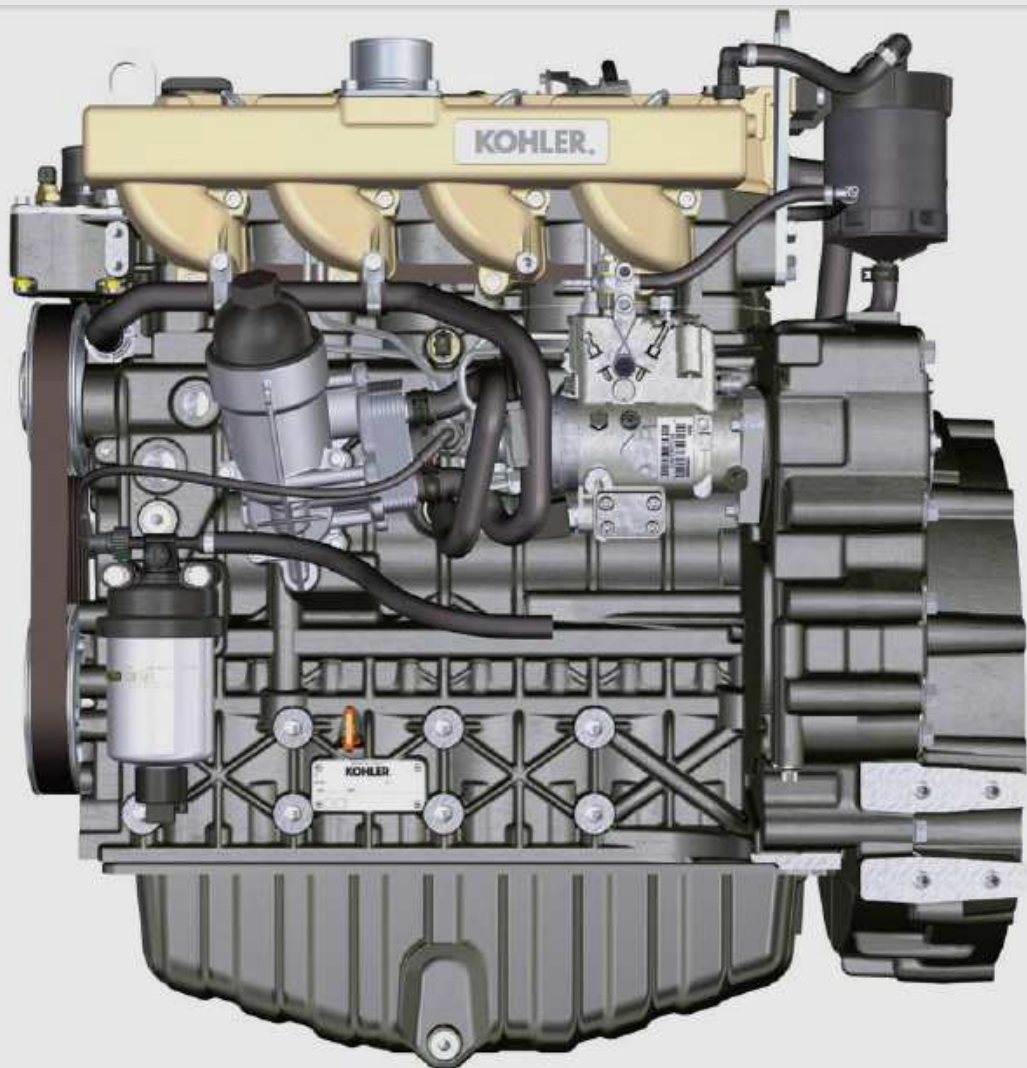


APPLICATION MANUAL

3404 TM

E-Pack

KOHLER Diesel KDI



KOHLER

REVISION HISTORY

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

Drafting body	Code document	Model N°	Edition	Revision	Date issue	Date Review	Written by	Endorsed
DITEC/APLI	ED0053030550	55757	1°	04	30/01/2015	29/07/2016	P.Grassigli	M.Bonanni

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1. General Information

Manual's purpose

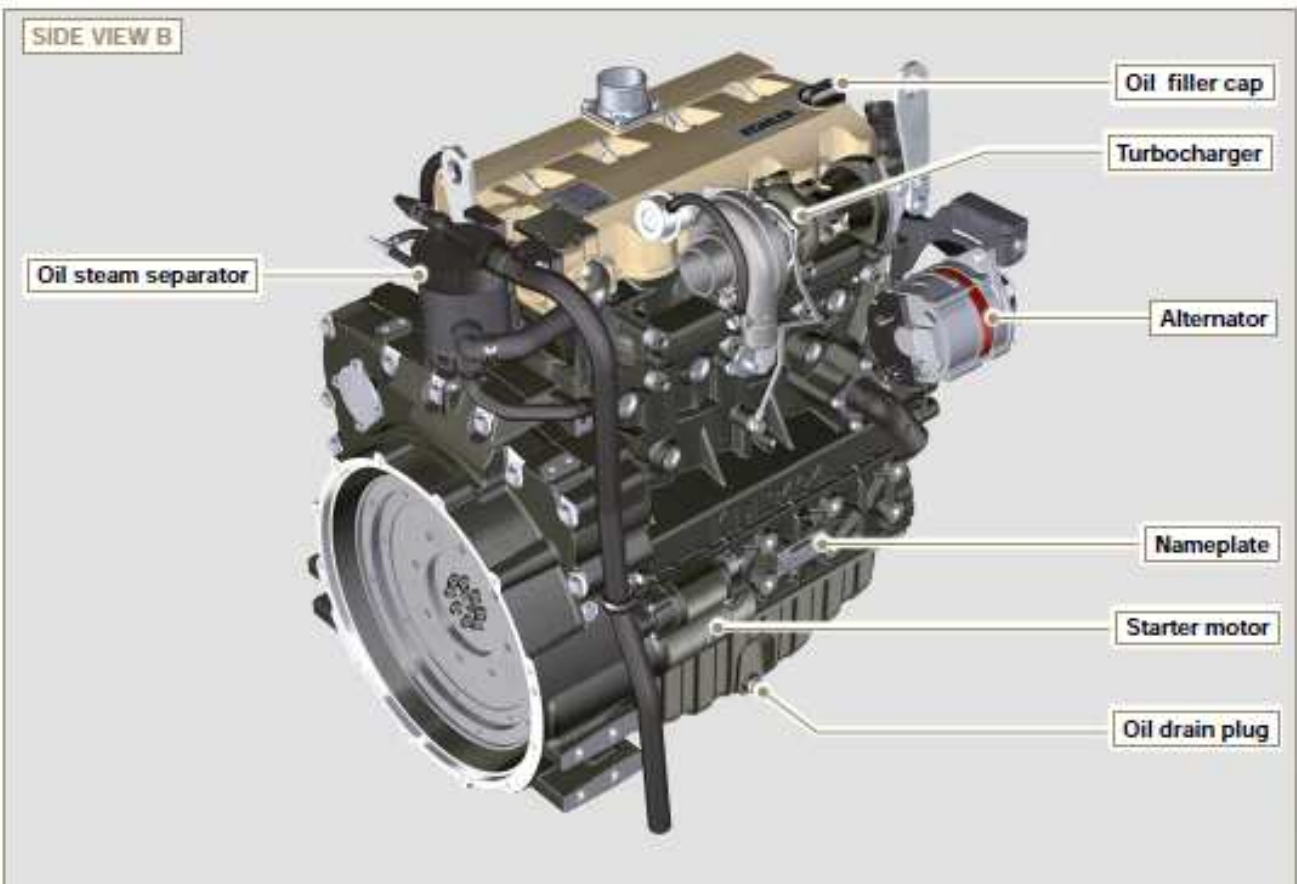
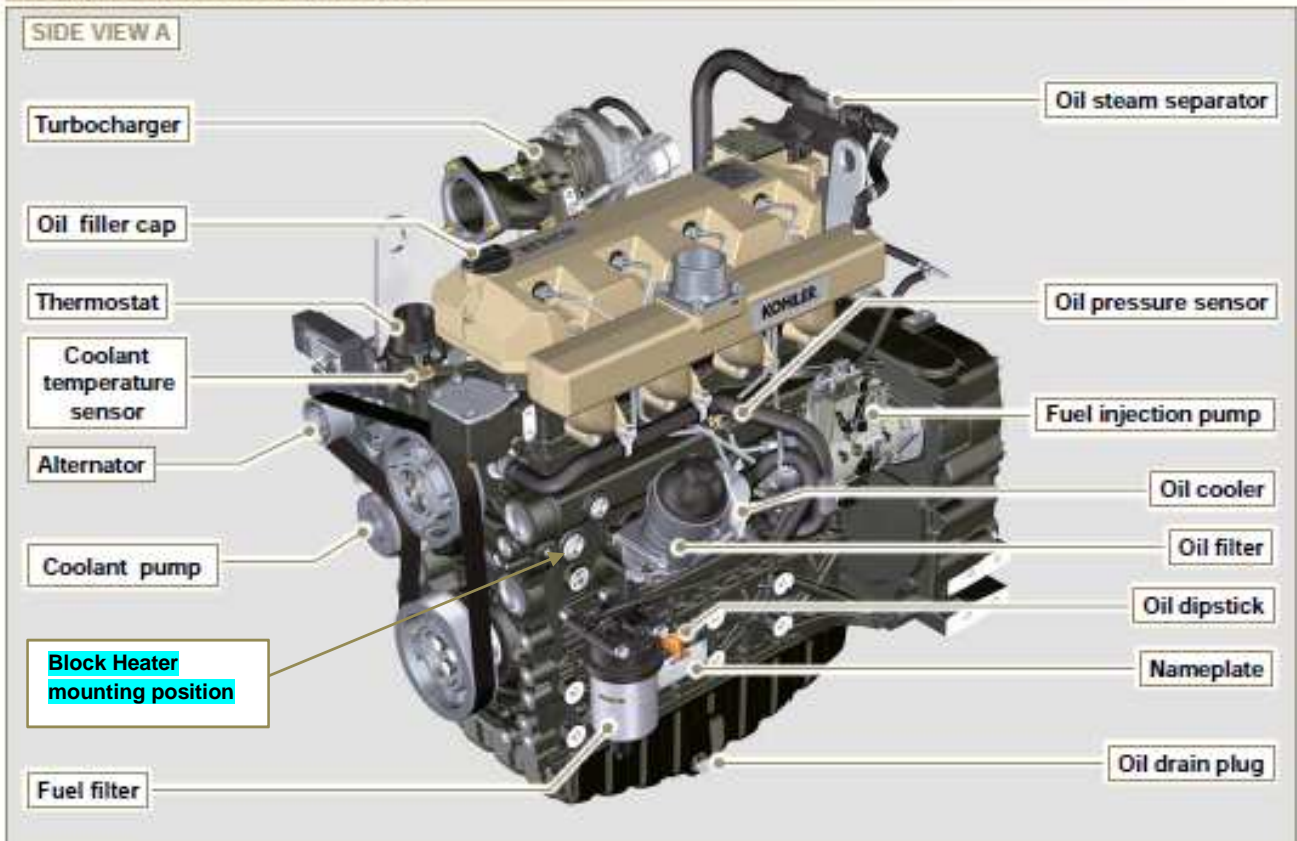
- This manual contains the instructions needed to carry out a proper use and maintenance of the engine, therefore it must always be available, for future reference when required.
- This manual is an integral part of the engine, in the event of transfer or sale, it must be always attached to it.
- Safety 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.
- **KOHLER** reserves the right to make, at any time, changes in the engines for technical or commercial reasons.
- These changes do not require **KOHLER** to intervene on the marketed production up to that time and not to consider this manual as inappropriate.
- Any additional section that **KOHLER** 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 **KOHLER**. As such, no reproduction or replication in whole or part is allowed without the express written permission of **KOHLER**.

Glossary and Definitions

All data, measurements and relevant symbols are shown in the table below.

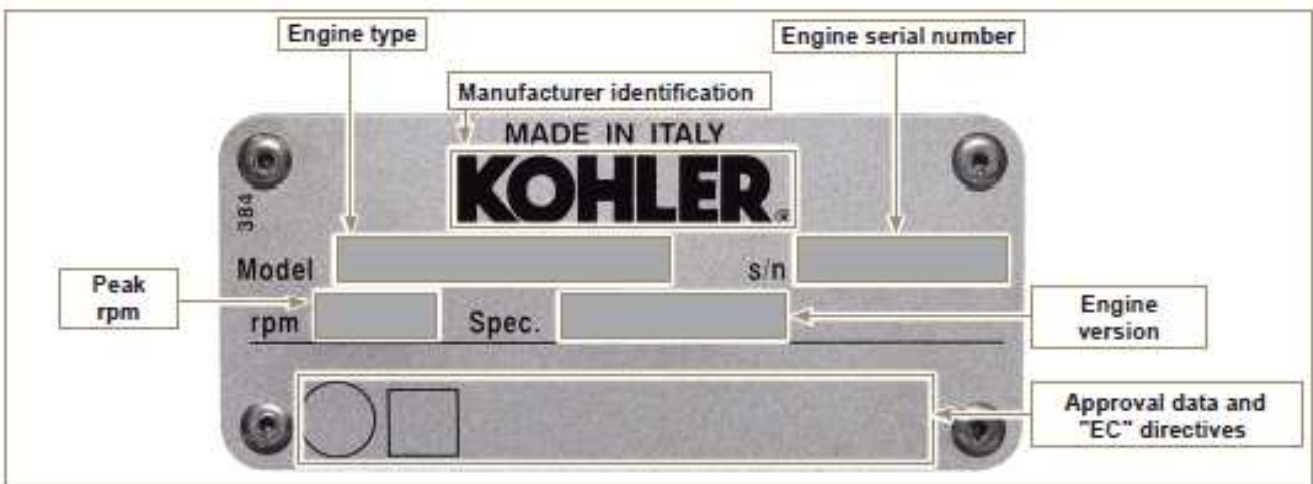
DATA	MEASUREMENT	SYMBOL	EXAMPLE
Dimension	millimeter	mm	1 mm
Torque	newton-meter	Nm	1 Nm
Force	newton	N	1 N
Weight	Kilogram	Kg	1 kg
Volume	cubic centimeter	cm ³	1 cm ³
Barometric	pascal	Pa	1 Pa
Liquids	liter	lt.	1 lt.
Angle	grade	α	1°
Power	kiloWatt	kW	1 kW
Temperature	centigrade degree	°C	1°C

1.5 Engine component identification



1.6 Manufacturer and motor identification data

The nameplate motor identification is found on side A or side B.



1.7 Label for EPA rules



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 (*BTDC)
9	Injector opening pressure (bar)
10	Production date (example: 2013.JAN)

2. Technical Information

2.1 General description of the engine

- 4-stroke, in-line cylinders Diesel engine;
- Liquid-cooling system;
- 4 valves per cylinder with hydraulic tappets;
- Turbocharger with Waste-gate valve;
- Common Rail - Direct injection.

2.2 Engine specifications

Tab. 2.1

TECHNICAL DATA		UNIT OF MEASURE	
ENGINE TYPE			KDI 3404 TM
CYLINDERS		n.	4
BORE		mm	96
STROKE		mm	116
DISPLACEMENT		cm ³	3359
MAX INCLINATION DURING OPERATION (even in combined)		degree	40° max. 30 minutes
		degree	45° max.1 minute
OIL CAPACITY (MAX level.) Including oil filter	standard version	lt.	15.6
DRY WEIGHT		Kg	405
E-Pack version weight with coolant and oil		kg	478



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 (Par. 2.4.1).

2.4.1 SAE oil classification

- In the SAE classification, oils are identified according to viscosity without considering any other qualitative characteristic.



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 [Par. 6.5 DISPOSAL and SCRAPPING](#).

- The code is made up of two numbers. The first number refers to the viscosity when cold, for use during winter ("W"= winter), while the second number is for viscosity at high temperatures.

Tab. 2.2

RECOMMENDED OIL			
VISCOSITY	SAE	≥ -25°C	< -25°C
		5W-40	0W-30
WITH SPECIFICATIONS	API	CH-4	CH-4
	ACEA	E4 - E5 - E7	

CLASSIFICATION	DESCRIPTION ACEA SPECIFICATION
E4	High performance (Euro 1 - 2 - 3 Engines) heavy duty
E5	High performance (Euro 1 - 2 Engines) heavy duty
E7	High power over long distances (Euro 4 - 5 engines)

2.5 Fuel



Important

- Use the same type of diesel fuel as used in cars (EN 590 for E.U. - ASTM D975 regulation - S 15 for U.S). 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.

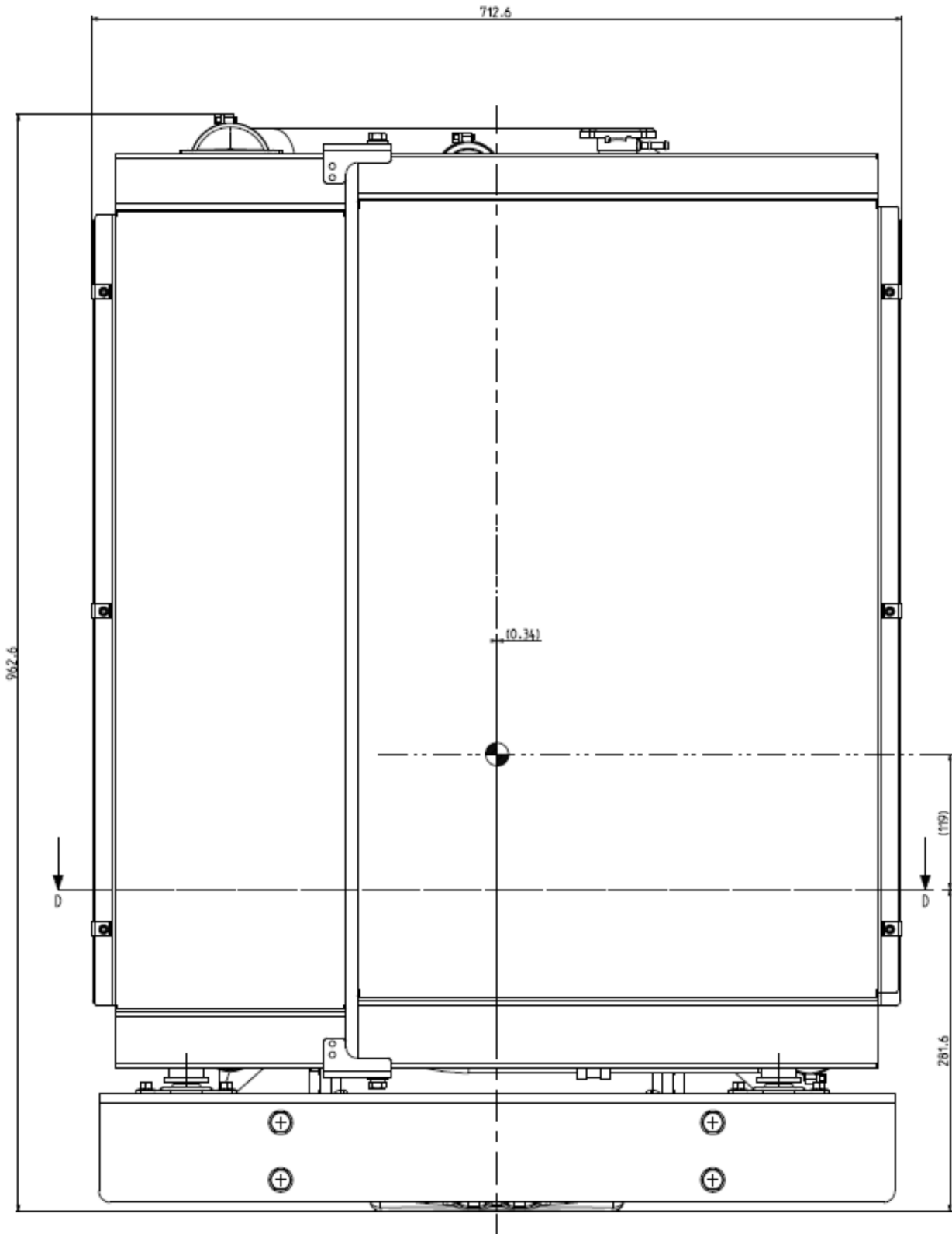


Warning

- 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.

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. 2.3](#).
- 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. 2.3.
- **DO NOT USE** vegetable oil as a biofuel for this engine.
- Any failures resulting from the use of fuels other than recommended will not be warranted.

Tab. 2.3

FUEL COMPATIBILITY								
	Compatible		Warranty coverage		Engine waste		Certification emission	
	yes	no	yes	no	yes	no	yes	no
EN 590, DIN 51628 - Military NATO fuel F-54 (S=10 ppm)							(2)	
Bio Fuels (EN14214)	(4)		(4)			(4)	(4)	
ARCTIC (EN 590/ASTM D 975)	(1)							
No 1 Diesel (US) - ASTM D 975 - Grade 1-D S 15 (S=15 ppm)							(3)	
No 1 Diesel (US) - ASTM D 975 - Grade 1-D S 500 (S=500 ppm)								
No 2 Diesel (US) - ASTM D 975 - Grade 2-D S 15							(3)	
No 2 Diesel (US) - ASTM D 975 - Grade 2-D S 1500								
Civil Jet Fuels Jet A/A1						(1)		
Civil Jet Fuels Jet B								

(1) Without adding oil.

(3) EPA TIER III.

(2) Stage 3A.

(4) Max. 10% in fuel.

2.5.3 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.

2.6 Coolant recommendation

Tab. 2.4

TECHNICAL SPECIFICATIONS
50% ETHYLENEGLYCOL e 50% DECALCIFIED WATER
50% PROPYLENE GLYCOL e 50% DECALCIFIED WATER

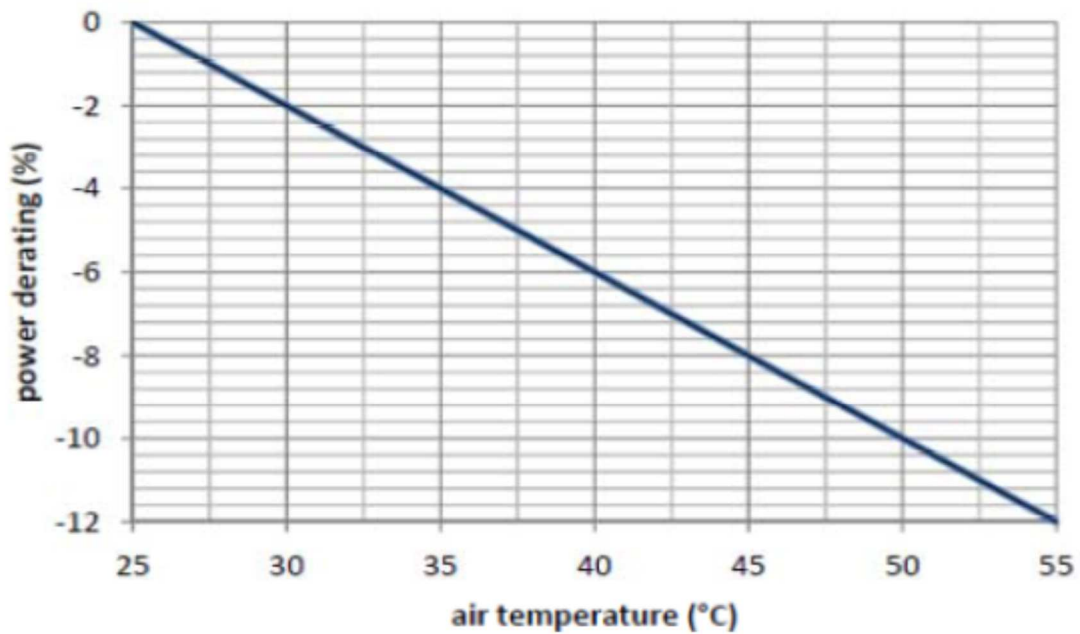
2.7 Battery recommendation

Battery not supplied by Kohler

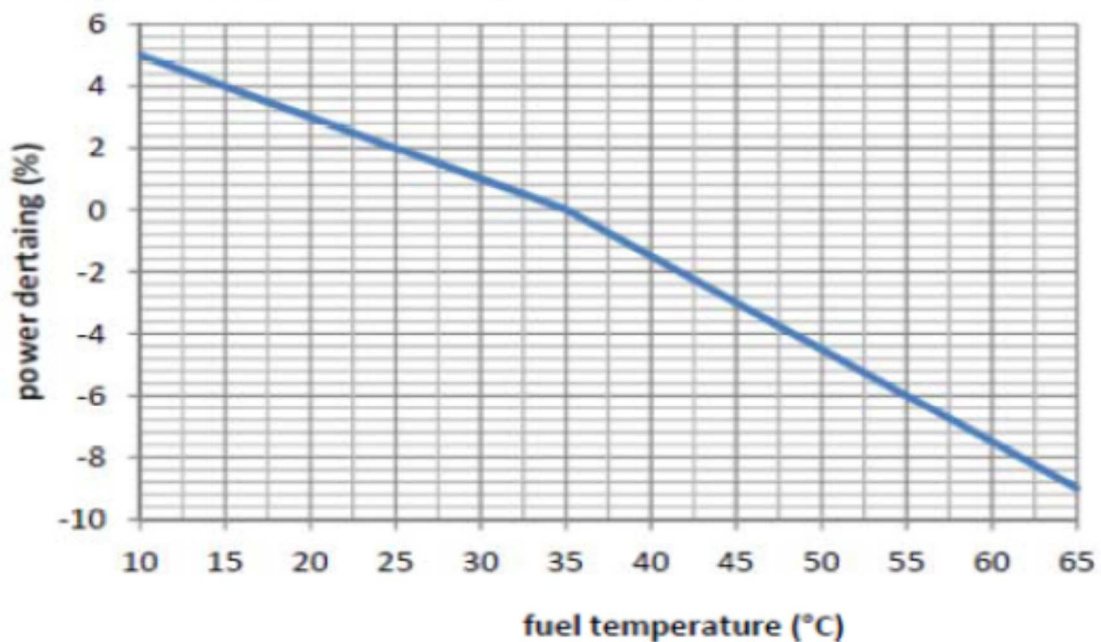
RECOMMENDED BATTERIES	
AMBIENT TEMPERATURE	BATTERY TYPE
$\geq -15^{\circ}\text{C}$	100Ah 800CCA (SAE)
$< -15^{\circ}\text{C}$; $\geq -30^{\circ}\text{C}$	120Ah 1000CCA (SAE)

2.8 Power De-rating

Power derating depending on operating air temperature above 25°C



Power derating depending on operating fuel temperature at injection pump inlet



Max usable engine power output depending on altitude above sea level:

Please contact KOHLER R&D

3. Safety Information

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

- When installing the KDI engines, always bear in mind that any variation to the functional systems may result in serious failures to the engine.
- Any improvement must be verified at KOHLER testing laboratories before application of the engine.
- In case the approval to a modification is not granted, KOHLER shall not be deemed responsible for any consequential failures or damages to the engine.
- The engine may only be assembled on a machine by personnel specifically trained by KOHLER 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 KOHLER, which therefore declines all responsibility for accidents caused by such operations.

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.
- 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 and oil are inflammable. The tank must only be filled when the engine is off. Before starting, dry any spill fuel.
- Make sure that no soundproofing panels and the ground or floor on which the machine is standing have not soaked up any fuel.
- 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.



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.



Important

- Only use the eyebolts **A** installed by KOHLER to move the engine (Fig. 3.1).
- The angle between each lifting chain and the eyebolts shall not exceed 15° inwards.
- The correct tightening of the lifting screws is 25Nm.
- Do not interpose spacers or washers between the eyebolts and engine head.
- Provided that the above requirements are met, if the lifting eyebolts are subject to permanent deformation (inwards), all subsequent lifting operations must be performed in order to prevent them from bending in the opposite direction.

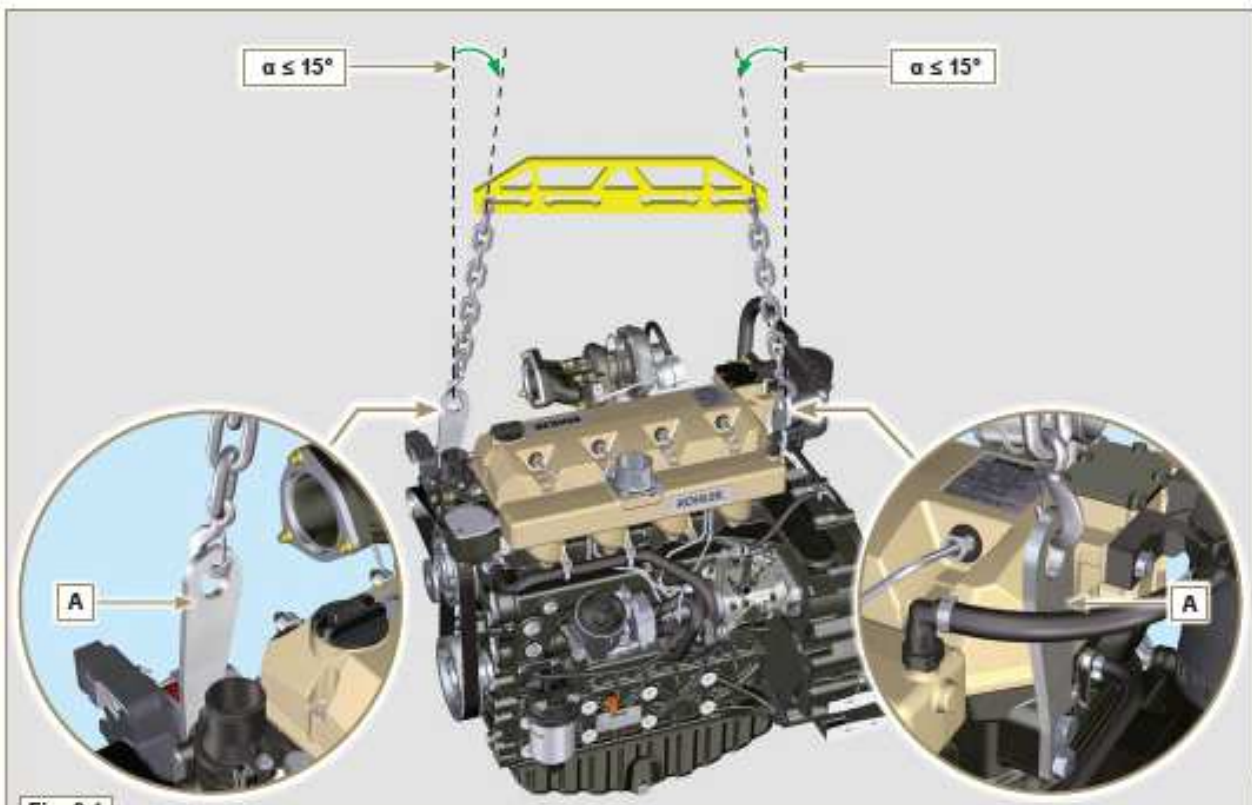


Fig. 3.1

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 ([Par. 3.6](#)).



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.



Lifting point.



Electrical shock.
Danger of severe scalding or death.



High pressure fluid.
Danger of fluid penetration.



Lethal Exhaust Gases.
Danger of poisoning or death.

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 protective gloves before carrying out the operation.



Use protective glasses before carrying out the operation.



Use sound absorbing protections before carrying out the operation.

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



	HOT PARTS
	Hot Parts can cause severe burns.
<i>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.</i>	



	ROTATING PARTS
	Rotating Parts can cause severe injury.
<i>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.</i>	

	LETHAL EXHAUST GASES
	Carbon Monoxide can cause severe nausea, fainting or death.
<i>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.</i>	

	ELECTRICAL SHOCK
	Electrical Shock can cause injury.
<i>Do not touch wires while engine is running.</i>	

	HIGH PRESSURE FLUID RISK OF PUNCTURE
	High Pressure Fluids can puncture skin and cause severe injury or death.
<i>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.</i>	

	EXPLOSIVE FUEL
	Explosive fuel can cause fires and severe burns.
<i>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.</i>	

	EXPLOSIVE GAS
	Explosive Gas can cause fires and severe acid burns.
<i>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.</i>	

CALIFORNIA WARNING - DECLARATION 65	
<i>Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.</i>	

3.5 Safety and environmental impact

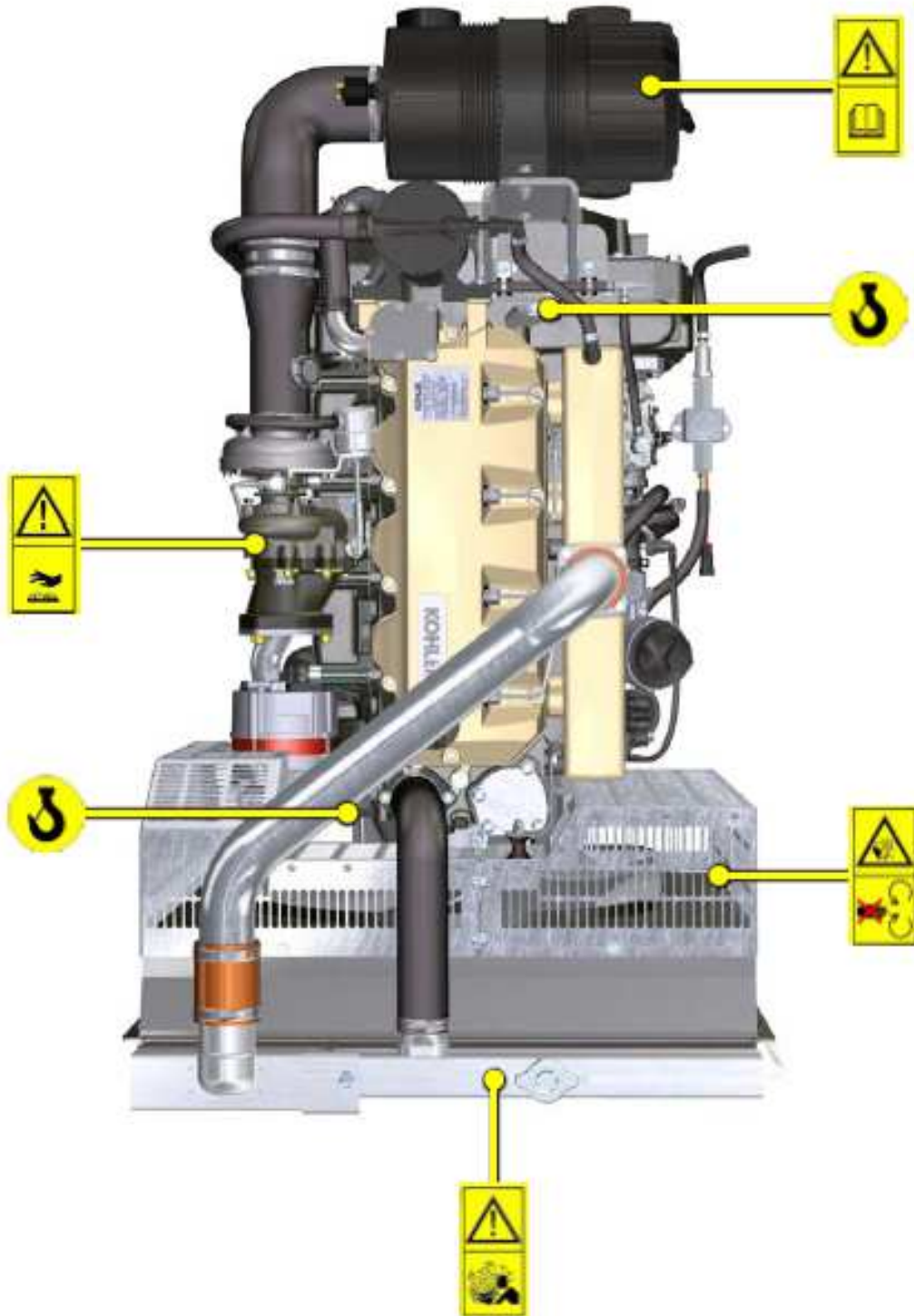
Every organisation has a duty to implement procedures to identify, assess and monitor the influence of its own activities (products, services, etc.) on the environment. Procedures for identifying the extent of the impact on the environment must consider the following factors:

- Liquid waste.
- Waste management.
- Soil 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, KOHLER 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 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.
- Increase the frequency of maintenance operations in heavy working conditions (engine starts but stops, very dusty and hot environments, etc...).



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.

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](#) and [Par. 4.6](#)).
- 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

- 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. 7.1](#) and [Tab. 7.2](#), to locate the cause.

4.3.2 After starting



Warning

- Make sure that all the warning lights on the control panel are off when the engine is running.

To use the TM E-Pack on Stand-By Gen.Set it is necessary to install a block heater set 40°C coolant temperature.

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 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](#) pag. 12.
- In those countries where diesel has a high sulphur content, it 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.

NOTE: At the first fuelling or if the tank was empty [filling the fuel system \(Par. 6.3 point 8\)](#).

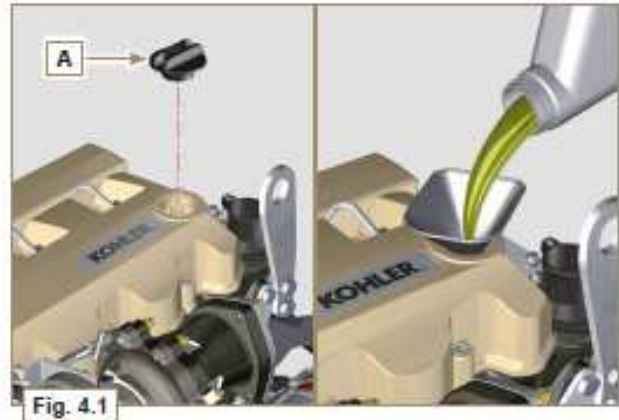
4.5 Oil filling



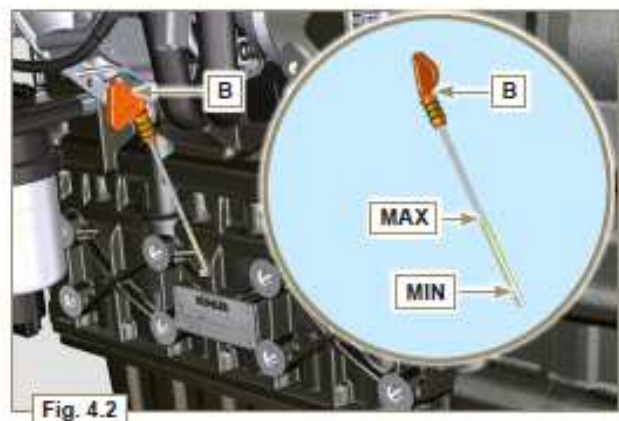
Important

- For safety precautions see [Par. 3.1](#).
- Before proceeding with operation, read [Par. 3.2.2](#).

- 1 - Loosen the oil filler cap.
- 2 - Add the type and amount of oil recommended ([Tab. 2.1](#) and [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.



4.6 Coolant filling



Important

- Before proceeding with operation, read [Par. 3.2.2.](#)



Warning

- An anti-freeze protection liquid (ANTIFREEZE) - mixed with decalcified water - must be used.
- 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 of protection prevents the formation of rust, galvanic currents and calcium deposits.

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.
- 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 - Loosen the screw **C**, release any air and tighten the screw **C** (Tightening torque of 50 Nm - Fig. 4.6).
 - 5 - Re-tighten the cap **A**.
 - 6 - After a few hours of operator, stop the engine and allow the liquid to cool returns to a ambient temperature and check the coolant level again.

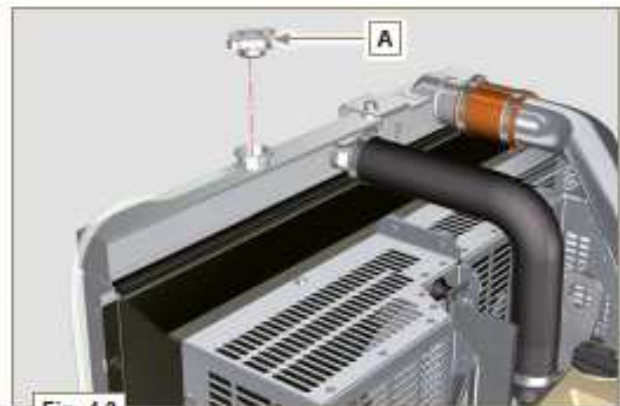


Fig. 4.3



Fig. 4.4



Fig. 4.5



Fig. 4.6

5.3 Oil level check

- 1 - Remove the oil dipstick **B** and check that the level is up to **MAX**.
- 2 - Pour in recommended oil until reaching the **MAX** level mark.
- 3 - Reinstall the oil dipstick **B** completely.
- 4 - Re-tighten the cap **A** (Fig. 5.2).

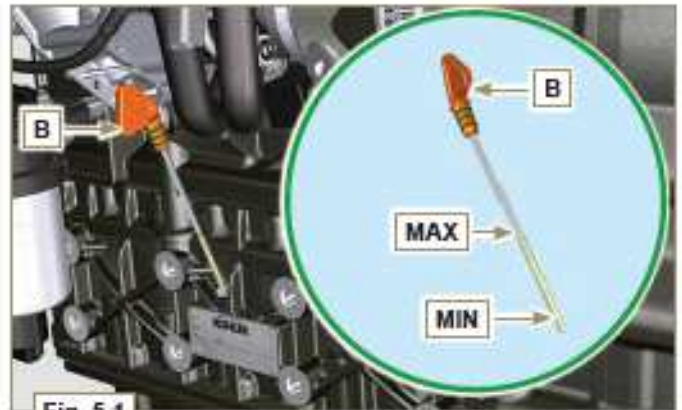


Fig. 5.1

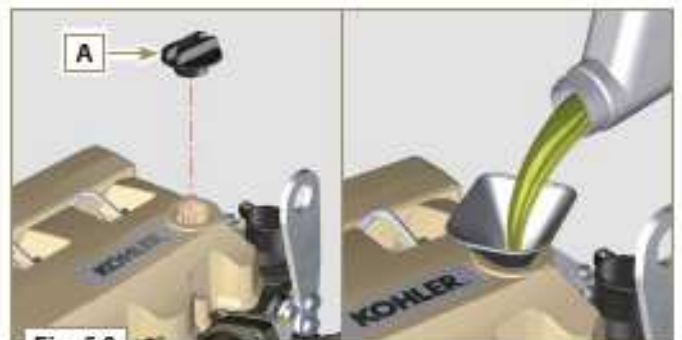


Fig. 5.2

5.4 Air filter check

NOTE: Components not necessarily supplied by KOHLER.

- 1 - Release the two clasps **F** of the cover **A**.
- 2 - Remove the cartridge **B**.
- 3 - Clean the inside components **A** and **D** with a damp cloth.
- 4 - Do not use compressed air, repeatedly tap the front side **E** on a flat surface.
- 5 - Reinstall:
 - cartridge **B**.
 - the cover **A** checking the right tightness of clasps **F**.

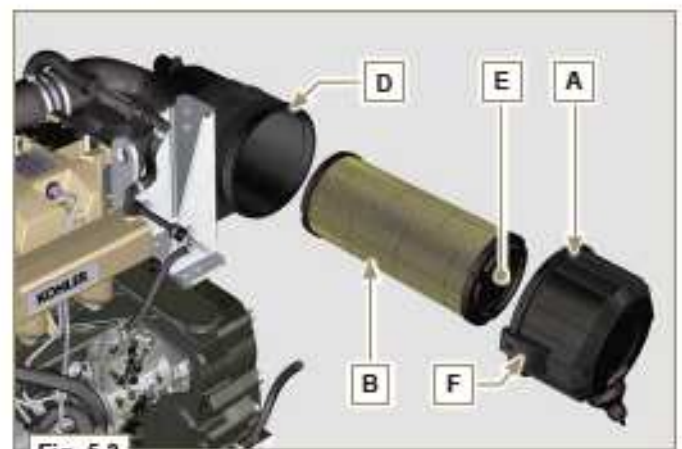


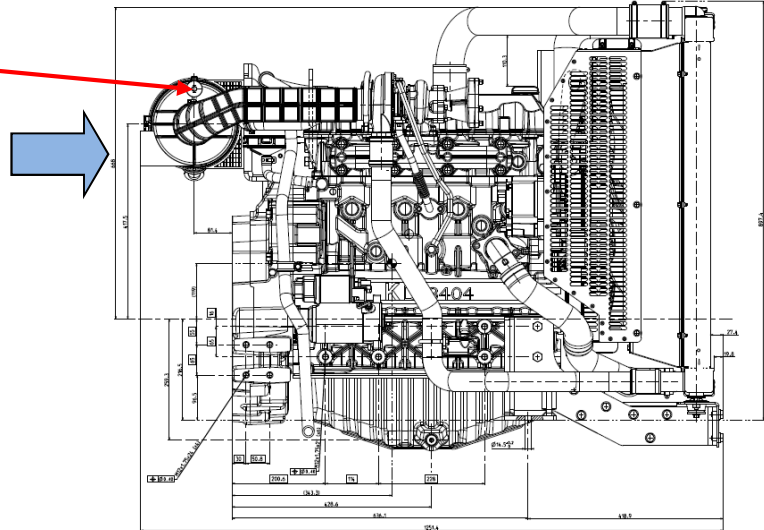
Fig. 5.3

4A. Air Intake System

Heavy Duty Air Cleaner Specs: 7" HDAC for rating 1500-1800 rpm

It is mandatory to connect the electrical restriction switch (supplied on E-Pack version) to the control panel of the gen. set to drive a warning signal.

For proper emission control system operations, follow the Maximum Allowed Air Intake Restriction with Dirty Filter @ FLRS guidance.

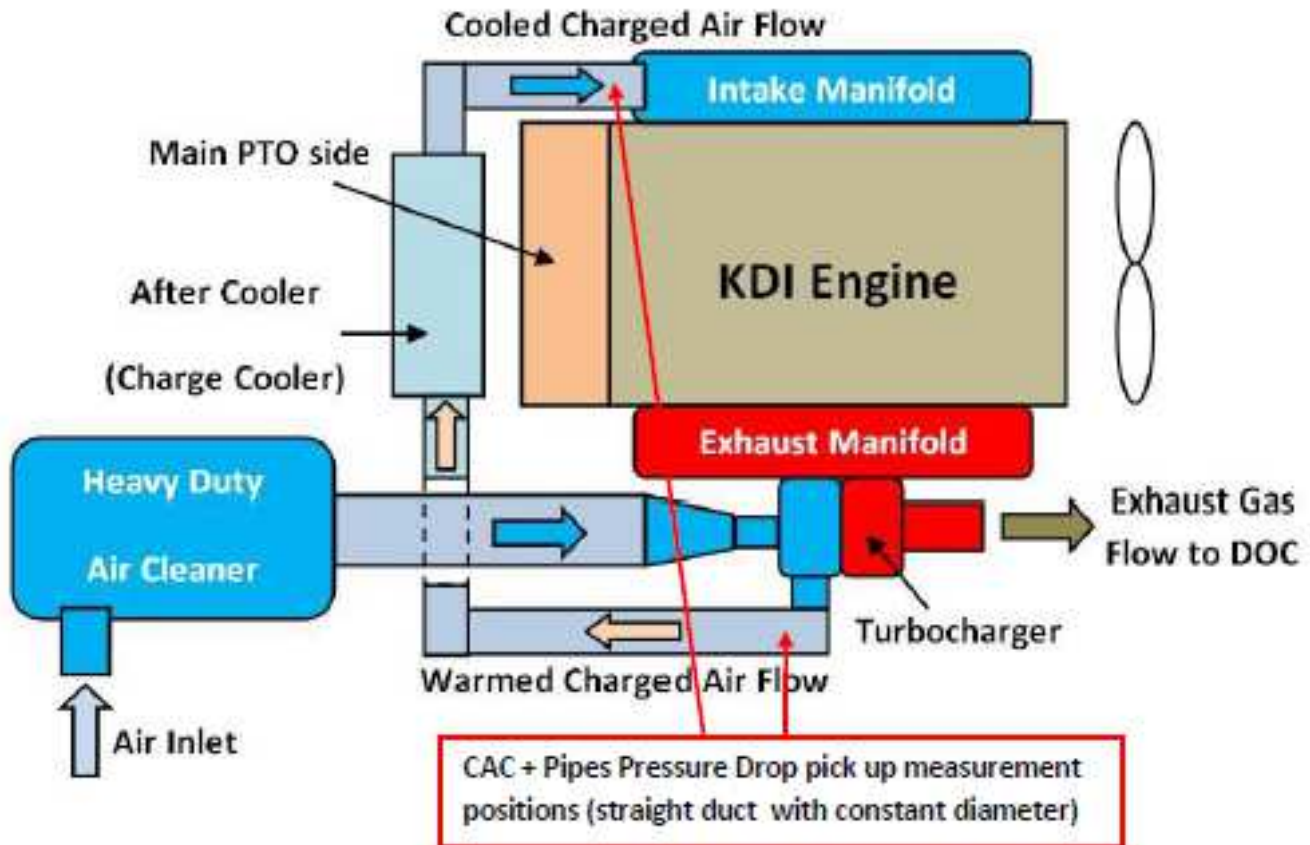


Air requirements for combustion

Tab. 4A.1 MASS AIR FLOW and MAX ALLOWED AIR INTAKE RESTRICTION @ FLRS (ESP)			
KDI 3404 TM			
Rating	NO CAC 61 kW @ 1500 rpm Not Emissionised	CAC 61 kW @ 1500 rpm EU Stage 3A	CAC 68 kW @ 1800 rpm EPA Tier III
Mass Air Flow [kg/h]	330	310	375
Air Intake Max Depression CLEAN FILTER [mbar](*)	min .15 max 42	min .15 max 42	min .15 max 42
Air Intake Max Depression DIRTY FILTER [mbar](*)	52	52	52
(*) Air Cleaner + Pipes			

Requirements for Charge After Cooler and pipes

Tab. 4A.2 AFTER COOLER and PIPES MAX ALLOWED PRESSURE DROP @ FLRS (ESP)			
KDI 3404 TM			
Rating	NO CAC 61 kW @ 1500 rpm Not Emissionised	CAC 61 kW @ 1500 rpm EU Stage 3A	CAC 68 kW @ 1800 rpm EPA Tier III
Max Pressure Drop CAC + Pipes [mbar]	NA	80	90
CAC Inlet Temperature [°C]	NA	190	190
Max CAC Outlet Temp. [°C]	NA	30 Rise Over Ambient	30 Rise Over Ambient

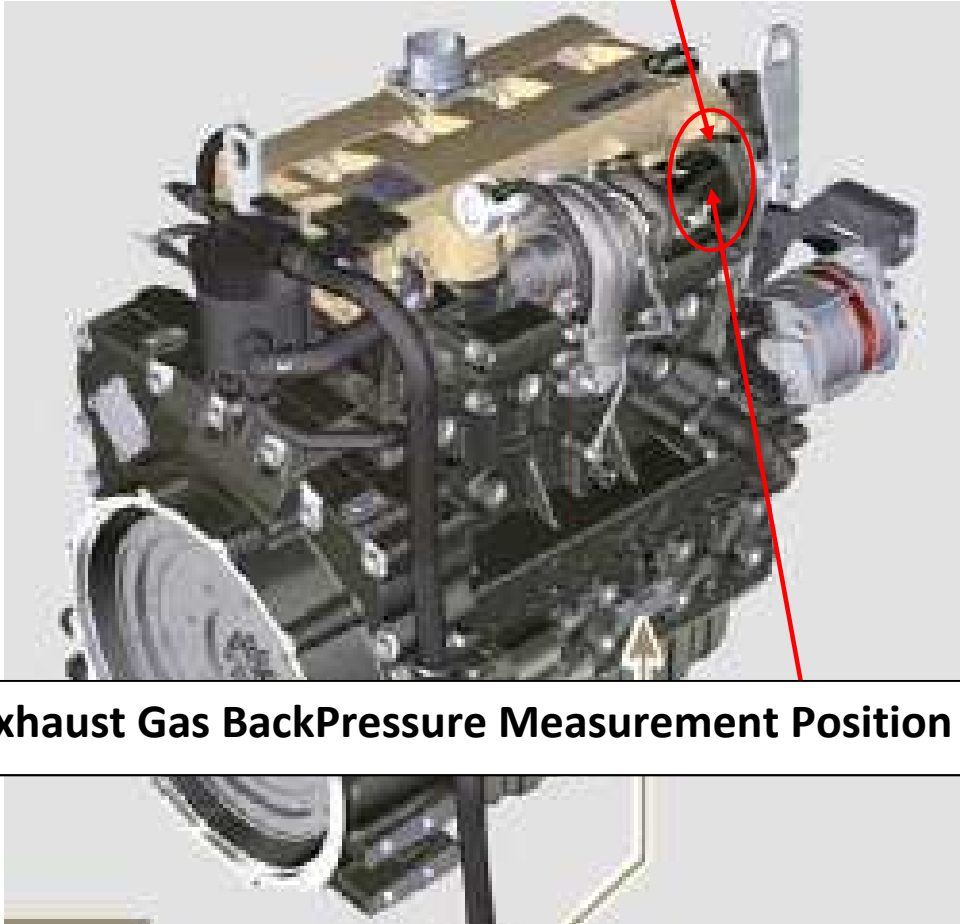


Air intake hoses requirements

- Intake system air hoses must be rated to the following performance requirements for safety and engine reliability:
 - Hose from Turbocharger to Charge Air Cooler
 - Temperature resistant: 220°C
 - Pressure resistant: 3 bar
 - Hose from Charge Air Cooler to Engine Air Intake Manifold
 - Temperature resistant: 100°C
 - Pressure resistant: 3 bar
- Also the intake system air hoses clamps must be rated taking in account the listed above pressure and its pulsation.
- A rigid hose must be installed between the HDAC and turbocharger compressor inlet. Engine damage will result if the connecting hose collapses as oil from the breather system will be ingested into the turbocharger.

4B. Exhaust Gas System

Exhaust Gas Turbocharger Outlet duct

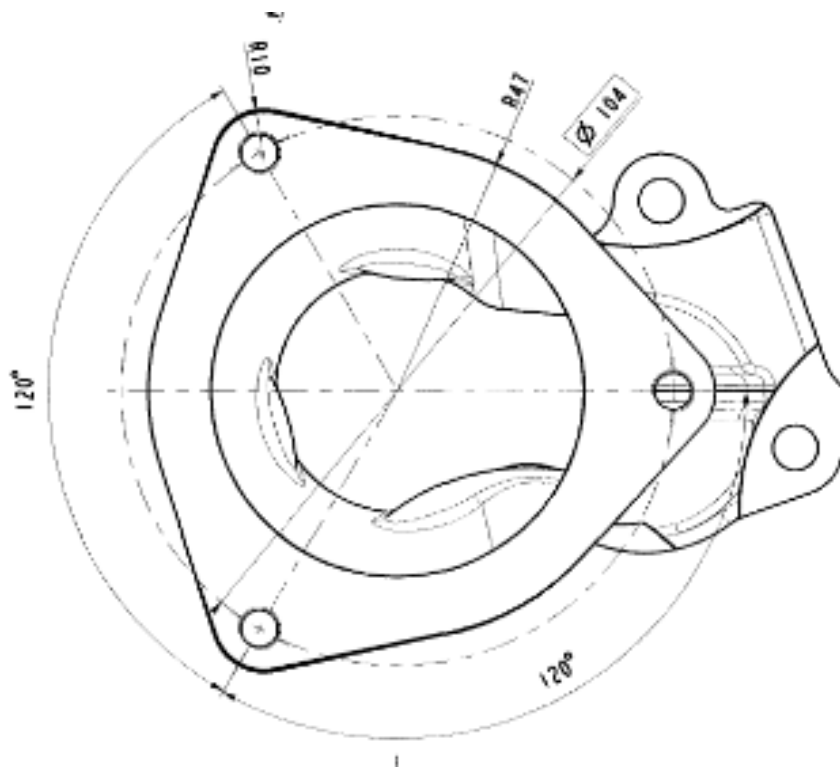
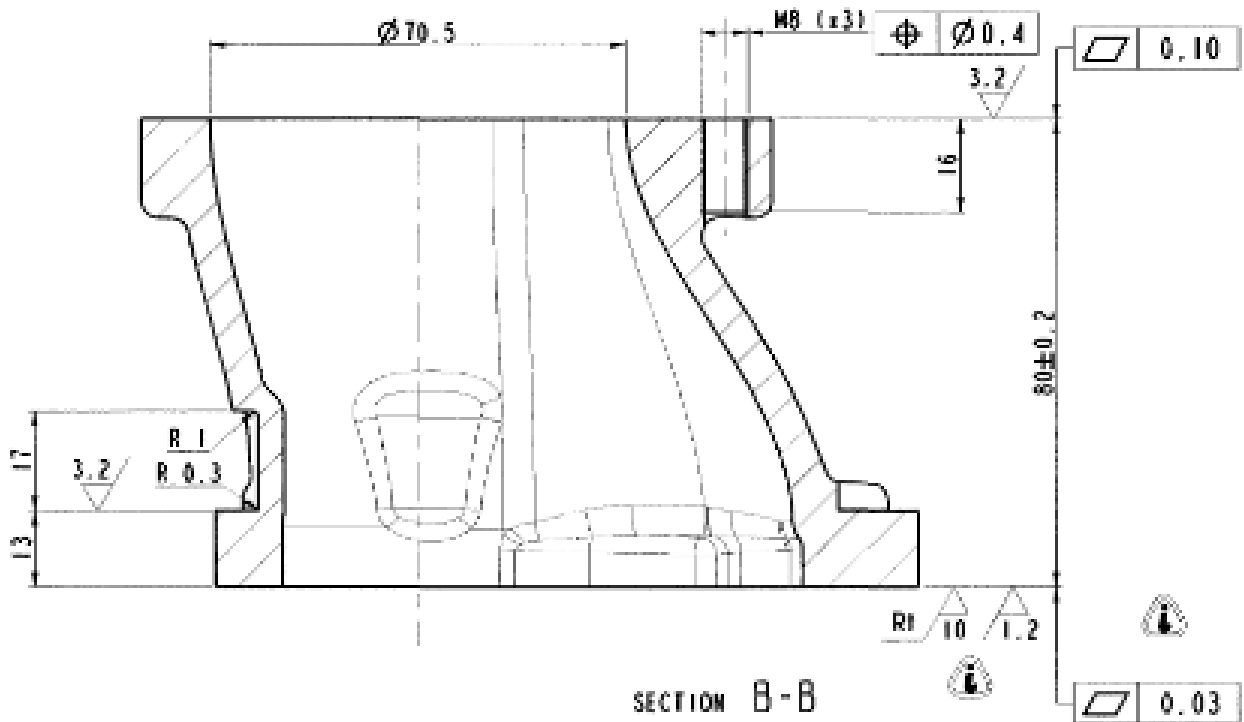


Exhaust Gas BackPressure Measurement Position

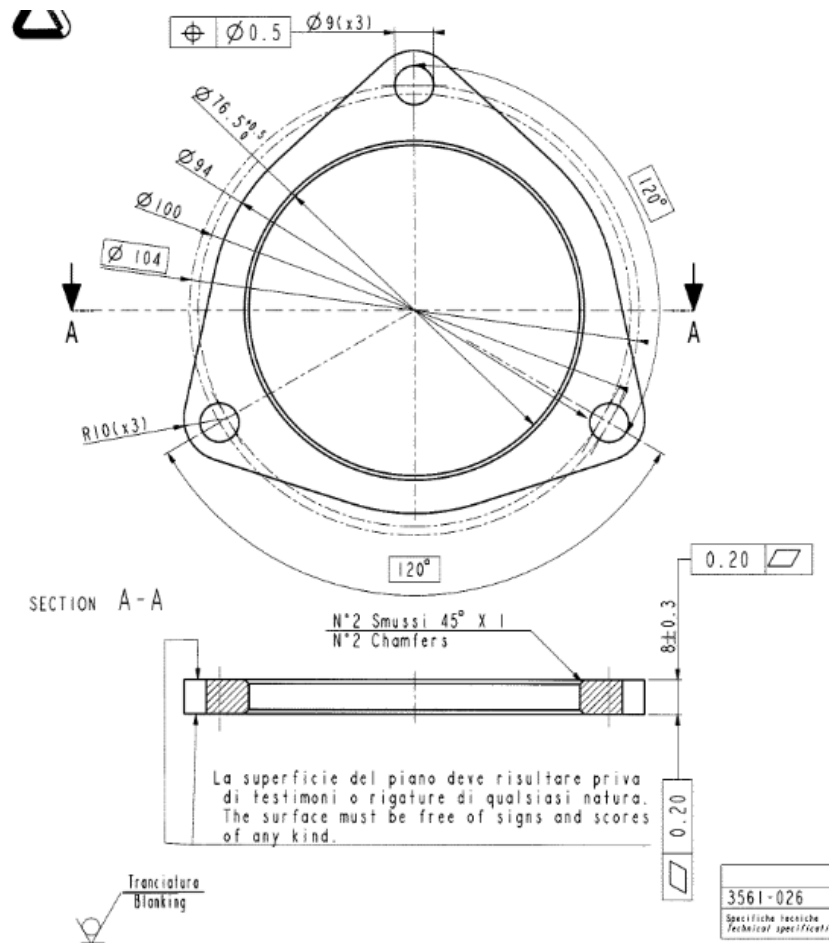
The muffler should be install to the equipment chassis or frame.

Always connect the Exhaust Gas Turbocharger Outlet to the Muffler using a flexible coupling (300 mm long flexible pipe) in the exhaust line.

Exhaust Gas Turbocharger Outlet duct features:



Exhaust Gas Flange, available to weld the exh. gas pipe:

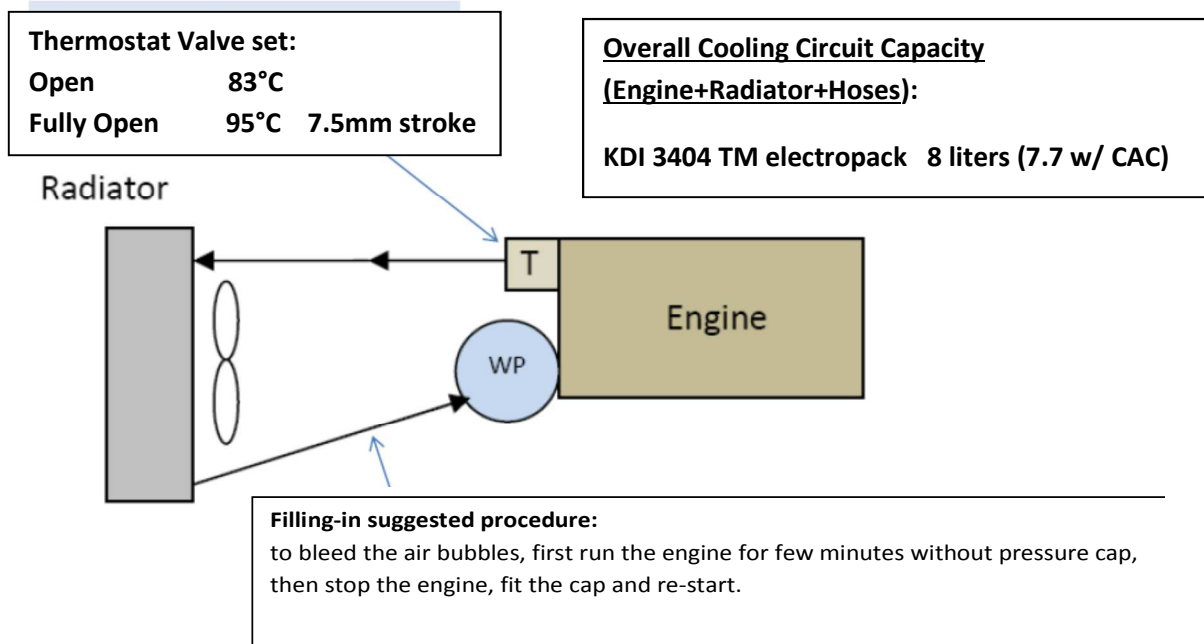


Exhaust Gas Requirements (FLRS) for proper Turbocharger operations

Tab. 4B.1			
MASS EXH. GAS FLOW and EXH. GAS BACKPRESSURE ALLOWED RANGE @ FLRS (ESP)			
KDI 3404 TM			
Rating	NO CAC 61 kW @ 1500 rpm Not Emissionised	CAC 61 kW @ 1500 rpm EU Stage 3A	CAC 68 kW @ 1800 rpm EPA Tier III
Exhaust Gas Mass Flow [kg/h]	347	326	395
Exhaust Gas Temperature at Turbine Outlet [°C]	500	490	490
Allowed Exhaust Gas Backpressure Min-Max [mbar]	Min 60 - Max 90	Min 60 - Max 90	Min 60 - Max 90

For proper emission control system operations, follow the Max Allowed Exh Gas Backpressure @ FLRS guidance.

5. Cooling System



Cooling Requirements FLRS (ESP)

Tab. 5.1

Heat Balance and Cooling System @ FLRS (ESP)			
KDI 3404 TM			
Rating	NO CAC 61 kW @ 1500 rpm Not Emissioned	CAC 61 kW @ 1500 rpm EU Stage 3A	CAC 68 kW @ 1800 rpm EPA Tier III
Heat to Coolant [kW]	45	38	43
Heat to CAC [kW]	NA	12	14.3
E-Pack Fan Power [kW] (ratio engine to fan 1:1.1)	1.1	1.1	1.5
Cooling Air Flow [m3/h] without canopy	6120	6120	7308
Coolant Flow [l/min]	105	105	125
Max Rad. Pressure Drop [bar]	0.4	0.4	0.4

Radiator cap set 1 bar

6. Lubrication System

6.1 Engine oil replacement

Important

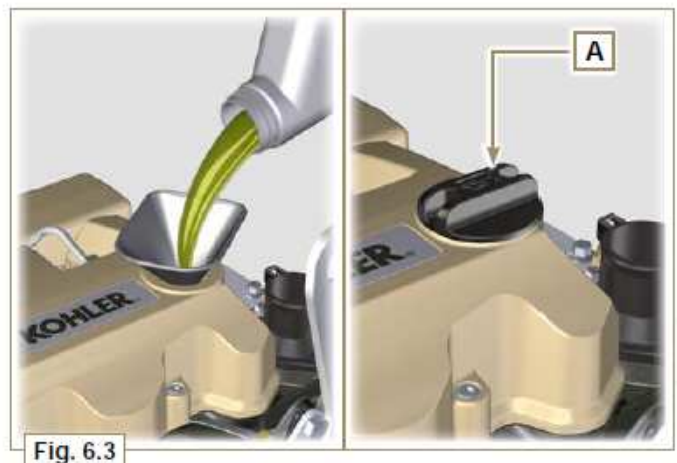
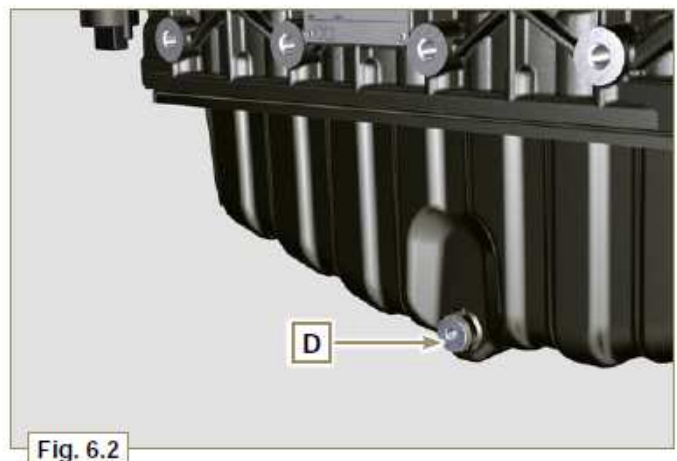
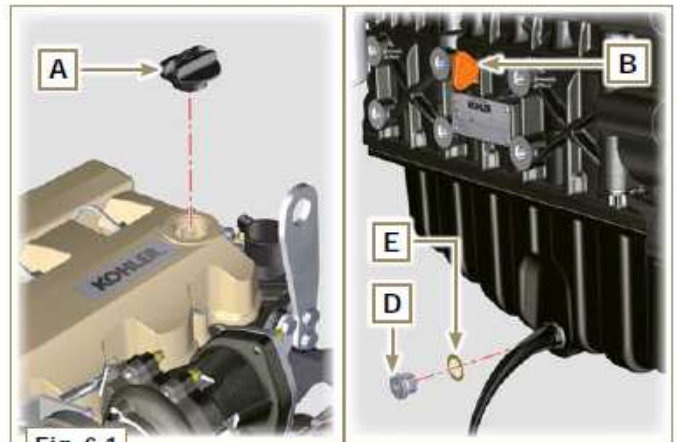
- Place engine on level surface to ensure accurate measurement of oil level.
- Before proceeding, perform the operation described in [Par. 6.2 - Point 1](#).

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 (Fig. 6.1).
- 2 - Remove the oil dipstick B.
- 3 - Remove the oil drain plug D and the gasket E (the oil drain plug is on both sides of the oil sump).
- 4 - Drain oil in an appropriate container.
(For the exhausted oil disposal, refer to [Par. 6.5 DISPOSAL](#) and [SCRAPPING](#)).
- 5 - Replace gasket E.
- 6 - Tighten the drain oil plug D (tightening torque at 50 Nm).
- 7 - Add the type and amount of oil recommended ([Tab. 2.1](#) and [Tab. 2.2](#)).

Important

- Do not exceed the MAX level on the dipstick.



- 8 - Fit and remove the oil dipstick B to check the level. Pour in fluid until reaching the MAX level mark.
- 9 - Upon completion, reinstall the oil dipstick B completely.
- 10 - Tighten the cap A.

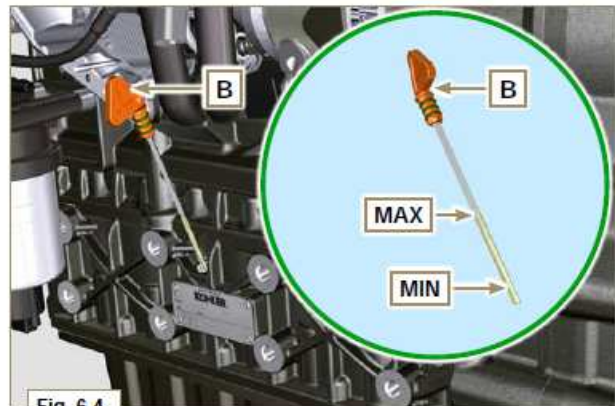


Fig. 6.4

6.2 Oil filter cartridge replacement

Warning

- Electric/pneumatic screwdrivers are forbidden.

- 1 - Unscrew cartridge holder cover A by performing three complete turns and wait 1 minute.

NOTE: this operation allows to oil contained in the support F to flow into the oil sump in the correct way.

- 2 - Unscrew cartridge holder cover A and check that the oil in the lub. oil filter support F has flowed towards the oil sump.

- 3 - Remove the cap A as well as the oil cartridge B from the oil filter support.

- 4 - Remove and replace the oil cartridge B with a new one. Remove and replace the gaskets C, D and E with new ones.

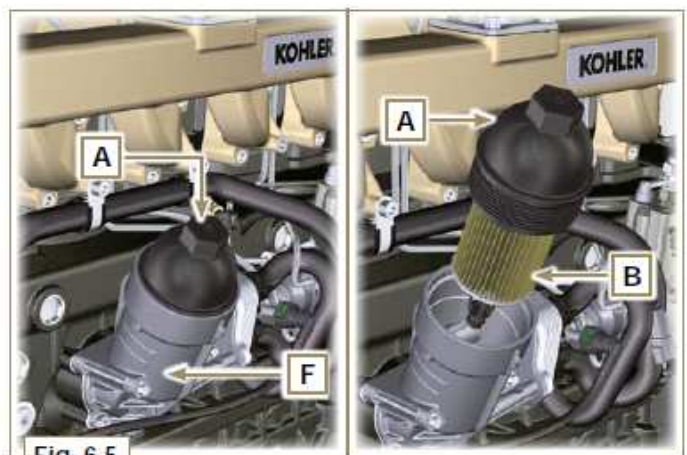


Fig. 6.5

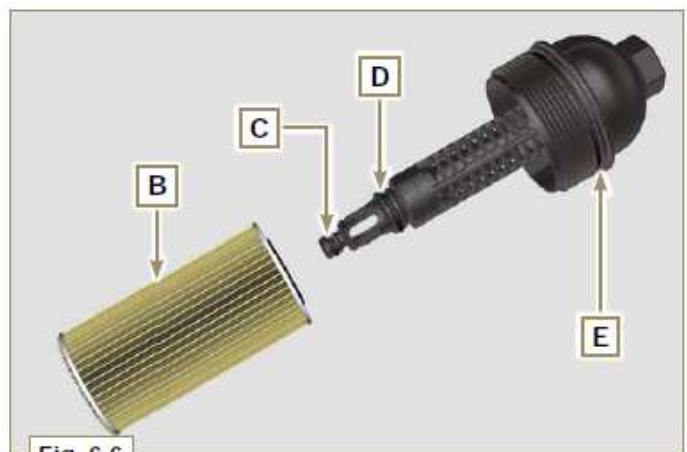
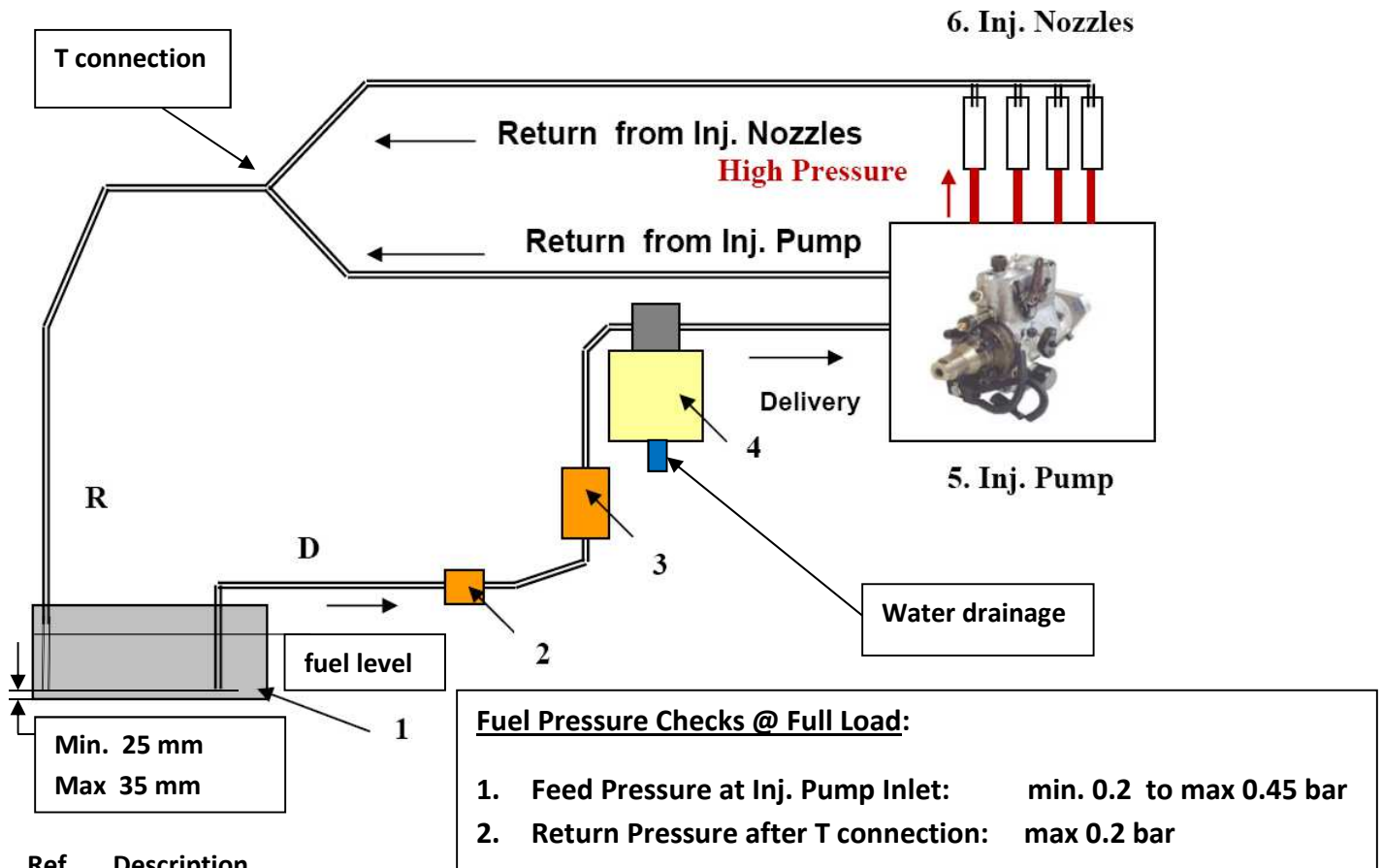


Fig. 6.6

7. Fuel System

Fuel Supply System Layout



Ref. Description

- | | | | | |
|---|--|------------|--------------|---------------------------------------|
| 1 | Fuel tank | | | |
| 2 | In-Line Fuel Pre-Filter as protection for fuel feed pump | | | |
| | 1500 rpm | KOHLER p/n | ED0037302240 | supplied by KOHLER with el. feed pump |
| | 1800 rpm | KOHLER p/n | ED0037302240 | supplied by KOHLER with el. feed pump |
| 3 | Electrical feed pump, necessary, supplied by KOHLER as loose part: | | | |
| | 1500 rpm | KOHLER p/n | ED0065851630 | |
| | 1800 rpm | KOHLER p/n | ED0065851630 | |

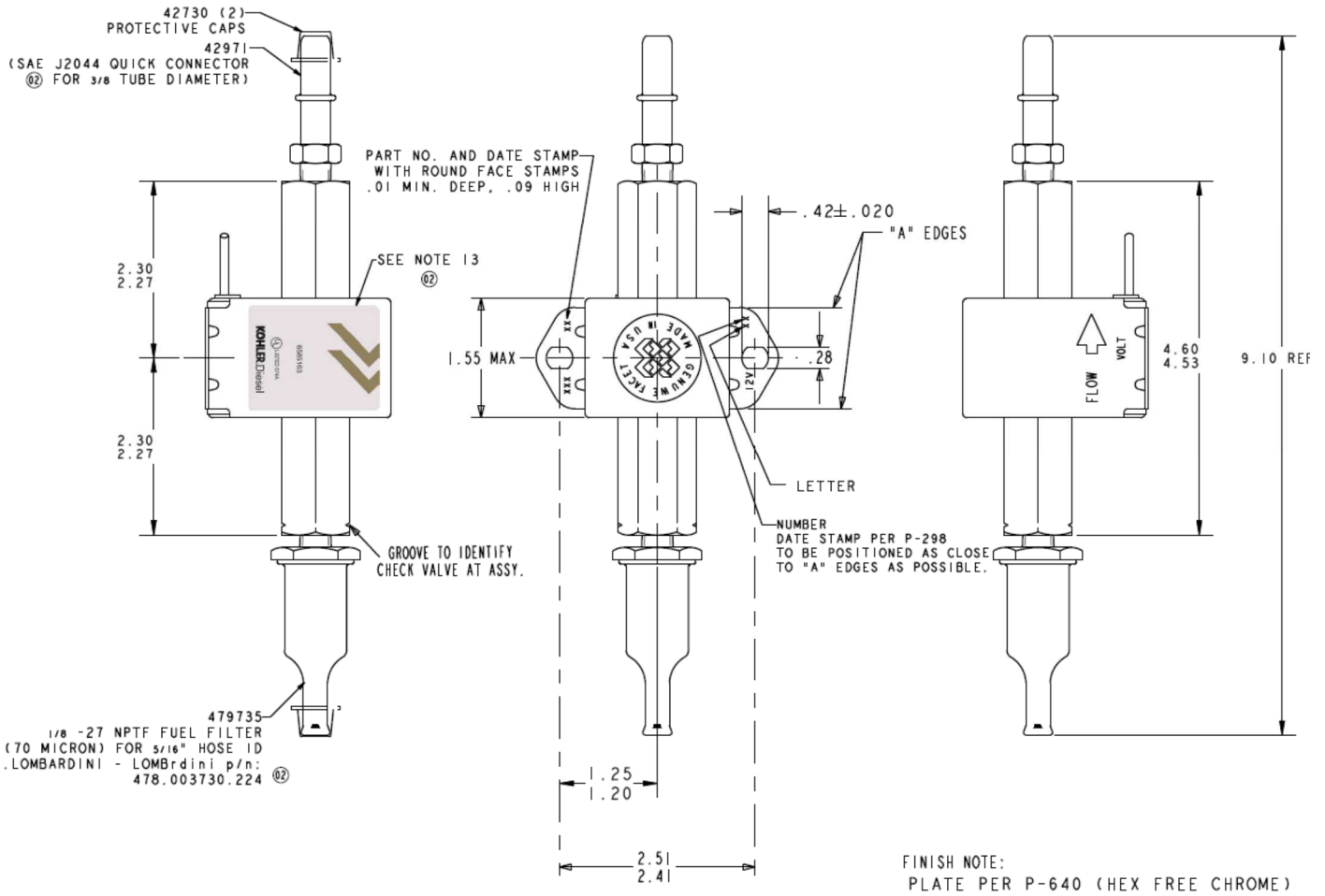
Mounting instructions: feed pump must be not mounted on the engine

- 4 Fuel Filter (Main) with water drainage, 5 micron filtration mesh
- 5 Injection Pump with Electrical Shut Off Valve (ETR) and Cold Start Advance
- 6 Injection Nozzles



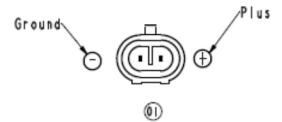
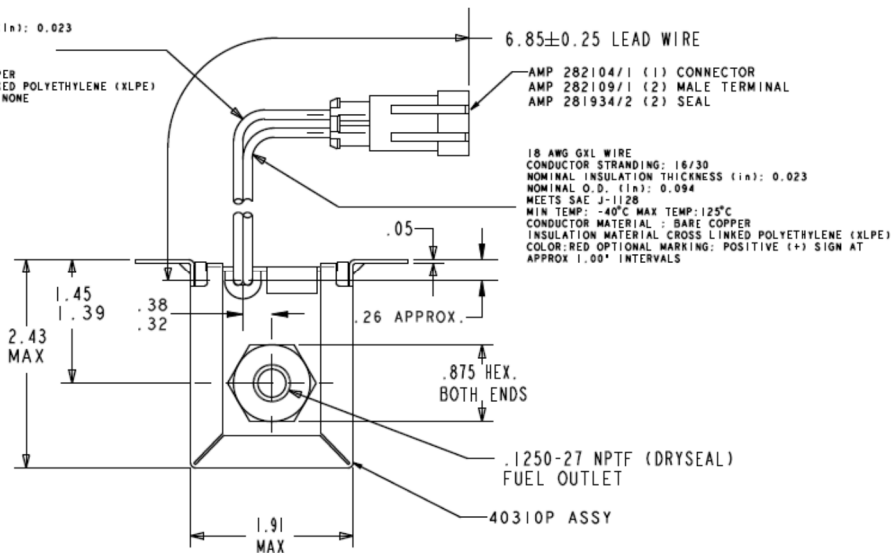
The Fuel Hoses must be mounted far from hot engine parts like exhaust system parts!

Electrical feed pump, KOHLER p/n ED0065851630 with pre-filter, 1500-1800 rpm:



PUMP IS FUEL COMPATIBLE WITH ALL KNOWN COMMERCIAL DIESEL FUELS,
BIO DIESEL B20, GASOLINES, KEROSENES

18 AWG GXL WIRE
CONDUCTOR STRANDING: 16/30
NOMINAL INSULATION THICKNESS (in): 0.023
NOMINAL O.D. (in): 0.094
MEETS SAE J-1128
MIN TEMP: -40°C MAX TEMP: 125°C
CONDUCTOR MATERIAL: BARE COPPER
INSULATION MATERIAL: CROSS LINKED POLYETHYLENE (XLPE)
COLOR: BLACK OPTIONAL MARKING: NONE



Mounting Instructions:

Pump must be max 305 mm (12") higher
above the fuel tank bottom

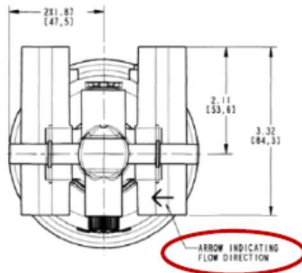
1. OPERATING VOLTAGE RANGE: 10 - 16VDC
NOMINAL TEST VOLTAGE: 13.8VDC
2. AVERAGE CURRENT @ 13.8VDC: 3.0AMPS
3. REVERSE POLARITY PROTECTED
4. SHUT OFF PRESSURE @ 13.8VDC: 12 - 15PSI
5. MIN. PUMP FLOW DELIVERY @ 13.8 VDC: 14.5GPH @ 6 PSI IN DIESEL
6. OPERATING TEMPERATURE (PUMP AND FUEL): -40°F TO 180°F
ASSUMING NO FUEL GELLING
7. DRY PRIMING @ 12VDC: -1.48PSIG OR 50" OF DIESEL FUEL
8. DRY PRIMING @ 10VDC: -1.48 PSIG OR 50" OF DIESEL FUEL

Main Fuel Filter:

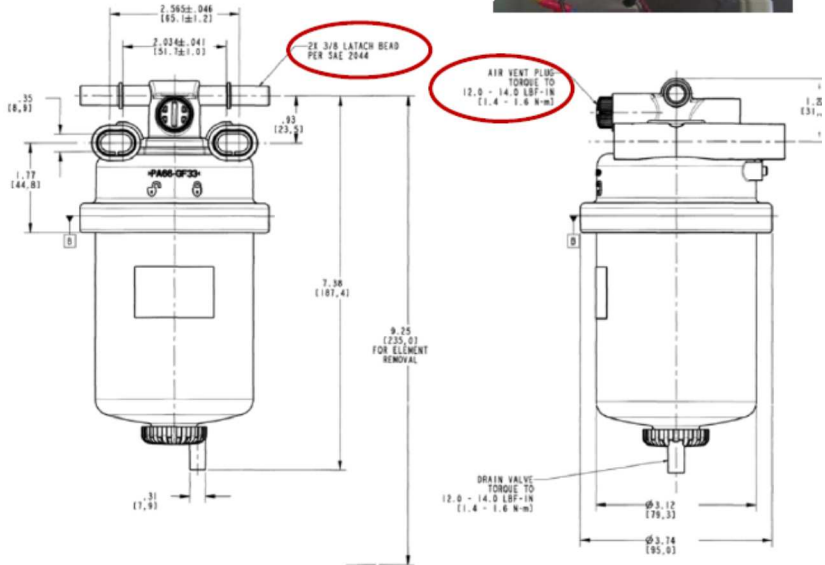
The fuel filter could be supplied as loose part

NOTES:

1. FLAT WASHERS ARE REQUIRED UNDER MOUNTING BOLT HEADS.
2. FILTER RATING: 5 MICRON NOMINAL
3. CUSTOMERS PART NUMBER 3750127



SAE J2044
3/8" 90° quick
connector
for Rilsan Hose
ID 6mm



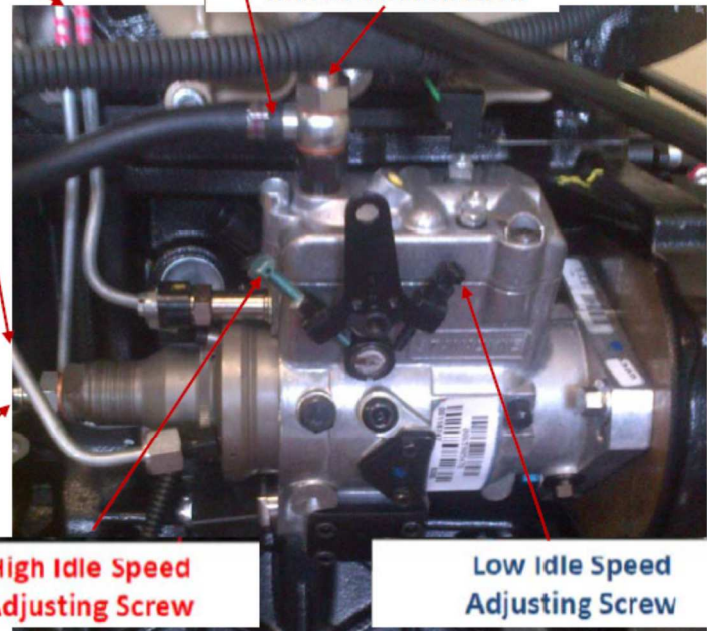
Injection Pump:

High Pressure Pipes to the Injectors Nozzles

Overflow Return to Fuel tank
with de-aeration screw



Return from injectors



Inlet From Fuel Filter

High Idle Speed
Adjusting Screw

Low Idle Speed
Adjusting Screw

High Idle Speed set: it is possible to adjust the Max Frequency Without Load by the High and Low Idle Speed Adjusting Screw, **Min allowed frequency without load is = 52 Hz (62.5 Hz)**

Fuel Line Hoses ID

Inner Diameter (mm)	El. Feed Pump [^]		Main Fuel Filter		Injection Pump		Injectors	T connector	To Tank
	IN	OUT	IN	OUT	IN	RETURN	RETURN	RETURN	RETURN
Material	Rubber	Rubber	Rubber	Rilsan	Rilsan	Rubber	Rubber	Rubber	Rubber
1500 rpm	8	7*	7*	6**	6**	6	6	in 6/6; out 6	6
1800 rpm	8	7*	7*	6**	6**	6	6	in 6/6; out 6	6

Remarks:

* with SAE J2044 Quick Connector 90° 3/8" Female and Male **for ID 7mm Rubber Hose**, not supplied by KOHLER

** with SAE J2044 Quick Connector 90° 3/8" Female and Male **for ID 6mm Polyamide Rilsan Hose**, supplied by KOHLER as loose parts

Rubber Hose Material:

Feed: Textile Covered 0.6 MPa 100°C to be fitted with clamps

Return: SAE J30R7 1 MPa 125°C to be fitted with clamps

Rilsan Hose Material:

Feed: Polyamide PA11 or Pa12 DIN 74324 to be fitted **without** clamps

([^]) El. Feed Pump:

Rating	El. Feed Pump	In Line Pre-Filter
1500 rpm g.s.	6585.163.0	3730.224.0 (70 micron) supplied by KOHLER with feed pump
1800 rpm g.s.	6585.163.0	3730.224.0 (70 micron) supplied by KOHLER with feed pump

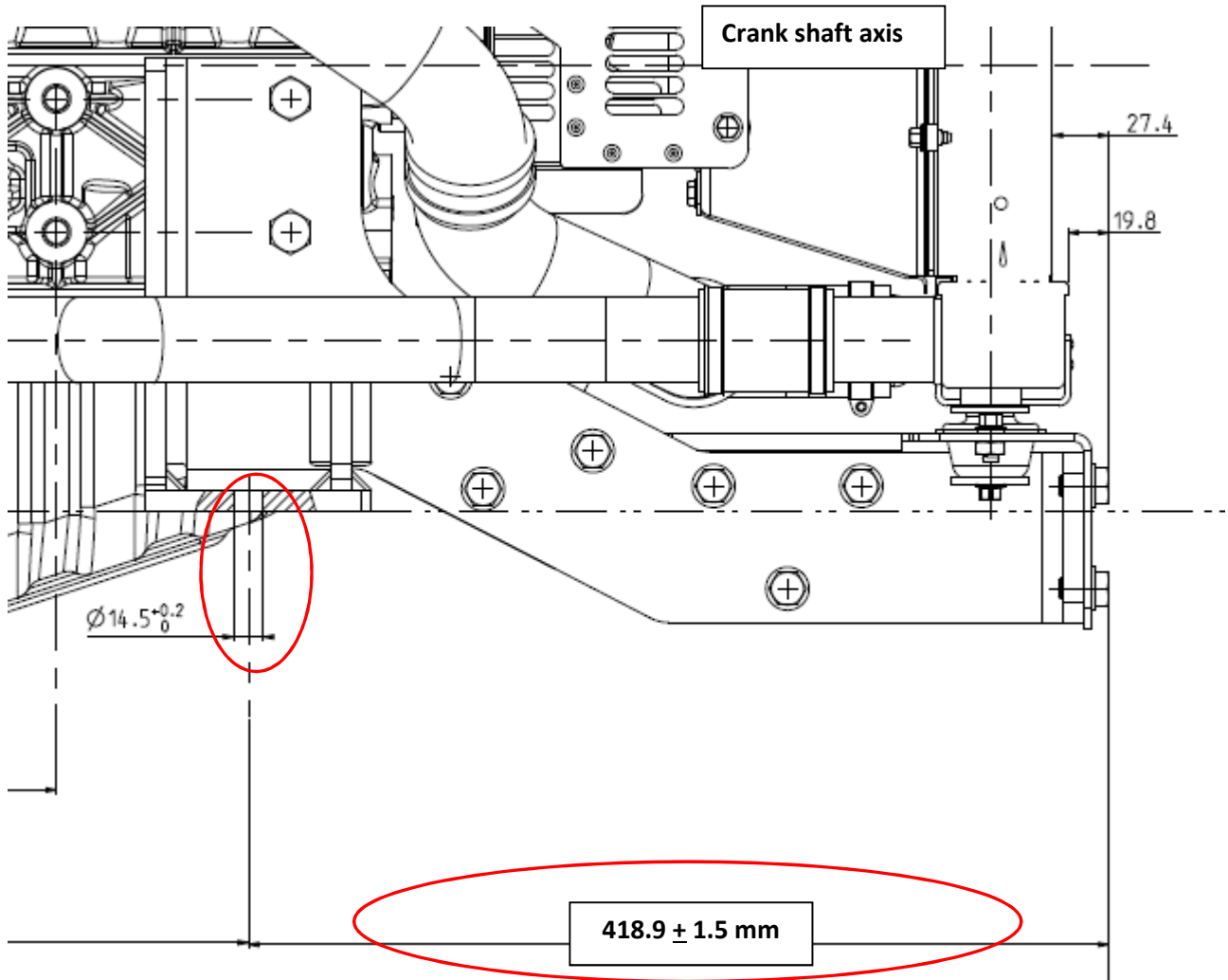
Optional kit as loose parts:

- Rilsan connection from F.Filter to Inj. Pump with SAE J2044 Quick Connector 90° 3/8" Female, p/n 9376.443.0
- T connector for ID 6mm rubber hose, p/n 7301.052.0

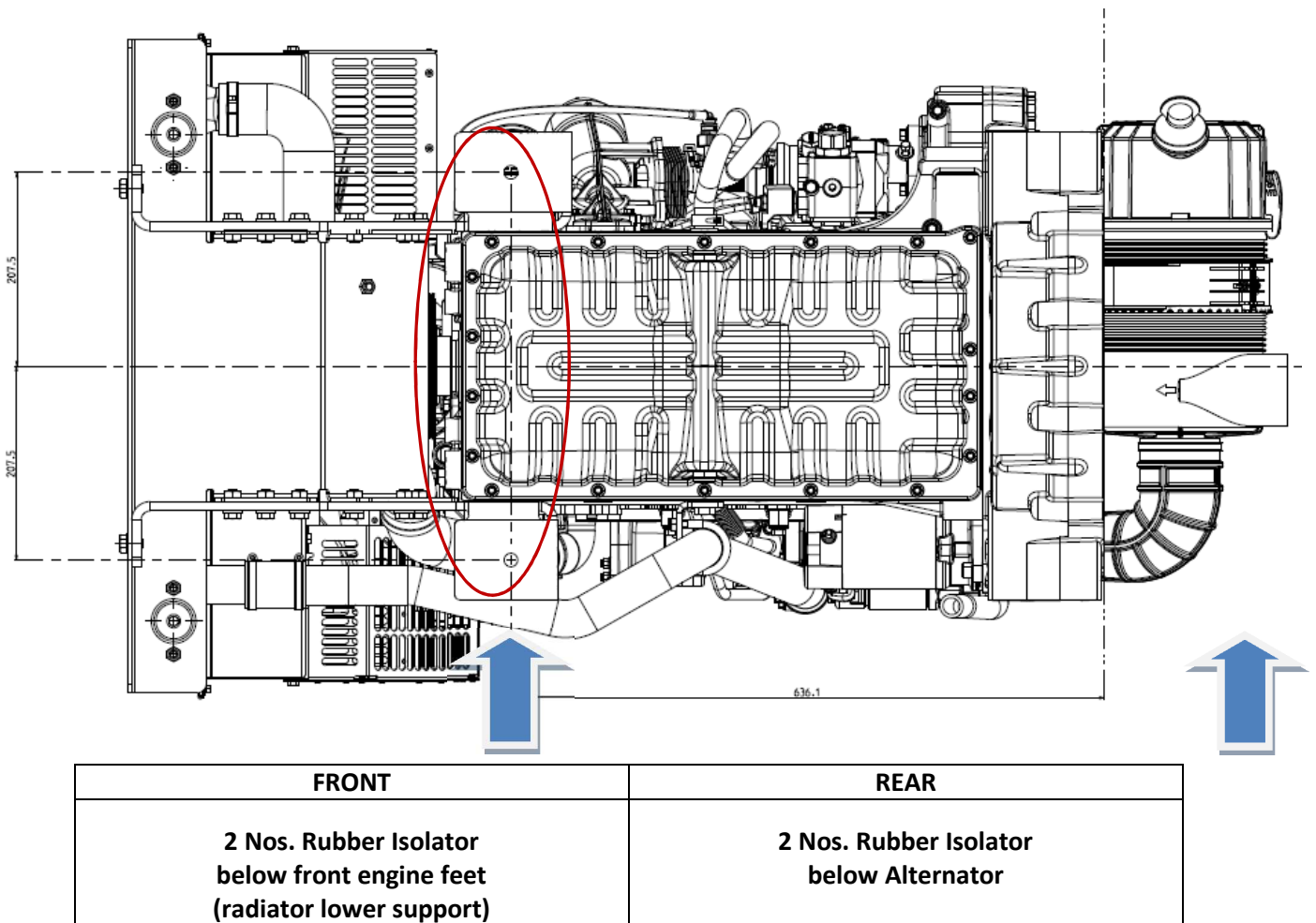
For markets with poor quality of the diesel fuel and high risk of water in fuel it is strictly suggested to install before the KOHLER feed pump (6585.163) a stronger pre-filter with higher capability and equipped with water separator.

8. Engine Mounting

Front engine feet integrated in the radiator lower support



Suggested Engine Mounting Layout:



Rubber Isolators Features depends on the overall weight of alternator + electropack engine.

Taking in account the following european 3-phase alternator weights:

- 280 kg (60 kVA 50 Hz 3 phase)
- 300 kg (70 kVA 60 Hz 3 phase)

We suggest to use the following option:

4 Nos. Cylindrical Rubber Isolators (Bobbins) D80x40 50 ± 5 Sh (K = 67 daN/mm)

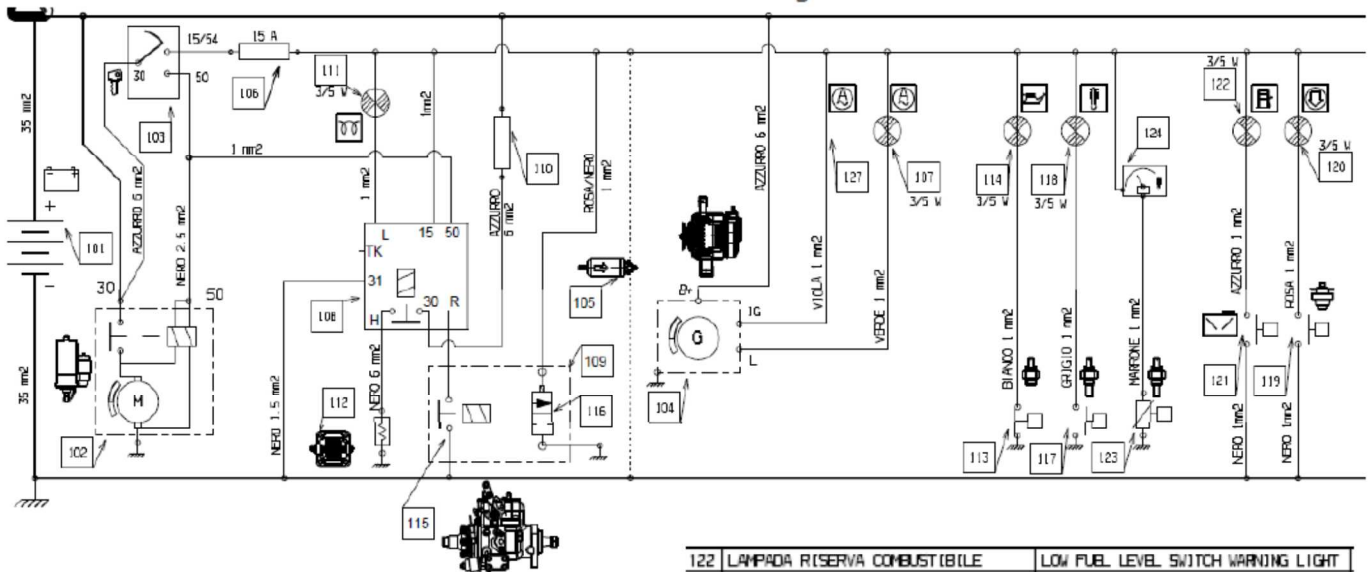
Only the vibration survey can confirm the correct rubber isolators choice!

10. Electrical System

The Electrical Wirings must be mounted far from hot engine parts like exhaust system parts!

Overall layout

Electrical System



109	POMPA INIEZIONE	INJECTION PUMP
108	CENTRALINA PER SCALD E ANTIC	HEATER AND CSA CONTROL UNIT
107	LAMPADA SPIA CARICA BATTERIA	BATTERY CHARGE WARNING LIGHT
106	FUSIBILE STRUMENTI	GENERAL FUSE
105	POMPA COMBUSTIBILE ELETTRIC	ELECTRICAL FUEL PUMP
104	ALTERNATORE	ALTERNATOR
103	INTERRUTTORE A CHIAVE	KEY SWITCH
102	MOTORINO D'AVVIAMENTO	STARTER MOTOR
101	BATTERIA	BATTERY
125	CONNETTORE LOHARDINI (n°contatto)	LOHARDINI 500/ET (connection number)
124	TERMOMETRO ACQUA	WATER TEMPERATUR GAUGE
123	SENSORE PER TERMOMETRO ACQUA	WATER TEMPERATUR GAUGE SWITCH

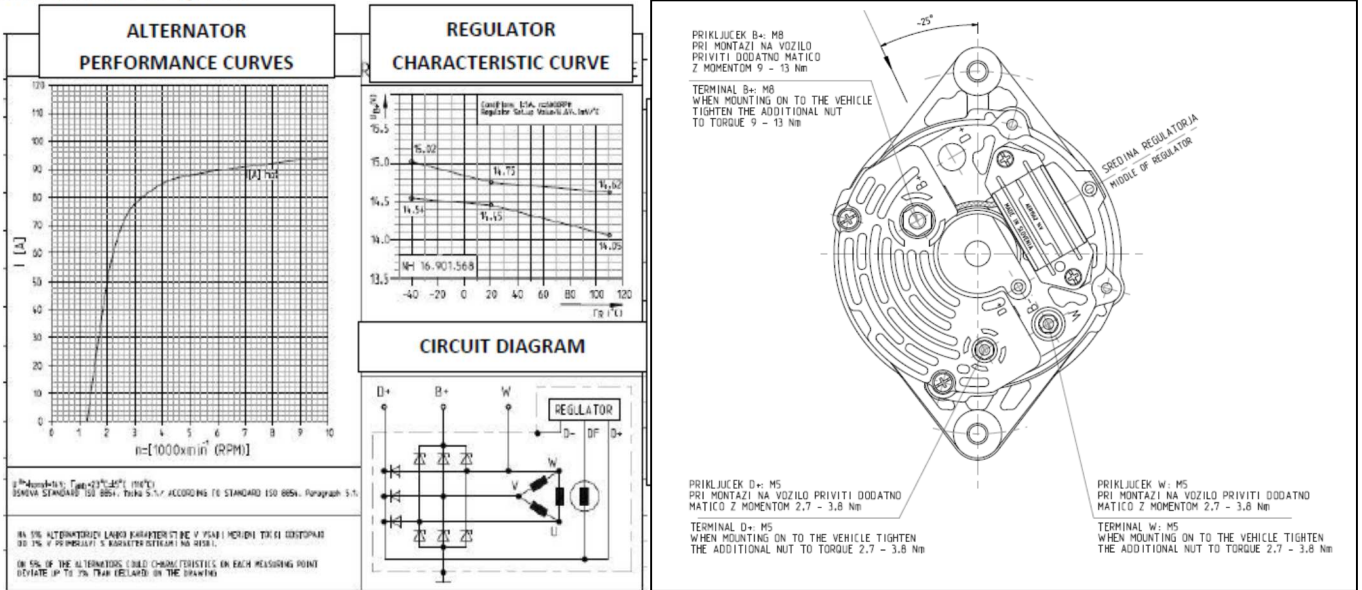
122	LAMPADA RISERVA COMBUSTIBILE	LOW FUEL LEVEL SWITCH WARNING LIGHT
121	INTERRUTTORE RISERVA COMBUSTIBILE	LOW FUEL LEVEL SWITCH
120	LAMPADA SPIA FILTRO INTASATO	AIR CLEANER RESTRICTION WARNING LIGHT
119	INTERRUTTORE FILTRO ARIA INTASATO	AIR CLEANER RESTRICTION SWITCH
118	LAMPADA SPIA TEMPERATURA	WATER TEMPERATURE WARNING LIGHT
117	INTERRUTTORE TEMPERATURA	TEMPERATUR SWITCH
116	ELETTROVALVOLA DI ARRESTO	ELETRIC SHUT OFF VALVE
115	ANTICIPO INIEZIONE A FREDDO	COLD START ADVANCE
114	LAMPADA SPIA PRESSIONE OLIO	OIL PRESSURE WARNING LIGHT
113	INTERRUTTORE PRESSIONE OLIO	OIL PRESSURE SWITCH

12V System

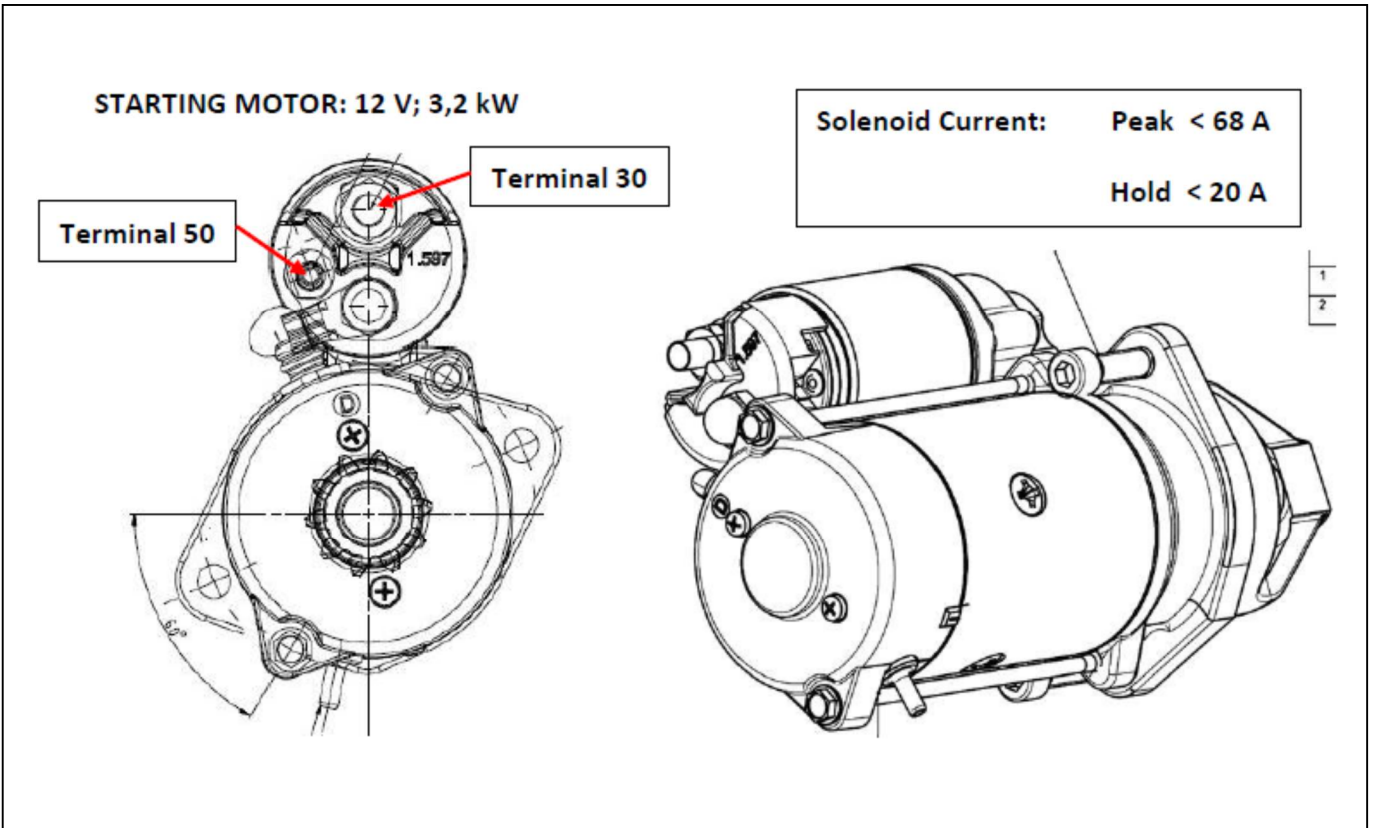
1	Alternator	90 Amps
2	Starter Motor	3.2 kW
3	Battery	See on page No. 12
4	Control Unit	To drive Cold Start Advance 10s after starting.
5	Air Grid Heater 550W	KOHLER accessory, required to cold start below Ambient -15°C, to install at intake manifold inlet. Below Ambient +20°C: block heater 1000W is required (see on page No.5 the available mounting position of Block Heater).
6	Coolant Temp. Switch/Sensor	Installed on the engine head (timing case side)
7	Oil Pressure Switch	Installed on the engine block (inj. pump side)
8	Electric shut off fuel valve	Installed on the fuel injection pump (ETR, Energized To Run)
9	Cold Start Advance	Installed on the fuel injection pump, to drive an injection timing advance immediately after the engine start for 10 sec. It is driven by KOHLER Control Unit or <u>it can be driven by GenSet control Panel.</u>

1. ALTERNATOR 14V

ALTERNATOR: 14 V; 90 A

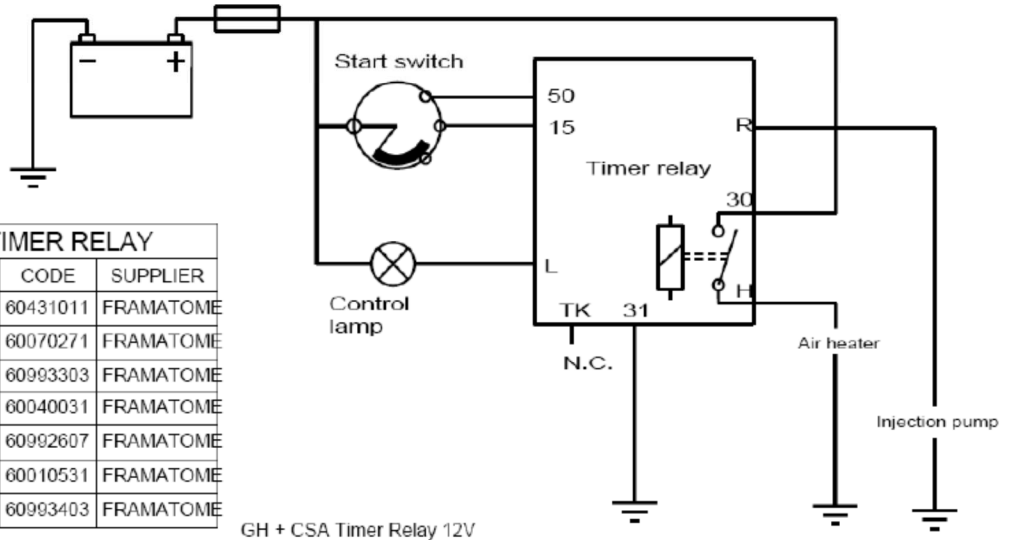


2 Starting motor 12V	3.2 kW
-----------------------------	---------------



4 Control Unit 12V Drives Cold Start Advance and Air Grid Heater

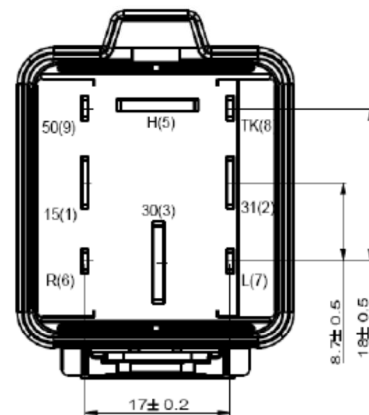
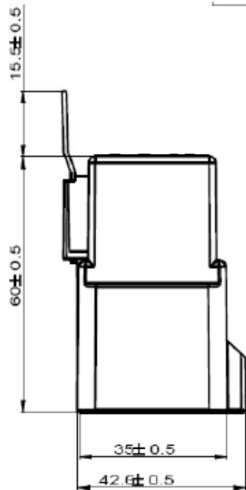
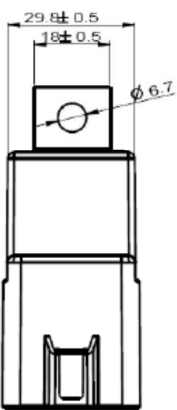
8. Connection scheme



HOW TO CONNECT TO TIMER RELAY		
DESCRIPTION	CODE	SUPPLIER
CONNECTOR 8 WAY	60431011	FRAMATOME
9.5 mm FEMALE TERMINAL 6-10 mmq	60070271	FRAMATOME
SEAL 9.5 for 6-10 mmq	60993303	FRAMATOME
6.3 mm FEMALE TERMINAL 0.5-1 mmq	60040031	FRAMATOME
SEAL 6.3	60992607	FRAMATOME
2.8 mm FEMALE TERMINAL 0.5-1 mmq	60010531	FRAMATOME
SEAL 2.8	60993403	FRAMATOME

GH + CSA Timer Relay 12V

4 Control Unit 12V Drives Cold Start Advance and Air Grid Heater



2:1

3. Terminals

30, H	Faston 9,5 x 1,2 tin covered
31, 15	Faston 6,3 x 0,8 tin covered
50, TK, R, L	Faston 2,8 x 0,8 tin covered

4. Terminals according to signal description

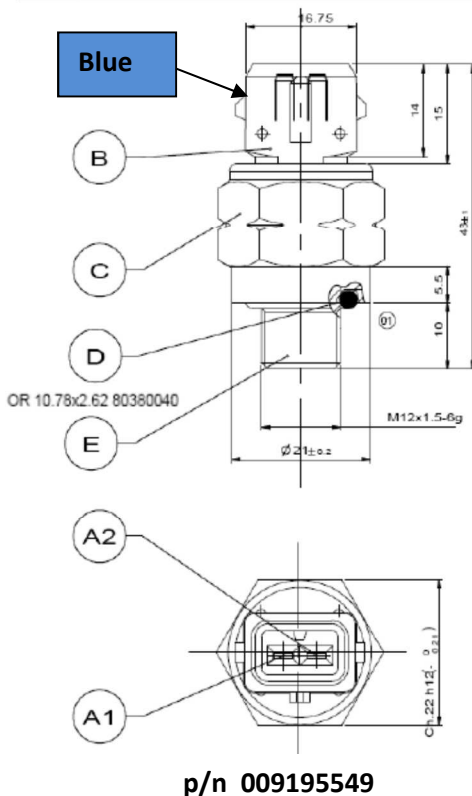
Pin No.	Signal	Note
7	L	Signal light
6	R	CSA pump
8	TK	N.C.
3	30	+Ubatt
9	50	Cranking
2	31	Ground
1	15	Ignition ON
5	H	Air heater

4 Control Unit 12V	Drives Cold Start Advance and Air Grid Heater
---------------------------	--

6. Technical data

Characteristics	Value
Nominal voltage	12 V
Operating voltage	8V to 16V
Over voltage protection threshold	17V \pm 1V
Voltage range at limited functionality	6 V -32 V
Nominal H output current	70 A / 10 min break between two attempts
Maximal H output current	140 A / 60 s
Load on connection L (control lamp)	max. 2 W, for ohmic and inductive loads or LED light
Max. current on connection R max.	1,5 A continuous
Max. current on connection R max.	2,5 A / 1 min
Operating temperature range	-40 + +85°C
Storage temperature	-40 + +125°C

6 Coolant temperature sensor	Sensor and switch (set 110°C)
-------------------------------------	--------------------------------------

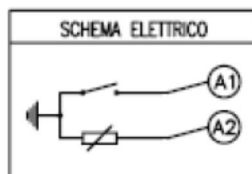


For Connector AMP 281844; A1 fast-on 2.8x0.8
A2 fast-on 2.8x0.7

Tightening torque: 20 Nm
12V, 3W

Switch Normally Open, closure at: 110°C +/-3°C
opening again at : > 88°C; <100°C

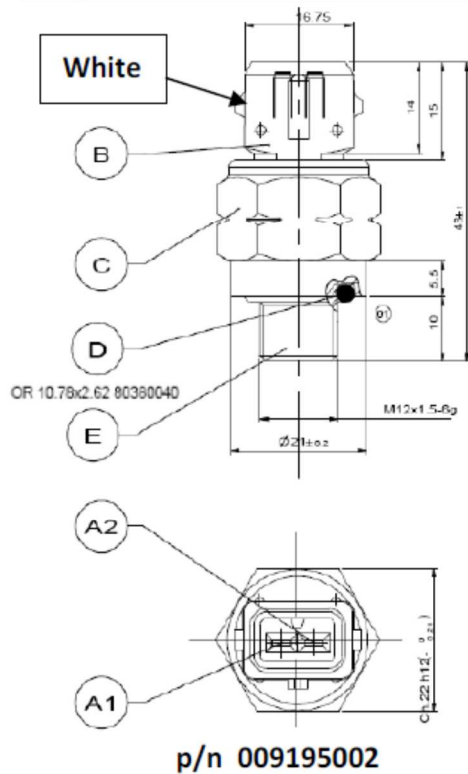
TEMPERATURA	RESISTENZA
-35 °C	63849Ω (53983-73806)
-30 °C	46085Ω (39229-52941)
-15 °C	19415Ω (18006-20825)
0 °C	8012Ω (7095-8929)
30 °C □	1872Ω (1717-2039)
60 °C □	554Ω (520-589)
90 °C □	196Ω (188-204)
120 °C	80Ω (76 - 84)



A1 signal to red warning lamp (*)
(*) shut down input for Gen. Sets
A2 signal to temperature indicator

6 Coolant temperature sensor

Sensor and switch (set 110°C)



For Connector AMP 281844; A1 fast-on 2.8x0.8
A2 fast-on 2.8x0.7

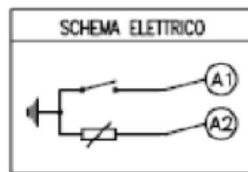
Tightening torque: 20 Nm

12V, 3W

Switch Normally Open, closure at: **110°C +/- 3°C**
opening again at : > 88°C; < 100°C

TEMPERATURA	RESISTENZA
-36 °C	13779Ω (11835-15724)
-30 °C	9546Ω (8258-10834)
-16 °C	4237Ω (3721-4753)
0 °C	1807Ω (1611-2003)
30 °C	453,5Ω (414,1-493)
60 °C	141,8Ω (132-151,7)
90 °C	53,19Ω (50,27-56,11)
120 °C	22,94Ω (21,6-24,29)

VDO
scale



A1 signal to red warning lamp (*)
(*) shut down input for Gen. Sets

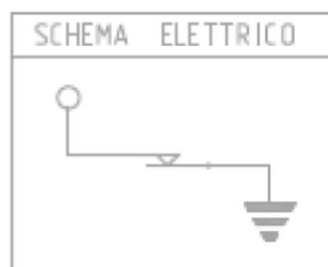
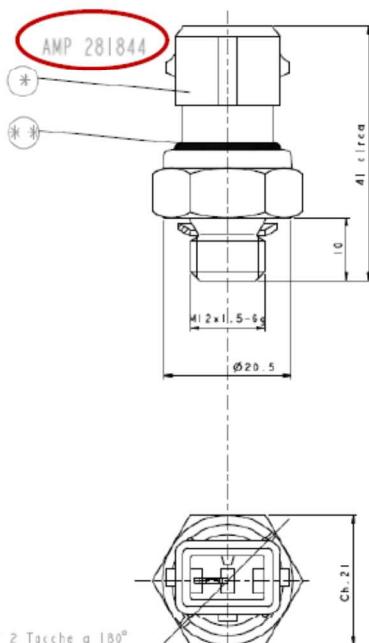
A2 signal to temperature indicator

7 Oil pressure switch

Installed on the block (injection pump side)

Switch Set: 0.6 +/- 0.1 bar

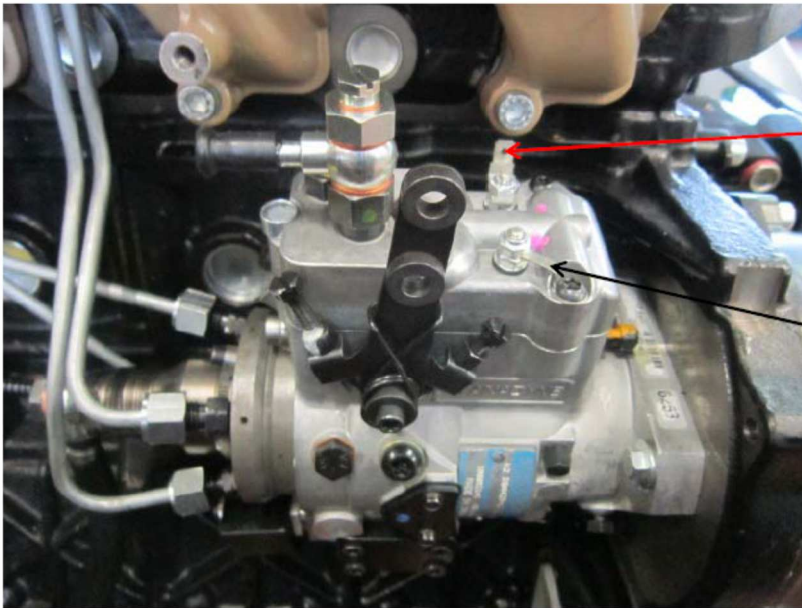
Tightening Torque: 35 Nm



Oil pressure switch (M12x1.5)

For Connector AMP 281844

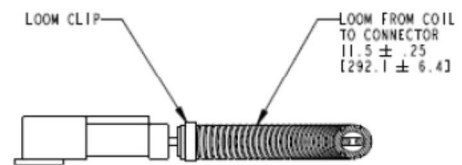
8	Electric shut off valve	Installed on the injection pump (Energised To Run)
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**Electric Shut Off (+),
to be driven by key switch,
nominal 3.75 Ohms 3.2 Amps
12V power supply
Normally Closed valve
Energised To Run.**

Electric Shut Off Ground

9	Cold Start Advance Solenoid	Installed on the injection pump (12V, 23.3 Ohms)
---	-----------------------------	--



FOR OPTIONAL COLD ADVANCE SOLENOID

DEUTCH LIMITED:

RECEPTICAL ASS'Y	DT04-2P-EP04	QTY 1
CONTACT PIN	0460-202-16141	QTY 2
WEDGE LOCK	W2P	QTY 1
CORRUGATED LOOM		QTY 1
CORRUGATED LOOM CLIP		QTY 3

CONNECTOR ASSEMBLY



Cold Advance Solenoid Connector, to be driven by external device

11. Cold Start Ability

12V System (Starter Motor 3.2 kW)

There are two different start requirements depending on the gen set mission:

Stand-By GenSet application (50Hz not emissionised; 60Hz Tier III)

Operating ambient temperature	Manifold Air Grid Heater 550W	Block Heater	Cranking Strategy ESP	Engine Oil	Fuel	Battery
- 15°C to + 20°C	No	Yes	Yes	5W-40 API CH-4	Winter	70Ah 660CCA (SAE)
- 25°C to - 15°C	Yes	Yes	Yes	5W-40 API CH-4	Arctic	100Ah 800CCA (SAE)
- 30°C to - 25°C	Yes	Yes	Yes	0W-30 API CH-4	Arctic	110Ah 950CCA (SAE)

Block Heater: Engine Coolant Set Temperature 30°C; it is suggested size 1000W.

Cranking strategy ESP (Stand-By GenSet):

Step	Action	Inj. Pump ETR valve	Duration
1	Cranking	OFF (no el. power)	10 s
2	Cranking	ON (el. power)	5 s
3	Stand-By (if engine not yet started at step 2)	OFF (no el. power)	15 s
4	Cranking	ON (el. power)	15 s
5	Stand-By (if engine not yet started at step 4)	OFF (no el. power)	15 s
6	Cranking	ON (el. power)	15 s
7	If engine is not started, then display standard "Crank Over " message		

Rental GenSet application (50Hz Stage 3A)

Operating ambient temperature	Manifold Air Grid Heater 550W	Cranking Strategy PRP	Engine Oil	Fuel	Battery
Above - 15°C	No	Yes	5W-40 API CH-4	Winter	100Ah 800CCA (SAE)

Cranking strategy PRP (Rental GenSet):

Step	Action	Inj. Pump ETR valve	Duration
1	Cranking	OFF (no el. power)	10 s
3	Stand-By	OFF (no el. power)	15 s
4	Cranking	OFF (no el. power)	5 s
5	Cranking	ON (el. power)	5 s
5	Stand-By (if engine not yet started at step 5)	OFF (no el. power)	15 s
6	Cranking	ON (el. power)	10 s
7	If engine is not started, then display standard "Crank Over " message		

Cable Sizing:

Cables sizing between battery “ + ” terminal and starter motor “ 30 ” terminal must be made as to have a minimum voltage drop; ground cable must have the same cross sectional area of the cable connected to battery “+” terminal.

Maximum length of cables is:

$$l = \frac{\Delta V \cdot S}{\rho \cdot I_{AK}} = \frac{0.04 \cdot U_N \cdot S}{0.0175 \cdot I_{AK}} \cong 2.3 \cdot \frac{U_N}{I_{AK}} \cdot S$$

l = max cable length [m]; S = cable cross sectional area [mm²]

U_N = battery nominal voltage [V]; I_{AK} = start-up current (DIN at -18 °C) [A] = 0.53 CCA (SAE)

ΔV = allowable voltage droop = 4% of nominal voltage [V];

ρ = linear resistivity of copper = 0.0175 μΩ·m

Battery Discharge Current at -18°C			12V/A(DIN)	Cable Max Lenght	S Cable Cross Section					
SAE (CCA)	EN (A)	DIN (A)	U_N / I_{AK}		25 (mm ²)	35 (mm ²)	50 (mm ²)	70 (mm ²)	95 (mm ²)	120 (mm ²)
510	528	268	0,045	l (m)	2,6	3,6	5,1	7,2	9,8	12,3
620	642	326	0,037	l (m)	2,1	3,0	4,2	5,9	8,0	10,2
660	683	347	0,035	l (m)	2,0	2,8	4,0	5,6	7,6	9,5
750	776	395	0,030	l (m)	1,7	2,4	3,5	4,9	6,6	8,4
800	828	421	0,029	l (m)	1,6	2,3	3,3	4,6	6,2	7,9
950	983	500	0,024	l (m)	1,4	1,9	2,8	3,9	5,2	6,6
1000	1035	526	0,023	l (m)	1,3	1,8	2,6	3,7	5,0	6,3

12. Temperature Tests

Cooling Test

It should be carried out running in the heaviest operating conditions foreseen for the application in terms of engine load, hot temperature, dust, etc., by monitoring and recording the temperature of the main engine functional parameters, as top hose coolant temperature, engine oil temperature, air intake temperature, exhaust temperature, engine room temperature, and the operating ambient temperature.

The coolant should be a mixture 50% water / 50% glycol.

The thermostat valve must be fitted jacked fully open (7.5 mm stroke).

fit here a 7.5 mm spacer as it is shown in the picture:



The test is completed when the top hose coolant temperature and the engine oil temperature are stabilized. Then, for each of these engine functional parameters it is possible to calculate a Limit Operating Air Temperature (LAT) using the following formula:

$$\text{LAT} = \text{Limit} - \text{Measured} + \text{Ambient}$$

Where:

- Limit = max allowed temperature for the considered engine parameter (top hose coolant, oil, etc.)
- Measured = max measured value for the considered engine parameter
- Ambient = average operating ambient temperature during the test

Air To Boil requirements

$$\text{ATB} = \text{Top Hose Coolant Limit Temp.} - \text{Measured} + \text{Ambient}$$

There the following Air to Boil requirements:

ATB	Prime Power (100%)	Stand-By Power (110%)
Stand-By GenSet	Min. 45°C Max 55°C	Min. 40°C
Rental GenSet	Min. 48°C Max 58°C	Min. 42°C

with radiator cap set 1 bar and coolant with 50% glycol concentration.

On the next page there are listed the limit temperature values for the main engine parameters



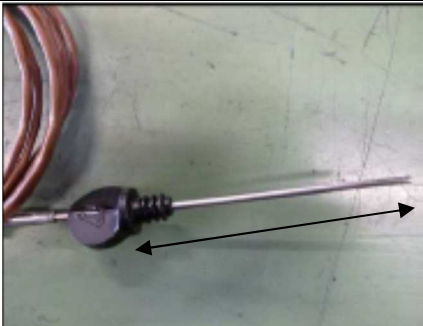


Limit Temperatures List (KDI 3404TM)


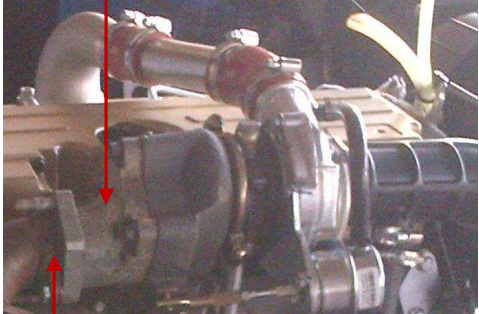
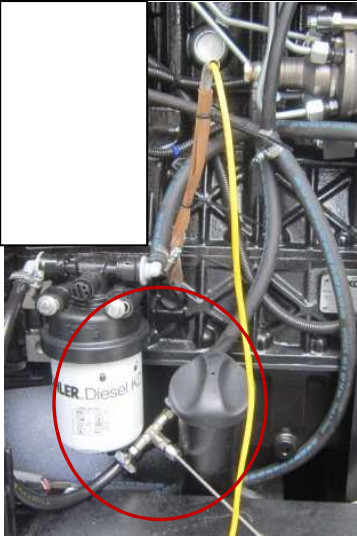
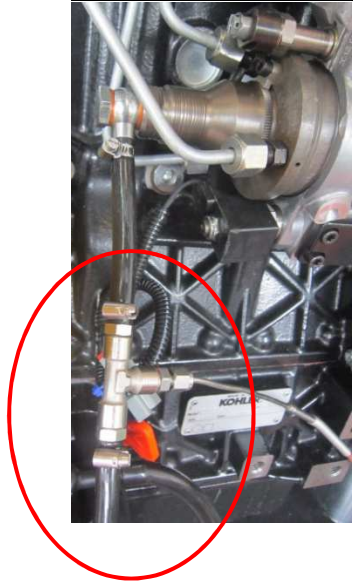
Pos.	Engine Functional Parameter	3404 TM 61kW @1500rpm Not Emissionised		3404 TM CAC 61kW@1500rpm EU Stage 3A		3404 TM CAC 70kW@1800rpm EPA Tier III	
		PRP (100%)	ESP (110%)	PRP (100%)	ESP (110%)	PRP (100%)	ESP (110%)
1	Top Hose Coolant	110°C	110°C	110°C	110°C	110°C	110°C
2	Bottom Hose Coolant	103-105°C	103-105°C	103-105°C	103-105°C	103-105°C	103-105°C
3	Engine Oil (in the sump) Oil 5W-40	135°C	135°C	135°C	135°C	135°C	135°C
4	Air Filter Inlet	Max 5°C ROA		Max 10°C ROA		Max 10°C ROA	
5	After CAC	na		Max 30°C ROA		Max 30°C ROA	
6	Exhaust Gas After Turbocharger (flange or duct)	480°C	500°C	470°C	490°C	470°C	490°C
7	Fuel Feed (at inj. pump inlet)	60°C (de-rating above 35°C)					
8	Alternator Regulator Surface	105°C					
9	Starter Motor Solenoid Surface	95°C					
10	Engine Head (air 10 mm above Head)	85°C					
10	Rocker Arm Cover (surface after TC)	115°C					
12	Battery (air 10mm above)	75°C					

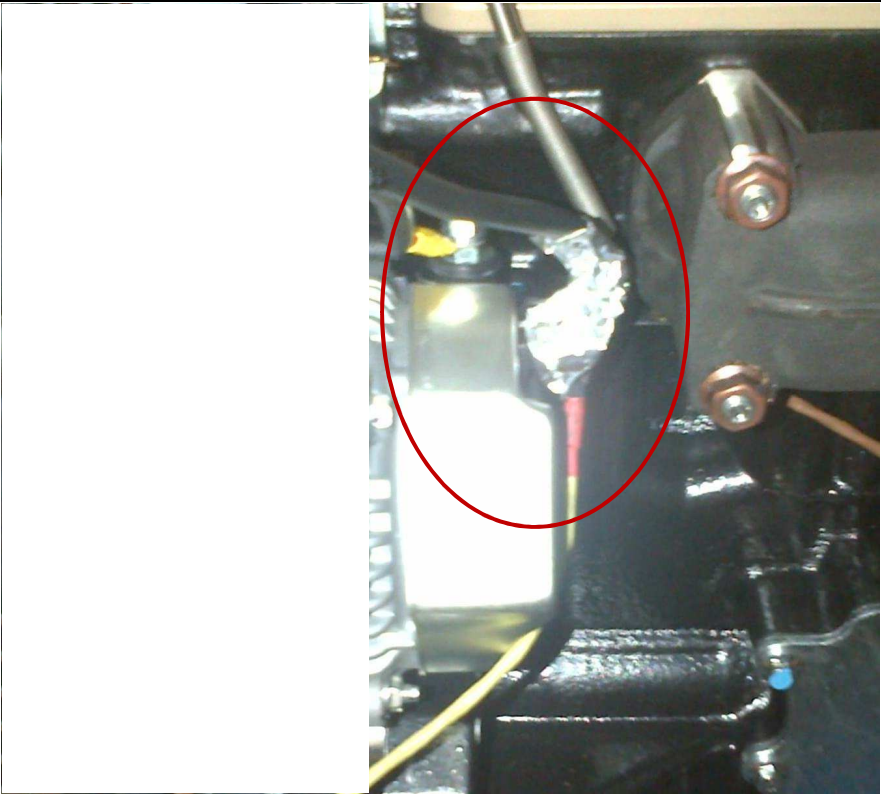
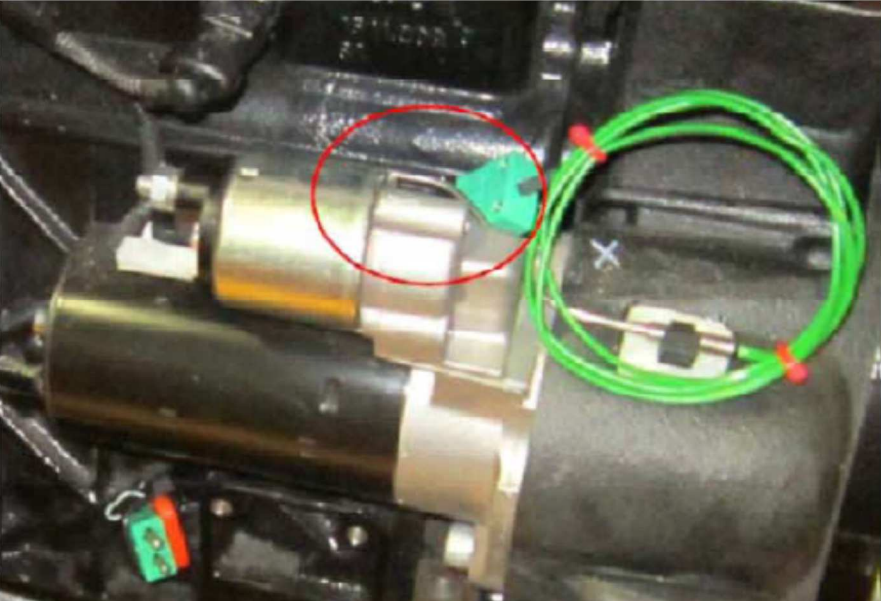
ROA = Rise Over Ambient



Temperature Measurements Positions

Pos.	Measurement	Probe	Position
1	<p>Top Hose Coolant (near thermostat housing)</p>	<p>Option 1 (t.stat body)</p>   <p>Option 2 (top hose)</p> 	<p>Option1 (t.stat body)</p>  <p>Option 2 (top hose)</p> 

Pos.	Measurement	Probe	Position
2	Bottom Hose Coolant (near water pump inlet)		
3	Engine Oil (in the sump)	 <p>At min. oil level tag</p>	
4	Air Filter Inlet		

Pos.	Measurement	Probe	Position
5	Exhaust Gas (manifold flange or elbow)	Option 2 (flange) 	Option 1 (duct)  Option 2 (flange)
6	Fuel Feed (at injection pump inlet)		

Pos.	Measurement	Position
7	Alternator (Regulator surface)	
8	Starter Motor (Solenoid surface)	

Pos.	Measurement	Position
9	Engine Head (air 10 mm above Head) Timing Cover Side	 A close-up photograph of the engine head area. A red circle highlights a specific component, likely a sensor or valve, located near the timing cover. The engine is mounted on a yellow and black frame.
10	Battery (air 10mm above)	 A close-up photograph of the battery. A red circle highlights a specific component, likely a sensor or valve, located on top of the battery. The battery is mounted on a yellow and black frame.

13. Hot Shut Down Test

The test must be done with thermostat valve working

The radiator or the inlet grid of the machine must be partially blanked to stabilize with engine running the Top Hose coolant temp. = 105°C then the engine must be suddenly shut down.

The KDI TM Cooling System has the following safety threshold:

Top Hose = 110°C

Red Lamp - Stop Engine

The Hot Shut Down Test should be carried out, especially in the machines with canopy, running in the heaviest operating conditions foreseen for the application in terms of engine load, hot temperature, dust, etc., by monitoring and recording the temperature of the main engine functional parameters, as top hose coolant temperature, engine oil temperature, air intake temperature, exhaust temperature, engine room temperature, and the operating ambient temperature.

The coolant should be a mixture 50% water / 50% glycol.

When the engine is suddenly shut down but it is necessary to continue to record the temperatures to check:

- the peak values of Top Hose temperature and of the air temperature around electrical parts;
- the recovery time necessary after the peak to have again the same max temp. values recorded before the shut down.

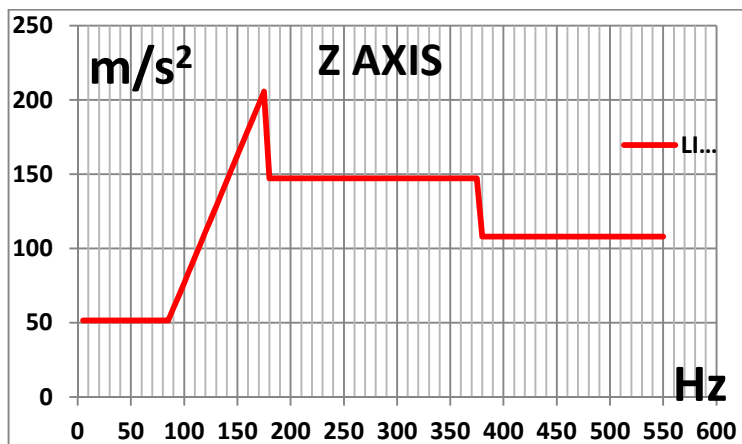
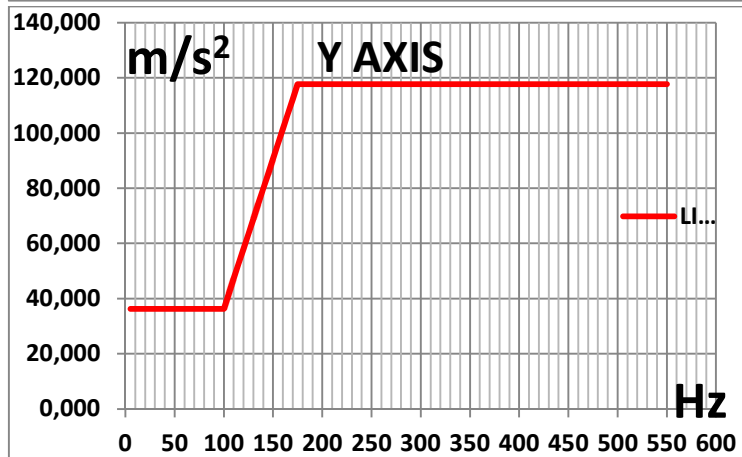
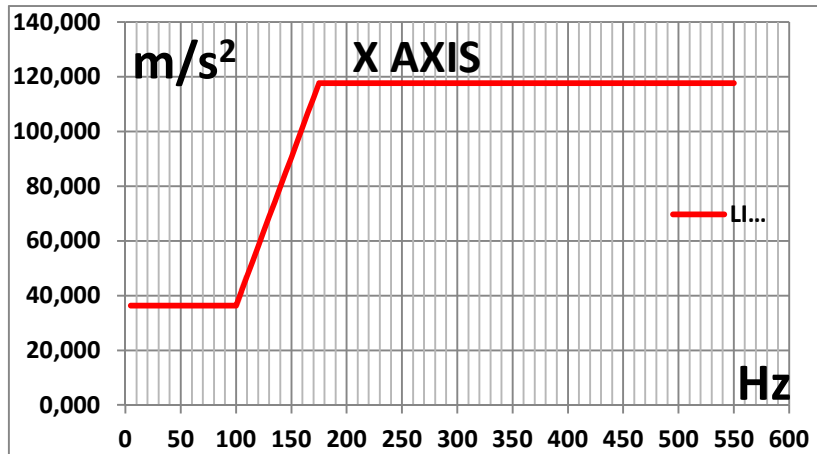
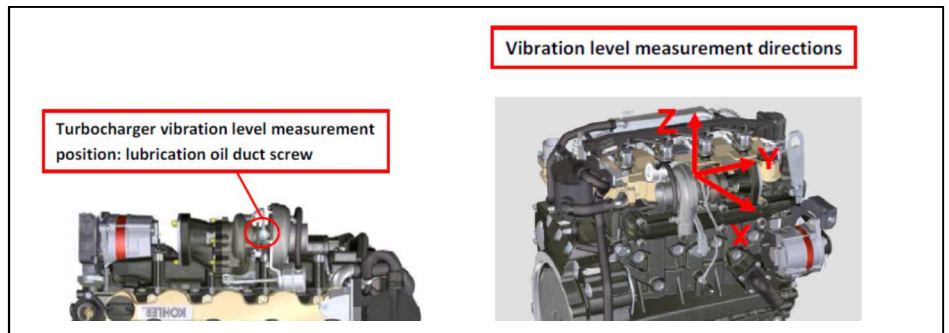
Limit Temperatures List (KDI 3404TM, 1500rpm and 1800 rpm)

Pos.	Engine Functional Parameter	Limit Temperatures Peak 1 minute
1	Top Hose Coolant (near thermostat housing)	118°C
3	Engine Oil (in the sump)	138°C with Oil 5W40
7	Alternator (regulator surface)	110°C
8	Starter Motor (solenoid surface)	100°C
9	Engine Head (air 10 mm above Head) Timing Cover Side	90°C
10	Rocker Arm Cover (surface after TC)	120°C
11	Battery (air 10mm above)	80°C

14. Vibration Survey

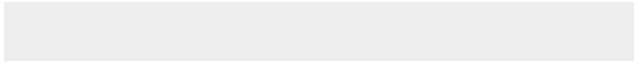
Turbocharger vibration limits

- Max peak-hold values [m/s²]
- Frequency range: 5-550 Hz
- Stay out frequency > 170 Hz



15. Application Checks List

KDI 3404 TM for stationary gs										
Cooling Test @ FL with t.stat valve jacked open; Hot Shut Down Test with std t.stat valve. Fuel Test to carry out @ FL with 1/8 fuel tank level FL = ESP (110%) but LAT to check also @ PRP (100%)				Limits			Results			
				3404 TM 61 kW 1500 rpm Not Emissionised	3404 TM CAC 61 kW 1500 rpm EU Stage 3A	3404 TM CAC 70 kW 1800 rpm EPA Tier III	Measured	ROA	LAT	Clearance
1	Pressure	Clean Air Filter Restriction @ FL	(mbar)	min 15 max 42	min 15 max 42	min 15 max 42		na	na	
2	Pressure	After Cooler + Pipes Pressure Droop @ FL	(mbar)	na	80	90		na	na	
3	Pressure	Exhaust Gas System Backpressure @ FL	(mbar)	min 60 max 90	min 60 max 90	min 60 max 90		na	na	
4	Pressure	Water Pump Inlet Press. @ FL warm eng. w/ t. stat	(bar)	min. 0,5				na	na	
5	Pressure	Fuel Feed Pressure at Injection Pump Inlet @ FL	(bar)	min 0.2 max 0.45				na	na	
6	Pressure	Fuel Return Pressure after T connection @ FL	(mbar)	max 0.2				na	na	
7	Temp.(Cooling Test)	Ambient	(°C)	> 12°C for test						
8	Temp.(Cooling Test)	Top Hose Coolant Max Temperature	(°C)	110						
9	Temp.(Cooling Test)	Bottom Hose Coolant Max Temperature	(°C)	103-105						
10	Temp.(Cooling Test)	Engine Oil (Sump) Max Temperature	(°C)	135 (with SAE 5W-40)						
11	Temp.(Cooling Test)	Air Filter Inlet Max Temperature	(°C)	max 5 ROA	max 10 ROA	max 10 ROA				
12	Temp.(Cooling Test)	After Cooler Inlet Max Temperature	(°C)	na	190	190				
13	Temp.(Cooling Test)	After Cooler Outlet Max Temperature	(°C)	na	max 30 ROA	max 30 ROA				
14	Temp.(Cooling Test)	Exhaust Gas Max Temperature after TC (@ FL)	(°C)	500	490	490				
15	Temp.(Cooling Test)	Alternator (Regulator surface) Max Temp.	(°C)	105						
16	Temp.(Cooling Test)	Starter Motor (Solenoid surface) Max Temp.	(°C)	95						
17	Temp.(Cooling Test)	Engine Head (air 10mm above; TC side) Max Temp.	(°C)	85						
18	Temp.(Cooling Test)	Rocker Arm Cover (surface after TC)	(°C)	115						
19	Temp.(Cooling Test)	Fuel Feed at Injection Pump Inlet @ FL	(°C)	60 (derating above 35)						
20	Temp.(Cooling Test)	Battery (air 10 mm above)	(°C)	75						
20	Temp.(Hot Shut Down)	Ambient	(°C)	> 12°C for test						
21	Temp.(Hot Shut Down)	Top Hose Coolant Max Temperature	(°C)	118						
22	Temp.(Hot Shut Down)	Bottom Hose Coolant Max Temperature	(°C)	na						
23	Temp.(Hot Shut Down)	Engine Oil (Sump) Max Temperature	(°C)	138 (with SAE 5W-40)						
24	Temp.(Hot Shut Down)	Alternator (Regulator surface) Max Temp.	(°C)	110						
25	Temp.(Hot Shut Down)	Starter Motor (Solenoid surface) Max Temp.	(°C)	100						
26	Temp.(Hot Shut Down)	Engine Head (air 10mm above; TC side) Max Temp.	(°C)	90						
27	Temp.(Hot Shut Down)	Rocker Arm Cover (surface after TC)	(°C)	120						



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29/07/2016