Thermal Oil / Hot Water Pump

HPK-L

Product Generation A

Installation/Operating Manual

UK CA

KSB

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Installation/Operating Manual HPK-L

Original operating manual

Subject to technical modification without prior notice.

Contents

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 partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance. (⇨ Section 7.5.5, Page 58)

1.3 Target group

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

1.4 Other applicable documents

Table 1: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump (set)
General arrangement drawing / outline drawing	Description of mating dimensions and installation dimensions for the pump (set), weights
Drawing of auxiliary connections	Description of auxiliary connections
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency and power input
General assembly drawing[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
List of components[1)]	Description of all pump components
Assembly drawing[1)]	Sectional drawing of the installed shaft seal

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

1.5 Symbols

Table 2: Symbols used in this manual

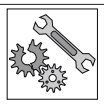
Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references

1 If included in agreed scope of supply

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

1.6 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
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 UK regulation titled 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. (⇨ Section 1.4, Page 7)
- Only operate pumps/pump sets which are in perfect technical condition.
- Do not operate the pump (set) in partially assembled condition.
- Only use the pump (set) to handle the fluids described in the data sheet or product literature of the pump 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 6.3, Page 42)
- Decontaminate pumps which handle fluids posing a health hazard. (⇨ Section 7.3, Page 49)
- 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 35)

2.8 Unauthorised modes of operation

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

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

2.9 Explosion protection

DANGER

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

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

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

Especially adhere to the sections in this manual marked with the symbol opposite and the following sections, (⇨ Section 2.9.1, Page 11) to (⇨ Section 2.9.4, Page 12)
The explosion-proof status of the pump is only assured if the pump is used in accordance with its intended use.
Never operate the product outside the limits stated in the data sheet and on the name plate.
Prevent impermissible modes of operation at all times.

2.9.1 Marking

Pump

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

Example of such marking:
II 2G Ex h IIC T5-T1 Gb

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

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

Shaft coupling

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

Motor

The motor has its own marking. The marking is maintained on the condition that the temperatures the pump causes to develop at the motor flange and motor shaft are permitted by the motor manufacturer.

The motors fitted by KSB on pumps certified for potentially explosive atmospheres meet this condition.

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

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[2)]
T1	Maximum 400 °C[3)]
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 6.2.4.1, Page 41) 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 6.2.4.1, Page 41) can be used to check whether an additional heat build-up may lead to a dangerous temperature increase at the pump surface.

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2 Subject to further limitations for mechanical seal temperature rise

3 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.

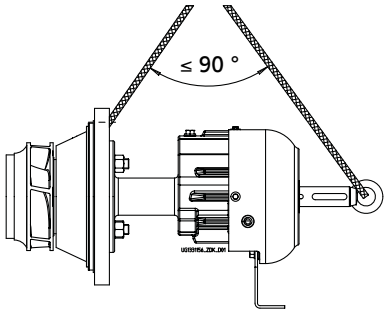

Fig. 1: Transporting the back pull-out unit

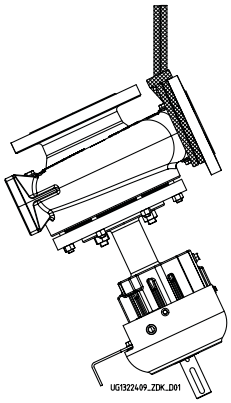

Fig. 2: Transporting the pump

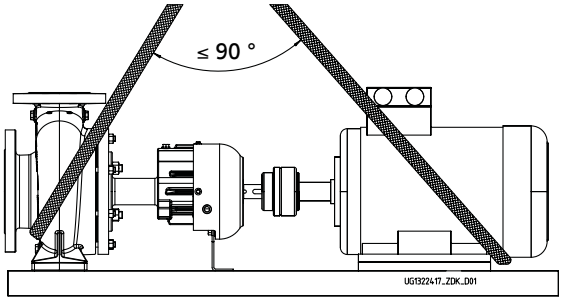

Fig. 3: Transporting the pump set

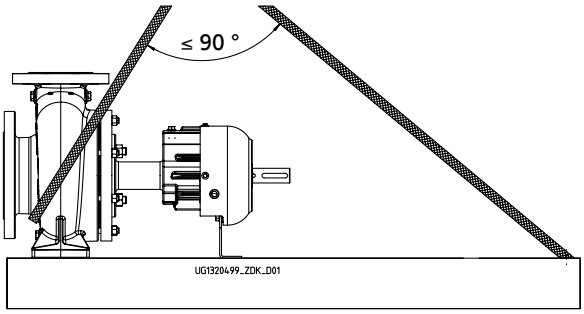

Fig. 4: Transporting the pump on the baseplate

CAUTION

Risk of pump (set) or bare shaft end hitting other objects

Damage to the ceramic plain bearing!

▷ Secure them properly.

3.3 Storage/preservation

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of pump (set)!

▷ For outdoor storage cover the pump (set) and accessories with waterproof material and protect against condensation.

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 42)

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3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 49)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
   Indicate any safety measures and decontamination measures taken.
   (⇨ Section 11, Page 69)

NOTE

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

3.5 Disposal

⚠ WARNING

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

Hazard to persons and the environment!

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

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

4 Description of the Pump (Set)

4.1 General description

- Heat transfer fluid / hot water pump

Pump for handling hot water and organic or synthetic heat transfer fluids in piping or tank systems.

Standard design for plants (large heating systems, forced circulation boilers, district heating systems, etc).

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: HPK- L S 4 80- 200

Table 5: Key to the designation

Code	Description
HPK	Type series
L	Air-cooled
S	Material of wetted components
4	Pressure class
80	Nominal discharge nozzle diameter [mm]
200	Nominal impeller diameter [mm]

4.4 Name plate

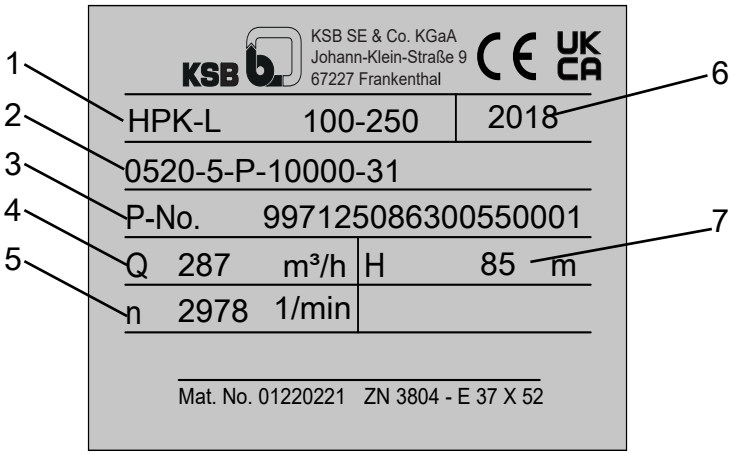

Fig. 5: Name plate (example)

1	Type series, size, material	2	Customer-specific information (optional)
3	KSB order number and order item 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
- Single-stage
- Technical requirements to ISO 5199
- Dimensions and ratings to ISO 2858
  complemented by pumps of nominal diameters DN 25, DN 200, DN 250 and nominal impeller diameter 500 mm

Pump casing

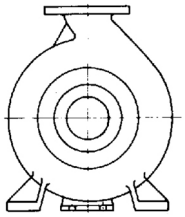

Fig. 6: Pump feet, bottom

- Single or double volute, depending on the pump size
- Radially split volute casing
- Volute casing (with casing wear ring, if applicable) and casing cover

Impeller type

- Closed radial impeller with multiply curved vanes
- Back vanes reduce axial thrust.

Shaft seal

- Single, balanced standardised mechanical seal
  - The seal chamber is located between the product-lubricated pump-end plain bearing and the external, drive-end rolling element bearing.

Mechanical seal in "dead end" arrangement

1. Never use mechanical seals which have not been approved by KSB.
2. Due to the complex conditions which need to be fulfilled for heat transfer fluid pumps, the use of mechanical seals not approved by KSB shall not be covered by KSB's scope of warranty.

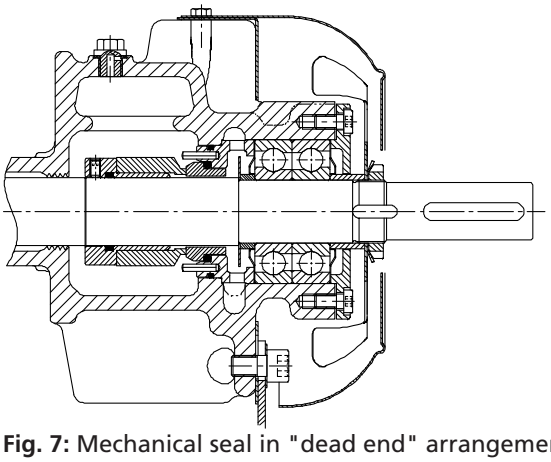

Fig. 7: Mechanical seal in "dead end" arrangement

The seal chamber is cooled by cooling fins and ambient cooling air.

There is no external cooling system!

Design specifications

Drive-end bearing:

- Fixed bearing
- Grease-packed angular contact ball bearings sealed for life
- Axial movement of the rotor limited to 0.5 mm maximum
- Axial seal rings on both sides

Pump-end bearing:

- Radial bearing
- Absorbs radial loads only
- Product-lubricated ceramic bearing

Bearing bracket designation

Example: P03

Table 6: Bearing bracket designation

Code	Description
L	Air-cooled bearing bracket with integrated shaft seal chamber
P	Process design
03	Size code (based on the dimensions of seal chamber and shaft end)

Refer to the data sheet to find your bearing design.

Bearings used

Table 7: Bearing design

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

Table 8: Standard bearings

Bearing bracket	Pump end	Drive end
	Plain bearing [diameter in mm]	Angular contact ball bearings
LP02	SSiC, 37 mm	2 x 7307 B.G
LP03	SSiC, 50 mm	2 x 7307 B.G
LP04	SSiC, 50 mm	2 x 7309 B.G.8
LP05	SSiC, 62 mm	2 x 7313 B.G
LP06	SSiC, 72 mm	2 x 7315 B.G

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4.6 Configuration and function

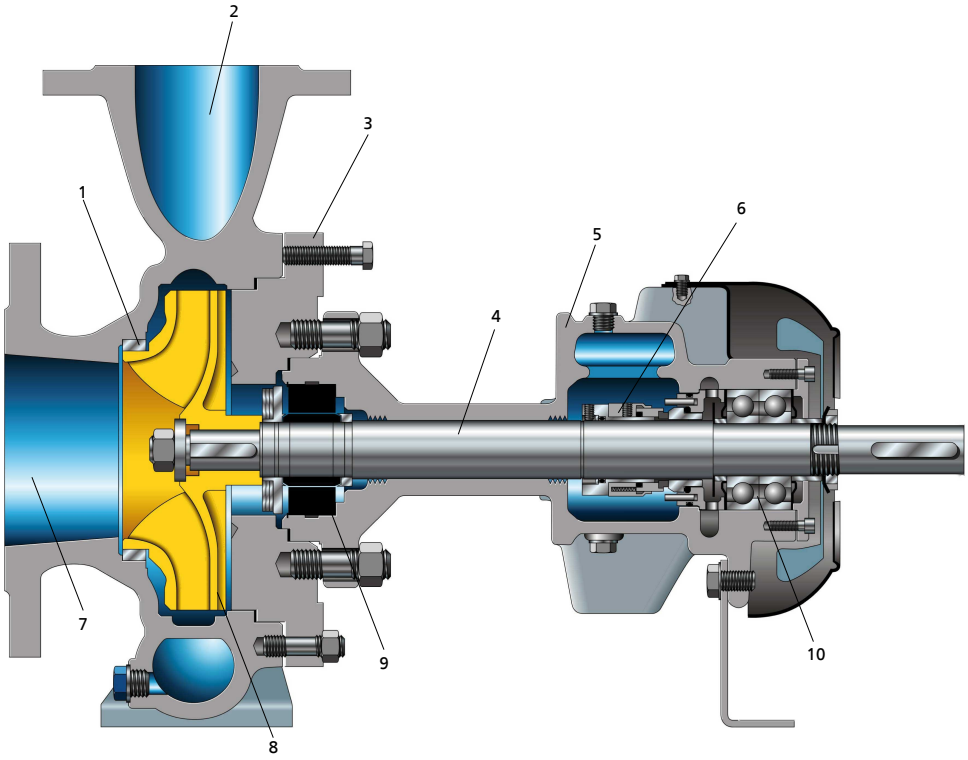

Fig. 8: Sectional drawing

1	Clearance gap	2	Discharge nozzle
3	Casing cover	4	Drive shaft
5	Bearing bracket	6	Shaft seal
7	Suction nozzle	8	Impeller
9	Plain bearing, pump end	10	Rolling element bearings, drive 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 (7) and is accelerated outward by the rotating impeller (8). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (2), where it leaves the pump. The clearance gap (1) prevents any fluid from flowing back from the casing to the suction nozzle. At the rear side of the impeller, the shaft (4) enters the hydraulic system via the casing cover (3). The shaft passage through the cover is sealed towards the atmosphere with a shaft seal (6). The shaft runs in a pump-end plain bearing (9) and drive-end rolling element bearings (10). The bearings are supported by a bearing bracket (5) linked with the pump casing and/or casing cover.

Sealing The pump is sealed by a KSB mechanical seal as standard. A standardised mechanical seal with shaft sleeve is available as an option.

4.7 Noise characteristics

Table 9: Surface sound pressure level L_{pA} [4) 5)]

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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4 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.

5 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 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.
- ▷ The mounting surface must be set, even, and level.
- ▷ Observe the weights indicated.

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.

5.2 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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5.2.1 Installation on the foundation

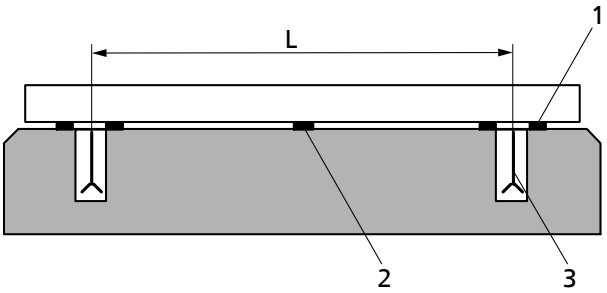

Fig. 9: Fitting the shims

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.

5.2.2 Installation without foundation

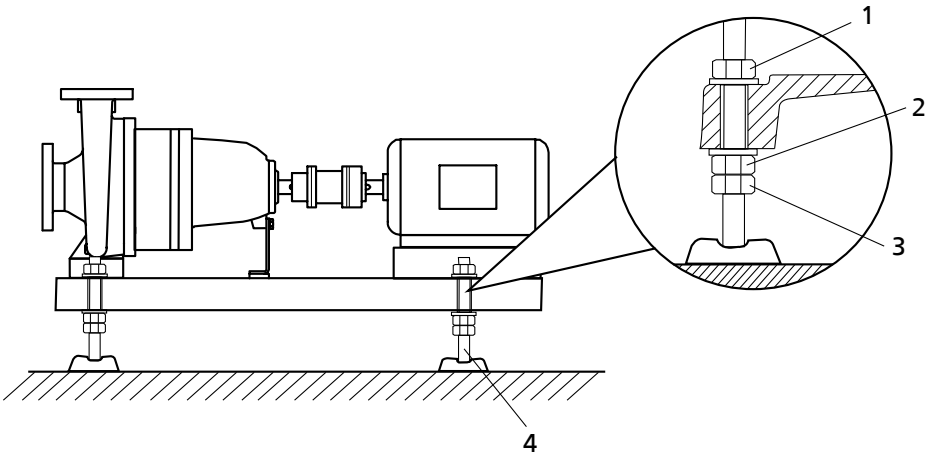

Fig. 10: Adjusting the levelling elements

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).

5.3 Piping

5.3.1 Connecting the piping

DANGER

Impermissible loads acting on the pump nozzles

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

- ▷ Do not use the pump as an anchorage point for the piping.
- ▷ Anchor the pipelines 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.
- ▷ 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 7.2.2.3, 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).

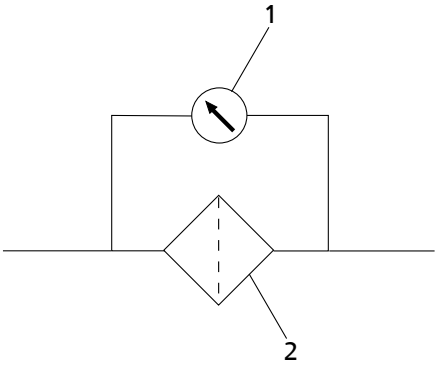


Fig. 11: Filter in the piping

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.

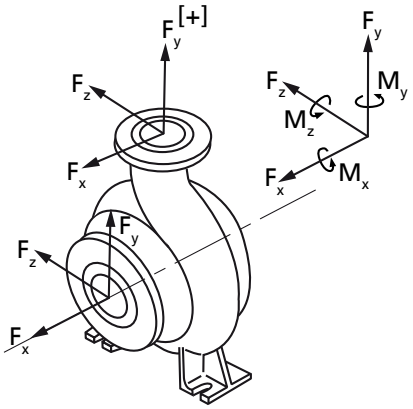
CAUTION

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.

5.3.2 Permissible forces and moments at the pump nozzles



Forces and moments at the pump nozzles

The permissible resultant 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 10: Forces and moments at the pump nozzles

Sizes	Suction nozzle				Discharge nozzle					Suction nozzle			Discharge nozzle		
	[N]				[N]					[Nm]			[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
100-250	3700	2400	2950	3800	2150	1350	2700	1750	2800	2750	2100	1400	2000	1500	1000
100-315	3700	2400	2950	3800	2150	1350	2700	1750	2800	2750	2100	1400	2000	1500	1000
100-400	3700	2400	2950	3800	2150	1350	2700	1750	2800	2750	2100	1400	2000	1500	1000
125-250	4700	3100	3750	4750	2950	1850	3700	2400	3800	3450	2650	1750	2750	2100	1400
125-315	4700	3100	3750	4750	2950	1850	3700	2400	3800	3450	2650	1750	2750	2100	1400
125-400	4700	3100	3750	4750	2950	1850	3700	2400	3800	3450	2650	1750	2750	2100	1400
150-250	7350	4700	5700	7400	3750	2350	4700	3100	4850	5300	3850	2650	3450	2650	1750
150-315	7350	4700	5700	7400	3750	2350	4700	3100	4850	5300	3850	2650	3450	2650	1750
150-400	7350	4700	5700	7400	3750	2350	4700	3100	4850	5300	3850	2650	3450	2650	1750
150-500	7350	4700	5700	7400	3750	2350	4700	3100	4850	5300	3850	2650	3450	2650	1750
200-250	7350	4700	5700	7400	5700	3550	7350	4700	7400	5300	3850	2650	5300	3850	2650
200-315	10000	6700	8000	10450	5700	3550	7350	4700	7400	7500	5700	3650	5300	3850	2650
200-400	10000	6700	8000	10450	5700	3550	7350	4700	7400	7500	5700	3650	5300	3850	2650
200-500	10000	6700	8000	10450	5700	3550	7350	4700	7400	7500	5700	3650	5300	3850	2650
250-315	12000	8000	10000	12800	8000	5000	10000	6700	10450	9150	6900	4500	7500	5700	3650
250-400	12000	8000	10000	12800	8000	5000	10000	6700	10450	9150	6900	4500	7500	5700	3650
250-500	12000	8000	10000	12800	8000	5000	10000	6700	10450	9150	6900	4500	7500	5700	3650

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

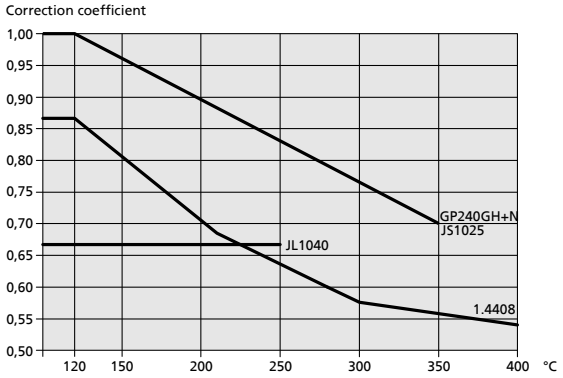

Fig. 12: Temperature correction diagram

No reduction is necessary for material 1.7706.

5.3.3 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.

The pump is fully functional without any external cooling system. Standard pump sets with one mechanical seal do not require any cooling liquid, barrier fluid or flushing liquid.

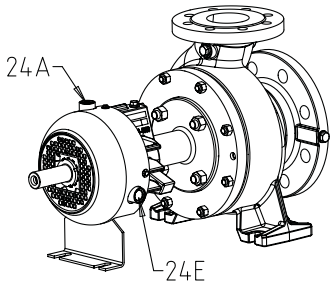

Fig. 13: Quench connections

24A	Quench outlet	24E	Quench inlet

For pump sets with two mechanical seals in tandem arrangement, connect an unpressurised quench liquid supply to the "Quench outlet" (24E) and "Quench inlet" (24A) connections.

5.4 Enclosure/insulation

DANGER

An explosive atmosphere forms due to insufficient venting

Explosion hazard!

- 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.

5.5 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.

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	**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.

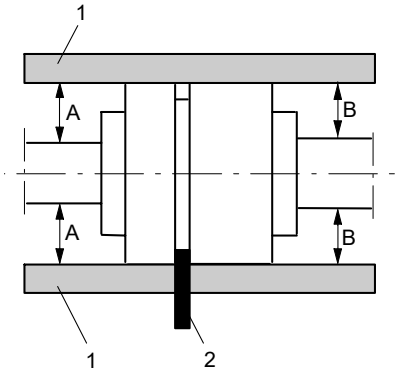

Fig. 14: Non-spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge

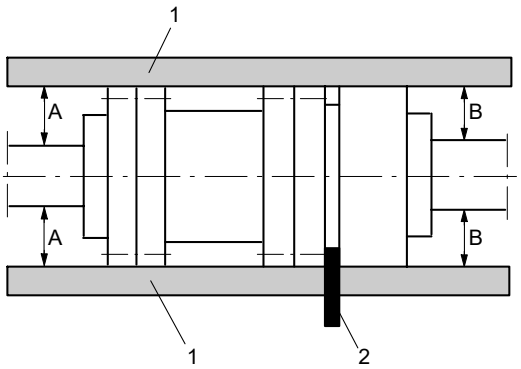

Fig. 15: Spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge

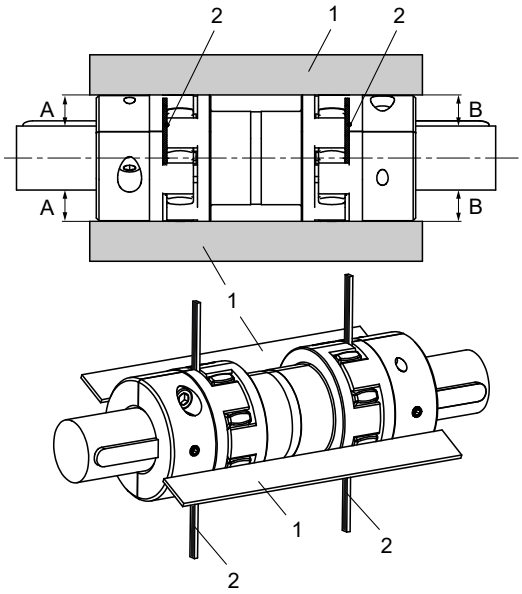

Fig. 16: Double Cardan spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge

Table 11: Permissible alignment offset of coupling halves

Coupling type	Radial offset [mm]	Axial offset [mm]
Non-spacer-type coupling (⇨ Fig. 14)	≤ 0,1	≤ 0,1
Spacer-type coupling (⇨ Fig. 15)	≤ 0,1	≤ 0,1
Double Cardan coupling (⇨ Fig. 16)	≤ 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 11) 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 11) both during standstill and at operating temperature as well as under inlet pressure.
5. If alignment is correct, re-install the coupling guard and its footboard, if any.

Checking the coupling alignment with a laser tool

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

5.6 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).

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5.6.1 Motors with adjusting screw

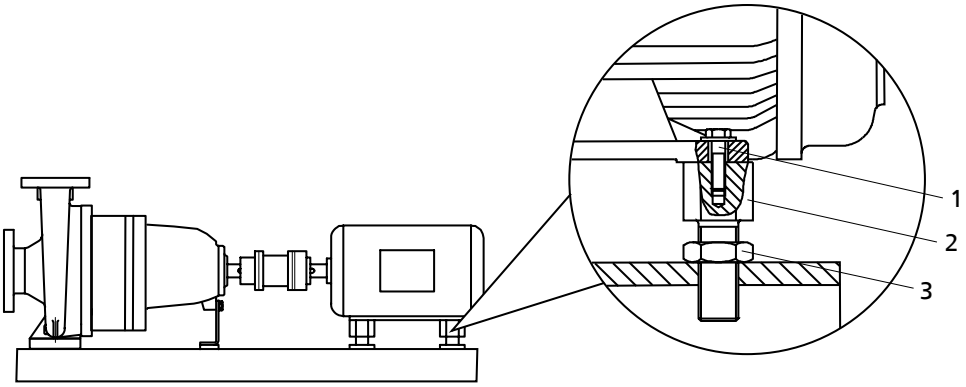

Fig. 17: Motor with adjusting screw

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.

⚠ 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.

5.6.2 Motors without adjusting screw

Any differences in the centreline heights of the pump and motor shafts are compensated by means of shims.

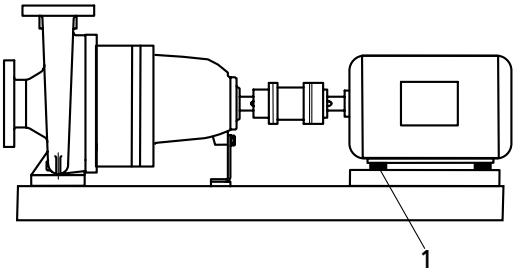

Fig. 18: Pump set with shim

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.

5.7 Electrical connection

⚠ DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

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

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⚠ 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.

5.7.1 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 12: Time relay settings for star-delta starting:

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

5.7.2 Earthing

⚠ DANGER

Electrostatic charging

Explosion hazard!

Damage to the pump set!

- ▷ Connect the PE conductor to the earthing terminal provided.
- ▷ Provide for potential equalisation between the pump set and the foundation.

5.7.3 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.

5.8 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.

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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 properly connected to the power supply and is equipped with all protection devices. (⇨ Section 5.7, Page 32)
- The pump, including the bearing bracket (mechanical seal chamber), has been primed with the fluid to be handled.
- The direction of rotation has been checked. (⇨ Section 5.8, Page 34)
- The lubricants have been checked. (⇨ Section 6.1.2, Page 35)
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇨ Section 6.4, Page 43)

NOTE

Hot water shall comply with the requirements of the VdTÜV technical instruction leaflet TCH 1466/AGFW 5-15 (edition 2.89) as a minimum.
Do not exceed the following limits:

Table 13: Limits for hot water

	Limits
Electrical conductivity	< 250 µs/cm
pH at 25 °C	9-10,5
Silicates (SiO_2)	< 10 mg/l
Solids	< 5 mg/l

NOTE

No warranty can be given for the service life of mechanical seals if hot water with an electrical conductivity exceeding 250 µs/cm or hot water of unknown water quality is handled.

For ultra-pure water (fully desalinated, demineralised water) with an electrical conductivity < 2 µs/cm, the temperature at the seal faces must be at least 20 % below the boiling point.

NOTE

When conditioners producing a greasy film on the mechanical seal faces are used, e.g. Maxigard, Antifrogen N, Preventol Cl-2, KeboX, Nalfleet 9-11, no warranty can be given on the seal life because of their adverse effect on the seal. In such cases please contact KSB.

6.1.2 Filling in lubricants

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

6.1.3 Shaft seal

Observe the instructions on dismantling (⇨ Section 7.4.7, Page 51) or assembly (⇨ Section 7.5, Page 53) .

When new plants are commissioned, large amounts of foreign matter in the system and a short service life of mechanical seals are to be expected during the initial phase of operation.

NOTE

Only modify the specified sealing concepts and seal types after consultation with KSB. Due to the complex conditions in hot water systems, the use of mechanical seals not approved by KSB shall not be covered by KSB's scope of warranty.

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.

6.1.4 Quench liquid supply

Permissible quench liquids

The quench liquid must be compatible with and suitable for mixing with the fluid handled.

For synthetic heat transfer oils, a mineral oil based thermal fluid or another mineral oil must be used as a quench liquid.
Heat transfer oils of the diphyl group are not suitable for use as quench liquids.

6.1.5 Priming and venting the pump

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.

DANGER

Hot fluid spurting out of the vent chamber

Burns, scalding!

- Always use utmost caution during the venting process and wear appropriate protective gear.

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.

Venting the seal chamber

In as-supplied condition, auxiliary connection 13 D for venting the seal chamber is closed with screw plug 903.85.

High-temperature pumps must be vented before they are commissioned.

For venting undo screw plug 903.85 by half a turn to one turn maximum. Leave it open until the gas has left the mechanical seal chamber and fluid starts to escape. Then, tighten the screw plug again.

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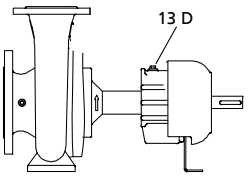

Fig. 19: Auxiliary connection 13 D

13 D	Screw plug 903.85

NOTE

We recommend replacing the screw plug with a globe valve and drain line, so that gases and hot fluids pumped can be drained safely during the venting process.

Venting during pump operation

1. Switch off the pump and let it run down to a standstill.
2. This allows the gases to escape reliably.
3. Close the shut-off elements as required by the system configuration.
4. To vent the bearing bracket undo screw plug 903.85 in steps of approx. 1/2 turn each until no more gas escapes.

Excessive venting

Excessive venting shall be avoided, as hot product from the piping system will flow through the volute casing into the mechanical seal chamber and result in an inadmissible heat build-up in the mechanical seal. Close the vent plug as soon as no more gas escapes.

6.1.6 Final check

1. Remove the coupling guard and its footboard, if any.
2. Check the coupling alignment; re-align the coupling, if required.
   (⇨ Section 5.5, 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.

6.1.7 Cooling of the mechanical seal chamber

The mechanical seal chamber is integrated in the bearing bracket and cooled by the ambient temperature via cooling fins.

An integrated fan impeller ensures a continuous cooling air flow.

An unobstructed supply of cooling air to the fan hood and fan impeller must be ensured at all times!

1. In exceptional cases, the pump can be operated without the integrated fan impeller.
   If the coarse dust blocks the cooling air intake, the following parts also have to be removed:

- Fan hood 832
- Guard 680

Cooling air flow with a cooling air velocity of at least 4 m/s must be provided in the proximity of the cooling fins.
The cooling air flow is generated by the motor cooling device or an external fan.

6.1.8 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.

6.1.9 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.

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.
- ▷ 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.

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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.

6.1.10 Checking the shaft seal

Mechanical seal

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

Slight leakage at the seal is permissible and desirable.

A continuously increasing, heavily dripping leakage at the seal indicates that the seal is defective and must be replaced.

6.1.11 Shutdown

✓ The shut-off element in the suction line is and remains open.

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 pumped 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 14: Permissible ambient temperatures

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

6.2.2 Minimum permissible speed

CAUTION

Plain bearing is overloaded

Damage to the bearings!

- ▷ Never use a speed of less than 800 rpm.

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6.2.3 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 15: 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.

6.2.4 Fluid handled

6.2.4.1 Flow rate

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

- Short-time operation: Q_{min} [6] = 0.1 × Q_{BEP} [7]
- Continuous operation: Q_{min} [6] = 0.3 × Q_{BEP} [7]
- 2-pole operation: Q_{max} [8] = 1.1 × Q_{BEP} [7]
- 4-pole operation: Q_{max} [8] = 1.25 × Q_{BEP} [7]

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.

$T_O = T_f + \Delta\vartheta$

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

6 Minimum flow rate

7 Flow rate at best efficiency point

8 Maximum flow rate

Table 16: Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Acceleration due to gravity	m/s^2
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

6.2.4.2 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.

6.2.4.3 Abrasive fluids

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

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

The pump (set) remains installed

✓ Sufficient fluid is supplied for the functional check run of the pump.

1. For prolonged shutdown periods, start up the pump (set) regularly between once a month and once every three months for approximately five minutes.
   ⇨ This will prevent the formation of deposits within the pump and the pump intake area.

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

✓ The pump has been properly drained. (⇨ Section 7.3, Page 49)

✓ The safety instructions for dismantling the pump have been observed. (⇨ Section 7.4.1, Page 49)

✓ The permissible ambient temperature for storing the pump is observed.

1. Spray-coat the inside wall of the pump casing and, in particular, the impeller clearance areas with a preservative.
2. Spray the preservative through the suction nozzle and discharge nozzle. It is advisable to then close the pump nozzles (e.g. with plastic caps)
3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil or grease, food-approved, if required) to protect them against corrosion.
   Observe the additional instructions on preservation. (⇨ Section 3.3, Page 14)

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

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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 35) (⇨ Section 6.2, Page 40)

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇨ Section 7, Page 44)

⚠ 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.

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.

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⚠ 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

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

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

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 40)

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

- The pump must run quietly and free from vibrations at all times.
- Check the shaft seal.
- 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).

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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 Checking the clearances

To check the clearance gaps, remove the back pull-out unit.
If the clearance gap is larger than permitted (see the following table), replace casing wear ring 502.01 with a new one.
The clearance gaps given refer to the diameter.

Table 17: Clearance gaps between impeller and casing / between impeller and casing wear ring

	HPK-LS/-LS4	HPK-LE/-LE4
up to DN 65	0.40 mm + 0.1	0.60 mm + 0.1
DN 80 to DN 200	0.50 mm + 0.1	0.60 mm + 0.1
DN 250 and above	0.65 mm + 0.1	0.75 mm + 0.1

All HPK-LS/-LS4 pumps are fitted with casing wear rings.

Table 18: Clearance gaps in the plain bearing

Bearing bracket	Bearing clearance
LP02	0.03 mm + 0.045
LP03	0.05 mm + 0.045
LP04	0.05 mm + 0.045
LP05	0.05 mm + 0.05
LP06	0.05 mm + 0.05

NOTE

If the clearances given are exceeded by more than 1 mm (referring to the diameter) replace the affected components or restore the original clearance by means of a casing wear ring.
Contact KSB.

7.2.2.3 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

7.2.3.1 Grease lubrication

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

7.2.3.1.1 Grease quality

We recommend using Petro-Canada Peerless LLG high-temperature grease or an equivalent product for lubrication. Under unfavourable operating conditions, e.g. high room temperature, high atmospheric humidity, dust-laden air, aggressive atmosphere etc., check the bearings earlier. If required, clean and re-lubricate them, preferably with Petro-Canada Peerless LLG.

Klüber Asonic HQ72-102 can be used as an alternative.

CAUTION

Mixing greases of differing soap bases

Changed lubricating qualities!

- ▷ Thoroughly clean the bearings.
- ▷ Adjust the re-lubrication intervals to the grease used.

7.2.3.1.2 Grease quantities

Bearing bracket	Bearings	Grease qty. per single bearing
LP02	7307 BG	6.5 to 8 g
LP03	7307 BG	6.5 to 8 g
LP04	7309 BG	13 to 15.5 g
LP05	7313 BG	23 to 26 g
LP06	7315 BG	29 to 33 g

The grease quantity indicated must be used for each single bearing of a bearing pair.

7.2.3.1.3 Intervals

- Under suitable operating conditions the grease-lubricated bearings will run for 25,000 operating hours.
- 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.
- Replace the rolling element bearings after 25,000 operating hours or 3 years of continuous operation.

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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

⚠ DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- ▹ Properly shut down the pump set.
- ▹ Close the shut-off elements in the suction line and discharge line.
- ▹ Drain the pump and release the pump pressure. (⇨ Section 7.3, Page 49)
- ▹ Shut off any auxiliary feed lines.
- ▹ Allow the pump set to cool down to ambient temperature.

⚠ 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.

⚠ WARNING

Thin metal foil used as carrier material in joint rings

Risk of injury (cuts)!

- ▹ Wear protective clothing.
- ▹ Always use an appropriate tool to remove joint rings.

Observe the general safety instructions and information. (⇨ Section 7.1, Page 44)

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

For dismantling and reassembly observe the exploded views and the general assembly drawing.

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

NOTE

After a prolonged period of operation the individual components may be hard to pull off the shaft. If this is the case, use a brand name penetrating agent and/or - if possible - an appropriate puller.

NOTE

We recommend placing a drip pan under the pump along its entire length to collect any fluid escaping during dismantling.

7.4.2 Preparing the pump set

1. Interrupt the power supply and secure the pump against unintentional start-up.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard.
4. Remove the coupling spacer, if any.

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

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

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 49) to (⇨ Section 7.4.3, Page 50) have been observed/carried out.

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⚠ 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. Loop a rope tightly around the neck of bearing bracket 330.
4. Undo hexagon nut 920.01 at the volute casing.
5. Pull the back pull-out unit out of the volute casing.
6. If necessary, clean the threaded holes for forcing screws 901.31 and use forcing screws.
7. Remove and dispose of joint ring 411.10.
8. 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 49) to (⇨ Section 7.4.4, Page 50) have been observed/carried out.

✓ The back pull-out unit has been placed in a clean and level assembly area.

1. Undo hexagon nut 920.95.
2. Remove disc 550.87 from shaft 210.
3. Pull impeller 230 off shaft 210.
4. Remove keys 940.01.

7.4.6 Removing the plain bearing

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 49) to (⇨ Section 7.4.5, Page 51) have been observed/carried out.

1. Pull cup spring 950.23 and locking ring 515.21 off the shaft. If possible, also pull out locking ring 515.22 and bearing sleeve 529.21 in the process.

7.4.7 Removing the mechanical seals

Pump set with KSB mechanical seal 4HL

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 49) to (⇨ Section 7.4.6, Page 51) have been observed/carried out.

✓ The bearing bracket has been placed in a clean and level assembly area.

1. Undo the socket head cap screw or grub screw in the coupling hub and use a puller to pull the coupling half off the pump shaft. Remove key 940.02.
2. Loosen hexagon head bolts 901.84 and remove fan hood 832.
3. Undo hexagon socket head cap screws 914.02.
4. Gently drive shaft 210 together with rolling element bearings 320.02, bearing cover 360.02, fan impeller 831, mating ring carrier 476 and mechanical seal 433 out of bearing bracket 330 towards the drive end.
5. Undo grub screws 904.32.
6. Pull mechanical seal 433.02 off shaft 210 towards the pump end.
7. Pull mating ring carrier 476 off at the pump end together with the mating ring of the mechanical seal.
8. Take the mating ring out of mating ring carrier 476.

Pump set with standardised mechanical seal

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 49) to (⇨ Section 7.4.6, Page 51) have been observed/carried out.

✓ The bearing has been placed in a clean and level assembly area.

1. Undo the socket head cap screw or grub screw in the coupling hub and use a puller to pull the coupling half off the pump shaft. Remove key 940.02.
2. Loosen hexagon head bolts 901.84 and remove fan hood 832.
3. Undo hexagon socket head cap screws 914.02.
4. Gently drive shaft 210 together with rolling element bearings 320.02, bearing cover 360.02, fan impeller 831, mating ring carrier 476 and mechanical seal 433 out of bearing bracket 330 towards the drive end.
5. Undo grub screws 904.32.
6. Remove support disc 550.59 (LP02 and LP03 only) and O-ring 412.07.
7. Pull shaft sleeve 523 with mechanical seal 433.02 off shaft 210 towards the pump end.
8. Pull mating ring carrier 476 off at the pump end together with the mating ring of the mechanical seal.
9. Take the mating ring out of mating ring carrier 476.
10. **For versions with mechanical seals in tandem arrangement only:** Unscrew the grub screw of the second mechanical seal and pull the seal off the shaft at the pump end.
11. **For versions with mechanical seals in tandem arrangement only:** Remove the second mating ring carrier 476.02 with the mating ring of the mechanical seal at the pump end.
12. **For versions with mechanical seals in tandem arrangement only:** Remove the mating ring from mating ring carrier 476.02.

7.4.8 Dismantling the bearings

NOTE

The bearings are packed with grease and must not be heated up for dismantling. If heated up, they must be re-packed with grease.

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 49) to (⇨ Section 7.4.7, Page 51) have been observed and carried out.

✓ The shaft with the rolling element bearings has been placed in a clean and level assembly area.

1. Unbend lock washer 931.01. Unscrew slotted round nut 920.21 (right-hand thread). Remove lock washer 931.01, fan impeller 831, bearing cover 360.02, spacer sleeve 525.24 and drive-end ring 500.32.
2. **For versions with bearing carriers LN02 to LN04 only:** Pull bearing 320.02 off the shaft. Remove thrower 507.12, spacer sleeve 525.03 and pump-end ring 500.32 from shaft 210.
3. **For versions with bearing carriers LN05 and LN06 only:** Pull bearings 320.02, 321.02 off the shaft.
4. **For versions with one mechanical seal and shaft seal ring only**: Remove pump-end ring 500.32 from shaft 210.
5. **For versions with one mechanical seal and shaft seal ring only**: Remove O-ring 412.03 and spacer sleeve 525.03.
6. **For versions with one mechanical seal and two angular contact ball bearings only:** Remove spacer sleeve 525.03 and thrower 507.12 from shaft 210.

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7.4.9 Removing the plain bearing bush

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 49) to (⇨ Section 7.4.8, Page 52) have been observed/carried out.

✓ The bearing bracket has been placed in a clean and level assembly area.

1. Remove circlip 932.05.
2. Completely pull bearing bush 545.21 and tolerance ring 500.61 out of the bearing bracket.

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.

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

Version with one mechanical seal and two angular contact ball bearings or version with two mechanical seals in tandem arrangement and one deep groove ball bearing or one four-point bearing

- ✓ 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.

1. **For versions with one mechanical seal only:** Slide thrower 507.12 onto shaft 210.
2. Slide spacer sleeve 525.03 (for LP02 to LP04 only) and ring 500.32 onto shaft 210.
3. Press ball bearing 320.02 onto the shaft as far as it will go.
   The standard pump set is fitted with two angular contact ball bearings. Version with two mechanical seals are fitted with either a deep groove ball bearing or a four-point bearing, depending on the pump size.

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.

NOTE

The bearings are packed with grease and must not be heated up for reassembly. If heated up, they must be re-packed with grease!

4. Slide spacer sleeve 525.24 onto shaft 210 and use a C-spanner to tighten slotted round nut 920.21 without lock washer 931.01. Then unscrew the slotted round nut again.
5. Slide ring 500.32, bearing cover 360.02 and fan impeller 831 onto the shaft.
6. Apply a few spots of Molykote to the contact faces of the lock washer and the locknut. Then slide on lock washer 931.01.
7. Tighten locknut 920.21 and bend over the lock washer.

Version with one mechanical seal, lip seal and one deep groove ball bearing or one four-point bearing

- ✓ 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.

NOTE

The bearings are packed with grease and must not be heated up for reassembly. If heated up, they must be re-packed with grease!

1. Slide spacer sleeve 525.03 and ring 500.32 onto shaft 210.
2. Insert O-ring 412.03 in spacer sleeve 525.03.
3. Press ball bearing 320.02/321.02 onto the shaft as far as it will go.
4. Slide spacer sleeve 525.24 onto shaft 210 and use a C-spanner to tighten slotted round nut 920.21 without lock washer 931.01. Then unscrew the slotted round nut again.
5. Slide ring 500.32, bearing cover 360.02 and fan impeller 831 onto the shaft.

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6. Apply a few spots of Molykote to the contact faces of the lock washer and the locknut. Then slide on lock washer 931.01.
7. Tighten locknut 920.21 and bend over the lock washer.
8. Press lip seal 421 into mating ring carrier 476.

DANGER

Excessive temperature caused by defective bearing seal

Explosion hazard!

- ▹ Grease the lip seal. Observe the indicated grease quality. (⇨ Section 7.2.3.1.1, Page 48)

9. Grease the sealing lip of the lip seal with rolling element bearing grease (⇨ Section 7.2.3.1.1, Page 48) .
10. Apply approx. 5 g of grease in the lower area between spacer ring 525.03 and the rear (bearing side) of lip seal 421.

7.5.3 Installing the mechanical seal

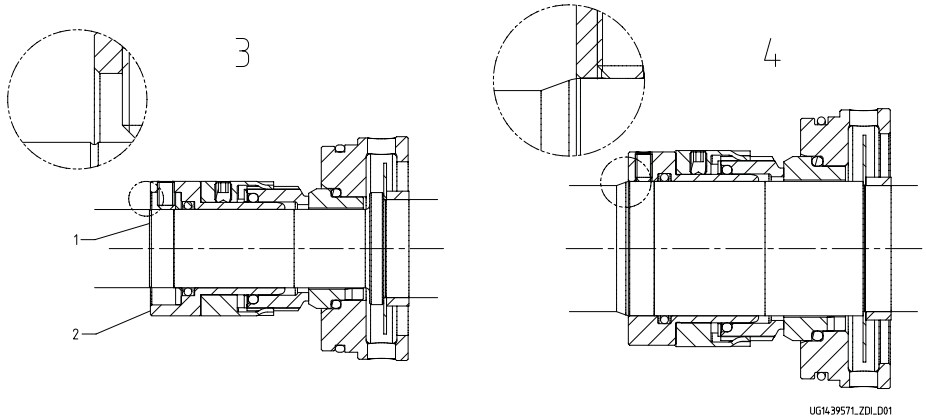

Fig. 20: Installing the mechanical seal

1	Markings on the shaft	2	Face of shaft sleeve
3	Bearing brackets LP02, LP03	4	Bearing brackets LP04, LP05, LP06

Pump set with KSB mechanical seal 4HL

- ✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.2, Page 54) have been observed/carried out.
- ✓ 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.

NOTE

Only remove the protective wrapping of the seal faces immediately before assembly takes place.

1. Insert the mating ring and the secondary seals of the mechanical seal into mating ring carrier 476 and slide them onto the shaft from the pump end.
2. Slide the rotating components of the mechanical seal (torque-transmitting element, springs, primary ring, secondary seal, etc.) onto the shaft as a complete sub-assembly.
3. **For LP02 and LP03:** The mechanical seal is correctly positioned on the shaft when its pump-end face (see "2" in Fig. "Installing the mechanical seal") is aligned with the mark on the shaft (see "1" in Fig. "Installing the mechanical seal"). On shafts without marking, align the mechanical seal with the shaft shoulder. The mechanical seal is generally positioned correctly when the bolt head is located in the centre of the slotted hole (marking) (see Fig. "Correct position of KSB mechanical seal")

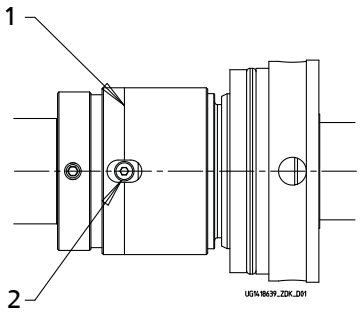

Fig. 21: Correct position of the KSB mechanical seal

1	Markings on the mechanical seal	2	Bolt head

4. Tighten the grub screws with cup point evenly, alternately and gradually to the torques specified, depending on the nominal thread diameter. Grub screws with cup point may be used without applying a thread-locking agent. Grub screws with cup point must not be re-used.

Table 19: Tightening torques for grub screws with cup point

Thread	Tightening torque [Nm]
M6	8
M8	15
M10	20

5. Verify the correct axial position of mechanical seal 433.02 on shaft 210.

CAUTION

Incorrect position of the mechanical seal

Hot fluid or steam may spurt out during operation!

▹ Make sure the mechanical seal is seated properly.

Pump set with standardised mechanical seal

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.2, Page 54) have been observed/carried out.

✓ 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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NOTE

Only remove the protective wrapping of the seal faces immediately before assembly takes place.

1. **Versions with two mechanical seal in tandem arrangement:** Insert the mating ring of the second mechanical seal into mating ring carrier 476.02 and slide both onto the shaft from the pump end.
2. **Versions with mechanical seals in tandem arrangement:** Slide the primary ring onto the shaft until it reaches the shaft shoulder. Secure it with a grub screw.
3. Insert the mating ring and the secondary seals of the mechanical seal into mating ring carrier 476 and slide them onto the shaft from the pump end.
4. Slide the rotating components of the mechanical seal (torque-transmitting element, springs, primary ring, secondary seal, etc.) onto shaft sleeve 523 as a complete sub-assembly. Slide this sub-assembly on until it will not go any further. Then lock it with the grub screws.
5. **For LP02 and LP03:** Slide shaft sleeve 523 onto shaft 210.
   The shaft sleeve is correctly positioned on the shaft when its pump-end face ("2" see Fig. "Installing the mechanical seal") is aligned with the mark on the shaft ("1" see Fig. "Installing the mechanical seal"). Guide O-ring 412.07 and support disc 550.59 carefully along the shaft and press them into the recess of shaft sleeve 523.
   For LP04, LP05 and LP06: Insert O-ring 412.07 into shaft sleeve 523. Carefully guide the shaft sleeve along the shaft.
   On shafts without marking, align the shaft sleeve with the shaft shoulder (see Fig. "Installing the mechanical seal").
6. Screw in grub screws 904.32 by several turns to hold the support disc in place.
7. Firmly tighten all grub screws 904.32.
8. Verify the correct axial position of shaft sleeve 523 and mechanical seal 433.02 on shaft 210.

CAUTION

Incorrect position of the mechanical seal

Hot fluid or steam may spurt out during operation!

- ▹ Make sure the mechanical seal is seated properly.

7.5.4 Fitting the plain bearing bush

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.3, Page 55) have been observed/carried out.

1. If bearing bush 545.21 is replaced with a new one, a new tolerance ring 500.61 must be fitted in the corresponding groove of the bearing bracket.

CAUTION

Incorrect position of the bearing bush

Excessive bearing load during operation!

- ▹ Check that the groove is positioned correctly.

2. Swiftly and evenly press bearing bush 545.21 into the bearing bracket. (Risk of fractures: do not subject it to any blows.) Check that the groove of the bearing bush is positioned correctly. The bearing bush is inserted correctly when its groove is on top (12 o'clock position).
3. Insert ring 932.05 into the groove of the bearing bracket to secure the bearing bush axially.

7.5.5 Fitting the bearing bracket

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.4, Page 57) been observed/carried out.

1. Place guard 680 onto the bearing bracket.
2. Place O-ring 412.82 on the mating ring carrier.
3. Slide shaft 210 with all assembled components into the bearing bracket.
4. Fasten the bearing cover with hexagon socket head cap screws 914.02.
5. Carefully insert joint ring 411.11.
6. Place bearing bracket 330 into casing cover 161 and firmly tighten it with nuts 920.04.

7.5.6 Fitting the plain bearing

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.5, Page 58) have been observed/carried out.

1. Clean all parts of plain bearing (sleeve) 310.10 and make sure that there are no dirt particles between the conical surfaces of the bearing parts. Otherwise, the parts will not be centred correctly, which will result in failure of the plain bearing.
2. Prior to reassembly check whether the bearing parts and the impeller can be easily fitted on shaft 210.
3. Slide locking ring 515.22, bearing sleeve 529.21, locking ring 515.21 and disc spring 950.23 onto shaft 210.
   Mount disc springs 950.23 in such a way that the outside diameter of the disc spring rests against locking ring 515.21.

7.5.7 Fitting the impeller

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.6, Page 58) 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 key 940.01. Guide impeller 230 onto shaft 210.
2. Insert disc 550.87 and tighten hexagon nut 920.95 with a torque wrench.
   - Tighten the nut evenly to prevent damage to the bearings.
   - Rotate the shaft by hand every now and then while tightening the nut (the shaft must be easy to rotate). Stop the tightening procedure if the shaft seems to be blocked. Loosen the nut and repeat the tightening procedure. If the shaft is blocked repeatedly, dismantle the parts. Check that they are clean and correctly dimensioned.
3. After the rotating pump assembly (pump without casing) has been assembled, check the radial shaft run-out at the impeller.
   Maximum permissible run-out: 0.15 mm.

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7.5.8 Fitting the back pull-out unit

✓ The notes and steps stated in (⇨ Section 7.5.1, Page 53) to (⇨ Section 7.5.7, Page 58) been observed/carried out.

✓ For back pull-out units without coupling, fit the coupling in accordance with the manufacturer's instructions.

1. Carefully insert joint ring 411.10 into volute casing 102.
2. Guide the back pull-out unit into volute casing 102 and tighten nut 920.01.
3. Make sure that the rotor can easily be rotated by hand.
4. Bolt support foot 183 to bearing bracket 330 and to the baseplate.
5. Mount fan hood 832 and fasten it together with guard 680, using hexagon head bolts 901.84.
6. Insert key 940.02. Fasten the coupling half on the shaft.

7.5.9 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 5.6, 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 for volute casing/bearing bracket

The threaded connections between volute casing and casing cover (902.01/920.01), between casing cover and bearing bracket (902.04/920.04) and between bearing cover and bearing bracket (914.02) as well as the hexagon nut for impeller fastening 920.95 and grub screws 904.32 for fastening the shaft sleeve must be tightened with a torque wrench. Observe the tightening torques given in the table.

Table 20: Tightening torques for bolted/screwed connections [Nm]

Item number	Screw/bolt	Material/stamp mark					
902.01 902.04	Stud DIN 939	1.7709+QT / GA			Monix 3K / MM		
920.01 920.04	Hexagon nut ISO 4032	1.7218+QT+A2D / G			Monix 3K / MM (M3K)		
Thread		Brand-new threads[9]	-15 %[10]	-20 %[10]	Brand-new threads[9]	-15 %[10]	-20 %[10]
M12		80	68	64	130	111	104
M16		190	162	152	320	272	256
M20		330	281	264	620	572	496

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

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

914.02	Hexagon socket head cap screw DIN 7984	8.8 / 8.8		
Thread		**Brand-new threads[9)]**	**-15 %[10)]**	**-20 %[10)]**
M8		25	21	20
M10		35	30	28
M12		59	50	47

904.32	Grub screw DIN 916	A4-50 / -
Thread		
M6		5 - 9

920.95	Hexagon nut ISO 8673	A4 / A4		
Thread		**Brand-new threads**	**-15 %[10)]**	**-20 %[10)]**
M16x1,5		100	85	80
M20x1,5		120	102	96
M24x1,5		150	128	120
M30x2		350	298	280

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 21: 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
		Quantity of spare parts						
210	Shaft	1	1	2	2	2	3	30 %
230	Impeller	1	1	2	2	2	3	30 %
310.10	Plain bearing (product-lubricated)	2	3	4	5	6	8	100 %
320.02	Angular contact ball bearing (set)	1	1	2	2	3	4	55 %
330	Bearing bracket	-	-	-	-	-	1	2 pcs.
433	Mechanical seal	1	1	2	2	2	3	25 %

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Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
		Quantity of spare parts						
502.01[11)]	Casing wear ring	2	2	2	3	3	4	50 %
523	Shaft sleeve	1	1	1	2	2	2	20 %
545.21	Bearing bush (product-lubricated)	2	3	4	5	6	8	100 %
---	Set of sealing elements	4	6	8	8	9	12	150 %

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 22: Interchangeability of pump components

Bearing bracket	Size	Description																					
		Casing cover	Support foot	Shaft	Plain bearing	Angular contact ball bearing	Angular contact ball bearing	Bearing bracket	Bearing cover	Mechanical seal		Mating ring carrier		Casing wear ring	Thrower	Shaft sleeve	Spacer sleeve	Spacer sleeve	Bearing bush	Guard	Fan impeller	Fan hood	Hexagon nut
		Part No.																					
		161	183	210	310.10	320.02	321	330	360	433.01	433.02	476.01	476.02	502.01	507.01	523	525.03	525.24	545.21	680	831	832	920.95
LP02	32-125	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
	25-160	1	2	1	1	1	1	1	1	1	1	1	1	25	1	1	2	1	1	1	1	1	1
	32-160	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
	40-160	1	2	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1
	50-160	1	3	1	1	1	1	1	1	1	1	1	1	3	1	1	2	1	1	1	1	1	1
	25-200	2	3	1	1	1	1	1	1	1	1	1	1	25	1	1	2	1	1	1	1	1	1
	32-200	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1
	40-200	2	3	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	1	1	1
	50-200	2	3	1	1	1	1	1	1	1	1	1	1	3	1	1	2	1	1	1	1	1	1
LP03	65-160	3	4	2	2	1	1	2	1	2	2	2	2	7	1	2	2	1	2	1	1	1	1
	80-160	3	5	2	2	1	1	2	1	2	2	2	2	9	1	2	2	1	2	1	1	1	1
	65-200	4	5	2	2	1	1	2	1	2	2	2	2	8	1	2	2	1	2	1	1	1	1
	80-200	4	5	2	2	1	1	2	1	2	2	2	2	10	1	2	2	1	2	1	1	1	1
	100-200	4	6	2	2	1	1	2	1	2	2	2	2	12	1	2	2	1	2	1	1	1	1
	32-250	5	5	2	2	1	1	2	1	2	2	2	2	6	1	2	2	1	2	1	1	1	1
	40-250	5	5	2	2	1	1	2	1	2	2	2	2	5	1	2	2	1	2	1	1	1	1
	50-250	5	5	2	2	1	1	2	1	2	2	2	2	4	1	2	2	1	2	1	1	1	1

11 Provided as a standard feature on HPK-LS and HPK-LS4 only, optional feature only on HPK-LE and HPK-LE4

Bearing bracket	Size	Description																					
		Casing cover	Support foot	Shaft	Plain bearing	Angular contact ball bearing	Angular contact ball bearing	Bearing bracket	Bearing cover	Mechanical seal		Mating ring carrier		Casing wear ring	Thrower	Shaft sleeve	Spacer sleeve	Spacer sleeve	Bearing bush	Guard	Fan impeller	Fan hood	Hexagon nut
		Part No.																					
		161	183	210	310.10	320.02	321	330	360	433.01	433.02	476.01	476.02	502.01	507.01	523	525.03	525.24	545.21	680	831	832	920.95
LP03	65-250	5	6	2	2	1	1	2	1	2	2	2	2	8	1	2	2	1	2	1	1	1	1
	80-250	5	7	2	2	1	1	2	1	2	2	2	2	11	1	2	2	1	2	1	1	1	1
	40-315	6	6	2	2	1	1	2	1	2	2	2	2	5	1	2	2	1	2	1	1	1	1
	50-315	6	7	2	2	1	1	2	1	2	2	2	2	7	1	2	2	1	2	1	1	1	1
LP04	100-250	5	8	3	2	2	2	3	2	3	3	3	3	13	2	3	2	2	2	2	2	2	2
	125-250	5	9	3	2	2	2	3	2	3	3	3	3	15	2	3	2	2	2	2	2	2	2
	150-250	5	10	3	2	2	2	3	2	3	3	3	3	16	2	3	2	2	2	2	2	2	2
	65-315	6	8	3	2	2	2	3	2	3	3	3	3	9	2	3	2	2	2	2	2	2	2
	80-315	6	9	3	2	2	2	3	2	3	3	3	3	12	2	3	2	2	2	2	2	2	2
	100-315	6	9	3	2	2	2	3	2	3	3	3	3	14	2	3	2	2	2	2	2	2	2
	125-315	6	10	3	2	2	2	3	2	3	3	3	3	16	2	3	2	2	2	2	2	2	2
	80-400	7	10	3	2	2	2	3	2	3	3	3	3	27	2	3	2	2	2	2	2	2	2
	100-400	7	10	3	2	2	2	3	2	3	3	3	3	14	2	3	2	2	2	2	2	2	2
	125-400	7	11	3	2	2	2	3	2	3	3	3	3	15	2	3	2	2	2	2	2	2	2
LP05	200-250	8	13	4	3	4	4	4	3	4	4	4	4	17	3	4	3	3	3	3	3	3	3
	150-315	9	12	4	3	4	4	4	3	4	4	4	4	2	3	4	3	3	3	3	3	3	3
	200-315	9	13	4	3	4	4	4	3	4	4	4	4	19	3	4	3	3	3	3	3	3	3
	250-315	9	16	5	3	4	4	4	3	4	4	4	4	21	3	4	3	3	3	3	3	3	3
	150-400	10	12	5	3	4	4	4	3	4	4	4	4	18	3	4	3	3	3	3	3	3	3
	200-400	10	13	5	3	4	4	4	3	4	4	4	4	20	3	4	3	3	3	3	3	3	3
	150-500	11	14	5	3	4	4	4	3	4	4	4	4	18	3	4	3	3	3	3	3	3	3
	200-500	11	17	5	3	4	4	4	3	4	4	4	4	28	3	4	3	3	3	3	3	3	3
LP06	250-400	12	17	6	4	5	5	5	4	5	5	5	5	22	4	5	4	4	4	3	3	3	4
	250-500	13	15	6	4	5	5	5	4	5	5	5	5	23	4	5	4	4	4	3	3	3	4

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 23: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy[12)]
✘	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller.[13)] 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.[13)] - 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.

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

13 Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy[12)]
-	✗	-	-	-	-	✗	-	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.[13)]
-	✗	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.
-	✗	✗	-	-	-	-	-	Speed is too high.	Reduce speed.[13)]
-	-	-	-	-	✗	-	-	Use of unsuitable materials	Change the material combination.
-	-	-	-	✗	-	-	-	Defective gasket	Fit new gasket between volute casing and discharge cover.
-	-	-	-	-	✗	-	-	Worn shaft seal	Fit new shaft seal. Check flushing liquid/barrier fluid.
✗	-	-	-	-	✗	-	-	Score marks or roughness on shaft protecting sleeve / shaft sleeve	Fit new shaft protecting sleeve / shaft sleeve. Fit new shaft seal.
-	-	-	-	-	✗	-	-	Dismantle to find out.	Repair necessary.
-	-	-	-	-	✗	-	-	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 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)	Fit new bearing(s).
-	-	-	✗	-	-	✗	✗	Flow rate is too low.	Increase the minimum flow rate.
-	-	-	-	-	✗	-	-	Incorrect inflow of circulation liquid	Increase the free cross-section.

9 Related Documents

9.1 General assembly drawing with list of components

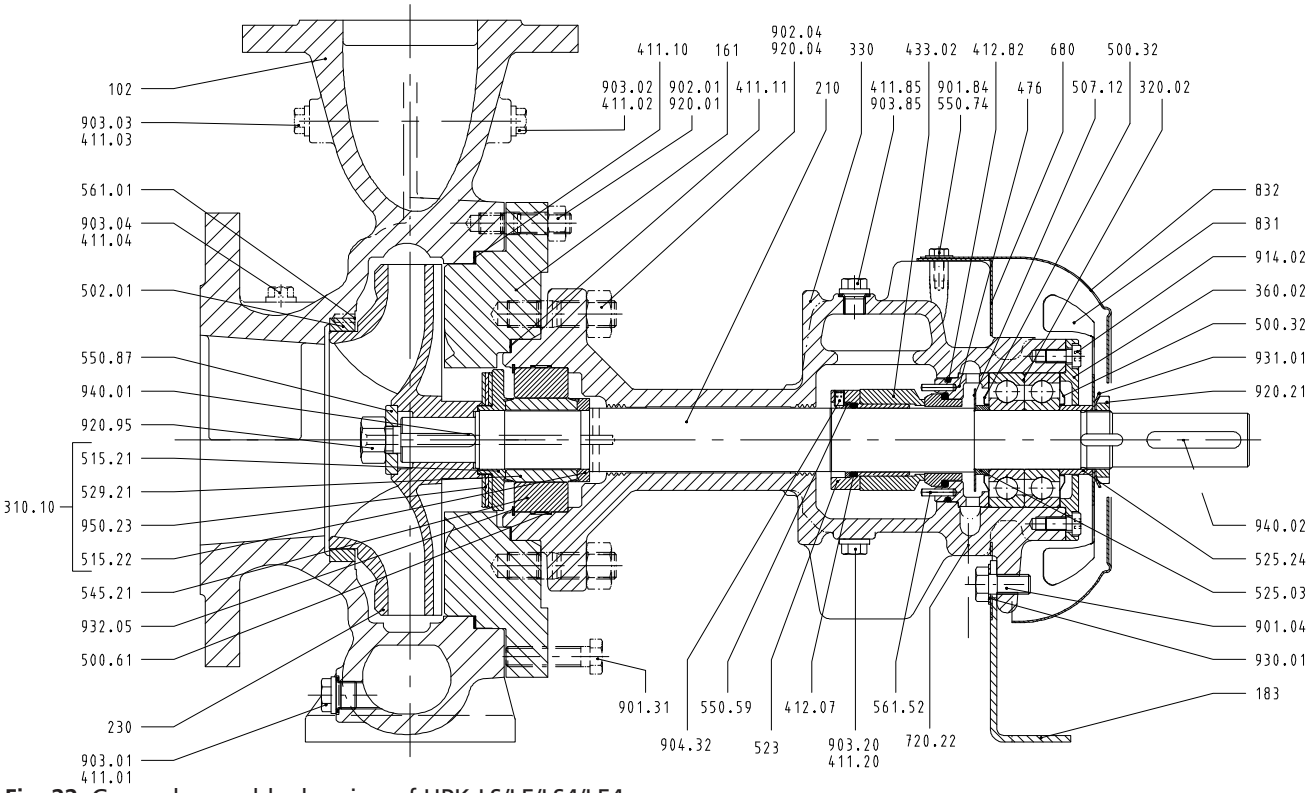
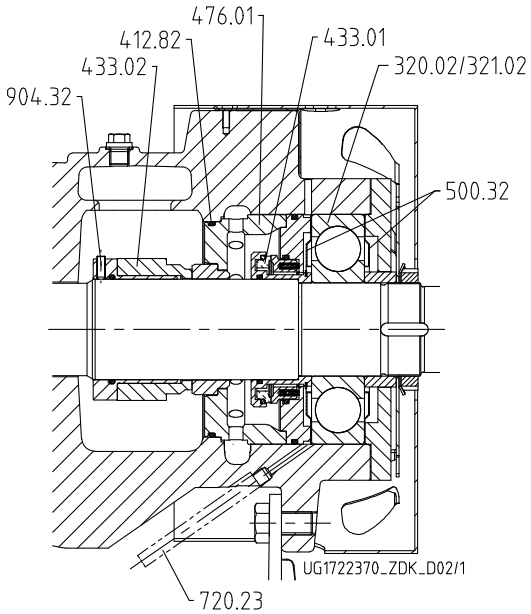
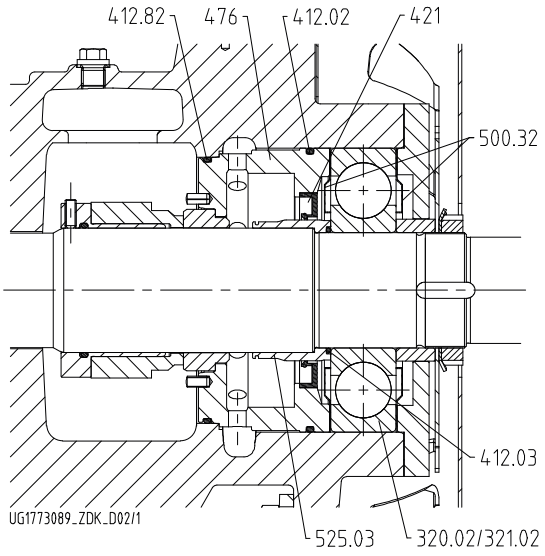


Fig. 22: General assembly drawing of HPK-LS/LE/LS4/LE4



Version with two mechanical seals and one deep groove ball bearing or one four-point bearing



Version with one mechanical seal with lip seal and one deep groove ball bearing or one four-point bearing

Table 24: List of components

Part No.	Comprising	Description
102	102	Volute casing
	411.01/.02/.03/.04/.10	Joint ring
	502.01[14)]	Casing wear ring
	561.01[14)]	Parallel pin
	902.01	Stud
	903.01/.02/.03/.04	Screw plug
	920.01	Hexagon nut
161	161	Casing cover
	411.11	Joint ring
	901.31	Hexagon head bolt
	902.04	Stud
	920.04	Hexagon nut
183	183	Support foot
	901.04	Hexagon head bolt
	930.01	Spring washer
210	210	Shaft
	550.87	Disc
	920.21	Slotted round nut
	920.95	Hexagon nut
	931.01	Lock washer
	940.01/.02	Key
230	230	Impeller
310.10	310.10	Plain bearing (sleeve)
	515.21/.22	Locking rings
	529.21	Bearing sleeve
	950.23	Disc spring
320.02	320.02	Angular contact ball bearing
330	330	Bearing bracket
330	330	Bearing bracket, complete
	210	Shaft
	310.10	Plain bearing (sleeve)
	320.02	Angular contact ball bearing
	360.02	Bearing cover
	411.20	Joint ring
	411.85	Joint ring
	433.02	Mechanical seal
	476	Mating ring carrier
	500.32	Ring
	500.61	Tolerance ring
	507.12	Thrower
	523	Shaft sleeve
	525.03	Spacer sleeve
	525.24	Spacer sleeve
	545.21	Bearing bush
	550.87	Disc
	561.52	Grooved pin

14 For HPK-LS/LS4 only

Part No.	Comprising	Description
330	680	Guard
	720.22	Barrel nipple
	831	Fan impeller
	832	Fan hood
	901.84	Hexagon head bolt
	903.20	Screw plug
	903.85	Screw plug
	914.02	Hexagon socket head cap screw
	920.95	Hexagon nut
	932.05	Circlip
523	523	Shaft sleeve
	412.07	O-ring
	550.59	Support disc (LP02 and LP03 only)
	904.32	Grub screws
99-9	99-9	Set of sealing elements
	Joint ring	411.01/.02/.03/.04/.10/.11/.20/.85
	412.07/.82	O-ring

10 UK Declaration of Conformity

Manufacturer:

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

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

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

HPK-L

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[15]: 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[16] have been applied:
  - ISO 12100
  - EN 809

Person authorised to compile the technical file:

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

The UK Declaration of Conformity was issued in/on:

Place, date

.....[17].....

Name

Function

Company
Address

15 Where applicable

16 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.

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

11 Certificate of Decontamination

Type: .....

Order number /

Order item number[18]: .....

Delivery date: .....

Application: .....

Fluid handled[18]: .....

Please tick where applicable[18]:

☐ Corrosive

☐ Oxidising

☐ Flammable

☐ Explosive

☐ Hazardous to health

☐ Seriously hazardous to health

☐ Toxic

☐ Radioactive

☐ Bio-hazardous

☐ Safe

Reason for return:[18]: .....

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

1136.87/01-EN

18 Required field

Index

1136.87/01-EN

T

W

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