CPKO

Standardized Chemical Pumps

to EN 22 858/ISO 2858 and ISO 5199
and Directive 94/9/EC
with open impeller
Reinforced thrust bearing (bearing brackets P 02s to P 05 s)
Reinforced bearing design with reinforced thrust bearing (P 02as to P 05 as)
Mechanical seal

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 always be kept close to the unit's location of operation or directly on the pump set.

Contents

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1 General

Caution This KSB pump 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 pump 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 pump 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 specified in the technical documentation for the medium handled, capacity, speed, density, pressure, temperature and motor rating. 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.
For noise characteristics please refer to section 4.3.6.

2 Safety

These operating instructions contain fundamental information which must be complied with during installation, operation, monitoring 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, particularly if the pump/unit is operated in hazardous areas (see section 2.9).

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 symbol

general hazard sign to ISO 7000 - 0434

The **electrical danger warning sign is**

safety sign to IEC 417 - 5036,
and special instructions concerning explosion protection are marked

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 functions,
- failure of prescribed maintenance and servicing practices,
- hazard to persons by electrical, mechanical and chemical effects as well as explosion,
- 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 and international explosion protection regulations, health and safety regulations and the operator's own internal work, operation and safety regulations.
Ex symbol relates to additional requirements which must be adhered to when the pump is operated in hazardous areas.

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 (e.g. at the shaft seal) of hazardous media handled (e.g. explosive, toxic, hot) must be contained so as to avoid any danger to persons or the environment. Pertinent legal provisions must be adhered to.
- 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.)

If the pumps/units are located in hazardous areas, it is imperative to make sure that unauthorized modes of operation are prevented. Non-compliance may result in the specified temperature limits being exceeded.

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 and to the extent permitted by 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.

2.9 Explosion Protection

If the pumps/units are installed in hazardous areas, the measures and instructions given in the following sections 2.9.1 to 2.9.6 must be adhered to without fail, to ensure explosion protection.

2.9.1 Unit Fill

It is assumed that the system of suction and discharge lines and thus the wetted pump internals are completely filled with the product to be handled at all times during pump operation, so that an explosive atmosphere is prevented.

If the operator cannot warrant this condition, appropriate monitoring devices must be used.

N.B.: In addition, it is imperative to make sure that the seal chambers, auxiliary systems of the shaft seal and the heating and cooling systems are properly filled.

2.9.2 Marking

The marking on the pump only refers to the pump part, i.e. the coupling and motor must be regarded separately. The coupling 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
The marking indicates the theoretically available temperature range as stipulated by the respective temperature classes. The temperatures permitted for the individual pump variants are outlined in section 2.9.5.

2.9.3 Checking the Direction of Rotation (see also 6.1.4)

If the explosion hazard also exists during the installation phase, the direction of rotation must never be checked by starting up the unfilled pump unit, even for a short period, to prevent temperature increases resulting from contact between rotating and stationary components.

2.9.4 Pump Operating Mode

Make sure that the pump is always started up with the suction-side shut-off valve fully open and the discharge-side shut-off valve slightly open. However, the pump can also be started up against a closed swing check valve. The discharge-side shut-off valve shall be adjusted to comply with the duty point immediately following the run-up process (see 6.1.7).
Pump operation with the shut-off valves in the suction and/or discharge pipes closed is not permitted.

N.B.: In this condition, there is a risk of the pump casing taking on high surface temperatures after a very short time, due to a rapid temperature rise in the pumped product inside the pump.

Additionally, the resulting rapid pressure build-up inside the pump may cause excessive stresses on the pump materials or even bursting.
The minimum flows indicated in section 6.2.5 refer to water and water-like liquids. Longer operating periods with these liquids 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 media handled are different from water, it is essential to check if an additional heat build-up may occur and if the minimum flow rate must therefore be increased. To check, proceed as described in section 6.2.5.
In addition, the instructions given in section 6 of this operating manual must be observed.

Both gland packings and mechanical seals may exceed the specified temperature limits if run dry. Dry running may not only result from an inadequately filled seal chamber, but also from excessive gas content in the medium handled.
Pump operation outside its specified operating range may also result in dry running.
In hazardous areas, gland packings shall only be used if combined with a suitable temperature monitoring device.

2.9.5 Temperature Limits

In normal pump operation, the highest temperatures are to be expected on 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 medium handled.
If the pump is heated, it must be ensured that the temperature classes stipulated for the plant are observed.
In the bearing bracket area, the unit surfaces must be freely exposed to the atmosphere.
In any case, responsibility for compliance with the specified product temperature (operating temperature) lies with the plant operator. The maximum permissible product temperature depends on the temperature class to be complied with.
The table below lists the temperature classes to EN 13463-1 and the resulting theoretical temperature limits of the medium handled. In stipulating these temperatures, any temperature rise in the shaft seal area has already been taken into account.

Temperature class to EN 13463-1:	Temperature limit of medium handled
T5	85 °C
T4	120 °C
T3	185 °C
T2	280 °C
T1	max. 400 °C *)

*) depending on material variant

Safety note:

Caution The permissible operating temperature of the pump in question is indicated on the data sheet. 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, the maximum permissible operating temperature must be enquired from the pump manufacturer.

Based on an ambient temperature of 40 °C and proper maintenance and operation, compliance with temperature class T4 is warranted in the area of the rolling element bearings. A special design is required for compliance with temperature class T6 in the bearing area. In such cases, and if ambient temperature exceeds 40 °C, contact the manufacturer.

2.9.6 Maintenance

Only a pump unit which is properly serviced and maintained in perfect technical condition will give safe and reliable operation.
This also applies to the reliable function of the rolling element bearings whose actual lifetime largely depends on the operating mode and operating conditions.
Regular checks of the lubricant and the running noises will prevent the risk of excessive temperatures as a result of bearings running hot or defective bearing seals (also see section 7.2.2.2).
The correct function of the shaft seal must be checked regularly. Any auxiliary systems installed must be monitored, if necessary, to make sure they function correctly.
Gland packings must be tightened correctly, to prevent excessive temperatures due to packings running hot.

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 lifting slings on the free shaft end of the pump or on the motor eyebolt.

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

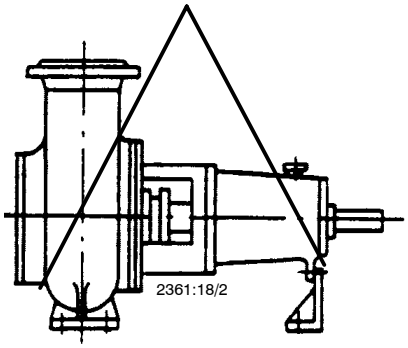


Fig. 3.1-1 Transport of the pump

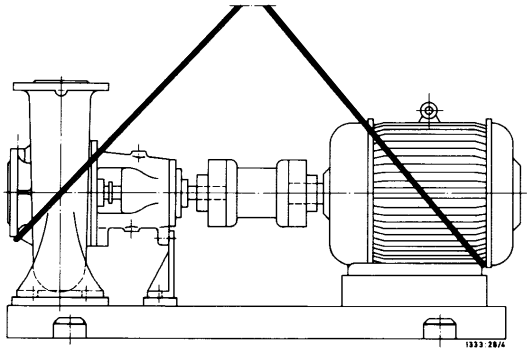


Fig. 3.1-2 Transport of the complete unit

3.2 Interim Storage (Indoors) / Preservation

When the unit is temporarily put into storage, only the wetted low alloy components (e.g. JL1040, JS1025, 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

Standardized chemical pumps handling aggressive, polymerizing media or media liable to form lumps as well as gas-containing liquids in the chemical and petrochemical industries.

4.2 Designation

CPK O - C M K 40 - 200

Type series
Open impeller
Material of wetted parts
Additional code
Discharge nozzle DN
Nominal impeller dia. in mm

Additional codes:
For materials refer to the data sheet.

F = Off-standard flange design
A = Mechanical seal with conical seal chamber, without circulation
M = Mechanical seal with internal or external circulation
K = Intensively cooled shaft seal chamber

4.3 Design Details

Horizontal, radially split volute casing pump in back pull-out design, with open impeller, single-entry, single-stage, in accordance with EN 22 858/ISO 2858/ISO 5199.
Complemented by pumps of DN 25.

4.3.1 Pump Casing

Radially split, consisting of volute casing and casing cover.

Double volute depending on the size.

The casing cover and the bearing bracket lantern form a chamber which can be used for heating or cooling with superheated steam or water.

For handling combustible media, the pump casing must be made of ductile material with a maximum magnesium content of 7.5 % (see EN 13463-1). This is a standard feature in all KSB supplies.

4.3.2 Impeller Form

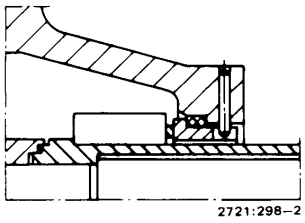
Open multi-vane impeller with multiply curved vanes. Axial thrust is balanced by means of back vanes.

4.3.3 Shaft Seal

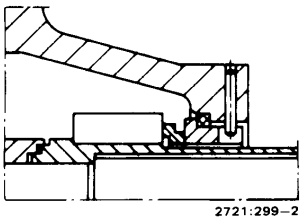
The shaft seal can be designed as a gland packing or a mechanical seal.
Conversion from gland packing to single-acting mechanical seal and vice versa is possible without any rework on the casing cover by using the relevant replacement parts.
Commercially available mechanical seals in single- and double-acting design can be used. We install standardized mechanical seals of various makes in accordance with EN 12 756 (DIN 24 296), L_1k design.
Single-acting mechanical seals may be fed with quench media.
Sealing against atmospheric influences is effected by means of a throttling bush, a shaft seal ring or a secondary mechanical seal.

Mechanical seal

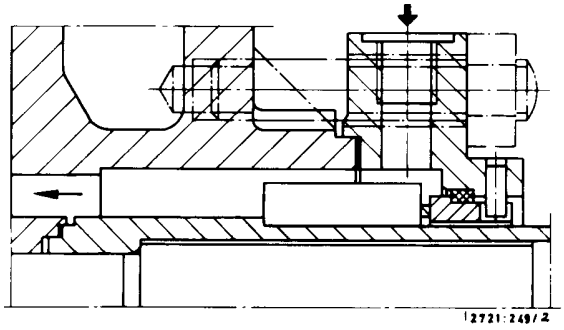
Arrangement drawing (example)



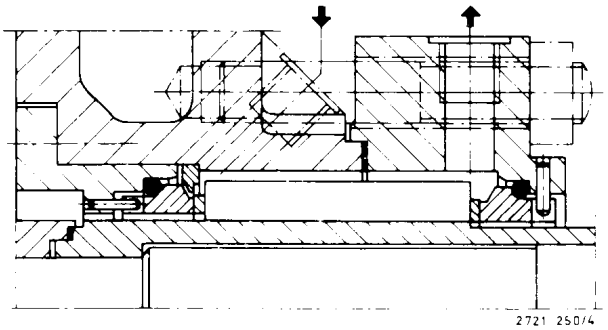
Shaft seal: single-acting, unbalanced standardized mechanical seal, short design, without circulation (additional code "A")



Shaft seal: single-acting, balanced standardized mechanical seal, short design, without circulation (additional code "A")



Shaft seal: single-acting mechanical seal, unbalanced



Shaft seal: double-acting mechanical seal, balanced on the atmospheric side.

For relevant installation drawing refer to the annex.

4.3.4 Bearings

4.3.4.1 Design Specifications

The shaft is supported by oil-lubricated rolling element bearings. The motor end bearing is a fixed bearing limiting the rotor's axial movement to max. 0.5 mm.
The pump end bearing is a radial bearing which can only absorb the radial load. It is always a cylindrical roller bearing.
The motor end bearing is designed as a paired angular contact ball bearing (P ...s, P ...as, depending on the operating conditions).

4.3.4.2 Bearing Bracket Designation

P 03 a s

Back pull-out bearing bracket
Size (refers to the dimensions of seal chamber and shaft end)
Reinforced (next bearing size)
Paired angular contact ball bearings (motor end)

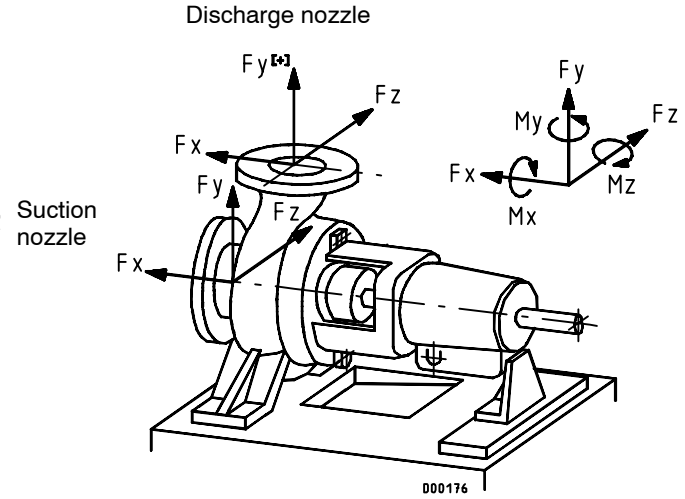
For the applicable bearing bracket design please refer to the data sheet.

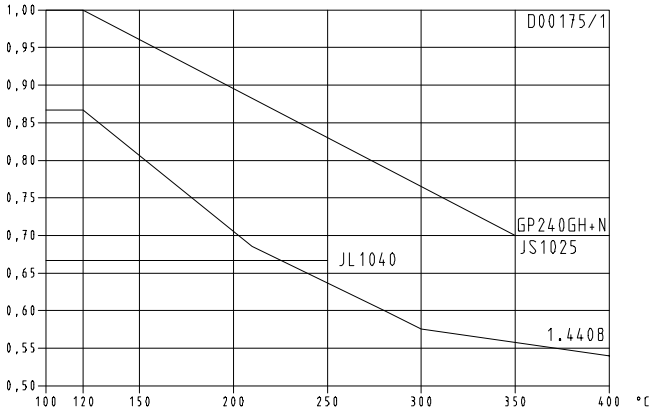
4.3.4.3 Bearings Used / Bearing Design

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

Bearing bracket	Rolling element bearings	
	Pump end 322.01	Motor end 320.02
P 02 s	NU 305	2 x 7206 BG
P 03 s	NU 307	2 x 7307 BG
P 04 s	NU 311	2 x 7311 BG8
P 05 s	NU 313	2 x 7313 BG8
P 02 as	NU 307	2 x 7307 BG
P 03 as	NU 311	2 x 7311 BG8
P 04 as	NU 313	2 x 7313 BG8
P 05 as	NU 413	2 x 7315 BG8

4.3.5 Permissible Forces and Moments at the Pump Nozzles (Pump Installation on Baseplate and Rigid Foundation)





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

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

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.
If temperatures exceed 120 °C, the values indicated must be reduced in accordance with the above diagram.

Pump sizes	Forces									Moments					
	Suction nozzle in N				Discharge nozzle N					Suction nozzle in Nm			Discharge nozzle in Nm		
	F_x	F_y	F_z	F_{res}	F_x	$F_{ytension}^-$	$F_{ypressure}^+$	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
32-125 -160 -200 -250	1350	900	1100	1400	700	450	850	550	900	700	550	350	450	350	250
40-160 -200 -250 -315	1750	1150	1400	1800	850	550	1100	700	1100	1150	850	600	550	450	300
50-160 -200 -250 -315	2150	1400	1700	2200	1100	700	1350	900	1400	1450	1100	750	700	550	350
65-160 -200 -250 -315	2700	1750	2150	2750	1400	900	1750	1150	1800	2000	1500	1000	1150	850	600
80-160 -200 -250 -315 -400	3700	2400	2950	3800	1700	1100	2150	1400	2200	2750	2100	1400	1450	1100	750
100-200	3700	2400	2950	3800	2150	1350	2700	1750	2800	2750	2100	1400	2000	1500	1000
200-315	10000	6700	8000	10450	5700	3550	7350	4700	7400	7500	5700	3650	5300	3850	2650

4.3.6 Noise Characteristics

Rated power input P_N (kW)	Sound pressure level $\overline{L}$ pA (dB) 1)2)					
	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	53.5	52.5	51.5	63.0	58.0	55.5
2.2	55.5	54.5	53.0	66.0	60.0	58.0
3.0	57.0	56.0	54.5	67.5	61.5	59.5
4.0	59.0	57.5	56.0	69.0	63.0	61.0
5.5	60.5	59.0	57.5	70.5	64.5	62.0
7.5	62.0	61.0	59.0	72.0	66.0	63.5
11.0	64.0	63.0	61.0	74.0	67.5	65.0
15.0	66.0	64.5	62.5	75.0	69.0	66.5
18.5	67.0	65.5	63.5	76.0	70.0	67.5
22.0	68.0	66.5	64.5	76.5	70.5	68.0
30.0	70.0	68.0	66.0	78.0	72.0	69.5
37.0	71.0	69.5	67.0	78.5	72.5	70.0
45.0	72.0	70.5	68.0	79.5	73.5	71.0
55.0	73.0	71.5	69.0	80.0	74.0	71.5
75.0	74.5	73.0	70.5	81.0	75.5	72.5
90.0	75.5	74.0	71.0	81.5	76.0	73.0
110.0	77.0	75.0	72.0	82.0	76.5	74.0
132.0	78.0	76.0	73.0	82.5	77.0	74.5
160.0	79.0	77.0	74.0	83.5	78.0	75.0
200.0	80.0	78.0	75.0	84.0	78.5	75.5
250.0	80.5	78.5	-	84.5	79.5	-

1) Measured at a distance of 1 m from the pump outline (as per DIN 45635 Part 1 and 24). Room and foundation influences have not been included. The tolerance for these factors is 1 to 2 dB.

2) Increase for 60 Hz operation
Pump without motor: ---
Pump with motor:
3500min^{-1}: +3dB, 1750min^{-1}: +1dB, 1160min^{-1}: --- dB

4.4 Accessories

Coupling: flexible coupling with / without spacer sleeve
Guard: coupling guard
Baseplate: (to ISO 3661) cast or welded for the complete unit (pump and motor); in torsion-resistant design

If a complete unit is supplied, coupling and coupling guard are provided by the supplier.
Special accessories: as required

4.5 Dimensions and Weights

For dimensions and weights please refer to the general arrangement drawing of the pump.

5 Installation at Site

5.1 Safety Regulations

Equipment operated in hazardous locations must comply with the relevant explosion protection regulations. This is indicated on the pump name plate and motor name plate (see 2.9).

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 / general arrangement drawing.
The concrete foundations shall have sufficient strength (min. class X0) 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 must be truly horizontal and even. The foundation bolts must be inserted in the baseplate holes.

5.3 Installing the Pump/Unit

The instructions given below refer to pump installation on a grouted baseplate and rigid foundation.
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 general arrangement drawing 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.

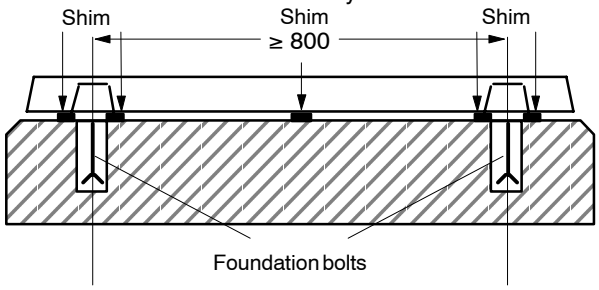


Fig 5.3-1 Fitting required shims

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.
The so-called "foundationless installation" on a baseplate and with horizontally flexible adjusting elements is permissible. For permissible forces and moments please refer to the general arrangement drawing of the pump.

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 realigned (at the motor), if required.
Prior to checking the alignment/realignment, loosen support foot 183 and re-tighten without transmitting any stresses or strains.
Coupling check and realignment 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 Figures 5.3-2 and 5.3-3).

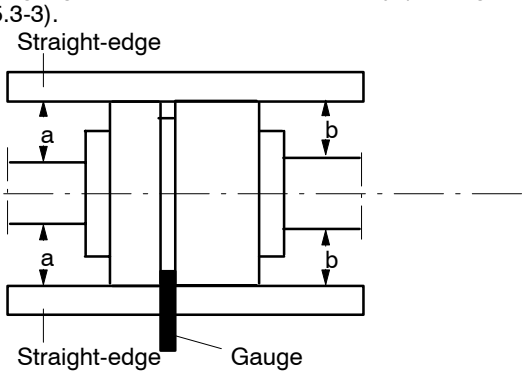


Fig. 5.3-2 Aligning the coupling with the help of a gauge and a straight-edge

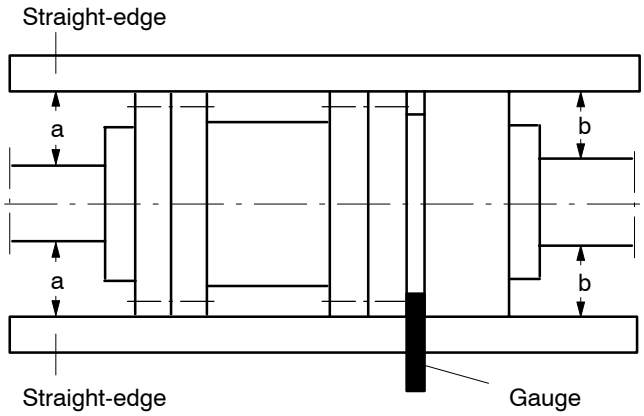


Fig. 5.3-3 Aligning a spacer-type coupling

The radial and axial deviation (tolerance) between the two coupling halves shall not exceed 0.1 mm.

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 realign 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.

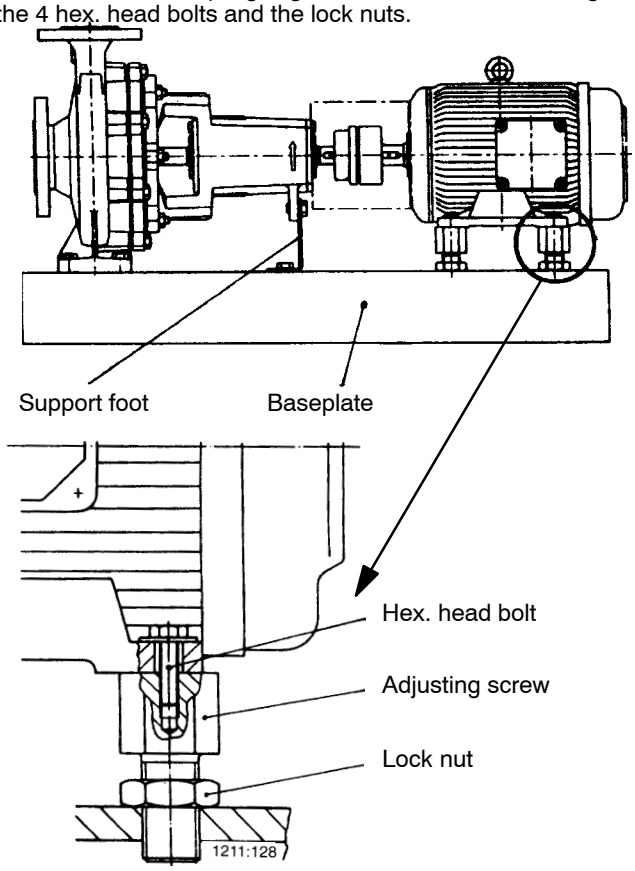


Fig. 5.3-4 Aligning the motor by means of adjusting screws

5.3.2 Place of Installation

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

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 must not be exceeded (see section 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 dimensions and locations of the auxiliary connections (cooling, heating, barrier liquid, flushing liquid, etc.) are indicated on the general arrangement drawing or piping layout.

Caution These connections are required for proper functioning of the pump and are therefore of vital importance!

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. In this case, it is important to make sure that the materials selected for coupling and coupling guard are non-sparking in the event of mechanical contact. KSB's scope of supply meets this requirement.

5.5 Final Check

Re-check the alignment as described in section 5.3 and verify the correct distance between the coupling and the coupling guard.

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 (motor protection switch).

In hazardous areas, compliance with IEC60079-14 is an additional requirement for electrical connection.

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.

If a constant-level oiler is provided, screw same into the upper tapping hole of the bearing bracket prior to adding the oil (see 6.1.1).

The operating data, the oil level, if required (6.1.1), and the direction of rotation (6.1.4) must have been checked. The pump set 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 connections (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

Oil-lubricated bearings

The bearing bracket has to be filled with lubricating oil. The quality of oil required is outlined in section 7.2.2.3 and the quantity in section 7.2.2.4.

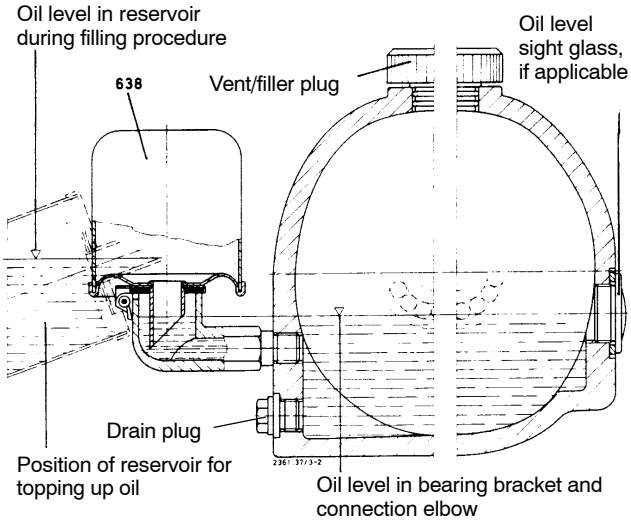


Fig. 6.1-1 Oil fill

Procedure:

Unscrew vent plug. Pour in the oil through the vent plug tapping hole after having hinged down the reservoir of the constant-level oiler until oil appears in the vertical portion of the connection elbow (see Fig. 6.1-1). Then fill the reservoir of the constant-level oiler with oil and snap it back into operating position. Screw vent plug in again. After a short time check whether the oil level in the reservoir has dropped. It is important to keep the reservoir properly filled at all times.

If access to the vent plug is difficult or impossible, e.g. in cases where the motor is arranged above the pump (piggy-back arrangement), the oil can be filled in through the connection elbow of the constant-level oiler.

Caution The oil level shall always be below the level of the vent opening arranged at the top edge of the connection elbow. For checking the oil level we recommend to slowly drain oil through the drain plug until the constant-level oiler starts to operate, i.e. until air bubbles can be seen in the oiler.

If no constant-level oiler is provided on the bearing bracket, make sure that the oil level reaches the centreline of the oil level sight glass arranged at the side of the bearing bracket.

6.1.2 Shaft Seal

Caution Mechanical seals are fitted prior to delivery.

On variants with quench supply tank, the tank must be filled in accordance with the general arrangement drawing.

On variants with double-acting mechanical seal, apply barrier pressure as specified in the general arrangement drawing prior to starting up the pump.

External supply requires application of the quantities and pressures specified in the data sheet and general arrangement drawing.

6.1.3 Priming the Pump and Checks to Be Carried out

Before start-up, the pump, suction line and (if applicable) the thermosiphon tank must be vented and primed. The shut-off element in the suction line must be fully open.

Fully open all auxiliary lines provided (flushing, barrier, cooling liquid, etc.) and check the throughflow.

For water cooling, use suitable non-aggressive cooling water not liable to form deposits and not containing suspended solids. (Hardness: on average 5; pH > 8, or conditioned and neutral with regard to mechanical corrosion).

Inlet temperature t_E = 10 to 30 °C

Outlet temperature t_A max. 45 °C

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

6.1.3.1 Cooling

Caution In general, the shaft seal must be cooled, if the vaporization pressure of the medium handled exceeds the atmospheric pressure.

Depending on the medium handled, the system pressure and the mechanical seal material, the limit may change (example: hot water).

Shaft seal cooling

Bearing bracket	Cooling liquid quantity in l/min at product temperatures			
	Standard design		"K" - Design	
	up to 250 °C	up to 400 °C	up to 250 °C	up to 400 °C
P 02 s/as	3	4	3	4
P 03 s/as	4	5	4	5
P 04 s/as	5	6	4	5
P 05 s/as	5	6	5	6

6.1.3.2 Heating (not on seal design "A")

If required, the space between discharge cover and bearing bracket lantern may be used as heating chamber and be supplied with hot water, steam or heat transfer oil, particularly in connection with internal circulation.

Design	Heating with			
	hot water / saturated steam		heat transfer oil	
	$t_{max.}$ in °C	$p_{max.}$ in bar	$t_{max.}$ in °C	$p_{max.}$ in bar
Standard design; lantern of JL1040 [1]; O-ring of EPDM	183	10	-	-
Lantern of JS1025 [2], profile joint of PTFE/alloyed steel	250	20	300	6
Welded casing cover	300	20	300	6

1) GJL-250 to EN 1561 2) GJS-400-18-LT to EN 1563

Caution Ⓔx Observe permissible temperature classes.

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. This can be verified by switching the pump 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 put your hands or any other objects into the pump.

Caution Ⓔx 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/motor coupling removed. If the pump is fitted with a gland packing, short start-up will not pose any risks.

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

The safety instructions set forth in section 2.9.3 must be complied with.

6.1.5 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.

6.1.6 Start-up Strainer

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.
For installation and monitoring, see additional instruction sheet.

6.1.7 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 slightly open shut-off valve. Only after the pump has reached full rotational speed shall the shut-off valve in the discharge line be opened slowly 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 Pump operation with the shut-off valves in the discharge and suction pipes closed is not permitted.
The permissible pressure and temperature limits might be exceeded. In extreme cases, the pump may burst.

Caution After the operating temperature has been reached and/or in the event of leakage, switch off the unit and re-tighten the bolts between lantern and casing.

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

6.1.8 Shutdown

Close the shut-off element in the discharge line.

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

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

Close the auxiliary lines but only turn off the cooling liquid supply (if applicable) after the pump has cooled down. The shaft seal in pumps where the liquid is fed in under vacuum must also be supplied with barrier liquid during standstill.

In the event of frost and/or prolonged shutdowns, the pump - and if applicable the cooling chambers - must be drained or otherwise protected against freezing.

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. Bearing bracket temperatures as described in section 7.2.1 must be observed.

The safety instructions set forth in section 2.9 must be complied with.

6.2.2 Switching Frequency

The start-up frequency usually depends on the max. temperature increase of the motor. It largely depends on the power reserves of the motor in steady-state operation and on the starting conditions (d.o.l., star-delta, moments of inertia, etc.)
For start-up with the discharge side gate valve slightly open, the following limits may be used for orientation. These limits are based on the assumption that start-ups are regularly spaced in the period indicated.

Motor rating (kW)	max. S (Start-ups/h)
up to 12	15
up to 100	10
above 100	5

If the above switching frequencies are exceeded, please contact the motor manufacturers or KSB.

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 and the shaft seal are to be expected. The intervals recommended for servicing and maintenance should 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

The data refer to water and water-like liquids. However, if the physical properties of the media handled are different from 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.

$$T_o = T_f + \Delta\vartheta$$

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

c	Specific heat	[J / kg K]
g	Acceleration due to gravity	[m/s²]
H	Pump head	[m]
T_f	Temperature of medium handled	[°C]
T_o	Temperature of casing surface	[°C]
η	Pump efficiency at duty point	[-]
$\Delta\vartheta$	Temperature difference	[°C]

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 rotor 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 specified in sections 7.1 to 7.4. Then apply appropriate preservatives:
   - Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative. Spray the preservative through the suction and discharge nozzles. It is advisable to close the nozzles (for ex. with plastic caps or similar).
   - If the pumps are out of service for more than 1 year, all elastomer seals 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.

Upon completion of the work, all safety-related and protective equipment must be properly refitted and/or reactivated before starting the pump set.

7 Maintenance / Repair

7.1 General Instructions

The operator is responsible for ensuring that all maintenance, inspection and installation work is carried out by authorized, duly qualified staff who are thoroughly familiar with these operating instructions.
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 to 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 to 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 element is not permitted. When running the pump with the discharge-side shut-off element slightly open for a short period, the permissible pressure and temperature values must not be exceeded.

A special design is required to comply with temperature class T6 in the bearing area. In such cases, and if ambient temperature exceeds 40 °C, contact the manufacturer. Verify correct oil level as described in section 6.1.1.

The shut-off elements and the auxiliary feed lines must not be closed during operation. Any stand-by pumps installed shall be switched on once a week to keep them operational.
Attention shall be paid to the correct functioning of the auxiliary lines. The cooling system must be thoroughly cleaned at least once a year to ensure proper cooling. Take the pump out of service for this purpose.

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

The rolling element bearings are lubricated with mineral oil. The lubricant change intervals as well as the required quantity and quality are specified below.

7.2.2.2 Oil Change (Operating Hours)

Temperature at the bearing	First oil change after ..... operating hours	All subsequent oil changes every .... operating hours
up to 70°C	300	8500 *)
70°C - 80°C	300	4200 *)
80°C - 90°C	300	2000 *)

1) at least once a year

Procedure:
Remove screwed plug below the constant-level oiler (oil level sight glass) and drain off the oil. After drainage of the bearing bracket, screw in the plug again and fill with fresh oil as described in section 6.1.1.

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

7.2.2.3 Oil Quality

Designation	Lubricating oil CLP 46 DIN 51 517 or HD 20W/20 SAE
Symbol to DIN 51 502	□
Kinematic viscosity at 40 °C Flash point (to Cleveland) Solidification point (pour point) Application temperature [1]	46 ±4 mm^2/s + 175 °C - 15 °C higher than permissible bearing temperature

1) For temperatures below -10 °C another suitable lubricating oil type must be used. Please contact KSB.

7.2.2.4 Oil Quantity

Bearing bracket	Oil quantity in l
P 02 s	0.2
P 02 as	0.3
P 03 s, P 03 as	0.5
P 04 s, P 04 as	0.5
P 05 s	1.5
P 05 as	1.2

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.

Use connections 6B to drain the pump set (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, secure the pump so as to make sure it cannot be switched on accidentally. The shut-off elements in the suction and discharge lines must be closed.

The pump must have cooled down to ambient temperature, it must be drained and its pressure must be released.

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 assembly drawing. The general assembly drawing and other relevant documents are found in the annex. The dismantling sequence can be derived from the general assembly drawing. In case of damage you can always contact our service departments.

7.4.2 Dismantling (General)

1. Drain the oil as described in 7.2.2.2.
2. Remove the coupling guard.
3. Dismantle the coupling spacer sleeve or, if not applicable, remove the drive. If required, refer to the additional sheet on couplings.
4. Disconnect and remove all auxiliary pipework.
5. Loop a rope tightly around the top stay of bearing bracket lantern 344.
6. Unscrew hex. head bolt 901.04 / socket head cap screw 914.04 on bearing bracket P 02s / P 02as with spring washer 930.01 and baseplate fixing bolts on support foot 183; remove the support foot.
7. Unscrew and remove hex. nuts 920.01 and pull complete bearing bracket 330 out of volute casing 102 together with shaft 210, impeller 230 and bearing bracket lantern 344 using forcing screws 901.31. Clean the screw threads beforehand.
8. Unscrew impeller nut 922 with thread insert (right-hand thread) and remove joint ring 411.31. Pull off impeller 230 and remove key 940.01.
9. Remove hex. nuts 920.02 and push back seal cover 471.01 until it abuts against thrower 507.01.
10. Remove casing cover 161 with O-ring 412.01.
11. Pull the complete mechanical seal assembly with shaft protecting sleeve off the shaft.
    For dismantling of mechanical seal please refer to the supplementary sheet. Make sure not to damage discs 550.12 on the shaft or shaft protecting sleeve!
12. Unscrew hex. nuts 920.04 at the flange of bearing bracket lantern 344 and remove the bearing bracket lantern with drip pan 648.
13. After having unscrewed the socket head cap screw in the coupling hub pull the coupling half off the pump shaft using a pull-off device and remove key 940.02.
14. Dismantle bearing covers 360.01 and 360.02 at the pump and drive end respectively.
15. Carefully pull out shaft 210 together with angular contact ball bearing 320.02 and the inner race of cylindrical roller bearing 322.01 towards the drive end.
16. Remove support disc 550.23. Inspect condition of circlips 932.01/.02. Remove cylindrical roller bearing 322.01 (roller cage) from the bearing bracket.
17. Bend back lockwasher 931.01, unscrew keywayed nut 920.21 (right-hand thread), remove lockwasher.
18. Heat up angular contact ball bearing 320.02 and the inner race of cylindrical roller bearing 322.01 and pull them off the shaft.
19. Clean all the components and examine them for signs of wear. Touch up the damaged components or replace them 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. Verify the dimensions given in section 7.5.5. Damaged or worn components are to be replaced by **original spare parts**.

Make sure that the seal faces are clean and that O-rings and gaskets are properly fitted.

It is recommended to 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 material 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 should 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!** Never use O-rings that have been glued together from material sold by the metre.

Caution Do not coat O-ring 412.01 with graphite or similar products. Use animal fats or silicone-base or PTFE-base lubricants instead.

The locating surfaces of the individual components shall 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 assembly drawing and the list of components for orientation.

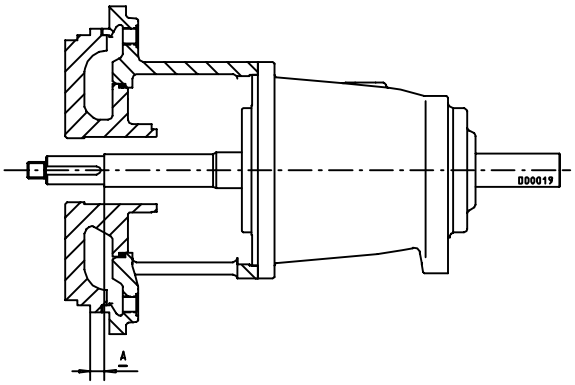
All screws and bolts must be properly tightened during assembly. For the required torques please refer to sections 7.5.3.1 and 7.5.3.2.

1. Use only the bearing types and sizes specified in section 4.3.4. Angular contact ball bearing 320.02 and the inner race of cylindrical roller bearing 322.01 must be heated up in an oil bath to approx. 80 °C before slipping them onto the shaft until they abut against the shaft shoulder.

   Caution The 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.
After having mounted angular contact ball bearings 320.02, screw on and tighten keywayed nut 920.21 using a C-wrench and without fitting lockwasher 931.01. Let the ball bearing cool down to approx. 5 °C above ambient temperature.
Re-tighten the keywayed nut, then unscrew it again. Put a few spots of Molykote on the contact faces of the lockwasher and of the keywayed nut, slip on the lockwasher, firmly tighten the keywayed nut and bend over the lockwasher.

2. When mounting bearing covers 360.01/.02, take care not to damage lip seals 421.01/.02.
3. The suction-side impeller clearance shall be adjusted as follows:
   - Place casing cover 161 into bearing bracket lantern 344.
   - Measure dimension A in accordance with fig. 7.2-1
   - Compare the actual dimension A with the required dimension A as specified in the table (fig. 7.2-1) and compensate the difference using discs 550.12.
4. Mount the mechanical seal as described in the supplementary sheet. Also observe the instructions in section 7.5.4.
   Check the sliding fit of the shaft protecting sleeve on the shaft.
5. Carefully insert the impeller joint ring making sure the ring and sealing surfaces are clean.
6. After installation in the pump casing which has remained in the piping, the coupling alignment shall be checked as described in section 5.3.1.
7. Fill in oil as described in section 6.1.1



Bearing bracket	Pump size	Dimension A
P 02 s, as	25-160 25-200 32-125 32-160 32-200 40-160 40-200 50-160 50-200	11.9
P 03 s, as	65-160 65-200 80-160 80-200 100-200	18.9
	32-250 40-250 40-315 50-250 50-315 65-250 80-250	12.9
P 04 s, as	65-315 80-315 80-400	15.9
P 05 s, as	200-315	13.3

Fig. 7.2-1 Dimension A for adjusting the impeller clearance

7.5.3 Tightening Torques

7.5.3.1Tightening Torques of the Impeller Nut

Impeller nut 922 shall be tightened with the following torques:

Bearing bracket	Tightening torque Nm	Wrench size mm
P 02, P 02s, P 02as	55	22
P 03, P 03s, P 03as	125	27
P 04, P 04s, P 04as	200	32
P 05, P 05s, P 05 as	300	41

The impeller nut must be re-tightened some 20 to 30 minutes after installation.

7.5.3.2 Tightening Torques for Screwed Connections

The screwed connections (part No. 902.01/920.01) between the volute casing and the bearing bracket lantern must be tightened using a torque wrench.
Only use the torques given in the table. These values are determined on the basis of a friction coefficient $\mu = 0.12$[1)].
Max. permissible tightening torques[2)] in Nm for studs to DIN 938/939 with hex. nuts to ISO 4032.

Material stud/hex. nut	C35E+QT/C 35 [3)]			A4-70/A4-70		
Stamp mark on stud/hex. nut	YK / Y [3)]			A4-70/A4-70		
	Tightening torques Nm					
Thread		- 15%	- 20%		- 15%	- 20%
M 10	-	-	-	30	25.5	24
M 12	40	34	32	55	46.7	44
M 16	100	85	80	155	131.7	124
M 20	-	-	-	200	170.0	160

Material stud/hex. nut	1.7709+QT/1.7258+QT					
Stamp mark on stud/hex. nut	GA / G					
	Tightening torques Nm					
Bearing bracket lantern [4)]	A	B	A	B	A	B
Thread			- 15%		- 20%	
M 10	47	30	39.9	25.5	37.6	24
M 12	80	55	68.0	46.7	64.0	44
M 16	190	155	161.5	131.7	152.0	124
M 20	330	200	280.5	170.0	264.0	160

1) Applicable to the initial tightening of brand-new threads.
2) After repeated tightening of the threads and in case of good lubrication the values should be reduced by 15 to 20 % (see table -15%, -20 %).
3) Unstamped screwed connections are to be treated as material combination C35E+QT/C 35.
4) Bearing bracket lantern A - of toughened material - except for JL1040.
Bearing bracket lantern B - material JL1040.

The values given in the table do not apply, if general assembly drawings or other instructions state different values.

7.5.4 Mounting the Mechanical Seal

The following rules must be observed when mounting the mechanical seal:
Extreme care and cleanliness during assembly are of overriding importance for trouble-free operation of the mechanical seal.
The protective wrapping of the contact faces shall only be removed immediately before assembly takes place.
After inserting the seat ring, check whether it is plane-parallel in relation to the casing part.
The surface of the shaft protecting sleeve must be absolutely clean and smooth, and the sleeve's mounting edge must be chamfered.
When sliding the rotating unit onto the shaft protecting sleeve, take appropriate steps to protect the shaft protecting sleeve's surface from damage.
On pumps with double-acting mechanical seal the mechanical seal chamber must be properly vented and the required pressure specified in the general assembly drawing must be applied (also during standstill).
Quench liquid supply must also be ensured during pump standstill.

7.6 Spare Parts Stock

When ordering spare parts please always quote the following data stated on the pump name plate:

Type series:	here CPKO
Pump size:	
Works No.:	

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	1	2	2	2	20%
230	Impeller	1	1	1	2	2	2	20%
320.02	Angular contact ball bearing (set)	1	1	2	2	2	3	25%
322.01	Cylindrical roller bearing	1	1	2	2	2	3	25%
433	Mechanical seal, complete	1	1	2	2	2	3	25%
	Mechanical seal: or							
	Mechanical seal: Spring-loaded ring	2	3	4	5	6	7	90%
	Mechanical seal: Seat ring	2	3	4	5	6	7	90%
	Mechanical seal: Secondary seal at spring-loaded ring	2	3	4	5	7	9	100%
	Mechanical seal: Secondary seal at seat ring	2	3	4	5	7	9	100%
	Mechanical seal: Spring (set)	1	1	1	1	2	2	20%
524.01	Shaft protecting sleeve	2	2	2	3	3	4	50%
---	Gaskets for pump casing (set)	4	6	8	8	9	12	150%
---	Torque-transmitting coupling elements (set)	1	1	2	2	3	4	30%

7.6.2 Interchangeability of Pump Components

		Description	Volute casing 1)	Casing cover	Support foot	Shaft 2)	Impeller 1)	Angular contact ball bearing 2)	Cylindrical roller bearing 2)	Lagerträger 2)	Bearing bracket lantern	Mechanical seal	Seal cover	Thrower	Shaft protecting sleeve	Drip pan	Guard	Impeller nut
Bearing bracket	Pump size	Part No.	102	161	183	210	230	320.02	322.01	330	344	433	471.01	507.01	524.01	648	680	922
P 02 s, P 02 as	25-160			2	2						2							
	25-200			3	3						3							
	32-125			1	1						1							
	32-160			2	2						2							
	40-160			2	2	1		1[1)]	1	1	2	1	1	1	1	1	1	1
	50-160			2	3						2							
	32-200			3	3						3							
	40-200			3	3						3							
	50-200			3	3						3							
P 03 s, P 03 as	65-160			4	4						4							
	80-160			4	5						4							
	65-200			5	5						5							
	80-200			5	5						5							
	100-200			5	6						5							
	32-250			6	5	2		1[1)]	1	2	6	2	2	2	2	2	2	2
	40-250			6	5						6							
	50-250			6	5						6							
	65-250			6	6						6							
	80-250			6	7						6							
	40-315			7	6						7							
	50-315			7	7						7							
P 04 s, P 04 as	65-315			9	8						7							
	80-315			9	9	3		2[1)]	2	3	7	3	3	3	3	2	3	3
	80-400			10	10						8							
P 05 s P 05 as	200-315			11	11	4		3[1)]	3	4	9	4	4	4	4	3	4	4

The components featuring the same number in a column are interchangeable.

1) Components cannot be used for other pump sizes

2) For identical bearing design

8 Trouble-shooting

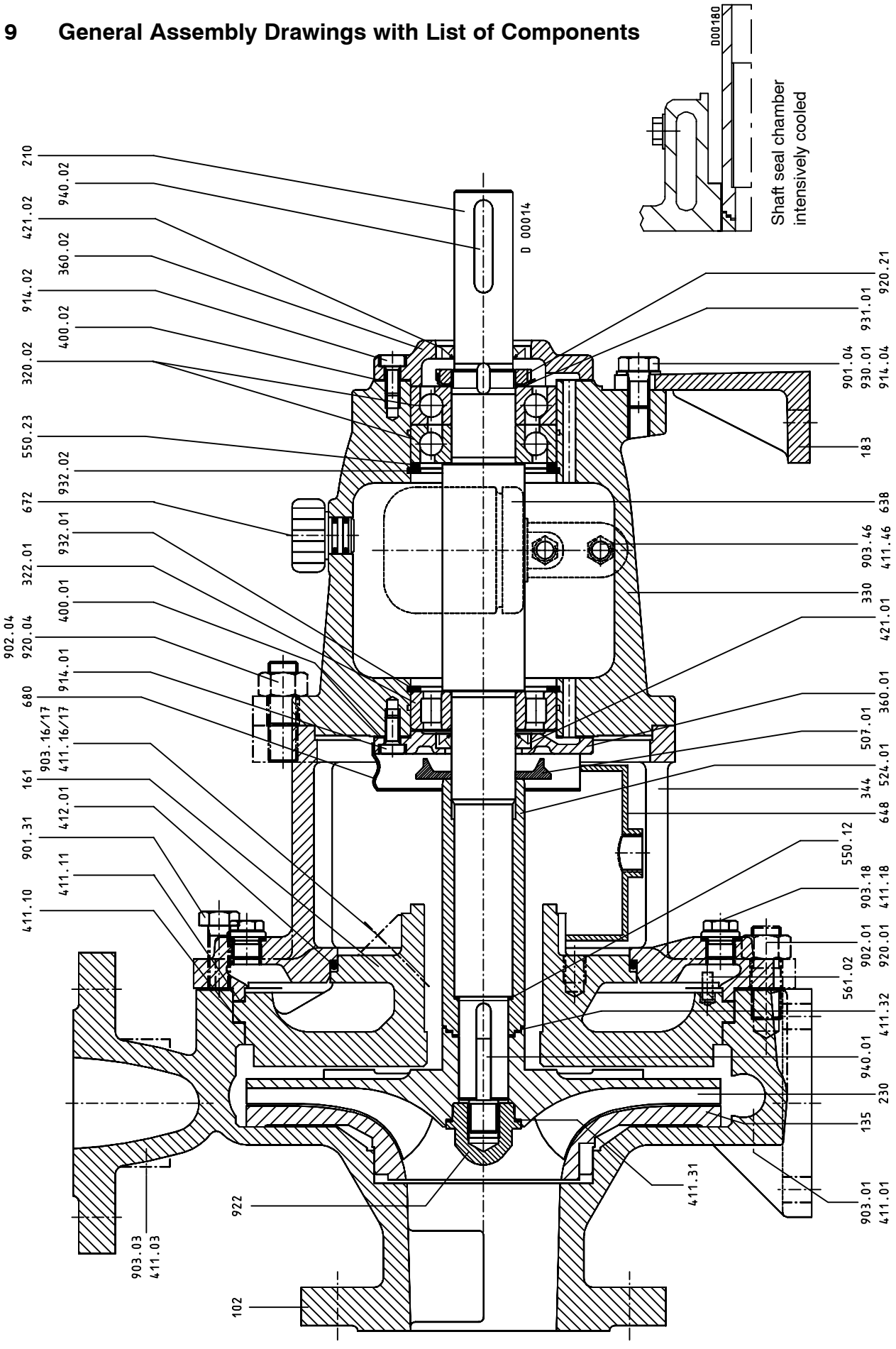
Pump delivers insufficient flow rate	Motor is overloaded	Excessive pump discharge pressure	Increase in bearing temperature	Leakage at the pump	Excessive leakage at the shaft seal	Vibrations during pump operation	Excessive rise of temperature inside the pump	Cause	Remedy [1]
*								Pump delivers against 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.
*								Wrong direction of 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 the speed [2].
				*				Tie bolts/seals and gaskets.	Tighten the bolts. Fit new seals and gaskets.
					*			Worn shaft seal.	Fit new shaft seal.
*					*			Score marks or roughness on shaft protecting sleeve.	Fit new shaft protecting sleeve. Fit new shaft seal/check the balancing line. Check throttling bush/throttling sleeve clearances.

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

Pump delivers insufficient flow rate	Motor is overloaded	Excessive pump discharge pressure	Increase in 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]
					*			Lack of cooling liquid or dirty cooling chamber.	Increase cooling liquid quantity. Clean out cooling chamber. Purify/clean cooling liquid.
					*			Stuffing box ring, cover plate, seal cover have been tightened incorrectly; wrong packing material.	Correct.
					*			Vibrations during pump operation.	Improve suction conditions. Re-align the pump. Re-balance the impeller. Increase the 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 general arrangement drawing.
	*							Operating voltage is too low.	Increase the voltage.
						*		Rotor is out of balance.	Clean the impeller. Re-balance the impeller.

1) The pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

9 General Assembly Drawings with List of Components



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

Part No.	Description	Scope of supply
102	Volute casing	with joint ring 411.01/.03/.10, stud 902.01, screwed plug 903.01/.03, hex. nut 920.01
135	Wear plate	
161	Casing cover	with joint ring 411.11/.16/.17, O-ring 412.01, drip plate 463.01, disc 550.01, stud 902.02, screwed plug 903.16/.17, hex. nut 920.02
183	Support foot	with hex. head bolt 901.04[1)] , spring washer 930.01
210	Shaft	with set of discs 550.12, keywayed nut 920.21, lockwasher 931.01, key 940.01/.02
230	Impeller	with joint ring 411.32
320.02	Angular contact ball bearing	
322.01	Cylindrical roller bearing	
330	Bearing bracket	
330	Bearing bracket (complete)	with bearing cover 360.01/.02, gasket 400.01/.02, joint ring 411.46, lip seal 421.01/.02, suppport disc 550.23, constant-level oiler 638, vent plug 672, screwed plug 903.46, hex. socket head cap screw 914.01/.02, circlip 932.01/.02
344	Bearing bracket lantern	with joint ring 411.18, O-ring 412.01, parallel pin 561.02, screwed plug 903.18, stud 902.04, hex. head bolt 901.31, hex. nut 920.04
360.01/.02	Bearing cover	with gasket 400.01/.02, hex. socket head cap screw 914.01/.02
421.01/.02	Lip seal	
433	Mechanical seal [2)]	
463.01	Drip plate	
471.01 [2)]	Seal cover	with joint ring 411.15, grooved pin 561.03
507.01	Thrower	
524.01	Shaft protecting sleeve	with joint ring 411.32
638	Constant-level oiler	
648	Drip pan	
680	Guard	
922	Impeller nut	with joint ring 411.31

1) on bearing brackets P 02a / P 02as / P 04as: socket head cap screw 914.04

2) not shown in drawing

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KSB Aktiengesellschaft
P.O. Box 1361, 91253 Pegnitz • Bahnhofplatz 1, 91257 Pegnitz (Germany)
Tel. +49 9241 71-0 • Fax +49 9241 71-1791 • www.ksb.com