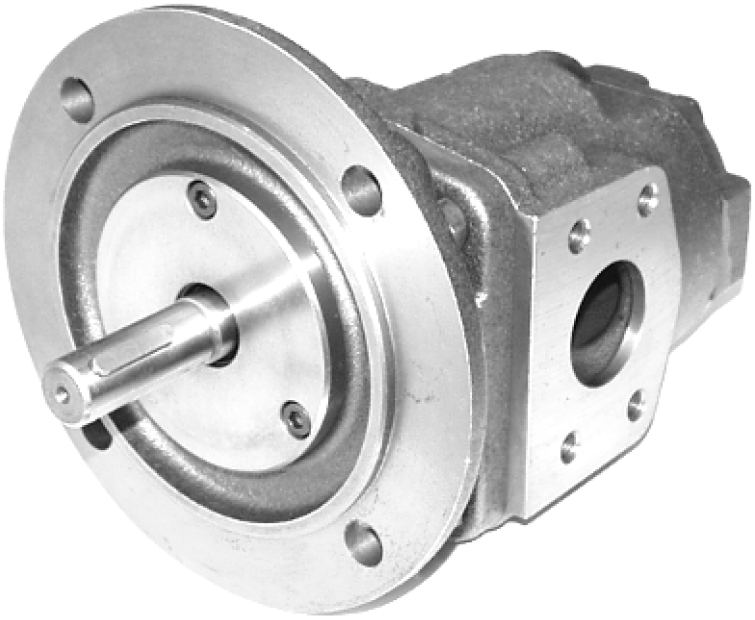
Operation instructions

BKF0097EN



Transfer Gear Pumps KF 3/63...KF 6/730

BKF0097EN_D0024860002-05

Englisch

2011-09-06

KRACHT

Table of Content

1 General points

1.1 About the documentation

These operating instructions describe the installation, operation and maintenance of the transfer gear pump **KF 3/63...KF 6/630**, 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 a pump for continuous delivery of liquids. 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 illegible or irrecognisable.

In cases of noncompliance, all warranty claims 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 Staff qualification and training

The staff designated to install, operate and maintenance the device must be properly qualified. This can be through training or specific instruction. Staff must be familiar with the contents of this operating manual.

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 prevention and health and safety at work must be observed, as well as internal regulations laid down by the operator, even if these are not specifically mentioned in this manual.
The operator must ensure that this operating manual is accessible to the staff responsible at all times.

2.4 Hazard statements

DANGER

Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressures can lead to damage to the device and to the 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.

- **Never** allow positive displacement pumps to pump against "closed gates".
- 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 the entire delivery volume can be conducted through it with the lowest possible pressure or must be depressurized.
- 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.

- Use only connections and lines approved for the expected pressure range.
- Comply with each manufacturer's regulations.

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, which can lead to accidents and severe injuries or even result in death.

- 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 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.

- Always pay attention to the correct direction of rotation when installing the pumps.
- Always pay attention to the correct direction of rotation when connecting the motors.
- Secure the fitting keys against flying off when monitoring the direction of rotation.

DANGER

Danger due to electric voltage!

Danger of death due to electric shock.

- Follow the special safety regulations during all work on electrical installations.
- Only allow electricians to work on electrical systems.

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 restult in death..

- Depressurize all connections lines during all work on the device.
- Depressurize or disconnect the driving motor during all work on the device.
- Securely prevent the motor and device from restarting during work.
- 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.

- Comply with the safety data sheets and regulations on handling the hazardous liquids!
- Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
- Comply with national and international rules at the place of installation.
- 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.

- Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
- Close any maintenance openings when using bell housings.
- 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.

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

WARNING

Danger due to falling loads and or loads falling over!

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

- Compliance with applicable industrial safety requirements is mandatory.
- Use only suitable means of conveyance and lifting tackle with sufficient load-bearing capacity.
- Attach lifting tackle only to suitable points (see table 5.1 and table 5.2).
- Attach the lifting tackle in such a manner that it cannot slip.
- The device's centre of gravity must lie between the lifting tackle mounting points on the device.
- Secure the device so that toppling over and falling down is impossible.
- Always avoid jerks, impacts and strong vibrations during transportation.
- Never walk under suspended loads, never work under suspended loads.
- To prevent damage to the device, be extremely cautious when shipping or transporting.
- 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 scalded when touching the hot surfaces.

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

CAUTION

Danger due to hot surfaces!

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

- Let the device cool off first when the medium temperature is over 48 °C.
- Wear safety gloves.

3 Device description

3.1 General points

KF series pumps are external gear pump types that work according to the positive displacement principle.

When rotated, two gears being engaged with each other cause volume expansion by opening the tooth gaps in the pump inlet (suction side) so that the medium can enter while a corresponding volume is being displaced in the pump outlet (pressure side) through engagement of the teeth into the filled tooth gap. Fluid transport takes place through entrainment in the tooth gaps along the wall of the wheel chamber. The so-called geometric flow rate V_g is being displaced per wheel rotation. A value that is stated in technical documents as rated volume V_{gn} to specify the pump size.

The actually delivered amount of liquid does not correspond with the theoretical value, it is being reduced through losses due to the necessary tolerances. The losses are less the lower the operating pressure and the higher the viscosity.

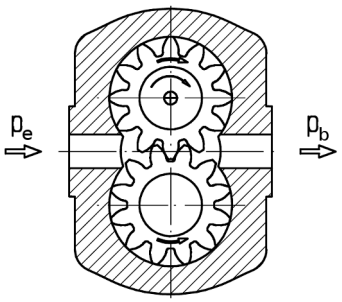
Gear pumps are self-priming within wide limits. The displacement cycle describe initially takes place without exhibiting appreciable pressure build-up. Only after setting external loads, for example, through delivery head, outlet resistances, line elements, etc. the required working pressure will arise to overcome these resistances.

As usual with so-called rigid pumps, i.e. non-axial play compensated pumps, the lateral clearance between gear and front face has been set in such a way that the maximum allowable operating pressure is managed in an adequate and secure way.

The medium lubricates the pump's friction bearings and shaft seal. The pump's operating life will be reduced if the medium contains abrasive ingredients.

The shaft sealing pocket is connected to the pump's suction side. Therefore, the max. permissible suction-side pressure is dependent on the type of seal.

Tab. 3.1: Functional principle external gear pumps

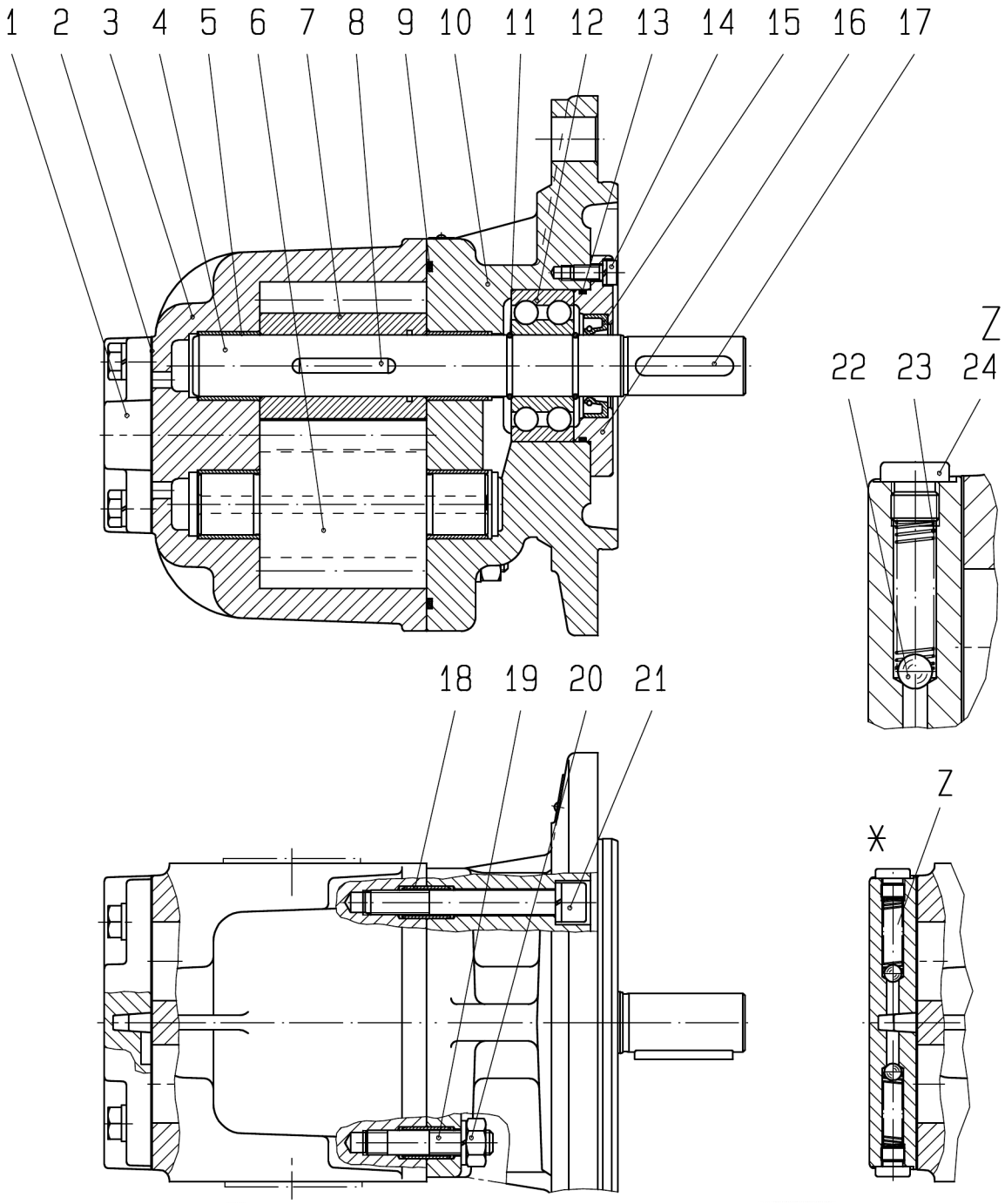


p_e = Suction side
p_b = Pressure side

3.2 Basic construction

3.2.1 KF 3/63...KF 6/730 (with end cover)

Tab. 3.2: Basic construction KF 3/63...KF 6/730



* Direction of rotation "3" (Right and left)

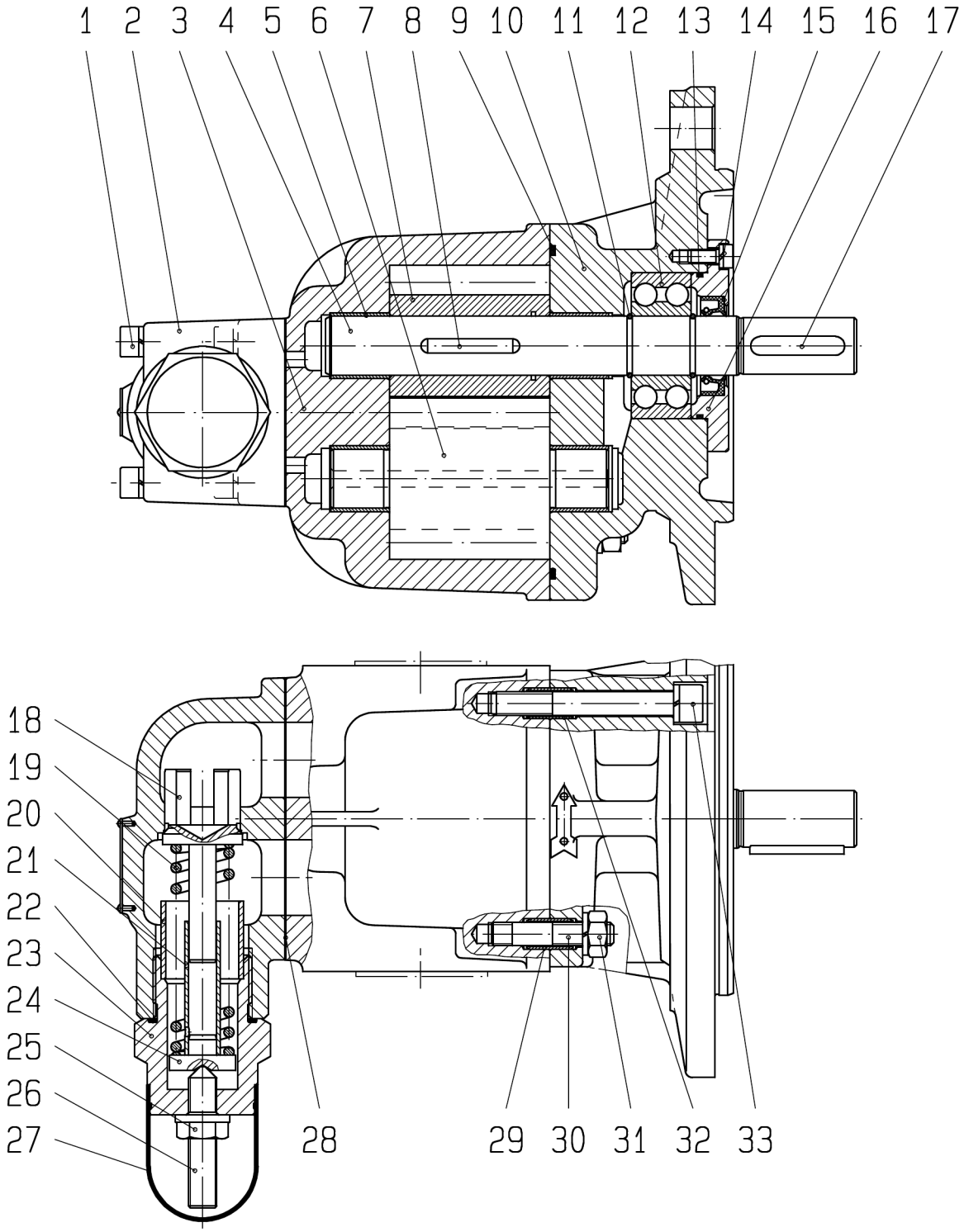
Tab. 3.3: Basic construction KF 3/63...KF 6/730

Description	
1. Cover	13. O-Ring
2. Gasket	14. Socket head cap screw
3. Housing	15. Rotary shaft lip seal
4. Shaft	16. Seal retainer
5. Plain bearing bush	17. Parallel key
6. Driven shaft	18. Centering sleeve
7. Gear	19. Stud
8. Parallel key	20. Hexagonal nut
9. O-Ring	21. Socket head cap screw
10. Flange cover	22. Ball
11. Retaining ring	23. Compression spring
12. Roller bearing	24. Screw plug

See section 3.3 “Type of seals” for further seal types.

3.2.2 KF 3/63...KF 6/730 + DKF ... (with pressure relief valve)

Tab. 3.4: Baisc construction KF 3/63...KF 6/730 + DKF ...



Tab. 3.5: Basic construction KF 3/63...KF 6/730 + DKF ...

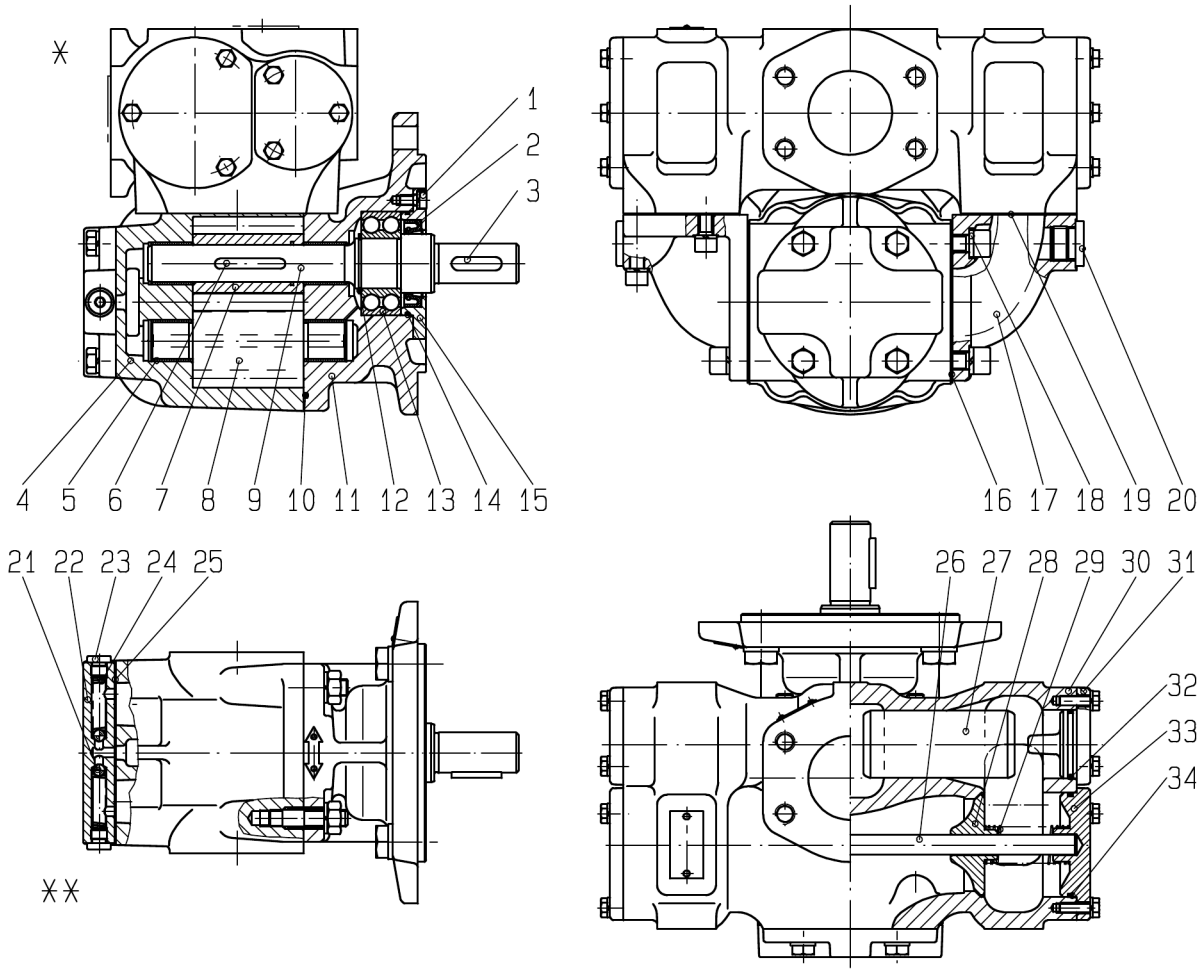
Description

1. Socket head cap screw
2. Valve cover
3. Housing
4. Shaft
5. Plain bearing bush
6. Driven shaft
7. Gear
8. Parallel key
9. O-Ring
10. Flange cover
11. Retaining ring
12. Roller bearing
13. O-Ring
14. Socket head cap screw
15. Rotary shaft lip seal
16. Seal retainer
17. Parallel key
18. Valve cone
19. Compression spring
20. Distance tube
21. Guide sleeve
22. O-Ring
23. Cap screw
24. Spring guide
25. Hexagonal nut
26. Set screw
27. Protection cap
28. Gasket
29. Centering sleeve
30. Stud
31. Hexagonal nut
32. Centering sleeve
33. Socket head cap screw

See section 3.3 “Type of seals” for further seal types.

3.2.3 KF 3/63...KF 6/730 + KF . U .. (with universal valve)

Tab. 3.6: Basic construction KF 3/63...KF 6/730 + KF . U ..



* View without connection elbow
** View without universal device

Tab. 3.7: Basic construction KF 3/63...KF 6/730 + KF . U ..

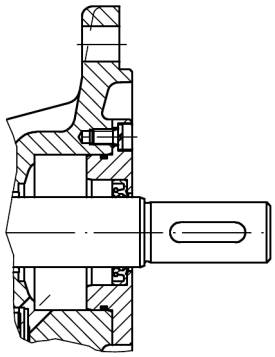
Description

1. Socket head cap screw
2. Rotary shaft lip seal
3. Parallel key
4. Housing
5. Plain bearing bush
6. Parallel key
7. Gear
8. Driven shaft
9. Shaft
10. O-Ring
11. Flange cover
12. Retaining ring
13. Roller bearing
14. O-Ring
15. Seal retainer
16. Gasket
17. Connection elbow
18. Usit-Ring
19. Gasket
20. Screw plug
21. Ball
22. Cover
23. Screw plug
24. Compression spring
25. Gasket
26. Rod
27. Piston
28. Valve cone
29. Compression spring
30. Valve housing
31. Cover
32. O-Ring
33. Cover
34. O-Ring

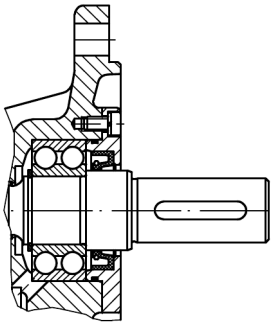
See section 3.3 “Type of seals” for further seal types.

3.3 Type of seals

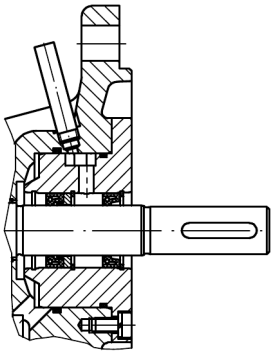
Tab. 3.8: Types of seals KF 3/63...KF 6/730



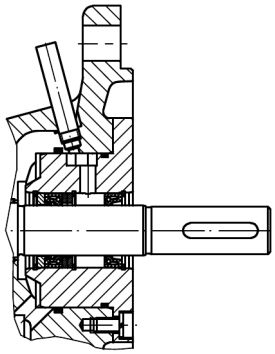
Pump with single rotary shaft lip seal
Sealing materials:
1: NBR
2: FKM
32: PTFE
37: FKM (low temperature, only KF 3/. P..)



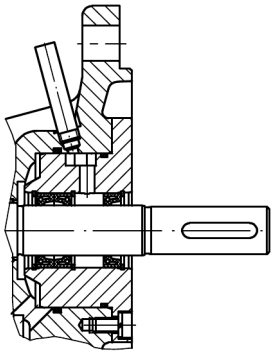
Pump with single rotary shaft lip seal and outboard bearing
Sealing materials:
1: NBR
2: FKM
32: PTFE



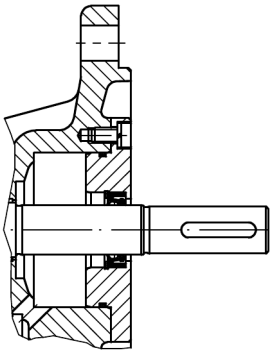
Pump with double rotary shaft lip seal and connection pipe 8x1 for liquid seal (quench)
Special number: 44, 261
Sealing materials:
1: NBR
2: FKM
32: PTFE



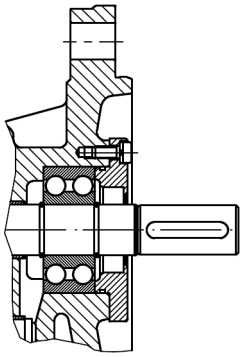
Pump with double rotary shaft lip seal for vacuum operation with connection pipe 8x1 for liquid seal (quench)
Special number: 74, 309
Sealing materials:
1: NBR
2: FKM



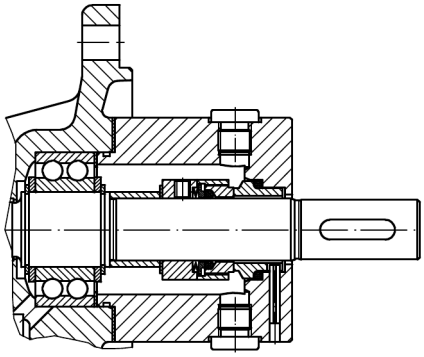
Pump with triple rotary shaft lip seal for vacuum and normal operation with connection pipe 8x1 for liquid seal (quench)
Special number: 94
Special number: 94
1: NBR
2: FKM



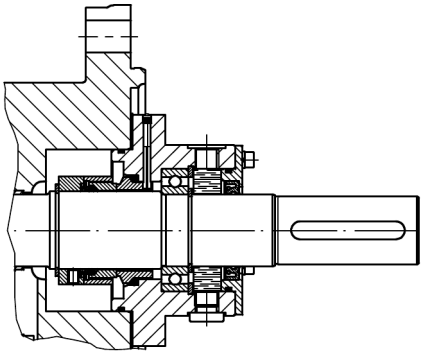
Pump with single rotary shaft lip seal for vacuum operation
Special number: 191
Sealing materials:
1: NBR
2: FKM



Pump with outboard bearing without shaft seal
Special number: 196
Sealing materials:
1: NBR
2: FKM



Pump with mechanical seal and outboard bearing
Sealing materials:
29: FKM
30: PTFE / FEP



Pump with mechanical seal and connection borehole G 1/4 for liquid seal (quench)
Sealing materials:
39: FKM
40: PTFE / FEP

3.4 Type key

Tab. 3.9: Ordering example KF 3/63...KF 6/730

KF 3/	63		F	1	0	B		P	0	0		7	D	P	2	/44	+	DKF 3	D	04
1.	2.		3.	4.	5.	6.		7.	8.	9.		10.	11.	12.	13.	14.		15.	16.	17.
																	+	KF 4 U 04		
																		18.		

Tab. 3.10: Explanation of type key KF 3/63...KF 6/730

Explanation of type key KF 3/63...KF 6/730				
1.	**Production name**			
2.	**Nominal size**			
	Vg	**KF 3:** 63, 80, 100, 112 cm^3 **KF 4:** 125, 150, 180 cm^3 **KF 5:** 200, 250, 315 cm^3 **KF 6:** 400, 500, 630, 730 cm^3		
3.	**Flange mounting cover**			
	F	KF 3	**H**	KF 5 / KF 6
	G	KF 4		
4.	**Direction of rotation**			
	1	Right	**3**	Right and left
	2	Left		
5.	**Mounting equipment**			
	X	Mounting angle	**0**	Without mounting flange
6.	**Construction of housing**			
	B	Housing with flange connection		
7.	**Shaft end**			
	P	Cylindrical shaft end without outboard bearing		
	N	Cylindrical shaft end with outboard bearing		
	M	Cylindrical shaft end without outboard bearing (reinforced)		
	R	Cylindrical shaft end with outboard bearing (reinforced), shaft end shortened		
8.	**2. shaft end**			
	0	Without 2. shaft end		
9.	**End cover**			
	A	For direction of rotation 1 or 2	**0**	Without end cover (for valve fitting)
	B	For direction of rotation 3		
10.	**Design serial number** (specified by manufacturer)			

Explanation of type key KF 3/63...KF 6/730				
11.	**Housing material and plain bearing**			
	D	EN-GJL-250 (GG-25) with DU / P10-bearing bushings	**V**	EN-GJS-400-15 (GGG-40) with DU / P10-bearing bushings
12.	**Type of gear**			
	P	Helical gear		
13.	**Seal**			
	1	Single rotary shaft lip seal NBR	**32**	Single rotary shaft lip seal PTFE
	2	Single rotary shaft lip seal FKM	**37**	Single rotary shaft lip seal FKM (low temperature only KF 3/. P..)
	29	Mechanical seal with FKM secondary seal	**39**	Mechanical seal with FKM secondary seal and connection for liquid (quench)
	30	Mechanical seal with PTFE secondary seal	**40**	Mechanical seal with PTFE secondary seal and connection for liquid (quench)
14.	**Special number for specific types**			
		See section 3.5 “Important special numbers”		
15.	**Size DKF**			
		DKF 3, DKF 4, DKF 5, DKF 6 = Size KF		
16.	**Housing material and seal DKF**			
	A	Housing EN-GJL-250, sealing NBR	**G**	Housing EN-GJS-400-15, sealing NBR
	C	Housing EN-GJL-250, sealing copper	**L**	Housing EN-GJS 400-15, sealing FKM
	D	Housing EN-GJL-250, sealing FKM		
17.	**Pressure setting ranges**			
	04	2 ... 4 bar	**16**	8 ... 16 bar
	08	4 ... 8 bar	**25**	16 ... 25 bar
18.	**Universal valve**			
	KF 3	KF 4 U 04	**KF 5/250**	KF 5 U 07
	KF 4	KF 4 U 05	**KF 5/315**	KF 5 U 07
	KF 5/200	KF 5 U 06	**KF 6**	KF 6 U 08

3.5 Important special numbers

Tab. 3.11: Important special numbers KF 3/63...KF 6/730

Special number	Description
44	Pump with double rotary shaft lip seal for liquid seal (quench), sealing effect of the radial shaft seals on the product side
74	Pump with double rotary shaft lip seal for vacuum operation and connection for liquid seal (quench), inner rotary shaft lip seal mounted with sealing lip towards shaft end
94	Pump with triple rotary shaft lip seal for vacuum and normal operation with connection for liquid seal (quench)
191	Pump with rotary shaft lip seal for vacuum operation, sealing lip mounted on shaft end, noise-optimized version for aerated oils and vacuum
196	Pump without shaft seal, noise-optimized version for aerated oils and vacuum, external leak oil drainage
197	Noise-optimized version for aerated oils and vacuum
261	Pump with double rotary shaft lip seal and connection for liquid seal (quench), noise-optimized version for aerated oils and vacuum
304	Bearing bushings Iglidur® X, Δp_{max} = 10 bar
309	Pump with double rotary shaft lip seal for vacuum operation and connection for liquid seal (quench), inner rotary shaft lip seal mounted with sealing lip towards shaft end, noise-optimized version for aerated oils and vacuum
317	Noise-optimized version for aerated oils and vacuum, bearing bushings Iglidur® X, Δp_{max} = 10 bar
332	Version for low-viscous media (only in connection with material GJS), bearing bushings Iglidur® X, v_{min} = 4 mm²/s at Δp_{max} = 10 bar
353	Noise-optimized version for aerated oils and vacuum, bearing bushings DP4 (leadfree)

Particularities in noise-optimized pumps

- Air trapped in the medium or too high negative pressure can result in delivery rate reduction for pumps in noise-optimized version.
- Measures for noise optimisation are only feasible for one rotational direction and only effective for aerated oils or vacuum.

4 Technical data

4.1 General characteristics

Tab. 4.1: General characteristics KF 3/63...KF 6/730

General characteristics KF 3/63...KF 6/730			
Construction		External gear pump	
Material		See section 4.4 “Overview materials”	
Fixing type		Flange mounting, mounting angle	
End of drive shaft		See "Technical data sheets"	
Pipe connection		Flange connection, threades connection, welding connection (see "Technical data sheets")	
Installtion position		KF 3/63...KF 6/730 without quench	Arbitrary*
		KF 3/63...KF 6/730 with quench	Horizontal, quenching connection on top
		KF 3/63...KF 6/730 + KF . U ..	Horizontal, pressure connection on top
Viscosity	v_{min} v_{max}	12 mm^2/s** 15000 mm^2/s	
Ambient temperature	$\vartheta_{u\ min}$ $\vartheta_{u\ max}$	-20°C 60°C	
Speed n		See section 4.2 “Overview of nominal sizes”	
Fluid temperature ϑ		See section 4.5 “Operating pressure and fluid temperature”	
Operating pressure p_e and p_b			
Filtering		Filter porosity ≤ 60 µm	
Permissible media		Fluids without abrasive components which are compatible with the pump materials used. The fluids must guarantee minimum lubrication. Media-specific characteristics must be taken into account. Petrols, solvents, etc. are **not** permissible.	

** A reduced service life must be expected for the shaft seal when vertically installed.*
*** Lower viscosities only in connection with GJS housings and reduced pressures (consult manufacturer).*

4.2 Overview of nominal sizes

Tab. 4.2: Overview of nominal sizes KF 3/63...KF 6/730

Nominal size*	Geom. delivery volume V_g cm³	Speed		Permissible radial force** F_{radial} N (n=1450 rpm)	Permissible axial force** F_{axial} N (n=1450 rpm)	Sound level**** L_{pA} db(A)	Weights kg		
		n_{min} rpm	n_{max} rpm				with cover	with DKF-valve	with universal device
3/63	63,8	200	2000	1500	200	≤ 75	12 13,5***	13,5 15***	32 33,5***
3/80	81,3					≤ 76			
3/100	100,8					≤ 76	13,5 15***	15 16,5***	34 35,5***
3/112	112,6					≤ 77			
4/125	129	200	2000	1500	200	≤ 78	18,5 20***	20 21,5***	39 40,5***
4/150	153					≤ 79	20 21,5***	21,5 23***	40 41,5***
4/180	184					≤ 80	21 22,5***	21,5 24***	41 42,5***
5/200	204	200	2000	2000	300	≤ 81	28 30***	30 32***	80 82***
5/250	255					≤ 82	33 35***	35 37***	85 87***
5/315	321					≤ 82	33 35***	35 37***	85 87***
6/400	405	200	2000	3000	500	≤ 82	51 54***	59 62***	103 106***
6/500	505					≤ 83	55 58***	63 66***	107 110***
6/630	629					≤ 84	65 68***	73 76***	117 120***
6/730	730		1500			-	65 68***	73 76***	117 120***

** See type key and type designation at pump: KF ...*
*** Permissible forces only at version with outboard bearing. F_{radial} on central shaft end.*
**** Valid for pump with mechanical seal.*
***** n=1500 rpm, HLP 46, v=12 / 34 / 85 mm²/s, p=5 bar...p_b*

4.3 Permissible speed

Tab. 4.3: Permissible speed depending on the viscosity

Kinematic viscosity v in mm^2/s									
< 300	300	500	1000	2000	3000	6000	10000	20000	30000
≥ 1450	1250	1000	750	600	500	400	300	200	100
Speed n_{max} in rpm									

4.4 Overview materials

Tab. 4.4: Materials KF 3/63...KF 6/730

Seal type*	Housing / Cover	Gear	Bearing	Shaft seal	Other seals
1	EN-GJL-250 (GG-25) EN-GJS-400-15** (GGG-40)	Carburising steel (1.7139)	DU, P10 (Steel, sintered bronze, PTFE, Pb) Iglidur G/X DP4 (Steel, sintered bronze, PTFE)	NBR	NBR, C4400
2				FKM	FKM, C4400
29				Cr-casting, Carbon antimon impregnated, FKM, 1.4571	FKM, C4400
30				Cr-casting, Carbon antimon impregnated, PTFE, 1.4571	FEP, C4400, Cu
32				PTFE	FEP, C4400, Cu
37				FKM (low temperature)	FKM (low temperature)
39				Cr-casting, Carbon antimon impregnated, FKM, 1.4571	FKM, C4400
40				SiC/SiC, PTFE, 1.4571	FEP, C4400, Cu

** See type key and type designation at pump: KF ...*
*** For version in EN-GJS-400-15 type designation: KF ... .VP.*

4.5 Operating pressure and fluid temperature

Tab. 4.5: Operating pressure suction side and fluid temperature KF 3/63...KF 6/730

Seal type*	Operating pressure				Fluid temperature	
	Suction side		Pressure side		ϑ_{min} °C	ϑ_{max} °C
	$p_{e\,min}$ bar abs.**	$p_{e\,max}$ bar	p_b bar	$p_{b\,max}$ bar		
1	0,6***	1	See table 4.6		-10	90
2						150
29		10				150
30						200
32		0,5				200
37					-30	150
39		10			-10	150
40						200
1/74	0,1	0,2				90
2/74						150
1/94						90
2/94						150
1/191						90
2/191						150
1/196	0,6***	like operating presssure at press-uer side				90
2/196						150
1/309	0,1	0,2				90
2/309						150

** See type key and type designation at pump: KF ...*
*** Heed restriction of $p_{e\,min}$ for universal design (KF ... U) (see table 4.7).*
**** Temporary during starting state: 0,4 bar absolute*

Tab. 4.6: Operating pressure at pressure side KF 3/63...KF 6/730

Nominal size*	Operating pressure at pressure side	
	p_b bar (perm. coninous pressure)	$p_{b\ max}$ bar (pressure peak)
3/63	25	50
3/80		40
3/100		30
3/112		25
4/125	25	40
4/150		30
4/180		25
5/200	25	30
5/250	20	25
5/315	16	20
6/400	25	30
6/500	20	25
6/630	16	20
6/730	14	16
** See type key and type designation at pump: KF ...*		

Tab. 4.7: Operating pressure suction side for universal device (KF ... U)

Nominal size*	Permissible operating pressure p_e at pump suction connection	
	$p_{e\ min}$ bar abs.	$p_{e\ max}$ bar
3/63	0,64	See table 4.5
3/80		
3/100		
3/112	0,65	
4/125	0,66	
4/150	0,67	
4/180	0,68	
5/200	0,62	
5/250	0,63	
5/315	0,64	
6/400	0,63	
6/500	0,64	
6/630	0,67	
6/730	-	
** See type key and type designation at pump: KF ...*		

NOTICE

Danger of property damage due to overload

Overloads in pumps with Iglidur® X bearings can cause the bearings to wear prematurely.

- **Never** exceed the max. permissible Δp = 10 bar.

NOTICE

Danger of property damage when simultaneously utilizing multiple operating limits

When simultaneously utilizing multiple operating limits (see chapter 4 "Technical data"), the pump could become damaged or prematurely wear.

- Do not use minimum and maximum parameters at the same time.

  For example, maximum operating pressure ist not permissible in connection with low speed and/or low viscosity.

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.

- Comply with the media-specific attributes.
- 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.
- 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.

4.6 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

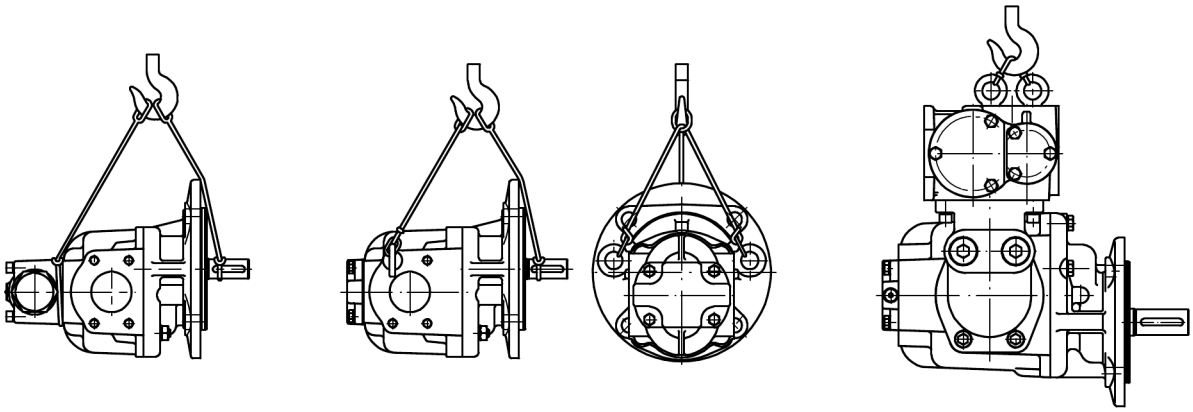
Danger due to falling loads and or loads falling over!
Due to the size and weight of the unit, accidents can occur resulting in severe injuries or death during transport and shipping.

- Compliance with applicable industrial safety requirements is mandatory.
- Use only suitable means of conveyance and lifting tackle with sufficient load-bearing capacity.
- Attach lifting tackle only to suitable points (see table 5.1 and table 5.2).
- Attach the lifting tackle in such a manner that it cannot slip.
- The device's centre of gravity must lie between the lifting tackle mounting points on the device.
- Secure the device so that toppling over and falling down is impossible.
- Always avoid jerks, impacts and strong vibrations during transportation.
- Never walk under suspended loads, never work under suspended loads.
- To prevent damage to the device, be extremely cautious when shipping or transporting.
- Wear suitable protective clothing.

Handling aid

- When transporting individuals devices, the eyebolts can be screwed into the connectiing flange as a handling aid.

Tab. 5.1: Examples for safe transport of pumps



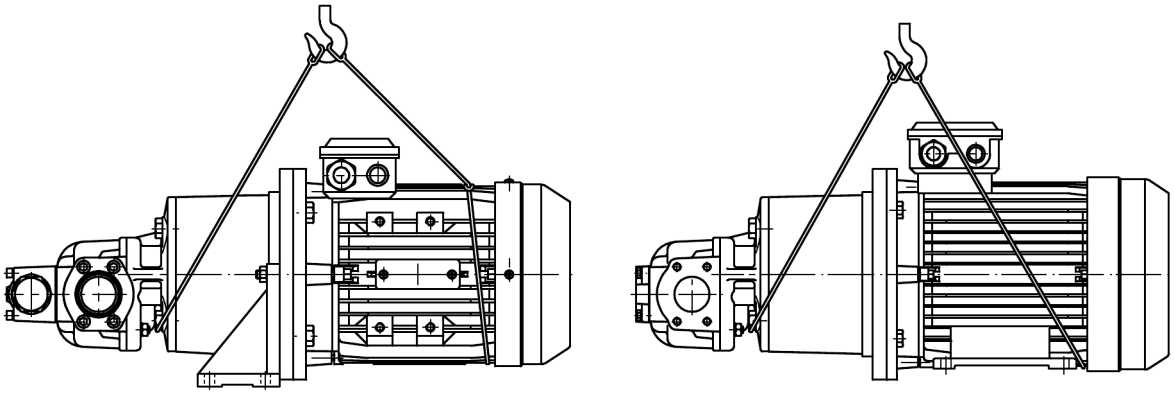
WARNING

Hazard from falling and tipping loads

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

- For pump devices: do **not** use eyelets on the motor to transport the pump devices. They can only support the weight of the motor.

Tab. 5.2: Examples for safe transport of pump units



5.3 Corrosion protection

The device's function is tested in the plant with mineral hydraulic oil. Then all connections are closed. The remaining residual oil protects the interior parts for about 6 months.

Clean bare outer metal parts have also been protected by anti-corrosive oil or protective metal paint for a period of 6 months against corrosion.

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

Corrosion damage on units with EPDM seals

The functionality of units with EPDM seals is not tested. There is no preservation of the interior parts. If the unit is not put into operation immediately, corrosion damage can occur.

- Protect the unit by using suitable corrosion-preventing measures.

NOTICE

Chemical impact on the device and the sealing materials

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

- Check to make sure the preservation agent is compatible with the materials and elastomers used in the device.
- 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 restult in death..

- Depressurize all connections lines during all work on the device.
- Depressurize or disconnect the driving motor during all work on the device.
- Securely prevent the motor and device from restarting during work.
- 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.

- 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.

- Pay attention to cleanliness during all work.

6.2 Noise reduction

Measures for sound optimizing

- In view of optimising noise protection, it is advisable to mount a bell-housing with vibration damper between pump and motor as well as vibration damper between motor and mounting surface. Suction and pressure piping must be able to move freely or it needs to be elastically suspended.
- Installation of suction and pressure hoses diminishes the noise level of hydraulic systems. Some hose manufacturers offer special, highly flexible suciton hoses for this purpose.
- Installation of the pump above the liquid level diminished the noise level of hydraulic systems. The pressure p_e on the pump's intake should be approx. 0.8...0.9 bar absolute.

6.3 Definition of the direction of rotation and pumping flow

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 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.

- Always pay attention to the correct direction of rotation when installing the pumps.
- Always pay attention to the correct direction of rotation when connecting the motors.
- Secure the fitting keys against flying off when monitoring the direction of rotation.

6.3.1 KF 3/63...KF 6/730 (with end cover or pressure relief valve)

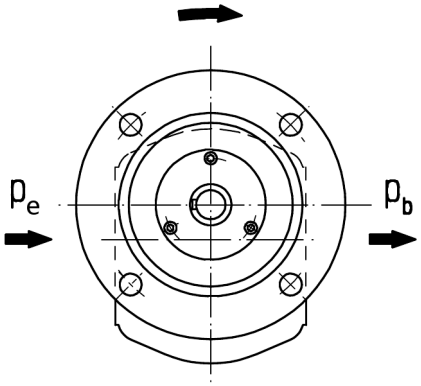
Tab. 6.1: Rotation and delivery direction KF 3/63...KF 6/730

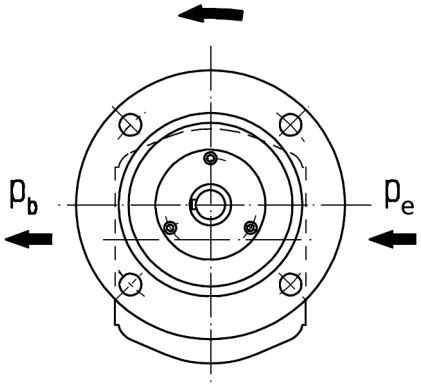
The following definition shall apply with respect to the rotation and delivery direction of external gear pumps in case of pump connections being positioned below the drive shaft:

Looking at the pump shaft end, the pumping flow is from left to right when the shaft is moving **clockwise**.

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

Without pressure relief valve

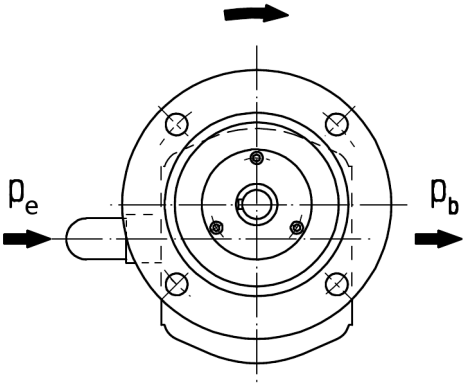


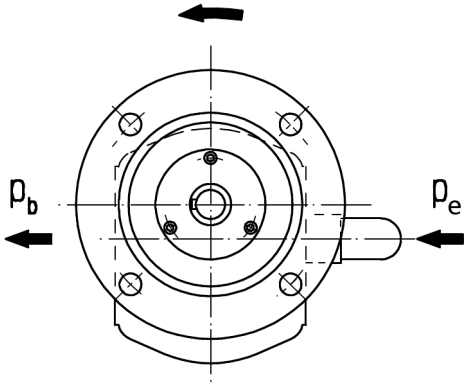


p_e = suction connection

p_b = pressure connection

With pressure relief valve





p_e = suction connection

p_b = pressure connection

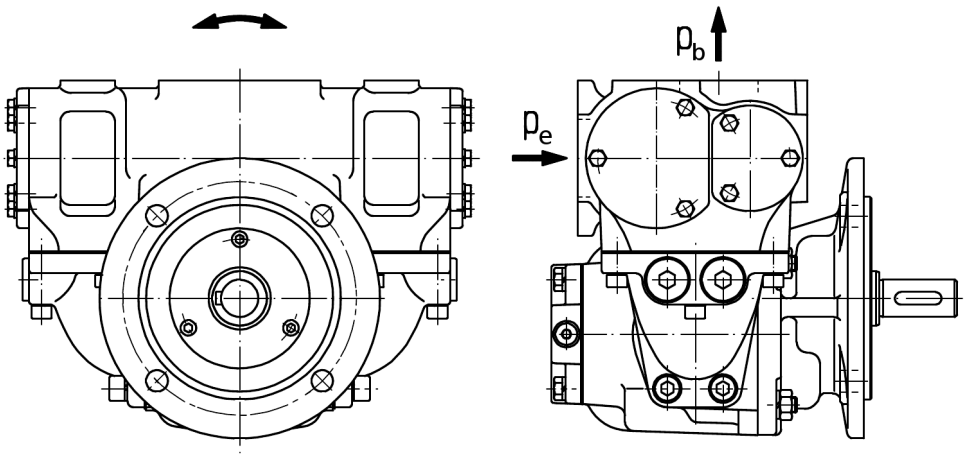
6.3.2 KF 3/63...KF 6/730 + KF . U .. (with universal valve)

Tab. 6.2: Rotation and delivery direction KF 3/63...KF 6/730 + KF . U ..

With ragard to the direction of rotation and pumping flow of pumps **KF 3/63...KF 6/730 + KF . U ...** the following definition shall apply then locking at the pump shaft end:

Direction of rotation right **and** left

Direction of discharge **consistent**



p_e = suction connection

p_b = pressure connection

6.4 Change of the direction of rotation

Change of the direction of rotation in the case of **KF 3/63...KF 6/730** with the direction of rotation code 1 or 2, i.e. pure clockwise or counterclockwise rotating pumps, is only possible by converting the pump.

The manufacturer normally carries out the conversion work and the customer should do this only in case of an emergency.

It is not possible to change the direction of rotation in pump types **KF 3/63...KF 6/730**. The device must be replaced.

Guarantee and manufacturer responsibility

- All warranty claims and manufacturer responsibility shall be void when improper conversation work takes place.

NOTICE

Danger of property damage due to incorrect installation

Improper retrofitting can lead to damages and malfunctions in the unit and in the plant.

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

NOTICE

Danger of leaks on the unit

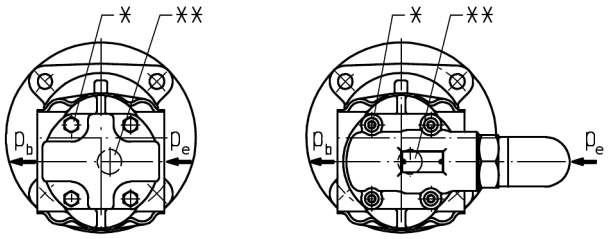
When altering the unit, seals that are removed, damaged or jammed can lead to leaks during operation.

- Do **not** remove, damage or jam seals.

6.4.1 Change of direction of rotation of pumps in standard version

This description does not apply to pumps in noise-optimized version for aeriferous oils and vacuum. Their conversion is described in section 6.4.2 “Change of the direction of rotation of pumps in noise-optimized version”.

Tab. 6.3: Change of the direction of rotation of KF 3/63...KF 6/730 direction of rotation code 1 or 2, standard version



p_e = suction connection
p_b = pressure connection

* = Fastening screws
** = Leak oil hole

In case of a pump´s change of the direction of rotation the cover and/or pressure relief valve must be rotated through 180°.

- Loose fastening screws.
- Remove the cover or the pressure relief valve respectively from the pump housing and put it back on rotated by 180°.
- Tighten all fastening screws applying the below mentioned tightening torques (see table 6.4).

When checking, pay attention to the following points:

- Pumps without pressure relief valve must have their leak oil hole on the interior cover side at the pump's suction side.
- Pumps with pressure relief valve must have their pressure relief valve adjusting screw point toward the pump´s suction side.

Tab. 6.4: Tightening torques for cover and valve fastening screws

Nominal size*	KF 3/...	KF 4/...	KF 5/...	KF 6/...
Tightening torque	20 $^{+5}$ Nm	20 $^{+5}$ Nm	45 $^{+5}$ Nm	45 $^{+5}$ Nm
** See type key and type designation at pump: KF ...*				

6.4.2 Change of the direction of rotation of pumps in noise-optimized version

NOTICE

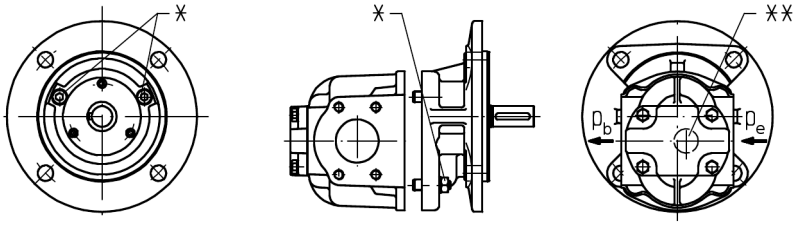
Danger of damage to the unit

The housing and flange cover are fixated to each other with centring bushings. If the bearings are damaged when assembling or dismantling the housing, e.g. by bending out of line, there could be malfunctions and a decrease of the service life. Furthermore, the seal faces on the housing and flange cover could be damaged. That can lead to leaks during operation.

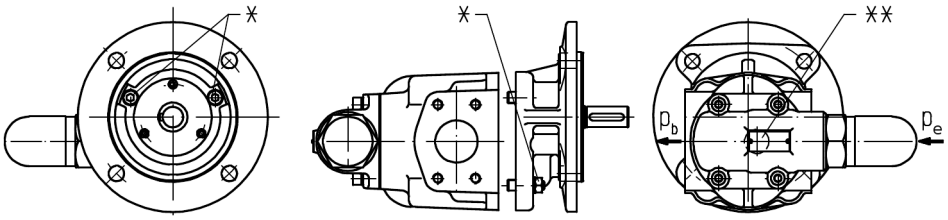
- When mounting and dismantling the housing, do **not** damage the housing, e.g. by bending out of line.
- When dismantling the housing, do **not** lever in the joint with a screwdriver or similar tools.

Tab. 6.5: Change of the direction of rotation KF 3/63...KF 6/730 direction of rotation code 1 or 2, noise-optimized version

KF 3/63...KF 6/730



KF 3/63...KF 6/730 + DKF



p_b = pressure connection
p_e = suction connection

* = Fastening screws
** = Leak oil hole

When changing the direction of rotation of the pump, rotate cover or pressure relief valve and the housing 180° together.

- Loose fastening screws.

- Remove the pump housing respectively from the flange cover and put it back on rotated 180°.
- Tighten all fastening screws applying the below mentioned tightening torques (see table 6.6).

When checking, pay attention to the following points:

- The grooves in the housing wheel chamber must be located on the delivery side of the pump.
- Pumps without pressure relief valve must have their leak oil hole on the interior cover side at the pump's suction side.
- Pumps with pressure relief valve must have their pressure relief valve adjusting screw point toward the pump´s suction side.

Tab. 6.6: Tightening torques for housing retaining nuts and bolts

Nominal size*	**KF 3/...**	**KF 4/...**	**KF 5/...**	**KF 6/...**
Tightening torque	45 $^{+5}$ Nm	45 $^{+5}$ Nm	45 $^{+5}$ Nm	75 $^{+10}$ Nm
** See type key and type designation at pump: KF ...*				

6.5 Design of suction and pressure 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.

- Use only connections and lines approved for the expected pressure range.
- Comply with each manufacturer's regulations.

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.

- Pipelines must be fitted absolutely tension-free to the device connections.
- Pipelines must be designed in such a way that no tension e.g. caused by changes in length 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 malfunctions there.

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

☞

Suction and pressure hoses

- Installation of suction and pressure hoses diminishes the noise level of hydraulic systems. Some hose manufacturer offer special, highly flexible suction hoses for this purpose.
- Lay pressure hoses in sufficiently large radii.

6.5.1 Suction line

NOTICE

Malfunction due to incorrectly designed inlet line

Due to excessive underpressure, an incorrectly designed inlet line can lead to a reduction of the delivery rate, increased noise emissions and cavitation.

- Design the inlet line with extreme care since it will strongly influence the pump's performance.

The suction line must be piped as short as possible and in a straight line.

Avoid large suction heights.

Additional line resistance such as formed parts, fittings and closed meshed suction filters increase the pipe resistance of the suction line and must be avoided.

The negative pressure in the suction line is calculated from the sum of all suction-side resistances and the suction height considering the media-specific data.

Check the underpressure

- The negative pressure can be controlled by fitting a vacuum gauge to the pump suction line connector.

Ensure proper suction when piping the suction line and the distances to the floor and to the bulkhead partitions must be sufficiently large.

The inlet port must have a sufficient distance to the lowest fluid level.

Nominal width of the suction line

- The nominal width of the suction line may actually be selected to be larger than the pump connection.

Expansion of the suction cross section

- Funnel-shaped formation of the suction port at the pump suction side or obliquely cutting the suction pipe end is recommended of enlargement of the suction cross section.

When hose lines are used on the pump suction side, care must be taken to ensure that the hoses are sufficient stability so that they will not be constricted through the sucking action.

The media-specific data need to be observed, for example, the device must be arranged below the fluid level in case of aqueous dispersions and solutions.

NOTICE

Danger of property damage when pumping aqueous fluids

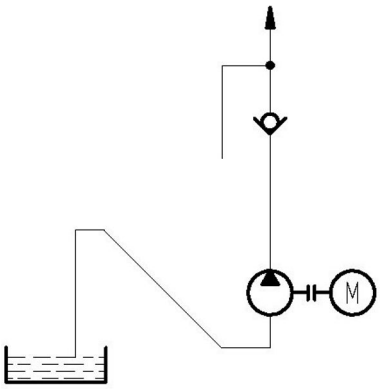
When pumping aqueous dispersions or solvents, low pressure on the inlet port can lead to cavitation damage on the pump.

- Comply with the media-specific attributes.
- 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.
- 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.

The recommended flow velocity in the suction line is max. 1,5 m/s.

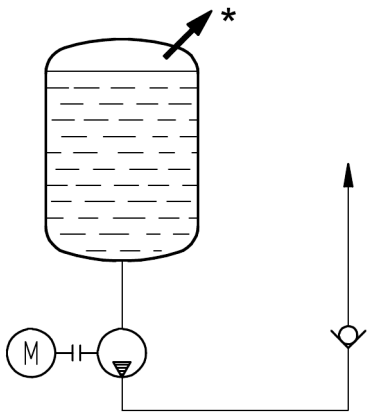
Tab. 6.7: Piping the suction line as siphon

If there is a possibility that the suction line can run dry if the pump stops, piping the suction line as siphon is an option to avoid suction problems. This way, the pump will remain permanently filled after initial commissioning.
The air in the pressure line can be conducted directly into the tank via a nozzel (see section 6.5.2 “Pressure line”).
It is appropriate to employ a foot valve or a non-return valve in case of longer suction lines that can run dry while the pump is at rest. These must have been designed for use in suction lines and should offer as low a flow resistance as possible.



Tab. 6.8: Suction line at vacuum operation

If the pump is to intake from a tank under vacuum, the pump must be arranged approx. 0.8 m below the tank. The suction line must run in a straight line and without any resistances.
The tank may be subjected to vacuum only then when the pipework and the pump have been filled with liquid.
For this application, only pumps designed as a vacuum system may be employed.



* = Vacuum

NOTICE

Malfunction due to excessive underpressure
Undercutting the permissible underpressure can lead to a decrease in the delivery rate (due to short filling of the pump), high noise emission and cavitation. Furthermore, in shaft seals the sealing lip can lift up allowing air to be sucked in.

- The permissible pressure at the pump inlet shall not be lower than value $p_{e\ min}$ as stated in the chapter 4 “Technical data”.

An exception to this is the pump's starting state during which a pressure of 0.4 bar absolute is tolerable for max. 30 minutes.

NOTICE

Damage or failure of the shaft seal due to high supply pressure
Exceeding the permissible supply pressure can lead to a failure of the shaft seal or to impermissible heating and increased wear.

- The permissible pressure at the pump inlet must not exceed the value $p_{e\ max}$ as stated in the chapter 4 “Technical data”.

6.5.2 Pressure line

DANGER

Danger due to breakage or squirting fluids!
Operating the device with impermissibly high pressures can lead to damage to the device and to the 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.

- **Never** allow positive displacement pumps to pump against "closed gates".
- 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 the entire delivery volume can be conducted through it with the lowest possible pressure or must be depressurized.
- Do **not** put the device into operation without a pressure relief device.

The nominal width of the pressure line must be selected such that the maximum permissible pressures are not exceeded.

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

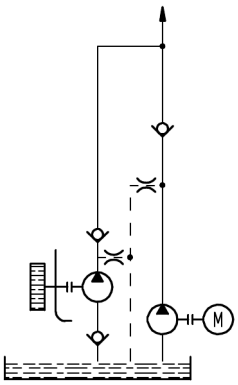
To avoid pump overload caused by an impermissibly high pressure, a pressure relief valve or a rupture disc with return to the supply tank must be installed as closely as possible to the pump's pressure connection.

Another option of pressure limiting is to mount a pressure relief valve directly to the pump.

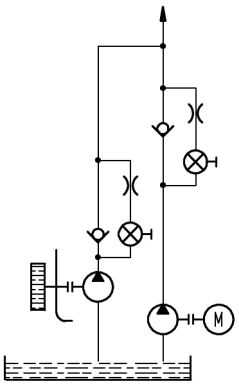
During operation of a pump that has to pump media via a non-return valve in a pressurized circuit (e.g. reserve pump in a lubricant circuit), intake problems can occur if the inlet pipe is filled with air. In this case the pressure pipe must be bled directly upstream of the non-return valve.

This can be carried out by a bleeding valve with return or a throttled bypass, for example.

Tab. 6.9: Bleeding valve and throttled bypass



Bleeding valve with return



Throttled bypass

If none of the measures described is carried out, the volume of the pressure pipe between the pump and the non-return valve must be at least 75 % of the inlet pipe volume.

6.6 Mounting the clutch

NOTICE

Danger of property damage due to falsely dimensioned coupling.
An incorrect design can lead to premature failure of the coupling due to breakage or wear.

- When dimensioning the coupling, pay attention to safe dimensioning to be able to transfer the expected maximum torque reliably and permanently.
- Take the vibrations, peak torques and temperatures into consideration. The permissible values from the coupling manufacturer must not be exceeded.
- Comply with the coupling manufacturer's installation rules.

When mounting the clutch, keeping the "E" measure exactly is of the essence so that the clutch will remain axially movable when used. In order to avoid any frontal pressure against the elastic gear rim, measure "E" should each be considered as minimum in the case of an axial displacement.

If the shaft clearance is less than clutch clearance "E", one of the shaft ends can easily extend into the gear rim. Size "d_W" corresponds to the max. shaft diameter that may extend with the parallel key into the gear rim, size "d_H". If there is the chance to offset the parallel key, i.e. only the shaft extends into the gear rim, the size of the shaft may be increased up to 2 mm below the specified "d_H" size in order not to obstruct the gear rim in its axial movability.

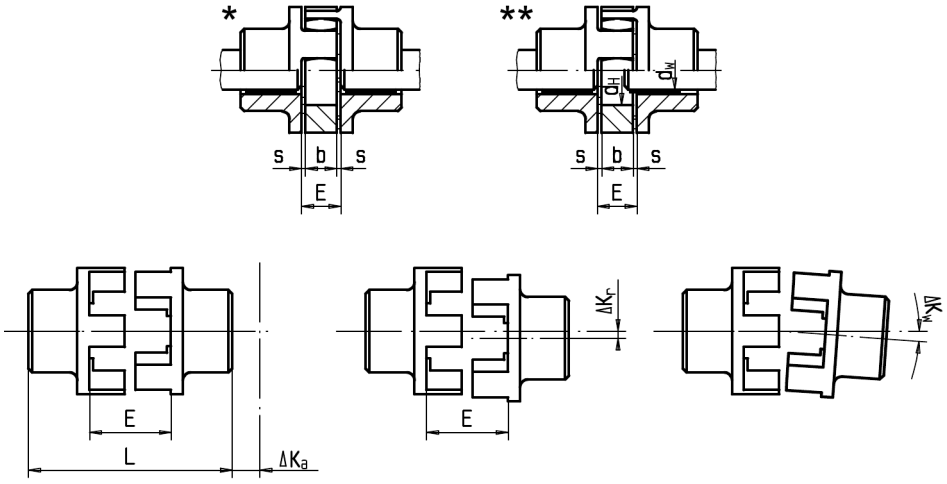
The permissible displacement values of the elastic clutches stated represent general guide values taking a clutch loading up the the clutch nominal torque and an operating speed n = 1500 rpm as well as an occurring ambient temperature of +30 °C into account. **Consultation with the manufacturer is necessary for deviating operating conditions.**

The displacement data may only be used individually in each case and in case of simultaneous appearance in proportion only.

☞ **Increasing the service life of the coupling**

- Careful and exact shaft alignment inreases clutch life.

Fig. 6.1: Displacements - aligning the clutch



* Clutch clearance "E"

** Shaft with parallel key extends into the gear rim (d_w)

Tab. 6.10: Types of coupling

Type of coupling*		19	24	28	38	42	48	55	65	75
		19/24	24/28	28/38	38/45	42/55	48/60	55/70	65/75	75/90
Clutch clearance**	E	16	18	20	24	26	28	30	35	40
Dimension**	s	2	2	2,5	3	3	3,5	4	4,5	5
Dimension**	d_H	18	27	30	38	46	51	60	68	80
Dimension**	d_W	12	20	22	28	36	40	48	55	65
Max. axial displacement**	ΔK_a	1,2	1,4	1,5	1,8	2,0	2,1	2,2	2,6	3,0
Max. radial displacement** n=1500 1/min	ΔK_r	0,20	0,22	0,25	0,28	0,32	0,36	0,38	0,42	0,48
Max. angular displacement n=1500 rpm	ΔK_w	1,2°	0,9°	0,9°	1,0°	1,0°	1,1°	1,1°	1,2°	1,2°

** Example: RA**19**-Z25/14-Z25/19* or *RA**19/24**-Z25/14-Z25/24*

*** Dimensions in mm*

NOTICE

Danger of property damage when mounting other types of couplings

If other coupling types are used, when mounting the coupling the instructions from the respective manufacturer is binding.

- The respective manufacturer's installation instructions must be complied with when using other coupling types.

NOTICE

Danger of property damage if installation is not correct

When installing the respective coupling halves, there is a hazard of damaging the inegrated bearing or other components.

- Do not knock onto the shafts during installation of the clutch halves!

☞

Easing coupling installation

- The hubs should be heated for mounting the clutch and slid onto the shaft while hot.

  Using a pinion gear drive, it must also be heated and slid onto the shaft end while hot.

NOTICE

Danger of property damage due to displacement of the coupling halves

When the coupling hub is not secured against axial displacement on each shaft, there is a danger that the coupling hub will shift during operation. That can lead to a failure of the coupling.

- Prevent axial displacement on every coupling hub on cylindrical shafts with a threaded pin that presses against the fitting key or the shaft.

6.7 Mechanical installation

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 restult in death..

- Depressurize all connections lines during all work on the device.
- Depressurize or disconnect the driving motor during all work on the device.
- Securely prevent the motor and device from restarting during work.
- Wear suitable protective clothing.

NOTICE

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

- Make sure all lines and connections are tight.

- 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.
- Mount clutch and clutch halves respectively to pump and drive (see section 6.6 “Mounting the clutch”").

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.

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

- Mount pump to bellhousing, foot or housing and pay attention to careful alignment and correct fitting position (see chapter 4 “Technical data”).
- Tighten all fastening screws applying the torque as prescribed by the manufacturer of the bellhousing avoiding any twisting of the pump in the process without fail.

- Remove the protective plugs in the pump's suction and pressure connections.

WARNING

Danger due to exposed gears!
Gears can pull in and crush or cut off fingers and hands.

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

WARNING

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

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

- 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.

- Use only connections and lines approved for the expected pressure range.
- Comply with each manufacturer's regulations.

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.

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

- Connect suction and pressure side according to the marking on the pump or the information on the type plate (see section 6.3 “Definition of the direction of rotation and pumping flow”).
- Connect the pipework to the suction and pressure piping. Always heed the respective manufacturer's instructions.
- Mount a suitable tank for the liquid seal (see chapter 7 “Operation start-up”, if applicable) when operating the pump with liquid seal (quench).

DANGER

Danger due to breakage or squirting fluids!
Operating the device with impermissibly high pressures can lead to damage to the device and to the 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.

- **Never** allow positive displacement pumps to pump against "closed gates".
- 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 the entire delivery volume can be conducted through it with the lowest possible pressure or must be depressurized.
- 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 scalded when touching the hot surfaces.

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

NOTICE

Danger of malfunctions 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 unit and in the system.

- 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!

6.8 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.

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

6.9 Electrical connection

DANGER

Danger due to electric voltage!

Danger of death due to electric shock.

- Follow the special safety regulations during all work on electrical installations.
- Only allow electricians to work on electrical systems.

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 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.

- Always pay attention to the correct direction of rotation when installing the pumps.
- Always pay attention to the correct direction of rotation when connecting the motors.
- Secure the fitting keys against flying off when monitoring the direction of rotation.

- All data stated on the motor type plate must be checked for conformity to the required operating data.
- Adjust the overload protection to the correct value.
- Check the rotational drive direction of the pump before switching on.

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.

- Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
- Close any maintenance openings when using bell housings.
- 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.

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

WARNING

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

- Comply with the safety data sheets and regulations on handling the hazardous liquids!
- Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
- Comply with national and international rules at the place of installation.
- 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 scalded when touching the hot surfaces.

- At medium temperatures above 60 °C, take measures against unintended contact.
- 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.

- Permit only expert and technically qualified personnel to work on the device.
- Comply with the permissible operating data such as rotational speed, pressure temperature, permissible media, etc. (see chapter 4 “Technical data”).
- Pay attention to cleanliness during all work.
- Before starting the system make sure that a sufficient quantity of the service fluid is extant to avoid dry running.
- Before starting the plant, pumps and inlet line must be filled with operating fluid to prevent damage to the pump and the shaft seal during dry runs. That also guarantees pump suction.
- For pumps with liquid seal (quench), fill the sealing cavity with a suitable confining fluid before it is used for the first time.
- Make sure that all lines and connections are tight and that no leakages can occur or air can be sucked in.

- Check the permissible operating data against the operating states to be expected.
- Check all fastening screws on the device.
- Fill the pump and suction line with the operating fluid.
- In the case of pumps with liquid seal (quench), fill the sealing cavity using an appropriate confining fluid (see section 7.2 “Pumps with liquid seal (quenching connection)”).
- Checking the direction of rotation. See section "Change of the direction of rotation" in chapter 6 “Installation” for any change in rotational direction.

7.2 Pumps with liquid seal (quenching connection)

7.2.1 General points

NOTICE

Danger of the failure of the seal due to a lack of sealing fluid

A lack of sealing fluid can lead to a failure of the shaft seal and to increased temperatures and increased wear.

- Fill the pump's sealing cavity with a suitable sealing medium. The sealing fluid must be compatible with the seals and materials used as well as with the pumping medium.
- The confining fluid's minimum and maximum filling level must be ensured using appropriate technical and/or organisational measures.
- The liquid seal in the quenching connection must not be subjected to pressure or vacuum.

If fluids are delivered,

- that cure in air,
- crystallise in contact with air humidity,
- the leakage of which must not be released into the environment,
- are under vacuum and their seal shall be gastight,

than the employment of a double seal with liquid seal is necessary.

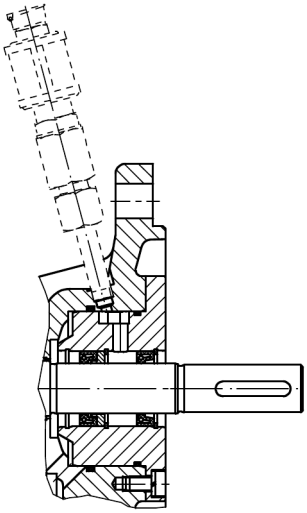
- A tank for the liquid seal is to be connected to the quenching connection. Suitable tanks are available from the manufacturer.
- The tank for the liquid seal must be placed above the pump.
- The installation position is restricted and the quenching connection shall be directed upward..
- Check of the fluid level in the tank must be possible at any time.

☞ **Flushing connection sealing cavity**

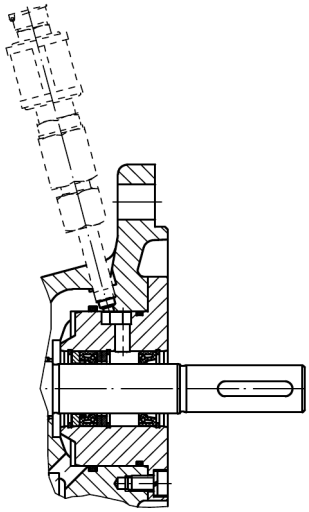
- A second port on the device enables purging of the sealing cavity and draining of the seal liquid.

7.2.2 Seal variants with liquid seal

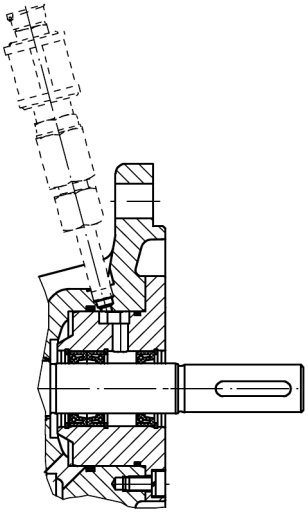
Tab. 7.1: KF 3/63...KF 6/730 with liquid seal (quench)



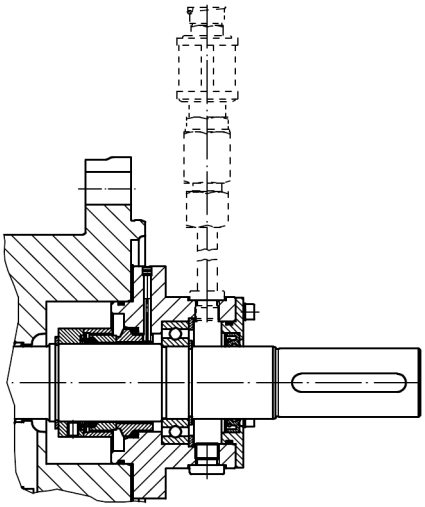
Sealing materials: 1, 2
Special numbers: 44, 261



Sealing materials: 1, 2
Special numbers: 74, 309



Sealing numbers: 1, 2
Special number: 94



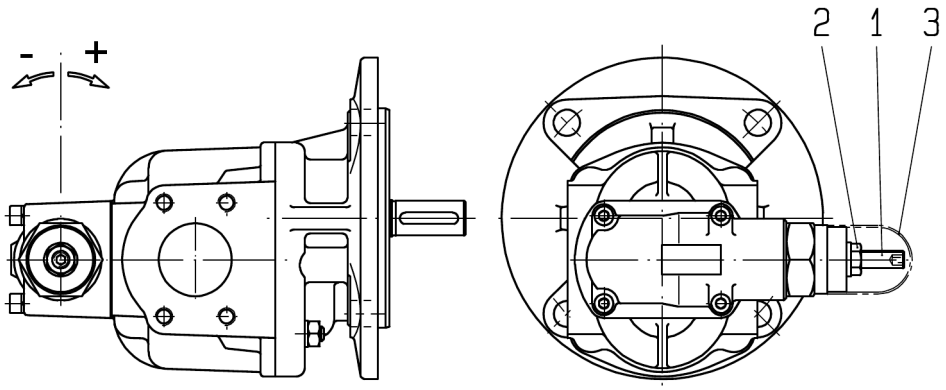
Sealing materials: 39, 40

7.3 Setting the pressure relief valve

Applies for pumps with built-on pressure relief valve

(Type designation: KF ... + DKF ...)

Fig. 7.1: Pressuer setting KF 3/63...KF 6/730 + DKF ...



+ response pressure higher

- response pressure lower

NOTICE

Danger of the pump overheating

The series D.. pressure relief valves are exclusively used to protect the pump. The valves must only respond for short durations. Permanent draining of the volumetric flow through the valve will destroy the pump through overheating.

- Make sure the valve responds only briefly.

For pressure setting on the pressure relief valve see figure 7.1:

- remove the protection cap (3)
- loosen the hexagon nut (2)
- adjust set screw (1)
  clockwise = response pressure higher
  counterclockwise = response pressure lower
- secure the set screw (1) using hexagon nut (2) once the desired pressure has been adjusted
- refasten the protection cap (3).

DANGER

Danger due to breakage or squirting fluids!

When Hexagon nut (2) is loose, Setscrew (1) can be screwed into the valve until the valve is completely shut. That can result in inadmissibly high pressures in the system if there is no other pressure relief device. 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.

Fluid can spurt out from the valve if Setscrew (1) is completely screwed out. That can lead to accidents with severe injuries or result in death.

- Never operate the unit with Hex nut (2) loosened.
- Never completely screw Setscrew (1) into the valve.
- Never completely unscrew Setscrew (1) out of the valve.

7.4 Further operation start-up

- The pumps may only start without or with low pressure load. 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 motor (jog mode) without reaching full speed until proper operation of the device is evident. This applies particularly when a cold pump is to start with already heated medium. The reason for this is to achieve slow heating of the pump and prevent the pump 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 pump after the intended operating characteristics have been reached. Checkpoints on the pump are the bearing locations, the housing and the shaft seal. The temperatures observed on the pump surface may be approx. 10 °C above medium temperature.
- 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 suction and pressure connections and the pump'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 motor and pump fastening screws after a few hours of 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.

- 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.

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

8.2 Disassembling the pump

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 restult in death..

- Depressurize all connections lines during all work on the device.
- Depressurize or disconnect the driving motor during all work on the device.
- Securely prevent the motor and device from restarting during work.
- 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.

- Comply with the safety data sheets and regulations on handling the hazardous liquids!
- Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
- Comply with national and international rules at the place of installation.
- 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 scalded when touching the hot surfaces.

- Let the device cool off first when the medium temperature is over 48 ° C.
- Wear safety gloves.

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

NOTICE

Danger of malfunction due to curing liquids

Curing liquids can engage the device mechanically and make it unusable.

- Immediately clean the pump or store it in such a way that curing is definitely prevented in cases where the pump was operated with curing liquids.

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.

- 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.

- Maintain the device regularly.
- Check the device initially right after commissioning.
- Adapt the scope and time between maintenance intervals to the demands posed by the location.
- During visual inspections, look purposefully for possible damages.
- The device must not be used if visible damages are found.
- 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 scope and time intervals for inspections and maintenance are generally specified by the operator in a respective plan.

Barriers and instructions

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

Checking the operating data

- 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.

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

NOTICE

Malfunctions due to leaking lines and connections

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

- 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, which can lead to accidents and severe injuries or even result in death.

- Immediately replace damaged connections, pipes and hose lines.

DANGER

Danger due to electric voltage!

Danger of death due to electric shock.

- Follow the special safety regulations during all work on electrical installations.
- Only allow electricians to work on electrical systems.

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 restult in death..

- Depressurize all connections lines during all work on the device.
- Depressurize or disconnect the driving motor during all work on the device.
- Securely prevent the motor and device from restarting during work.
- Wear suitable protective clothing.

DANGER

Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressures can lead to damage to the device and to the 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.

- **Never** allow positive displacement pumps to pump against "closed gates".
- 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 the entire delivery volume can be conducted through it with the lowest possible pressure or must be depressurized.
- 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.

- Comply with the safety data sheets and regulations on handling the hazardous liquids!
- Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
- Comply with national and international rules at the place of installation.
- 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 scalded when touching the hot surfaces.

- Let the device cool off first when the medium temperature is over 48 ° C.
- Wear safety gloves.

9.2 Unusual noise

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

9.3 Cleaning

The pump shaft as well as the associated hardware must not run in dust accumulations.

Regular cleaning of the device and its environment is therefore necessary.

Cleaning the device using a steam jet cleaner is not permissible.

9.4 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.

9.5 Confining fluid level

Checking the confining fluid filling level is mandatory for safe pump operation. Top up the confining fluid as required.

If there is no automatic monitoring, the filling level must be checked at least befor each shift begins.

The outer but also the inner shaft seal could be leaking if the filling level should drop unusually fast within a short period of time. The confining fluid will then leak into the coupling space or it will be sucked into the pump thereby mixing with the medium.

If the filling level should rise, the inner shaft seal may probably be leaking and the confining fluid is begin mixed with the pressurised medium.

Stop plant operation immediately in both cases.

9.6 Rotary shaft lip seal

Rotary shaft lip seals are particulary prone to wear for functional reasons and must accordingly be carfully checked. Excessicely 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 pump 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.

9.7 Mechanical seal

Mechanical seals are particularly prone to wear for functional reasons and must accordingly be carfully checked. Too high admission pressure, wrong rotational direction, frequent star-ups, gas or air portions in the oil or contamination lead to increased wear, increased leckage and impermissible temperature rises.

Small amounts of leckages, however, are indispensable for mechanical seal function. The permissible amount of leackage, though, is highly dependent on the operational conditions and cannot be quantified.

If there are excessive amounts of leakage, stop pump operation immediately. Replace the mechanical seal. In so doing, heed the assembly instructions of the mechanical seal manufacturer.

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

9.8 Clutch

Clutches must be maintained according to the specifications of the respective manufacturer.

9.9 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).

9.10 Damage

Check the pump as well as its environment regularly for damage such as dents in the clutch guard.

9.11 Surface temperature

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

This temperatures should never be much higher (max. 10 °C) than the media temperature at the pump inlet. Checkpoints on the pump 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 pump must be replaced in this case.

9.12 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 pump, however, can be analysed by the volumetric efficiency factor. Decrease of the efficiency factor would normally indicate wear. Therefore, a check on all operating data such as delivery, pressure, temperature, drive data, degree 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 pump failure in time. The pump must immediately be taken out of service at a drop of delivery or pressure to 80 % of the original values. 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 for the damage.
- **Elimination of the 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.

If corresponding expertise and sufficient equipment is available, the consumer or OEM can also make the repairs. For support, **spare parts lists** and **sectional drawings** are available. They can be requested from the manufacturer.

NOTICE

Danger of property damage due to incorrect work and use of non-original spare parts

Improper work can lead to damages and malfunctions in the device and in the plant. That also applies to the use of non-original spare parts.

- Permit only expert and technically qualified personnel to work on the device.
- Use only genuine original spare parts.

10.4 Return

If the device has to be repaired or checked over the manufacturer's premises, it 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 if 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 regualtions 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.

Tab. 10.1: Transfer pumps: Faults and causes

Fault	Potential causes	
Increased noise	Pump cavitation	• Negative pressure too high causing pump short filling • Suction height too high • Suction filter plugged or too small • Inner diameter of suction line too small • Suction line too long • Too many bends in the suction line • Too many local constrictions in the suction line • Suction line plugged or leaking • Too high viscosity • Temperature too low • Wrong direction of rotation • Place of installation too high

Fault	Potential causes	
	Foaming or trapped air in medium	• Suction line leaking • Fluid level in supply tank too low • Too little oil supply • Return line to tank leaking • Wrong tank dimensioning • Shaft seal or seal on suction line leaking • Return line end above the fluid level in the supply tank • Insufficient venting • Too strong foaming in the gear
	Mechanical vibrations	• Incorrectly aligned or loose clutch • Magnetic coupling defective • Faulty or insufficient line fastening • Wobbling pressure relief valve • No noise-optimized design (missing dampers) • Unfavourable place of pump installation • Pump worn out, tooth flanks worn out • Disturbances in pump operation
Pump does not suck		• Too high negative pressure • Fluid level in supply tank too low • Magnetic coupling torn off • Wrong direction of rotation • Throttled shut-off element in the suction line • Suction line too long • Suction line leaking • Suction resistance too high • Foreign objects in suction line • Volume of pressure pipe between pump and non-return valve too little, pump cannot compress the air contained in the suction line • Non-return valve not bled • Too high start-up pressure if suction line is filled with air • Speed too low • Place of installation too high

Fault	Potential causes	
Insufficient delivery		• Too high negative pressure • Throttled shut-off element in the suction line • Fluid level in supply tank too low • Suction filter plugged or too small • Too high viscosity • Too low viscosity • Too high speed • Too high pressure • Pressure relief valve set too low • Pump sucks air • Pump worn out • Too high proportion of air in the oil • Universal valve defective • Place of installation too high
Insufficient pressure	Delivery too low, work drags in pressure pipe too low	• Too low viscosity • Pressure relief valve set too low or does not shut • Too low speed • Driving power too low • Pump worn out
Excessive power consumption		• Too high pressure • Too high viscosity • Driving power too low • Motor winding defective
Excessive operating temperature		• Pressure relief valve set too high • Speed too high • 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 pump heating		• Delivery-side valve cone not completely shut • Directly mounted pressure relief valve set too low (does not apply for the "universal valve" and "T-valve" versions) • Too high pressure • Too low viscosity • Gland lid overtightened • Separating can insufficiently bled • Admission pressure impermissibly high • Pump worn out

Fault	Potential causes	
Leakages on shaft seal		• Admission pressure impermissibly high • Wrong direction of rotation • Too high radial shaft loading • Temperature at sealing point too high • Wrong seal material • Missing confining fluid • Separating can defective • Sealing wear due to poorly lubricating medium • Sealing wear through abrasive components in medium • Sealing wear through curing medium • Gland lid not sufficiently tightened
Clutch wear		• Incorrectly aligned or loose clutch • Axial clutch clearance insufficient • Clutch overloaded • Temperature too high
Magnetic coupling torn off		• Magnetic coupling under-dimensioned • Pressure too high • Driving motor oversized • Too high starting torque • Too high operating temperature • Pump is blocking due to foreign objects
Short operational lives	Wear on bearing, gear and housing parts	• Wear through abrasive components • Wear due to poorly lubricating medium • Too low viscosity • Check corrosion, material compatibility • Too high operating pressure for the media properties