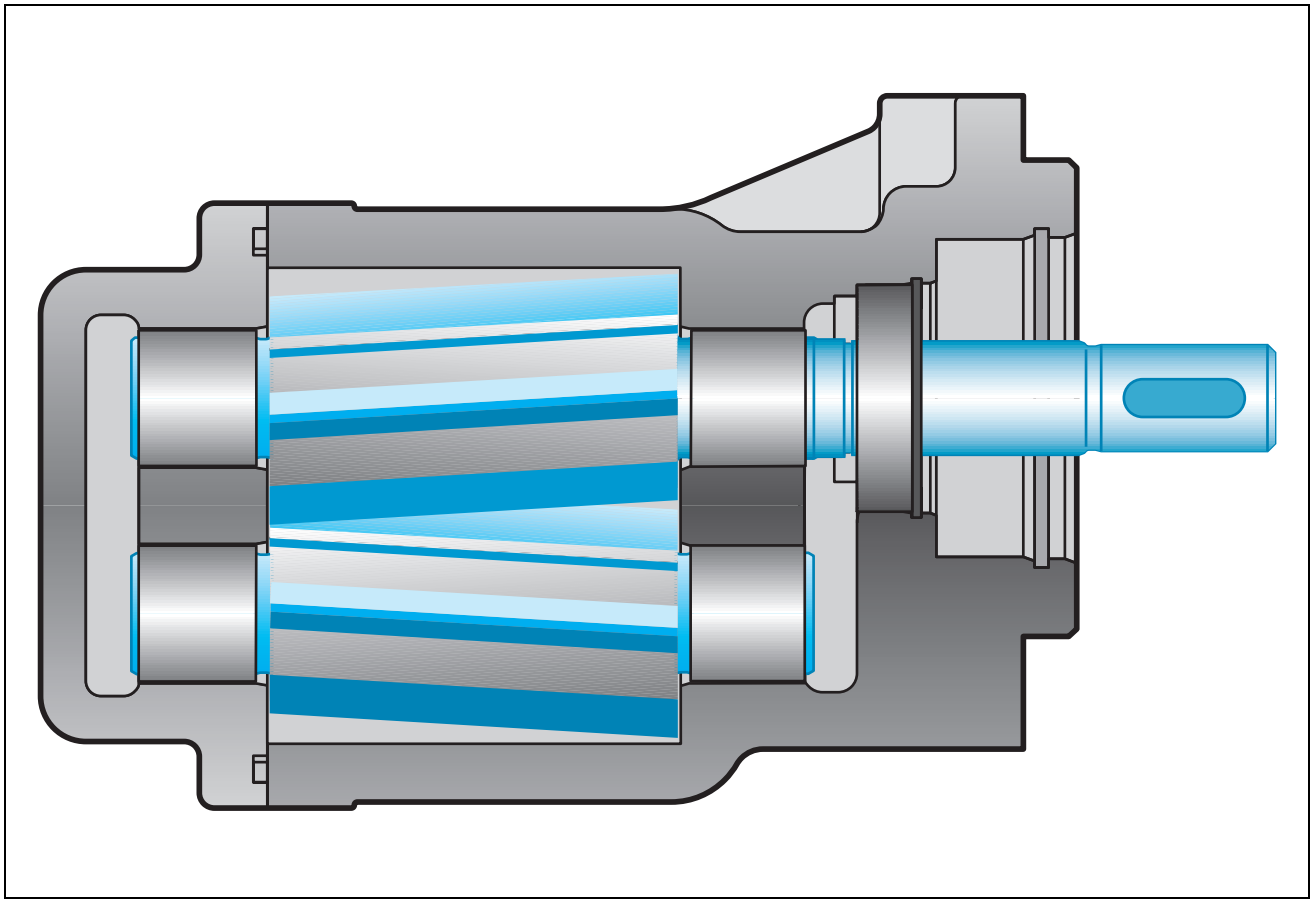
Transfer Gear Pumps

Operating and Maintenance Instructions



KF 4...80

KRACHT

Transfer Pumps

List of Contents

Safety

Safety Instruction Symbols

The safety notes contained in these operating instructions are identified by the following warning symbol.

If these warnings are not heeded, the consequence can be danger to life and limb and damage to equipment..

Other notes, which do not warn of danger, but which provide tips for optimum operation, are symbolised by a hand.

General Safety Instructions

The operating safety of the pump supplied is only guaranteed if the pump is used as specified (see "Description of equipment"). The stated limiting values (see "Technical data") must not be exceeded under any circumstances.

Personnel having the responsibility for installing, operating or repairing the pump must possess the appropriate qualifications; these may have been obtained through training or appropriate instruction. Such personnel must be familiar with the contents of these operating instructions.

During the execution of all work, the prevailing national regulations relating to accident prevention and safety at the work place and where appropriate, the internal regulations of the operator must be observed, even if the latter are not named in these operating instructions.

Leakages of dangerous substances handled by the pump must be contained and disposed of in such a way that there is no danger to personnel or to the environment. In so doing, the relevant statutory regulations must be observed.

During all work on the pump and prior to installation, the connecting pipework must be depressurised and the motor isolated!

The operator must ensure that these operating instructions are accessible at all times to personnel concerned with the operation of the equipment.

Address of Manufacturer:

KRACHT GmbH
Gewerbestrasse 20
58791 Werdohl

Tel. 0 23 92 / 93 5-0
Fax. 0 23 92 / 93 52 09

The Documentation

These operating instructions describe the installation, the operation and the repair of the KRACHT **KF 4…80** tranfer gear pump.

The equipment is manufactured in various versions. The specific version can be identified from the type label affixed to the pump. The format of the type designation and a detailed description of the individual versions and nominal sizes is to be found in the “Technical data” section (see “Description of equipment”).

Description of Equipment

General

KRACHT pumps in the KF Series are outside gear wheel pumps, which operate according to the displacement principle. Two gear wheels which are rotating in mesh with each other cause an increase in volume to occur as the spaces between the gear wheels are exposed at the pump inlet (suction side), so that the medium can flow into the pump. Simultaneously, a corresponding volume is displaced at the pump outlet (pressure side) through rotation of the gear teeth into the filled area vacated by the preceding teeth. The transport of fluid is achieved through the entrainment along the cavities between the gear teeth and the walls of the gear chambers. The so-called geometric delivery volume V_g is displaced per revolution of the gearwheels. A value V_{gn}, referred to as the nominal volume, is used in technical documentation to identify the pump size.

Gear wheel pumps are self-priming over a wide envelope. The described displacement process is initially achieved without noticeable pressure rise. It is only after the burden of external loading is applied, for example if a delivery head is imposed, there is resistance at the pump outlet, pipeline components, etc., that a working pressure must be generated to overcome these resistances.

Displacement pumps must never be operated against “closed valves”, since the uncontrollable pressure heads which occur in this case lead to damage to the pump and to the associated plant elements.

As is usual in the case of so-called rigid pumps, i.e., pumps without compensation for axial play, the lateral play between the gear wheel contact surfaces is set such that the permissible operating pressure is safely controlled. The directions of rotation and supply of outside gear wheel pumps, when viewed on the end of the drive shaft, are given as in the following diagrams:

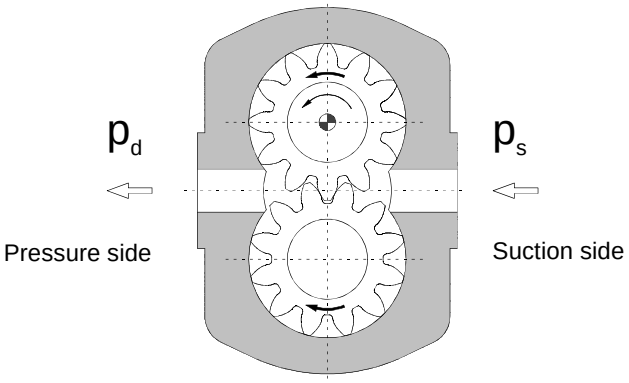


Fig. 1
Shaft rotating to left:
Delivery from right to left

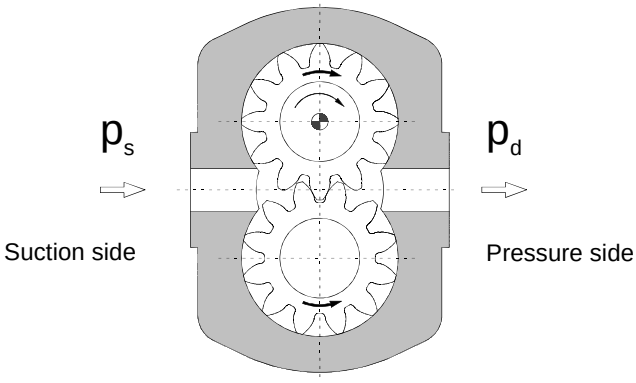


Fig. 2
Shaft rotating to right:
Delivery from left to right

Specified Use

The KF is a pump for the continuous delivery of fluids. The different types of seals available enable the pump to be used for various media.
It must be ascertained that the medium to be delivered is compatible with the materials used in the construction of the pump (see “Technical data”).
The maximum permissible operating data given in the “Technical data” section must be unconditionally adhered to.

Construction

The drawing below illustrates the principle features of the KF pump.

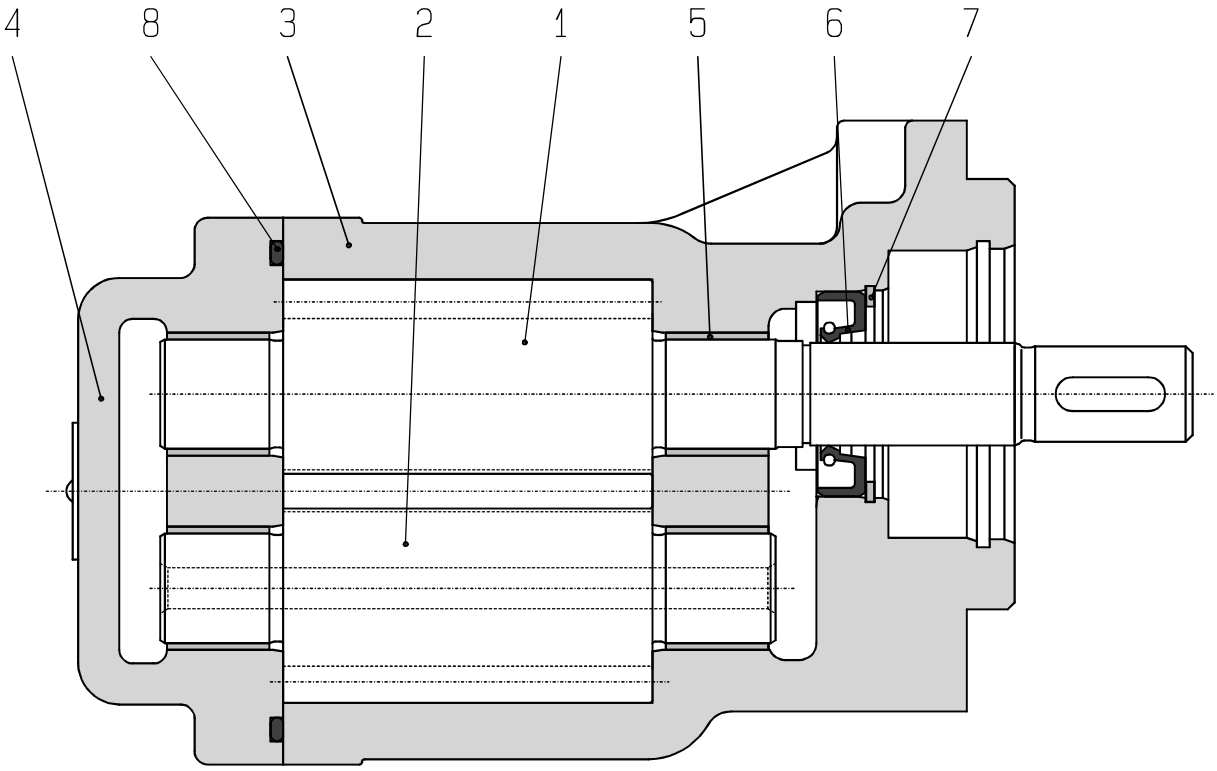


Fig. 3

1 *Drive shaft gear wheel*

2 *Driven gear wheel*

3 *Housing*

4 *End cover*

5 *Plain bearing bush*

6 *Radial shaft sealing ring*
(shaft seal varies to suit sealing requirements)

7 *Retaining ring*

Technical Data

Explanation of Type Code

Example: **KF** **40** **R** **F** **1** **D15** **/…**

Product name

Nominal size

V_g = 4 / 5 / 6,3 / 8 / 10 / 12,5
16 / 20 / 25 cm³
V_g = 32 / 40 / 50 / 63 / 80 cm³

Direction of rotation

R = right
L = left
B = right and left
U = universal
(Direction of flow delivery remains the same as the angle of rotation changes)

Mounting

F = DIN flange without support bearing
G = DIN flange with support bearing
W = mounting angle without support bearing
X = mounting angle with support bearing

Seal type

1 = radial shaft sealing ring NBR
2 = radial shaft sealing ring FPM
3 = radial shaft sealing ring PTFE
4 = double radial shaft sealing ring PTFE
5 = GLRD with FPM-secondary seals
6 = GLRD with PTFE-secondary seals
7 = double radial shaft sealing ring FPM

Pressure relief valve

D 15 adjustable over 0-15bar
D 25 adjustable over 15-25bar

Special Code - No.

Code-No. for special design

General Data

Type of construction		External gear pump
Materials		see “Materials” overview
Type of mounting		Flange DIN ISO 3019
Drive shaft end		ISO R 775 short/cylindrical
Pipe line connection		KF 4 to 25 Whitworth - pipe thread KF 32 to 80 SAE - flange connection
Installed attitude		Arbitrary*
Viscosity	ν_{min} ν_{max}	12 mm²/s 20000 mm²/s
Ambient temperature	$\vartheta_{u\,min}$ $\vartheta_{u\,max}$	-20 °C 60 °C
Filtering		Filter fineness ≤ 60 µm

* *With exception of universal version (KF…U…)*

Overview of Nominal sizes

Nominal size	**geom. Delivery Volume** V_g cm³	**RPM Range** n_{min} 1/min	n_{max} 1/min	**perm. radial Force**** F_{radial} N
4	4,03	200	3000	700
5	5,05			
6	6,38			
8	8,05			
10	10,11			
12	12,58			
16	16,09			
20	20,10			
25	25,10			
32	32,12	200	3000	1500
40	40,21			
50	50,20			
63	63,18			
80	80,50			

* *see Type label on pump: KF…*

** *Radial forces only on version with support bearing. F_{radial} on central shaft journal.*

Overview of Materials

Type of seal*	Housing / Cover	Gear	Bearing	Shaft seals	O-Ring
1	GG 25	Carburising steel (1.7139)	P 10	NBR	NBR
2				FPM	FPM
3				PTFE	FEP
4				PTFE	FEP
5				Carbonaceous (in synthetic resin), CrMo-Guß, FKM, 1.4571	FP
6				SiC-Si, FFKM, 1.4571	FEP
7				FPM	FPM

* *see Type label on pump: KF…*

Overview of Operating Pressures

Type of sealing*	Operating pressure: Suction side $p_{e\,min}$** bar	Suction side $P_{e\,max}$ bar	Pressure side p_b bar	Pressure side $p_{b\,max}$ bar	Temperature of delivered medium ϑ_{min} °C	Temperature of delivered medium ϑ_{max} °C
1	-0,4	1	25	40	-10	90
2						150
3		10				200
4		1				
5		10				150
6						200
7		1				150

* *see Type label on pump: KF…*

** *note restriction on p_{min}. on universal version (KF…U…)*

For certain operating conditions, the stated minimum and maximum values cannot be avoided!
Thus, for example, the maximum operating pressure is not permissible in conjunction with low rpm and minimal viscosity.

Pump installation and removal

Mechanical Installation

The pipeline components and connections used must be compatible with the anticipated operating pressure range.
The relevant manufacturers specifications should be consulted !

- Prior to installation, the pump is to be inspected for possible damage and soiling during transportation.
- The respective coupling hubs must be mounted on the motor and pump shaft.
  When installing the coupling, the hub should be heated up and slid onto the shaft in the heated condition.
- The shaft must not be struck during the mounting operation!

Each coupling hub must be secured on the respective shaft against axial displacement by means of the threaded pin, which presses on the adjusting spring!

- **Alignment of the Coupling**

  When installing the coupling, care should be taken that the dimension E is precisely maintained, so that during operation the coupling is free to move axially. In order that the elastic toothed rim is not exposed to pressure on its face, for axial movement, the dimension “E” is to be taken as a minimum.

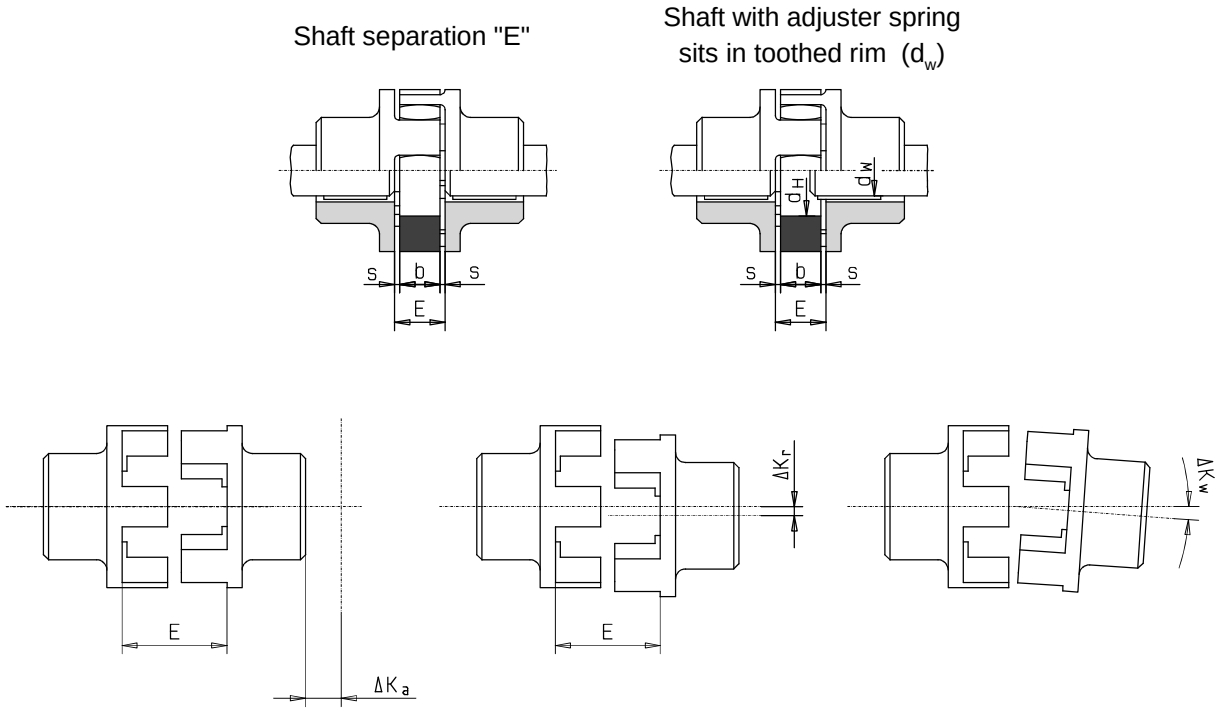


Fig. 4

☞ Careful and exact alignment of the shaft prolongs the life of the coupling!

Coupling Type	**19** 19/24	**24** 24/28	**28** 28/38	**38** 38/45	**42** 42/55	**48** 48/60	**55** 55/70	**65** 65/75	**75** 75/90
Dimn.* E	16	18	20	24	26	28	30	35	40
Dimn.* s	2	2	2,5	3	3	3,5	4	4,5	5
Dimn.* d_H	18	27	30	38	46	51	60	68	80
Dimn.* d_w	12	20	22	28	36	40	48	55	65
max. axial disp,mt * ΔK_a	1,2	1,4	1,5	1,8	2,0	2,1	2,2	2,6	3,0
max. radial offset * 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. ang. offset * n=1500 1/min ΔK_w	1,2°	0,9°	0,9°	1,0°	1,0°	1,1°	1,1°	1,2°	1,2°

* *dimensions in mm*

The given permissible misalignment values for the couplings represent general guidelines which take the loading of the coupling into consideration up to the nominal torque T_{KN} ,an operating rpm n = 1500 and an ambient temperature of +30°C. For operating conditions outside these limits, KRACHT GmbH should be consulted.
The misalignment values are individually applicable, in the case of a simultaneous occurrence they should be applied proportionately.

The couplings can **either** take up a radial **or** an angular misalignment.
If the shaft clearance dimension is less than the coupling dimension “E”, then one of the shaft ends can extend into the toothed rim section. The dimension “d_W” corresponds to the maximum shaft diameter which, with the adjuster spring, is allowed to penetrate into the toothed rim, dimension “d_H”. If it is possible to remove the adjuster spring, i.e., only the shaft penetrates into the toothed rim section, then the shaft dimension can be increased to up to 2 mm less than the given dimension “d_H”, so that the axial freedom of movement of the toothed rim is not restricted.

Rotating parts must be protected by the customer against unintentional contact!

- Mount the pump on the pump supports or feet.
- Before installing the pump, clean the pipework, removing dirt, sand, swarf, etc. Welded pipes, in particular, must be scoured or scavanged. Do not use cotton waste/rags for cleaning purposes.
- Remove the protective stoppers in the pump suction and pressure connections.
- **Determining the Direction of Rotation**

  The direction of rotation of the pump is determined as follows:

  - When viewed on the end of the pump shaft, the direction of supply is from left to right when the shaft rotates **clockwise**
  - When viewed on the end of the pump shaft, the direction of supply is from right to left when the shaft rotates **anti-clockwise**

Without pressure relief valve

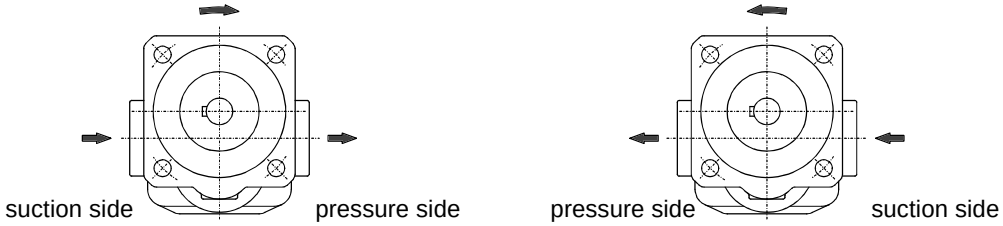


Fig. 5

With pressure relief valve

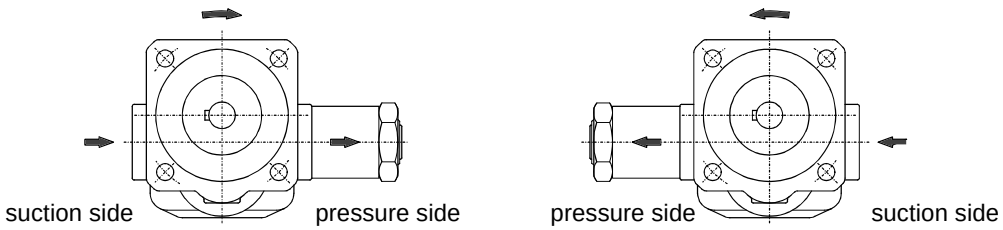


Fig. 6

- **Suction Pipework**

  Provision of the suction pipework should be carried out with great care, since the operational behaviour of the pump is greatly affected by this factor.

  The suction pipe should be as short and as straight as possible. Additional sources of pipeline resistance, such as formed parts and valves, should be avoided.
  The reduced pressure in the suction pipe depends on the sum of all the resistances in the suction line and the suction head, taking account of the data specific to the medium in the line.

☞ The suction can be checked by installing a vacuum meter on the pump/suction connection.

The permissible pressure at the pump inlet must not fall below the value $p_{e\ min}$ given in the "Technical data" section.
The only exception to this is the start-up condition of the pump, when a pressure of - 0.6 bar (suction) is tolerable for up to 30 minutes.

☞ The nominal diameter of the suction line can be chosen to be considerably larger than that of the pump connection.

⚠ **If the permissible values (see "Technical data") are exceeded, the consequence is a reduction in the delivery volume (caused by reduced filling of the pump), higher noise level and cavitation.**

If hosing is used on the suction side of the pump, then this must be of adequate stability such that the hose does not deform and constrict the flow under the suction effect.

☞ The provision of a funnel-shaped suction opening or an oblique intersection at the end of the suction pipe are of value in increasing the cross-section on the suction side.

When laying out the suction pipe in the medium container, attention should be paid to the achievement of unimpaired suction.
There should be no partition walls adjacent to the opening of the suction pipe.
Laying out the suction pipe as a siphon, whereby the pump is continually full after start-up, is a possible way of avoiding suction problems (see Fig. 7).

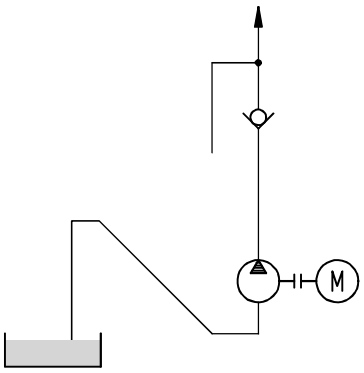


Fig. 7

- **Pressure Line**

  The nominal diameter of the pressure pipe should be selected such that the velocity of flow does not exceed the values given in the following table.

Pressure	≤ 10 bar	≤ 25 bar
Flow velocity	≤ 3 m/s	≤ 3,5 m/s

The pump pressure should be checked by a manometer installed as close as possible to the pump connection.

⚠ **KRACHT pumps are displacement pumps (see "Equipment description" section). This means that the use of a pressure relief valve or some other means of restricting pressure in the system is essential !**

In order to avoid overloading the pump due to pressure above the permissible value, a pressure-limiting valve, incorporating return flow to the reservoir, must be installed as near as possible to the pump pressure connection.

An alternative method of limiting the pressure on KRACHT feed pumps is to install a pressure-limiting valve directly onto the pump.

When operating a pump which is to feed, via a non-return valve, into a circuit which is under pressure (e.g. reserve pump in a lubrication circuit), suction difficulties can occur if the suction line is filled with air. In these cases, the pressure line should be vented directly before the non-return valve.
This can be achieved, for example, by fitting a venting jet in the circuit (Fig. 8), or by providing a restricted by-pass (Fig. 9).

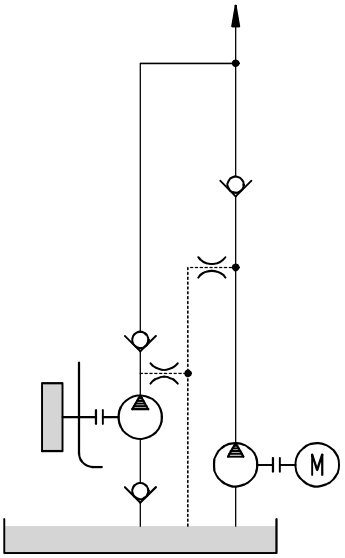


Fig. 8

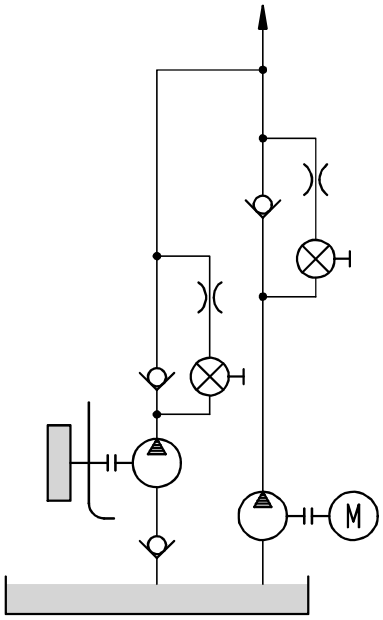


Fig. 9

The volume in the pressure line between the pump and the non-return valve must be at least 75% of the volume of the suction line.

- Connect the pipelines on the suction and pressure sides of the pump. In doing so, the instructions of the relevant manufacturer should be followed.

Neither the suction nor the pressure side pipelines should transfer loads to the pump !

The pipelines must connect with the pump supports in an absolutely stress-free condition.
The pipelines are to be constructed in such a way, that even during operation, no stresses can be transferred through the pipelines, for example through changes in length due to temperature fluctuations.

Damaged pipes and hoses must be replaced immediately !

- On installation, it must be ensured that no sealing material can enter the pipeline. Sealing materials such as hemp and mastic are not permissible, since they can lead to soiling and hence to operating failures.
- Fill the medium container with the prescribed fluid.

Care should be taken that the cleanest possible conditions prevail when filling the fluid container !

Clean filler plugs and caps on fluid transport and storage containers before opening.
Check fluid containers and clean if necessary. The filter gauze on filling tubes and filter inserts on fitted filters must not be removed under any circumstances.
Attention should be paid to adequate filling of the fluid container!

In order to achieve optimum noise protection, it is recommended that an anti-vibration flange is fitted between the pump and the pump supports and that damping elements are inserted between the electric motor and the installation.

Likewise, the use of suction and pressure hoses reduces the noise level of an hydraulic installation.

Pump Removal

The cleanest possible conditions should be assured during all work. Prior to loosening screwed connections, their external surroundings should be cleaned.

During all work on the pump and prior to removal, the connecting pipework must be depressurised and the motor isolated!
In addition, precautions must be taken to ensure that the motor cannot run-up during work on the pump.

- Remove the depressurised pipelines from the pump.

Leakages of dangerous media must be collected and disposed of in such a way that no danger results to personnel or to the environment. In so doing, the statutory regulations must be observed..

- Secure the pump connections and pipelines against the ingress of dirt.

Commissioning

Commissioning is only to be carried out by appropriately trained and qualified personnel. Prior to starting up plant, it must be ascertained that an adequate quantity of the operating medium is available, in order to avoid dry running.

- Check the permissible operating values against the anticipated operating conditions.
- Check all fixing bolts on the pump.
- Check the direction of rotation. If the direction of rotation has to be changed, refer to the section on “Maintenance”.

The pumps must only run in the direction of rotation indicated by the arrow / in the direction of rotation indicated by the symbol on the type plate.

Operation of the pump in the opposite direction of rotation to that indicated will lead to failure of the slide ring sealing in the case of sealing version 5.

Prior to commissioning, the pump must be filled with the fluid medium.

- **Special feature on sealing variants 4 and 7 (Double radial shaft sealing ring)**
- The sealing chamber (see Fig. 10) must be filled with a suitable barrier medium prior to initial operation of the pump.

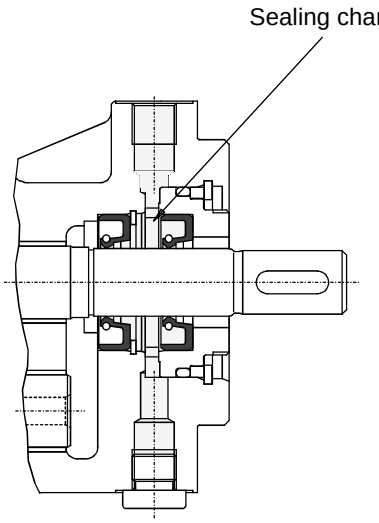


Fig. 10

Before commissioning, the sealing chamber must be filled with a barrier medium..

- The pumps should be started up at either very low or zero pressure loading. The existing shut-off devices should be fully opened and the pressure relief valve, installed in the pressure line, should be adjusted to the lowest opening pressure setting.
- **Pressure setting of the pressure relief valve**

  Applies only to pumps with a built-in pressure relief valve (Pump Type Code: KF … -D15 and KF … -D25)

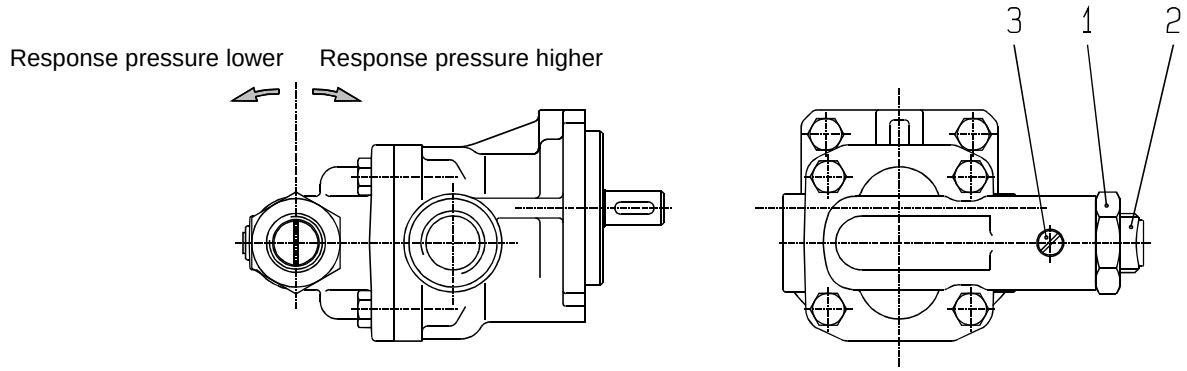


Fig. 11

1 *Lock nut*

2 *Adjuster screw*

3 *securing screw* ***(do not loosen)***

CAUTION: The pressure relief valves on series DKF are purely safety valves!
These valves only respond <u>briefly!</u>

Continual drawing off of the conveyed fluid medium via the DKF will result in the destruction of the pump due to overheating!

To adjust the pressure setting on the pressure relief valve (see Fig. 11):
- Loosen the lock nut (1).
- Set the adjuster screw (2)
  Rotation right = higher response pressure
  Rotation left = lower response pressure
- When the desired pressure has been set, re-lock the adjuster screw (2) with the lock nut (1).

The securing screw (3) must not be loosened!

Start-up is achieved by repeated rapid switching on and off of the drive motor (inching mode), without reaching full rpm, until it is apparent that the pump is operating satisfactorily. The satisfactory operation being detectable either from manometer readings, or from the noise generated by the pump, and being achieved over a period of not longer than 30 seconds. This particularly applies when a cold pump must be started-up with a fluid medium that has already been warmed, in order to achieve a slow heating up of the pump and to prevent jamming of the pump due to heat shock. After switching on the motor, it is then allowed to run for a few minutes, under zero or low pressure. The pressure loading can then be increased in stages until the desired operating pressure is reached.

- On attaining the required operating values, the temperature of the medium and of the pump should be checked. The control points on the pump are the shaft bearing positions and the shaft seals. The temperatures reached on the surface of the pump housing should be approx. 10°C greater than the temperature of the medium.
- After several hours of running time, the final operating temperature should be checked (for maximum temperatures, see the section on “Technical data”).

Maintenance

Assuming correct installation in accordance with the conditions of use and correct operation, KRACHT gear pumps are of such construction that a long and fault-free operational life should be obtained. They require a minimum of maintenance which, however, is necessary for reliable operation, since experience has shown that a high percentage of the faults and damage which can occur are attributable to the ingress of dirt and inadequate maintenance. The extent of servicing required and the service and inspection intervals are, in general, laid down by the manufacturer in an appropriate plan.

The regular examination of all operating data, such as pressure, temperature, current consumption, degree of filter soiling, etc., contributes to the early detection of potential failure.

Extreme cleanliness should be ensured during all work. Before loosening screwed connectins, the surrounding areas are to be cleaned. All openings are to be closed with protective covers, so that there is no ingress of dirt into the system.

Leakages of dangerous media must be collected and disposed of in such a way that no danger results to personnel or to the environment. In so doing, the statutory regulations must be observed.

Seals

- **Maintenance of the seal variants 4 and 7 (Double radial shaft sealing ring)**

  The filling level in the sealing chamber should be inspected at regular intervals and the barrier medium replenished if necessary.

- **Maintenance of the seal variants 5 and 6 (Slide ring seals)**

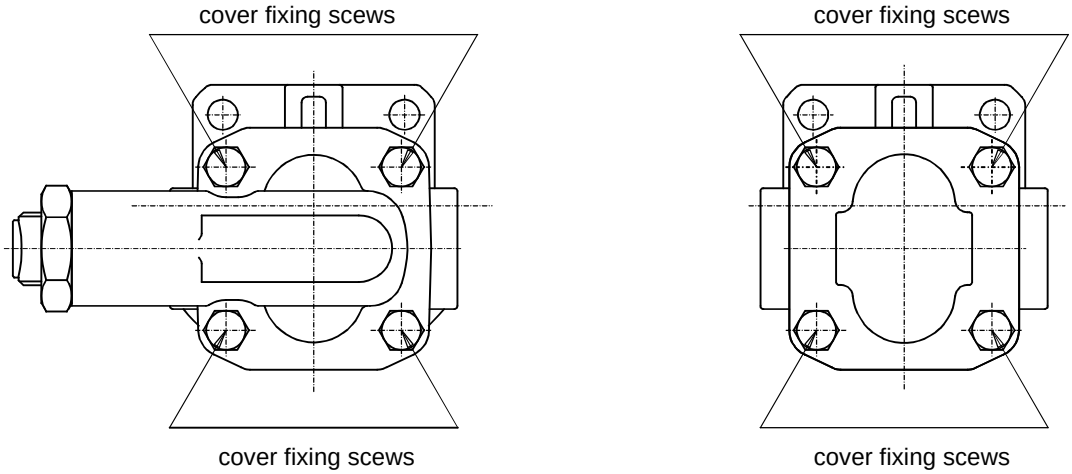
  The slide ring sealing is particularly subject to wear, depending on the application and accordingly, must be carefully checked. Too high an inlet pressure, incorrect direction of rotation or soiling, lead to increased wear and greater leakage.

  Low leakage rates are essential to the functioning of the slide ring sealing. The slide ring sealing should be renewed if the leakage rate increases.

  The installation instructions from the manufacturer of the slide ring sealing should be consulted.

- **Changing the direction of rotation of the pump**

  On pump types **KF**…**R**… and **KF**…**L**… , i.e. pure left or right rotating pumps, a change in the direction of rotation is only possible by re-building the pump.



Tightening torque for cover fixing screws

Nominal size**	**4 … 25**	**32 … 80**
Tightening torque	25 Nm	49 Nm

** see Type code on unit: KF…*

If the direction of rotation of a pump is required to be changed, the cover and the pressure relief valve on the pump housing must be freed, in order that they can be rotated through 180° and re-fitted.
On pumps without a pressure relief valve, the leakage oil bore on the inside of the cover must be on the suction side of the pump.
On pumps with a pressure relief valve, the relief valve adjuster screw must point towards the pressure side of the pump (see the section on “Mechanical installation”, Fig. 6 on page 8).

This conversion of the pump must only be carried out by appropriately trained and experienced personnel!

- **Change in direction of rotation with sealing variant 5 (Slide ring sealing)**

  A change in the direction of rotation on sealing variant 5 cannot be carried out immediately!
  In this case, in order to carry out the rotation of the cover and the relief valve, as detailed above, in addition the slide ring seal must be exchanged (note the direction of coiling of the spring).
  When exchanging the slide ring seal, the installation instructions of the seal manufacturer should be consulted.

Repairs

A repair comprises:

- Diagnostic examination, i.e. isolation of the fault. Determining and localising the cause of the fault.
- Elimination of fault**,** i.e. replacement or repair of defective components and
- elimination of the primary cause.

Elimination of the Fault

The elimination of the fault takes place on site, predominantly through exchange of the defective component/s. The repair of components is generally undertaken by the manufacturer..

Repairs must only be carried out by trained specialist personnel.

Given the appropriate know-how and adequate equipment, the repair may also be carried out by the end user or the initial equipper. Assistance in this is available in the form of **spares lists** and **repair instructions.**

Diagnosis

Lack of adequate sealing is a frequent source of failure. If this occurs at the pipeline connections, it may be eliminated by simply tightening the screwed fittings.
In the case of a lack of sealing on the pump, the respective seals must be replaced (see spares list).

Detection and Elimination of Faults

The following list gives the causes of faults which are most frequently encountered during operational failures together with an indication of the problem areas to be rectified.
In the event of the occurrence of a fault which cannot be identified, please request assistance from KRACHT.

Fault	Possible cause	
Increased noise	Pump cavitation	• Suction level too high • Suction filter blocked or too small • Internal dia. Suction line too small • Suction line too long • Too many curves in suction line • Too many local constrictions in suction line • Suction line blocked or not sealed • Viscosity too high • Viscosity too high
	Formation of foam or Inclusion or air in Medium	• Suction line not sealed • Fluid reservoir level too low • Tank return line not sealed • Incorrect container layout • Lack of sealing, suction side or shaft seal • Return line ends above level of fluid in reservoir • Inadequate venting
	Mechanical vibrations	• Faulty aligned or loose coupling • Faulty or inadequate pipeline fixing • Mechanical vibrations • Installation not optimised for noise (lack of damping elements) • Pump installed in unfavourable position • Pump worn out, tooth flank wear

Fault	Possible cause	
Pump does not suck		• Fluid level in reservoir too low • Incorrect direction of rotation • Throttling element in suction line • Foreign body in suction line • Volume of the pressure linebetween pump and non-return valve too small, pump cannot compress the air found in the suction line into the pressure line • Non-return valve in the pressure line not vented
Insufficient supply flow		• Throttling element in suction line • Fluid level in reservoir too low • Suction filter blocked or too small • Viscosity too high • Rpm too high • Pressure too high • Pressure relief valve set too low • Pump sucks air • Pump is worn out
Insufficient pressure	Supply flow too low Working resistances in pressure line too low	• Viscosity too low • Rpm too low • Drive power too low • Pump worn out
Power consumption too high		• Pressure too high • Viscosity too high • Drive power too low • Motor winding defective
Operating tempertature too high		• Cooling and heat dissipation inadequate • Fluid supply too low • Fluid conveyed under load into the reservoir via pressure relief valve
Pump heat-up above Permissible level		• Built-in pressure relief valve set too low • Pressure too high • Viscosity too low • Spectacle gland tightened excessively • Pump worn out
Leakage at the shaft sealing		• Inlet pressure above permissible value • Incorrect direction of rotation • Shaft radial loading too high • Seal wear • Seal temperature too high • Incorrect seal material
Coupling wear		• Incorrectly aligned or loose coupling • Inadequate axial play in coupling • Coupling overloaded • Temperature too high