

Dry-installed Volute Casing Pump

**KWPR**

## Installation/Operating Manual



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Installation/Operating Manual KWPR

Original operating manual

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## Glossary

### Back pull-out design

The complete back pull-out unit can be pulled out without having to remove the pump casing from the piping.

### Back pull-out unit

Pump without pump casing; partly completed machinery

### Certificate of decontamination

A certificate of decontamination is enclosed by the customer when returning the product to the manufacturer to certify that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

### Discharge line

The pipeline which is connected to the discharge nozzle

### Hydraulic system

The part of the pump in which the kinetic energy is converted into pressure energy

### Pool of pumps

Customers/operators' pumps which are purchased and stored regardless of their later use.

### Pump

Machine without drive, additional components or accessories

### Pump set

Complete pump set consisting of pump, drive, additional components and accessories

## 1 General

### 1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover.

The operating manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB service facility to maintain the right to claim under warranty.

### 1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance. (⇒ Section 7.5.6, Page 66)

### 1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.3, Page 9)

### 1.4 Other applicable documents

**Table 1:** Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump (set)
General arrangement drawing / outline drawing	Description of mating dimensions and installation dimensions for the pump (set), weights
Drawing of auxiliary connections	Description of auxiliary connections
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency and power input
General assembly drawing <sup>1)</sup>	Sectional drawing of the pump
Sub-supplier product literature <sup>1)</sup>	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists <sup>1)</sup>	Description of spare parts
Piping layout <sup>1)</sup>	Description of auxiliary piping
List of components <sup>1)</sup>	Description of all pump components
Assembly drawing <sup>1)</sup>	Sectional drawing of the installed shaft seal


For accessories and/or integrated machinery components, observe the relevant manufacturer's product literature.

### 1.5 Symbols

**Table 2:** Symbols used in this manual








Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇒	Result of an action
⇔	Cross-references

<sup>1)</sup> If included in agreed scope of supply

Symbol	Description
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

## 1.6 Key to safety symbols/markings

**Table 3:** Definition of safety symbols/markings

Symbol	Description
 <b>DANGER</b>	<b>DANGER</b> This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	<b>WARNING</b> This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	<b>CAUTION</b> This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	<b>Explosion protection</b> This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with the <i>Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016</i> .
	<b>General hazard</b> In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	<b>Electrical hazard</b> In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	<b>Machine damage</b> In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.





## 2 Safety

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

### 2.1 General

- This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.
- Comply with all the safety instructions given in the individual sections of this operating manual.
- The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.
- The contents of this operating manual must be available to the specialist personnel at the site at all times.
- Information and markings attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:
  - Arrow indicating the direction of rotation
  - Markings for connections
  - Name plate
- The operator is responsible for ensuring compliance with all local regulations not taken into account.

### 2.2 Intended use

- The pump (set) must only be operated in the fields of application and within the use limits specified in the other applicable documents. (⇒ Section 1.4, Page 7)
- Only operate pumps/pump sets which are in perfect technical condition.
- Do not operate the pump (set) in partially assembled condition.
- Only use the pump (set) to handle the fluids described in the data sheet or product literature of the pump variant.
- Never operate the pump (set) without the fluid to be handled.
- Observe the minimum flow rate and maximum flow rate indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Always operate the pump (set) in the direction of rotation it is intended for.
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

### 2.3 Personnel qualification and training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

## 2.4 Consequences and risks caused by non-compliance with this manual

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

## 2.5 Safety awareness

In addition to the safety information contained in this operating manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

## 2.6 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If stopping the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

## 2.7 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energised).
- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.

- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.3, Page 47)
- Decontaminate pumps which handle fluids posing a health hazard. (⇒ Section 7.3, Page 55)
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1, Page 38)

## 2.8 Unauthorised modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this operating manual.

The warranty relating to the operating reliability and safety of the pump (set) supplied is only valid if the equipment is used in accordance with its intended use. (⇒ Section 2.2, Page 9)

## 2.9 Explosion protection



**Always observe the information on explosion protection given in this section when operating the product in potentially explosive atmospheres.**

Pumps/Pump sets must not be used in potentially explosive atmospheres unless marked as explosion-proof **and** identified as such in the data sheet.

Special conditions apply to the operation of explosion-proof pump sets in accordance with the UK's *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016*.

Especially adhere to the sections in this manual marked with the Ex symbol and the following sections, (⇒ Section 2.9.1, Page 11) to (⇒ Section 2.9.4, Page 12)

The explosion-proof status of the pump is only assured if the pump is used in accordance with its intended use.

Never operate the product outside the limits stated in the data sheet and on the name plate.

Prevent impermissible modes of operation at all times.

### 2.9.1 Marking

**Pump** The marking on the pump refers to the pump part only.

Example of such marking:

II 2G Ex h IIC T5-T1 Gb

Refer to the Temperature limits table for the maximum temperatures permitted for the individual pump variants. (⇒ Section 2.9.2, Page 11)

The pump complies with the requirements of type of protection constructional safety "c" to ISO 80079-37.

**Shaft coupling** An EC manufacturer's declaration is required for the shaft coupling; the shaft coupling must be marked accordingly.

**Motor** The motor must be considered separately.

### 2.9.2 Temperature limits

In normal pump operation, the highest temperatures are to be expected at the surface of the pump casing, at the shaft seal and in the bearing areas.

The surface temperature at the pump casing corresponds to the temperature of the fluid handled. If the pump is heated in addition, the operator of the system is responsible for observing the specified temperature class and fluid temperature (operating temperature).

The table (⇒ Table 4) lists the temperature classes and the resulting maximum permissible fluid temperatures. The values shown correspond to the theoretical limits. They include only a general safety margin for the mechanical seal. For single mechanical seals, the safety margin required for specific operating conditions and mechanical seal designs may be substantially higher. If operating conditions differ

from those stated on the data sheet, or if different mechanical seals are used, the actual safety margin required needs to be determined individually. If in doubt please contact the manufacturer.

The temperature class specifies the maximum permissible temperature at the surface of the pump set during operation.

For the permissible operating temperature of the pump in question refer to the data sheet.

**Table 4:** Temperature limits

Temperature class to ISO 80079-36	Maximum permissible fluid temperature <sup>2)</sup>
T1	Maximum 400 °C <sup>3)</sup>
T2	280 °C
T3	185 °C
T4	120 °C
T5	85 °C
T6	Only after consultation with the manufacturer

**Temperature class T5** Based on an ambient temperature of 40 °C and proper maintenance and operation, compliance with temperature class T5 is warranted in the area of the rolling element bearings. If the ambient temperature exceeds 40 °C, contact the manufacturer.

**Temperature class T6** A special design is required to comply with the requirements of temperature class T6 in the bearing area.

Misuse, malfunctions or non-compliance with the instructions may result in substantially higher temperatures.

If the pump is to be operated at a higher temperature, the data sheet is missing or if the pump is part of a pool of pumps, contact KSB for the maximum permissible operating temperature.

### 2.9.3 Monitoring equipment

The pump (set) must only be operated within the limits specified in the data sheet and on the name plate.

If the system operator cannot warrant compliance with these operating limits, appropriate monitoring devices must be used.

Check whether monitoring equipment is required to ensure that the pump set functions properly.

Contact KSB for further information about monitoring equipment.

### 2.9.4 Operating limits

The minimum flow rates indicated in (⇒ Section 6.2.3.1, Page 46) refer to water and water-like fluids handled. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures at the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check whether an additional heat build-up may occur and if the minimum flow rate must therefore be increased. The calculation formula in (⇒ Section 6.2.3.1, Page 46) can be used to check whether an additional heat build-up may lead to a dangerous temperature increase at the pump surface.

<sup>2)</sup> Subject to further limitations for mechanical seal temperature rise



<sup>3)</sup> Depending on the material variant

## 3 Transport/Storage/Disposal

### 3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

### 3.2 Transport

	<p><b>! DANGER</b></p> <p><b>The pump (set) could slip out of the suspension arrangement</b>            Danger to life from falling parts!</p> <ul style="list-style-type: none"> <li>▷ Always transport the pump (set) in the specified position.</li> <li>▷ Never attach the suspension arrangement to the free shaft end or the motor eyebolt.</li> <li>▷ Observe the information about weights, centre of gravity and fastening points.</li> <li>▷ Observe the applicable local accident prevention regulations.</li> <li>▷ Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Improper transport of components made of CeramikPolySiC®</b>            Damage to component!</p> <ul style="list-style-type: none"> <li>▷ Never suspend impellers or other components made of CeramikPolySiC® from steel ropes or chains.</li> <li>▷ Always use suitable lifting tackle (e.g. straps, loops) for transporting impellers or other components made of CeramikPolySiC®.</li> </ul>

To transport the pump/pump set or back pull-out unit suspend it from the lifting tackle as shown.

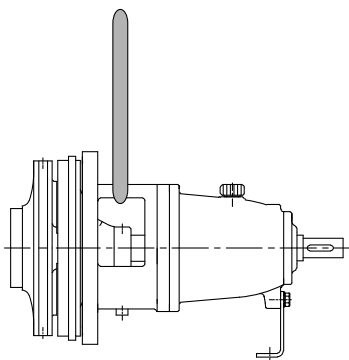


Fig. 1: Transporting the back pull-out unit

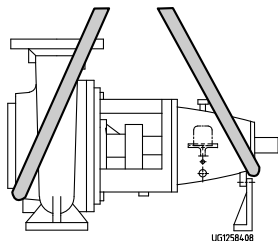


Fig. 2: Transporting the pump

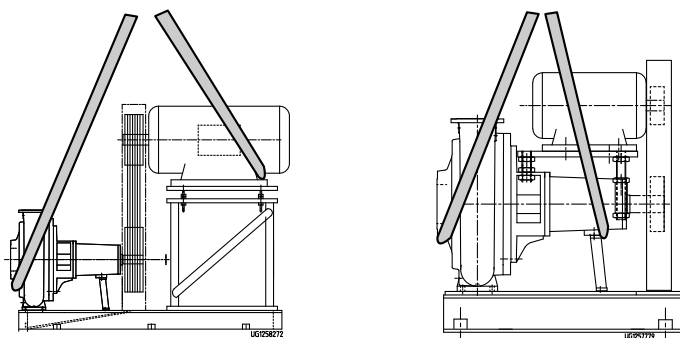


Fig. 3: Transporting a pump set with belt drive (figures 3Z and 4H)

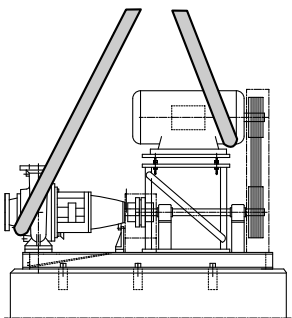


Fig. 4: Pump set on baseplate with counter shaft and belt drive (figure 3H)

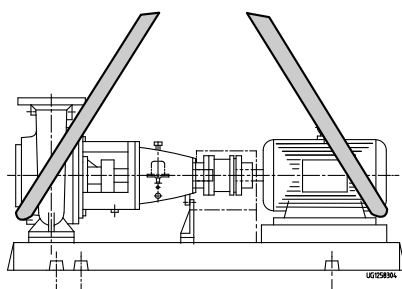




Fig. 5: Transporting a pump set on a baseplate (figure 3)

### 3.3 Storage/preservation

	<p><b>CAUTION</b></p> <p><b>Damage during storage due to humidity, dirt or vermin</b> Corrosion/contamination of pump (set)!</p> <ul style="list-style-type: none"> <li>▶ For outdoor storage cover the pump (set) and accessories with waterproof material and protect against condensation.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Wet, contaminated or damaged openings and connections</b> Leakage or damage to the pump!</p> <ul style="list-style-type: none"> <li>▶ Clean and cover pump openings and connections as required prior to putting the pump into storage.</li> </ul>

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump (set) storage.

- Store the pump (set) in a dry, protected room where the atmospheric humidity is as constant as possible.
- Rotate the shaft by hand once a month, e.g. via the motor fan.

If properly stored indoors, the pump set is protected for a maximum of 12 months. New pumps/pump sets are supplied by our factory duly prepared for storage.

For storing a pump (set) which has already been operated, the shutdown measures must be adhered to. (⇒ Section 6.3.1, Page 47)

### 3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.3, Page 55)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.  
Indicate any safety measures and decontamination measures taken.  
(⇒ Section 11, Page 78)



#### NOTE

If required, a blank certificate of decontamination can be downloaded from the following web site: [www.ksb.com/certificate\\_of\\_decontamination](http://www.ksb.com/certificate_of_decontamination)

### 3.5 Disposal



#### WARNING

**Fluids handled, consumables and supplies which are hot and/or pose a health hazard**

Hazard to persons and the environment!

- ▷ Collect and properly dispose of flushing fluid and any fluid residues.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).  
Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
  - Metals
  - Plastics
  - Electronic waste
  - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

## 4 Description of the Pump (Set)

### 4.1 General description

- Dry-installed volute casing pump

Pump for handling pre-treated sewage, waste water, all types of slurries without stringy material and pulps up to 5 % bone dry with a maximum density of 2000 kg/m<sup>3</sup>.

### 4.2 Product information as per Regulation No. 1907/2006 (REACH)

For information as per chemicals Regulation (EC) No. 1907/2006 (REACH), see <https://www.ksb.com/ksb-en/About-KSB/Corporate-responsibility/reach/>.

### 4.3 Designation

Example: KWP R A 100 - 250

Table 5: Key to the designation

Code	Description
KWP	Type series
R	Impeller type, e.g. R = worm wheel
A	Additional code, e.g. A = mechanical seal (in the casing cover)
100	Nominal discharge nozzle diameter [mm]
250	Nominal impeller diameter [mm]

### 4.4 Name plate

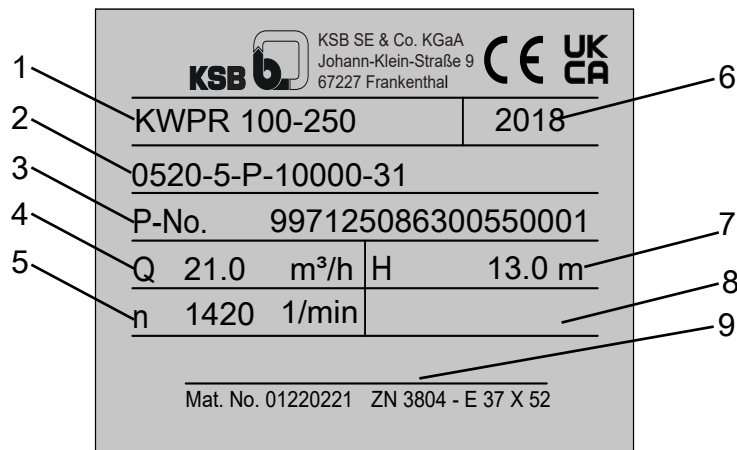


Fig. 6: Name plate (example)

1	Type series, size, material, and design variant	2	Customer-specific information (optional)
3	KSB order and order item number	4	Flow rate
5	Speed	6	Year of construction
7	Head	8	Pump input power (optional)
9	Further required information (optional)		



## 4.5 Design details

### Design

- Volute casing pump
- Back pull-out design
- Horizontal installation
- Single-stage
- Single-suction

### Pump casing

- Radially split volute casing
- Volute casing with integrally cast pump feet
- Discharge cover available in the following versions:
- Pump casing with an integrally cast discharge nozzle and with a suction and discharge cover (suction cover with integrally cast suction nozzle).

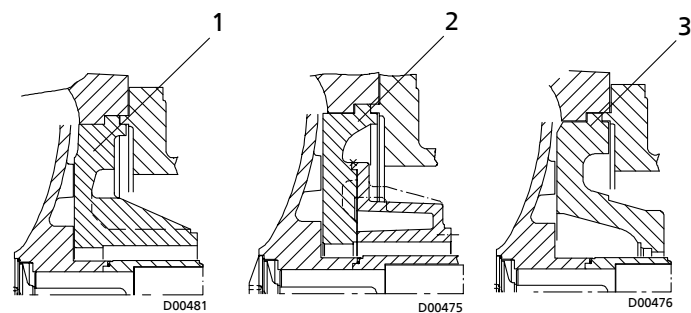


Fig. 7: Discharge cover versions

1	Discharge cover with integrally cast stuffing box housing; material variants: G, C2, GC2	2	Discharge cover with coolable stuffing box housing; material variants: GH, H
3	For pump sets with mechanical seal: discharge cover with conical seal chamber (A-type cover); material variants: G, GC2, C2, GH, H		

### Impeller type

- Non-clogging worm wheel

### Bearing assembly

- Oil-lubricated rolling element bearings
- Back pull-out bearing bracket with axially adjustable rotor to adjust the clearance between impeller and suction cover

Bearings used Table 6: Standard bearings

Bearing bracket	Rolling element bearings	
	Pump end <sup>4)</sup>	Motor end <sup>5)</sup>
P04ax	NU 411	2 x 7311 BG
P05ax	NU 413	2 x 7313 BG
P06x	NU 413	2 x 7313 BG

### Shaft seal

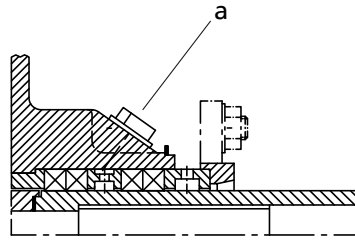
1. Shaft equipped with replaceable shaft protecting sleeve in the shaft seal area

### Uncooled gland packing

- Gland packing

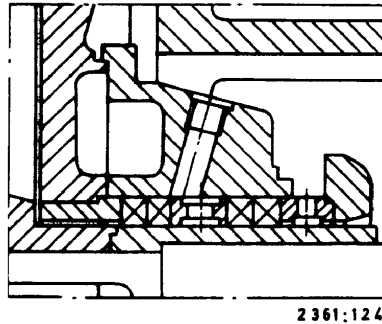
<sup>4</sup> To DIN 5412

<sup>5</sup> To DIN 628



**Fig. 8:** Uncooled gland packing with a) connection for barrier fluid or flushing liquid (connections 10 A.1 and 10 E.1)

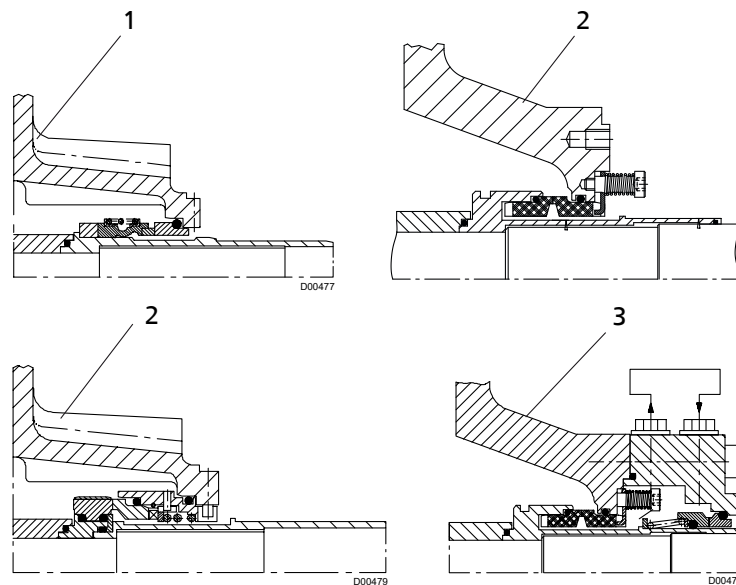
Cooled gland packing



2 361:12 4

**Fig. 9:** Cooled gland packing

- Single mechanical seal / double mechanical seal



**Fig. 10:** Mechanical seals in conical seal chamber (A-type)

1	Single mechanical seal with spring-loaded stationary assembly (4K)	2	Single mechanical seal, unbalanced
3	Single mechanical seal with spring-loaded stationary assembly	4	Mechanical seal in tandem arrangement, with quench

#### Drive

- Electric motor connected to the pump via a coupling or belt drive

#### 4.6 Configuration and function

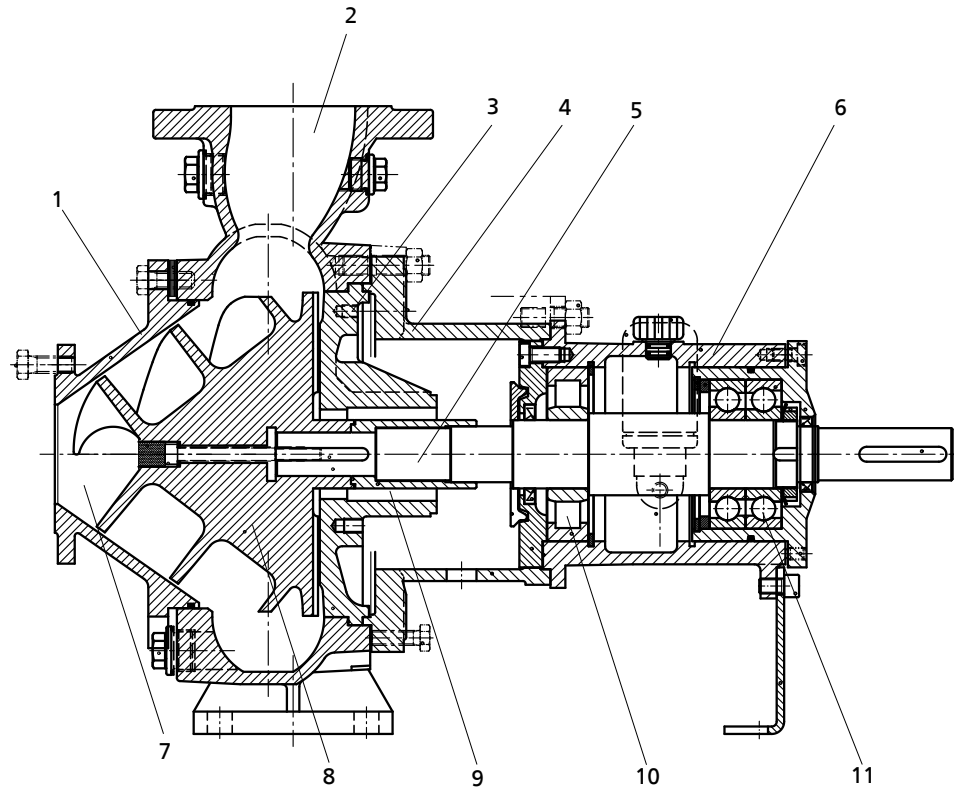


Fig. 11: Sectional drawing

1	Suction cover	2	Casing / discharge nozzle
3	Discharge cover	4	Bearing bracket lantern
5	Shaft	6	Bearing bracket
7	Casing / suction nozzle	8	Impeller
9	Shaft seal	10	Rolling element bearing, pump end
11	Rolling element bearing, drive end		

**Design** The horizontal, non-self-priming, radially split volute casing pump in back pull-out design is designed with an axial fluid inlet and a radial outlet.

The rotor runs in an axially adjustable bearing assembly and is connected to the motor by a shaft coupling.

**Function** The uniformly rotating impeller of the centrifugal pump transfers mechanical energy to the fluid passing through the pump.

The fluid enters the pump axially via the suction nozzle (7) and is accelerated outward by the rotating impeller (8). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid leaves the pump via the discharge nozzle (2).

The casing is fitted with a replaceable suction cover (1). The diagonal clearance prevents frequent deflection of the clearance flow heading in the direction of the suction nozzle. Owing to the axially adjustable bearing assembly, the clearance can be set to an optimum width.

The casing is closed by a discharge cover (3). The shaft (5) enters the casing via this cover. A shaft seal (9) provides reliable sealing to atmosphere.

The shaft is supported by oil lubricated rolling element bearings (10 and 11). The bearing bracket (6) is connected to the casing via a bearing bracket lantern (4).

- Sealing** The pump is sealed by a shaft seal. Variants:
- Mechanical seal (single seal or in tandem arrangement)
  - Gland packing with connection for barrier fluid or flushing liquid in the cylindrical seal chamber

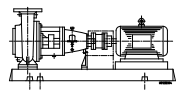
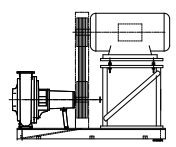
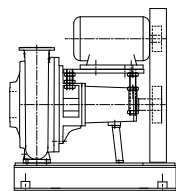
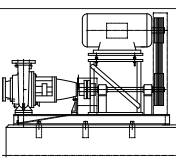
### 4.7 Materials

**Table 7:** Materials

Code	Description
G	Standard design <ul style="list-style-type: none"> <li>▪ Entire pump made of GJL-250<sup>6)</sup></li> </ul>
GC2	<ul style="list-style-type: none"> <li>▪ Like G</li> <li>▪ Impeller and suction cover made of NORIDUR 1.4593</li> </ul>
C2	Entire hydraulic system made of NORIDUR 1.4593
GH	<ul style="list-style-type: none"> <li>▪ Casing made of GJL-250<sup>6)</sup></li> <li>▪ Impeller, suction and discharge cover made of NORIHARD</li> </ul>
H	Entire hydraulic system made of NORIHARD

### 4.8 Installation types

**Table 8:** Installation types

Installation type	Illustration	Description
Figure 3		Pump set with directly coupled motor
Figure 3Z		Pump set with belt drive. Motor bracket positioned in front of the pump
Figure 4H		Pump set with belt drive. Motor support plate positioned on the pump.
Figure 3H		Pump set with belt drive and countershaft. Motor bracket positioned over countershaft.

<sup>6)</sup> New code for JL1040

### 4.9 Noise characteristics

**Table 9:** Surface sound pressure level  $L_{pA}$  [dB]<sup>7) 8)</sup>

Rated power input PN [kW]	Pump			Pump set <sup>9)</sup>		
	2900 rpm	1450 rpm	960/760 rpm	2900 rpm	1450 rpm	960/760 rpm
1,1	54	52	51	63	57	55
2,2	55	53	52	65	59	53
3	57	55	54	67	61	59
4	58	57	55	69	62	61
5,5	60	58	57	70	64	63
7,5	61	59	58	71	65	64
11	63	61	60	73	67	66
15	64	62	61	74	68	67
18,5	65	63	62	75	69	68
22	66	64	63	75	69	68
30	67	65	64	76	71	69
37	68	66	65	77	71	70
45	69	67	66	77	72	71
55	70	68	67	78	73	71
75	-	69	68	-	74	72
90	-	70	69	-	74	73
110	-	71	70	-	75	73
132	-	72	71	-	75	74
160	-	73	72	-	76	74
200	-	75	74	-	76	75
250	-	76	75	-	80	79

### 4.10 Scope of supply

Depending on the model, the following items are included in the scope of supply:

- Pump
- Surface-cooled IEC three-phase current squirrel-cage motor
- Belt drive or flexible coupling with or without spacer
- Belt guard / coupling guard to EN 294
- Baseplate (to ISO 3661), cast or welded, for pump and motor, in torsion-resistant design

### 4.11 Dimensions and weights

For dimensions and weights refer to the general arrangement drawing/outline drawing of the pump/pump set.



<sup>7)</sup> Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361 ; valid for a pump operating range of  $Q/Q_{BEP} = 0.8 - 1.1$  and non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance.

<sup>8)</sup> Increase for 60 Hz operation: 1750 rpm +1 dB, 1160 rpm ±0 dB

<sup>9)</sup> For belt-driven pump sets add 2 dB.


## 5 Installation at Site

### 5.1 Safety regulations

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperatures in the shaft seal area</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Never operate a pump (set) with gland packing in potentially explosive atmospheres.</li> </ul>
	<div style="background-color: #0072bc; color: white; padding: 5px;"><b>NOTE</b></div> <p>Operating pump sets with gland packings in combination with a frequency inverter / variable speed system is not recommended.</p>

### 5.2 Checks to be carried out prior to installation



#### Place of installation

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></div> <p><b>Installation on a mounting surface which is unsecured and cannot support the load</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XS1 to EN 206 .</li> <li>▷ The mounting surface must be set, even, and level.</li> <li>▷ Observe the weights indicated.</li> </ul>
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1. Check the structural requirements.  
All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

### 5.3 Installing the pump set

Always install the pump set in a horizontal position.

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperatures due to improper installation</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Install the pump in a horizontal position to ensure self-venting of the pump.</li> </ul>
	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Electrostatic charging due to insufficient potential equalisation</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Make sure that the connection between pump and baseplate is electrically conductive.</li> </ul>

### 5.3.1 Installation on the foundation

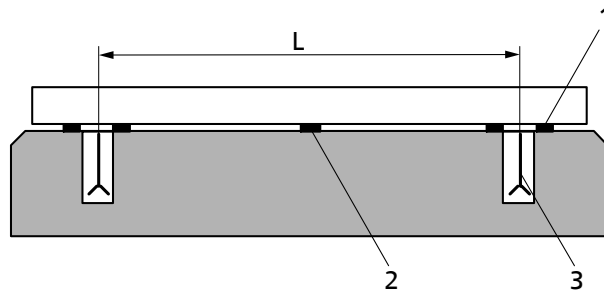


Fig. 12: Fitting the shims

L	Bolt-to-bolt distance	1	Shim
2	Shim if (L) > 800 mm	3	Foundation bolt

- ✓ The foundation has the required strength and characteristics.
  - ✓ The foundation has been prepared in accordance with the dimensions given in the outline drawing/general arrangement drawing.
1. Position the pump set on the foundation and level it with the help of a spirit level placed on the shaft and discharge nozzle.  
Permissible deviation: 0.2 mm/m
  2. Use shims (1) for height compensation if necessary.  
Always fit shims, if any, immediately to the left and right of the foundation bolts (3) between the baseplate/foundation frame and the foundation.  
For a bolt-to-bolt distance (L) > 800 mm fit additional shims (2) halfway between the bolt holes.  
All shims must lie perfectly flush.
  3. Insert the foundation bolts (3) into the holes provided.
  4. Use concrete to set the foundation bolts (3) into the foundation.
  5. Wait until the concrete has set firmly, then level the baseplate.
  6. Tighten the foundation bolts (3) evenly and firmly.
  7. Grout the baseplate using low-shrinkage concrete with a standard particle size and a water/cement ratio of  $\leq 0.5$ .  
Produce flowability with the help of a solvent.  
Perform secondary treatment of the concrete to EN 206.



#### NOTE

For low-noise operation contact the manufacturer to check whether the pump set can be installed on anti-vibration mounts.



#### NOTE

Expansion joints can be fitted between the pump and the suction line or discharge line.

### 5.3.2 Installation without foundation

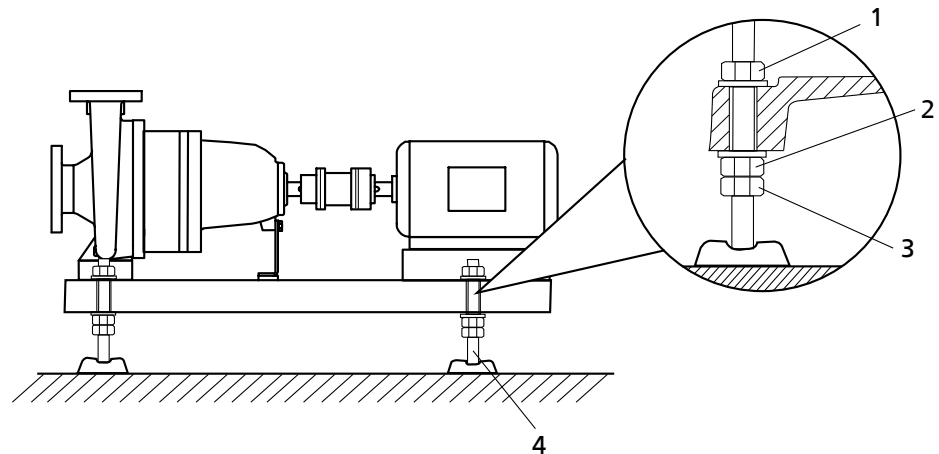




Fig. 13: Adjusting the levelling elements

1, 3	Locknut	2	Adjusting nut
4	Machine mount		

- ✓ The installation surface has the required strength and characteristics.
- 1. Position the pump set on the machine mounts (4) and align it with the help of a spirit level (on the shaft/discharge nozzle).
- 2. To adjust any differences in height, loosen the locknuts (1, 3) of the machine mounts (4).
- 3. Turn the adjusting nut (2) until any differences in height have been compensated.
- 4. Re-tighten the locknuts (1, 3) at the machine mounts (4).

## 5.4 Piping

### 5.4.1 Connecting the piping

	<div style="background-color: #e67e22; color: white; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Impermissible loads acting on the pump nozzles</b>            Danger to life from leakage of hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> <li>▷ Do not use the pump as an anchorage point for the piping.</li> <li>▷ Anchor the pipelines in close proximity to the pump and connect them properly without transmitting any stresses or strains.</li> <li>▷ Observe the permissible forces and moments at the pump nozzles.              (⇒ Section 5.4.2, Page 26)</li> <li>▷ Take appropriate measures to compensate for thermal expansion of the piping.</li> </ul>
	<div style="background-color: #f1c40f; color: black; padding: 5px;"><b>CAUTION</b></div> <p><b>Incorrect earthing during welding work at the piping</b>            Destruction of rolling element bearings (pitting effect)!</p> <ul style="list-style-type: none"> <li>▷ Never earth the electric welding equipment on the pump or baseplate.</li> <li>▷ Prevent current flowing through the rolling element bearings.</li> </ul>





### NOTE

Installing check valves and shut-off valves in the system is recommended, depending on the type of plant. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
  - ✓ A flow stabilisation section having a length equivalent to at least twice the diameter of the suction flange has been provided upstream of the suction flange.
  - ✓ The nominal diameters of the pipelines are equal to or greater than the nominal diameters of the pump nozzles.
  - ✓ Adapters to larger nominal diameters are designed with a diffuser angle of approx. 8° to avoid excessive pressure losses.
  - ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.
1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).
  2. Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump.



### CAUTION

#### Welding beads, scale and other impurities in the piping

Damage to the pump!

- ▷ Remove any impurities from the piping.
- ▷ If necessary, install a filter.
- ▷ Observe the information in (⇒ Section 7.2.2.2, Page 52) .

3. Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.
4. If required, install a filter in the piping (see drawing: Filter in the piping).

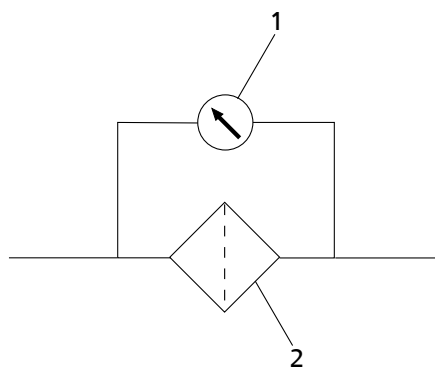


Fig. 14: Filter in the piping

1	Differential pressure gauge	2	Filter
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### NOTE

Use a filter made of corrosion-resistant material.  
Use a filter with a filter area three times the cross-section of the piping.  
Conical filters have proved suitable.

5. Connect the pump nozzles to the piping.



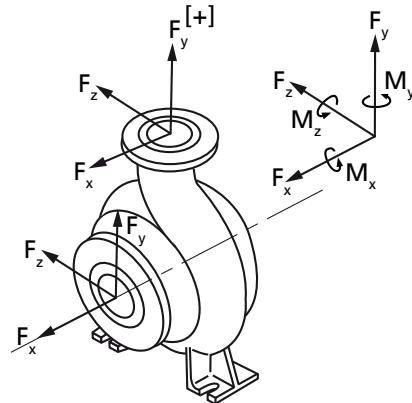
### CAUTION

#### Aggressive flushing liquid and pickling agent

Damage to the pump!

- Match the cleaning operation mode and duration of flushing and pickling to the casing materials and seal materials used.

#### 5.4.2 Permissible forces and moments at the pump nozzles



The resulting permissible forces have been determined according to

$$F_{\text{res D}} \leq \sqrt{F_x^2 + F_z^2}$$

$$F_{\text{res S}} \leq \sqrt{F_y^2 + F_z^2}$$

#### Forces and moments at the pump nozzles

The data on forces and moments apply to static piping loads only. If the limits are exceeded, they must be checked and verified.

If a computerised strength analysis is required, values are available on request only.

The values are only applicable if the pump is installed on a completely grouted baseplate and bolted to a rigid and level foundation.

Correction coefficients depending on material and temperature (see diagram below).

#### Material variant C2: correction coefficients by temperature

For material variant C2 and temperatures >20 °C reduce the values given in (⇒ Section 5.4.2.1, Page 27) in accordance with the following diagram:

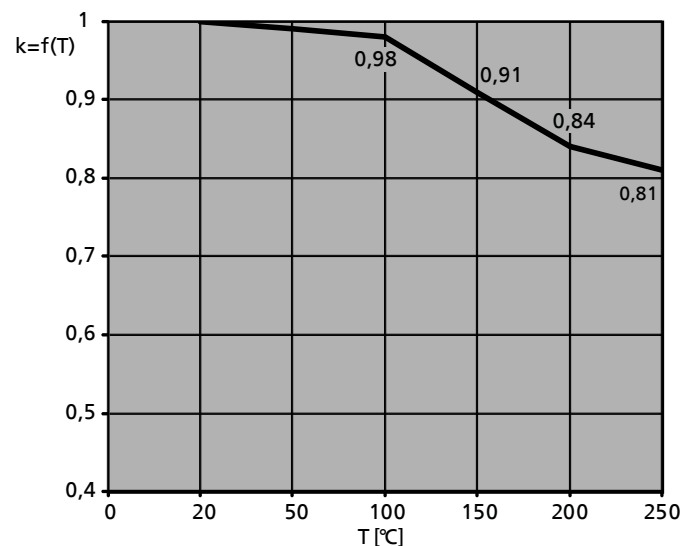


Fig. 15: Example: correction coefficient for material variant C2

Calculation of forces and moments for T > 20 °C

#### Reduction formula:

Permissible force/moment = k (T) x force/moment from table

Example:

- Material = C2
- T = 100°C
- k = 0.98

#### 5.4.2.1 Material variant C2

**Table 10:** Material variant C2 (NORIDUR): permissible forces and moments at the pump nozzles<sup>10)</sup>



Size	Forces									Moments					
	Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
	F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	F <sub>res</sub>	F <sub>x</sub>	F <sub>yTens+</sub>	F <sub>yPress-</sub>	F <sub>z</sub>	F <sub>res</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>
	[N]	[N]	[N]	[N]	[N]	[N]	[N]	[N]	[N]	[Nm]	[Nm]	[Nm]	[Nm]	[Nm]	[Nm]
080-315	4850	3145	3860	4940	3055	1975	3860	2515	3950	3595	2695	1795	2605	1975	1345
100-250	6645	4310	5300	6825	3860	2425	4850	3145	5030	4940	3770	2515	3595	2695	1795
125-315	8445	5570	6735	8710	5300	3325	6645	4310	6825	6200	4760	3145	4940	3770	2515
200-400	13205	8445	10240	13295	10240	6380	13205	8445	13295	9520	6915	4760	9520	6915	4760

#### 5.4.2.2 Material variants G, GH, H (grey cast iron, NORIHARD)

**Table 11:** Material variants G, GH, H (grey cast iron, NORIHARD): permissible forces and moments at the pump nozzles<sup>11)</sup>


Size	Forces									Moments					
	Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
	F <sub>x</sub>	F <sub>y</sub>	F <sub>z</sub>	F <sub>res</sub>	F <sub>x</sub>	F <sub>yTens+</sub>	F <sub>yPress-</sub>	F <sub>z</sub>	F <sub>res</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>
	[N]	[N]	[N]	[N]	[N]	[N]	[N]	[N]	[N]	[Nm]	[Nm]	[Nm]	[Nm]	[Nm]	[Nm]
080-315	2700	1750	2150	2750	1700	1100	2150	1400	2200	2000	1500	1000	1450	1100	750
100-250	3700	2400	2950	3800	2150	1350	2700	1750	2800	2750	2100	1400	2000	1500	1000
125-315	4700	3100	3750	4750	2950	1850	3700	2400	3800	3450	2650	1750	2750	2100	1400
200-400	7350	4700	5700	7400	5700	3550	7350	4700	7400	5300	3850	2650	5300	3850	2650

#### 5.4.3 Auxiliary connections






 	<b>⚠ DANGER</b>
	<p><b>Risk of potentially explosive atmosphere by incompatible fluids mixing in the auxiliary piping</b></p> <p>Risk of burns!</p> <p>Explosion hazard!</p> <p>▷ Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.</p>

<sup>10)</sup> For temperatures >20 °C: adjust the values in accordance with the associated temperature adjustment diagram (correction coefficient for material variant C2).

<sup>11)</sup> Application range: up to 200 °C (without reduction); for other sizes please contact KSB

	<b>⚠ WARNING</b>
	<p><b>Failure to use or incorrect use of auxiliary connections (e.g. barrier fluid, flushing liquid, etc.)</b></p> <p>Risk of injury from escaping fluid!</p> <p>Risk of burns!</p> <p>Malfunction of the pump!</p> <ul style="list-style-type: none"> <li>▷ Refer to the general arrangement drawing, the piping layout and pump markings (if any) for the quantity, dimensions and locations of auxiliary connections.</li> <li>▷ Use the auxiliary connections provided.</li> </ul>

### 5.5 Enclosure/insulation



	<b>⚠ DANGER</b>
	<p><b>Risk of potentially explosive atmosphere due to insufficient venting</b></p> <p>Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Make sure the space between the casing cover/discharge cover and the bearing cover is sufficiently vented.</li> <li>▷ Never close or cover the perforation of the bearing bracket guards (e.g. by insulation).</li> </ul>
	<b>⚠ WARNING</b>
	<p><b>Unprotected rotating pulleys</b></p> <p>Risk of injury by rotating pulleys!</p> <ul style="list-style-type: none"> <li>▷ Always operate the pump set with a belt guard. If the customer specifically requests not to include a belt guard in KSB's delivery, then the operator must supply one!</li> <li>▷ Observe all relevant regulations for selecting a belt guard.</li> </ul>
	<b>⚠ WARNING</b>
	<p><b>The volute casing and casing/discharge cover take on the same temperature as the fluid handled</b></p> <p>Risk of burns!</p> <ul style="list-style-type: none"> <li>▷ Insulate the volute casing.</li> <li>▷ Fit protective equipment.</li> </ul>
	<b>CAUTION</b>
	<p><b>Heat build-up in the bearing bracket</b></p> <p>Damage to the bearing!</p> <ul style="list-style-type: none"> <li>▷ Never insulate the bearing bracket, bearing bracket lantern and casing cover.</li> </ul>
	<b>NOTE</b>
	<p>Pump casings handling fluids at temperatures below freezing point may be insulated at the site, subject to the manufacturer's prior approval.</p>

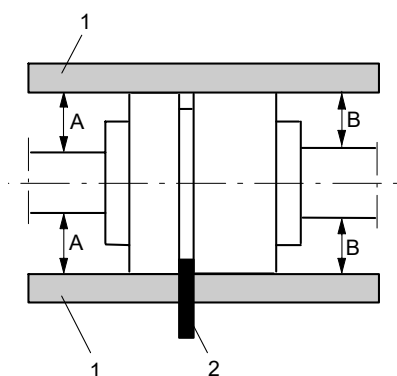
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### 5.6 Checking the coupling alignment / belt drive

After the pump set has been installed (⇒ Section 5.3, Page 22) and connected to the piping (⇒ Section 5.4, Page 24), check the coupling alignment or belt drive.

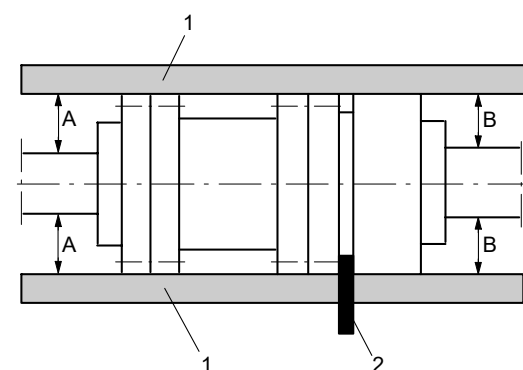
### 5.6.1 Checking the coupling alignment

	<div style="background-color: #e67e22; color: white; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Inadmissible temperatures at the coupling or bearings due to misalignment of the coupling</b>  Explosion hazard!  Risk of burns!</p> <p>▷ Make sure that the coupling is correctly aligned at all times.</p>
	<div style="background-color: #f1c40f; padding: 5px;"><b>CAUTION</b></div> <p><b>Misalignment of pump and motor shafts</b>  Damage to pump, motor and coupling!</p> <p>▷ Always check the coupling after the pump has been installed and connected to the piping.  ▷ Also check the coupling of pump sets supplied with pump and motor mounted on the same baseplate.</p>



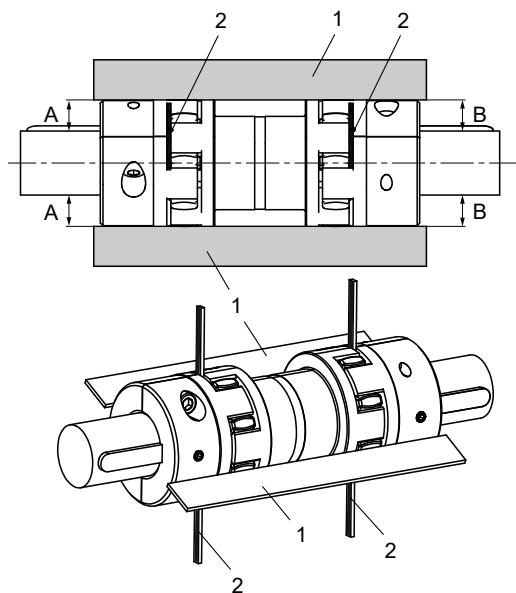
**Fig. 16:** Non-spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge
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**Fig. 17:** Spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge
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**Fig. 18:** Double Cardan spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge
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**Table 12:** Permissible alignment offset of coupling halves


Coupling type	Radial offset	Axial offset
	[mm]	[mm]
Non-spacer-type coupling (⇒ Fig. 16)	≤ 0,1	≤ 0,1
Spacer-type coupling (⇒ Fig. 17)	≤ 0,1	≤ 0,1
Double Cardan coupling (⇒ Fig. 18)	≤ 0,5	≤ 0,5

- ✓ The coupling guard and its footboard, if any, have been removed.
- 1. Loosen the support foot and re-tighten it without transmitting any stresses and strains.
- 2. Place the straight edge axially on both coupling halves.
- 3. Leave the straight edge in this position and turn the coupling by hand.  
The coupling is aligned correctly if the distances A and B to the respective shafts are the same at all points around the circumference.  
Observe the permissible radial offset in coupling half alignment (⇒ Table 12) both during standstill and at operating temperature as well as under inlet pressure.
- 4. Check the distance (dimension see general arrangement drawing) between the two coupling halves around the circumference.  
The coupling is correctly aligned if the distance between the two coupling halves is the same at all points around the circumference.  
Observe the permissible axial offset in coupling half alignment (⇒ Table 12) both during standstill and at operating temperature as well as under inlet pressure.
- 5. If alignment is correct, re-install the coupling guard and its footboard, if any.

#### Checking the coupling alignment with a laser tool


Coupling alignment may also be checked with a laser tool. Observe the documentation provided by the manufacturer of the measuring instrument.

### 5.6.2 Checking the belt drive

	<div style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></div> <p><b>Poorly checked, inaccurately aligned motor connection</b> Increased wear, insufficient power transmission, loud running noises!</p> <ul style="list-style-type: none"> <li>▷ Always use clean pulleys without any signs of wear.</li> <li>▷ Align the shaft end of pump/motor flush with the pulleys.</li> <li>▷ For multiple V-belt drives: Use V-belts of equal lengths.</li> <li>▷ Tension the V-belts properly.</li> </ul>
---	---

#### 5.6.2.1 Checking the pulleys and V-belts

- ✓ The information on checking the belt drive has been observed.  
(⇒ Section 5.6.2, Page 31)
- 1. Remove the belt guard.
- 2. Check the pulleys and the V-belts.
  - ⇒ The V-belts are not worn.
  - ⇒ All V-belts of a multiple V-belt drive have the same length.
- 3. Replace any pulleys worn as a result of burrs or rust.
- 4. Clean any dirty pulleys and remove burrs if necessary.

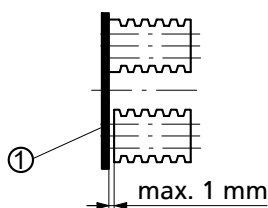
	<div style="background-color: #0070C0; color: white; padding: 5px;"><b>NOTE</b></div> <p>If V-belts need to be replaced, always replace the entire set of belts.</p>
--	--

#### 5.6.2.2 Checking the alignment of pump and motor shaft

- ✓ The notes and steps stated in (⇒ Section 5.6.2, Page 31) to  
(⇒ Section 5.6.2.1, Page 31) have been observed/carried out.
- 1. Measure the distance between the shaft stubs in two points with a straight-edge.  
The shafts are correctly aligned if the distances measured in both points are equal (parallel axes).
- 2. If the distances differ, align the motor bracket by turning threaded rods 904.23/904.24 until equal distances are measured in both points.

#### 5.6.2.3 Checking the alignment of the pulleys

- ✓ The notes and steps stated in (⇒ Section 5.6.2.1, Page 31) to  
(⇒ Section 5.6.2.2, Page 31) have been observed/carried out.
- ✓ Required tools: wedge gauge, straight-edge
- 1. Place the straight-edge (1) vertically on both pulleys.
- 2. Leave the straight-edge (1) in this position and turn the measuring point by hand.
- 3. Adjust the alignment, if required. (⇒ Section 7.5.9, Page 68)
- 4. Re-fit the belt guard.



**Fig. 19:** Checking the pulley alignment

### 5.6.2.4 Checking the belt tension

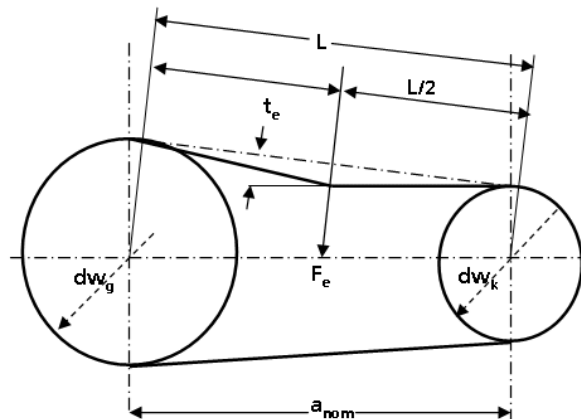


Fig. 20: Tension check for V-belts

- ✓ The notes and steps stated in (⇒ Section 5.6.2, Page 31) to (⇒ Section 5.6.2.3, Page 31) have been observed/carried out.
- 1. Check the V-belt tension with a belt tension measuring tool (measuring tool not included in the scope of supply).
- 2. If the tension is incorrect, tension the V-belt. (⇒ Section 5.7.3, Page 34)

### Tension forces for V-belts

Table 13: Form for tension forces

Characteristic	Value	Unit
Test force [ $F_e$ ]		N
Deflection distance of individual belts [ $t_e$ ]		mm
The set of V-belts consists of: <ul style="list-style-type: none"> <li>▪ Number of belts:</li> <li>▪ Dimension:</li> <li>▪ Effective length [LW]</li> </ul>		mm
Diameter of large pulley [ $d_{w_g}$ ]		mm
Diameter of small pulley [ $d_{w_k}$ ]		mm
Speed [n]		rpm
Distance between pulleys [ $a_{nom}$ ]		mm

## 5.7 Aligning the pump and motor

### 5.7.1 Motors with adjusting screw

Any differences in shaft centre height between the pump and motor are adjusted with adjusting screws.



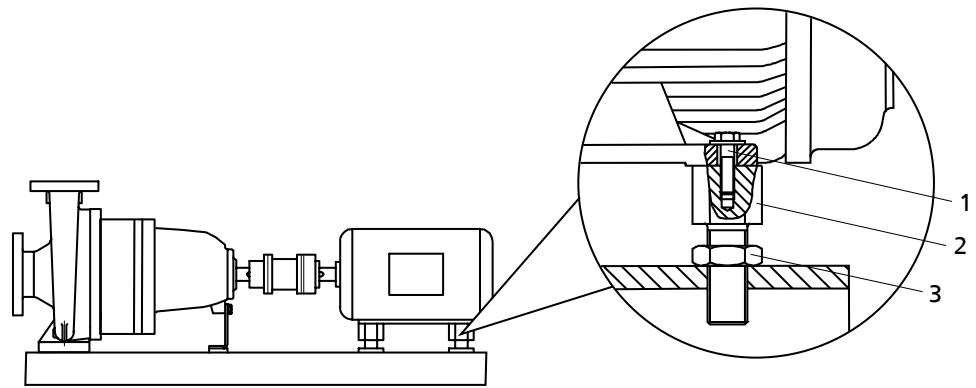


Fig. 21: Motor with adjusting screw

1	Hexagon head bolt	2	Adjusting screw
3	Lock nut		

- ✓ The coupling is misaligned (⇒ Section 5.6.1, Page 29) .
- ✓ The coupling guard and footboard, if any, have been removed.
- 1. Unscrew the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
- 2. Turn the adjusting screws (2) by hand or by means of an open-end wrench until the coupling alignment is correct and all motor feet rest squarely on the baseplate.
- 3. Re-tighten the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
- 4. Check proper functioning of coupling/shaft.  
Check that coupling/shaft can easily be rotated by hand.

	<b>⚠ WARNING</b>
	<b>Unprotected rotating coupling</b> Risk of injury by rotating shafts! <ul style="list-style-type: none"> <li>▷ Always operate the pump set with a coupling guard. If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!</li> <li>▷ Observe all relevant regulations for selecting a coupling guard.</li> </ul>
	<b>⚠ DANGER</b>
	<b>Risk of ignition by frictional sparks</b> Explosion hazard!! <ul style="list-style-type: none"> <li>▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.</li> </ul>

- 5. Re-install the coupling guard and footboard, if any.
- 6. Check the distance between coupling and coupling guard.  
The coupling guard must not touch the coupling.

#### 5.7.2 Motors without adjusting screw

Any differences in shaft centre height between the pump and the motor are compensated by means of shims.

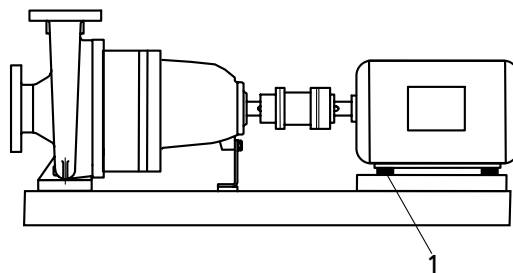




Fig. 22: Pump set with shim


1 Shim

- ✓ Misalignment of the coupling (⇒ Section 5.6.1, Page 29) .
- ✓ The coupling guard and footboard, if any, have been removed.
- 1. Unscrew the hexagon head bolts at the motor.
- 2. Insert shims (1) underneath the motor feet until the difference in shaft centre height has been compensated.
- 3. Re-tighten the hexagon head bolts.
- 4. Check that the coupling and shaft can easily be rotated by hand.

	<b>WARNING</b>
	<b>Unprotected rotating coupling</b> Risk of injury by rotating shafts! <ul style="list-style-type: none"> <li>▷ Always operate the pump set with a coupling guard. If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!</li> <li>▷ Observe all relevant regulations for selecting a coupling guard.</li> </ul>
	<b>DANGER</b>
	<b>Risk of ignition by frictional sparks</b> Explosion hazard!! <ul style="list-style-type: none"> <li>▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.</li> </ul>



- 5. Reinstall the coupling guard and footboard, if any.
- 6. Check the distance between coupling and coupling guard.  
The coupling guard must not touch the coupling.

### 5.7.3 Pump sets with belt drive

	<b>CAUTION</b>
	<b>Incorrect tension</b> Insufficient power transmission! Increased wear of the V-belt! <ul style="list-style-type: none"> <li>▷ Always ensure correct tensioning of the V-belt.</li> </ul>



- ✓ The belt guard has been removed.
- ✓ The tension of the V-belt is too low or too high (⇒ Section 5.6.2.4, Page 32) .
- 1. Move motor bracket 81-54.01 up or down by turning threaded rods 904.23/904.24 until the V-belt is tensioned correctly.  
Tension forces (⇒ Section 5.6.2.4, Page 32)
- 2. Check the V-belt tension with a belt tension measuring tool (measuring tool not included in the scope of supply).
- 3. Check the tension again between ½ hour and 1 hour after initial operation.



4. If the tension is too low or too high, re-adjust the motor bracket and check the tension again.

	 <b>WARNING</b>
	<p><b>Unprotected rotating pulleys</b> Risk of injury by rotating pulleys!</p> <ul style="list-style-type: none"> <li>▷ Always operate the pump set with a belt guard. If the customer specifically requests not to include a belt guard in KSB's delivery, then the operator must supply one!</li> <li>▷ Observe all relevant regulations for selecting a belt guard.</li> </ul>


5. Re-fit the belt guard.
6. Check the distance between V-belt and belt guard.  
The belt guard must not touch the V-belt.

### 5.8 Electrical connection


	 <b>DANGER</b>
	<p><b>Electrical connection work by unqualified personnel</b> Danger of death from electric shock!</p> <ul style="list-style-type: none"> <li>▷ Always have the electrical connections installed by a trained electrician.</li> <li>▷ Observe regulations IEC 60364 and, for explosion-proof versions, EN 60079 .</li> </ul>

	 <b>WARNING</b>
	<p><b>Incorrect connection to the mains</b> Damage to the power supply network, short circuit!</p> <ul style="list-style-type: none"> <li>▷ Observe the technical specifications of the local energy supply companies.</li> </ul>

1. Check the available mains voltage against the data on the motor name plate.
2. Select an appropriate starting method.

	<b>NOTE</b>
	<p>Installing a motor protection device is recommended.</p>


#### 5.8.1 Setting the time relay

	<b>CAUTION</b>
	<p><b>Switchover between star and delta on three-phase motors with star-delta starting takes too long.</b> Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▷ Keep switch-over intervals between star and delta as short as possible.</li> </ul>

**Table 14:** Time relay settings for star-delta starting:




Motor rating [kW]	Y time to be set [s]
≤ 30	< 3
> 30	< 5

### 5.8.2 Connecting the motor








	<div style="background-color: #005596; color: white; padding: 5px;"><b>NOTE</b></div> <p>In compliance with IEC 60034-8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub). The pump's direction of rotation is indicated by an arrow on the pump.</p>
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1. Match the motor's direction of rotation to that of the pump.
2. Observe the manufacturer's product literature supplied with the motor.

### 5.8.3 Earthing

 	<div style="background-color: #e67e22; color: white; padding: 5px;"> <b>DANGER</b></div> <p><b>Electrostatic charging</b> Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Connect the PE conductor to the earthing terminal provided.</li> <li>▷ Provide for potential equalisation between the pump set and the foundation.</li> </ul>
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### 5.9 Checking the direction of rotation

 	<div style="background-color: #e67e22; color: white; padding: 5px;"> <b>DANGER</b></div> <p><b>Temperature increase resulting from contact between rotating and stationary components</b> Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never check the direction of rotation by starting up the unfilled pump set.</li> <li>▷ Separate the pump from the motor to check the direction of rotation.</li> </ul>
	<div style="background-color: #f1c40f; color: white; padding: 5px;"> <b>WARNING</b></div> <p><b>Hands inside the pump casing</b> Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Always disconnect the pump set from the power supply and secure it against unintentional start-up before inserting your hands or other objects into the pump.</li> </ul>
	<div style="background-color: #f1c40f; color: white; padding: 5px;"><b>CAUTION</b></div> <p><b>Incorrect direction of rotation with non-reversible mechanical seal</b> Damage to the mechanical seal and leakage!</p> <ul style="list-style-type: none"> <li>▷ Separate the pump from the motor to check the direction of rotation.</li> </ul>
	<div style="background-color: #f1c40f; color: white; padding: 5px;"><b>CAUTION</b></div> <p><b>Drive and pump running in the wrong direction of rotation</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Refer to the arrow indicating the direction of rotation on the pump.</li> <li>▷ Check the direction of rotation. If required, check the electrical connection and correct the direction of rotation.</li> </ul>

The correct direction of rotation of the motor and pump is clockwise (seen from the drive end).

1. Start the motor and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.  
The motor's direction of rotation must match the arrow indicating the direction of rotation on the pump.
3. If the motor is running in the wrong direction of rotation, check the electrical connection of the motor and switchgear, if any.

## 6 Commissioning/Start-up/Shutdown

### 6.1 Commissioning/Start-up

#### 6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:



- The pump set has been mechanically connected as specified.
- The pump set has been properly connected to the power supply and is equipped with all protection devices. (⇒ Section 5.8, Page 35)
- The pump has been primed with the fluid to be handled. The pump has been vented. (⇒ Section 6.1.4, Page 40)
- The direction of rotation has been checked. (⇒ Section 5.9, Page 36)
- All auxiliary connections required are connected and operational. (⇒ Section 5.4.3, Page 27)
- The lubricants have been checked. (⇒ Section 6.1.2, Page 38)
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇒ Section 6.4, Page 48)

#### 6.1.2 Filling in lubricants

**Oil-lubricated bearings** Fill the bearing bracket with lubricating oil.  
Oil quality see  
Oil quantity see (⇒ Section 7.2.3.1.3, Page 54)

#### Filling the constant level oiler with lubricating oil (oil-lubricated bearings only)

- ✓ The constant level oiler is screwed into the upper tapping hole of the bearing bracket.

	<p><b>NOTE</b></p> <p>If no constant level oiler is provided on the bearing bracket, the oil level can be read in the middle of the oil level gauge arranged at the side of the bearing bracket (optional).</p> <p><b>Figure 4H:</b> If access to the vent nozzle is difficult or impossible, the oil can be filled in through the connection elbow of the constant level oiler.</p> <p>Make sure that the indicated oil level is within the scale.</p>
	<p><b>CAUTION</b></p> <p><b>Insufficient quantity of lubricating oil in the reservoir of the constant level oiler</b></p> <p>Damage to the bearings!</p> <ul style="list-style-type: none"> <li>▷ Regularly check the oil level.</li> <li>▷ Always fill the oil reservoir completely.</li> </ul>

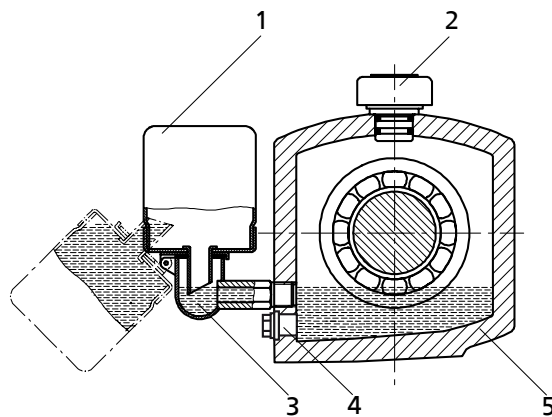


Fig. 23: Bearing bracket with constant level oiler

1	Constant level oiler	2	Vent plug
3	Connection elbow of the constant level oiler	4	Screw plug
5	Bearing bracket		

1. Pull out the vent plug (2).
2. Hinge down the reservoir of the constant level oiler (1) from the bearing bracket (5) and hold it in this position.
3. Fill in oil through the hole for the vent plug until the oil reaches the connection elbow of the constant level oiler (3).
4. Completely fill the reservoir of the constant level oiler (1).
5. Snap the constant level oiler (1) back into its operating position.
6. Fit the vent plug (2) again.
7. After approximately 5 minutes, check the oil level in the glass reservoir of the constant level oiler (1).  
The oil reservoir must be properly filled at all times to provide a constant oil level. Repeat steps 1 - 6, if necessary.
8. To check the function of the constant level oiler (1), slowly drain some oil via the screw plug (4) until air bubbles can be seen in the oil reservoir.



#### NOTE

An excessively high oil level can lead to a temperature rise and to leakage of the fluid handled or oil.

#### 6.1.3 Preparing the shaft seal

Shaft seals are fitted prior to delivery.

Observe the instructions on dismantling (⇒ Section 7.4.6, Page 58) or assembly (⇒ Section 7.5.4, Page 62) .

**Quench reservoir** If applicable, fill the quench reservoir in accordance with the general arrangement drawing.

**External liquid feed** Apply the quantities and pressures specified in the data sheet and the general arrangement drawing.


**Gland packing** Cool the gland packing to the following criteria:

Table 15: Cooling the gland packing

Characteristic	Value
Fluid temperature	≥ 105 °C
	≥ 90 °C and contaminated fluids

Characteristic	Value
Cooling water quantity at an inlet temperature of 20 °C	0.5 to 5 l/min <sup>12)</sup>
Connections	See general arrangement drawing.



**Double mechanical seal** Prior to starting up the pump, apply barrier pressure or supply flushing/quench liquid as specified in the general arrangement drawing.

	<b>CAUTION</b>
	<b>Air in the mechanical seal area</b> Insufficient lubrication! Mechanical seal failure! ▷ Never start up the pump with the clearance between impeller and casing only partially filled.

Prime the pump and the seal chamber with the fluid handled. The conical seal chamber is self-venting. The mechanical seal is operational.


- To ensure trouble-free continuous operation, the pressure at the seal must be at least 0.2 bar above the atmospheric pressure in normal operation.
- For temperatures exceeding 20 °C a sufficient vapour pressure margin must be ensured.
- The seal must not be subjected to low pressure when the pump is running in reverse rotation.
- Avoid operation outside the specified pressure range as well as surge pressures from the piping system.
- The mechanical seal must be permanently surrounded by the fluid handled in order to build up a lubricating film in the sealing gap and to dissipate heat.

#### 6.1.4 Priming and venting the pump

 	<b>⚠ DANGER</b> <b>Risk of potentially explosive atmosphere by incompatible fluids mixing in the auxiliary piping</b> Risk of burns! Explosion hazard! ▷ Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.
	<b>⚠ DANGER</b> <b>Risk of potentially explosive atmosphere inside the pump</b> Explosion hazard! ▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times. ▷ Provide sufficient inlet pressure. ▷ Provide an appropriate monitoring system.


<sup>12)</sup> Depending on the fluid temperature



	<b>! DANGER</b>
	<p><b>Shaft seal failure caused by insufficient lubrication</b> Hot or toxic fluid could escape! Damage to the pump!</p> <p>▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.</p>

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.
3. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).

#### 6.1.5 Water cooling

	<b>CAUTION</b>
	<p><b>Deposit-forming, aggressive cooling water</b> Damage to the pump!</p> <p>▷ Observe the cooling water quality.</p>





Observe the following quality data of the cooling water:

- Not deposit-forming
- Not aggressive
- Free from suspended solids
- Hardness on average 5 °dH (~1 mmol/l)
- pH > 8
- Conditioned and neutral with regard to mechanical corrosion
- Inlet temperature  $t_{inl}=10$  to 30 °C  
Outlet temperature  $t_{outl}= 45$  °C max.

#### 6.1.6 Final check

1. Remove the coupling guard / belt guard and, if applicable, the coupling guard footboard.
2. Check the coupling/belt drive alignment, re-align if necessary.  
(⇒ Section 5.6, Page 28) or (⇒ Section 5.7, Page 32)
3. Check proper functioning of coupling, shaft and belt drive.  
Check that the coupling / shaft can be easily rotated by hand.
4. Fit the coupling guard / belt guard and, if applicable, the coupling guard footboard.
5. Check the distance between the coupling and the coupling guard / between the pulleys and the belt guard.  
The coupling guard must not touch the coupling, the belt guard must not touch the pulleys.


### 6.1.7 Start-up

	<div><b>! DANGER</b></div> <p><b>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and/or discharge line closed.</b></p> <p>Explosion hazard! Hot or toxic fluids escaping!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.</li> <li>▷ Only start up the pump set with the discharge-side shut-off element slightly or fully open.</li> </ul>
	<div><b>! DANGER</b></div> <p><b>Excessive temperatures due to dry running or excessive gas content in the fluid handled</b></p> <p>Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Prime the pump as per operating instructions. (⇒ Section 6.1.4, Page 40)</li> <li>▷ Always operate the pump within the permissible operating range.</li> </ul>
	<div><b>CAUTION</b></div> <p><b>Abnormal noises, vibrations, temperatures or leakage</b></p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Switch off the pump (set) immediately.</li> <li>▷ Eliminate the causes before returning the pump set to service.</li> </ul>
	<div><b>CAUTION</b></div> <p><b>Start-up against open discharge line</b></p> <p>Motor overload!</p> <ul style="list-style-type: none"> <li>▷ Make sure the motor has sufficient power reserves.</li> <li>▷ Use a soft starter.</li> <li>▷ Use speed control.</li> </ul>

- ✓ The system piping has been cleaned.
- ✓ Pump, suction line and inlet tank, if any, have been vented and primed with the fluid to be handled.
- ✓ The lines for priming and venting have been closed.

1. Fully open the shut-off element in the suction head/suction lift line.
2. Close or slightly open the shut-off element in the discharge line.
3. Start up the motor.

4. Immediately after the pump has reached full rotational speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.


	<div style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></div> <p><b>Misalignment of pump and belt drive</b> Damage to pump, motor and belt drive!</p> <ul style="list-style-type: none"> <li>▷ When the operating temperature has been reached, switch off the pump set and check the belt drive alignment.</li> </ul>
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5. Check the alignment of coupling and belt drive, if any, and re-align if necessary.


#### 6.1.8 Checking the shaft seal

**Mechanical seal** The mechanical seal only leaks slightly or invisibly (as vapour) during operation. Mechanical seals are maintenance-free.

**Double mechanical seal**

	<div style="background-color: #FF4500; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperature of barrier fluid (pumps with double mechanical seal)</b> Explosion hazard! Excessive surface temperature</p> <ul style="list-style-type: none"> <li>▷ For pumps with double mechanical seal, make sure that the barrier fluid's temperature does not exceed 60 °C.</li> </ul>
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**Gland packing** The gland packing must drip slightly during operation.  
Continuously check the throughflow of any barrier fluid and flushing liquid connections provided.

	<div style="background-color: #FF4500; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperatures caused by gland packings</b> Hot or toxic fluids escaping! Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Gland packings must be packed properly.</li> <li>▷ If the gland packing has been tightened to the limit, the gland has to be completely repacked.</li> </ul>
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**Pure graphite packing** If pure graphite packing rings are used, there must always be some leakage.

**Table 16:** Leakage rate of the pure graphite packing (rings)

Quantity	Values
Minimum	10 cm <sup>3</sup> /min
Maximum	20 cm <sup>3</sup> /min

#### Adjusting the leakage

- Prior to commissioning**
1. Only lightly tighten the nuts of the gland follower by hand.
  2. Use a feeler gauge to verify that the gland follower is mounted centred and at a right angle to the shaft.
- ⇒ The gland must leak after the pump has been primed.
- After five minutes of operation**

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></div> <p><b>Unprotected rotating parts</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Do not touch rotating parts.</li> <li>▷ When the pump is running, perform all work with utmost caution.</li> <li>▷ Wear appropriate personal protective equipment.</li> </ul>
---	--

The leakage can be reduced.

1. Tighten the nuts on the gland follower by 1/6 turn.
2. Monitor the leakage for another five minutes.

**Excessive leakage:**

Repeat steps 1 and 2 until the minimum value has been reached.

**Not enough leakage:**

Slightly loosen the nuts at the gland follower.

**No leakage:**

Immediately switch off pump set!

Loosen the gland follower and repeat commissioning.


**Checking the leakage**


After the leakage has been adjusted, monitor the leakage for about two hours at maximum fluid temperature.


Check that enough leakage occurs at the gland packing at minimum fluid pressure.

**6.1.9 Shutdown**

- ✓ The shut-off element in the suction line is and remains open.
- ✓ On pump sets with double mechanical seal, apply the required pressure specified in the general arrangement drawing to the mechanical seal chamber also during standstill.
- ✓ Quench supply must also be ensured during pump standstill.
  1. Close the shut-off element in the discharge line.
  2. Switch off the motor and make sure it runs down smoothly to a standstill.

	<div style="background-color: #0072bc; color: white; padding: 5px;"><b>NOTE</b></div> <p>If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.</p>
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	<div style="background-color: #0072bc; color: white; padding: 5px;"><b>NOTE</b></div> <p>If shut-off is not possible, the pump will run in reverse direction. The reverse runaway speed must be lower than the rated speed.</p>
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	<div style="background-color: #ffd966; padding: 5px;"><b>CAUTION</b></div> <p><b>Risk of freezing during pump shutdown</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Drain the pump and cooling/heating chambers (if any) or otherwise protect them against freezing.</li> </ul>
---	---


For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close any auxiliary connections.  
If the fluid to be handled is fed in under vacuum, also supply the shaft seal with barrier fluid during standstill.  
Only turn off the cooling liquid supply after the pump has cooled down.
3. Drain the pump. (⇒ Section 7.3, Page 55)

## 6.2 Operating limits

	<p><b>⚠ DANGER</b></p> <p><b>Non-compliance with operating limits for pressure, temperature, fluid handled and speed</b> Explosion hazard! Hot or toxic fluid could escape!</p> <ul style="list-style-type: none"> <li>▷ Comply with the operating data specified in the data sheet.</li> <li>▷ Never use the pump for handling fluids it is not designed for.</li> <li>▷ Avoid prolonged operation against a closed shut-off element.</li> <li>▷ Never operate the pump at temperatures, pressures or rotational speeds exceeding those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Formation of a potentially explosive atmosphere inside the pump</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ When draining tanks take suitable measures to prevent dry running of the pump (e.g. fill level monitoring).</li> </ul>

### 6.2.1 Ambient temperature

	<p><b>CAUTION</b></p> <p><b>Operation outside the permissible ambient temperature</b> Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▷ Observe the specified limits for permissible ambient temperatures.</li> </ul>
---	--



Observe the following parameters and values during operation:

**Table 17:** Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	50 °C 40 °C <sup>13)</sup>
Minimum	See data sheet.

<sup>13</sup> For compliance with UK *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016*. Higher ambient temperature possible in individual cases, see data sheet and name plate.


### 6.2.2 Frequency of starts

	 <b>DANGER</b>
	<p><b>Excessive surface temperature of the motor</b></p> <p>Explosion hazard! Damage to the motor!</p> <p>▷ In case of explosion-proof motors, observe the frequency of starts specified in the manufacturer's product literature.</p>

The frequency of starts is determined by the maximum temperature increase of the motor. The frequency of starts depends on the power reserves of the motor in steady-state operation and on the starting conditions (DOL starting, star-delta starting, moments of inertia, etc). If the start-ups are evenly spaced over the period indicated, the following limits serve as orientation for start-up with the discharge-side shut-off valve slightly open:

**Table 18:** Frequency of starts

Motor rating [kW]	Maximum frequency of starts [Starts/hour]
≤ 12	15
≤ 100	10
> 100	5

	<b>CAUTION</b>
	<p><b>Re-starting while motor is still running down</b></p> <p>Damage to the pump (set)!</p> <p>▷ Do not re-start the pump set before the pump rotor has come to a standstill.</p>

### 6.2.3 Fluid handled

#### 6.2.3.1 Flow rate

Unless specified otherwise in the characteristic curves or in the data sheets, the following applies:

- Short-time operation:  $Q_{min}^{14)} = 0.1 \times Q_{BEP}^{15)}$
- Continuous operation:  $Q_{min}^{14)} = 0.3 \times Q_{BEP}^{15)}$
- 2-pole operation:  $Q_{max}^{16)} = 1.1 \times Q_{BEP}^{15)}$
- 4-pole operation:  $Q_{max}^{16)} = 1.25 \times Q_{BEP}^{15)}$

The data refer to water and water-like fluids. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures on the pump surface. However, if the physical properties of the fluids handled differ from those of water, the calculation formula below must be used to check if an additional heat build-up may lead to a dangerous temperature increase at the pump surface. If necessary, the minimum flow must be increased.

$$T_O = T_f + \Delta \vartheta$$

$$\Delta \vartheta = \frac{g \times H}{c \times \eta} \times (1 - \eta)$$

<sup>14</sup> Minimum flow rate

<sup>15</sup> Flow rate at best efficiency point


<sup>16</sup> Maximum flow rate

Table 19: Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Acceleration due to gravity	m/s <sup>2</sup>
H	Pump discharge head	m
T <sub>f</sub>	Fluid temperature	°C
T <sub>o</sub>	Temperature at the casing surface	°C
$\eta$	Pump efficiency at duty point	-
$\Delta\vartheta$	Temperature difference	K

### 6.2.3.2 Density of the fluid handled

The power input of the pump set will change in proportion to the density of the fluid handled.

	<div style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></div> <p><b>Impermissibly high density of the fluid handled</b> Motor overload!</p> <ul style="list-style-type: none"> <li>▷ Observe the information about fluid density in the data sheet.</li> <li>▷ Make sure the motor has sufficient power reserves.</li> </ul>
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### 6.2.3.3 Abrasive fluids

Do not exceed the maximum permissible solids content specified in the data sheet. When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and shaft seal are to be expected. In this case, reduce the commonly recommended inspection intervals.

## 6.3 Shutdown/storage/preservation

### 6.3.1 Measures to be taken for shutdown

#### The pump (set) remains installed

- ✓ Sufficient fluid is supplied for the functional check run of the pump.
  1. For prolonged shutdown periods, start up the pump (set) regularly between once a month and once every three months for approximately five minutes.
    - ⇒ This will prevent the formation of deposits within the pump and the pump intake area.

#### The pump (set) is removed from the pipe and stored




- ✓ The pump has been properly drained. (⇒ Section 7.3, Page 55)
- ✓ The safety instructions for dismantling the pump have been observed. (⇒ Section 7.4.1, Page 55)
- ✓ The permissible ambient temperature for storing the pump is observed.
  1. Spray-coat the inside wall of the pump casing and, in particular, the impeller clearance areas with a preservative.
  2. Spray the preservative through the suction nozzle and discharge nozzle. It is advisable to then close the pump nozzles (e.g. with plastic caps)
  3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil or grease, food-approved, if required) to protect them against corrosion.
    - Observe the additional instructions on preservation. (⇒ Section 3.3, Page 14)

If the pump set is to be stored temporarily, only preserve the wetted components made of low-alloy materials. Commercially available preservatives can be used for this purpose. Observe the manufacturer's instructions for application/removal.

#### 6.4 Returning to service

For returning the equipment to service observe the sections on commissioning/start-up and the operating limits. (⇒ Section 6.1, Page 38) (⇒ Section 6.2, Page 45)












In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 49)

	<div> <b>WARNING</b></div> <div><b>Failure to re-install or re-activate protective devices</b></div> <div>Risk of injury from moving parts or escaping fluid!</div> <div>▷ As soon as the work is completed, properly re-install and re-activate any safety-relevant devices and protective devices.</div>
	<div><b>NOTE</b></div> <div>If the equipment has been out of service for more than one year, replace all elastomer seals.</div>




## 7 Servicing/Maintenance

### 7.1 Safety regulations

	<div>  <b>DANGER</b> </div> <div> <b>Improper cleaning of coated pump surfaces</b> </div> <div> Explosion hazard by electrostatic discharge! </div> <div> <ul style="list-style-type: none"> <li>▷ When cleaning coated pump surfaces in atmospheres of Explosion group IIC, use suitable anti-static equipment.</li> </ul> </div>
	<div>  <b>DANGER</b> </div> <div> <b>Sparks produced during servicing work</b> </div> <div> Explosion hazard! </div> <div> <ul style="list-style-type: none"> <li>▷ Observe the safety regulations in force at the place of installation!</li> <li>▷ Always perform maintenance work at an explosion-proof pump (set) outside of potentially explosive atmospheres.</li> </ul> </div>
 	<div>  <b>DANGER</b> </div> <div> <b>Improperly serviced pump set</b> </div> <div> Explosion hazard! </div> <div> Damage to the pump set! </div> <div> <ul style="list-style-type: none"> <li>▷ Service the pump set regularly.</li> <li>▷ Prepare a maintenance schedule with special emphasis on lubricants, shaft seal and coupling.</li> </ul> </div>
	<div>  <b>WARNING</b> </div> <div> <b>Unintentional starting of the pump set</b> </div> <div> Risk of injury by moving components and shock currents! </div> <div> <ul style="list-style-type: none"> <li>▷ Ensure that the pump set cannot be started unintentionally.</li> <li>▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.</li> </ul> </div>
	<div>  <b>WARNING</b> </div> <div> <b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b> </div> <div> Risk of injury! </div> <div> <ul style="list-style-type: none"> <li>▷ Observe all relevant laws.</li> <li>▷ When draining the fluid take appropriate measures to protect persons and the environment.</li> <li>▷ Decontaminate pumps which handle fluids posing a health hazard.</li> </ul> </div>

The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

	<b>⚠ WARNING</b>
	<b>Insufficient stability</b> Risk of crushing hands and feet! <ul style="list-style-type: none"> <li>▷ During assembly/dismantling, secure the pump (set)/pump parts to prevent tilting or tipping over.</li> </ul>


A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump, pump set and pump parts with a minimum of servicing/maintenance expenditure and work.



	<b>NOTE</b>
	All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. For contact details refer to the enclosed "Addresses" booklet or visit " <a href="http://www.ksb.com/contact">www.ksb.com/contact</a> " on the Internet.



Never use force when dismantling and reassembling the pump set.





## 7.2 Servicing/Inspection

### 7.2.1 Supervision of operation

	<b>⚠ DANGER</b>
	<b>Risk of potentially explosive atmosphere inside the pump</b> Explosion hazard! <ul style="list-style-type: none"> <li>▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times.</li> <li>▷ Provide sufficient inlet pressure.</li> <li>▷ Provide an appropriate monitoring system.</li> </ul>


 	<b>⚠ DANGER</b>
	<b>Incorrectly serviced shaft seal</b> Explosion hazard! Hot, toxic fluid escaping! Damage to the pump set! Risk of burns! Fire hazard! <ul style="list-style-type: none"> <li>▷ Regularly service the shaft seal.</li> </ul>

 	<b>⚠ DANGER</b>
	<b>Excessive temperatures as a result of bearings running hot or defective bearing seals</b> Explosion hazard! Fire hazard! Damage to the pump set! Risk of burns! <ul style="list-style-type: none"> <li>▷ Regularly check the lubricant level.</li> <li>▷ Regularly check the rolling element bearings for running noises.</li> </ul>



	<div> <b>DANGER</b></div> <p><b>Incorrectly serviced barrier fluid system</b>  Explosion hazard!  Fire hazard!  Damage to the pump set!  Hot and/or toxic fluids escaping!</p> <ul style="list-style-type: none"> <li>▷ Regularly service the barrier fluid system.</li> <li>▷ Monitor the barrier fluid pressure.</li> </ul>
	<div><b>CAUTION</b></div> <p><b>Increased wear due to dry running</b>  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Never close the shut-off element in the suction line and/or supply line during pump operation.</li> </ul>
	<div><b>CAUTION</b></div> <p><b>Impermissibly high temperature of fluid handled</b>  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).</li> <li>▷ Observe the temperature limits in the data sheet and in the section on operating limits. (⇒ Section 6.2, Page 45)</li> </ul>

While the pump is in operation, observe and check the following:

- The pump must run quietly and free from vibrations at all times.
- In case of oil lubrication, ensure the oil level is correct. (⇒ Section 6.1.2, Page 38)
- Check the shaft seal. (⇒ Section 6.1.8, Page 43)
- Check the static sealing elements for leakage.
- Check the rolling element bearings for running noises.  
Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the correct functioning of any auxiliary connections.
- Cooling system  
Take the pump out of service at least once a year to thoroughly clean the cooling system.
- Monitor the stand-by pump.  
To make sure that the stand-by pumps are ready for operation, start them up once a week.
- Monitor the bearing temperature.  
The bearing temperature must not exceed 90 °C (measured on the outside of the bearing bracket).

	<div><b>CAUTION</b></div> <p><b>Operation outside the permissible bearing temperature</b>  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ The bearing temperature of the pump (set) must never exceed 90 °C (measured on the outside of the bearing bracket).</li> </ul>
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### 7.2.2 Inspection work

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperatures caused by friction, impact or frictional sparks</b>  Explosion hazard!  Fire hazard!  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Regularly check the coupling guard, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.</li> </ul>
	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Electrostatic charging due to insufficient potential equalisation</b>  Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Make sure that the connection between pump and baseplate is electrically conductive.</li> </ul>


#### 7.2.2.1 Checking the coupling

Check the flexible elements of the coupling. Replace the relevant parts in due time if there is any sign of wear and check the alignment.

#### 7.2.2.2 Cleaning filters


	<div style="background-color: #f4a460; padding: 5px;"><b>CAUTION</b></div> <p><b>Insufficient inlet pressure due to clogged filter in the suction line</b>  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Monitor contamination of filter with suitable means (e.g. differential pressure gauge).</li> <li>▷ Clean filter at appropriate intervals.</li> </ul>
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#### 7.2.2.3 Checking the bearing seals

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperatures caused by mechanical contact</b>  Risk of explosion!  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Check correct seating of axial seal rings mounted on the shaft.  Only gentle contact of the sealing lip shall be established.</li> </ul>
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#### 7.2.2.4 Visual inspection through the inspection hole (optional)

If there are problems with clogging, the inside of the casing and the impeller can be checked via the inspection hole.

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></div> <p><b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b>  Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of flushing fluid and any fluid residues.</li> <li>▷ Wear safety clothing and a protective mask if required.</li> <li>▷ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>
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	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></div> <p><b>Hands or foreign objects in the pump casing</b> Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.</li> <li>▸ Never insert your hands or any other objects into the pump, if the pump set has not been disconnected from the power supply and secured against unintentional start-up.</li> </ul>
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If a problem has occurred which requires visual inspection, observe the following instructions:

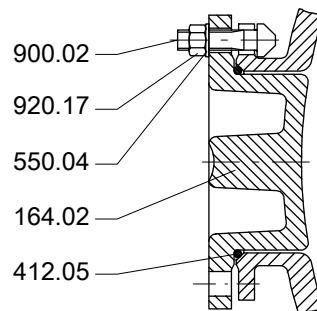


Fig. 24: Inspection hole in the casing


#### Opening the inspection hole

- Close the shut-off element on the suction side.
- Switch off the drive and make sure it cannot be re-started unintentionally.
- Close the shut-off element on the discharge side.
- Open the drain plug (auxiliary connection 6B).
- Collect and dispose of any liquid residues.
- Loosen nuts 920.17 at the inspection hole. Remove inspection cover 164.02.
- Perform a visual inspection with a lamp or similar.

#### Closing the inspection hole

- Fit new O-ring 412.05.
- Fit inspection cover 164.02.
- Fit discs 550.04 and nuts 920.17 on screws 900.02. Tighten the nuts.
- Observe the instructions on commissioning/start-up.

### 7.2.3 Lubrication and lubricant change of rolling element bearings

	<div style="background-color: #d95319; color: white; padding: 5px;"><b>⚠ DANGER</b></div> <p><b>Excessive temperatures as a result of bearings running hot or defective bearing seals</b> Explosion hazard! Fire hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Regularly check the condition of the lubricant.</li> </ul>
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#### 7.2.3.1 Oil lubrication

The rolling element bearings are lubricated with mineral oil.

### 7.2.3.1.1 Intervals

**Table 20:** Oil change intervals

Oil change	Interval <sup>17)</sup>	
	Bearing bracket up to P04ax	Bearing bracket from P05ax
Change of initial oil fill	After 300 operating hours	After 300 operating hours
Further oil changes	Every 6000 operating hours <sup>18)</sup>	Every 8000 operating hours <sup>18)</sup>

If the oil is contaminated, change the oil more frequently, as required.

### 7.2.3.1.2 Oil quality

**Table 21:** Lubricant characteristics



Description	Properties	
Lubricating oil CL68 or CLP68 to DIN 51517	Kinematic viscosity at 40 °C	68±6 mm²/s
	Flash point (to Cleveland)	+175 °C
	Solidification point (pour point)	-9 °C
	Application temperature <sup>19)</sup>	0-175 °C

### 7.2.3.1.3 Oil quantity

**Table 22:** Standard bearings

Bearing bracket	Rolling element bearings		Oil quantity [l]
	Pump end <sup>20)</sup>	Motor end <sup>21)</sup>	
P04ax	NU 411	2 x 7311 BG	0,6
P05ax	NU 413	2 x 7313 BG	1,8
P06x	NU 413	2 x 7313 BG	1,8

### 7.2.3.1.4 Changing the oil

	 <b>WARNING</b>
	<p><b>Lubricants posing a health hazard and/or hot lubricants</b></p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▶ When draining the lubricant take appropriate measures to protect persons and the environment.</li> <li>▶ Wear safety clothing and a protective mask if required.</li> <li>▶ Collect and dispose of any lubricants.</li> <li>▶ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>

<sup>17)</sup> At temperatures up to 90 °C at the bearing

<sup>18)</sup> At least once a year

<sup>19)</sup> For ambient temperatures below 0 °C use a different suitable type of lubricating oil. Contact the manufacturer.

<sup>20)</sup> To DIN 5412

<sup>21)</sup> To DIN 628

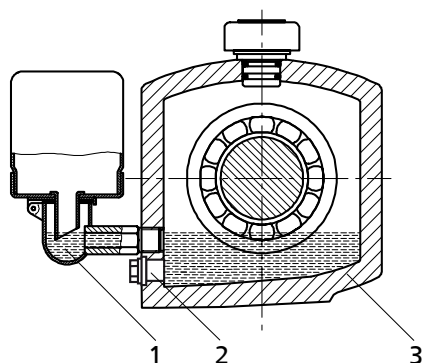


Fig. 25: Bearing bracket with constant level oiler

1	Constant level oiler	2	Screw plug
3	Bearing bracket		

- ✓ A suitable container for the used oil is on hand.
1. Place the container underneath the screw plug.
  2. Undo the screw plug (2) at the bearing bracket (3) and drain the oil.
  3. Once the bearing bracket (3) has been drained, re-insert and re-tighten the screw plug (2).
  4. Re-fill with oil. (⇒ Section 6.1.2, Page 38)

### 7.3 Drainage/cleaning

		<b>WARNING</b>
		<p><b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b></p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of flushing fluid and any fluid residues.</li> <li>▷ Wear safety clothing and a protective mask if required.</li> <li>▷ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>







If the pump set has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump set must be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.

Use connection 6B to drain the fluid handled (see drawing of auxiliary connections).

### 7.4 Dismantling the pump set

#### 7.4.1 General information/Safety regulations

		<b>DANGER</b>
		<p><b>Insufficient preparation of work on the pump (set)</b></p> <p>Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Properly shut down the pump set. (⇒ Section 6.1.9, Page 44)</li> <li>▷ Close the shut-off elements in the suction line and discharge line.</li> <li>▷ Drain the pump and release the pump pressure. (⇒ Section 7.3, Page 55)</li> <li>▷ Shut off any auxiliary feed lines.</li> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>



	<div> <b>WARNING</b></div> <div><b>Unqualified personnel performing work on the pump (set)</b></div> <div>Risk of injury!</div> <div> <ul style="list-style-type: none"> <li>▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.</li> </ul> </div>
	<div> <b>WARNING</b></div> <div><b>Hot surface</b></div> <div>Risk of injury!</div> <div> <ul style="list-style-type: none"> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul> </div>
	<div> <b>WARNING</b></div> <div><b>Improper lifting/moving of heavy assemblies or components</b></div> <div>Personal injury and damage to property!</div> <div> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul> </div>

Always observe the safety instructions and information. (⇒ Section 7.1, Page 49)

For any work on the motor, observe the instructions of the relevant motor manufacturer.

For dismantling and reassembly observe the exploded views and the general assembly drawing. (⇒ Section 9.1, Page 73)



In the event of damage you can always contact our service departments.

	<div><b>NOTE</b></div> <div> <p>All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. For contact details refer to the enclosed "Addresses" booklet or visit "<a href="http://www.ksb.com/contact">www.ksb.com/contact</a>" on the Internet.</p> </div>
	<div><b>NOTE</b></div> <div> <p>After a prolonged period of operation the individual components may be hard to pull off the shaft. If this is the case, use a brand name penetrating agent and/or - if possible - an appropriate puller.</p> </div>

#### 7.4.2 Preparing the pump set


1. De-energise the pump set and secure it against unintentional start-up.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard or belt guard.
4. Remove the coupling spacer, if any.
5. Drain the oil fill of oil-lubricated bearings (⇒ Section 7.2.3.1.4, Page 54) .

#### 7.4.3 Dismantling the motor

	<div> <b>WARNING</b></div> <div><b>Motor tipping over</b></div> <div>Risk of squashing hands and feet!</div> <div> <ul style="list-style-type: none"> <li>▷ Suspend or support the motor to prevent it from tipping over.</li> </ul> </div>
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### Version with coupling

	<table><tr><th>NOTE</th></tr><tr><td>On pump sets with spacer-type couplings, the back pull-out unit can be removed while the motor remains bolted to the baseplate.</td></tr></table>	NOTE	On pump sets with spacer-type couplings, the back pull-out unit can be removed while the motor remains bolted to the baseplate.
NOTE			
On pump sets with spacer-type couplings, the back pull-out unit can be removed while the motor remains bolted to the baseplate.			



- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.2, Page 56) have been observed and carried out.

1. Disconnect the motor from the power supply.
2. Undo the coupling fasteners.
3. Unbolt the motor from the baseplate.
4. Shift the motor to separate it from the pump.

### Version with belt drive


1. Disconnect the motor from the power supply.
2. Lower motor support plate 81-54.01 by turning threaded rods 904.23/904.24 and nuts 920.63/920.64 until the V-belts slacken.
3. Remove the V-belts.
4. Undo and remove hexagon bolts 901.62 and discs 550.62 fastening the motor to the motor bracket.
5. Lift the motor off the motor bracket.
6. Undo hexagon nuts 920.23/920.24 at the pump or motor stand (Figure 3Z).
7. Remove the motor bracket from the pump or baseplate (Figure 3Z) and set it down.
8. Undo bushing 540.02 at pump-end V-belt pulley 882.01.
9. Remove V-belt pulley 882.01 from shaft 210.

### 7.4.4 Removing the back pull-out unit

	<div><b>WARNING</b></div> <div><b>Back pull-out unit tilting</b> Risk of squashing hands and feet! ▷ Suspend or support the back pull-out unit at the pump end.</div>
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- ✓ The steps and notes stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.3, Page 56) have been observed and carried out.
- ✓ On pump sets with a belt drive or pump sets with a coupling without spacer sleeve, the motor has been removed.

1. Loop a rope tightly around bearing bracket lantern 344.
2. Unbolt and remove support foot 183 from the baseplate.
3. Undo hexagon nuts 920.01 at the volute casing.
4. Pull the back pull-out unit out of volute casing 101.

	<table><tr><th>NOTE</th></tr><tr><td>Use forcing screws 901.31 to facilitate disassembly. Clean the threads of the forcing screws before using them.</td></tr></table>	NOTE	Use forcing screws 901.31 to facilitate disassembly. Clean the threads of the forcing screws before using them.
NOTE			
Use forcing screws 901.31 to facilitate disassembly. Clean the threads of the forcing screws before using them.			

5. Carefully place the back pull-out unit on a clean and level surface.
6. Remove and dispose of joint ring 411.10.

#### 7.4.5 Removing the impeller

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.4, Page 57) have been observed/carried out.
- ✓ The back pull-out unit is kept in a clean and level assembly area.
  1. Remove plug 400.65.
  2. Undo impeller screw 914.12 (right-hand thread).
  3. Remove and dispose of joint ring 411.59.
  4. Remove impeller 230 with an impeller removal tool.
  5. Place impeller 230 on a clean and level surface.
  6. Remove keys 940.01 from shaft 210.

#### 7.4.6 Removing the shaft seal

##### 7.4.6.1 Dismantling the mechanical seal – type 4K

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.5, Page 58) have been observed and carried out.
- ✓ The back pull-out unit of the pump has been placed in a clean and level assembly area.
- ✓ The impeller and keys have been removed from the pump shaft.
  1. Position the bearing vertically by clamping it at the drive-end shaft end.
  2. Pull shaft sleeve 523 with mating ring 475.52 of the mechanical seal and O-ring 412.06 off the shaft using an extractor in the removal groove in the shaft sleeve.
  3. Pull mating ring 475.52 of the mechanical seal out of shaft sleeve 523.
  4. Undo hexagon head bolts 901.22. Remove discharge cover 163 with joint ring 411.10 as well as the primary ring with the secondary seal and the spring arrangement from the bearing bracket lantern.
  5. Press primary ring 472.53 with secondary seal 412.51 out of discharge cover 163.
  6. Undo hexagon socket head cap screws 914 with springs 477 and thrust ring 474.53.


##### 7.4.6.2 Dismantling the gland packing

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.5, Page 58) have been observed/carried out.
- ✓ The back pull-out unit is kept in a clean and level assembly area.
  1. Undo hexagon nuts 920.02 at gland follower 452.01.
  2. Remove gland follower 452.01.  
Watch discs 550.01.
  3. Undo hexagon head bolts 901.22. Then remove discharge cover 163 from bearing bracket lantern 344.
  4. Remove discharge cover 163 with gland packing and drip plate 463.01.
  5. Remove the gland packing from the packing chamber.
  6. Press out neck bush 456.01.

#### 7.4.7 Dismantling the bearings

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.6, Page 58) have been observed/carried out.
  1. Undo hexagon nuts 920.04 and remove bearing bracket lantern 344.
  2. Pull shaft protecting sleeve 524.01 with gasket 400.04 or O-ring 412.06 off shaft 210.
  3. Bend open and pull off thrower 507.01
  4. Undo the hexagon socket head cap screw in the coupling hub.

5. Pull the coupling hub off shaft 210 with a puller.
6. Remove key 940.02.
7. Undo hexagon socket head cap screws 914.01/914.02. Pull off bearing cover 360.01/02 with gasket 400.01 and shaft seal ring 421.01 at the pump end.
8. Carefully drive shaft 210 together with angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 out of bearing bracket 330 towards the drive end.
9. Place shaft 210 with the rolling element bearing on a suitable surface.
10. Remove support disc 550.23 and circlips 932.01/932.02.
11. Remove the outer ring of cylindrical roller bearing 322.01 (roller cage) from bearing bracket 330.
12. Pull bearing bracket 382 with O-ring 412.02 and shaft seal ring 421.01 off angular contact ball bearing 320.02.
13. Bend open lock washer 931.01.
14. Undo slotted round nut 920.21 (right-hand thread!)
15. Remove lock washer 931.01.

	<b>⚠ WARNING</b>
	<p><b>Hot surfaces due to heating of components for assembly/dismantling</b> Risk of burns!</p> <ul style="list-style-type: none"> <li>▷ Wear heat-resistant protective gloves.</li> <li>▷ Remove flammable substances from the danger zone.</li> <li>▷ Observe the applicable local occupational safety regulations and accident prevention regulations.</li> </ul>



16. Heat up angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 to 80 °C, and pull them off shaft 210.

#### 7.4.8 Removing the suction cover

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 55) to (⇒ Section 7.4.7, Page 58) have been observed/carried out.
1. Undo hexagon head bolts 901.03.
  2. Remove suction cover 162 with O-ring 412.05. Watch shims 89-4.06.


### 7.5 Reassembling the pump set

#### 7.5.1 General information/Safety regulations

	<b>⚠ WARNING</b>
	<p><b>Improper lifting/moving of heavy assemblies or components</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Improper reassembly</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.</li> <li>▷ Use original spare parts only.</li> </ul>

**Sequence** Always reassemble the pump in accordance with the corresponding general assembly drawing.

- Sealing elements**
- **Gaskets**
    - Always use new gaskets, making sure that they have the same thickness as the old ones.
    - Always fit gaskets of asbestos-free materials or graphite without using lubricants (e.g. copper grease, graphite paste).
  - **O-rings**
    - Never use O-rings that have been glued together from material sold by the metre.
  - **Packing rings**
    - Always use pre-compressed packing rings.

	<p style="text-align: center;"><b>CAUTION</b></p> <p><b>Contact of O-ring with graphite or similar material</b> Fluid could escape!</p> <ul style="list-style-type: none"> <li>▷ Do not coat O-ring with graphite or similar material.</li> <li>▷ Use animal fats or lubricants based on silicone or PTFE.</li> </ul>
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- **Assembly aids**
  - For gaskets, avoid the use of assembly adhesives, if possible.
  - If assembly adhesives are required, use a commercially available contact adhesive (e.g. Pattex).
  - Only apply adhesive at selected points and in thin layers.
  - Never use quick-setting adhesives (cyanoacrylate adhesives).
  - Coat the locating surfaces of the individual components and screwed connections with graphite or similar before reassembly.
  - Prior to reassembly, screw back any forcing screws or alignment screws.


**Tightening torques** For reassembly, tighten all screws and bolts as indicated. (⇒ Section 7.6.1, Page 68)

### 7.5.2 Fitting the suction cover


- ✓ The individual parts have been placed in a clean and level assembly area.
  - ✓ All dismantled parts have been cleaned and checked for wear.
  - ✓ Any damaged or worn parts have been replaced by original spare parts.
  - ✓ The sealing surfaces have been cleaned.
  - ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) have been observed/ carried out.
1. Fit O-ring 412.05 on suction cover 162.
  2. Fit the set of shims 89-4.06.
  3. Fit suction cover 162 with O-ring 412.05 and the set of shims 89-4.06 in casing 101.
  4. Fasten pre-assembled suction cover 162 to the pump casing using hexagon nuts 901.03. Observe the tightening torques. (⇒ Section 7.6.1, Page 68)

### 7.5.3 Fitting the bearings

- ✓ The individual parts have been placed in a clean and level assembly area.
- ✓ All dismantled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.2, Page 60) have been observed/carried out.

	<div style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></div> <p><b>Hot surfaces due to heating of components for assembly/dismantling</b> Risk of burns!</p> <ul style="list-style-type: none"> <li>▷ Wear heat-resistant protective gloves.</li> <li>▷ Remove flammable substances from the danger zone.</li> <li>▷ Observe the applicable local occupational safety regulations and accident prevention regulations.</li> </ul>
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1. Heat up angular contact ball bearing 320.02 / deep groove ball bearing 321.01 and the inner ring of cylindrical roller bearing 322.01 to approx. 80 °C in an oil bath.
2. Slide angular contact ball bearing 320.02 / deep groove ball bearing 321.01 and the inner ring of cylindrical roller bearing 322.01 onto shaft 210 until they will not go any further.

	<div style="background-color: #0070c0; color: white; padding: 5px;"><b>NOTE</b></div> <p>Angular contact ball bearings must be installed in back-to-back arrangement. Angular contact ball bearings installed in pairs must always be from the same manufacturer.</p>
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3. Use a C-spanner to tighten slotted round nut 920.21 without lock washer 931.01.
4. Let angular contact ball bearing 320.02 / deep groove ball bearing 321.01 cool down to approximately 5 °C above ambient temperature.
5. Re-tighten slotted round nut 920.21, then unscrew it again.
6. Apply a few spots of a suitable lubricant (e.g. Molykote) to the contact faces of lock washer 931.01 and slotted round nut 920.21.
7. Fit lock washer 931.01.
8. Tighten slotted round nut 920.21.
9. Bend back lock washer 931.01.
10. Pull bearing carrier 382 onto angular contact ball bearing 320.02.
11. Fit support disc 550.23.
12. Fit circlips 932.01/932.03 in the bearing bracket / bearing carrier.
13. Fit the outer ring of angular contact ball bearing 322.01.
14. Carefully slide pre-assembled shaft 210 with bearing carrier 382, O-ring 412.02 and lip seal 421.02 from the drive end into bearing bracket 330 until it will not go any further.  
Verify that the oil return bores are positioned correctly.
15. Tighten hexagon socket head cap screws 914.02. Observe the tightening torques. (⇒ Section 7.6.1, Page 68)
16. Insert grub screws 902.04.
17. Fit O-ring 412.36 and disc 507.11.
18. Fit pump-end bearing cover 360.01 with joint ring 400.01.  
Take care not to damage lip seal 421.01.

19. Tighten hexagon socket head cap screws 914.01 at the pump end. Observe the tightening torques. (⇒ Section 7.6.1, Page 68)
20. Fit bearing bracket lantern 344 with studs 902.04.
21. Tighten hexagon nuts 920.04 at the flange of bearing bracket lantern 330.
22. Fit keys 940.02.
23. Slide the coupling hub onto the shaft end.
24. Secure the coupling hub with an adjusting screw.
25. Fit thrower 507.01, if any.

#### 7.5.4 Fitting the shaft seal

##### 7.5.4.1 Installing the mechanical seal

The following rules must be observed when installing the mechanical seal:

- For installing the mechanical seal, proceed as shown in the seal installation drawing.
- Work cleanly and accurately.
- Only remove the protective wrapping of the seal faces immediately before installation takes place.
- Prevent any damage to the sealing surfaces or O-rings.
- After inserting the mating ring, check that it is plane-parallel in relation to the casing part.
- The surface of the shaft protecting sleeve must be absolutely clean and smooth, and the sleeve's mounting edge must be chamfered.
- When sliding the rotating assembly onto the shaft protecting sleeve, take appropriate measures to protect the surface of the shaft protecting sleeve from damage.
- On pumps with double mechanical seal, properly vent the mechanical seal chamber and apply the required pressure specified in the general arrangement drawing (also during standstill).
- Quench supply must also be ensured during pump standstill.


##### Installing the mechanical seal, type 4 K

- ✓ The bearing assembly and the individual parts of mechanical seal 433 have been placed in a clean and level assembly area.
  - ✓ All dismantled parts have been cleaned and checked for wear.
  - ✓ Any damaged or worn parts have been replaced by original spare parts.
  - ✓ The sealing surfaces have been cleaned.
  - ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to have been observed/ carried out.
1. Insert thrust ring 474 into the turned recess on the rear side of the discharge cover.
  2. Slide springs 477 onto hexagon socket head cap screws 914.
  3. Apply a thread-locking agent to the threads of hexagon socket head cap screws 914 (recommended).


**Table 23:** Tightening torques of hexagon socket head cap screws 914

Seal size	Thread	Tightening torque [Nm]
Small seal sizes	M6	8
Large seal sizes	M10	20

4. Thread hexagon socket head cap screws 914 with fitted springs 477 through the holes in thrust ring 474 and fasten them inside the pump cover.  
Make sure that thrust ring 474 can move freely. When tightening the screws, make sure not to block the axial movement of the thrust ring.  
Observe the tightening torques. (⇒ Section 7.6.1, Page 68)

	<div style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></div> <p><b>Contact of O-ring with lubricant made of mineral grease or oil</b> Damage to the O-ring!</p> <ul style="list-style-type: none"> <li>▷ Make sure that O-rings made of ethylene propylene rubber cannot come into contact with mineral oil or mineral grease.</li> <li>▷ Make sure that O-rings made of silicone rubber cannot come into contact with silicone oil or silicone grease.</li> </ul>
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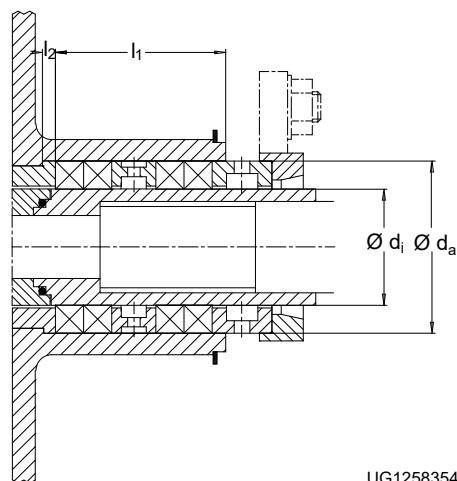
5. Coat O-ring 412.51 and the O-ring seat in primary ring 472.51 with a suitable lubricant.
6. Insert O-ring 412.51 into the groove of the discharge cover.
7. Carefully install primary ring 472.51.  
Make sure that thrust ring 474 can move freely. When tightening the screws, make sure not to block the axial movement of the thrust ring.
8. Mount the complete discharge cover with joint ring 411.10 on bearing bracket lantern 344.
9. Tighten hexagon head bolts 901.22.  
Observe the tightening torques. (⇒ Section 7.6.1, Page 68)
10. Insert O-ring 412.52 for mating ring 472.52 into shaft sleeve 523.

	<div style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></div> <p><b>Use of grease or other permanent lubricants</b> Torque transmission impeded / overheating of and damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Never use grease or other permanent lubricants for fitting the torque-transmitting elements of a mechanical seal.</li> <li>▷ Use soft soap to reduce any friction caused during assembly.</li> <li>▷ Never coat the mechanical seal faces with grease or oil.</li> </ul>
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11. Carefully press in mating ring 472.52.
12. Dry and clean the seal faces (e.g. with acetone).
13. Slide shaft sleeve 523 with mating ring 472.52 onto pump shaft 210 until it abuts against the shaft shoulder.

### 7.5.4.2 Fitting the gland packing

#### Gland packing chamber



UG1258354

Fig. 26: Dimensions of the packing chamber / Number of packing rings

Table 24: Gland packing chamber

Bearing bracket	Gland packing chamber					Number of packing rings	
	Ø d <sub>i</sub>	Ø d <sub>a</sub>	□	l <sub>1</sub>	l <sub>2</sub>	with lantern ring	without lantern ring
P04ax	55	75	10	64	8	4 <sup>22)</sup>	6
P05ax	70	95	12,5	79	8	4 <sup>22)</sup>	6
P06x	80	105	12,5	79	10	4 <sup>22)</sup>	6

#### Versions

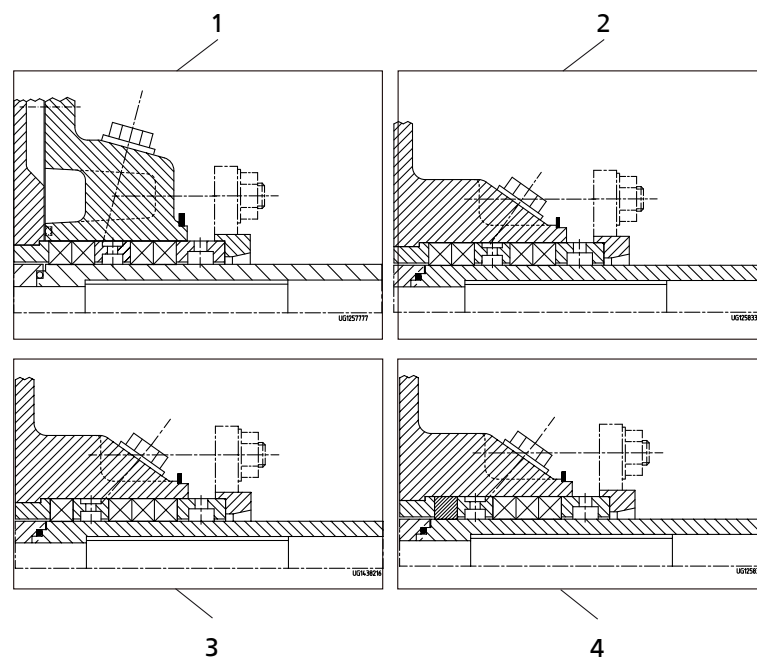


Fig. 27: Available versions

1	Packing with barrier fluid connection (standard)	2	Packing with barrier fluid connection (standard)
3	Packing with barrier fluid connection	4	Packing with flushing liquid connection

<sup>22</sup> For versions with flushing liquid connection: 1 spacer ring and 3 packing rings



- Procedure** For variants with pure graphite packings see supplementary operating instructions. Always use pre-compressed packing rings.
- ✓ The bearing assembly as well as the individual parts are kept in a clean and level assembly area.
  - ✓ All dismantled parts have been cleaned and checked for wear.
  - ✓ Any damaged or worn parts have been replaced by original spare parts.
  - ✓ The sealing surfaces have been cleaned.
  - ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.3, Page 61) have been observed/carried out.
1. Screw stuffing box housing 451.01 (if any) to discharge cover 163. Observe the tightening torques (⇒ Section 7.6.1, Page 68)
  2. Press neck bush 456.01 into the discharge cover.
  3. For packings with barrier fluid connection (see illustration "Available versions" 1 and 2) also fit lantern ring 458.01 in its specified location.
  4. Insert the first packing ring, ensuring that its cut edge is in horizontal position.
  5. Hold the packing ring in place and slide shaft protecting sleeve 524 (chamfered side first) into the gland packing chamber from the pump end.
  6. Slightly expand the inside diameter of the packing ring by moving shaft protecting sleeve 524 back and forth. Then pull out the shaft protecting sleeve. Insert subsequent packing rings one at a time, with their joints staggered at approximately 90°. Repeat the expansion procedure for each packing ring. Insert lantern ring 458.01, if any, in its specified location (see illustration "Available versions"). After inserting the last packing ring, do not remove shaft protecting sleeve 524 from the packing chamber.
  7. Insert stuffing box ring 454.01 so that the joint face is in vertical position to gland follower 452.01.
  8. Fit gland follower 452.01 and lightly fasten it by hand with the two hexagon nuts 920.02. Watch discs 550.01.
  9. Install the completely packed discharge cover 163 with joint ring 411.10 and shaft protecting sleeve 524 in the pump and screw it to bearing bracket lantern 344.
  10. Tighten hexagon head bolts 901.22. Observe the tightening torques. (⇒ Section 7.6.1, Page 68)

#### 7.5.5 Fitting the impeller

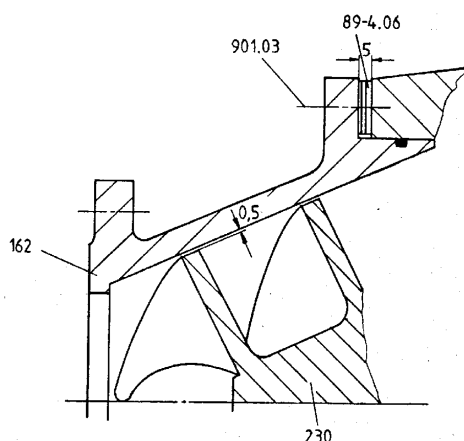
- ✓ The bearing assembly with the shaft seal and the individual parts have been placed in a clean and level assembly area.
  - ✓ All dismantled parts have been cleaned and checked for wear.
  - ✓ Any damaged or worn parts have been replaced by original spare parts.
  - ✓ The sealing surfaces have been cleaned.
  - ✓ Impeller bore, shaft and keyways are clean and free from burrs.
  - ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.4, Page 62) have been observed/carried out.
1. Insert keys 940.01 into the shaft keyway.
  2. Fit gasket 400.04 on shaft sleeve 524.01.
  3. Mount the impeller with an impeller fitting and removal tool.
  4. Carefully insert impeller seal 411.59. Make sure all sealing elements and sealing surfaces are clean!
  5. Insert and tighten impeller screw 914.12. Observe the tightening torques. (⇒ Section 7.6.1, Page 68)

6. Insert plug 400.65.
7. Check the axial rotor adjustment and correct it, if necessary.  
Make sure the distance between the back vane/impeller 230 and discharge cover 163 is  $\leq 1.5$  mm.

### 7.5.6 Installing the back pull-out unit

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.5, Page 65) have been observed/carried out.
  - ✓ Any damaged or worn parts have been replaced by original spare parts.
  - ✓ The sealing surfaces have been cleaned.
  - ✓ For back pull-out units without coupling, fit the coupling in accordance with the manufacturer's instructions.
1. Mount support foot 183.
  2. If required, suspend or support the back pull-out unit to prevent it from tipping over.
  3. Slide the back pull-out unit with new gasket 411.10 into pump casing 101.  
Make sure that impeller 230 does not rest against the wear plate.
  4. Tighten nuts 920.01.
  5. Bolt support foot 183 to the baseplate.

### 7.5.7 Adjusting the clearances



**Fig. 28:** Adjusting the clearance

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.6, Page 66) have been observed/carried out.
1. Verify that the clearance between the impeller back vane and discharge cover 163 measures 1.5 mm.
  2. If adjustment is required: Undo socket head cap screws 914.02.
  3. Screw in grub screws 904.01 to pull back the rotor until it will not go any further (impeller back vanes at discharge cover 163).
  4. Measure the axial clearance between bearing bracket 330 and bearing carrier 382.
  5. Undo grub screws 904.01 and use hexagon socket head cap screws 914.02 to move the rotor 1.5 mm towards the pump end.
  6. Lock the rotor in position by tightening grub screws 904.01.  
(⇒ Section 7.6.1, Page 68)
  7. Adjust the clearance between impeller 230 and suction cover 162. To do so, insert a 5 mm set of shims 89-4.06 at screws 901.03. Tighten suction cover 162. Check that the impeller can rotate freely. Measure the clearance. Remove shims until the clearance measures 0.5 mm.

For sizes 100-205, 125-315 and 200-400 an axial adjustment of 0.3 mm will result in the clearance being increased/reduced by 0.1 mm.

For size 80-315 an axial adjustment of 0.175 mm will result in the clearance being increased/reduced by 0.1 mm.


If the sealing clearance needs to be reduced because of wear, for example, the rotor position can be adjusted accordingly, within limits. The position of the suction cover can also be adjusted.

#### Completing reassembly

1. Fit forcing screws 901.30 on bearing bracket lantern 344 and forcing screws 901.31 on discharge cover 330.
2. For components which are not rotation-symmetrical, fit guard 680.11 (perforated plate) to bearing bracket lantern 344. 12xM6x10 threaded holes are provided for this purpose.


#### 7.5.8 Mounting the motor

##### Version with coupling

	<div style="background-color: #0056b3; color: white; padding: 5px;"><b>NOTE</b></div> <p>Steps 1 and 2 do not apply to versions with spacer-type coupling.</p>
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- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.6, Page 66) have been observed/carried out.
- 1. Shift the motor to align and connect it with the pump via (⇒ Section 5.7, Page 32) the coupling.
- 2. Fasten the motor to the baseplate.
- 3. Align the pump and motor. (⇒ Section 5.7, Page 32)
- 4. Connect the motor to the power supply (refer to manufacturer's product literature).

##### Version with belt drive

	<div style="background-color: #f4a460; color: black; padding: 5px;"><b>WARNING</b></div> <p><b>Motor tipping over</b> Risk of squashing hands and feet!</p> <ul style="list-style-type: none"> <li>▸ Suspend or support the motor to prevent it from tipping over.</li> </ul>
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- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.6, Page 66) have been observed/carried out.
- 1. Position motor support plate 81-54.01 on pump or baseplate.
- 2. Install motor support plate with threaded rods and hexagon nuts 920.23/920.24 on pump or baseplate.
- 3. Position and align the motor on the motor support plate.
- 4. Fasten the motor with hexagon bolts 901.62 and discs 550.6.

### 7.5.9 Fitting the belt drive


	<div style="background-color: yellow; text-align: center;"><b>CAUTION</b></div> <p><b>Poorly checked, inaccurately aligned motor connection</b> Increased wear, insufficient power transmission, loud running noises!</p> <ul style="list-style-type: none"> <li>▷ Always use clean pulleys without any signs of wear.</li> <li>▷ Align the shaft end of pump/motor flush with the pulleys.</li> <li>▷ For multiple V-belt drives: <ul style="list-style-type: none"> <li>- If replacing V-belts always replace the entire set of V-belts.</li> <li>- Use V-belts of the same length.</li> </ul> </li> <li>▷ Only pull on V-belts if this is possible without using any force.</li> <li>▷ Only pull on V-belts by hand. Do not use any tools (e.g. levers).</li> <li>▷ Tension the V-belts properly (⇒ Section 5.6.2, Page 31) .</li> </ul>
	<div style="background-color: yellow; text-align: center;"><b>CAUTION</b></div> <p><b>Swelling of V-belts due to aggressive ambient conditions</b> Reduced service life of V-belts!</p> <ul style="list-style-type: none"> <li>▷ Protect V-belts suitably from oil mist, dripping oil and other chemical influences.</li> </ul>

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 59) to (⇒ Section 7.5.8, Page 67) have been observed and carried out.
1. Use bush 540.02 to fit V-belt pulley 882.01 on pump shaft 210.
  2. Use bush 540.03 to fit V-belt pulley 882.02 on the motor shaft.
  3. Align V-belt pulleys 882.01/882.02 so that they are flush with each other.  
(⇒ Section 5.6.2, Page 31)
  4. Move fully threaded studs 590.23/590.24 and hexagon nuts 920.63/64 to position motor support plate 81-54.01 in such a way that the V-belts can be pulled onto pulleys 882.01/882.02 without any force.
  5. Pull V-belts on V-belt pulleys 882.01/882.02.  
The use of belt wax or similar is not necessary.
  6. Tension the V-belts. (⇒ Section 5.6.2, Page 31) (⇒ Section 5.7.3, Page 34)
  7. Fit the belt guard.
  8. Connect the motor to the power supply (refer to manufacturer's product literature).

## 7.6 Tightening torques

### 7.6.1 Tightening torques for the pump

#### Casing studs

	<div style="background-color: yellow; text-align: center;"><b>CAUTION</b></div> <p><b>Use of impact screw drivers on NORIHARD casings (NH 153)</b> Damage to screws/bolts and threads!</p> <ul style="list-style-type: none"> <li>▷ Never use an impact screw driver.</li> <li>▷ Make sure that the studs can be screwed in easily for the entire length of the thread.</li> </ul>
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**Table 25:** Tightening torques for bolted/screwed connections<sup>23)24)</sup>

Material	C35E+QT/ C35+N-A2A	A4-70/ A4-70	8.8 A2A/ 8
Stamp mark	YK/Y	A4-70/ A4-70	8.8/ 8
Thread	Tightening torques [Nm]		
M8	-	16	23
M10	-	30	46
M12	40	55	80
M16	100	140	190
M20	190	200	380
M24	330	455	660

## 7.7 Spare parts stock

### 7.7.1 Ordering spare parts

Always quote the following data when ordering replacement or spare parts:

- Order number
- Order item number
- Consecutive number
- Type series
- Size
- Material variant
- Seal code
- Year of construction

Refer to the name plate for all data. (⇒ Section 4.4, Page 16)

Also specify the following data:

- Part number and description (⇒ Section 9.1, Page 73)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

### 7.7.2 Recommended spare parts stock for 2 years' operation to DIN 24296

**Table 26:** Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)							
		1	2	3	4	5	6 and 7	8 and 9	10 and more
135.01	Suction cover	1	2	2	2	3	3	4	50%
210	Shaft	1	1	1	1	2	2	2	20%
230	Impeller	1	1	1	1	2	2	2	20%
320.02	Angular contact ball bearing (set)	1	1	1	2	2	2	3	25%
322.01	Cylindrical roller bearing	1	1	1	2	2	2	3	25%
330	Bearing bracket, complete	-	-	-	-	-	-	1	2
-	Sealing elements for pump casing (set)	2	4	6	8	8	9	12	150%
For variants with mechanical seal									

<sup>23</sup> The values indicated are valid for unlubricated bolts/screws at room temperature.

<sup>24</sup> After repeated tightening of the threads and in case of good lubrication reduce the values by 15 to 20 %.

Part No.	Description	Number of pumps (including stand-by pumps)							
		1	2	3	4	5	6 and 7	8 and 9	10 and more
433.01	Mechanical seal, complete <sup>25)</sup>	1	1	1	2	2	2	3	25%
	Primary ring <sup>25)</sup>	1	2	3	4	5	6	7	90%
	Mating ring <sup>25)</sup>	1	2	3	4	5	6	7	90%
	Secondary seal at mating ring <sup>25)</sup>	1	2	3	4	5	7	9	100%
	Secondary seal at primary ring <sup>25)</sup>	1	2	3	4	5	7	9	100%
	Spring (set) <sup>25)</sup>	1	1	1	1	1	2	2	20%
<b>Variants with gland packing</b>									
456.01	Neck bush	1	1	1	2	2	2	3	30%
461.01	Gland packing (set)	2	4	4	6	6	6	8	100%
524.01	Shaft protecting sleeve	1	2	2	2	3	3	4	50%

### 7.7.3 Interchangeability of pump components


Components featuring the same number in a column are interchangeable.

**Table 27:** Interchangeability of pump components

Size	Description															
	Pump casing	Suction cover	Discharge cover	Shaft	Impeller	Rolling element bearing	Bearing bracket	Bearing bracket lantern	Stuffing box housing	Gland follower	Stuffing box ring	Lantern ring	Gland packing	Thrower	Shaft protecting sleeve	Impeller screw
	Part number															
	101	162	163	210	230	320/321	330	344	451.01	452.01	454.01	458.01	461	507	524.01	906
<b>Bearing bracket P04ax</b>																
80-315	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
100-250	2	2	2	1	2	1	1	2	1	1	1	1	1	1	1	1
<b>Bearing bracket P05ax</b>																
125-315	3	3	3	2	3	2	2	3	2	2	2	2	2	2	2	2
<b>Bearing bracket P06x</b>																
200-400	4	4	4	3	4	2	2	4	3	3	3	3	3	3	3	3

<sup>25)</sup> Optional

## 8 Trouble-shooting

	<b>⚠ WARNING</b>
	<b>Improper work to remedy faults</b> Risk of injury! <p>► For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.</p>

If problems occur that are not described in the following table, consultation with the KSB service is required.

- A Pump delivers insufficient flow rate
- B Motor is overloaded
- C Excessive discharge pressure
- D Increased bearing temperature
- E Leakage at the pump
- F Excessive leakage at the shaft seal
- G Vibrations during pump operation
- H Impermissible temperature increase in the pump

Table 28: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy <sup>26)</sup>
X	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point.
X	-	-	-	-	-	-	-	Excessively high back pressure	Check system for impurities. Increase speed (turbine, I.C. engine).
X	-	-	-	-	-	X	X	Pump or piping are not completely vented or primed.	Vent and/or prime.
X	-	-	-	-	-	-	-	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
X	-	-	-	-	-	-	-	Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
-	-	-	X	-	X	X	-	Pump is warped or sympathetic vibrations in the piping.	Check the piping connections and secure fixing of pump; if required, reduce distances between the pipe clamps. Fix the pipelines using anti-vibration material.
X	-	-	-	-	-	X	X	Suction lift is too high/ NPSH <sub>available</sub> (positive suction head) is too low.	Check/alter fluid level. Fully open the shut-off element in the supply line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed/suction opening. Observe permissible speed of pressure fall.
-	-	-	X	-	-	-	-	Increased axial thrust <sup>27)</sup>	Correct rotor adjustment.
X	-	-	-	-	-	-	-	Air intake at the shaft seal	Fit new shaft seal.
X	-	-	-	-	-	-	-	Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
X	X	-	-	-	-	-	-	Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
X	-	-	-	-	-	-	-	Speed is too low.	Increase speed.
-	-	-	-	-	-	X	-	Defective bearing(s)	Replace.
-	-	-	X	-	-	X	X	Flow rate is too low.	Increase the minimum flow rate.

<sup>26)</sup> Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

<sup>27)</sup> Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy <sup>26)</sup>
X	-	-	-	-	-	X	-	Wear of internal components	Replace worn components by new ones.
-	X	-	-	-	-	X	-	Pump back pressure is lower than specified in the purchase order.	Re-adjust to duty point.
-	X	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.
-	-	-	-	-	X	-	-	Use of unsuitable materials	Change the material combination.
-	X	X	-	-	-	-	-	Speed is too high.	Reduce speed.
-	-	-	-	X	-	-	-	Tie bolts/sealing element defective	Fit new seal between volute casing and discharge cover. Re-tighten the bolts.
-	-	-	-	-	X	-	-	Worn shaft seal	Fit new shaft seal.
X	-	-	-	-	X	-	-	Score marks or roughness on shaft protecting sleeve / shaft sleeve	Replace shaft protecting sleeve/shaft sleeve. Replace shaft seal. Check balancing line. Check throttling bush/throttling sleeve clearances.
-	-	-	-	-	X	-	-	Lack of cooling liquid or dirty cooling chamber	Increase cooling liquid quantity. Clean out cooling chamber. Purify/clean cooling liquid.
-	-	-	-	-	X	-	-	Stuffing box cover and/or seal cover have been tightened incorrectly; wrong packing material.	Correct.
-	-	-	-	-	X	-	-	Vibrations during pump operation	Correct the suction conditions. Re-align the pump set. Re-balance the impeller. Increase pressure at the pump suction nozzle.
-	-	-	X	-	X	X	-	The pump set is misaligned.	Check the coupling; realign if required.
-	-	-	X	-	-	-	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
-	-	-	X	-	-	-	-	Non-compliance with specified coupling distance	Correct the distance according to general arrangement drawing.
-	X	-	-	-	-	-	-	Operating voltage is too low.	Increase the voltage. Check voltage drop in the power cable.
-	-	-	-	-	-	X	-	Rotor out of balance	Clean rotor. Re-balance rotor.



## 9 Related Documents

### 9.1 General assembly drawing with list of components

#### 9.1.1 Bearing brackets P04ax to P06x

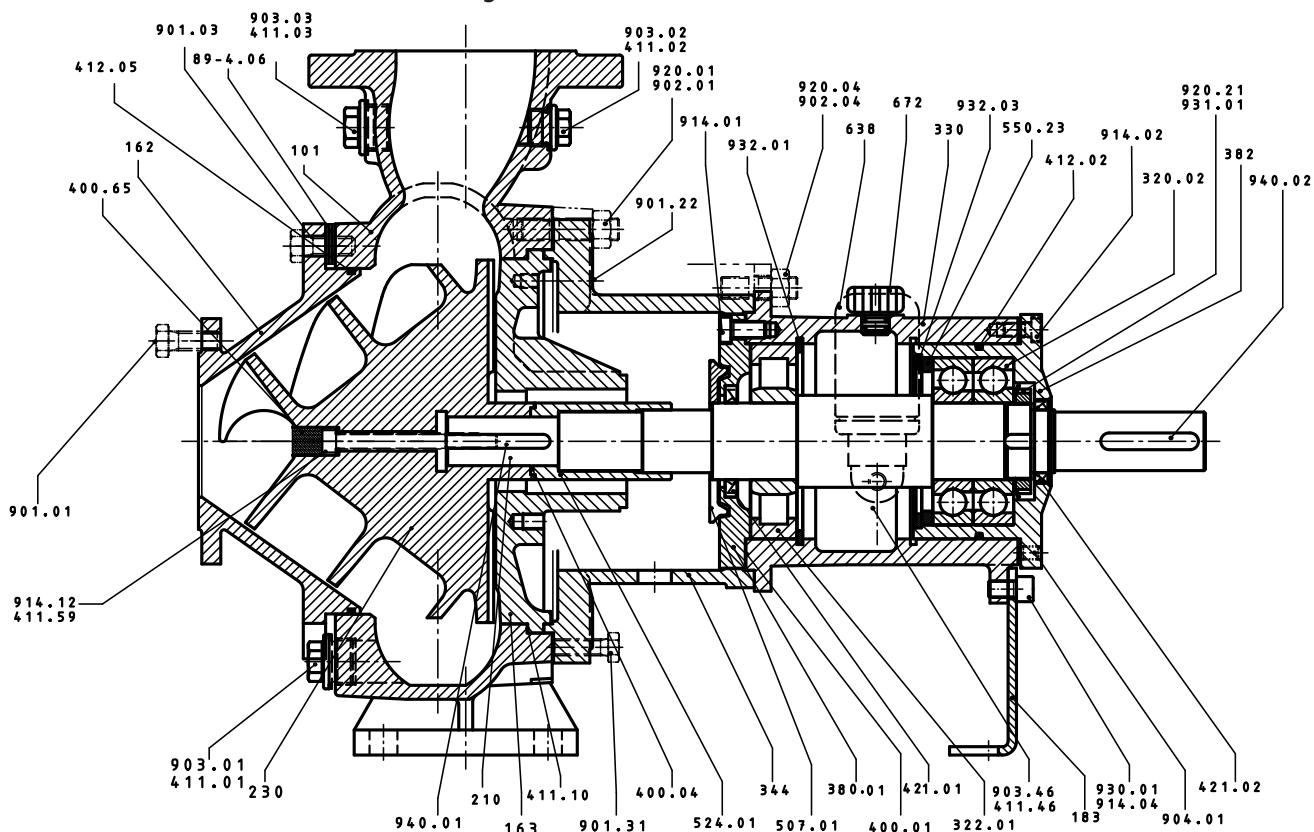


Fig. 29: Bearing brackets P04ax to P06x

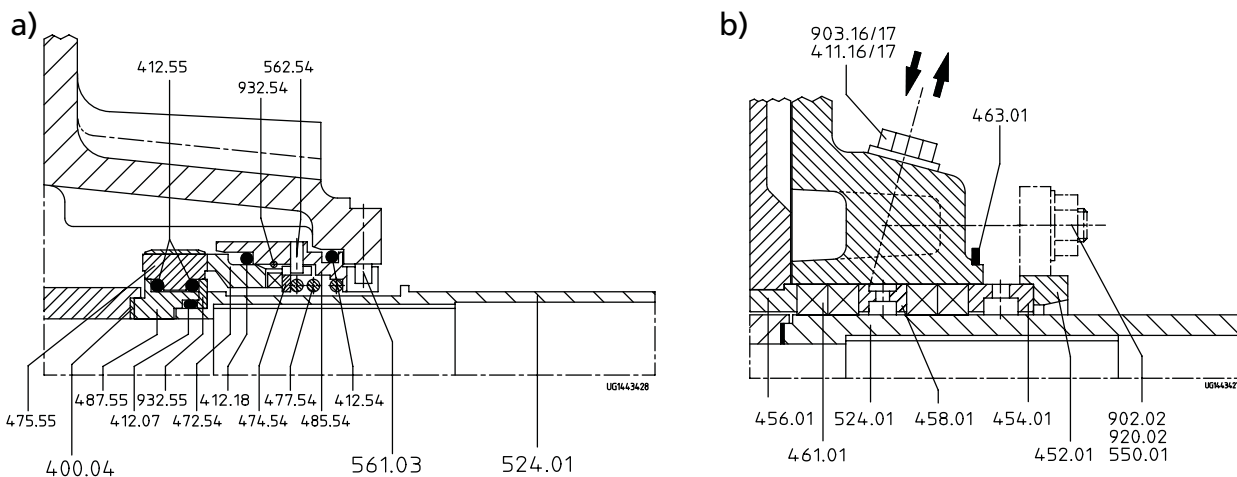


Fig. 30: Shaft seal P03ax to P12sx: a) HRZ mechanical seal; b) coolable gland packing

Table 29: <sup>28)</sup>List of components

Part No.	Scope of supply	Description
101	101	Pump casing
	411.01 <sup>29)</sup> /02 <sup>29)</sup> /03 <sup>29)</sup> /10	Joint ring

<sup>28)</sup> Depending on the design

<sup>29)</sup> If any

Part No.	Scope of supply	Description
101	901.01	Hexagon head bolt
	902.01	Stud
	903.01 <sup>29)</sup> /.02 <sup>29)</sup> /.03 <sup>29)</sup>	Screw plug
	920.01	Hexagon nut
162	162	Suction cover
	412.05	O-ring
	901.01/.03	Hexagon head bolt
	89-4.06	Shim
163 <sup>30)</sup>	163	A-type discharge cover
	412.35/.50	O-ring
	900.07	Eyebolt
	901.22/.30/.31	Forcing screw
	902.15	Stud
	920.15	Hexagon nut
163 <sup>31)</sup>	163	Discharge cover with integrally cast stuffing box housing
	411.16/.17	Joint ring
	463.01	Drip plate
	550.01	Disc
	901.22	Hexagon head bolt
	902.02	Stud
	903.16/.17	Screw plug
	920.02	Nut
163	163	Discharge cover (with bolted-on stuffing box housing)
	400.05	Gasket
	411.26	Joint ring
	901.22	Hexagon head bolt
183	183	Support foot
	914.04	Hexagon socket head cap screw
	930.01	Spring washer
210	210	Shaft
	920.21	Slotted round nut
	931.01	Lock washer
	940.01/.02	Key
230	230	Impeller
	400.04/.65	With gasket
	411.59	Joint ring
	914.12	Hexagon socket head cap screw
320.02	320.02	Angular contact ball bearing
322.01	322.01	Cylindrical roller bearing
330	330	Bearing bracket
330	330	Bearing bracket, complete
	360.01	Bearing cover
	382	Bearing carrier
	400.01	Gasket
	411.46	Joint ring
	412.02	O-ring
	421.01/.02	Lip seal

<sup>30</sup> For pump sets with mechanical seal

<sup>31</sup> For material variants G, GC2, C2 with gland packing

Part No.	Scope of supply	Description
330	550.23	Support disc
	638	Constant level oiler
	672	Vent plug
	903.46	Screw plug
	914.01/.02	Hexagon socket head cap screw
	932.01/.03	Circlip
344	344	Bearing bracket lantern
	901.22	Hexagon head bolt
	901.31	Forcing screw
	902.04	Stud
	920.04	Hexagon nut
360.01	360.01	Bearing cover
	400.01	Gasket
	914.01	Hexagon socket head cap screw
382	382	Bearing carrier
	412.02	O-ring
	904.01	Grub screw
	914.02	Hexagon socket head cap screw
	932.03	Circlip
411.16/.17	411.16/.17	Joint ring
412.01/.18/.54	412.01/.18/.54	O-ring
421.01/.02	421.01/.02	Lip seal
451.01	451.01	Stuffing box housing
	400.05	Gasket
	411.16/.17/.18/.19/.26	Joint ring
	463.01	Drip plate
	550.01	Disc
	902.02	Stud
	903.16/.17/.18/.19	Screw plug
	920.02	Hexagon nut
452.01	452.01	Gland follower
454.01	454.01	Stuffing box ring, split
456.01	456.01	Neck bush
458.01	458.01	Lantern ring, split
461.01	461.01	Packing ring
463.01	463.01	Drip plate
472.54	472.54	Primary ring
474.54	474.54	Thrust ring
475.55	475.55	Mating ring
477.54	477.54	Spring for mechanical seal
485.54	485.54	Tappet
487.55	487.55	Mating ring carrier
507.01	507.01	Thrower
524.01	524.01	Shaft protecting sleeve
	400.04	Gasket
550.01	550.01	Disc
561.03	561.03	Grooved pin
902.02	902.02	Stud
903.16/.17/	903.16/.17/	Screw plug

Part No.	Scope of supply	Description
920.02	920.02	Hexagon nut
932.55	932.55	Circlip
99-9	99-9	Set of sealing elements
	400.01/.02/.03/.04	Gasket
	411.01/.02/.03/.10/.13/.46	Joint ring
	412.02/.03/.05	O-ring

## 10 UK Declaration of Conformity

Manufacturer:

**KSB SE & Co. KGaA**  
**Johann-Klein-Straße 9**  
**67227 Frankenthal (Germany)**

This UK Declaration of Conformity is issued under the sole responsibility of the manufacturer.

The manufacturer herewith declares that **the product**:

### **KWP, KWPR, KWP-Bloc**

KSB order number: .....

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
  - Pump (set): Supply of Machinery (Safety) Regulations 2008
  - Electrical components<sup>32)</sup>: The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

The manufacturer also declares that

- the following harmonised international standards<sup>33)</sup> have been applied:
  - ISO 12100
  - EN 809

Person authorised to compile the technical file:

Name  
 Function  
 Address (company)  
 Address (street, No.)  
 Address (post or ZIP code, city) (country)

The UK Declaration of Conformity was issued in/on:

Place, date

.....<sup>34)</sup>.....

Name  
 Function  
 Company  
 Address

<sup>32)</sup> Where applicable

<sup>33)</sup> Apart from the standards listed here referring to the *Supply of Machinery (Safety) Regulations 2008*, further standards are observed for explosion-proof versions (*Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016*) as applicable and are listed in the legally binding UK Declaration of Conformity.

<sup>34)</sup> A signed, legally binding UK Declaration of Conformity is supplied with the product.

## 11 Certificate of Decontamination

Type: .....

Order number /  
Order item number<sup>35)</sup>: .....

Delivery date: .....

Application: .....

Fluid handled<sup>35)</sup>: .....

Please tick where applicable<sup>35)</sup>:



Corrosive



Oxidising



Flammable



Explosive



Hazardous to health



Seriously hazardous to health



Toxic



Radioactive



Bio-hazardous



Safe

Reason for return:<sup>35)</sup> .....

Comments: .....

.....

The product / accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch / placing at your disposal.

We herewith declare that this product is free from hazardous chemicals and biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

- ☐ No special safety precautions are required for further handling.
- ☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....  
Place, date and signature

.....  
Address

.....  
Company stamp

<sup>35)</sup> Required field

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