Hot Water Recirculation Pump

HPH

Installation/Operating Manual

UK CA

KSB

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Installation/Operating Manual HPH

Original operating manual

Contents

Glossary

Back pull-out design

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

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

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

Discharge line

The pipeline which is connected to the discharge nozzle

Hydraulic system

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

Pool of pumps

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

Pump

Machine without drive, additional components or accessories

Pump set

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

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

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1 General

1.1 Principles

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

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

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

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

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance. (⇨ Section 7.5.5, Page 64)

1.3 Target group

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

1.4 Other applicable documents

Table 1: Overview of other applicable documents

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

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

1.5 Symbols

Table 2: Symbols used in this manual

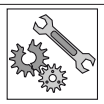
Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇨	Cross-references

1 If included in agreed scope of supply

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

1.6 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

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

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2 Safety

DANGER

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

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

2.1 General

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

2.2 Intended use

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

2.3 Personnel qualification and training

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

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

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

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

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

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

2.5 Safety awareness

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

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

2.6 Safety information for the operator/user

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

2.7 Safety information for maintenance, inspection and installation

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

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- When taking the pump set out of service always adhere to the procedure described in the manual. (⇨ Section 6.3, Page 42)
- Decontaminate pumps which handle fluids posing a health hazard. (⇨ Section 7.3, Page 51)
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇨ Section 6.1, Page 34)

2.8 Unauthorised modes of operation

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

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

2.9 Explosion protection

DANGER

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

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

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

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

2.9.1 Marking

Pump

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

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

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

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

Shaft coupling

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

Motor

The motor must be considered separately.

2.9.2 Temperature limits

In normal pump operation, the highest temperatures are to be expected at the surface of the pump casing, at the shaft seal and in the bearing areas.
The surface temperature at the pump casing corresponds to the temperature of the fluid handled. If the pump is heated in addition, the operator of the system is responsible for observing the specified temperature class and fluid temperature (operating temperature).

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

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

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

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

Table 4: Temperature limits

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

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

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

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

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

2.9.3 Monitoring equipment

The pump (set) must only be operated within the limits specified in the data sheet and on the name plate.
If the system operator cannot warrant compliance with these operating limits, appropriate monitoring devices must be used.
Check whether monitoring equipment is required to ensure that the pump set functions properly.

Contact KSB for further information about monitoring equipment.

2.9.4 Operating limits

The minimum flow rates indicated in (⇨ Section 6.2.3.1, Page 41) refer to water and water-like fluids handled. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures at the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check whether an additional heat build-up may occur and if the minimum flow rate must therefore be increased. The calculation formula in (⇨ Section 6.2.3.1, Page 41) can be used to check whether an additional heat build-up may lead to a dangerous temperature increase at the pump surface.

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2 Subject to further limitations for mechanical seal temperature rise

3 Depending on the material variant

3 Transport/Storage/Disposal

3.1 Checking the condition upon delivery

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

3.2 Transport

DANGER

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

Danger to life from falling parts!

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

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

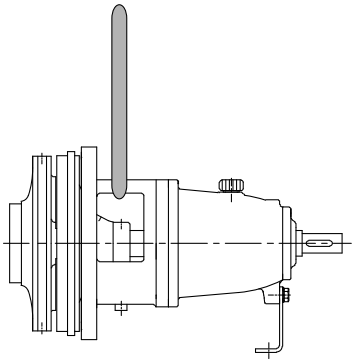

Fig. 1: Transporting the back pull-out unit

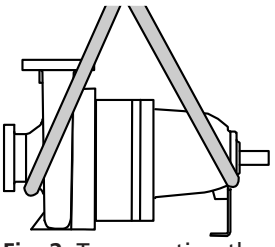

Fig. 2: Transporting the pump

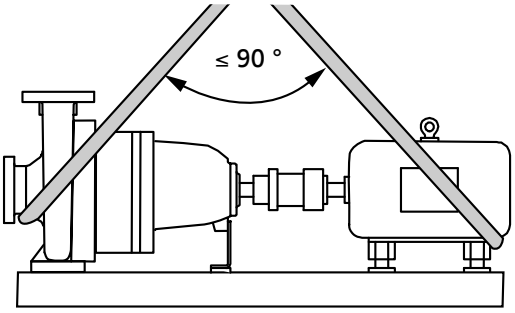

Fig. 3: Transporting the pump set

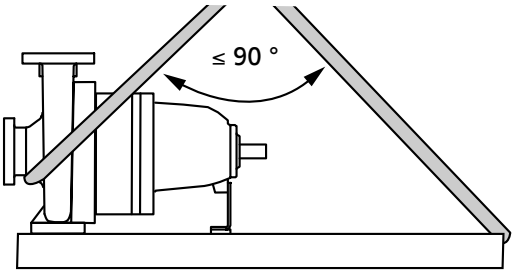

Fig. 4: Transporting the pump on the baseplate

3.3 Storage/preservation

CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of pump (set)!

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

CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

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

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

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

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

For storing a pump (set) which has already been operated, the shutdown measures must be adhered to. (⇨ Section 6.3.1, Page 42)

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇨ Section 7.3, Page 51)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
   Indicate any safety measures and decontamination measures taken.
   (⇨ Section 11, Page 79)

NOTE

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

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3.5 Disposal

⚠ WARNING

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

Hazard to persons and the environment!

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

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

4 Description of the Pump (Set)

4.1 General

Pump for handling hot water in high-pressure hot water generation plants.

For use as feed and circulation pump.

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

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

4.3 Designation

Example: HPH 50 - 200 F

Table 5: Key to the designation

Code	Description
HPH	Type series
50	Nominal discharge nozzle diameter [mm]
200	Nominal impeller diameter [mm]
F	Special design e.g. F= special flange design

4.4 Name plate

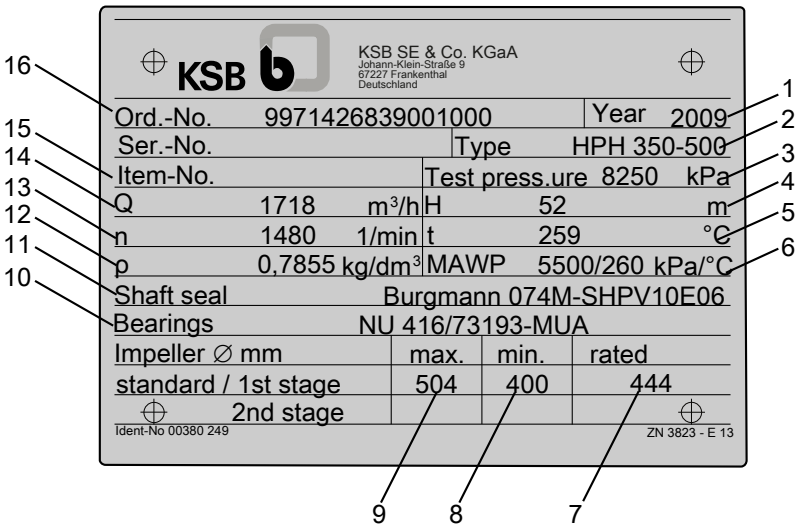

Fig. 5: Name plate (example)

1	Year of construction	2	Type series, size
3	Test pressure	4	Head
5	Application temperature	6	Maximum application pressure @ temperature
7	Impeller diameter installed	8	Minimum impeller diameter
9	Maximum impeller diameter	10	Bearings
11	Shaft seal	12	Density of the fluid handled
13	Rated speed	14	Flow rate
15	Item number	16	KSB order number

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4.5 Design

Design

- Volute casing pump
- Back pull-out design
- Horizontal installation
- Single-stage
- Technical requirements to ISO 5199

Pump casing

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

Impeller type

- Closed radial impeller with multiply curved vanes

Bearings

Drive end:

- Fixed bearing
- On pumps with reinforced bearing assembly: paired angular contact ball bearing
- Axial movement of the rotor limited to 0.5 mm maximum
- Oil lubrication

Pump-end:

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

4.6 Bearings

Bearing bracket designation

Example: P06as/atk

Table 6: Bearing bracket designation

Code	Description
P	Back pull-out bearing bracket
04	Size code (based on dimensions of seal chamber and shaft end)
a	Reinforced (next bearing size up)
s	Paired angular contact ball bearings (motor end)
t	Paired angular contact ball bearings in tandem/O-arrangement (motor-end)
k	Cooled bearings

Refer to the data sheet to find your bearing design.

Bearings used

Table 7: Bearing design

Sizes	Bearing bracket	Rolling element bearing	
		Pump end	Motor end
050-200	P02as	NU307	2 x 7307 B.G
080-200			
100-200	P03s P03as	NU307 NU311	2 x 7307 B.G 2 x 7311 B.G.8
040-250			

Sizes	Bearing bracket	Rolling element bearing	
		Pump end	Motor end
080-250	P03s P03as	NU307 NU311	2 x 7307 B.G 2 x 7311 B.G.8
100-250	P04s P04as	NU311 NU313	2 x 7311 B.G.8 2 x 7313 B.G.8
150-250			
080-315			
100-315			
050-400			
150-315	P06s P06as P06atk	NU413 NU416	2 x 7315 B.G.8 2 x 7319 B.G 3 x 7319 B.U.A
200-250			
200-315			
200-316			
200-400			
250-316			
200-401			
250-401			
200-501			
250-501			
300-400			
350-400			
300-500	B07	NU324	2 x 7324 B.G
350-500			
300-630			
400-504			

Table 8: Reinforced bearing assembly with reinforced thrust bearing

Bearing bracket	Rolling element bearing	
	Pump end	Motor end
P02as	NU307	2 x 7307 B.G
P03as	NU311	2 x 7311 B.G.8
P04as	NU313	2 x 7313 B.G.8
P05as	NU413	2 x 7315 B.G.8
P06as	NU416	2 x 7319 B.G

Table 9: Bearing design

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

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4.7 Design and function

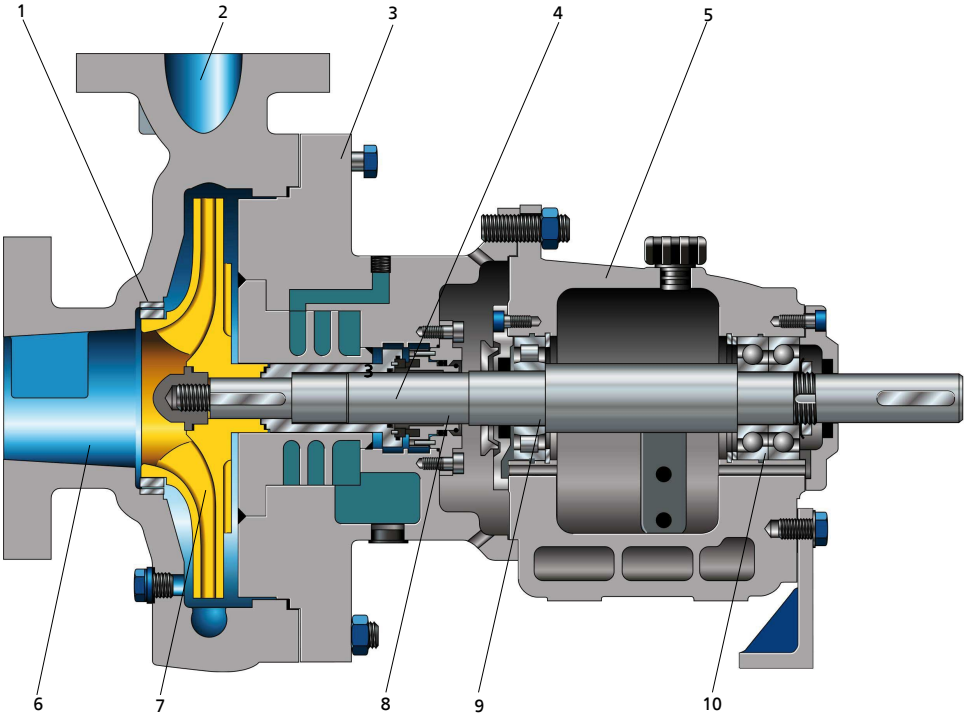

Fig. 6: Sectional drawing of an HPH

1	Clearance gap	2	Discharge nozzle
3	Bearing bracket lantern	4	Shaft
5	Bearing bracket	6	Suction nozzle
7	Impeller	8	Shaft seal
9	Rolling element bearing	10	Rolling element bearing

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

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

Sealing The pump is sealed by a mechanical seal.

4.8 Noise characteristics

Table 10: Surface sound pressure level L_{pA} [4) 5)]

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

4.9 Scope of supply

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

- Pump

Drive

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

Coupling

- Flexible coupling with or without spacer

Contact guard

- Coupling guard

Baseplate

- Baseplate (to ISO 3661), cast or welded, for pump and motor, in torsion-resistant design

Special accessories

- As required

Pump sets are supplied by KSB with coupling, coupling guard and baseplate.

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

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

4.10 Dimensions and weights

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

5 Installation at Site

5.1 Checks to be carried out prior to installation

Place of installation

⚠ WARNING

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

Personal injury and damage to property!

- ▷ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XS1 to EN 206 .
- ▷ The mounting surface must be set, even, and level.
- ▷ Observe the weights indicated.

1. Check the structural requirements.
   All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

5.2 Setting up the pump set

Always install the pump set in horizontal position.

⚠ DANGER

Excessive temperatures due to improper installation

Explosion hazard!

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

⚠ DANGER

Electrostatic charging due to insufficient potential equalisation

Explosion hazard!

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

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5.2.1 Installation on the foundation

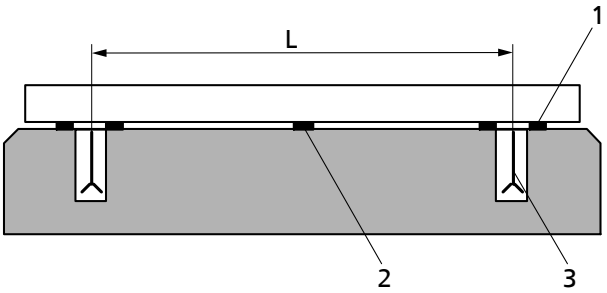

Fig. 7: Fitting the shims

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

✓ The foundation has the required strength and characteristics.

✓ The foundation has been prepared in accordance with the dimensions given in the outline drawing/general arrangement drawing.

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

NOTE

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

NOTE

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

5.2.2 Installation on a foundation

The position, type and number of flexible elements are determined by the weight and centre of gravity of the complete pump set under consideration of piping forces and pump speed.

CAUTION

Impact of seawater and mineral oil

Rubber elements will be destroyed!

▷ Cover rubber elements with protective coating or protective film.

NOTE

Flexible elements require sufficient room for expansion.

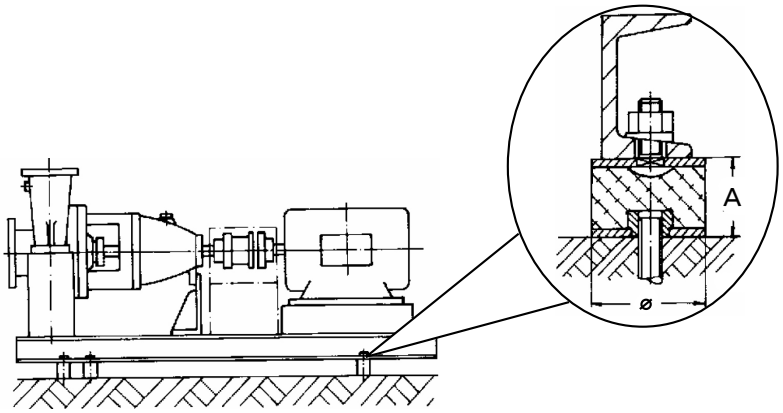

Fig. 8: Installation on rubber-metal elements or springs

A	Height of installed pump set

✓ Place the baseplate on the flexible elements.

1. Fasten the elements to the baseplate.
2. Mark and drill foundation boreholes.
3. Screw the pump set to the foundation.

5.3 Piping

5.3.1 Connecting the piping

⚠ DANGER

Impermissible loads acting on the pump nozzles

Danger to life from leakage of hot fluids!

- ▹ Do not use the pump as an anchorage point for the piping.
- ▹ Anchor the pipes in close proximity to the pump and connect them properly without transmitting any stresses or strains.
- ▹ Observe the permissible forces and moments at the pump nozzles. (⇨ Section 5.3.2, Page 26)
- ▹ Take appropriate measures to compensate for thermal expansion of the piping.

CAUTION

Incorrect earthing during welding work at the piping

Destruction of rolling element bearings (pitting effect)!

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

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NOTE

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

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
- ✓ A flow stabilisation section having a length equivalent to at least twice the diameter of the suction flange has been provided upstream of the suction flange.
- ✓ The nominal diameters of the pipes are equal to or greater than the nominal diameters of the pump nozzles.
- ✓ Adapters to larger nominal diameters are designed with a diffuser angle of approx. 8° to avoid excessive pressure losses.
- ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.

1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).
2. Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump.

CAUTION

Welding beads, scale and other impurities in the piping

Damage to the pump and shaft seal!

- ▷ Fit a differential pressure gauge.
- ▷ Remove any impurities from the piping.
- ▷ If required, fit a filter or clean the strainer.

3. If required, install a filter in the piping (see drawing: Filter in the piping).

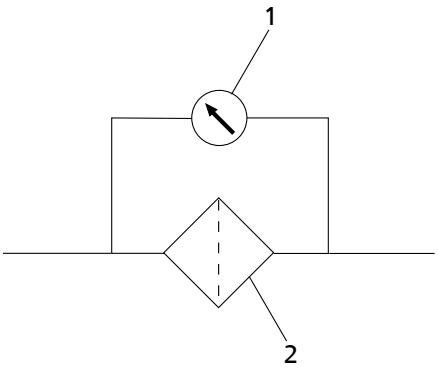


Fig. 9: Filter in the piping

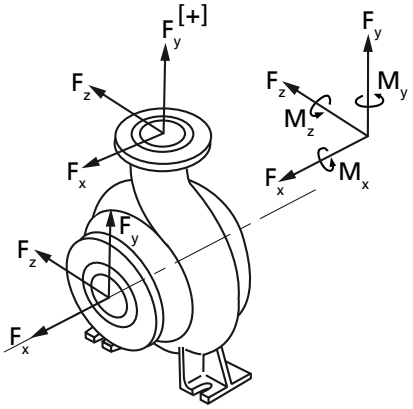
1	Differential pressure gauge	2	Filter

NOTE

Use a filter with laid-in wire mesh (mesh width 0.5 mm, wire diameter 0.25 mm) of corrosion-resistant material.
Use a filter with a filter area three times the cross-section of the piping.
Conical filters have proved suitable.

4. Connect the pump nozzles to the piping.

5.3.2 Permissible forces and moments at the pump nozzles



The permissible resultant forces have been determined according to:

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

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

Forces and moments at the pump nozzles

The data on forces and moments apply to static piping loads only. If the limits are exceeded, they must be checked and verified.
If a computerised strength analysis is required, values are available on request only.
The values are only applicable if the pump is installed on a completely grouted baseplate and bolted to a rigid and level foundation.

Table 11: Forces and moments at the pump nozzles

Sizes	Suction nozzle [N]				Discharge nozzle [N]					Suction nozzle [Nm]			Discharge nozzle [Nm]		
	F_x	F_y	F_z	F_{res}	F_x	$F_{yTens}+$	$F_{yCompr}-$	F_z	F_{res}	M_x	M_y	M_z	M_x	M_y	M_z
040-250	1800	1200	1400	1800	1150	700	1400	900	1500	1100	800	500	600	600	400
050-200	2850	1900	2280	2900	1400	900	1800	1150	1850	1900	1450	1000	1050	800	500
080-200	3600	2300	2850	3700	2300	1400	2850	1900	3000	2650	2000	1350	1900	1450	1000
080-250	3600	2300	2850	3700	2300	1400	2850	1900	3000	2650	2000	1350	1900	1450	1000
080-315	3600	2300	2850	3700	2300	1400	2850	1900	3000	2650	2000	1350	1900	1450	1000
100-200	6200	4100	5000	6450	2850	1800	3600	2300	3700	4600	3550	2350	2650	2000	1350
100-250	6200	4100	5000	6450	2850	1800	3600	2300	3700	4600	3550	2350	2650	2000	1350
100-315	6200	4100	5000	6450	2850	1800	3600	2300	3700	4600	3550	2350	2650	2000	1350
150-250	9800	6200	7600	9800	5000	3100	6200	4100	6450	7050	5150	3550	4600	3550	2350
150-315	9800	6200	7600	9800	5000	3100	6200	4100	6450	7050	5150	3550	4600	3550	2350
200-250	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
200-315	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
200-316	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
200-400	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
200-401	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
200-501	13350	8900	10700	13900	7600	4700	9800	6200	9800	10050	7600	4900	7050	5150	3550
250-316	16000	10700	13350	17100	10700	6700	13350	8900	13900	12200	9200	6000	10050	7600	4900
250-401	16000	10700	13350	17100	10700	6700	13350	8900	13900	12200	9200	6000	10050	7600	4900
250-501	16000	10700	13350	17100	10700	6700	13350	8900	13900	12200	9200	6000	10050	7600	4900
300-400	17800	11600	14250	18350	13350	8200	16000	10700	17100	12750	9500	6250	12200	9200	6000
300-500	17800	11600	14250	18350	13350	8200	16000	10700	17100	12750	9500	6250	12200	9200	6000
300-630	17800	11600	14250	18350	13350	8200	16000	10700	17100	12750	9500	6250	12200	9200	6000
350-400	17800	11600	14125	18250	14250	8900	17500	11600	18350	12750	9500	6250	12750	9500	6250
350-500	17800	11600	14125	18250	14250	8900	17500	11600	18350	12750	9500	6250	12750	9500	6250
400-504	20500	13350	16900	21550	16900	10700	20500	13350	21550	14650	10850	7350	14650	10850	7350

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

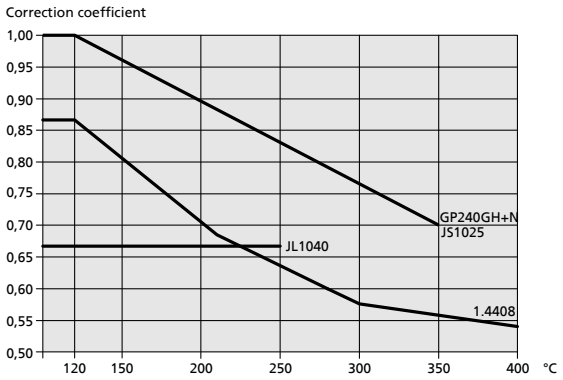


Fig. 10: Temperature correction diagram

Reduction is not required for materials 1.7706 and 1.4931.

5.3.3 Auxiliary connections

DANGER

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

Risk of burns!

Explosion hazard!

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

WARNING

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

Risk of injury from escaping fluid!

Risk of burns!

Malfunction of the pump!

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

5.4 Enclosure/insulation

DANGER

An explosive atmosphere forms due to insufficient venting

Risk of explosion!

- Ensure venting of the space between the bearing bracket lantern and the bearing cover.
- Never close or cover the perforation of the bearing bracket guards (e.g. by insulation).

⚠ WARNING

Volute casing and bearing bracket lantern take on the same temperature as the fluid handled.

Risk of burns!

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

CAUTION

Heat build-up in the bearing bracket

Damage to the bearing!

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

5.5 Checking the coupling alignment

⚠ DANGER

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

Explosion hazard!

Risk of burns!

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

CAUTION

Misalignment of pump and motor shafts

Damage to pump, motor and coupling!

- ▷ Always check the coupling after the pump has been installed and connected to the piping.
- ▷ Also check the coupling of pump sets supplied with pump and motor mounted on the same baseplate.

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Checking the coupling alignment with a dial gauge

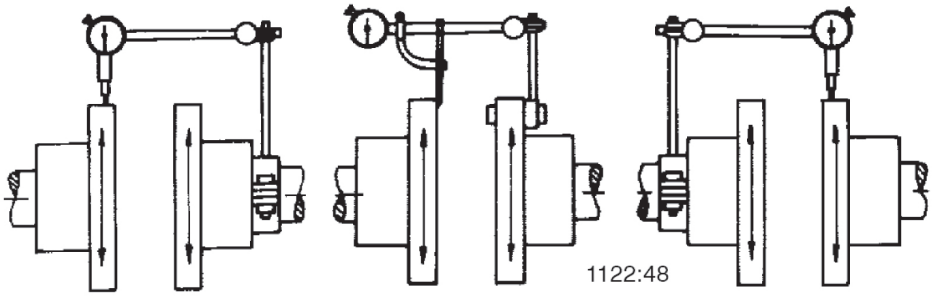

Fig. 11: Checking the spacer-type coupling with a dial gauge

1. Mark the installation position of the coupling by dotting marks (balance condition).
2. Remove the coupling spacer.

NOTE

While the pump's coupling is disengaged, also check the direction of rotation.
(⇨ Section 5.8, Page 33)

3. Check the alignment of the coupling halves with a dial gauge (see drawing "Checking the spacer-type coupling with a dial gauge").
   The maximum permissible run-out of the coupling face (axial) equals 0.1 mm.
   The maximum permissible radial deviation, measured over the complete circumference, equals 0.2 mm.

Checking the coupling alignment with a laser tool

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

5.6 Aligning the pump and motor

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

5.6.1 Motors with adjusting screw

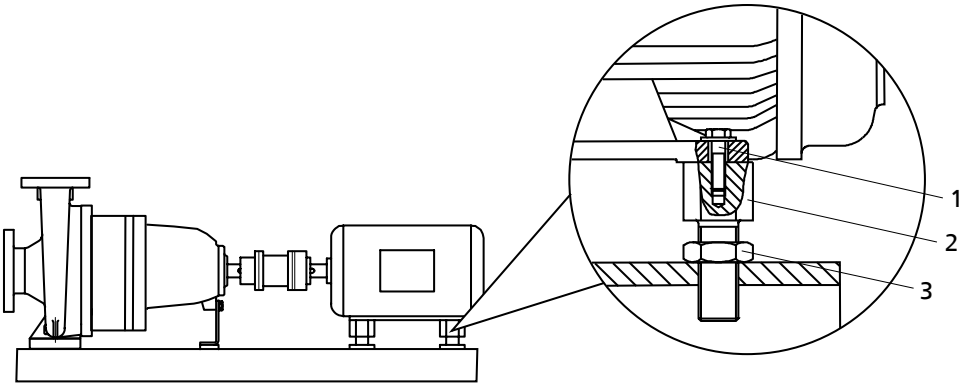

Fig. 12: Motor with adjusting screw

1	Hexagon head bolt	2	Adjusting screw
3	Locknut		

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

1. Check the coupling alignment.
2. Unscrew the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
3. Turn the adjusting screws (2) by hand or by means of an open-end wrench until the coupling alignment is correct and all motor feet rest squarely on the baseplate.
4. Re-tighten the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
5. Check proper functioning of coupling/shaft.
   Check that coupling/shaft can easily be rotated by hand.

⚠ WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

- ▹ Always operate the pump set with a coupling guard.
  If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!
- ▹ Observe all relevant regulations for selecting a coupling guard.

⚠ DANGER

Risk of ignition by frictional sparks

Explosion hazard!!

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

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

5.6.2 Motors without adjusting screw

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

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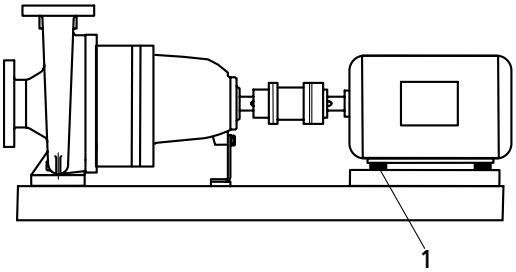

Fig. 13: Pump set with shim

1	Shim

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

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

⚠ WARNING

Unprotected rotating coupling

Risk of injury by rotating shafts!

- ▹ Always operate the pump set with a coupling guard.
  If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!
- ▹ Observe all relevant regulations for selecting a coupling guard.

⚠ DANGER

Risk of ignition by frictional sparks

Explosion hazard!!

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

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

5.7 Electrical connection

⚠ DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

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

⚠ WARNING

Incorrect connection to the mains

Damage to the power supply network, short circuit!

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

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

NOTE

Installing a motor protection device is recommended.

5.7.1 Setting the time relay

CAUTION

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

Damage to the pump (set)!

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

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

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

5.7.2 Earthing

⚠ DANGER

Electrostatic charging

Explosion hazard!

Damage to the pump set!

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

5.7.3 Connecting the motor

NOTE

In compliance with IEC 60034-8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub).

The pump's direction of rotation is indicated by an arrow on the pump.

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

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5.8 Checking the direction of rotation

DANGER

Temperature increase resulting from contact between rotating and stationary components

Explosion hazard!

Damage to the pump set!

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

WARNING

Hands inside the pump casing

Risk of injuries, damage to the pump!

- ▷ Always disconnect the pump set from the power supply and secure it against unintentional start-up before inserting your hands or other objects into the pump.

CAUTION

Incorrect direction of rotation with non-reversible mechanical seal

Damage to the mechanical seal and leakage!

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

CAUTION

Drive and pump running in the wrong direction of rotation

Damage to the pump!

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

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

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

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Prerequisites for commissioning/start-up

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

- The pump set has been mechanically connected as specified.
- The pump set has been properly connected to the power supply and is equipped with all protection devices. (⇨ Section 5.7, Page 31)
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked. (⇨ Section 5.8, Page 33)
- All auxiliary connections required are connected and operational.
- The lubricants have been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇨ Section 6.4, Page 42)

6.1.2 Filling in lubricants

DANGER

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

Fire hazard!

Damage to the pump set!

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

Oil-lubricated bearings

Fill the bearing bracket with lubricating oil.

- Oil quality (⇨ Section 7.2.3.1.2, Page 50)
- Oil quantity (⇨ Section 7.2.3.1.3, Page 50)

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

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

NOTE

If no constant level oiler is provided on the bearing bracket, the oil level can be read in the middle of the oil level gauge arranged at the side of the bearing bracket.

CAUTION

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

Damage to the bearings!

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

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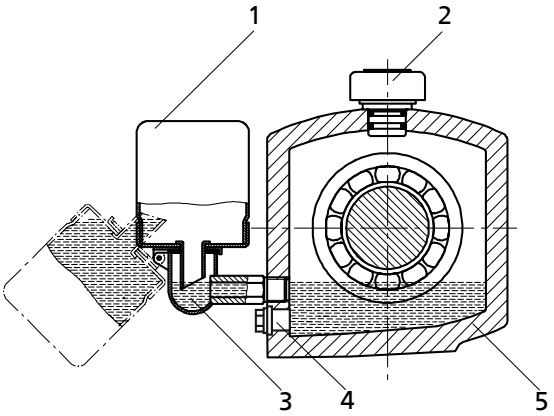

Fig. 14: Bearing bracket with constant level oiler

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

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

NOTE

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

6.1.3 Shaft seal

Shaft seals are fitted prior to delivery.
Observe the instructions on dismantling (⇨ Section 7.4.6, Page 53) or assembly (⇨ Section 7.5.3, Page 59) .

NOTE

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

NOTE

Only modify the specified sealing concepts and seal types after consultation with KSB.

Due to the complex conditions in hot water systems, the use of mechanical seals not approved by KSB shall not be covered by KSB's scope of warranty.

6.1.4 Priming and venting the pump

DANGER

Risk of potentially explosive atmosphere inside the pump

Explosion hazard!

- ▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times.
- ▷ Provide sufficient inlet pressure.
- ▷ Provide an appropriate monitoring system.

CAUTION

Increased wear due to dry running

Damage to the pump set!

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

✓ The pump is cold and the pump pressure has been released.

1. Vent the pump and suction line and fill both with the fluid handled.
2. Fully open the shut-off valve in the suction line.
3. Fill the circulation system of the mechanical seal with clean water via vent connection 741.Z9.
4. Vent seal chamber and heat exchanger via valve 741.Z9.

6.1.5 Water cooling

CAUTION

Deposit-forming, aggressive cooling water

Damage to the pump!

- ▷ Observe the cooling water quality.

Observe the following quality data of the cooling water:

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

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6.1.6 Cooling of the mechanical seal

Table 13: Cooling of the mechanical seal

Bearing bracket	Cooling liquid volume flow[6] [l/min]
P02	8
P03	8
P04	8
P06/P06atk	8
B07	8

6.1.7 Cooling of the heat exchanger

Table 14: Cooling liquid volume flow [l/min]

Bearing bracket	Speed	
	1450/1750 rpm	2900/3500 rpm
P02	3	15
P03	4	15
P04	6	20
P06/P06atk	10	30
B07	10	30

6.1.8 Cooling points

The casing support on the baseplate must be cooled from an impeller diameter of 315 mm and temperatures exceeding 250 °C.
Connections see general arrangement drawing.

Cooling liquid quantity at an inlet temperature of 20 °C:

Table 15: Cooling liquid volume flow [l/min]

Cooling point	Speed	
	1450/1750 rpm	2900/3500 rpm
Casing support on baseplate	3 l/min[7] 5 l/min [8]	
Bearings	3 l/min	

6.1.9 Heating up/keeping warm the pump (set)

CAUTION

Pump blockage

Damage to the pump!

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

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

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

Fluid temperatures above 150 °C

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

6 The cooling liquid ratings indicated are based on Δt = maximum 15 °C. In the case of deviations, the cooling liquid requirement changes in direct proportion to the change in the temperature difference. Qcooling water for Δtx = Qcooling water x (15 : Δtx)

7 For operation in parallel with casing support and bearing brackets

8 For operation in series with bearing bracket

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

6.1.10 Start-up

DANGER

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

Explosion hazard!

Hot or toxic fluids escaping!

- Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.
- Only start up the pump set with the discharge-side shut-off element slightly or fully open.

DANGER

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

Explosion hazard!

Damage to the pump set!

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

CAUTION

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

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

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

CAUTION

Start-up against open discharge line

Motor overload!

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

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

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

CAUTION

Misalignment of pump and coupling

Damage to pump, motor and coupling!

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

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

6.1.11 Checking the shaft seal

Mechanical seal

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

Slight leakage at the seal is permissible and desirable.

If the leakage exceeds 8 l/h the seal is defective and needs to be replaced.

Double mechanical seal

DANGER

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

Explosion hazard!

Excessive surface temperature

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

6.1.12 Shutdown

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

✓ Also ensure quench liquid supply during pump standstill.

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

NOTE

If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.

NOTE

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

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close the auxiliary connections.
   If the fluid to be pumped is fed in under vacuum, also supply the shaft seal with barrier liquid during standstill.
   Only turn off the cooling liquid supply after the pump has cooled down.

CAUTION

Risk of freezing during prolonged pump shutdown periods

Damage to the pump!

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

6.2 Operating limits

DANGER

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

Explosion hazard!

Hot or toxic fluid could escape!

- ▷ Comply with the operating data specified in the data sheet.
- ▷ Never use the pump for handling fluids it is not designed for.
- ▷ Avoid prolonged operation against a closed shut-off element.
- ▷ Never operate the pump at temperatures, pressures or rotational speeds exceeding those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.

DANGER

Formation of a potentially explosive atmosphere inside the pump

Explosion hazard!

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

6.2.1 Ambient temperature

CAUTION

Operation outside the permissible ambient temperature

Damage to the pump (set)!

- ▷ Observe the specified limits for permissible ambient temperatures.

Observe the following parameters and values during operation:

Table 16: Permissible ambient temperatures

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

6.2.2 Frequency of starts

DANGER

Excessive surface temperature of the motor

Explosion hazard!

Damage to the motor!

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

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

Table 17: Frequency of starts

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

CAUTION

Re-starting while motor is still running down

Damage to the pump (set)!

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

6.2.3 Fluid handled

6.2.3.1 Flow rate

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

- Short-time operation: Q_{min} [9] = 0.1 × Q_{BEP} [10]
- Continuous operation: Q_{min} [9] = 0.3 × Q_{BEP} [10]
- 2-pole operation: Q_{max} [11] = 1.1 × Q_{BEP} [10]
- 4-pole operation: Q_{max} [11] = 1.25 × Q_{BEP} [10]

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

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

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

Table 18: Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Acceleration due to gravity	m/s^2
H	Pump discharge head	m
T_f	Fluid temperature	°C
T_O	Temperature at the casing surface	°C
η	Pump efficiency at duty point	-
$\Delta\vartheta$	Temperature difference	K

9 Minimum flow rate

10 Flow rate at best efficiency point

11 Maximum flow rate

6.2.3.2 Density of the fluid handled

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

CAUTION

Impermissibly high density of the fluid handled

Motor overload!

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

6.2.3.3 Abrasive fluids

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

6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

The pump (set) remains installed

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

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

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

✓ The pump has been properly drained. (⇨ Section 7.3, Page 51)

✓ The safety instructions for dismantling the pump have been observed. (⇨ Section 7.4.1, Page 51)

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

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

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

6.4 Returning to service

For returning the equipment to service observe the sections on commissioning/start-up and the operating limits. (⇨ Section 6.1, Page 34) (⇨ Section 6.2, Page 40)

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

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⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of injury from moving parts or escaping fluid!

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

NOTE

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

7 Servicing/Maintenance

7.1 Safety regulations

DANGER

Improper cleaning of coated pump surfaces

Explosion hazard by electrostatic discharge!

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

DANGER

Sparks produced during servicing work

Explosion hazard!

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

DANGER

Improperly serviced pump set

Explosion hazard!

Damage to the pump set!

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

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

WARNING

Unintentional starting of the pump set

Risk of injury by moving components and shock currents!

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

WARNING

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

Risk of injury!

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

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⚠ WARNING

Insufficient stability

Risk of crushing hands and feet!

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

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

NOTE

All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. For contact details refer to the enclosed "Addresses" booklet or visit "www.ksb.com/contact" on the Internet.

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/Inspection

7.2.1 Supervision of operation

⚠ DANGER

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

Explosion hazard!

Fire hazard!

Damage to the pump set!

Risk of burns!

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

⚠ DANGER

Incorrectly serviced shaft seal

Explosion hazard!

Hot, toxic fluid escaping!

Damage to the pump set!

Risk of burns!

Fire hazard!

- ▷ Regularly service the shaft seal.

⚠ DANGER

Risk of potentially explosive atmosphere inside the pump

Explosion hazard!

- ▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times.
- ▷ Provide sufficient inlet pressure.
- ▷ Provide an appropriate monitoring system.

CAUTION

Increased wear due to dry running

Damage to the pump set!

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

CAUTION

Impermissibly high temperature of fluid handled

Damage to the pump!

- ▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).
- ▷ Observe the temperature limits in the data sheet and in the section on operating limits. (⇨ Section 6.2, Page 40)

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

- The pump must run quietly and free from vibrations at all times.
- In case of oil lubrication, ensure the oil level is correct. (⇨ Section 6.1.2, Page 34)
- Check the shaft seal. (⇨ Section 6.1.11, Page 39)
  Monitor the cooling circuit of the mechanical seal with a contact thermometer. Fit the contact thermometer directly to the outlet of the mechanical seal. Set the alert to 80 °C and the pump cut-out to 100 °C.
- Check the static sealing elements for any leakage.
  Monitor the leakage of the mechanical seal (1-10 cm^3/h during operation).
- Check the rolling element bearings for running noises.
  Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the correct functioning of any auxiliary connections.
- Cooling system
  Check the flow sight glasses at the cooling points daily.
  Take the pump out of service and thoroughly clean the cooling system at least once a year.
- Vent seal chamber and heat exchanger via valve 741.Z9 once a week.
- Monitor the stand-by pump.
  To make sure that stand-by pumps are ready for operation, start them up once a week.
  Monitor the auxiliary connections.
- Monitor the bearing temperature.
  The bearing temperature must not exceed 90 °C (measured on the outside of the bearing bracket).

NOTE

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

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7.2.1.1 Temperature monitoring at the mechanical seal

CAUTION

Excessive temperature at the mechanical seal

The sealing elements will be destroyed!

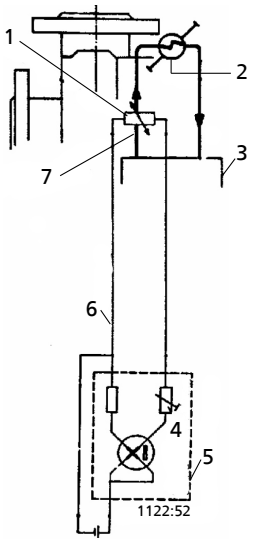
▷ Monitor the temperature with a temperature sensor.

✓ A temperature sensor (Pt100, thermocouple, thermometer) can be inserted in the protective thermometer well welded into the circulation system of the pump.

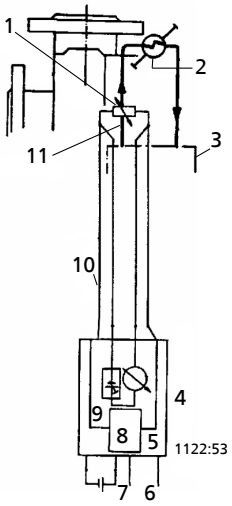
1. Use a suitable measuring transducer to transfer the temperature measurement to the plant process control system.

Table 19: Recommended settings for temperature monitoring

At a temperature of [°C]	Recommended setting
80	Alert
100	Tripping



Connection of a PT 100 temperature sensor wiring of two conductors



Connection of a PT 100 temperature sensor wiring of four conductors

1	PT100	1	PT100
2	Inlet	2	Inlet
3	Mechanical seal cover	3	Mechanical seal cover
4	Balancing resistance for the power lines	4	Display unit
5	Display unit	5	Display or pen recorder
6	Power line	6	220 V-
7	Circulation line, outlet	7	+ optional
		8	Constant-current source
		9	Balancing voltage
		10	Power line
		11	Circulation line, outlet

Temperature monitoring applies to duty and stand-by pumps.

Changeover from duty to stand-by pump

When starting up the stand-by pump the temperature can rise to 120 °C - 140 °C for a short period.

Temperature monitoring starts after a delay of 1 minute.

Shutdown

1. After the pump has been shut down, do not start it up again for 10 minutes.
2. For temperatures between 120 and 130 °C set the delay of alert/cut-out to 15 minutes.

The temperature can also be monitored via a contact thermometer with 2 switching contacts.

7.2.1.2 Water conditioning

To extend the service life of the mechanical seal, it is important to condition the water suitably.

Observe the following quality aspects:

- Water with a low salt content (e.g. feed water, boiler feed water, deionised water or condensate)
- No additives (e.g. Antifrogen, Preventol or KEBO-X)
- Water quality to VdTÜV Directive TCh 1466

7.2.2 Inspection work

DANGER

Excessive temperatures caused by friction, impact or frictional sparks

Explosion hazard!

Fire hazard!

Damage to the pump set!

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

DANGER

Electrostatic charging due to insufficient potential equalisation

Explosion hazard!

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

7.2.2.1 Checking the coupling

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

7.2.2.2 Checking the clearances

To check the clearance gaps, remove the back pull-out unit.
(⇨ Section 7.4.4, Page 53)
If the clearance gap is larger than permitted (see the following table), replace casing wear ring 502.1/502.02 with a new one.
The clearances given refer to the diameter.

Table 20: Clearances between impeller and casing/between impeller and casing wear ring

Size	Clearances	Clearance diameter [mm]
040-250	0,7 $^{+0,104}$	85
050-200	0,7 $^{+0,104}$	105
050-400	0,7 $^{+0,113}$	125
080-200	0,7 $^{+0,113}$	140

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Size	Clearances	Clearance diameter [mm]
080-315	0,7 $^{+0,113}$	160
100-200	0,7 $^{+0,113}$	175
080-250	0,7 $^{+0,113}$	145
100-250	0,7 $^{+0,113}$	165
100-315	0,7$^{+0,113}$	175
150-250	0,8 $^{+0,122}$	190
150-315	0,8 $^{+0,113}$	200
200-250	0,8 $^{+0,113}$	220
200-315	0,8 $^{+0,122}$	230
200-316	0,8 $^{+0,122}$	250
200-400	0,8 $^{+0,122}$	230
200-401	0,9 $^{+0,122}$	250
200-501	0,9 $^{+0,161}$	255
250-316	0,8 $^{+0,131}$	300
250-401	1,0 $^{+0,189}$	330
250-501	1,0 $^{+0,161}$	310
300-400	1,0 $^{+0,189}$	330
300-500	1,0 $^{+0,189}$	350
300-630	1,0 $^{+0,189}$	360
350-400	1,0 $^{+0,157}$	350
350-500	1,0 $^{+0,189}$	380
400-504	1,0 $^{+0,163}$	410

7.2.2.3 Cleaning filters

CAUTION

Insufficient inlet pressure due to clogged filter in the suction line

Damage to the pump!

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

7.2.3 Lubrication and lubricant change of rolling element bearings

⚠ DANGER

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

Explosion hazard!

Fire hazard!

Damage to the pump set!

- ▷ Regularly check the condition of the lubricant.

7.2.3.1 Oil lubrication

The rolling element bearings are usually lubricated with mineral oil.

7.2.3.1.1 Intervals

Table 21: Oil change intervals

Temperature at the bearing	First oil change	All subsequent oil changes[12)]
Up to 70 °C	After 300 operating hours	Every 8,500 operating hours
70 °C - 80 °C	After 300 operating hours	Every 4,200 operating hours
80 °C - 90 °C	After 300 operating hours	Every 2,000 operating hours

7.2.3.1.2 Oil quality

Oil quality

Table 22: Oil quality

Description	Symbol to DIN 51502	Properties	
CLP46 lubricating oil to DIN 51517 or HD 20W/20 SAE	□	Kinematic viscosity at 40 °C	46±4 mm^2/s
		Flash point (to Cleveland)	+175 °C
		Solidification point (pour point)	-15 °C
		Application temperature[13)]	Higher than permissible bearing temperature

7.2.3.1.3 Oil quantity

Table 23: Oil quantity

Bearing bracket	Oil quantity [l]
P02as	0.3
P03s, P03as	0.5
P04s, P04as	0.5
P06s	1.8
P06as	1.4
P06atk	2.4
B07	4.7

7.2.3.1.4 Changing the oil

⚠ WARNING

Lubricants posing a health hazard and/or hot lubricants

Hazard to persons and the environment!

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

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12 At least once a year

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

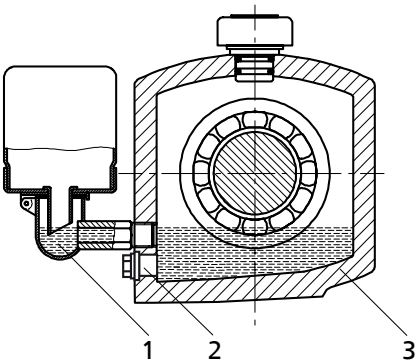

Fig. 15: Bearing bracket with constant level oiler

1	Constant level oiler	2	Screw plug
3	Bearing bracket		

✓ A suitable container for the used oil is on hand.

1. Place the container underneath the screw plug.
2. Undo the screw plug (2) at the bearing bracket (3) and drain the oil.
3. Once the bearing bracket (3) has been drained, re-insert and re-tighten the screw plug (2).
4. Re-fill with oil. (⇨ Section 6.1.2, Page 34)

7.3 Drainage/cleaning

⚠ WARNING

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

Hazard to persons and the environment!

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

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

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

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

⚠ WARNING

Unqualified personnel performing work on the pump (set)

Risk of injury!

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

⚠ WARNING

Hot surface

Risk of injury!

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

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

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

Observe the general safety instructions and information. (⇨ Section 7, Page 44)

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

For dismantling and reassembly refer to the general assembly drawing.

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

⚠ DANGER

Insufficient preparation of work on the pump (set)

Risk of injury!

- ▹ Properly shut down the pump set.
- ▹ Close the shut-off elements in the suction line and discharge line.
- ▹ Drain the pump and release the pump pressure. (⇨ Section 7.3, Page 51)
- ▹ Shut off any auxiliary feed lines.
- ▹ Allow the pump set to cool down to ambient temperature.

7.4.2 Preparing the pump set

1. Interrupt the power supply and make sure it cannot be switched on again unintentionally.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard.
4. Remove the coupling spacer if fitted.
5. Drain the oil fill of oil-lubricated bearings. (⇨ Section 7.2.3.1.4, Page 50)

7.4.3 Removing the motor

NOTE

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

⚠ WARNING

Motor tipping over

Risk of crushing hands and feet!

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

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

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7.4.4 Removing the back pull-out unit

⚠ WARNING

Motor tipping over

Risk of crushing hands and feet!

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

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 51) to (⇨ Section 7.4.3, Page 52) have been observed/carried out.

1. If required, suspend or support bearing bracket 330 to prevent it from tipping over.
2. Unbolt support foot 183 from the baseplate.
3. Undo hexagon nut 920.01 at the volute casing.
4. Clean the threads of forcing screws 901.30 and then use them to remove the back pull-out unit from volute casing 102.
5. Take care not to damage joint ring 411.10.

7.4.5 Dismantling the impeller

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 51) to (⇨ Section 7.4.4, Page 53) have been observed/carried out.

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

1. Unscrew impeller nut 922 with threaded insert (right-hand thread).
2. Remove impeller 230 with an impeller removal tool.
3. Place impeller 230 on a clean and level surface.
4. Remove keys 940.1 from shaft 210.
5. Remove and dispose of joint rings 411.31.

Bearing brackets B07 300-630 and 400-504

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 51) to (⇨ Section 7.4.4, Page 53) have been observed/carried out.

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

1. Unscrew impeller hub cap 260 (right-hand thread).
2. Remove and dispose of joint rings 411.31.
3. Bend open lock washer 931.02, remove impeller screw 906 with lock washer 931.02 and disc 550.85.
4. Remove impeller 230 with an impeller removal tool.
5. Place impeller 230 on a clean and level surface.
6. Remove keys 940.1 from shaft 210.

7.4.6 Removing the shaft seal

7.4.6.1 Dismantling the mechanical seal

Bearing bracket P02
Borg Warner type D/DW

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 51) to (⇨ Section 7.4.5, Page 53) have been observed/carried out.

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

1. Unscrew hexagon nuts 920.02 and remove seal cover 471.01 with O-ring 412.15/55, mating rings 475.55/56 and throttling bush 542.05.
2. Remove mating ring 475.55/56 with stud 560.55, O-ring 412.55 and throttling bush.
3. Remove O-ring 412.15.

4. Pull the rotating assembly straight off shaft protecting sleeve 524.01 without any screwing movement.
5. Undo socket head cap screws 914.07 and push neck bush 456.01 out of stuffing box housing 451.01.

Bearing bracket P03-P06/ B07

✓ When removing the mechanical seal cartridge always observe the instructions on handling hazardous substances and on accident prevention!

Burgmann, type SHPV10/74-E... Crane, type ...8BVS-RS

1. Undo hexagon nuts 920.04.
2. Carefully remove bearing bracket lantern 344 complete with mechanical seal and shaft protecting sleeve.
3. Undo hexagon head bolts 901.21. Then remove the complete stationary unit (seal cover 471.01, primary ring 472.54, springs and O-rings) and the complete rotating unit (shaft protecting sleeve 524.01 and mating ring 475.55) from the bearing bracket lantern.
4. **Burgmann type SHPV10/74-E...**
   Remove O-rings 412.53 and dismantle the stationary unit.
   Crane type ...8BVS-
   Remove circlip 932.54. Then dismantle the stationary unit.

7.4.7 Dismantling the bearings

✓ The notes and steps stated in (⇨ Section 7.4.1, Page 51) to (⇨ Section 7.4.6, Page 53) have been observed/carried out.

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

1. Unscrew hexagon nuts 920.04 at the flange of bearing bracket lantern 344.
2. Carefully remove bearing bracket lantern 344 (complete with mechanical seal and shaft protecting sleeve).
3. Undo the hexagon socket head cap screw in the coupling hub.
4. Pull the coupling half off the pump shaft with a puller.
5. Remove key 940.02 and thrower 507.02.
6. For variants with atk-bearing or labyrinth seals, pull motor-end V-ring 411.77 off the shaft.
7. Undo screws 914.02 and remove motor-end bearing cover 360.02 and joint ring 400.02.
8. **For** variants with atk-bearing or labyrinth seals, pull pump-end V-ring 411.78 off the shaft.
9. **For** variants with labyrinth seal, undo screws 914.01 and remove pump-end bearing cover 360.01 and joint ring 400.01.
10. **For** variants with atk-bearing or labyrinth seals, remove thrower 507.11 and O-ring 412.36.
11. Carefully drive shaft 210 together with angular contact ball bearing 320.02 and the inner race of cylindrical roller bearing 322.01 out of the bearing bracket towards the drive end.
12. For variants with atk-bearings, remove O-ring 412.02.
13. Remove support disc 550.23 from bearing bracket 330.
14. Check circlips 932.01/02.
15. Remove cylindrical roller bearing 322.01 (roller cage) from bearing bracket 330.
16. Bend open lock washer 931.01 behind slotted round nut 920.21 on shaft 210.
17. Unscrew slotted round nut 920.21 (right-hand thread) and remove lock washer 931.01.

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⚠ WARNING

Hot surfaces due to heating of components for assembly/dismantling

Risk of burns!

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

18. Heat up angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 to 80 °C, and pull them off shaft 210.
19. Dispose of joint rings 400.01/.02.

Version with bearing bracket B07

1. Undo grub screws 904.41/.42 and remove throwers 507.01/.02.
2. Undo hexagon socket head cap screws 914.01 and take off the pump-end bearing cover 360.01 with gasket 400.01.
3. Undo hexagon head bolts 901.37 and remove motor-end bearing cover 360.02.
4. Remove O-ring 412.22, if any.
5. Carefully drive shaft 210 together with angular contact ball bearing 320.02 and the inner race of cylindrical roller bearing 322.01 (on special pump design including oil thrower 508.01) out of the bearing bracket towards the drive end.
6. Remove cylindrical roller bearing 322.01 (roller cage) from the bearing bracket. Heat up the inner race of the cylindrical roller bearing and pull it off the shaft.
7. If oil thrower 508.01 is fitted, remove grub screw 904.20 and pull the oil thrower off the shaft.
8. Bend back lock washer 931.01. Unscrew keywayed nut 920.21 (right-hand thread). Remove the lock washer.
9. Heat up angular contact ball bearing 320.02 and pull it off the shaft.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

⚠ WARNING

Improper lifting/moving of heavy assemblies or components

Personal injury and damage to property!

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

CAUTION

Improper reassembly

Damage to the pump!

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

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

Sealing elements

- **Gaskets**
  - Always use new gaskets, making sure that they have the same thickness as the old ones.

  - Always fit gaskets of asbestos-free materials or graphite without using lubricants (e.g. copper grease, graphite paste).
- **O-rings**
  - Never use O-rings that have been glued together from material sold by the metre.
- **Packing rings**
  - Always use pre-compressed packing rings.

CAUTION

Contact of O-ring with graphite or similar material

Fluid could escape!

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

- **Assembly aids**
  - For gaskets, avoid the use of assembly adhesives, if possible.
  - If assembly adhesives are required, use a commercially available contact adhesive (e.g. Pattex).
  - Only apply adhesive at selected points and in thin layers.
  - Never use quick-setting adhesives (cyanoacrylate adhesives).
  - Coat the locating surfaces of the individual components and screwed connections with graphite or similar before reassembly.
  - Prior to reassembly, screw back any forcing screws or alignment screws.

Tightening torques For reassembly, tighten all screws and bolts as indicated.

7.5.2 Fitting the bearings

- ✓ The individual parts have been placed in a clean and level assembly area.
- ✓ All dismantled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.

⚠ WARNING

Hot surfaces due to heating of components for assembly/dismantling

Risk of burns!

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

1. Heat up angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 to approx. 80 °C in an oil bath.
2. Slide angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 onto shaft 210 until they will not go any further.

NOTE

Angular contact ball bearings must be installed in back-to-back arrangement. Angular contact ball bearings installed in pairs must always be from the same manufacturer.

3. Use a spanner wrench to tighten angular contact ball bearing with keywayed nut 920.21, without lock washer 931.01.

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4. Let angular contact ball bearing 320.02 cool down to approximately 5 °C above ambient temperature.
5. Re-tighten slotted round nut 920.21, then unscrew it again.
6. Apply a few spots of a suitable lubricant (e.g. Molykote) to the contact faces of lock washer 931.01 and slotted round nut 920.21.
7. Fit lock washer 931.01.
8. Tighten slotted round nut 920.21.
9. Bend back lock washer 931.01.
10. Insert circlip 932.01/932.02 into the bearing bracket.
11. Insert support disc 550.23 of angular contact ball bearing 320.02 into bearing bracket 330.
12. Fit cylindrical roller bearing 322.01 (roller cage) in the bearing bracket.
13. Carefully insert pre-assembled shaft 210 with angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 into bearing bracket 330 from the drive end.
14. Fit pump-end bearing cover 360.01 with joint ring 400.01.
    For variants with lip seals:
    Take care not to damage lip seal 421.01.
    For variants with labyrinth seal:
    Make sure that the return bore of the labyrinth seal is positioned at the bottom of the bearing cover.
15. Fit motor-end bearing cover 360.02 with joint ring 400.02.
    For variants with lip seals:
    Take care not to damage lip seal 421.02.
    For variants with labyrinth seal:
    Make sure that the return bore of the labyrinth seal is positioned at the bottom of the bearing cover.
16. Fit bearing bracket lantern 344.
17. Tighten hex. nuts 920.04 at the flange of bearing bracket lantern 330.
18. Fit keys 940.02.
19. Slide the coupling hub onto the shaft end.
20. Secure the coupling hub with an adjusting screw.
21. Fit thrower 507.01, if any.

Variants with atk-bearing

- ✓ The individual parts have been placed in a clean and level assembly area.
- ✓ All dismantled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.

⚠ WARNING

Hot surfaces due to heating of components for assembly/dismantling

Risk of burns!

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

1. Heat up angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 to approx. 80 °C in an oil bath.
2. Slide angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01 onto shaft 210 until they will not go any further.

NOTE

Angular contact ball bearings must be installed in back-to-back arrangement. Angular contact ball bearings installed in pairs must always be from the same manufacturer.

3. Use a C-spanner to tighten slotted round nut 920.21 without lock washer 931.01.
4. Let angular contact ball bearing 320.02 cool down to approximately 5 °C above ambient temperature.
5. Re-tighten slotted round nut 920.21, then unscrew it again.
6. Apply a few spots of a suitable lubricant (e.g. Molykote) to the contact faces of lock washer 931.01 and slotted round nut 920.21.
7. Fit lock washer 931.01.
8. Tighten slotted round nut 920.21.
9. Bend back lock washer 931.01.

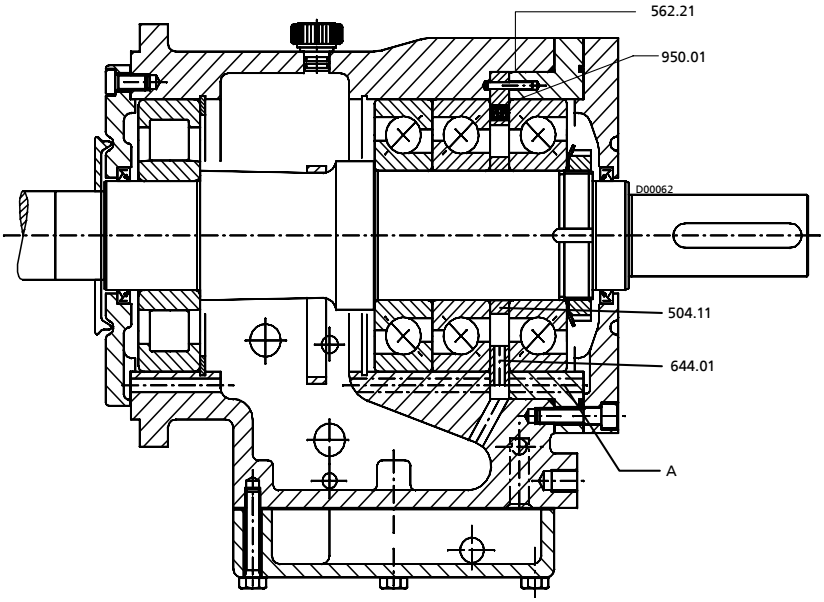


Fig. 16: Tandem bearing arrangement

A	Oil return bores
504.11	Spacer ring
562.21	Spring-type straight pin
644.01	Lubricating ring
950.01	Springs

10. Install the bearings in tandem arrangement.
11. Clamp the bearings,
    using spacer ring 504.11, lubricating ring 644.01 and spring 950.01.
12. Fit parallel pin 562.21 to secure lubricating ring 644.01 in place.
    Make sure spring-type straight pin 562.21 is in the correct position.
13. Insert thrower 507.01 and O-ring 412.36 into the thread of pump-end bearing cover 360.01.
14. Fit pump-end bearing cover 360.01 with joint ring 400.01.
    Make sure that the return bore of the labyrinth seal is positioned at the bottom of the bearing cover.

15. Fit motor-end bearing cover 360.02 with joint ring 400.02.
    Make sure that the return bore of the labyrinth seal is positioned at the bottom of the bearing cover.

	**CAUTION** **Incorrect assembly** Oil leakage! ▷ Push V-rings 411.77/78 into the bearing cover until they will not go any further and pre-load them.

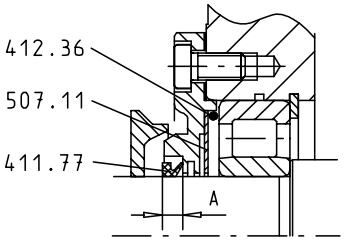


Fig. 17: Dimension A

16. Push V-rings 411.77/78 into the bearing cover until they will not go any further and pre-load them until width A = 9 ± 1.2 mm.

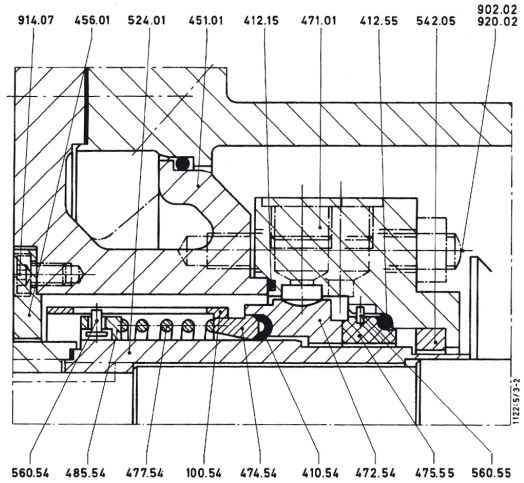
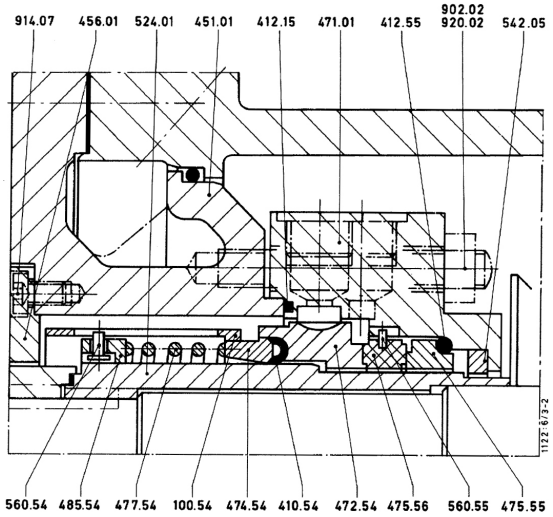
7.5.3 Fitting the shaft seal

7.5.3.1 Installing the mechanical seal

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

- For installing the mechanical seal, proceed as shown in the seal installation drawing.
- Work cleanly and accurately.
- Only remove the protective wrapping of the contact faces immediately before installation takes place.
- Prevent any damage to the sealing surfaces or O-rings.
- After inserting the stationary ring of the mechanical seal, check that it is plane-parallel in relation to the casing part.
- The surface of the shaft protecting sleeve must be absolutely clean and smooth, and the sleeve's mounting edge must be chamfered.
- When sliding the rotating assembly onto the shaft protecting sleeve, take appropriate steps to protect the surface of the shaft protecting sleeve from damage.

Bearing bracket P02

Borg-Warner type D	Borg-Warner type DW
	

100.54	Housing	412.15/.55	O-ring
410.54	Profile joint	451.01	Stuffing box housing
472.54	Spring-loaded ring	456.01	Neck bush
474.54	Thrust ring	471.01	Seal cover
475.55/.56	Seat ring	524.01	Shaft protecting sleeve
477.54	Spring	542.05	Throttling bush
485.54	Torque-transmitting element	902.02	Stud bolt
560.54/.55	Stud	914.07	Hexagon socket head cap screw
		920.02	Hexagon nut

- ✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.2, Page 56) have been observed/carried out.
- ✓ The assembled bearing and the individual parts of mechanical seal 433 are kept in a clean and level assembly area.
- ✓ All disassembled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.

NOTE

We recommend arranging the shaft vertically for dismantling.

1. Check the sliding fit of shaft protecting sleeve 524.01 on the shaft 210. Note position of the keyway.
2. Pre-assemble seal cover 471.01.
3. Press in throttling bush 542.05.
4. Push in O-ring 412.15 or 412.55 and seat ring 475.55 or 475.55/.56.
5. Check that they are plane-parallel in relation to seal cover 471.01.
6. Insert O-ring 412.15.
7. Fit seal cover 471.01 on shaft 210.
8. Screw pre-assembled seal cover 471.01 to stuffing box housing 451.01. Then insert them into bearing bracket lantern 344.
9. Take care not to damage O-ring 412.01 and joint ring 411.11
10. Clean shaft protecting sleeve 524.01 and apply a suitable lubricant.
11. Push on the rotating unit.
    Note position of stud 560.54.

12. Wet the contact faces of spring-loaded ring 472.54 and seat ring 475.55 or 475.56 with oil.
13. Push pre-assembled shaft protecting sleeve 524.01 onto shaft 210.
14. Fit neck bush 456.01.

Bearing bracket P03-P06/ B07 **Burgmann SHPV10/74-E..**

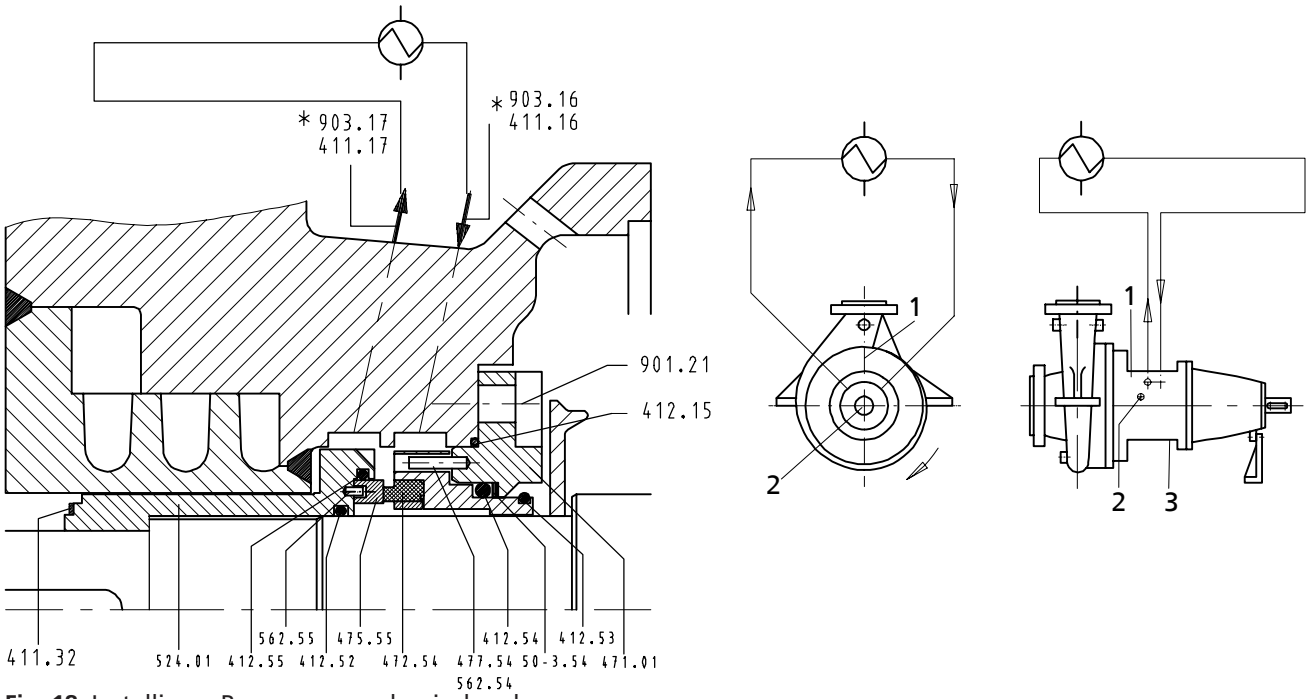


Fig. 18: Installing a Burgmann mechanical seal

* Remove when connecting the piping			
412.52/.53/.54/.55	O-ring	1	Cooling liquid, outlet
472.54	Spring-loaded ring	2	Cooling liquid, inlet
475.55	Seat ring	3	Drain
477.54	Spring		
562.54/.55	Parallel pin		
50-3.54	Support ring		
471.01	Seal cover		
524.01	Shaft protecting sleeve		

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

✓ The assembled bearing and the individual parts of mechanical seal 433 are kept in a clean and level assembly area.

✓ All disassembled parts have been cleaned and checked for wear.

✓ Any damaged or worn parts have been replaced by original spare parts.

✓ The sealing surfaces have been cleaned.

1. Check the sliding fit of shaft protecting sleeve 524.01 on shaft 210.
2. Insert springs 477.54.
3. Fit seat ring 472.54 with well-greased O-ring 412.54 and support ring 50-3.54 in seal cover 471.01.
   Make sure parallel pins 562.54 engage in the holes of the seat ring.
4. Fit O-ring 412.53 to hold the assembly together.
5. Clean shaft protecting sleeve 524.01 and fit gasket 411.32 to the corresponding diameter of the shaft protecting sleeve.

6. Insert the rotating assembly (shaft protecting sleeve 524.01 with fitted seat ring 475.55 and O-rings 412.52/.55) into bearing bracket lantern 344 in such a way that the centring collar at the outer diameter of the shaft protecting sleeve prevents any radial movement.
7. Insert O-ring 421.15 into the corresponding groove of bearing bracket lantern 344.
8. Install the complete stationary unit (seal cover 471.01 and spring-loaded ring 472.54 with the corresponding springs and hardware).
9. Tighten screws 921.21. Make sure not to squash O-ring 412.15.
   Observe the tightening torques (see table: tightening torques of the mechanical seal).
10. Coat the hub with Molykote.
11. Carefully push bearing bracket lantern 344 with installed mechanical seal onto the shaft stub of complete bearing 330 and fasten it with screws.
12. Fit key 940.01.
13. Check that the shaft can be rotated easily.

Crane type: 8BVS-RS

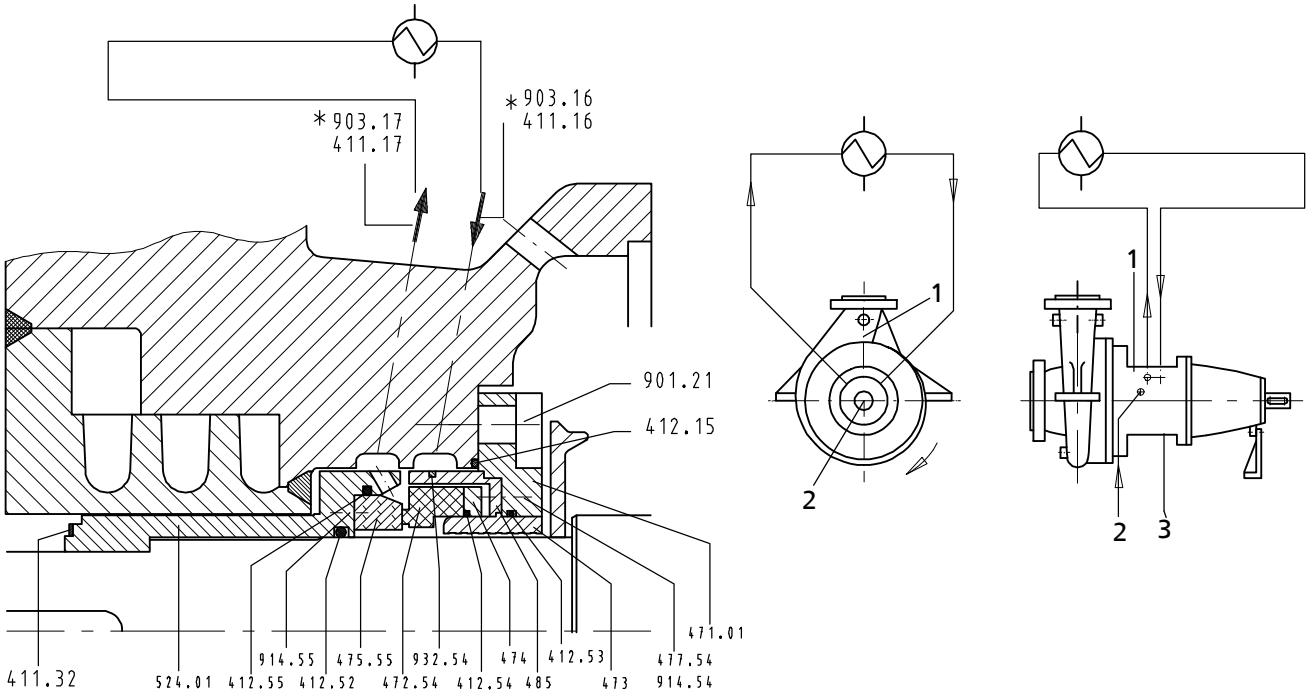


Fig. 19: Installing a Crane mechanical seal

* Remove when connecting the piping			
412.52/.53/.54/.55	O-ring	1	Cooling liquid, outlet
472.54	Spring-loaded ring	2	Cooling liquid, inlet
475.55	Seat ring	3	Drain
477.54	Spring		
562.54/.55	Parallel pin		
50-3.54	Support ring		

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471.01	Seal cover		
524.01	Shaft protecting sleeve		

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

✓ The assembled bearing and the individual parts of mechanical seal 433 are kept in a clean and level assembly area.

✓ All disassembled parts have been cleaned and checked for wear.

✓ Any damaged or worn parts have been replaced by original spare parts.

✓ The sealing surfaces have been cleaned.

1. Check the sliding fit of shaft protecting sleeve 524.01 on shaft 210.
2. Insert O-ring 421.53 into seal cover 471.01.
3. Fasten spring-loaded ring holder 473 and torque-transmitting element 485 with parallel pin 914.54 inside seal cover 471.01.
4. Insert spring 477.54 into the corresponding drilled hole.
5. Insert thrust ring 474, well-greased O-ring 412.54 and spring-loaded ring 472.54 into torque-transmitting element 485 and use circlip 932.54 to hold the assembly together.
6. Clean shaft protecting sleeve 524.01 and fit gasket 411.32 to the corresponding diameter of the shaft protecting sleeve.
7. Insert the rotating assembly (shaft protecting sleeve 524.01 with fitted seat ring 475.55 and O-rings 412.52/.55) into bearing bracket lantern 344 in such a way that the centring collar at the outer diameter of the shaft protecting sleeve prevents any radial movement.
8. Insert O-ring 421.15 into the corresponding groove of bearing bracket lantern 344.
9. Install the complete stationary unit (seal cover 471.01 and spring-loaded ring 472.54 with the corresponding springs and hardware).
10. Tighten screws 921.21. Make sure not to squash O-ring 412.15.
    Observe the tightening torques (see table below: tightening torques of the mechanical seal).
11. Coat the hub with Molykote.

CAUTION

Incorrect installation

O-ring will be destroyed!

▹ Wet the contact face for O-ring 412.52 with a suitable lubricant free from silicone and mineral oil.

12. Carefully push bearing bracket lantern 344 with installed mechanical seal onto the shaft stub of complete bearing 330 and fasten it with screws.
13. Fit key 940.01.
14. Check that the shaft can be rotated easily.

Table 24: Tightening torques of the mechanical seal

Material	Stamp mark	Screw type	Thread	Tightening torques[14] [Nm]	
				Maximum	- 20%[15]
1.6772 (Monix 3K)	MM (M3K)	Reduced shank bolt	M12	66	53

[14] The tightening torques in this table refer to a friction coefficient μ = 0.12.

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

The values in this table do not apply if other instructions state different values.

7.5.4 Fitting the impeller

- ✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.3, Page 59) have been observed/carried out.
- ✓ The pre-assembled bearing bracket as well as the individual parts are kept in a clean and level assembly area.
- ✓ All disassembled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.

1. Insert key 940.1 and push impeller 230 onto shaft 210.
2. Insert joint ring 411.31.
3. Tighten impeller nut 922 with disc 550, if any.
   For variants with B07 bearing:
   Tighten impeller screw 906, lockwasher 931.02 and disc 550.85, if any (see table: Tightening torques of screwed connections at the pump).

7.5.5 Fitting the back pull-out unit

⚠ WARNING

Back pull-out unit tilting

Risk of crushing hands and feet!

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

- ✓ The notes and steps stated in (⇨ Section 7.5.1, Page 55) to (⇨ Section 7.5.4, Page 64) have been observed/carried out.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
- ✓ For back pull-out units supplied without coupling: Fit the coupling in accordance with the manufacturer's instructions.

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

7.5.6 Mounting the motor

NOTE

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

1. Shift the motor to connect it to the pump via the coupling.
2. Fasten the motor to the baseplate.
3. Align pump and motor. (⇨ Section 5.6, Page 29)
4. Connect the motor to the power supply (refer to manufacturer's product literature).

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7.6 Tightening torques

7.6.1 Tightening torques

Use a torque wrench to tighten the screwed connections (902.01/920.01/900.42/920.42/902.15/920.15) between the volute casing and the bearing bracket lantern.

Table 25: Tightening torques[16)]

Material	1.7709 1.7258				1.6772 1.6772			
Stamp mark	GA G				MM (M3K) MM (M3K)			
Screw type DIN939/DIN2510	Full shank bolt		Reduced shank bolt		Full shank bolt		Reduced shank bolt	
Thread	Max.	- 20 %[17)]	Max.	- 20 %[17)]	Max.	- 20 %[17)]	Max.	- 20 %[17)]
M12	66	53	38	31	113	90	66	53
M16	163	130	107	86	280	224	185	148
M20	330	265	220	175	565	450	375	300
M24	565	450	375	300	970	775	640	510
M27	840	670	550	440	1440	1150	940	750
M30	1160	930	740	590	1980	1580	1260	1010
M33	1390	1110	1030	825	2210	1770	1610	1290
M36	1800	1440	1300	1040	2850	2280	2060	1650
M39	2210	1770	1700	1360	3680	2940	2600	2080

7.6.2 Tightening torques for the impeller nut

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

Table 26: Tightening torques for the impeller nut

Bearing bracket	Tightening torques [Nm]	Width across flats [mm]
P02as	55	22
P03s P03as	125	27
P04s P04as	200	32
P06s P06as P06atk	300[18)]	41
P06s P06as P06atk	520	55
B07	1000	60
B07 300-630	400[19)]	46
B07 400-504		

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

16 The tightening torques in this table refer to a friction coefficient μ = 0.12.

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

18 Pump sizes 150-315, 200-250, 200-316, 250-316

19 Values for material 1.4021

7.7 Spare parts stock

7.7.1 Ordering spare parts

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

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

Refer to the name plate for all data.

Also specify the following data:

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

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

Table 27: Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6	8	10 and more
210	Shaft	1	1	1	2	2	2	20 %
230	Impeller	1	1	1	2	2	2	20 %
320.02	Angular contact ball bearing	1	1	2	2	2	3	25 %
322.01	Cylindrical roller bearing	1	1	2	2	2	3	25 %
330	Bearing bracket (complete)	-	-	-	-	-	1	2
433	Mechanical seal, spring-loaded ring	2	3	4	5	6	7	90 %
	Seat ring	2	3	4	5	6	7	90 %
	Set of O-rings	2	3	4	5	6	9	100 %
502.01	Casing wear ring	2	2	2	3	3	4	50 %
503.01	Impeller wear ring	2	2	2	3	3	4	50 %
524.01	Shaft protecting sleeve (part of the mechanical seal)	2	2	2	3	3	4	50 %
	Sealing elements for volute casing (set)	4	6	8	8	9	12	150 %

7.7.3 Interchangeability of pump components

Components featuring the same number in a column are interchangeable.

NOTE

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

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Table 28: Interchangeability of pump components

Size	Bearing bracket	Part description											
		Support foot[20]	Shaft[20]	Angular contact ball bearing[20]	Cylindrical roller bearing[20]	Bearing bracket	Bearing bracket lantern	Mechanical seal[21]	Casing wear ring	Impeller wear ring	Thrower	Impeller screw	Impeller nut
		Part No.											
		183	210	320.02	322.01	330	344	433	502.01	503.01	507.01	906	922
050-200	P02as	1	1	1	1	1	1	1	1	1	1	-	1
080-200	P03s	2	2	2	2	2	2	2	2	2	2	-	2
100-200	P03as	3	2	2	2	2	2	2	3	3	2	-	2
040-250		4	2	2	2	2	2	2	4	4	2	-	2
080-250		3	2	2	2	2	3	2	5	5	2	-	2
100-250	P04s	3	3	3	3	3	4	3	6	6	3	-	3
150-250	P04as	5	3	3	3	3	4	3	7	7	3	-	3
080-315		3	3	3	3	3	5	3	8	8	3	-	3
100-315		5	3	3	3	3	5	3	3	9	3	-	3
050-400		5	3	3	3	3	6	3	9	10	3	-	3
150-315	P06s	6	4	4	4	4	7	4	10	11	4	-	4
200-250		6	6	5	5	5	10	5	11	12	4	-	4
200-315		7	5	5	5	5	7	6	12	13	4	-	5
200-316		8	4	5	5	5	7	4	13	14	4	-	4
200-400		7	5	5	5	5	8	6	12	13	4	-	4
200-401	P06as	9	5	6	6	5	8	6	14	14	4	-	5
200-501		9	5	6	6	5	9	6	15	15	4	-	5
250-316		8	7	6	6	5	7	4	13	16	4	-	4
250-401		9	5	6	6	5	8	6	16	17	4	-	5
250-501		10	5	6	6	5	9	6	17	18	4	-	5
300-400		11	5	6	6	5	8	6	16	17	4	-	5
150-315	P06atk	12	9	7	7	6	7	4	10	11	4	-	4
200-250		13	10	7	7	6	10	5	11	12	4	-	6
200-315		12	12	7	7	6	7	6	12	13	4	-	6
200-316		14	9	7	7	6	7	4	13	14	4	-	6
200-400		12	12	7	7	6	8	6	12	13	4	-	6
200-401		16	12	7	7	6	8	6	14	14	4	-	6
200-501		16	12	7	7	6	9	6	15	15	4	-	6
250-316		13	11	7	7	6	7	4	13	16	4	-	6
250-401		16	12	7	7	6	8	6	16	17	4	-	6
250-501		17	12	7	7	6	9	6	17	18	4	-	6
300-400		18	13	7	7	6	8	6	16	17	4	-	6
350-400		19	14	7	7	6	8	6	18	19	4	-	6
300-500	B07	20	15	8	8	7	-	10	19	20	5	-	7
350-500		20	15	8	8	7	-	10	20	21	5	-	7
400-504		21	16	8	8	7	-	11	21	22	5	1	-
300-630		22	16	8	8	7	-	11	22	23	5	1	-

20 Parts differ between bearing bracket P..s and P..as.

21 The shaft protecting sleeve is part of the mechanical seal.

8 Trouble-shooting

⚠ WARNING

Improper work to remedy faults

Risk of injury!

- ▷ For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.

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

A Pump delivers insufficient flow rate

B Motor is overloaded

C Excessive discharge pressure

D Leakage at the pump

E Excessive leakage at the shaft seal

F Vibrations during pump operation

G Impermissible temperature increase in the pump

Table 29: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy[22]
✗	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller.[23]
✗	-	-	-	-	-	✗	✗	Pump and/or piping are not completely vented and/or primed.	Vent and/or prime. Clean vent hole.
✗	-	-	-	-	-	-	-	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
✗	-	-	-	-	-	-	-	Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
✗	-	-	-	-	-	✗	✗	Suction lift is too high/$NPSH_{available}$ (positive suction head) is too low.	Check/alter fluid level. Fully open the shut-off element in the suction line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed/suction opening. Observe permissible speed of pressure fall.
-	-	-	✗	-	-	-	-	Air intake at the shaft seal	Clean barrier fluid duct, supply external barrier fluid, if necessary, or increase barrier fluid pressure. Replace shaft seal.
✗	-	-	-	-	-	-	-	Wrong direction of rotation[24]	Check the electrical connection of the motor and the control system, if any.
✗	-	-	-	-	-	-	-	Speed is too low. - Operation with frequency inverter - Operation without frequency inverter	- Increase voltage/frequency at the frequency inverter in the permissible range. - Check voltage.
✗	-	-	-	-	-	✗	-	Impeller	Replace worn components by new ones.
-	✗	✗	-	-	-	✗	-	Pump back pressure is lower than specified in the purchase order.	Re-adjust to duty point. In the case of persistent overloading, turn down impeller.[24]
-	✗	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.

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

23 Contact KSB.

24 Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy[22)]
-	✗	-	-	-	✗	-	-	Gland follower over-tightened or cocked	Correct.
-	✗	✗	-	-	-	-	-	Speed is too high.	Reduce speed.[24)]
-	-	-	-	✗	-	-	-	Defective gasket	Fit new gasket between volute casing and discharge cover.
-	-	-	-	-	✗	-	-	Worn shaft seal	Fit new shaft seal.
✗	-	-	-	-	✗	-	-	Score marks or roughness on shaft protecting sleeve / shaft sleeve	Replace shaft protecting sleeve/shaft sleeve. Fit new shaft seal.
-	-	-	-	-	✗	-	-	Vibrations during pump operation	Correct suction conditions. Re-align the pump. Re-balance the impeller. Increase pressure at the pump suction nozzle.
-	-	-	✗	-	✗	✗	-	The pump set is misaligned.	Re-align.
-	-	-	✗	-	✗	✗	-	Pump is warped or sympathetic vibrations in the piping.	Check the piping connections and secure fixing of pump; if required, reduce distances between the pipe clamps. Fix the pipelines using anti-vibration material.
-	-	-	✗	-	-	✗	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
-	-	-	✗	-	-	-	-	Non-compliance with specified coupling distance	Correct the distance according to general arrangement drawing.
✗	✗	-	-	-	-	-	-	Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
-	-	-	-	-	-	✗	-	Rotor out of balance	Clean the impeller. Re-balance the impeller.
-	-	-	-	-	-	✗	-	Defective bearing(s)	Replace.
-	-	-	-	-	-	✗	✗	Flow rate is too low.	Increase the minimum flow rate.
-	-	-	-	-	✗	-	-	Incorrect inflow of circulation liquid	Increase the free cross-section.

9 Related Documents

9.1 General assembly drawing with list of components

9.1.1 Bearing bracket designs P02 - P06

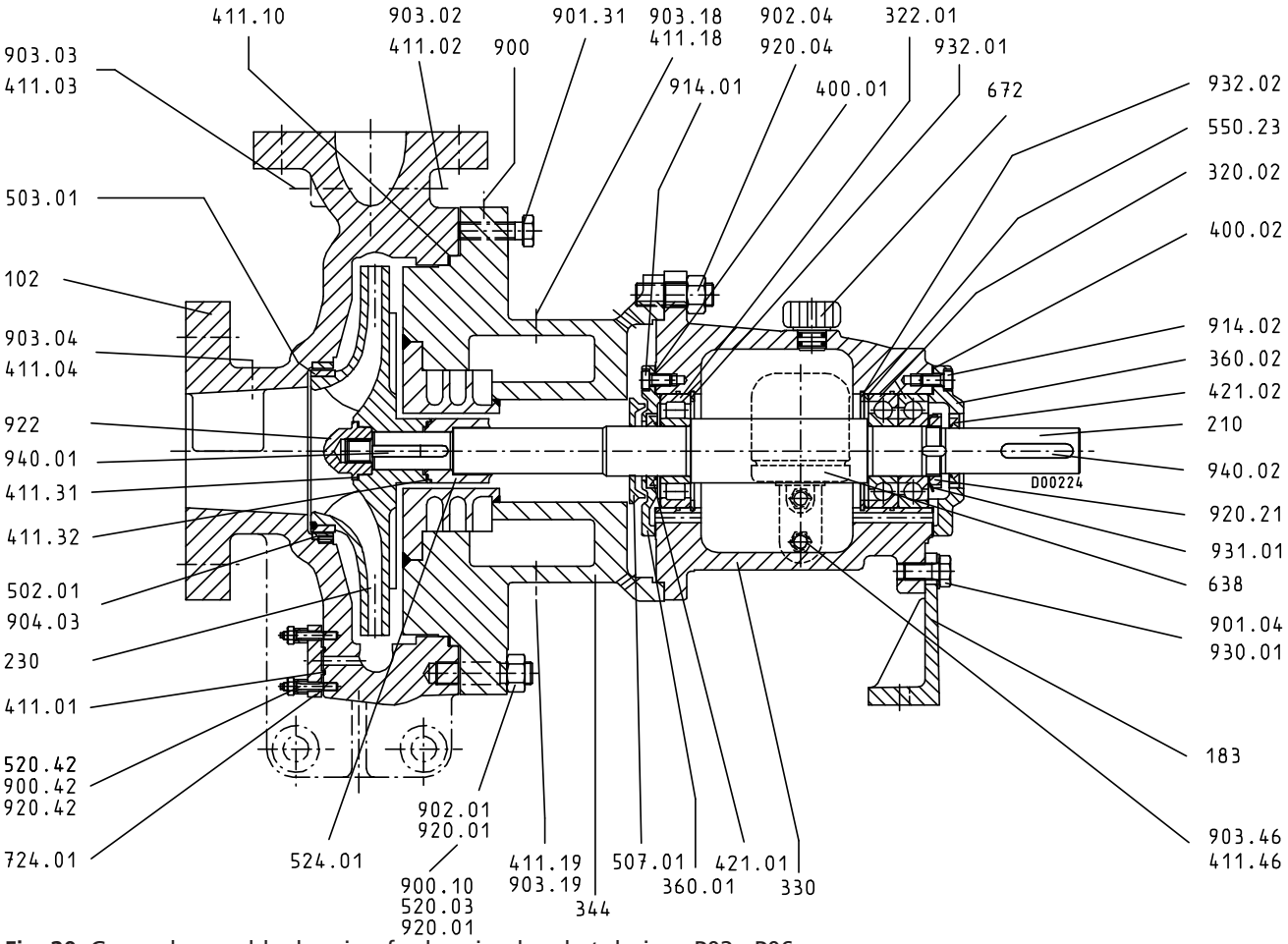
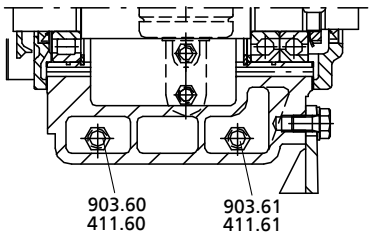
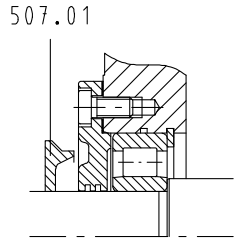


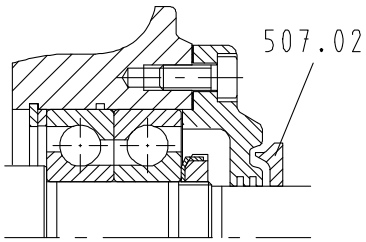
Fig. 20: General assembly drawing for bearing bracket designs P02 - P06



Cooling LT P02 - P06



Drawing of thrower 507.01



Drawing of thrower 507.02

Part No.	Comprising	Description
102	102	Volute casing
	411.01/.10	Joint ring
	502.01	Casing wear ring
	902.01[25)]	Stud
	904.03	Grub screw
	920.01	Hexagon nut
		Casing drain[26)]

25 For higher pressures, stud 902.01 is replaced by reduced shank bolt 900.10 and extension sleeve 520.03.

26 For low pressures, blind flange 724.01, reduced shank bolt 900.42, extension sleeve 520.42 and hexagon nut 920.42 are replaced by screw plug 903.01.

Part No.	Comprising	Description
183	183	Support foot
	901.04	Hexagon head bolt
	930.01	Spring washer
210	210	Shaft
	920.21	Slotted round nut
	931.01	Lock washer
	940.01/.02	Key
230	230	Impeller
	411.32	Joint ring
	503.01	Impeller wear ring
320.02	320.02	Angular contact ball bearing
	550[27)]	Disc
322.01	322.01	Cylindrical roller bearing
330	330	Bearing bracket, complete
	183	Support foot
	360.01/.02	Bearing cover
	400.01/.02	Gasket
	411.46/.60[28)]/.61[28)]	Joint ring
	421.01[29)]/.02[29)]	Lip seal
	550.23	Support disc
	638	Constant level oiler
	672	Vent plug
	901.04	Hexagon head bolt
	903.46/.60[28)]/.61[28)]	Screw plug
	914.01/.02	Hexagon socket head cap screw
	930.01	Spring washer
	932.01/.02	Circlip
344	344	Bearing bracket lantern
	411.10/.18/.19	Joint ring
	901.31	Hexagon head bolt
	902.04	Stud
	920.04	Hexagon nut
	903.18/.19	Screw plug
360.01	360.01	Bearing cover (pump end)
	400.01	Gasket
	914.01	Hexagon socket head cap screw
360.02	360.02	Bearing cover (motor end)
	400.02	Gasket
	914.02	Hexagon socket head cap screw
421.01/02	421.01/02	Lip seal (for pumps with lip seal at the bearing bracket)
502.01	502.01	Casing wear ring
	904.03	Grub screw
503.01	503.01	Impeller wear ring
507.01	507.01	Thrower

27 Only for size 200-315 with bearing bracket P06 and 3000 rpm
28 For cooled bearing brackets only
29 On labyrinth seal variants replaced by thrower 507.02

Part No.	Comprising	Description
507.02	507.02	Thrower (for pumps with labyrinth seal at the bearing bracket)
524.01	524.01	Shaft protecting sleeve (part of the mechanical seal)
638	638	Constant level oiler
922	922	Impeller nut
	411.31	Joint ring

9.1.2 Bearing bracket design B07

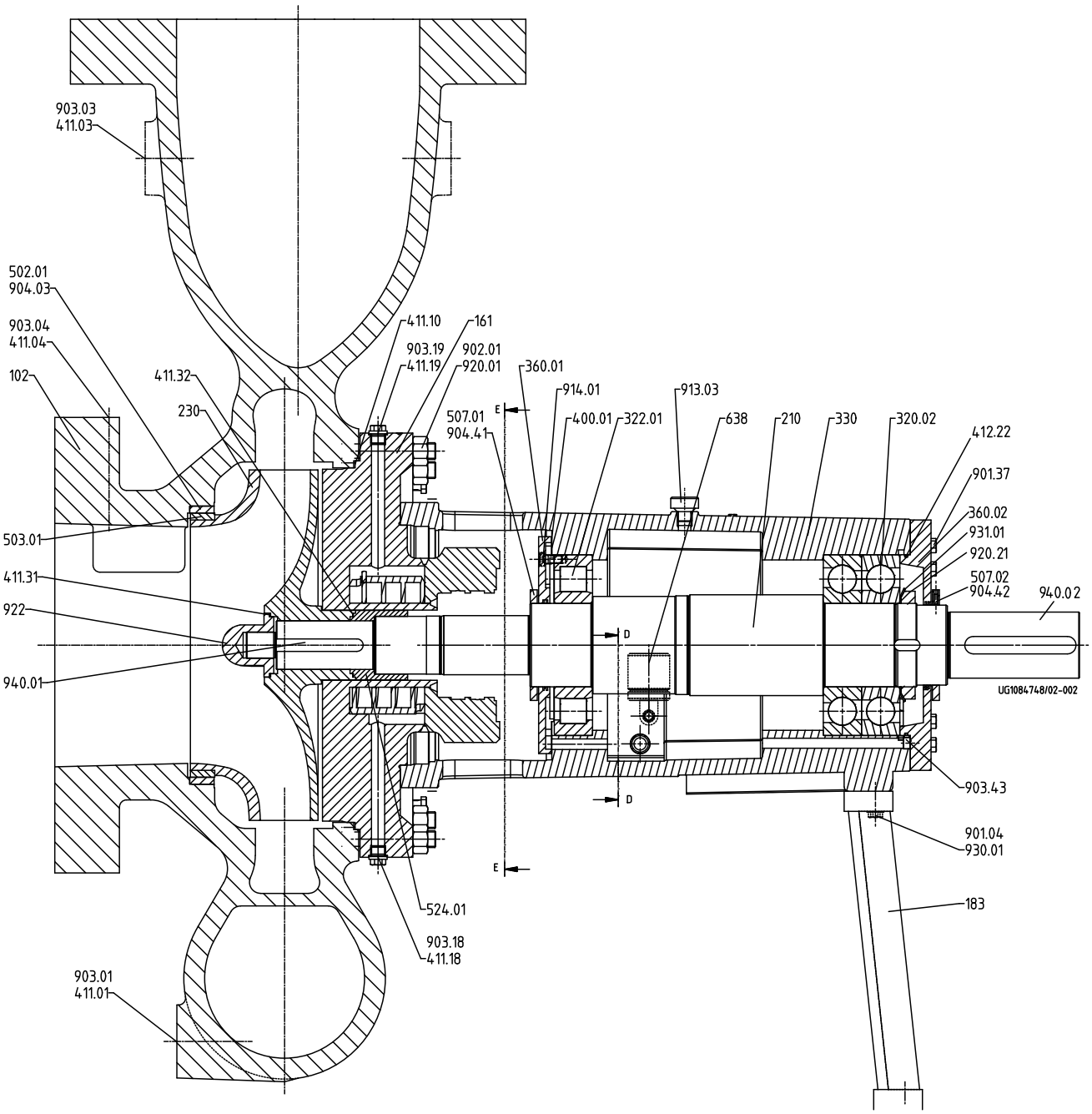


Fig. 21: General assembly drawing, version with bearing bracket B07

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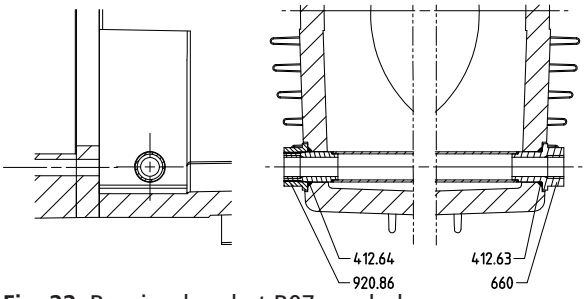
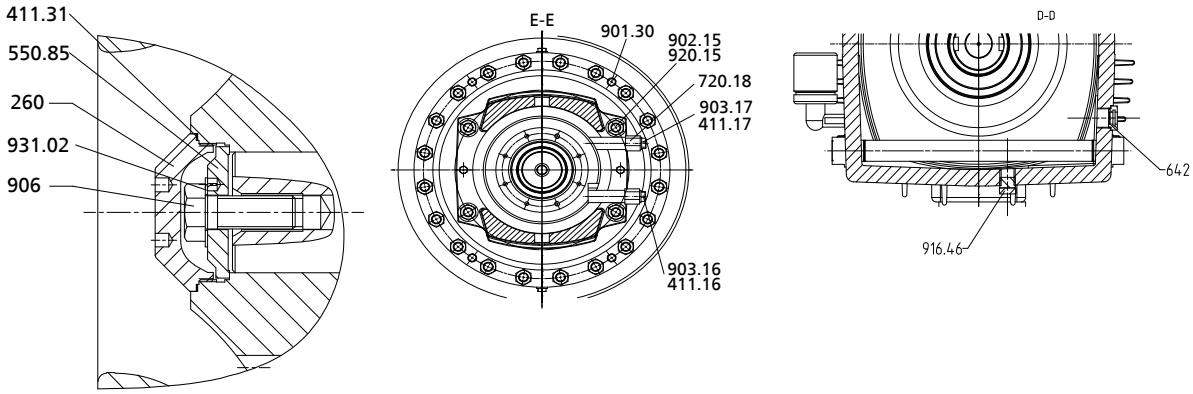


Fig. 22: Bearing bracket B07, cooled



Sizes 300-630 and 400-504 Section E-E Oil sight glass

Part No.	Comprising	Description
102	102	Volute casing
	411.01/.10	Joint ring
	502.01	Casing wear ring
	902.01[30)]	Stud
	904.03,	Grub screw
	920.01	Hexagon nut and casing drain[31)]
161	161	Casing cover
	411.10/.18/.19	Joint ring
	901.30	Hexagon head bolt
	902.15	Stud
	903.18/.19	Screw plug
	920.15	Hexagon nut
183	183	Support foot
	901.04	Hexagon head bolt
	930.01	Spring washer
210	210	Shaft
	920.21	Slotted round nut
	931.01	Lock washer
	940.01/.02	Keys
230	230	Impeller
	411.31/.32	Joint ring
	503.01	Impeller wear ring
260	260	Impeller hub cap
320.02	320.02	Angular contact ball bearing
322.01	322.01	Cylindrical roller bearing

30 For higher pressures, stud 902.01 is replaced by reduced shank bolt 900.10 and extension sleeve 520.03.

31 For low pressures, blind flange 724.01, reduced shank bolt 900.42, extension sleeve 520.42 and hexagon nut 920.42 are replaced by screw plug 903.01.

Part No.	Comprising	Description
330	330	Bearing bracket
330	330	Bearing bracket, complete
	183	Support foot
	360.01/.02	Bearing cover
	400.01	Gasket
	412.22	O-ring
	638	Constant level oiler
	642	Oil sight glass
	901.04/.31/.37	Hexagon head bolt
	913.03	Vent plug
	914.01	Hexagon socket head cap screw
	916.46	Plug
	930.01	Spring washer
360.01	360.01	Bearing cover (pump end)
	400.01	Gasket
	914.01	Hexagon socket head cap screw
360.02	360.02	Bearing cover (motor end)
	412.22	O-ring
	901.37	Hexagon head bolt
412.63/.64	412.63/.64	O-ring
502.01	502.01	Casing wear ring
	904.03	Grub screw
503.01	503.01	Impeller wear ring
507.01/.02	507.01/.02	Thrower
	904.41/.42	Grub screw
524.01	524.01	Shaft protecting sleeve (part of the mechanical seal)
550.85	550.85	Disc
638	638	Constant level oiler
660	660	Cooling system
906	906	Impeller screw
	411.31	Joint ring
920.86	920.86	Nut
922	922	Impeller nut
	411.31	Joint ring
931.02	931.02	Lock washer

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9.1.3 Bearing bracket design P06atk labyrinth seal

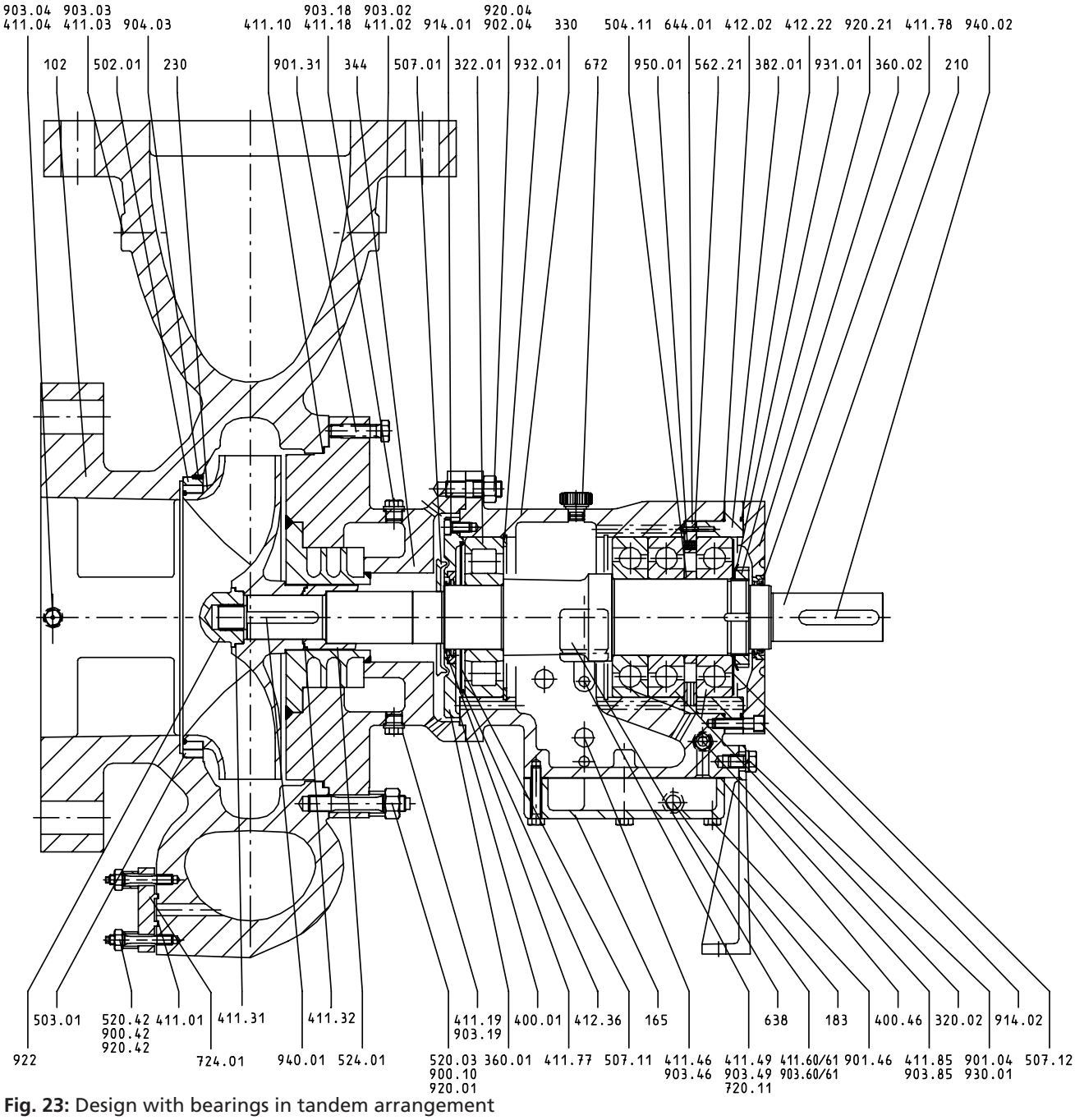

Fig. 23: Design with bearings in tandem arrangement

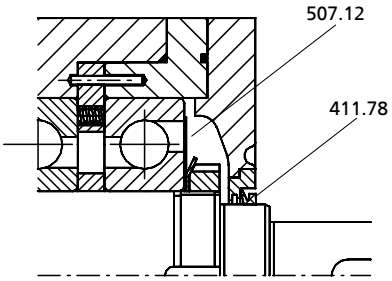

Fig. 24: Pre-loaded bearing

Part No.	Comprising	Description
102	102	Volute casing
	411.01/.02/.03/.04/.10	Joint ring
	502.01	Casing wear ring

Part No.	Comprising	Description
102	900.10[32)]	Reduced shank bolt
	903.02/.03/.04	Screw plug
	904.03	Grub screw
	920.01	Hexagon nut
	520.03	Extension sleeve
	724.01	Blind flange
	900.42	Reduced shank bolt
	920.42	Hexagon nut
	520.42	Extension sleeve
165	165	Cooling chamber cover
	400.46	Gasket
	411.60/.61	Joint ring
	901.46	Hexagon head bolt
	903.60/.61	Screw plug
183	183	Support foot
	901.04	Hexagon head bolt
	930.01	Spring washer
210	210	Shaft
	920.21	Slotted round nut
	931.01	Lock washer
	940.01/.02	Key
	507.12	Thrower
230	230	Impeller
	411.32	Joint ring
	503.01	Impeller wear ring
320.02	320.02	Angular contact ball bearing
322.01	322.01	Cylindrical roller bearing
330	330	Bearing bracket
330	330	Bearing bracket (complete, except the bearing)
	165	Cooling chamber cover
	183	Support foot
	360.01/.02	Bearing cover
	400.01/.46	Gasket
	411.46/.49/.60[33)]/.61[33)]/.85	Joint ring
	412.77/.78	V-ring
	412.36	O-ring
	507.11	Thrower
	638	Constant level oiler
	672	Vent plug
	720.11	Hexagon nipple
	901.04/46[33)]	Hexagon head bolt
	903.46/.49/.60[33)]/.61[33)]/.85	Screw plug
	914.01/.02	Hexagon socket head cap screw
	930.01	Spring washer
	932.01	Circlip
344	344	Bearing bracket lantern

32 For low-pressure variants, the reduced shank bolt and extension sleeve are replaced by stud 902.01, and blind flange 724.01 is replaced by screw plug 903.01.

33 For cooled bearing brackets only.

Part No.	Comprising	Description
344	411.10/.18/.19	Joint ring
	902.04	Stud
	920.04	Hexagon nut
	901.31	Hexagon head bolt
	903.18/.19	Screw plug
360.01	360.01	Bearing cover (pump end)
	400.01	Gasket
	914.01	Hexagon socket head cap screw
360.02	360.02	Bearing cover (motor end)
	412.22	O-ring
	914.02	Hexagon socket head cap screw
382.01	382.01	Bearing carrier
	412.02	O-ring
411.77/.78	411.77/.78	V-ring
502.01	502.01	Casing wear ring
	904.03	Grub screw
503.01	503.01	Impeller wear ring
507.01/.11/.12	507.01/.11/.12	Thrower
524.01	524.01	Shaft protecting sleeve (part of the mechanical seal)
638	638	Constant level oiler
644.01	644.01	Lubricating ring
	504.11	Spacer ring
	562.21	Parallel pin
	950.01	Compression spring
922	922	Impeller nut
	411.31	Joint ring

10 UK Declaration of Conformity

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

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

HPH

KSB order number: .....

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
  - Pump (set): Supply of Machinery (Safety) Regulations 2008
  - Electrical components[34]: The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

The manufacturer also declares that

- the following harmonised international standards[35] have been applied:
  - ISO 12100
  - EN 809

Person authorised to compile the technical file:

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

The UK Declaration of Conformity was issued in/on:

Place, date

.....[36].....

Name

Function

Company
Address

34 Where applicable

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

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

11 Certificate of Decontamination

Type: .....

Order number /

Order item number[37]: .....

Delivery date: .....

Application: .....

Fluid handled[37]: .....

Please tick where applicable[37]:

☐ Corrosive

☐ Oxidising

☐ Flammable

☐ Explosive

☐ Hazardous to health

☐ Seriously hazardous to health

☐ Toxic

☐ Radioactive

☐ Bio-hazardous

☐ Safe

Reason for return:[37]: .....

Comments: .....

.....

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

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

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

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

☐ No special safety precautions are required for further handling.

☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

.....

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

.....	.....	.....
Place, date and signature	Address	Company stamp

1122.8117/01-EN

37 Required field

Index

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