File Name: KSB_Pump_HPK_LS_LE_LS4_LE4_operate_D403

Operating Instructions
1136.8-10 G2

HPK-LS/LE/LS4/LE4

HPK-L Hot Water Circulating Pump
without external cooling
Standard programme

Works No.: _____

Type series:

These operating instructions contain fundamental information and precautionary notes. Please read the manual thoroughly prior to installation of unit, electrical connection and commissioning. It is imperative to comply with all other operating instructions referring to components of individual units.

This manual shall be kept either near or directly at the pump set.

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1 General

Caution This KSB product has been developed in accordance with state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control.
These operating instructions are intended to facilitate familiarization with the unit and its designated use.
The manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the unit and to avoid any risks.
These operating instructions do not take into account local regulations; the operator must ensure that such regulations are strictly observed by all, including the personnel called in for installation.
This pump / unit must not be operated beyond the limit values for the medium handled, capacity, speed, density, pressure, temperature and motor rating specified in the technical documentation. Make sure that operation is in accordance with the instructions laid down in this manual or in the contract documentation. (Contact the manufacturer, if required.)
The name plate indicates the type series / size, main operating data and works number; please quote this information in all queries, repeat orders and particularly when ordering spare parts.
If you need any additional information or instructions exceeding the scope of this manual or in case of damage please contact KSB's nearest customer service centre.
Noise characteristics see section 4.3.6.

2 Safety

These operating instructions contain fundamental information which must be complied with during installation, operation and maintenance. Therefore this operating manual must be read and understood both by the installing personnel and the responsible trained personnel / operators prior to installation and commissioning, and it must always be kept close to the location of operation of the machine / unit for easy access.
Not only must the general safety instructions laid down in this chapter on "Safety" be complied with, but also the safety instructions outlined under specific headings.

2.1 Marking of Instructions in the Manual

The safety instructions contained in this manual whose non-observance might cause hazards to persons are specially marked with the **general hazard sign**, namely

safety sign to DIN 4844 - W9

The electrical danger warning sign is

safety sign to DIN 4844 - W8

The word

Caution

is used to introduce safety instructions whose non-observance may lead to **damage to the machine and its functions.**

Instructions attached directly to the machine, e.g.
- arrow indicating the direction of rotation
- markings for fluid connections

must always be complied with and be kept in a perfectly legible condition at all times.

2.2 Personnel Qualification and Training

All personnel involved in the operation, maintenance, inspection and installation of the unit must be fully qualified to carry out the work involved.
Personnel responsibilities, competence and supervision must be clearly defined by the operator. If the personnel in question is not already in possession of the requisite know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to take care of such training. In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by the responsible personnel.

2.3 Non-compliance with Safety Instructions

Non-compliance with safety instructions can jeopardize the safety of personnel, the environment and the machine / unit itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages.
In particular, non-compliance can, for example, result in:
- failure of important unit / plant functions,
- failure of prescribed maintenance and servicing practices,
- hazard to persons by electrical, mechanical and chemical effects,
- hazard to the environment due to leakage of hazardous substances.

2.4 Safety Awareness

It is imperative to comply with the safety instructions contained in this manual, the relevant national health and safety regulations and the operator's own internal work, operation and safety regulations.

2.5 Safety Instructions for the Operator / User

- Any hot or cold components that could pose a hazard must be equipped with a guard by the operator.
- Guards which are fitted to prevent accidental contact with moving parts (e.g. coupling) must not be removed whilst the unit is operating.
- Leakages of hazardous media handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons or the environment. All relevant laws must be heeded.
- Electrical hazards must be eliminated. (In this respect refer to the relevant safety regulations applicable to different countries and/or the local energy supply companies.)

2.6 Safety Instructions for Maintenance, Inspection and Installation Work

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
The pump must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained.

Work on the machine / unit must be carried out only during standstill. The shutdown procedure described in the manual for taking the unit out of service must be adhered to without fail.

Pumps or pump units handling media injurious to health must be decontaminated.

Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and / or re-activated.

Please observe all instructions set out in the chapter on ”Commissioning / Start-up” before returning the unit to service.

2.7 Unauthorized Modification and Manufacture of Spare Parts

Modifications or alterations of the equipment supplied are only permitted after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety.
The use of other parts can invalidate any liability of the manufacturer for consequential damage.

2.8 Unauthorized Modes of Operation

The warranty relating to the operating reliability and safety of the unit supplied is only valid if the equipment is used in accordance with its designated use as described in the following sections. The limits stated in the data sheet must not be exceeded under any circumstances.

3 Transport and Interim Storage

3.1 Transport

Transport of the unit requires proper preparation and handling. Always make sure that the pump or the unit remains in horizontal position during transport and cannot slip out of the transport suspension arrangement. Do not use a lifting sling on the free shaft end of the pump or the motor eyebolt.

⚠ If the pump / unit slips out of the suspension arrangement, it may cause personal injury and damage to property!

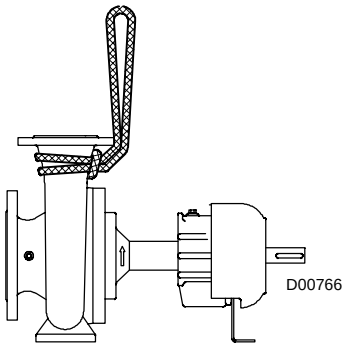


Fig. 3.1-1 Transport of HPK-L pump

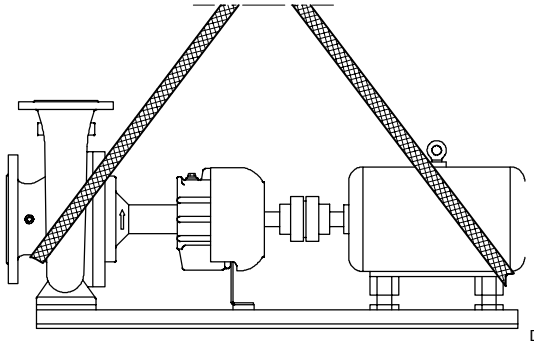


Fig. 3.1-2 Transport of complete HPK-L unit

Caution The HPK-L pump is fitted with a ceramic plain bearing which is sensitive to shock and impact. During transport, make sure that neither the pump, the unit nor the bare shaft ends in particular hit any other objects.

3.2 Interim Storage (Indoors) / Preservation

When the unit is temporarily put into storage, only the wetted low alloy components (e.g. JL1040, JS1025, C22.8; GP240GH+N, etc.) must be preserved. Commercially available preservatives can be used for this purpose. Please observe the manufacturer’s instructions for application/removal.
The relevant procedure is described in section 6.3.
The unit / pump should be stored in a dry room where the atmospheric humidity is as constant as possible.
If stored outdoors, the unit and crates must be covered by waterproof material to avoid any contact with humidity.

Caution Protect all stored goods against humidity, dirt, vermin and unauthorized access! All openings of the assembled unit components are closed and must only be opened when required during installation.
All blank parts and surfaces of the pump are oiled or greased (silicone-free oil and grease) to protect them against corrosion.

4 Description of the Product and Accessories

4.1 Technical Specification

HPK–L pumps in standard design are suitable for plants where hot water is to be pumped through piping or tank systems, particularly for medium- and large-scale heating systems, forced circulation boilers, district heating systems and similar, unless inspection in acc. with German Pressure Vessel Regulations (”Technische Regeln für Druckbehälter”) or DIN 4752 is required.

4.2 Designation

HPK- L S 4 80- 200

Type series
Air-cooled
Material of wetted components
Pressure class
Discharge nozzle DN
Nom. impeller diameter in mm

Materials

Part No.	Description	Material HPK-L		
		S, S4	E	E4
102	Volute casing	JS 1025	GP240GH +N	1.7706
161	Casing cover	C 22.8	C 22.8	C 22.8
210	Shaft	1.4021+QT 700	1.4021+QT 700	1.4021+QT 700
230	Impeller	JL 1040	JL 1040	JL 1040
310.01 310.10	Plain bearing	SSiC	SSiC	SSiC
330	Bearing bracket (=seal housing)	JS 1025	JS 1025	JS 1025
476	Seat ring holder	1.4021+QT 700	1.4021+QT 700	1.4021+QT 700
502.01	Casing wear ring	JL 1040	-	-
523	Shaft sleeve	1.4021+QT 700	1.4021+QT 700	1.4021+QT 700
920.95	Impeller nut	A4	A4	A4

Pressure class:

(blank) = PN25
4 = PN40

4.3 Design Details

Horizontal, radially split, single-stage, single-flow volute casing pump in back pull-out design, with radial impeller, to EN 22 858/ ISO 2858/ISO 5199.

Complemented by pumps of nominal size DN 25.

4.3.1 Pump Casing

Radially split, consisting of volute casing (on HPK-LS/LS4 with casing wear ring) and casing cover.

Double volute depending on pump size.

Pumps of the HPK-L series are foot-mounted.

4.3.2 Impeller Type

Closed radial impeller with multiple vanes. Axial thrust is balanced by back vanes.

4.3.3 Shaft Seal

4.3.3.1 Mechanical Seal for Hot Water Applications

Mechanical seal designs and types other than specified herein shall only be used in exceptional cases and only after prior consultation with the KSB factory.

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.

The following seal design is used for hot water applications:

4.3.3.1.1 Mechanical seal in "dead end" arrangement

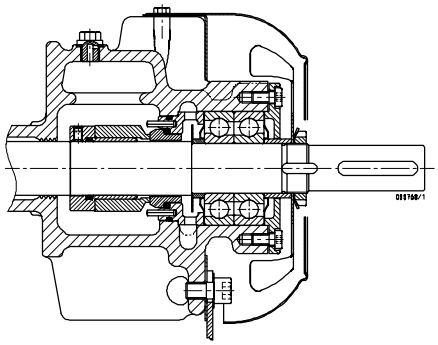


Fig. 4.3-1 Mechanical seal in "dead end" arrangement

The pump is fitted with a single-acting, balanced standardized mechanical seal. The seal chamber is located between the product-lubricated pump-side plain bearing and the outboard, motor-side rolling element bearing. The seal chamber is cooled by cooling fins and ambient cooling air without special external cooling devices.

4.3.4 Bearings

4.3.4.1 Design Specifications

At the motor end, the shaft runs in grease-lubricated angular contact ball bearings which are sealed for life. The bearings are fixed bearings limiting the rotor's axial movement to max. 0.5 mm. The bearings are sealed off by axial joint rings on both sides.

The pump-end bearing is a product-lubricated ceramic bearing. It is a radial bearing which can only absorb radial loads.

4.3.4.2 Designation of Bearing Bracket

L P 03

Air-cooled bearing bracket with integrated shaft seal chamber
Back pull-out design
Size code (based on dimensions of seal chamber and shaft end)

For the applicable bearing bracket version please refer to the data sheet.

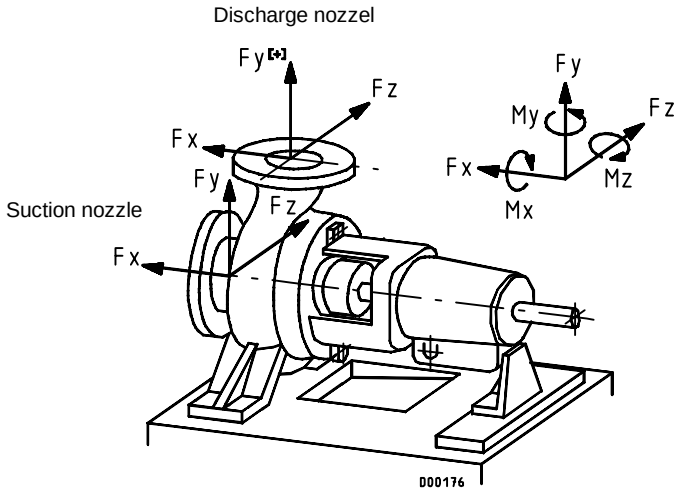
4.3.4.3 Bearings Used / Bearing Design

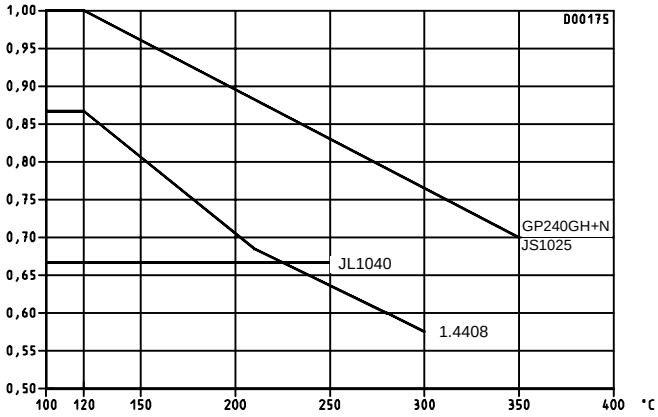
KSB designation	FAG designation	SKF designation
B.G	B. TVP. UA BUA	BGM BG
B.G 8	BUA 80	BEGP/C 86

Standard bearing assembly

Bearing bracket	Pump end Plain bearing	Motor end Angular contact ball bearing
LP02	SSiC, 37	2 x 7307 BG
LP03	SSiC, 50	2 x 7307 BG
LP04	SSiC, 50	2 x 7309 BG8

4.3.5 Permissible Forces and Moments at the Pump Nozzles





The forces and moments were determined on the basis of API 610 (6th edition), table 2, doubled values.

The resulting permissible forces have been determined according to

$F_{res\ D} \pm \sqrt{F_x^2 + F_z^2}$ and $F_{res\ S} \pm \sqrt{F_y^2 + F_z^2}$

The data on forces and moments apply to static pipelines only. If the limits are exceeded, they must be checked and verified. If a computerized strength analysis is required, please contact KSB!
The values are only applicable if the pump is installed on a completely grouted baseplate and bolted to a rigid and level foundation.
For temperatures > 120 °C, the values indicated must be reduced in accordance with the above diagram.

Pump sizes	Forces									Moments					
	Suction nozzle in N				Discharge nozzle in N					Suction nozzle in Nm			Discharge nozzle in Nm		
	F_x	F_y	F_z	F_{res}	F_x	F_{yTens}^+	F_{yPress}^-	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
25-160 -200	1050	700	850	1100	500	350	650	450	700	550	450	300	400	300	200
32-160 -200 -250	1350	900	1100	1400	700	450	850	550	900	700	550	350	450	350	250
40-160 -200 -250	1750	1150	1400	1800	850	550	1100	700	1100	1150	850	600	550	450	300
50-160 -200 -250	2150	1400	1700	2200	1100	700	1350	900	1400	1450	1100	750	700	550	350
65-160 -200 -250	2700	1750	2150	2750	1400	900	1750	1150	1800	2000	1500	1000	1150	850	600
80-160 -200 -250	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750
100-200 -250	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
150-250	7350	4700	5700	7400	3750	2350	4700	3100	4850	5300	3850	2650	3450	2650	1750

4.3.6 Noise Characteristics

Rated-power input PN (kW)	Sound pressure level L pA (dB) [1]					
	Pump only			Pump with motor		
	2900 1/min	1450 1/min	960/760 1/min	2900 1/min	1450 1/min	960/760 1/min
1.5	54.5	53.5	52.5	64.0	59.0	56.5
2.2	56.5	55.5	54.0	67.0	61.0	59.0
3.0	58.0	57.0	55.5	68.5	62.5	60.5
4.0	60.0	58.5	57.0	70.0	64.0	62.0
5.5	61.5	60.0	58.5	71.5	65.5	63.0
7.5	63.0	62.0	60.0	73.0	67.0	64.5
11.0	65.0	64.0	62.0	75.0	68.5	66.0
15.0	67.0	65.5	63.5	76.0	70.0	67.5
18.5	68.0	66.5	64.5	77.0	71.0	68.5
22.0	69.0	67.5	65.5	77.5	71.5	69.0
30.0	71.0	69.0	67.0	79.0	73.0	70.5
37.0	72.0	70.5	68.0	79.5	73.5	71.0

Rated-power input PN (kW)	Sound pressure level L pA (dB) [1]					
	Pump only			Pump with motor		
	2900 1/min	1450 1/min	960/760 1/min	2900 1/min	1450 1/min	960/760 1/min
45.0	73.0	71.5	69.0	80.5	74.5	72.0
55.0	74.0	72.5	70.0	81.0	75.0	72.5
75.0	75.5	74.0	71.5	82.0	76.5	73.5
90.0	76.5	75.0	72.0	82.5	77.0	74.0
110.0	78.0	76.0	73.0	83.0	77.5	75.0
132.0	79.0	77.0	74.0	83.5	78.0	75.5
160.0	80.0	78.0	75.0	84.5	79.0	76.0
200.0	81.0	79.0	76.0	85.0	79.5	76.5
250.0	81.5	79.5		85.5	80.5	

1) Measured at a distance of 1 m from the pump outline

4.4 Accessories

Coupling:	flexible coupling with/without spacer sleeve
Contact guard:	coupling guard
Baseplate (acc. to ISO 3661)	cast or fabricated for the complete unit (pump and motor) in torsion-resistant design
Special accessories:	as required

If a complete unit is supplied, coupling and coupling guard are provided by the supplier.

4.5 Dimensions and Weights

For dimensions and weights please refer to the pump installation plan.

5 Installation at Site

5.1 Safety Regulations

Electrical equipment operated in hazardous locations must comply with explosion protection regulations. This is indicated on the motor rating plate.

If the equipment is installed in hazardous locations, the applicable local explosion protection regulations and the regulations of the test certificate supplied with the equipment and issued by the responsible approval authorities must be observed and complied with. The test certificate must be kept close to the location of operation for easy access (e.g. foreman's office).

5.2 Checks to be Carried out Prior to Installation

All structural work required must have been prepared in accordance with the dimensions stated in the dimension table / installation plan.

The concrete foundations shall have sufficient strength (min. BN 15) to ensure safe and functional installation in accordance with DIN 1045 or equivalent standards.

Make sure that the concrete foundation has set firmly before placing the unit on it. Its surface shall be truly horizontal and even. The foundation bolts shall be inserted in the baseplate.

5.3 Installing the Pump/Unit

After placing the pump on the foundation, align it with the help of a spirit level placed on the shaft/discharge nozzle. Permissible deviation 0.2 mm/m. The correct distance between the coupling halves as specified in the installation plan must be observed. Shims shall be fitted between the baseplate and the foundation itself; they shall always be inserted to the left and right of the foundation bolts and in close proximity to these bolts. For a bolt-to-bolt clearance > 800 mm, additional shims shall be inserted halfway between the adjoining holes. All shims must lie perfectly flush.

Insert the foundation bolts and set them into the foundation using concrete. When the concrete has set, align the baseplate as described in section 5.3.1 and tighten the foundation bolts evenly and firmly. Then grout the baseplate using low-shrinkage concrete with a standard particle size and a water/concrete ratio of ≤ 0.5.The flowability must be produced with the help of a solvent. Secondary treatment of the concrete to DIN 1045 is an absolute necessity.

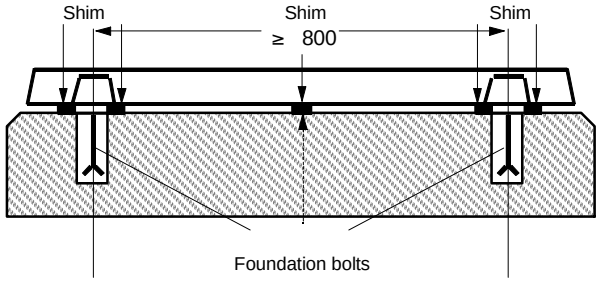


Fig 5.3-1 Fitting required shims

To ensure low-noise operation, the unit can be mounted on vibration dampers (please confirm with KSB first). Expansion joints can be fitted between pump and suction/discharge line.

5.3.1 Aligning the Pump/Drive

Caution After fastening the baseplate on the foundation and connecting the piping, the coupling must be thoroughly checked and the pump set be re-aligned (at the motor), if required.

Caution The HPK-L pump is fitted with a ceramic plain bearing which may be damaged by shock or impact, e.g. from pump alignment by hammer or lead slug.

Prior to checking the alignment/re-alignment, loosen support foot 183 and re-tighten without transmitting any stresses or strains.

Coupling check and re-alignment must be effected even if pump and motor are supplied completely assembled and aligned on a common baseplate.

The pump set is correctly aligned, if a straight-edge placed axially on both coupling halves is the same distance from each shaft at all points around the circumference. In addition, the distance between the two coupling halves must remain the same all around the circumference. Use a feeler gauge, a wedge gauge or a dial micrometer to verify (see figs. 5.3-2 and 5.3-3).

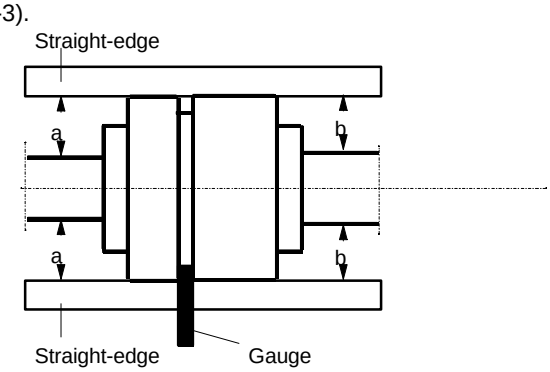


Fig. 5.3-2 Aligning the coupling with the help of a gauge and a straight-edge

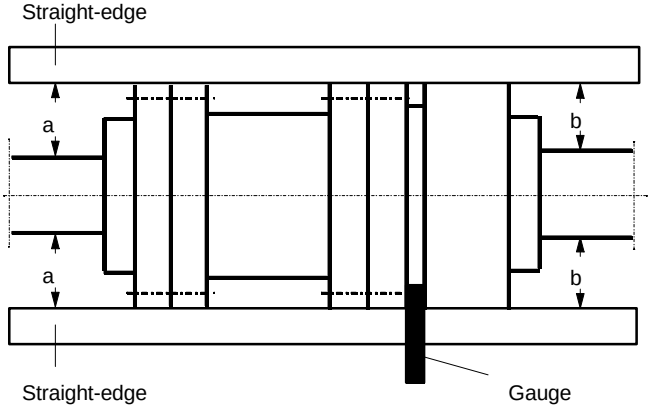


Fig. 5.3-3 Aligning a spacer-type coupling

The radial and axial deviation between the two coupling halves must not exceed 0.1 mm.

If other couplings are used, please refer to the enclosed supplementary operating instructions.

⚠ Improper alignment of the unit can cause damage to both the coupling and the unit itself!

Motor alignment by means of adjusting screws

In order to re-align the coupling, first loosen the 4 hex. head bolts on the motor as well as the lock nuts.

Turn adjusting screw by hand or by means of an open-jawed wrench until the coupling alignment is correct. Then re-tighten the 4 hex. head bolts and the lock nuts.

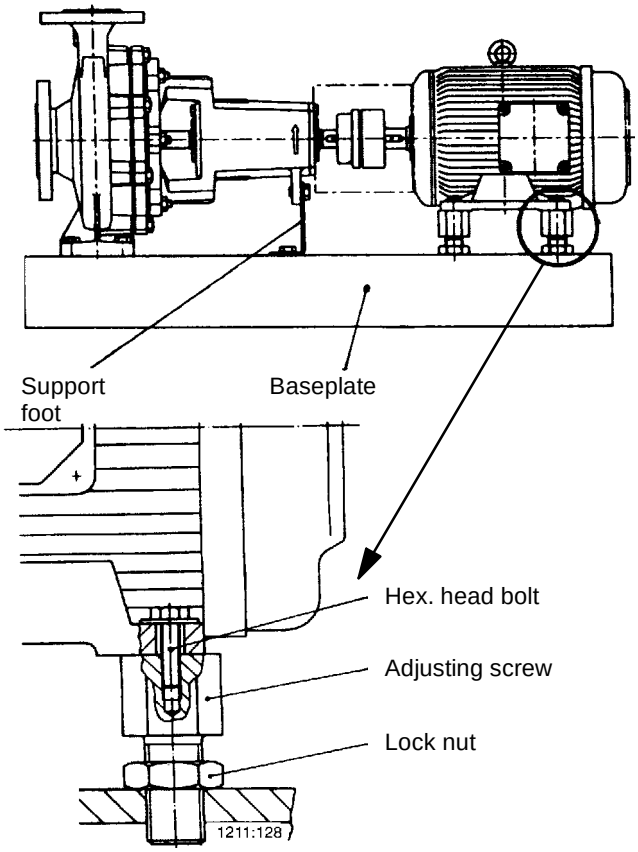


Fig. 5.3-4 Motor alignment with adjusting screws

5.3.2 Place of Installation

The volute casing and casing cover take on roughly the same temperature as the medium handled. The casing cover and the bearing bracket must not be insulated.

Caution An unimpeded supply of cooling air is indispensable for trouble-free operation. The temperature of the ambient air must not exceed 40°C.

⚠ Take the necessary precautions to avoid burns!

5.4 Connecting the Piping

Caution Never use the pump itself as an anchorage point for the piping. The permissible pipeline forces/moments must not be exceeded (see 4.3.5).

Suction lift lines shall be laid with a rising slope towards the pump and suction head lines with a downward slope towards the pump. The pipelines shall be anchored in close proximity to the pump and connected without transmitting any stresses or strains. The nominal diameters of the pipelines shall be at least equal to the nominal diameters of the pump nozzles.

It is recommended to install check and shut-off elements in the system, depending on the type of plant and pump. It must be ensured, however, that the pump can still be drained and dismantled without problems.

Thermal expansions of the pipelines must be compensated by appropriate measures so as not to impose any extra loads on the pump exceeding the permissible pipeline forces and moments.

⚠ An excessive, impermissible increase in the pipeline forces may cause leaks on the pump where the medium handled can escape into the atmosphere.

Danger of life when toxic or hot media are handled!

The flange covers on the pump suction and discharge nozzles must be removed prior to installation in the piping.

5.4.1 Auxiliary Connections

The HPK-L pump is designed to give trouble-free operation without external cooling facilities. The mechanical seal does not require any cooling liquid, sealing liquid or flushing liquid.

In the as-supplied condition, auxiliary connection 13D for venting the seal chamber is closed with a screwed plug with vent hole. It is recommended to replace it with a globe valve and drain line at the site, so that gases and hot liquid can be drained safely during the venting process.

The pump can be supplied with auxiliary connections (e.g. for pressure or temperature measuring instruments), depending on the pump version. Auxiliary connections for pump drainage and leakage disposal are also provided. The dimensions and locations of all auxiliary connections are indicated on the installation plan or piping layout.

5.4.2 Coupling Guard

⚠ In compliance with the accident prevention regulations the pump must not be operated without a coupling guard. If the customer specifically requests not to include a coupling guard in our delivery, then the operator must supply one.

The coupling guard must not obstruct air flow to the fan hood and the bearing bracket.

5.5 Final Check

Verify the alignment as described in section 5.3.

It must be easy to rotate the shaft by hand at the coupling.

5.6 Connection to Power Supply

Connection to the power supply must be effected by a trained electrician only. Check available mains voltage against the data on the motor rating plate and select appropriate start-up method.

We strongly recommend to use a motor protection device.

VDE 0171/2.61 stipulates that explosion-proof motors, type of protection IP 54, increased sefety Ex EEx, temperature class T3, must always be connected via a motor protection switch.

6 Commissioning, Start-up / Shutdown

Caution Compliance with the following requirements is of paramount importance. Damage resulting from non-compliance shall not be covered by the scope of warranty.

6.1 Commissioning

Before starting up the pump make sure that the following requirements have been checked and fulfilled.

- The operating data must have been checked.
- The direction of rotation (6.1.4) must have been checked.
- The pump and the bearing bracket (mechanical seal chamber) must have been primed (6.1.3).
- Make sure that the unit has been properly connected to the electric power supply and is equipped with all protection devices.
- Make sure that all auxiliary lines (5.4.1) are connected and functioning.
- If the pump has been out of service for a longer period of time, proceed in accordance with section 6.4.

6.1.1 Lubricants

The rolling element bearings are grease-packed for life at the factory and do not require any special measures prior to commissioning. See section 7.2.2 on maintenance and re-lubrication.

6.1.2 Shaft Seal

Mechanical seals have been fitted prior to delivery.

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

The water in the circulation line must be analysed at regular intervals.

Caution The hot water shall comply with the minimum requirements of the VdTÜV regulations TCH 1466/AGFW 5-15 (edition 2.89). In particular, the following limits must not be exceeded:

Requirements		
Electrical conductivity	µs/cm	< 250
pH value at 25 °C	-	9 -10.5
Silicates (SiO_2)	mg/l	< 10
Solids	mg/l	< 5

- For hot water with an electrical conductivity exceeding 250 µs/cm and for hot water with unknown water quality, no warranty can be given on the service life of the mechanical seal.
- **Caution** When conditioners producing a greasy film on the seal faces are used, e.g. Maxigard, Antifrogen N, Preventol Cl-2, Kebo-X, 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.

For high-purity water (fully demineralized) with an electrical conductivity < 2 µs/cm, the temperature at the seal faces must be at least 20 °C below the boiling point.

6.10.3 Priming the Pump and Checks to be Carried out

Before start-up, the volute casing, bearing bracket and inlet line must be vented and primed with the liquid to be pumped.

The pump can be primed with clean product from the system via the inlet line. Open the discharge-side shut-off valve to vent the volute casing. If the pump is not pressurized, the bearing bracket can also be filled through connection 13D after the vent valve has been removed. To vent the bearing bracket, open the vent valve installed at auxiliary connection 13D repeatedly for a short period. Rotate the shaft by hand several times when priming the pump, to ensure complete venting of the bearing bracket. (Liquid escapes).

After priming has been completed, close the vent valve on connection 13D.

Depending on the system pressure and temperature of the medium handled hot liquid or steam may escape or spurt out under high pressure when the vent valve is opened. Risk of scalding!

Protect the electrical components against escaping liquid!

Caution **Dry-running will result in failure of the plain bearing and the mechanical seal and must be avoided!**

6.1.4 Checking the Direction of Rotation

When the unit has been connected to the electric power supply, verify the following (local and national regulations have to be taken into account separately):

Caution For trouble-free operation of the pump, the correct direction of rotation of the impeller is of paramount importance. If running in the wrong direction of rotation, the pump cannot reach its duty point; vibrations and overheating will be the consequence. The unit or the shaft seal might be damaged.

Correct direction of rotation:

The direction of rotation must correspond to the direction indicated by the arrow on the pump. Verify by switching the motor on and then off again immediately.

Before checking the direction of rotation make sure that there is no foreign matter in the pump casing.

Never hold your hands or any other objects into the pump!

Caution Do not run the pump without liquid while checking the direction of rotation! If there is no medium handled available, the motor's direction of rotation must be checked with the pump decoupled.

If the pump runs in the wrong direction of rotation, interchange two of the three phases in the control cabinet or motor terminal box.

6.1.5 Cooling

On the HPK-L pump, the mechanical seal is integrated in the bearing bracket. The latter is cooled by the ambient air via the cooling fins. An integrated fan impeller generates a continuous cooling air flow. An unobstructed supply of cooling air to the fan hood and fan impeller must be ensured at all times!

In exceptional cases, the pump can also be operated without the integrated fan impeller (831), e.g. if the cooling air intake would be blocked by coarse dust. In this case,

- also remove the fan hood (832);
- remove the guard (680);
- ensure a **cooling air flow** with a cooling air velocity of **at least 4 m/s** in the proximity of the cooling fins (e.g. from the motor cooling device or an external fan).

6.1.6 Cleaning the Plant Piping

The cleaning operation mode and duration for flushing and pickling service must be matched to the casing and seal materials used.

6.1.7 Start-up Strainer

Caution If a start-up strainer has been fitted to protect the pumps against dirt and/or to retain contamination from the plant, the strainer's contamination level must be monitored by measuring the differential pressure so as to ensure adequate inlet pressure for the pump. If the start-up strainer is included in the scope of supply of the pump, please refer to the supplementary operating instructions supplied for installation and monitoring.

6.1.8 Start-up

Before starting the pump, ensure that the shut-off valve in the suction line is fully open! The pump may be started up against a closed discharge-side swing check valve or shut-off valve. Only after the pump has reached full rotational speed shall the shut-off valve in the discharge line be opened further and adjusted to comply with the duty point. When starting up against an open discharge-side shut-off valve, take the resulting increase in input power into account!

Caution 24 hours after the operating temperature has been reached and/or in the event of leakage, switch off the unit, allow to cool down and re-tighten the connection bolts between the casing cover and the casing. For permissible tightening torques please refer to section 7.5.3.1.

Caution Check the coupling alignment at operating temperature as described in section 5.3.1 and re-align, if necessary.

6.1.9 Venting During Pump Operation

Caution If the pumped product is expected to liberate gas (e.g. during the commissioning phase of a plant or when the pump is filled with tap water), the bearing bracket must be vented at regular intervals.

For venting we recommend to switch off the pump for a short period and let it run down to a standstill, to ensure reliable venting of any gases. Depending on the system configuration, the shut-off valves may have to be closed to do so. To vent the bearing bracket, open the valve fitted at connection 13D repeatedly for a short period, until no further gases escape.

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. The vent valve must be closed again as soon as no further gases escape.

⚠ **Depending on the system pressure and temperature of the medium handled hot liquid or steam may escape or spurt out under high pressure when the vent plug is opened. Risk of scalding!**

The venting intervals required depend on the amount of gas escaping during the venting process.

6.1.10 Shutdown

Close the shut-off valve in the discharge line.

If the discharge line is equipped with a non-return or check valve, the shut-off valve may remain open. If shut-off is not possible, the pump will run in reverse direction. The reverse runaway speed must be lower than the rated speed.

Switch off the drive, making sure that the unit runs down smoothly to a standstill.

In the event of frost and/or prolonged shutdowns, the pump incl. the mechanical seal chamber in the bearing bracket must be drained or otherwise protected against freezing.

Secure the pump set in such a way that it cannot be switched on while in reverse rotation.

6.2 Operating Limits

⚠ The pump's/unit's application limits regarding pressure, temperature and speed are stated on the data sheet and must be strictly adhered to! If a data sheet is not available, contact KSB!

6.2.1 Temperature of the Medium Handled, Ambient Temperature, Bearing Temperature

Caution Do not operate the pump at temperatures exceeding those specified on the data sheet or the name plate unless the written consent of the manufacturer has been obtained. Damage resulting from disregarding this warning will not be covered by the KSB warranty.

Ambient temperature must not exceed 40°C.

Bearing bracket temperature see 7.2.1

6.2.2 Switching Frequency

To prevent high temperature increases in the motor and excessive loads on the pump, coupling, motor, seals and bearings, the switching frequency shall not exceed the following number of start-ups per hour (S).

Motor rating (kW)	max. S (start-ups/h)
up to 12	25
up to 100	20
more than 100	10

6.2.3 Density of the Medium Handled

The power input of the pump will increase in proportion to the density of the medium handled. To avoid overloading of the motor, pump and coupling, the density of the medium must comply with the data specified on the purchase order.

6.2.4 Abrasive Media

When the pump handles liquids containing abrasive substances, increased wear of the hydraulic system, shaft seal and plain bearing are to be expected. The intervals recommended for servicing and maintenance shall be shortened.

6.2.5 Minimum/Maximum Flow

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

Q_{min} = 0.1 x Q_{opt} for short operation
Q_{min} = 0.3 x Q_{opt} for continuous operation
Q_{max} = 1.1 x Q_{opt} for 2-pole operation
Q_{max} = 1.25 x Q_{opt} for 4-pole operation
Q_{opt} = optimum efficiency

6.3 Shutdown / Storage / Preservation

Each KSB pump leaves the factory carefully assembled. If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump storage.

6.3.1 Storage of New Pumps

- New pumps are supplied by our factory duly prepared for storage. Maximum protection for up to 12 months, if the pump is properly stored indoors.
- Store the pump in a dry location.
- Rotate the shaft by hand once a month.

6.3.2 Measures to be Taken for Prolonged Shutdown

1. **The pump remains installed; periodic check of operation**

In order to make sure that the pump is always ready for instant start-up and to prevent the formation of deposits within the pump and the pump intake area, start up the pump set regularly once a month or once every 3 months for a short time (approx. 5 minutes) during prolonged shutdown periods. Prior to an operation check run ensure that there is sufficient liquid available for operating the pump.

2. **The pump is removed from the pipe and stored**

Before putting the pump into storage, carry out all checks and maintenance work specified in sections 7.1 to 7.4. Then apply appropriate preservatives:

- Spray-coat the inside wall of the pump casing and the mechanical seal chamber with a preservative, in particular the impeller clearance areas. Spray the preservative through the suction and discharge nozzles. It is advisable to close the pump nozzles (e.g. with plastic caps or similar).
- If the pump has been out of service for more than 1 year, the elastomer components of mechanical seal, shaft sleeve and seat ring holder must be replaced.

6.4 Returning to Service after Storage

Before returning the pump to service, carry out all checks and maintenance work specified in sections 7.1 and 7.2.

In addition, the instructions laid down in the sections on "Commissioning" (6.1) and "Operating Limits" (6.2) must be observed.

Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and/or re-activated.

7 Maintenance / Repair

7.1 General Instructions

The operator is responsible for ensuring that all maintenance, inspection and installation work be performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.

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

Work on the unit must only be carried out with the electrical connections disconnected. Make sure that the pump set cannot be switched on accidentally (danger of life!).

Pumps handling liquids posing health hazards must be decontaminated. When draining the medium see to it that there is no risk to persons or the environment. All relevant laws must be adhered to (danger of life)!

7.2 Maintenance/Inspection

7.2.1 Supervision of Operation

Caution The pump must run quietly and free from vibrations at all times.

The pump must never be allowed to run dry.

Prolonged operation against a closed shut-off valve is not permitted. When operating the pump set against a closed shut-off valve in the discharge line for a short period of time, make sure not to exceed the permissible pressure and temperature limits.

The bearing temperature may exceed room temperature by up to 50 °C, but must never rise above + 90 °C.

The shut-off valves and the auxiliary feed lines must not be closed during operation.

Any stand-by pumps installed shall be switched on and then immediately off again once a week to keep them operational. Attention shall be paid to the correct functioning of the auxiliary connections.

Caution If the flexible coupling elements begin to show signs of wear, they must be replaced in due time.

7.2.2 Lubrication and Lubricant Change

7.2.2.1 Lubrication Intervals

The pumps are supplied with the rolling element bearings packed with a high-quality grease. Under normal conditions grease-lubricated rolling element 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 etc., the bearings shall be checked earlier and cleaned and re-lubricated, if required.

The bearings are designed for a lifetime (L10h) of at least 25 000 hours. This corresponds to a continuous operating period of almost three years. After this period, the rolling element bearings should be replaced.

7.2.2.2 Grease Quality

The grease must meet the requirements of DIN 51825 K1/2 P-20.

Use a calcium-sulphonate complex, free of resin and acid, not liable to crumble and with good rust-preventive characteristics. The grease should have a penetration number between 1 and 2, corresponding to a worked penetration between 265 and 340 mm/10. Its drop point must not be below 175°C. The bearing cavities must only be half-filled with grease. Recommended grease quality: FINA CERAN HV.

If required, the bearings may be lubricated with greases of other soap bases. Since greases of differing soap bases must not be mixed, the bearings must be thoroughly cleaned beforehand. The re-lubrication intervals required must then be adjusted to the greases used.

Caution Please observe the local laws applicable to the disposal of such substances.

7.2.2.3 Grease Quantity

Bearing bracket	Bearing	Grease qty. per single bearing
LP02	7307 BG	6.5 to 8 g
LP03	7307 BG	6.5 to 8 g
LP04	7309 BG8	13 to 15.5 g

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

7.3 Drainage/Disposal

Caution If the pump was used for handling liquids posing health hazards, see to it that there is no risk to persons or the environment when draining the medium. All relevant laws must be heeded. If required, wear safety clothing and a protective mask!

If the media handled by the pumps leave residues which might lead to corrosion when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, then the unit must be flushed through, neutralized, and then for drying purposes anhydrous gas must be blown through the pump.

To drain the pumped product, use connection 6B.1 on the volute casing and 6B.2 on the bearing bracket (see installation plan).

The flushing liquid used and any liquid residues in the pump must be properly collected and disposed of without posing any risk to persons or the environment.

7.4 Dismantling

⚠ Before dismantling the pump, secure it so as to make sure it cannot be switched on accidentally. The shut-off valves in the suction and discharge lines must be closed.

The pump must have cooled down to ambient temperature, pump pressure must have been released and the pump must have been drained.

Dismantling and reassembly must always be carried out in accordance with the relevant sectional drawing.

7.4.1 Fundamental Instructions and Recommendations

Repair and maintenance work to the pump must only be carried out by specially trained personnel, using original spare parts (see 2.7).

Observe the safety regulations laid down in section 7.1. Any work on the motor shall be governed by the specifications and regulations of the respective motor supplier.

Dismantling and reassembly must always be carried out in accordance with the relevant general drawing. The general drawing and other relevant documents are found in the annex. The dismantling sequence can be derived from the general drawing.

For installation and in case of damage you can always contact our service departments.

7.4.2 Dismantling (General)

1. Remove the coupling guard.
2. Remove the coupling spacer, or if not applicable, remove the drive. If required, refer to the additional sheet concerning the coupling!
3. Disconnect and remove all auxiliary pipework.
4. Unscrew baseplate fixing bolts on support foot 183.
5. Loop a rope tightly around the neck of bearing bracket 330.
6. Unscrew hex. nuts 920.01 and pull complete bearing bracket 330 with shaft 210, impeller 230 and casing cover 161 out of volute casing 102. If necessary, clean the thread of forcing screws 901.31 and use forcing screws.
7. Undo hex. nut 920.95 and take disc 550.87 off shaft 210. Pull impeller 230 off shaft 210 and remove key 940.01.
8. Pull cup spring 950.23 and taper lock ring 515.21 off the shaft. If possible, also pull out taper lock ring 515.22 and bearing sleeve 529.21 in the process.
9. Undo the socket head cap screw or grub screw in the coupling hub and use an extractor to pull the coupling half off the pump shaft. Remove key 940.02.
10. Loosen hex. head bolts 901.84 and remove fan hood 832.
11. Loosen hex. head bolt 901.04 with spring washer 930.01 on the bearing bracket, remove support foot.
12. For work on the rolling element bearings or mechanical seal, casing cover 161 need not be disassembled from bearing bracket 330. In all other cases, unscrew hex. nuts 920.04 and pull bearing bracket 330 out of casing cover 161.
13. Unscrew socket head cap screws 914.02 and gently drive shaft 210 together with rolling element bearings 320.02, bearing cover 360.02, fan impeller 831, seat ring holder 476 and mechanical seal 433 out of bearing bracket 330 towards the drive end.
14. Taper lock ring 515.22 and bearing sleeve 529.21 are pulled off the shaft in the process, unless this has already been done in operation 8. Take taper lock ring 515.22 and bearing sleeve 529.21 out of the bearing bracket.
15. Bend back lockwasher 931.01, unscrew keywayed nut 920.21 (right-hand thread). Remove lockwasher 931.01, fan impeller 831, bearing cover 360.02, spacer sleeve 525.24 and drive-end ring 500.32.
16. Unscrew grub screws 904.32, take out support disc 550.59 (LP02 and LP03 only) and O-ring 412.07. Pull shaft sleeve 523 with mechanical seal 433.02 off shaft 210 towards the pump end. (For mechanical seal also refer to section 7.5.4)
17. Remove seat ring holder 476 with the seat ring of the mechanical seal towards the pump end. Take the seat ring out of seat ring holder 476.
18. Pull bearing 320.02 off the shaft. Take thrower 507.12, spacer sleeve 525.03 and pump-end ring 500.32 off shaft 210.

    Caution 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 plain bearing 310.01 can only be replaced completely:

19. Pull the complete assembly consisting of circlip 932.05, bearing bush 545.21, bearing carrier 382.02 and tolerance ring 500.61 as well as spring-type straight pins 562.01 out of the bearing bracket and replace.

Caution After disassembly, the individual components of plain bearings 310.01 must not be re-used. They must be re-placed by a new assembly 310.01, which must only be used as a complete assembly. Individual components from different assemblies must not be combined.

20. Clean all components and inspect them for signs of wear. Re-work damaged components or replace by new ones.

7.5 Reassembly

7.5.1 General Instructions

The pump shall be reassembled in accordance with the rules of sound engineering practice.

Clean all dismantled components and check them for signs of wear. Damaged or worn components are to be replaced by original spare parts. Make sure that the seal faces are clean and that gaskets are properly fitted.

Always use new sealing elements (O-rings/gaskets) whenever the pump is reassembled. Make sure that new gaskets have the same thickness as the old ones.

Gaskets made of graphite or other asbestos-free materials must always be fitted without using lubricants such as copper grease or graphite paste.

Avoid the use of mounting aids as far as possible. Should a mounting aid be required after all, use a commercially available contact adhesive (e.g. ”Pattex”). The adhesive shall only be applied at selected points (3 to 4 spots) and in thin layers.

Do not use cyanoacrylate adhesives (quick-setting adhesives)!

If in certain cases mounting aids or anti-adhesives other than described herein are required, please contact the sealing material manufacturer.

Caution All graphite gaskets must only be used once!

Caution Do not coat O-rings with graphite or similar products. Use animal fats or silicone-base or PTFE- base lubricants instead.

The locating surfaces of the individual components must be coated with graphite or similar before reassembly. The same applies to screwed connections.

7.5.2 Reassembly (General)

Reassembly is effected in reverse order to dismantling. Use the general drawing and the list of components for orientation.

All screws and bolts must be properly tightened during assembly. For required torques see 7.5.3.1.

Use only the bearing types and sizes specified in section 4.3.4. Angular contact ball bearings 320.02 must be installed in 'O' arrangement. Angular contact ball bearings installed in pairs must always be from the same manufacturer.

Caution 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 correct axial position of shaft sleeve 523 and mechanical seal 433.02 on shaft 210 is indispensable for the trouble-free operation of the mechanical seal. If positioned incorrectly, hot liquid and steam may spurt out during operation! See fig. 7.5.4-1)

1. Slip thrower 507.12, spacer sleeve 525.03 and ring 500.32 onto shaft 210.
2. Press angular contact ball bearing 320.02 onto the shaft as far as it will go.
3. Push spacer sleeve 525.24 onto shaft 210 and use a C-wrench to tighten keywayed nut 920.21 without lockwasher 931.01, then unscrew the keywayed nut again.
4. Slip ring 500.32, bearing cover 360.02 and fan impeller 831 onto the shaft.
5. Put a few spots of Molykote on the contact faces of the lockwasher and of the keywayed nut, slip on lockwasher 931.01, tighten keywayed nut and bend over lockwasher.
6. Insert the seat ring and the secondary seal of the mechanical seal into seat ring holder 476 and push onto the shaft from the pump end.
7. Mount the mechanical seal on shaft sleeve 523. The mechanical seal must be pushed onto the shaft sleeve as far as it will go and locked with grub screws.
8. **For LP02 and LP03:** Push the shaft sleeve on the shaft. Then guide O-ring 412.07 and support disc 550.59 carefully along the shaft and press them into the recess of the shaft sleeve. Make sure the sealing elements and sealing surfaces are clean! Screw in grub screws 904.32 by several turns, to hold the support disc in place.

   For LP04: Place O-ring 412.07 into shaft sleeve 523. Carefully guide the shaft sleeve along the shaft.
9. Push shaft sleeve 523 onto shaft 210 up to the mark. (See section 7.5.4). In doing so, the springs of the mechanical seal are compressed and the seal faces are pressed against each other. Firmly tighten all grub screws 904.32.

If plain bearing 310.01 has to be replaced:

10. Press plain bearing assembly 310.01 into the bearing bracket. Drill a hole into both bearing carrier 382.02 and bearing bracket 330 together and fix with spring-type straight pins 562.01.

Caution The plain bearing assembly 310.01 (bush) must be used as complete assembly only. Individual components from different assemblies must not be combined. After dismantling, the individual components must not be re-used. Risk of breakage or misalignment!

Clean all components of plain bearing (sleeve) 310.10 and make sure that there are no dirt particles between the conical surfaces of the bearing components. The components will not be centered correctly otherwise, which will result in failure of the plain bearing. Prior to re-assembly check whether the bearing components and the impeller can be easily fitted on shaft 210.

11 Place guard 680 onto the bearing bracket.

12. Place O-ring 412.82 onto the seat ring holder. Push shaft 210 with all assembled components into the bearing bracket. Make sure all sealing elements and sealing surfaces are clean! Fasten the bearing cover with socket head cap screws 914.02.
13. Carefully insert joint ring 411.11. Place bearing bracket 330 into casing cover 161 and firmly tighten with nuts 920.04.
14. Slip taper lock ring 515.22, bearing sleeve 529.21, taper lock ring 515.21 and cup spring 950.23 onto the shaft.

    Caution Mount cup springs 950.23 in such a way that the outside diameter of the cup spring rests against taper lock ring 515.21.
15. Insert key 940.01 and pull impeller 230 onto shaft 210. Insert disc 550.87 and tighten hex. nut 920.95 with a torque wrench.
    - Tighten evenly to prevent damage to the bearings.
    - Rotate the shaft by hand several times while tightening. (It must be easy to rotate the shaft). 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 components again and check for cleanliness and correct dimensions.

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.

16. Carefully insert joint ring 411.10 into volute casing 102. Guide the rotating pump assembly into volute casing 102 and tighten nut 920.01. Check whether the rotor can easily be turned by hand.
17. Bolt support foot 183 to bearing bracket 330 and to the baseplate.
18. Mount fan hood 832 together with guard 680, using hex. head bolts 901.84.
19. Insert key, fasten coupling half on the shaft.
20. After the rotor/bearing bracket assembly has been fitted to the volute casing which has remained in the piping and on the baseplate, the pump shall be re-commissioned as described in section 6.1. (Connect and open auxiliary feed lines, prime the pump.) Verify coupling alignment as described in section 5.3.1.
21. Start up the pump for a short period, switch off again and re-check coupling alignment at operating temperature and system pressure as described in section 5.3.1.

7.5.3 Tightening Torques

7.5.3.1 Tightening Torques of Screwed Connections

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 hex. nut for impeller fastening 920.95 and grub screws 904.32 for fastening the shaft sleeve must be tightened with a torque wrench.

The tightening torques given in the table shall apply. These values are determined on the basis of a friction coefficient μ = 0.12.

Tightening torque Nm							
Pos.	Screw	Material / Stamp mark					
902.01 902.04	Stud DIN 939	1.7709.05 / GA			Monix 3K / MM		
920.01 920.04	Hex. nut ISO 4032	1.7258 A2D / G			Monix 3K / MM (M3k)		
Thread		New	-15%	-20%	New	-15%	-20%
M12		80	68	64	130	111	104
M16		190	162	152			
914.02	Socket head cap screw DIN 7984	8.8 / 8.8					
Thread		New	-15%	-20%			
M8		25	21	20			
M10		35	30	28			
904.32	Grub screw DIN 916	A4-50 / -					
Thread							
M6		5 - 9					
920.95	Hex. nut ISO 8673	A4 / A4					
Thread		New	-15%	-20%			
M16x1,5		100	85	80			
M20x1,5		120	102	96			

The ”New” column applies to the initial tightening of brand-new threads. After repeated tightening of the threads and in case of good lubrication the values shall be reduced by 15 to 20% (see table -15%, -20%).

They do not apply, if general drawings or other instructions state different values.

7.5.4 Mechanical Seal Installation

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

Extreme care and cleanliness during installation are of overriding importance for the trouble-free operation of the mechanical seal.

The protective wrapping of the contact faces shall only be removed immediately before assembly takes place.

The seat ring and its secondary seal are mounted in seat ring holder 476.

The rotating components of the mechanical seal (tappet, springs, spring-loaded ring, secondary seal, etc.) must be pushed onto the shaft sleeve as a complete sub-assembly until they will not go any further and locked with the grub screws. The shaft sleeve must be mounted on the shaft flush with the mark on the shaft and all three grub screws 904.32 must be tightened firmly. (For tightening torques please refer to section 7.5.3.) The shaft sleeve is correctly positioned on the shaft when its pump-end face (”S” in fig. 7.5.4-1) is aligned with the mark on the shaft (”M” in fig. 7.5.4-1). On pumps with bearing bracket size LP04, no mark is supplied on the shaft; the shaft sleeve must be aligned with the shaft collar in this case; see fig. 7.5.4-1.

When all components have been mounted on the shaft, immediately before the shaft is pushed into the bearing bracket (operation 11), make sure that the contact faces are slightly pre-loaded by the springs of the mechanical seal.

⚠ The correct axial position of shaft sleeve 523 and mechanical seal 433.02 on shaft 210 is indispensable for the trouble-free operation of the mechanical seal. If incorrectly positioned, hot liquid or steam may spurt out during operation!

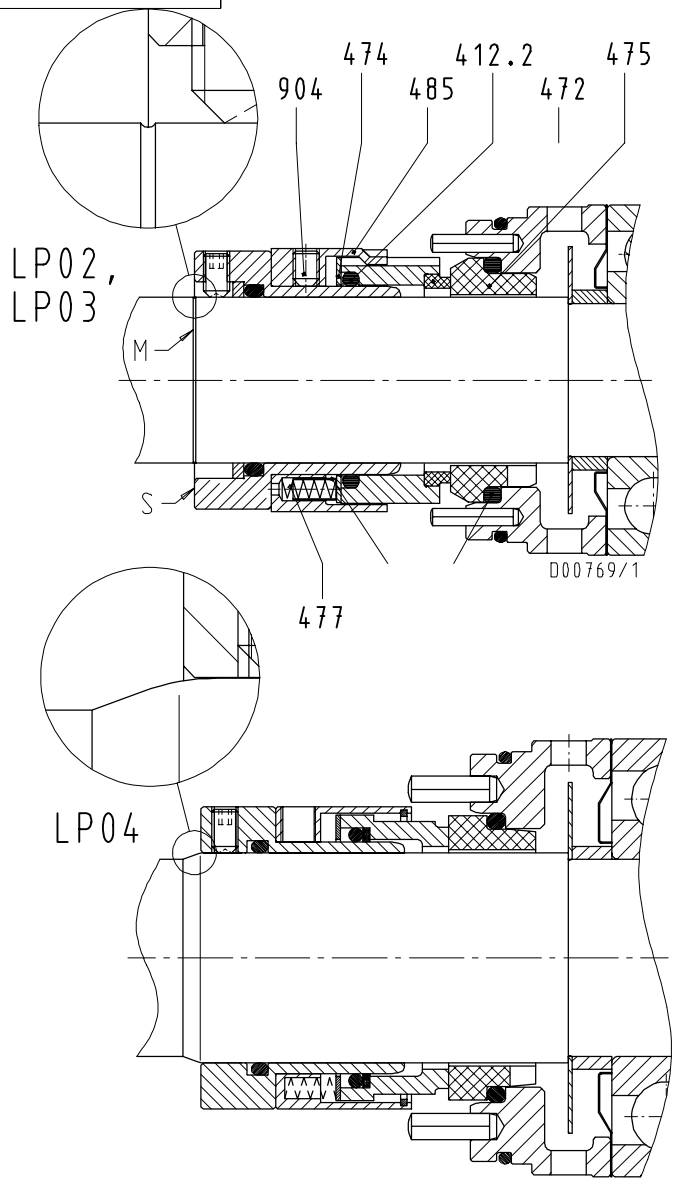


Fig. 7.5.4-1 Mechanical seal M = mark on the shaft; S = face of shaft sleeve.

Mechanical seal components:

Part No.	Description
412.1	O-ring
412.2	O-ring
472	Spring-loaded ring
474	Thrust ring
475	Seat ring
477	Spring
485	Tappet
520	Sleeve
904	Grub screw

(For information only, parts not available separately. For pump part Nos. please refer to section 9.)

7.5.5 Diametral Clearances

The clearances given refer to the diameter!

Between impeller and volute casing / casing wear ring

Discharge nozzle DN	HPK-LS/-LS4	HPK-LE/-LE4
≤ DN 65	0.40 mm + 0.1	0.60 mm + 0.1
DN 80 to DN 150	0.50 mm + 0.1	0.60 mm + 0.1

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

In plain bearing

Bearing bracket	Bearing play
LP02	0.03 mm + 0.045
LP03	0.05 mm + 0.045
LP04	0.05 mm + 0.045

7.6 Spare Parts Stock

When ordering spare parts please always quote the following data:

Type series: here: HPK-L

Pump size:

Works No.:

This data is stated on the pump name plate.

7.6.1 Recommended Spare Parts Stock for 2 Years' Operation to DIN 24 296

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6	8	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%
310.01	Plain bearing (product-lubricated)	2	3	4	5	6	8	100%
310.10								
320.02	Angular contact ball bearing (set)	1	1	2	2	3	4	50%
330	Bearing bracket	–	–	–	–	–	1	2 off
433	Mechanical seal	1	1	2	2	2	3	25%
502.01 [1)]	Casing wear ring	2	2	2	3	3	4	50%
523	Shaft sleeve	1	1	1	2	2	2	20%
---	Set of sealing elements	4	6	8	8	9	12	150%

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

7.6.2 Interchangeability of Pump Components

	Part No. Description	Volute casing	Casing cover	Support foot	Shaft	Impeller	Plain bearing	Plain bearing	Angular contact ball bearing	Bearing bracket	Bearing cover	Mechanical seal	Seat ring holder	Casing wear ring	Thrower	Shaft sleeve	Spacer sleeve	Spacer sleeve	Guard	Fan impeller	Fan hood	Hex. nut
Bearing bracket	Pump size	102	161	183	210	230	310.01	310.10	320.02	330	360	433.02	476	502.01	507.01	523	525.03	525.24	680	831	832	920.95
LP02	25-160	not interchangeable among different pump sizes	1	1	1	not interchangeable among different pump sizes	1	1	1	1	1	1	1	14	1	1	1	1	1	1	1	1
	32-160			1										1								
	40-160			1										2								
	50-160			2										3								
	25-200		2	2										14								
	32-200			2										1								
	40-200			2										2								
	50-200			2										3								
LP03	65-160		3	3	2		2	2		2		2	2	7		2						
	80-160			4										9								
	65-200		4	4										8								
	80-200			4										10								
	100-200			5										12								
	32-250		5	4										6								
	40-250			4										5								
	50-250			4										4								
	65-250			5										8								
	80-250			6										11								
LP04	100-250			7	3				2	3	2	3	3	13	2	3	2	2	2	2	2	2
	125-250			8										15								
	150-250			9										16								

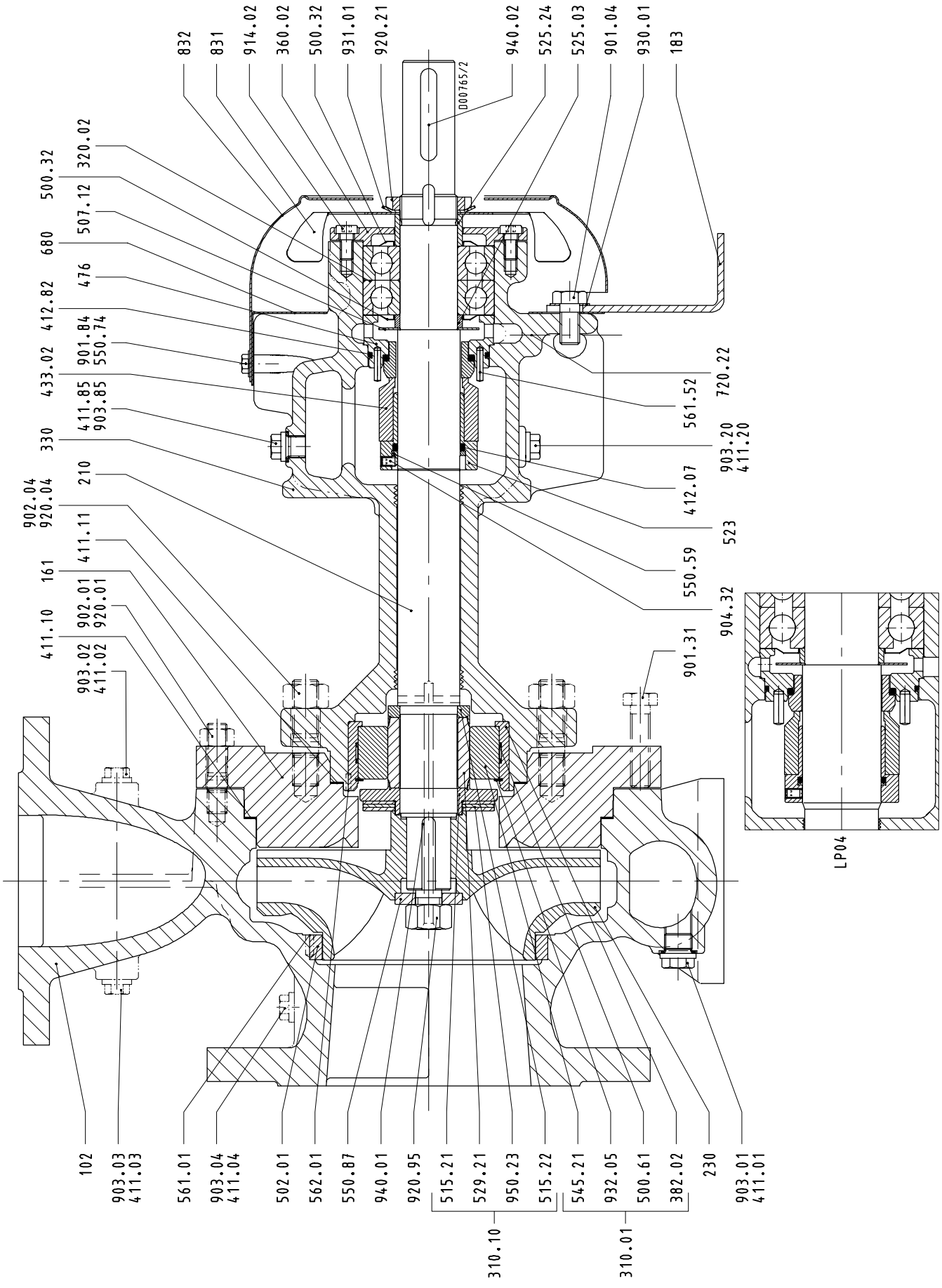
Components featuring the same number in a column are interchangeable.

8 Trouble-Shooting

Pump delivers insufficient flow rate	Motor is overloaded	Excessive pump discharge pressure	Excessive bearing temperature	Leakage at the pump	Excessive leakage at the shaft seal	Vibrations during pump operation	Excessive rise of temperature inside the pump	Cause	Remedy [1]
*								Pump delivers against an excessively high discharge pressure.	Re-adjust duty point.
*								Excessively high back pressure	Check plant for impurities. 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 a vent valve.
			*		*	*		Pump is warped or sympathetic vibrations in piping.	Check pipeline connections and secure fixing of pump; if required, reduce the distances between the pipe clamps. Fix the pipelines using anti-vibration material.
*						*	*	Suction head is too high/$NPSH_{available}$ (positive suction head) is too low.	Check/alter liquid level. Fully open shut-off valve 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.
			*					Increased axial thrust [2]	Correct rotor adjustment.
*								Air intake at the shaft seal	Fit new shaft seal.
*								Reverse rotation	Interchange two of the phases of the power supply cable.
*	*							Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
*								Speed is too low. [2]	Increase speed.
						*		Defective bearings	Fit new bearings.
			*			*	*	Insufficient rate of flow	Increase the minimum rate of flow.
*						*		Wear of internal pump parts.	Replace worn components by new ones.
	*					*		Pump back pressure is lower than specified in the purchase order.	Adjust duty point accurately.
	*							Density or viscosity of the fluid pumped is higher than stated in the purchase order.	2)
					*			Use of unsuitable materials	Change the material combination.
	*	*						Speed is too high.	Reduce speed. [2]
				*				Tie bolts / seals and gaskets	Tighten the bolts. Fit new seal elements.
					*			Worn shaft seal	Fit new shaft seal.
*					*			Score marks or roughness on shaft protecting sleeve	Fit new shaft protecting sleeve. Fit new shaft seal.
					*			Dismantle to find out.	Correct.
					*			Vibrations during pump operation	Improve suction conditions. Re-align the pump. Re-balance the impeller. Increase pressure at the pump suction nozzle.
			*		*	*		The unit is misaligned.	Check the coupling; re-align, if required.
			*					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 the installation plan.
	*							Operating voltage is too low.	Increase the voltage.
						*		Rotor is out of balance.	Clean the impeller. Re-balance the impeller.

1) Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.
2) Contact KSB

9 General Drawing with List of Components



When ordering spare parts, please always specify:
Type series/pump size, works No. (stamped on the nameplate and on the suction nozzle flange), motor No. (serial No.),
year of construction, quantity required, part No., description, material, medium handled, sectional drawing No. and mode of dispatch.

	Part No.	Description	Scope of supply
	102	Volute casing	with joint ring 411.01/.02/.03/.04/.10, casing wear ring 502.01[1)], parallel pin 561.01[1)], stud 902.01, screwed plug 903.01/.02/.03/.04, hex. nut 920.01
	161	Casing cover	with joint ring 411.11, hex. head bolt 901.31, stud 902.04, hex. nut 920.04
	183	Support foot	with hex. head bolt 901.04, spring washer 930.01
*	210	Shaft	with disc 550.87, keywayed nut 920.21, hex. nut 920.95, lockwasher 931.01, key 940.01/.02
	230	Impeller	
*	310.01	Plain bearing (bush) [2)]	with bearing carrier 382.02, tolerance ring 500.61, bearing bush 545.21, circlip 932.05, spring-type straight pin 562.01
*	310.10	Plain bearing (sleeve)	with taper lock rings 515.21/.22, bearing sleeve 529.21, cup spring 950.23
*	320.02	Angular contact ball bearing	
*	330	Bearing bracket	
	330	Bearing bracket (complete)	Comprising all parts marked *.
*	360.02	Bearing cover	
*	411.20	Joint ring	
*	411.85	Joint ring	
*	433.02	Mechanical seal	
*	476	Seat ring holder	
*	500.32	Ring	
*	507.12	Thrower	
*	523	Shaft sleeve	with O-ring 412.07, support disc 550.59 (LP02 and LP03 only), grub screws 904.32
*	525.24	Spacer sleeve	
*	525.03	Spacer sleeve	
*	550.87	Disc	
*	561.52	Grooved pin	
*	680	Guard	
*	720.22	Nipple joint	
*	831	Fan impeller	
*	832	Fan hood	
*	901.84	Hex. head bolt	
*	903.20	Screwed plug	
*	903.85	Screwed plug	
*	914.02	Socket head cap screw	
*	920.95	Hex. nut	
	99-9	Set of sealing elements	with joint ring 411.01/.02/.03/.04/.10/.11/.20/.85, O-ring 412.07/.82

1) For HPK-LS/LS4 only
2) Can only be supplied and replaced as a complete unit

Explosion Protection

Short operating instructions concerning explosion protection

for type series CPK, CPKN, CPP, Eta R, HPK, HPH, KWP and RPH

Caution These short operating instructions cover only the main issues concerning explosion protection. The operating instructions for the pump or pump set, as applicable, for the specific works number must also be complied with. The following points must be adhered to:

1. The explosion protection marking on the pump only refers to the pump part. The coupling, if any, must have an EC manufacturer's declaration. The driver must be regarded separately. Example of marking on the pump part:
   Ex II 2 G T1 - T5.
2. Any operation of the pump outside its specified operating range and any unauthorized modes of operation may result in the specified temperature limits being exceeded.
3. In all areas of elevated temperatures (bearing bracket), in particular, the unit surfaces must be freely exposed to the atmosphere.
4. It is assumed that the pump internals including seal chamber and auxiliary systems are completely filled with the product to be handled during pump operation, so that an explosive atmosphere is prevented. If this cannot be ensured, suitable monitoring facilities must be provided.
5. Explosion protection is subject to the following material requirements:
   - For combustible liquids, all pressure-retaining components must be made of ductile materials.
   - For coupling parts made of aluminium, the coupling guard must be made of brass.

   The material variants supplied by KSB meet these requirements.
6. If there is a risk of explosion during the installation phase, the direction of rotation must not be checked by starting up the unfilled pump set, even for a short period. If it is not possible to fill the pump, the direction of rotation must be checked with the pump/motor coupling removed.
7. The pump must never be operated with the shutoff valves in the suction and/or discharge lines closed.
8. For minimum flow operation with liquids whose physical properties are distinctly different from water, it is essential to check if an additional heat build-up may occur and if the flow rate must therefore be increased. To do so, please proceed as described in section 6.2.5 of the operating instructions. Contact the manufacturer, if necessary, and observe the information provided in the data sheet.
9. Responsibility for compliance with the specified product temperature lies with the operator.
10. If temperature classes T 5 (100°C) and T6 (85°C) have to be complied with, special measure may have to taken with regard to bearing temperature. In such cases, and if ambient temperature exceeds 40°C, contact the manufacturer.
11. Both gland packings and mechanical seals may exceed the specified temperature limits if run dry. Dry running may result from:
    - incompletely filled seal chamber,
    - excessive gas content in medium handled,
    - unauthorized mode of operation, or if
    - gland packing is tightened too much (there must be visible leakage).

    The correct function of the shaft seal must be checked regularly.
12. The bearing assembly must be checked regularly for correct function, running noises and heat build-up. The same applies to lubricants.
13. In hazardous areas, compliance with IEC60079-14 is an additional requirement for electrical connection.
14. Belt-driven pump sets must always be earthed. The condition of the belts must be checked regularly. The belts must be made of conductive material.

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