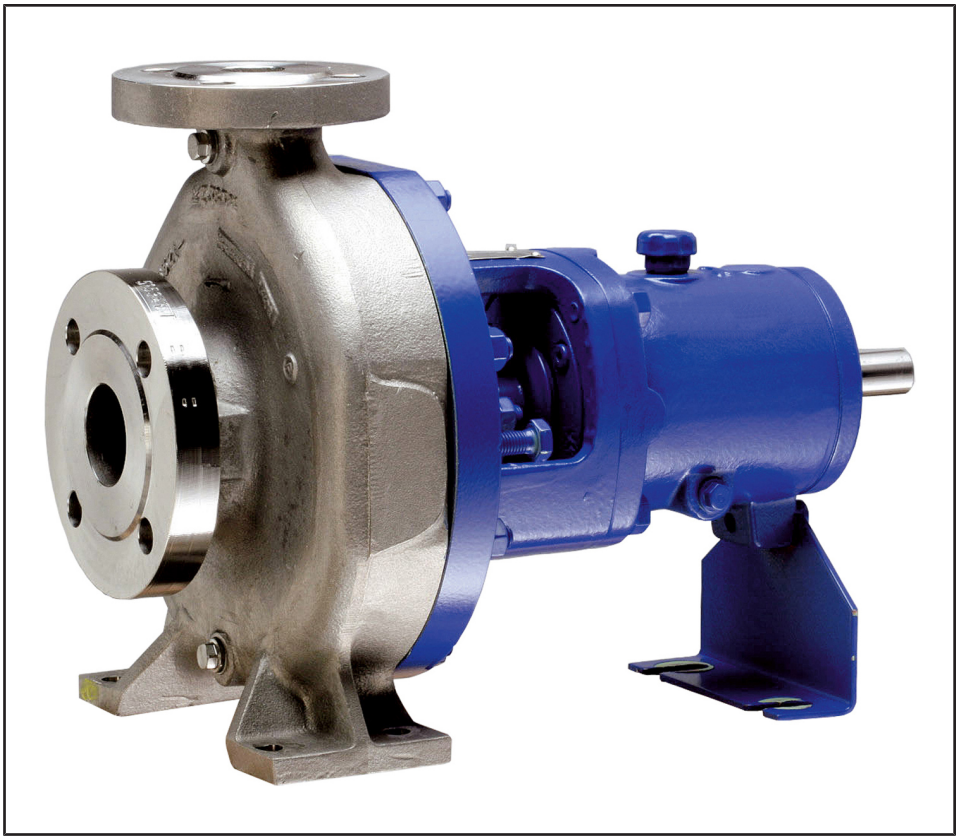
Standardised Chemical Pump

CPKNO

Installation/Operating Manual



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Installation/Operating Manual CPKNO

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

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

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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 KSB partly completed machinery supplied by refer to the sub-sections under Servicing/Maintenance. (⇨ Section 7.5.5, Page 61)

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 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[1)]	Sectional drawing of the pump
Sub-supplier product literature[1)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[1)]	Description of spare parts
Piping layout[1)]	Description of auxiliary piping
Seal installation drawing[1)]	Drawing of the installed shaft seal
Supplementary sheet[2)]	Instructions for installing the start-up strainer
List of components[1)]	Description of all pump components

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

1.5 Symbols

Table 2: Symbols used in this manual

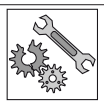
Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions

1 If agreed to be included in the scope of supply
2 Depending on the design

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

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2 Safety

DANGER

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.
- 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 model.
- 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.

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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.

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- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.1.12, Page 41) (⇨ Section 6.3, Page 44)
- Decontaminate pumps which handle fluids posing a health hazard. (⇨ Section 7.3, Page 52)
- 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 34)

2.8 Unauthorised modes of operation

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

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

2.9 Explosion protection

DANGER

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

Only pumps/pump sets marked as explosion-proof **and** identified as such in the data sheet may be used in potentially explosive atmospheres.

Special conditions apply to the operation of explosion-proof pump sets in accordance with UK *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 is only assured if the product 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[3)]
T1	Maximum 400 °C[4)]
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 43) 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 43) can be used to check whether additional heat build-up may lead to a dangerous temperature increase at the pump surface.

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3 Subject to further limitations for mechanical seal temperature rise

4 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

DANGER

The pump (set) could slip out of the suspension arrangement

Danger to life from falling parts!

- Always transport the pump (set) in the specified position.
- Never attach the suspension arrangement to the free shaft end or the motor eyebolt.
- Observe the information about weights, centre of gravity and fastening points.
- Observe the applicable local accident prevention regulations.
- Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.

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

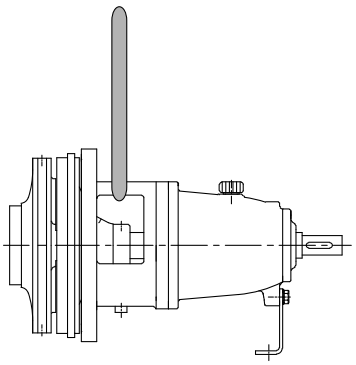

Fig. 1: Transporting the back pull-out unit

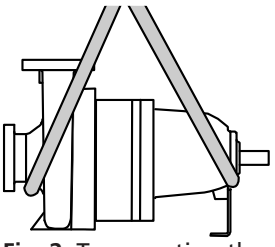

Fig. 2: Transporting the pump

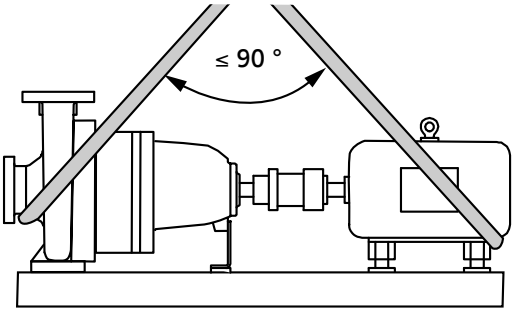

Fig. 3: Transporting the pump set

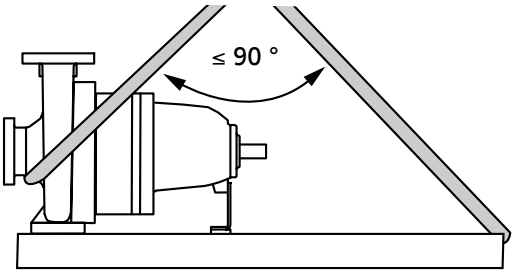

Fig. 4: Transporting the pump on the baseplate

3.3 Storage/preservation

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of the pump (set)!

- ▷ For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.

CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

- ▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

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 44)

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 52)
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 also neutralise the pump and blow through with anhydrous inert gas 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 72)

NOTE

If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination

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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

- Standardised chemical pump with shaft seal

For handling aggressive and polymerising liquids, liquids liable to clot as well as gas-containing liquids in chemical and petrochemical industries.

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: CPKNO - 040-200 VC

Table 5: Designation key

Code	Description
CPKN	Type series
O	Open impeller
VC	Material of wetted components
040	Nominal discharge nozzle diameter in mm
200	Nominal impeller diameter in mm

4.4 Name plate

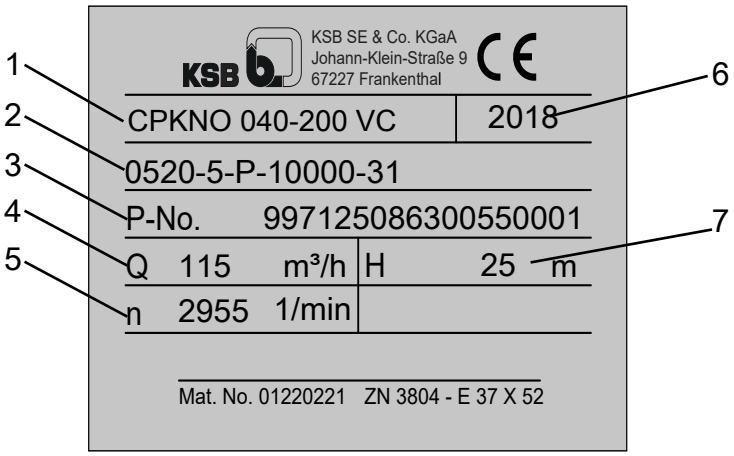

Fig. 5: Name plate (example)

1	Type series designation	2	Customer-specific information (optional)
3	KSB order number	4	Flow rate
5	Speed	6	Year of construction
7	Head		

4.5 Design details

Design

- Volute casing pump
- Horizontal installation
- Back pull-out design

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- Single-stage
- Technical requirements to ISO 5199
- Dimension and ratings to ISO 2858
  complemented by pumps of nominal diameters DN 25 and DN 200

Pump casing

- Single or double volute, depending on the pump size
- Radially split volute casing
- Volute casing with integrally cast pump feet

Impeller type

- Semi-open multi-vane impeller
- Back vanes reduce axial thrust.

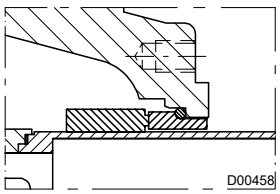
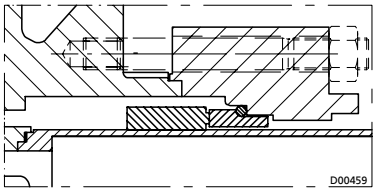
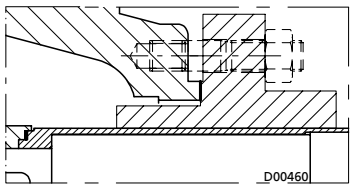
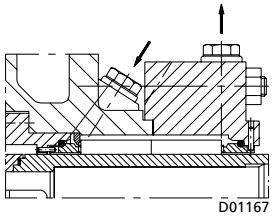
Shaft seal

- Gland packing
- Single mechanical seal / double mechanical seal
- Component seal
- Cartridge seal

Preferred:

- Standardised mechanical seals to EN 12756, K design

Table 6: Seal chamber with different shaft seals (examples)

Type of seal	Drawing
Conical seal chamber (A-type cover) Standardised mechanical seal	
Cylindrical seal chamber Standardised mechanical seal	
Cartridge seal	
Double mechanical seal in back-to-back arrangement, both sides unbalanced	

Bearings

Design specifications

Drive-end bearing:

- Fixed bearing
- Paired angular contact ball bearings
- Axial movement of the rotor limited to 0.5 mm maximum
- Oil lubrication

Pump-end bearing:

- Radial bearing
- Cylindrical roller bearing
- Absorbs radial loads only
- Oil lubrication

Bearing bracket designation

Example: UP03

Table 7: Bearing bracket designation

Designation	Description
UP	Bearing bracket
03	Size code (based on dimensions of seal chamber and shaft end)

Bearings used

Table 8: Bearing design

KSB designation	FAG designation	SKF designation
B.G	B-TVP-UA	BECBP
B.G 8	B-TVP-UA 80	BEC86P

Table 9: Standard bearing assembly

Bearing bracket	Rolling element bearing	
	Pump end	Motor end
UP02	NU307	2 x 7307 B.G
UP03	NU311	2 x 7311 B.G.8
UP04	NU311	2 x 7311 B.G.8
UP05	NU313	2 x 7313 B.G.8

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4.6 Design and function

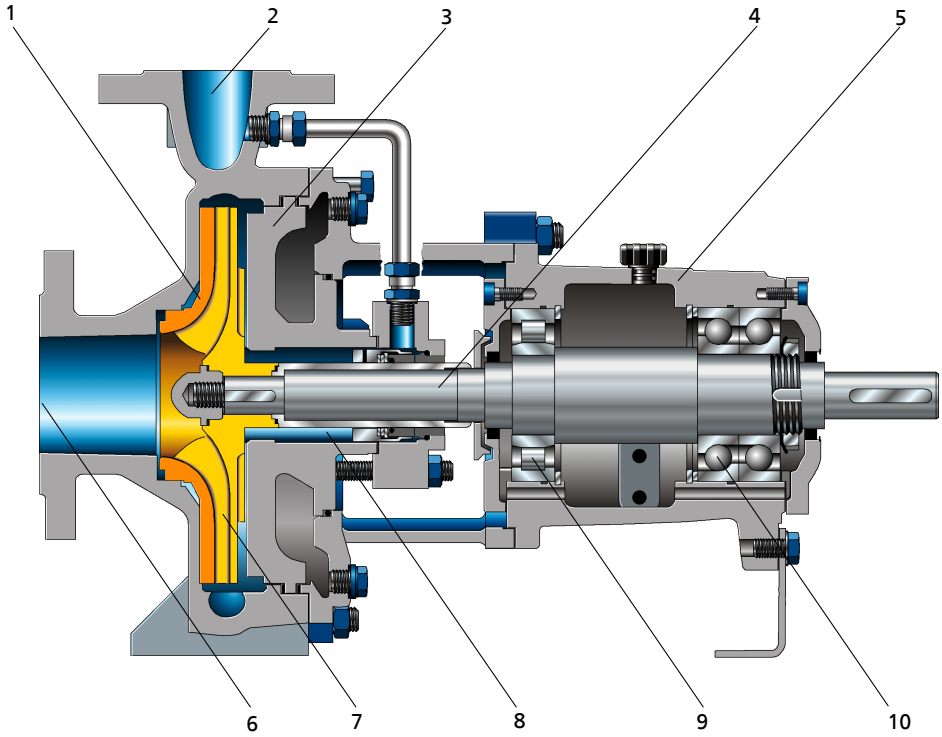

Fig. 6: Sectional drawing

1	Wear plate	2	Discharge nozzle
3	Casing cover	4	Drive shaft
5	Bearing bracket	6	Suction nozzle
7	Impeller	8	Shaft seal
9	Rolling element bearing, pump end	10	Rolling element bearing, motor end

Design The pump is designed with an axial fluid inlet and a radial or tangential outlet. The hydraulic system runs in its own bearings and is connected to the motor by a shaft coupling.

Function The fluid enters the pump axially via the suction nozzle (6) and is accelerated outward by the rotating impeller (7). In the flow passage of the wear plate and pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (2), where it leaves the pump. The clearance between the open impeller (7) and the wear plate (1) can be adjusted to a specified value. At the rear side of the impeller, the shaft (4) enters the hydraulic system through the casing cover (3). The shaft passage through the cover is sealed to atmosphere with a shaft seal (8). The shaft runs in rolling element bearings (9 and 10), which are supported by a bearing bracket (5) linked with the pump casing and/or casing cover.

Sealing The pump is sealed by a shaft seal (standardised mechanical seal or gland packing).

4.7 Noise characteristics

Table 10: Surface sound pressure level L_{pA} [5) 6)]

P_N	Pump			Pump set		
	960 rpm, 760 rpm	1450 rpm	2900 rpm	960 rpm, 760 rpm	1450 rpm	2900 rpm
[kW]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
1,5	52	53	54	56	58	63
2,2	53	55	56	58	60	66
3	55	56	57	60	62	68
4	56	58	59	61	63	69
5,5	58	59	61	62	65	71
7,5	59	61	62	64	66	72
11	61	63	64	65	68	74
15	63	65	66	67	69	75
18,5	64	66	67	68	70	76
22	65	67	68	68	71	77
30	66	68	70	70	72	78
37	67	70	71	70	73	79
45	68	71	72	71	74	80
55	69	72	73	72	74	80
75	71	73	75	73	76	81
90	71	74	76	73	76	82
110	72	75	77	74	77	82
132	73	76	78	75	77	83
160	74	77	79	75	78	84
200	75	78	80	76	79	84
250	-	79	81	-	80	85

4.8 Scope of supply

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

- Pump

Drive

- Surface-cooled IEC frame three-phase squirrel-cage motor

Coupling

- Flexible coupling with or without spacer

Contact guard

- Coupling guard
- Baseplate (to ISO 3661), cast or welded, for pump and motor, in torsion-resistant design
- Channel section steel or folded steel plate

Special accessories

- As required

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5 Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361 ; valid for a pump operating range of Q/QBEP = 0.8 - 1.1 and non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance.

6 Increase for 60 Hz operation: 3500 rpm +3 dB; 1750 rpm +1 dB; 1160 rpm ±0 dB

4.9 Dimensions and weights

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

5 Installation at Site

5.1 Safety regulations

DANGER

Excessive temperatures in the shaft seal area

Explosion hazard!

- Never operate a pump (set) with gland packing in potentially explosive atmospheres.

NOTE

Operating pump sets with gland packings in combination with a frequency inverter / variable speed system is not recommended.

5.2 Checks to be carried out prior to installation

Place of installation

WARNING

Installation on a mounting surface which is unsecured and cannot support the load

Personal injury and damage to property!

- Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XC1 to EN 206-1.
- The mounting surface must be set, flat, and level.
- Check the indicated weights.

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.

DANGER

Excessive temperatures due to improper installation

Explosion hazard!

- Install the pump in a horizontal position to ensure self-venting of the pump.

DANGER

Electrostatic charging due to insufficient potential equalisation

Explosion hazard!

- Make sure that the connection between pump and baseplate is electrically conductive.

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5.3.1 Installation on the foundation

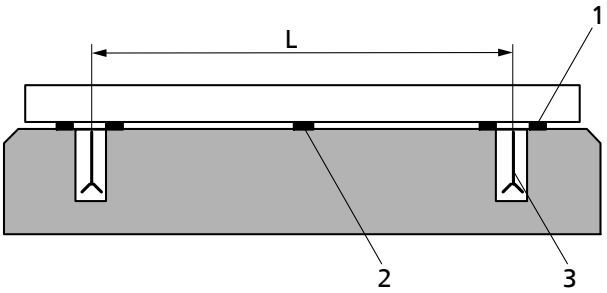

Fig. 7: Fitting the shims

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 ≤ 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

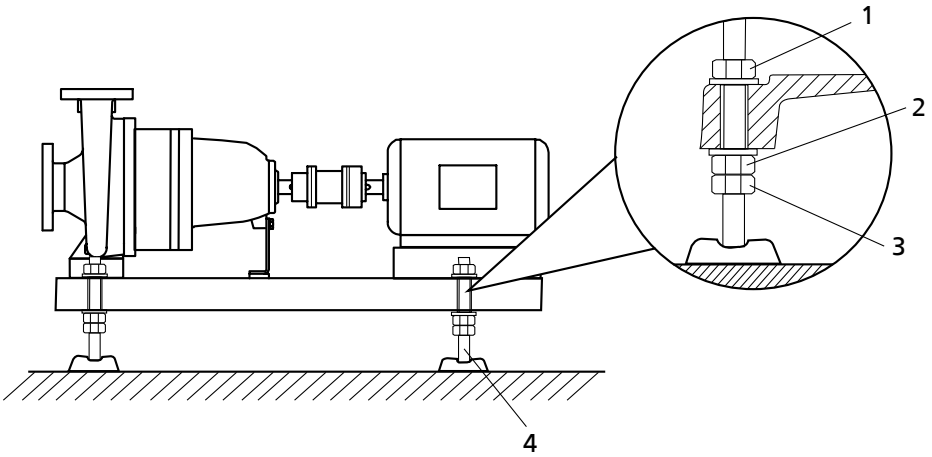

Fig. 8: Adjusting the levelling elements

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

DANGER

Impermissible loads acting on the pump nozzles

Danger to life from escaping hot, toxic, corrosive or flammable fluids!

- ▷ Do not use the pump as an anchorage point for the piping.
- ▷ Anchor the pipes in close proximity to the pump and connect them properly without transmitting any stresses or strains.
- ▷ Observe the permissible forces and moments at the pump nozzles. (⇨ Section 5.4.2, Page 26)
- ▷ Take appropriate measures to compensate for thermal expansion of the piping.

CAUTION

Incorrect earthing during welding work at the piping

Destruction of rolling element bearings (pitting effect)!

- ▷ Never earth the electric welding equipment on the pump or baseplate.
- ▷ Prevent current flowing through the rolling element bearings.

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NOTE

Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. 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 at least equal to the nominal diameters of the pump nozzles.
- ✓ Adapters to larger diameters have a diffuser angle of approximately 8° to prevent excessive pressure losses.
- ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.

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 48) .

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.
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 figure: Filter in the piping).

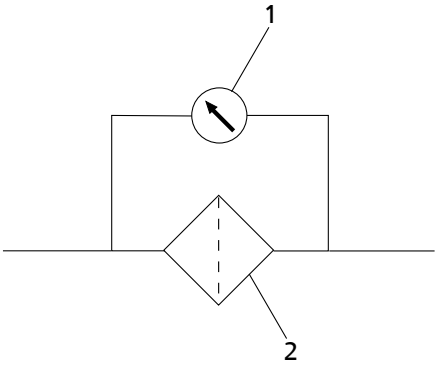


Fig. 9: Filter in the piping

1	Differential pressure gauge	2	Filter

NOTE

Use a filter with laid-in wire mesh (mesh width 0.5 mm, wire diameter 0.25 mm) 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.

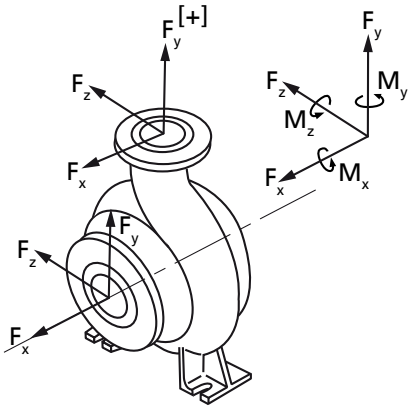
CAUTION

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



Forces and moments at the pump nozzles

The resulting permissible forces have been determined according to

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

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

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.

Table 11: Forces and moments at the pump nozzles

Sizes	Suction nozzle [N]				Discharge nozzle [N]					Suction nozzle [Nm]			Discharge nozzle [Nm]		
	F_x	F_y	F_z	F_{res}	F_x	$F_{yTens}+$	$F_{yCompr}-$	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
25-160	1050	700	850	1100	500	350	650	450	700	550	450	300	400	300	200
25-200	1050	700	850	1100	500	350	650	450	700	550	450	300	400	300	200
32-125	1350	900	1100	1400	700	450	850	550	900	700	550	350	450	350	250
32-160	1350	900	1100	1400	700	450	850	550	900	700	550	350	450	350	250
32-200	1350	900	1100	1400	700	450	850	550	900	700	550	350	450	350	250
32-250	1350	900	1100	1400	700	450	850	550	900	700	550	350	450	350	250
40-160	1750	1150	1400	1800	850	550	1100	700	1100	1150	850	600	550	450	300
40-200	1750	1150	1400	1800	850	550	1100	700	1100	1150	850	600	550	450	300
40-250	1750	1150	1400	1800	850	550	1100	700	1100	1150	850	600	550	450	300
40-315	1750	1150	1400	1800	850	550	1100	700	1100	1150	850	600	550	450	300
50-160	2150	1400	1700	2200	1100	700	1350	900	1400	1450	1100	750	700	550	350
50-200	2150	1400	1700	2200	1100	700	1350	900	1400	1450	1100	750	700	550	350
50-250	2150	1400	1700	2200	1100	700	1350	900	1400	1450	1100	750	700	550	350
50-315	2150	1400	1700	2200	1100	700	1350	900	1400	1450	1100	750	700	550	350
65-160	2700	1750	2150	2750	1400	900	1750	1150	1800	2000	1500	1000	1150	850	600
65-200	2700	1750	2150	2750	1400	900	1750	1150	1800	2000	1500	1000	1150	850	600
65-250	2700	1750	2150	2750	1400	900	1750	1150	1800	2000	1500	1000	1150	850	600
65-315	2700	1750	2150	2750	1400	900	1750	1150	1800	2000	1500	1000	1150	850	600
80-160	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750
80-200	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750
80-250	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750

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Sizes	Suction nozzle [N]				Discharge nozzle [N]					Suction nozzle [Nm]			Discharge nozzle [Nm]		
	F_x	F_y	F_z	F_{res}	F_x	F_{yTens}+	F_{yCompr}-	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
80-315	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750
80-400	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750
100-200	3700	2400	2950	3800	2150	1350	2700	1750	2800	2750	2100	1400	2000	1500	1000
200-315	10000	6700	8000	10450	5700	3550	7350	4700	7400	7500	5700	3650	5300	3850	2650

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

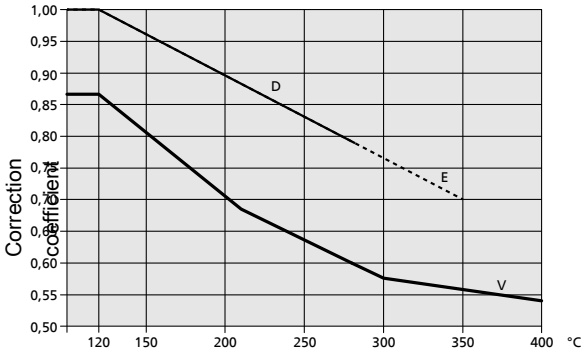

Fig. 10: Temperature correction diagram

5.4.3 Auxiliary connections

DANGER

Risk of potentially explosive atmosphere by incompatible fluids mixing in the auxiliary piping

Risk of burns!

Explosion hazard!

- ▷ Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.

WARNING

Failure to use or incorrect use of auxiliary connections (e.g. barrier fluid, flushing liquid, etc.)

Risk of injury from escaping fluid!

Risk of burns!

Malfunction of the pump!

- ▷ Refer to the general arrangement drawing, the piping layout and pump markings (if any) for the quantity, dimensions and locations of auxiliary connections.
- ▷ Use the auxiliary connections provided.

5.5 Enclosure/insulation

DANGER

Risk of potentially explosive atmosphere due to insufficient venting

Explosion hazard!

- ▷ Make sure the space between the casing cover/discharge cover and the bearing cover is sufficiently vented.
- ▷ Never close or cover the perforation of the bearing bracket guards (e.g. by insulation).

⚠ WARNING

The volute casing and casing/discharge cover take on the same temperature as the fluid handled

Risk of burns!

- ▷ Insulate the volute casing.
- ▷ Fit protective equipment.

CAUTION

Heat build-up in the bearing bracket

Damage to the bearing!

- ▷ Never insulate the bearing bracket, bearing bracket lantern and casing cover.

NOTE

Pump casings handling fluids at temperatures below freezing point may be insulated at the site, subject to the manufacturer's prior approval.

5.6 Checking the coupling alignment

⚠ DANGER

Inadmissible temperatures at the coupling or bearings due to misalignment of the coupling

Explosion hazard!

Risk of burns!

- ▷ Make sure that the coupling is correctly aligned at all times.

CAUTION

Misalignment of pump and motor shafts

Damage to pump, motor and coupling!

- ▷ 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.

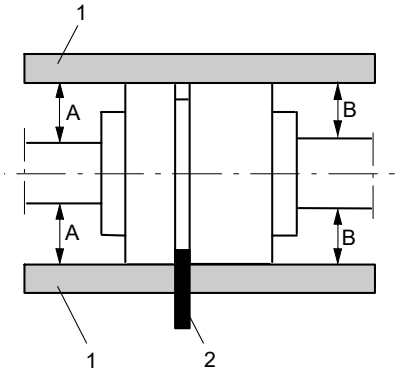

Fig. 11: Non-spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge

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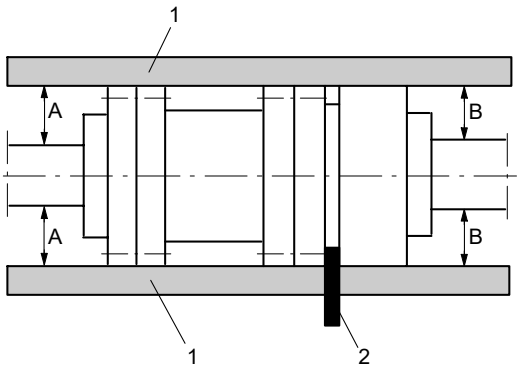

Fig. 12: Spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge

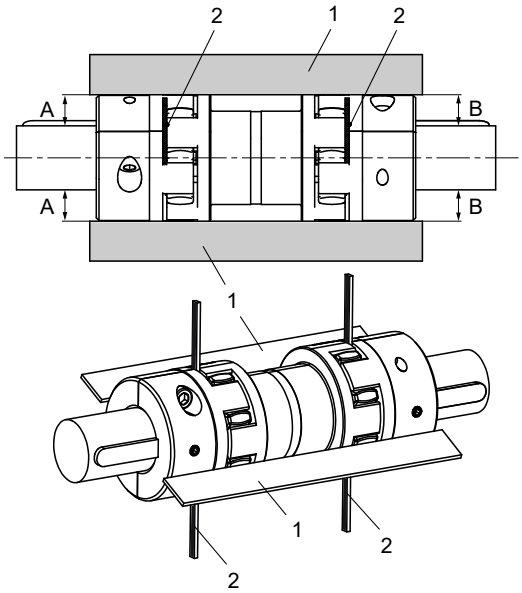

Fig. 13: Double Cardan spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge

Table 12: Permissible alignment offset of coupling halves

Coupling type	Radial offset [mm]	Axial offset [mm]
Non-spacer-type coupling (⇨ Fig. 11)	≤ 0,1	≤ 0,1
Spacer-type coupling (⇨ Fig. 12)	≤ 0,1	≤ 0,1
Double Cardan coupling (⇨ Fig. 13)	≤ 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.

5.7 Aligning the pump and motor

After having installed the pump set and connected the piping, check the coupling alignment and, if required, re-align the pump set (at the motor).

5.7.1 Motors with adjusting screw

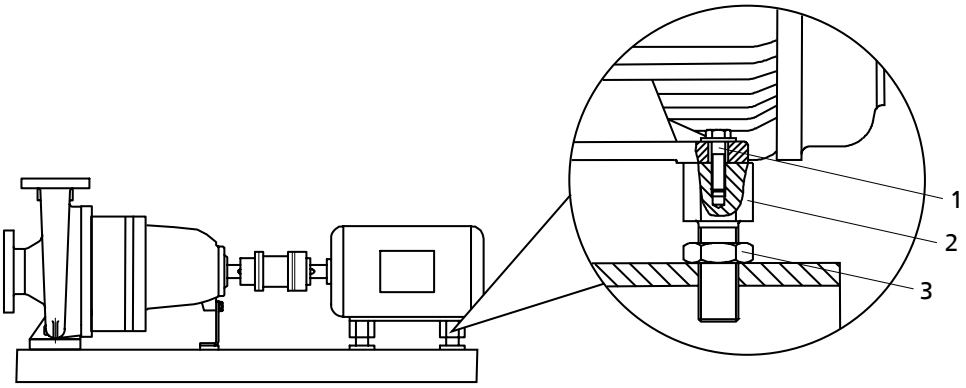

Fig. 14: Motor with adjusting screw

1	Hexagon head bolt	2	Adjusting screw
3	Locknut		

✓ The coupling guard and its footboard, if any, have been removed.

1. Check the coupling alignment.
2. Unscrew the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
3. 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.
4. Re-tighten the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
5. Check proper functioning of coupling/shaft.
   Check that coupling/shaft can easily be rotated by hand.

⚠ WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

- ▷ 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!
- ▷ Observe all relevant regulations for selecting a coupling guard.

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DANGER

Risk of ignition by frictional sparks

Explosion hazard!!

- ▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

6. Fit the coupling guard and its footboard, if any.
7. 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 the centreline heights of the pump and motor shafts are compensated by means of shims.

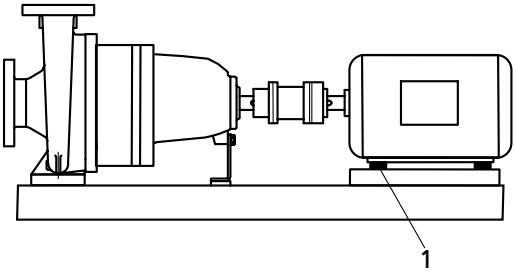

Fig. 15: Pump set with shim

1	Shim

✓ The coupling guard and its footboard, if any, have been removed.

1. Check the coupling alignment.
2. Loosen the hexagon head bolts at the motor.
3. Insert shims underneath the motor feet until the difference in shaft centreline height has been compensated.
4. Re-tighten the hexagon head bolts.
5. Check proper functioning of coupling/shaft.
   Check that coupling/shaft can easily be rotated by hand.

WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

- ▷ 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!
- ▷ Observe all relevant regulations for selecting a coupling guard.

DANGER

Risk of ignition by frictional sparks

Explosion hazard!!

- ▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

6. Fit the coupling guard and its footboard, if any.
7. Check the distance between coupling and coupling guard.
   The coupling guard must not touch the coupling.

5.8 Electrical connection

DANGER

Electrical connection work by unqualified personnel

Risk of fatal injury due to electric shock!

- ▷ Always have the electrical connections installed by a trained and qualified electrician.
- ▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

WARNING

Incorrect connection to the mains

Damage to the power supply network, short circuit!

- ▷ Observe the technical specifications of the local energy supply companies.

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

NOTE

Installing a motor protection device is recommended.

5.8.1 Setting the time relay

CAUTION

Switchover between star and delta on three-phase motors with star-delta starting takes too long.

Damage to the pump (set)!

- ▷ Keep switch-over intervals between star and delta as short as possible.

Table 13: Time relay settings for star-delta starting:

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

5.8.2 Connecting the motor

NOTE

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.

1. Match the motor's direction of rotation to that of the pump.
2. Observe the manufacturer's product literature supplied with the motor.

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5.9 Checking the direction of rotation

DANGER

Temperature increase resulting from contact between rotating and stationary components

Explosion hazard!

Damage to the pump set!

- ▷ Never check the direction of rotation by starting up the unfilled pump set.
- ▷ Separate the pump from the motor to check the direction of rotation.

WARNING

Hands inside the pump casing

Risk of injuries, damage to the pump!

- ▷ 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.

CAUTION

Incorrect direction of rotation with non-reversible mechanical seal

Damage to the mechanical seal and leakage!

- ▷ Separate the pump from the motor to check the direction of rotation.

CAUTION

Drive and pump running in the wrong direction of rotation

Damage to the pump!

- ▷ Refer to the arrow indicating the direction of rotation on the pump.
- ▷ Check the direction of rotation. If required, check the electrical connection and correct the direction of rotation.

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 32)
- The pump has been filled with the fluid to be handled. The pump has been vented. (⇨ Section 6.1.4, Page 36)
- The direction of rotation has been checked. (⇨ Section 5.9, Page 33)
- All auxiliary connections required are connected and operational.
- The lubricants have been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇨ Section 6.4, Page 44)

6.1.2 Filling in lubricants

Grease-lubricated bearings

Grease-lubricated bearings have been packed with grease at the factory.

Oil-lubricated bearings

Fill the bearing bracket with lubricating oil.
Oil quality see (⇨ Section 7.2.3.1.2, Page 49)
Oil quantity see (⇨ Section 7.2.3.1.3, Page 49)

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.

NOTE

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.

CAUTION

Insufficient quantity of lubricating oil in the reservoir of the constant level oiler

Damage to the bearings!

- ▷ Regularly check the oil level.
- ▷ Always fill the oil reservoir completely.

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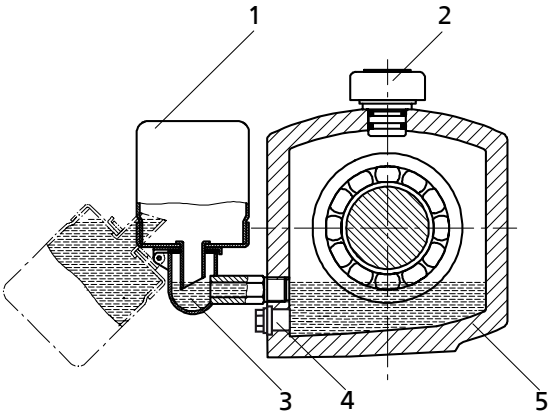

Fig. 16: Bearing bracket with constant level oiler

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 Shaft seal

Shaft seals are fitted prior to delivery.
Observe the instructions on dismantling (⇨ Section 7.4.6, Page 54) or assembly (⇨ Section 7.5.3, Page 59) .

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

Double mechanical seal Prior to starting up the pump, apply barrier pressure as specified in the general arrangement drawing.

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

6.1.4 Priming and venting the pump

DANGER

Risk of potentially explosive atmosphere by incompatible fluids mixing in the auxiliary piping

Risk of burns!

Explosion hazard!

- ▷ Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.

DANGER

Risk of potentially explosive atmosphere inside the pump

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.

DANGER

Shaft seal failure caused by insufficient lubrication

Hot or toxic fluid could escape!

Damage to the pump!

- ▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.

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 Final check

1. Remove the coupling guard and its footboard, if any.
2. Check the coupling alignment; re-align the coupling, if required.
   (⇨ Section 5.6, Page 28)
3. Check proper functioning of coupling/shaft.
   Check that coupling/shaft can be easily rotated by hand.
4. Fit the coupling guard and its footboard, if any.
5. Check the distance between coupling and coupling guard.
   The coupling guard must not touch the coupling.

6.1.6 Water cooling

CAUTION

Deposit-forming, aggressive cooling water

Damage to the pump!

- ▷ Observe the cooling water quality.

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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_{ini}=10 to 30 °C
  Outlet temperature t_{outl}= 45 °C max.

6.1.7 Cooling of the shaft seal

CAUTION

Vaporisation pressure of fluid handled higher than atmospheric pressure

Damage to the shaft seal/pump!

▷ Cool the shaft seal.

▷ Provide sufficient quantities of cooling liquid (see table).

NOTE

The vaporisation pressure varies depending on the fluid handled, the system pressure and the material of the shaft seal (e.g. hot water).

Table 14: Cooling of the shaft seal[7)]

Bearing bracket	Cooling liquid quantity in l/min at a fluid temperature of			
	Standard design		"K" design	
	up to 250 °C	up to 400 °C	up to 250 °C	up to 400 °C
UP02	3	4	3	4
UP03	4	5	4	5
UP04	5	6	4	5
UP05	5	6	5	6

6.1.8 Heating (not for shaft seal variant "A")

The space between discharge cover and bearing bracket lantern can be used as a heating chamber, if necessary. It can be fed with hot water, steam or thermal oil, especially in combination with internal circulation.

DANGER

Excessive surface temperature

Explosion hazard!

Risk of burns!

▷ Observe the permissible temperature classes. (⇨ Section 2.9.2, Page 11)

CAUTION

Lack of heating medium

Damage to the pump!

▷ Provide sufficient quantities of a suitable heating medium.

7 Not possible for conical seal chamber (A-type)

CAUTION

Time for warming up the pump too short

Damage to the pump!

▷ Check that the pump is sufficiently warmed up throughout.

CAUTION

Impermissibly high temperature of the heating medium

Fluid handled or heating medium could escape!

▷ Observe the application limits of the heating media.

Table 15: Temperature limits for heating with hot water or thermal oil

Design	Hot water / saturated steam		Thermal oil	
	t_{max} [°C]	p_{max} [bar]	t_{max} [°C]	p_{max} [bar]
Standard design; lantern JL 1040 [8], O-ring EPDM	183	10	-	-
Lantern JS 1025 [9]; profile seal PTFE/alloyed steel	250	20	300	6
Welded casing cover	300	20	300	6

6.1.9 Heating up/keeping warm the pump (set)

CAUTION

Pump blockage

Damage to the pump!

▷ Prior to pump start-up, heat up the pump as described in the manual.

Observe the following when heating up the pump (set) and keeping it warm:

- Make sure that the temperature is increased continuously.
- Heating speed: max. 10 °C/min (10 K/min)

Fluid temperatures above 150 °C

When the pump is used for handling fluids at temperatures above 150 °C make sure that the pump has been heated throughout before starting it up.

Temperature difference

The temperature difference between the pump's surface and the fluid handled must not exceed 100 °C (100 K) when the pump is started up.

6.1.10 Start-up

DANGER

Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and/or discharge line closed.

Explosion hazard!

Hot or toxic fluids escaping!

▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.

▷ Only start up the pump set with the discharge-side shut-off element slightly or fully open.

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8 GJL-250 to EN 1561

9 GJS-400-18-LT to EN 1563

DANGER

Excessive temperatures due to dry running or excessive gas content in the fluid handled

Explosion hazard!

Damage to the pump set!

- ▹ Never operate the pump set without liquid fill.
- ▹ Prime the pump as per operating instructions. (⇨ Section 6.1.4, Page 36)
- ▹ Always operate the pump within the permissible operating range.

CAUTION

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

- ▹ Switch off the pump (set) immediately.
- ▹ Eliminate the causes before returning the pump set to service.

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

CAUTION

Start-up against open discharge line

Motor overload!

- ▹ Make sure the motor has sufficient power reserves.
- ▹ Use a soft starter.
- ▹ Use speed control.

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.

CAUTION

Misalignment of pump and coupling

Damage to pump, motor and coupling!

- ▹ When the operating temperature has been reached, switch off the pump set and check the coupling alignment.

5. Check the coupling alignment and re-align the coupling, if required.

6.1.11 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

DANGER

Excessive temperature of barrier fluid (pumps with double mechanical seal)

Explosion hazard!

Excessive surface temperature

- ▷ For pumps with double mechanical seal, make sure that the barrier fluid's temperature does not exceed 60 °C.

Gland packing

The gland packing must drip slightly during operation.

Pure graphite packing

If a pure graphite packing is used, there must always be some leakage.

Table 16: Leakage rate of the pure graphite packing

Quantity	Values
Minimum	10 cm^3/min
Maximum	20 cm^3/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

WARNING

Unprotected rotating parts

Risk of personal injury!

- ▷ Do not touch rotating parts.
- ▷ When the pump is running, perform any work with utmost caution.

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.

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6.1.12 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.

✓ Also ensure quench liquid supply is ON during pump standstill.

1. Close the shut-off element in the discharge line.
2. Switch off the motor and make sure the pump set runs down smoothly to a standstill.

NOTE

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.

NOTE

If shut-off is not possible, the pump will run in reverse direction.
The reverse runaway speed must be lower than the rated speed.

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close the 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.

CAUTION

Risk of freezing during prolonged pump shutdown periods

Damage to the pump!

- ▹ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.

6.2 Operating limits

DANGER

Non-compliance with operating limits for pressure, temperature, fluid handled and speed

Explosion hazard!

Hot or toxic fluid could escape!

- ▹ Comply with the operating data specified in the data sheet.
- ▹ Never use the pump for handling fluids it is not designed for.
- ▹ Avoid prolonged operation against a closed shut-off element.
- ▹ 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.

DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

- ▹ When draining tanks take suitable measures to prevent dry running of the pump (e.g. fill level monitoring).

6.2.1 Ambient temperature

CAUTION

Operation outside the permissible ambient temperature

Damage to the pump (set)!

- ▷ Observe the specified limits for permissible ambient temperatures.

Observe the following parameters and values during operation:

Table 17: Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	40 °C
Minimum	See data sheet.

6.2.2 Frequency of starts

DANGER

Excessive surface temperature of the motor

Explosion hazard!

Damage to the motor!

- ▷ In case of explosion-proof motors, observe the frequency of starts specified in the manufacturer's product literature.

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

CAUTION

Re-starting while motor is still running down

Damage to the pump (set)!

- ▷ Do not re-start the pump set before the pump rotor has come to a standstill.

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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} [10] = 0.1 × Q_{BEP} [11]
- Continuous operation: Q_{min} [10] = 0.3 × Q_{BEP} [11]
- 2-pole operation: Q_{max} [12] = 1.1 × Q_{BEP} [11]
- 4-pole operation: Q_{max} [12] = 1.25 × Q_{BEP} [11]

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.

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

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

Table 19: Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Acceleration due to gravity	m/s²
H	Pump discharge head	m
T_f	Fluid temperature	°C
T_O	Temperature at the casing surface	°C
η	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.

CAUTION

Impermissibly high density of the fluid handled

Motor overload!

- ▷ Observe the information about fluid density in the data sheet.
- ▷ Make sure the motor has sufficient power reserves.

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.

10 Minimum flow rate

11 Flow rate at best efficiency point

12 Maximum flow rate

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 piping and stored

✓ The pump has been properly drained. (⇨ Section 7.3, Page 52)

✓ The safety instructions for dismantling the pump have been observed. (⇨ Section 7.4.1, Page 52)

✓ 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 and 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 34) (⇨ Section 6.2, Page 41)

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇨ Section 7, Page 45)

⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of injury from moving parts or escaping fluid!

▹ As soon as the work is completed, properly re-install and re-activate any safety-relevant devices and protective devices.

NOTE

If the equipment has been out of service for more than one year, replace all elastomer seals.

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7 Servicing/Maintenance

7.1 Safety regulations

DANGER

Improper cleaning of coated pump surfaces

Explosion hazard by electrostatic discharge!

- When cleaning coated pump surfaces in atmospheres of Explosion group IIC, use suitable anti-static equipment.

DANGER

Sparks produced during servicing work

Explosion hazard!

- Observe the safety regulations in force at the place of installation!
- Always perform maintenance work at an explosion-proof pump (set) outside of potentially explosive atmospheres.

DANGER

Improperly serviced pump set

Explosion hazard!

Damage to the pump set!

- Service the pump set regularly.
- Prepare a maintenance schedule with special emphasis on lubricants, shaft seal and coupling.

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

WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

- Ensure that the pump set cannot be started unintentionally.
- Always make sure the electrical connections are disconnected before carrying out work on the pump set.

WARNING

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

Risk of injury!

- Observe all relevant laws.
- When draining the fluid take appropriate measures to protect persons and the environment.
- Decontaminate pumps which handle fluids posing a health hazard.

⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

- ▷ During assembly/dismantling, secure the pump (set)/pump parts to prevent tilting or tipping over.

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.

NOTE

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 "www.ksb.com/contact" on the Internet.

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/Inspection

7.2.1 Supervision of operation

⚠ DANGER

Excessive temperatures as a result of bearings running hot or defective bearing seals

Explosion hazard!

Fire hazard!

Damage to the pump set!

Risk of burns!

- ▷ Regularly check the lubricant level.
- ▷ Regularly check the rolling element bearings for running noises.

⚠ DANGER

Incorrectly serviced shaft seal

Explosion hazard!

Hot, toxic fluid escaping!

Damage to the pump set!

Risk of burns!

Fire hazard!

- ▷ Regularly service the shaft seal.

⚠ DANGER

Incorrectly serviced barrier fluid system

Explosion hazard!

Fire hazard!

Damage to the pump set!

Hot and/or toxic fluids escaping!

- ▷ Regularly service the barrier fluid system.
- ▷ Monitor the barrier fluid pressure.

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DANGER

Risk of potentially explosive atmosphere inside the pump

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.

CAUTION

Increased wear due to dry running

Damage to the pump set!

- Never operate the pump set without liquid fill.
- Never close the shut-off element in the suction line and/or supply line during pump operation.

CAUTION

Impermissibly high temperature of fluid handled

Damage to the pump!

- Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).
- Observe the temperature limits in the data sheet and in the section on operating limits. (⇨ Section 6.2, Page 41)

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 34)
- Check the shaft seal. (⇨ Section 6.1.11, Page 39)
- 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 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).

CAUTION

Operation outside the permissible bearing temperature

Damage to the pump!

- The bearing temperature of the pump (set) must never exceed 90 °C (measured on the outside of the bearing bracket).

NOTE

After commissioning, increased temperatures may occur at grease-lubricated rolling element bearings due to the running-in process. The final bearing temperature is only reached after a certain period of operation (up to 48 hours depending on the conditions).

7.2.2 Inspection work

⚠ DANGER

Excessive temperatures caused by friction, impact or frictional sparks

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▹ Regularly check the coupling guard, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.

⚠ DANGER

Electrostatic charging due to insufficient potential equalisation

Explosion hazard!

- ▹ Make sure that the connection between pump and baseplate is electrically conductive.

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

CAUTION

Insufficient inlet pressure due to clogged filter in the suction line

Damage to the pump!

- ▹ Monitor contamination of filter with suitable means (e.g. differential pressure gauge).
- ▹ Clean filter at appropriate intervals.

7.2.3 Lubrication and lubricant change of rolling element bearings

⚠ DANGER

Excessive temperatures as a result of bearings running hot or defective bearing seals

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▹ Regularly check the condition of the lubricant.

7.2.3.1 Oil lubrication

The rolling element bearings are usually lubricated with mineral oil.

7.2.3.1.1 Intervals

Table 20: Oil change intervals

Temperature at the bearing	First oil change	All subsequent oil changes[13)]
Up to 70 °C	After 300 operating hours	Every 8,500 operating hours
70 °C - 80 °C	After 300 operating hours	Every 4,200 operating hours
80 °C - 90 °C	After 300 operating hours	Every 2,000 operating hours

7.2.3.1.2 Oil quality

Oil quality

Table 21: Oil quality

Description	Symbol to DIN 51502	Properties	
CLP46 lubricating oil to DIN 51517 or HD 20W/20 SAE	□	Kinematic viscosity at 40 °C	46±4 mm^2/s
		Flash point (to Cleveland)	+175 °C
		Solidification point (pour point)	-15 °C
		Application temperature[14)]	Higher than permissible bearing temperature

7.2.3.1.3 Oil quantity

Table 22: Oil quantity

Bearing bracket	Oil quantity [l]
UP02	0.3
UP03	0.5
UP04	0.5
UP05	1.5

7.2.3.1.4 Changing the oil

⚠ WARNING

Lubricants posing a health hazard and/or hot lubricants

Hazard to persons and the environment!

- ▷ When draining the lubricant take appropriate measures to protect persons and the environment.
- ▷ Wear safety clothing and a protective mask if required.
- ▷ Collect and dispose of any lubricants.
- ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

13 At least once a year

14 For ambient temperatures below -10 °C use a different suitable type of lubricating oil. Contact KSB.

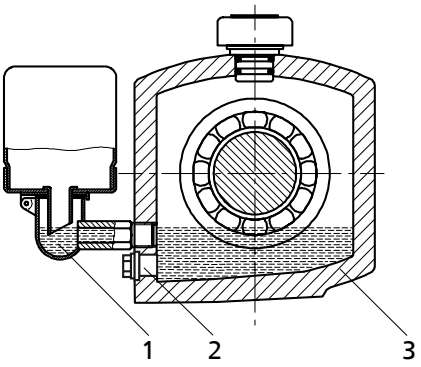

Fig. 17: Bearing bracket with constant level oiler

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, fit and tighten the screw plug (2) again.
4. Re-fill with oil. (⇨ Section 6.1.2, Page 34)

7.2.3.2 Grease lubrication

The bearings are supplied packed with high-quality lithium-soap grease.

7.2.3.2.1 Intervals

The bearings are re-lubricated via the lubricating nipples, see the following drawing.

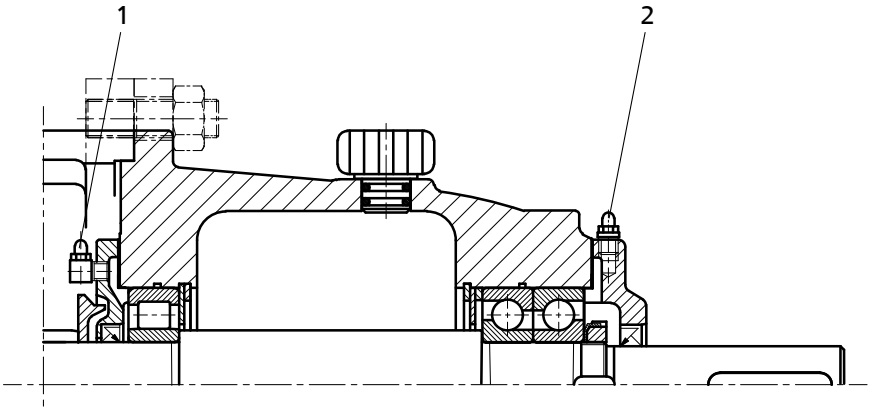

Fig. 18: Position of lubricating nipples

1	Lubricating nipple	2	Lubricating nipple

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CAUTION

Contaminated lubricating nipples

Contamination of the lubricating grease!

▷ Clean the grease lubricating nipples before re-lubricating them.

Re-lubrication

- After approx. 5000 operating hours
- At least once a year
- Required grease quantity

Grease change

- After 16,000 operating hours
- At least every 2 years
- Required grease quantity

Under unfavourable operating conditions (e.g. high room temperature, high atmospheric humidity, dust-laden air, aggressive industrial atmosphere) check the bearings earlier and clean and re-lubricate them, if required.

7.2.3.2.2 Grease quality

Table 23: Grease quality to DIN 51825

Soap basis	NLGI grade	Worked penetration at 25 °C in mm/10	Drop point	Temperature range
Lithium	2 to 3	220-295	≥ 175 °C	-30 °C to 120 °C

7.2.3.2.3 Grease quantities

Table 24: Grease quantities for re-lubrication and re-filling

Bearing assembly	Re-lubrication		Re-fill	
	Pump-end bearing	Drive-end bearing	Bearing+cover, pump end	Bearing+cover, drive end
UP02	7.5 g / 8.5 cm^3	15 g / 17 cm^3	approx. 10 g / 11 cm^3	approx. 30 g / 33 cm^3
UP03	12.5 g / 14 cm^3	25 g / 28 cm^3	approx. 25 g / 28 cm^3	approx. 60 g / 67 cm^3
UP04	12.5 g / 14 cm^3	25 g / 28 cm^3	approx. 25 g / 28 cm^3	approx. 60 g / 67 cm^3
UP05	17.5 g / 20 cm^3	35 g / 40 cm^3	approx. 40 g / 45 cm^3	approx. 80 g / 90 cm^3

7.2.3.2.4 Changing the grease

CAUTION

Mixing greases of differing soap bases

Changed lubricating qualities!

▷ Thoroughly clean the bearings.

▷ Adjust the re-lubrication intervals to the grease used.

✓ The pump has been dismantled for changing the grease.

1. Only half-fill the bearing cavities with grease.
2. Fill the cavities in the bearing cover until they are about 1/3 full.

7.3 Drainage/cleaning

⚠ 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.

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

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of injury!

- ▹ Always have repair work and maintenance work performed by specially trained, qualified personnel.

⚠ WARNING

Hot surface

Risk of injury!

- ▹ Allow the pump set to cool down to ambient temperature.

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▹ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Observe the general safety instructions and information. (⇨ Section 7, Page 45)

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

For dismantling and reassembly refer to the general assembly drawing. (⇨ Section 9.1, Page 67)

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

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DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- ▷ Properly shut down the pump set. (⇨ Section 6.1.12, Page 41)
- ▷ Close the shut-off elements in the suction line and discharge line.
- ▷ Drain the pump and release the pump pressure. (⇨ Section 7.3, Page 52)
- ▷ Shut off any auxiliary connections.
- ▷ Allow the pump set to cool down to ambient temperature.

7.4.2 Preparing the pump set

1. Interrupt the power supply and make sure it cannot be switched on again unintentionally.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard.
4. Remove the coupling spacer if fitted.
5. Drain the oil fill of oil-lubricated bearings. (⇨ Section 7.2.3.1.4, Page 49)

7.4.3 Removing the motor

NOTE

On pump sets with spacer-type couplings, the back pull-out unit can be removed while the motor remains bolted to the baseplate.

WARNING

Motor tipping over

Risk of crushing hands and feet!

- ▷ Suspend or support the motor to prevent it from tipping over.

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

7.4.4 Removing the back pull-out unit

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 52) to (⇨ Section 7.4.3, Page 53) have been observed/carried out.

✓ On pump sets without spacer-type coupling, the motor has been removed.

WARNING

Back pull-out unit tilting

Risk of crushing hands and feet!

- ▷ Suspend or support the bearing bracket at the pump end.

1. If required, suspend or support bearing bracket 330 to prevent it from tilting.
2. Unbolt support foot 183 from the baseplate.
3. Undo hexagon nut 920.01 at the volute casing.
4. Pull the back pull-out unit out of the volute casing.
5. Remove and dispose of joint ring 411.10.
6. Place the back pull-out unit on a clean and level surface.

7.4.5 Removing the impeller

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 52) to (⇨ Section 7.4.4, Page 53) have been observed/carried out.

✓ The back pull-out unit is kept in a clean and level assembly area.

1. Undo impeller nut 922 (right-hand thread).
2. Remove impeller 230 with an impeller removal tool.
3. Place impeller 230 on a clean and level surface.
4. Remove keys 940.01 from shaft 210.
5. Remove and dispose of joint rings 411.31/411.32.

7.4.6 Removing the shaft seal

7.4.6.1 Dismantling the mechanical seal - cylindrical casing cover

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 52) to (⇨ Section 7.4.5, Page 54) 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 and slide back seal cover 471.01 (if fitted) until it rests against thrower 507.01.
2. Remove casing cover 161 with O-ring 412.01.
3. Remove and dispose of O-ring 412.01.
4. Pull complete mechanical seal 433 with shaft protecting sleeve 524.01, seal cover 471 and thrower 507.01 off shaft 210.

7.4.6.2 Dismantling the mechanical seal - conical casing cover

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 52) to (⇨ Section 7.4.5, Page 54) have been observed/carried out.

✓ The back pull-out unit is kept in a clean and level assembly area.

1. Pull shaft sleeve 524.01 with the rotating assembly of mechanical seal 433 off the shaft.
2. Dismantle casing cover 161 with the stationary ring of mechanical seal 433.
3. Remove thrower 507.01.
4. Press the stationary ring of mechanical seal 433 out of casing cover 161.

7.4.6.3 Dismantling the gland packing

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 52) to (⇨ Section 7.4.5, Page 54) have been observed/carried out.

✓ The back pull-out unit is kept in a clean and level assembly area.

1. Unscrew hexagon nuts 920.02 at gland follower 452 and remove the gland follower.
2. Remove stuffing box ring 454.01 and drip plate 463.01.
3. Remove casing cover 161 with O-ring 412.01 and gland packing 461.01.
4. Remove packing rings 461.01 and lantern ring 458.01, if any, from the packing chamber.
5. Pull off guard 680.
6. Pull shaft protecting sleeve 524.01 and thrower 507.01 off shaft 210.

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7.4.7 Dismantling the bearings

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 52) to (⇨ Section 7.4.6, Page 54) have been observed/carried out.

✓ The bearing bracket is kept in a clean and level assembly area.

1. Unscrew hexagon nuts 920.04 at the flange of bearing bracket lantern 344.
2. Remove bearing bracket lantern 344.
3. Unscrew the hexagon socket head cap screw in the coupling hub.
4. Pull the coupling half off the pump shaft with a puller.
5. Remove key 940.02.
6. Undo screws 914.02 and remove drive-end bearing cover 360.02 and joint ring 400.02.
7. Undo screws 914.01 and remove pump-end bearing cover 360.01 and joint ring 400.01.
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 the bearing bracket towards the drive end.
9. Remove support disc 550.23 of angular contact ball bearing 320.02 from bearing bracket 330.
10. In case of grease lubrication, remove disc 550.25.
11. Remove cylindrical roller bearing 322.01 (roller cage) from bearing bracket 330.
12. In case of grease lubrication, remove disc 550.24.
13. Bend open lock washer 931.01 behind keywayed nut 920.21 on shaft 210.
14. Unscrew keywayed nut 920.21 (right-hand thread) and remove lock washer 931.01.

⚠ WARNING

Hot surfaces due to heating of components for assembly/dismantling

Risk of burns!

- ▹ Wear heat-resistant protective gloves.
- ▹ Remove flammable substances from the danger zone.
- ▹ Observe the applicable local occupational safety regulations and accident prevention regulations.

15. 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.
16. Dispose of joint rings 400.01/.02.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

- ▹ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

CAUTION

Improper reassembly

Damage to the pump!

- ▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.
- ▷ Use original spare parts only.

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 made by cutting an O-ring cord to size and gluing the ends together.
- **Packing rings**
  - Always use pre-compressed packing rings.

CAUTION

Contact of O-ring with graphite or similar material

Fluid could escape!

- ▷ Do not coat O-ring with graphite or similar material.
- ▷ Use animal fats or lubricants based on silicone or PTFE.

- **Assembly adhesives**
  - 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 and adjusting screws.

Tightening torques

For reassembly, tighten all screws and bolts as specified in this manual.

7.5.2 Installing 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.

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⚠ WARNING

Hot surfaces due to heating of components for assembly/dismantling

Risk of burns!

- ▷ Wear heat-resistant protective gloves.
- ▷ Remove flammable substances from the danger zone.
- ▷ Observe the applicable local occupational safety regulations and accident prevention regulations.

1. Heat up angular contact ball bearing 320.02 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 and the inner ring of cylindrical roller bearing 322.01 onto shaft 210 until they will not go any further.

NOTE

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.

3. Use a C-spanner to tighten slotted round nut 920.21 without lock washer 931.01.
4. Let angular contact ball bearing 320.01 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. Insert circlip 932.01/932.02 into the bearing bracket.
11. On grease-lubricated models, insert disc 550.24.
12. Fit cylindrical roller bearing 322.01 (roller cage) in the bearing bracket.

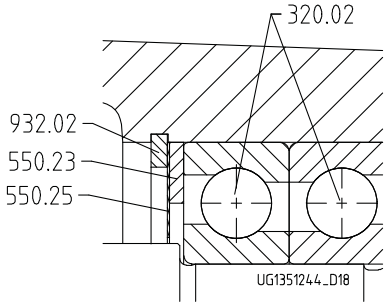

Fig. 19: Installing the bearings

13. On grease-lubricated models, insert disc 550.25.
14. Insert support disc 550.23 of angular contact ball bearing 320.02 into bearing bracket 330.
15. In case of grease lubrication, fill the bearings and bearing covers with grease. Grease lubrication
16. Carefully insert pre-assembled shaft 210 with angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 into bearing bracket 330 from the drive end.
17. Fit pump-end bearing cover 360.01 with joint ring 400.01; take care not to damage lip seal 421.01.

18. Fit motor-end bearing cover 360.02 with joint ring 400.02; take care not to damage lip seal 421.02.
19. Fit bearing bracket lantern 344.
20. Tighten hexagon nuts 920.04 at the flange of bearing bracket lantern 330.
21. Fit casing cover 161 in bearing bracket lantern 344.
    Make sure gasket 411.11 and O-ring 412.01 are positioned correctly.

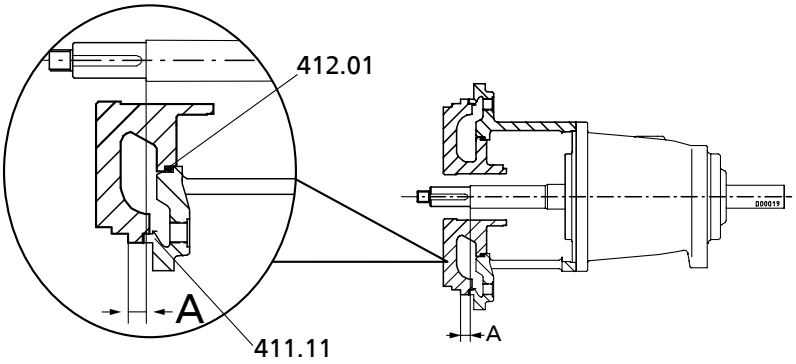

Fig. 20: Dimension A impeller clearance

22. Measure dimension A (see drawing).
23. Compare the actual dimension A with the specified dimension A (see table below: Dimension A for adjusting the impeller clearance).
    Compensate any difference with adjusting washers 550.12.
24. Fit keys 940.02.
25. Slide the coupling hub onto the shaft end.
26. Secure the coupling hub with a hexagon socket nut.
27. Fit thrower 507.01, if any.

Table 25: Dimension A for adjusting the impeller clearance

Bearing bracket	Size	Dimension A
UP02	25-160	6,5
	25-200	
	32-125	
	32-160	
	32-200	
	40-160	
	40-200	
	50-160	
	50-200	
UP03	65-160	10,5
	65-200	
	80-160	
	80-200	
	100-200	
	32-250	4,5
	40-250	
	40-315	
	50-250	
	50-315	
	65-250	
	80-250	
UP04	65-315	6,5
	80-315	

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Bearing bracket	Size	Dimension A
UP04	80-400	6,5
UP05	200-315	3,9

7.5.3 Fitting the shaft seal

7.5.3.1 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 contact faces immediately before installation takes place.
- Prevent any damage to the sealing surfaces or O-rings.
- After inserting the stationary ring of the mechanical seal, 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 steps to protect the surface of the shaft protecting sleeve from damage.

Re-installing the mechanical seal - cylindrical casing cover

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.2, Page 56) have been observed/carried out.

✓ The bearing assembly and the individual parts of mechanical seal 433 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.

1. Slide thrower 507.01 (if any) onto shaft 210 from the pump end.
2. Fasten seal cover 471 with inserted O-ring and the stationary ring of the mechanical seal to casing cover 161 with hexagon nut 920.02.
3. Insert casing cover 161 with O-ring 412.01 into lantern 344; watch joint ring 411.11.
4. Fit the rotating assembly of mechanical seal 433 on shaft protecting sleeve 524.01 (observe distance B - see Supplementary Sheet of the mechanical seal).
5. Slide pre-assembled mechanical seal 433 and shaft protecting sleeve 524.01 onto shaft 210.

Fitting the mechanical seal - conical casing cover

- ✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.2, Page 56) have been observed/carried out.
- ✓ The bearing assembly and the individual parts of mechanical seal 433 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.

1. Slide thrower 507.01 (if any) onto shaft 210 from the pump end.
2. Carefully press the stationary ring of mechanical seal 433 with O-ring into casing cover 161.
3. Fit casing cover 161 with the inserted stationary ring of the mechanical seal into lantern 344.
4. Fit the rotating assembly of mechanical seal 433 and the spacer ring, if any, on shaft protecting sleeve 524.01 (observe distance B - see Supplementary Sheet for the mechanical seal).
5. Slide pre-assembled mechanical seal 433 and shaft protecting sleeve 524.01 onto shaft 210.

7.5.3.2 Packing the gland

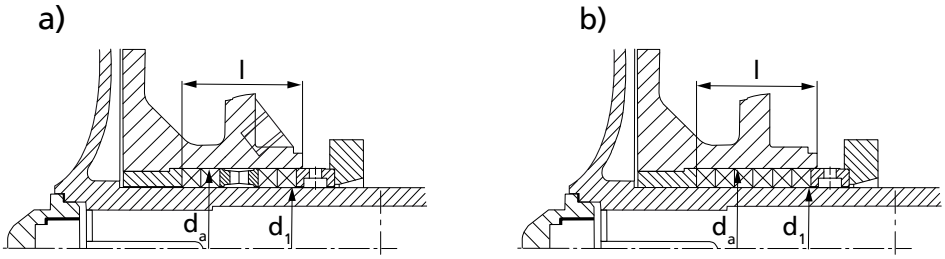

Fig. 21: Gland packing chamber a) with lantern ring and b) without lantern ring

Table 26: Gland packing chamber

Bearing bracket	Gland packing chamber			Packing cross-section	Packing rings
	Ø d_1	Ø d_a	l		
UP02	35	51	53	8 x 8	4 rings and 1 lantern ring or 6 rings
UP03	45	65	64	10 x 10	
UP04	55	75	64	10 x 10	
UP05	70	95	79	12.5 x 12.5	

For variants with pure graphite packings see supplementary operating instructions! Always use pre-compressed packing rings.

- ✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.2, Page 56) have been observed/carried out.
- ✓ The bearing assembly as well as the individual parts are kept in a clean and level assembly area.
- ✓ All disassembled 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.

1. Clamp casing cover 161 into a vice.
2. Push in neck bush 456.01.
3. Insert the first packing ring, ensuring that its cut edge is in horizontal position.
4. Hold the packing ring in place and slide shaft protecting sleeve 524 (chamfered side first) into the gland packing chamber from the pump end.

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5. Slightly expand the inside diameter of the packing ring by moving the shaft protecting sleeve back and forth. Then pull out shaft protecting sleeve 524.
   Insert lantern ring 458, if any (see drawing above).
   Insert each subsequent packing ring separately with its joint offset by approx. 90° in relation to the previous one. Repeat the expansion procedure.
   After inserting the last packing ring, shaft protecting sleeve 524 remains in the packing chamber.
6. Insert stuffing box ring 454.01 with the drilled hole down.
7. Fit gland follower 452 and lightly fasten it by hand with the two hexagon nuts 920.02; watch discs 550.01.
8. Fit guard 680.
9. Install complete discharge cover 161 with shaft protecting sleeve 524 in the pump; take care not to damage joint ring 411.11.

7.5.4 Fitting the impeller

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.3, Page 59) have been observed/carried out.

✓ The bearing assembly/mechanical seal as well as 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.

1. Insert keys 940.01 into the shaft keyway.
2. Insert joint ring 411.32.
3. Coat the impeller seat with a suitable lubricant.
4. Slide impeller 230 onto shaft 210.
5. Insert joint ring 411.31.
6. Fit and tighten impeller nut 922 on shaft 210.

7.5.5 Fitting the back pull-out unit

⚠ WARNING

Back pull-out unit tilting

Risk of crushing hands and feet!

▷ Suspend or support the bearing bracket at the pump end.

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.4, Page 61) 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 supplied without coupling: Fit the coupling in accordance with the manufacturer's instructions.

1. If required, suspend or support the back pull-out unit to prevent it from tilting. Then slide it into volute casing 102 with a new gasket 411.10.
2. Tighten nut 920.01 at the volute casing.
3. Bolt support foot 183 to the baseplate.

7.5.6 Mounting the motor

NOTE

Steps 1 and 2 do not apply to versions with spacer-type coupling.

1. Shift the motor to connect it to the pump via the coupling.
2. Fasten the motor to the baseplate.
3. Align pump and motor. (⇨ Section 5.7, Page 30)
4. Connect the motor to the power supply (refer to manufacturer's product literature).

7.6 Tightening torques

7.6.1 Tightening torques

Use a torque wrench to tighten the bolted connections (902.01/920.01) between the volute casing and the bearing bracket lantern.

Table 27: Tightening forces [Nm] for screwed connections

Material of stud/hexagon nut	C35E+Qt/C 35			A4-70/A4-70			1.7709+QT/1.7258+QT 1.6772/1.6722					
Stamp mark on stud/hexagon nut[15]	YK/Y			A4-70/A4-70			GA/G					
Bearing bracket lantern[16]							A	B	A	B	A	B
	New threads[17]	-15 %[18]	-20 %[18]	New threads[17]	-15 %[18]	-20 %[18]	New threads[17]		-15 %[18]		-20 %[18]	
M10	-	-	-	30	25,5	24	47	30	39,9	25,5	37,6	24
M12	40	34	32	55	46,7	44	80	55	68	46,7	64	44
M16	100	85	80	155	131,7	124	190	155	161,5	131,7	152	124
M20	-	-	-	200	170	160	330	200	280,5	170	264	160

7.6.2 Tightening torques for the impeller nut

Observe the following tightening torques for impeller nut (922):

Table 28: Tightening torques for the impeller nut

Bearing bracket	Tightening torques [Nm]	Width across flats [mm]
UP02	80	22
UP03	125	27
UP04	200	32
UP05	300	41

Re-tighten the impeller nut some 20 to 30 minutes after assembly.

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15 Treat unstamped screwed connections like material pair C35/E+QT/C 35.

16 A: made of ductile material – except for JL 1040; B: made of material JL 1040

17 These values are determined on the basis of a friction coefficient of μ = 0.12.

18 After repeated tightening of the threads and in case of good lubrication the values shall be reduced by 15 to 20 %.

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
- Type series
- Size
- Material variant
- Year of construction

Refer to the name plate for all data.

Also specify the following data:

- Part number and description
- 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 29: Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
210	Shaft	1	1	1	2	2	2	20%
230	Impeller	1	1	1	2	2	2	20%
320.02	Angular contact ball bearing (set)	1	1	1	2	2	3	25%
322.01	Cylindrical roller bearing	1	1	2	2	2	3	25%
524.01	Shaft protecting sleeve	2	2	2	3	3	4	50%
- - -	Seal elements for pump casing (set)	4	6	8	8	9	12	150%
- - -	Coupling and torque-transmitting elements (set)	1	1	2	2	3	4	30%
Variants with mechanical seal:								
433	Mechanical seal, complete	1	1	2	2	2	3	25%
Variants with gland packing:								
456.01	Neck bush	1	1	2	2	2	3	30%
461.01	Gland packing (set)	4	4	6	6	6	8	100%

7.7.3 Interchangeability of pump components

Components featuring the same number in a column are interchangeable.

NOTE

Volute casing 102 and impeller 230 are not interchangeable between different pump sizes.

Table 30: Interchangeability of pump components

Bearing bracket	Pump size	Part description																		
		Casing cover	Support foot	Shaft	Angular contact ball bearing	Cylindrical roller bearing	Bearing bracket	Bearing bracket lantern	Thrower	Shaft protecting sleeve[19]	Drip pan	Guard	Impeller nut	Mechanical seal	Seal cover	Gland follower	Stuffing box ring	Neck bush	Lantern ring	Gland packing
		Part No.																		
		161	183	210	320.02	322.01	330	344	507.01	524.01	648	680	922	433	471.01	452.01	454.01	456.01	458.01	461.01
UP02	25-160	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
	25-200	3	3	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
	32-125	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	32-160	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
	32-200	3	3	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
	40-160	2	2	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
	40-200	3	3	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
	50-160	2	3	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
	50-200	3	3	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1
UP03	32-250	6	5	2	2	2	2	6	2	2	2	2	2	2	2	2	2	2	2	2
	65-160	4	4	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	2
	65-200	5	5	2	2	2	2	5	2	2	2	2	2	2	2	2	2	2	2	2
	40-250	6	5	2	2	2	2	6	2	2	2	2	2	2	2	2	2	2	2	2
	40-315	7	6	2	2	2	2	7	2	2	2	2	2	2	2	2	2	2	2	2
	50-250	6	5	2	2	2	2	6	2	2	2	2	2	2	2	2	2	2	2	2
	50-315	7	7	2	2	2	2	7	2	2	2	2	2	2	2	2	2	2	2	2
	65-250	6	6	2	2	2	2	6	2	2	2	2	2	2	2	2	2	2	2	2
	80-160	4	5	2	2	2	2	4	2	2	2	2	2	2	2	2	2	2	2	2
	80-200	5	5	2	2	2	2	5	2	2	2	2	2	2	2	2	2	2	2	2
	80-250	6	7	2	2	2	2	6	2	2	2	2	2	2	2	2	2	2	2	2
	100-200	5	6	2	2	2	2	5	2	2	2	2	2	2	2	2	2	2	2	2
UP04	65-315	9	8	3	2	2	2	7	3	3	2	3	3	3	3	3	3	3	3	3
	80-315	9	9	3	2	2	2	7		3	2	3	3	3	3	3	3	3	3	3
	80-400	10	10	3	2	2	2	8		3	2	3	3	3	3	3	3	3	3	3
UP05	200-315	11	11	4	3	3	3	9	4	4	3	4	4	4	4	4	4	4	4	4

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[19] Depending on mechanical seal type

8 Trouble-shooting

⚠ WARNING

Improper work to remedy faults

Risk of injury!

- ▷ 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.

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 31: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy[20]
✘	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller.[21] Increase the speed (turbine, I.C. engine).
✘	-	-	-	-	-	✘	✘	Pump or piping are not completely vented or primed.	Vent and/or prime.
✘	-	-	-	-	-	-	-	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
✘	-	-	-	-	-	-	-	Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
✘	-	-	-	-	-	✘	✘	Suction lift is too high/$NPSH_{available}$ (positive suction head) is too low.	Check/alter fluid level. Install pump at a lower level. Fully open the shut-off element in the suction 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.
✘	-	-	-	-	-	-	-	Air intake at the shaft seal	Clean barrier fluid duct, supply external barrier fluid, if necessary, or increase barrier fluid pressure. Replace shaft seal.
✘	-	-	-	-	-	-	-	Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
✘	-	-	-	-	-	-	-	Speed is too low.[21] - Operation with frequency inverter - Operation without frequency inverter	 - Increase voltage/frequency at the frequency inverter in the permissible range. - Check voltage.
✘	-	-	-	-	-	✘	-	Impeller	Replace worn components by new ones.

20 Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

21 Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy[20)]
-	✗	-	-	-	-	✗	-	Pump back pressure is lower than specified in the purchase order.	Re-adjust to duty point. In the case of persistent overloading, turn down impeller.[21)]
-	✗	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.
-	✗	-	-	-	✗	-	-	Gland follower over-tightened or cocked	Correct.
-	✗	✗	-	-	-	-	-	Speed is too high.	Reduce speed.[21)]
-	-	-	-	✗	-	-	-	Defective gasket	Fit new gasket between volute casing and casing cover.
-	-	-	-	-	✗	-	-	Worn shaft seal	Fit new shaft seal. Check flushing liquid/barrier fluid.
✗	-	-	-	-	✗	-	-	Score marks or roughness on shaft protecting sleeve / shaft sleeve	Replace shaft protecting sleeve/shaft sleeve. Fit new shaft seal.
-	-	-	-	-	✗	-	-	Vibrations during pump operation	Correct suction conditions. Re-align the pump. Re-balance the impeller. Increase pressure at the pump suction nozzle.
-	-	-	✗	-	✗	✗	-	The pump set is misaligned.	Re-align.
-	-	-	✗	-	✗	✗	-	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.
-	-	-	✗	-	-	✗	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
-	-	-	✗	-	-	-	-	Non-compliance with specified coupling distance	Correct the distance according to general arrangement drawing.
✗	✗	-	-	-	-	-	-	Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
-	-	-	-	-	-	✗	-	Rotor out of balance	Clean the impeller. Re-balance the impeller.
-	-	-	-	-	-	✗	-	Defective bearing(s)	Replace.
-	-	-	-	-	-	✗	✗	Flow rate is too low.	Increase the minimum flow rate.
-	-	-	-	-	✗	-	-	Incorrect inflow of circulation liquid	Increase the free cross-section.

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9 Related Documents

9.1 General assembly drawing with list of components

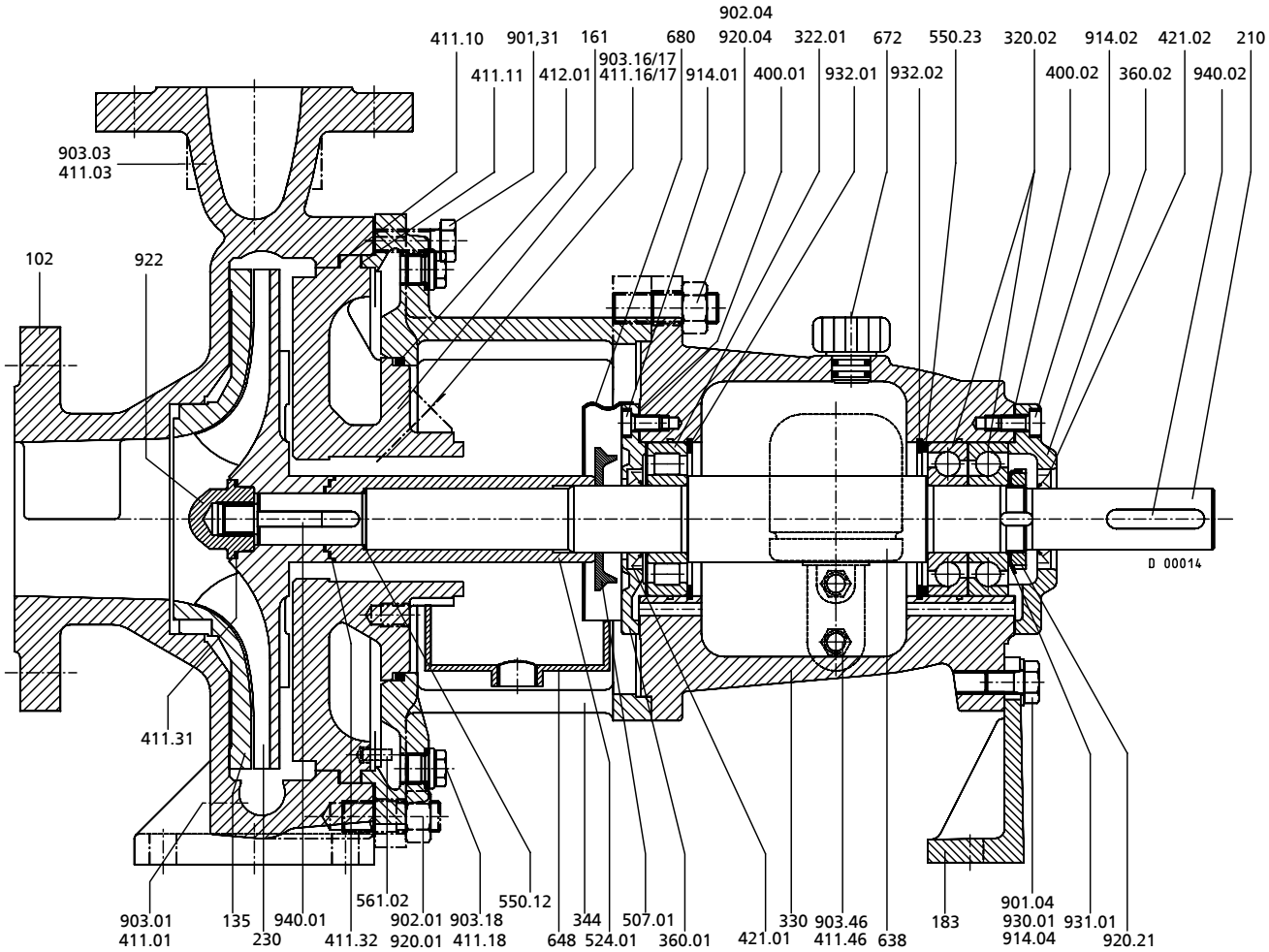

Fig. 22: Version with mechanical seal

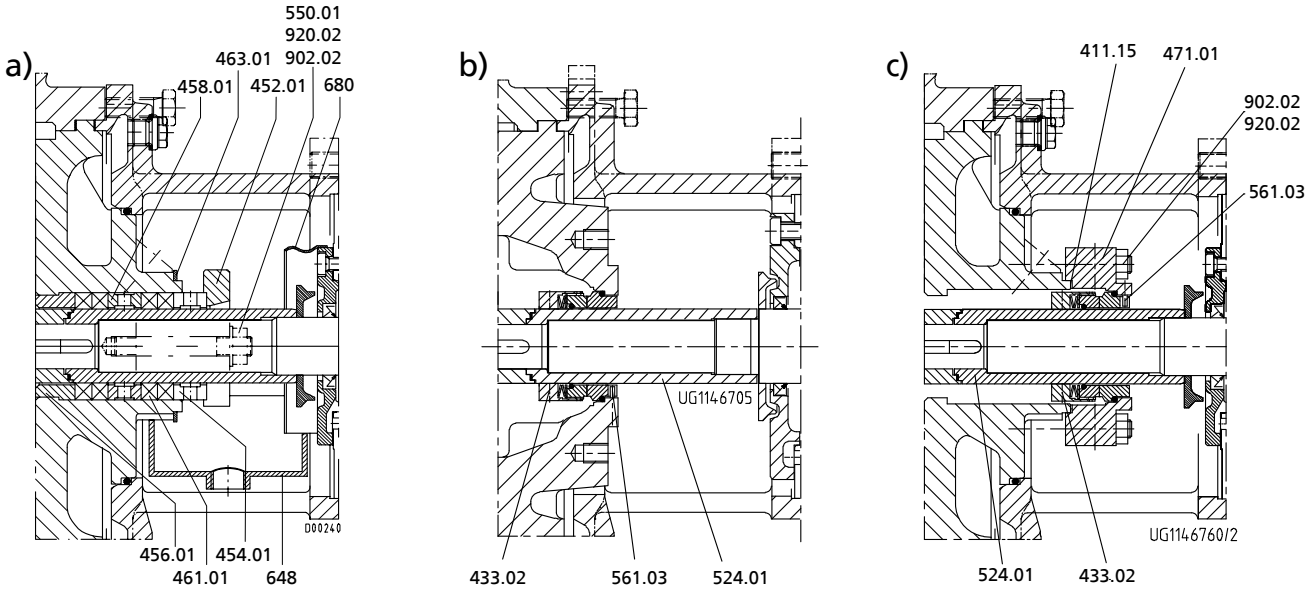

Fig. 23: a) Version with gland packing, b) Mechanical seal with conical casing cover, c) Mechanical seal with cylindrical casing cover

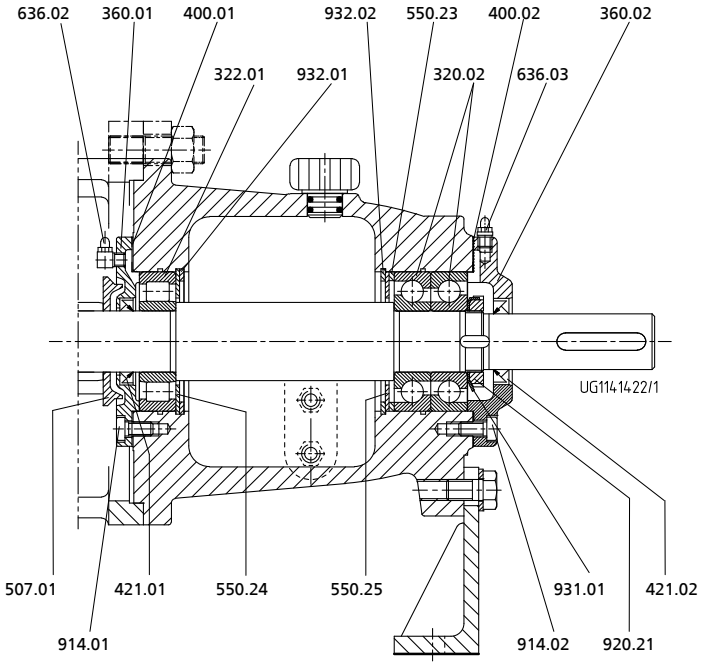

Fig. 24: Grease-lubricated version

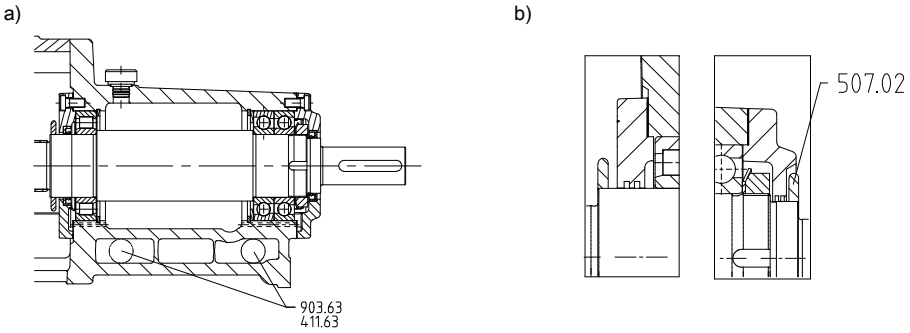

Fig. 25: a) Version with coolable bearing bracket, b) Version with labyrinth seal

Table 32: List of components

Part No.	Comprising	Description
102	102	Volute casing
	411.01/.03	Joint ring
	411.10[22)]	Joint ring
	902.01	Stud
	903.01/.03	Screw plug
	920.01	Hexagon nut
135	135	Wear plate
161	161	Casing cover
	411.11/.16/.17	Joint ring
	412.01[23)]	O-ring
	463.01[24)]	Drip plate
	550.01[24)]	Disc
	902.02	Stud
	903.16/.17	Screw plug

22 Joint ring 411.10 (and 411.15 for version with mechanical seal) depending on the operating temperature. To be ordered separately in spare parts order.

23 Not fitted on version with conical seal chamber

24 Provided for version with gland packing only

Part No.	Comprising	Description
161	920.02	Hexagon nut
183	183	Support foot
	901.04[25)]	Hexagon head bolt
	930.01	Spring washer
210	210	Shaft
	550.12	Set of adjusting washers
	920.21	Slotted round nut
	931.01	Lock washer
	940.01/.02	Key
230	230	Impeller
	411.32	Joint ring
320.02	320.02	Angular contact ball bearing
322.01	322.01	Cylindrical roller bearing
330	330	Bearing bracket
	360.01/.02	Bearing cover
	400.01/.02	Gasket
	411.46	Joint ring
	421.01/.02	Lip seal
	550.23	Support disc
	638[26)]	Constant level oiler
	672	Vent plug
	903.46	Screw plug
	914.01/.02	Hexagon socket head cap screw
	932.01/.02	Circlip
	550.24/.25[27)]	Disc
	636.02/.03[27)]	Lubricating nipple
344	344	Bearing bracket lantern
	411.18	Joint ring
	412.01[23)]	O-ring
	561.02	Parallel pin
	903.18	Screw plug
	902.04	Stud
	901.31	Hexagon head bolt
	920.04	Hexagon nut
360.01/.02	360.01/.02	Bearing cover
	400.01/.02	Gasket
	914.01/.02	Hexagon socket head cap screw
421.01/.02	421.01/.02	Lip seal
433	433	Mechanical seal
452.01[24)]	452.01[24)]	Gland follower
454.01[24)]	454.01[24)]	Stuffing box ring
456.01[24)]	456.01[24)]	Neck bush
458.01[24)]	458.01[24)]	Lantern ring
461.01[24)]	461.01[24)]	Gland packing
463.01[24)]	463.01[24)]	Drip plate

25 For bearing brackets UP02 and UP04: socket head cap screw 914.04

26 Not applicable to grease-lubricated versions

27 Only included for grease-lubricated versions

Part No.	Comprising	Description
471.01	471.01	Seal cover
	411.15[22)]	Joint ring
507.01	507.01	Thrower
	561.03	Grooved pin
524.01	524.01	Shaft protecting sleeve
	411.32	Joint ring
561.02	561.02	Grooved pin
638[26)]	638[26)]	Constant level oiler
648[24)]	648[24)]	Drip pan
680	680	Guard
922	922	Impeller nut
	411.31	Joint 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**:

CPKN, CPKNO

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[28]: 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[29] have been applied:
  - ISO 12100
  - EN 809
- Applied national technical standards and specifications, in particular:
  - DIN EN ISO 5199

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

.....[30].....

Name

Function

Company
Address

28 Where applicable

29 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.

30 A signed, legally binding UK Declaration of Conformity is supplied with the product.

11 Certificate of Decontamination

Type: .....

Order number /

Order item number[31)]: .....

Delivery date: .....

Application: .....

Fluid handled[31)]: .....

Please tick where applicable[31)]:

☐ Corrosive

☐ Oxidising

☐ Flammable

☐ Explosive

☐ Hazardous to health

☐ Seriously hazardous to health

☐ Toxic

☐ Radioactive

☐ Bio-hazardous

☐ Safe

Reason for return:[31)]: .....

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

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31 Required field

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