Operating instructions

BKM0187EN

High pressure gear motor KM 5/219 ... KM 5/300

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Englisch

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KRACHT

Table of Content

1 General points

1.1 About the documentation

These operating instructions describe the installation, operation and maintenance of the high pressure gear motor **KM 5/219 ... KM 5/300**, also referred to below as the device.

The device is manufactured in different versions. Information about the version concerned in the individual case can be found on the device's type plate.

The structure of the type designation and a more detailed description of the individual series and nominal sizes can be found in the chapter 3 “Device description” and in the chapter 4 “Technical data”.

If you have any questions about this operating manual, please contact the manufacturer.

1.2 Manufacturer´s address

Kracht GmbH

Gewerbestraße 20

DE 58791 Werdohl

phone: +49 (0) 23 92 / 935-0

fax: +49 (0) 23 92 / 935-209

email: info@kracht.eu

web: www.kracht.eu

1.3 Intended use

The device is intended as a drive motor in hydraulic systems. The various seal variants and materials enable use with different media.

The device has been designed for operation with fluids. Dry operation is not permitted. The medium must guarantee a minimum lubrication.

The medium must not contain any abrasive constituents.

Petrols, solvents, etc. are **not** permissible.

Use in explosive areas is **not** permissible.

The operator must guarantee that the medium to be conveyed is compatible with the materials used in the device (see "Overview materials" in the chapter 4 “Technical data”). Chemical expertise is required for that.

The maximum permissible operating data listed in the chapter 4 “Technical data” must always be observed.

Deviations from the above-mentioned data and operating conditions require express approval by the manufacturer and/or are specified on the type plate.

Type plates or other references on the device must not be removed nor made unlegible or unrecognisable.

In cases of noncompliance, all warranty and manufacturer responsibility shall be void.

2 Safety

2.1 Safety instructions and symbols

The safety notices in these operating instructions are marked with caution symbols.
Non-compliance can lead to hazards for people and the device.
In addition, the safety instructions are marked with signal words. They have the meanings as explained below:
Caution: Identification of a low risk hazard, which could lead to minor or medium bodily injury if not avoided.
Warning: Identification of a potential medium risk hazard, which would lead to death or severe bodily injury if not avoided.
Danger: Identification of an immediate hazard, which would result in death or severe bodily injury if not avoided.

Notice: Flagging of notices to prevent property damage.

Flagging of special user tips and other especially useful or important information.

2.2 Personnel qualification and training

The personnel designated to install, operate and maintenance the device must be properly qualified. This can be through training or specific instrucion. Personnel must be familiar with the contest of this operating instruction.

2.3 General safety instructions

The operational safety of the device delivered is only guaranteed when it is used for the intended purpose (see chapter 1 “General points”).
The limit values given must never be exceeded (see chapter 4 “Technical data”).
National regulations concerning accident preventation and health and safety at work must be observed, as well as internal regulations laid down by the operator, even of these are not specifically mentioned in this manual.
The operator must ensure that this operating manual is accessible to the personnel responsible at all times.

2.4 Hazard statements

DANGER

Danger due to breakage or squirting fluids!

If the device is blocked it acts like a closed gate. The pressure level that occure in this case can result in damage to the device and to up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. A pressure relief valve or other kind of over-pressure safeguard must be installed before the device. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
2. Do **not** put the device into operation without a pressure relief device.

DANGER

Danger due to breakage or squirting fluids!

Using unsuitable connections and lines can lead to breakage. Parts flying around uncontrolled or squirting fluids can lead to accidents with severe injuries or even lead to death.

1. Use only connections and lines approved for the expected pressure range.
2. The respective manufacturer's regulations must be heeded.

DANGER

Danger due to breakage or squirting fluids!

Using damaged connections and lines can cause parts to fly around uncontrolled or fluids to squirt out, wich can lead to accidents and severe injuries or even result in death.

1. Immediately replace damaged connections, pipes and hose lines.

DANGER

Hazard caused by incorrect direction of rotation!

Operating the device with the incorrect direction of rotation can lead to damage to the device and to the up and/or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. Always pay attention to the correct direction of rotation when installing the device.
2. Always pay attention to the correct direction of rotation when connecting the motors.
3. Secure the fitting keys against flying off when monitoring the direction of rotation.

WARNING

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

WARNING

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

WARNING

Hazard caused by rotating parts!

Rotating parts can cause accidents with severe injuries or result in death due to body parts, hair or clothing getting caught or wrapped up.

1. Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
2. Close any maintenance openings when using bell housings.
3. Do **not** operate the device without safeguards.

WARNING

Danger due to exposed gears!

Gears can pull in and crush or cut off fingers and hands.

1. Do **not** reach into the gears.
2. Put the device into operation with connected lines only.

WARNING

Danger due to falling and or loads falling over!

Due to the size and weight of the device, accidents can occur resulting in severe injuries or death during transport and shipping.

1. Compliance with applicable industrial safety requirements is mandatory.
2. Use only suitable means of conveyance and lifting tackle with sufficient load-bearing capacity.
3. Attach lifting tackle only to suitable points (see figure 5.1).
4. Attach the lifting tackle in such a manner that it cannot slip.
5. The device's centre of gravity must lie between the lifting tackle mounting points on the device.
6. Secure the device so that toppling over and falling down is impossible.
7. Always avoid jerks, impacts and strong vibrations during transportation.
8. Never walk under suspended loads, never work under suspended loads.
9. To prevent damage to the device, be extremely cautious when shipping or transporting.
10. Wear suitable protective clothing.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scaled when touching the hot surfaces.

1. At medium temperatures above 60 °C, take measures against unintended contact.
2. Wear safety gloves.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scaled when touching the hot surfaces.

1. At medium temperatures above 48 °C, let the device cool off.
2. Wear safety gloves.

3 Device description

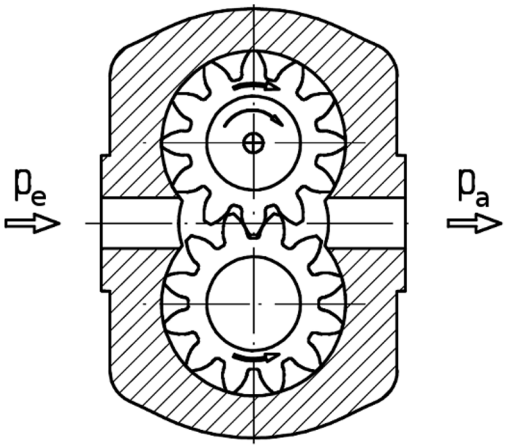
3.1 General points

Geared motors are used to convert hydraulic energy into mechanical energy. The hydraulic energy is usually generated by an upstream pump. With the aid of a suitable hydraulic fluid, the energy is transmitted through two external gears as the torque via the output shaft to the consumers.

The construction of a geared motor is fundamentally similar to that of a gear pump. They are manufactured for one or also for two rotary directions. Depending on the version and application, the leak oil is drained off internally or externally. The so-called geometric displacement V_g is consumed per wheel rotation. This value is stated in the technical documents to designate the size of the motor.

The operating pressure of the motor only adjusts itself when loaded with the connected consumers. During this process, the rotational speed of the motor depends on the supplied pressure liquid volume per time unit.

Tab. 3.1: Functional principle external gear motors

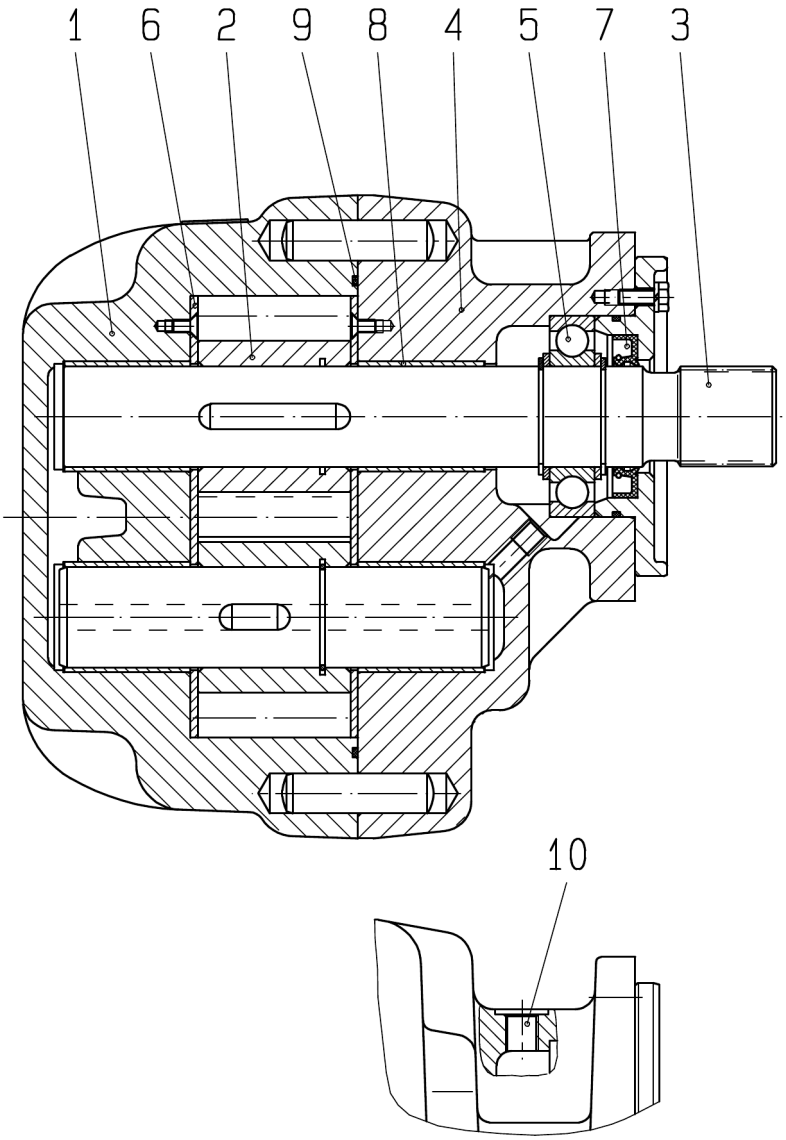


p_e = Inlet side
p_a = Outlet side

3.2 Basic construction

3.2.1 KM 5/...

Tab. 3.2: KM 5/...



1. Housing
2. Gear
3. End of drive shaft
4. Flange cover
5. Roller bearing
6. Slide plate
7. Rotary shaft lip seal
8. Plain bearing
9. Housing seal
10. Leak oil connection

External gear motors of the KM 5 construction design size, due to their structure (design principle) and the materials employed, are suitable for employment under the most extreme operating conditions. The main components (see sectional drawing) are formed by the housing and flange cover - both made of GG-30 cast iron. They can be dynamically highly loaded and are thus insensitive to pressure peaks and continuous vibrations. Large-surface-dimensioned PTFE-pb coated, bronze plain bearings on steel bridges in the housing and flange cover bear the micro-finish ground bearing journals of the shaft and bolt. To realise optimum running properties, the tooth flanks of the gear, which are manufactured out of carburizing steel, are ground. A high volume flow with a relatively small construction size is achieved with the low number of teeth (n=10) and in association with a tooth shape created for the specific concerns of the hydraulics.

The PFT-Pb coated lateral slide pates made of steel and bronze ensure durability.

The tight seating guarantees high efficiency.

External forces
The robust construction and the outboard bearing permit the absorption of external forces.
Axial 400 N - Radial 1500 N

3.3 Type key

Ordering example KM 5/219 ... KM 5/300															
KM	**5/**	**250**		**E**	**3**	**0**	**K**		**Z**	**0**	**0**		**0**	**D**	**E**	**1**	**/000**
1.	2.	3.		4.	5.	6.	7.		8.	9.	10.		11.	12.	13.	14.	15.

Explanation of type key KM 5/219 ... KM 5/300				
1.	**Product name**			
2.	**Size 5**			
3.	**Nominal size**			
	V_g	(219) / 250 / 300 cm^3		
4.	**Flange cover version**			
	E	SAE-C-4-hole flange; LA = 114,55; ∅Z = 127		
	LA = Hole distance ; ∅Z = Centering diameter			
5.	**Direction of rotation**			
	3	Clockwise and counterclockwise		
6.	**0**	Without		
7.	**Housing connection**			
	K	1 1/2" SAE flange connection (Ø 38)		
8.	**Shaft end**			
	V	Gear shaft profile W 40x2; DIN 5480	**Z**	Cylindrical shaft end ∅ 1 1/4" (Ø 31,57) Special number 194 350 Nm_{max}
	T	Gear shaft profile SAE-C; Z = 14; DP 12/24; α = 30°; 500 Nm_{max}		
9.	**2nd shaft end**			
	0	Without		
10.	**Adapter**			
	0	Without		
11.	**Design serial number**			
	0	specified by manufacturer		
12.	**Housing and bearing version**			
	D	Iron cast housing with multi-component plain bearings		
13.	**Gear version**			
	E	Gear are made of cast-hardened steel; hardened and carburizing		
14.	**Seal**			
	1	NBR $\vartheta \leq 90$ °C	**2**	FKM $\vartheta \leq 120$ °C
15.	Code for special versions			

4 Technical data

4.1 General characteristics

General characteristics KM 5/219 ... KM 5/300		
Construction		High pressure gear motor
Material		See section 4.3 “Overview materials”
Fixing type		Flange mounting
End of drive shaft		See type key or technical data sheets
Connection type		Flange connection; Dimensions see type key or technical data sheets
Installation position		Arbitrary*
Viscosity	v_{min} v_{max}	13 mm²/s 600 mm²/s
Recommendet viscosity range	v	16...90 mm²/s
Ambient temperature	ϑ_{min} ϑ_{max}	-20 °C 60 °C
Speed	n	See section 4.4 “Operating pressures and speeds”
Fluid temperature range	$\vartheta_{m\ max}$	80 °C for NBR 120 °C for FKM
Bleed oil backpressure	$p_{L\ max}$	at n = 1000 l/min ⇒ 4,5 bar at n = 1800 l/min ⇒ 2,5 bar
Operating pressure intake side Operating pressure discharge side	$p_{b\ max}$ $p_{b\ max}$	See section 4.4 “Operating pressures and speeds” 40 bar
Filtering		Filter for filtration quotients $\beta_{60} \geq 75$
Permissible media		Mineral oil according to DIN 51524/25 Motor oil according to DIN 51511 Flame-retardant hydraulic fluids on request Bio-oils of the "HEES" group can be used up to 70 °C and at maximum pressure reduction by about 20 % (please request)
** A reduced service life must be expected for the shaft seal when vertically installed.*		

NOTICE

Danger of property damage when pumping aqueous fluids

When pumping aqueous dispersions or solvents, low pressure on the inlet port can lead to cavitation damage on the pump.

1. Comply with the media-specific attributes.
2. When designing the inlet line, make sure the inlet port pressure on the pump inlet during operation is always higher than the steam pressure of the pumping fluid. While doing so, also take the altitude of the site of the device over mean sea level into consideration.
3. For aqueous dispersions and solvents, limit the operating temperature to max. 50 °C, install the pump underneath the liquid level and limit the rotational speed to maximal 1500 rpm.

4.2 Overview nominal sizes

Overview nominal sizes KM 5			
Nominal size*	**Geom. displacement** Vg cm^3/r	**Mass inertia** **x 10^{-3}** J kg m^2	**Weight** kg
219**	215	4,9	47
250	245	5,87	49
300	293	6,50	53
** See type key and type designation at device*			

4.3 Overview materials

Seal type*	Housing / Cover	Gear	Bearing	Seal
1	EN-GJL-300 (GG-30)	Casehardened and carburizing steel as per DIN 17 210	Multi-component bearing bushings	NBR
2				FKM
** See type key and type designation at device*				

4.4 Operating pressures and speeds

Operating pressures and speeds KM 5				
Nominal size	**Max. operating pressure**	**Pressure peaks**	**Max. speed**	**Minimum speeds**
	p_b bar	p_s bar	n_{max} rpm	n_{max} rpm bei $p = p_b$
219**	100	120	2000	800
250	100	120	1800	800
300	80	120	1500	800

** request deliverability

4.5 Equations for calculating hydro-pumps and motors

Parameter	Equation symbols	Unit
Delivery/displacement	Q	l/min
Geom. delivery/displacement	V_g	cm^3/r
Pressure	p	bar
Speed	n	rpm
Torque	M	Nm
Power	P	kW
Overall efficiency	η_{tot}	-
Volumetric efficiency	η_{vol}	-
Hydr.-/ Mech. efficiency	η_{hm}	-
Flow velocity	v	m/s
Pipe diameter	d	mm

General

1 = Inlet, drive

2 = Outlet, output

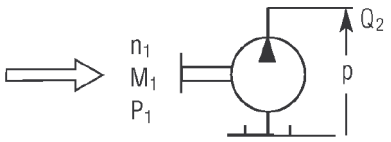
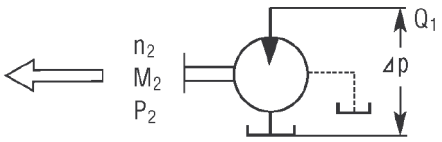
$Q_{th} = V_g \cdot n$

$\eta_{tot} = \eta_{vol} \cdot \eta_{hm}$

$M = 9549 \cdot P/n$

$v = 21{,}22 \cdot Q/d^2$

Equations for calculating hydro-pumps and motors

			Pump	Motor
				
Parameter für:	Volumetric flow	Discharge flow	$Q_2 = \frac{V_g \cdot n_1 \cdot \eta_{vol}}{10^3} \left[\frac{l}{min}\right]$	Displacement: $Q_1 = \frac{V_g \cdot n_2}{10^3 \cdot \eta_{vol}} \left[\frac{l}{min}\right]$
	Torque	Drive torque	$M_1 = \frac{p \cdot V_g}{20 \cdot \pi \cdot \eta_{hm}}$ [Nm]	Output torque: $M_2 = \frac{\Delta p \cdot V_g \cdot \eta_{hm}}{20 \cdot \pi}$ [Nm]
	Power	Drive power	$P_1 = \frac{p \cdot Q_2}{600 \cdot \eta_{tot}}$ [kW]	Output power: $P_2 = \frac{\Delta p \cdot Q_1 \cdot \eta_{tot}}{600}$ [kW]

4.6 Dimensions

Dimensions of the device can be found in the relevant technical data sheets.

5 Transport and storage

5.1 Transport damage

Inspect the device for shipping damage as soon as the delivery has been received.

If shipping damage is discovered, inform the shipping company.

If proper operation of the device is impaired by the damage, the device must be replaced or repaired. In that case, contact the manufacturer.

5.2 Transport

WARNING

Danger due to falling and or loads falling over!

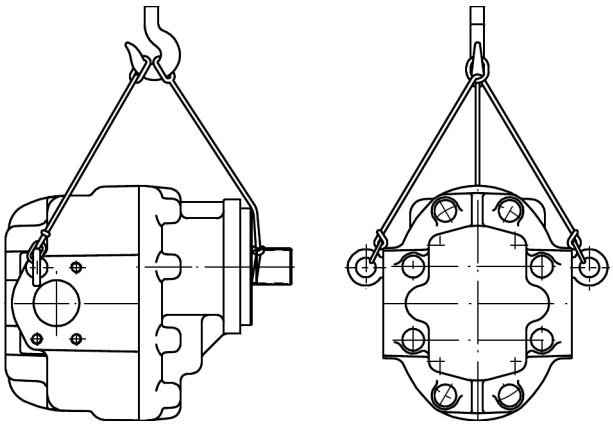
Due to the size and weight of the device, accidents can occur resulting in severe injuries or death during transport and shipping.

1. Compliance with applicable industrial safety requirements is mandatory.
2. Use only suitable means of conveyance and lifting tackle with sufficient load-bearing capacity.
3. Attach lifting tackle only to suitable points (see figure 5.1).
4. Attach the lifting tackle in such a manner that it cannot slip.
5. The device's centre of gravity must lie between the lifting tackle mounting points on the device.
6. Secure the device so that toppling over and falling down is impossible.
7. Always avoid jerks, impacts and strong vibrations during transportation.
8. Never walk under suspended loads, never work under suspended loads.
9. To prevent damage to the device, be extremely cautious when shipping or transporting.
10. Wear suitable protective clothing.

Handling aid

1. When transporting individuals devices, the eyebolts can be screwed into the connecting flanges as a handling aid.

Fig. 5.1: Example for safe transport of high pressure gear motor



5.3 Corrosion protection

The device's functionality is tested in the factory with mineral hydraulic oil. After that, all connections are sealed with plugs, so the interior parts are **not** protected against corrosion for long periods.

The device must not be exposed in the influence of the weather and major fluctuations in temperature during transport and storage and must be stored in a dry place.

If the device is stored over a longer period, it must be treated on the inside and outside with a suitable corrosion protecting oil. In addition, it must be protected from humidity by a humidity-absorbing agent.

If high air humidity or aggressive atmosphere is to be expected during transport, suitable corrosion prevention measures must be carried out.

NOTICE

Chemical impact on the device and the sealing materials

Incompatibility between the preservation agents and the materials and elastomeres used in the device can lead to damage of the device and the seals being used.

1. Check to make sure the preservation agent is compatible with the materials and elastomers used in the device.
2. Check to make sure the preservation agent is compatible with the media to be pumped.

6 Installation

6.1 General points

WARNING

Hazard caused by rotating parts and fluid squirting out!
During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

NOTICE

Danger of property damage due to insufficiently qualified personnel
Improper work can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.

NOTICE

Danger of property damage due to a lack of cleanliness
During installation, foreign bodies can get into the interior of the device or the plant due to a lack of cleanliness and cause malfunctions there.

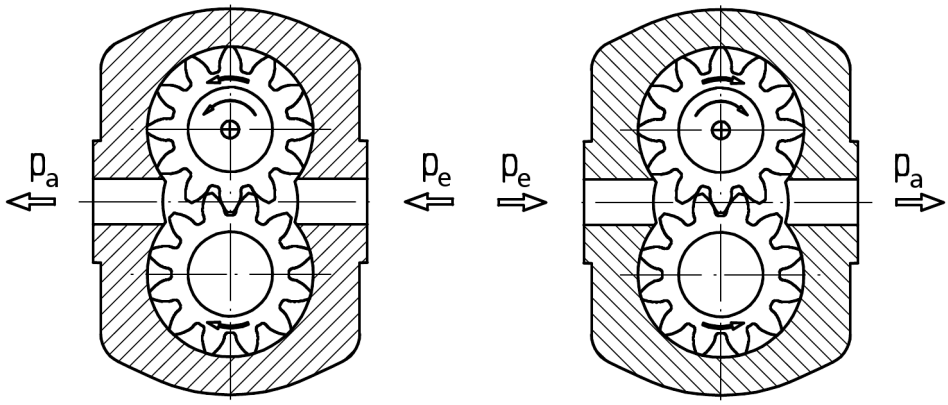
1. Pay attention to cleanliness during all work.

6.2 Definition of the direction of rotation and pumping flow

The following definition shall apply with respect to the rotation and flow direction of geared motors when viewed from the drive shaft end:

Looking at the drive shaft end, the liquid flow is from right to left when the shaft is moving **counterclockwise**.

Looking at the drive shaft end, the liquid flow ist from left to right when the shaft is moving **clockwise**.



p_e = Input side

p_a = Output side

6.3 Execution of inlet, output and leak-oil line

DANGER

Danger due to breakage or squirting fluids!

Using unsuitable connections and lines can lead to breakage. Parts flying around uncontrolled or squirting fluids can lead to accidents with severe injuries or even lead to death.

1. Use only connections and lines approved for the expected pressure range.
2. The respective manufacturer's regulations must be heeded.

NOTICE

Danger of property damage due to distortion

The load on the device due to impermissible external loads can lead to malfunctions or to breakage of the flange or housing.

1. Pipelines must be fitted absolutely tension-free to the device connections.
2. Pipelines must be designed in such a way that no tension e.g. caused by changes in lenght due to fluctuations in temperature can be transferred to the device.

NOTICE

Danger of property damage caused by foreign bodies in the device

During installation, when using unsuitable sealing materials foreign bodies can get into the interior of the device or the plant due to a lack of cleanliness and cause malfunction there.

1. During installation, do not use **any** hemp or filler as sealing material.

6.3.1 Inlet line

DANGER

Danger due to breakage or squirting fluids!

If the device is blocked it acts like a closed gate. The pressure level that occure in this case can result in damage to the device and to up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. A pressure relief valve or other kind of over-pressure safeguard must be installed before the device. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
2. Do **not** put the device into operation without a pressure relief device.

The nominal width of the inlet line must be selected such that the flow velocity of 3...5 m/s is not exceeded.

The pressure must be checked by a manometer installed as close as possible to the inlet connection.

To avoid motor overload caused by an impermissibly high pressure, a pressure relief valve or a rupture disc with return to the supply tank must be installed as close as possible to the motor's pressure connection.

6.3.2 Output line

- Output and leak-oil line concept development must be carried out with extreme care since this will strongly influence the motor's performance.
- Select a sufficiently large output line and route it in a straight line.
- The recommended flow velocity in the output line should be max. 1.5 m/s.
- In version with an external leak-oil line, the permissible pressure in the output line can amount to up to 40 bar. In this case, the flow velocity in the output line can actually be higher.
- Additional line resistances such as formed parts, fittings and narrow-meshed filters increase the pipe resistance of the output line and must be avoided.
- The output pressure is the sum of all output-side resistances plus the fluid-specific data.

6.4 Motor adaptation

NOTICE

Clarify together with the motor manufacturer

Due to customised attachments on the motor, installation is not always unproblematic.

1. Since customised attachments are undertaken on the motor, together with the manufacturer be sure to clarify if the intended installation can be accomplished as planned.

6.5 Mechanical installation

NOTICE

Malfunction due to leaking lines and connections

Leaks can occure and air can be sucked if lines or connections are not tight. Suctioned air leads to a decrease of the delivery rate and foams up the medium.

1. Make sure all lines and connections are tight.

WARNING

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

- Before installation, the device must be checked for transport damage and soiling.
- Any preserving agents must be removed before installation using benzine or solvent.
- Clean the pipework of dirt, scale, sand, swarf, etc. prior to installation. Welded pipes in particularly must be pickled or flushed. Cotton waste must not be used for cleaning.

WARNING

Hazard caused by rotating parts!

Rotating parts can cause accidents with severe injuries or result in death due to body parts, hair or clothing getting caught or wrapped up.

1. Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
2. Do **not** operate the device without safeguards.

- Mount the motor to the motor support or foot and pay attention to careful alignment and correct fitting position (see chapter 4 “Technical data”).
- Remove the protective plugs in the unit's connections.

WARNING

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

WARNING

Danger due to exposed gears!

Gears can pull in and crush or cut off fingers and hands.

1. Do **not** reach into the gears.
2. Put the device into operation with connected lines only.

- Wet devices interiors with fluid being pumped.

DANGER

Danger due to breakage or squirting fluids!

Using unsuitable connections and lines can lead to breakage. Parts flying around uncontrolled or squirting fluids can lead to accidents with severe injuries or even lead to death.

1. Use only connections and lines approved for the expected pressure range.
2. The respective manufacturer's regulations must be heeded.

NOTICE

Danger of property damage due to distortion

The load on the device due to impermissible external loads can lead to malfunctions or to breakage of the flange or housing.

1. Pipelines must be fitted absolutely tension-free to the device connections.
2. Pipelines must be designed in such a way that no tension e.g. caused by changes in lenght due to fluctuations in temperature can be transferred to the device.

- Mount the lines on the inlet and output sides and, if applicable, on the leak-oil connection. Always heed the respective manufacturer's instructions while doing so.
- During installation, make sure that no sealing material gets into the interior of the pipeline. Sealing agents such as hemp and putty are not permitted since they lead to soiling and thus to functional problems.

DANGER

Danger due to breakage or squirting fluids!

If the device is blocked it acts like a closed gate. The pressure level that occure in this case can result in damage to the device and to up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. A pressure relief valve or other kind of over-pressure safeguard must be installed before the device. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
2. Do **not** put the device into operation without a pressure relief device.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scaled when touching the hot surfaces.

1. At medium temperatures above 60 °C, take measures against unintended contact.
2. Wear safety gloves.

NOTICE

Danger of malfunction through polluted medium

When filling the storage tank with the medium, impurities or small parts can get into the tank and cause damage or malfunctions on the device or in the system.

1. When filling the storage tank pay attention to the greatest possible cleanliness.

- Before opening, clean filler screw and shutoff on fluid transport and storage tank.
- Check media tank for contamination and clean if necessary. On no account remove the filter screen on the filler neck or the filter insert during the filling process.
- Filling the media tank with the prescribed fluid.
- Ensure sufficient filling of the media tank!

6.6 Assembly with further components and devices

NOTICE

Danger of property damage if installation is not correct

Incorrect assembly with components or devices from other manufacturers can lead to breakdowns.

1. Comply with each manufacturer's operating instructions when assembling with additional components or devices.

7 Operation start-up

7.1 Preparation

WARNING

Hazard caused by rotating parts!

Rotating parts can cause accidents with severe injuries or result in death due to body parts, hair or clothing getting caught or wrapped up.

1. Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
2. Do **not** operate the device without safeguards.

WARNING

Danger due to exposed gears!

Gears can pull in and crush or cut off fingers and hands.

1. Do **not** reach into the gears.
2. Put the device into operation with connected lines only.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scaled when touching the hot surfaces.

1. At medium temperatures above 60 °C, take measures against unintended contact.
2. Wear safety gloves.

NOTICE

Danger of property damage due to incorrect commissioning

Improper commissioning can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.
2. Comply with the permissible operating data such as rotational speed, pressure temperature, permissible media, etc. (see chapter 4 “Technical data”).
3. Pay attention to cleanliness during all work.
4. Before starting the system make sure that a sufficient quantity of the operating fluid is extant to avoid dry running.
5. The motor is only permitted to run in the the direction of rotation indicated by rotation direction arrow or the direction of rotation on the rating plate.
6. Fill the motor with the pressure fluid before commissioning the motor. The customer or operator must take functional leaks on the shaft seals into consideration.
7. Make sure that all lines and connections are tight and that no leakages can occur or air can be sucked.

- Check the permissible operating data against the operating states to be expected.
- Check all fastening screws on the device.
- Check the direction of rotation.

7.2 Further operation start-up

- The motor may only start without or with low pressure loads. For this purpose, open the existing shut-off elements and adjust the pressure relief valve incorporated in the pressure pipe to the lowest opening pressure.
- Start-up takes place by repeated quick on-off switching of the driving pump (jog mode) without reaching full speed until proper operation of the device is evident. This applies particularly when a cold motor is to start with already heated medium. The reason for this is to achieve slow heating of the motor and prevent the motor seizing through thermal shock.
- Proper function indicated by noise generation or on the pressure gage should be reached after max. 30 seconds.
- First of all, run the pump at zero pressure or low pressure for a couple of minutes after switching on the motor.
- Bleed the plant on the distribution pipes, preferably at the highest point.
- Pressure loading can be gradually increased up to the desired operating pressure (max. permissible pressures, see chapter 4 “Technical data”)

- Check the temperature of the medium and that of the unit after the intended operating characteristics have been reached. Checkpoints on the unit are the bearing locations, the housing and the shaft seal. The tempertures observed in the unit surface may be approx. 15 °C above medium temperature.
- Check the final operating temperature after several hours running time (see chapter 4 “Technical data” for max. permissible temperatures).
- Check the fluid level of the plant once more and top up if necessary.
- Check the final operating temperature after several hours running time (see chapter 4 “Technical data” for max. permissible temperatures).
- Check the static seals on the inlet and outlet port and the motor's joints for leakages.
- Check the threaded connections for leakages. Such leakages can be easily eliminated by simply retightening the threaded connections.
- Also check all fastening screws after a few hours of operation.

NOTICE

Danger due to surface temperature

The more measured surface temperature must not exceed by more than 15 °C above the inlet temperature of the media, since it may cause damage or malfunction to the device.

The volumetric efficiency in normal operation should be between 75...98 % to ensure optimum head disiaption. If this is not the case the system must be put out of operation immediately to prevent damage to the device.

1. Check the surface temperature, which occures in normal operation.
2. Check the volumetric efficiency, which occures in normal operation.

8 Removal

8.1 General points

NOTICE

Danger of property damage due to insufficiently qualified personnel

Improper work can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.

NOTICE

Danger of property damage due to a lack of cleanliness

A lack of cleanliness can lead to damages and malfunctions in the device and in the plant.

1. Pay attention to cleanliness during all work.
2. Close all openings with protective caps to prevent dirt from penetrating into the system.

8.2 Disassembling the motor

WARNING

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

WARNING

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scaled when touching the hot surfaces.

1. At medium temperatures above 48 °C, let the device cool off.
2. Wear safety gloves.

- Remove the depressurised pipelines from the motor.
- Seal the connections and pipelines to prevent dirt penetration.
- Disassemble the motor
- Pull off clutch hub resp. the driving pinion from shaft end using an extractor.

9 Maintenance

9.1 General points

NOTICE

Danger of property damage due to insufficiently qualified personnel

Improper work can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.

NOTICE

Danger of damages and malfunctions due to a lack of maintenance

If the device is not regularly maintained, damage that is not discovered or not repaired can lead to malfunctions and to the failure of the device.

1. Maintain the device regularly.
2. Check the device initially right after commissioning.
3. Adapt the extent and time between maintenance intervals to the demands posed by the location.
4. During visual inspections, look purposefully for possible damages.
5. The device must not be used if visible damages are found.
6. Document the type and extent of the maintenance work. That allows the fastest possible detection of a change in operating performance.

When designed to the conditions of use and fitted correctly, the devices are able to be used for long and problem-free operation. They only require a little maintenance. This is absolutely essential for problem-free operation, however. Experience shows that a high percentage of the problems and damage that occur can be traced back to dirt and lack of maintenance.

The extent and time intervals for inspections and maintenance are generally specified by the operator in a respective plan.

Barriers and instructions

1. All removed barrieres and warning signs must be put back to their original position on completing maintenance and/or repair.

Checking the operating data

1. Regular checking of all operating data such as pressure, temperature, current consumption, degree of filter soiling etc. contributes to early problem detection.

NOTICE

Danger of property damage due to a lack of cleanliness

A lack of cleanliness can lead to damages and malfunctions in the device and in the plant.

1. Pay attention to cleanliness during all work.
2. Close all openings with protective caps to prevent dirt from penetrating into the system.

NOTICE

Malfunction due to leaking lines and connections

Leaks can occure and air can be sucked if lines or connections are not tight. Suctioned air leads to a decrease of the delivery rate and foams up the medium.

1. Make sure all lines and connections are tight.

DANGER

Danger due to breakage or squirting fluids!

Using damaged connections and lines can cause parts to fly around uncontrolled or fluids to squirt out, wich can lead to accidents and severe injuries or even result in death.

1. Immediately replace damaged connections, pipes and hose lines.

WARNING

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

DANGER

Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressure can lead to damage to the device an to the up and/or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. **Never**allow positive displacement pumps to pump against "closed gates".
2. A pressure relief valve or other kind of over-pressure safeguard must be installed as close as possible to the pump pressure connection. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
3. Do **not** put the device into operation without a pressure relief device.

WARNING

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scaled when touching the hot surfaces.

1. At medium temperatures above 48 °C, let the device cool off.
2. Wear safety gloves.

9.2 Unusual noise

Some damage is indicated by unusual noises. If there is a change in the device's operating noise, a thorough examination of the cause must always take place.

9.3 Static seals

The static seals on the device's separation joints and the connection lines must be periodically checked for leakproofness.

If there are any visible leaks, immediately stop plant operation.

If the leaks cannot be stopped by simply retightening the connection, replace all affected seals.

9.4 Rotary shaft lip seal

Rotary shaft lip seals are particulary prone to wear for functional reasons and must accordingly be carfully checked. Excessively high supply pressure or negative suction pressure, wrong rotational direction or pollution leads to increased wear, increased and impermissible temperature rises.

Small amounts of leakage, however, are indispensable for function. The permissible amount of leakage, though, is highly dependet on the operational conditions and cannot be quantified.

If there are excessive amounts of leakage, stop device operation immediately. Replace the rotary shaft lip seal.

Increased wear on the rotary shaft lip seal should be taken into account in the case of vertical pump installation.

9.5 Screw joints

All the screw joints must be checked at regular intervals to make sure they are tight fit. Loose screw joints must be tightened and, if necessary, secured against loosening by e.g. Loctite (medium stregth).

9.6 Damage

Check the motor as well as its encironment regularly for damages such as dents in the clutch guard.

9.7 Surface temperature

For identifying premature wear or motor overload, it is useful to check the temperatures on the motor surface at regular intervals.

This temperature should never be much higher (max. 15 °C) than the media temperature at the unit inlet. Checkpoints on the unit are the bearing locations, the housing and the shaft seal.

If the measured temperatures are higher than the permissible values, this is an indication of wear or bearing damages. The unit must be replaced in this case.

9.8 Bearing, gear, wheel chamber housing

Like shaft seals, bearings, gear and wheel chamber housings are wear items. Wear largely depends on the occurring loads, life cycle as well as type and proportion of solids in the medium. Wear cannot be identified from the outside.

The condition of a motor, however, can be analysed by the volumetric efficiency factor. Decrease of the efficiency factor would normally indicate wear. Therefore, a check an all aperating data such as suction volume, pressure, temperature, drive data, dagree of filter contamination should also be carried out during maintenance work.

Further investigations into the cause are necessary in the event of major deviations (> 10 %) to the reference values. This helps detecting premature motor failure in time. The motor must immediately be taken out of service at a volumetric efficiency factor to < 70%. The achieved values at initial commissioning serve as reference in this case.

10 Repairs

10.1 General points

The term repairs covers:

- **Troubleshooting**, in other words establishing damage, determining and localising the reason of the damage.
- **Elimination of damage**, in other words eliminating the primary causes and replacing or repairing faulty components.

10.2 Troubleshooting

Leaks are the most frequent problem. If these occure on the pipelines, they can be eliminated by straightforward tightening of the screw joints.

If the device itself is leaking, the respective seals have to be replaced.

10.3 Elimination of damage

Repair damage onsite, predominantly by replacing the defective device. The device itself is generally repaired by the manufacturer.

10.4 Return

If the device has to be repaired or checked over the manufacturer's permises, ist must be packed suitably for transport. In addition, a safety data sheet for the medium used must be enclosed with the device. In case of well-known mineral oils, at least the exact type description is required.

If harding or agglutinative media are involved, the device must be cleaned befor it is returned.

Cleaning is also necessary of the device has been operated with hazardous fluids.

Any openings must be closed.

10.5 Disposal

Disposal of the packaging and used parts must be garried out according to the regulations valid in the country where the device is installed.

10.6 Detecting and eliminating problems

The following table lists the possible causes of the most frequently occuring malfunctions and notes on possible remedies.

If the problems cannot be identified, please request help from the manufacturer.

Fault	Potential causes	
Increased noise	due to cavitation	• Air in the oil, check the supply pump and setup • Inner diameter of pressure line too small
	due to mechanical vibrations	• Incorrectly aligned or loose clutch • Faulty or insufficient line fastening • Wobbling pressure relief valve • No noise-optimized design (missing dampers) • Unfavourable motor installation location • Motor worn out, tooth flanks used up
Motor does not start		• Wrong direction of rotation • Throttled shut-off element on the supply or discharge side • Foreign objects in supply line
Speed too low		• Throttled shut-off element on the supply or discharge side • Too low viscosity • Volumetric flow too low • Incorrect design (see data sheets) • Pressure relief valve set too low • Motor worn out, tooth flanks used up
Excessive operating temperature		• Cooling and heat dissipation insufficient • Supply of fluid too low • Fluid is being delivered into the supply tank via pressure relief valve under load
Impermissible motor heat		• Pressure on shaft seal too high • Delivery output torque too high • Too high viscosity • Motor worn out, tooth flanks used up
Leakages on shaft seal		• Output or leak-oil pressure impermissibly high • Wrong direction of rotation • Too high radial shaft loading • Sealing wear due to poorly lubricating medium • Temperature at sealing point too high • Wrong seal material

Fault	Potential causes	
Clutch wear		● Incorrectly aligned or loose clutch ● Axial clutch clearance insufficient ● Clutch overloaded ● Temperature too high