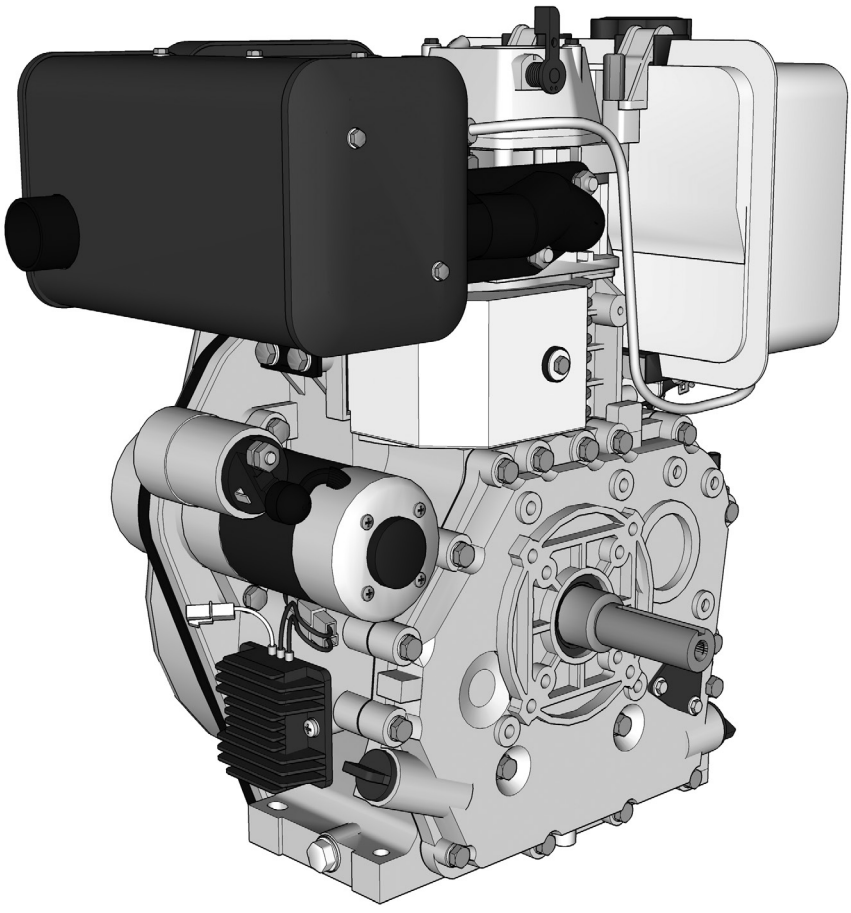
ROTEK

Air-cooled single cylinder diesel engine

ED4-series

User and maintenance manual

EN L1601 version Nov. 2015



ED4-0219
ED4-0306
ED4-0418
ED4-0474

Introduction

Dear Customer,
Please take time to read this manual carefully and thoroughly. It is important to know about the instructions for correct installation of your device, its components as well as proper and safe handling, before putting it into operation.

This manual should be kept close to your device, to use it as a reference if necessary and, if the device is sold on, to hand it on to subsequent owners.

Operation and maintenance of this device involves dangers, which are explained via symbols in this manual. The following symbols are used in this text. Please read these instructions very carefully.

Security precaution
Dangers are marked by this symbol.

General advice
User advice is marked by this symbol.

We worked on the contents of this handbook to make sure your device fits the described device. However, differences cannot be ruled out so that we do not guarantee entire congruence of device and manual. The information in this handbook is constantly reviewed and updated when necessary. Corrected versions are available on our website. Should questions come up about the device or its proper handling, please contact us before installing or using it.

All pictures are used as symbols and may not look exactly the same as your device. Technical changes, errors and misprints reserved.

Damage done to the device due to ignorance of the instructions in this manual will not be covered by its warranty. We assume no liability over damage caused by wrong handling.

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Inspection of delivered products
After receiving the device, it is recommended to check whether the goods correspond to the components mentioned in the order, waybill or delivery note. Remove the packaging carefully to make sure no damage is done to the device. Furthermore, make sure to check the device for any transport damage. If the delivery is incomplete or flawed, do not hesitate to contact your retailer.

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1. Safety Instructions

The guidelines in this manual have to be added to the valid local legal requirements and technical standards. They do not replace any plant standards or additional (also legal) regulations, which were adopted as safety measures.

1.1. Equipment

Always wear tight-fitting clothes during maintenance and make sure their ends are closed with elastic bands.

When working on the device always wear safety shoes, gloves, a helmet and hearing protection in accordance with the applicable regulations to avoid accidents at work.

Make sure that a first aid kit and a working fire extinguisher are close by before starting to work on the device.

1.2. Risks from noise development

The operating noise of the motor can cause damage to your hearing. Do not linger around a running engine and always wear ear protection.

The engine must never be operated without a muffler/exhaust system.

Make sure that all legal regulations relating to the local noise level are obeyed before starting up the device.

1.3. Risks posed by moving parts

Never perform work on moving parts.

The engine must never be put into operation when the protective covers are open or loose.

Never approach the machine in operation wearing ties, scarves, bracelets etc. These could get caught on moving parts and cause serious injuries.

1.4. Risks posed by gas emissions

To avoid the risks posed by dangerous gases:
Make sure that the location of the unit is well ventilated (in emergencies using a forced ventilation system). Avoid inhaling dangerous gases (by wearing breathing protection). Verify that there are no hazardous gases present at the installation site.

1.5. Risks posed by fuel

It is necessary to shut down the engine during refuelling. Let the device cool down for at least 5 minutes before refuelling.

Do not smoke in close proximity to the device, keep it away from fire and ignition sources. Diesel is flammable and poisonous! Moreover, lead acid batteries develop explosive gases when charging and discharging.

Never spill fuel onto the engine or the muffler when refuelling.

Never put the engine in operation when there are apparent leaks in the lines supplying oil or diesel.

Never spill diesel or oil. Do not inhale fumes, do not swallow and avoid skin contact. After swallowing any amount of diesel or oil, immediate medical attention is required! Do not attempt to vomit after swallowing!

Should fuel spill over your skin or clothes immediately rinse with soap and water, and change your clothes.

Always keep the floor on the site of the device clean – spilt oil or diesel should be removed as soon as possible.

When using an additional external tank make sure it is installed and connected in accordance with the valid standards and regulations.

1.6. Risks posed by high temperatures

The engine must only be used in places where no untrained people, passers-by or children are at risk.

Children are not allowed to stay in close proximity to the engine.

Never store combustible or flammable substances (diesel, oil, paper, woodchips etc.) in the vicinity of the device. Note that diesel, oil, engine and exhaust pipe are hot after operation – avoid skin contact – there is a risk of burning or scalding.

Always keep a minimum safety distance of 1 meter to walls or similar structures to avoid overheating the engine.

Never cover the engine during operation – there is a risk of overheating!

1.7. Risks posed by exhaust gas

The engine must not be used in poorly ventilated areas (such as enclosed spaces, tunnels, containers), unless those installations were expressly approved by ROTEK.

Exhaust gases are toxic. They can cause loss of consciousness or even death. When using the device in closed or partially closed spaces, make sure that the exhaust gases are lead outside by means of a leak-free line. Regard the maximum permitted exhaust back pressure in order to prevent the motor from overheating. Make sure that the exhaust adaption (muffler, pipe) is free from combustible materials and that the escaping gases do not pose a threat. Observe the pertinent standards and regulations at all times.

1.8. Maintenance intervals

If the mandatory maintenance intervals were not complied with it is forbidden to start the engine – vapours of unspent fuel (developed by incorrectly adjusted valves for example) are explosive!

Never start the engine without an air filter – the engine could be damaged.

Only original spare parts may be used in the course of maintenance. The only exception are standardised parts (such as ball bearing, screws, nuts, etc.) which match the specifics of the original part.

1.9. Disposal of toxic waste

The incorrect disposal of toxic waste poses a threat to the environment and is prohibited by law. Hazardous wastes include: lubricants, fuels, filters and batteries.

Collect poisonous liquids in suitable sealed containers.

2. Transportation and storage

2.1 Transportation for assembly

Incorrect handling can cause serious damage to the device.

You can pick up the device using the motor base plate (using nooses) and move it.

Pay attention that the lifting point is not located in the centre of the device.

Persons have to keep a safety distance during lifting operation.

Make sure that the lifting gear and the supporting construction is suited to carry the weight of the device.

Please also consider following points:

- All used lifting means must be in good order.
- The loading capacity must be suited to the weight of the load.
- Wrong movements can cause personal injury or serious damage to the device.
- Make sure nobody is in the vicinity of the hanging motor.
- When picking up the device vertically it is important to position the lifting point exactly into the focal point. Additionally, guide rope should be used.
- It is forbidden to pick up the device outside in unsafe weather conditions (i.e. strong wind, storms).
- Always put down the engine carefully onto an even surface that suits the weight of the device.

2.2. Storage as newdrive

- If the device is not used instantly, the engine has to be stored at a safe, clean, dry and vibration free location (only if no fuel and/or oil were filled into the device).
- Should there be a starter battery included in your order (which is not the default), please consider following points:

Make sure to disconnect the minus (-) pole first and the plus (+) pole second. During assembly the plus (+) pole is connected first, the minus (-) pole second.

When storing batteries without battery loader make sure the temperature of your storage room is at 20°c. Do not forget to charge the battery every 3 months. The self-drain can significantly shorten your batteries lifespan.

- The ball bearing does not have to be cared for when the device is in storage.

2.3. Prolonged downtime/Storage

2.3.1. From 30 days to 6 months

If a previously used device is to be stored for longer than 30 days follow these instructions:

- Start the motor and let it get to operating temperature (about 5 minutes of running the engine).
- Stop the motor and drain the lubricating oil using the drain plug.
- Fill motor protection oil into the device and let it run for 5 minutes.
- Drain the motor protection oil when the engine is still warm and replace it with normal motor oil.
- Drain the fuel, clean the diesel tank if necessary, and maybe change the filter.
- Clean the device and conserve it with oil mist.
- Close up all suction intakes with masking tape (recoil starter, air filter)
- Remove the injection nozzle, add a few splashes of motor oil into the cylinder and turn the motor with your hand to distribute the oil. Reinstall the injection nozzle.
- Add splashes of oil into intake- und exhaust-manifold, Rocker-arm, valves, valve-rod etc. and protect non painted parts with fat.
- Disconnect the battery and remove it from the device and, if available, connect it to a battery loader.

Consider during disassembly the minus (-) pole is disconnected first and the plus (+) pole second. During assembly the plus (+) pole is connected first, the minus (-) pole second.

When storing batteries without battery loader make sure the temperature of your storage room is at 20°c. Do not forget to charge the battery every 3 months. The self-drain can significantly shorten your batteries lifespan.

- Wrap the engine in plastic foil.
- Only store at dry locations.
- Preparation for reactivation:
- Remove all cladding and protective foil.
- Put the engine in operation following the instructions for first start-up.

2.3.2. Longer than 6 months

Additionally to the instructions in 2.3.1.:

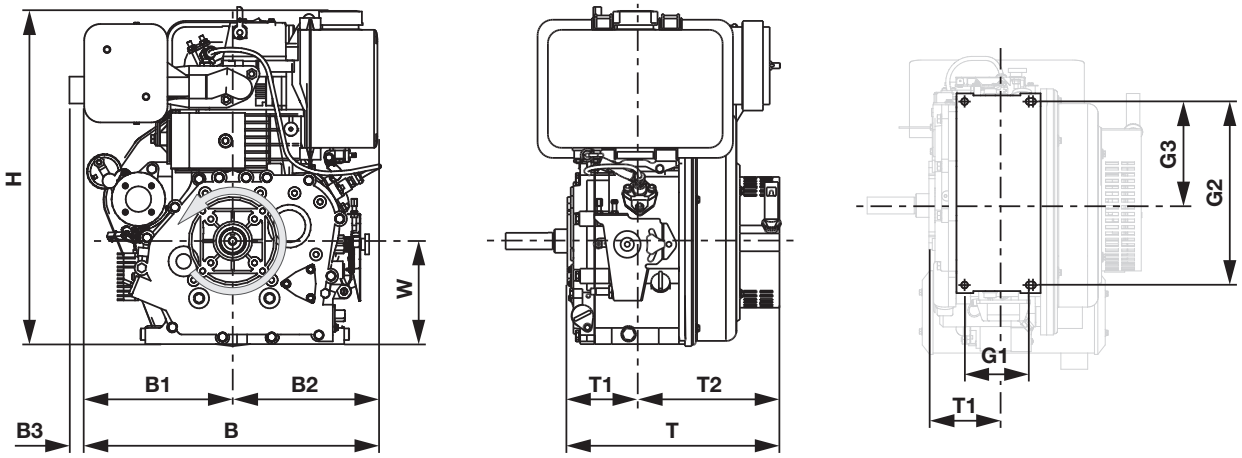
- lube-system, fuel-system, and all moving parts are to be protected with slushing oil SAE 30 (ex. ESSO RUST, AGIP RUSTIA). Turn the motor to distribute the oil and drain the excess.
- Every so often turn the motor by hand.

Preparations for reactivation:

- Remove the intake-manifold, pour motor oil close to the valves, turn the motor shaft a few times and change the oil without starting up the engine.
- Check the valve-clearance and oil- and air filtration.
- Do the earlier service instructed by the motor operation hour maintenance chart (i.e. after 120 operation hours the 200 hour service should be executed).

3. Specification

3.1. Technical data



Model		ED4-0219	ED4-0306	ED4-0418	ED4-0474
Design		1-cylinder four-cycle engine with direct injection			
Displacement		219 ccm	306 ccm	418 ccm	474 ccm
Bore x Stroke		70 x 57 mm	78 x 64 mm	86 x 72 mm	88 x 78 mm
Rated Continous power [1]		2,5 kW - 3.000 min^{-1} 2,8 kW - 3.600 min^{-1}	3,7 kW - 3.000 min^{-1} 4,0 kW - 3.600 min^{-1}	5,7 kW - 3.000 min^{-1} 6,4 kW - 3.600 min^{-1}	6,6 kW - 3.000 min^{-1} 7,2 kW - 3.600 min^{-1}
Maximum power [1]		2,8 kW - 3.000 min^{-1} 3,1 kW - 3.600 min^{-1}	4,1 kW - 3.000 min^{-1} 4,5 kW - 3.600 min^{-1}	6,4 kW - 3.000 min^{-1} 7,5 kW - 3.600 min^{-1}	7,3 kW - 3.000 min^{-1} 8,0 kW - 3.600 min^{-1}
Idle speed		Min: ≥ 1.300 min^{-1} / Max: ≤ 108% of idle speed			
Type of output		depending on design using crankshaft or camshaft (camshaft is half the nominal speed)			
Rotation direction		anticlockwise (see schematic picture)			
Fuel [2]		Diesel (Premium Diesel)			
Tank capacity		2,5 l	3,5 l	5,5 l	
Fuel consumption		264 g/kWh-3.000 min^{-1} 288 g/kWh-3.600 min^{-1}	263 g/kWh-3.000 min^{-1} 286 g/kWh-3.600 min^{-1}	261 g/kWh-3.000 min^{-1} 283 g/kWh-3.600 min^{-1}	259 g/kWh-3.000 min^{-1} 287 g/kWh-3.600 min^{-1}
Speed regulation		integrated centrifugal governor acting directly onto the injection pump			
Cooling system		Forced air cooling system using a fan wheel and air vents			
Lubrication system		combined splash- and pump-forced lubrication system			
Oil volume		0,75 l	1,10 l	1,65 l	1,65 l
Start system		depending on design: recoil-starter or combined recoil- and electric starter			
Electric starter		in version "H": - / in version "E": 12 V / 0,8 kW			
Dynamo		in version "H": - / in version "E": 12V 5A cont. (dynamo and loading regulator)			
Battery		12 V / min. 12 Ah, recommended 20 Ah (not included in delivery)		12 V / min. 20 Ah, recommended 36 Ah (not included in delivery)	
Device width	B	376 mm	396 mm	441 mm	441 mm
	B1	184 mm	193 mm	218 mm	218 mm
	B2	192 mm	203 mm	223 mm	223 mm
	B3	16 mm	25 mm	29 mm	29 mm
Device depth	T	238 mm	311 mm	328 mm	328 mm
	T1	89 mm	112 mm	105 mm	105 mm
	T2	149 mm	199 mm	223 mm	223 mm
Overal height	H	415 mm	450 mm	494 mm	494 mm
Height of shaft	W	130 mm	145 mm	155 mm	155 mm
Baseplate	G1	75 mm	85 mm	95 mm	95 mm
	G2	210 mm	249 mm	272 mm	272 mm
	G3	96 mm	104 mm	117 mm	117 mm
Net weight (H / E)		25 / 29 kg	37 / 41 kg	44 / 49 kg	46 / 51 kg
Sound level		82 dB(A) @ 4m	85 dB(A) @ 4m	88 dB(A) @ 4m	89 dB(A) @ 4m

[1] Rated / maximal power

All given information applies to the engine at 0m sea level and a surrounding temperature of +20c°. The total capacity of the device must be reduced because of cooling issues when using the device in higher temperatures or in greater heights (see 3.2. Derating chart).

[2] Fuel

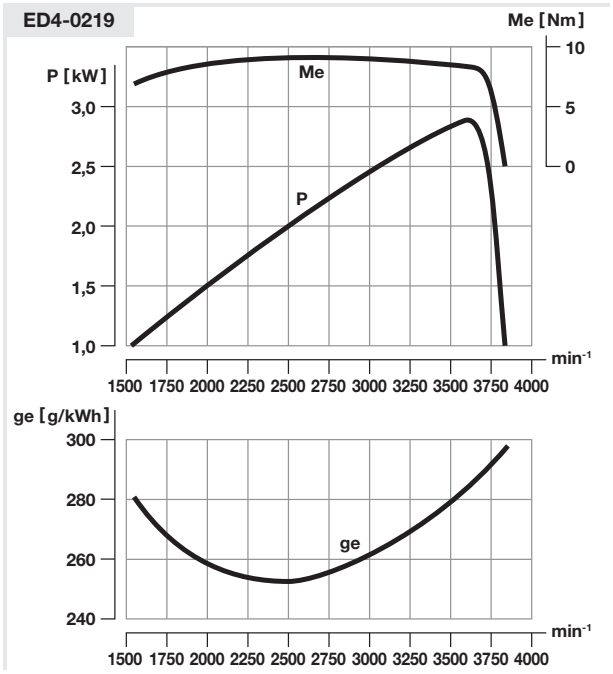
You cannot use fuels other than regular diesel such as biodiesel, plant oil or heating oil without changing the engine! Never use fuels other than standard diesel without clearing with ROTEK first. Your engine could be damaged! We would like to point out that in Western Europe it is mandatory to mix biodiesel into available diesel fuels. Because of this mix, the “normal” diesel only keeps about 6 months in storage! After about 6 months microbial growth increases considerably in the diesel. These organisms further on corrosion in tank and motor, and they produce biomass which clogs the injection nozzle, the injection pump and damages the motor over time. This is a particular problem if the engine is only used rarely. Pay attention to the date you last refuelled and drain the tank in appropriate time intervals. Also available are types of so called "premium diesel" (SHELL© V-Power, ARAL© Ultimate, OMV© MaxxMotion, ...) which either do not contain biodiesel at all (ex. BP© Ultimate) or contain special biodiesel made from hydrated plant oils (ex. OMV© Maxxmotion) and can therefor be stored for 2 years without worries.

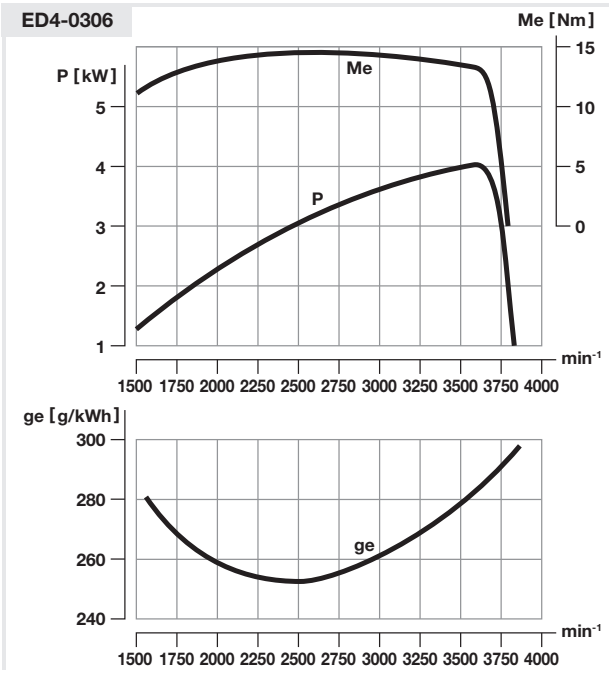
3.2. Derating chart for operation under different conditions

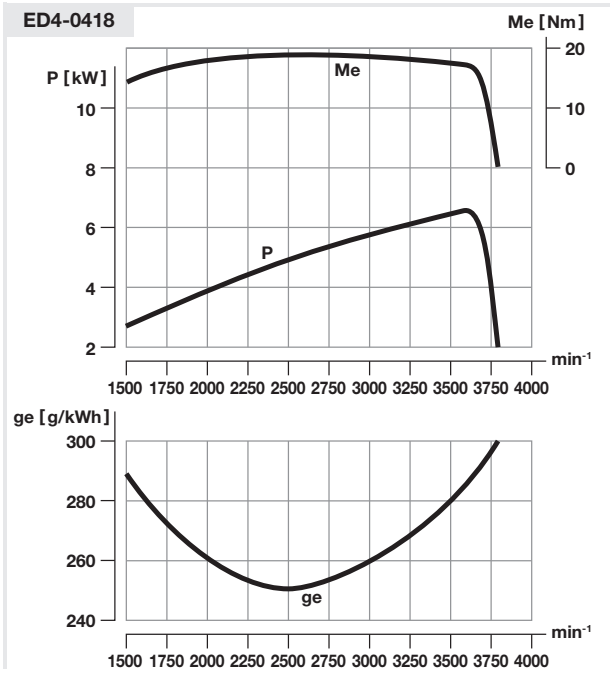
Operate at sea-height (m)	Ambient temperature (°C)												
	0	5	10	15	20	25	30	35	40	45	50	55	60
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.85	0.76	0.67
500	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.82	0.73	0.64
1000	0.96	0.95	0.93	0.93	0.92	0.91	0.91	0.91	0.88	0.84	0.76	0.67	0.59
1500	0.90	0.89	0.89	0.88	0.87	0.87	0.87	0.86	0.84	0.80	0.73	0.65	0.57
2000	0.84	0.84	0.83	0.82	0.82	0.80	0.80	0.80	0.79	0.76	0.68	0.62	0.55
2500	0.79	0.78	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.71	0.66	0.60	0.52
3000	0.74	0.73	0.73	0.73	0.71	0.70	0.69	0.69	0.68	0.68	0.63	0.57	0.50
3500	0.70	0.70	0.70	0.69	0.66	0.64	0.64	0.64	0.63	0.63	0.61	0.55	0.48
4000	0.66	0.65	0.65	0.64	0.61	0.59	0.59	0.58	0.58	0.58	0.55	0.52	0.46
4500	0.60	0.60	0.60	0.58	0.56	0.54	0.54	0.53	0.53	0.52	0.50	0.49	0.44
5000	0.55	0.55	0.55	0.53	0.52	0.50	0.50	0.49	0.49	0.47	0.45	0.44	0.40

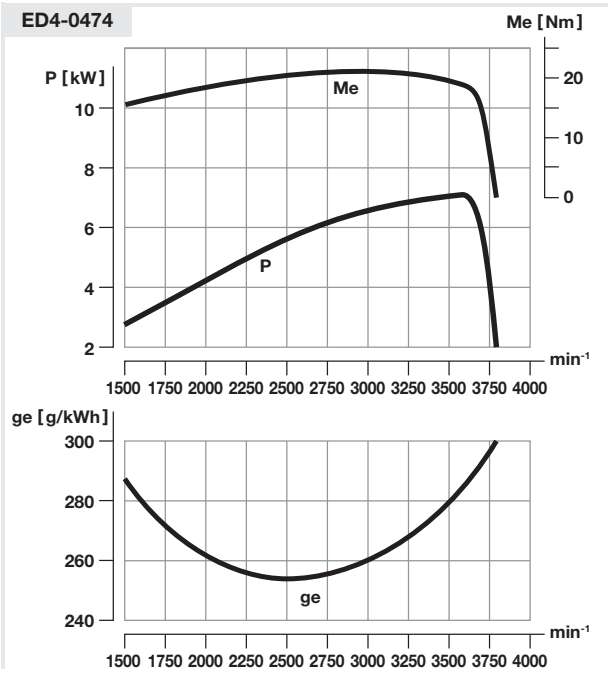
Multiply the given factor with the relative nominal capacity – ex. ED4-0418 engine: operation with 3.000 min^{-1} in 2.000m operational height, at +40c° ambient temperature. The continuous rating must be around 4,50kW (5,70 kW * 0,79 factor = 4,50 kW).

3.3. Performance Curve









KEY:
P = power in kW
Me = torque in Nm
ge = fuel consumption in g/kWh

NOTE:
In engines with camshaft output the graph refers to the crankshaftpower. Therefor the speed value must be halved and the torque value doubled.

3.4. Flange and shaft dimensions

ED4-0219

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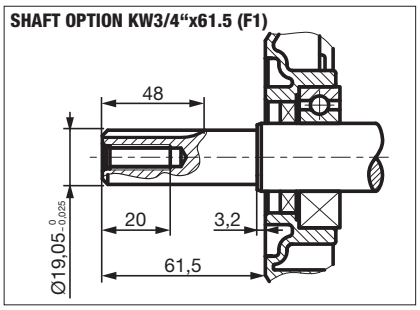

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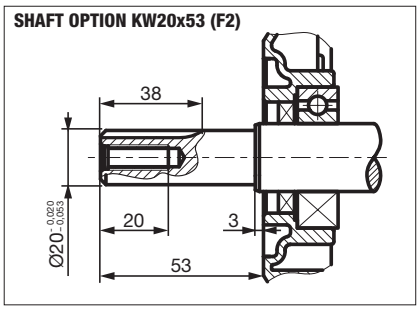

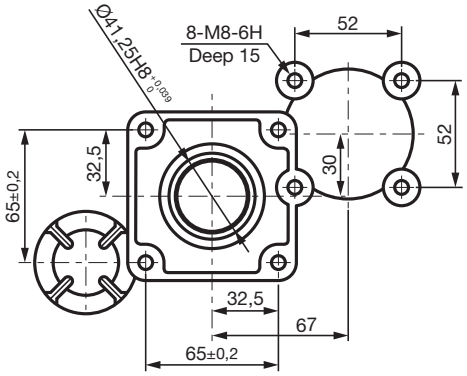

ED4-0306

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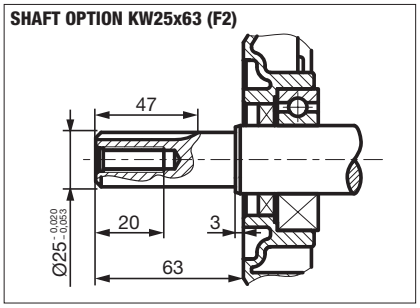

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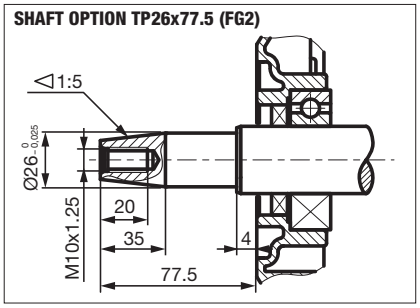

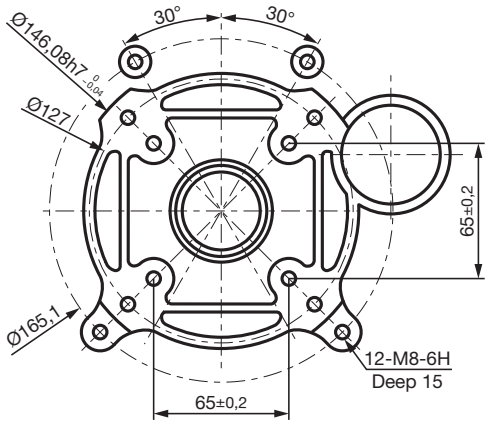

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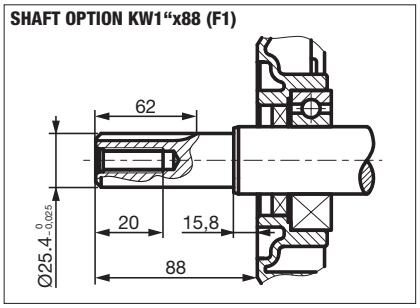
SHAFT OPTION KW1“x88 (F1)



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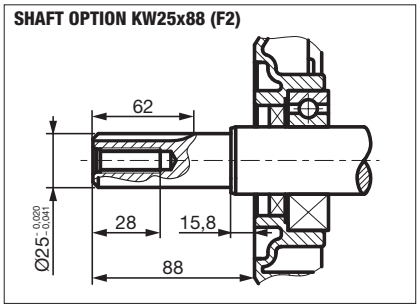

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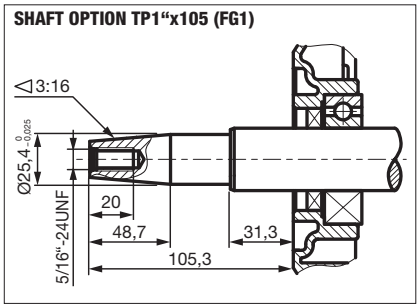

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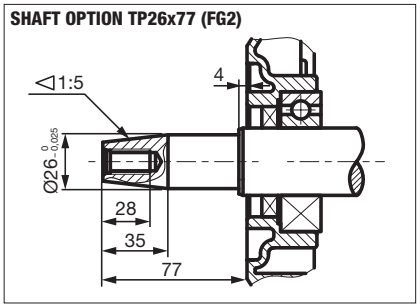
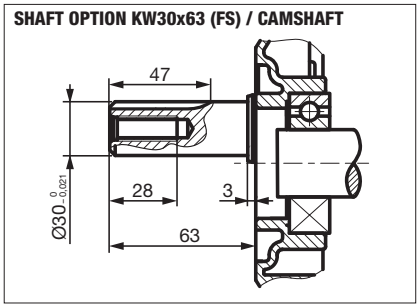
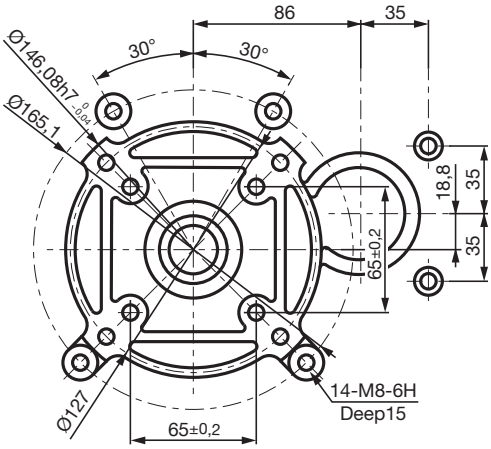


SHAFT OPTION KW30x63 (FS) / CAMSHAFT





4. Installation

The installation has to be done by professionals. Poor installation can damage the device (ex. bearing failure because of inadequate parallelism). The professionals present are responsible for the observance of appropriate regulations and standards.

All operations on the device including maintenance and start-up must be done on a resting engine.

4.1. Preparation

- All devices are packed in a different way, depending on sales channel and method of transportation. Remove all packaging carefully, to avoid damaging the device.

Before installation, make sure that any protective coats, covers for transport (ex. shaft cover) or other protective means were removed.

4.2. State of installation site

- The installation site must be well ventilated with dry, clean, conditioned or ambient air, because the motor radiates heat that would raise the room temperature so high, it would have negative effects on the motor capacity.
- The installation site should be chosen so that normal maintenance is easily possible.
- The ground underneath the must be able to take the weight of the device. It should also be even and nonslip.
- The installation site must be designed so that accidental touching with the engine case, rotating or otherwise dangerous parts is impossible.
- The installation site must be protected from any natural forces (such as rain, snow, hail, storms, flooding, direct sun radiation, frost or heat) as well as air pollutants (such as abrasive dust, electric smog, fluff, smoke, oil, mist, exhaust gases or other pollutants).
- Consider the noise limits at the installation site.

4.2.1. In- and outtake Ventilation

Normally, the engine can draw enough air from its surroundings. However, the motor radiates heat that in closed spaces would raise the room temperature so high it would have negative effects on the motor capacity.

The ventilation plan must consider following aspects:

- diverting heat produced by the engine
- necessary air rate:
  for the engine to consume properly
  to cool any other devices

If the surrounding air is not suited due to dust, pollution or heat, an additional air vent must be installed.

If the engine is to be built into an enclosed space, the air vents must be large enough to make free air circulation possible. A guide value for non-forced air ventilation is 0.4m².

When installing for continuous operation or in places where the installation site is very hot, it is recommended to install an exhaust fan with appropriate volume.

To reach the highest capacity possible, the surrounding air must not rise above +25°C. In case of higher temperatures it is necessary to derate the power of the engine capacity.

Make sure that hot exhaust gas is not sucked in again by the engine

4.3. Motor mounting

The motor assembly must be done through four montage holes in the base plate. A mechanical assembly using the motor flange is not allowed.

Please also consider following points:

- The installation frame or foundation must be adequately dimensioned and torsion-resistant. It has to be robust enough to absorb vibrations and to maintain alignment.
- The foundation must be chosen so that all mounting feet are laid out evenly on the ground to avoid tension (possibly use underpinning).
- Make sure the dimensions of the attachment screws are appropriate.

In order to achieve a large enough surface area, use a large washer between the base plate and the mounting nut.

The engine plus any add-on device should be well balanced and attached onto a hard metal structure with vibration damper in between. This reduces vibration.

4.4. Exhaust gas system

4.4.1. Mounting the muffler

The muffler contained in the order is made to be used in industrial areas. If the engine is to be used uptown it might be necessary to replace it with a better one.

4.4.2. Information about other exhaust gas systems

When installing a different exhaust gas system please consider following points:

The exhaust back pressure has a significant effect on the engines power. Too high exhaust back pressure causes lower power, hotter exhaust gas and a hotter motor, and high consumption of fuel. The exhaust back pressure can be held to a minimum when the exhaust system is well dimensioned.

- Make sure that during the installation of the exhaust pipes the radiated heat cannot be sucked in by the motor. The pipes should be insulated. If the exhaust pipe go through walls, insulation is mandatory.
- The exhaust pipe should be kept as short as possible and have no bends. If this is not possible the radius of the curvature should be held as wide as possible.
- When using exhaust pipes up to 10 meters in length the radius of the pipes has to be about 30% higher than the diameter of the exhaust manifold or the muffler exhaust pipe. The diameter must not be smaller than that.
- If the exhaust pipe has a significantly larger radius than the device connection, a cone-shaped connector with an angle less than 30° should be installed additionally in order to avoid exhaust back pressure.
- The installed exhaust pipe has to be complete and 100% leak-proof in order to avoid heat, poisonous gases and power lost.
- It is recommended to install a screw at the lowest point of the exhaust pipe to drain the condensate.
- Between the outtake manifold of the motor/muffler and the exhaust pipe a flexible pipe should be installed in order to avoid vibration transmit and to enable thermal expansion of the pipes.
- Make sure that muffler and any exhaust pipes are free from flammable material (fire hazard).

4.5. Fuel System

The fuel system of the motor must provide a clean and continuous diesel supply. Pay attention to the following points during the installation of an additional fuel tank:

- Only use diesel durable tubes with wire netting for diesel fuel.
- Tank ventilation is necessary in order to avoid too high or too low pressure in the tank.
- Avoid too high pressure in the integrated tank. This can happen when the tank ventilation is clogged up or the overrun is connected to another external tank.
- It is recommended to choose a tank that has a cone-shaped bottom, in order to collect condensed water, and has an integrated drain valve.
- Fuel tubes to and from the tank must have at least the same diameter as their counterparts on the motor. When the pipes are very long or the surrounding air cool, the diameter of the pipes has to be wider to let through enough fuel.

4.6. Coupling

Before the motor can be connected to a load their compatibility needs to be checked!

It is important to check

- whether motor and load are compatible in oscillation
- whether the measurements of shaft and flange of the motor are compatible with the measurements of the coupling.

Motor and load have to be levelled carefully! An incorrect levelling can lead to vibrations and bearing failure.

When starting up the motor BEFORE the montage of a coupling or a pulley the key has to be fixed to the nut very tightly!

Make sure that while assembling a coupling or a pulley all safety measures concerning touching rotational parts are obeyed. Consider the appropriate installation instructions from the manufacturer.

In no case whatsoever should pressure, hits or blows hit the shaft (for example with a hammer). This could damage the bearings.

Assembly and disassembly has to be done with suitable attachment and detachment tools!

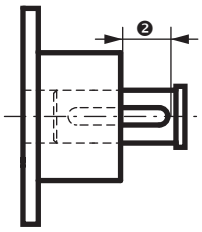
4.6.1. Maximum axial and radial load

Make sure that the maximum axial and radial load of the motor main bearing aren't exceeded before operating. If you're using pulleys it is necessary to recalculate the life-span of both shaft bearings and to adjust maintenance intervals accordingly.!

4.6.2. Balancing

The crankshaft of the engine is dynamically balanced with half the key. Each element of the coupling also has to be balanced out accordingly.

When the coupling is too short the overhanging key part has to be worked off until it is the diameter of the shaft ❷ or covered up with rings using the key nut in the according size. If the coupling is too long the missing key part has to be filled out in the overhanging coupling.



4.6.3. Direct coupling

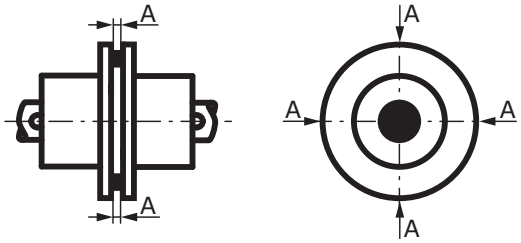
When directly attaching a moving element (ex. pump, ventilator) to the motor shaft, balance is extremely important!

The coupling has to be chosen so that the transferred torque, the running characteristics of the engine and the necessary safety characteristics are considered.

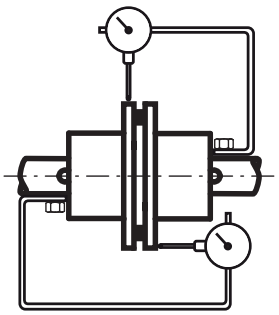
The motor plus the load should be balanced out so that out-of-rounds and deviations in balance of the two coupling halves comply with the tolerance of the manufacturer. Sloppy balancing can lead to vibrations, bearing failure or to the shaft breaking.

Instructions:

- Attach both coupling halves so that a movement is possible with both halves.
- Set up the parallelism of both shafts with a comparator or a thickness gauge at four points which are located 90° from each other (the distance set up equals the value A).
- Measure the distance between the two contact-areas of the coupling at four different points which are also set 90° from each other.
- The difference between the two values may not be greater than 0.05mm.



You can use two measure-devices to set up parallelism and coaxal at the same time. While turning the shaft slowly deviations can be measured precisely.

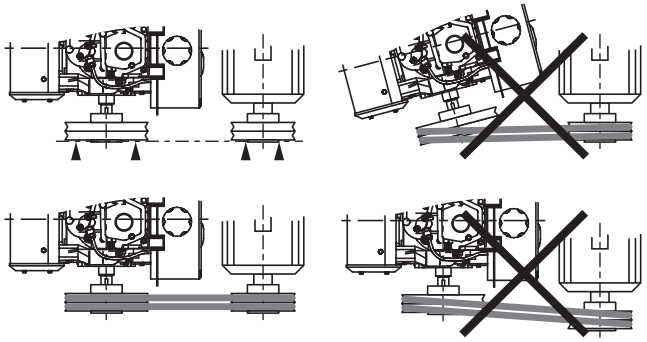


Alignment errors are corrected by using washers between the base and the foundation. After refastening the nuts the alignment has to be checked again.

If you are using 2-part couplings you have to make sure to leave a distance of 1-2mm to the shaft in order to allow thermal expansion of both shafts.

4.6.4. Operating with a pulley

The axis of the motor shaft must be parallel to the axis of the moving device, in order to minimize the axial force on the bearing. Make sure the pulleys are set up in one line (see diagram below).

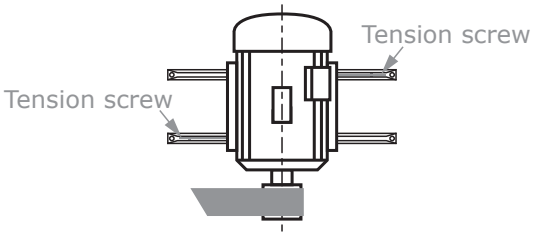


Assembly with a fixed axle distance:

- Attach an additional tension roller to the belt. The tension roller should be placed on the inside of the V-belt. In case a flat belt is used - the roller can also be placed on the outside of the belt.

Assembly with variable axle distance:

- Attach two clamping rails to the base. They must be parallel to the belt.
- Attach the load (not the motor) as shown in the diagram below. This way everything can be balanced out as precisely as possible.



The tension of the belt has to be set up very precisely. If the tension is too high the shaft bearing wears out very fast and the crankcase or the shaft might break. If the tension is too low, vibration can occur, which can also damage the device.

Starting at a pulley diameter of 315mm and a rotational speed of 3.000min^{-1} we do not recommend using pulleys made from gray cast iron or using flat belts.

Please note that all moving (rotating) parts must be protected from touching anything before starting up the device!

4.7. Concluding mechanical installation instructions

After the first start-up the correct alignment is to be checked while the motor is as warm as it usually is while operating..

- All screws, nuts and other clamped or bolted connections must be correctly assembled and fastened.
- The cooling air must be able to circulate without a problem.

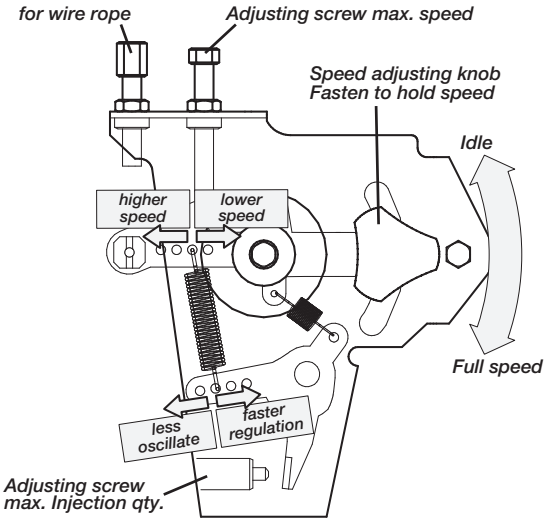
The engines are equipped with a mechanical, adjustable speed regulator. Make sure the injection pipe cannot vibrate with the engine at any time, particularly when using the device at different speeds. This could severely damage the injection pipes already after a short period of time. If necessary support the injection pipes at appropriate spots..

4.8. Speed controller

4.8.1. Type “A” – for variable speed

At delivery the engine is set up as follows:

- Maximal speed: 3.000 min^{-1}
- Idle speed: 1.300 min^{-1}



- If necessary attach a appropriate wire rope for speed regulation. There is a clamp located at the left end of the governor. Here the rope should be attached.
- If an outher maximum speed than 3.000 min-1 is necessary in your application, you can adjust the regulation-spring in different positions. Highest allowed speed is 3.700 min^{-1}

If you change the set-up for the maximum speed, you also have to readjust the adjusting screw for the maximum injection quantity.

Open the check-nut and adjust the screw as follows:

Load the engine with the nominal load according to the performance curve and adjust the screw so that the engine achieves a Bosch count below 4. Make sure to refasten the check-nut after the adjustments.

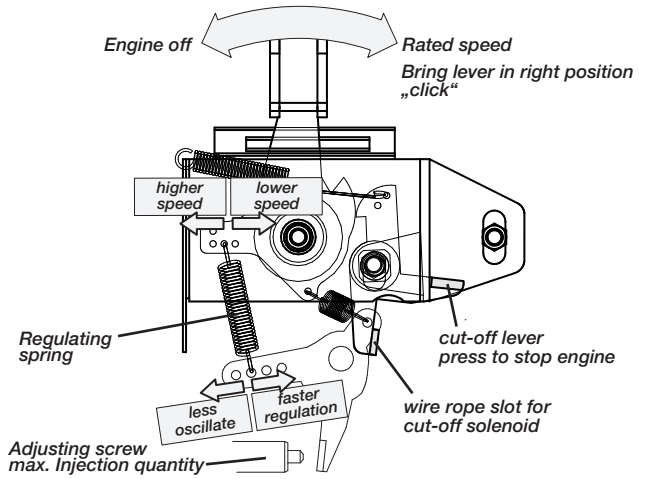
If the engine is used above 1.000m sea level, readjustments of the maximum injection quantity are also necessary.

4.8.2. Type “C” – for constant speed

This speed controller is made for fixed speed and is usually used as a speed controller for generators. At delivery the engine is set up as follows:

- Rated speed: 3.000 min^{-1}

If you want to change the engine speed, the regulating-spring must be exchanged.



4.9. Electrical installation

Depending on the version the engine is equipped with following electrical components:

- Version "H":

  No electrical components
- Version "E":

  Dynamo, Battery loading regulator and electric starter
- Special components (not included, additionally available):
  - Starting battery
  - Key box
  - Oil pressure sensor
  - Injection pump with mounted 12V magnetic valve

4.9.1. Electrical connection (chords)

Only use stranded wire cable as a connection.

Battery(+) as well as battery(-) chords are to be held as short as because the current of the starter is very high.

Note that the motor and add-on-parts get hot when used. Always protect the cable from touching hot parts by using a protective hose.

Caused by motor vibration during operation all screw connections must be secured with spring washers or lock-nuts.

4.9.2. Starter battery

A starter battery and a battery cable are not included in the delivery, they can however be ordered separately as add-ons. Make note of following points:

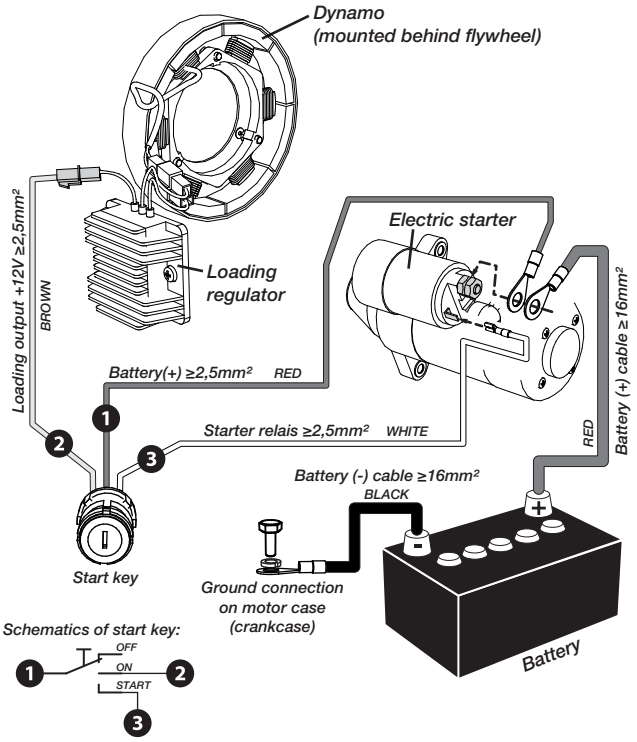
Lead acid batteries contain sulfuric acid. If there are liquids escaping from the battery, do not touch or swallow them. Carefully dilate the acid with water and neutralize it with soda (sodium carbonate).

Always wear protective gloves and safety goggles when working with the starter battery.

- You can find the necessary capacities in the chart in chapter 3.1. The usage of valve-regulated (maintenance free) batteries is recommended..
- Always connect the plus(+) pole first, then the minus(-) pole. Fasten the connections properly.

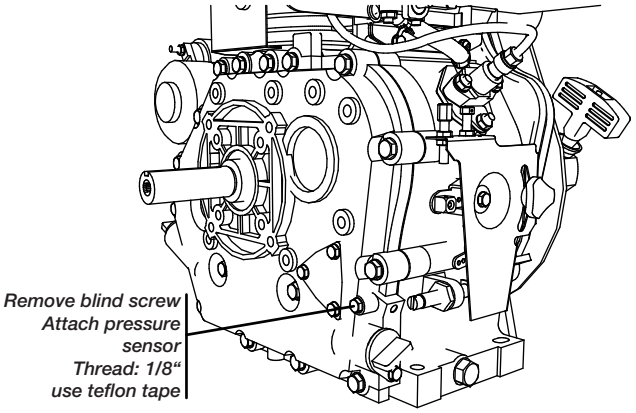
4.9.3. Circuit diagram of starter-dynamo

Motors in versions "E" are delivered with preassembled dynamo, loading regulator and electric starter.



4.9.4. Oil-pressure sensor

The optionally available oil pressure sensor (order: ZSPMOT00003) is attached to the crankcase cover. To attach it, remove the blind screw first (see diagram).

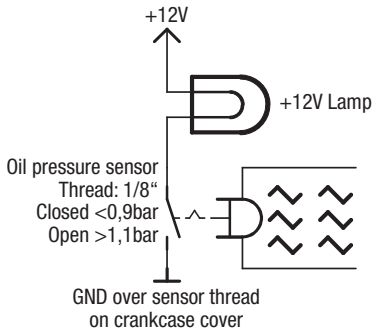


The sensor is equipped with a switch, which opens at 1,1bar oil pressure (and is closed below 0,9bar).

4.9.4.1. Schematics of oil-pressure sensor-lamp

The easiest wiring of the oil-pressure sensor is by using a 12V lamp.

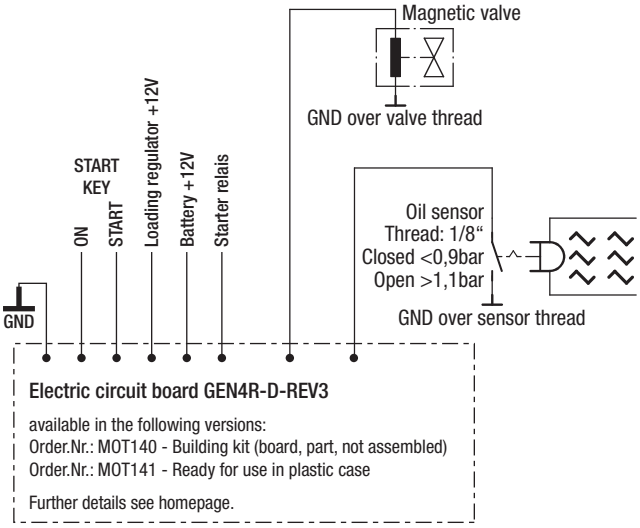
Disadvantage:
The lamp only lights up when there is too little oil. A sudden fall in oil-pressure cannot be measured.



4.9.4.2. Oil-pressure sensor with magnetic valve

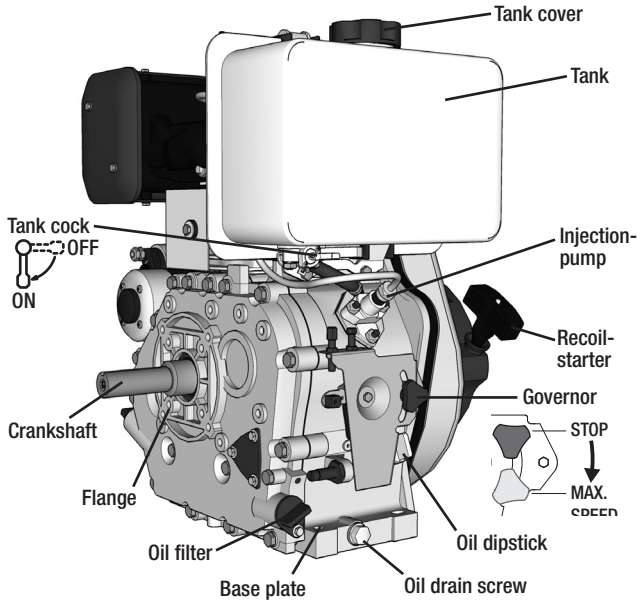
Optionally, you can use an injection pump with an integrated magnetic valve in the series ED4-0306 and ED4-0418.

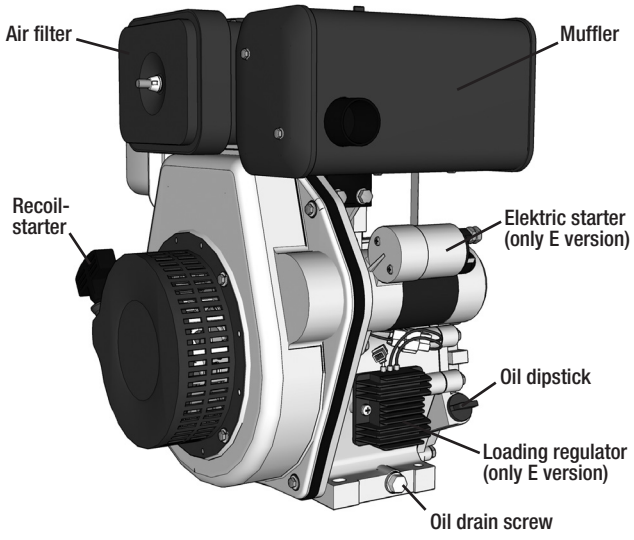
This magnetic valve can be connected to the oil-pressure-sensor in such fashion, that the motor stops automatically when there is too little oil. In order to ensure that the engine always stops, even if there is just a short disruption in oil pressure, a small circuit-board must be integrated. You can find the up-to-date wiring schematics on our website. We offer all the necessary parts, including the board.

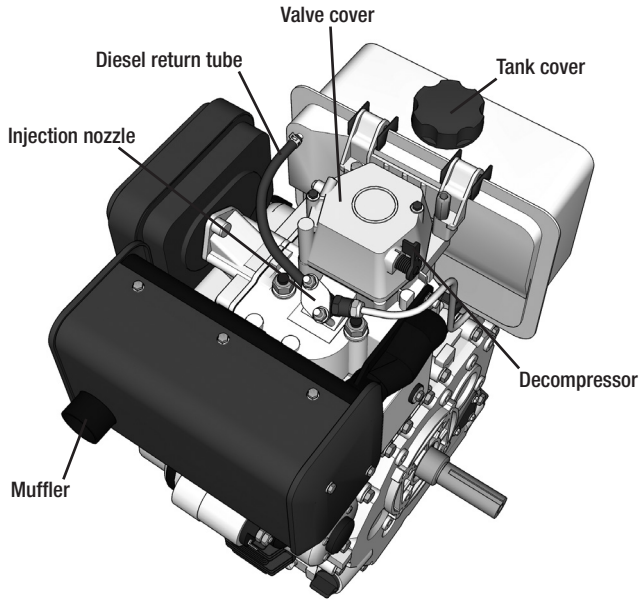


5. Usage

5.1. Components







5.2. Information about engine performance

The performance refer to standard conditions (0m sea level, +25°C ambient temperature). For higher temperature or usage at higher sea level it is necessary to calculate a derating of the maximum performance (see 3.3).

5.3. Information about starter battery (optional)

Please consider following points:

Lead acid batteries contain sulfuric acid. If there are liquids escaping from the battery do not touch or swallow them. Carefully dilate the acid with water and neutralize it with soda (sodium carbonate).

Always wear protective gloves and safety goggles when working with the starter battery.

When correctly set up, the battery will be charged via the built in dynamo.

If the motor is operated without a battery (ex. when using an external battery to start up), the plus cable from loading regulator has to be isolated against the crankcase. A shortcut could damage the dynamo or loading regulator.

When using a car battery to jump start the engine, first disconnect the starter battery of the motor. If the built in battery is completely drained the car battery could load an extremely large current into the starter battery. This seriously damages the battery, in extreme cases the battery might even explode.

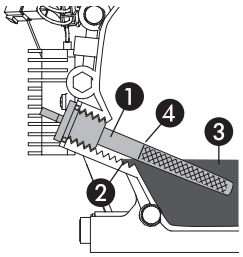
Be very attentive when handling starter cables, if it comes to an electrical shortcut very large currents can be transmitted. Therefore remember: always connect the plus(+) pole first, then the minus(-) pole.

5.4. Check-ups before every start-up

5.4.1. Engine oil

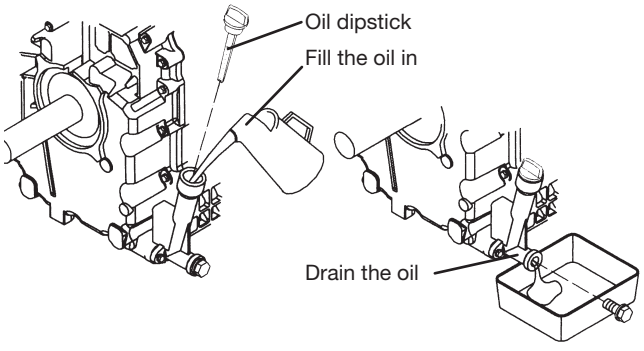
Oil is the most important resource of the motor. Only use high quality motor oil for diesel engines.

Check the oil level bevor every start up! ATTENTION – when delivered the engine is NOT supplied with oil and must not be started up under any circumstance!!



Remove the oil dipstick ❶ and wipe it with a clean piece of cloth. Reinsert the clean dipstick ❶ completely, then remove it again. The correct oil level ❸ is now marked by the oil film covering the dipstick. The line has to be close to the maximum mark ❹. If necessary add more oil, in order to achieve the correct oil level ❷ (lower edge of the thread in the crankcase).

Do not add too much oil – too much oil is damaging and must be drained! Different types of oils and brands may not be mixed together! Note the maintenance intervals of the oil change.



Ambient temperature	Oil viscocity
+20 up to +40°C	SAE 40
0 up to +30°C	SAE 30
-20 up to +10°C	SAE 20
-20 up to +20°C	SAE 10W 30
-10 up to +40°C	SAE 15W 40

5.4.2. Fuel

- Fill up the tank completely with diesel.

You cannot use fuels other than regular diesel such as biodiesel, plant oil or heating oil without changing the engine! Never use fuels other than standard diesel without clearing with ROTEK first. Your engine could be damaged!

We would like to point out that in Western Europe it is mandatory to mix biodiesel into available diesel fuels. Because of this mix, the "normal" diesel only keeps about 6 months in storage! After about 6 months microbial growth increases considerably in the diesel. These organisms further on corrosion in tank and motor, and they produce biomass which clogs the injection nozzle, the injection pump and damages the motor over time. This is a particular problem if the engine is only used rarely. Pay attention to the date you last refuelled and drain the tank in appropriate time intervals. Also available are types of premium diesel (SHELL© V-Power, ARAL© Ultimate, OMV© MaxxMotion, ...) which either do not contain biodiesel at all (ex. BP© Ultimate) or contain special biodiesel made from hydrated plant oils (ex. OMV© Maxxmotion) and can be stored for 2 years without worries.

5.4.3. Fuel system ventilation

If air got into the injection system (first time start-up, completely empty tank, storage over a very long time, etc.) it is possible that the motor can't start.

If that is the case, follow these instructions:

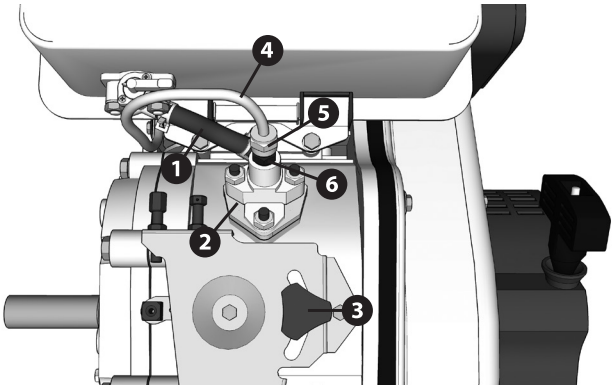
- Fill up the diesel tank completely, remove the fuel-pipe ❶ from the injection pump ❷. Open the fuel cock and drain diesel until the diesel flowing is not foaming.
- Reconnect the tube to the injection pump.
- Switch the governor ❸ to position "motor OFF".
- Disconnect the injection pipe ❹ from the injection pump ❷ – loose only the top nut ❺.
- Loose the bottom nut ❻ of the injection pump ❷ carefully until diesel drains out of it.

Careful - do not unscrew the nuts completely. Behind them is a spring that could be lost.

- After some diesel drained out, refasten the bottom nut ❻.

During operation no diesel should escape! Check this during a test run!

- Reconnect the injection pipe ❹ and switch the governor ❸ to full speed.
- The motor should start after a few tries. The engine will be a little restless for the first 30s after the start up until all air has escaped the system.



5.4.4. Other check-ups

- Remove any dirt or dust, so that the engine cooling cannot suck in any foreign matter.

Note that the motor must NOT be started up if the protective covers are not attached properly.

- Check that the device does not have any leaks (fuel, oil, battery acid). Fasten leaking sealing caps appropriately.
- Make sure the device is well ventilated. The exhaust gas of the motor can be damage your personal health.
- Check whether the governor (as well as a possible pulley) moves easily and whether it is possible to set it to idle-speed (=engine off) and rated speed/max. speed.

5.5. Start-up

5.5.1 Special information about initial start-up

The motor must only be started up when the device was installed following the rules and instructions of this manual and the engine base is fixed properly to a stable mounting frame.

- Vent the injection nozzle, as explained in 5.4.3.
- Let the motor run on half rated rotational speed (aprox. 1.500-1.800 min^{-1}) for 1 hour after starting up for the first time.
- Turn off the engine after initial start-up and check the oil level.
- Check all screws, nuts and clamp connections after initial start-up. Refasten if necessary.

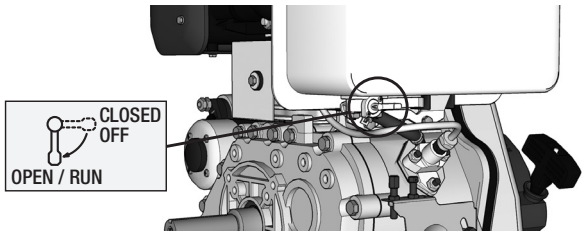
If the engine behaves abnormally (noise, smoke) turn off the motor immediately and solve the cause of error before putting the engine into operation again.

To ensure a maximum life-span of the motor it is recommended not to operate above 3.000 min^{-1} in the first 50 hours of operation. Only change the speed slowly during this 50 hours (change governor position slowely)!

5.5.2. Starting the engine

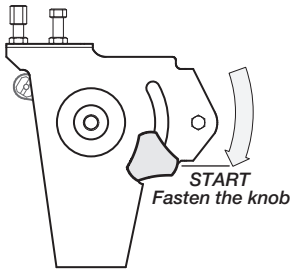
It is forbidden to start up the motor without properly assembled air filter and muffler!

- Open the fuel cock

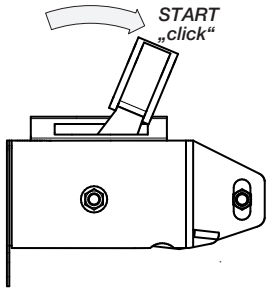


- Governor in position START / FULL SPEED

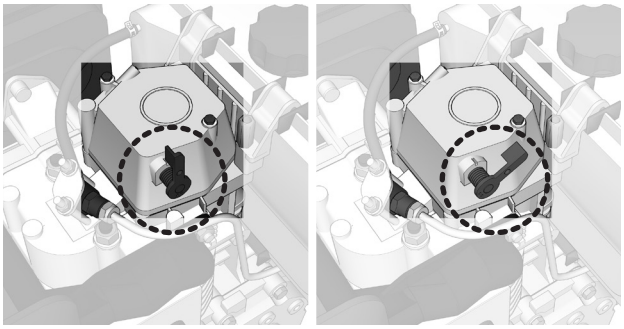
Governor version „A"



Governor version „C"

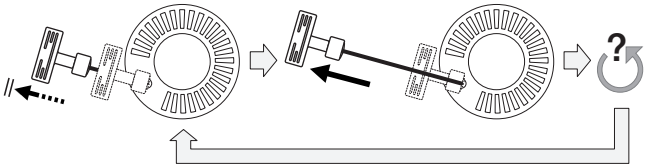


- Press decompressor lever



5.5.2.1. Hand start (all versions)

- Pull the recoil-starter slowly until you feel some resistance. Bring the recoil handle slowly back.
- Press the decompressor lever.
- Pull the recoil handle hard and fast.
- Repeat until the motor starts up..



5.5.2.2. Electric start (only motor version “E”)

When operating at temperatures below +5°C, it is recommended to hold decompressor lever for 2-3s during starter activity. Afterr this period release the decompressor lever.

- Turn the start key to “START”. Let go of the key as soon as the motor starts up.

Only start up for a maximum of 10 seconds! If the engine doesn’t start, wait one minute until trying to start-up again. This process may only be repeated for a maximum of 3 times, then the electric starter has to be left to cool down for at least 15 minutes. Contravening can result in damaging the starter and/or motor. Never start into the running engine!

If the motor does not start, try to vent the injection system as described in 5.4.3.

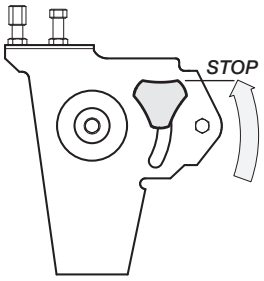
Generally you should not connect a load higher than 50% of the nominal load when the engine is cold.

- Observe the engine run and the colour of the exhaust gas after starting up. The engine should run smoothly after a few seconds.

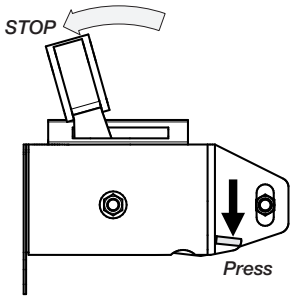
5.5.3 Stopping the engine

- Let the engine run without load for about five minutes after being used for heavy load – this way the motor can cool down.
- Turn off the motor via the governor.

Governor version „A“



Governor version „C“



- When using devices of version “E” turn the start-key to position “OFF” – otherwise the battery will discharge.

6. Maintenance

Regular service and maintenance prolongs the life-span of your device and enables an undisturbed user experience.

The staff responsible for maintaining and cleaning the device must be trained to do so. Never let unable people handle the device in any way at all.

6.1. Instructions about maintenance

If you hire a specialised company to maintain the device, please get a conformation from them.

Any damage done to the device due to inappropriate maintenance or not maintaining the device at all do not carry warranty.

Fixing issues that can be fixed by the user himself do not carry warranty either but fall into the normal maintenance of this device.

6.2. Precautions

Before cleaning, oiling or servicing the device follow these instructions:

- Turn off the motor. The motor must be at rest.
- Use appropriate measures to keep the motor from starting up again.
- The motor and all of its add-on parts must have cooled down to the surrounding temperature.

Pay attention while working in close proximity to moving parts and parts that might be hot.

6.3. Starter battery

If you are using a battery that needs to be maintained, make sure to regularly check the state of the connectors and the water level. If necessary fill distilled water up to the maximum mark.

After a long storage period the loading condition of the battery must be checked before putting the device into operation. Weak batteries must not be used.

6.4. Cleaning the crankcase

Clean the engine block from the outside with compressed-air or with suitable detergents.

Electric parts (clamps, electric starter, etc.) must not be cleaned with compressed-air or any liquid cleaners. This could lead to a short or other disruptions.

It is extremely important to have free air ventilation in order to cool the motor down. Therefore you must clean the bars and ribs of the air vents immediately, even if they're only slightly dirty.

6.5 Upkeep

Engines are technologically complex mechanisms with many moving parts. There parts are subjected to strong mechanical, thermal and chemical forces because of the environment and the combustion process. Choosing the correct fuel and oil as well as thoroughly servicing and maintaining the device significantly prolongs the life-span of your device. Small mistakes can cause huge problems – even break the device entirely.

Here you will find instructions how to properly identify and maybe even correct some disruptions. However, some difficulties can only be handled by trained staff or professionals. If you have a problem go over this list point by point – often the problem is small and easily solved.

A diesel engine needs 4 things to work:

➽ OIL ➽ AIR ➽ DIESEL ➽ CORRECT TIMING

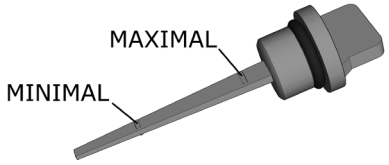
You should check in this order to find the cause of a possible problem.

6.5.1 Changing the engine oil

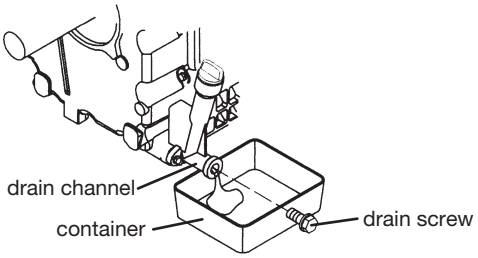
Always check the oil level before starting up! There are marks on the dipstick marking the minimum and maximum – when the device is set up on an even surface the oil level should be between these two marks.

Do not overfill! Too much oil can cause damage and must be drained.

Oil is the most important resource of the motor. Stick to the maintenance intervals and its schedule!



Put a suitable container under the drain screw, open the drain-screw and drain the motor oil. Always change the motor oil while it is warm!



Normally, the oil should be black because of the combustion residue of the motor. There should be no foreign substances, white colouring (water in the oil) or foaming visible.

The spent oil taken from the motor has to be brought to a collecting point for toxic waste!

Close the drain screw after draining.

Remove the oil filter (loosen the screw and pull it out). Wash it in petroleum ether (=benzine). After drying it, reattach it.

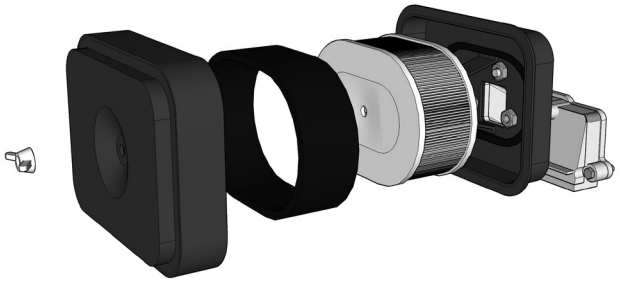
Fill new oil into the motor, make sure to use the correct one (see 5.4.1.).

After changing the oil, start up the engine and let it run for 5 minutes. Then check the oil filter and the drain-screw for any leaks. Check the oil level again and refill oil if necessary.

If the oil level increased from one check to the other do NOT start the machine. Fuel or water might have gotten into the motor oil – this can damage your device. In those cases drain the oil completely and try to identify pollutants such as water or fuel (check the smell, maybe try to set small amounts on fire, see whether water separates from the oil). Find out why there is leakage into your oil and fix it. Wash out the crankcase with fresh oil and change the oil. (Also clean/change the oil filter).

6.5.2 Cleaning and exchanging the air filter

If the air filter is lose or dirty the engine performance will be low (ex. motor produces black gas under load). Therefor you must always change the filter according to the maintenance intervals.



Open the nut of the air-filter-cover and take it off. The air filter can now be taken out of its case. There are two filters: the coarse filter and the fine filter. Carefully take the coarse filter off the fine filter.

The filter can be cleaned with compressed air. Check for any tears or other damage. If the filter is damaged in any way it must be replaced.

- Cleaning interval: 100 working hours
- Changing interval: 6 month / 300 working hours

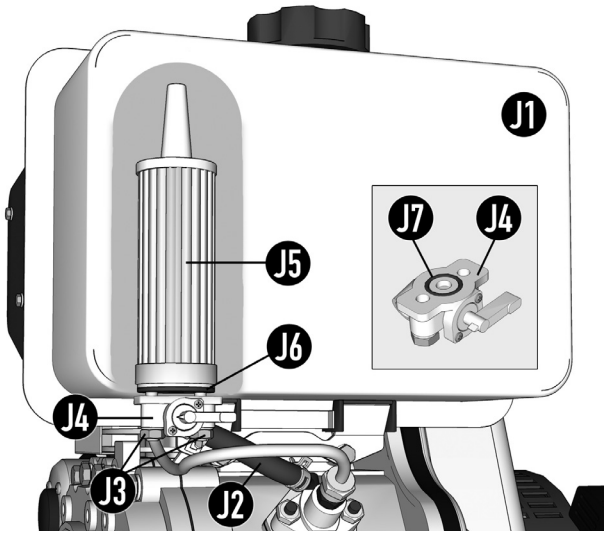
Clean the inside of the air-filter-housing with a dust cloth, then replace either a new or the cleaned air filter. Close the lid.

6.5.3. Fuel Supply

Check whether there is enough fuel in the tank. Look into the tank to check for dirt, rust or, during winter, small ice crystals. If you find any of the above drain the tank completely and fill it up with new diesel.

- Close the fuel cock and remove the fuel tube from it.
- If you carefully open the cock fuel should leak out. If this is not the case clean or replace the fuel filter.
- If the above point is ensured, check the injection system.

6.5.3.1. Changing the fuel filter



- Completely empty the tank (J1). Note that there still might be diesel in the tube (J2).
- Open the two nuts (J3) of the fuel cock (J4).
- Check the fuel cock (J4) for any pollution as well as the o-ring (J7) for wearing.
- Open the tank cap and take out the fuel filter. You can use a needle nose pliers to pull the fuel filter.

Make sure the gasket and the o-ring of the fuel cock are securely set when reassembling. After reassembling check for any leakage.

6.5.3.2. Ventilating the injection system

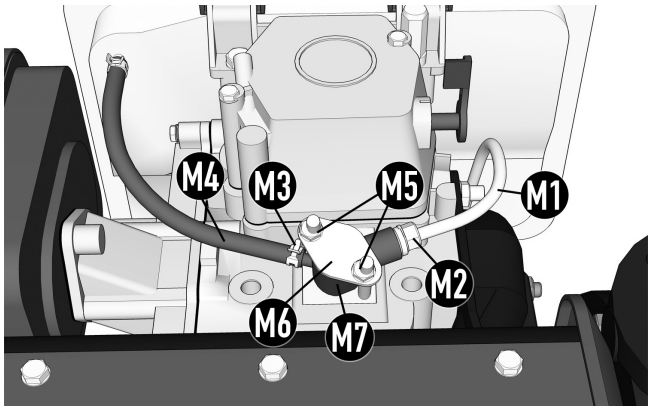
see 5.4.3.

After the device stood still for a long time it is possible that the piston of the injection pump is stuck. In this case remove the injection pump, put it into petroleum ether (=benzine) and actuate it a few times while it is lying in the benzine. Then check whether you can move the piston and the adjusting-knob easily. When reassembling be careful to place the adjusting-knob of the injection pump into the regulation-arm (fork shaped) of the governor!

6.5.3.3. Examining and cleaning the injection nozzle

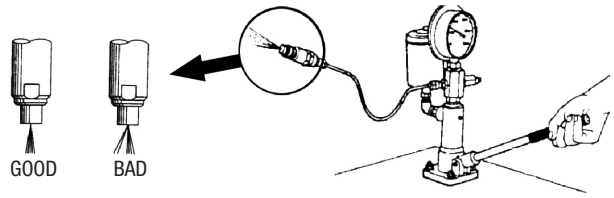
If the injection nozzle is dirty it can be cleaned the following way:

- Remove the injection pipe (M1) by loosening the golden nut (M2).
- Open the clamp (M3) and pull down the overflow-tube (M4) of the injection nozzle.
- Open the screws (M5) and remove the plate (M6).
- The injection nozzle can now be removed. If necessary push it out with the leaver.



The injection nozzle (M7) has 4 openings on its bottom out of which diesel is pumped into the combustion chamber. If one or more nozzles are clogged up, the diesel won't be distributed evenly in the chamber. Clean the injection nozzle with a piece of cloth.

- Attach the injection nozzle to a injection-tester and check the distributed fuel spray.



- During the spray test the nozzle as well as the screwing should also be checked for leaks. Attach the nozzle including the high-pressure-pipe to the checker for 10s at a pressure of 12,7 MPa (127 bar). The system must be leak proof.

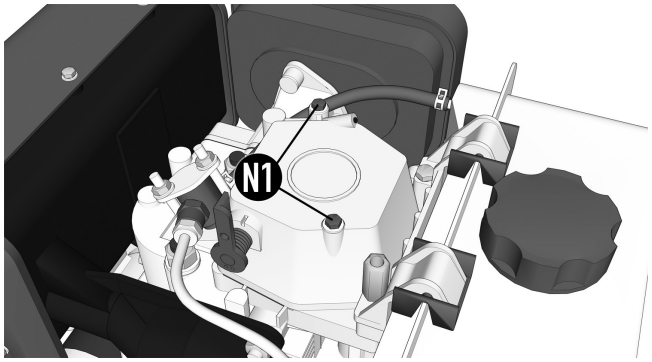
You can also check the fuel-spray without injection-checker. Connect the injection-pipe (M1) in dissembled state to the nozzle. Put down a piece of paper so that the nozzle is pointing at it vertically (at a distance of about 5mm). Press the decompressor and shortly use the starter of the motor. The nozzle should be producing fuel. You can see the fuel-spray on the piece of paper – the fuel should be distributed evenly.

6.5.4. Proper timing/adjusting the valves

Improper valve clearance is noticeable by restless engine run, backfire or low performance.

In order to set up the valves follow these instructions:

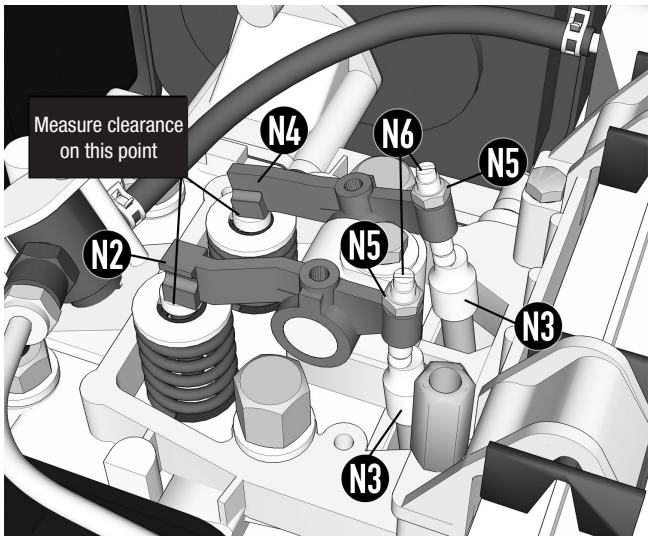
- Remove the valve bonnet by unscrewing 2 screws (N1).



- Press the Outtake-valve (N4) and turn the shaft manually by hand (pull the recoil starter) until both valves are closed (valves are completely closed - push rods N3 on lowest position).
- The push-rods (N3) should be easily to move. Check the valve clearance with a feeler gauge. The valve clearance should be approx. 0,15mm for both valves (N2) and (N4).

Should there be no feeler gauge available, normal typewriter paper is fine (meaning two layers of paper is approx. 0,15mm also).

- Unscrew the check nut (N5) in order to set up the valves. Set up the valves with the screw (N6) so that if the feeler gauge is moved through the gap, there is a noticeable resistance. Then hold the screw until the check nut is refastened.
- Check the valve clearance again and repeat the process if necessary. Set up both the intake valve (N4) and the outtake valve (N2).



It has to be easy to move or turn the push rods. The valve springs must not be broken and the push rod guides must not be worn. The position (how deep is the nut) of the check nuts should be nearly the same. Significant differences of nut deeps are a sign of incorrect assembly or a damaged rocker arm, push rod or valve. In that case remove the rocker arm entirely and pull out the push rod. Always replace damaged or deformed parts..

When reassembling the push rods they have to lay on the appropriate tapers of the camshaft (in the engine). Check whether the valves are working properly by turning the camshaft.

The timing of this device is fixed and cannot be changed..

- After setting up the valves, reassemble the bonnet assembly. Check whether the bonnet gasket is properly mounted.

6.5.5. Governing behaviour

The mechanical governer can be influenced in its regulation in different ways. The governing (how much the actual speed deviates from the ideal speed) and the oscillating (engine speed oscillates arround ideal speed) are important. These two characteristics disagree with each other. Optimal balance is reached when the speed changing causes a 1-time low oscillation.

This means: set up the speed without load. Then burden the motor up with maximum load. Now the speed must first sink, then become higher than the rated speed and then final go back to rated speed. Engine speed should not oscillate around the rated speed.

To improve the governing, the regulating spring can be hung closer to the middle of the regulation-arm. To decrease the oscillation the regulating spring can be hung closer to the outside of the regulation-arm. Normally a allready marked rated speed has to be reset after changing the spring position – see the diagrams of the governor in 4.8.

Normally it is not necessary to change the speed or the behaviour. At too low engine speed first check for any other causes of error (air filter, diesel, valves, etc.)!

6.5.6. Muffler and colours of exhaust fumes

Backfire can be a result of loose screws on the outtake-manifold or the muffler. In that case the fit of the screws as well as the state of the gaskets should be checked. The exhaust pipe should be leak and damage free

Residue must be removed from the exhaust pipe and the muffler. However, such residue indicates that either the wrong fuel is being used or that oil is being burnt.

Too much exhaust back pressure can overheat the engine.

The colour of the exhaust gas can be an indication of the current operation state of the motor:

motor is smoking white or grey	water in the fuel	drain the fuel tank
motor is smoking blue	motor oil is being burned	check the oil level, valve guides and compression
motor is smoking black	too heavy load	check the air filter as well as the injection nozzle. Maybe reduce the load

6.5.7. Other

Unusual noises might be caused by worn piston, piston-rings, cylinder, piston bolt, bearings, etc..

Too little compression might be caused by worn piston, broken cylinder, incorrect set up or leaking valves.

If the motor gets too hot, the cause is either a too heavy load or a clogged up ventilation system (air housing, ventilator).

If there is water in the fuel the engine does not start up, it smokes white or it runs very restlessly. In this case drain the fuel.

6.5.8. General tightening torque

	Torque [Nm ±5%]			
	Electric	Low Strength [1]	High Strength [1]	Tension rod
M4	1,2	1	1,5	2,5
M5	2,5	2	3	4
M6	4	2,7	5	6
M8	8	5,5	18	22
M10	12	13	20	25
M12	20	20	35	44
M16	40	35	80	100

[1] screws which don't have to be so hard (screws in alluminium, mounting screws external parts, flywheel cover, etc.)

[2] screws in parts which have to be very hard (base plate, flange etc.)

6.5.9. Engine torque and measured values

	ED4-0219	ED4-0306	ED4-0418
cylinder head	28-32 Nm	42-46 Nm	54-58 Nm
connection rod	20-22 Nm	20-22 Nm	40-45 Nm
plate of injection nozzle	8-10 Nm	8-10 Nm	10-12 Nm
flywheel	100-110 Nm	120-135 Nm	120-135 Nm
exhaust temperature	< 480 °C	< 480 °C	≤ 500 °C
oil temperature	< 100 °C	< 100 °C	≤ 110 °C
injection pressure	19,6 ± 0,49 MPa	19,6 ± 0,49 MPa	19,6 ± 0,49 MPa
injection timing	at 3.000min^{-1}: 17° ±1° bTDC [1] at 3.600min^{-1}: 18° ±1° bTDC [1]		
valve clearance intake valve	0,10-0,15 mm cold		
valve clearance outtake valve	0,10-0,15 mm cold		

[1] bTDC means "before Top Dead Center"

6.5.10. Solving electric issues

This chapter only concerns motors in version "E".

6.5.10.1 Starter malfunction

If the starter is running without load (the starter turns but the motor does not run with it) the starter gear may be broken. In this case the starter has to be changed.

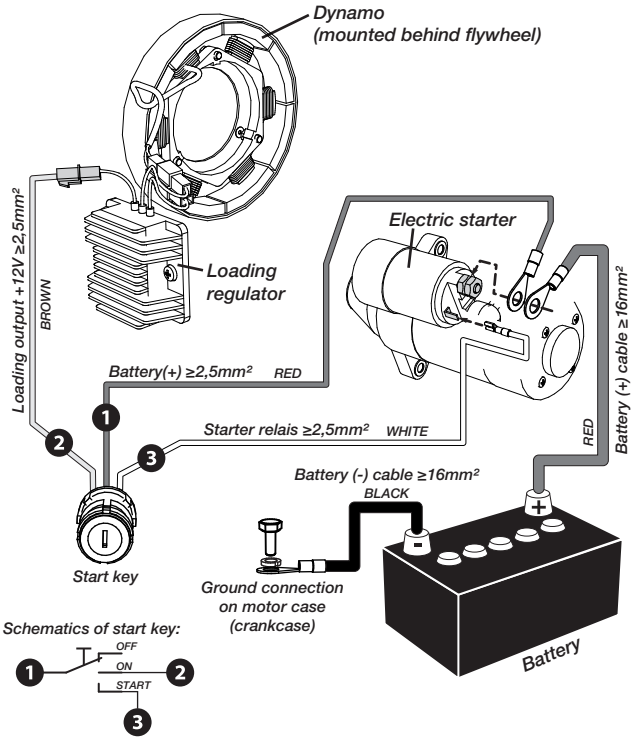
If the starter does not react when you are trying to start please check following points:

- Check the battery voltage. This should be >12,5V.
- Check the voltage between battery (+) pole and crankcase. The battery voltage must be the same. If not, the battery(-) pole cable to the crankcase is broken or loose.

From here on all measurements should be done against the crankcase (crankcase is 0V/GND).

- Measure the battery voltage at the starter (M8 screw). If there is no voltage the battery (+) pole cable is broken.
- Check the voltage at the faston-connector of the starter. When the start-key is set to position "OFF" or "ON" there should be 0 Volt – when it is set to "START" voltage has to be battery voltage. If this does not coincide either the cable connection (1) or (2) or the switch itself is broken.

If all above measure points coincide with the battery voltage, the starter itself is probably broken and must be replaced.



6.5.10.2. Battery does not charge

When the motor has started, the starter battery is charged via the built in dynamo. If this is not the case please follow these instructions:

- Disconnect the battery. Isolate the plus pole cable in order to avoid a short and start the motor manually.
- Measure the voltage of the dynamo when the engine is running and the battery is disconnected (2 isolated cables coming from the crankcase and connected with the loading regulator). The output voltage of the dynamo should be at around 18 Volt AC. If the voltage is 0V, the dynamo is probably broken and must be replaced.
- If this measurement coincides, measure the output voltage of the loading regulator against the crankcase. The output voltage is about 14V DC. If the voltage is 0V the loading regulator is broken.
- If this measurement also coincides check the cables (1) and (2) and check the key-switch.

6.6. Maintenance intervals

		before each start	after 50 hours (Initial)	all 200 hours (6 month)	all 400 hours (12 month)	all 800 hours (24 month)	all 1600 hours (36 month)
Fuel	Refuel	●					
	Check the fuel tube for leaks	●					
	Change the fuel filter				●		
Oil	Check oil level	●					
	Check whether any oil is leaking	●					
	Change the Oil, Clean the oil filter		●	●			
Cooling	Clean cooling lamellars			●			
Air	Clean the air filter and the filter housing			●			
	Change the air filter				●		
Tubes	Replace fuel tube and (including overflow tube of the injection nozzle)						❑
Elektrics only Version "E"	Check the electric connections whether they are well attached and in good state		●	●			
	Check the electric cables for scrub marks or burn marks		●		●		
	Check loading state of the battery		●		●		
Muffler	Check muffler and exhaust manifold for leaks				❑		
	Check muffler and exhaust manifold for clogs				❑		
	Check Bosch count on rated power						❑
Screws	Check all screws (including coupled device and the screws of the pedestal)			●			
	Check all screws which are easily accessible		●				
	Refasten cylinder head- and flywheel screws					❑	
Governing	Check easy moving of the governing lever	●					
	Readjust maximum speed					❑	
Cylinder head	Check valve clearance		●/❑		●/❑		
	Check valve sunk deep						❑
	Change cylinder head gasket and tunnel gasket of push-rod (beside cylinder head gasket)					●/❑	
	Check compression					❑	
	Change piston rings						❑
Injection pump	Clean injection nozzle				❑		
	Check injection pressure					❑	
	Check injection timing					❑	
	Clean injection pump						❑
Other	Check for abnormal noise during operation	●					

● to be done by the user
❑ to be done by a professional

6.7. Possible errors and their solutions

6.7.1. Engine does not start

Problem	Cause	Solution
Electrical problem in option “E”	main switch switched off	Turn on the main switch
	Battery broken or too weak	Charge battery externally and check the state of the battery again.
	Wiring damaged or loose	Check the battery cables to the starter as well as the control cables to the starting relais
	Electric starter is broken	Test electric starter according to maintenance instructions
	Surrounding temperature too low	Use the decompressor
Bad fuel delivery	Too little fuel in the tank	Refuel
	Air in the fuel delivery	Ventilate the injection pump
	Wrong fuel	Remove all fuel from the system and refuel with diesel
	Fuel filter clogged	Change the fuel filter
	Injection nozzle clogged	Check nozzle spray outcome and injection pressure
	Wrong timing	Check the injection pump
Bad air intake	Air filter or air intake clogged	Clean or replace the air filter Clean the air-intake
Wrong timing	Wrong valve clearance	Check valve clearance of both valves
Too little compression	Intake valve doesn’t close properly	Check the valve-clearance as well as whether the intake-valve is leak-free
	Piston or piston rings worn	Send in device for repair

6.7.2. Abnormal colour of exhaust gas

Problem	Cause	Solution
Black smoke	Generally the motor is overloaded when it is releasing black smoke. On the one hand it can be caused by overload – in this case lower the load. Note that the motor does not perform as well over temperatures over 25°C or at heights above 1.000m (see derating chart). Another cause is a flaw in the motor – but here the motor is overloaded as well, for example if the air filter is clogged and the motor is getting too little air and therefor has low performance.	
	air filter clogged	Clean or replace the air filter Clean air filter housing and intake manifold
	Wrong fuel	Remove all fuel from the tank and replace it with diesel
	Too little fuel	Refuel. Check whether the injection nozzle is getting enough fuel.
	Wrong valve clearance	Check valve clearance
	Injection nozzle clogged	Clean and check injection nozzle
	Wrong timing	Check injection pump position/mounting
	Intake valve does not close correctly	Check valve clearance and proper closing of intake valve
	Piston or piston rings worn	Send in device for repair
Blue smoke	When the motor is releasing blue smoke, motor oil is being burnt. This flaw has to be treated with special care as it could destroy the entire motor. In rare cases blue smoke can be caused by the timing (position of injection pump) having been set up incorrectly.	
	Too much oil (oil level too high)	Check the oil level and if necessary drain some oil via the drain screw
	Breather gasket of the crankcase broken or wrongly adjusted	Check breather gasket of the crankcase
	valve gaskets worn	Check valve gaskets (primarly intake valve gasket)
	Cylinder head gasket worn	Change cylinder head gasket. Allways take also rubber gasket for tunnel of push-rods
	Rubber gasket for tunnel of push-rods worn	Change rubber gasket for tunnel of push-rods. Clean and check cylinder head gasket
	Wrong timing	Check injection pump position/mounting
White smoke	When the engine releases white smoke there is water in the fuel. Reasons see below	
	Ambient temperature < 5°C	At low temperatures white smoke is normal during starting. As soon as the motor has the heat it usually operate on, the white smoke has to stop.
	Water in the fuel	Water can be in the tank because of condensation. That’s what causes the white smoke. Drain the tank and refuel with fresh diesel.

6.7.3. Low engine performance

Problem	Cause	Solution
Bad air supply	Air filter or air intake clogged	Clean or replace air filter, air housing and intake manifold
Bad fuel supply	Too less fuel in tank - no continous fuel supply	Refuel tank Check injection pump and fuel tubes
	Air in fuel system	Ventilate fuel system
	Wrong fuel	Drain the tank entirely and refill with diesel
	Fuel filter clogged	Check or replace fuel filter
	Injection nozzle clogged	Clean and check injection nozzle
	Wrong timing	Check injection pump position/mounting
Wrong valve clearance		Check valve clearance
Compression too low	Intake valve does not close correctly	Check valve clearance and proper closing of intake valve
	Piston or piston rings worn	Send in device for repair
Wrong reading of motor performance	Using the device at above 1.000m sea level	The specification only apply to usage below 1.000m sea level. Above 1.000m sea level the specification has to be derated.
	Ambient temperature is above +25°C	The specification only apply to usage below +25°C ambient temperature. Above +25°C the specification has to be derated.

6.7.4. Rough engine run

Problem	Cause	Solution
Fuel supply unsteady	Air in fuel system	Ventilate fuel system
	Injection nozzle clogged	Clean and check injection nozzle
	Injection pump not proper mounted or broken	Check injection pump position/mounting If this is not the solution change the injection pump
Governor blocked	Speed adjust lever blocked	Check lever for easy movement
	Governor system (centrifugal system) blocked	Send in device for repair

6.7.5. Engine overheating

Problem	Cause	Solution
Oil temperature too high	Motor overloaded	Reduce load
	Ambient temperature too high	
	Cooling lamellars clogged/dirty	Clean cooling lamellars
	Wrong oil level	Check oil level
	Wrong engine oil	Drain oil and fill in correct oil according specification
	Piston or piston rings worn	Send in device for repair

6.7.6. Engine suddenly stopps

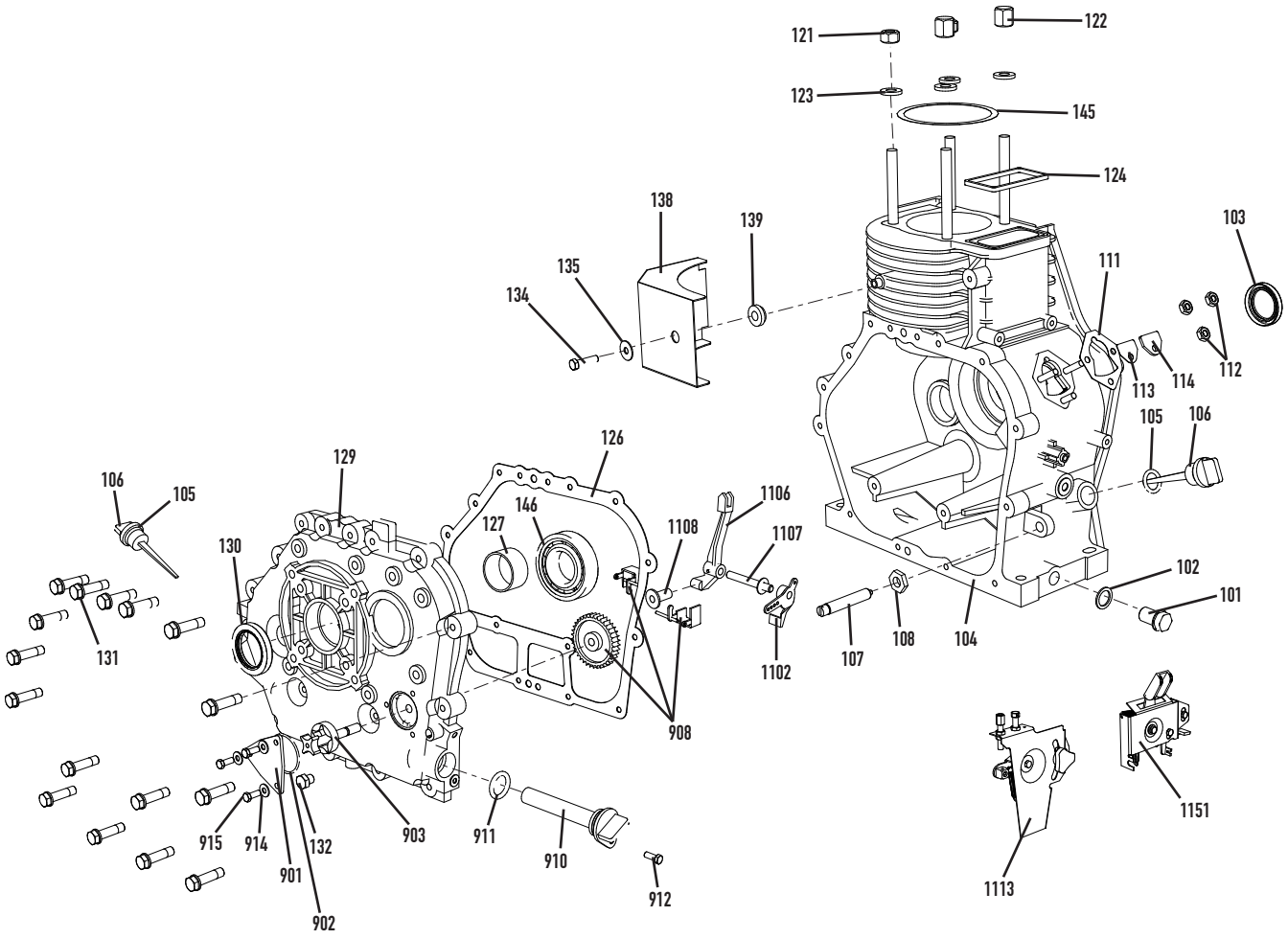
Problem	Cause	Solution
No fuel	Tank completely empty	Fill up the tank and ventilate the injection pump
	Fuel tube leakage	Check all fuel tube and pipes (including high pressure pipe)
	Fuel filter clogged	Change fuel filter
	Injection pump is broken	Try to ventilate injection pump to see pump function If this is not the solution change the injection pump
Mechanical issues	Crankshaft, camshaft or piston is blocked	Send in device for repair

6.7.7. Abnormal running noise

Problem	Cause	Solution
Dejustage oder Verschleiss	Wrong valve clearance	Check and adjust valve clearance
	Piston or piston rings worn	Send in device for repair
	Bearing of piston pin worn	
	Connection rod bearing worn	
	Wrong injection timing	
	Injection nozzle clogged	

6.8. List of parts/exploded assembly drawing

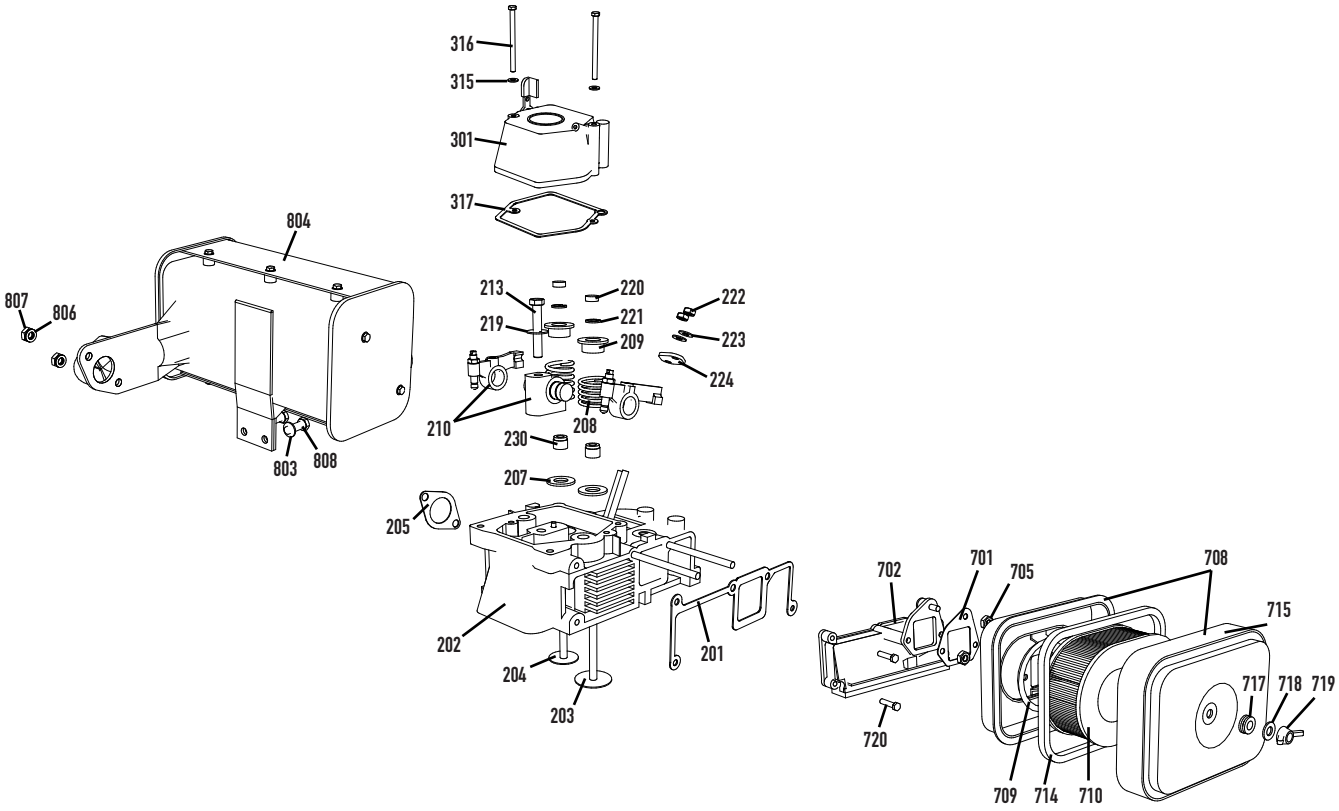
6.8.1. Crankcase



			Rotek order nr.		
Nr.	Description	pcs.	ED4-0219	ED4-0306	ED4-0418
101	Oil drain screw	2	-	-	-
102	Oil drain gasket	2	ZSPMOT00040		
103	Seal ring	1	standard part		
104	Crankcase	1	-	-	-
105	O-Ring	2	ZSPNT00047		
106	Oil dipstick	2	ZSPMOT 00021	ZSPMOT 00341	ZSPMOT 00341
107	Screw	1	-	-	-
108	Check nut	1	standard part		
111	Distance plate	1-3	ZSPMOT00384		
112	Screw	3	-	-	-
113	Damping element	1	-	-	-
114	Base	1	-	-	-
121	Cyl. head screw A	2	-	-	-
122	Cyl. head screw B	2	-	-	-
123	Washer	4	-	-	-
124	Tunnel gasket	1	ZSPMOT 00102	ZSPMOT 00103	ZSPMOT 00104
126	Crankcase gasket	1	ZSPMOT 00443	ZSPMOT 00444	ZSPMOT 00019
127	Main bearing	1	ZSPMOT 00105	ZSPMOT 00106	ZSPMOT 00107
129	Crankcase cover	1	-	-	-
130	Seal ring front	1	standard part		
131	Screw	16	standard part		
132	Blind screw	1	-	-	-
	Oil pressure sensor	opt.	ZSPMOT00003		
134	Screw	1	standard part		
135	Washer	1	standard part		

			Rotek order nr.		
Nr.	Description	pcs.	ED4-0219	ED4-0306	ED4-0418
138	Air guide	1	-	-	-
139	Rubber part	1	-	-	-
145	Cylinder head gasket	1	ZSPMOT 00375	ZSPMOT 00548	ZSPMOT 00020
146	Camshaft bearing	1	standard part		
901	Oil pump cover	1	ZSPMOT00141		
902	Cover gasket	1	ZSPMOT00142		
903	Oil pump	1	ZSPMOT00008		
908	Governor system	1	-	-	-
910	Oil filter	1	ZSPMOT00018		
911	Oil filter gasket	1	ZSPMOT00038		
912	Screw	1	standard part		
914	Washer	3	standard part		
915	Screw	3	standard part		
1102	Regulating arm	1	-	-	-
1106	Injection lever	1	-	-	-
1107	Regulation axle	1	-	-	-
1108	Bushing governor	1	-	-	-
1113	Governor Typ A	0-1	ZSPMOT00374		
1151	Governor Typ C	0-1	ZSPMOT00063		

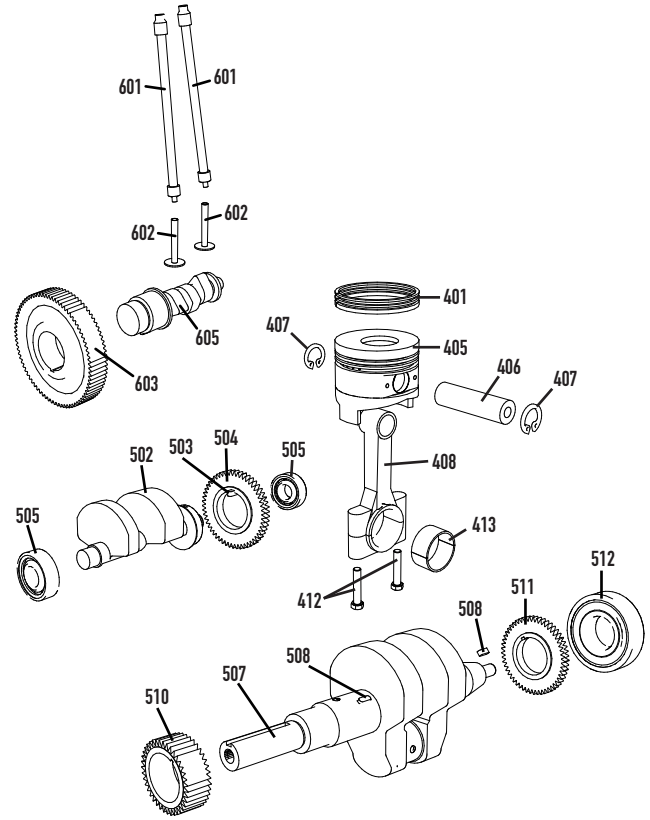
6.8.2. Cylinder head



			Rotek order nr.		
Nr.	**Description**	**pcs.**	**ED4-0219**	**ED4-0306**	**ED4-0418**
201	Gasket	1	ZSPMOT 00435	ZSPMOT 00436	ZSPMOT 00032
202	Cylinder head	1	ZSPMOT 00376	ZSPMOT 00377	ZSPMOT 00378
203	Intake valve	1	ZSPMOT 00108	ZSPMOT 00109	ZSPMOT 00029
204	Outtake valve	1	ZSPMOT 00110	ZSPMOT 00111	ZSPMOT 00030
205	Muffler gasket	1	ZSPMOT 00112	ZSPMOT 00112	ZSPMOT 00031
207	Valve washer	2	-	-	-
208	Valve spring	2	ZSPMOT 00117	ZSPMOT 00118	ZSPMOT 00119
209	Backing washer	2	ZSPMOT 00120	ZSPMOT 00121	ZSPMOT 00122
210	Rocker arm assy.	1	ZSPMOT 00706	ZSPMOT 00706	ZSPMOT 00024
213	Screw	1	-	-	-
219	Washer	1	-	-	-
220	Valve cap	2	ZSPMOT 00123	ZSPMOT 00124	ZSPMOT 00125
221	Cotter Pin	2	ZSPMOT 00126	ZSPMOT 00127	ZSPMOT 00128
222	Plate	1	ZSPMOT00709		
223	Nut	2	standard part		
224	Washer	2	standard part		
230	Valve gasket	2	ZSPMOT 00129	ZSPMOT 00130	ZSPMOT 00131
301	Bonnet assy.	1	ZSPMOT 00143	ZSPMOT 00143	ZSPMOT 00145
315	Washer	2	standard part		
316	Screw	2	standard part		
317	Bonnet gasket	1	ZSPMOT 00149	ZSPMOT 00746	ZSPMOT 00517
701	Air filter gasket A	1	ZSPMOT 00194	ZSPMOT 00194	ZSPMOT 00195
702	Intake gasket	1	-	-	-

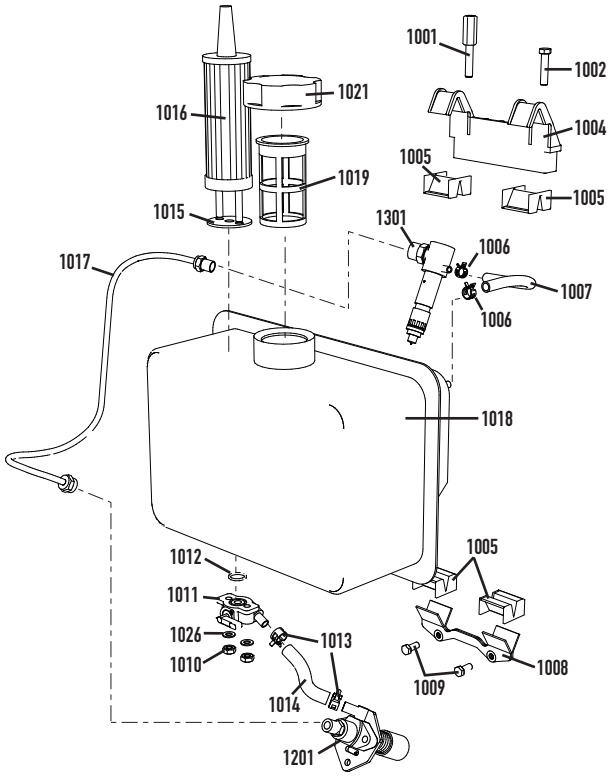
			Rotek order nr.		
Nr.	**Description**	**pcs.**	**ED4-0219**	**ED4-0306**	**ED4-0418**
705	Nut	2	Normteil		
708	Air filter housing	1	ZSPMOT 00453	ZSPMOT 00453	ZSPMOT 00389
709	Air filter gasket B	1	ZSPMOT 00456	ZSPMOT 00456	ZSPMOT 00451
710	Air filter assy.	1	ZSPMOT 00009	ZSPMOT 00009	ZSPMOT 00010
714	Housing gasket	1	ZSPMOT 00457	ZSPMOT 00457	ZSPMOT 00452
715	O-Ring	1	ZSPMOT 00454	ZSPMOT 00454	ZSPMOT 00446
717	Rubber element	1	standard part		
718	Washer	1	standard part		
719	Butterfly nut	1	standard part		
720	Screw	1-3	standard part		
803	Washer	2	standard part		
804	Muffler	1	ZSPMOT 00132	ZSPMOT 00133	ZSPMOT 00134
806	Washer	2	standard part		
807	Screw	2	standard part		
808	Screw	2	standard part		

6.8.3. Shafts



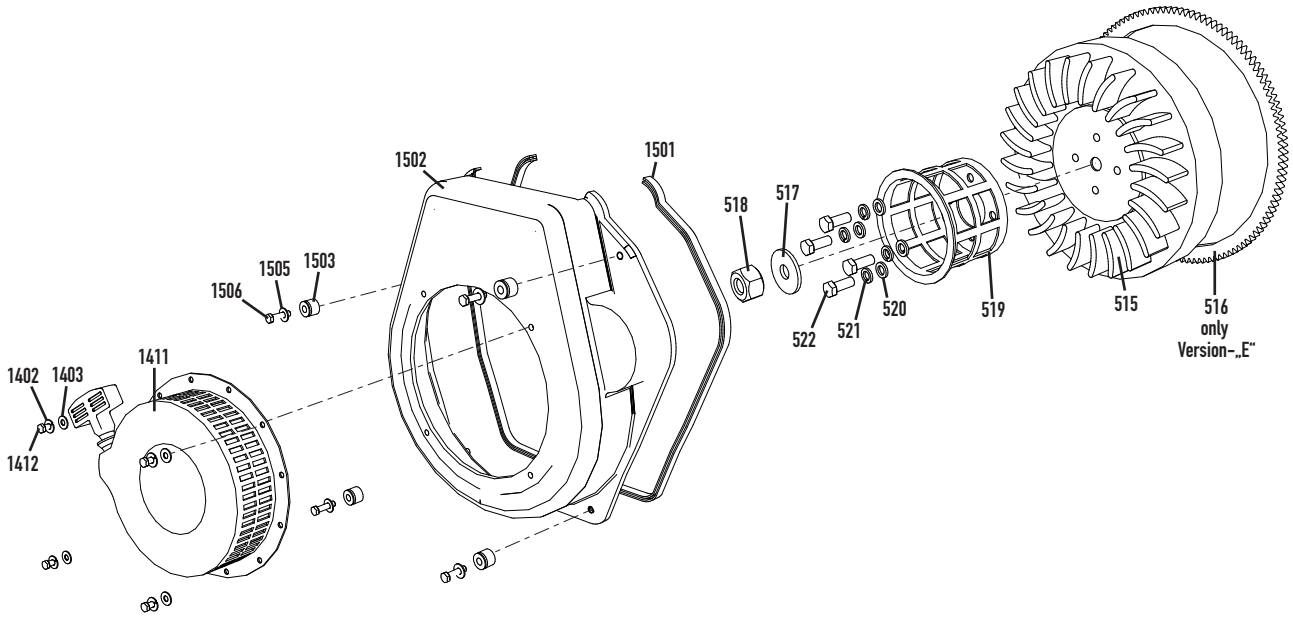
Nr.	Description	pcs.	Rotek order nr.		
			ED4-0219	ED4-0306	ED4-0418
118	Needle bearing camshaft	1	standard part		
401	Piston ring assy.	1	ZSPMOT 00162	ZSPMOT 00163	ZSPMOT 00164
405	Piston	1	ZSPMOT 00165	ZSPMOT 00166	ZSPMOT 00167
406	Piston pin	1	ZSPMOT 00169	ZSPMOT 00170	ZSPMOT 00171
407	Piston pin circlip	2	ZSPMOT 00172	ZSPMOT 00173	ZSPMOT 00174
408	Connection rod	1	ZSPMOT 00175	ZSPMOT 00176	ZSPMOT 00177
412	Connection rod bolt	2	ZSPMOT 00178	ZSPMOT 00179	ZSPMOT 00180
413	Connection rod bearing	1	ZSPMOT 00181	ZSPMOT 00182	ZSPMOT 00028
502	Balance shaft	1	ZSPMOT 00154	ZSPMOT 00155	ZSPMOT 00156
503	Key	1	-	-	-
504	Gear balance shaft	1	ZSPMOT 00204	ZSPMOT 00205	-
505	Bearing of balance shaft	2	standard part		
507	Crankshaft	1	depens on motor version		
508	Key	2	-	-	-
510	Gear of camshaft	1	ZSPMOT 00201	ZSPMOT 00202	ZSPMOT 00203
511	Gear of balance shaft	1	ZSPMOT 00204	ZSPMOT 00205	ZSPMOT 00206
512	Main bearing of crankshaft	1	ZSPMOT 00105	ZSPMOT 00106	ZSPMOT 00107
601	Push rod	2	ZSPMOT 00183	ZSPMOT 00184	ZSPMOT 00027
602	Push rod tappet	2	ZSPMOT 00185	ZSPMOT 00185	ZSPMOT 00186
603	Gear of camshaft	1	ZSPMOT 00188	ZSPMOT 00189	ZSPMOT 00190
605	Camshaft	1	ZSPMOT 00191	ZSPMOT 00192	ZSPMOT 00193

6.8.4. Fuel



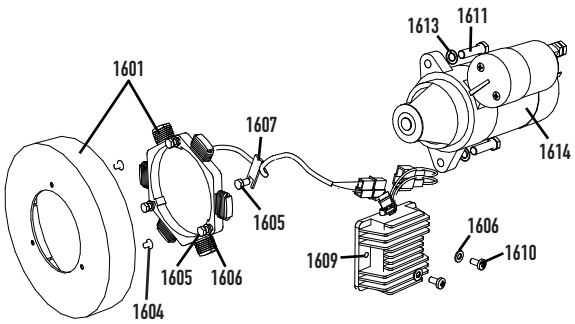
Nr.	Description	pcs.	Rotek order nr.		
			ED4-0219	ED4-0306	ED4-0418
1001	Bolt	1	standard part		
1002	Screw	1	standard part		
1004	Upper stay	1	-	-	-
1005	Rubber element	4	-	-	-
1006	Tube clamp	2	standard part		
1007	Fuel return tube	1	standard part		
1008	Lower stay	1	-	-	-
1009	Screw	2	standard part		
1010	Nut	2	standard part		
1011	Fuel cock	1	ZSPMOT00583		
1012	O-Ring	1	ZSPNT00013		
1013	Tube clamp	2	standard part		
1014	Fuel tube	1	standard part		
1015	Fuel filter gasket	1	ZSPMOT00042		
1016	Fuel filter	1	ZSPMOT 00023	ZSPMOT 00339	ZSPMOT 00340
1017	Injection pipe	1	ZSPMOT 00026	ZSPMOT 00004	ZSPMOT 00022
1018	Fuel tank	1	ZSPMOT 00379	ZSPMOT 00380	ZSPMOT 00381
1019	Filter net	1	ZSPMOT00152		
1021	Tank cap	1	ZSPMOT00153		
1026	Washer	2	standard part		
1201	Injection pump Standard	1	ZSPMOT 00007	ZSPMOT 00007	ZSPMOT 00001
	Injection pump with magnetic valve	opt.	ZSPMOT 00747	ZSPMOT 00747	ZSPMOT 00392
1301	Injection nozzle	1	ZSPMOT 00005	ZSPMOT 00005	ZSPMOT 00062

6.8.5. Flywheel



			Rotek order nr.		
Nr.	**Description**	**pcs.**	**ED4-0219**	**ED4-0306**	**ED4-0418**
515	Flywheel	1	-	-	-
516	Gear	(1)	ZSPMOT 00135	ZSPMOT 00136	ZSPMOT 00137
517	Washer	1	-	-	-
518	Flywheel nut	1	-	-	-
519	Starter pulley	1	ZSPMOT 00543	ZSPMOT 00545	ZSPMOT 00068
520	Washer	4	standard part		
521	Circlip	4	standard part		
522	Screw	4	standard part		
1402	Circlip	4	standard part		
1403	Washer	4	standard part		
1411	Recoil starter assy.	1	ZSPMOT 00065	ZSPMOT 00006	ZSPMOT 00017
1412	Screw	4	standard part		
1501	Gasket	1	-	-	-
1502	Flywheel cover	1	-	-	-
1503	Rubber element	4	-	-	-
1505	Washer	4	standard part		
1506	Screw	4	standard part		

6.8.6. Electrics



			Rotek order nr.		
Nr.	**Description**	**pcs.**	**ED4-0219**	**ED4-0306**	**ED4-0418**
1601	Dynamo	1	ZSPMOT00138		
1604	Screw	3	standard part		
1605	Screw	4	standard part		
1606	Circlip	5	standard part		
1607	Plate	1	-	-	-
1609	Loading regulator	1	ZSPMOT00015		
1610	Screw	2	standard part		
1611	Screw	2	standard part		
1613	Circlip	2	standard part		
1614	Electric starter	1	ZSPMOT00012		

7. Appendix

7.1. Warranty conditions

The warranty duration of this device lasts 12 month, starting at the delivery to the end-user, at most 14 months after delivery date of Rotek.

Or, if the engine is used professionally and very often, the warranty expires after 1.000 hours of operation. In devices that do not have a working hour meter the general engine condition is used as a reference. At least 3 hours of operation every day are assumed in this calculation.

The warrenty duration of spare parts lasts 6 months, starting at the delivery to the end-user. The receipt of the delivery note is proof for the delivery date.

Inside of the previously mentioned borders Rotek mandates themselves to repair or replace parts that after being examined by Rotek or an authorised service subsidiary prove to have production or material errors. Repairing or exchanging broken parts does not prolong the warranty duration of the device. All during the warrenty duration repaired or replaced parts have the same warrenty end-date as the original part.

Excluded from warranty is any damage that was caused by following reasons:

- Ignoring the instructions and rules in this manual. Inproper usage.
- Forbidden environmental conditions.
- Overload
- Normal wearout
- Unauthorized changes on the device
- Using not original spare parts
- Insufficient or wrong cleaning or maintenance
- Damage because of missing resources (engine oil, etc.)
- Damage because of using unsuitable fuels or oils
- Damage at the bearing because of too little lubrication or wrong assembly

Furthermore, all wearing parts, resources like oil, filter (oil-, air- and fuel filter), shaft bearings, lubricating fats and shaft seals are excluded from warranty.

Smaller flaws (scratches, miscolouring) can happen, however do not impair the usage of the device and are therefore excluded from warranty.

Rotek can not be hold responsible for costs, damage, direct or indirect losses (including possible loss of profit, loss of contract or loss of production), which are a result of using the device ot not being able to use the device.

The warranty repair will be done at the location of Rotek or at the location of a from Rotek authorized service subsidiary.

Transport costs of any possibly broken parts that are required by Rotek to be evaluated are to be paid for by the customer. The transport costs to the location of the device or to an authorized service subsidiary for parts where the warranty is accepted is payed for by Rotek.

The broken, within the warranty period replaced parts automatically transfer into the ownership of Rotek after being replaced.

7.2. Declaration of conformity

CE Hiermit erklären wir,
We herewith declare,

Rotek Handels GmbH
Handelsstraße 4
2201 Hagenbrunn
Österreich / Austria

Dass das nachfolgend bezeichnete Gerät aufgrund seiner Konzipierung und Bauart sowie in der von uns in Verkehr gebrachten Ausführung den einschlägigen, grundlegenden Sicherheits- und Gesundheitsanforderungen der EG-Richtlinien entspricht.

That the following Appliances complies with the appropriate basic safety and health requirements of the EC Directive based on its design and type, as brought into circulation by us.

Bezeichnung	**Diesel Motor luftgekühlt**
Description	***Air-cooled diesel engine***

Modellserie (Subnummer / Bauform) ***Typeseries (Subnumber / Design)***	ED4-0219 (-E-KW19.05x61.5, -E-KW20x53, -H-KW19.05x61.5, -H-KW20x53 / L1601)
	ED4-0306 (-E-KW25x63, -E-TP26x77.5, -H-KW25x63 / L1601)
	ED4-0418 (-E-KW25x88, -E-KW25.4x88, -E-TP25.4x105, -E-TP26x77, -E-KW30x63-Camshaft, -H-KW25x88 / L1601)
	ED4-0474 (-E-KW25x88, -E-KW25.4x88, -E-TP25.4x105, -E-TP26x77, -E-KW30x63-Camshaft, -H-KW25x88 / L1601)

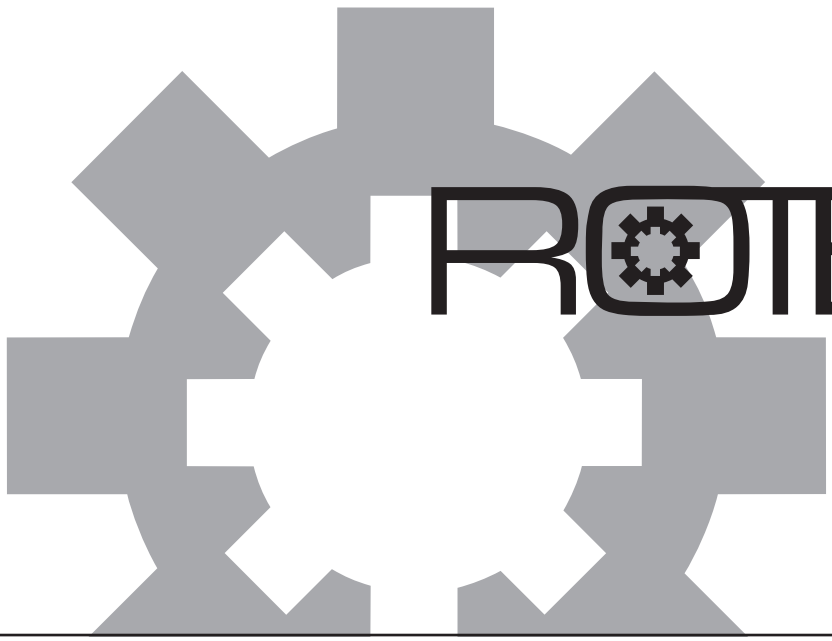
Einschlägige EG-Richtlinien	**89/392/EWG 93/68/EWG 89/336/EWG 73/23/EWG 2000/14/EWG**
Applicable EC Directives	

Angewandte harmonisierte Normen	**EN 292 EN 50081-1 EN 50082-1 EN 55014 EN 55011**
Applicable harmonized standards	

Bei einer nicht mit uns abgestimmter Änderung des Gerätes verliert diese Erklärung ihre Gültigkeit.

In a case of the alternation of the machine, not agreed upon by us, this declaration will lose its validity.

(Robert Rernböck, Geschäftsführer)



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