited to tanks, fuel lines, or fuel injection components; (vii) unapproved modifications.

- Failures caused by: (i) faulty repairs made by any party other than Rehiko or an authorized service facility designated by Rehiko; (ii) use of non-Rehiko replacement service parts; or (iii) additional damages caused by a lack of prescribed actions as a result of an alarm light activation, either caused by fault or negligence or un-attended use of the engine; (iv) an act beyond the control of Rehiko, which includes but is not limited to theft, vandalism, fire, lightning, earthquake, windstorm, hail, volcanic eruption, flood or tornado.
- Transportation charges or travel expenses in connection with the repair or replacement of defective parts on the engine.
- Engine accessories such as fuel tanks, clutches, transmissions, power drive assemblies, and batteries, unless supplied or installed by Rehiko
- Engines installed in an application not formally reviewed by Rehiko.
- Rental of other equipment during performance of warranty repairs All items subject to wear and to periodical maintenance such as listed in the Use & Maintenance Manual (such as air, oil or fuel filters, belts etc.) are warranted for a period equal to the prescribed interval of replacement as listed in the Manual.
- Fuel, lubricating oil, coolant/antifreeze.

IMPLIED OR STATUTORY WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY LIMITED TO THE DURATION OF THIS WRITTEN WARRANTY. REHLKO MAKES NO OTHER EXPRESS WARRANTY, NOR IS ANYONE AUTHORIZED TO MAKE ANY ON REHLKO'S BEHALF. REHLKO AND/OR THE SELLER SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND.

3. TO OBTAIN WARRANTY SERVICE

The repair shall be executed by a REHLKO Authorized Service Dealer designated by Rehiko.

USA & CANADA:

List of Authorized dealers can be found by visiting <https://www.engines.rehiko.com/> or telephone 1-800-544-2444 (U.S.A. and Canada) ENGINE DIVISION, Rehiko, Rehiko Wisconsin

EUROPE, MIDDLE EAST, AND ASIA

List of Authorized dealers can be found by visiting <https://www.engines.rehiko.com/dealers>.

CENTRAL AND SOUTH AMERICA

List of Authorized dealers can be found by visiting <https://www.engines.rehiko.com/dealers>.

CHINA AND ASIA PACIFIC

List of Authorized dealers can be found by visiting <https://www.engines.rehiko.com/dealers>.

INDIA

List of Authorized dealers can be found by visiting <https://www.engines.rehiko.com/dealers>.

Note: Specific Warranty Terms and conditions do apply to engines directly sold in India.

4. OWNER'S WARRANTY RESPONSIBILITIES

1. As the off-road engine owner, you are responsible for the performance of the required maintenance listed in your Use & Maintenance Manual. Rehiko recommends that you retain all receipts covering

maintenance on your off-road & marine engine, but Rehiko cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

2. As the off-road & marine engine owner, you should however be aware that Rehiko may deny you warranty coverage if your off-road & marine engine or a part shows signs of malfunction or failed due to abuse, neglect, improper maintenance or unapproved modifications.
3. Your engine is designed to operate on diesel fuel only. Diesel fuel and all other fluids used shall comply with the recommendation listed in the Use & Maintenance Manual. Use of any other fuel or fluids may result in your engine breakage, premature wear or no longer operating in compliance with the California & US EPA emissions requirements.
4. You are responsible for initiating the warranty process. The ARB & US EPA suggests that you present your off-road & Marine engine to a Rehiko dealer as soon as a problem exists. The warranty repairs should be completed by the dealer as expeditiously as possible.

5. COVERAGE

Rehiko will repair or replace emission control system parts, components and sub-assemblies found to be defective with respect to materials or workmanship at no cost to you including engine exhaust system related diagnosis, labor and parts, provided that no un-authorized modification of any kind has been executed on the engine, and its parts, components and sub-assemblies.

The choice and responsibility of the decision to repair or replace an emission control system defect will be solely that of Rehiko. Emission control system parts/ components covered by the Federal and California Emission Control Systems Limited Warranty are listed below. If an engine is defective, the part will be repaired or replaced by Rehiko.

Fuel injector(s)	Electronic control unit (ECU) if equipped
Injection pump(s)	Sensors associated with ECU operation
Exhaust manifold	Emission control information labels
Intake manifold	Turbocharger (if equipped)
Exhaust gas recirculation (EGR) tube	Fuel limiting device
Crankcase ventilation valve	Aftertreatment Systems if equipped and other components when present

Parts/components that are scheduled to be replaced as part of the required maintenance schedule will be covered under the warranty provisions for a period of time up to the first scheduled replacement point for the subject parts/ components. Subsequent damage to other engine components as a direct result of a warrantable failure of an exhaust emission part/ component will be covered under the warranty provisions described herein.

6. MAINTENANCE AND REPAIR REQUIREMENTS

The owner is responsible for the proper use and maintenance of the engine. Rehiko recommends that all receipts and records covering the performance of regular maintenance be retained in case questions arise. If the engine is resold during the warranty period, the maintenance records should be transferred to each subsequent owner. Rehiko may not deny warranty repairs solely because of the lack of repair, maintenance or failure to keep maintenance records.

Normal maintenance, replacement or repair of emission control devices and systems may be performed by any repair establishment or individual; however, warranty repairs must be performed by a Rehiko authorized service center.

7. CALIFORNIA AND FEDERAL EMISSION CONTROL WARRANTY STATEMENT, OFF-ROAD & MARINE DIESEL ENGINES (USA ONLY)

The California air resources board (carb), U.S. environmental protection agency (EPA), and Rehlko are pleased to explain the emission control system warranty on your [current model year – {2+ current model year}] off-road compression ignition and marine (diesel) engine. In California (“the state”) and US EPA regulated region, new heavy-duty off-road & marine engines must be designed, built and equipped to meet the state’s and US EPA anti-smog standards. The warranty period shall begin on the date the engine or equipment is delivered to an ultimate purchaser. Rehlko must warrant the emission control system on your engine for the periods of time listed in the section below, provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel injection system and the air-induction system. Also included maybe hoses, belts, connectors and other emission related assemblies.

When a warrantable condition exists, Rehlko will repair your heavy-duty off-road & marine engine at no cost to you including diagnosis, parts and labor.

The owner shall not be charged for diagnostic labor that leads to the determination that a warranted part is in fact defective, provided that such diagnostic work is performed at a warranty station.

MANUFACTURER’S WARRANTY COVERAGE

The [current model year – {2+ current model year}] heavy-duty off-road & marine engines are warranted for the periods listed below. If any emission-related part on your engine is defective, the part will be repaired or replaced by Rehlko

VARIABLE SPEED OR CONSTANT SPEED	KW <19	ANY SPEED	1,500 HOURS OR TWO YEARS, WHICHEVER COMES FIRST
Constant speed	$19 \leq \text{kW} < 37$	3,000 rpm or higher	1,500 hours or two years, whichever comes first
Constant speed	$19 \leq \text{kW} < 37$	Less than 3,000 rpm	3,000 hours or five years, whichever comes first
Constant speed	$19 \leq \text{kW} < 37$	Any speed	3,000 hours or five years, whichever comes first
Variable speed or constant speed	$\text{kW} \geq 37$	Any speed	3,000 hours or five years, whichever comes first

MARINE DIESEL ENGINE

ENGINE POWER	WARRANTY PERIOD
$\text{kW} < 19$	1,500 hours or 2.5 years, whichever comes first
$19 \leq \text{kW} < 37$	2,500 hours or 3.5 years, whichever comes first
$37 \leq \text{kW} < 75$	5,000 hours or 5 years, whichever comes first

7 GLOSSARY

7.1 Glossary

A	Alternator:	A component that transforms mechanical energy into AC electrical energy.
	Authorised service station:	REHLKO authorised workshop.
	Authorised workshop:	REHLKO authorised service centre.

B	Bore	Internal diameter of the cylinder in combustion engines.
---	-------------	--

C	Combustion:	Chemical reaction of a mixture composed of fuel and fuel (air) inside a combustion chamber.
	Crankshaft:	A component that transforms straight operation into rotary operation, and vice-versa.

E	EC:	"European Community".
---	------------	-----------------------

F	Fig.:	Figure.
	Functional units:	Component, or group of main components, able to carry out specific functions on the engine.


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.
	PTO:	Power Take Off - a point provided to take advantage of alternative operation transmission.
R	Ref.:	Reference.
	Rpm:	Rounds per minute.
S	s/n:	Serial number (engine identification name plate) indicating the engine identification series/chassis number.
	Spec.:	Specification, (engine identification name plate) indicating the engine version.
	STD:	(Standard), base configuration of a component, or a group of components.
T	Tab.:	Table.
	Thermostatic valve:	A valve that adjusts the flow of coolant liquid; it is able to operate by means of temperature variation.
	Torque:	Force applied to an object that rotates on an idler shaft.
U	Used oil:	Oil altered by operation or time, which is no longer compliant for correct lubrication of the components.
W	Warning Lamp:	A warning light (usually red) that indicates a serious anomaly during engine operation.

7.1

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	Circumference	Ø 1 mm
Nm	newton-metre	Torque	1 Nm
mm	millimetre	Length	1 mm
µm	1/1000 of a millimetre (micron)		1 µm
H	hour	Time	1 h
g/kW	grammes per kilowatt per hour	Specific consumption	1 g/kWh
kg/h	kilogramme 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.	gramme	Weight	1 gr.
kg	kilogramme		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	1 Ra
°C	degree centigrade	Temperature	1°C
V	Volt	Electrical voltage	1 V
	millimetre	Hex-head capscrew	●1 mm
cm ³	cubic centimetre	Volume	1 cm ³
Lt.	litre		1 Lt.



Contacts: <https://www.engines.rehiko.com/contact>

Parts Catalogue: [Global Parts Lookup](#)